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PARTS

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Part D. PROTISTA 3 (chiefly Radiolaria, Tintinnina), xii + 195 p., 1,050 fig., 1954.
Part G. BRYOZOA, xii + 253 p., 2,000 fig., 1953.

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Part W. MISCELLANEA (Supplement 1). Trace Fossils and Problematica (Revised and Enlarged), xxi + 269 p., 912 fig., 1975.

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Part X. ADDENDA, INDEX.

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EDITORIAL PREFACE

INTRODUCTION

During the nearly 30 years since publication of the first, slim *Treatise* volume (Part G, 1953) the Editorial Preface has undergone many evolutionary changes and has grown in length, but its scope and purpose have remained unchanged. The objectives of the Introduction of the Editorial Preface are 1) to give a brief history of a particular part of the *Treatise*, 2) to explain the aims of the *Treatise* in general terms, and 3) to make appropriate acknowledgments for support received. The bulk of the Editorial Preface is devoted to an explanation of nomenclatural practices adopted in the *Treatise*, and it concludes with listing and discussion of important stratigraphic divisions used in the text.

The present volumes deal with all Paleozoic corals, but also include description of some Mesozoic descendants, especially among the Chaetetida. The groups described in this Supplement to *Treatise* Part F were, in the original edition of Part F (1956, reprint 1967), arranged in three different sections, which were treated as orders of the class Anthozoa: Rugosa by DOROTHY HILL (p. F233-324), Heterocorallia by DOROTHY HILL (p. F324-327), and Tabulata by DOROTHY HILL and ERWIN C. STUMM (p. F444-477), totaling approximately 140 pages.

In early 1964, when stocks of the original
edition of Part F fell below expected demand for the following few years, I began to discuss the possibility of a revised edition with the principal authors of the volume. It soon developed that, as of that date, planning for revisionary work on the Paleozoic coral groups could be begun on a realistic basis, and plans began to crystallize during a brief visit by Professor Hill to Lawrence in May 1965. There followed the usual gestation period of two to three years during which few communications were exchanged; but in the beginning of 1968, Dorothy Hill and Erwin C. Stumm finally committed themselves to the plan of a revised edition of the description of all Paleozoic corals, to be published as a Supplement to Part F. The material was to be divided between the two authors along the lines of the treatment in the original edition. After Professor Stumm's untimely death in 1969, Dorothy Hill agreed to take over those groups that had originally been assigned to him. She further merged the order Heterocorallia as an order with the Rugosa, thus returning time-honored two-fold division of the Paleozoic corals into Rugosa and Tabulata, now treated as subclasses of the class Anthozoa.

At the time these arrangements were made, Professor Hill was also committed to undertake a revision of the Archaeocyatha and it was mutually agreed that this task should receive priority. In consequence, the revised treatment of Archaeocyatha was published in 1972 as Treatise, Part E, volume 1 (revised and enlarged edition). Immediately upon publication of this volume, Dorothy Hill turned to work on the revision of the Paleozoic corals, a huge task, as became increasingly obvious as the work progressed. The results of these efforts are presented in these two volumes, whose contents measure up to the highest standards obtained in the Treatise on Invertebrate Paleontology.

The aim of the Treatise on Invertebrate Paleontology, as originally conceived and consistently pursued, is to present the most comprehensive and authoritative, yet compact statement of knowledge concerning invertebrate fossil groups that can be formulated by collaboration of competent specialists in seeking to organize what has been learned of this subject up to the year of publication of each individual part. Such work has value in providing a most useful summary of the collective results of multitudinous investigations and thus constitutes an indispensable text and reference book for all persons who wish to know about remains of invertebrate organisms preserved in rocks of the earth's crust. This applies to neozoologists as well as paleozoologists and to beginners in study of fossils as well as to thoroughly trained, long-experienced professional workers, including teachers, stratigraphical geologists, and individuals engaged in research on fossil invertebrates. The making of a reasonably complete inventory of present knowledge of invertebrate paleontology is yielding needed foundation for future research.

The Treatise is divided into parts which bear index letters, each except the initial and concluding ones being defined to include designated groups of invertebrates. The chief purpose of this arrangement is to provide for independence of the several parts as regards date of publication, because it was judged desirable to print and distribute each segment as soon as possible after it is ready for press. Pages in each part bear the assigned index letter joined with numbers beginning with 1 and running consecutively to the end of the part. Materials for several individual parts were so voluminous that these parts had to be published in two or even three volumes. In such cases, pagination is continuous through successive volumes.

The outline of subjects to be treated in connection with each large group of invertebrates includes: 1) description of morphological features, with special reference to hard parts, 2) ontogeny, 3) classification, 4) geologic and geographic distribution, 5) evolutionary trends and phylogeny, 6) paleoecology, and 7) systematic description of genera, subgenera, and higher taxonomic units. Selected lists of references only were furnished in earlier parts of the Treatise, but since the mid-1960's the tendency has been to make these lists as comprehensive as possible, and in particular, to supply reliable bibliographical documentation for all taxonomic names dealt with in the text.
Features of style in the taxonomic portions of this work have been fixed by the editors with aid furnished by advice from representatives of the societies which have undertaken to sponsor the Treatise. It is the editors’ responsibility to consult with authors and coordinate their work, seeing that manuscripts properly incorporate features of adopted style. Especially they are called on to formulate policies in respect to many questions of nomenclature and procedure. The subject of genus-group as well as family and subfamily names is reviewed briefly in a following section of this preface, and features of Treatise style in generic descriptions are explained.

A generous grant of $35,000 was made in 1948 by The Geological Society of America for initial work in preparing Treatise illustrations. Additional grants were made by the Geological Society of America in 1971 ($6,200), 1972 ($6,000), $7,000 each year for 1973 and 1974, and $20,000 each year from 1975 through 1980. Administration of expenditures has been the charge of the editors and most of the work by photographers and artists has been done under their direction at the University of Kansas, but sizable parts of this program have also been carried forward in Washington, London, Ottawa, and many other places.

In December, 1959, the National Science Foundation of the United States, through its Division of Biological and Medical Sciences and the Program Director for Systematic Biology, made a grant in the amount of $210,000 for the purpose of aiding the completion of yet-unpublished volumes of the Treatise. Payment of this sum was provided to be made in installments distributed over a five-year period, with administration of disbursements handled by the University of Kansas. An additional grant (No. GB 4544) of $102,800 was made by the National Science Foundation in January, 1966, for the two-year period 1966-1967, and this was extended for the calendar year 1968 by payment of $25,700 in October, 1967. This grant was extended further by payments of $57,800 in 1968 for calendar year 1969, and $66,000 each for calendar years 1970 through 1972. For the years 1973 through 1977, grants totaled $197,400. These funds were used primarily to maintain editorial operations at the University of Kansas and to provide assistance to authors in preparation of manuscripts and illustrations. Grateful acknowledgment to the Foundation is expressed on behalf of the societies sponsoring the Treatise, the University of Kansas, and innumerable individuals benefited by the Treatise project.

Since April 1977 the University of Rochester has provided the editor with full office facilities and support without which his tasks could not have been completed; this generous assistance is gratefully acknowledged.

ZOLOGICAL NAMES

Many questions arise in connection with zoological names, especially including those that relate to their acceptability and to alterations of some which may be allowed or demanded. Procedure in obtaining answers to these questions is guided and to a large extent governed by regulations published (1961) in the International Code of Zoological Nomenclature (hereinafter cited simply as the Code). The prime object of the Code is to promote stability and universality in the use of the scientific names of animals, ensuring also that each name is distinct and unique while avoiding restrictions on freedom of taxonomic thought or action. Priority is a basic principle, but under specified conditions its application can be modified. This is all well and good, yet nomenclatural tasks confronting the zoological taxonomist are formidable. They warrant the complaint of some that zoology, including paleozoology, is the study of animals rather than of names applied to them.

Several ensuing pages are devoted to aspects of zoological nomenclature that are judged to have chief importance in relation to procedures adopted in the Treatise. Terminology is explained, and examples of style employed in the nomenclatural parts of systematic descriptions are given.

A draft of a revised edition of the Code was submitted to the meeting of the International Union of Biological Sciences at Helsinki, Finland, in August 1979. It is

expected that this revised edition will not come into force before some time in 1981 (R. V. Melville, written commun., October 1979) and the existing Code of 1961 is, therefore, strictly followed in the present volume.

TAXA GROUPS

Each taxonomic unit (taxon, pl., taxa1) belongs to a rank in the adopted hierarchy of classificatory divisions. In part, this hierarchy is defined by the Code to include a species-group of taxa, a genus-group, and a family-group. Units of lower rank than subspecies are excluded from zoological nomenclature and those higher than superfamily of the family-group are not regulated by the Code. It is natural and convenient to discuss nomenclatural matters in general terms first and then to consider each of the taxa groups separately. Especially important is the provision that within each taxa group, classificatory units are coordinate (equal in rank), whereas units of different taxa groups are not coordinate.

FORMS OF NAMES

All zoological names are divisible into groups based on their form (spelling). The first-published form (or forms) of a name is defined as original spelling (Code, Art. 32) and any later-published form (or forms) of the same name is designated as subsequent spelling (Art. 33). Obviously, original and subsequent spellings of a given name may or may not be identical and this affects consideration of their correctness. Further, examination of original spellings of names shows that by no means all can be distinguished as correct. Some are incorrect, and the same is true of subsequent spellings.

Original Spellings

If the first-published form of a name is consistent and unambiguous, the original spelling is defined as correct unless it contravenes some stipulation of the Code (Arts. 26-31), or the original publication contains clear evidence of an inadvertent error, in the sense of the Code, or, among names belonging to the family-group, unless correction of the termination or the stem of the type genus is required. An original spelling that fails to meet these requirements is defined as incorrect.

If a name is spelled in more than one way in the original publication, the form adopted by the first reviser is accepted as the correct original spelling, provided that it complies with mandatory stipulations of the Code (Arts. 26-31).

Incorrect original spellings are any that fail to satisfy requirements of the Code, represent an inadvertent error, or are one of multiple original spellings not adopted by a first reviser. These have no separate status in zoological nomenclature and therefore cannot enter into homonymy or be used as replacement names and they call for correction. For example, a name originally published with a diacritic mark, apostrophe, diaeresis, or hyphen requires correction by deleting such features and uniting parts of the name originally separated by them, except that deletion of an umlaut from a vowel in a name derived from a German word or personal name requires the insertion of “e” after the vowel.

Subsequent Spellings

If a name classed as a subsequent spelling is identical with an original spelling, it is distinguishable as correct or incorrect on the same criteria that apply to the original spelling. This means that a subsequent spelling identical with a correct original spelling is also correct, and one identical with an incorrect original spelling is also incorrect. In the latter case, both original and subsequent spellings require correction (authorship and date of the original incorrect spelling being retained).

If a subsequent spelling differs from an original spelling in any way, even by the omission, addition, or alteration of a single letter, the subsequent spelling must be defined as a different name (except that such changes as altered terminations of adjectival specific names to obtain agreement in gender with associated generic names, of family-group names to denote assigned taxonomic rank, and corrections for originally used diacritic marks, hyphens, and the like

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1 Inasmuch as the word taxon is an artificial one, not of classical origin, the plural should more properly be taxons, but the spelling taxa is now so deeply rooted in the literature that it seems inadvisable to change it.
are excluded from spelling changes conceived to produce a different name). In certain cases species-group names having variable spellings are regarded as homonyms as specified in Art. 58 of the Code.

Altered subsequent spellings other than the exceptions noted may be either intentional or unintentional. If demonstrably intentional, the change is designated as an emendation. Emendations may be either justifiable or unjustifiable. Justifiable emendations are corrections of incorrect original spellings, and these take the authorship and date of the original spellings. Unjustifiable emendations are names having their own status in nomenclature, with author and date of their publication; they are junior objective synonyms of the name in its original form.

Subsequent spellings that differ in any way from the original spellings, other than previously noted exceptions, and that are not classifiable as emendations are defined as incorrect subsequent spellings. They have no status in nomenclature, do not enter into homonymy, and cannot be used as replacement names. It is the purpose of the following chapters to explain in some detail the implications of various kinds of subsequent spellings and how these are dealt with in the Treatise.

AVAILABLE AND UNAVAILABLE NAMES

Available Names

An available zoological name is any that conforms to all mandatory provisions of the Code. Such names are classifiable in groups which are recognized in the Treatise, though not explicitly differentiated in the Code. They are as follows:

1) So-called "inviolate names" include all available names that are not subject to alteration from their originally published form. They comprise correct original spellings and commonly include correct subsequent spellings, but include no names classed as emendations. Here belong most genus-group names (including those for collective groups), some of which differ in spelling from others by only a single letter or by the sequential order of their letters.

2) Names may be termed "perfect names" if, as originally published, they meet all mandatory requirements, needing no correction of any kind, but nevertheless are legally alterable in such ways as changing the termination (e.g., many species-group names, family-group names). This group does not include emended incorrect original spellings (e.g., Boucekites, replacement of Boucekites).

3) "Imperfect names" are available names that as originally published contain mandatorily emendable defects. Incorrect original spellings are imperfect names. Examples of emended imperfect names are: among species-group names, guerini (not Guérini), obrienae (not O'Brienae), terranovae (not terra-novae), nunezi (not Nuñezí), Spironema rectum (not Spironema recta, because generic name is neuter, not feminine); among genus-group names, Broeggeria (not Bröggeria), Obrienia (not O'Brienia), Maccookites (not McCookites); among family-group names Guembellotriinae (not Giembrillotriinae), Spironematidae (not Spironemidae, incorrect stem), Athyrididae (not Athyridae, incorrect stem). The use of "variety" for named divisions of fossil species, according to common practice of some paleontologists, gives rise to imperfect names, which generally are emendable (Code, Art. 45e) by omitting this term so as to indicate the status of this taxon as a subspecies. The name of a variety is always of feminine gender. If the variety is converted into a species or subspecies, the name takes on the gender of the associated genus.

4) "Vain names" are available names consisting of unjustified intentional emendations of previously published names. The emendations are unjustified because they are not demonstrable as corrections of incorrect original spellings as defined by the Code (Art. 32c). Vain names have status in nomenclature under their own authorship and date. They constitute junior objective synonyms of names in their original form. Examples are: among species-group names, geneae (published as replacement of original unexplained masculine, geni, which now is not alterable), ohioae (invalid change from original ohioensis); among genus-group names, Graphiodactylus (invalid change from original Graphiadactylis); among family-group names, Graphi...
odactyliidae (based on junior objective synonym having invalid vain name).

5) An important group of available zoological names can be distinguished as “transferred names.” These comprise authorized sorts of altered names in which the change depends on transfer from one taxonomic rank to another, or possibly on transfers in taxonomic assignment of subgenera, species, or subspecies. Most commonly the transfer calls for a change in termination of the name so as to comply with stipulations of the Code on endings of family-group taxa and agreement in gender of specific names with associated generic names. Transferred names may be derived from any of the preceding groups except the first. Examples are: among species-group names, *Spirifer ambiguus* (masc.) to *Composita ambigua* (fem.), *Neochonetes transversalis* to *N. granulifer transversalis* or vice versa; among genus-group names, *Schizoculina* to *Oculina* (*Schizocolina*) or vice versa; among family-group names, Orthidae to Orthinae or vice versa, or superfamily Orthacea derived from Orthidae or Orthinae; among suprafamilial taxa (not governed by the Code), order Orthida to suborder Orthina or vice versa. The authorship and date of transferred names are not affected by the transfer, but the author responsible for the transfer and the date of his action are recorded in the Treatise.

6) Improved or “corrected names” include both mandatory and allowable emendations of imperfect names and of suprafamilial names, which are not subject to regulation as to name form. Examples of corrected imperfect names are given with the discussion of group 3. Change from the originally published ordinal name *Endoceroida* (Teichert, 1933) to the presently recognized *Endocerida* illustrates a “corrected” suprafamilial name. Group 6 names differ from those in group 5 in not being dependent on transfers in taxonomic rank or assignment, but some names are classifiable in both groups.

7) “Substitute names” are available names expressly proposed as replacements for invalid zoological names, such as junior homonyms. These may be classifiable also as belonging in groups 1, 2, or 3. The glossary appended to the Code refers to these as “new names” (*nomina nova*) but they are better designated as substitute names, since their newness is temporary and relative. The first-published substitute name that complies with the definition here given takes precedence over any other. An example is *Marieita Loeblich & Tappan, 1964*, as substitute for *Reichelina Marie, 1955, non Eek, 1942. 8) “Conserved names” include a relatively small number of species-group, genus-group, and family-group names which have come to be classed as available and valid by action of the International Commission on Zoological Nomenclature exercising its plenary powers to this end or ruling to conserve a junior synonym in place of a rejected “forgotten” name (*nomen oblitum*) (Art. 23b). Currently, such names are entered on appropriate “Official Lists,” which are published from time to time.

It is useful for convenience and brevity of distinction in recording these groups of available zoological names to employ Latin designations in the pattern of *nomen nudum* (abbr., *nom. nud.*) and others. Thus we recognize the preceding numbered groups as follows: 1) *nomina inviolata* (*sing., nomen inviolatum, abbr., nom. inviol.*), 2) *nomina perfecta* (*nomen perfectum, nom. perf.*), 3) *nomina imperfecta* (*nomen imperfectum, nom. imperf.*) 4) *nomina vana* (*nomen vanum, nom. van.*), 5) *nomina translata* (*nomen translatum, nom. transl.*), 6) *nomina correcta* (*nomen correctum, nom. correct.*), 7) *nomina substituta* (*nomen substitutum, nom. subst.*), 8) *nomina conservata* (*nomen conservatum, nom. conserv.*). It should be noted that the Code does not differentiate between different kinds of subsequent intentional changes of spelling, all of which are grouped as “emendations” (see below).

Additional to the groups differentiated above, the Code (Art. 17) specifies that a zoological name is not prevented from availability a) by becoming a junior synonym, for under various conditions this may be reemployed, b) for a species-group name by finding that original description of the taxon relates to more than a single taxonomic entity or to parts of animals belonging to two or more such entities, c) for species-group names by determining that it first
was combined with an invalid or unavailable genus-group name, d) by being based only on part of an animal, sex of a species, ontogenetic stage, or one form of a polymorphic species, e) by being originally proposed for an organism not considered to be an animal but now so regarded, f) by incorrect original spelling which is correctable under the Code, g) by anonymous publication before 1951, h) by conditional proposal before 1961, i) by designation as a variety or form before 1961, j) by concluding that a name is inappropriate (Art. 18), or k) for a specific name by observing that it is tautonymous (Art. 18).

Unavailable Names

All zoological names which fail to comply with mandatory provisions of the Code are unavailable names and have no status in zoological nomenclature. None can be used under authorship and date of original publication as a replacement name (nom. subst.) and none preoccupies for purposes of the Law of Homonymy. Names identical in spelling with some, but not all, unavailable names can be classed as available if and when they are published in conformance to stipulations of the Code, and they are then assigned authorship and take date of the accepted publication. Different groups of unavailable names can be discriminated as follows.

9) "Naked names" include all those that fail to satisfy provisions stipulated in Article 11 of the Code, which states general requirements of availability. In addition they include names that, if published before 1931, were unaccompanied by a description, definition, or indication (Arts. 12, 16), as well as names published after 1930 that lacked accompanying statement of characters purporting to serve for differentiation of the taxon, or definite bibliographic reference to such a statement, or that were not proposed expressly as replacement (nom. subst.) of a preexisting available name (Art. 13a), or that were unaccompanied by definite fixation of a type species by original designation or indication (Art. 13b). Examples of "naked names" are: among species-group taxa, Valvulina mixta PARKER & JONES, 1865 (=Cribrubulimina mixta CUSHMAN, 1927, available and valid); among genus-group taxa, Orbitolinopsis Silvestri, 1932 (=Orbitolinopsis Henson, 1948, available but classed as invalid junior synonym of Orbitolina D'ORBIGNY, 1850); among family-group taxa, Aequilateralidae D'ORBIGNY, 1846 (lacking type-genus), Hélicostégues D'ORBIGNY, 1826 (vernacular not latinized by later authors, Art. 11e(iii)), Poteriocrinidea AUSTIN & AUSTIN, 1843, =family Poteriocrinoidea AUSTIN & AUSTIN, 1842 (neither 1843 or 1842 names complying with Art. 11e, which states that "a family-group name must, when first published, be based on the name then valid for a contained genus," such valid name in the case of this family being Poteriocrinites MILLER, 1821).

10) "Denied names" include all those that are defined by the Code (Art. 32c) as incorrect original spellings. Examples are: specific names, nova-zelandica, mulleri, 10-brachiatus; generic names, M'Coyia, Stérmorella, Römerina, Westergårdia; family name, Rüžičkinidae. Uncorrected "imperfect names" are "denied names" and unavailable, whereas corrected "imperfect names" are available.

11) "Impermissible names" include all those employed for alleged genus-group taxa other than genus and subgenus (Art. 42a) (e.g., supraspecific divisions of subgenera), and all those published after 1930 that are unaccompanied by definite fixation of a type species (Art. 13b). Examples of impermissible names are: Martellispirifer GATINAUD, 1949, and Mirtellispirifer GATINAUD, 1949, indicated respectively as a section and subsection of the subgenus Cystospirifer; Fusarchaias REICHEL, 1949, without definitely fixed type species (=Fusarchaias REICHEL, 1952, with F. bermudezi designated as type species).

12) "Null names" include all those that are defined by the Code (Art. 33b) as incorrect subsequent spellings, which are any changes of original spelling not demonstrably intentional. Such names are found in all ranks of taxa. It is not always evident from the original publication whether an incorrect subsequent spelling is intentional, resulting in a "vain name" which is invalid but available (category 4 above), or unintentional, resulting in a "null name" which is invalid and unavailable. In such cases,
the decision of a subsequent author will sometimes have to be arbitrary according to his best judgment.

13) “Forgotten names” are defined (Art. 23b) as senior synonyms that have remained unused in primary zoological literature for more than 50 years. Such names are not to be used unless so directed by ICZN.

Latin designations for the discussed groups of unavailable zoological names are as follows: 9) nomina nuda (sing., nomen nudum, abbr. nom. nud.), 10) nomina negata (nomen negatum, nom. neg.), 11) nomina vetita (nomen vetitum, nom. vet.), 12) nomina nulla (nomen nullum, nom. null.), 13) nomina oblita (nomen oblitum, nom. oblit.).

**VALID AND INVALID NAMES**

Important distinctions relate to valid and available names, on one hand, and to invalid and unavailable names, on the other. Whereas determination of availability is based entirely on objective considerations guided by Articles of the Code, conclusions as to validity of zoological names may be partly subjective. A valid name is the correct one for a given taxon, which may have two or more available names but only a single correct name, generally the oldest. Obviously, no valid name can also be an unavailable name, but invalid names may include both available and unavailable names. Any name for a given taxon other than the valid name is an invalid name.

A sort of nomenclatorial no-man’s-land is encountered in considering the status of some zoological names, such as “doubtful names,” “names under inquiry,” and “forgotten names.” Latin designations of these are nomina dubia, nomina inquirenda, and nomina oblita, respectively. Each of these groups may include both available and unavailable names, but the latter can well be ignored. Names considered to possess availability conduce to uncertainty and instability, which ordinarily can be removed only by appealed action of ICZN. Because few zoologists care to bother in seeking such remedy, the “wastebasket” names persist.

**SUMMARY OF NAME GROUPS**

Partly because only in such publications as the *Treatise* is special attention to groups of zoological names called for and partly because new designations are here introduced as means of recording distinctions explicitly as well as compactly, a summary may be useful. In the following tabulation valid groups of names are indicated in boldface type, whereas invalid ones are printed in italic.

**Definitions of Name Groups**

nomen conservatum (nom. conserv.). Name unacceptable under regulations of the Code which is made valid, either with original or altered spelling, through procedures specified by the Code by action of ICZN exercising its plenary powers.

nomen correctum (nom. correct.). Name with intentionally altered spelling of sort required or allowable by the Code but not dependent on transfer from one taxonomic rank to another (“improved name”). (See Code, Arts. 26b, 27, 29, 30a(i)(3), 31, 32c(i), 33a; in addition, change of endings for suprafamilial taxa not regulated by the Code.)

nomen imperfectum (nom. imperf.). Name that as originally published meets all mandatory requirements of the Code but contains defect needing correction (“imperfect name”). (See Code, Arts. 26b, 27, 29, 32c, 33a.)

nomen inviolatum (nom. inviol.). Name that as originally published constitutes invalid original spelling, and although possibly meeting all other mandatory requirements of the Code, cannot be used and has no separate status in nomenclature (“denied name”). It is to be corrected wherever found.

nomen nudum (nom. nud.). Name that as originally published fails to meet mandatory requirements of the Code and, having no status in nomenclature, is not correctable to establish original authorship and date (“naked name”).

nomen nullum (nom. null.). Name consisting of an unintentional alteration in form (spelling) of a previously published name (either available name, as nom. viol., nom. perf., nom. imperf., nom. transl.; or unavailable name, as nom. neg., nom. nud., nom. van., or another nom. null.) (“null name”).

nomen oblittum (nom. oblitt.). Name of senior synonym unused in primary zoological literature in more than 50 years, not to be used unless so directed by ICZN (“forgotten name”).

nomen perfectum (nom. perf.). Name that as originally published meets all mandatory requirements of the Code and needs no correction of any kind but which nevertheless is validly alterable by change of ending (“perfect name”).

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nomen substitutum (nom. subst.). Replacement name published as substitute for an invalid name, such as junior homonym (equivalent to "new name").

nomen translatum (nom. transl.). Name that is derived by valid emendation of a previously published name as result of transfer from one taxonomic rank to another within the group to which it belongs ("transferred name").

nomen vanum (nom. van.). Name consisting of an invalid intentional change in form (spelling) from a previously published name, such invalid emendation having status in nomenclature as a junior objective synonym ("vain name").

nomen vetitum (nom. vet.). Name of genus-group taxon not authorized by the Code or, if first published after 1930, without definitely fixed type species ("impermissible name").

Except as specified otherwise, zoological names accepted in the Treatise may be understood to be classifiable either as nomina inviolata or nomina perfecta (omitting from notice nomina correcta among specific names) and these are not discriminated. Names which are not accepted for one reason or another include junior homonyms, senior synonyms classifiable as nomina negata or nomina nuda, and numerous junior synonyms which include both objective (nomina vana) and subjective types; rejected names are classified as completely as possible.

NAME CHANGES IN RELATION TO TAXA GROUPS

Species-group Names

Detailed consideration of valid emendation of specific and subspecific names is unnecessary here because it is well understood and relatively inconsequential. When the form of adjectival specific names is changed to obtain agreement with the gender of a generic name in transferring a species from one genus to another, it is never needful to label the changed name as a nom. correct. Likewise, transliteration of a letter accompanied by a diacritical mark in manner now called for by the Code (as in changing originally published brøggeri to broeggeri) or elimination of a hyphen (as in changing originally published corru-oryx to corruoryx) does not require "nom. correct." with it.

Genus-group Names

So rare are conditions warranting change of the originally published valid form of generic and subgeneric names that lengthy discussion may be omitted. Only elimination of diacritical marks of some names in this category seems to furnish basis for valid emendation. It is true that many changes of generic and subgeneric names have been published, but virtually all of these are either nomina vana or nomina nulla. Various names which formerly were classed as homonyms now are not, for two names that differ only by a single letter (or in original publication by presence or absence of a diacritical mark) are construed to be entirely distinct.

Examples in use of classificatory designations for genus-group names as previously given are the following, which also illustrate designation of type species as explained later.

_Paleomeandron_ Peruzzi, 1881, p. 8 [*P. elegans; SD HANTZSCHEL, 1975, p. 9*] [=**Paleomeandron Fuchs, 1885, p. 395, nom. van.].

_Stichophyma_ POMEL, 1872 [*Manon turbinatum RÖMER, 1841; SD RAUFF, 1893]* [=**Stichophyma VOSMAER, 1885, nom. null.; Stichophyma MORET, 1924, nom. null.].


_Cyrtograptus_ CARRUTHERS, 1867, p. 540, nom. correct. LAPWORTH, 1873, pro __Cyrtograptus__ CARRUTHERS, 1867, ICZN Op. 650, 1963 [*Cyrtograptus murchisoni; OD.*]

As has been pointed out above, it is in
many cases difficult to decide whether a change in spelling of a name by a subsequent author was intentional or unintentional, that is, whether it should be classified as *nomen vanum* or *nomen nullum*, and the decision will often have to be arbitrary.

**Family-group Names; Use of “nom. transl.”**

The Code specifies the endings only for subfamily (-inae) and family (-idae) but all family-group taxa are defined as coordinate, signifying that for purposes of priority a name published for a taxon in any category and based on a particular type genus shall date from its original publication for a taxon in any category, retaining this priority (and authorship) when the taxon is treated as belonging to a lower or higher category. By exclusion of -inae and -idae, respectively reserved for subfamily and family, the endings of names used for tribes and superfamilies must be unspecified different letter combinations. These, if introduced subsequent to designation of a subfamily or family based on the same nominate genus, are *nomina translata*, as is also a subfamily that is elevated to family rank or a family reduced to subfamily rank. In the Treatise it is desirable to distinguish the valid alteration comprised in the changed ending of each transferred family-group name by the abbreviation “*nom. transl.*” and record of the author and date belonging to this alteration. This is particularly important in the case of superfamilies, for it is the author who introduced this taxon that one wishes to know about rather than the author of the superfamily as defined by the Code, for the latter is merely the individual who first defined some lower-rank family-group taxon that contains the nominate genus of the superfamily. The publication containing introduction of the superfamily *nomen translatum* is likely to furnish the information on taxonomic considerations that support definition of the unit.

Examples of the use of “*nom. transl.*” are the following.

**Subfamily STYLININAE** d’Orbigny, 1851

[nom. transl. Verrill, 1864, *ex* Stylinidae d’Orbigny, 1851]

**Superfamily ARCHAEOCOTONOIDEA** Petrunkevitch, 1949


**Superfamily ANCYLOCERATAE** Meek, 1876

[nom. transl. Wright, 1957, *ex* Ancyloceratidae Meek, 1876]

**Family STREPTESMATIDAE** Nicholson, 1889


**Family PALAEOSCORPIDAE** Lehmann, 1944


**Family AGLASPIDIDAE** Miller, 1877

[nom. correct. Stürmer, 1959, *pro* Aglaspidae Miller, 1877]

**Superfamily AGARICIIDAE** Gray, 1847


**Family-group Names: Replacements**

Family-group names are formed by adding letter combinations (prescribed for family and subfamily) to the stem of the name belonging to the genus (nominate genus) first chosen as type of the assemblage. The type genus need not be the oldest in terms of receiving its name and definition, but it must be the first-published as name-giver to a family-group taxon among all those included. Once fixed, the family-group name remains tied to the nominate genus even if its name is changed by reason of status as a junior homonym or junior synonym, either objective or subjective. Seemingly, the Code requires replacement of a family-group name only in the event that the nominate genus is found to have been invalid when it was proposed (Arts.
11e, 39), and then a substitute family-group name is accepted if it is formed from the oldest available substitute name for the nominate genus. Authorship and date attributed to the replacement family-group name are determined by first publication of the changed family-group name, but for purposes of the Law of Priority, they take the date of the replaced name. Numerous long-used family-group names are incorrect in being *nomina nuda*, since they fail to satisfy criteria of availability (Art. 11e). These also demand replacement by valid names.

The aim of family-group nomenclature is greatest possible stability and uniformity, just as in other zoological names. Experience indicates the wisdom of sustaining family-group names based on junior subjective synonyms if they have priority of publication, for opinions of different workers as to the synonymy of generic names founded on different type species may not agree and opinions of the same worker may alter from time to time. The retention similarly of first-published family-group names which are found to be based on junior objective synonyms is less clearly desirable, especially if a replacement name derived from the senior objective synonym has been recognized very long and widely. To displace a much-used family-group name based on the senior objective synonym by disinterring a forgotten and virtually unused family-group name based on a junior objective synonym because the latter happens to have priority of publication is unsettling.

Replacement of a family-group name may be needed if the former nominate genus is transferred to another family group. Then the first-published name-giver of the family-group assemblage in the remnant taxon is to be recognized in forming a replacement name.

**Family-group Names; Authorship and Date**

All family-group taxa having names based on the same type genus are attributed to the author who first published the name for any of these assemblages, whether tribe, subfamily, or family (superfamily being almost inevitably a later-conceived taxon). Accordingly, if a family is divided into subfamilies or a subfamily into tribes, the name of no such subfamily or tribe can antedate the family name. Also, every family containing differentiated subfamilies must have a nominate (*sensu stricto*) subfamily, which is based on the same type genus as that for the family, and the author and date set down for the nominate subfamily invariably are identical with those of the family, without reference to whether the author of the family or some subsequent author introduced subdivisions.

Changes in the form of family-group names of the sort constituting *nomina correcta*, as previously discussed, do not affect authorship and date of the taxon concerned, but in the *Treatise* it is desirable to record the authorship and date of the correction.

**Suprafamilial Taxa**

International rules of zoological nomenclature as given in the *Code* are limited to stipulations affecting lower-rank categories (subspecies to superfamily). Suprafamilial categories (suborder to phylum) are either unmentioned or explicitly placed outside of the application of zoological rules. The *Copenhagen Decisions on Zoological Nomenclature*¹ (1953, Arts. 59-69) proposed to adopt rules for naming suborders and higher taxonomic divisions up to and including phylum, with provision for designating a type genus for each, hopefully in such manner as not to interfere with the taxonomic freedom of workers. Procedures for applying the Law of Priority and Law of Homonymy to suprafamilial taxa were outlined and for dealing with the names for such units and their authorship, with assigned dates, when they should be transferred on taxonomic grounds from one rank to another. The adoption of terminations of names, different for each category but uniform within each, was recommended.

The Colloquium on Zoological Nomenclature which met in London during the week just before the XVth International Congress of Zoology convened in 1958

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thoroughly discussed the proposals for regulating suprafamilial nomenclature, as well as many others advocated for inclusion in the new Code or recommended for exclusion from it. A decision which was supported by a wide majority of the participants in the Colloquium was against the establishment of rules for naming taxa above family-group rank, mainly because it was judged that such regulation would unwisely tie the hands of taxonomists. For example, a class or order defined by an author at a given date, using chosen morphologic characters (e.g., gills of bivalves), should not be allowed to freeze nomenclature, taking precedence over another, later-proposed class or order distinguished by different characters (e.g., hinge-teeth of bivalves). Even the fixing of type genera for suprafamilial taxa might have small value, if any, hindering taxonomic work rather than aiding it. At all events, no legal basis for establishing such types and for naming these taxa has yet been provided.

The considerations just stated do not prevent the editors of the Treatise from making “rules” for dealing with suprafamilial groups of animals described and illustrated in this publication. At least a degree of uniform policy is thought to be needed, especially for the guidance of Treatise authors. This policy should accord with recognized general practice among zoologists; but where general practice is indeterminate or nonexistent, our own procedure in suprafamilial nomenclature needs to be specified as clearly as possible. This pertains especially to decisions about names themselves, about citation of authors and dates, and about treatment of suprafamilial taxa which on taxonomic grounds are changed from their originally assigned rank. Accordingly, a few “rules” expressing Treatise policy are given here, some with examples of their application.

1) The name of any suprafamilial taxon must be a Latin or latinized uninnominal noun of plural form, or treated as such, a) with a capital initial letter, b) without diacritical mark, apostrophe, diaeresis, or hyphen, and c) if a component consisting of a numeral, numerical adjective, or adverb is used, this must be written in full (e.g., Stethostomata, Trionychi, Septemchitonina, Scorpiones, Subselliﬂora). No uniformity in choice of ending for taxa of a given rank is demanded (e.g., orders named Gorgonacea, Millepotina, Rugosa, Scleractinia, Stromatoporoidea, Phalangida).

2) Names of suprafamilial taxa may be constructed in almost any way, a) intended to indicate morphological attributes (e.g., Lamellibranchiata, Cyclostomata, Toxoglossa), b) based on the stem of an included genus (e.g., Bellerophontina, Nautilida, Fungiina), or c) arbitrary combinations of letters (e.g., Yania), but none of these can be allowed to end in -idae or -inae, reserved for family-group taxa. No suprafamilial name identical in form to that of a genus or to another published suprafamilial name should be employed (e.g., order Decapoda Latreille, 1803, crustaceans, and order Decapoda Leach, 1818, cephalopods; suborder Chonetoida Muir-Wood, 1955, and genus Chonetoida Jones, 1928). Worthy of notice is the classificatory and nomenclatural distinction between suprafamilial and family-group taxa which respectively are named from the same type genus, since one is not considered to be transferable to the other (e.g., suborder Bellerophontina Ulrich & Scofield, 1897; superfamilly Bellerophontacea M'Coy, 1851; family Bellerophontidae M'Coy, 1851). Family-group names and suprafamilial names are not coordinate.

3) The Laws of Priority and Homonymy lack any force of international agreement as applied to suprafamilial names, yet in the interest of nomenclatural stability and the avoidance of confusion these laws are widely applied by zoologists to taxa above the family-group level wherever they do not infringe on taxonomic freedom and long-established usage.

4) Authors who accept priority as a determinant in nomenclature of a suprafamilial taxon may change its assigned rank at will, with or without modifying the terminal letters of the name, but such change(s) cannot rationally be judged to alter the authorship and date of the taxon as published originally. a) A name revised from its previously published rank is a “transferred name” (nom. transl.), as illustrated in the following.
Order CORYNEXOCHIDA Kobayashi, 1935
[nom. transl. Moore, 1959, ex suborder Corynexo-
chida Kobayashi, 1935]

b) A name revised from its previously pub-
lished form merely by adoption of a differ-
ent termination, without changing taxo-
nomic rank is an "altered name" (nom. 
correct.). Examples follow.

Order DISPARIDA Moore & Laudon, 1943
[nom. correct. Moore in Moore, Lalicker, & 
Fischer, 1952, pro order Disparata Moore & 
Laudon, 1943]

Suborder AGNOSTINA Salter, 1864
[nom. correct. Harrington & Leanza, 1957, pro 
suborder Agnostini Salter, 1864]

c) A suprafamilial name revised from its 
previously published rank with accompany-
ing change of termination (which may or 
may not be intended to signalize the change 
of rank) is recorded as nom. transl. et 
correct.

Order HYBOCRINIDA Jaekel, 1918
[nom. transl. et correct. Moore in Moore, 
Lalicker, & Fischer, 1952, p. 613, ex suborder 
Hybocrinites Jaekel, 1918, p. 90]

5) The authorship and date of nominate 
subordinate and superordinate taxa among 
suprafamilial taxa are considered in the 
Treatise to be identical since each actually 
or potentially has the same type. Examples 
are given below.

Subclass ENDOCERATOIDEA Teichert, 1933
[nom. transl. Teichert in Teichert et al., 1964, 
p. K128 (ex superorder Endoceratoidea Shimanskiy 
& Zhuravleva, 1961, nom. transl. Teichert in 
Teichert et al., 1964, p. K128, ex order Endo-
ceroidea Teichert, 1933)]

Order ENDOCERIDA Teichert, 1933
[nom. correct. Teichert in Teichert et al., 1964, 
p. K165, pro order Endoceridea Teichert, 1933]

Suborder ENDOCERINA Teichert, 1933
[nom. correct., herein, ex Endoceratina Sweet, 
1958, suborder]

TAXONOMIC EMENDATION

Emendation has two distinct meanings as 
regards zoological nomenclature. These are: 
1) alteration of a name itself in various 
ways for various reasons, as has been re-
viewed, and 2) alteration of taxonomic 
scope or concept in application of a given 
zoo logical name. The Code (Art. 33a and 
Glossary p. 148) concerns itself with only 
the first type of emendation, applying the 
term to either justified or unjustified 
changes, both intentional, of the original 
spelling of a name. These categories are 
identified in the Treatise as nomina correcta 
and nomina vana, respectively. The second 
type of emendation primarily concerns clas-
sification and inherently is not associated 
with change of name. Little attention gen-
erally has been paid to this distinction in 
spite of its significance.

Most zoologists, including paleozoolo-
gists, who have signified emendation of 
zoo logical names refer to what they con-
sider a material change in application of 
the name such as may be expressed by an 
importantly altered diagnosis of the assem-
blage covered by the name. The abbrevia-
tion "emend." then may accompany the 
name, with statement of the author and 
date of the emendation. On the other hand, 
many workers concerned with systematic 
zoo logy think that publication of "emend." 
with a zoological name is valueless, because 
more or less alteration of taxonomic sort is 
introduced whenever a subspecies, species, 
genus, or other assemblage of animals is 
incorporated under or removed from the 
coverage of a given zoological name. In-
evitably associated with such classificatory 
expansions and restrictions is some degree 
of emendation affecting diagnosis. Grant-
ing this, still it is true that now and then 
somewhat radical revisions are put forward, 
generally with published statement of rea-
sons for changing the application of a name. 
To erect a signpost at such points of most 
significant change is worthwhile, both as 
aid to subsequent workers in taking ac-
count of the altered nomenclatural usage 
and as indication that not-to-be-overlooked 
discussion may be found at a particular 
place in the literature. Authors of contribu-
tions to the Treatise are encouraged to in-
clude records of all specially noteworthy 
emendations of this nature, using the ab-
bre viation "emend." with the name to 
which it refers and citing the author and 
date of the emendation.

Examples from Treatise volumes follow.
Order ORTHIDA Schuchert & Cooper, 1932  
[emend. Williams & Wright, 1965]

Subfamily ROVEACRININAE Peck, 1943  

STYLE IN GENERIC DESCRIPTIONS

Citation of Type Species

The name of the type species of each genus and subgenus is given next following the generic name with its accompanying author, date, and page reference or alter entries needed for definition of the name if it is involved in homonymy. The originally published combination of generic and trivial names for this species is cited, accompanied by an asterisk (*), with notation of the author and date of original publication. An exception in this procedure is made, however, if the species was first published in the same paper and by the same author as that containing definition of the genus that it serves as type; in such case, the initial letter of the generic name followed by the trivial name is given without repeating the name of the author and date. Examples of these two sorts of citations are as follows:

Diplotrypa Nicholson, 1879 [*Favosites petrophalantls Pander, 1830].

Chainodictyon Foerste, 1887 [*C. laxum].

If the cited type species is a junior synonym of some other species, the name of this latter also is given, as follows:

Acervularia Schweigger, 1819 [*A. balica; M; =*Madrepora ananas Linné, 1758].

In the Treatise, the name of the type species is always given in the exact form it had in the original publication; in cases where mandatory changes are required, these are introduced later in the text, mostly in a figure caption. Examples are:

Ceratostreon Bayle, 1978, pl. 133-134 explanations [*Exogyra spinoza Matheron, 1843, p. 192].

Misspelling of Exogyra.

Obinautillus Kobayashi, 1954 [*O. pulchra]. Wrong gender for species name (recte pulcher).

It is desirable to record the manner of establishing the type species, whether by original designation or by subsequent designation.

Fixation of type species originally. The type species of a genus or subgenus, according to provisions of the Code, may be fixed in various ways in the original publication or it may be fixed in specified ways subsequent to the original publication as stipulated by the Code (Art. 68) in order of precedence as 1) original designation (in the Treatise indicated as “OD”) when the type species is explicitly stated or (before 1931) indicated by “n. gen., n. sp.” (or its equivalent) applied to a single species included in a new genus, 2) defined by use of typus or typicus for one of the species included in a new genus (adequately indicated in the Treatise by the specific name), 3) established by monotypy if a new genus or subgenus has only one originally included species (in the Treatise indicated as “M”), and 4) fixed by tautonymy if the genus-group name is identical to an included species name not indicated as type belonging to one of the three preceding categories.

Fixation of type species subsequently. The type species of many genera are not determinable from the publication in which the generic name was introduced and therefore such genera can acquire a type species only by some manner of subsequent designation. Most commonly this is established by publishing a statement naming as type species one of the species originally included in the genus, and in the Treatise fixation of the type species in this manner is indicated by the letters “SD” accompanied by the name of the subsequent author (who may be the same person as the original author) and the date of publishing the subsequent designation. Some genera, as first described and named, included no mentioned species and these necessarily lack a type species until a date subsequent to that of the original publication when one or more species are assigned to such a genus. If only a single species is thus assigned, it automatically becomes the type species and in the Treatise this subsequent monotypy is indicated by the letters “SM.” Of course, the first publication containing assignment of species to the genus which originally lacked any included species is the one con-
cerned in fixation of the type species, and if this named two or more species as belonging to the genus but did not designate a type species, then a later "SD" designation is necessary. Examples of the use of "SD" and "SM" as employed in the Treatise follow.

**Hexagonaria** Gürich, 1896 [*Cyathophyllum hexagonum Goldfuss, 1826; SD Lang, Smith, & Thomas, 1940*].

**Muriceides** Studer, 1887 [*M. fragilis Wright & Studer, 1889; SM Wright & Studer, 1889*].

Another mode of fixing the type species of a genus is action of the International Commission on Zoological Nomenclature using its plenary powers. Definition in this way may set aside application of the Code so as to arrive at a decision considered to be in the best interest of continuity and stability of zoological nomenclature. When made, it is binding and commonly is cited in the Treatise by the letters "ICZN," accompanied by the date of announced decision and reference to the appropriate numbered Opinion.

It should be noted that subsequent designation of a type species is admissible only for genera established prior to 1931. A new genus-group name established after 1930, and not accompanied by fixation of a type species through original designation or original indication, is invalid (Code, Art. 13b). Effort of a subsequent author to "validate" such a name by subsequent designation of a type species constitutes an original publication making the name available under authorship and date of the subsequent author. This provision of the Code has not been consistently applied in all earlier Treatise volumes, but is rigged adhered to in the present volume.

**Type species of synonyms.** In about 1969 a decision was made by the editors to include the names of type species of genera that were placed in subjective synonymy. Such species are simply identified as "type." An example is:

**Trachycardium** Morch, 1853 [*Cardium isocardia Linne, 1758; SD von Martens, 1870*] [=Kathocardia Tucker & Wilson, 1932 (type, Cardium (K.) acclinense, OD)].

**Fixation of types of type species.** The present Supplement to Part F introduces an important innovation in that documentation on the type specimen (or specimens) of type species is supplied, which has not been included in any previous Treatise volume. Citation of type species and indication of the manner of its designation is followed by a symbol (+) that precedes the museum designation, usually a number of the type specimen or specimens and the name and location of the repository. The status of the types is indicated next. When no information follows the repository citation, it is understood that a holotype was satisfactorily designated in the original publication (including designation by monotypy in species established on the basis of only one specimen). When syntypes only are available, this has been indicated. If no holotype was selected by the original author, subsequent choice of a lectotype, if any, is indicated by author and date, and where the original holotype has been lost, the same procedure is followed for the neotype if one has been selected. Holotype, paratypes and syntypes, lectotype, and neotype are the only categories of types recognized in this Supplement.

The procedure described and followed here does not establish a precedent to be followed necessarily in future Treatise parts and supplements.

**Homonyms**

Most generic names are distinct from all others and are indicated without ambiguity by citing their originally published spelling accompanied by name of the author and date of first publication. If the same generic name has been applied to two or more distinct taxonomic units, however, it is necessary to differentiate such homonyms, and this calls for distinction between junior homonyms and senior homonyms. Because a junior homonym is invalid, it must be replaced by some other name. For example, *Callopora* Hall, 1851, introduced for Paleozoic trepostome bryozoans, is invalid because Gray in 1848 published the same name for Cretaceous to-Holocene cheilostome bryozoans, and Bassler in 1911 introduced the new name *Hallopora* to replace Hall's homonym. The Treatise style of entry is:

*Hallopora* Bassler, 1911, nom. subst. pro *Callopora* Hall, 1851 non Gray, 1848.

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In like manner, a needed replacement generic name may be introduced in the Treatise (even though first publication of generic names otherwise in this work is generally avoided). The requirement that an exact bibliographic reference must be given for the replaced name commonly can be met in the Treatise by citing a publication recorded in the list of references, as shown in the following example.

Mysterium de Laubenfels, herein, nom. subst. pro Mystrium Schrammen, 1936, p. 60, non Roger, 1862 [*Mystrium porosum Schrammen, 1936].

Otherwise, no mention of the existence of a junior homonym generally is made.

Synonymous homonyms. An author sometimes publishes a generic name in two or more papers of different date, each of which indicates that the name is new. This is a bothersome source of errors for later workers who are unaware that a supposed first publication that they have in hand is not actually the original one. Although the names were separately published, they are identical and therefore definable as homonyms; at the same time they are absolute synonyms. For the guidance of all concerned, it seems desirable to record such names as synonymous homonyms, and in the Treatise the junior one of these is indicated by the abbreviation “jr. syn. hom.”

Identical family-group names not infrequently are published as new names by different authors, the author of the later-introduced name being ignorant of previous publication(s) by one or more other workers. In spite of differences in taxonomic concepts as indicated by diagnoses and grouping of genera and possibly in assigned rank, these family-group taxa are nomenclatural homonyms, based on the same type genus, and they are also synonyms. Wherever encountered, such synonymous homonyms are distinguished in the Treatise as in dealing with generic names.

A special, though rare, case of synonymy exists when identical family names are formed from generic names having the same stem but differing in their endings. An example is the family name Scutellidae R. & E. Richter, 1925, based on Scutellum Pusch, 1833, a trilobite. This name is a junior synonym of Scutellae Gray, 1825, based on Scutella Lamarck, 1816, an echi-noid. The name of the trilobite family was later changed to Scutellullidae (ICZN, Op. 1004, 1974).

Synonyms

Citation of synonyms is given next following record of the type species and if two or more synonyms of differing date are recognized, these are arranged in chronological order. Objective synonyms are indicated by accompanying designation “obj.,” others being understood to constitute subjective synonyms, of which the types are also indicated. Examples showing Treatise style in listing synonyms follow.

Modiomorpha Hall & Whitfield, 1869, p. 72 [*Pterinea concentrica Conrad, 1838; SD Hall, 1885] [=Palamaiina Hall & Whitfield, 1870 (type, P. typa, OD)].

Staurocyclia Haeckel, 1882 [*S. cruciata Haeckel, 1887] [=Coccostaurus Haeckel, 1882 (obj.); Phacostaurus Haeckel, 1887 (obj.)].

Graphiocrinus de Koninck & Le Hon, 1854, p. 115 [*G. encrinoides; M] [=Scaphiocrinus Hall, 1858b, p. 550 (type, S. simplex, OD)].

Some junior synonyms of either objective or subjective sort may take precedence desirably over senior synonyms wherever uniformity and continuity of nomenclature are served by retaining a widely used but technically rejectable name for a generic assemblage. This requires action of ICZN using its plenary powers to set aside the unwanted name and validate the wanted one, with placement of the concerned names on appropriate official lists.

STRATIGRAPHIC DIVISIONS

It has been customary in previous Treatise parts to conclude the Editorial Preface with a tabulation of condensed versions of the subdivisions of the geologic timetable as they are applied in stratigraphic practice in Europe and in North America. In this Supplement the Cambrian and all Mesozoic and Cenozoic systems may be ignored because no undoubted rugose and tabulate corals are known to occur in them (with the possible exception of some Chaetetida). The correlation of the subdivisions of each of
the remaining systems (Ordovician, Silurian, Devonian, Carboniferous, and Permian) to which all undisputed Rugosa and Tabulata are restricted presents some problems, which are discussed below.

**Ordovician System**

The Ordovician System is subdivided rather differently in Europe and North America. The most essential units of the two schemes are as follows.

<table>
<thead>
<tr>
<th>Europe</th>
<th>North America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashgillian Series</td>
<td>Upper Ordovician (Cincinnatian Series)</td>
</tr>
<tr>
<td>Caradocian Series</td>
<td>Richmondian Stage</td>
</tr>
<tr>
<td></td>
<td>Maysvillian Stage</td>
</tr>
<tr>
<td></td>
<td>Edenian Stage</td>
</tr>
<tr>
<td>Llandeilian Series</td>
<td>Middle Ordovician (Champlainian Series)</td>
</tr>
<tr>
<td></td>
<td>Trentonian Stage</td>
</tr>
<tr>
<td></td>
<td>Blackriverian Stage</td>
</tr>
<tr>
<td>Llanvirnian Series</td>
<td>Chazyan Stage</td>
</tr>
<tr>
<td>Arenigian Series</td>
<td>Whiterockian Stage</td>
</tr>
<tr>
<td>Tremadocian Series</td>
<td>Lower Ordovician (Canadian Series)</td>
</tr>
</tbody>
</table>

The European standard is based on stratotypes in Great Britain (Williams et al., 1972). There, it is not customary to divide the Ordovician into lower and upper, or lower, middle, and upper series as is the practice with other systems. If a Lower and Upper Ordovician Series are recognized at all, the boundary is placed at the base of the Zone of *Nemagraptus gracilis*, which lies within the Llandeilian in Britain and corresponds to the Kukruse Stage of the Viruan Series in Estonia. In North America, the base of the *Nemagraptus gracilis* Zone lies at the top of the Chazyan. In Estonia, the Viruan Series is often classified as Middle Ordovician (Jaanusson, 1976). If recognized at all in Europe, Middle Ordovician includes the equivalents of the Llandeilian and Llanvirnian of English usage.

In Britain, the Tremadocian Series is traditionally included in the Cambrian System (Cowie et al., 1972), but this practice does not affect its correlation with the lower part of the Canadian Series in North America.

Outside Europe, other than in North America, the British subdivisions are in general use, although locally, e.g. in southeastern Australia, a special stage nomenclature has been developed (see Treatise, Part V, revised edition, p. V102).

**Silurian System**

The internationally recognized major subdivisions of the Silurian System are as follows, listed from oldest to youngest: Llandoverian Series, Wenlockian Series, Ludlovian Series, Pridolian Series.

Until recently, a threefold division of the Silurian was recognized in North America, based on the stratigraphic sequence known in New York State: Alexandrian (or Medinan) Series, Niagaran Series, Cayugan Series.

Berry and Boucot (1970) advocated restriction of this terminology to its type area, New York State, and adoption, in North America, of the international type sequence as known and used in the British Isles, Scandinavia, and Czechoslovakia. The name Niagaran is still widely used in North America and is frequently cited in this Treatise Supplement. In general, this age designation is more or less synonymous with Wenlockian, but, if applied to western North America, may include somewhat older or younger Silurian rocks.

The name Downtonian was formerly widely used for the uppermost series (or stage) of the Silurian in Europe, but is now restricted to the nonmarine beds of that age in the area of the so-called Old Red continent.
Devonian System

The internationally recognized major subdivisions of the Devonian System are as follows, oldest to youngest. Lower Devonian Series: Gedinnian Stage, Siegenian Stage, Emsian Stage; Middle Devonian Series: Couvinian Stage, Givetian Stage; Upper Devonian Series: Frasnian Stage, Famennian Stage.

In previous Treatise parts, the stratigraphic nomenclature applied to the Devonian sequence in New York State was given for North America, with the restriction that in western North America the “European” stage terminology is used (see Treatise, Part A, p. xxiii). New York State nomenclature is not used in this Supplement.

In earlier European literature, the name Coblentzian (or Coblenzian) was widely used, first for all of the Lower Devonian above the Gedinnian, later restricted to what is now known as Emsian. “Coblentzian,” as quoted from older literature in this Supplement, is probably mostly synonymous with Emsian, but may include equivalents of the Siegenian (Richter, 1954; Ziegler, 1979).

The term Eifelian which occurs frequently in this supplement is, in most cases, probably synonymous with Couvinian, but may, in some authors, refer to the upper Couvinian only, and, in others, include part of the upper Emsian (Assise de Bure) (see R. & E. Richter, 1950; Lecompte, 1955, 1968; Ziegler, 1979).

In Czechoslovakia, the following subdivisions of the Lower Devonian Series are accepted: Lochkovian Stage, Pragian Stage, Zlichovian Stage. These three stages are roughly, though not exactly, equivalent to the three stages of the standard sequence.

Carboniferous System

Traditionally, since the late nineteenth century, the Carboniferous System has been divided into two parts, called Lower Carboniferous Series and Upper Carboniferous Series. The first of these was divided into the Tournaisian and Visean stages, the second into Namurian, Westphalian, and Stephanian. In eastern Europe, however, a threefold division of the Carboniferous into Lower, Middle, and Upper Carboniferous has been in vogue at least since the earliest part of this century. In the United States, the rocks of the corresponding time interval have long been subdivided into two systems, called Mississippian and Pennsylvanian, and the term Carboniferous is not used at all. Generally, in these volumes the terms Mississippian and Pennsylvanian and the names for their subdivisions are used to denote the ages of occurrences in the United States only. The term Carboniferous and the names for its subdivisions are employed for occurrences in most of the rest of the world. In Canada, both stratigraphic scales are in use (see Douglas, 1979).

Each series (or system) in these stratigraphic schemes has been subdivided into stages (or series), but it is not possible to construct a correlation table for these subdivisions that would do justice to all opinions expressed by many authors. The correlations presented in the chart are a compromise at best and some explanatory notes are offered below.

The Etroeungt beds of Belgium, constituting the “Strunian Stage,” are a facies of Oberdevonstufe VI (Wocklumeria-Stufe) of West Germany. This is placed as the topmost Famennian by German authors (see Erben & Zagora, 1967) and as lowermost Tournaisian (or as the lowest Carboniferous stage below the Tournaisian) by English, Belgian, and Soviet authors (see George et al., 1976; Stepanov, 1964). It is not considered by us to be a chronostratigraphic unit of international validity.

The Namurian presents a problem in that it has been variously assigned to the Lower, Middle, or Upper Carboniferous. In western Europe (including Britain), the Namurian is regarded as the lowermost stage of the Upper Carboniferous, but its upper part (Namurian C) is correlated with the lower Bashkirian of the U.S.S.R., which is there classified as Middle Carboniferous. In earlier Soviet literature, the Namurian was generally classified in its entirety as uppermost Lower Carboniferous, overlain by the Middle Carboniferous Bashkirian Stage (Stepanov et al., 1962). Subsequently, the Namurian was divided between the Lower and Middle Carboniferous (Stepanov, 1964) or placed

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Correlation chart for the Carboniferous System in western Europe, the Soviet Union, and North America (greatly modified from Francis & Woodland, 1964, Table 1). Units identified as “horizon” and “formation” in the column for the Moscow Basin are best regarded as equivalent to stages or substages in western European usage; the orthography of their names is that used by Nalivkin (1973). The subdivisions of the Mississippian and Pennsylvanian of North America are treated as series by most authors, but as stages by some. Subdivisions of stages (or series) into lettered units are still widely used in Europe and the Soviet Union.

entirely in the Middle Carboniferous (see Nalivkin, 1973, who called this the “correct solution,” although retaining the Namurian in the Lower Carboniferous in his Table 8).

In the stratigraphic charts of this supplement the twofold division of the Carboniferous System is maintained and the Namurian is placed as the lowest subdivision of the Upper Carboniferous. In the systematic descriptions the age of the Namurian is, in many cases, indicated to be Early Carboniferous, in accordance with the practice of the authors from which the information was copied.

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**Permian System**

A great many names have been proposed for divisions of stage and substage rank of the Permian System in various parts of the world (see *WATERHOUSE*, 1976).

The stratotype of the system is in the eastern part of the Russian Platform and the western slopes of the Ural Mountains. The classical sequence for this area (*STEPANOV*, 1973) is below juxtaposed with the standard divisions of the Permian in the western United States.

**U.S.S.R.**

<table>
<thead>
<tr>
<th>Upper Permian Series</th>
</tr>
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<tbody>
<tr>
<td>Tatarian Stage</td>
</tr>
<tr>
<td>Kazanian Stage</td>
</tr>
<tr>
<td>Ufimian Stage</td>
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<tr>
<td>Lower Permian Series</td>
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<tr>
<td>Kungurian Stage</td>
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<td>Artinskian Stage</td>
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<td>Sakmarian Stage</td>
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<tr>
<td>Asselian Stage</td>
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</tbody>
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**U.S.A.**

<table>
<thead>
<tr>
<th>Upper Permian Series</th>
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<tbody>
<tr>
<td>Ochoan Stage</td>
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<tr>
<td>Guadalupian Stage</td>
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<tr>
<td>Lower Permian Series</td>
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<tr>
<td>Leonardian Stage</td>
</tr>
<tr>
<td>Wolfcampian Stage</td>
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</tbody>
</table>

A drawback of these classical schemes is that both in the United States and in the Soviet Union, the latest Permian is a time of regression of the sea and formation of evaporite deposits. In the Tethys area, more or less complete sections of marine deposits are known in Soviet Armenia, northwestern Iran, and southern China. A composite stage scheme for the Upper Permian Series of the Tethys is this, oldest to youngest: Guadalupian Stage, Dzhulfian Stage, Changxingian Stage.

A near equivalent of the Changxingian Stage, whose stratotype is in southern China, is the Dorashamian Stage with the stratotype in the Nakhichevan ASSR of the southern Soviet Union (*Tozer*, 1979).

Other important sequences are found in central Asia, specifically the Pamir, where the following stage nomenclature is in use (*NALIVKIN*, 1973). Lower Permian Series: Karachatyrian Stage, Darvazian Stage; Upper Permian Series: Murgabian Stage, Pamirian Stage. This nomenclature has also been applied to parts of the section in northwestern Iran.

Additional, more elaborate stratigraphic subdivisions have been proposed for Japan and New Zealand, but are not used in this Supplement.

**REFERENCES CITED**


MUSEUM AND REPOSITORY ABBREVIATIONS

Letter symbols and locations for deposits holding type material, which are used throughout the systematic sections of the text, are listed and defined below.

AGS, Peking [Beijing]: Institute of Geology, Academy of Geological Sciences
AM, Sydney: Australian Museum
AMNH, New York: American Museum of Natural History
Anglo-Iranian Oil Co.: location of specimens not traced
ANU, Canberra: Department of Geology, Australian National University
AU, Aberdeen: Aberdeen University
BA, Clausthal-Zellerfeld: Technische Universität Clausthal
BM (NH), London: British Museum (Natural History)
BPI, Vladivostok: Biologo-pochvenniy institut
CU, Peking: Chinghua [Tsinghua] University; the undergraduate section of the Geology Department now moved to Wuhan but the postgraduate section remains in Beijing (Peking)
DI, Kilmarnock: Dick Institute
DPI, Donetsk: Donetskiy polyteknicheskiy institut
DPO, Oviedo: Departamento de Paleontologia, Universidad de Oviedo
EGM, Tallinn: Eesti NSV Teaduste Akadeemia, Geoloogia Instituudi
FM, Chicago: Field Museum; houses also the Walker Museum collections
GB, Nanjing [Nanking]: Geological Bureau, Jiangsu [Kiangs] Province
GB, Nanning: Geological Bureau of Guangxi [Kwangsi] Province
GC, Changchun: Geological College, Jilin [Kilin] Province
GFC, Lille: Géologie-Faculté Catholique de Lille
GGI, Ufa: Gorno-geologicheskii institut Akademii nauk SSSR
GI, Prague: Geological Institute of the Czechoslovakian Academy of Sciences
GPI, Münster/Westfalen: Geologisch-Paläontologisches Institut der Westfälischen Wilhelms-Universität Münster
GPI, Tübingen: Geologisch-Paläontologisches Institut und Museum, Eberhard-Karls-Universität
GSC, Ottawa: Geological Survey of Canada, National Type Collection
GSGI, Peking: Graduate School of the Geological Institute (H. C. Wang's specimens of 1950)
GSI, Calcutta: Geological Survey of India, Type Collection
GSM, London: Institute of Geological Sciences, London; Carboniferous corals housed at IGS, Leeds
GSM, Sydney: New South Wales Geological Survey Museum
GSQ, Brisbane: Geological Survey of Queensland
GSV, Melbourne: Geological Survey of Victoria; as of 1978, collections transferred to NM, Melbourne
HM, Glasgow: Hunterian Museum, University of Glasgow
HPRIGS, Yichang: Hubei [Hupei] Provincial Research Institute of Geological Sciences
HU, East Berlin: Haupt-Sammlung, Paläontologische Abteilung des Naturkunde-Museums der Humboldt-Universität
IAGG, Osaka: Osaka University of Liberal Arts and Education

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ABBREVIATIONS

Abbreviations used in this division of the Treatise are explained in the following alphabetically arranged list. Standard abbreviations or those found only in the references are not included.

Afghan., Afghanistan
Afr., Africa
Akkan., Akkanian
Alg., Algeria
Algonk., Algonkian
Alleghen., Alleghenian
Anasu., Anasuan
approx., approximately
Arch., Archipelago
Ariz., Arizona
Ark., Arkansas
Armen. SSR., Armenian Soviet Socialist Republic
Artinsk., Artinskian
Ashgill., Ashgillian
Asia M., Asia Minor
auct., auctorum (of authors)
Aus., Austria
Aynasu., Aynasuan
B.C., British Columbia
Belg., Belgium
Bend., Bendian
Blackriv., Blackriveran
Boh., Bohemia
Borschchov., Borschchovian
Brit. I., British Isles
Bur., Bureau
C., Central
Cal., California
C. Am., Central America
Cam., Cambrian
Camb., Cambodia
Can., Canada
Caradoc., Caradocian
Carboniferous
Carn., Carnian
Cenoman., Cenomanian
Chazy., Chazyan
Chester., Chesterian
Chih., Chihian
Co., co., County
Coblenz., Coblenzian
coll., collection
Colo., Colorado
comb., combination
commun., communication
congl., conglomerate
cosmop., cosmopolitan
Covin., Couvinian
Cr., Creek
Cret., Cretaceous
Czech., Czechoslovakia
Dalyan., Dalyanian
Dev., Devonian
diagr., diagram
diagram., diagrammatic
diam., diameter
Dinant., Dinantian
distr., district
Dol., Dolomite
Dolbor., Dolborian
Donbas, Donets Basin
Downton., Downtonian
REFERENCES TO LITERATURE

Each part of the Treatise is accompanied by a list or lists of references to the paleontological literature. In Treatise parts published in the 1950’s and early 1960’s, these lists were highly selective, consisting of recent and comprehensive monographs, but also including some important older works. In time, however, Treatise authors and readers pressed for more exhaustive documentation, complete with author, publication year, and page number, for all publications to which reference is made anywhere in the text.

The following is a statement of the full names of serial publications cited in abbreviated form in the list of references in this volume. The list is alphabetized according to the serial titles that were employed at the time of publication. Those following in parentheses are those under which the publication may be found currently in the Union List of Serials, the United States Library of Congress listing, and most library card catalogues. The names of serials published in Cyrillic are transliterated; in the references, these titles, which may be abbreviated, are accompanied by transliterated authors’ names and titles, with English translation of the title. Titles of works in Chinese only are enclosed in brackets. The place of publication is added if it is not included in the serial title.

The method of transliterating Cyrillic letters is that suggested by the Geographical Society of London and the U.S. Board on Geographic Names. It follows that names of some Russian authors in transliterated form derived in this way differ from other forms, possibly including one used by the author himself. In Treatise reference lists the alternative form is given in brackets.

List of Serial Publications

Academia Sinica. Peking.
Académie des Sciences de Paris; Comptes Rendus; Mémoires.
Académie Impériale des Sciences, St. Pétersbourg (Akademiya Nauk SSSR), Mémoires.
Académie Royale de Belgique, Bulletins. Brussels.
Academy of Natural Sciences of Philadelphia, Proceedings.

Acta Geologica Polonica. Warsaw.


[K.] Akademie der Wissenschaften zu Wien, mathematische-naturwissenschaftliche Klasse; Denkschriften; Sitzungsberichte.
Akademiya Nauk SSSR; Doklady; Geologicheskii Institut, Trudy; Izvestiya, Seriya Geologicheskaya; Izvestia, Seriya Biologicheskaya; Mongolskaya Komissiya, Trudy; Paleontolicheskii Zhurnal; Paleontologicheskii Institut, Trudy; Polyarnoy Komissii, Trudy; Trudy. Moscow.
Akademiya Nauk SSSR, Komi filial, Trudy. Syktyvkar.
Akademiya Nauk Tadzhikskoy SSR; Doklady; Otdelenie Estestvennykh Nauk, Izvestiya. Dushanbe.
Akademiya Nauk Uzbekskoi SSR, Doklady. Tashkent.
Alcheringa. Sydney.
American Association for the Advancement of Science, Proceedings. Washington, D.C.
American Geologist. Minneapolis, Minnesota.
Annales de Geologie et de Paleontologie. Palermo.
Annals and Magazine of Natural History. London.
Archives Géologiques du Viet-Nam. Saigon.
Australian Museum; Memoir; Records. Sydney.
Bayerisch Akademie der Wissenschaften, Abhandlungen. Munich.
Bergens Museum Årbok, Naturvitenskapelig Rekke. Bergen.
Bihang till Konglig Svenska Vetenskapsakademiens Handlingar. Stockholm.
Boston Society of Natural History, Proceedings.
British Association for the Advancement of Science, Reports. London.
British Museum (Natural History), Geology Bulletin. London.
Buffalo Society of Natural Sciences, Bulletin.
Canada, Geological Survey of; Bulletin; Contributions to Canadian Paleontology; Memoirs; Papers; Report of Activities; Museum Bulletin; Victoria Memorial Museum, Bulletin. Ottawa.
Canadian Journal of Science, Literature and History. Toronto.
Canadian Naturalist and Geologist. Montreal.
Carinthia II. Klagenfurt, Austria.
Carnegie Institution of Washington, Publications.
Casopis pro Mineralogii a Geologii. Prague.
Casopis Vlasteneckého Muzeumy Spolku Olovnického (Spolku Muzejního v Olomouci). Prague.
Centralblatt für Mineralogie, Geologie, Paläontologie. Stuttgart.
České Akademie Věd a Umění, Třída II, Rozpravy. Prague.
Chicago Academy of Sciences, Transactions.
Colorado School of Mines, Quarterly. Golden.
Connecticut Academy of Arts and Sciences, Transactions. New Haven.
Denison University, Scientific Laboratories; Bulletin; Journal. Granville, Ohio.

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Leeds Philosophical Society, Science Section, Proceedings.
Leidsche Geologische Mededeelingen. Leiden.
Leningrad Gornyi Institut, Zapiski. Moscow.
Lithia. Oslo.
Linnean Society of London (Zoology); Journal; Transactions.
Linnean Society of New South Wales, Proceedings. Sydney.
Lotos. Prague.
Lunds Universitets Arsskrift. Lund.
Marine Geology. Amsterdam.
Materialy po Geologii Tsentralnogo Kazakhstana. Moscow.
Matériaux pour la Carte Géologique de l'Algérie. Alger.
Meddelser om Grønland. Copenhagen.
Mijnwezen in Nederlandisch-Oost-Indië, Jaarboek. The Hague.
Mitteilungen der Geologischen Gesellschaft in Wien.
Moskovskogo Oshchestva Ispytatelei Prirody, Byulleten.
Moskovskogo Universiteta, Vestnik, Seria 4, Geologiya.
Münsterische Forschungen zur Geologie und Paläontologie. Marburg.
Musée Royal d'Histoire Naturelle de Belgique; Mémoires. Brussels.
Muséum d'Histoire Naturelle; Archives; Mémoires. Paris.
Musée für Bergbau, Mitteilungen, Geologie und Technik Landesmuseum “Joanneum.” Graz.
Nanking (Nanjing) Institute of Geology and Palaeontology (Academia Sinica, Nan King Ti Chi Ku Sheng Wuh Yan Jiow Shoo), Memoirs.
Nassauischen Vereins für Naturkunde, Jahrbücher. Weisbaden.
Naturwissenschaftliche Vereins für Steiermark, Mitteilungen. Graz.
Nauchno-Issledovatelskii Institut Geologii Arktiki (NIIGA); Sbornik Statyey; Trudy; Uchenye Zapiski Paleontologiya i biostratigrafiya. Leningrad.
Neftyanii Geologo-Razvedochnyi Institut, Trudy. Moscow.
New Mexico Institute of Mining and Technology, State Bureau of Mines and Mineral Resources, Memoir, Socorro.
New Scientist. London.
New South Wales, Geological Survey of; Palaeontology, Memoirs; Records. Sydney.
New York Academy of Sciences, Annals.
New York State Cabinet of Natural History, Annual Reports. Albany.
New York State Museum [of Natural History], Bulletin. Albany.
Niederrheinischen Gesellschaft für Natur- und Heilkunde zu Bonn, Sitzungsberichte.
Norske Videnskaps-Akadem i Oslo, Mathematisk-naturvidenskabelig Klasse, Skrifter.
Norsk Polarinstirutett, Skrifter. Oslo.
Nova Acta Regiae Societatis Scientiarum Upsaliensis.
Ohio Journal of Science. Columbus.
Osaka University, Liberal Arts Education, Memoirs (Daigaku; Gakugei Gakubu, Kiyo).
Ottawa Naturalist (Canadian Field Naturalist). Ottawa.
Pacific Geology. Tokyo.
Palaeontographia Italica. Pisa.
Palaeontographica. Stuttgart, Kassel.
Palaeontographical Society, Monograph. London.
Palaeontologia Polonica. Warsaw.
Palaeontological Society of Japan; Special Papers; Transactions and Proceedings. Tokyo.
Palaontologie von Timor. Stuttgart.
Pääläontologische (Geologische und Paläontologische), Abhandlungen. Jena.
Palaontologische Zeitschrift. Stuttgart.
Palaontology. London.
Palaontological Journal. Washington, D.C.

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Sources of Illustrations

At the end of each figure caption, the name of the author of the illustration and the date of publication are given, reference being made to publications cited in the reference lists. Although original sources do not always produce the best illustrations, they are, historically speaking, definitive and are commonly selected by Treatise authors. Previously unpublished illustrations are indicated by the name of the author and the letter n (“new”). Repository and museum catalogue numbers are given where appropriate.
PART F SUPPLEMENT 1

COELENTERATA: ANTHOZOA
SUBCLASSES RUGOSA, TABULATA

By Dorothy Hill
[University of Queensland, Brisbane]

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INTRODUCTION TO PALEOZOIC CORALS

Paleozoic corals that can be referred with certainty to the Tabulata or the Rugosa, which are herein regarded as subclasses of Anthozoa, appeared late in the history of exploitation of the mineral skeleton, in the early Middle Ordovician. Though they flourished in the shallow-water environments in which carbonate reefs were formed, they were, with the possible exception of the Tabulata in parts of the Devonian, seldom the most important reef-builders.

Their origin is still uncertain; also uncertain are the relation of the two subclasses to one another and the relation of the Rugosa to the Scleractinia. Exciting possibilities exist for the elucidation of the evolutionary process in the Anthozoa, and rewards should be gained especially by careful study of Early and Middle Ordovician faunas, as well as by work on Late Ordovician and Early Triassic faunas.

The soft parts are universally considered to be polypal, as in the Scleractinia, with each polyp secreting an exoskeleton of calcium carbonate; but discussion still continues on whether the Paleozoic skeletons were originally of calcite or aragonite. The skeleton of a single polyp or of the procorallite of a colony appears to be an inverted cone, thus differing from that of the Scleractinia, where an expanding cylinder seems to be the mode.

In the twenty years since publication of the first edition of the Treatise, Part F, there has been a remarkable increase in our knowledge of both Tabulata and Rugosa: the number of genera has doubled and the number of species has been multiplied many times. Much, perhaps most, of this growth has occurred in works published in the Russian language; and quite recently significant additions have been made in publications in Chinese. Indeed, this growth is such as to justify devoting a special part of the Treatise revision to the Paleozoic corals. The esthetic and intellectual appeal of the corals remains strong, and there is no lack of recruits to the ranks of specialists.

For this revision, only works published before the end of 1976 have been covered completely. Entries for new genera named between then and the end of September, 1978, have been made, but without illustration. The reviser has found it appropriate to be less audacious than in the first edition in placing generic names in subjective synonymy. Improvements in travel and communications make it possible and, indeed, essential to support judgments on subjective synonymy by study of the actual types and their supporting series, and we may look forward to work that is less peremptory but increasingly more definitive as future workers move by jet plane into such rigorous comparative studies. To facilitate such efforts, this revision indicates the name (see list of abbreviations, Editorial Preface, p. xxxi) and city of the institution conserving the type material, and the catalogue numbers of the holotypes or lectotypes of type species of genera wherever it has been possible to verify them.

Acknowledgments.—I am deeply indebted to my fellow workers on Paleozoic corals in all countries for sending me copies of their works and for correspondence quickening this revision of the Treatise. The soft-cover works have been bound in volumes of collected papers and, with the hardcover books, have been catalogued and placed in the Library of the University of Queensland in Brisbane.

I am beholden to officers of those museums where type specimens of type species of Paleozoic coral genera are held for correspondence concerning catalogue numbers, which have been incorporated in this revision for the convenience of traveling specialists—an innovation in Treatise convention. The correspondence has been filed with the Hill Papers in the archives section of the Fryer Memorial Library of the University of Queensland.

Many coral workers have kindly sent photographs of thin sections of type specimens of type species, and where these have been
published in the *Treatise* acknowledgment has been made in the text.

Since my retirement in 1972 I have been working full-time on this revision, the University of Queensland having made available to me an office and other facilities such as postage and photography. Dr. John S. Jell, my colleague over many years, has continued to devote much time to discussion of coral matters and to details of photography.

Finally, I record my great appreciation of the devoted work of the editorial staff for *Treatise* revisions, Prof. Curt Teichert, Mrs. Lavon McCormick, Mr. Roger B. Williams and, Mr. Michael L. Frederick, and, since mid-1977, Prof. R. A. Robison and Mrs. Virginia Ashlock.

**TERMINOLOGY**

There are a number of historical reviews, glossaries, and commentaries on rugosan terminology. Hill (1935) traced the evolution of Milne-Edwards and Haime's original terminology (1848a, bis 1850) through British and other English language publications and used updated results in the first edition of this *Treatise*. Weissermel (1937, p. 87) commented on this terminology in the light of the German literature. In several studies on morphogenesis, culminating in Schouppé and Stacul (1966), Schouppé introduced some new terms and redefined old terms in the light of his morphogenetic assumptions. Soskhina (in Soskhina, Dobrolyubova, & Kabakovich, 1962) set out the Russian terminology; Ivanovskiy (1971a, p. 21, Engl. transl. 1971, p. 18) discussed several examples of lack of uniformity in usage and (1975a, p. 13) gave an updated glossary; and Sokolov, Ivanovskiy, and Krasnov (1971) presented a Russian terminological dictionary for the Coelenterata that included terms introduced in other languages. A glossary of equivalent morphological terms for Scleractinia in English, German, French, Italian, Spanish, Polish, Russian, and Bulgarian, edited by Zlatarsky et al., was circulated to coral specialists in "Fossil Cnidaria" (vol. 1973, no. 2). A handy modern French commentary is by Semenoff-Tian-Chansky (1974, p. 32). Many authors sensibly clarify their own usage of terms, and several of them, such as Minato and Kato (1965a, p. 1), have defined new and useful terms. The terms used herein are, as far as is humanly possible, objectively morphographic, and are intended to be used with descriptive adjectives or phrases appropriate to individual genera.

**GENERAL FEATURES OF THE SKELETON**

The Rugosa are an extinct Paleozoic subclass of corals forming calcareous exoskeletons in which the radial plates (septa, sing. septum) of each individual skeleton (corallite) are generally more noticeable than the transverse plates. The fundamental shape of the corallite is an inverted cone. Symmetry is bilateral, as indicated by the rugosan mode of septal insertion. The septa are typically of two orders, major and minor, the major (longer) septa alternating with the minor (shorter) septa. After insertion of the first four major septa, the remaining major septa are inserted serially at four points only. Minor septa are inserted serially and at an equal rate (but perhaps retroactively) with the major septa; in some forms they may be rudimentary and immersed in the corallite wall until late stages; they are confined to or extend but little beyond the marginarium (marginal zone), which in some forms is a peripheral stereozone of contiguous thick septa or septal bases without interseptal loculi. Septa are composed of cylindrical trabeculae directed distally and adaxially. In a very few Rugosa, there are no transverse plates; in many, the only transverse plates are the arched, flat, or sagging tabulae of the tabularium (wide axial space crossed by tabulae); in the others, the marginarium that surrounds the tabularium is a dissepimentarium with smaller, commonly arched plates inclined toward the tabularium and called dissepiments. Axial structures, which are longitudinal skeletal elements that in some forms are supported by transverse plates, may develop.
FINE STRUCTURE, MICROSTRUCTURE, AND ULTRASTRUCTURE

The calcareous tissue of the skeleton is sclerenchyme. With few exceptions, it is now of calcite. Diagenetic replacement of the original carbonate by silica, or more rarely by other substances, has occurred in some specimens.

Opinions differ on the original composition of the skeletal material. In many Rugosa, the apparent retention since the Ordovician of fibrous structure with extinction parallel to the long (c) axes of the fibers has been taken to support the view that the carbonate was originally calcite. *Lophophyllidium* skeletons found in impermeable Carboniferous shales and retaining their fibrous structure were of calcite, whereas orthocone cephalopod shells in the same shales were, as originally, of aragonite; further, the Sr/Ca ratios and MgCO₃ content of the rugosan skeletons were consistent with levels to be expected if the calcite were original (LOWENSTAM, 1963, p. 187).

Skeletal inclusions found in authigenic quartz crystals formed in Devonian rugosan skeletons were of high-Mg calcite, whereas inclusions of other skeletons that were originally aragonite, but had transformed to calcite before their inclusion in the quartz, were of low-Mg calcite; consequently, RICHTER argued (1972, p. 211) that the rugosan skeletons were originally of calcite and not of aragonite.

On the other hand, OEKENTORP (1972, 1974a) has noted that some of the different types of microstructure in the rugosan skeleton appear to be the result of recrystallization, and are approximately the types that would be expected if the original skeleton had been aragonitic. OEKENTORP (1972, 1974a) has described many recrystallization patterns that are consistent with alteration from original aragonite to calcite, which he considered to be so similar to alteration patterns found in Scleractinia as to indicate an original aragonitic constitution in Rugosa also.

As seen under low magnifications, skeletal fine fabrics, where these have been retained, are fibrous and crystalline. The fibers extinguish with their long (c) axes perpendicular to the distal (growing) surface or edge of a skeletal element; they are commonly grouped in slender to very slender inverted cones, within which they spread apart slightly toward the depositional surface in the manner characteristic of conical segments of spherulites. In some very favorably preserved material, density (or light and dark) banding normal to the fibers and parallel to the growing surface is taken to indicate layered growth increments; apices of cones, where observed, are always directed toward the base of the layer.

Scanning electron microscope studies on the least altered material show that the fibrous structure is resolvable under higher and higher magnifications into a series of units decreasing in size, each of which is a narrowly to very narrowly conical aggregate of acicular crystals distally slightly spreading, again as in segments of spherulites (SORAUF, 1971, pl. 5-8). The smallest units are aggregated into larger ones of various dimensions; where the larger units are based one upon another, still with their long axes at right angles to the growing surface, the composite effect is the fiber seen through an optical microscope, which extinguishes parallel to its length. Altered material may show a secondarily lamellate structure (SORAUF, 1971, pl. 9-11).

In septa and other longitudinal skeletal elements, the fibers (and their constituent conical aggregates of distally slightly spreading needles) radiate from the axes of trabeculae, or less commonly from the axial plane of the septum. In tabulae and dissepiments, the fibers are directed at right angles to the growing surface of the plate. The patterns are those of spherulitic crystallization, plumose in the trabeculae and pilose in the tabulae. Where fibers are seen between septal bases in the outer wall (but not in its epitheca), they are perpendicular to the inner surface of the wall. The crystalline constitutions of the epitheca and of the basal 'dark line' (selvage appearing dark in transmitted light, but densely white in reflected light) to the tabulae and dissepiments have not been satisfactorily resolved.

even in one corallum. Diagenesis of thick, contiguous trabeculae may produce holacanths immersed in pseudo-growth lamellae. Holacanths are clear calcite recrystallizations of the axial parts of trabeculae, particularly of rhabdacanths, and the secondary lamellation (possibly cleavage) is commonly somewhat oblique to the original growth lamellation. In some thick septa the 'median plane' (normally dark as seen by transmitted light, but densely white by reflected light) may be selectively recrystallized into clear calcite, commonly in patterns of some value taxonomically, as, indeed, other diagenetically induced patterns may be. The zigzag structure noted by Schindewolf (1942, pl. 12) is now seen to be a secondary (?cleavage) structure in originally normally structured, thick sclerenchyme. In many Rugosa, all or part of the original fibrous fabric is replaced by a secondary, fine or coarse calcite mosaic.

The microstructure (seen by means of the optical microscope) and the ultrastructure (shown by the scanning electron microscope) of the rugosan sclerenchyme are so similar to those of Scleractinia that the same processes are assumed to have formed them. The smallest unit (microtuft) yet found by ultramicroscopy in scleractinian sclerenchyme is probably composite. Etched material indicates that it tapers proximally but is terminated distally by pyramidal faces, and is 0.3 to 1.5 μm thick at the broadest part and 8 to 15 μm long; smaller crystals based on its distal end diverge somewhat from its long axis (Jell & Hill, 1974, p. 9, pl. 1, fig. 5). These units are arranged in layers parallel to the growing surface of the plate, and the axis of each unit is perpendicular to this surface. Aggregations of the units (Fig. 1) form a series of increasingly larger conical segments of spherulites (tufts); larger aggregates of tufts may project from the surface of the plate as fascicles (called sclerodermites by some).

As in the Rugosa, a simple trabecula is composed of tufts or fascicles radiating orthogonally or clinogonally from its axis as in plumose spherulitic aggregates. In a tabula or dissepiment (except for the basal dark line), tufts and fascicles have their long axes perpendicular to the surface of the plate in a pilose spherulitic pattern.

Fig. 1. Rugose coral morphology; ultrastructure of septum of Phacellphyllum caespitosum (Goldfuss), M.Dev., Ger.—la, transv. sec., arrow points to lateral margin of septum parallel to top of photo, X 435; 1b, part of same, aggregates of microtufts radiate from trabecular centers, X1,740 (Sorauf, 1971).

(Bryan & Hill, 1941, p. 89; Sorauf, 1972a; Jell & Hill, 1974).
FORM OF CORALLA

SOLITARY CORALS

Solitary corallites may be curved or erect, and the fundamental shape is an inverted cone. Depending on the angle of the apex and such characteristics as the growth form of the mature region and the occurrence of sharp angulations or flattened areas (assumed to be due to rejuvenescence), the shape (Fig. 2) may be designated as ceratoid (very slenderly conical, horn-shaped), cylindrical (nearly straight and of uniform diameter except in the apical region), scolecoid (like cylindrical but irregularly bent in the manner of a worm), trochoid (regularly expanding from an apical angle of about 40°), turbinate (like trochoid but with wider apical angle, 70°), patellate (with still wider apical angle, about 120°), discoid (nearly all in a single plane), calceoloid (like the tip of a slipper, as in Calceola), or pyramidal (with flattened sides meeting at angles).

COMPOUND CORALS

In compound corals the entire skeleton forms the corallum. This term is traditionally used for the skeleton of the whole organism whether a colony or a single polyp. A compound corallum (Fig. 3) is called fasciculate if the corallites are cylindrical and not in contact. Fasciculate corals may be classified as dendroid (irregularly branching) or phaceloid (with neighboring corallites more or less parallel but not in contact). In some phaceloid coralla the corallites may be connected here and there by connecting processes (outgrowths from the wall, commonly hollow); or they may be catenoid (contiguous in separate ranks as in Palaeophyllum); or they may be connected by periodic lateral expansions of the calicular platforms (connecting platforms) of the corallites that occur simultaneously throughout the corallum, which is thus alternately phaceloid and cerioid as in Sanidoophyllum. In verticillate coralla, fasciculate offsets are given off laterally in verticils (whorls) as in Cratanioophyllum.

Compound coralla are described as massive if neighboring corallites are in contact and polygonal in section. Massive coralla are clothed in a common epithecal sheath, the holotheca, which may show the epithecal furrows proper to outer walls of the peripheral corallites, and may also show growth rings. Massive coralla are distinguished as...
ceroid if each corallite is defined by a wall; some coralla are cerioid in some places, phaceloid in others. Coralla in which the corallites are not defined by walls are sometimes termed plocoid, though this term is used with a different meaning in Scleractinia; plocoid coralla are called 1) astreoid if the individual corallites lose their walls without reduction of the septa, which usually alternate in neighboring corallites; 2) thamnasterioid (thamnastreoid) if the septa of neighboring corallites are confluent and arranged between the axes of corallites like the lines of force between poles in a magnetic field; or 3) aphroid, if the septa have become longitudinally discontinuous peripherally so that neighboring corallites are united by dissepiments only. Meandroid coralla are not known in Rugosa; some in which walls are locally discontinuous within neighboring series have been described as pseudomeandroid.

CALICE

The calice is the distal surface of a corallite, and is a mold of the base of the polyp.
(Fig. 4,1). Many corallites have an evenly rounded, bowl-shaped calice, ranging in depth from very shallow (saucerlike) to deep (beakerlike). In some genera, particularly those with marginaria, the calice shows marked differentiation of inner and outer parts. The outer area, which may be nearly plane or even everted, constitutes the calicular platform, whereas the central part is abruptly depressed (calicular pit), or raised in a rounded or pointed prominence (calicular boss) (Fig. 4,3). In pyramidal or calceoloid coralla, the calice may be closed by an independent plate or plates, the operculum (Fig. 4,2), which is evidently drawn into a position of closure by the retraction of the polyp. Notable fossular depressions may occur at the edge of the tabularial floor, especially in solitary corals. The most marked of these is always the cardinal fossula, affecting the septal loculi on either side of the cardinal septum: it is most commonly located on the longest (convex) side of the corallite; in some it is on the shortest (concave) side; and in at least a small number of species it appears not to have taxonomic value in that it is variably placed in relation to the curvature of the corallite. It is much better developed in solitary corallites than in the corallites of compound coralla. In some solitary coralla, also, the calice is very deep, extending almost to the apex; in a few it is separated from the wall, not by tabulae and dissepiments but only by layers of sclerenchyme that thicken the wall and septa. Minor septa as well as major septa are always distinguishable at the calical edge. Epithecal growth rings mark the successive positions of the calical edge, which is commonly transverse to the erect or curving axis of growth of the corallite. Weyer (1972b, p. 722) has stressed the taxonomic importance of features of the calice.

WALLS

OUTER WALL

The wall (outer wall) is developed up to the edge of the calice in most solitary corallites and in the corallites of fasciculate coralla. Common double walls define the limits of neighboring corallites in cerioid coralla, but a common wall may be absent or imperfectly developed in astraeoid, aphroïd, and thamnasterioid coralla.

The wall may be extended as hollow or solid spines; or into radiiform processes (if tubular termed rootlets or flattened, talons) that fix the corallite to the substrate. In fasciculate coralla such processes fix a corallite to its neighbors and are termed connecting tubules.

The external surface of the wall is seldom smooth in the unworn state. It may show transverse growth rings or longitudinal furrows and ribs. The growth rings may show periodicity in spacing, and less commonly in strength of development (Fig. 5,2). The furrows coincide with the median planes of the septa and hence are called septal furrows, and the ridges lie opposite the interseptal loculi and are thus interseptal ridges or ribs. The furrows are commonly narrow and deep, and the intervening ridges broad and rounded, but in some species with thick...
contiguous septal bases, the furrows may be very broad and shallow, corresponding with the entire septal base, and the ridges may be narrow and sharp (Fig. 5,1). In a few species with very coarse longitudinal ribbing and grooving, there seems to be no correspondence between furrow and median septal plane (Fig. 5,5a,b); these require study.

Small scales in overlapping series may be attached to the furrows and ribs; they are known not only in Rugosa (Tryplasmatisidae mainly), but also, rarely, in Tabulata (Fig. 5,7).

The plan of the septal furrows is diagnostic of the Rugosa. They are arranged in four groups. In two of these, they lie pinnately to the cardinal septal furrow; in each of the other two, they lie at an acute angle to an alar septal furrow. Unworn apices are very uncommon. In the few available unretouched photographic illustrations (Fig. 5,3), a furrow that lies next to and parallel with the cardinal or alar septal furrow appears additively composite due to the way in which each successive furrow, whether major or minor, joins (or nearly joins) it. The length of furrow between successive junctions may be approximately equal, or unequal as in Figure 5,2. For discussion of the initiation and lengthening of furrows, see below in the section on septal insertion.

In a few genera, faint longitudinal furrows, which may arise by intercalation, appear on the ridges between neighboring major and minor septal furrows (Fig. 5,3).

In thin section in well-preserved material, the outermost part of the wall may be seen to consist of a very thin layer of or with growth rings, the *epitheca sensu stricto*. Some authors use the term epitheca for the whole of the outer wall, but herein only the outer layer is termed epitheca, and the total structure is called the outer wall, or simply the wall. The epitheca has a texture different from that of the rest of the wall, which is much thicker and consists of fibers like those of the septal trabeculae and tabulae. In many Rugosa it appears that fibers proper to neighboring septal bases may be contiguous so that except for the epitheca the wall is of septal origin; in many of these, not only the base but much more of the peripheral ends of the septa are so thickened as to be contiguous and thus to widen the

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**Fig. 5. Rugose coral morphology; outer wall.**

INNER WALLS

Walls inside the lumen are quite varied in nature and are best described specifically (Fig. 6). One type, delimiting the tabularium from the dissepimentarium, develops when, as in most dissepimented genera, the proximal edge of each dissepiment of the innermost series rests on the distal surface of the dissepiment next below (Fig. 6,3). In some genera, however, the dissepiments interdigitate with the outermost tabellae and there is no continuous wall to the dissepimentarium (Fig. 6,2).

A wall separating inner and outer parts of a tabularium is an aulos when the axial space it encloses is crossed only by tabulae, and a column wall when it surrounds an axial column that contains both septal lamellae and tabellae (Fig. 192,3).

Walls within the dissepimentarium include a pipe of horseshoe dissepiments (in the Phillipsastreidae, Fig. 6,1) and a regular inner septal stereozone formed by a narrow zonal thickening to contiguity of neighboring septa (in Acervulariidae, Fig. 6,2). Both these types may have developed outside them a narrow zone of flat dissepiments and both types develop at the position of fanwise divergence of the septal trabeculae in the radial longitudinal planes of neighboring septa.
FIG. 7. Rugose coral morphology; types of trabeculae.—1, Rhabdacanths in *Rhabdocyclus porpitoides* (LANG & SMITH), Sil., Eng.; 1a, transv. sec. cut at right angle to trabeculae; 1b, transv. sec. cut obliquely to trabeculae; 1c, long. sec. with three central trabeculae shown in median long. sec., others in tang. long. sec., all enl.—2, Holacanths (secondary structures formed during diagenesis) in *Tryplasma primitum* HILL, M.Sil., Eng.; 2a, transv. sec. cut at right angle to trabeculae; 2b, transv. sec. cut obliquely to trabeculae; 2c, long. sec., all enl.—3, Monacanths in *Palaeocyculus porpita* (LINNÉ), Sil., Eu.; 3a, four septa in transv. sec. cut at right angle to trabeculae; 3b, two septa in transv. sec. cut obliquely to trabeculae; 3c, one septum in long. sec., structure of only two trabeculae being shown, all enl.—4, "Dimorphacanths..."
TRABECULAE

First order trabeculae have their axes entirely within the midplane of the septum, so that they end distally in the midline of its distal edge; second order trabeculae, which are shorter and finer, commonly originate either at the axis of a first order trabecula or in the midplane of the septum. Those originating in the midplane all diverge to end distally either on the lateral faces of the septa or on the lateral slopes of the round-arched distal edges of thick septa (Fig. 7).

First order trabeculae may be monacanths, rhabdacanths, or rhipidacanths. Second order trabeculae, as far as known, are always monacanthine in the arrangement of their constituent fibers. Monacanths have their fibers all related to one center only, radiating upward and outward from an axis formed by the upward shifting of the center (Sulipectra). A rhabdacanth has its fibers radiating from any number of separate, smaller transient centers so that it is composed of secondary trabeculae radiating upward and outward (Tryplasmatidae). In a rhipidacanth, those second order trabeculae directed laterally from the main axis are elongated relative to those in all other directions, and form closely spaced opposed carinae on the septal faces (Phillipsastreidae) (Fig. 8). First order trabeculae are commonly directed adaxially upward, but in some genera they may diverge inward and outward from a generally vertical or oblique axis of divergence in the septum. A septal carina (flange parallel to direction of distal growth of trabeculae) may be a single monacanthine trabecula, or a compound trabecula either of monacanthine elements branching prolifically, or of bundled trabeculae that branch infrequently or at a very low angle (SORAUF & OLIVER, 1976, p. 331).

Fig. 7. (Explanation continued from facing page.)

SEPTA

Septa may be distinguished by the type of simple or compound trabeculae of which they are composed. Thus they may be monacanthate, rhabdacanthate, or rhipidacanthate when each consists of a single series of monacanths, rhabdacanths, or rhipida-
canths; or they may be holacanthine when recrystallization has affected contiguous rhabdacanths (and possibly also monacanths) with the production of holacanths in secondarily lamellated sclerenchyme. Monacanthate and rhabdacanthate septa are acanthine when the trabeculae are not contiguous either wholly or distally; the latter type may be called pectinate (comblike); where the trabeculae are only periodically in contact (by elongation of their fibers), the septum is perforate (fenestrate), e.g., in *Calostylis*.

Septa may also be distinguished by the ways in which their trabeculae are related to their median planes. Uniseriate septa have a single series of trabeculae, either simple or compound, whose axes lie constantly in the median plane so that their distal ends are found at the axial septal edges, which may be more or less coarsely toothed as a result (Fig. 7, 3). Aseriate septa (Fig. 9, 3) are composed of short, fine trabeculae that curve laterally so as to end in the septal faces. An aseriate septum is best studied in sections cut at right angles to both the curvature of its distal edge and its midplane. In many, the fine or very fine short trabeculae clearly originate in the midline of the distal edge of the septum and then diverge; their divergence is commonly subopposite or alternate (FEDOROWSKI, 1974a, p. 471). In others, not all the fine trabeculae can be seen to have originated at the midplane, though they are always curved at right angles to the growth lamellae. Thickening of the septa is effected by elongation of the fibers, growth (or accretion) lamellae showing that the process is periodic (possibly related to feeding times or to alternation of day and night). Where thickening affects the septa in a particular zone of a coral, a septal stereozone is formed.

The septum may not be continuous longitudinally and radially. Thus amplexoid septa (Fig. 79, 2c) are fully developed only on upper surfaces of tabulae, but above this position they extend progressively a shorter distance from the wall, as in *Amplexus*. Lonsdaleoid septa are discontinuous toward the opposite peripheral edge; they do not extend continuously through the dissepimentarium, but may bound interseptal loculi for certain distances only, dying out toward the wall in a series of septal crests, each crest resting on dissepiments like the axial ends of amplexoid septa that rest on tabulae. Perforate and retiform septa are rare in Rugosa but occur in Calostylidae.

The distal edge of a septum seen in the
Fig. 9. Rugose coral morphology; types of septa.—1, Yardarm carinae, Heliophyllum sp., M.Dev., N.Am.; diagramm., enl. (Sorauf & Oliver, 1976).—2, Metriophylloid flange, Metriophyllum sp., Dev., Eu., diagramm., enl. (Holwill, 1964).—3, Aseriate septum, Timrophyllum wanneri GERTH, U.Perm., Timor; 3a, median radial long. sec., 3b, trans. sec., trabeculae very fine, short, originating in median plane but rapidly diverging to septal faces, both X42 (Fedorowski, 1974a). See also Fig. 79,2c, for illustration of amplexoid septum, Fig. 133,1a-c, for illustrations of naotic septa, and Fig. 133,2a-c, for illustrations of arachnophylloid septa.

calice may be entire, toothed (denticulate), or pectinate; pectinate septa are sometimes described as septal combs. It may be declined at varying angles from the wall toward the axis, or be subhorizontal, or, as in an everted calice, it may be arched so that it rises above the distal edge of the epitheca and wall. Its profile is commonly nearly parallel with the surface of the dissepimental platform, and is normally at right angles to the direction of the trabeculae in uniseriate septa.

The axial edge of a septum may have springing from it a number of irregular, upwardly directed slender or cylindrical axial lobes as in Streptelasmatidae. A septum may be represented in axial structures by a septal lamella, which is a radial axial plate
commonly not in continuity with it. The distal edge of the septal lamella may be declined abaxially, and when it is uniseriate its component trabeculae are directed abaxially upward.

The sides (faces) of a septum may be smooth, or provided with denticulations or with tall ridges. The denticulations or vepreculae may be randomly arranged or may run in the direction of the trabeculae of uniseriate septa. Ridges may be related to the axes of trabeculae, to the distal edges of septa, or possibly to the axis of growth of the corallite. Those that are lateral expansions of trabeculae are called carinae, and these may be opposite, subopposite, or alternate on the opposing septal faces. Opposed carinae are sometimes called yardarm or cross-bar carinae (Fig. 9,1), though the adjective strictly applies only to their appearance in transverse section of the septum; alternate carinae are sometimes said to be zigzag or xyloid.

Ridges that are developed parallel to the distal edges of the septa are sometimes distinguished as flanges (Fig. 9,2), and this term is also applied to the scooplike metriophyllloid ridges in Metriophyllum and others.

Synapticulae, rough, rodlike connections between neighboring septa, are found in Calostylidae.

SEPTAL INSERTION

The first septa appearing at the apex of the apical cone establish the bilateral symmetry of the plan of insertion (Fig. 10). In solitary Rugosa studied by serial grinding and thin sectioning (DuRden, 1902, 1906; Carruthers, 1906, 1908; Brown, 1909; Faurot, 1909; Schindewolf, 1942) the first two septa, cardinal (C) and counter (K) major septa appear opposed in the one diameter, commonly connected at the axis as an axial septum; next to arise is a pair of major septa at the peripheral end of the cardinal septum. Though remaining attached to the wall and commonly to the axial septum also, this pair gradually spreads outward and becomes the two alar septa (A); shortly afterward a second pair, the first counter-lateral septa (KL), develops similarly at the peripheral end of the counter septum but spreads outward only a short distance (Fig. 10). Thereupon, in Carruthers' (1906, p. 358) view, a pause ensues; Hudson (1936a, p. 70), however, recognized no such pause, though he noted that the first six septa, all major septa, were often formed simultaneously, especially in hysterocorallites. Hudson considered as primary (protosepta) only the cardinal and counter septa; Kunth (1869, p. 651), in showing that new septa were inserted at only four loci, nominated only the cardinal, counter, and two alar septa as primary. DuRden (1902, 1906) and Carruthers (1906, 1908) considered the first six septa to be protosepta. Wright (1969, p. 1232) has reviewed much of the literature on the septal plan.

Schindewolf (1942, p. 52) and Fedorowski (1973, p. 115) described as pentaphyllloid a plan of development of the first six septa in which five short septa not joining one another are sequentially developed, first the cardinal, then the two alar septa, and then the (first) counter-lateral pair, but no trace of the counter septum is seen until a much later stage. Technically it is extremely difficult to maintain consistency of orientation of the ground or cut surfaces in an apical cone, especially in curved apices, in relation either to the calical edge or to the axis of growth of the corallum, and thus to establish the exact order of insertion of septa in the apex, and it is equally difficult to be consistent in the treatment of different specimens. Also, septal stunting, when the

![Fig. 10. Rugose coral morphology; septal insertion. Diagram showing serial insertion of both major and minor septa after insertion of six protosepta (after Faurot, 1909). A, alar septa; C, cardinal septum; K, counter septum; KL, counter-lateral septa; Km, minor septa in loculi between counter and counter-lateral septa; M1-3, remaining major septa in order of insertion; m1-3, remaining minor septa in order of insertion (Hill, 1935).](https://example.com/fig10.png)
septum is or becomes so short as to be entirely contained in the wall, or to project but very slightly from the wall, may mask the presence of septa, especially of minor septa, in thin transverse sections; possibly the late appearance of the counter septum in the pentaphylloid plan may be due to this phenomenon (Reduktion of Weyer, 1972b, p. 723).

Spatial development of all succeeding major septa (metasepta) is characteristic of the Rugosa. There are only four loci where they arise: one in each interseptal loculus beside the cardinal septum, and one in the loculus on the counter side of each alar septum; commonly they first appear very short and close to the peripheral end of the major septum that was formed immediately before them, and to which their adaxial ends may or may not be or become attached as they lengthen. Commonly more major septa are inserted in the counter quadrants than in the cardinal quadrants. This plan of septal insertion is associated with a differentiation in size and shape of at least the tabularial parts of the four interseptal loculi that are the loci of insertion; these loculi are commonly called fossulae; cardinal fossula, or just fossula, denotes the two combined cardinal loci and usually shows a notable depression of its tabular floor; alar fossulae are always so termed, and may not have depressed floors. The loculi between the counter septum and its neighboring counter-lateral septa may be enlarged in some and called a counter fossula. Non-technical adjectives are used to describe different features and shapes of transverse sections of fossulae; thus, a closed fossula is one in which the axial ends of the neighboring septa curve around to form a fossular wall, whereas an open fossula is not so bounded axially.

The fundamental sequence of minor septal insertion appears also to be serial (counter-cardinal or dorsoventral). First, the pair of minor septa commonly symbolized as $K_n$ appears, one on each side of $K$ (Fig. 10); next, on the cardinal side of each alar septum and of each of the first counter-lateral septa, a new short septum arises and lengthens to become a major septum, whereupon two new short septa are inserted, one on each side of it. The one on the counter side remains short and is clearly a minor septum; the other, on the cardinal side, becomes a major septum, and the process continues. In the septal plan of Cyathaxonia (Faurot, 1909), of Petraia (Schindewolf, 1931), and many others, it is notable that the minor septa normally lie close to and adaxially touching the major septa on their counter side (contratintent).

Serial section studies suggested to Carruthers (1908, p. 25) and to Smith (1913, p. 62, and in discussion in Schindewolf, 1931, p. 648) and others that in many Rugosa, perhaps the majority, the appearance of the minor septa, though continuously potential, may be delayed until relatively late stages of development, when they may appear in rapid succession in all the loculi, after which new major and minor septa are inserted normally in each of the four loci of insertion. This process is best regarded as merely a modification of the normal plan, and not as a distinct plan with analogy to the cyclic insertion of Scleractinia (fide Weyer, 1972b, p. 72). Normal minor septal furrows are present throughout, and minor septa are always to be seen at the distal edge of the calice, provided that the edge is not damaged in any way during fossilization. Minor septal stunting seems a sufficient explanation for the modification.

In a few Rugosa, additional septa may appear in the loculi between major and minor septa. These are shorter and usually thinner than minor septa and are commonly described as septa of a third (and even of a fourth) order; perhaps the term minisepta may be found acceptable for them. Their mode of insertion has not been studied; a few solitary Rugosa show weak longitudinal furrows on their epithecate walls, inserted apparently by intercalation (Weyer, 1974b, p. 359, fig. 7.2) and possibly indicating minisepta.

**SEPTAL FURROWS AND 'SEPTAL SPLITTING'

Kunth (1869, p. 651, 663, fig. 1-3) deduced from the pattern of epithecal septal furrows and the arrangement of the septa in thin section that in each of four quadrants new major and minor septa were inserted alternately, in sequence, in a cardinal direction (dorsoventral). He did not use the verb abspalten (i.e., to split off); his litho-
Fig. 11. Rugose coral morphology; septal furrows.—1, Order of appearance of longitudinal furrows (and corresponding septa) assumed by Kunth, 1869.—2, Order of appearance of septa (and of furrows) assumed by Vollbrecht, 1928.—3, Order of appearance of furrows and septa to fit Weyer’s (1974b) assumptions of ‘septal splitting.’—4, Weyer’s model of development of furrows (and corresponding major and minor septa); K, counter septum; A, alar septum; solid lines connect furrows for major septa at successively higher levels in corallum, while dotted lines connect furrows for each minor septum (Weyer, 1974b).
Rugosa—Morphology

In both Weyer’s and Vollbrecht’s schemes, if the furrow next to the counter septum really is continuous, it would represent the sum of the curved proximal parts of successive major septal furrows. There are too few unretouched photographic illustrations of apices in which the epithecal septal furrows are sufficiently unworn to offer conclusive proof for any of the three views concerning the proximal ends of the furrows, but it can be said that, while rare apices are consistent either with Kunth’s view or with Weyer’s, none is known that supports Vollbrecht’s conception.

AXIAL STRUCTURES

Axial structures commonly project from the calicular floor and are formed from the axial parts of septa reinforced by transverse skeletal elements (Fig. 12); these axial parts tend to be continuous with the peripheral parts only in very early stages. The axial lobes of many of the Streptelasmatidae form a spongy axial structure. Many genera have a columella that is a dense axial structure, lenticular, barlike, or cylindrical in section, and which may be simply or complexly structured (Fig. 12, 1). It commonly originates as an extended and thickened axial end of the counter (or in some cases the cardinal) septum, and may retain this connection or become free; in Cyathaxonia it apparently rises free right from the apical cone. In many it is augmented by septal lamellae that may be contiguous throughout or free laterally in places (Amygdalphyllum). Where little altered, the lamellae are seen to be composed of trabeculae like those of the septa; in some, the septal lamellae may be developed only on the upper surfaces of the tabellae. Other genera have an axial coil (formerly vortex) formed by the similar twisting of the axial ends of the long major septa (Ptychophyllum, Fig. 12, 3). Coiling is commonly counterclockwise adaxially in calical view. Still others have an axial structure composed of septal lamellae that are usually discontinuous from the septa to which they belong and are united by transverse skeletal elements; such structures may be 1) clisiophylloid, like a spiderweb with a short medial plate derived from the conjoined cardinal and counter septa in the early stages (Clisiophyllum),
2) *dibunophylloid* (Fig. 12,4), bisected by a medial plate (*Dibunophyllum*), or 3) *aulophylloid* (Fig. 12,5), without a medial plate (*Aulophyllum*). The aulophylloid structure, having a wall formed by tabellae, is sometimes called an *axial column*. An *aulos* (inner tube) may be formed from the similar turning aside of the axial edges of the septa to meet their neighbors, as well as by downturn of the tabulae and in other ways (Fig. 12,5).

**TABULAE AND DISSEPIMENTS**

Tabulae are present in all Rugosa except a few solitary coralla in which the calice extends right down to the apex of the corallite and is floored by sclerenchyme continuous with that of the wall and septa. They are the chief and in some families the only transverse skeletal elements to be developed, but in many others the central space in which they occur (tabularium) is surrounded by a marginarium with dissepiments (dissepimentarium) (Fig. 13). Successive tabular floors may each consist of a single tabula, then said to be complete; the floors may be domed, horizontal, or inversely conical, or have a median boss that may itself have an axial depression; commonly, the tabular floors are each composed of a series of smaller, subglobose plates, tabellae, so that the tabulæ are incomplete. The inclination of the tabellae varies with the profile of the calicular floor, in which the order of their formation is from proximal to distal.

**Clinotabulæ**, found mainly in Waagenophyllidae, are elongate periaxial tabellae that
are steeply declined from the dissepimental wall and then either cross transversely to meet the axial column or abut onto the upper surface of an earlier clinotabula (Minato & Kato, 1965a, p. 1); the term “clinotabellae” was used (Minato & Kato, 1965b, p. 22) to distinguish shorter, more globose inclined tabellae of the Durhaminidae.

Very thin, horizontal skeletal elements that appear to have no direct parallelism with the calicular floor are found in genera in which the interceptal loculi are much restricted by synapticulae (Calostylidae) or by long vepreculae (Multicarinophyllum); some may extend from wall to wall, with some change of curvature at or near the inner boundary of the marginarium.

Dissepiments are small, curved or globose plates inclined parallel to the calical slope of the dissepimentarium, each overlapped slightly by its outer, younger neighbor (Fig. 14). They normally extend across the loculi between major and minor septa,
Fig. 14. Rugose coral morphology; dissepiments and marginaria (after Hill, 1956b).—1, Haplolasma subbicinum (M'Coy), L.Carb., Eu.; part of transv. sec. showing dissepiments arranged in regular concentric pattern, enl.—2, Caninia juddii (Thomson), L.Carb., Eu.; part of transv. sec. showing dissepiments arranged in herringbone (inosculating) pattern, enl.—3, Caninia sp.; part of median long. sec. showing many vertical series of dissepiments, corresponding to structure of 1, 2, enl.—4a,b, Lonsdaleia duplicata (Martin), L.Carb., Eu.; parts of long. and transv. secs. showing lonsdaleoid (transeptal) dissepiments, enl.—5, Trapezophyllinum elegantulum Etheridge, L.Dev., Australia (Vict.); median long. sec. showing inner series of horseshoe dissepiments and outer series of flat dissepiments, X3.—6, Loyolophyllinum cresswelli Chapman, L.Dev., Australia (Vict.); median long. sec. showing isolated dissepiments, X3.—7a,b, Kodonophyllum truncatum (Linne), Sil., Eu.; transv. and median long. secs. showing marginarium composed of dissepimentarium, X2.—8a,b, Entelophyllum articulatum (Wahlenberg), Sil., Eu.; transv. and median long. secs. showing marginarium composed of dissepimentarium, X2.

their lateral edges rising toward the confining septa; such a dissepimentarium, where the dissepiments appear in transverse section as concentric series of which each plate is concave toward the axis, is called regular or concentric; in some corals this upward concavity may become angular. A herringbone dissepimentarium forms when the minor septa become longitudinally discontinuous while the major septa remain continuous, so that the dissepiments between major septa inosculate (Fig. 14,2,3). Where major septa also are longitudinally discontinuous, all the dissepiments, including those passing through discontinuous septa, may be distally arched and thus present transverse sections that are convex toward the axis; these are transeptal (Semenoff-Tian-Chansky, 1974, p. 35) (i.e., lonsdaleoid) when the septa are represented by septal
crests on their upper surfaces (Fig. 14,4), or cystiphyloid where the septal crests are of separate or only in part contiguous trabeculae. In the Cystiphyllidae, periodic thickening of the combined dissepimental and tabularial floor occurs, possibly due to rejuvenescence, forming a stereozone in the shape of an inverse cone (septal cone) in which the constituent separate or contiguous trabeculae of the septal crests are visible.

In some genera with thick septa, these septa are replaced in their peripheral parts each by a column of naotic dissepiments, distally arched plates connected to one another by their bases and also by granules or short rods. In others, radially disposed, lateral dissepiments may line the septal faces, narrowing the interseptal loculi.

The successive dissepimental floors, like the tabularial floors, are conformable with the floor of the calice; commonly they are declined adaxially from the wall; in some they are horizontal except at the boundary with the tabularium, where they are usually steeply declined adaxially; in a few they are everted, those in a narrow-to-wide peripheral zone being declined abaxially from an axis of divergence of the trabeculae in each of the septa. In a calicular floor in any interseptal loculus, dissepiments are formed in centrifugal sequence, their proximal edges overlapping the distal and upper surface of the preceding dissepiment.

In a considerable number of genera, however, the interseptal loculi on either side of a moderately long minor septum are notably different. In some Laccophyllidae, for instance, where the minor septa are contranting (each with its axial edges contingent on the major septum next on its counter side), horizontal skeletal elements developed within the triangular loculus so bounded are adaxially declined or horizontal, recalling periaxial tabellae rather than dissepiments. In the longer loculi, open adaxially, complete tabulae are declined abaxially right to the wall. Weyer (1972c, p. 439) advocated describing such genera as having a biform tabularium. In some genera, where dissepiments are lacking, the wall may be thicker in the loculus to the counter side of each short minor septum, and each such loculus may be narrower than that on its cardinal side. In some aulophyllids and palaeosmiliids, the width of the dissepimented interseptal loculi on either side of a minor septum may differ, those on the counter side being narrower, and the minor septa may be contracing or even contranting, but the dissepiments in both types of loculus are normal and declined adaxially. Such a dissepimentarium may perhaps be described as biform. It would seem prob-
able that all these differences between neighboring interseptal loculi are inherent in the septal insertion specific to the Rugosa.

In a few Columnariidae and Stauriidae, isolated dissepiments may develop in single series, both their upper and lower edges being adherent to the inner surface of the wall.

In some Entellophyllidae and Disphyllidae, the outermost series of dissepiments may be peneckielloid, that is, subquadrate in longitudinal section, swollen so that the distal surface is horizontal or rising slightly adaxially, and the adaxial surface is longitudinal, its lower edge resting on the dissepiment next below (e.g., Peneckiella).

In the Phillipsastridae, a pipe of horseshoe dissepiments commonly develops in a zone that encloses the axes of trabecular divergence of all the septa; in radial longitudinal section of the corallum cut through the interseptal loculi, the section of each superposed dissepiment in the pipe appears like a horseshoe, its ends based on the one below. Also in the Phillipsastridae, and again in the Acervulariidae, a longitudinal series of flat dissepiments may develop in the zone immediately peripheral to the pipe of horseshoe dissepiments or to the zone of the axes of divergence of the septal trabeculae.

**SKELETAL GROWTH RATES**

There is considerable agreement that limits between species may be clarified by comparison of the ratios of the number of their septa to their diameter at successive growth stages (Oliver, 1960a, p. 65; Pedder, Jackson, & Philip, 1970, p. 227), though errors may arise because of difficulty in maintaining strict control over the orientation of thin sections, and because of the phenomenon of septal stunting. Some species appear to show identifiable points of change in the ratios as growth proceeds, points which may perhaps be identifiable with particular growth stages (Kullman, 1972).

Much of the increase in the circumference of the rugosan wall is effected at the four loci of septal insertion, as evidenced by the pattern of the epithecal septal furrows. There is also, clearly, some increase in circumference in the wall segments bounding the interseptal loculi during development; and in corals with contratingent septa this amount is greater in the segment on the cardinal side of the minor septum than in that on the counter side.

**PERIODICITIES IN SKELETAL GROWTH**

Of the periodicities noted in the skeletal growth of Rugosa, Tabulata, and Scleractinia, the fine epithecal rings known as growth ridges (average width 0.05 mm) are the best known (Wells, 1963, p. 949; 1970, p. 4). Few specimens show these delicate ridges very clearly (Fig. 16). In Scleractinia they may be found not only in reef corals but also in deepwater corals without zooxanthellae, which indicates that daily variation in light intensity is not the primary or only control. They are, however, widely regarded as daily in their periodicity, and Barnes (1972, p. 344) found that in the scleractinian reef coral Manicina areolata (Linne) they could be related to a daily cycle of expansion and contraction of the polyp; but he thought that, in the ahermatypic Gardineria sp., which he studied and which grew in shaded positions below 50 m, it was very improbable that the rings represented daily increments. He pointed out that they could be related to almost any stimulus that shifted the position of the free body wall of the polyp, such as feeding or any other (perhaps long-term) rhythmic event.

Wells (1970, p. 7) had already commented that daily fluctuations in the nutrient supply (e.g., diurnal movements of plankton), daily tidal flux, and diurnal variations in terrestrial magnetism are conceivable mechanisms for the rhythm; he ruled out daily temperature variations because at-depth temperatures are constant. He suggested that to account for the growth rings in both reef corals and such deep-sea corals with zooxanthellae as Flabellum curvatum Moseley obtained by the Challenger Expedition at a depth of 1,200 m off the Rio de la Plata and figured by Stubbs (1966, p. 828) (Fig. 16,3), a biologic clock control, i.e., daily changes effected by internal biochemical action, perhaps inherited from the distant past, might be needed.

Scrutton (1965, p. 552; 1970, p. 11) examined 10 specimens referable to several genera of Rugosa from the Middle De-
vonian of Michigan and Belgium. He assumed the growth rings to be daily, and judged that they were developed in groups (bands) limited above and below by constrictions, usually deep grooves around the circumference of the epitheca, but occasionally emphasized by a change in thickness of the corallite. He counted an average of 30 growth rings to a band (min. 27, max. 35) and regarded each band as formed during a single lunar month. His specimens were not characterized by alternating ex-
pansions and contractions in diameter that could be taken to indicate annual increments. Wells (1963, p. 950) had noted, in specimens from the Middle Devonian of New York and Ontario, that an average of about 400 rings could be counted on each presumed annual increment shown on the specimens he used (Fig. 16,2). He did not observe lunar monthly banding on these specimens. He later (1970, p. 7) listed results obtained from one specimen of Streptelasma from the Upper Ordovician of Ohio (about 412 daily rings per year); one specimen of Ketophyllum from the Middle Silurian of Gotland (about 400); a number of specimens, including the Tabulata Favosites from the Middle Devonian of New York and Ontario (avg. 398, range 385–405); one Lithostrotion from the Lower Carboniferous of Wales (398); two specimens of Lophophyllidium from the Upper Carboniferous of Pennsylvania and Texas (380 and 390 layers per year). Assuming a constant rate of decrease in the number of days per year from the Cambrian to the Holocene, he plotted his values of days per year against the radioactive age data for the periods as accepted in 1961, and noted that his very limited readings were consistent with the view of certain astronomers that there has been a deceleration of the earth’s rotation on its polar axis. He suggested that the potentiality of corals as geological chronometers would be worth investigation.

Subsequently there has been very little rugosan work published that either supports or negates these preliminary speculations, possibly because individual specimens on which epithecal growth rings, bands, and annual groupings are all sufficiently distinct for counting are very rare, and because recognition of lunar monthly and annual groupings can be very subjective.

Scrutton and Hipkin (1973, p. 266) pointed out that the only data in which both days per month and days per year are implied to have been counted on the same specimens are those of Mazzullo (1971, p. 1085), but that even here the number of days per month appears to be simply the days per year divided by 13 in each case. Recently Johnson and Nudds (1975, p. 31) estimated lunar months of 30.5 days for Lithostrotion from the Visean of Great Britain, based on the number of epithecal growth rings between narrow constrictions which they interpreted as lunar monthly; they thought the absence of “annual” constrictions on their specimens consistent with tropical latitudes deduced for the region from paleomagnetic data.

Johnson and Nudds also suggested (1975, p. 40) that there was a linkage between lunar monthly constrictions and the spacing of the tabulae such that 6.5 to 7.5 tabulae may have been formed each lunar month. Whether successive horizontal skeletal plates (tabulae, dissepiments) have a daily, weekly, or other temporal rhythm in their formation seems best determined experimentally in living Scleractinia. The staining studies of Buddemeier and Kinzie (1975, p. 135) on Porites chronicle a promising start to the strict examination of periodicity in Scleractinia.

Ma, in a series of papers on his observations of longitudinal thin sections and externals of Paleozoic and Holocene corals (Ma, 1933, 1937, 1956), has interpreted as annual, seasonal, and therefore temperature-controlled, certain rhythmic alternations of zones of narrowly and widely spaced tabulae and dissepiments. In many cases he noted an associated thickening and lengthening of the septa in the zones of narrow spacing as well as a reduction in diameter of corallite. These rhythmic alterations should be most marked in the corals growing farthest from the equator, and the length of the annual increment should decrease away from the equator. By identifying and measuring the assumed annual increments in corals from as many localities as possible for a given Paleozoic period, and plotting them on maps, he deduced the position of the equator and the tropics of Capricorn and Cancer for each continent in each Paleozoic period. These equators did not coincide with the Holocene equator but approximated those calculated from paleomagnetic data, assuming continental drift.

In some instances, the intervals Ma regarded as annual coincided with a rhythmic rejuvenescence in a corallum; rejuvenescence (Fig. 18,1) is commonly considered to represent recovery of a corallite after a period.

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of reduction caused by adverse circumstances, of which seasonal temperature lowering would be only one. In Heliolitina, alternation of closely spaced tabulae with dark-colored, vertical skeletal elements, and widely spaced tabulae with light-colored, longitudinal skeletal elements has been attributed to alternation of sexual and asexual reproduction (Bondarenko, 1971a, p. 23). This recalls Scrutton’s (1965) suggestion that “lunar monthly banding” of epithecal growth rings may be due to control of reproduction by phases of the moon.

Periodicity of skeletal structure on fine and ultrafine scales is seen in the lamellation apparent in the sclerenchyme of both septa and tabulae, not only in reef Scleractinia but also in ahermatypic scleractinians from the aphytic zones of Holocene seas. It is also notable in Rugosa and Tabulata, and has been discussed already in the section on morphology. Daily increments cannot be recognized with any confidence; each lamella on successive examination under higher and higher magnifications by optical and electron microscopes is seen to be composed of successively smaller and smaller increments (Jell & Hill, 1974, p. 10; Jell, 1974, p. 308).

**INCREASE OF THE CORALLUM**

Rugosan colonies are assumed to have arisen from single polyps, as in scleractinian colonies, by asexual reproduction. The parent polyp of the colony is the protopolyp, which lays down the protocorallite, and the subsequent or daughter polyps are the hysteropolyps or buds, which lay down the hysterocorallites or offsets.

Documentation of the patterns formed by the sequential three-dimensional development of offsets in a compound corallum is not plentiful. Oliver (1968) has reviewed what is known. In most such coralla, the general pattern is consistent, at least after the first few generations of offsets. Diagrams of common patterns given by lateral (marginarial) increase in both fasciculate and massive coralla as well as by axial (tabularial) increase are shown in Figure 17.1-3 (Oliver, 1968, p. 21).

In tabularial modes of increase, the offsets arise in part in the axial (tabularial) region; the tabularium of the parent ceases to grow; the increase is thus parricidal. In these, two or more offsets are formed and may occupy the whole of the calice of the parent, either initially or by more or less rapid expansion toward the axis (adaxial increase). Over the marginarium of the parent they are built up by the extension of the septa and wall of the parent; the tissue carried forward from parent to offset and common to both is the atavo-tissue. Neotissue in the form

**FIG. 17. Rugose coral morphology; patterns in Paleozoic coral colonies. Each line represents one corallite; arrowheads indicate position of calice and direction of growth (Oliver, 1968).**
of new wall and septa arises upon the tabularial floor of the parent calice. Two types of tabularial increase have been distinguished. In the staurioid type, commonly
four, in some three or five, offsets arise simultaneously, their new dividing walls arranged in a cross at the axis of the parent. In Stauria itself (Fig. 18,6), two opposite walls may grow upon the old cardinal and counter septa; but in Acervularia and others, there appears to be no general relationship to the protosepta of the parent. In the entelophylloid type (Fig. 18,4a-c), neowalls arise within the tabularium but toward its outer edge, and the offsets may then expand toward or to meet at the axis. In some examples studied the C/K plane of the offset in general lies at a tangent to the tabularium of the parent. In some species, there may be transitions between staurioid and entelophylloid types.

Other modes of increase involve only the marginarium and have commonly been termed lateral. Herein the term marginarial is preferred in most cases. With few exceptions these modes are nonparricidal; that is, the tabularium of the parent continues to grow and the parent competes with its offsets for living space. The offsets are commonly smaller than those produced in tabularial increase and in general make little use of atavo-tissue. In some, the original diameter of the offset is so small that there is only room for the protosepta and a few meta- and minor septa; in such cases, septal insertion, as interpreted from serial transverse acetate peels or thin sections, follows, with slight irregularities, the normal rugosan mode more or less from the beginning. In others, the original diameter within the neowalls is larger, and more meta septa and minor septa may be found; but here again, in the later stages of hystero-ontogeny, insertion of new septa has, with perhaps few exceptions (Jull, 1973), been found to follow the rugosan mode, though in some with irregularity. Even in the large offsets of tabularial increase, the rugosan mode can be traced at least in the later stages. The preferred orientation of the C/K plane in the offsets in marginarial increase is radial to the axis of the parent, though less common examples of tangential orientation also occur. Jull (1965, 1967, 1969a, 1974) has given valuable detail on the relations between atavo- and neotissue, the adaptation of old or the insertion of new septa, and the orientation of the offsets, and has referred to the recent work of others. (See also Spasskiy & Kravtsov, 1974, p. 165; Fedorowski & Jull, 1976, p. 37.)

The ontogeny of a protocorallite has been studied in only one species, Hexagonaria anna (Whitfield), and by only two authors (see Jull, 1973). The species is exceptional in having a relatively large and long-lasting protocorallite, but it is a difficult one in which to ensure correct interpretation of septal insertion from peels and sections, due to the exceeding shortness of the septa and a tendency for them to be obscured by thickening in the very narrow dissepimentarium. Jull could not identify a rugosan mode in either protocorallite or offsets. No description of the arrangement of the septal epithecal furrows in a protocorallite is known.

Solitary corals may show offsets; in many species such offsets may remain small relative to the parent corallite and do not themselves increase; the resultant corallum can then scarcely be called compound. In other species there are grounds for assuming that either phaceloid or massive coralla may develop from normally solitary coralla.

Rejuvenescence is often observed. A corallite, instead of continuing its growth with increasing or constant diameter, suddenly becomes much constricted, usually leaving a ledge of older calice around the constricted part. It then increases in diameter again, and the process may be repeated (Fig. 18,1). During rejuvenescence, the internal structure of the corallite may revert to the morphology of an earlier growth stage. It is possible that some of the short-lived offsets found in the calices of normally solitary species are rejuvenescence phenomena (see Spasskiy & Kravtsov, 1974, p. 168). "Total rejuvenescence" is suggested by Birenheide and Soto, 1977, p. 12, as responsible for the production of small, solitary Rugosa with a wall-free apex. Perhaps transverse fission like that in the Holocene scleractinian Fungia sp. may be involved.

**ONTogeny**

It has sometimes been thought useful to distinguish different morphological stages in the ontogeny (development) of a corallite, and to apply to the successive stages
such terms as embryonic, neanic (adolescent), brephic (adult), and gerontic (senile). Arbitrary limits to the stages have been put at convenient places, such as the insertion of the protosepta, insertion of the first few meta- and minor septa, appearance of dissepiments, and abaxial withdrawal of septa. In this volume, stage terminology is left more fluid, early and late being used in comparison with the average. Morphological variation during ontogeny has been discussed by NEUMAN (1974, p. 151).

The sequence of morphological changes to be observed by serial sectioning, e.g., in the length of septa and the septal arrangement, is commonly found to distinguish families, and indeed, FEDOROWSKI (1973, p. 89) has considered pentaphylloid ontogeny to be so distinctive as to warrant the separation of a new suborder Tachylasmatina. The shortage of specimens with complete apical cones restricts the practical use that can be made of serial section studies; nevertheless, an expansion of such work is much to be desired.

Apparent differences between the ontogenies of offsets in the one corallum as well as the ontogeny of protocorallites have been discussed above in the section on Increase.

GLOSSARY OF MORPHOLOGICAL TERMS APPLIED TO PALEOZOIC CORALS

Terms commonly used in this revision are printed in boldface capitals; less generally used terms are printed in boldface lower case letters. The capital letters in parentheses after each definition indicate whether the term applies to R, Rugosa, H, order Heterocorallia of subclass Rugosa, or T, Tabulata. Terms applying only to the Tabulata are to be found in the section on morphology of the Tabulata.

abaxial declination of dissepimental or tabularial floors. Floors slope down away from axis (H, R).

acanthine septum. Type composed of a single series of trabeculae with free distal ends forming spineose projections (R, T).

adaxial declination of dissepimental or tabularial floors. Floors slope down toward axis (R).

adaxial (axial) increase. Offsets arise from parent corallite by growth of new dividing walls from wall toward axis (R, T).

ALAR FOSSULA. Relatively prominent interseptal space at locus of insertion of new septa on counter side of alar septum (see fossula, cardinal fossula, counter fossula) (R).

ALAR SEPTUM (symbol A). One of two protosepta located about midway between cardinal and counter septa, distinguished by insertion of newly formed metasepta on side facing counter septum (see other types: cardinal, counter, counter-lateral) (R).

amplexoid septum. Type characterized by shortness except where septum is extended adaxially on distal side of a tabula, as in Amplexus (R).

APEX. Conical tip at proximal end of solitary corallite (R) or protocorallite (R, T).

aphroid. Massive corallum like astreoid type but septa shortened peripherally, adjacent corallites being united by a dissepimental zone (R).

arachnophylloid. Type of septum consisting of a rectilinear network of short trabeculae based on dissepiments and connected by transverse rods, as in Arachnophyllum (R).

asperulate septum. Type of septum composed of short, fine trabeculae that curve laterally so as to end in septal faces, not on the distal or axial septal edges (R).

astreoid. Massive corallum in which septa of each corallite are fully developed but walls between corallites are lacking; septa of adjacent corallites are generally in alternating position (R).

atavo-tissue. Skeletal elements of parent corallite that proceed distally without change and are incorporated in architecture of offset (R, T).

aulophylloid. Type of axial structure like that termed disophylloid but lacking a medial plate and outlined by a tabellar wall, as in Aulophyllum (R).

AULOS. Tubular axial structure that divides inner, commonly horizontal parts of tabularial floors from outer, abaxially declined parts (R).

axial coil. Longitudinal structure in axial region of corallite formed by twisting of inner edges of major septa commonly associated with transverse skeletal elements; coiling is commonly counterclockwise adaxially in calical view (R).

axial column. Axial structure with wall formed by tabellae each with its outer edge based on the one next below (R).

axial lobe. Digitate or veriform adaxial septal projection (R).

axial septum. Longitudinal plate composed of cardinal and counter septa conjoined at axis (R).

axial structure. Collective term for various longitudinal structures in axial region of corallite, whether solid or nonsolid, a rodlike columnella or an axial coil (R, T).

axis of divergence. Generally vertical or oblique line in septum from which trabeculae diverge inward and outward (R).

biform tabularium. Type commonly found in corallites with contrangent minor septa; the slope of the outer part of the tabularial floor is reversed or reduced in loculi between the minor septa and
the major septa against which they impinge (R).
calcocloid. Solitary corallite shaped like tip of pointed slipper as in *Calcocela*, with angulated edges between flattened and rounded sides (R).

**CALICE.** Distal surface of corallite, generally bowl-shaped (R, T).
calicular boss. Protuberance in central part of calice in some corallites; may rise from calicular pit (R).
calicular pit. Abruptly depressed central part of calice in some corallites, surrounded by a calicular platform (R).
calicular platform. Part of floor of calice, having a subhorizontal orientation or outwardly sloping (everted) form; generally surrounds a calicular pit (R).

**CARDINAL FOSSULA.** Relatively prominent interseptal space developed in position of cardinal septum and generally with deepening of tabular floor; comprises the two cardinal loci of metaseptal insertion (R).

**CARDINAL SEPTUM** (symbol C). Protoseptum in plane of bilateral symmetry of a corallite, distinguished from other protosepta by insertion of newly formed metasepta adjacent to it on either side (R).

**CARINA.** Keel-like elevation on face (side) of septa (R).
catenoid. Corallum with corallites united laterally as palisades which appear chainlike in cross section (R).
ceroid. Very slenderly conical, horn-shaped solitary corallite (R).
ceroid. Massive corallum in which walls of adjacent polygonal corallites are closely united (R, T).
clinotabella. Somewhat globose short tabella declined adaxially from dissipated wall and abutting on earlier tabella (R).
clinotabula. Elongate tabella steeply declined adaxially from dissipated wall and either crossing transversely to meet axial column or abutting on upper surface of earlier clinotabula (R).
disiphylloid. Type of axial structure with short medial plate in cardinal-counter plane, in transverse section resembling a spider web, as in *Clisiozylium* (R).

closed fossula. Prominent interseptal space enclosed toward axis of corallite by united edges of septa (R).

**COLUMELLA.** Solid or nonsolid axial structure formed by various modifications of inner edges of septa; commonly projects into calice in form of a calicular boss (R).

**COMPLETE TABULA.** Type consisting of a single platform, not composed of several small plates joined together (H, R, T).

**COMPONENT CORALLUM.** Type consisting of protocorallite and offsets (R, T).
convergent. Minor septum that inclines toward but does not connect with major septum adjacent on side toward counter septum (R).
convex side. The side of longest curvature in a curved solitary corallum (R).

counter fossula. Relatively prominent interseptal space developed in position of counter septum (R).

counter-lateral septum (symbol KL). One of two presumed protosepta that adjoin counter septum on either side (R).

***COUNTER SEPTUM*** (symbol K). Protoseptum opposite cardinal septum in position (R).
cylindrical. Type of corallite of nearly uniform diameter except in the apical region of solitary forms (H, R, T).
cystiphyllloid dissipated. Type found in corals in which septa are longitudinally discontinuous and are represented by septal crests of separate or only in part contiguous trabeculae (R).
dendroid. Irregularly branching types of fasciculate corallum (R, T).
dibunophyllum. Type of axial structure like that termed clysiophylloid but with longer medial plate and fewer septal lamellae, as in *Dibunophyllum* (R).
dilated septum. Type partly or wholly thickened (R).
discoid. Solitary corallite with buttonlike form (R).

**DISSEPTIMENT.** Small domed plate forming cystiform enclosure in marginarium of a corallite (R, T).

**DISSEPTIMENTARIUM.** Peripheral zone of corallite interior occupied by dissepiments (R).
distal. Direction away from point of origin of a corallite (see proximal) (H, R, T).

**EPITHECA.** Thin external sheath covering inner fibrous part of outer wall of corallite (R, T).

**EXsert.** Type of septum with axis of trabecular divergence such that distal ends of abaxially inclined trabeculae rise free above upper edge of epitheca (R).
fascicle. Microstructural unit, a conical aggregate of fibers of CaCO₃, expanding distally (H, R, T).
fiber. Fine structural unit, composed of tufts of needles of CaCO₃ grouped into fascicles (H, R, T).

fine structure. The fine skeletal structure as it appears in study by hand lens (H, R, T).

first order trabecula. Type that extends from wall to distal or axial edge of septum; commonly large (H, R, T).

flange. Keel on face of septum and directed parallel to distal edge of septum or horizontal (R).

foliase. Type of corallum with laminar branches (R, T).

FOSSULA. Interseptal space distinguished by unusual shape and size; when used alone refers to cardinal fossula (R).

groove. See septal furrow.

growth ridges (rings). Fine accretion rings of epitheca (R, T).

herringbone dissepimentarium. Type in which dissepiments between major septa inosculate, minor septa being longitudinally discontinuous (R).

holacanth. Seeming trabecula consisting of clear calcite, an effect of diagenesis on axial part commonly of rhabdacanth or monacanth (R, T).

holotheca. Epithecal sheath common to peripheral corallites of a compound corallum (R, T).

horseshoe dissepiment. Type with horizontal base and strongly arched top part, arranged in a pipe in single vertical series (R).

hystero- corallite. New corallite formed in compound corallum (see offset) (R, T).

incomplete tabula. Type consisting of several small plates (tabellae) joined together (R, T).

INCREASE. Addition of corallites to compound corallum (see offset, hystero-corallite) (R, T).

inner septal stereozone. Wall within dissepimentarium and formed by localized thickening of septa (R).

interseptal ridge. Longitudinal elevation on outer side of corallite wall, corresponding in position to space between a pair of adjacent septa inside of wall (R).

keyhole fossula. Prominent interseptal space at position of cardinal septum, expanding more or less suddenly toward its closed adaxial end (R).

laminar septum. Longitudinal radial partitioning wall in corallite formed of trabeculae that are contiguous throughout their length (H, R, T).

lateral dissepiment. Type having blisterlike form developed in isolated manner on sides of septa (R).

lateral increase. Formation of new corallite in fasciculate corallum by sideward growth (R, T).


lonsdaleoid dissepiment. Transseptal dissepiment developed across longitudinal discontinuities in septa, as in Lonsdaleia (R).

lonsdaleoid septum. Type characterized by longitudinal discontinuity toward peripheral edge, as in Lonsdaleia (R).

lumen. Interior of corallite bounded by outer wall (H, R, T).

MAJOR SEPTUM. One of the proteosepta or metasepta (H, R).

MARGINARIAL INCREASE. Type in which offsets arise wholly within marginarium (R, T).

MARGINARIUM. Peripheral part of interior of corallite distinguishable from tabularium by difference in constituent structures, generally abundant dissepiments, or dense deposit of skeletal tissue producing a stereozone (R, T).

MASSIVE. Corallum composed of corallites closely in contact with one another (R, T).

METASEPTUM. One of the main septa of a corallite other than proteosepta, generally distinguished by their extension adaxially much beyond minor septa (R).

microstructure. Skeletal structure as it appears in study by optical microscope (H, R, T).

microtuft. Smallest conical aggregate of crystallites resolvable under electron microscope (R, T).

miniseptum. Short septum found in some corals in interseptal loculi between adjacent major and minor septa (R).

MINOR SEPTUM. One of the relatively short septa that are inserted between adjacent major septa (H, R).

monacanth. Simple trabecula in which fibers are related to a single center of calcification (R, T).

naotic septum. Type characterized by development peripherally in a series of closely spaced dissepiment-like plates, as in Naos (R).

neotissium. New skeletal tissue formed during increase and belonging to the offset alone (R, T).

OFFSET. New corallite formed during increase in a compound corallum (R, T).

open fossula. Prominent interseptal space not enclosed toward axis of corallite by united edges of septa (R).

operculum. Lidlike covering of calice in some corallites, formed of one or more independent plates (R).

parricidal. Term applied to increase in which tabularium of parent corallite ceases to grow distally (R, T).

patellate. Low solitary corallite with sides expanding from apex at angle of about 120° (R).

pattern. Arrangement of offsets in compound corallum (R, T).

pectinate septum. Type in which distal ends of first order trabeculae are separate and project like teeth of comb (R, T).

penneckiellloid dissepiment. Type formed in a peripheral vertical series, such that in longitudinal section the upper part is flat or declined slightly outward, and the inner part is globose adaxially, as in Penneckiella (R).

phaceloid. Fasciculate corallum having subparallel corallites (R, T).

pipe. Single vertical series of dissepiments, of either horseshoe or flat longitudinal section (R).
plocoid. Massive corallum in which corallites are not defined by walls (R).

protocorallite. The first-formed corallite of a compound corallum (R, T).

PROTOSEPTUM. One of six first-formed septa of a corallite (H, R, T).

proximal. Direction toward point of origin of a corallite (H, R, T).

pyramidal. Solitary corallite with flattened sides that meet at angles, as in Goniophyllum (R).

quadrant. Space in interior of a corallite bounded by cardinal septum and an alar septum or by counter septum and an alar septum (R).

radiciform process. Rootlike epithecate outgrowth of a corallite wall, serving for fixation (see also rootlet, talon) (R, T).

ramose. Branching form of cerioid or plocoid corallum (R, T).

rejuvenescence. Type of growth in which diameter is periodically suddenly reduced before again increasing; the reduction may be accompanied by revision of internal structure to that of earlier stage of development (R, T).

refit septum. Type of perforate septum composed of an irregular network of skeletal tissue (R, T).

rhabdactanth. Compound trabecula with second order trabeculae grouped around its primary axis of growth (R, T).

rhipidactanth. Compound trabecula with second order trabeculae projecting perpendicular to median septal plane (R).

rhopaloid septum. Type characterized by distinctly thickened axial edge appearing club-shaped in cross section (R).

rootlet. See radiciform process (R, T).

scale. Small platelike structure attached to septal grooves or ridges or to smooth epitheca (R, T).

SCLERENCHYME. Calcareous tissue of corallite (H, R).

sclerocone (septal cone). Zone of skeletal thickening on selected old calicular floors, more or less widely spaced in the corallite, and affecting septal trabeculae, dissepiments, and tabulae; of inverted conical form (R).

scoloid. Solitary subcylindrical corallite bent irregularly in wormlike manner (R).

second order trabeculae. Small trabeculae commonly originating either at axis of first order trabecula or in median plane of septum (R, T).

secondary lamellar structure. Fine structure of parallel lamellae commonly oblique to growth lamellae, or zigzag, produced during diagenesis (H, R, T).

septal comb. Septum that is laminar near outer wall of corallite but spinose on distal and axial edges (see pectinate septum) (R, T).

septal cone. Alternative term for sclerocone, which see.

septal crest. Short laminar part of longitudinally discontinuous septum based on upper surface of
dissepiment or tabula (R).

septal face. Side of laminar septum (R, T).

septal furrow (groove). Longitudinal furrow on outer side of corallite wall, corresponding in position with a septum on inner side of wall (R).

septal lamella. Radially disposed longitudinal plate in axis of corallite, aligned with a septum but discontinuous with it (R).

septal (axial) lobe. Fingerlike or scolecidoid process extending adaxially from axial edge of septum (R).

SEPTUM. Radially disposed longitudinal partition of corallite (H, R, T).

SOLITARY. Corallite of polyp not forming part of a colony (H, R).

spongy columnella. Type consisting of axial lobes and septal lamellae associated with tabulae or tabellae (R).

STEREOZONE. Area of dense skeletal deposits in a corallite, generally peripheral or intradissepimental in position (R, T).

stunted septum. Type that projects briefly or not at all into lumen, though represented on outside of wall by septal furrow (R).

synapticula. Small rod or bar connecting opposed faces of adjacent septa (R).

TABELLA. Small subglobose plate in axial part of corallite forming part of an incomplete tabula (R, T).

TABULA. Transverse partition of corallite, nearly plane, or upwardly convex or concave, extending to outer wall or to inner marginal wall (H, R, T).

tabularial floor. Calical surface or vacated calical surface in tabularium (H, R, T).

TABULARIAL INCREASE. Type in which neowalls of offsets arise first in part in axial (tabularial) region, and the tabularium of the parent then ceases to grow (R, T).

TABULARIUM. Axial part of the interior of a corallite in which tabulae or tabellae are developed (H, R, T).

talon. Buttress produced by outgrowth of corallite wall, serving as aid in fixation (see radiciform process) (R).

thamnasterioid. Massive corallum characterized by absence of corallite walls and by confluent septa that join neighboring corallites together, with pattern of septa resembling lines of force in a magnetic field (R).

TRABECULA. Pillar of radiating calcareous fibers comprising skeletal element in structure of septum and related components (H, R, T).

trabecular fan. Fan of septal trabeculae radiating in plane of septum from an axis of divergence (R).

transseptal dissepiment. Type developed across longitudinal discontinuity in septum (R).

TRANSVERSE SKELETAL ELEMENTS. Plates developed transverse to the direction of growth of corallite (H, R, T).
**ASSUMPTIONS ON THE SOFT PARTS**

**POLYP**

The rugosan polyp is assumed to have been like other cnidarian polyps, a cylindrical body terminated above and below by transverse oral and aboral body walls, with a ring or rings of tentacles either near or at the edge of the oral body wall, the tentacles having sensory, tactile, and food-capturing functions (Fig. 19).

As in other Anthozoa with retractile or contractile polyps, the scleractinian mouth, and presumably the rugosan mouth, is connected with the gastrovascular cavity (coelenteron or enteron) by the esophaguslike stomodaeum, and the enteron is radially and longitudinally divided by soft plates or mesenteries that extend from the oral to the aboral body wall and inward from the cylindrical (column) wall, and which may or may not be connected to the stomodaeum (i.e., complete or incomplete). In its aboral end the scleractinian enteron is further divided by radial upfolds in the aboral body wall (septal invaginations) in which the calcareous septa are formed, and which alternate with the mesenteries.

The body wall consists of three tissue layers, two epithelial and one, the mesogloea, supportive. The inner epithelium is the endoderm. The outer epithelium, the ectoderm, is modified on the aboral body wall in Scleractinia and presumably in Rugosa also, by the development of calicoblast cells involved in the production of the calcareous exoskeleton. Muscle fibrils forming sheet-like muscle fields are developed mainly in the admesogloele parts of the endoderm, which has the important metabolic and reproductive functions as well.

Scleractinians are carnivores, using tentacles, nematocysts, cilia, mucus, and mesenterial filaments to remove zooplankton and other animal fragments from suspension in sea water, selecting by chemical cues. Although ahermatypic corals and some hermatypic corals feed primarily with tentacles, most hermatypic corals rely on ciliary mucoid feeding mechanisms. The majority of corals expand and feed at night, whereas others do so during the day. The stimuli governing such behavior are not yet known (Muscatine, 1973, p. 78). Possibly the rugosan polyps had similar devices.

**ZOOXANTHELLAE**

Also to be found in the endoderm of hermatypic Scleractinia (i.e., those that are reef-builders, or are found only in waters of temperature, depth, and salinity conducive to the formation of reefs), are resting phases of dinoflagellate algae known as zooxanthellae. These do not occur in ahermatypic Scleractinia, which are found in waters too deep or too cold for hermatypic corals. It has been suggested that those Paleozoic corals that are reef-builders also had zooxanthellae.

Zooxanthellae enhance metabolic efficiency by absorbing waste products, and by increasing the rate of calcareous skeletal formation. They may also assist qualita-
assumptions on the soft parts.

Whereas there is no conclusive evidence that zooxanthellae are digested by corals, there are experimental data showing that soluble products of photosynthesis may be released by zooxanthellae into the host cells and thus may be available in metabolism; zooxanthellae may be essential as a source of such nutrients as phosphorous, even though they may be inadequate in some cases as a source of reduced organic carbon (MUSCATINE, 1973, p. 111).

Fig. 19. Assumptions on rugose coral soft parts; the scleractinian polyp.—1, Relation of polyp and skeleton; young caryophyllid with edge zone (mesenteries not shown between septa in foreground).—2, Flabellum; 2a, lacking edge zone; 2b,c, transv. secs. of 2a along lines a-a' and b-b' (after Wells, 1956).
MESENTERIES

The mesenteries are the most vital parts of recent Anthozoa. With their filaments extending from their axial edges below the aboral end of the stomodaeum, they are the organs of digestion, absorption, and excretion; they are also the site of development of the gonads. The muscle fibers in the mesenteries are always more strongly developed on one side, where folds or pleats of mesogloea develop as a result. By the contraction of their endodermal muscle fibrils (longitudinal, radial, and parieto-basilar), the mesenteries retract the scleractinian polyp down into the protection of its calice and assist in controlling hydrostatic pressure within the polyp. (For a review of recent work, see FLüGEL, 1975b, p. 421.)

Scleractinian mesenteries are inserted and arranged in couples, each one of a couple being placed opposite the other, which forms its mirror image on the other side of the plane of bilateral symmetry of the polyp that runs diametrically and longitudinally through mouth and stomodaeum. Mesenteries are also arranged in pairs of neighbors in which the mesogloele pleats are symmetrically placed, facing either toward or away from one another (Fig. 20; FLüGEL, 1975b, p. 417, fig. 7b,c). The outward-facing condition is found in the so-called dorsal and ventral (directive) pairs, but the inward-facing condition characterizes the other four primary pairs; thus is established the primary bilateral symmetry of the Scleractinia. The site on the column wall of the planula where the first bulge appears as a precursor of the first couple of mesenteries is arbitrarily termed dorsal.

In the free-swimming scleractinian planula, the mesenteries appear in successive couples in a complex dorsoventral sequence that includes some translation around the perimeter (Fig. 21). It is not until six primary pairs of mesenteries have been established that the symmetry is seen to be hexameral and biradial; this is effected before the planula settles. Upon fixation the scleractinian polyp lays down a tenuous flat circular disc of CaCO₃ and the first six calcareous septa are initiated within the six primary mesenterial pairs. A secondary entocoelic pair of mesenteries (i.e., with inward-facing pleats) and enclosed calcareous septum is then established in each of the six exocoelic spaces alternating with the primary pairs, commonly in dorsoventral sequence. The tertiary entocoelic pair (and enclosed septum) is inserted in each of the 12 spaces (exocoeeles), alternating with the secondary and primary pairs, again commonly in dorsoventral sequence. In the Dendrophyllidae, however, the attainment of 12 tertiary entocoeeles and 24 quaternary entocoeeles is complicated by a substitution process involving 'splitting' of the peripheral ends of six calcareous exosepta (septa formed in exocoeeles) of the second cycle and later of the peripheral ends of the 12 calcareous septa of the third cycle.

The development of the first part of the rugosan skeleton indicates that, on settling of the planula, no flat basal calcareous disc was formed, but instead, a cuplike epithecate wall was deposited; the first septa were probably initiated immediately. First, on opposite radii, the cardinal and counter (C and K), commonly conjoined as an axial septum; the next two pairs of septa appeared in cardinal-dorsal sequence, the first pair becoming the alar septa, the second the first counter-lateral septa.

Whether the metasepta and minor septa that pseudoradially ridge the floor of the rugosan calice were, like those of the scleractinian calice, located within entocoeeles, either from the beginning or after a substitution process (as for instance in dendro-
phyllids), is still a matter of opinion.

Wells and Hill (1956) explored the possibility that the metasepta of Rugosa were formed within entocoeces of incomplete mesenteries, inserted, like the calcareous septa within them, in dorsoventral sequence in four sectors, which might correspond to the lateral and ventrolateral exocoeces of Scleractinia (see Fig. 38). This figure shows only major septa; minor septa could be accommodated by showing them (within entocoelic pairs of incomplete mesenteries) formed in seriation with the metasepta. On this assumption the Rugosa are reasonably considered Zoantharia. If Kunth's mode of septal insertion were involved, minor septal entocoeces of incomplete mesenteries might arise between the newest metaseptum and the cardinal oralar septum; if Weyer's mode were involved, they might arise on the other (counter) side of the newest metaseptum. Differential rates of growth in the circumference of the wall between minor septa and their neighboring major septa might also be involved.

Birenheide (1965a, p. 31; 1969c, p. 65) did not accept Wells and Hill's reconstruction. In his view, new major septa were formed by peripheral 'splitting' from the cardinal side of the last-formed major septum. He noted that 'splitting' was described in dendrophyllid Scleractinia in which septa of second and later cycle formed temporarily in exocoeces, and were later 'substituted' by septa formed in permanent entocoeces (Wells, 1956, fig. 238, 239). Only 'exosepta' were ever noted as being 'split' (branched) in Scleractinia. There is no evidence, such as pali, that substitution occurred in the Rugosa. He concluded that the rugosan metasepta (and perhaps also minor septa) were exosepta, and as such were not enclosed in mesenterial pairs; and thus that mesenteries were probably absent from rugosan polyps. He further considered that the Rugosa, with the Heterocorallia, should therefore be regarded as a separate, new subclass, the Eoanthozoa. His conclusions were not accepted by Schindewolf (1968) nor by Schouppe and Stacul (1968).

'Splitting' as a process in rugosan septal formation requires critical examination. It may possibly involve only the septal fur-
of calcification for the first trabecula of a new septum may originate at the epithelial septal furrow of a previously formed septum, then shift away as the septal invagination lengthens with the development of subsequent trabeculae. There seems no evidence to suggest that several neighboring peripheral trabeculae of a septum laterally give off secondary trabeculae that collectively diverge as a 'split' septum; 'splitting,' if it occurs at all, presumably occurs only at a point right at the periphery, and not adaxially along the septum.

**BIOCRYSTALLIZATION**

In a working hypothesis of biocrystallization of the scleractinian sclerenchyme, clusters of aragonite needles are assumed to form extracellularly in the patterns and modes of spherulitic crystallization in a gel matrix secreted by the basal ectoderm of the polyp. The needles are directed at right angles to the surface of the calicoblast layer. The most active centers of calcification are located at indentations into the calicoblastic layer, and their arrangement and spacing are characteristic of species and even genera (Bryan & Hill, 1941; Sorauf, 1972a, p. 89). The processes governing arrangement and spacing have not as yet been investigated. Carbohydrates (?chitin), proteins, and lipids have been found in the gel, which forms the organic matrix for the calcareous skeleton. The source of the Ca$^{++}$ and CO$_3^{-}$ ions used in the crystallization process and the biochemically and physiologically suggested paths taken by them to the sites of calcification are indicated in Figure 22 and further discussed by Chapman (1974, p. 116). The hypothesis may be applied to the rugosan sclerenchyme, though there is a probability that calcite, not aragonite, may have been involved.

In the Scleractinia, the septa and their constituent trabeculae are formed from the calicoblast layer in radial septal invaginations in the aboral body wall; other longitudinal skeletal elements are similarly formed; centers of calcification for the trabeculae are located in minor indentations along the crest of the invaginations. Presumably the longitudinal skeletal elements of Rugosa are similarly related to the soft parts. The dissepiments and tabulae, ex-
cept for their basal dark line, are formed by the calicoblastic layer of those uninvaginated portions of the aboral body wall between the septal invaginations (SORAUF, 1972a). The outer wall and its epitheca are formed, as BARNES (1972, p. 341) showed, at the region where the cylindrical polyp wall joins the aboral body wall and a ring-like lappet is developed. The epitheca sensu stricto is initiated at the top of the crease between the lappet and the aboral body wall, with a periodicity due to the expansion and contraction of the polyp; the inner, thicker part of the wall is deposited on the inner face of the epitheca by those parts of the calicoblastic layer between the peripheral ends of the septal invaginations. Whether the basal dark lines seen in dissepiments and tabulae of both Scleractinia and Rugosa are formed by adaxial horizontal infolds from this part of the aboral body wall, as SORAUF (1972a) and others suggest, requires confirmation, as also does his view that the dark line has an axis or median plane (his "septotheca") from which very fine conical spherulitic segments radiate as shown diagrammatically in his 1972a figure 3.

Distal growth of septa (and septal lamellae) and their constituent trabeculae is apparently continuous apart from the possibly diurnal periodicity evinced by growth lamellae. These growth lamellae may be seen to be continuous with, though differing in thickness from, the growth lamellae of the tabulae and dissepiments that adjoin the septa. Successive growth lamellae of a septum may appear to be continuous, the one with one dissepiment or tabula, the next with the subsequent dissepiment or tabula; yet there may be a considerable space between the two successive dissepiments or tabulae (Fig. 23).

The continuation of lamellae from septum to dissepiment or tabula may perhaps indicate either a relatively rapid change in the position of the calicoblastic layer, or the formation of a new calicoblastic layer. Speculation runs on three main lines. Two assume uplift of the aboral body wall to a new position. One of these suggests that tensile stresses are set up in the aboral body wall due to differential rates of growth between septa and dissepiments or tabulae, and that the stress is relieved by periodic uplift of the soft aboral wall between the septal invaginations. The difficulty of releasing intact soft tissue passing through fenestrate or cribriform septa of common walls is considered by some to negate this view. The second assumes uplift due to pressure generated by the secretion of gas or liquid between skeleton and calicoblastic layer, i.e., by 'blistering.' The third line deduces that by an infolding of the soft wall, a proximal part of the polyp is cut off by strangulation so that the cut-off part dies; the infold provides the new calicoblastic layer for the formation of a new dissepiment or tabula. (For reviews see WELLS, 1969; SORAUF, 1970; WEYER, 1972b, p. 715; FLÜGEL, 1975b.)

FUNCTIONAL MORPHOLOGY OF THE SKELETON

A useful review of speculations on the functional morphology of the rugosan skele-
Fig. 24. Assumptions on rugose coral soft parts; theories of dissepimental and tabular development (highly schematic).—A, Simplified polyp-corallum relations.—B, C, Tractive updrawal of polyp away from dissepiment (or tabula), followed by deposition of fibers (a) normal to secreting surface of pedal disc.—B', C', Horizontal infolding of column wall (Matthai; Weyer) with ingrowth of dissepiment (or tabula) with inner 'dark line' (b) eventually cutting off lower part of polyp (C') that becomes necrotic.—B'', C'', Hydraulic up-pushing of pedal disc and column wall (Wedekind), accompanied by centripetal ingrowth of thin dissepimental (or tabular) rings of more or less horizontally oriented fibers (B'', c), followed by secretion of fibers normal to pedal disc (C'', d) (Wells, 1969).

The calice, into which the polyp must, as in Scleractinia, have been retractable, had important protective functions. The ridging of its floor by septa imparted greater resistance against dislodgement, and the spaces between major septa in the tabularial region are considered to have supplied greater accommodation for the retracted soft parts, particularly the mesenteries and their mesenterial filaments. Retraction, like distension, was presumably controlled by contraction of the sheets of muscle fibrils, which varied the hydrostatic pressure in the enteron; this complexly coordinated mechanism also controlled the manner of feeding and the ways in which the polyp shed sediment.

Observations on recent Scleractinia suggested to Hubbard and Pocock (1972, p. 617) that a positive correlation exists between the strength of retractional and distensional muscular activity of polyps, and the following features of the skeleton: larger number of septa, complexity of septal ornament, fenestrate septa, higher calical relief, V-shaped calical floor, and lighter skeleton. Such features in Rugosa may thus have had similar functional significance.

Whether or not the septa supply fulcra...
for sheets of muscle fibrils appears not yet to have been established by direct observation of Scleractinia, in which the mesenteries are attached to the cylindrical, oral, and aboral body walls; in the floor of the calice the lines of their attachment to the aboral body wall alternate with the septal invaginations. Bourne (1899, p. 499) noted that desmoid processes in the soft wall are concentrated exactly opposite the junctions with the mesenteries, and Wise (1970, p. 978) noted on the inner face of the calcareous wall (theca) between septa, and infrequently on the upper surfaces of tabulæ, certain minute depressions that he interpreted as attachment pits for the desmoid processes opposite the mesenteries. So far, no such pits have been described from the lateral faces or distal edges of scleractinian septa, nor have any been recorded on rugosan skeletons.

Another feature of the rugosan calice to which functional significance has been ascribed is the fossula. It has variously been suspected to house a receptacle for enlarged gonad-bearing directive mesenteries or for collections of excrement, and as part of a diametral channel for gastrovascular currents, ciliary and otherwise (see Flügel, 1975b, p. 423). It is much better developed in solitary corallites than in corallites of compound coralla, which presumably had asexual as well as sexual increase.

The position of the fossula in the calice, i.e., in the plane of symmetry, and very commonly on the convex (curved or longer) side of a curved solitary corallum, may possibly be related to a preference of the planula to settle on its cardinal side, though the reason for this preference is unclear (possibly phototaxy) (Flügel, 1975b, p. 424). A positive phototaxy conceivably leads the polyp by muscular activity to keep its calice perpendicular to the direction of light, i.e., commonly parallel with the surface of the sea, so that the under (commonly cardinal) side may grow distinctly faster than the opposite side (Scrutton, 1965, pl. 87, fig. 3). A second explanation, explored for example by Weissermel (1897, text-fig. 2), is that the unequal growth is determined by positive rheotaxy in reaction to unilateral food-bearing currents. Against this it is argued that corals are not filter feeders, which commonly show positive rheotropism, but suspension feeders (Muscatine, 1973, p. 78), which are more likely to show positive phototaxy.

Withdrawal of septa in an amplexoid manner from the axis of a solitary rugose corallum, together with development of both a pseudoradial arrangement of the septa and a cylindrical form, were considered by Carruthers (1910, p. 525) to be modifications that ensured the most economical way to use CaCO₃ to lift the polyp above rapidly accumulating sediment.

An axial structure might provide selective advantage to the coral in two ways, chemical and physical. Firstly, by protruding into the calice and indenting the aboral body wall of the polyp, the axial structure may have displaced fluid from the enteron, increasing concentration of nutrients therein and the efficiency of absorption. Secondly, attachment of the aboral body wall to the axial structure may have increased muscular efficiency and hence feeding activity (Easton, 1973, p. 127).

Clearly, however, investigations on functional morphology of the various skeletal elements of the scleractinian skeleton are required to give credence to or invalidate assumptions made for the Rugosa.

**EVOLUTION**

**ORIGINS OF THE RUGOSA**

It has been suggested that the Rugosa and Tabulata shared common roots in the early Paleozoic (Sokolov, 1962c, p. 211, and fig. 8 on p. 212), and that the common ancestor of the early Rugosa (Streptelasmatidae and Stauriidae) shared some features with the early Tabulata Aulopora and Lichenaria. Ivanovskiy (1966, p. 455) concluded that all Rugosa descended from the Auloporida, whereas Flower (1961, p. 33; Flower & Duncan, 1975, p. 177, and figure) saw in Lichenaria the common ancestor for the Rugosa and Tabulata. There is as yet no solid evidence to substantiate any of these opinions on origin.

Also, it does not seem likely that the new
Family Cothoniidae JELL and JELL (1976, p. 181), of compound calcareous skeletons composed of conical operculate corallites with radially corrugated and septate calices and fibrous and possibly trabeculate microstructure, from the lower Middle Cambrian of New South Wales, could have been the ancestor of the Rugosa. It has not been possible to establish that members of that family have rugosan septal insertion; it seems that, although increase in circumference of wall takes place at four positions, these positions lie one on each side of each end of a plane of bilateral symmetry, not one on each side of one end and the other two lateral as in the Rugosa.

TRENDS OF DEVELOPMENT

Whether the appearances of particular features in the rugosan skeleton are to be seen as manifestations of evolutionary trends may be debatable. Authors have presumed that some features are primitive and that others, more advanced, have evolved from them. Such presumptions are difficult to assess, because the accumulation and study of sufficiently extensive biostratigraphical evidence is so time-consuming.

Among features of taxonomic value that appeared (or disappeared) at different times (or even approximately simultaneously) in different genera and families are: axial structures of various types; elongation or shortening or stunting of septa; lateral contiguity (or discontinuity) of trabeculae within septa; peripheral or axial longitudinal discontinuity within septa; other complexities of septal structure; marginaria of different types; contours of tabular floors; and compound (or solitary) nature of the corallum. SPASSKIY (1971a, p. 56) has codified the features he considered diagnostic in Devonian superorders, orders, suborders, families, and genera, has devised formulae for genera, and supplied a key to his classification. SPASSKIY and KRAVTSOV (1971, p. 5) and SPASSKIY (1974, p. 127) discussed the appearance and disappearance of such features in terms of heterochronous or isochronous parallelism or homeomorphy, and considered that new features were produced by adaptive variation primarily within marine basins isolated by regression of the seas after epochs of folding; they listed five peaks of concentration in the appearance of new features of higher taxonomic value, one each at the beginnings of the Middle Ordovician, Late Ordovician, Silurian, Devonian, and Carboniferous.

Other recent discussions of such apparent trends of evolution and of some of the taxonomic implications may be found in IVANOVSKIY (1971b, p. 9; 1975a, p. 26) and WEYER (1973-1977).

ORIGINS OF AND PHYLOGENY IN THE SUBORDERS

It is perhaps not as yet very profitable to speculate on the origin of the 16 suborders of the Rugosa, and only a few tentative suggestions are put forward herein. Two of the three suborders of nondissepimented small solitary Rugosa, the Stereolasmatina and the Plerophyllina, may have evolved from the Metriophyllina, and these three might therefore be regarded as forming an order. However, the idea that either or both arose from the Streptelasmatina is not untenable.

Another possibility is that the Columnariina arose from the Stauriina; if so, the Acervulariidae should perhaps be divorced from the former. The Ketophyllina and Ptenophyllina also may well have developed from the Stauriina. The Streptelasmatina possibly gave rise to the Arachnophyllina and Lycophyllina as well as to the Cyathophyllina, from which perhaps the Aulophyllina derived. The Caniniina are a problem; an origin from the Lycophyllina is possible. Both the Lithostrotionina and Lonsdaleiina may conceivably have derived from the Aulophyllina.

Different sets of speculations have been offered in diagrams by SPASSKIY (1974, p. 133) and IVANOVSKIY (1965a, p. 53; 1967, fig. 7 on p. 18; 1975a, p. 39). IVANOVSKIY (1971b, p. 9) has also discussed stages in the evolution of the Rugosa. Many authors, notably WEYER, have included in their discussions of families, subfamilies, genera, and species, opinions on the relationships between them.

Phylogenetic relations between families of Ordovician and Silurian Rugosa have been suggested by IVANOVSKIY (1965a, fig. 7 on p. 51; 1968, fig. on p. 86) and between genera within families by IVANOVSKIY.
(1965a, p. 46; 1969, fig. 21 on p. 97) and by Lavrusevich (1971a, fig. 22 on p. 96).

For Devonian families, Soshkina (1952, fig. 21, on p. 28; 1954, table 3 on p. 20) has suggested schemes. Spasskiy (1960a, fig. 4 on p. 93; 1964, fig. 1,2; 1965a, fig. 1-4) has provided diagrams of possible phylogenetic relationships between genera in his families and suborders of Devonian Rugosa, and Ivaniya (1965, p. 226) has also speculated on Devonian phylogenies. Rozkowska (1953, fig. 40 on p. 73) has suggested relationships within the Polish species and genera with pipes of horseshoe dissepiments, and (1969, fig. 5 on p. 27) for the Upper Devonian Polish families and genera of small, mainly nondissepimented, solitary Rugosa.

Possible relations between Carboniferous families have been suggested by Ivanovskiy (1967, fig. 8 on p. 19) and for Carboniferous genera and species of the Urals by Degtyarev (1973a, figure on p. 81). For the Pennsylvanian Pseudopavonidae, Kato and Minato (1975, fig. 4 on p. 112) have suggested a scheme of relationship between genera. Minato and Kato (1970, fig. 2 on p. 6) deduced phylogenetic lines between and within the Carboniferous and Permian families Durhaminidae, Waagenophyllidae, and Lithostrotionidae.

For the Devonian to Permian plerophyllin families and genera, Ilina (1974, fig. 1 on p. 212) and Sokolov (1960, fig. 2 on p. 51) have given phylogenetic schemes, and both of these authors subscribe to the view that genera of Scleractinia arose from this suborder.

This Treatise does not accept the theory that the Scleractinia evolved from the Rugosa.

DIVERSITY GRADIENTS

Both horizontal (geographical) and to a lesser degree vertical (bathymetric) gradients in generic diversity have been analyzed for the Holocene scleractinian reef corals, based on taxonomic distribution data provided mainly by Wells (1954) and analyzed using statistical methods by Stehli and Wells (1971) and Rosen (1971). Rosen's horizontal diversity contour map (Fig. 25) shows three foci of maximum diversity, each roughly centered on the equatorial region: one in the western Pacific about New Guinea, a second of slightly lesser diversity in the western Indian Ocean which, with further data, may prove to be continuous with the first, and a third, much less diversified, in the western Atlantic (West Indies). Whereas the contours are more or less latitudinal, there is a distinctly greater extension northward than southward, in the western part of the oceans particularly. The western regions are no doubt favored by the Holocene circulation patterns of the surface equatorial currents; the western faunas are enriched and the eastern faunas winnowed by the net direction of transport of planulae. The warm northerly or northeasterly currents of the western regions (Gulf Stream and Kuroshio Current) penetrate farther toward the pole than do the southern currents. These regional diversity contour patterns closely resemble the equal temperature contour patterns. Rosen's (1971, p. 275) diversity-temperature curve for the Indian Ocean becomes less steep at about 25°C and suggests a peak at about 28 or 30°C, thus according well with the acknowledged optimum for reef-coral growth (25-29°C, Wells, 1957a, p. 1088). As temperatures rise to 40°C, diversity theoretically will be reduced to nil.

As one moves out from a focus of maximum diversity, the same genera drop out, generally in the same sequence, and the remaining peripheral faunas are of the same generic composition and include only genera also found more centrally (Wells, 1954, p. 389). The genera with extensive distribution are usually the oldest (Stehli & Wells, 1971, p. 125) and also the most important reef contributors (Rosen, 1971, p. 279). In reef Scleractinia, maximum diversity apparently occurs within limits that are optimal for maximum skeletal production: at temperatures from 25 to 29°C, normal salinities between 34 and 36‰, depths up to 18 m, in agitated water with nutrient-bearing currents, minimum supply of terrigenous detritus, and bulk supply of calcareous skeletal...
Temperature is considered to be the most important single controlling factor for horizontal (geographical) diversity, and the influence of minimum temperature on reproduction of chief importance (YONGE, 1940, p. 380).

The principal controls for vertical (bathymetric) diversity gradients in Holocene reef Scleractinia appear to be, first, the amount of radiant energy available to the symbiont zooxanthellae for photosynthesis, which decreases with increase of depth, latitude, and amount of suspended matter; second, possibly, the decrease of water movement with depth. Temperature appears not to apply in depth diversity, because diversity at depth is invariably lower than the prevailing temperature would permit (WELLS, 1954, p. 386, 406). Present depth records indicate that diversity is greatest between 0 and 18 m, decreasing rapidly downward to a limit between 45 and 110 m (see also WELLS, 1967, p. 350).

Rugosan diversity gradient studies are complicated by the difficulty we have in precisely identifying the fauna proper to even a single age over the whole world; a third gradient, the chronological gradient, almost inevitably obscures the geographic and bathymetric gradients. Analogy with scleractinian reef corals is generally assumed.

Oliver (1976a, p. 40), from his studies on the Lower and Middle Devonian colonial Rugosa of New York, concluded that environmental factors permitting high species diversity also permit greater variation within the species. Thus in the Edgecliff bioherm facies, there is high species diversity and high intercolony variation. At the other extreme is the Moorehouse Acinophyllum-Eridophyllum bed with only two species of corals; although coralla are abundant, inter-colony variation is minimal.

Of the few precise geographical diversity studies attempted, that published by ANSTEY and CHASE (1974, p. 1142) confines itself to the Upper Ordovician corals (presumably both Rugosa and Tabulata) of North America. It suffers, perhaps, from the small number of Upper Ordovician genera and species. The results, considered in relation to a paleoequator based on paleomagnetic data, were interpreted as indicating that the lithofacies control of coral diversity overrode that of latitude; they found a marked correlation between carbonate lithofacies and diversity.

Many initial surveys of geographical distribution have been used herein in the preparation of the chapter on distribution. Based on analogy with scleractinian reef corals, it may be assumed that rugosan rates of evolution increased in regions of maximum diversity, that new species and genera spread outward therefrom, and that cosmopolitan genera, in addition to being those successful over the widest range of environments, may well have had the longest ranges in time.

Little is known of bathymetric diversity gradients in rugosan faunas, though several authors have indicated that assemblages change with changing depth and with related changes in degree of water turbulence (LOWENSTAM, 1957, p. 231; BIRENHEIDE, 1962c, p. 21; KLOVAN, 1964; LECOMPTE,
PALEOECOLOGY

The Rugosa were epifaunal benthos, predominantly neritic, most profuse and diverse in carbonate perireefal and reefal environments, though they were seldom significant reef-builders. It is assumed that in the Paleozoic, as in the Holocene, carbonate provinces with reefs characterized warm (tropical to warm-temperate), shallow (epicontinental and shelf), well-oxygenated seas with high radiant energy, normal salinity, and rich nutrient sources. These generalizations are supported by much observed sedimentological data, though there are many uncertainties in detail.

Three gradational facies faunas are recognized. The first is a fauna of very small to small, solitary nondissepimented genera, not of great diversity, but accompanied by two or three genera of Tabulata developing colonies of small size, and by small brachiopods. This fauna is commonly found in dark or olive calcareous shale with or without thin-bedded argillaceous limestone or thin-bedded crinoidal limestone. In rare occurrences of a limited number of species in bioherms (e.g., Amplexus in the Lower Carboniferous knoll reefs), members of the fauna may attain considerable size while retaining simple internal structure. It is regarded as adapted to the muddier, darker, quieter, and therefore deeper parts of epicontinental or shelf sea floors. Also, in the middle and late Paleozoic beds of the Variscan geosyncline, very small laccophyllids occur as sparse benthos in cephalopodan limestone originally deposited as abyssal oozes composed largely of the skeletons of pelagic organisms; depth of deposition was assumed to be between 200 and 4,000 m below sea level (Bandel, 1974, p. 112). This fauna may thus be ecologically analogous to the Holocene ahermatypic scleractinian fauna; its members are largely Metriophyllina and Plerophyllina and it has been variously called a zaphrentid, Cyathaxonia, syringaxonid, or polycoeliid fauna (or facies or phase) (Vaughan, 1910, p. 190; Hill, 1938, p. 5; Hudson & Cotton, 1945, p. 281; Bandel, 1974, p. 112; Kullman, 1975, p. 161).

The second gradational facies fauna, predominantly of larger, dissepimented solitary corals, appears in all periods from Ordovician to Permian, and is to be found in the somewhat more calcareous rocks, mainly in argillaceous limestones. The greater size of coralla and, in many cases, the greater diversity of species and genera in these limestones seem to indicate conditions more favorable than those tolerated by the first fauna. Where paleoslopes or transgressions or regressions have been deduced, this fauna occupied shallower zones than the smaller, nondissepimented coralla (Birenheide, 1962c, p. 22). In some coral beds, coralla are found upright, indicating growth on quiet bottoms; in others, they lie on their sides and may be curved, irregularly or regularly, with the growth rings on their epitheca reflecting attempts to keep their calical floors perpendicular to the surface of water or source of light, or to the rain of zooplankton. In some beds they lie on their sides with the upper parts eroded, and this is taken to indicate that water movement, possibly due to storm action, has winnowed away the supporting muds (Hubbard, 1970, p. 193). Attachment to substrate was commonly abandoned soon after settling of the planula.

In the Middle Devonian of the Eifel, this fauna represents a slightly deeper-water subfauna than the common, quiet-water coral meadows or turf-reefs in which the solitary Rugosa, like those of forereef aprons, commonly possess rootlets or talons to keep them upright (Birenheide, 1962c, p. 23); in the turf-reefs the solitary coralla are somewhat eclipsed by the vigorous development of fasciculate coralla and the rather sparse massive coralla. The fasciculate habit so characteristic of this turf-reef subfauna is that found in lagoonal or backreef
or other quiet but shallow environments of modern reefs. In the Devonian the solitary corals of these subfaunas are predominantly Ptenophyllidae and cystimorphs; in the Carboniferous, Caniniina or Aulophyllina have replaced the Devonian taxa, and there are suggestions that the Aulophyllidae, with their complex axial structures, represent more propitious conditions than the Caniniina limestones. This fauna grades into the third as the compound coralla came to dominate the solitary corals.

In limestone with little or no argillaceous matter, or deposited in more agitated waters, compound coralla may outnumber solitary coralla, and thus the second fauna grades into the third or perireefal fauna. In exposed parts of Silurian or Devonian reefs, its hemispherical coralla may compete with blocky stromatoporoids. In still more exposed waters, subject presumably to surf action, its massive coralla may be extensiform, increasing their ability to withstand translocation by waves. This third fauna compares best with the scleractinian fauna with symbiotic zooxanthellae that is characteristic of Holocene reefs. Whether its members also possessed zooxanthellae is uncertain. MANTEN (1971, p. 466) considers this fauna to have been so profuse in the Silurian as to suggest that they did, but COATES and OLIVER (1973, p. 24) assumed that the Rugosa were without zooxanthellae.

The most clearly defined geological factor controlling the distribution of these three faunal types is the sedimentary environment; an increase in size and in complexity of structure of corallum accompanies decreasing terrigenous content, an increase that is accompanied (as the work of OLIVER, 1976a, p. 40, shows) by increasing taxonomic diversity and intercolonial variability. Conditions for corals clearly improved at the same rate as conditions favoring reef growth.

There are also suggestions that these faunas replace one another vertically, either in topographic zones up paleo slopes (BIRENHEIDE, 1962c, p. 22) or with fall in sea level or with the growth upward into shallower waters of reefal bodies or sedimentary piles (LECOMpte, 1958, p. 390).

Scleractinian hermatypes flourish and breed best in water temperatures between 25 and 29°C. Although, in general, organic diversity is dependent mainly on temperature, in Scleractinia with zooxanthellae the number of species is controlled by light intensity and radiant energy rather than by temperature or by oxygen supply (i.e., by aeration) (WELLS, 1957c, p. 611; 1967, p. 352). Thus, the symbiotic algae appear to increase evolution rates as well as skeletal carbonate production. That ambient light has an important effect on reef coral growth form has been supported by a computer simulation program by GRAUS and MACINTYRE (1976, p. 895). The scleractinian Monastrea annularis in the Caribbean area is approximately hemispherical in shallow water (1-5 m), peaked or columnar at depths between 5 and 25 m, and platelike at the greatest depths for the species (25 m); over the same depth intervals, maximum annual skeletal growth decreases from 1.1 to 0.3 cm. The salinity range favored is the normal 34 to 36‰, and the optimum depth lies above 25 m and probably within the top 15 m. Planulae settle only on a firm, smooth substrate. Corals cannot survive where large amounts of sediment are shifted over the bottom by waves or currents. Sediment in suspension is not inhibiting, but corals are suffocated if the accumulation of sediment is too great to be removed by normal water movement assisted by the very considerable sediment-removing or rejecting activities of the polyps. These mechanisms include hydrodistension, tentacular movement, and mucus and ciliary currents (YONGE, 1930, p. 16; MARSH & ORR, 1931, p. 130; HUBBARD & POCOCK, 1972, p. 617).

Ahermatypic scleractinians are insignificant as reef constructors and have a very wide range of habitat. They live at depths from 0 to 6,000 m in both lighted and aphotic zones, though the greatest variety is at moderate depths, from 50 to 300 m, where they flourish in almost complete darkness. They tolerate temperatures from 0.5 to 28°C, and are found in all seas where salinities are not below 34‰ (WELLS, 1957a, p. 1089; 1967, p. 353).

Our assumption that the two rugosan faunas found in or near Paleozoic reefal environments flourished within the same general ranges of temperature, salinity, radi-
ant energy, and depth as did the scleractinin reef fauna with zooxanthellae should be tested as far as possible in future research. Whether or not the Rugosa of the Paleozoic reef possessed zooxanthellae seems at present to be incapable of proof. On the basis of conditions as deduced from the form of the corallum and enclosing sediments, or by analogy with modern corals, Wells (1957b, p. 774) considered that most Paleozoic corals lived in ecological niches similar to those occupied by the nonsurface, essentially lagoon reef corals of the present day: 1) to a maximum depth of about 50 m; 2) well within the lighted zone; 3) in temperatures with annual minima between 16 and 21°C; 4) in well-oxygenated, gently circulating water; and 5) on bottoms free, or relatively free, from rapid accumulation of sediment, but not necessarily in clear, nonturbid water. These generalizations are still in accord with the collected data. Wells also considered the Paleozoic corals relatively unimportant as reef-builders and suggested that the reason might be their failure to develop adequate capacity to adhere strongly to substrate.

Variation within species with change in environmental niche has been suggested. Thus, Birenheide (1963b, p. 405) indicated that Peripadium planum developed flat colonies with strongly everted calices in the uppermost zone of greatest water agitation dominated by blocky stromatoporoids in the Middle Devonian of the Eifel, whereas in slightly less turbulent conditions this species developed hemispherical colonies with only shallowly everted or flat calicular platforms. Tsien (1970, p. 161) remarked that in the quiet-water (sous-turbulente) zone of the Frasnian basin facies of Belgium, colonies of Disphylleum goldfussi are small and erect, while on the shelf, where they preferred subturbulent or turbulent zones, colonies are larger and more bushy; and also that, in general, Disphylleum possessed more or less rounded calicular platforms in a reefal or turbulent milieu, but in lagoonal or restricted environments its calicular platforms were steeply declined adaxially. Hubbard and Pocock (1972, p. 617) associated deep, V-shaped calices with stronger activity in the polyp's rejection of sediment, and indicated other features that might also be correlated with efficiency in sediment rejection.

Commensalism. Intergrowths of fasciculate or more rarely of solitary Rugosa with stromatoporoids are not uncommon; there seems little evidence on which to base a discussion on possible mutual benefit from such intergrowths. The Silurian ?stauriid Prisciturben Kunth, 1870, p. 28, may be one example.

Tubes situated commonly in or between the common walls and seldom at the angles between walls of corallites of species of the Devonian ptenophyllid Xystriphyllum Hill, 1939b, p. 62, have been considered by Kravtsov (1965, p. 126) to be the tubes of a commensal worm, a spiral annelid, of a type previously known in Tabulata.

**PALEOZOOGEOGRAPHIC PROVINCES AND SEQUENCE OF FAUNAS**

Paleozoogeographical regions and provinces suggested in the literature on Rugosa up to the present can only be regarded as tentative and preliminary; substantial modifications must be expected as rugosan taxonomy and chronostratigraphy become more precise. The broad outline of the sequence of faunas that follows includes references to relevant reviews.

**ORDOVICIAN**

The Middle Ordovician Blackriveran Stage of North America provides the oldest proven rugosan fauna, but its few small solitary corals and cerioid stauriids Favistina are still inadequately described. In a probably slightly younger fauna from New South Wales (Fauna 1; McLean & Webby, 1976, p. 232), a small rugosan with discrete monacanthine septa (Hillophyllum) is at present regarded as the first tryplasmatid, though its relationship to the probable calostylid Lambeophyllum of North America needs further evaluation. Faunas of probably Trenton age are known not only from North America, but also from Europe, the
Fig. 26. Paleozoogeographic provinces; distribution of Late Ordovician corals (after Kaljo & Klaamann, 1973). Legend: A, North America; Au, Australia; B, Baltic and Scandinavia; C, China; E, Great Britain; G, Greenland; J, Iran; K, northeastern USSR; M, Bohemia and Podolia; S, Siberia; T, Tadzhikistan; U, the Urals; Z, Kazakhstan, the Sayans, and the Altai; spotted areas, land; white areas, sea. Abbreviations of generic names: Age, Agelolites; Ams, Amsassia; Arc, Arctilria; Cal, Calostylis; Cox, Coxia; Cry, Cryptolichenaria; Cyr, Cryptophyllum; Est, Esthonia; Fav, Favistella; Ken, Kenophyllum; Kol, Kolymopora; Lic, Lichenaria; Lyo, Lyopora; Nyc, Nyctopora; Phy, Phystopis; Pli, Paliphyllum; Pro, Propora; Prt, Protatryphyllum; Pta, Protoarea; Reu, Reuichia; Sar, Sarcinita; Sib, Sibiriolites; Str, Strombodes; Tet, Tetradium; Tol, Tolla; Wor, Wormsipora.
Rugosa—Paleozoogeographic Provinces

Siberian Platform, and eastern Australia. In the latter, *Hillophyllum* is joined by the fasciculate stauriid *Palaeophyllum*; in eastern North America the small, solitary *Lambeophyllum* and *Lambeasma*, at present considered to be early calostylds, and *Palaeophyllum* together with *Streptelasma*, join *Favistina*. In Europe *Favistina* and *Palaeophyllum* are absent, or rare locally, but new small, solitary, calostyld genera and *Streptelasma* appear together with the early palaeocyclids or tryplasmatsids *Primitophyllum* and *Neotryplasma*. In Kazakhstan, only *Kenophyllum* (a streptelasmatid) and the stauriid *Proterophyllum* are known so far. Mongolia has the earliest metriophyllinan (*Protozaphrentis*), and China has possibly the earliest *Calostylis* and some fasciculate calostylds. These data are too few for meaningful discussion of Middle Ordovician provincialism of Rugosa.

The Upper Ordovician faunas are somewhat richer and better known, but grounds for distinguishing zoogeographical provinces are still slight.

*Favistina*, *Crenulites*, *Palaeophyllum*, *Streptelasma*, *Helicelasma*, and *Grewingkia* are cosmopolitan, being found in North America, Europe, Asia, and eastern Australia. There are, however, various genera, mainly of solitary corals, that up to now have been described and recognized from one continent only. Thus, North America, including the Arctic regions and Greenland, is characterized by the angulate or longitudinally grooved streptelasmatids *Lobocorallium* and *Deiracorallium* (Nelson, 1963, p. 34). Northern Europe (Balto-Scandia) has several streptelasmatid genera not so far recognized elsewhere (Neuman, 1969, p. 70; 1975, p. 346).

Solitary corals with acanthine septa referable to Palaeocyclidae or Tryplasmatidae have been described from Balto-Scandia and the Urals (Shurygina, 1973, p. 147) and others from eastern Australia (McLean & Webb, 1976, p. 239); others have been listed from South China (Yi, 1974, p. 22). Fasciculate and columellate stauriids known only from Tadzhikistan (Lavrusevich, 1971c, p. 5) or the Altay (Cherepnina, 1960, p. 389) distinguish those parts of central Asia, supplemented by *Calostylis* and a doubtful lambelesmatin (*Sogdianophyllum*) (Lavrusevich, 1971c, p. 3).

Several genera of rather large, solitary, dissepimented Rugosa, referred to the Palaeophyllidae, have been described from the Siberian Platform (Ivanovskiy, 1963, p. 71), the Altay (Cherepnina, 1960, p. 390), Tadzhikistan (Lavrusevich, 1971c, p. 5), and the Balto-Scandian regions (Neuman, 1968, p. 230). This family, and possibly the Lykophyllidae, may also be represented in North America (Nelson, 1963, p. 43). Some specimens referred to the Lykophyllidae have been reported but not illustrated by Lavrusevich (1975b, p. 124) from Tadzhikistan.

How much these apparent differences are due to our limited knowledge of Upper Ordovician Rugosa, which are always overshadowed by the associated Tabulata, and how much they reflect provincialism is at present doubtful. Kaljo and klaamann (1973, p. 39) (Fig. 26) considered that, based on the Tabulata and Rugosa, only two faunal provinces existed in both Middle and Late Ordovician times, the America-Siberian and the Eurasian. Yi (1974, p. 22) considered that in North China, Middle and Late Ordovician faunas were most closely related to the fauna of the North American-Siberian province, but that those of South China showed an admixture of Baltic Tabulata with North American elements, and that South China should occupy an independent province.

**SILURIAN**

Silurian rugosan faunas are much richer than those of the Ordovician, from which they differ, as do those of later periods, in being dominated by corals with dissepimentaria (pleonophoric corals). Of the non-dissepimented (diaphragmatophoric) corals, solitary streptelasmatids are the most important. Laccophyllidae are rare until the Late Silurian. Hill (1959, p. 151) noted that Rugosa are rare to absent in southern Europe, Africa, South America, Antarctica, and New Zealand, and thought that on the whole the Silurian fauna was cosmopolitan, though there were suggestions of Austral-asian and North American subprovincialism. Ivanovskiy (1965a, p. 109) commented on
Fig. 27. Paleozoogeographic provinces; distribution of selected Ludlovian corals (after Kaljo & Klaamann, 1973). Legend as in Fig. 26. Abbreviations of generic names: Ace, Acrvulada; Axu, Axilites; Bar, Barrandeolites; Coe, Coenites; Dal, Daljanolites; Ent, Entelophyllum; Fos, Fossopora; Gya, Gyalophyllum; Kod, Kodonophyllum; Lac, Laceripora; Mes, Mesosolenia; Muc, Mucophyllum; Nip, Nipponophyllum; Pli, Plicatomurus; Pro, Propora; Rip, Rhipaeolites; Sax, Syringaxon; Sch, Schedohalysites; Squ, Squameoflavosites; Ste, Stelliporella; Str, Stromboides; Sub, Subalveolites; The, Thecostegites; Tra, Trachypora; Yas, Yassia; Zel, Zelophyllum.
the roles of regression and transgression in promoting, respectively, provincialism and cosmopolitanism. KALJO and KLAAMANN (1973, p. 40) (Fig. 27) reviewed known stratigraphic and geographic distribution on maps with continents in their present positions, but PICKETT (1975, p. 147) attempted a contribution to the testing of some current theories of plate tectonics by plotting distributions on the speculative continental reconstructions assumed for the Lower Devonian continents by SMITH, BRIDEN, and DREWRY (1973), for Silurian—very Early Devonian continents by CREER (1973) and for Pangea by RICKARD and BELBIN (in PICKETT, 1975) (Fig. 28).

The small lower and middle Llandovery rugosan faunas known so far from Europe, Asia, Australia, and the Americas are very similar to the Upper Ordovician faunas. Disseminated paliphyllids are still outnumbered by nondisseminated fasciculate and cerioid stauriids and solitary streptelasmats, including now the columnellate Dalmanophyllum. Rare Calostylis and, in Siberia, Palaeocaruea are found; the earliest Cystiphyllum may be those of the middle Llandovery of Tadzhikistan, the western Siberian Platform, and New South Wales. Some new genera are reported from one continent or state only, but, as in the Upper Ordovician, our knowledge is too fragmentary for reliable zoogeographical deductions to be drawn.

By the end of the late Llandovery, the distinctive, rich Silurian rugosan fauna had entered in a great burst of vigor; it is richest in reefal carbonate regions. Pycnostylidae, Dinophyllinae, Kodonophyllidae, Mucophyllidae, Entelophyllidae, Arachnophyllidae, Ketophyllidae, Endophyllidae, Lykophyllidae, Ptychophyllidae, Palaeocyclidae, Holmophyllidae, and Goniophyllidae had all appeared. Not all of these families have as yet been recognized in all the known regions of marine Lower Silurian, and as knowledge increases it may become possible to establish points of origin for families. The European fauna is the best known, containing a great number of species and genera common to Great Britain, Gotland, and Estonia.

An association of Arachnophyllum with Palaeocycillus, Goniophyllum, Dinophyllum, and Schlotheimophyllum characterizes the top of the Llandovery in all three countries; and, as elements of the assemblage are found as far west as the southwestern United States and as far east as the Siberian platform, it would appear that migration was possible throughout this vast region. None of these five genera are yet known from eastern Australia. Some Australian
taxa appear to be endemic, or to have Siberian affinities; others are relicts of the Ordovician fauna.

After the beginning of the Middle Silurian (Wenlockian), evolutionary vigor decreased into the Early Devonian, with gradual extinction of the characteristically Silurian families and genera. Some Llandoverian taxa died out before or early in the Wenlockian. Nondisseminated streptelasmatids declined. Some new genera and families entered, such as the Acervulariidae, Expressophyllidae, Spongophyllidae, Actinocyctinae, and rare Laccophyllidae; the cystiphyllids proliferated, as did in some areas holmophyllids and tryplasmatids. Some Wenlockian genera were apparently restricted in both geographical and chronological range. IVANOVSKIY (1965b, p. 85) thought that Scandinavian-Baltic and North American biogeographical regions became discernible with the retreat of the Early Silurian transgression; he cited the basins of the Urals and the Siberian Platform as being intermediate between the two, while the basins south of the Siberian Platform together with eastern Kazakhstan and southern China were apparently semi-isolated separate provinces, as possibly were Britain and Czechoslovakia within the Scandinavian-Baltic province.

In Upper Silurian (Ludlovian and Pridolian) strata some few new families are found. Included are the eastern North American transients Amsdenioididae and Anisophyllidae; the Polycelooidae, represented by Amandaraita in Tadzhikistan, which did not reach its acme until the late Paleozoic; the subfamily Ptenophyllinae that became so characteristic of the Lower and Middle Devonian; and a possible early representative of the eastern North American family Eridophyllidae. Only doubtful records of Silurian disphyllids exist, however. Regression of the seas from Asia probably began early in the Ludlovian, reaching a maximum in the earliest Devonian (NIKIFOROVA & OBUT, 1965, unnumbered color plate) (Fig. 29), each with some degree of endemism (SPASSKIY, 1974, p. 131). But, as Devonian transgression proceeded, and the basins merged, characteristically Devonian families developed in a great and sustained burst of vigor, so that by Couvinian times the diversity and profusion of rugosan faunas reached its maximum in the history of the subclass. Notable were the Ptenophyllidae, Disphyllidae, Phillipastreidae, Stringophyllidae, and Digonophyllidae (SPASSKIY, 1967, p. 51; 1968, p. 3; DUBATOLOV & SPASSKIY, 1970, p. 15; SPASSKIY et al., 1975, p. 68). KRAVTSOV (1970, p. 36) has suggested Lower Devonian Asiatic migration routes to and from the Taymyr. Suggestions of barriers to migration decreased during the Middle Devonian, at the same time that the rates of diversification and profusion passed their acmes and decreased, and by the Givetian the evidence suggests only subprovinciality (Fig. 30). In North America also, barriers around the eastern North American region were breeched in
FIG. 29. Paleozoogeographic provinces; Tiverian geography of Eurasia (Hill, 1967). Legend: Open stars, volcanoes of Pacific Ocean type; closed stars, volcanoes of Mediterranean Sea type; dotted pattern, unknown or not analysed areas; white area, sea; contouring of land indicated by closeness of lining; mouths of rivers are shown. Letter symbols: A, Paleo-Baltic Sea; B, South European Sea; D, Ural Sea with volcanoes; E, Tien Shan Sea; F, Tadzhik Sea; G, Balkhash-Karaganda Sea; H, Altai Sea; I, Sayan Gulf; J, Tuva-Mongolian remnant basin; K, Novozemel Sea; L, Tungus Sea; M, Amur remnant basin; N, Verkhoian Sea.

The Givetian, and by Frasnian time a greatly impoverished fauna may be considered almost universal.

On SPASSKY’S maps coral localities were plotted on the continents shown in their present relative positions, though DUBATOVLOV (1972c, p. 88, 109), in discussion of tabulatan distribution, showed a Devonian equator running from southeast Australia through Indo-China, Taymyr, southeast Greenland, and off the eastern North American coast to Guatemala. IVANOVSKII (1974a, p. 21) plotted Paleozoic coral localities onto a map with the continents arranged in pre-drift positions as assumed reasonable in 1969 for Lower Triassic time. OLIVER (1976b, fig. 5) (Fig. 31) plotted Middle Devonian coral localities onto a map with the continents translocated to accord with current (1975) assumptions on paleomagnetic latitude and with OLIVER’s views on paleolongitude. His equator runs from California through southern Greenland, Denmark, and New Guinea. The barrier separating eastern North America, Spain, and northwest Africa he showed (1976a, p. 28) as largely of Old Red Sandstone facies. Also, dispersal between eastern Australia and western North America does not seem to be improved on this model.

By Frasnian time the Ptenophyllidae and Digonophyllidae and probably also the Stringophyllidae had become extinct, and by Famennian time the rich Devonian rugosan fauna had dwindled away to mere remnants, even in the biohermal facies of...
Fig. 30. Paleozoogeographic provinces; Middle Devonian (Givetian) (after Dubatolov & Spasskiy, 1970). Province letter symbols: A, Appalachian; AM, Amazonian; CC, Californian-Canadian; M, Mediterranean; MO, Mongolian-Okhotsk; SA, Sino-Australian; UNA, Ural-Northern Asiatic.
Fig. 31. Paleozoogeographic provinces; Middle Devonian world (generalized, China omitted) (after Oliver, 1976b). Known coral assemblages are shown as follows: Eastern Americas Realm, circles; Old World Realm, squares. Land areas lined. Arrows indicate probable seaway connections and directions of coral migrations.
Coelenterata—Anthozoa

Fig. 32. Paleozoogeographic provinces; Early Carboniferous coral faunal regions and provinces (after Hill, 1973).
The Carboniferous rugosan fauna is characterized by new suborders of disseminated forms: Caniniina, Aulophyllina, Lithostrotionina, and Lonsdaleiina, and by the continuation of long-ranging families of the small, nondisseminated forms, which now became dominated by the Hapsiphyllidae and Zaphrentoididae. After the rugosan poverty of the Famennian, some slight enrichment occurred in the Tournaisian, but it was not until the Visean transgressions that the characteristically Carboniferous fauna really diversified and proliferated. Many genera are wide-ranging and some are cosmopolitan.

Three distinctive zoogeographical regions are apparent for the Dinantian and Namurian, those of North America, Eurasia, and Eastern Australia (Hill, 1957b, p. 155; 1973, p. 133) (Fig. 32). The North American region has recently been assessed by Sando, Bamber, and Armstrong (1975, p. 661) (Fig. 33) on degrees of endemism and generic similarities as being divisible into five provinces and five subprovinces. Those provinces on the periphery of the continents had favorable connections for migration to the Eurasian region, but those in the interior were relatively isolated and were characterized by low to high endemism; however, dispersal was possible between the subprovinces and was aided in areas of carbonate facies and impeded in areas of terrigenous facies of sedimentation. An exception was that the Visean Nova Scotian province had relatively free migration to the Eurasian region and is, indeed, to be classed as part of that region. Similarly, the great Eurasian region shows considerable provincialism within itself, although barriers to dispersal within it were by no means absolute. Patterns of degrees of endemism and generic

Western Australia; practically all the Famennian Rugosa are small, solitary corals mostly lacking disseptions, like the small Polish fauna made known by Rozkowska (1969, p. 32).
Fig. 34. Paleozoogeographic provinces; paleobiogeographic subdivision based on coelenterate faunas in the Moscovian of the USSR (after Vasilyuk, Kachanov, & Pyzhyanov, 1970). Legend: 1, land; 2, sea; 3, paralic; 4, province boundaries; 5, probable direction of migration. Provinces: I, East European; II, Mediterranean. Subprovinces: IA, Ural; IB, Moscow; IIA, Central Mediterranean (regions a, Donbas, and b, Pamir); IIB, Chinese.
Fig. 35. Paleozoogeographic provinces; paleobiogeographic subdivision based on coelenterate faunas in the Early Permian of the USSR (after Vasilyuk, Kachanov, & Pyzhyanov, 1970). Legend as for Fig. 34. Provinces: I, Uralo-Arctic, with regions a, European-Arctic, b, western slopes of Urals, and c, Moscow basin; II, Mediterranean, with II A, Central Mediterranean subprovince (including regions d, Donbas, e, trans-Caucasia, and f, Pamir), and II B, Eastern Mediterranean subprovince.
similarity are like those of North America; some genera dispersed throughout the region, others were limited to one or more provinces or even subprovinces (Vasilyuk, Kachanov, & Pyzhyanov, 1970, p. 45; Hill, 1973, p. 136). Vasilyuk (1974, p. 10) considered that a great faunal change occurred between Namurian A and Namurian B, i.e., approximately at the end of the Mississippian. The eastern Asiatic or Kueichophyllum province has an outlier in the Kimberly district of northwestern Australia. The eastern Australian region is characterized by the endemic family Aphrophyllidae, but is also rich in the cosmopolitan genus Lithostrotion.

In the Middle and Upper Carboniferous (Bashkirian to Olenburgian; = Pennsylvanian), there was a decrease in the area of epicontinental seas and a gradual decline toward extinction of the Aulophyllidae, Lithostrotionidae, and Axophyllidae, although some new genera developed locally; the entrance of the Pseudopavonidae, Geyerophyllidae, Durhaminidae, and Waagenophyllidae greatly changed the faunal constitution; of these Pseudopavonidae are known in Japan (and possibly in Sinkiang) but the others are common to America and Eurasia. Neither Middle nor Upper Carboniferous Rugosa have been identified from Australia. Eurasian and American zoogeographical provinces are recognizable (Hill, 1957b, p. P55; Vasilyuk, Kachanov, & Pyzhyanov, 1970, p. 53) (Fig. 34). The Eurasian region is considered divisible into two provinces, a Uralo-Arctic province and a Mediterranean (Tethyan) province; the former, the Durhaminid province, comprising Spitsbergen, the Moscow basin, the Urals, and Novaya Zemlya, and the latter including Spain, Carnic Alps, Czechoslovakia, Donetz Basin, Tien Shan, Pamirs, China, and Japan. The distribution of several families in these paleozoogeographical regions and provinces from the Middle Carboniferous to the Late Permian has been discussed in a series of papers by Minato and Kato (1965a, b; 1970; 1975a, b), Kato and Minato (1975), and Rowett (1975b). Minato (1975, p. 111, 116) considered that coral reefs have not been proved to have existed in Japan, though Ota (1968, p. 1) interpreted the Akiyoshi Limestone Group as a geosynclinal atoll or organic reef complex developed upon submarine volcanics.

PERMIAN

Permian faunas were dominated by the Waagenophyllidae among the dissepimented Rugosa, and by the Plerophyllidae, Polycoeliidae, and Lophophyllidae among the nondissepimented solitary small forms, though stragglers from and some new genera of characteristically Carboniferous families may still be found.

Two major zoogeographical regions appear to be distinguishable, the American...
and the Eurasian, in the latter of which Australia and New Zealand may be included. In the Eurasian region two provinces are fairly clearly defined in the Early Permian (Fig. 35): 1) a Uralo-Arctic province with Durhaminidae dominant, including the European Arctic, the west slope of the Urals, and the Moscow basin, and 2) a Tethyan province with Waagenophyllidae dominant, extending from Tunisia, Sicily, and the Carnic Alps eastward across southern Asia and possibly continuing around the Pacific into Japan and western North America (Fig. 36) (MINATO & KATO, 1970, fig. 6; VASILYUK, KACHANOV, & PYZHYANOV, 1970, p. 57; HILL, 1957b, p. 56). In Japan and western America, elements of both durhaminid and waagenophyllid faunas are found. In North America, a transcontinental arch may have separated a western from a midcontinent subprovince (ROWETT, 1975a, p. 205; 1975b, p. 79). In discussing Permian distribution patterns of both dissepimented and nondissepimented Rugosa, ROWETT (1975b, fig. 1 on p. 82) (Fig. 36) considered that translocation of continents would eliminate some anomalies in distribution.

Rugosa appear to have become extinct nearly everywhere at the end of the Yabeina zonal time; a few plerophyllids lingered on into strata in Soviet Armenia regarded as Lower Triassic by some (ILINA, 1965, p. 8) but by WATERHOUSE (1976, p. 157) as Late Permian; similar strata with corals in neighboring Iran were adjudged Late Permian by TEICHERT, KUMMEL, and SWEET (1973). TEICHERT & KUMMEL (1976, p. 43) concluded also that some fragmentary solitary Rugosa in the Kap Stosch area in East Greenland were Late Permian fossils redeposited in Early Triassic beds with Glyptophiceras (Hypophiceras).
TECHNIQUES OF STUDY

Techniques used in the preparation of Rugosa or Tabulata for study are those aimed at the interpretation of internal structure, microstructure, and ultrastructure, and those used in clearing matrix from the exterior so that calical and epithecal characters become visible. The preparation of thin transparent sections for use with a microscope or hand lens is by far the most commonly used.

Internal structure can be mentally reconstructed in three-dimensional architecture by coordinating observations made from sections cut in controlled directions through the corallum. The routine sections are a pair for each corallum, one transverse to and the other one parallel with the direction of growth. Thin sections for use with the microscope are essential for good quality work. The best thickness is greater than that for petrological thin sections, because, as one approaches rock-slice thinness, recrystallization fabrics begin to mask traces of the original microstructure of the skeletal plates. Additional thin sections are made for special purposes; for cylindrical or branching coralla, a tangential section just below the surface is always taken, because the walls may be modified there by thickening. For study of the microstructure of the tabulatan wall and septal elements and the characters of mural pores, a longitudinal section parallel with and within the wall, or very oblique to the wall, and another radially through the septal elements are necessary.

For the study of 1) the pattern in which offsets are inserted, 2) the nature of the increase, and 3) the ontogeny of the protocorallite and offsets, serial sectioning at controlled intervals is necessary, the intervals being smallest when septal insertion is being studied. Thin sectioning and thin serial sectioning procedures have been described in KUMMEL and RauP's Handbook of Paleontological Techniques (1965). A recent refinement is the use of the Capco saw, applications of which were described by Joysey and Breimer (1963, p. 473).

For the photography of thin sections, transmitted light is used; negatives prepared X2 are recommended, for enlargement to X4, or, for microstructural illustrations, up to X10.

An inferior but quick method of preparation for study is to make cellulose acetate peels, also described in the Handbook; a cut and polished surface is prepared like the surface of a thin section before mounting; it is then weakly etched, and cellulose acetate is applied, dried, and a film drawn off. Much microstructural detail is lost by this method and photographs prepared from peels cannot be recommended. Controlled serial grinding rather than thin sectioning is commonly used for ontogenetic studies, and camera lucida or lantern-projected drawings are made from the successive acetate peels. This use of peels is acceptable because of the reduction in loss of coral material, inevitable in sectioning; but there is some loss in accuracy due to the subjectiveness of the drawings.

A new field of study is presently being developed by application of the scanning electron microscope; preparational technique was outlined by Sorauf (1972a, p. 89) for Scleractinia, but the assistance of highly skilled technicians is required for effective use. This study is aimed at elucidating the original ultrastructure of the skeleton, and is rendered difficult by all the postmortem changes whose effects must necessarily be identified.

In the cleaning of marly or clayey sheaths from coralla released by natural weathering from sedimentary rocks, industrial vibrotools, adaptations of dental probes, and steel needles may be used. Matrix softer or more cleaved than coral is flaked away by mechanical force; action at the point of the instrument is observed by means of a binocular microscope of low power. Sandblasting from industrial mini-airabrasive units may be used when the matrix is softer than the fossil; experiment is necessary to find the most suitable size and kind of abrasive grain for the specimens from each formation and locality.

Chemical cleaning may be found useful. Alternate wetting and drying, with water or kerosene, sometimes works. Oxalic acid, or sometimes potassium hydroxide, may be found effective. If the coral has been re-
placed by silica, calcareous matrix may be dissolved away in HCl or other acids of appropriate dilution. As well as the sectioning and grinding techniques, cleaning techniques have been described in KUMMEL and RAUP’s *Handbook*.

As a technique in classification, KRAVTSOV and SPASSKIY (1967, p. 89) have outlined a method for the codification of the principal characters of Rugosa on punched cards, and constructed by this means a key to a classification of orders, suborders, and families of Devonian Rugosa. SPASSKIY (1971a) expanded the key to give formulae for genera, and noted that it could be extended to species and subspecies.

**CLASSIFICATION**

**HISTORY OF CLASSIFICATION**

From the early eighteenth century, when LEOPOLD in 1720 and BROMELL in 1728 illustrated species from Gotland (REGNELL, 1949, p. 15), the similarity of those fossil corals later called Rugosa to those later termed Scleractinia was recognized. The two orders suffered together during the gropings after a natural system of classification in the eighteenth and early nineteenth centuries. Corals had long been regarded as members of the vegetable kingdom because of their sessile habit and their flower-like polyps. In 1749, LINNE’S *Corallia Baltica* appeared, the first work devoted entirely to fossil corals. By that time, observations already published had indicated that these organisms belonged, with their relatives, to the animal kingdom. LINNE in the tenth edition (1758) of his *Systema naturae* exemplified the prevailing perplexity: although he grouped the stony corals in his genus *Madrepora* in the animal kingdom, and removed its constituents from the Zoophyta (this name reflecting the then commonly held view of the dual nature of these betentacled, sessile, radiated, and flowerlike organisms), he yet employed instead the name Lithophyta (JOHNSTON, 1847, p. 407 et seq.).

Eighteenth century and earlier workers noted their tentacles, whence is derived the term polyp, and called these organisms Polypi (from their analogy with cuttlefish) or Radiata (from their seeming radial symmetry). Early in the nineteenth century, their characteristic gastrovascular cavity (coelenteron) was seen to distinguish them from such other radiate animals as echinoderms, and hence the name Coelenterata was introduced, as well as the name Cnidaria from their capacity to sting (HILL & WELLS, 1956, p. F5).

By the time MILNE-EDWARDS and HAIMÉ introduced their classification in 1850 and MILNE-EDWARDS (1857) improved it, Protozoa, Porifera, and Polyzoa had been recognized as distinct. Coelenterate classification then remained reasonably stable for many decades. Indeed, the classification adopted in this *Treatise* was and is in most essentials an updated version of the MILNE-EDWARDS and HAIMÉ classification. There has been considerable discussion on the possible relationships between the Rugosa and the recent orders of Zoantharia and on the appropriateness of ranking the Rugosa as an order of the subclass Zoantharia of the Class Anthozoa as is the prevailing practice. Suggestions (e.g., CHAPMAN, 1893, p. 93) that the Rugosa (with the Tabulata) are closer to Hydrozoa than to Anthozoa, or that they might be classified with the Scyphomedusae because of their alleged tetra-radial symmetry (VAN BENEDEN, 1898, p. 179) have received little support.

The Anthozoa are exclusively polypoid, mostly sedentary coelenterates with one or more rings of tentacles around an oral disc. A stomodaeum leads from the mouth into the coelenteron, which is radially partitioned by mesenteries, some of which have endodermal gonads. They are exclusively marine. They are divided into three subclasses, Ceriantipatharia, Octocorallia (or Alcyonaria), and Zoantharia, on the nature of their mesenteries and tentacles; the first two have unpaired mesenteries whereas the Zoantharia have paired mesenteries (WELLS & HILL, 1956, p. F164).

The Zoantharia include solitary and colonial polyps, with calcareous trabecular skeletons in some orders. The polyps have simple or divided tentacles, never pinnate or cyclically arranged, and are essentially dis-
tinguished by paired mesenteries. Basically, there are eight complete mesenteries and almost invariably two additional lateral couples making a total of six pairs (Fig. 38,e); generally, additional cyclically arranged pairs are present. New mesenterial pairs are inserted according to several different plans (Fig. 38,f-h). The subclass includes four orders separated largely on the presence or absence of a skeleton and by the arrangement and development of the mesenteries. These orders are Zoanthiniaria, Corallimorpharia, Scleractinia, and Actiniaria; the first edition of this Treatise also included as orders the extinct Rugosa, Heterophyllia, and more tentatively, the Tabulata. Montanaro-Gallitelli (1975, p. 21) has recently named a new order of Triassic Zoantharia, the Hexanthiniaria.

**PRESENT CLASSIFICATION**

The Zoanthiniaria (zoanthids) are weakly colonial, anemonelike forms lacking a skeleton. The mesenteries are in a single cycle with two directive pairs, of which only the ventral one is complete, and new pairs of mesenteries beyond the first six are inserted only in the ventrolateral exocoeles on either side of the ventral directive pair (Fig. 38,f). They are unknown as fossils but are believed by some to be representative of the most primitive zoantharians.

The orders Corallimorpharia, Scleractinia, and Actiniaria are together sometimes called the Hexactiniaria; they include the living sea anemones and corals, all lacking a skeleton except the Scleractinia, which are distinguished from the corallimorphs largely by this criterion. The mesenterial plan is practically identical in all and differs from that of the Zoanthiniaria and perhaps of the extinct Rugosa in that the mesenterial pairs beyond the first cycle of six are inserted in dorsoventral order in all six primary exocoeles (hexactinarian) rather than in two or four (Fig. 38,h); in some groups septa may also develop in the endocoeles of the lateral pairs. The Scleractinia alone have a fossil record, from the Middle Triassic to recent.

The Rugosa are extinct, known only from the Paleozoic, and their relationships to recent Zoantharia are still speculative. Their mesenterial arrangement and development can only be inferred from the mode of septal insertion, and this is capable of several interpretations. Many investigators are inclined to see closest affinities of the Rugosa in the Zoanthiniaria, from which they would differ only by having a calcareous exoskeleton and by insertion of new septa (and mesenterial pairs) not only in exocoeles on either side of the cardinal septum (ventral mesenterial pair), as in the zoanthiniarians, but also in spaces between the alar and counterlateral septa (between lateral mesenterial pairs), that is, in four instead of two primary exocoeles (Fig. 38,g). Relationships to the endocoelactarian actiniarian anemones (Carlgen, 1918) and to the scleractinian corals has also been claimed (Schindewolf, 1942, p. 267).

Schindewolf considered that there was evidence, both from stratigraphical sequence and skeletal morphology, that the Scleractinia, which have septa inserted in cycles of six but in dorsoventral sequence both in cycles and in primary interseptal loculi, evolved from the Rugosa, which have septa inserted in countercardinal sequence in only four of six primary interseptal loculi. However, when subsequently reexamined, his evidence has not produced strong support. Weyer (1974b, p. 358) reaffirmed that only four of the rugosan septa are primary, but he based his affirmation in part on the grounds that each metaseptum 'splits' twice, first on its counter side to produce a minor septum, and second on its cardinal side to produce a new major septum (metaseptum). He thus considered the major septa next to the counter septum, one on each side, to be metasepta, and not primary septa like C, K, and the two alar septa, none of which, in his view, 'split off' a minor septum.

In direct contrast to the view that Scleractinia evolved from Rugosa, Birenheide (1965a, p. 33) proposed a new Class Eoanthozoa composed of two orders, Rugosa Milne-Edwards and Haine, 1850, and Heterocorallia Schindewolf, 1941, on the basis of his views: 1) that new septa are formed in these by 'splitting' from previously formed septa; 2) that in Scleractinia the only septa that 'split' are exosepta formed.
Fig. 38. Anthozoan classification; suggested relations and mesenterial arrangements of principal anthozoan groups (Wells & Hill, 1956).
in exocoeles; and 3) that (although no substitution such as occurs in dendrophyllid Scleractinia is known in Rugosa), the septa of Rugosa are exosepta and 
\textit{ipso facto} were not separated by mesenteries (i.e., that mesenteries were not present in the Rugosa, which thus could not have been Anthozoa). IVANOVSKIY (1966, p. 455) named an anthozoan subclass Sclerocorallia to comprise orders Rugosa, Heterocorallia, Scleractinia, Actiniaria, and Corallimorpharia. Neither the class Eoanthozoa nor the subclass Sclerocorallia are adopted in this revision of the Treatise.

Clearly, the position of the Rugosa is still far from settled. It does not seem likely to me that the Rugosa gave rise to the Scleractinia. They are herein considered to be Anthozoa, since it seems so highly probable that their septate calices indicate that they had mesenteries to retract their polyps. The assumption made by WELLS and HILL (1956, p. F163) that they had paired mesenteries like those of recent Zoantharia still seems quite reasonable; nevertheless, this revision does not continue the assumption. An agnostic position is taken by which the Rugosa are classified as a subclass of Anthozoa, as are the Tabulata and Heterocorallia.

**SUBDIVISION OF THE RUGOSA**

Several reviews with commentaries are available on the many successive classifications that have been attempted within the Rugosa as new generic taxa have been introduced at an ever-increasing rate; perhaps the most comprehensive are those of POCTA (1902), WANG (1950), SOSHKINA, DOBROLYUBOVA, and KABAKOVICH (1962), and IVANOVSKIY (1965a, 1973a,b).

MILNE-EDWARDS and HAIMÉ (1850, 1851), founders of the Rugosa, relied mainly on the longitudinal continuity or discontinuity of the septa and the presence or absence of dissepiments or tabulae to group the genera then known into four families: Stauridae,\(^1\) Cyathaxoniidae, Cyathophyllidae (with subfamilies Zaphrentinae, Cyathophyllinae, and Axophyllinae), and Cystiphylidae.

DE FROMENTEL (1861) grouped these and several new families according to the external form of the corallum, whether solitary (Monastrées), compound with calices of corallites separated (Disastrées), or massive (Polyastrées). Within the families, genera were distinguished mainly by septal characters, presence or absence of a fossula or columella, and the nature of the wall and tabulae. Later examples of the use of growth form as an initial discriminant are those of SPASSKIY (1965a) and COTTON (1973). SPASSKIY divided the "Sub-class Tetracorallia" into two superorders, Asso- ciata (compound coralla) and Solitaria (solitary coralla) on the basis of asexual reproduction (which he regarded as primitive) in the former, and sexual reproduction in the latter. These superorders he divided into orders mainly on the form of 'budding' and the type of septa (e.g., laminar, acanthine, wedge shaped). He distinguished suborders by the types of horizontal skeletal elements (complete or incomplete tabulae, presence or absence of dissepiments), and families by the characters of construction of their offsets and of their horizontal skeletal elements. COTTON's version was professedly an identification key, not a classification, and he named no suprageneric taxa.

DYBOWSKI (1873-74), on the other hand, used the horizontal skeletal elements as the prime differentiator. He recognized two groups, the first being the Inexpleta, in which neither tabulae nor dissepiments were developed, and in which he included Cyathaxonidiidae and Palaeocyclidae. The second, the Expleta, possessed horizontal skeletal elements and comprised the Diaphragmatica, with tabulae, and the Adiaphragmatica (or Cystiphora), without complete tabulae but with cystose horizontal skeletal elements. The Diaphragmatica comprised the Diaphragmatophora, with complete tabulae and without dissepiments, and the Pleonophora, those with incomplete tabulae but with dissepiments present. The Cystiphora had two subdivisions, Anoperculata (Cystiphyllidae and Plasmophyllidae) and Operculata (Goniophyllidae). The families within these divisions and subdivisions were distinguished mainly by the characters of their septa, external walls, and axial structures if present. DYBOWSKI's scheme was expanded by POČTA (1902),

\(^1\) In this section original spellings of taxa are amended in accordance with the current rules of the International Commission on Zoological Nomenclature.
who introduced an intermediate group, Semiplena, for solitary forms (Lindstroemiidae, Polycoeliidae) in which tabulae were weakly developed, occupying scarcely more than the proximal quarter of the corallite. Dybowski's and Pocta's suprafamilial taxa have been little used, but their work certainly led to greater taxonomic value being given to horizontal skeletal elements than formerly.

Wang (1950) attempted a revision of the classification on the basis of such microstructural features of the septa as trabeculae; however, this is a particularly difficult character to use because of insufficient understanding of the effect of diagenesis on the microstructure. Kato (1963) and Oekendorp (1972; 1974a) subsequently described many diagenetic effects.

Experience seems to show that a simplistic approach to overall classification within the Rugosa is inappropriate and leads to too many apparently absurd unions and separations. Most classifications now attempt to apply evolutionary theory and to express the most likely phylogenetic relationships as well as degrees of morphological similarity and dissimilarity. Some regard a feature that is stable over a considerable time as of family or suprafamily taxonomic value, and use the more variable characters for subdividing such a grouping. Others may regard a particular feature or aspect of a feature as primitive, perhaps because it is noted in the oldest known forms. Environmental changes and natural selection operate to produce species with features fitted to particular environments; ontogeny may be considered a reasonable guide to phylogeny, particularly when changes are followed through successive stages.

As knowledge expands, the process of classification becomes difficult. To be entirely objective in the evaluation of lineages is almost impossible. A weakly based hypothesis may be treated as acceptable theory and we tend to argue in a circle. A classification stands or falls on its subsequent usefulness, and, indeed, on its capacity to be improved by more or less minor amendments.

In this revision of the Treatise, as in the first edition, an attempt has been made to present a classification that expresses degrees of relationship as well as degrees of morphological similarity. Published evidence of variation within species and genera and families both in space and in time has been evaluated; however, the reasoning leading to the choices made is omitted because of its volume. A practical classification that accords with the actual evidence and reflects understanding of the need for stability has been the aim throughout.

**SUBDIVISION ADOPTED IN THE TREATISE**

The subclass Rugosa is divisible into two orders, both of which first appear in the Middle Ordovician, the Cystiphyllida and the Stauriida.

The Cystiphyllida are a relatively small order that became extinct in the late Middle or Late Devonian. Members are distinguished by the possession of septa formed each of a single longitudinal series of coarse monacanths or rhabdacanths that are commonly thickened to contiguity within each septum and between neighboring septa so as to form a more or less narrow peripheral stereozone, adaxial to which their distal ends are free. Diagenesis may convert the thick trabeculae into holacanths and the sclerenchyme of the peripheral stereozone into a secondarily lamellate structure. The Palaeocyclidae lack tabulae and dissepiments, and the Tryplasmatidae have complete and horizontal tabulae but lack a dissepimentarium; but the other families have dissepimentaria in which the trabeculae may be discontinuous between successive dissepimentarial floors, and they have tabular floors that are commonly inversely conical and replaced by tabellae.

The Stauriida, on the other hand, are divided herein into 16 suborders, four of which, the Stauriina, Streptelasmatina, Calostylina, and Metrophyllina, entered during the Middle Ordovician. Stauriida, except for the Calostylina, have laminar septa in each of which the constituent trabeculae are contiguous. They have marginaria that in some orders are peripheral stereozones, and in others are either normal dissepimentaria in which the septa are longitudinally continuous plates, or londsaleoid dissepimentaria in which the septa are longitudinally discontinuous, being developed in whole or
in part as crests upon the surfaces of the dissepiments. Except for a few genera without tabulae but with thickened walls, they have complete or incomplete tabulae that are fundamentally conical or domed, commonly with upturned margins, or horizontal to mesas shaped, and may develop axial depressions or become inversely conical axially.

In the first edition of this Treatise, the Rugosa were divided into three suborders, the Streptelmatina, the Columnariina, and the Cystiphyllina. In merging the first two into the Stauriida in this revision, I have taken account of the lack of a clear separation between families with lonsdaleoid dissepimentaria (i.e., former Columnariina) and families with normal dissepimentaria (i.e., former Streptelmatina), and have preferred a somewhat more agnostic arrangement with the sum of the old Columnariina and Streptelmatina divided into 16 suborders on combinations of septal characters (including longitudinal continuity or discontinuity), marginarial characters, and tabularial characters.

Of the four suborders that are known from the Middle Ordovician, the Calostylina resemble the Cystiphyllida in having coarse uniserial septal trabeculae, but those of each septum are here discontiguous more or less regularly periodically and further may be connected to those of neighboring septa by rough synapticulae. The marginaria of Calostylina may have rather irregular filmy dissepiments and the tabulae similarly may be filmy and without the rigid curvature characteristic of the tabulae and tabellae of the other Stauriida; an axial complex may be present. The Calostylina became extinct at or near the boundary between Silurian and Devonian.

The Stauriina are commonly compound, cerioid, or fasciculate; they mostly lack dissepimentaria but may have elongate and sporadic dissepiments in single series. Their tabulae are complete and subhorizontal or mesas shaped or with axial depression, and the axial edges of their laminar septa are not lobed but may become amplexoid, i.e., developed only as crests on upper surfaces of tabulae.

The Streptelmatina are dominantly solitary and are characterized by a more or less wide peripheral stereozone; in most families dissepiments are absent; the septa are laminar, commonly with coarse contiguous trabeculae, and their axial edges are lobed and may or may not form an axial structure; their tabular floors are domed and tabulae are commonly complete. As did the Stauriina, they became extinct in the Middle Devonian.

The Metriophyllina are the first of the suborders of small, solitary, nondissepimented Rugosa. They have a narrow peripheral stereozone and all but a few lack dissepiments; their septa are laminar, commonly with fine trabeculae, and are longitudinally continuous; minor septa may be long and contratingent; a columella may be present in some, an aulos in others; and tabulae are abaxially declined and commonly complete. The Metriophyllina reached their acme in the Devonian and became extinct during the Permian.

Five suborders entered early in the Silurian; they are the Arachnophyllina, Ketonophyllina, Lycophyllina, Ptenophyllina, and Columnariina. The first three reached maximum diversification in and are characteristic of the Silurian; the last two reached maximum diversification in and are characteristic of the Devonian; all became extinct by the end of the Devonian.

The Arachnophyllina are dominantly colonial, with wide dissepimentaria in which interseptal dissepiments are small and subglobose; tabular floors are domes with upturned edges and axial depressions, and the tabulae are incomplete; in one family complex septal structure is developed. They became extinct early in the Devonian.

The Ketonophyllina include solitary and compound forms, and corallites are large; septa are commonly thickened and disrupted by lonsdaleoid dissepiments but they thin adaxially; tabular floors are flat or mesas shaped or low domes with axial depressions, and tabulae are incomplete; in one family complex septal structure is developed. They became extinct during the Upper Devonian.

The Lycophyllina are mostly solitary, a few are fasciculate; septal thickening is common and is retained longest in cardinal quadrants of the tabularium; a dissepimentarium is commonly wide with normal concentric and angulo-concentric dissepiments, and tabular floors are variable.
The Ptenophyllina are dominantly colonial with a wide dissepimentarium that is commonly normal but may be lonsdaleoid at least in part; tabular floors are concave with a median notch or groove. The suborder died out in the Late Devonian.

The Columnariina are commonly compound; septal trabeculae may be rhipidacanthine; the dissepimentarium of small subglobose dissepiments may include a pipe of horseshoe dissepiments in some, surrounded by a pipe of flat dissepiments; the tabular floor is flat or slightly arched with a broad inversely conical depression.

It is somewhat doubtful whether the Cyathophyllina developed before the Devonian, in which it was one of the characteristic suborders; the Silurian Ptychophyllidae are tentatively included in it herein. They are characterized by solitary or colonial forms with large corallites, numerous long septa that may be complexly structured in some, wide normal dissepimentaria, and domed tabular floors that may be depressed axially.

The Stereolasmatina and the Plerophyllina are two suborders of small, solitary Rugosa without dissepiments. The Stereolasmatina have long septa with smooth axial edges that may be rhopaloid (expanded axially) in some, or may form a solid axial structure that does not project as a calical boss; septa may have subhorizontal flanges in some; minor septa are short, except $Km$ in some; and tabulae are declined abaxially; the cardinal septum is commonly shortened and $K$ may be long. In the Plerophyllina, one or more of the six first major septa are longer than the others and the metasepta (which may be of unequal length), and are commonly more rhopaloid; cardinal or counter septa or both may be shortened, minor septa, including $Km$, seldom extend inward from the peripheral sterezone; an axial structure, commonly formed from the axial end of $K$, may extend as a boss from the calical floor. The oldest Stereolasmatina appear to be early Middle Devonian, but the oldest genus assigned to the Plerophyllina is from the Kunzhak horizon of Tadzhikistan, which is variously regarded as Late Silurian or Early Devonian. Both ranged into the Late Permian.

Of the characteristically Carboniferous and Permian suborders of disseminated Rugosa, the Caniniina are dominantly large and solitary, with wide dissepimentaria commonly with lonsdaleoid dissepiments dominant at least in late stages; septa are thick in early stages, thinning from the axis and toward the cardinal fossula, and are amplexoid in the tabularium; tabular floors are mainly flat with downturned edges, and tabulae complete.

The Aulophyllina also are predominantly large and solitary, with wide dissepimentaria that are commonly normal or angulate; an axial structure is commonly present—a platelike columella, or a complex of septa or septal lamellae and tabellae that may include a median plate, or a sharply bounded axial column; tabular floors are declined abaxially.

The Lithostrotionina and Lonsdaleiina are the two dominantly colonial orders of Carboniferous and Permian disseminated Rugosa. Each is characterized by axial structures; the former has commonly a simple platelike columella, but the latter has a complex axial structure commonly with a median lamella and septal lamellae. The dissepimentarium of the Lithostrotionina is commonly normal, that of the Lonsdaleiina commonly lonsdaleoid; in the Lonsdaleiina clinotabulae may develop in the outer part of the tabularium.

For other recent proposals for subdivision of the Rugosa, see Ivanovskiy (1971b, p. 9; 1975a, p. 36), and, for the Devonian, Spasskiy (1971b, p. 56; 1977, p. 23).
OUTLINE OF CLASSIFICATION OF THE SUBCLASS RUGOSA

The following outline of the subclass Rugosa summarizes taxonomic relationships, geologic occurrence, and numbers of recognized genera and subgenera in each supra­generic group from order to subfamily. A single number refers to genera; where two numbers are given, the second indicates subgenera additional to nominotypical ones.

Order Cystiphyllida, 47;15. M.Ord.-?U.Dev.
Tryplasmatidae, 11. M.Ord.-?M.Dev.
Tryplasmatinae, 10. M.Ord.-?M.Dev.
Wenlockiinae, 1. M.Sil.
Holmophyllidae, 8. Sil.-M.Dev.
Goniophyllidae, 6. L.Sil.-M.Dev.
Digonophyllidae, 5;5. M.Dev.
Suborder Stauriina, 37.
Stauriidae, 18.
Kiziliidae, 2.
Streptelasmatidae, 50.
Acervulariidae, 3.
Lambelasmatinae, 4.
Coelostylinae, 4.
Dalmanophyllinae, 2.
Dinophyllinae, 5.
Nevadaphyllinae, 1.
Streptelasmatinae, 32.
Breviphyllidae, 2.
L.Carb.
Suborder Streptelasmatina, 83.
Streptelasmatinae, 32. M.Ord.-M.Dev.
Streptelasmatinae, 32. M.Ord.-M.Dev.
Nevadaphyllinae, 1.
L.Dev.
Dinophyllinae, 5.
L.-?M.-U.Sil.-?base Dev.
Dalmanophyllinae, 2.
U.Ord.-M.Sil.
Homalophyllinae, 4.
L.-M.Dev.
Enterolasmatinae, 4.
U.Sil.-L.Dev.
Breviphyllinae, 2.
L.Dev.
Disphyllinae, 35.
M.-U.Dev.
Amsdenoididae, 2.
U.Sil.-L.Dev.
Cyathaxonidae, 5.
Petraiidae, 4.
Metriophyllidae, 5.
Laccophyllidae, 27.
Sil.-Perm.
Laccophyllinae, 12.
Guerichiphyllinae, 1.
M.Ord.
?Friedbergiinae, 1.
U.Dev.
Neaxoninae, 6.
L.Dev.-L.Carb.
Taralasmatinae, 1.
L.Dev.
Amplexocariniinae, 5.
U.Dev.-Perm.
Subfamily uncertain, 1.
Kielcephyllidae, 3.
U.Dev.
?Lindstroemiidae, 1.
Dev.
Hadrphyllidae, 2.
L.-M.Dev.
Combophyllidae, 1.
L.-M.Dev.
Family uncertain, 3.
Suborder doubtful, 2.
M.Dev., M.Penn.
Suborder Arachnophyllina, 29.
L.Sil.-M.Dev.
Entelophyllidae, 15.
Sil.-L.Dev.
Expressophyllidae, 4.
M.-U.Sil., ?L.Dev.
Arachnophyllidae, 10.
L.Sil.-M.Dev.
Suborder Ketophyllina, 25.
U.Ord.-?Carb.
Ketophyllidae, 7.
Sil.-L.Dev.
Kyphophyllidae, 7.
U.Ord.-L.Dev.
Endophyllidae, 11.
L.Sil.-?Carb.
Suborder Ptenophyllina, 43;1.
L.Sil.-U.Dev.
Ptenophyllidae, 5.
Ptenophyllinae, 25.
U.Sil.-U.M.Dev.
Actinocystinae, 4.
Sil.-L.Dev.
Fasciphyllidae, 3.
L.-M.Dev.
?Stringophyllidae, 6;1.
L.-M.Dev.
Suborder Lycophyllina, 24.
Sill.-M.Dev.
Lykophyllidae, 17.
Sil.-L.Dev.
Haliidae, 7.
L.-M.Dev.
Hallinae, 3.
M.Dev.
Papiliphyllinae, 3.
Aspasmophyllinae, 1.
M.Dev.
Suborder Columnariina, 58.
M.Sil.-Dev.
Acrervulariidae, 3.
M.-U.Sil.
Columnariidae, 4.
Dev.
Disphyllidae, 35.
U.Sil.-U.Dev.
Disphyllinae, 17.
Dev.
Paradisphyllinae, 8.
U.Sil.-M.Dev.
Hexagonarinae, 3.
M.-U.Dev.
Spongophyllinae, 7.
Dev.
Phillipasstreidae, 16.
Dev.
Group 1, 3.
L.-M.Dev.
Group 2, 5.
Dev.
Group 3, 6.
Dev.
Group 4, 2.
?L.-U.Dev.
Suborder Cyathophyllina, 35.
Sil.-Dev., L.Carb.
Eridophyllidae, 8.
U.Sil.-M.Dev.
Eridophyllinae, 4.
U.Sil.-M.Dev.
Cylindrophyllinae, 4.
L.-M.Dev.
Zaphrentidae, 5.
L.-M.Dev.
Cyathophyllidae, 16.
Dev.
?Bethanyphyllidae, 2.
M.Dev.
Campophyllidae, 1.
M.Dev. or L.Carb.
Ptychophyllidae, 3.
L.Dev.-L.M.Dev.
Suborder Stereolasmatina, 38.
L.Dev.-U.Perm.
Stereolasmatidae, 5.
M.Dev., L.-M.Carb.
Antiphyllidae, 9.
L.Carb.-L.Perm.
Antiphyllinae, 8.
L.Carb.-L.Perm.
Pseudoclaviphyllinae, 1.
L.Carb.

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Adradosiniae, 1. L.Dev.
Zaphrentoididae, 8. L.Miss.-L.Penn., U.Perm.
Zaphrentoidiniae, 6. L.Miss.-L.Penn., U.Perm.
Cumminsiinae, 2. Miss.-L.Penn.
Prosmiliinae, 1. U.Perm.
Anisophyllidae, 1. U.Sil.
Baryphyllinae, 2. L.Carb.
Endotheciidae, 1. U.Perm.
Adamanophyllidae, 3. L.-U.Carb.
Adamanophyllinae, 2. L.-U.Carb.
Communiae, 1. U.Dev.
Daliniinae, 1. U.Dev. or L.Carb.
Timorphyllidae, 1. U.Perm.
Verbeekellidae, 5. L.Miss.-L.Penn., U.Penn.-Perm.
Cyathopsidae, 13. Carb.-L.Perm.
Bothrophyllidae, 10. Carb.-L.Perm.
Uraliniidae, 7. L.Carb.
Endamplexidae, 2. U.Perm.
Aulophyllidae, 47. L.Carb.-L.Perm.
Aulophyllinae, 6. L.Miss.-U.Penn.

Ranges of taxa

Only records accompanied by illustrations from which I have been able to make myself reasonably sure that the generic identifications are correct have been incorporated in the range data that follow the diagnosis of each genus. Nevertheless, these data are still defective. Preparation of the diagnoses from the literature has made it clear to me that the greatest impediments to precise taxonomy are the incompleteness of descriptions and the imperfection of illustrations of type species, and the lack of analyses of variation in totopotypes. A very great improvement in our knowledge would result from critical redescriptions and new figures by specialist officers of museums housing such types. Without precise taxonomy little of real value can be contributed to current debates on plate tectonics and continental drift. Uncritical use of “faunal lists” is merely stultifying.

The stratigraphic distribution of orders, suborders, superfamilies, families, and subfamilies of Rugosa recognized in the Treatise is indicated graphically in the table that follows (compiled by Jack D. Keim).
Table 1. Stratigraphic Distribution of the Rugosa.

<table>
<thead>
<tr>
<th>SUBORDER and above</th>
<th>SUPERFAMILY</th>
<th>FAMILY</th>
<th>SUBFAMILY</th>
<th>GENUS</th>
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<th>Occurrence inferred</th>
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Table 1. (Continued)

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STAURIIDA
CALOSTYLINA
CALOSTYLLICAE

|                |          |            |          |          |               |               |         |
|Lambelasmatidae |          |            |          |          |               |               |         |
|Lambelasmatinae |          |            |          |          |               |               |         |
| ?Lambeophyllum  |          |            |          |          |               |               |         |
| Lambelasma      |          |            |          |          |               |               |         |
| Dybowskinia     |          |            |          |          |               |               |         |
| ?Sogdianophyllum|          |            |          |          |               |               |         |
| Coelostylinae   |          |            |          |          |               |               |         |
| Coelostylis     |          |            |          |          |               |               |         |
| Coelolasma      |          |            |          |          |               |               |         |
| Estonielasma    |          |            |          |          |               |               |         |
| ?Prototryplasma |          |            |          |          |               |               |         |
| Calostylidae    |          |            |          |          |               |               |         |
| ?Ningnanophyllum|          |            |          |          |               |               |         |
| ?Yohophyllum    |          |            |          |          |               |               |         |
| Calostylis      |          |            |          |          |               |               |         |
| Palaearaea      |          |            |          |          |               |               |         |
| Helminthidium   |          |            |          |          |               |               |         |
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**F76 Coelenterata—Anthozoa**

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SYSTEMATIC DESCRIPTIONS: RUGOSA¹

Phylum COELENTERATA Frey & Leuckart, 1847
[nom. transl. Haekel, 1866, p. li, as phylum, ex class Coelenterata Frey & Leuckart, 1847, p. 137]

Multicellular animals with biradial or radiobilateral symmetry; body wall with cells arranged in two layers (ectoderm and endoderm) connected by a structureless mesogloea containing cells chiefly of ectodermal origin; within the body wall is a single cavity (enteron) having a single opening (mouth) for ingestion and egestion and commonly divided by radial folds and partitions; digestion partly intracellular; nervous system comprised of a network of cells; no respiratory, excretory, or circulatory systems. *Precam.-Holo.*

Subphylum CNIDARIA Hatschek, 1888
[nom. transl. Delage & Hérouard, 1901, p. 2, as sous-embouchement Cnidaires, Cnidarta, (sic), ex phylum Cnidaria Hatschek, 1888, p. 40]

Mainly distinguished by possession of stinging capsules (nematocysts) and well-developed muscular action. Commonly with power of budding, by which either individuals or colonies may be formed; sexual reproduction typically producing an ovoid, uniformly ciliated larva (planula); polymorphism characteristic, chief types being fixed cylindrical polyps and free, cup-shaped medusae; some groups with endo- or exoskeleton of calcitic, aragonitic, horny, or chitinophosphatic nature. *Precam. (Algonk.-)Holo.*

Class ANTHOZA Ehrenberg, 1834
[Anthozoa Ehrenberg, 1834, p. 255 (31), less hydroids]
[=Endoaria Rapp, 1829, p. 21; Actinozoa de Blainville, 1830 (partim); Actinoidea Dana, 1846b, p. 16, 29; Corallaria Milne-Edwards & Haime, 1850, p. ix (partim); Oecidea Hustey, 1852, p. 80; Corallaria Milne-Edwards & Haime, 1857a, p. 2 (partim); Cnidaria Milne-Edwards & Haime, 1857a, p. 95; Cnidaria Osse, 1860, p. 6; Polycyclia, Monocyclus (partim) Bronn, 1860, p. 42; Cnidaria Verkell, 1865, p. 145; Corallia, Corallia Haekel, 1866, p. liii; Coralligena Hustey, 1869, p. 117; Scyphopolypi, Scyphozoa (partim) Goette, 1887, p. 59; Anthozoa De Lacce & Hérouard, 1901, p. 370; Anthozoa Birenheide, 1965a, p. 33; includes subclass Sclerocorallia Ivanovskiy, 1966, p. 455]

Exclusively polypoid, solitary or colonial, mostly sedentary coelenterates. Oral end expanded as oral disc with centrally located mouth surrounded by peristome, around which are one or more rings of hollow tentacles. Stomodaeum strongly developed, leading from mouth into gastrovascular cavity biradially partitioned into compartments by complete or incomplete mesenteries, some of which bear endodermal gonads. Some groups characterized by horny or calcareous spicular endoskeleton or by calcareous exoskeleton. Exclusively marine. *Ord.-Holo.*

Representatives of this class are divided into six subclasses, only three of which have living representatives. Of the three living subclasses, one, the Zoantharia, has paired mesenteries. The other two subclasses have unpaired mesenteries; they may be distinguished by the tentacles, which are simple in the Ceriantipatharia and pinnate in the Octocorallia. Nature of the septa distinguishes two of the three extinct subclasses. The Rugosa have septa of two orders in-
Solitary or compound epithecal corals with septa typically in two orders alternating in length but in some with three or four orders; symmetry bilateral; in solitary corallites, and in many offsets, with meta-septa inserted in four positions only, on the counter side of each alar septum and on each side of the cardinal septum. A marginarium, consisting of a dissepimentarium or a peripheral stereozone formed by thickening of the septa, may be developed around the tabularium in the zone of minor septa. Tabulae may be conical, domed, horizontal, sagging (in some with a median trough), or inversely conical; each tabula may be complete, consisting of one plate, or incomplete, consisting of a number of tabellae. An axial structure may develop. M.Ord.-U.Perm.

Order CYSTIPHYLLOIDA
Nicholson, 1889

Solitary coralla with or without opercula or epipetal scales; less commonly compound coralla, fasciculate or massive; with numerous, more or less well-formed to scarcely noticeable acanthine to (in Digonomyphyllida) laminar major and minor septa; septal presence may be confined to zones of skeletal thickening on more or less widely spaced old calicular floors (scler cones, septal cones); trabeculae commonly do not form laminar septa or septal segments, but are discrete monacanths or, rarely, rhadbacanths, and may be long and extending through successive calical floors or be simple tubercles on upper surfaces of such floors; except in Palaeocyclidae and Tryplomatidae, which lack dissepiments, and possibly in Holmophyllidae, alternation of length of septa is interrupted in counter position, where three long septa may show no intervening short septa; dissepimentarium and tabularium not sharply separated, dissepiments and tabellae together commonly forming inversely conical or bowl-shaped calicular floors; in Tryplomatidae tabular floors commonly of complete horizontal tabulae with median notch; tabulæ and tabellæ absent in Palaeocyclidiæ. M.Ord.-?U.Dev.

Family PALAEOCYCLIDÆ
Dybowski, 1873

Corallum solitary, small, discoid to trochoid; calice extending to apex; axial structures absent; tabulae and dissepiments absent; septa pinnately inserted, of two orders, acanthine; axial ends of trabeculae discrete [see Weyer, 1973a, p. 46]. M.Ord.-?U.Ord., L.Sil.-M.Dev.

Palaeocyclus Milne-Edwards & Haime, 1849a, p. 71 [*Madrepora porpita Linné, 1767a, p. 1272; M; see Wells, 1936, p. 127; not traced (no. 232 in Hisinger Coll., RM, Stockholm, may be suitable neotype)]. Corallum discoid, cone of attachment central on base of disc; major and minor

established. The number of septal orders and their plan of insertion is not yet serted sequentially at four loci; the Tabulata have short, acanthine septa of one order, for which the plan of insertion is not yet

Subclass RUGOSA Milne-Edwards & Haime, 1850

Solitary coralla, with or without opercula or epipetal scales; less commonly compound coralla, fasciculate or massive; with numerous, more or less well-formed to scarcely noticeable acanthine to (in Digonomyphylida) laminar major and minor septa, septal presence may be confined to zones of skeletal thickening on more or less widely spaced old calicular floors (scler cones, septal cones); trabeculae commonly do not form laminar septa or septal segments, but are discrete monacanths or, rarely, rhadbacanths, and may be long and extending through successive calical floors or be simple tubercles on upper surfaces of such floors; except in Palaeocyclidae and Tryplomatidae, which lack dissepiments, and possibly in Holmophyllidae, alternation of length of septa is interrupted in counter position, where three long septa may show no intervening short septa; dissepimentarium and tabularium not sharply separated, dissepiments and tabellae together commonly forming inversely conical or bowl-shaped calicular floors; in Tryplomatidae tabular floors commonly of complete horizontal tabulae with median notch; tabulæ and tabellæ absent in Palaeocyclidiæ. M.Ord.-?U.Dev.

Order CYSTIPHYLLOIDA
Nicholson, 1889


Solitary coralla with or without opercula or epipetal scales; less commonly compound coralla, fasciculate or massive; with numerous, more or less well-formed to scarcely noticeable acanthine to (in Digonomyphylida) laminar major and minor septa; septal presence may be confined to zones of skeletal thickening on more or less widely spaced old calicular floors (scler cones, septal cones); trabeculae commonly do not form laminar septa or septal segments, but are discrete monacanths or, rarely, rhadbacanths, and may be long and extending through successive calical floors or be simple tubercles on upper surfaces of such floors; except in Palaeocyclidae and Tryplomatidae, which lack dissepiments, and possibly in Holmophyllidae, alternation of length of septa is interrupted in counter position, where three long septa may show no intervening short septa; dissepimentarium and tabularium not sharply separated, dissepiments and tabellae together commonly forming inversely conical or bowl-shaped calicular floors; in Tryplomatidae tabular floors commonly of complete horizontal tabulae with median notch; tabulæ and tabellæ absent in Palaeocyclidiæ. M.Ord.-?U.Dev.

Palaeocyclus Milne-Edwards & Haime, 1849a, p. 71 [*Madrepora porpita Linné, 1767a, p. 1272; M; see Wells, 1936, p. 127; not traced (no. 232 in Hisinger Coll., RM, Stockholm, may be suitable neotype)]. Corallum discoid, cone of attachment central on base of disc; major and minor

Order CYSTIPHYLLOIDA
Nicholson, 1889

[nom. transl. as order Cystiphylloida Bulvander et al., 1960, p. 231, et correct. Ivanovskiy, 1961c, p. 185, ex Order Zoantharia, Section II Milioporaria Rugosa (Tetracorallia), section Cystiphylloidea" Nicholson in Nicholson & Lydekker, 1889, p. 296; it is assumed, from this citation, that the name is of the ordinal group] [nom. transl. Lythophylloidea Weidell, 1905, p. 22; suborder; Cystiphylloidea Weidell, 1927, p. 9; section of suborder; Cystiphylloidea Weidell, 1927, p. 9; section of suborder; Cystiphylloidea Weidell, 1927, p. 11; section of suborder; Calleceoida Weidell, 1937, p. 41; Cystiphylloidea Hult., 1954, p. 29, suborder; Cystiphylloidea Wargo, 1948, p. 2, nom. null.; Pholidophyllina Spasskiy, 1956a, p. 86, suborder; Zonastreina Spasskiy, Kraytov, & Tyskanka, 1971, p. 84, invalid, 1974, p. 171, order; Zonastreina Spasskiy, Kraytov, & Tyskanka in Tyskanka, 1971, p. 21, suborder (validation of Zonastreina Spasskiy, Kraytov, & Tyskanka in Tyskanka, 1971, p. 84, in which Zonastreina was nom. nud. and Zonastreinae Spasskiy, Kraytov, & Tyskanka in Tyskanka, 1971, p. 85, was invalid); Rhadba-chithina Spasskiy, Kraytov, & Tyskanka, 1974, p. 171, suborder (cf. Pholidophyllina Spasskiy, Kraytov, & Tyskanka in Tyskanka, 1971, p. 84, invalid subordinal name, based on invalid generic name without assigned species, and invalid family name)]
septa laterally contiguous, each a single series of monacanthine trabeculae with axial ends projecting into calice; tabulae, dissepiments, and axial structures absent. *L.Sil.* (up.*Llandovery*), Eu.(Gotl.-U. K.)-N. Am. (Ont.-Anticosti-B.C.-Mich.-Cal.-Utah); *M.Sil.* (basal *Wenlock*), Eu.-N.Am.—Fig. 39,3a-f. *P. porpita* (LINNÉ), Gotl.; *a*, base, side, ×1; *c*, top, ×2; *d-f*, transv., long. secs. of sepa showing monacanthine trabecule, enl. (after Hill, 1936).

**Bojocyclus** PRANTL, 1939, p. 104 [*B. bohemicus*; tno number?*, Prantl Coll., NM, Prague]. Broadly conical to turbinated, curved, apex of cone eccentric; calice with smooth outer border; sepa rhabdacanthine [fide WEYER, 1973a, p. 46], of two orders; no tabulae, no dissepiments; no distinct fossula. *M.Dev.* (Eifel), Eu.(Czech.-Ger.).—Fig. 39,4a,b. *B. bohemicus*, holotype, Hlubočepčk Ls., gy, “White Bed” at the top, quarry at Holyň, W. of Prague; *a*, calical, proximal views, ×4 (Prantl, 1939).

**Primitophyllum** KALJO, 1956b, p. 35 [*P. primum*; t1023, coll 77, EGM, Tallinn] [=Sinkiangolasma Yü, 1960, p. 96 (type, *S. simplex*, OD; t10382-10383, IGP, Nanking; U.Ord., Sinkiang; like *Primitophyllum* but apical parts unknown; see Weyer, 1973a, p. 46); ?Protostreptelasma Brown, 1909, p. 88, invalid name, nom. nud. for hypothetical ancestral coral]. Corallum solitary, small, trochoid, weakly curved; calice reaching apex of corallum; epitheca complete, with septal furrows indicating rugosan septal insertion; sepa of two orders, short, subequal, acanthine; ?monocanths [Weyer, 1973a, p. 46] forming discontinuous septal combs; tabulae absent. *M.Ord.*, Eu.(Est.)?Asia(Salair); *U.Ord.*, Asia(Kazakh.-Sinkiang).—Fig. 39,2a,b. *P. primum*, M.Ord., Est.; *a*, long. sec., ×0.7; *b*, Idaeve horizon, Unikyula, Est., ext. view showing rugosan septal furrows, ×0.7 (Kaljo, 1956b).—Fig. 39,2c,d. ?*P. simplex* (Yu), holotype, U.Ord., Sinkiang, Mt. Uryzig-tag, Kuruk-tag; *c*, transv., long. secs., ×0.7 (Yü, 1960).

**Rhabdocyclus** LANG & SMITH, 1939, p. 152, nom. subst. pro *Acanthocyclus* DybowskI, 1873c, p. 359 (103), non *Acanthocyclus* LUCAS, 1844, a recent crustacean [*PalaeocycIus fletcheri MILNE-EDWARDS & HAIME, 1851, p. 205; SD Lang & Smith, 1927, p. 450; tA6850, SM, Cambridge; lectotype by Hill, 1936, p. 201]. Solitary, small, discoid or patellate, with cone of attachment eccentric; without tabulae or dissepiments; with stereozone of rhabdacanthine or dimorphacanthine sepa; major sepa not confluent axially (see Weyer, 1973a, p. 46). *L.Sil.*, Asia(Kweichow)-N. Am. (Nev.-Utah); *L.Sil.-low.* *U.Sil.*, Eu.(U.K.-Gotl.)-Asia(Sib.Platf.); *L.Dev.* (Gedinn.), Eu.(Ger.).—Fig. 39,1a,b. *R. fletcheri* (Milne-Edwards & Haime), M.Sil.(Wenlock.); *a*, Dudley, U. K., long. sec., ×2.0 (after Lang & Smith, 1927); *b*, Wales, U. K., long. sec., ×1.3 (Hill, 1936).

**Family TRYPLASMATIDAE** Etheridge, 1907


Solitary, fasciculate or cerioid; sepa commonly short, contiguous peripherically in
more or less narrow stereozone; trabeculae monacanths, or rhabdacanths and holacanths, contiguous in laminar septal bases, axial ends free; counterseptal loculi normal; cardinal fossula seldom distinct; tabulae complete and subhorizontal, in some with median notch, or with supplementary peripheral tabellae; no dissepiments. M.Ord.-?M.Dev.


Tryplasmatidae with septa rhabdacanthine or holacanthine; cardinal fossula not distinct, cardinal septum not noticeably short. M.Ord.-?M.Dev.

Tryplasma Lonsdale, 1845, p. 613 [*T. aequabile; SD Etheridge, 1907, p. 42; neotype, 1, coll. 486, IGG, Novosibirsk; by Ivanovskiy & Shurygina, 1975, p. 15] [=Philodophyllum Lindström, 1871a, p. 925; 1871b, p. 125 (type, Cyathophylllum? [sic] loveni Milne-Edwards & Haime, 1851, p. 364, M; figured syntype Milne-Edwards & Haime, 1855, pl. 66, fig. 2; M.Sil., Wren’s Nest, Dudley, U.K., presumably destroyed in Bouchard-Chantereux Coll. at Boulogne during war; unfigured syntypes, ride S. Smith, written commun., 1930, in boxes 694, 712 in de Verneuil Coll., EM, Paris, Sil., Gotl.); Scarthodes Duncan, 1884, p. 177, nom. null.; Spiniferina Pennecke, 1894, p. 592, nom. subst. pro Acanthodes Dybowsky, 1873c, p. 364 (108), non Acanthodes Agassiz, 1833, p. 19, a Permian fish (type, A. cylindricus, SD Sherzer, 1891, p. 278; syntypes not traced; Sil., Lauberg and Karlso, Gotl.); Philodophyllum Lang, Smith, & Thomas, 1940, p. 99, nom. van.]. Corallum solitary or with one or more parricidal offsets from calice but not forming fasciculate coralla; may have epithecal scales; with a narrow peripheral stereozone of contiguous laminar bases of commonly short rhabdacanthine, holacanthine, or dimorphacanthine septa, trabeculae being free distally; tabulae complete and commonly subhorizontal, some with median notch; dissepiments absent [see Ivanovskiy & Shurygina, 1975, p. 15]. U.Ord.(Vormsi.), Eu.(Est.-Swed.-Urals); Sil.-L. Dev., cosmop.; ?M.Dev.(Eifel.), Asia(Eurals).

——Fig. 40,2a,b. *T. aequabile, neotype, L.Dev. (or Eifel, ride Ivanovskiy, written commun.), R. Kavka, E. slope of Urals; a,b, transv., long. secs., X2.7 (Hill, n; photographs courtesy A.B. Ivanovskiy).——Fig. 40,2c,d. T. loveni (Milne-Edwards & Haime), M.Sil., U.K., Knowle Quarry, Wenlock Edge; c,d, transv., long. secs., X1 (after Hill, 1936).

Aphyllum Sokhrina, 1937, p. 45 [*A. sociale; OD; syntypes 229 and slides 324, 325, coll. 143, PIN, Moscow] [=Aphyllostylus Whiteaves, 1904, p. 113 (type, A. gracilis, M; +4409, Natl. Type Coll.,
FIG. 41. Tryplasmatidae (p. F98-F100).

England," OD; but LINNÉ, 1758, p. 796, cited the fossil figured in "Corallia Baltica," 1749, 1, p. 96, t. 4, fig. XIII, no. 5, which is now missing, *fide Lindström, 1896a, p. 617, but, *fide Lonsdale, 1839, p. 689, was from the shores of the Baltic. Any neotype should come from there. Lindström, 1896a, p. 632, thought *M. flexuosa Linné identical with a species living in long-stretching reefs in the shale beds along the shores on both sides of Likkersham in Gotland, i.e., in upper Llandovery Visby marls); *Holacantha Ivanovsky, 1969, p. 31, nom. van.; *Rhabdacantha Ivanovsky, 1969, p. 45 (type, *R. rugosum Milne-Edwards & Haime, 1851, p. 425, OD; †-162, EM, Paris, lectotype by Smith & Lang, 1927, p. 307; Sil., Gotl.; fasciculate but species has connecting talons and *rhabdacanthine septa, whereas *H. flexuosa (Linné, 1758) has no talons and has holacantha septa), as holacanths can develop by diagenesis of rhabdacanths, *Rhabdacantha is considered a subjective synonym of *Holacantha and of *Aphyllum; Soskina 'na Gorjanov & Lavruischev, 1972, p. 91, nom. subst. pro *Aphyllum Soshkina, 1937, non *Aphyllum Bergroth, 1906, a hemipteran; see *Aphyllum Ivanovsky, 1974b, p. 128). Fasciculate, increases lateral or peripheral and pseudoxial; may have epibital scales; corallites with acanthine septa and narrow peripheral stereozone of contiguous laminar septal bases from which discrete rhabdacanthine or holacantha trabeculae are directed inward and commonly upward; tabulae complete, horizontal and in some with median notch, or slightly curved. [See Ivanovsky & Shurygina, 1975, p. 27. No type species in the above synonymy has been sufficiently described or illustrated from topotypic material. I have separated as a true genus the consistently fasciculate species of *Tryplasma autt. with tryplasmatid septa and tabulae from solitary species and those species in which a few calical offsets may appear in otherwise solitary coralla. Wenlockia Kato, 1966a, is considered a distinct genus because of its marked cardinal fossula.] *U.Ord., N.Am. (Mainit.); *L. Sil., Eu.(Gol.).-?Asia(Tadzhik.-Kweichow); *M. Sil., Eu.(G. Est.-Gol.).-Asia (E.Urals-Sib.Platf.-N.Am. (Yukon)); *U.Sil., Eu.(Podolia).-Asia (E.Urals-Kazakh.-?Iran).-Australia (New S.Wales-Queensl.-S.Am.-Sib.Platf.).-S.Am.(Venez.).-?L.Dev., Asia(Tadzhik.).-?M.Dev., (Givet.), Asia(Tadzhik.).—Fig. 41,2a,b. *A. sociale, syntype, up. Wenlock, W. slope Urals, right bank R. Vys, near Elkin; *a,b. transv., long. secs., X4 (Ivanovsky & Shurygina, 1975).
Fig. 42. Tryplasmatidae (p. F100, F103).
minor septa may be difficult to distinguish from major; septa each a longitudinal series of closely placed trabeculae contiguous only at periphery; trabeculae long, many reaching axis where they may form weak axial complex; tabulae thin, concave, in part incomplete, with long dissepimentlike plates peripherally. [Family position uncertain due to described presence of weak axial complex.]

U. Ord. (Vormsi), Eu. (Est.-Urals).—Fig. 43, 3a, b. *N. longiseptatum, holotype, Fb, Saksbi (north), Est.; a, b, transv., long. secs., X1 (Kaljo, 1957).

Polyorope Lindström, 1896b, p. 43 [*P. glabra; M; syntypes Cn21678, 21703, 21811-3, 21822-4, RM, Stockholm] [=Polyorope Lindström, 1882a, p. 16, 20, nom. nud.]. Corallum solitary or with a few small peripheral offsets; in type
species, epitheca draped in transverse folds extended on one side as holdfasts; peripheral stereozone with major and minor septa of holacanthine trabeculae altered during diagenesis in lamellate sclerenchyme; tabulae subhorizontal, commonly complete, their upper surfaces with subradial rows of cornlike trabeculae representing major septa. [See MINATO, 1961, p. 92. LINDSTRÖM's 1896b, pl. 8, fig. 99-101 suggest that, as in Cystiphyllidae, septum in each loculus neighboring counter septum is long like major septum.] L.Sil.-M.Sil., Eu.(Gotl.-Karlsl)-Asia(Tadzhik.); ?U.Sil., Asia (Turkey).—Fig. 43,la-f. *P. glabra, Gotl.; a,b, ext. views, ×1.0; c, transv. sec., ×0.8; d, calice with five offsets, ×1.0; e, part of long. sec., ×5.0; f, calical view, ×1.0 (a,b,d, Lindström, 1896b; e,f, after Lindström, 1896b).

Rhabdelasma McLEAN & WEBBY, 1976, p. 240 [*R. exiguum; OD; †P75212, SU, Sydney]. Solitary, or possibly with lateral increase; septa numerous, each a single series of rhabdacanths; marginarium a stereozone in which major and minor septa are contiguous, rhabdacanths contiguous within each septum; major septa almost reaching axis; in moderately wide tabularium rhabdacanths discrete within each septum, tabulae thin, somewhat sagging and commonly complete. U.Ord., Australia (New S.Wales).—Fig. 42,la-c. *R. exiguum, ls. at top of Malachi's Hill beds, Malachi's Hill, central New S.Wales; a, paratype, transv. sec., ×5; b, holotype, long. sec., ×5; c, paratype, tang.-long. sec. curved specimen, ×10 (McLean & Webb, 1976; photographs courtesy B. D. Webby).

Stortophyllum WEDEKIND, 1927, p. 30 [*S. simplex; SD LANG, Smith, & Thomas, 1940, p. 124; †Cn54864, RM, Stockholm] [=Thecaspinellum NIKOLAEVA, 1949, p. 106 (type, T. jakowlevi, OD; †73, coll. 5746, TsGM, Leningrad; U.Sil., Bobrovsk horizon, R. Taltiya, E. slopes Urals), has epithecal scales, U.Sil., Asia (E.Urals), U.Sil.(us.Dalyan.), Asia (Tadzhik.); ?Oboryophyllum OZAKI, 1956a, p. 170, 1956b, p. 77, with some remarks but not described, OZAKI, 1957, p. 11 (type, O. oboerense, †SD FLÜGEL, 1970, p. 187; †not traced, ?in OZAKI or KATO Coll., KU, Kanazawa; Sil., Oborodani, Fukui Pref., Japan, fide KATO, written commun., 1975), with epitecal scales; see Ivanovskiy & Shurygina, 1975, p. 37]. Solitary, rejuvenescence common, septa acanthine, bases of long rhabdacanths contiguous to form narrow peripheral stereozone; tabulae either horizontal and complete or inversely conical and complete, with supplementary peripheral tabellae. U.Sil., Eu. (Gotl.-Podolia-Urals)-N.Am.(Tenn.); L.Dell., Eu. (?N.Zemlya)-Asia(Tadzhik.-Salair).—Fig. 43,2a. *S. simplex, holotype, U.Sil., Eke marls, Gotl., Lau backar; long. sec., ×1.5 (Hill, n; photograph courtesy of RM, Stockholm).—Fig. 43,2b,c. ?S. jakowlevi (NIKOLAEVA), holotype, U.Sil., E. slopes

Urals, R. Taltiya; b,c, transv., long. secs., ×4.0 (Ivanovskiy & Shurygina, 1975).

Subfamily WENLOCKINAE

Spasskiy & Kravtsov, 1974
[Subfamily Spasskiy & Kravtsov in Spasskiy, Kravtsov, & Tsyganko, 1974, p. 171]

Tryplasmatidae with monacanthine septa and short cardinal septum in notable fos­sula. M.Sil.

Wenlockia KATO, 1966a, p. 257 [*W. thomasi; OD; †R18586, UH, Sapporo]. Corallum fasciculate, increase ?lateral; corallites slender, with rela-
tively wide peripheral septal stereozone; major septa not reaching axis; septa each a single series of monacanths, contiguous except at their distal ends; cardinal septum shorter, in distinct wide fossula; tabulae thin, complete, sagging, deepening in fossula. [Differs from Tryplasmatidae in presence of tabular cardinal fossula.] M.Sil., Eu. (U.K.)—Fig. 44, la,b. *W. thomasi*, holotype, Wenlock, Shropshire; a,b, long., transv. secs., X4 (Kato, 1966a).

**Family FLETCHERIIDAE Zittel, 1876**  
[nom. transl. et correct. Weisserm., 1939, p. 85, ex Fletcherinae Zittel, 1876, p. 235, tribe]

Corallum dendroid or phaceloid; corallites large, cylindrical or in places contiguous and irregularly prismatic; without connecting tubuli or mural pores; wall a thin stereozone, with very short septa, either of thin discontinuous laminae or spinose, extending but slightly beyond stereozone; tabulae horizontal, complete; increase calicular and either axial, peripheral, or lateral. [Possibly Tabulata, Auloporida.] L.Sil.-M. Sil.

**Fletcheria Milne-Edwards & Haime, 1851**, p. 300  
[*F. tubifera*; OD; †monotype, 641, de Verneuil Coll., EM, Paris (only one specimen catalogued; may be figured specimen, but shows smaller group of corallites of more circular section, fide S. Smith, 1930 MS)]. Corallum ramose, small; corallites cylindrical but closely attached, in places becoming prismatic; walls a thin stereozone, without mural pores or connecting processes; septa thin, sometimes discontinuous laminae; tabulae
horizontal; increase calicular, up to five offsets initially within wall of parent. [See Stasinak, 1967, p. 101. The possibility that this genus is of the subclass Tabulata (?Auloporina), as suggested by Stasinak (1967, p. 101), must not be overlooked; study of calice is required to establish trabecular nature of septa and whether minor septa are present; epithecal furrows should be studied to establish manner of septal insertion.]

M.Sil.(Wenlock), Eu.(Gotl.).—Fig. 45,1a-d. *F. tubifera, Stora Carlso; a,b, ?monotype, Gotl., transv., long. secs., X2 (Hill, n; photographs courtesy J. Lafuste); c,d, calical view, transv. sec., X4, X5 (Stasinska, 1967).

?Parafletcheria Yang, 1973, work not traced; Yang, in Yang, Kim, & Chow, 1978, p. 223 [*P. dupliformis Yang, 1973, named as type species and described and figured; †Gct 512-514, GB, Guiyang; L. Sil., Shiniulan F., Shimenkan, Shiqian, Guizhou (Kweichow)]. Corallum dendroid, with numerous cylindrical corallites becoming subrounded in section when contiguous, but no mural pores then observed; numerous smaller corallites arising by calical and ?lateral increase; walls thin, septal elements not observed; tabulæ complete, flat. [Diagnosis tentative, from illustrations.] L.Sil., Asia(Kweichow).

Family HOLMOPHYLLIDAE
Wang, 1947


Corallum solitary, fasciculate or massive; major and minor septa numerous, subequal, somewhat withdrawn from axis and in part of discrete trabeculae and in part of laminar segments formed by contiguous trabeculae; tabulæ subhorizontal or concave, complete or of tabellæ; marginarium a moderately wide disseptarium; dissepiments may extend across more than one interseptal loculus; cardinal fossula commonly not distinct; counterseptal loculi ?normal. Sil.-M.Dev.

Holmophyllum Wedekind, 1927, p. 30 [*H. Holmi; OD; †Cn54865, RM, Stockholm] [=Holmophyllia Sytova, 1970, p. 68 (type, Gkisiphylleum borealis; OD; †18, coll. 10316, TsGM, Leningrad;
L.Dev., Vaygach I., USSR; rhabdacanths so closely spaced that septa are almost laminar), see also McLEAN, 1975a, p. 185; ?Gukoviphylum SYTOVA, 1968, p. 54 (type, Holmophyllum septatum BULVANKER, 1952b, p. 13, OD; †9, coll. 7151, TsGM, Leningrad; mid. Skalian, Gukov, Podolia, U.Sil., Podolia, L.Dev., S.Urals; trabeculae 'flabella- canthine' and closely spaced to contiguous in major septa, very widely spaced and thin in minor septa, impersistent except in narrow peripheral
stereozone in early stages); ?Aculeatophyllum
Zhavoronkova in Strelnikov & Zhavoronkova,
1972, p. 94 (type, A. uralicum, OD; †27-a-1,
GGI, Ufa; Eifel., W. slopes S. Urals, R. Malý Ik).
Corallum solitary or with few offsets; major and
minor septa long, subequal, of discrete rhabda-
canth or tufted monacanth; tabular floors hori-
zontal or sagging, tabulae complete or incom-
plete; dissepsimentarium moderately wide and
distinct from tabularium, of numerous dissepi-
ments [see also McLean, 1975a, p. 183]. L.Sil.,
Australia (New S. Wales); M.Sil., Asia (Tadzhik.-
Yunnan); U.Sil., Eu. (Gotl.-Podolia-Vaygach)-Aus-
tralia (New S. Wales-Queensl.-Asia (E. Urals-
Kazakh.-Tadzhik.-Kuzbas-Sib.Platf.); basal Dev.,
Asia (Tadzhik.).—Fig. 46,la,b. *H. holmi, holo-
type, Ludlov., Gotl., Lau backar; a,b, transv., long.
secs., X5 (Hill, n; photographs courtesy RM,
Stockholm).—Fig. 46,1c-e. ?H. septatum Bul-
vanker, mid. Skalian, Bukov, Podolia; c,e,
transv., d, long. secs., X4 (all Bulvanker, 1952b).
—Fig. 46,1f,g. ?H. uralicum (Zhavoronkova),
holotype, Eifel., W. slopes S. Urals, R. Malý Ik;
f,g, transv., long. secs., X2 (Strelnikov & Zha-
voronkova, 1972).
Cystiphorolites Miller, 1889, p. 183, nom. subst.
pro Vesicularia Rominger, 1876, non Vesicularia
Thompson, 1830, a bryozoan [*Vesicularia major
Rominger; OD; †806, UMMMP, Ann Arbor].
Massive, thamnasterioi or aphroid; septa repre-
sented by very numerous longitudinal series of
more or less discrete, rough trabeculae developed
on upper surfaces of wide, flat and somewhat
everted dissepsimentarium platforms and seldom
continuous through more than two successive
platforms; major septa continued into tabularium
as fine ridges on upper surfaces of flat tabular
floors, and approximately reaching axis; large,
lonsdaleoid dissepsiments common in wide dissepi-
mentarium. M.Sil./Niag.), N.Am.(Mich.).—
Fig. 47,1. *C. major (Rominger), figured syn-
type, probably from Cordell dol., Drummond I.,
L. Huron; ext. view, X0.7 (Rominger, 1876).
Dendroholmia Spasskiy & Kravtsov in Spasskiy,
Kratsoy, & Tsyganko, 1974, p. 171 [*Holmo-
phyllum obscure Smolovskaya, 1963, p. 186;
OD; †slides 89/III-50-51, MGU, Moscow]. Like
Holmophyllum but fasciculate with parri
cial increase; septa with discrete rhabdacoths.
M.Sil.,
Asia (Kazakh.-?Shensi); †up.M.Sil. or low.U.Sil.,
Australia (New S.Wales).—Fig. 47,2a,b. *D.
obscure (Smolovskaya), holotype, Wenlock.
R.
Ak-Chokka, S. slopes Tarbagatau Ra.; a,b, transv.,
long. secs., X2.7 (Smolovskaya, 1963).
Mazaphyllum Crook, 1955, p. 1052 [*M. corti-
jonesi; OD; †6136, SU, Sydney] [Aksamgina
Kaplan, 1971b, p. 17, diagnosed but not illus-
trated; 1975, in Sytova & Kaplan, p. 67 (type,
A. concavotabulata, OD; †5, coll. 10287, TsGM,
Leningrad; L.Dev., Gedinn., Karaespa suite, Asia,
Kazakh.; astroid at least in part and with
holacanthine trabeculae). Corallum thamnasteri-
oi or astroid; septa numerous, very long, major
and minor equal or subequal, each septum of
numerous discrete, thin rhabdacoth plates may occur in some. ?U.Sil., Australia (New S.Wales-Queensl.-N.Am. (Somerset I.); U.Sil.-L.
Dev. (Gedinn.), Asia (Kazakh.).—Fig. 47,3a,b.
*M. cortisonesi, holotype, near Bathurst, New
S. Wales; a,b, transv., long. secs., X2 (Crook, 1955).
—Fig. 47,3c,d. M. concavotabulatum (Kaplan),
holotype, Gedinn., Kazakh., near Aksarly; c,d,
transv., long. secs., X2 (Sytova & Kaplan, 1975).
Mesouralinia Shurygina, 1971, p. 106 [*M. mag-
ifica; OD; †453/47, coll. 1715, UGUP, Sver-
lovsk]). Solitary, large, major septa long, of thick,
closely spaced to contiguous trabeculae in dissepi-

Fig. 48. Holmophyllidae (p. F107-F108).
Fig. 48. Holmophyllidae (p. F108).

Nipponophyllum Sugiyama, 1940, p. 116 [*N. giganteum; OD; t63005, TohU, Sendai] [=Baeophyllum HILL, 1940c, p. 403 (type, B. colligatum, OD; +F.9148, slide 704, AM, Sydney; Bow-spring Ls., New S. Wales, Boonoor Ponds Cr., Yass R.).] Corallum fasciculate, epithecal scales in some; major and minor septa subequal, somewhat withdrawn from axis, acanthine; trabeculae either discrete throughout or in part contiguous in laminar segments, ?monacanthine; tabulae subhorizontal or sagging, complete or incomplete, more or less sharply demarcated from plates of moderately wide dissepimentarium; dissepimentarium with shallow dissepiments that may each extend across more than one interseptal loculus and that, in many, are horizontally based so that calice has flat or everted platform [see also McLean, 1975a, p. 183]. M.Sil., Asia(E.Urals–Tadzhik.)—Fig. 49,1a-c. *N. giganteum, holotype, U.Sil., Halysites Ls., Japan, Higuiti-zawa in Kiwatui; a-c, transv., long., tang. secs., X1 (Sugiyama, 1940).

Nodophyllum Kaplan, 1971b, p. 19, diagnosed but not illustrated; 1975, in Sytova & Kaplan, p. 66 [*N. scissum; OD; t4, coll. 10287, TsGM, Leningrad]. Solitary; septa composed of long, thin holacanths not only piercing several successive dissepimentarial floors, but also acting as nodes around which dissepiments are grouped; in some places trabeculae may be contiguous to form laminar septal segments; tabularium wide, floors concave, of wide low tabellae; dissepiments somewhat irregular, unequal [cf. Digonoclisia Yu, Liao, & Deng, 1974, p. 226]. L.Dev.(Gedinn.), Asia(Kazakh.)—Fig. 49,3a,b. *N. scissum, holotype, Karaespa suite, SE. spur of Mt. Aksarly; a,b, transv., long. secs., X3 (Sytova & Kaplan, 1975).

Xiphelasma Smith & Lang, 1931, p. 84 [*Tubiporites tubulatus SCHLOTHEIM, 1813, p. 37; OD; ?no number, Schlotheim Coll., HU, E. Berlin] [=?Storthygophyllum Weissermel, 1894, p. 617 (type, S. megalocystis, M; toriginal of pl. 49, fig. 6, “Ostpreuss.-provinz. Mus., Konigsberg,” by Lang, Smith, & Thomas, 1940, p. 124; ex Pleistocene drift, near Königsberg)]. Cerioid or subcerioid; septa acanthine, trabeculae discrete and based on wall and on large, irregularly developed dissepiments; tabulae concave or subhorizontal, complete or incomplete. Sil., Eu.(Gotl.)—Fig. 49,2a,b,d–f. *X. tubulatum (SCHLOTHEIM), holotype, Sil., Gotl.; a,d, transv. secs., X1.5, X3.0; b,d,e, long. secs., X1.5, X3.0, X3.0 (a,b,e, Smith & Lang, 1931; d,f, after Smith & Lang, 1931).—Fig. 49,2c. ?X. megalocystis (WEISSERMEL), lectotype, ex pebble in Pleistocene drift, E. Prussia; transv. sec., X2.0 (Weissermel, 1894).
Family GONIOPHYLLIDAE
Dybowski, 1873

[Goniophyllidae Dybowski, 1873c, p. 332] [=Calceolidae Lindström, 1883c, p. 9; Heterotoechidae Lindström, 1883c, p. 9, nom. null.; Araeopomatidae Lindström, 1883c, p. 9; Homotoechidae Lindström, 1883c, p. 9, nom. null.; Goniophyllinae Birkenheide, 1974a, p. 460]

Corallites semicircular (calceoloid) or square in transverse section; calice with operculum of one or four plates of dense sclerenchyme; corallites either with wide dissepimentarium and inversely conical floors of tabellae, or completely or almost completely filled with skeletal thickening, or with intermittent zones of skeletal thickening (septal cones); septa either incomplete, of short, fine, isolated cornlike trabeculae developed sporadically on dissepiments and tabellae, in places coalesced in short, thin septal segments at or near periphery, or in complete but short plates so thick as to be almost contiguous laterally; minor septa difficult to distinguish from
major; septum in each loculus neighboring counter septum long like major septum [see Birenheide, 1974a]; tabularium and dissepimentarium not sharply separated.

L.Sil.(up.Llandovery).-M.Dev.(up.Givet.).

Goniophyllum MILNE-EDWARDS & HAME, 1850, p. Ixxi [*Turbinolia pyramidalis* Hisinger, 1831, p. 128; OD; +Cn54963, RM, Stockholm, Sil., Gotl.; lectotype by Hill, herein (original of Hisinger, 1831, pl. 7, fig. 5)]. Solitary, square in section, calice with operculum of four triangular plates of dense sclerenchyme; septa thick, mostly laminar and contiguous, as long as dissepimentarium is wide; septum in each loculus neighboring counter septum long like major septum [see Birenheide, 1974a, pl. 3]; dissepiments and tabellae commonly thickened, in zones with no or little thickening, numerous. L.Sil.(up.Llandovery), Eu.(U.K.-Eire-Gotl.).-N.Am.(Ont.-Iowa).--Fig. 50a-c. *G. pyramidale* (Hisinger), Sil., Gotl.; a, ext. view, X1; b,c, part of long., transv. secs., X1, X2 (after Lindström, 1883c).

Aracopoma LINDBRÅM, 1883c, p. 57 [*Cystiphyllum prismaticum* Lindström, 1868, p. 421; M; *not* identified, RM, Stockholm] [=Protaeropoma TING, 1937, p. 414 (type, *P. wedekiindi*, OD; *not* traced, ?Marburg; Sil., Visby, Gotl.; has much intermittent skeletal thickening); Protaeropoma LANG, SMITH, & THOMAS, 1940, p. 106, nom. van.]. Solitary, square in section in adult stages and with four triangular laminate opercula in calice; with rootlets; septa long, represented each by radial longitudinal row of cornlike trabeculae based on inner surface of wall and on upper surfaces of dissepiments and tabellae, which are distinguished from one another only by size and position; trabeculae strongly developed only in intermittent zones of skeletal thickening (septal cones), seldom continuous from one dissepiment to the next above; septum in each loculus neighboring counter septum long like major septum [see Birenheide, 1974a, pl. 4]; dissepiments and tabellae numerous, seldom thickened and coalesced radially and laterally to form peripheral stereozone on counter (flattened) side or on both sides of corallum; part of counter septum near periphery may be expanded laterally and anteriorly as calical knob consisting of long slender trabeculae radiating obliquely upward from longitudinal axis; in some, septum in each loculus neighboring counter septum long like major septum [see Birenheide, 1974a, pl. 4]; dissepiments and tabellae numerous, seldom thickened, not readily distinguishable in size or inclination. L.Sil.(Llandovery).-L.Dev.(Em.)., Eu.(U.K.-France.-Sweden.-Czech.-Poland.-Urals).
Fig. 51. Goniophyllidae (p. FM10-F112).

Rhytidophyllum LINDSTRÖM, 1883c, p. 62 [*R. plIsillllm; aD; figured syntypes Cn2l848-9, 2185-3, RM, Stockholm (original of fig. 9 not identified)]. Corallum minute, calceoloid and operculate; calice deep, thin-walled; septa faint. U.Sil.(Lud/olJ.), Eu.(Gotl.).—FIG. 50,2a,b. -R. pllsillum, syntypes, U.Sil., Qvarnbacken, Slite; a,b, ext. view calice, underside of operculum, both enl. (Lindström, 1883c).

Family CYSTIPHYLLIDAE

Milne-Edwards & Haime, 1850

[Cystiphyllidae MILNE-EDWARDS & HAIME, 1850, p. lxxii] [*Cystiphyllinae McCoy, 1851b, p. 29; Zonophyllinae WEBEKIND, 1924, p. 12; Lithophyllidae WEBEKIND, 1925, p. 49; Lytophyllidae, Lytophyllinae WEBEKIND & VOLLBRECHT, 1931, p. 81, 1932, p. 99; Zonophyllidae SOSHKINA, 1936b, p. 18; Lithophyllidae, nom. van., Cystiphyllidae, Cystiphyl·

Predominantly solitary Cystiphyllida, without opercula; some with epithecal scales; with numerous, long, acanthine major and minor septa predominantly developed as discrete trabeculae, in some forming septal combs; without carinae or arched peripheral crossbars; trabeculae mainly monacaths, in some rhabdacanths, commonly affected by diagenesis resulting in holacanths buried in pseudolamellate sclerenchyme; septal presence may be confined to sclercones more or less widely separated and thicker and more continuous in marginarium in Silurian genera, in tabularium in Devonian genera. U.Ord.-U.Dev.

Cystiphyllum LONSDALE, 1839, p. 691 [*C. si-luriense; SD MILNE-EDWARDS & HAIME, 1850, p. lxxii; †GS6565 & PF4448-9, GSM, London; lectotype by LANG & SMITH, 1927, p. 476] [=Conophyllum HALL, 1851, p. 399, 1852a, p. 114 (type, C. niagarense, M; syntypes 1694/1, AMNH, New York; low. Niag. Ls., Lockport, N.Y., see STUMM, 1965, p. 51); Cysteophyllum MEEK, 1867, p. 80, nom. null.; ?Coronoruga STUSSZ, 1961, p. 347 (type, C. dripstonensis, OD; †11104, SU, Sydney; M.Sil., New S.Wales near Wellington), scleroconal thickening may be continuous at boundary between dissepimentarium and tabularium, see McLEAN, 1975a, p. 189; ?Cystilasma ZAPRUDSKAYA & IVANOVSKY, 1962, p.

Fig. 52. Cystiphyllidae (p. F112-F113).
51 (type, *C. sibiricum*; OD; †3, coll. 654; VNIIGRI, Leningrad; L.Sil., up.Llandov., Sib. Platf., R. Gorbiyachin), trabeculae apparent only in early stages, on and near wall, disseipmentarium narrow, peripheral plates very small; *?Spinolasma Ivanovskiy*, 1965a, p. 124 (type, *S. crassimarginalis*, OD; †4, coll. 236, IGG, Novosibirsk; L.Sil., up.Llandov., Sib. Platf., R. Gorbiyachin); peripheral ends of short trabeculae contiguous to form narrow stereozone, tabulilium very wide, floors concave; *?Lamellophyllum Erina*, 1978, p. 73 (type, *E. hitecum*, OD; †20b, coll. 10472, TsGM, Leningrad; U.Ord., Archalyksk Beds, Khodzha-Kurgan, S. Tyan Shan), solitary with thin holocanths immersed in thick wall; *?Sinanoiphyllum He & Huang in Kong & Huang*, 1978, p. 113 (type, *S. sinanense*, OD; †Gr 505-508, GB, Guiyang; L.Sil., Sinan, Kweichow). Solitary, turbinate to cylindrical; major and minor septa long, each represented by trabeculae typically developed only on upper surfaces of successive globose disseiments and tabellae; sclerocones not strongly developed, thicker and more continuous peripherally than axially; calicular floors inversely conical, inclination of disseiments and tabellae commonly being similar U.Ord.-M.Dev., cosmop.

C. (*Cystiphyllum*). Axis of sclerocones centric, thickening weak, commonly absent on tabellae; trabeculae grainlike to moderately long and contiguous to separate. *Sil.*, cosmop.—Fig. 52, 1a. *C. (C.) siluriense*, lectotype, M.Sil.(Wenlock Ls.), U.K., Wenlock; eccentric long. sec., ×1.5 (Hill, n; photograph courtesy Geological Survey Museum, London).—Fig. 52, 1b-d. *C. (C.) sibiricum* (Zapрудская & Ivanovskiy), holotype, L.Sil.(up. Llandov.), Sib. Platf., R. Gorbiyachin; b, c, transv., d, long. secs., all ×3.0 (Ivanovskiy, 1963).

C. (*Cruciphyllum*) Lavruševič in Ivanovskiy, 1976, p. 49; Lavruševič, 1977b, p. 36 [*Cruciphyllum cruciferum*; OD; †1101/16-17, UpG, Dushanbe]. Four longitudinal ridges of disseipmentarium project into tabulilium which, therefore, has cruciform outline in transverse section; tabular floors upraised axially. *U.Sil.(Downton).* Asia(Tadzhik.).—Fig. 53, 2a, b. *C. (C.) cruciferum* (Lavruševič), Isfara horizon, R. Isfara, Turkestan Ra.; a, b, transv., long. secs., ×2 (Ivanovskiy, 1976; photographs courtesy A. I. Lavruševič).

C. (*Cysticonophyllum*) Zapрудская & Ivanovskiy, 1962, p. 48 [*C. khantaiense* Zapрудская in Zapрудская & Ivanovskiy, 1962, p. 49; †1, coll. 654; VNIIGRI, Leningrad]. Sclerocones one-sided and eccentric, on convex side of corallum; trabeculae weakly developed. *L.Sil. (up. Llandov.)-M. Sil.(low. Wenlock.)*, Asia(Sib. Platf. - Hupei); Eu.(Swed. - Nor. - U.K.) - Australia(New S.Wales).—Fig. 54, 1a-d. *C. (C.) khantaiense*, holotype, Llandov., Sib. Platf., R. Mogokta, right tributary of R. Khantayka; a, c, d,
FIG. 54. Cystiphyllidae (p. F113-F115).

Like C. (Zonophyllum) Wedekind, 1924, p. 12, 20 Solitary, small; traces of separate trabeculae or of septal combs or of long, thin, laminar segments of septa appearing in some specimens on upper surfaces of dissepiments and tabulae; sclerocones thin, rare to absent, in a few, thickest in tabularium; no arched crossbar plates peripherally. L.Dev.-M.Dev. (Eifel.), Eu. (Ger.-France-N.Urals)-Asia (Salair-Altay-NE. USSR-Urals); M. Dev. (Givet.), Eu. (U.K.-N.Urals); M. Dev., Asia (Kweichow); ?U. Dev. (Pamenn.), Eu. (Pol.)-W. Australia.

C. (Hedstroemophyllum) Wedekind, 1927, p. 64 [*Hedstroemophyllum articulationum; OD; + Wedekind, 1927, pl. 26, fig. 6, not traced]. Trabeculae long, tufted monocanths, continuous through several successive calicular floors, separate except at their bases on wall or in sclerocones, sclerocones commonly thin especially in axial parts [see Jell & Hill, 1970a, p. 10]. L. Sil. (up. Llandovery)-M. Sil., Eu. (Gotl.)-Asia (China); U. Sil. (Greben.), Eu. (Arctic Urals)-Asia (Kazakh).—Fig. 53, la,b. *C. (H.) articulationum, para­type, Gotl., Stenkyrka; a,b, transv., long. secs., ×3 (Hill, n; photographs courtesy V. Jaanisson).


Asterophyllum Sposik in Dubatlov & Spasskiy, 1964, p. 132 [*A. armatum; OD; +4-5A, coll. 248, IGG, Novosibirsk; M. Dev., Arctic Urals] [=Kymocystis Strelnikov, 1968a, p. 15 (type, K. notabilis, OD; +1. coll. 9485, T. G. M., Lening­grad; up. Wenlock., Arctic Urals)]. Solitary, calice bowl-shaped with gently sloping, wide margins; septa numerous, major and minor subequal, long, each a more or less regular series of subglobose naotice plates connected more or less along the midline of their curvature by thin, short septal combs or of low, thin, laminar segments of septa appearing in some specimens on upper surfaces of dissepiments and tabulae; sclerocones thin, rare to absent, in a few, thickest in tabularium; no arched crossbar plates peripherally. L. Dev.-M. Dev. (Eifel.), Eu. (Ger.-France-N. Urals)-Asia (Salair-Altay-NE. USSR-Urals); M. Dev. (Givet.), Eu. (U.K.-N. Urals); M. Dev., Asia (Kweichow); ?U. Dev. (Pamenn.), Eu. (Pol.)-W. Australia.

Asperophyllum Spasskiy in Dubatlov & Spasskiy, 1964, p. 132 [*A. armatum; OD; +4-5A, coll. 248, IGG, Novosibirsk; M. Dev., Arctic Urals]
Chernysheva Ridge; b, c, transv., d, long. secs., all × 4 (Strelnikov, 1968a).

*Bucanophyllum* ULRICH, 1886, p. 31 [*B. gracile*; M; syntypes 25249, AMNH, New York; =*Cystiphyllum ohiense* NICHOLSON, 1875c, p. 234, *fide* STUMM, 1961, p. 227, syntypes not located]. Small, trumpet-shaped, with slender cylindrical hollow stalklike basal part rapidly expanding into wide, deep funnel-shaped calice; typically with one row of dissepients, on upper surfaces of which are fine, radiating septal crests; tabulae absent. M.Dev.(Eifel.), N.Am.(Ohio-Ind.-Ky.).

---Fig. 56, 2a, b. *B. ohiense* (NICHOLSON); syntypes of *B. gracile* ULRICH, Jeffersonville Ls., above coral zone, Falls of the Ohio; a, b, ext. views, × 1 (Stumm, 1965).

*Ceriocysta* ZHAVORONKOVA, 1976, p. 67 [*C. aculeofera*; OD; 174/17, IG, Ufa]. Corallum cerioid, calical floors infundibuliform; septa acanithine, ?rhabdacanths amalgamated peripherally to form narrow irregular stereozone; in successive, separated, inversely conical zones of skeletal thickening, septal spines are developed in crests on upper surfaces of tabulae and dissepients. L.Dev.
**Cystiphyllida**

*Rugosa—Cystiphyllida*

Coleophyllum Hall, 1883, p. 317 [*C. romingeri*; SD Miller, 1889-1897, p. 179; t3220/1, 238 (plastotype), type coll. NYSM, Albany, see Stumm, 1965, p. 144]. Subcylindrical to ceratoid with broad basal scar of attachment and funnel-shaped calice; successive sclerocones in contact, suppressing tabellae and dissepiments; apices of sclerocones centric; short septal trabeculae laterally contiguous in sclerocones [see Stumm, 1965, p. 52; Birenheide (Eifel.), N.Am.(Ind.-Ky.).—FIG. 56,1a-c. *C. romingeri*, coral zone, Jeffersonville Ls., Ind., Falls of the Ohio, Jeffersonville; a, holotype, weathered ext. view, ×1.0; b,c, topotype, transv., long. secs., ×1.5 (Stumm, 1965).

Cystiphyllidae Chapman, 1893, p. 46 [*Cystiphyllum aggregatum* Billings, 1859b, p. 137; tnot traced, GSC, Ottawa (in absence of monotype and exact topotypes, species is interpreted on specimen figured in Lambe, 1901, pl. 18, fig. 3, GSC6331, Ottawa, ?Bois Blanc F., Lot 6, concession 13, Walpole, Ont.)]. Predominantly solitary; a few species phaceloid or subcerioid with peripheral increase; septa represented by spinelike trabeculae, isolated or in septal combs, commonly based in sclerocones and not extending through successive dissepiments or tabellae; laminar septal segments and peripheral arched crossbar plates not developed; sclerocones more pronounced in early stages and commonly strongest in axial parts; cardinal fossula may be evident as deepening in tabularial floors; nature of ambicounter septal loculi seldom apparent. L.Dev.-M.Dev., cosmop.


C. (Cladionophyllum) Stumm, 1961, p. 229 [*Cystiphyllum cicatrificerum* Davis, 1887, pl. 125, fig. 10 only; OD; t7754, MCZ, Cambridge; by Stumm, 1961, p. 230] [Birenheide (1974a, p. 457) considers that Cladionophyllum may be a junior synonym of Bucanophyllum Ulrich, which see]. Solitary, club-shaped, broadly pyriform distally with long, narrow, cylindrical stalklike proximal part terminating in broad basal scar of attachment; calice funnel-shaped, with rounded base; septa represented on upper surfaces of dissepiments by discontinuous radial crests; sclerocones present, axes centric. Differs from other

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Cystiphylloides in pedicillate form. M.Dev. (Eifel.), N.Am.(Ind.-Ky.). — Fig. 58.2a-d. C. (C.) cicatricifera (Davis); a, lectotype, coral zone, Jeffersonville Ls., Ind., Falls of the Ohio, Jeffersonville, ext. view, ×1.0; b-d, another specimen, b, long., c-d, transv. secs., all ×1.5 (Stumm, 1961).

FIG. 58. Cystiphyllidae (p. F117-F121).

29): Paralytophyllum Wedekind & Vollbrecht, 1932, p. 114, nom. van.; Paralithophyllum Lang, Smith, & Thomas, 1940, p. 95, nom. van.; 'Cystiphyloides Yoh, 1937, p. 53 (type, Atelophyllum (Cystiphyloides) kwangsiensis, SD Lang, Smith, & Thomas, 1940, p. 48; †not traced: low. Givet., E.Kwangsi, Tung-kan-ling; although septa may be represented by series of naotic dispemments, no atelophyllloid arched peripheral crossbar plates are seen in type material figured), junior homonym of Cystiphyloides Chapman, 1893, which see; Patridophyllum Ultina, 1963a, p. 5, 15, nom. imperf.; 1968, p. 86 (type, P. paterllum, M; †552, coll. 1993, PIN, Moscow; up. Eifel., R.Arpa, Nakichevansk ASSR; stereocones thick, of massive
monacanthine trabeculae in contiguous septal combs); *Partidophyllum* SYTOVA, 1968, p. 59, **nom. nul**. Calices funnel-shaped, tabularial floors inversely conical; axes of cones centric or nearly so. 

**C. (Lythophyllum)** WEDEKIND, 1925, p. 32 [*L. marginatum*; OD; +3303, 3304, and 9232, WEDEKIND Coll., SM, Frankfurt; M.Dev., Givet., Dachsberg, probably Loogh Beds] [*Edaphophyllum* SIMPSON, 1900, which see; ?Cayugasæa LAMBE, 1901, p. 196 (type, *C. whiteaevisiana*, OD; +4690, Nat!. Type Coll., GSC, Ottawa; M.Dev., Eifel., Cayuga, Ont.), see STUMM, 1961, p. 228; *Nardophyllum* WEDEKIND, 1925, p. 36, and *Plagiophyllum* WEDEKIND & VOLLEBRECHT, 1931, in explanation, pl. 17, figs. 4-5, 1932, p. 115 (type of both is *Nardophyllum exzentricum* BORCHERS MS, in WEDEKIND, 1925, p. 36; OD; +1969 and 8451-8453, WEDEKIND Coll., SM, Frankfurt; M.Dev., Givet., Berndorf), BIRENHEIDE, 1964, p. 33, rated the type species of both genera as a subjective synonym of *Cystiphyllum macrocystis* SCHLÜTER, 1889, p. 346 (88), +191, SCHLÜTER Coll., IP, Bonn, lectotype by BIRENHEIDE, 1964, p. 34, M.Dev., Soetinich, Abbach to Loogh Beds; *Lytophyllum* WEDEKIND & VOLLEBRECHT, 1932, p. 113, **nom. van.**; *Weedelypphyllum* STUMM, 1949, p. 39, **nom. subst.** pro *Lithophyllum* LANG, SMITH, & THOMAS, 1940, p. 78, **nom. van.**, non *Lithophyllum* MUELLER, 1859, a protozoan]. Solitary, subcylindrical with funnel-shaped calice; apices of sclerocones and tabularial floors eccentric, lying against one side of dissepimentarium; sclerocones in part with discernible septal boundaries; trabeculae grainlike on dissepiments but rare; tabellae and dissepiments mostly large, elongated. M.Dev.(Eifel.-Givet.), (Ger.-U.K.-Pol.)-Asia(Kuzbas-Asia M.)-Afr.(Moroc.).—**C. (L.) macrocystis** (SCHLÜTER); *a,b*, holotype of *Lytophyllum marginatum* WEDEKIND, Givet., Dachsberg, transv., long. sec., X 1.2; *c*, holotype of *Nardophyllum exzentricum* WEDEKIND, Givet., Berndorf, transv. sec., X 1.2 (all Wedekind, 1925).—**C. (L.) whiteaevisiana** (LAMBE), monotype, Eifel., Ont., Cayuga; *d,e*, transv., long. secs., X 0.9 (Stumm, 1961). 

**C. (Skoliophyllum)** WEDEKIND, 1937, p. 52, no species named but figure given [*Cyanophyllum lanellolium* GOLDFUSS, 1826, p. 58; SD LANG, SMITH, & THOMAS, 1940, p. 118; +201b, Goldfuss Coll., IP, Bonn; lectotype by STUMM, 1949, p. 42; M.Dev., Eifel.]{*Scoliophyllum* LANG, SMITH, & THOMAS, 1940, p. 118, **nom. van.**; *Praeannardophyllum* SPASSKIY, 1955, p. 99 (type, *P. domracavi*, OD; +5, coll. 507, VNIGRI, Leningrad; low.Eifel., Calceola Beds, R.Kosva, C.Urals; may have greater skeletal thickening than *C. (S.) lanellolium* GOLDFUSS). Solitary, predominantly flat, with successive flat calices developed en échelon; cardinal fossula may be indicated in calice on side toward apex of coralite; sclerocones predominant in early stages, in
mature stages septa may be represented by isolated grainlike trabeculae on upper surfaces of highly globose tabellae and dissepiments (giving circular transverse sections). M.Dev.(Eifel.), Eu. (Ger.-?Urals)-N. Am. (Ohio-Ind.-Ky.)-?Asia M. (Nakhichev.).—Fig. 58,1a,b,e. *C. (S.) lamellosus (GOLDFUSS), Eifel., Junkerberg Beds, Hillesheim syncline, Eifel; a, lat. view, ×0.5; b,e, long., transv. secs., ×1.5 (Birenheide, 1962c, 1964).—Fig. 58,1c,d,f. ?C. (S.) domrachevi (SPASSKIY), holotype, Eifel., Calceola Beds, C. Urals; c,d, calical, lat. views, f, transv. secs., all ×4.0 (Spasskiy, 1955).

?Diplochone FRECH, 1886, p. 219 [*D. striata; OD; †no number, HU, E. Berlin; lectotype by CHENG, 1971, p. 189]. Solitary, conical; epitheca with rugosan septal furrows, but in thin sections of syntype coralla no vestiges of septa recognized; dissepimentarium very narrow, of one or two series of elongate, highly inclined plates; tabular floors wide, inversely conical, of large tabellae; skeletal thickening absent [see CHENG, 1971, p. 189; BIRENHEIDE, 1974a, p. 461]. M.Dev.(Givet.), Eu.(Ger.).—Fig. 60,2a,b. *D. striata, lectotype, up. Stringocephalus Beds, Ger., Rhineland; a,b, long., transv. secs., ×1 (Cheng, 1971).

Edaphophyllum SIMPSON, 1900, p. 221 [*Cystiphyllum bipartitum HALL, 1882, p. 55; OD]; †11142, type coll., NYSM, Albany [†Cystiphyllloides (Lythophyllum) WEDEKIND, 1925, which sec]. Solitary, with normal or oblique, shallow, bowl-shaped calice in which septa are represented by ridges on surface of sclerocone and in which bilateral symmetry is marked by thickened, raised, long counter septum and narrow cardinal fossula; sclerocones separated by dissepiments and tabellae, their apices eccentric [see STUMM, 1961, p. 233; 1965, p. 57]. M.Dev.(Eifel.), N.Am.(Ind.-Ky.).—Fig. 60,1. *E. bipartitum (HALL), holotype, coral zone, Jeffersonville Ls., Ind., Falls of the Ohio, ext. calical view, ×1.5 (Stumm, 1965).

Mackenziephyllum PEDDER, 1971b, p. 48 [*M. insolitum; OD; †24657, Natl. Type Coll., GSC, Ottawa] [=Zonastaera TSYGANKO in SPASSKIY, KRAVTSOV, & TSYGANKO, 1971, p. 85, nom. nud.; Zonastaera TSYGANKO, 1972, p. 21 (type, Z. graciosa, OD; †604/101, IG, Syktyvkar; Givet., R. Belkovskaya, Pay-Khoy)]. Corallum aphyroid; long major and minor septa represented only by isolated, very short, spineous trabeculae and in places by short series of globose, naotic dissepiments; normal dissepiments typically large, inflated, forming arched floors between narrow tabularia with concave floors of tabellae similar in size to normal dissepiments; sclerocones weak to absent; no arched peripheral crossbar plates. M.Dev., N. Am.(NW.Terr.)-Eu.(USSR).—Fig. 61,2a,b. *M. insolitum, Hume F., Can., Carnworth R., Mackenzie distr., a, holotype, transv. sec., ×1.9; b, paratype, long. sec., ×1.9 (Pedder, 1971b).

Microplasma DYBOWSKI, 1873c, p. 340, genus diagnosed but no species named, 1874, p. 508 [*M. gotlandicum; SD WEDEKIND, 1927, p. 64; syntype Col1337, coll. 11, EGM, Tallinn (original of DYBOWSKI, 1874, pl. 5, fig. 5)] [=Cystostyllum WHITFIELD, 1880, p. 63 (type, C. typicus, OD; †34213, MPUC, Berkeley, L.Sil., up.Llandovery, coral beds, Wis., Sturgeon Bay; Cystistyllum LANG, SMITH, & THOMAS, 1940, p. 48, nom. van., see STUMM, 1969, p. 241; ?Microconoplasm IVANOVSKY, 1966a, p. 122 (type, M. crassus; OD; †3, coll. 236, IGG, Novosibirsk; top of up.Llandovery, R. Stony Tunguska), dissepiments relatively small and numerous, with intermittent sclerocones; ?Coronoplasm SPASSKIY & KRAVTSOV in SPASSKIY, KRAVTSOV, & TSYGANKO, 1974, p. 171 (type, Coronorina regia SHURYGINA, 1970, p. 81, OD; †423/12, UGUp, Sverdlovsk; Wenlock., E. slopes of Urals); ?Hedistroemoplasm SPASSKIY & KRAVTSOV in SPASSKIY, KRAVTSOV, & TSYGANKO, 1974, p. 171 (type, Hedistroemophyllum fasciculatum ZHETLONOGOVA, 1961, p. 85, OD; †3484, ZSGUp, Novokuzevetsk; Wenlock., left bank R. Uksunay, Salair), fasciculate]. Corallum phaceloid, with peripheral increase, offsets may lack dissepiments in early stages; in mature stages a marginarium of steeply inclined dissepiments, and tabularia of large, flat-lying, convex to globose tabellae; septa represented by small, thornlike trabeculae, projecting from narrow peripheral stereozone or
Fig. 61. Cystiphyllidae (p. F121, F125).
Fig. 62. Cystiphyllidae (p. F121-F125).

Fig. 62, 1a,b. *M. gotlandicum*, M.Sil., Swed., Karlsö; a,b, transv., long. secs., ×13.6, ×1.8
(Dybowski, 1874).—Fig. 62,1.e.d. *M. loveni­
anum* DyBowski, M.Sil.(Wenlock.), U.K., Usk
Inlier; *cf.*, transv., long. secs., ×1.8 (White,
1966).—Fig. 62,1.e.f. ?M. regium (Shurygina),
holotype, M.Sil.(Wenlock.), E. slopes of Urals;
*cf.*, transv., long. secs., ×3.6 (Shurygina, 1970;
photographs courtesy M. V. Shurygina).

Pseudodigonophyllum SPASSKIY, 1960c, p. 39 [*
*P. macroseptatum*; OD; 17/10 slide 186, coll. 7653,
TsGM, Leningrad; Eifel., Loishinsk Beds, Rudny
Altay]. Solitary; calice funnel-shaped or with
platform, with wide, inversely conical axial pit
without notable keyhole outline; major septa some­
what irregularly withdrawn from axis, laminar,
thickest at periphery, their trabeculae may be
free distally; minor septa weaker; sclerocones thin,
with grainlike traces of trabeculae on tabellae,
which are distinguished from dissepiments mainly
by larger size; lateral dissepiments on septa very
rare, and arched peripheral crossbar plates absent.

L.Dev., Asia(Tadzhik.); M.Dev.(Eifel.), Asia
(Rudny Altay).—Fig. 61,1.a-c. *P. macroseptu­
atum*, holotype, Loishinsk Beds (Da'), CAsia,
Kholozova Hill, Rudny Altay; *a*, long., *b,c*
transv. secs., all ×1.9 (Spasskiy, 1960c).

Family DIGONOPHYLLIDAE

Wedekind, 1923

[nom. transl. Wedekind, 1924, p. 12, ex Digonophyllinae
Wedekind, 1923, p. 33] [=Arcophyllinae MARKOV, 1926,
p. 54; Cosmophyllinae WEDekind & Vollbrecht, 1932, p.
99; Cosmophyllinae Rukhin, 1938, p. 29; Arcophyllinae
Stumm, 1949, p. 43; Ateleiophyllinae Taylor, 1951, p. 202;
Mochlophyllinae Taylor, 1951, p. 202]

Predominantly solitary, a few species
phaceloid; septa long, laminae complete in
a few species, but commonly represented
by thin and weak to thick and strong
laminar segments distally and adaxially;
segments may or may not have lateral dis­
sepiments based on their sides, and, toward
their peripheral bases, arched crossbar plates
and naotic dissepiments; calicular pit com­
monly with keyhole outline, narrow end
cardinal; sclerocones present, combined dis­
sepimental and tabularial floors inversely
conical or with median ?trough; cardinal
septum commonly short, counter septum
and septum in each loculus neighboring it
long. *M.Dev.*

Digonophyllum Wedekind, 1923, p. 27 [*D.
Schulzi; M; 1359-361 and 7776-7778, Wedekind
Coll., SM, Frankfurt; 359 lectotype by Birenhei­
de, 1968, p. 25; Eifel., Nohn, Eifel; =Actionycystis
pseudoorthoceras Schulz, 1883, p. 84, 14, Schulz
Coll., IP, Bonn, Eifel., Nohn, see Birenheide,
1964, p. 46]. Solitary, calice with calicular pit of
markedly keyhole outline, narrow end cardinal
tabularial fossula; major septa numerous, very
long, commonly thick and continuously laminar
except peripherally, where isolated arched
crossbar plates and associated series of naotic dis­
sepiments may represent them; lateral dissepiments
may occur; sclerocones may be notable in axial
regions; minor septa weaker; cardinal septum
commonly short; septum in each loculus neighboring
long counter septum long like major septa.

M.Dev., Eu.-Asia-?N.Am.

D. (Digonophyllum). Calice commonly with plat­
form; major septa thick to very thick in axial
third of their length, thinning towards periphery,
may have lateral dissepiments but almost lack
(Ger.-Urals)-Asia(Altay); M.Dev., Eu.(Moravia),
M.Dev.(Givet.), Asia(Kuzbas).—Fig. 63,1.a,b.

* *D. (D.) pseudoorthoceras* (Schulz, 1883, p. 84, 14, Schulz
Coll., SM, Frankfurt; Eifel.; Ger., Nohn; *a*, transv., long. secs., ×1 (Biren­

D. (Mochlophyllum) Wedekind, 1923, p. 31
[*Cyathophyllum maximum (sic) Wedekind,
1923, p. 35; M; 12580, Wedekind Coll., SM,
Frankfurt, formerly 207 (partrim), Schützer
Coll., IP, Bonn; lectotype by Birenheide,
1964, p. 42; Eifel., Gerolstein; =Actionycystis
maxima Schulz, 1882, p. 207) [=Bothriophyllum
Vollbrecht, 1926, p. 220, nom. imperf., figured
but no species named, M.Dev., Heiligenstein near
Gerolstein, ?transitional to Dialytophyllum; En­
telespathyllum Walther, 1928, p. 103 (type, E.
sunwigensi, SD Lang, Smith, & Thomas, 1940,
p. 57; 7060-7063, Wedekind Coll., SM, Frank­
furt; Givet., Sundwig, Sauerland; =Actionycystis
laevis Schulz, 1883, p. 82, t3b, Schulz Coll.,
IP, Bonn, lectotype by Birenheide, 1964, p. 44,
Givet., Berndorf); Pseudocosmophyllum Wedekind
& Vollbrecht, 1931, explanation pl. 33­
35, 1932, p. 112 (type, P. geigeri, SD Lang,
Smith, & Thomas, 1940, p. 109; t1895-1904,
Wedekind Coll., SM, Frankfurt; Givet., Nie­
derehe; =A. laevis Schulz, see above); Uralo­
phyllum Soshkina, 1936b, p. 44 (type, U. uni­
cum, M; tslides 127-9, coll. 2869, PIN, Moscow;
M.Dev., Biya Beds, W.Urals, R.Maly Patok)].
Solitary, with moderately deep bell-shaped to
funnel-shaped calice; septa commonly replaced
peripherally by isolated, arched, crossbar plates
and associated naotic dissepiments; lateral dissepiments
more or less profuse. *M_DEV., Eu.(Ger.-
Belg.-U.K.-Czech.-Urals)-?Asia(Iran-Kuzbas)-?N.
Am.—Fig. 63,2.a-c. *D. (M.) maximum* (Schüt­
er), lectotype, Eifel., Gerolstein, transv. sec.,
×0.25 (after Vollbrecht, 1926).—Fig. 63,
2b,d.f. *D. (M.) laeve* (Schulz); *b*, holotype of
Enteleophyllum sundwigense Walther, Givet,
Sundwig, Gerolstein, transv. sec., ×1.0 (after
Walther, 1928); *d,f*, monotype of Pseu­
docosmophyllum geigeri, Givet, Niederhe, transv.,
long. secs., ×1.0 (after Wedekind & Vollbrecht,
1931).

—Fig. 63,2.e-f. *D. (M.) unicum* (Soshkina),

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Fig. 64. Digonophyllidae (p. F127).
Mesophyllum SCHLÜTER, 1889, p. 325 [*Actinocyxis defecta SCHLÜTER, 1882, p. 208; SD WEDEKIND, 1925, p. 38; t199d, Goldfuss Coll., IP, Bonn; lectotype by STUMM, 1949, p. 44, which is also lectotype by STUMM, 1949, p. 44, of *Cyathophyllum vesiculosum Goldfuss, 1826, p. 58 (pl. 17, fig. 5e only), M.Dev., Eifel, [Eifel]. Coralium solitary or phaceloid; calicular pit with weakly expressed keyhole outline, narrow end a cardinal tabularial fossula; major septa commonly thin to very thin, laminar or partly laminar except peripherally, where they are discontinuous and may be replaced by isolated arched crossbar plates associated with naotic dissepiments; sclerocones commonly weakly expressed, strongest in tabularium; septum in each loculus neighboring septum long like major septa; minor septa weakly expressed, M.Dev.

M. (Mesophyllum). [=Atelophyllum WEDEKIND, 1925, p. 37 (type, Mesophyllum Emsti WEDEKIND, 1922b, p. 57, OD; t4503-4506 and 9729-9730, WEDEKIND Coll., SM, Frankfurt, Givet, Emst near Hagen, Sauerland); Arcophyllum Markov, 1926, p. 50 (type, A. typus, OD; t570/635, coll. 3849, TsGM, Leningrad; M.Dev., Calceola Beds, W.Urals); *Scissoplasma SPASSKIN & KRATYSOV in SPASSKIN, KRATYSOV, & TSYGANKO, 1974, p. 171 (type, Atelophyllum sebracis McLAREN, 1964, p. 25, OD; t16485, GSC, Ottawa, M.Dev., Horn Plateau F., near Fawa Lake, Mackenzie distr., Can.); *possibly phaceloid; isolated arched crossbar plates very sparse]. Phaceloid or solitary with funnel-shaped calice; thin and laminar major septa withdrawn from or discontinuous in tabularium, and discontinuous peripherally where replaced by isolated arched crossbar plates and commonly by naotic dissepiments locally; sclerocones weak to absent. M.Dev., Eu.(Ger.-U.K.-Czech.-Urals)-Australia (Queensl.)-Asia (Kuzbas-Schwelm Ls., Sauerland, Genna near Letmathe, transv. secs., X 1.5 (Wedekind, 1925).


M. (Dialithophyllum) WEDEKIND, 1925, p. 40 [*D. complicatum; OD; t4361, 4362, 9646-9648, WEDEKIND Coll., SM, Frankfurt; =Actinocyxis lissingenensis SCHLÜTER, 1882, p. 206, t183, SCHLÜTER Coll., IP, Bonn, Eifel, Lissingen] [=Dialithophyllum WALTHER, 1928, p. 102, nom. van.; Dialithophyllum Hill, 1942a, p. 246, nom. van.; Dialithophyllum (Protodialithophyllum) KONG in KONG & HUANG, 1978, p. 158 (type, D. (P.) quianannense, OD; t1928, 929, GB, Guiyang; M.Dev., Dushan, S.Kweichow)] [Although AMANSHAUSER is usually cited as author of Dialithophyllum, WEDEKIND (1925, p. 40) writes (transl.), “AMANSHAUSER recognized that a small group of very peculiar forms . . . differs from previously known coral groups and he gave them the name Dialithophyllum. Subsequently, I have obtained additional material and have formulated the genus on this basis.” Apparently, WEDEKIND took the name and illustrations from AMANSHAUSER’S thesis, but the description is his own. AMANSHAUSER’S contribution, therefore, does not meet the requirements of Article 50 of the Code, and WEDEKIND is here named as author.—Ed.]. Solitary, with calicular platform; major septa very long, commonly reaching almost to axis or countercardinal plane, commonly not withdrawn from periphery, thick and laminar in inner third of length, elsewhere may have or be represented or buttressed by lateral dissepiments; peripheral arched crossbar plates rare; minor septa much weaker. M.Dev., Eu. (Ger.-U.K.-Urals)-Asia (Kwangsi-Kuzbas-Schwelm Ls., Sauerland, Genna near Letmathe, transv. secs., X 1.5 (Wedekind, 1925).
Hemicosmophyllum

Fig. 66. Digonophyllidae (p. F128-F131).
are isolated but arched crossbar plates are rare to absent; sclerocones rare in mature stages, may be marked in young stages. *M. Dev. (Eifel.), Eu. (Ger.)-Asia (Asia M.-Kuzbas)-N. Am. (Canada-?Nev.); *M. Dev. (Givet.), Asia M. —Fig. 66, 2a, 2b, *M. (L.) punctatum Wedekind, monotype, Eifel., Junkerberg Beds, Auburg; a,b,d, transv. secs., ×2.0 (after Wedekind, 1924). —Fig. 66, 2c,e, ?M. (L.) longispinosum (Ulitina), holotype, Givet., Nakhichev., R.Aspa; c.e, long., transv. secs., ×1.5 (Ulitina, 1963b).

Order STAUROIDA Verrill, 1865


Solitary or compound Rugosa; marginalia a stereozone or a dissepimentarium; septa laminar, of contiguous trabeculae; each lamina may be longitudinally contiguous throughout, or may be either amplexoid in tabularium or londsdaleoid in dissepimentarium, or both; tabular floors horizontal or uparched or sagging; tabulae complete or incomplete. M.Ord.-U.Perms.

Suborder STAIUINea Verrill, 1865

[nom. correct. Hill, herein (pro suborder Stauriacea Verrill, 1865, nom. correct. Moore, 1952, p. 133, pro Stauriacea Verrill, 1865, p. 146)]

Fasciculate or ceroid Stauriida with marginalia a narrow stereozone and in some with sporadic elongate dissepiments; septa laminar, not lobed or acanthine axially; tabulae commonly complete. Increase tabularial or less commonly marginal (lateral). M.Ord.-U.Miss.

Family STAUROIDAE

Milne-Edwards & Haime, 1850

[nom. correct. Hill, 1951, p. 13 (ex Stauriidae Milne-Edwards & Haime, 1850, p. 13; =Stauriidae Fromentel, 1861, p. 74; Stauriinae, Stauriicae Ivanovsky, 1965a, p. 79, 81)]

≡Cyathophylloidae Dybowsky, 1873c, p. 331 (nom. transl. Ivanovsky, 1966, p. 75, ex Cyathophylloidae Dybowsky, 1873c, p. 331); Cyathophyllinae Dybowsky, 1873c, p. 331; =Favistella Chapman, 1893, p. 43 (based on Favistella Dana, 1849b, which is herein considered indeterminate); Cyathophylloidae Ivanovsky, 1973a, p. 79]

Phaceloid or ceroid; corallites commonly with narrow peripheral septal stereozone; septa thin elsewhere; major septa commonly long and subequal and may reach axis; minor septa rudimentary to moderately long; tabulae commonly complete, may be somewhat arched and with broad median depression; narrow and, in some, impersistent dissepimentarium of longitudinally elongate interseptal plates may develop; in-

platform, keyhole outline of pit weak; major septa somewhat withdrawn from axis, longitudinally and radially nearly continuous or interrupted between sclerocenes, which are prominently developed in early stages; minor septa weak; peripheral arched crossbar plates absent. M.Dev., (Eifel.), Eu.(Ger.-Urals)? NW. Am.(Nev.); M. Dev., (Givet.), Asia (Kuzbas).—Fig. 66, Ia, c-e, *M. (Z.) cylindricum (Schlüter); a, c, lectotype, Eifel, Ger., Liisingen; transv., long. sec., ×1.5 (Birenheide, 1964); d-e, holotype of Zonodigonophyllum primun Vollbrecht, Eifel, Ger., Noh; transv. sec., ×1.0, ×1.5, ×1.0 (after Vollbrecht, 1926).—Fig. 66, I b-f, ?M. (Z.) frechi (Wedekind), holotype, Givet, Ger., Loogh; transv. sec., ×2.0 (after Wedekind, 1925).

?Paracystiphylloides Tsien, 1969, p. 107 [*P. inconditus; OD; ↑68001, LG, Louvain; Co2a, Eau Noire, Couvin]. Solitary, subcylindrical; septa thick (?of mainly contiguous monacanths), major septa withdrawn from axis; minor septa long; dissepimentarium narrow, dissepiments ?large, horizontally based in peripheral series; tabulae wide, tabular floors shallowly concave. M.Dev. (up.Couvin.), (Belg.).—Fig. 67, 2a, b. *P. inconditus, holotype; a, b, transv., long. sec., ×3 (Tsien, 1969).

Parazonophyllum Kong in Kong & Huang, 1978, p. 149 [*Pseudozonophyllum intermedium Yü & Liao in Yü, Liao, & Deng, 1974, p. 228; OD; ↑18787-18790, IGP, Nanking; M.Dev., (Dushan)]. Solitary; septa thick, laminae in early stages, of laminar segments and discrete trabeculae in late stages, not thinning in peripheral regions, and without crossbar carinae; fossula of keyhole section. [Diagnosis tentative; from illustrations.] M.Dev., Asia (Kweichow).

Schlechter Schlüter, 1889, p. 81 [*Cyathophyllum goldfusci Milne-Edwards & Haime, 1851, p. 363, non Castelnau, 1843, p. 47; M; figured specimen not found in MN, Paris, with Birenheide, 1964, p. 20; =Cyathophyllum limbatum Quenstedt, 1879, p. 465, ↑Coec3/158/37, GPI, Tübingen, lectotype by Birenheide, 1964, p. 19, Gerolstein, Eifel]. Solitary, small, curved-comical; calice with platform from which commonly rise distal edges of laminar septa or locally isolated grainlike trabeculae; cardinal fossula weakly expressed or indistinguishable; in early stages sclerocenes predominant, with thick, partly laminar septa discernible, each composed of a series of short, thick trabeculae; zones of coarse tabellae may appear in some, and between the septa, smaller dissepiments; peripheral arched crossbar plates absent. M.Dev., Eu.(Ger.-Belg.-Urals)-Asia (Altay-Kuzbas).—Fig. 67, Ia-e. *S. limbatum (Quenstedt), Eifel, Prüm syncline; a, b, transv. sec.; c, d, second specimen, transv. sec.; e, third specimen, long. sec., all ×2 (Birenheide, 1964).
Fig. 68. Stauriidae (p. F133-F134).
crease in some quadripartite and parricidal, in others nonparricidal. *M.Ord.-M.Dev.*

**Stauria** MILNE-EDWARDS & HAIMÉ, 1850, p. lxiv [*S. astreiformis; species not described or figured until MILNE-EDWARDS & HAIMÉ, 1851, p. 316; †unfigured †syntype, Z115a, in MILNE-EDWARDS & HAIMÉ Coll., MN, Paris; †lectotype by LANG, SMITH, & THOMAS, 1940, p. 122, not traced; †Madrepora favosa LINNÉ, 1758, p. 796, †not traced]. Cerioid, or partly phaceloid; commonly four, in some three peripheral and parricidal offsets arise simultaneously, their dividing walls arranged in cross at axis, two opposite walls commonly growing above counter and cardinal septa; major septa reaching almost to axis, minor septa short, dissepiments in up to two series, or sparse and isolated, in some disrupting minor septa; tabulae subhorizontal or slightly convex, complete or with some tabellae [see SMITH & RYDER, 1927, p. 337]. *L.Sil.,* *M.Sil., Asia(Kweichow); M.Sil., Eu.(Gotl.).* ——**Fig. 68,la,b. *S. favosa (LINNÉ), M.Sil., Slite Gr., Gotl., Bögklint; a,b, oblique, transv. secs., X2, X4 (Hill, n; UQF34301).**

**Astrictophyllum** SPASSKY, 1971b, p. 24, nom. subst. pro Stereophyllum SOKHINA, 1937, p. 19, non Stereophyllum SCHLÜTER, 1889, p. 339, a Devonian Cystiphyllina, nec Stereophyllum GRABAU, 1917a, p. 199, * nom. nud. [*Stereophyllum mas-sivum SOKHINA, 1937, p. 19; OD; †thin sections 411-2, coll. 143, PIN, Moscow].* Cerioid; septa thick, in early stages almost wedge-shaped, peripheral ends contiguous and forming wide peripheral sterezone, major septa almost reaching axis, one
may be longer than others, their inner ends may be rhopaloid and curved; minor septa confined to stereozone; tabulae complete, horizontal [see Ivanovsky & Shurygina, 1975, p. 21]. M.Dev. (Eifel.), Eu.(Urals).—Fig. 69,1a, b. *A. massivum (Soshkina), holotype, zone of Favositess regularissimus. C.Urals, mouth of R. Bardym, W. slopes; a, b, transv., long. secs., ×2.7 (Ivanovsky & Shurygina, 1975).

Ceriaster LINDSTRÖM, 1883a, p. 61 [*C. calamites; M; syntypes in RICHTOFEN Coll., HU, E. Berlin] [=?Stauria MILNE-EDWARDS & HAIM, 1850, which see]. Ceroid or fasciculate; increase axial, tripartite or quadripartite; corallites small; septa few; major septa long, axial ends joining at axis; minor septa very short or not developed; tabulae complete, slightly convex or horizontal; no dissepiments [see Lavrusevich, 1965, p. 27]. L. Sil., Asia (Tadzhik.-Shensi-Kweichow); M.Sil., Asia (Szechwan).—Fig. 68,3a-c. *C. calamites, M. Sil., bed 1, China, Chaotien, Szechwan; a,b, transv., long. secs., ×1; c, transv. sec. showing tripartite axial increase, greatly enl. (Lindström, 1883a).

?Columnolasma PAVLOVA, 1973, p. 39 [*C. ramosum; OD; +84, coll. 347, UpG, Frunze]. Fasciculate or in part ceroid; increase peripheral, not parricidal; septa short, laminar, laterally contiguous peripherally to form narrow stereozone, beyond which ?amplexoid major septa may extend, thinning very rapidly; minor septa rudimentary; tabular floors shallowly concave, tabulae complete or incomplete, one inconsistent series of peripheral dissepiments developed. U.Sil.(Ludlov.), Asia (Kirg.).—Fig. 68,2a,b. *C. ramosum, holotype, Dalyan horizon, Tabulasma oblongum Zone, Tashbulak, Turkestan Ra.; a,b, long., transv. secs., ×3 (Pavlova, 1973).

Crenulites FLOWER, 1961, p. 84 [*C. duncanae; OD; +671, NMBM, Socorro]. Corallum ceroid; common walls thin; septa thin, of two orders, 10 to 12 of each, major amplexoid, minor short; tabulae thin, complete, tabularium biform; of each pair of interseptal loculi on either side of minor septa, that on cardinal side with tabular margins much more strongly downturned than that on counter side; no dissepiments [see Weyer, 1972c, p. 44f]. U.Ord., N.Am.(Texas-Iowa-Minn.-Que.-Akpatok I.)-Asia (W. Sib. Platf.)-Australia (New S.Wales).—Fig. 70,1a,b. *C. duncanae, holotype, Second Value F., Texas, El Paso; a, transv. sec., ×3.0; b, long. sec., ×2.4 (Flower, 1961).—Fig. 70,1c-i. Biform tabularium of Crenulites, diagram.; c, idealized long. sec. with margins of four different amplexoid megasepta (calical stage uppermost); d-f, several transv. secs. of corallites; g, nearly median long. sec., two bars on left indicate maximal intervals in which accurately oriented cross sections could show more or

Fig. 70. Stauriidae (p. F134-F135).
less clearly indicated biform tabularium; h,j, tangential long. secs. with typical arrangements of tabulae (Weyer, 1972c).

Cyathophylloides Dybowski, 1873c, p. 379 [*C. kassariensis; SD Sherzer, 1891, p. 278; syntype, Co1335, coll. 11, EGM, Tallinn]. Ceriod; increase peripheral, nonparallidal, corallites with long major septa running together in groups axially, and with long minor septa; septa thin, peripheral stereozone narrow; tabulae domed, in some interseptal loculi with strongly upturned margins (?=biform tabularium), and complete or incomplete. ?U.Ord., Asia(Kazakh.); L.Sil. (Gz20), Eu.(Est.)-N.Am.(Nev.);—Fig. 69,2a,b. *C. kassariensis, L.Sil., Est., Tamsalu; a,b, transv., long. secs., x2.7 (Hill, n; UOF26866).

Dendrostella Glinski, 1957, p. 87 [*Cyathophylloides rhenanum FRECH, 1886, p. 207; OD; +to- type, SMF xxv 625a,b, SM, Frankfurt, figured syntype, I, FRECH Coll., IP, Bonn (Glinski, 1957, p. 88); (=Cyathophyllum caespitosum trigemme Weyrer, 1881, pl. 162, fig. 5-8; lectotype, pl. 182, fig. 5, fide Flegel, 1959, p. 114, in GPl, Tubingen, ?M.Dev., Bensberg, Ger.; FRECH did not include fig. 5-8 in his syntypes of C. rhenanum)]. —Soshkinella I. Ivaniva, 1960, p. 41 (type, Columnaria vulgaris Soshkina, 1936b, p. 22, OD; tslides 149, 460-1, coll. 2869, PIN, Moscow; Givet., R.Schugor, N. Urals); *Iteophyllum CRICKMAY, 1962, p. 1 (type, I. virgatum, OD; syntypes 27073, PRI, Ithaca; M.Dev., Norman Wells F., W.Can.); *Styphophyllum Ivanovskiy, 1973b, p. 283, nom. null.; Dendrostelloides Jia in Jia et al., 1977, p. 115 (type, D. zhongguoensis, OD; t47005, HPRIGS, Yichang; M.Dev., ?M.Dev., Guizhi [Kuilin], Guangxi [Kwangsi]). Dendroid or phaceloid with nonparallidal peripheral increase; corallites with moderately thick peripheral stereozone; septa thin inside stereozone, one or two (? (cardinal and counter), and sometimes also two other major septa more or less normal to these, may be longer than others; minor septa short; tabulae commonly slightly arched, complete; no dissepiments. L.Dev.-M.Dev., Asia(Kwangsi); M. Dev., Eu.(France-Belg.-U.K.-Carnic Alps-Urals)-Asia(Urals-Altay-Kuzbas-Viet Nam-S.China)-N.Am.(Can.)-Australia(Queensl.-New S. Wales).—Fig. 71,1a,b. *D. rhena (FRECH), Givet, Büchel Beds, Ger., Schladetal, near Ber­gisch-Gladbach; a,b, long., transv. secs., x2 (Glinski, 1957).

Favistina Flower, 1961, p. 77 [*Favistella undulata BASSLER, 1950, p. 273; OD; t46294, USNM, Washington] ?=Favistella Dana, 1846b, p. 538, 635 (type, "Columnaria alveolaris Van Cleve," M; figured, fide Dana, in Van Cleve's unpublished "Western Fossils"); Favistella Hall, 1847, p. 275 (type, F. stellata, M; 11168/A, AMNH, New York, SD Browne, 1965, p. 1186, quo vide; Rich mondian Saluda beds, Madison, Ind.), invalid junior homonym of Favistella Dana, 1846b]. Ceriod; increase lateral, from peripheral region of calice and nonparallidal; septa thin except in wall; major septa almost attaining axis, commonly to 12 or minor septa as short ridges projecting inward from wall; tabulae complete, flat, commonly with slightly down-turned edges and median depression. M.Ord., N.Am.(Wis.); low.?U.Ord.(4c7), Eu.(Nor.-Urals); U.Ord.(Rich mond.), N.Am.(Ind.-Ohio-Ky.-Ont.-N.Mex.)-Asia(Altay Mts.-W.Sib.Platf.-China)-Australia(New S.Wales-Tasm.).—Fig. 72,la-ce. *F. undulata (Bassler), holotype, M. Ord. (Blackriv.), Platte­ville Ls., Wis., Beloit; a, calieal view, X4; b,e, transv. secs., X4; X2; c, long. sec., X2 (Bassler, 1950).—Fig. 72,1f-i. *F. stellata (Hall), U. Ord., Saluda Ls., Ind., Madison; d, lectotype, transv. sec., X3 (Browne, 1965); f-h, syntype, long., secs., X3 (Flower, 1961).

Loyolophyllum Chapman, 1914, p. 306 [*Columnaria (Loyolophyllum) cresswelli; M; t12904, NM, Melbourne]. Ceriod; corallites with very narrow peripheral stereozone; septa few, thin, without carinae, major septa unequal, some extending almost to axis; minor septa short; tabulae complete, commonly sagging, or horizontal; a few scattered lonsdaleoid dissepiments adhering to wall by both upper and lower edges, or partial longitudinal series may be developed [see Hill, 1939a, p. 239]. L.Dev.(Siegen.), Austral­ia(Vict.), ?M.Dev., Australia(Queensl.-Asia(Salair-Kuzbas)-Eu.(Urals)].—Fig. 71,4a,b. *L. cresswelli, L.Dev., Vict., Griffith's Quarry, Loyola, near Mansfield; a,b, long., transv. secs., x2.7 (Hill, 1939a).

Modesta Chevrepin, 1962, p. 140 [*M. prima; OD; t445-577, coll. 405, SNIIGIMS, Novosibirsk]. Corallum small, fasciculate; corallites with deep, sharply-edged calice and two orders of septa laterally contiguous in wide peripheral stereozone;

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1 Van Cleve's specimen is lost (fide Lang, Smith, & Thomas, 1940, p. 60). The name Columnaria alveolaris does not appear in the only list published by Van Cleve (1849), but two species with similar names do: "Columnaria alveolaris Gould, Dayton: quarries, Madison, Ind." (p. 22) and "Favosites alveolaris Goldf., yellow limestone, Dayton" (p. 23). It likewise does not occur in Hill's (1883, p. 23) discussion of Van Cleve's fossil corals, nor in White's (1882, p. 44) illustration of the "first plate" of Van Cleve's fossil corals. "F. alveolaris Goldf." Van Cleve was illustrated (fide Stumm, 1946b, p. 3) by Hall (1883, pl. 5) with Hall's designation of "Favosites hemisphericus Yandell & Shumard," and was accepted as a Devonian talutate. It was reasonably presumed by Stumm (1946b, p. 3) that Dana, 1846b, p. 635, was citing a species referred by Van Cleve to Columnaria alveolaris Goldf., but this does not justify interpreting Favistella Dana as Goldfuss's type specimen (240 in Goldfuss Coll., GPI, Bonn; M) from glacial drift, which was described by Stumm (1964, p. 984). This Treatise follows Lang, Smith, & Thomas (1940, p. 61) and Flower (1961, p. 77) in regarding Favistella Dana, 1846 as indeterminate.
each septum composed of a single longitudinal series of contiguous trabeculae directed upward and inward; ?cardinal septum long, other major septa moderately long, directed toward it but not
Fig. 72. Stauriidae (p. F135).
Coelenterata—Anthozoa

reaching it; no tabulae [none observed]. U.Ord., Asia (Altay Mts.).—Fig. 71,5a,b. *M. prima*, holotype, Altay Mts., USSR, right bank of Muta Cr., 2 km. SE. of Bolshaya Muta; a,b, long., transv. secs., ×2.7 (Cherepnina, 1962; photographs courtesy of S. K. Cherepnina).

?Nadotia Tsyganko, 1974, p. 87 [*N. stylifera; OD; †607/216, IG, Syktyvkar]. Phaceloid; wall slightly thickened; major septa moderately thick, with rhopaloid axial ends, not reaching axis except for counter septum, counter septum extending beyond axis and thickened to form laminar, solid columella that may have longitudinally ribbed sides; minor septa shorter, thinner; dissepimentarium narrow, inconstant, of one or two series of longitudinally elongate plates; tabulae complete or incomplete, sparse, tabular floors hori-

zontal or strongly curved. M.Dev. (Givet.), Eu.,(N. Urals).—Fig. 73,2a,b. *N. stylifera*, holotype, Givet., Polar Urals, R. B. Hadota; a,b, long., transv. secs., ×3.5, ×2.1 (Tsyganko, 1974).

?Neotabularia Ivaniiya in Ivaniiya, Kosareva, & Fedorovich, 1968, p. 98 [*N. simplex; OD; †19-1-8, TGU, Tomsk]. Cerioid; septa short, triangular in transverse section, thickened and contiguous, forming ridged, narrow peripheral stereozone; tabulae commonly concave and saclike or infundibuliform, complete or less commonly incomplete; dissepiments absent. L.Dev., Asia (Altay).—Fig. 71,3a,b. *N. simplex*, holotype, Gaininskaya subsuite, N. Altay, triangulation beacon, S. of Kamysheks; a,b, long., transv. secs., ×1.3 (Ivaniiya, Kosareva, & Fedorovich, 1968).

Palaeoentelophyllum Lavrusevich, 1971c, p. 6 [*P. sangtariense; OD; †133/60, coll. 1030, UpG, Dushanbe]. Fuscilitate, increase lateral; narrow peripheral stereozone formed by thickened ends of septa; major septa long, almost attaining axis, minor septa seldom extending beyond stereozone; axial tabellae wide, convex, with axial depression; perialaxial tabellae narrow, weakly concave; one imperisent series of unequal dissepiments may develop. U.Ord., Asia (Tadzhik.).—Fig. 71,2a,b. *P. sangtariense*, holotype, low. Archaly Beds, Zeravshan-Gissar Ra., right side of R. Karasu, 2 km. W. of meridian of Sangtar Pass; a,b, transv., long. secs., ×2.7 (Lavrusevich, 1971c).

Palaeolitostrotion Lavrusevich, 1975a, p. 31 [*P. zachonense; OD; †14-17, coll. 1101, UpG, Dushanbe]. Phaceloid to subcerioid, with peripheral, nonparricidal increase; corallites slender, with cylindrical or somewhat compressed columella, columella rarely isolated or connected with all or most major septa, more commonly connected with only one of them; minor septa short, projecting slightly from narrow peripheral septal stereozone; tabulae complete, long cones. U.Ord. or L.Sil., Asia (Tadzhik.).—Fig. 74,2a,b. *P. zachonense*, holotype, Zeravshan-Gissar Ra., upper reaches Saya Zakhona; a, transv. sec., ×6; b, long. sec., ×3 (Lavrusevich, 1975a; photographs courtesy A. I. Lavrusevich).

Palaeophyllum Billings, 1858, p. 168 [*P. rugosum; M; †1379, GSC, Ottawa; lectotype by Lambe, 1899, p. 218] [=Paleophyllum acutt., nom. van.; ?Sympamplexoides Stearn, 1956, p. 80 (type, S. varioseptatus, OD; †11047, GSC, Ottawa; M.Sil., Chemahawin Mbr., Cedar Lake F., Lundar Quarry, Maniit.), see under Pycnostyills Whiteaves, 1884]. Corallum phacelocerioid or phaceloid, commonly with marginal (lateral) increase; corallites with narrow peripheral stereozone formed by thickening of peripheral ends of septa; short minor septa alternate with long and somewhat wavy major septa that thin rapidly just inside stereozone, then attenuate more slowly as they approach axis, which they reach or almost reach,
Fig. 74. Stauriidae (p. F138-F140).
their axial edges being without pilaform lobes; tabulæ complete, commonly with axial depression and slightly downturned edges; dissepiments absent; cardinal fossula not distinct. Up.M.Ord.-U. Ord., N. Am. (Que.-Manit.-Ont.-Texas-N. Mex.-Cal.)-Eu.(Nor.-Est.-Urals)-Asia (Sib.Platf.-Shoria Ms.-Sinkiang)-Australia (New S.Wales); L. Sil., N. Am. (Greenl.)-Eu. (Nor.-Est.-Asia (Hupei-Sib. Platf.-Altay-Sayan); M. Sil., Australia (New S. Wales)-N. Am. (Cal.-Yukon-Manit.-N.Y.).—Fig. 74,1a-d. *P. rugosum*, lectotype, Blackriv. or low-est Most Trenton., Can., L. St. John, Little Discharge, a,c, long. secs., b,d, oblique, transv. secs., all ÷2 (Hill, 1961).—Fig. 74,1e,f. ?P. varioseptatum (Stearn), M. Sil., Cedar Lake F., Manit.; e, holotype, long. natural sec., X4; f, paratype, from type locality, transv. sec., ÷2 (Stearn, 1956).

**Parastauria** He & Lee, 1974, publication not traced, quoted without bibliographic reference or page number in KONG & HUANG, 1978, p. 65 [*P. polygonalis; OD; †not traced]. Cerioid, corallites small; walls and septa thin; major septa long, straight, minor septa reduced to wall; tabulæ subhorizontal, dissepiments large, globose in single series. [Diagnosis tentative, from illustrations.]

**Proterophyllum** SOKOLOV in IVANOVSKY, 1969, p. 63 [*Favistella simplex* Sokolov, 1955, p. 462; OD; †113, coll. 599, VNIGRI, Leningrad]. Corallum cerioid, small, increase peripheral and lateral, non-parricidal; corallites with complete horizontal tabulæ and short, uneven, septal combs; [neither presence of minor septa nor order of septal insertion established in type species]; possibly tryplasmatid. M. Ord.-U. Ord., Asia (Sib.Platf.-Altay-Sayan).—Fig. 73,1a-b. P. simplex (SOKOLOV), holotype, M. Ord., USSR, R. Moyero, Sib. Platf.; a,b, long., transv. sec., ÷3.5 (Ivanovskiy, 1969).

**Family PYCNOSTYLIDAE** Stumm, 1953

[Pycnostylidae STUMM in SHRECK & TWENHOEFEL, 1953, p. 158] [=Cephyllidae IVANOVS'KAYA, 1965a, p. 72; Coelophyllumideae ROEMER, 1883, p. 499, invalid name based on junior homonym Coelophyllum ROEMER, 1883, p. 409]

Solitary or fasciculate; corallites with moderate peripheral stereozone, major septa elsewhere thin and amploid, minor septa very short; tabulæ subhorizontal, commonly complete; dissepiments absent; increase peripheral, either quadripartite and parricidal or lateral. Sil.-Dev.

**Pycnostylus** WHITEAVES, 1884, p. 2 [*P. guelphensis; SD MILLER, 1889, p. 202; syntypes 2789a,b, 2793, 2932a, GSC, Ottawa] [=Synamplexoides STEARN, 1956, p. 80, see under *Palaeophyllum* BILLINGS, 1858; ?Neofletcherina YANG in YANG, KIM, & CHOW, 1978, p. 225 (type, *N. guelphensis*; OD; †Gct 647-649, GB, Guiyang; L. Sil., Shimulian F., Xishui Xian [county], Guizhou [Kweichow]), nature of septa unclear; possibly Tabulata, Auloporida. Fasciculate, increase peripheral, commonly four offsets simulating axial quadripartite increase; corallites with very narrow peripheral stereozone; septa amploid, peripheral continuous part very short; no dissepiments; tabulæ complete, horizontal. L. Sil., Asia (Kweichow); M. Sil., N. Am.(Ont.-B.C.-Mich.)-Eu.(Urals); U. Sil., Australia (New S.Wales-Queensland)-Asia (C. Kazakh.); Sil., N. Am. (Cal.).—Fig. 75,3a,b. *P. guelphensis*, syntype, M. Sil., Guelph Ls., Ont.; a, transv. fracture, X1; b, isolated corallite, X1 (Whiteaves, 1884).—Fig. 75,3c,d. *P. acanthinus* (KESLING et al.), Hendriks dol., Fiborn Ls. Mbr., Mich., quarry of Inland Lime & Stone Company, Mackinac Co.; c,d, transv., long. secs., ÷10, X1 (Kesling et al., 1973; photographs courtesy G. Ehlers).

**Cyathopæcum** SCHLÜTER, 1889, p. 263, nom. subst. pro Coelophyllum ROEMER, 1883, p. 409, non SCUDER, 1875, an insect, nec SCHRAMMEN, 1924 [*Calophyllum paucitubulatum* SCHLÜTER, 1880a, p. 52; M; †157a,b, SCHLÜTER Coll., IP, Bonn]. Fasciculate, with connecting processes, increase peripheral, parricidal, calical edges not flared; corallites with widely spaced subhorizontal tabulæ, septa short, developed only as low nonspinose ridges at periphery and on upper surfaces of tabulæ [see also PEEDE, 1976b, p. 289]. M. Dev. (Givet.), Eu.(Ger.).—Fig. 75,5a-c. *C. paucitubulatum* (SCHLÜTER); holotype, String-ceilophyllum Ls., Ger., Hebborn, Bergisch-Gladbach; a, side view, X0.5; b, calice showing peripheral increase, X1.0; c, long. sec., X1.0 (Scherter, 1881).

**Depasophyllum** GRABAU, 1936, p. 43 [*D. adnetum* GRABAU, 1936, p. 44; OD; syntypes 25651a-i, UMPM, Ann Arbor] [=Depasophyllum GRABAU, 1922, p. 21, nom. nud.; not *Depasophyllum* YÜ, 1934, p. 85, which, fide McLAREN, 1959, p. 17, is not valid, since it was published after 1930 without nomination of type species, although two new species were described and illustrated (type, Diphyphyllum (Depasophyllum) hochangpingense Yü, 1934, p. 86, SD SMITH & THOMAS in THOMAS, 1956, p. 181; 15012, IGP, Nanking; L.Carbo, Tzemenchiao Ls., Ho-chang-ping, Pao-ching-hsien, Hunan); ?Synaptophyllum SIMPSON, 1900, which see; Prode帕phyllum COTTON, 1973, p. 161,
Fig. 75. Pycnostylidae (p. F140-F142).
Coelenterata—Anthozoa

nom. subst. pro Depasophyllum Grabau, 1936]. Fasciculate, increase lateral, some corallites with connecting processes; septa thin, short, major extending to change of slope in low domed or mesa-shaped tabulae, downturned edges of some of which may form sporadic and imperfect aulos; minor septa commonly rudimentary; cardinal fossula indistinct; no dissepiments [see Ehlers & Stumm, 1949, p. 31]. M.Dev.(Givet.), N.Am. (Mich.).—Fig. 75,1a-d. *D. adnetum, syntypes, Traverse Gr. (bioherm in Four Mile Dam F.), Mich., Four Mile Dam, Thunder Bar R., Alpena Co.; a,d, long., b,c, transv. secs. of two specimens, all X2 (Ehlers & Stumm, 1949).

?Fletcherina Lang, Smith, & Thomas, 1955, p. 261, nom. subst. pro Yabeia Lang, Smith, & Thomas, 1940, p. 140, non Yabeia Resser & Endo, 1935, a trilobite, nom. subst. pro Cylindrophyllum Yabe & Hayasaka, 1915, p. 90, non Cylindrophyllum Simpson, 1900, a Devonian rugosan [*Cylindrophyllum simplex Yabe & Hayasaka, 1915, p. 90; OD; †not traced]. Corallum phaceloid; walls of corallites thin; septa or septal spines ?absent; tabulae complete, horizontal; increase lateral; no connecting tubuli or mural pores. Dev., Asia(Yunnan); M.Dev.(Givet.), Australia(Queensl.).—Fig. 76,2a,b. *F. simplex (Yabe & Hayasaka), †holotype, Dev., Yunnan, Hung-kuo-chi, Ta-kienhsien; a,b, transv., long. secs., X2 (Yabe & Hayasaka, 1920).

thickened wedgewise forming narrow peripheral stereozone; major septa amplexoid and attenuated toward axis in tabularium; minor septa short; tabulae thin, subhorizontal, commonly somewhat incomplete; dissepiments absent. L.Sil. (up. Llandovery)-M. Sil., Asia (Sib. Platt.) — Fig. 76, a, b. *P. cylindricum, holotype, up. Wenlock, R. Moyero; a, b, transv., long. secs., X4 (Ivanovskiy, 1963; photographs courtesy A. B. Ivanovskiy).

?Synamplexus Grabau, 1922, p. 62 [*Amplexus viduus Lindström, 1883a, p. 62; M; tK96 in Richthoven Coll., HU, E. Berlin] [=Pycnostylius Whiteaves, 1884, which see; ?Zelophyllum Wedekind, 1927, which see; or ?Aphyllum Soshkina, 1937, which see]. Fasciculate; septa short and confined to narrow peripheral stereozone; tabulae horizontal, complete. [Data lacking on increase and septal structure.] ?M.Sil., Asia (Szechwan). — Fig. 76, 3. *S. viduus (Lindström), monotype, China, Chaotien, Szechwan, long. ?fracture, ?X1 (Lindström, 1883a).

Synaptophyllum Simpson, 1900, p. 212 [*Diphyphyllum arundinaceum Billings, 1859b, p. 134; OD; t3602, GSC, Ottawa; lectotype by McLaren, 1959, p. 19] [=Placophyllum Simpson, 1900, p. 216 (type, P. tabulatum, OD; syntypes 300, NYSM, Albany; Onondaga Ls., Walpole, Ont.), insufficiently known, see McLaren, 1959, p. 17; ?Depassophyllum Grabau, 1936, which see]. Phaceloid, increase peripheral or axial; corallites long, slender, cylindrical, rarely connected by lateral projections from corallite walls; septa noncarinate, thin except in narrow peripheral stereozone; major septa short or extending nearly to axis, minor septa short; no dissepiments; tabulae complete, horizontal to distally arched and strongly deflected proximally near periphery [see McLaren, 1959, p. 16; Oliver, 1976a, p. 46]. M.Dev. (Covin.), N.Am.(Ont.-N.Y.-Wash.). — Fig. 76, 1-4. *S. arundinaceum (Billings), lectotype, Bois Blanc F., Ont., 3 mi. W. of Cayuga; a, b, transv., c, d, long. secs., all X3 (McLaren, 1959).

?Thecacristatus Strelnikov, 1973, p. 50 [*T. horridus; OD; t4, coll. 9520, TsGM, Leningrad]. Fasciculate; epitheca with short, sharp crests girdling corallites; wall thin, commonly with thin short septa projecting from it; tabulae complete, thin, sparse, flat or concave. [Tangential section required to prove transverse nature of epithecal ridges and laminar nature of septa not available.]

U.Sil. (Ludlov.), Eu.(Polar Urals). — Fig. 77, 2a, b. *T. horridus, holotype, Yengani-Ye Ra., Nuja-Yu R.; a, b, transv., long. secs., X4 (Strelnikov, 1973).

Zelophyllum Wedekind, 1927, p. 34 [*Z. intermedium; OD; t10207, 10208, 10209 (thin sections), SM, Frankfurt] [=Synamplexus Grabau, 1922, which see]. Fasciculate; increase lateral; major and minor septa short, subequal, thick and
contiguous, forming narrow peripheral stereozone from which their nondentate axial edges project but slightly; without dissepiments; tabulae complete, thin, subhorizontal. M.Sil.-U.Sil., Eu.(Gotl.-Podilia)-Asia (Urals-Altay-?Szechwan).—Fig. 77,1a,b. *Z. intermedium, holotype, Reef Ls., Gotl., Högklint; a,b, transv., long. secs., X2 (Hill, n; photographs courtesy R. Birenheide, 10207, 10209, SM, Frankfurt).

Family NEOCOLUMNARIIDAE

Soshkina, 1949

[Neocolumnariidae Soshkina, 1949b, p. 145]

Phaceloid; corallites with moderate peripheral septal stereozone; septa thin elsewhere, moderately long to long, major septa somewhat amplexoid; dissepimentarium present in late stages, of longitudinally elongate and unequal plates that become angu­monly slightly arched but may have broad somewhat amplexoid; dissepimentarium discontinuous; tabularium wide, floors commonly discontinuous longitudinally in mature stages, leaving an angulate dissepimentarium of unequal, longitudinally somewhat elongate plates adaxial to stereozone; tabulae with downturned edges, may be depressed axially and may have irregular supplementary tabellae in zone of downturning. M.Dev. (Eifel.), Asia(N.Urals); ?M.Dev. (Givet.), N.Am.(NW.Terr.).—Fig. 78,1a,b. *C. anavarenensis (Goryanov), holotype, Krasnaya shapochka no. 19; a,b, transv., long. secs., X3 (Soshkina, 1949b).

Family CENTRISTELIDAE

Tsyganko, 1971

[Centristelidae Tsyganko, 1971, p. 43]

Fasciculate or cerioid, increase lateral; corallites with narrow peripheral stereozone and irregular axial structure of few radial major septal lamellae and conical tabellae separated from normal concentric dissepimentarium by small concave tabellae; major and minor septa subequal; lonsdaleoid dissepiments absent. M.Dev.(Givet.).

Centristela Tsyganko, 1967, p. 124 [*C. fasciculata; OD; t53/5-1, IG, Syktyvkar] [=Arcotabulophyllum Goryanov in Bulvanker et al., 1968, p. 43 (type, A. anavarenensis; OD; t16, coll. 271, LGU, Leningrad; Givet., C.Asia); Acrotabulophyllum Flügel, 1970, p. 6, nom. null.]. Fasciculate or cerioid, increase lateral, nonparricidal; major and minor septa subequal, peripheral ends dilated to form narrow peripheral stereozone; tabularium an axial structure of four to eight subradial major septal lamellae and conical tabellae separated from dissepimentarium by very narrow concave tabulae; a few lonsdaleoid plates may develop in other­wise normal dissepimentarium [see also Tsyganko, 1971, p. 44]. M.Dev.(Givet.), Eu.(Pay-Khoy-Polar & near Polar Urals)-Asia(S.Fergana).—Fig. 78,1a,b. *C. anavarenensis (Goryanov), holotype, S.Fergana, Katran Ra.; a,b, transv., long. secs., X4 (Bulvanker et al., 1968).—Fig. 78,1c,d. *C. fasciculata, holotype, Givet., USSR, Pay-Khoy, Belovskaya R., c,d, transv., long. secs., X4, X3 (Tsyganko, 1967).

Family AMPLEXIDAE

Chapman, 1893


Solitary; septa amplexoid (i.e., longitudi­nally continuous only in peripheral ends, but extending and thinning toward axis as short low ridges developed on upper surfaces only of tabulae and without axial lobes or swelling; cardinal septum may be shorter, in slight fossula, and counter septum longer than others; tabulae subhorizontal with downturned edges. L.Sil.-M.Sil.; L.Dev.-M.Dev.; Miss.

Amplexus Sowerby, 1814, p. 165 [*A. coralloides; M; t44115, BM(NH), London; lectotype by Smith & Thomas, 1963, p. 163] [?=Bordenia Greene, 1901, which see; Gorskyella Kachanov, 1973, p. 83 (type, Amplexus; ischigariensis Fomichev, 1953a, p. 87, OD; 1871, coll. 5030, TsGM, Leningrad; M.Carb., C3, Donbas, ls. Nal, right bank of Zheleznaya ravine), new name for provisional new subgenus of Amplexus, Amplex­oides Fomichev, 1953a, p. 88, nom Wang, 1947a)]. Solitary, cylindrical and scoloid; wall very thin, interseptal ridges indistinguishable; tabulae flat, with downturned edges and with cardinal fossular depression; major septa thin, subequal, continuous vertically only at peripheral edges, but may extend about halfway toward axis as low, short ridges developed only on upper surfaces of tabulae; minor septa commonly not distinguishable; dissepiments absent [see Hill, 1938-1941, p. 147; Smith & Thomas, 1963, p. 43; A. anavarenensis, OD; t16, coll. 271, LGU, Leningrad; Givet., C.Asia); Acrotabulophyllum Flügel, 1970, p. 6, nom. null.]. Fasciculate or cerioid, increase lateral, nonparricidal; major and minor septa subequal, peripheral ends dilated to form narrow peripheral stereozone; tabularium an axial structure of four to eight subradial major septal lamellae and conical tabellae separated from dissepimentarium by very narrow concave tabulae; a few lonsdaleoid plates may develop in other­wise normal dissepimentarium [see also Tsyganko, 1971, p. 44]. M.Dev.(Givet.), Eu.(Pay-Khoy-Polar & near Polar Urals)-Asia(S.Fergana).—Fig. 78,1a,b. *C. anavarenensis (Goryanov), holotype, S.Fergana, Katran Ra.; a,b, transv., long. secs., X4 (Bulvanker et al., 1968).—Fig. 78,1c,d. *C. fasciculata, holotype, Givet., USSR, Pay-Khoy, Belovskaya R., c,d, transv., long. secs., X4, X3 (Tsyganko, 1967).
Fig. 78. Neocolumnariidae (2); Centristelidae (1) (p. F144).
Amplexoides Wang, 1947a, p. 174 [*Amplexus appendiculatus* Lindström, 1883a, p. 63; OD; syntypes in Richthofen Coll., HU, E. Berlin]

solitary, trochoid to subcylindrical, septa amplexoid, longitudinally continuous only in narrow peripheral stereozones, major septa extending axially only as long, low ridges developed on upper surfaces of complete, horizontal tabulae that may have downturned edges; minor septa short, no dissepiments. ?L.Sil., N.Am.(Ont.); L.Sil.-M. Sil., Asia(Szechwan).—Fig. 79,1a.b. *A. appendiculatus (Lindström), syntype, M.Sil., Szechwan, Chaotien; a,b, transv., long. secs., ×1 approx. (Lindström, 1883a).—Fig. 79,1c. A. severnensis (Parks), holotype, ?L.Sil., Ont., limestone rapids, Severn R., long. sec., restored, ×3 (Parks, 1915).

Bordenia Greene, 1901, p. 57 [*B. zaphrentiformis; OD; syntypes 23593-23600, AMNH, New York] [=?Amplexis Sowerby, 1814, which see]. Solitary, irregularly ceratoid or trochoid with talon, or weakly colonial, with peripheral offsets; major septa long but amplexoid; minor septa short; tabulae complete, horizontal, with downturned edges; no dissepiments. [See Stumm, 1948d, p. 71. Thin sections of early stages are lacking.] Miss., N.Am.(Ind.-Ky.).

?Heterophrentis Billings, 1875, p. 235 [*H. spatiosa; SD Miller, 1889, p. 193 (=Zaphrentis spatiosa Billings, 1858, p. 178, syntype, 3451a, GSC, Ottawa, not sectioned or illustrated and calcite filled with matrix, M.Dev., Rama's Farm, Pt. Colborne, Ont.; assumed to =Zaphrentis prolifica Billings, 1858, p. 176, †3449h, GSC, Ottawa, same loc., by O'Connell, 1914, p. 183)]. Solitary, large, ceratoid to trochoid; cardinal fossula prominent on convex side of corallum, alar fossulae may be prominent also; major septa thick, amplexoid, thinning toward axis; axial lobes present; cardinal septum very short; minor septa short; tabular floors horizontal in wide axial region, distally arched in periaxial region and bending abruptly downward peripherally; no dissepiments. [Diagnosis based on H. prolifica (Billings), sensu Stumm, 1949, pl. 5, fig. 10. Billings' type material must be restudied before generic name can be safely used.] M.Dev.(Couvin.), N.Am.(Ind.-Ky.-Ont.-Ohio)-S.Am.(Venez.)-Eu.(Spain).

?Lindstroemophyllum Wang, 1947a, p. 175 [*L. involutum; OD; †45053-4, GSG1, Peking]. Corallum solitary, trochoid; major septa amplexoid, long ridges on upper surfaces of tabulae, discontinuous between tabulae, convolute in axial region; minor septa very short, tertiary septa possibly present; narrow peripheral stereotype formed of dilated peripheral ends of septa; tabulae flat, complete, widely spaced; no dissepiments. M.Sil., Asia(Yunnan).—Fig. 79,3a-c. *L. involutum, holotype, Choukeng, Hueitse; a,b, transv., long. secs., ×1.5; c, part of transv. sec. showing part of peripheral stereotype between two major septa, altered during diagenesis, ×15.0 (Wang, 1947a).

Fig. 80. Kiziliidae (p. F148).

?Siphonophrentis O'Connell, 1914, p. 187 [*Caryophyilla gigantea Lesueur, 1820-1821, p. 296; OD; †not traced; M.Dev., Waren near Utica, N.Y.; =Turbinolia boucera var. elongata Rafinesque & Clifford, 1820, p. 233, †616, UMMF, Ann Arbor, neotype by Stumm, 1965, p. 23]. Solitary, large, ceratoid to cylindrical; major septa long, numerous, amplexoid, minor septa short, longitudinal ridges, their peripheral edges thickened and contiguous with those of major septa to form narrow stereozones; tabulae slightly convex, flat or depressed axially, depressed at fossula with short cardinal septum; no axial structure, no dissepiments. [Sensu Stumm, 1965, p. 23; neotype requires study by thin section before generic and subfamily names may be safely used.]
Family KIZILLIIDAE Degtyarev, 1965


**Lanophyllum** (Melanophyllidium) lanophyllum (Melanophyllidium) latitlesiculosum; OD: +4, coll. 8945, TSGM, Leningrad

Suborder STREPTELASMATINA Wedekind, 1927


Solitary, in some with a few offsets, or rarely, compound; septa imperforate; septal trabeculae coarse monacanths; major septa long but in some somewhat withdrawn from axis; axial edges of major septa ragged, with vermiform lobes or meandroid septal lamellae sparse to common and in many forming axial structure that may project as calcal boss and in which septal elements may be connected by ?synapticulae; minor septa short, commonly buried in or scarcely projecting from somewhat irregular peripheral stereozone, in a few longer and contratingent or contraclined; fossula inconspicuous and commonly on convex side of curved coralla, in early forms more or less parallel-sided, in later forms may merge with axial space within axial structure; tabulae tall domes, complete or incomplete; dissepimentlike tabellae may develop between a minor septum and the major septum against which it is contraclined. **M. Ord.-Dev.**

Subfamily STREPTELASMATINAE

Nicholson, 1889


Solitary or with few offsets, or, rarely, compound; axial edges of major septa ragged with vermiform lobes or meandroid septal lamellae in many forming axial structure; minor septa short, commonly buried in or scarcely projecting from irregular peripheral stereozone; tabular floors tall domes, tabulae complete or incomplete; no dissepiments. **M. Ord.-Dev.**
Streptelasma Hall, 1847, explanation to pl. 25, fig. 1 [*S. corniculum; SD ROEMER, 1861, p. 19; t645/1(a), AMNH, New York; lectotype by NEUMAN, 1969, p. 10] [=Streptoplasma Hall, 1847, p. 17, nom. nud.; Brachyelasma LANGE, SMITH, & THOMAS, 1940, p. 28, nom. subst. pro Dybowskaia WEDEKIND, 1927, p. 18, non DALL, 1876, nec others (type, Dybowskaia prima WEDEKIND, 1927, p. 18, OD; t11384, 11385 (dides), WEDEKIND Coll., SM, Frankfurt; U.Ord., Tyrifjord, Nor.).] Corallum solitary; trochoid, ceratoid, or cylindrical, with convex cardinal side, cardinal fossa open; major septa in early stages long, thin or moderately thick, normally fused into weak axial structure, in late stages thin, somewhat withdrawn from axis, and not forming axial structure, axial edges of major septa transversely corrugated and with sparse vermiciform lobes; minor septa rudimentary or short; peripheral stereozone present in all stages; tabulae complete, convex, with wide axial depression and mostly with lateral tabellae; no dissepiments. [See NEUMAN, 1969, p. 8. NEUMAN's revision requires reassessment of previous cosmopolitan records from Middle Ordo- vician to Lower Silurian.] M.Ord., N.Am.(N.Y.-Mich.); U.Ord., Eu.(U.K.-Nor.-Swe.-Est.-Ural); L.Sil., Asia (SW-China) S. Am. (Venez.).--Fig. 81.1a-g. *S. corniculum Hall, lectotype, up.M. Ord., low. part of Trenton Ls., USA, Middleville, N.Y.; a, central long. sec., b-g, parts of transv. secs., all X3 (Neuman, 1969).

?Aknisophyllum OLIVER, 1960a, p. 97 [*A. consuitem; OD; t137185, USNM, Washington.] Solitary, trochoid; calice inverted-conical, fossula visible in base with unthickened cardinal septum and on concave side of corallum; major septa long, dilated, and laterally contiguous so that lumen is filled; axial ends somewhat curved; minor septa extremely short; tabulae commonly suppressed due to thickening of septa except just below calice in a few corallites; no dissepiments. L.Dev., N.Am. (N.Y.).--Fig. 81.2a-b. *A. consuitem, holotype, reef facies, Coeymans Ls., N.Y.; a, b, transv. secs., ×1.5, ×6.7 (Oliver, 1960a; photographs courtesy W. A. Oliver).

Altaioelasma IVANIYA, 1955, p. 85 [*A. belgebaschiicum; OD; t1948-22, TGU, Tomsk] [=Zmeinogorskiia SPASSKII, 1960c, p. 31 (type, Z. bullischenkoi, OD; t75, coll. 7653, TSGM, Leningrad; Strizhkovsk beds, Givet, Rudny Altay), see IVANIYA, 1965, p. 10; Zmeinogorskiia FLüGEL, 1970, p. 309, nom. null.]. Solitary, cylindroconical; calice shallow, with gently sloping walls and sharp edges; major septa amplexoid and somewhat withdrawn from axis, thicker and pinnately arranged in cardinal quadrants, where their axial ends curve around inner edge of fossular depression in tabulae; cardinal septum short in mature stages; tabulae flat or somewhat sagging and with downturned edges, and with accessory tabellae grouped in zone of downturning; minor septa short, very steeply inclined, dissepiments present in some interseptal loculi. M.Dev., Asia (Altay Mongolia-Altay Kazakh.).--Fig. 82.3a-c. *A. belgebaschiicum, holotype, up. Givet, Altay, R. Belgebash, right tributary of R. Chi; a-c, transv. secs., ×2.5, ×2.0; b, long. sec., ×2.0 (Ivanovskiy, 1965).

?Archeozaphrentis IVANOVSKIY, 1959, p. 897 [*A. primigenius (figured only); OD]. IVANOVSKIY states (1963, p. 49) that this genus was founded on very scanty material and that (1965a, p. 97) the type specimens are fragments probably not from the one corallum. L.Sil.(mid.Llandov.), Asia (Sib.Platf.).

Asthenopllium GRUBBS, 1939, p. 546 [*A. orthoseptatum; OD; IUC46014, FM, Chicago]. Very small, calice very deep; major septa subequal, radial but twisting slightly together to form slight axial structure with central calical depression; minor septa very short, commonly projecting from wall as longitudinal rows of spines; presence or absence of streptelasmoid septal lobes not established; tabulae rare to absent. M.Sil., N.Am.(Ill.-Wis.).--Fig. 82.1a,b. *A. orthoseptatum, holotype, N.Y., Ill., Federal Stone Quarry, near Chicago; a, b, lat., calical views, ×3, ×4 (Grubbs, 1939).

Axiphoria CHEREPNINA, 1960, p. 389 [*A. kanica; OD; t790/1416, coll. 210, SNIGGIMS, Novosibirsk]. Solitary, rather small, conical, with rejuvenescence; well-marked isolated columella, tenui- lar in section, formed by detachment from conjoined cardinal and counter septa; septa of two orders, minor very short, confined to narrow peripheral stereozone; separated axial septal lobes interlace in axial region; tabulae domed, rising to columella or freely curved. [Fossula not described.] U.Ord., Asia(Mt.Altay).--Fig. 83.3a-b. *A. kanica, holotype, USSR, near Yakonur, Mt. Altay; a, b, transv., long. secs., ×3 (Cherep­nina, 1960).

Axolasma IVANOVSKIY, 1963, p. 33 [*A. flexuosum; OD; t8, coll. 305, IGG, Novosibirsk] [=Proto- sysringaxon IVANOVSKIY, 1963, p. 37 (type, P. primivitus, OD; t12, coll. 305, IGG, Novosibirsk; up. Llandov., R.Moyero), see WETER, 1973f, p. 702]. Solitary; septa thickened, to confluency in narrow peripheral stereozone with short, not con- tragent minor sepal; weak axial structure formed of conjoined and lobed axial ends of major septa, curved in same sense around small calical axial depression, but free laterally in outer part of tabularium in adult stages; fossula somewhat expanded toward, but not into, axis and with long, rather thin cardinal septum; tabulae sparse; dissepiments absent. L.Sil.(Llandov.), Asia (Sib.Platf.).--Fig. 83.2a-c. *A. primivitus (IVANOVSKIY), holotype, up. Llandov., R.Moyero; a-c, long., transv. secs., ×4 (Ivanovskiy, 1963;
FIG. 82. Streptelasmatidae (p. F150, F154).

photographs courtesy A. B. Ivanovskiy).

83,2b. *A. flexuosum*, holotype, up. Llandov.,
R.Moynro; transv. sec., X4 (Ivanovskiy, 1963;
photographs courtesy A. B. Ivanovskiy).

Bighornia DUNCAN, 1957, p. 608 [*B. parva; OD;
1127574, USNM, Washington]. Corallum solitary;
counter side convex, flattened in apical region with angulations at edges of flattened area coinciding with edges of alar septa; minor septa very short; cardinal septum short, in well-defined fossula; counter septum thickened at axial end and produced into lathlike, terminally rounded columella.
that rises from Grewingkia-like axial structure; tabulae present in late stages of reduced septal thickening, domed, complete or incomplete; no dissepiments. U.Ord., N.Am.(Wyo.-Colo.-Ida.-Utah-Nev.-Cal.-Texas-Iowa-Minn.-Arctic Arch.-B. C.-Manit.-Greenl.)-Eu.(Est.).—Fig. 83,4a-c. *B.
parva, Bighorn dol., Wyo., Bighorn Mts.; a, paratype, alar view, ×2; b, holotype, long. sec., ×3; c, paratype, transv. sec., ×5 (Duncan, 1957; a, USNM124801, e, USNM127576).

Borelasma NEUMAN, 1969, p. 65 [*B. crassitangens; OD; +Cn2055, RM, Stockholm]. Corallum solitary, trochoid, ceratoid or cylindrical, with convex cardinal side; cardinal fossula open; in early stages septa strongly dilated, normally contiguous laterally, major septa reaching axis without forming axial structure and cardinal septum prominent; axial lobes few; in late stages major septa short and thin; peripheral stereozoan present; tabulae numerous, complete, not highly curved, with or without lateral tabellae. U.Ord., Eu.(Swed.-Est.).—Fig. 82,2a-k. *B. crassitangens; a-d, holotype, Dalmatinita Beds, Swed., Borenshult Österg.; a, long., b-d, transv. secs., all ×3; e-k, transv., long. secs., diagram. (Neuman, 1969).

Bovenelasma SCRUTTON, 1973, p. 242 [*B. typa; OD; FR45094, BM(NH), London]. Corallum curved, ceratoid with cardinal septum on convex side; septa thickened and closing lumen in early stages and strongly thickened in cardinal quadrants in late stages; fossula narrow or poorly developed; intertwined septal elements in axial area may form low boss in calice; minor septa well developed but no dispacements; tabulae downturned peripherally, undulating or highly domed in axial area. M.Dev.(up. Llandov.), S.Am.(Venez.).—Fig. 83,5a,b. *B. typa, holotype, Cano Grande F., Cano Grande; a,b, long., transv. secs., ×2 (Scrutton, 1973).

Briantelasma OLIVER, 1960a, p. 89 [*B. americanum; OD; +11069, NYSM, Albany]. Solitary, not large, trochoid to cylindrical, erect or curved, cardinal fossula on convex side; major septa subpinnately arranged, long, extending almost to axis; minor septa one-half this length; marginarium a wide stereozoan formed by thickened and contiguous major and minor septa; thickened axial ends (?and lobes) of major septa contiguous in dense axial structure forming broad, low mesa-like boss in calice; tabulae strongly domed with axial depression and cardinal fossular depression [see Scrutton, 1973, p. 247]. Sil., N.Am.(Que.).—L.Dev., N.Am.(N.Y.-Me.); low-M.Dev., S.Am.(Venez.).—Fig. 84,3a-c. *B. americanum, holotype, recf facies, L.Dev., Coeymans Ls., N.Y.; a-c, transv. secs., ×3.0, ×1.5, ×1.5 (Oliver, 1960a; photographs courtesy W. A. Oliver).

Deiracorallium NELSON, 1963, p. 37 [*D. manitobense; OD; +10844, GSC, Ottawa]. Corallum solitary, curved, convex side markedly angulated at outer end of cardinal septum; calice fairly deep; cardinal fossula long, narrow, deep; septa numerous, straight, in cardinal quadrants arranged pinnately to fossula, in counter quadrants successively decreasing in length toward alar septa, [presence or absence of axial lobes not determined]; minor septa very short. U.Ord., N.Am.(Manit.).—Fig. 83,1. *D. manitobense, holotype, Chasm Crk. F., Churchill R.; calical view, ×2 (Nelson, 1963).

Densigrewingka NEUMAN, 1969, p. 50 [*D. pyrgoides; OD; +172919, PM, Oslo]. Like Grewingka but cardinal fossula on concave side, and axial structure with septal lobes and lamellae connected by stereoplasmatic deposits in early stages. U.Ord. (5a), Eu.(Nor.).—Fig. 84,1a-i. *D. pyrgoides, Stavnaestangen, Ringerike area; a-e, diagram, illus. of ontogeny; stippled areas indicate stereoplasmatic deposits; f, long. sec., ×1.5; g-i, holotype, transv. secs., ×2.0 (Neuman, 1969).

Densiphrenius IVANOVSKIY, 1963, p. 56 [*D. fosculatum; OD; +127, coll. 305, IGGS, Novosibirsk]. [=Rhegmaphyllum WEDEKIND, 1927, which see; ?Tungassiphyllum IVANOVSKIY, 1959, see Ivanovskiy, 1970, p. 121, WEYER, 1974a, p. 157; ?Pterophysen IVANOVSKIY, 1963, which see]. Solitary, small; major septa thickened and contiguous; in late stages cardinal septum very short, in long, wide pear-shaped fossula extending beyond axis; tabulae not distinguishable in few interseptal spaces noted; presence of axial septal lobes not proved. L.Sil.(up. Llandov.), Asia(Sib. Plat.).—Fig. 84,2a,b. *D. fosculatum, holotype, up. horizon of up. Llandov., R. Gremychi; a,b, transv., long. secs., ×4 (Ivanovskiy, 1963; photographs courtesy A. B. Ivanovskiy).

Densiphyllum DUBOWSKI, 1873c, p. 335 [*D. thomsoni; SD SHERZER, 1891, p. 284; Col1336, syntype, coll. 11, EGM, Tallinn]. [=Pycnophyllum LINDESTROM, 1873b, p. 32, nom. van. pro Densiphyllum]. Solitary, small, ceratoid; major septa straight, radially arranged, axial ends contiguous and interfingered; minor septa long, not constricting, buried in peripheral stereozoan; fossula not distinct; septal trabeculae impart scalloped edges and sides to tabulae; tabulae complete, low domes. [ imperfectly known; presence or absence of septal lobes not established.] L.Sil. (low. Llandov.), Eu.(Est.).—Fig. 85,2a-c. *D. thomsoni, syntype, Herkull; a-c, long., transv. secs., ×8, ×20, ×5 (Dwyowski, 1873c).

Grewingka DUBOWSKI, 1873c, p. 384 [*Clisiophyllum buceros EICHWALD, 1856, p. 108; SD SHERZER, 1891, p. 284; t1/241, Eichwald Coll., LGU, Leningrad]. [=Kiaerophyllum WEDEKIND, 1927, p. 17 (type, K. kiaeri WEDEKIND, 1927, p. 17, OD; t1/1469, 11470, 11486, WEDEKIND Coll., SM, Frankfurt; U.Ord., Stavnaestangen, Nor.; ?Clisiophyllum buceros Eichwald, 1856, see Neuman, 1969, p. 36); ?Cyatholasma IVANOVSKIY, 1961a, p. 120 (type, C. perforata, OD; +41, IVANOVSKIY Coll., SNIIIGIMS Novosibirsk; U. Ord., Salair; see Weyer, 1973a, p. 27); also see Rectigrewingka KALJO, 1961]. Corallum solitary, trochoid, ceratoid or cylindrical, with convex cardinal side; in early stages septa moderately or strongly dilated, major septa being long and feebly fused into narrow axial structure; in later stages major septa thin and short; axial structure broad.
Fig. 85. Streptelasmatidae (p. F154-F156).
spongy, of numerous mostly irregularly intertwined vermiform septal lobes and lamellae [possibly with synapticulae], may include medial plate; calicular boss present or absent; minor septa projecting variably from moderately wide peripheral stereozone; tabulae complete or incomplete, convex [see Neuman, 1969, p. 33].

Helicelasma Neuman, 1969, p. 28 [*H. simplex; OD; T10g.117, PM, Uppsala]. Corallum solitary; trochoid, ceratoid or cylindrical, with convex cardinal side; cardinal fossula open, indistinct; in early stages septa strongly dilated, normally contiguous laterally and major septa reaching axis without forming axial structure; in late stages major septa long and thin, their axial edges normally variably joined into loosely built axial structure; axial septal lobes few; peripheral stereozone present; tabulae complete, convex, with lateral tabellae. M.Ord.-U.Ord., Eu.(U.K.-Swed.-Est.)-N.Am.(USA-Can.-Akpatok I); ?L.Sil., Eu. (U.K.).—Fig. 86,la-f. *H. simplex, U.Ord., Dalmanitina Beds, Swed., Boremshult, Östergötld.; a, holotype, long. sec., ×2.4; b-f, serial transv. secs., ×3.0 (Neuman, 1969).

Kalijolasma Wever, 1972c, p. 450 [*Streptelasma giganteum Kaljo, 1958a, p. 21; OD; TCol1220, EGM, Tallinn]. Like Helicelasma but large and with long and commonly contratingent minor septa; small dissepiment-like plates present within contratingencies. U.Ord.(Porkun.), Eu.(Est.-?Nor.).—Fig. 85,la-c. *K. giganteum (Kaljo), holotype, Fa, Est., Porkuni; a, long. sec., ×2.0; b,c, transv. secs., ×1.3, ×2.0 (Kaljo, 1958a).

Kenophyllum Dybowsk, 1873c, p. 358 [*K. subcylindricum; M; TCol1113, coll. 11, EGM, Tallinn; lectotype by Kaljo, 1958a, p. 23] [=Cenophyllum Rye, 1875, in Zool. Rec., p. 534, nom. van.]. Corallum solitary, ceratoid or subcylindrical, cardinal side commonly concave; calice deep with deep fossula; all septa strongly dilated and contiguous laterally except in last phases, and coarsely trabeculate; major septa long, cardinal septum dominant in early stages, shortened in later stages; in early stages axial ends of septa feebly interlaced but not forming axial structure; tabulae occasional to absent. [See Neuman, 1969, p. 70; Kaljo, 1958a, p. 22; 1961, p. 59. Presence or absence of axial septal lobes not established.]

Kionelasma Simpson, 1900, p. 207 [*Streptelasma mammijemm Hall, 1882, p. 21; OD; T11057, NYSM, Albany; lectotype by Oliver, 1958, p. 825] [=Cionelasma Lang, Smith, & Thomas, 1940, p. 36, nom. van.]. Solitary, moderately large, curved, conical or somewhat compressed parallel to counter-cardinal plane, with curvature perpendicular to plane of compression; septa numerous, dilated peripherally to form moderately wide stereozone, beyond which axial ends of minor septa project but slightly; long axial ends (and lobes) of major septa dilated, twirled and connected so that large axial structure with few irregular spaces is formed and projects as boss in calice; fossula wide and deep near but not invading axial structure, with shortened cardinal septum; tabulae rising to axial structure; no dissepiments. Up.L.Dev.-?low.M.Dev., N.Am.(Ind.-Ky.).—Fig. 87,la-b. *K. mammijemm (Hall), lectotype, Jeffersonville Ls., Falls of the Ohio; a, polished sec., ×1; b, calical view, ×1 (Oliver, 1958).

Leolasma Kaljo, 1956b, p. 36 [*L. reinaniti; OD; TCol1040, coll. 77, EGM, Tallinn]. Small to medium-sized, solitary; conical, cardinal side convex; septa thickened and long in early stages, in
Fig. 87. Streptelasmataceae (p. F156-F159).
late stages thin; a few septal lobes present; in axial parts of corallum some major septa form more or less solid axial structure that does not form calicular boss; in peripheral parts thick major and minor septa form peripheral stereozone; fossula commonly indistinct; tabulae sparse, mostly incomplete [see Weyer, 1973a, p. 41; Neuman, 1975, p. 337]. M.Ord.-L.Sil.(low.Llandow.), Eu.(Est.-Nor.-Swed.)-Asia (China)-S.Am. (Venez.)

---Fig. 87,2a-h. *L. reimani, holotype, M.Ord. (Vasalem.,) Est., Rakvere; a-d, transv., e, long. secs., all diagram. (Neuman, 1975); f, long., g,h, transv. secs., X1 (Kaljo, 1956b).

**Lobocorallium** Nelson, 1963, p. 34 [*Streptelasma rusticum var. trilobatum* Whiteaves, 1895, p. 113; syntypes not traced, never figured]. Corallum solitary, curved, with two broad longitudinal furrows, giving corallum trilobate appearance, each furrow with deepest part midwall in each cardinal quadrant; cardinal fossula long, narrow, open, on convex side of corallum; septa variably thickened, numerous, major long, their axial edges with vermiciform lobes and lamellae that form with domed tabulae loose axial structure; minor septa buried in or extending but little from moderate peripheral stereozone; tabulae numerous, strongly arched. [In absence of syntypes, diagnosis framed on "Lobocorallium trilobatum var. major" of Nelson, 1963, p. 35.] U.Ord., N.Am. (Manit.-Baffin I.-GreenI.-?Anticosti).---Fig. 88,1a-c. *L. trilobatum* var. major Nelson; a, Stony Mt. F., Manit., Stony Mt., X0.75; b,c, holotype, transv. secs. at places indicated in a, X1.0 (Nelson, 1963).

*Ogilvilasma* Pedder, 1978, p. 44 [*O. discors; OD; 46098, GSC, Ottawa*]. Corallum solitary, cardinal side convex; marginarium a septal stereozone; cardinal and counter septa long in early stages, short in late stages, major septa sinuous, amplexoid, flanged; minor septa short, locally with acanthine axial edges; tabularium wide, tabulae mesa-shaped in longitudinal section. [Possibly mucophyllid.] L.Dev. (low.Zliczow.), N.Am. (Yukon).

*Parabrackyselasma* Cherepnina, 1960, p. 388 [*P. lebediense; OD; 17/5, coll. 210, SNIIGGIMS, Novosibirsk*]. Corallum dendroid to fasciculate, increase lateral; corallites cylindrical, each with narrow peripheral stereozone; septa laminar, each composed of contiguous parallel trabeculae, thinning adaxially; in adult stages major septa do not reach axis but their interlaced axial ends form loose axial structure; minor septa short; tabulae convex. [Webby, 1972, p. 152, considers this genus a synonym of *Palaeophyllum* Billings, 1858, but transverse section of the holotype appears to show streptelasmatid septal lobes and lamellae in axial zone.] U.Ord., Asia (Mt.Altay).

---Fig. 87,1a,b. *P. lebediense, holotype, R. Lebed; a, transv. sec., X3 (Ivanovskiy, 1969); b, long. sec. of single corallite, X2 (Cherepnina, 1960).

*Paramplexoides* He in Kong & Huang, 1978, p. 44
**Rugosa—Stauriida—Streptelasmatina**

[*P. cylindricus*; OD; ǂKO96-KO99, museum not traced; U.Ord., up. Wufeng F., Chandi Xian (county), Guizhou (Kweichow)]. Solitary; septa thin, major moderately long, somewhat waved, minor very short; tabulae adaxially declined, commonly complete. [Diagnosis tentative, from illustrations. U.Ord., Asia (Kweichow).

**?Pterophrentis** IVANOVSKIY, 1963, p. 53 [*P. allae; OD; ǂ24, coll. 305, IGG, Novosibirsk*] [=*Tungussophyllum* IVANOVSKIY, 1959, p. 897, see *?Densiphylen*, *Rhegmaphylum* IVANOVSKIY, 1970, p. 121; WEVER, 1974a, p. 157]. Corallum solitary, with narrow peripheral sterezone and long cardinal fossula lenticular in section, bisected by long cardinal septum and lined by thickening on neighboring septa; septa thickened, especially in cardinal quadrants; axial ends of metasepta pinnately curved with regard to cardinal and alar septa, and may not attain axis; minor septa short; tabulae rare, complete; no dissepiments; [presence of axial lobes unproved]. L.Ord., Asia (Sib. Plaf.).—Fig. 87, 5a, b, *P. allae*, holotype, R. Stony Tunguska; a, b, long., transv. sees., X4 (Ivanovskiy, 1965a).

**?Pycnactoides** HE in KONG & HUANG, 1978, p. 52 [*P. marginotabulatus*; OD; ǂKO43-KO45, museum not traced; U.Ord., up. Wufeng F., Bijie, Guizhou (Kweichow)]. Solitary; septa numerous, thickened, with axial lobes, and possibly amplexoid; tabular floors concave, tabulae complete; no dissepiments. [Diagnosis tentative, from illustrations suggesting in places that septa may be of discrete to contiguous monacanths as in *Hilophyllum* WEBBY, 1971, Cystiphyllida, Tryplasmatidae.] V.Ord., Asia (Kweichow).

**Rectigrewingkia** KALJO, 1961, p. 62 [*Grewingkia anthelmion FYDBOWSKY, 1873c, p. 388; OD; ǂprobably lost, orig. fig. FYDBOWSKY, 1873c, pl. 2, fig. 6; lectotype by KALJO, 1961, p. 62*] [=*Grewingkia* FYDBOWSKY, 1873c, which see; see NEUMAN, 1969, p. 35; WEVER, 1972c, p. 450]. Like *Grewingkia* but with septal lobes uniform and erect, forming wide, open axial structure protruding as low calicular boss and granular in transverse section. U.Ord., Eu. (Est.).—Fig. 89, 3a, b, *R. anthelmion* (FYDBOWSKY); a, lectotype, Wormsi horizon, Palukyula, Est., lateral view, X1 (Dybowski, 1873c); b, another specimen, Fb, Paopä, Est., transv. sec., X2 (Kaljo, 1961).

**Rhegmaphylum** WEDEKIND, 1927, p. 14 [**"Regmaphylum turbinatum* (HSINGER),**] questionably =*Zaphrentis? conulus* LINDBRÖM, 1868, p. 428; SD SOSHINKA, 1937, p. 85, see LANG, SMITH, & THOMAS, 1940, p. 114, also WEVER, 1974a, p. 159; selection of type should be made only after detailed study of HSINGER'S and WEDEKIND'S material [**=Regmaphylum** WEDEKIND, 1927, p. 74, nom. null.; **Rhegmatophyllum** LANG, SMITH, & THOMAS, 1940, p. 114, nom. van.: **=Tungussophyllum** IVANOVSKIY, 1959, p. 897 (type, *Zaphrentis? conulus* LINDBRÖM, 1868, p. 428, OD; ǂCN5942, RM, Stockholm; Sil., Gotl.).] = *Densiphyloides* GE & YI, 1974, p. 166 (type, *D. yichangensis*, M; ǂ22064-6, IGP, Nanking; L.Sil., Peng Jai F., Hupei, Yichang). Solitary, relatively small, erect-conical, with infundibuliform calice; septa radically arranged, thick in early stages, thinning distally; axial ends of major septa connected in groups that...
vary distally, at or near axis, and giving off vermiform axial lobes; cardinal septum shortened in fossula in calice and in some immediately below calice; septal trabeculae associated with sculpturing of distal edge and faces of peripheral parts of septa; fossula may open into axial tabulate space; tabulae axially horizontal or slightly concave, peripherally moderately steeply declined; no dissepiments. *L.Sil.-M.Sil., Eu.(Goll.-Est.-UK.); Asia(Sib.Platf.- ?Hupei) - N.Am.(Que.-Cal.); *U.Sil., Eu.(Goll.)—Fig. 89, a-a. *R. conulus (Lindström), M.Sil., Goll.; a, calical view, X2; b, part of a, X4; c, long. sec., X2 (Lindström, 1896b).

**Siphonolasma** HE in KONG & HUANG, 1978, p. 43 [*S. obliquitabulatum; OD; tYO143-YO146, museum not traced, chosen by HE, 1978, p. 42; U. Ord., up. Wufeng F., Bijie, Guizhou (Kewichow)]. Solitary; cardinal side concave, cardinal fossula very deep; septa thick, major septa long and somewhat ?plexoid, axial edges lobed, confluent in groups; minor septa moderately long, confined to peripheral stereozones; tabulae complete or incomplete, obliquely declined from counter to cardinal side of corallum and markedly deepened in cardinal fossula. [Diagnosis tentative, from illustrations.] U.Ord., Asia(Kewichow).

**Triplophyllum** SIMPSON, 1900, p. 209 [*Zaphrentis terebrata HALL, 1883, p. 316; OD; t3841/1 (=341), NYSM, Albany (original HALL, 1883, pl. 23, fig. 5); lectotype by Simpson, 1900, p. 209]. Solitary, curved-conical; calice deep, with deep narrow fossula on concave? side, bounded by unfused adjacent metasepta and occupied by cardinal septum with distal edge lower than others; septal insertion accelerated in counter quadrants; major septa long, but in very late stages withdrawn somewhat from axis, leaving axial space floored by tabulae; minor septa short, ?no dissepiments; tabular floors domed. [Presence or absence of axial septal lobes unknown. See STUMM, 1965, p. 22; EASTON, 1944b, p. 38.] M.Dev.(Eifel.). N.Am.(Ind.-Ky.).—Fig. 89,2. *T. terebratum (HALL), holotype, M.Dev., Falls of the Ohio; calical view, X1 (Easton, 1944b). [It is assumed from this photograph that the uppermost tabula has been broken between the axis and the withdrawn axial edges of the major septa of the counter quadrants.]

**Ullernelasma** NEUMAN, 1975, p. 346 [*U. swartoevenae; OD; t16761, PM, Oslo]. Solitary, conical to cylindrical, cardinal side convex; in early stages septa strongly dilated, almost filling lumen, major septa long, may be fused in weak axial structure with few septal lobes; in late stages major septa short and thin, axial structure absent and peripheral stereozone moderately wide, minor septa extending but little beyond it; tabulae few, incomplete. U.Ord.(5b), Eu.(Nor.).—Fig. 89, 1a-d. *U. swartoevenae, holotype, Vestre Svartøya, Ringerike; a-c, transv., d, long. secs., all diagram, approx. X1.5 (Neuman, 1975).

Subfamily **NEVADAPHYLINAE** Hill, new subfamily

Solitary, large; marginarium wide, peripherally an irregular septal stereozone and adaxially a variably wide dissepimentarium with distinctive long, irregular, adaxially declined dissepiments; fossula large, deep, expanding adaxially where it penetrates axial structure of convolute and lobed major septal ends and domed tabularial floors. *L.Dev.(Ems.)*

**Nevadaphyllum** STUMM, 1937, p. 429 [*N. masoni; OD; t94447, USNM, Washington]. Solitary; septa numerous, long; cardinal fossula long, expanding adaxially, with short cardinal septum and with deeply depressed floor; septa dilated in marginarium to form wide, somewhat irregular peripheral stereozone in which few interseptal loculi remain, with elongate dissepiments; major septa thinner in tabularium, attaining axial region and somewhat convolute; tabular floors axially depressed domes, their peripheral edges curved so that periaxial trough is formed; tabulae incomplete, of numerous tabellae. *L.Dev.(Ems.)* [see also MERRIAM, 1974, p. 44], N.Am.(Nev.).—Fig. 90,3a-b. *N. masoni, paratype, basal 500 ft. of Nevada Ls., Nev., Lone Mt., 18 mi. NW. of Eureka; a,b, transv., long. secs., X1.3 (Hill, n; photographs courtesy W. A. Oliver, USNM94447a).

Subfamily **DINOPHYLLINAE** Wang, 1947


Solitary, moderately large; major septa long, in late stages thin, forming with septal lamellae and conical or domed tabulate an axial structure that projects as calical boss; cardinal fossula shallow, broad, open, on convex side; minor septa short, no dissepiments. *L.Sil.-M.Sil.-U.Sil.?base of Dev.*

**Dinophyllum** LINDSTRÖM, 1882b, p. 21 [*D. involutum; M; figured syntypes Cn44a, 20687-20693, 55155-55157, RM, Stockholm] [=Streptophyllum Grabau in CHI, 1931, p. 24 (type, Clisiophyllum hisingeri MILNE-EDWARDS & HAME, 1851, p. 410, SD LANG, SMITH, & THOMAS, 1940, p. 125; t299ter.b, MN, Paris, lectotype by LANG, SMITH, & THOMAS, 1940, p. 125; =Dinophyllum involutum LINDSTRÖM, 1882b, p. 21; ?Neo­brachyelasma NIKOLAEVA, 1960, which see; ?Porfrievella IVANOVSKY, 1963, which see; ?Tennelarina IVANOVSKY, 1965a, which see]. Solitary, curved, conical or conicocylindrical coralla, cardinal fossula moderately deep and wide, on convex side; major septa long, thin in late stages, reaching to axis where, with or without convoluted of their axial ends, they form an axial struc-
ture (and calical boss) with steeply conical tabulae, septal lamellae, and vermiform lobes; minor septa extremely short; no dissepiments. \textit{L.Sil.}, Eu. (Gotl.-Nor.-Vaygach l.)-Asia (Sib.Platf.)-Australia (Queensl.); \textit{M.Sil.}, Eu.-Asia (Sib.Platf.)-Australia (Queensl.).—Fig. 91,2a-c. \*\textit{D. hisingeri} (MILNE-EDWARDS \& HAIME), \textit{L.Sil.}, Gotl.; \textit{a,c}, calical views, X1; \textit{b}, long. sec., X2 (Lindström, 1896b).

\*\textit{Crassilasma} IVANOVSKII, 1962, p. 126 [\*\textit{C. simplex}; OD; t68b, coll. 2, SNIIGGIMS, Novosibirsk, holotype lost; neotype, 71, coll. 305, IGG, Novosibirsk, by IVANOVSKII, 1976, p. 47]. Coralium solitary, major septa long, thick, and radially arranged peripherally, but thinning somewhat and twirling adaxially in groups; minor septa rudimentary; presence or absence of axial septal lobes unclear; fossula indistinct; tabulae sparse, flat or slightly concave or convex; dissepiments absent. \textit{L.Sil.}, Asia (Sib.Platf.-Szechwan)-?Eu. (U.K.-Vaygach l.).—Fig. 91,3a-d. \*\textit{C. simplex}, up. Llandov., Asia, R. Moyero; \textit{a}, long., \textit{b-d}, transv. secs., X2 (Ivanovskii, 1962).

\*\textit{Neobrachyelasma} NIKOLAEVA in MARKOVSKII, 1960, p. 220 [\*\textit{N. balchaschica}; OD; t1, coll. 5747, TsGM, Leningrad] \*\textit{Dinophyllium LINDBOM, 1882b}, which see, IVANOVSKII, 1970, p. 121]. Large, solitary, conical or conicocylindrical; calice
deep, with steep walls and convex-concave floor, fossula not strongly marked; an insignificant peripheral stereozone; major septa thin, long, spirally curved, ends or lobes or lamellae coiled in wide axial structure; minor septa short; tabulae complete or incomplete, convex in marginal zone and concave at axis and connected to one another in batteries of omphymoid character; dissepiments absent. U.Sil. or ?L.Dev., Asia (N.L.Balkhash area).—Fig. 92,1a,b. *N. balchaschicum, holotype, Aynasu horizon, Tokkau-Kenterlau Interfluve, L. Balkhash area; a,b, transv., long. secs., X1.3 (Markovskiy, 1960). *Porfirieviella IVANOVSKY, 1963, p. 39 [*Zaphrentis stockii MILNE-EDWARDS & HAIMÉ, 1851, p. 330, sensu SHROCK & TWINHOFEL, 1939, p. 250, pl. 27, fig. 7-10; OD; not traced; MILNE-EDWARDS & HAIMÉ figured specimen is ZI4a in MILNE-EDWARDS & HAIMÉ Coll., MN, Paris] [=Dinophyllum LINDSTROM, 1882b, which see, IVANOVSKY, 1970, p. 121]. Solitary, conical, erect to curved; major septa reach or nearly reach axis where they may coil somewhat; minor septa short; dissepiments may occur in late stages; tabular floors domed to conical, of tabellae. [Insufficiently known.] L.Sil., N.Am.(Newf.).—Fig. 91,la,b. *P. stockii (MILNE-EDWARDS & HAIMÉ sensu SHROCK & TWINHOFEL), Pike Arm F., Newf.; a,b, transv. secs. of 2 specimens, X1 (Shrock & Twenhofel, 1939). Tenuilasma IVANOVSKY, 1965a, p. 103 [*T. tenue; OD; in coll. 236, IGG, Novosibirsk] [Dinophyllum LINDSTROM, 1882b, which see, IVANOVSKY, 1970, p. 121]. Solitary, with thin metasepta arranged pinnately in relation to short, thin cardinal and counter septa; minor septa thin, very close to major septa on their counter sides; tabulae domed, commonly with supplementary tabellae, especially peripherally; dissepimentlike plates possibly present in narrow minor septal loculi, normal tabulae in wider ones. L.Sil., Asa(Sib.Plat.).—Fig. 92,2a-c. *T. tenue, holotype, up.Llandov., R. Gorbiyachin; a, long. sec., b,c, transv. secs., all X2.7 (Ivanovskiy, 1965a; photographs courtesy A. B. Ivanovskiy).

Subfamily DALMANOPHYLLINAE Lecompte, 1952

[Dalmanophyllinae Lecompte, 1952, p. 464]

Solitary, not large, curved, cardinal side convex; with axial structure dominated by median plate continuous in early stages with cardinal and counter septa, but disconnected from one or both in late stages, when cardinal septum may shorten; major septa with axial vermiform lobes or septal lamellae that may conjoin in axial structure; minor septa short; tabulae complete or incomplete, somewhat declined abaxially; no dissepiments. U.Ord.-M.Sil.
Dalmanophyllum Lang & Smith, 1939, p. 153
[*Cyathaxonia dalmani Milne-Edwards & Haime, 1851, p. 322; OD; figured syntype, 704, de Verneuil Coll., EM, Paris (S. Smith, 1930, in litt.)] [=Centrotus Lindström in Thomson & Nicholson, 1876a, p. 128 (type, Cyathaxonia dalmani Milne-Edwards & Haime, 1851, M), non Centrotus Fabricius, 1803, a hemipteron; ?Protyria Cotton, 1973, p. 166, nom. subst. pro Cyathaxonia Schaff, 1933, p. 33 (type, T. inserta, OD; 174640, PM, Oslo, lectotype by Lang, Smith & Thomas, 1940, p. 136; Zone 5b, Lilla Svarth, Tyrifjord), non Tyria Huebner, 1819, a lepidopteron]. Solitary or (in Protyria) ?compound, calice deep with large, bladelike columellar boss, elliptical in section; major septa long and thick with axial lobes joining columella, which is upwardly produced part of conjoined cardinal and counter septa; cardinal septum in fossula on convex side of corallum, and shortened in late stages; minor septa very short, peripheral stereochrome narrow; tabulae thin, steeply declined abaxially [see Minato, 1961, p. 85]. L.Sil.-M.Sil. (low.Wenlock.), Eu.(Gotl.-U.K.); L.Sil., N.Am. (Cal.); M.Sil., ?N.Am.(Ind.-Ky.-Wis.).—Fig. 90,2a,b. D. dalmani (Milne-Edwards & Haime), Gotl.; a,b, transv., long. secs., ×2.7 (Minato, 1961).

Bodophyllum Neuman, 1969, p. 54 [*B. osmundense; OD; †D1292, PM, Uppsala]. Solitary, small to medium-sized; ceratoid, trochoid, or subcalcoid; cardinal side convex; calice deep with prominent calicular boss rounded or elliptical in transverse section; axial structure solid, fairly narrow, of septal lobes, ?synapticulae, and few lamellae originating from long major septa; minor septa short, peripheral stereochrome narrow; tabulae few, domed, incomplete or complete [see Weyer, 1974a, p. 158]. U.Ord., Eu.(Nor.-Swed.-?Scot.-?Eire.-?Wales.).—Fig. 90,1a-h. *B. osmundense,
Small, compressed or calceoloid streptelasmatsids without axial septal lobes. L. Dev.-M. Dev. Grouping very tentative.

Homalophyllum SIMPSON, 1900, p. 221 [*Zaphrentis ungula ROMINGER, 1876, p. 151; OD; t8619, UMMPP, Ann Arbor; see STUMM, 1965, p. 23]. Solitary, at least in early stages calceoloid, with flattened side cardinal, or somewhat compressed in alar septal plane; septa numerous, long, thickened to contiguity in wide marginarium and in axial region, but in calice may leave narrow trenchlike space in alar septal plane; counter septum taller or thicker, cardinal septum less tall than others; cardinal septum in deep fossula extending to axis into axial zone of septal thickening that forms nonspongy axial structure; no dissepiments, minor septa not contratingent [see OLIVER, 1958, p. 819; SCHINDEWOLF, 1938, p. 451]. L. Dev., N. Am. (Ind.-Ky.).——Fig. 93, la,b. ·H. ungula (ROMINGER), holotype, L. Dev., Jeffersonville Ls., coral zone, Ind., Falls of the Ohio; a,b, calicular side views, X1 (Stumm, 1965).

Angustiphyllum ALTEVOGT, 1965, p. 88 [*A. cuneiforme; OD; tB.28, type coll., GPl, Münster/Westfalen]. Corallum small, solitary, sphenoid; no epitheca preserved; calical edges of septa sloping down toward wall, calice without axial deepening; major septa thick, almost completely contiguous, directed toward and meeting at long axial plane of wedge; cardinal septum in middle of broad side of wedge; minor septa stunted to absent; no coarse septal trabeculae observed; tabellae rare. M. Dev. (Eifel), Eu. (Spain).——Fig. 93, 3a-e. ·A. cuneiforme, Gosseletia Ss., Spain, Playa de Candas, Prov. Oviedo; a,b, holotype, lat., calicular views, X2; c-e, paratype, transv. secs., X2 (Altevogt, 1965).

Compressiphyllum STUMM, 1949, p. 13 [*Zaphrentis compressa ROMINGER, 1876, p. 151; OD; t8620, UMMPP, Ann Arbor; see STUMM, 1965, p. 22; =Zaphrentis dusiana MILLER, 1889, p. 209, nom. subst.; non Z. compressa MILNE-EDWARDS, 1860, p. 342]. Solitary, compressed parallel to countercardinal plane; cardinal fossula deep, long; septa dilated peripherally to form narrow peripheral stereozone, elsewhere attenuate; major septa extending almost to axis, minor septa reaching but little beyond stereozone; cardinal septum long, but distally shortened in calice; axial edges of septa with lobes; tabulæ arched periaxially; no dissepiments [see also OLIVER, 1958, p. 826]. L. Dev., N. Am. (Ind.-Ky.).——Fig. 93, 4a-e. ·C.
Subfamily ENTEROLASMATINAE Hill, new subfamily

Solitary, with spongy axial structure of corrugated and variably fused axial ends of major septa, of vermiciform axial lobes or lamellae, and of ?synapticulae; major septa carinate or waved parallel to distal edges; minor septa short; fossula may be indistinct; tabulae domed; no dissepiments. U. Sil.-L.Dev.

Enterolasma SIMPSON, 1900, p. 203 [*Streptelasma strictum HALL, 1874, p. 114; OD; syntypes, 258-259, 11051-11053, NYSM, Albany, and 2283, AMNH, New York] [=Palaeocyathus FOERSTE, 1888, which see, but in U.Sil. species E. waynense (SAFFORD), thin tabular films appear parallel to distal edges of septa; Enterelasma LANG, SMITH, & THOMAS, 1940, p. 58, nom. van.]. Small, cylin-droconical, commonly erect; narrow peripheral stereozone formed by thickening of peripheral ends of major and short minor septa; major septa ridged, furrowed or waved parallel to distal edges, their axial edges lobed and variably coalescent; axial edges of minor septa free; cardinal and counter septa long; tabulae domed, or, in some, tabular films parallel to distal edges of septa [see SUTHERLAND, 1965, p. 22; WEYER, 1974a, p. 161]. U.Sil.-L.Dev., N.Am.(N.Y.-Okla.-Tenn.); L.Dev.(Ems.), Eu.(Spain).—Fig. 94, 3a-b. *E. strictum (HALL), L.Dev.(Helderberg), N.Y., Clarksville; a, natural long. sec., enl.; b, axial ends of major septa in natural transv. sec., enl. (Simpson, 1900).

Palaeocyathus FOERSTE, 1888, p. 129 [*Cyathophyllum australi, p. 128; SD LANG, SMITH, & THOMAS, 1940, p. 94; tR26519, BM(NH), London; lectotype by HILL, 1940c, p. 410] [=Enterolasma SIMPSON, 1900, which see; Orthopaterophyllum
Subfamily BREVIPHYLLINAE Hill, new subfamily

Solitary; septa numerous, major septa withdrawn more or less from axis and amplexoid; minor septa long, projecting far into tabularium; long, steeply declined dissepiments may develop peripherally; fossula more or less distinct, cardinal septum short; tabular floors low domes with wide, flat or more or less distinct, cardinal septum short; tabular floors low domes with wide, flat or depressed axial parts. L.Dev.

Breviphyllum STUMM, 1949, p. 25 [*Amplexus lonesis STUMM, 1937, p. 428; OD; t94445, USNM, Washington]. [?Breviphyllum STUMM, 1949, which see]. Solitary; septa numerous, major septa withdrawn about halfway from axis, minor septa half as long, cardinal fossula indistinct; inner plates between minor and major septa mostly concave outward and thus periaxially tabellae; true periaxial tabellae only, dissepiments absent; tabular floors mesa-shaped, edges declined abaxially to wall or bent downward to join tabula next below [see MERRIAM, 1974, p. 42]. L.Dev.(Ens.).—Fig. 95, a,b. *B. invaginata (STUMM), holotype, low beds Nevada F., Nev., Attyra Peak, Eureka mining dist.; a,b, transv., long. secs., x2 (Hill, n; photographs courtesy of W. A. Oliver).

Family DITOECHOLASMATIDAE Sutherland, 1965

[Ditoechasmatidae Sutherland, 1965, p. 35] [=Ditoechasmatinae Weyer, 1972c, p. 452]

Solitary, small, with slender peripheral stereozone; septa long, somewhat thickened, may be waved or carinate parallel to distal edges; axial edges of major septa lobed and variably carinate, forming loose axial structure; alternate (?minor) septa less long, contratingent; in contratingently closed interseptal loculi, horizontal skeletal elements commonly subparallel to distal edges of septa, i.e., declined somewhat adaxially; in alternate interseptal loculi, tabulae declined abaxially to wall; in all except four contratingencies [interpreted by Sutherland as due to splitting of cardinal, counter and the two Kim septa], two very short ridges (?tertiary septa) projecting adaxially from wall; correspondence between median septal planes and longitudinal furrows on epithecate wall imperfect. U.Sil.

Ditoecholasma SIMPSON, 1900, p. 200 [*Petraia fanningana SAFFORD, 1869, p. 320; OD; tmissing, fide Sutherland, 1965, p. 36] [=Ditoecholasma LANG, SMITH, & THOMAS, 1940, p. 53, nom. van.]. Characters as for family. U.Sil.(Ludlov.). N.Am. (Tenn.-Okla.).—Fig. 95, 2a,b. *D. fanninganum (SAFFORD), Brownsport F., Tenn.; a,b, long., transv. secs., x3 (Amsden, 1949).—Fig. 95, 2c,d. D. laurencensia SUTHERLAND, Henryhouse F., Okla.; c,d, diagram., transv. secs., showing septal pattern, X15, X9; 1, major septa; 2, minor septa; 3, third order septa added in position I (contratingently closed interseptal loculus) only; position II, in alternate interseptal loculi (Sutherland, 1965).

Family PALIPHYLLIDAE Soshkina, 1955

[Paliphyllidae Soshkina, 1955, p. 121] [=Paliphyllinae IVANOVSKY, 1965a, p. 75]

Solitary, moderately large; septa numerous, long, trabeccular axes distant; axial septal lobes or lamellae forming, with tabulae and tabellae, axial structure that may also contain medial plate or colurnella;
FIG. 95. Streptelasmataidae (1, 3); Ditoccholasmatidae (2) (p. F166).
minor septa may be contratingent, contralined, or normal; tabular floors domed; marginarium a more or less wide dissepi­mentarium. *U. Ord.-M. Sil.*

**Paliphyllum** Soshkina in Ivanova et al., 1955, p. 121 [*P. primarium*; OD; t3057, coll. 587, PIN, Moscow] [=?*Sclerophyllum* Reyman, 1956, which see, Neuman, 1968, p. 231; *?Protocyathar­tis* Ivanovskiy, 1961b, which see, Ivanovskiy, 1970, p. 121]. Corallum solitary, conical, slightly curved, cardinal fossula on convex side, calice with broad axial boss; major and minor septa long, numerous, thickening slightly toward periphery, thinned adaxially; peripheral stereozone absent; cardinal septum in long, narrow fossula; cardinal and counter septum may be continuous and form, with interlaced axial ends and lamellae.
from other major septa, an axial boss; tabular floors domed; dissepimentarium wide, of variably sized, somewhat globose dissepiments, moderately steeply inclined [see Newman, 1968, p. 230].

*P. primarium*, holotype, up. Stolbor suite, Sib., R. Stony Tunguska; a,b, transv., long. secs., X3 (Ivanova et al., 1955).

†Cystipaliphyllum Lavrusevich, 1964, p. 22 [†C. kimi; OD; 16/58, ?UpG, Dushanbe]. Solitary,
cornute; major septa long but not reaching axis, though septal lobes or discrete trabeculae form very open structure axially; minor septa long and contraclined; cardinal fossula with shortened cardinal septum; dissepimentarium wide, lonsdaleoid peripherally, normal in inner parts; tabular floors subhorizontal in narrow peripheral zone and broadly domed in wide axial region; tabulæ close, elongate. *L.Sil.(low-LLand.)*, Asia(Tadzhik.).—Fig. 97,1a,b. *G. kimi*, holotype, low. LLand., Zeravshan-Gissar Ra., right bank R. Karasu at Shakhrimonon crossing; a,b, transv., long. secs., X2 (Lavrusevich, 1964).

**Gissarophyllum** LAVRUSEVICH, 1964, p. 23 [*G. paligerum; OD; †8806, UpG, Dushanbe*]. Solitary, large, septa long, major septa extending unequally almost to axis, and may have lobed axial edges, minor septa contraclined or contraquent; in early stages septa thickened especially in tabularium, thickening retained longest in tabularium during ontogeny; dissepimentarium wide, normal; tabulæ domed, incomplete. *L.Sil.(low-LLand.)*, Asia(Tadzhik.).—Fig. 98,1a-c. *G. paligerum*, holotype, mouth of Arba-shir gully, Zeravshan-Gissar Ra.; a,b, transv. secs., X1; c, long. sec., X1 (Lavrusevich, 1964).

**Neopaliphyllum** ZHELTONOGOVA, 1961, p. 76 [*N. soshkinae; OD; †1301, coll. 1508, ZSGUp, Novokuznetsk*]. Solitary, calice shallow with reverted margins and low axial boss; major and minor septa numerous, long, thickened and carinate in wide dissepimentarium, minor septa contraquent, contraclined or normal; a narrow, well-defined axial structure formed of isolated, curved, major septal lamellae, of tabellae, and of small solid columella, oval in transverse section, formed by thickening and isolation of axial end of cardinal septum that lies in narrow, open fossula; dissepiments numerous. *M.Sil.*, Asia(Salair Mts.-Altay-E.Urals.).—Fig. 96,3a,b. *N. soshkinae*, holotype, Baskuskan suite, Salair, left bank R. Baskuskan; a,b, long., transv. secs., X3 (Zheltonogova, 1961).

**Protocyathactis** IVANOVSKIY, 1961b, p. 205 [*P. cybaea; OD; †11, coll. 304, IGG, Novosibirsk*] [*=Paliphyllum Soshkina, 1955, which see, Ivanovskiy, 1970, p. 121*]. Corallum subcylindrical or ceratoid; septa somewhat thickened throughout, of two orders; minor septa moderately long, contraquent, contraclined or normal; axial complex very weak, of few lobes or lamellae; tabulæ domed, incomplete; dissepimentarium moderately wide with numerous small inflated dissepiments. *U.Ord.*, Asia(Sib.Platf.).—Fig. 98,2a,b. *P. cybaea*, holotype, up. Dolbor., USSR, R. Lower Chunku, basin of R. Stony Tunguska; a,b, transv., long. secs., X4 (Ivanovskiy, 1961b).

**?Protoramulophyllum** NIKOLAEVA, 1964, p. 50 [*P. kazakhstanicum; OD; †R-1/5747, TsGM, Leningrad*]. Solitary; septa moderately thick, major

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Fig. 98. Paliphyllidae (p. F170-F171).
septa long, their axial ends somewhat curved, lobed, running irregularly together; minor septa not long; tabularium wide, tabulae incomplete, tabular floors broad domes somewhat flattened axially, their edges turned neither out nor up; disseminatium narrow, disseminata declined adaxially, interseptal, somewhat elongate, commonly obscured by septal thickening; cardinal fossula evident in early stages. L-Sil., Asia (C. Kazakh.).—Fig. 96, a-b. *P. kazakhstanicum*, holotype, S. foothills, Chingiz Ra., near Karanay; a-b, long., transv. secs., X3 (Nikolaeva, 1964).


**Sumsarophyllum** Lavrusevich, 1971c, p. 5 [*S. patella*, OD; t133, coll. 1030, UpG, Dushanbe]. Solitary, large; patellate; with very wide disseminatium; disseminata very small and numerous, some horizontally based; septa very long, of fine trabeculae; alternation of major and minor septa unclear [suggesting septal structural modification, cf. *Arcanophyllum*]; tabularium narrow, with axial structure of axial lobes granular in section and convex tabellae. [Insufficiently known; possibly arachnophyllinan.] U.Ord., Asia(Tadzlik).—Fig. 97, 3-a-c. *S. patella*, holotype, low. Archalyk Beds; Zeravshan-Gissar Ra., right side R. Karasu, 2 km. W. of meridian of Sanglar crossing; a-c, transv., b, long. secs., all X1.5 (Lavrusevich, 1971c).

**Family KODONOPHYLLIDAE** Wedekind, 1927


Solitary, fasciculate or cerioid; marginarium a wide stereozone of contiguous thickened major and minor septa, axial ends of major septa more or less curved and ragged (lobed); septal trabeculae unserial, compound, or multiserial; tabular floors domed, tabulae complete or incomplete; no disseminata. ?U.Ord.; Sil.-M.Dev.

**Kodonophyllum** Wedekind, 1927, p. 34 [*Streptelasma Milne-Edwards* Dywowski, 1873c, p. 409; OD; tnot traced; =Madrepora truncata Linné, 1758, p. 795, see Smith & Tremberth, 1929, p. 368; tnot traced] [=Patrophontes Lang & Smith, 1927, p. 456, type, Madrepora truncata Linné, 1758, p. 795, OD; tnot traced; Sil., Gotl.]. *Kodonophyllum* Lang, Smith, & Thomas, 1940, p. 39, nom. van.). Solitary or weakly fasciculate, with peripheral increase; marginarium a wide septal stereozone without disseminata; fossula indistinct; major septa extending almost to axis, but relatively thin in tabularium where axial edges may be lobed or waved and turned aside; septal trabeculae unserial monacanth, wider in tangential than in radial direction; tabulae incomplete, floors arched [see Couper, 1962, p. 23; Oliver & Galle, 1971b, p. 68]. ?U.Ord.-L-Sil., Eu.(Est.); L-Sil., Asia(SW.China); M-Sil.-U.Sil. (Ludlov.). Eu.(U.K.-Nor.-Swd.-Est.-Urals)-Asia (Kazakh.).—Fig. 99, a-b. *K. truncatum* (Linné); up.Wenlock-lower.Ludlov., Klinkert berg, Gotl., Klintenberg; a-b, transv., long. secs., X2 (Hill n; UQF34169).

**Bulvankeriphyllum** Goryanov, 1966, p. 56 [*B. mirandum*; OD; t107, coll. 271, LGU, Leningrad]. Solitary coralla with wide marginarium formed by dilation to contiguity of minor septa and peripheral parts of major septa; major septa withdrawn from axis, except that two ?(cardinal and counter) may unite and have lenticular dilation at axis forming lamellar columnella; septa uncertain (?or lobes) sparse; fossula indistinct; tabulae domed, complete or of wide tabellae; no disseminata. L.Dev., Asia(Zeravshan Ra., C.Asia).—Fig. 99, a-b. *B. mirandum*, holotype, left bank of Shishkat ravine; a-b, long., transv. secs., X5 (Goryanov, 1966).

**Chlamydoophyllum** Pojeta, 1902, p. 134 [*C. obtusum*; M; t7329, NM, Prague; lectotype by Oliver & Galle, 1971b, p. 78] [=Zelophyllia Soskina, 1952, which see]. Solitary; marginarium a wide peripheral stereozone formed from contiguous major and minor septa; in tabularium major septa notably less thickened and may be weakly convolute, their axial edges irregularly thickened and tortuous; tabulae complete or incomplete, floors flat or arched; near periphery septal trabeculae multiserially arranged and subparallel, in tangential planes diverging somewhat, but toward tabularium septal trabeculae ?rabdactans. L.Dev. (Siegen-Ems.). Eu.(Czech.-France)-Australia (New S.Wales-Queens.).—Fig. 99, a-b. *C. obtusum*, up. Koněprusy Ls., Czech., Zlatý Kůň near Koněprusy; a, lectotype, transv. sec., X2; b, paralectotype, long. sec., X2 (Oliver & Galle, 1971b).
Kodonophyllidae (p. F171-F173).

Fig. 99. Kodonophyllidae (p. F171-F173).

Bulvankeriphyllum

Kodonophyllum

Circophyllum

Chlamydophyllum
Rugosa—Stauriida—Streptelasma
tina

*Circophyllum* Lang & Smith, 1939, p. 153, nom. subst. pro *Rhysodes* Smith & Tremberth, 1927, p. 311, non *Rhysodes* Illiger in Kalman, 1823, a coleopteron [*Rhysodes samsugnensis* Smith & Tremberth, 1927, p. 311; OD; tR24355, BM (NH), London] [= *Rhysodes Ivanovskyi*, 1973b, p. 282, nom. van.]. Fasciculate, increase peripheral, parricidal; corallites slender with narrow peripheral septal stereozone; major septa long, straight, united axially in variable groups, axial ends somewhat thickened and may be deflected; tabular floors conical with upturned edges; dissepiments absent. U.Sil.(Ludlov.), Eu.(Gotl.); ?Asia(Altay-Kazakh.); ?Sil., N.Am.(Utah); ?L. Dev., Asia(Tadzhik.-E.Urals).——Fig. 99,3a,b.

*C. samsugnense* (Smith & Tremberth), U.Sil., Slite Gr., Swed., Fårö, Gotl.; a,b, long., transv. secs., ×5 (Hill, n; UQF34671).

> **Cronyphyllum** Ulitina, 1975, p. 273 [*C. gross-axiale*; OD; t39, coll. 3294, PIN, Moscow]. Ceroïd; septa long, major septa coiling somewhat in axial region; marginarium a wide stereozone breached here and there by poorly developed, small, steeply sloping dissepiments; tabular floors domed with upturned edges, tabulae incomplete. [Possibly an entelophyllid.] M.Sil.-U.Sil.(Wenlock.-Ludlov.), Asia(E.Mongolia).

*Niajuphyllum* Strelnikov, 1973, p. 48 [*N. obsoletum*; OD; t2, coll. 9520, TsGM, Leningrad]. Ceroïd, increase peripheral, nonparricidal; marginarium wide, a stereozone formed by contiguous peripheral ends of thick septa each of contiguous trabeculae; fossula indistinct; major septa reaching axis, presence or absence of streptelasma
tid lobes or lamellae unproved; minor septa long; tabular floors domed; dissepiments ?absent [see also Pedder, 1976a, p. 286]. U.Sil.(Ludlov.), Eu. (Polar Urals)-N.Am.(Yukon).——Fig. 100,2a,b.

*N. obsoletum*, holotype, Yengane-Pe Ra., Niya-Yu R.; a,b, transv., long. secs., ×2.9 (Strelnikov, 1973).

*Pilophyllia* Ge & Yu, 1974, p. 170 [*P. involuta*; OD; t22131-2, IGP, Nanking]. Solitary, large; marginarium a narrow peripheral stereozone composed of thick minor septa and thickened peripheral ends of major septa; major septa thinning in tabularium towards axis, slowly at first, then rapidly becoming attenuate, and either involute or straight; cardinal septum may be short in indistinct fossula; tabularium wide, tabular floors close, shallow domes or subhorizontal, tabulae commonly complete; no dissepiments. [Possibly amplexid; nature of discontinuity in axial parts of septa unclear.] L.Sil.-M.Sil., Asia(SW.China).——Fig. 101,1a,b. [*P. involuta*, holotype, M.Sil., Ning Qiang F., Shensi, Ning Qiang; a,b, transv., long. secs., ×1.5 (Ge & Yu, 1974).

*Pseudoblothrophyllum* Oliver, 1960a, p. 91 [*P. holdenbergen*; OD; t11081, NYSM, Albany]. Solitary, large, cylindrical; marginarium in adult stages a wide stereozone in which major and...
minor septa are almost everywhere dilated to contiguity, a very few interseptal loculi or dissepiments present; major septa long, extending nearly to axis, relatively thin in tabularium, axial ends somewhat convolute, peripheral ends may have lonsdaleoid discontinuities; cardinal fossula limited to tabularium, marked by short cardinal septum; tabulae complete, axially concave, periaxially arched, strongly bent downward toward marginarium. *L.Dev.* (Coeymans), N.Am.(N.Y.) — Fig. 101,2a,b. *P. hederbgrium*, holotype, reef facies, Coeymans Ls., N.Y.; a,b, transv., long. secs., ×1 (Oliver, 1960a; photographs courtesy W.A. Oliver).

**Schlotheimophyllum Smith, 1945, p. 18 [*Fungites pateellatus Schlotheim, 1820, p. 347; OD; †un-numbered, in Schlotheim Coll., HU, E. Berlin; lectotype by Smith, 1945, p. 19].** Solitary, large, discoid or patellate, commonly with reflected calicular platform as wide as very wide marginarium, which is sterile zone without dissepiments; major septa long, thinner in tabularium where their axial edges twirl in vacuolar axial structure forming low boss in calice; axial lobes few; septal trabeculae in marginarium multiserially arranged without strict relationship to median plane of septum, subparallel, in tangential planes diverging slightly; tabulae incomplete, floors arched. *L.Sil.* (?p.Llandovery)-U.Sil. (?Ludlov.), Eu. (U.K.-Swed.-Nor.)-Asie (C.Kazakh.)-N.Am.(Can.-Ind.-Ky.). — Fig. 101,3a,b. *S. pateellatum* (Schlotheim); a, ?M.Sil., N.Gotl., Hatting Klint, transv. sec., ×1.25; b, M.Sil., Gotl., long. sec., ×1.25 (Lang, 1926).

**Sinochlamydophyllum Guo, 1976, p. 79 [*S. crasiseptatum*; OD; †Ru4053, IGMR, Shenyang (Mukden); low.M.Dev., Inner Mongolia].** Solitary, large, marginarium a wide sterile zone of contiguous thickened major and minor septa; axial ends of major septa moderately thick, extending to axis and somewhat twisted; cardinal fossula not prominent; tabular floors uparched, but may sag in wide axial zone [as in Pseudoblothrophyllum Oliver, 1960a. Diagnosis tentative, from illustrations.] *M.Dev.* (Eifel.), Asia (Inner Mongolia).

**Symphyphyllum Spasskiy in Bulvanker et al., 1968, p. 14 [*S. styliferum*; OD; †6, coll. 9347, TsGM, Leningrad].** Solitary; major septa confluent axially to form compact axial column, minor septa long, extending but little beyond wide peripheral sterile zone formed by dilated and contiguous septa; tabulae incomplete, somewhat elevated at the column; no dissepiments. *L.Dev.* ("Coblenz."); Asia (Altay). — Fig. 101,4a,b. *S. styliferum*, holotype, Baragashkiy skaya suite, "Rensellaria" horizon, Gorny Altay, Gainn Log; a,b, transv., long. secs., ×4 (Bulvanker et al., 1968).


[?Chlamydophyllum Počta, 1902, which see, Soshkina in Soshkina, Dobrolyubova, & Kabakovitch, 1962, p. 309, but see Oliver & Galle, 1971b, p. 77]. Large, solitary, but may form parridical offsets; epitheca smooth; peripheral ends of thick septa fused to form moderately wide sterile zone; major septa long, not reaching axis, unequal, slightly thickened and irregularly curved; minor septa short; tabulae thin, distant, subhorizontal; no dissepiments [see Ivanovskiy & Shurygina, 1975, p. 35]. *L.Dev.-M.Dev.* (Eifel.), Asia (Urals). — Fig. 100,1a,b. *Z. tabulata* (Soshkina), holotype, D2, Urals, left bank R. Vagran, **fide Spasskiy, 1960a, p. 84; a,b, transv., long. secs., ×2.9 (Ivanovskiy & Shurygina, 1975).

**Family MUCOPHYLLIDAE**

Soshkina, 1947

*Mucophyllum Etheridge, 1894, p. 12 [*M. crateroides*; OD; †F3048, AM, Sydney; lectotype by Hill, 1940c, p. 400] [=Myco phyllum Lang, Smith, & Thomas, 1940, p. 87, nom. van.].** Solitary, broadly trumpet-shaped, with tabularium surrounded by peripheral sterile zone as wide as minor septa are long, and formed by contiguous thick septa of rhabdacanthine trabeculae; sterile zone extending at calice into very wide rim that may be everted; major septa but little longer than minor; tabulae horizontal, complete, may be greatly thickened; no dissepiments. *U.Sil.*, Australia (New S.Wales-Queensl.)—Eu.(Godt.)-Asia (Manchuria-?Szechuan)—*L.Dev.*, N.Am.(Nev.). — Fig. 102,1a-c. *M. crateroides*, U.Sil., New S. Wales, Yass; a, long. sec., b, part of tang. sec. of septa, c, part of transv. sec. of septa, all ×1 (after Etheridge, 1894, and Lang, 1926).

**Briantia Barrois, 1889, p. 44 [*B. repleta*; M; †not traced].** Solitary; marginarium a wide septal sterile zone; major septa almost reaching axis, subequal; free axial ends of minor septa projecting slightly into tabularium, whose tabular floors are domed and tabulae are complete or incomplete; fossula not distinct. [Type requires restudy.] *L.Dev.* (Em.), Eu.(France). — Fig. 103,3a,b. *B. repleta*, holotype, Calcaire d’Erbray, Chateau-
Kungejophyllum SULTANBEKOVA, 1971, p. 28 [K. ajagusense; OD; t1/20, IG, Alma-Ata]. Solitary, large, cylindrical or conical; major and minor septa short, dilated peripherally to form stereozone; growth of sclerenchymal layers may thicken axial ends of major septa also, may then continue as thickening on upper surfaces of tabulae; nature of septal trabeculae not known; tabulae complete, depressed medianly, a little everted peripherally; no dissepiments. L.Sil.(up.Llandov.), Asia.
Fig. 103. Mucophyllidae (p. F175-F178).

(Kazakh.)—Fig. 102, a-d. *K. ajagusense*, holotype, R. Ayaguz, Chingiz Ra.; a, b, transv. secs., c, long. sec., all X2; d, diagram, part of transv. sec., X9 (Sultanbekova, 1971).

"?Ningqiangophyllum" Cao in Li et al., 1975, p. 184, invalid jr. homonym of Ningqiangophyllum
Coelenterata—Anthozoa

Pseudotryplasma

FIG. 104. Mucophyllidae (p. F178).

Ge & Yü, 1974 [*N. temniseptatum; OD; tG360, IGMR, Sian; M.Sil., Ningqiang, Shensi]. Solitary; marginarium a narrow septal stereozone; major septa long, amplexoid and attenuate in wide tabularium, but cardinal septum short; tabulae mostly complete, closely spaced, thin, with somewhat downturned edges. M.Sil., Asia(Shensi).

Pseudamplexophyllum Shurygina, 1968, p. 132 [*Op. insolitum; OD; t506/68a, col. 930, UGP, Sverdlovsk]. Compound; corallites cylindrical; increase periodic, following sudden wide, thin, subhorizontal extension of peripheral stereozone to form thin marginal calicular platform from which nonparricidal offsets arise; septa short, confined to peripheral stereozone and of contiguous rhabdacanthine trabeculae; tabulae complete, horizontal; no dissepiments. Low.L.Dev., Asia(Urals).

--FIG. 103,2a-e. Op. insolitum, Ivdel distr., R. Sauma; a,b, holotype, transv., long. secs., X4; c, another specimen, long. sec. showing offset rising from calical marginal platform, X4 (Shurygina, 1968).

Pseudamplexus Weissemel, 1897, p. 878 [*Zaphrentis igeriensis Barrois, 1889, p. 52; M; tnot traced, ?in Barrois Coll., Laboratoire de Géologie, Université des Sciences et Techniques, Lille] [=Pseuophyllum Počta, 1902, p. 82 (type, P. bohemicum, SD Hill, 1940a, p. 158; lectotype L7332, NM, Prague, by Oliver & Galle, 1971b, p. 63; L.Dev., up. Koněprusy Ls., Zlatý Kůň near Koněprusy, Czech.); ?Pseudophyms Wedekind, 1927, p. 34 (type, P. profunda, OD; tSMF10870, 10871, 4960, Wedekind Coll., SM, Frankfurt; M.Sil., Gotl.); Psieophyllum Lang, Smith, & Thomas, 1940, p. 107, nom. van.; ?Pseudotryplasma Ivaniya, 1958, which see; ?Gyalophyloides Cao in Li et al., 1975, p. 193 (type, G. elegantus, OD; tG401, IGMR, Sian; M.Sil., Ningqiang, Shensi)]. Solitary, large, subcylindrical; marginarium a wide septal stereozone; major septa but slightly longer than minor; septa each a single series of coarse rhabdacanthine trabeculae, free at their axial ends; tabulae complete. ?L.Sil., Asia(Altay-Sayan); ?M.Sil., Eu.(Gotl.-Asia(Shensi)); ?L.Dev., Eu.(France-Czech.-Urals)-Asia (Kuzbas-Tadzhik.-Altay-Sayan-Taimyr-NE USSR)-Australia (Queens.-New S. Wales-Vict.-Tasm.).——Fig. 102,3a,b. *P. igeriensis (Barrois), Ems., France, Calcaire d’Erbray; a,b, transv., long. secs., X0.5 (Barrois, 1889).——Fig. 102, 3c,d. *P. profundus (Wedekind), holotype, M. Sil., N. Gotl., Storugus near Kappelshamn; c,d, transv., long. secs., X2.0 (Hill, n; photographs courtesy R. Birenheide).

Family ACROPHYLLIDAE Stumm, 1949


Solitary, large, with numerous long septa, wide tabularium in which conical tabulae form, with the convolute axial ends of major septa and with septal lamellae, a tent-shaped axial structure rising in wide
calical boss; cardinal fossula deep, with shortened cardinal septum; minor septa short to very short, scarcely visible on inner surface of wall; dissepiments sparse, vertically based. Up.L.Dev.

Acrophyllum THOMSON & NICHOLSON, 1876a, p. 455 [*Cleiophyllum onediaense BILLINGS, 1859b, p. 128; OD; syntypes 3416a-c, GSC, Ottawa]. Solitary, large, with numerous, long, thin, major septa and excessively short minor septa, a wide tabularium in which conical tabulæ form with thin convoluted axial ends of major septa a tent-shaped axial structure; a narrow dissepimentarium of vertically based dissepiments; those parts of major septa in peripheral zone of tabularium may be somewhat thickened, cardinal septum short, in fossula deepened at edge of tabularium [see OLIVER, 1958, p. 826; STUMM, 1965, p. 27]. Up. L.Dev., N.Am.(Ont.-N.Y.).—Fig. 105,1. *A. onediaense (BILLINGS), Onondaga Ls., Ont.; transv. sec., x0.7 (Lambe, 1901).

Scenophyllum SIMPSON, 1900, p. 210 [*Zaphrentis conigera ROMINGER, 1876, p. 149; OD; 18585, UMMP, Ann Arbor; lectotype by STUMM, 1965, p. 26]. Solitary, ceratoid, large; calice elliptical, deep, with thin, erect walls and large, conical axial boss; septa numerous, axial ends thin and somewhat convolute in loose, wide axial boss; cardinal fossula deep, wide near boss, with shortened cardinal septum; minor septa short, dissepiments few; tabular floors conical, close, of elongate tabellae [see STUMM, 1965, p. 26]. Up.L. Dev., N.Am.(Ind.-Ky.).—Fig. 105,2a-c. *S. conigerum (ROMINGER), Jeffersonville Ls., coral zone, Ind., Falls of the Ohio; a, lectotype, ext. view, x0.7; b,c, another specimen, transv., long. secs., x1.4 (Stumm, 1965).

Family AMSDENOIDIDAE Hill, new family

Solitary, with periodic rejuvenescence; major septa long, thin, axial ends intermeshing at or somewhat withdrawn from axis, axial septal lobes present; minor septa long or short; septa commonly richly vepreulate; horizontal skeletal elements commonly calcareous films of inconsistent curvature, drawn up adaxially but, when minor septa are long, may form shallow marginal troughs peripherally. U.Sil., ?M. Dev.

Amsdenoides SUTHERLAND, 1965, p. 18 [*Diteochoelasma acutianultatul AMSDEN, 1949, p. 102; OD; S17665, YPM, New Haven]. Solitary, with irregularly spaced, acutely projecting rejuvenescence rims; minor septa long, no dissepiments; major septa commonly coarsely vepreulate and reaching or nearly reaching axis with or without slight convolution, their axial edges may be variably coalescent or lobed; tabulae as films declined abaxially, sparse. U.Sil.(Ludlov.), N.Am. (Tenn.-Ky.-Ind.).—Fig. 106,la-f. *A. acutianultatus (AMSDEN), Brownsville F., Tenn.; a-c, holotype, a, ext. view, x1, b,c, transv., long. secs., x4; d-f, another specimen, d,e, transv., j, f, long. secs., all x4 (Sutherland, 1965).

?Multicarinophyllum SPASSKIY, 1965b, p. 24 [*M. multica linedatum; OD; f, coll. 9349, TSGM, Leningrad]. Moderately large, solitary, corneous, with rejuvenescence; calice shallow, with sharp edges; major septa long, thin, convolute in axial zone, in places with conjunct axial ends; minor septa long; both orders vepreulate; in axial zone tabular films numerous, low domes, in peripheral zone, shallow troughs. ?M.Dev.(Eifel.), Asia (Dzhungarian Alatau).—Fig. 106,2a,b. *M. multica linedatum, holotype, Eifel., Dzhungarian Alatau, R. Kyzylagach; a,b, transv., long. secs., x2 (Markovskiy, 1968).

Suborder CALOSTYLINA
Prantl, 1957

[nom. correct. WEYER, 1973a, p. 23, pro Calostylacea Prantl, 1957, p. 491, as suborder]

Rugosa with perforate septa that may be laterally connected by synapticulae. M.Ord.-U.Sil. or L.Dev.(Aynasu.).
Superfamily CALOSTYLCÆAE
Zittel, 1879

[R. D. Walker, 1963, p. 92, pro Calostylaceæ
[IVÁNOVSKÝ, 1961a, p. 120, nom. transl. ex Calostylinae
Zittel, 1879, p. 241] (=Calostylaceæ PRANTL, 1957, p. 491,
suborder; Calostylaceæ WEYER, 1973, p. 33, superfamily]

Rugosa with perforate septa. Solitary or
compound (fasciculate, astreoid), epitheca
commonly incomplete, when present may
show longitudinal septal furrows in normal
rugosan arrangement of septal insertion,
calice everted in some, in many with axial
boss; septa of two orders, perforate, may
be laterally connected by synapticulae,
minor septa contraclined to contrastingent;
trabeculae monacanthine, in single series,
connected radially by outgrowths that may
or may not be arranged in regular series
parallel to distal edges of septa; axial struc-
Fig. 107. Calostylidae (p. F182-F183).
Coelenterata—Anthozoa

Calostylis Lindström, 1868, p. 421 [*C. cribraria; M; \+Cn15679, RM, Stockholm; lectotype by Weyer, 1973a, p. 29; \=Clictphyllum denticulatum Kjørlf, 1865, p. 25, Sil., Gotl., \=not traced, see Smith, 1930b, p. 267, Weyer, 1973a, p. 29] \=[Hemiphyllum tomesi, 1887, p. 98 (type, Calostylis tomesi Smith, 1930b, p. 269, M, nom. nov. pro "Hemiphyllum siluriensis McCoy sp." Tomes, 1887, p. 99; \+R18446, BM(NH), London; M.Sil., (Wenlock.), U.K., Wenlock]; \=Stanleysmithia Weyer, 1973a, p. 30 (type, Calostylis roemeri Smith, 1930b, p. 262, OD; \+48598, GSM, London; up.llandovery, U.K., Pentamerus beds near Buildwas)]. Solitary, not epithectate in distal region, calice being steeply everted near peripheral margin; major and minor septa slightly perforate, connected by irregular synapticular; trabeculae \=monacanthine, connected radially in single series by synapticular extensions; axial ends of large major septa lobed and reticulate, forming spongy axial structure that may form calical boss; tabulae domed, filmy, complete and widely separated, continuous in marginarium with filmy plates parallel to distal edges of major septa. Up.M.Ord.-U.Ord., Asia(Szechwan-Kweichow); U.Ord., Eu.(Est.); Sil., Eu.(U.K.-Gotl.-Nor.-Est.-Urals)-Asia (Kazakh.-Sayan-Himalaya-Sib. Platt-Kweichow-Szechwan)-Australia(New S.Wales)-N. Am.(Ky.-Ohio); U.Sil. or L.Dev.(Aynasu.), Asia (Kazakh.).—Fig. 107.1a-d. \*C. cribraria, Sil., Gotl.; a, lectotype, calical view, X15.0; b, another specimen, side view, X1.0; c, d, third specimen, transv., long. secs., X2.8, X1.8 (Smith, 1930b).

Helminthidium Lindström, 1882a, p. 16 [*H. mirum; M; \=original specimen figured as "unknown coral from Djuvpik," Lindström, 1870, p. 12, fig. 14, not traced, RM, Stockholm]. Coralum solitary, scolecoid, epitheca complete and septal furrows faint to absent; calice slightly convex or concave, without axial boss; septa perforate and reticulate with but faint trace of radial pattern, of division in orders, or of component trabeculae [see Smith, 1930b, p. 272; Weyer, 1973a, p. 30]. M.Sil.-U.Sil.(Ludlow.), Eu.(Gotl.-U.K.-Czech.)-Asia(Japan).—Fig. 107.4a,b. \*H. mirum, Sil., Gotl.; a,b, calical view, long. sec., X4, X2 (Lindström, 1896b).

?Ningnanophyllum Lin, 1965, p. 69 [*N. ningnanense; OD; \+1002A63", \=AGS, \=Peking]. Small, fasciculate, calices keg-shaped; septa thick, perforate, axial edges of major septa united about axial tabular space; marginarium a spongy stereozone; tabulae complete, sparse; without dissepiments. [Weyer, 1973a, p. 28, considers septal structure inconsistent with that of Calostylidae.] M.Ord., Asia(Szechwan-Kweichow).—Fig. 107.1a,b. \*N. ningnanense, holotype, Ningnan distr., Szechwan; a,b, transv., long. secs., X4 (Lin, 1965).

Palaearaea Lindström, 1882b, p. 11 [*P. lopatini;
Family LAMBELASMATIDAE Weyer, 1973

[Lambelasmatidae Weyer, 1973a, p. 33]

Calostylicae with calices not everted and without connecting rods or bars (synapticulae) between the perforate major and minor septa; with or without axial septal boss. M.Ord. (low.Caradoc-mid.Caradoc.-L.Sil.)

Subfamily LAMBELASMATINAE Weyer, 1973

[Lambelasmatinae Weyer, 1973a, p. 34]


Lambelasma Weyer, 1973a, p. 34 [*L. lambei; OD; tK61, coll. D. Weyer, 1968, HU, E. Berlin] [*=Lambelophyllum Okulitch, 1938, which see, presence of pores in septa uncertain]. Corallum solitary, small; cardinal fossula on concave side of apically curved corallum; septa of two orders, arranged pinnately in cardinal quadrants and somewhat more radially in counterquadrants, minor septa short, barely projecting beyond peripheral stereonoe; septa coarsely monacanthine, monacanths radially incompletely fused whereby septal pores are formed; spinose edges of septa attaining skeletal thickness and crossed by sparse tabulae. [Photographs of median longitudinal sections required for proof of pores.] Up.M.Ord. (mid.Caradoc.), Eu. (Ger. Pleist. drift derived from Baltoscandia)-N.Am. (Mich.-Wis.).—Fig. 109, 2ab. *L. lambei, holotype, M.Ord., Macrurus Ls. drift, Ger. Warnemünde; a, transv. sec. above highest tabula, ×3.0; b, transv. sec. through proximal part, ×7.5 (Weyer, 1973a).

Dybowskinia Weyer, 1973a, p. 37 [*D. dybowskii; OD; tX4115, coll. Bähm, ca. 1880, ZG, E. Berlin]. Like Lambelasma but with spongy axial structure, low calical boss, and less markedly pinnate arrangement of septa. [Photographs of longitudinal sections required to confirm presence of septal pores.] Up.M.Ord. (mid.Caradoc.), Eu. (Pleist. erratics from Baltoscandia).—Fig. 109, 1ac. *D. dybowskii, monotype, Macrurus Ls.; a, transv. sec. through lower part of calice, ×3; b,c, transv. secs., ×6, ×15 (Weyer, 1973a).

?Lambelophyllum Okulitch, 1938, p. 100 [*Cyathophyllum profundum Conrad, 1843, p. 335; OD; tneotype, 45346 (?=20703), UMMN, Ann Arbor; by Stumm, 1963a, p. 25, Weyer, 1973a, p. 35, considers this nomination invalid] [*=Lambelasma Weyer, 1973a, which see]. Corallum solitary, conical, small; major septa extending to axis in early stages, may shorten in mature stages, dENTICULATE, of contiguous trabeculae; minor septa each a longitudinal row of short spines; tabulae not known; cardinal septum prominent in long, narrow fossula; alar and counter septa also long and prominent [see WEBB, 1971, p. 165]. M.Ord. (Blackrav.), N. Am. (Wis.-Mich.-Ont.-N.Y.).—Fig. 109, 3a-e. *L. profundum (Conrad), Black River Gr., Plateville Ls., Wis., Mineral Point; a,b, neotype, lat., calical views, ×1; c, topotype, showing denticulate axial edges of septa, ×1 (Stumm, 1963a).

?Sogdianophyllum Lavruševič, 1971c, p. 3 [S. karasuevi; OD; t133/4, coll. 1030, UpG, Dushanbe]. Corallum fascicate; increase lateral; septa monacanthine, thick and contiguous in narrow peripheral sterilezone, thinning adaxially; within wide tabularium septa not completely laminar [unclear whether perforate as in Calostyliae or of discrete axial ends of trabeculae as in Tryplasmatidae]; axial structure present [unclear whether of axial ends of monacanths as in Coelostylia or of curved axial lobes as in Calostylia]; tabulae convex; dissepiments absent. U.Ord. (Ashg.)], Asia (Tadzhik.).—Fig. 109, 4ab. *S. karasuevi, holotype, L. Archaly beds, Zeravshan-Gissar Mts., Kashkadarya R. basin, 2 km. W. of meridian of Sangtor Pass; a,b, transv., long. secs., ×4 (Lavruševič, 1971c).

Subfamily COELOSTYLINAE Weyer, 1973

[Coelostylinae Weyer, 1973a, p. 38]

Solitary; septa coarsely monacanthine, with monacanths incompletely fused so that septal pores are left; septa radially arranged
with cardinal septum on convex side; major septal monacanths attaining axial region; major septa thick, so that only narrow and sparse loculi occur between major septa, crossed by sparse tabellae. **Mid.M.Ord.-L.Sil.**

*Coelostylis* **Lindström** in **Angelin & Lindström**, 1880, p. 34 [*Cyathaxonia? Tornquisti Lindström*, 1873b, p. 25; M; tCn54653, RM, Stockholm]. Solitary, small to medium-sized; when curved, cardinal side convex; calice deep; septa of large, periodically contiguous, monacanthine trabeculae very dilated in early stages; axial structure and calicular boss loosely constructed of inner ends of trabeculae; minor septa short; dissepiments absent and tabulae absent to rare [see **Neuman**, 1967, p. 454; **Weyer**, 1973a, p. 40]. **Mid.M.Ord. (Virm.**, Eu. (Swed.-Nor.-Ger. in Pleist. drift).

---Fig. 110,1a-b. *C. toernquisti*, holotype, *Macrurus* Ls., Swed., Fjäcka, Siljan distr.; a,b, long. sec., part of transv. sec., X4 (Neuman, 1967).

---Fig. 110,1c-i. *Coelostylis* sp.; diagram, dotted area in e indicates width of peripheral stereozone (Neuman, 1967).

*Coelolasma* **Weyer**, 1973a, p. 38 [*C. neumani; OD; tK64, coll. D. Weyer, 1968, HU, E. Berlin*]. Corallum with cardinal septum lateral to convex side of short, curved, apical portion; no calical boss; septa coarsely monacanthine, radially arranged; monacanths incompletely fused so that septal pores occur; axial ends of major septal monacanths variably connected in axial region or reduced; minor septa very short; skeletal thickening great, leaving so few interseptal spaces that tabulae may be absent. [Photographs of longitudinal sections required.] **Up.M.Ord. (mid.Cardon.**, Eu. (Ger., erratics in Pleist. drift).---Fig. 110,2a-b. *C. neumani*, holotype, drift at Warnemünde; a,b, calical, transv. secs., X6, X5 (Weyer, 1973a).

*Estonielasma* **Weyer**, 1973a, p. 43 [*Tryplasma hemicymatelasma Reyman in Kaljo*, 1957, p. 156; OD; tCo1274, EGM, Tallinn; lectotype by **Reyman**, 1958, p. 39]. Solitary, septa monacanthine, radially arranged, amplexoid in mature stage but reaching axis in early stages, monacanths incompletely fused in laminar parts of septa so that septal pores result [confirmatory photographs of longitudinal sections required]; minor septa short; tabulae numerous, thin, horizontal. **?Up.M.Ord.-U.Ord. (Vormsi.**, Eu. (Est.).---Fig. 110,3a-b. *E. hemicymatelasma* (Reyman), holotype, U.Ord. (Vormsi.), F,ba horizon, Est., Kohila; a,b, transv., long. secs., X2.4, X2.3 (Reyman, 1958).

?*Prototryplasma* **Ivanovskiy**, 1963, p. 96 [*P. oreniana; OD; t57, coll. 305, IGG, Novosibirsk*]. Small, solitary, epitheca ribbed, calice deep with sharp edges; septa short, acanthine, strongly thickening toward periphery so that narrow peripheral stereozone is formed; tabellae sparse, strongly inflated, steep, resembling dissepiments. [Ivanovskiy, 1963, p. 96].

---Fig. 109. Lambelasmataidae (p. F183).
Suborder METRIOPHYLLINA
Spasskiy, 1965

[Metriophyllina Spasskiy, 1965a, p. 83]

Predominantly small, solitary Stauriida with narrow peripheral stereozone and, except in a few, lacking dissepiments; septa laminar, longitudinally continuous, trabeculae commonly fine; minor septa may be long and contratingent; fossula inconspicuous; columella or axial structure present in some, absent in others; tabulae abaxially declined, commonly complete. M.Ord.; L. Sil.-U.Perm.

Family CYATHAXONIIDAE
Milne-Edwards & Haime, 1850


Solitary, small, ceratoid; calice deep with steep sides and axial boss; major septa long, equal, may meet dense columella rising independently from apex of corallum; minor septa long, commonly contratingent; tabulae declined from columella in noncontratingent loculi. U.Sil.; U.Dev.-L.Penn.; L. Perm.-U.Perm.

Cyathaxonia MICHELIN, 1847, p. 257 [*C. cornu; SD MILNE-EDWARDS & HAIOME, 1850, p. lxv; not traced] [=Cyathocarina Soshkina, 1928, p. 376 (type, C. tuberculata, SD LANG, SMITH, & THOMAS, 1940, p. 43; ?1546, coll. 146, PIN, Moscow; L. Perm., R. Ilych, N. Urals); Cyathaxonia DOBRULYUBOVA, 1936b, p. 92, nom. null.]. Small, ceratoid, with cylindrical columella projecting as calicular boss and developed independently of, but in contact with, major septa, and with long and commonly contratingent minor septa clearly inserted alternately with major septa; with complete tabulae declined abaxially (?) (open, i.e., noncontratingent, interseptal loculi) and without dissepiments; sides of septa may be vepreculate. U.Dev. (Famenn.), Eu. (Pol.); L. Carb., Eu. (U.K.-Eire-Belg.-Urals)-N.Afr. (Sahara)-Asia (Laos)-Australia (New S.Wales); Miss., N.Am. (Mo.); L. Perm., Eu. (Urals); U. Perm. (Kazan.), Asia (Camb.).—Fig. 111,2a-e. *C. cornu; a,b, L. Carb. (Visean), Scot., Southfold Quarry, Dunfermline, central part of transv. sec., long. sec. through septa and columella, X8; c.d, L. Carb. (Tournais.), Belg., Cornet Quarry, Tournai, transv., long. secs., X4; e, L. Carb. (Visean), Eng., Stock, near Bracewell, long. sec. showing vepreculate sides of septa, X5 (Carruthers, 1913).

Columnaxon SCRUTTON, 1971, p. 199 [*C. angelae; OD; ?R46748 (A2579), BM(NH), London]. Very small, solitary, conicocylindrical; aulos formed from axial ends of major septa present in early stage; in later stages, axial end of counter septum where projecting into aulos greatly expanded, almost closing the axial space and in calice projecting as axial boss; minor septa contratingent except in calice, Km longest; tabulae within aulos in early stage flat; periural tabulae imperfectly known, those of larger alternate interseptal loculi concave distally and thus probably declined abaxially. U.Sil. (Ludlov.), S.Am.(Venez.).—Fig. 111,4a-g. *C. angelae, holotype, Merida Andes, Río Aricagua sec.; a-g, serial transv. secs. of holotype from edge of calice downward, X4 (Scrutton, 1971).

Cyathaxonella SHTUKENBERG, 1895, p. 25 [*E. gracilis; OD; ?in coll. 305, TgSM, Leningrad]. Small, solitary; calice deep; calical surface of columella showing slightly convolute septal lamellae; cardinal septum short in fossula, major septa reaching columella, minor septa moderately long; no dissepiments; no tabulae. [Types require re-study.] L. Carb., Eu. (W.Urals).

Epiphanophyllum ILINA, 1970, p. 149 [*E. sinuosum; OD; ?1363, coll. 2376, PIN, Moscow]. Solitary, small, cardinal side convex, with peripheral stereozone; septa long, waved (?) (parallel to distal edge), major septa thick, coarsely trabeculate, almost joining or joining columella formed from axial edge of cardinal septum; minor septa long, thin, contratingent; loculi within contratingent septa very narrow, containing horizontal skeletal elements that in transverse section are ?concave toward axis, alternate interseptal loculi wider, with tabulae convex toward axis [see WEYER, 1972c, p. 462]. U.Perm. (Murgab.), Asia (Pamir).—Fig. 111,3a,b. *E. sinuosum, holotype, SE. Pamirs; a,b, transv. secs., X4 (Ilina, 1970).

Lophoiphanthus MOORE & JEFFORDS, 1945, p. 111 [*L. vesicum; OD; ?7385-24s, KUIMP, Lawrence]. Moderately small, curved, conical; with narrow peripheral stereozone; major septa long, thin, not rhopaloid, in early stages joined in groups of two or three or singly to thickened axial end of long counter septum, which is produced in calice as columellar boss, in late stages major septa withdrawing from axial edge, cardinal septum shortening most; minor septa either long or short, thinner, contratingent Km longer than others; horizontal skeletal elements in interseptal loculi closed by contratingency declined slightly adaxially, in alternate loculi tabulae declined steeply abaxially [see WEYER, 1972c, p. 456]. L. Penn., N.Am. (Okla.); L.Perm. (Wolfcamp.), N.Am. (Texas).—Fig. 111,1a-c. *L. vesicum, topotype, Hale F., Okla., Greenleaf Lake, Bragg's; a,b, transv. secs., arrows mark positions of septa C, K, A. and KL, X4; c, another specimen, long. sec., X4 (Moore & Jeffords, 1945).
Family PETRAIIDAE de Koninck, 1872
[nom. correct. GRABAU, 1922, p. 27, pro Petraidae de
Koninck, 1872, p. 113] [=Petraiinae Dybowsk, 1873c,
p. 331; Petraiinae Wang, 1950, p. 205; Protophyllidae
Ivanovskiy, 1959, p. 895; Petraiinae Ivanovskiy, 1968, p. 86]

Small, solitary, conical; calice deep, not
sulmellate; major septa or groups of major
septa joining axially and, in some, with­
drawing from axis in late stages; minor
septa long and contratingent; tabulae absent
or declined abaxially; small plates within
contratingencies absent or declined adaxially.
M.Ord.; V.Sil.; L.Dev.; V.Dev.

Petraia Münster, 1839a, p. 42 [*P. decessata; SD
Miller, 1889-1897, p. 199; †not traced; =P.
radiata, fide Schindewolf, 1931, p. 634, †neo-
type K90.1 in Münster Coll., HU, E. Berlin, by
Schindewolf, 1931, p. 634]. Small, solitary,
calice deep, not sulmellate; with narrow periph-

eral stereozone; septa equal, finely trabeculate,
thin, laterally smooth; major septa meeting axially,
minor septa long, contratingent and clearly in-
serted alternately with major; tabulae sparse; small
plates within contratingencies also sparse [see
703]. U.Sil.(eβ), Eu.(Ger.)-N.Am.(Okla.).—

Fig. 112.a-d. P. semistriata Münster, Ludlov.,
Orthoceratites Ls., Bavaria, Elbersreuth; a-d, serial
transv. secs., ×15 (Schindewolf, 1931).

Haptothelium Pedder, 1967b, p. 110 [*Metriophyl-
limus erisma Hill, 1950, p. 142; OD; +48901,
GSV, Melbourne] [=Haptothelium Hatch &
Armitage, 1970, p. 23, nom. null.]. Solitary,
small, with peripheral stereozone; septa thin,
wavc and ?flanged parallel to calical edges; axial
edges of major septa confluent at or near axis;
minor septa long and contratingent; tabella in
open interseptal loculi steeply declined abaxially,
those within contratingencies sloping down ad-
axially; counter septum greatly shortened and appearing forked peripherally [fide Weyer, 1972c, p. 452]. L.Dev.(Ems.), Australia(Vict.).—Fig. 112,3a,b. *H. erisma* (Hill), toptotypes, Vict., Taravale mudstone near Buchan; a,b, transv., long. secs., X5 (Pedder, 1967b).

**Petraiella** Rozkowska, 1969, p. 43 [*P. kielcensis; OD; †Tc 3/961, PZI, Poznan*]. Small, solitary; calice shallow, not columellate; distal edges of septa smooth; in early stages axial ends of thin major septa at axis, but in later stages may withdraw; in some, in late stage, peripheral ends of counter and cardinal septa may appear to be split; minor septa long, contratingent, septal insertion accelerated in counter quadrants; copious adaxially declined plates within contratingencies, and abaxially declined tabellae in alternate inter­ septal loculi [see Weyer, 1972c, p. 456; 1973f, p. 704]. U.Dev.(Famenn.), Eu.(Pol.-Czech.).—Fig. 112,2a-e. *P. kielcensis*, low. Famenn., Pol., Kielce; a-d, holotype, transv. secs., X3.5; e, para­ type, long. sec., X3.5 (Rozkowska, 1969).

Fig. 112. Petraiidae (p. F187-F189).
Protozaphrentis Yü, 1957, p. 317 [*P. minor; M; \#8925-8932, IGP, Nanking]. Corallum solitary, small, conical, not columellate, cardinal side convex; calice deep; fossula faint; septa coarsely trabeculate, long, thick, with sculptured sides; major septa forming axial structure by conjunction of swollen axial ends that are lower in axial calical depression; minor septa long, contratingent, \( K_m \) (those of ambicounter septal loculi) longest; tabulae absent, no plates observed within contratingen-
cies [see Weyer, 1973f, p. 696]. M.Ord., Asia (Sinkiang).—Fig. 112,1a-d. *P. minor, holotype, China, Liu-Wang-shan, Kuluk-Tag Ra.; a-d, transv. secs., \( \times 10 \) (Yü, 1957).

**Family METRIOPHYLLIDAE Hill, 1939**

Fig. 114. Metriophyllidae (p. F190-F191).

Solitary, small, ceratoid, suberect, with narrow peripheral stereozone; major septa flanged or not flanged, subradially arranged, thick, meeting to form thick axial structure that does not project into, but may be excavate in, calice; fossula commonly not obvious; minor septa insignificant, contrasting or not; tabulae absent or present, declined abaxially. L.Sil.-?Miss.; ?L.Perm.-U.Perm.

Metriophyllum Milne-Edwards & Haime, 1850, p. lix [*M. boucharidi; OD; tspecimen figured Milne-Edwards & Haime, 1851, p. 318, pl. 7, fig. 1, 1a; lectotype by Lang, Smith, & Thomas, 1940, p. 84, specimen lost tide Holwill, 1964, p. 112]. Small, solitary, turbinate to ceratoid, erect or slightly curved with cardinal side convex; with narrow peripheral stereozone and without dissepiments; major septa with horizontal flanges (parallel to epithecal growth rings) with upturned lateral edges alternating in level in neighboring septa; axial ends of major septa uniting at axis, but axial structure thus formed not projecting from base of calice; cardinal septum not shortened; minor septa including Km short, below calice reduced to wall, not contrasting; tabulae thin and sloping downward from axis [see Holwill, 1964, p. 109]. L.Dev., Australia (Vic.); M.Dev.-U.Dev., Eu. (France-Ger.-U.K.)-N.Am. (N.Y.)-Australia (W.Australia)-Asia (China-Indoch.); ?Miss., N.Am. (Mo.); ?L.Perm., Eu. (Ural).—Fig. 113, 2a-d. *M. boucharidi; U.Dev. (Frasn.), France, Ferques, near Boulogne; a, calical view, X5.4; b, transv. sec., X8.0; c, long. sec., X4.0; d, diagram. (Holwill, 1964).

?Asserculinia Schouppé & Stacul, 1959, p. 284 [*A. prima; OD; tSe 230, Schouppé Coll., GPI, Münster] [=Asserculina Nakazawa et al., 1975, p. 41, nom. null.]. Solitary, small, ceratoid; major septa long, meeting at axis, or in groups before reaching axis, without forming projecting columnella, with metriophylloid flanges opposite or subopposite on either side of each septum; minor septa including Km short, axial edges free; tabulae declined from axis; no dissepiments; in young stages septa of cardinal quadrants pinnate about cardinal fossula, which is possibly on concave side of corallum [see also Weyer, 1970a, p. 58]. U.Perm., Eu. (Greece)-Asia (Timor).—Fig. 113, 3a-c. ·A. prima, holotype, Basleo, Timor; a, transv. sec., X4; b, long. sec., X3; c, tang. sec., X3 (Schouppé & Stacul, 1959).

?Duncanella Nicholson, 1874b, p. 333 [*D. borealis; OD; syntypes 01554-01558, Nicholson Coll., AU, Aberdeen, and 1968.15.40, RSM, Edinburgh, fide Benton, 1979]. Very small, solitary, suberect, ceratoid to cylindrical; in short conical apical region without wall so that peripheral bases of septa are exposed; major septa thick, sculptured laterally, confluent axially although small round pit may develop in calice on the dense axial structure so formed; Km long, other minor septa very short, amalgamate with major septa to their counter side; tabulae absent. [Type material never revised; diagnosis based in part on Weyer, 1972c, p. 446, fig. 9,11b.] Sil. (Niag.), N.Am. (Ind.).—Fig. 114, 1a-d. ·D. borealis, Ind., Waldron; a-c, transv., calical secs., X8.3; d, growth layers in two major septa and their amalgamated minor septa, diagram. (Weyer, 1972c).

?Metrioplexus Glinski, 1963, p. 328 [*M. richteri; OD; tF17084, SM, Frankfurt]. Solitary, not large; early stages metriophylloid, i.e., major septa meeting at axis in axial structure that disappears in later stages when septa are withdrawn from axis and amplexoid; major septa with metriophylloid flanges; tabulae commonly complete, in early
stages declined from axis, in later stages horizontal or distally convex axially, peripherally declined to wall, but no aulos noted; cardinal septum commonly short and fossula weakly expressed on concave side of corallum in type species; \( K_m \) moderately long, contragent in early stages, remaining minor septa reduced to wall; no dissepiments. \( M.Dev.\ up.Ei(l.) \), Eu. (Ger.) — Fig. 113,1a,b. *M. richteri*, holotype, Ahback Beds, Lahr horizon, Hillesheim Mulde; \( a,b \), transv., long. secs., \( \times 5 \) (Glinski, 1963).

Petronella Birenheide, 1965b, p. 2 [*Duncanella pygmaea* Schlüeter, 1885a, p. 6; OD; \( \uparrow 160 \), Schlüter Coll., IP, Bonn; lectotype by Birenheide, 1965b, p. 2]. Very small, solitary; peripheral edges of thick septa in small, inversely conical tip bare of epitheca and not connected by wall; upper part of corallum subcylindrical, with slender, epithecate peripheral stereozone and showing longitudinal septal grooves; insertion of septa accelerated in counter quadrants; major septa axially united or free, may form platy axial structure that does not project into calice; minor septa insignificant, contragent; no septal flanges; tabulae ?absent. \( M.Dev. \), Eu. (Ger.-Spain). —Fig. 114,2a-c. *P. pygmaea* (Schlüeter); \( a,b \), lectotype, Eifel, apical, side views, \( \times 11 \); \( c \), another specimen, Eifel, probably Freiling Beds, Eifel, transv. sec., \( \times 11 \) (Birenheide, 1965b).

**Family LACCOPHYLLIDAE**
Grabau, 1928


Solitary, not large; major septa in early stages meeting at axis on metriophyllid plan, in later stages withdrawing from axis and aulos formed by thickening and conjunction or by deflection of their axial ends or by conjunction of downturned edges of axial tabellae or by some combination of these modes; in latest stages aulos may be breached or disappear; minor septa may be long and contragent with \( K_m \) longest, or may be reduced to wall; tabularium biform when minor septa are contragent, periaxial tabellae within contragenties being declined adaxially, those in alternate loculi declined abaxially; aular tabellae horizontal or concave; dissepiments present in some. Sil.-Perm.

**Subfamily LACCOPHYLLINAE**
Grabau, 1928


Laccophyllidae with aulos in late stages dominantly of septal origin; with long, contragent minor septa, \( K_m \) longest, and biform tabularium; dissepiments present in some; in some laccophyllids, some or all of the septa \( K, KL, C, \) and \( K_m \) may have 'split' peripheral ends. L.Sil.-U.Dev.; ?L. Perm.-U.Perm.

**Laccophyllum** Simpson, 1900, p. 201 [*L. acuminate*; OD; syntypes, 288, 289, type coll., NYSM, Albany] \( [=Syringaxon Lindström, 1882b, \)

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which see]. Small, solitary, with aulos of septal origin, in part at least from deflection of axial ends of major septa; [identification of protosepta cannot be made unambiguously from Simpson's figured transverse thin section, which was subsequently damaged]; minor septa long and contranting; tabellae in aulos horizontal or slightly concave, those within contratigencies dissepiment-
like and declined adaxially, those in alternate interseptal loculi mostly complete and declined abaxially. [Presence or absence of peripheral septal 'splitting' not established.] *M.Sil.(Niag.), N. Am.(Tenn.).—Fig. 115,a-c. *L.acuminatum, syntypes, M.Sil.(Niag.), Tenn., Perry Co.; *b, transv., long. secs., X 10, X 5 (Hill, n; photographs courtesy W. A. Oliver); c, SIMPSON’S drawing of transv. sec. in a, enl. (Simpson, 1900).

*Alleynia* Počta, 1902, p. iv, nom. subst. pro Nic­holos­onia Počta, 1902, p. 184, non Nicholas­onia SCHLÜTER, 1885c, p. 53 [*Nicholas­onia bohemica BARRANDE in Počta, 1902, p. 186; SD GRABAU, SM, Frankfurt]. Solitary, *Hlubocepy. bo­ga, bohemica*; AG327, PoCTA, “*B. acuminatum, syntype, Branik Ls., 1902, p. 190*” pycnotheca; NM, Prague; lectotype by bohemica, Alleynia POCTA, 1902, p. iv, BARRANDE, 1865, p. 51, nom. nud. Lectotype ?un­sectioned, definition based on BARRANDE, 1938, p. 24, text-fig. 1, transverse section of topotype, and his descriptions of paratypes.] [*=*Syringaxon LINDBSTRÖM, 1882b, which see]. Solitary, small, conical; major septa moderately thick, their axial ends contiguous in thickened aulos that is crossed by flat or slightly concave tabellae; minor septa contratingent, thin, moderately long, *Km* very long; periallar tabellae declined abaxially [presence or absence of tabellae within contratingencies not stated; no evidence of peripheral splitting of protosepta]. *M.Dev.(low.Eifel.), Eu.(Czech.).—Fig. 116,a,b. *A. bohemica (BARRANDE), Daleje Sh., gh, Hlubocěpy; a, holotype, ext. view, X 2 (Počta, 1902); b, topotype, transv. sec., enl. (Prantl, 1938).

*Barrandeophyllum* Počta, 1902, p. 190 [*B. per­plexum*; M; *L.10077, NM, Prague; lectotype by PRANTL, 1938, p. 35. The lectotype has never been sectioned and OLIVER & GALLE (1971b, p. 89) point out that PRANTL’S concept of the species is based on Počta’S syntypes, which may or may not be conspecific with the lectotype. The diag­nosis given below is based on PRANTL, 1938, p. 35.] [*=*Syringaxon LINDBSTRÖM, 1882b, which see]. Solitary, small; major septa moderately thick, reaching axis in early stages; in later stages their axial edges withdrawing from axis but remain­ing conjoined, forming narrow aulos crossed by slightly concave tabellae; minor septa thinner, moderately long, contratingent, *Km* longest; car­dinal septum may be longer than others; periallar tabularium biform, tabellae within contratingencies dissepimentlike, those in alternate interseptal loculi declined abaxially. Presence or absence of 'splitting' at peripheral edges of septa not noted. *L.Dev. or M.Dev., Eu.(Czech.).—Fig. 116,a,b. *B. perplexum, syntype, Branik Ls., ga, Hlubocěpy Valley; a, transv. sec., X 7 (Počta, 1902); b, PRANTL’S drawing of same transv. sec., X 7 (Prantl, 1938).

*Bitaria* GALLE & Weyer, 1973, p. 708 [*B. bo­hemica*; OD; *TAG327, UUG, Prague]. Solitary, small; calice very deep, wall relatively thick; aulos crossed by flat tabellae; sepa and with flangelike swellings parallel to calical edges; car­dinal septum not shortened; minor septa commonly long and contratingent, may be free at axial ends, *Km* longest; tabellae within contratingencies declined abaxially parallel to calical edges of sepa, those of alternate loculi between minor sepa declined abaxially. *M.Dev.(up.Eifel.), Eu.(Czech.).—Fig. 116,a-c. *B. bohemica*, holotype, Acanthopyge Ls., Zlatý Káň near Koněprusy; a;b, transv. sec., photograph and drawing, X 8.0; c,d, long. sec., photograph and drawing, X 9.0; e, transv. sec., X 23.5 (Galle & Weyer, 1973).

*Boolelasma* PEDDER, 1967b, p. 122 [*B. pycnotheca*; OD; *TF8985, UNE, Armidale] [*=Bodelasma FLÜGEL, 1970, p. 35, nom. null.]. Solitary, small, slender, with narrow peripheral stereozones; major sepa united axially to form narrow, regular aulos; minor septa long, contratingent; both orders with ?waves or metriophyllloid flanges; aular tabellae flat; tabellae within contratingencies gently declined abaxially, those of alternate inter­septal loculi steeply declined abaxially. [WEYER, 1972c, p. 455, states that the cardinal, counter, counter-lateral, and *Km* sepa appear forked peripherally.] *L.Dev.(Siegen.), Australia(Vict.); L. Dev.(up.EMS.), Eu.(Spain).—Fig. 116,2a,b. *B. pycnotheca*, holotype, Siegen., Cooper’s Cr. F., Vict., Tyler’s R.; a;b, transv., long. secs., X 5 (Pedder, 1967b).

*Kabakovichtiella* Weyer, 1972c, p. 451 [*Amplexo­carina duplicis duplex SCHOPPÉ & STACUL, 1959, p. 322; OD; *TF262, GPl, Münster*]. Solitary, small, with thread-thin sepa; major sepa short, minor sepa relatively long and either contratingent, contrajunct, or free at axial ends; thin-walled irregular ?aulos formed by downturned edges of broad, meso-shaped axial tabellae [evidenced by longitudi­nal section of holotype]; periallar tabularium possibly biform [based on different levels of inter­section of tabellae in alternate loculi between minor sepa as seen in transverse section]; ?without tabular fossula. [L.Perm., Eu.(Carnic Alps); U.Perm., Asia(Timor).—Fig. 116,1a,c. *K. dup­lex (SCHOPPÉ & STACUL), holotype, Basleo Beds, Timor; a,b, transv. secs., c, long. sec., all X 3 (Schoppé & Stacul, 1959).]

*Metriaxon* GLINSKI, 1963, p. 324 [*M. schua­teri*; OD; *TFXX549, SM, Frankfurt*]. Solitary, small, small cardinal side concave; major sepa with subhorizontal metriophyllloid flanges and unifying axially to form narrow aulos crossed by more or less horizontal tabellae; *Km* long and contratingent, remaining minor sepa very short; per­iallar tabellae sparse or absent [see also Plusquel­lec, 1966, p. 834]. *L.Dev.(EMS.), Eu.(Spain); M.Dev., Eu.(Ger.-France-Pol.).—Fig. 117,6a,b. *M. schlueteri, Prümmer Mulde, Ger.; a, holotype, Junkerberg beds, median long. sec., X 5; b, another specimen, Freiling beds, median long. sec., X 5 (Glinski, 1963).
Pedderelasma Weyer, 1972c, p. 455 [*Syringaxon? furcaseptatus Flügel & Free, 1962, p. 240; OD; tP1117, UG, Graz]. Solitary, small; with imperfect aulos developed only in middle stages of growth; septa long, thin, irregularly waved, major septa withdrawing toward periphery in late stages,
counter septum may be 'split' at peripheral end; minor septa contratingent or with axial ends free; tabularium biform, within contratingencies tabellae declined adaxially, in alternate loculi between minor septa declined steeply abaxially; aular tabellae flat. M.Dev. (Eifel.), Eu. (Ger.)—Fig. 117, 3a,b. *P. furcaseptatum (Flügel & Free), Greifenstein Ls., Rhenish Schiefergebirge; a, holotype, transv. sec., ×6 (Weyer, 1972c); b, toptotype, long. sec., ×6 (Flügel & Free, 1962).

Saurophyllum Philip, 1962, p. 172 [*S. pocillum; OD; ?M3021, MU, Melbourne] [≡Syringaxon Lindström, 1882b, which see]. Solitary, small; major septa long, axial ends thickened and con­junct in aulos that is crossed by subhorizontal tabellae; cardinal and counter septa may be longer than others; minor septa long, contractingeut, Km longest; periaulal tabularium biform, with dissepi­mentlike plates within contratingencies and sub­horizontal tabellae in alternate loculi between minor septa. [Weyer, 1972c, p. 453; states that there are no septa with peripheral ends 'split,' but this is not apparent from the illustrations and descriptions of the type material.] L.Dev., Aus­tralia (Vic.).—Fig. 117,5a,b. *S. pocillum, Gedinn., Vict., Boola Beds, Tyer’s area; a, holotype, long. sec.; b, toptotype, transv. sec., both ×2 (Philip, 1962).

Schindewolfia Weissermel, 1943b, p. 24 [*Lind­strömia (Schindewolfia) lauterbergensis; M; not traced, ?in ZGL, E. Berlin] [≡Syringaxon Lindström, 1882b, which see]. Solitary; calice with area of axial structure appearing excavate, axial structure constructed of the dilated and somewhat withdrawn axial ends of major sepa, which form an aulos, and of sclerenchyme infilling the aular space; counter septum and in some stages cardinal also longer and slightly more rhopaloid than others; Km very long, axially free or contra­tingent; other minor septa moderately long and contractingeut; peripheral ends of major sepa forming stereozone; [in transverse section, adaxially con­vex interections of periaular tabellae cross loculi between major sepa, and sparse interections of ambiguous curvature are seen within some contratingencies; see also Kellman, 1965, p. 71]. U.Sil. or L.Dev., Eu. (Ger.)—Fig. 117,2a,b. *S. lauterbergensis; synotype, Oberharz, Heilbeck near Lauterberg; a,b, transv. secs., ×5.5 (Weissermel, 1943b).

Sutherlandinia Weyer, 1972c, p. 453 [*Saurop­hyllum arbuscule Sutherland, 1965, p. 39; OD; ?M510, OU, Norman] [≡Syringaxon Lindström, 1882b, which see]. Solitary, small, with slender aulos formed by conjunction of slightly rhopaloid axial ends of long major sepa which counter and in some stages cardinal also may be slightly longer than others; aulos with sparse subhorizontal tabellae; minor sepa long and contractingeut, Km longest; tabellae within contratingencies declined adaxially, those of alternate interseptal loculi subhorizontal or declined ab­axially; peripheral ends of cardinal, counter, and Km sepa may appear split. U.Sil., N.Am.(Okla.); U.Sil.-L.Dev., Eu. (Ger.).—Fig. 117,4a,b. *S. arbuscule (Sutherland), U.Sil., Henryhouse Ls., Okla.; a, holotype, long. sec., cardinal side to left, b, paratype, transv. sec., ×6 (Sutherland, 1965).

Syringaxon Lindström, 1882b, p. 20 [*Cyathaxonia siluriensis McCoy, 1850, p. 281; M; ?A5468, SM, Cambridge] [≡Laccophyllum Simpson, 1900, which see; ?Allevinia Počta, 1902, which see; ?Barrandeophyllum Počta, 1902, which see; ?Schindewolfia Weissermel, 1943b, which see; ?Saurophyllum Philip, 1962, which see; ?Sutherlandinia Weyer, 1972c, which see; ?Neo­syringaxon Jia in Jia et al., 1977, p. 118 (type, N. elegans; OD; ?IV37013, HPRIGS, Yi­chang; M. Dev., Xianzhe Co., Guangxi [Kwangsi]); no evidence available of presence of horizontal skeletal elements in contratingencies). Of the genera included tentatively in this synonymy of Syringaxon, only Sutherlandinia has its type species adequately described and illustrated. The diagnosis given below is based on the holotype of the type species of Syringaxon. Diagnoses of the subjective synonyms given under the several generic names are based as strictly as possible on their type species.] Small, solitary, ceratoid, with aulos formed dominantly by thickening to contiguity of somewhat rhopaloid and withdrawn axial ends of major sepa; minor sepa contratingent, and tabularium biform, periaular tabellae except within contratingencies convex adaxially, indicating declination from axis to wall [within contratingencies only one section of tabella noted, concave adaxially, indicating declination abaxially; Weyer, 1972c, p. 461, suggests that peripheral ends of counter and Km sepa may be 'split']. [See Hill & Jell, 1970b, p. 17; Sutherland, 1970, p. 1126. Sutherland showed that the holotype of S. siluriensis had been twice buried, eroded, and transported before final fossilization, so that unambiguous morphological reconstruction is hardly possible.] U.Sil., Eu. (Eng.), sensu latu Sil.-Dev., Eu.-Asia-N. Am.-S. Am.-Australia.—Fig. 117,1. *S. siluriensis (McCoy), holotype, Ludlov, Westmoreland; transv. sec., ×8 (Sutherland, 1970).

Subfamily GUERICHPHYLLINAE

Rozkowska, 1969

[Guerichiphyllinae Rozkowska, 1969, p. 70]

Solitary, small; in early stages major sepa joining at axis, later withdrawing, forming aulos by deflection or thickening to contiguity of neighboring axal ends; in late stages aulos fails to continue; cardinal sepa may be shorter, in shallow tabular fossula; minor sepa short, not contra-
Coelenterata—Anthozoa

**Fig. 118. Laccophyllidae (p. F196-F198).**

Tingent; dissepiments present, and, where minor septa are withdrawn, crossing loculi between major septa; tabulae horizontal in and above aular region, abaxially declined peripherally. *M.Dev.-U.Dev.*

**Guerichiphyllum** Rozkowska, 1969, p. 71 [*Blothophyllum skalense* Gürich, 1896, p. 173; OD; neotype, here chosen on request of Fedorowski (written commun., May 28, 1974), P128, PZI, Poznan, figured Fedorowski, 1965b, pl. 5, fig. 1]. Small, solitary, ?convex side cardinal; major septa united at axis in earliest stages, then withdrawing but forming aulos by turning aside to contiguity or by thickening of neighboring axial ends; aulos fails to continue into latest stages; minor septa short or reduced to wall or surfaces of dissepiments, not contratingent; septa of cardinal quadrant, or in places of all quadrants may be thickened; cardinal septum shortens in shallow fossula; lonsdaleoid dissepiments may occur. *M.Dev.-U.Dev.*

**Friedbergia** Rozkowska, 1969, p. 78 [*F. bipartita; M; ?163I, II, 62, IG, Warsaw*]. Solitary, small, in early stages major septa of cardinal quadrants thick, those of counter quadrants thin and bent around axial space to form half aulos in counter quadrants, which are separated from cardinal by partition formed by thick alar septa; cardinal septum short, thick, in open shallow fossula, counter septum long, thin, and in open fossula; septal insertion accelerated in counter quadrants; in later stages cardinal septum lengthens and thins, and counter septum equals other septa of counter quadrants, and with them forms half aulos; bilateral symmetry persists throughout; minor septa reduced in wall; no dissepiments. [Rozkowska (in Weyer, 1973e, p. 685) states that an explanation of the juvenile stages as a talon anomaly is quite unlikely and that additional *Friedbergia* material has been found in Famennian of the Urals.] *U.Dev.* (up.Famenn.), *Eu.(Pol.)*—Fig. 118,2a-c. *G. skalense* (Gürich), *M.Dev., Pol., Skaly; a, neotype, transv. sec., ×2.3; b,c, other specimens, transv., long. secs., ×2.3 (Fedorowski, 1965b).

?Subfamily FRIEDBERGIINAE Rozkowska, 1969

[Friedbergiinae Rozkowska, 1969, p. 78]

Characters as for genus. *U.Dev.*

**Friedbergia** Rozkowska, 1969, p. 78 [*F. bipartita; M; ?163I, II, 62, IG, Warsaw*]. Solitary, small, in early stages major septa of cardinal quadrants thick, those of counter quadrants thin and bent around axial space to form half aulos in counter quadrants, which are separated from cardinal by partition formed by thick alar septa; cardinal septum short, thick, in open shallow fossula, counter septum long, thin, and in open fossula; septal insertion accelerated in counter quadrants; in later stages cardinal septum lengthens and thins, and counter septum equals other septa of counter quadrants, and with them forms half aulos; bilateral symmetry persists throughout; minor septa reduced in wall; no dissepiments. [Rozkowska (in Weyer, 1973e, p. 685) states that an explanation of the juvenile stages as a talon anomaly is quite unlikely and that additional *Friedbergia* material has been found in Famennian of the Urals.] *U.Dev.* (up.Famenn.), *Eu.(Pol.)*—Fig. 118,2a-g. *F. bipartita*, holotype, Kowala, Holy Cross Mts.; a-g, serial transv. secs., ×2.6 (Rozkowska, 1969).

Subfamily NEAXONINAE Hill, new subfamily

Small, solitary, erect or curved, commonly with cardinal side convex; major septa meeting near axis to form aulos and not flanged, but of coarse trabeculae; minor septa including *Km* short, not contratingent,

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**Fig. 118. Laccophyllidae (p. F196-F198).**
commonly buried in more or less thick wall; aular tabellae complete or incomplete, periaular tabellae declined from aulos. *L. Dev.–L.Carb.*

**Neaxon** Kullman, 1965, p. 81 [*N. regularis*; OD; *Casel281/1005, Kullman Coll., GPI, Tübingen*]. Small, solitary, erect or curved with cardinal side convex; septa without flanges, may be coarsely monacanthate; cardinal and counter septa may be longest; minor septa very short, not contratangent; in early stages major septa joining at axis, in later stages their axial ends withdrawn but united to form aulos, in which are horizontal tabellae; periaxial tabellae declined from aulos; no dissepiments [see Weyer, 1971b, p. 295]. *L.Dev. (up. Ems.), Eu.(Spain); *M.Dev.(Eifel.), Eu.(Ger.); U.Dev. (Famenn.), Eu.(Ger.-Pol.)-W.Australia; L.Carb., Eu.(Eng.)-Asia(Kansu)].—Fig. 119,3a,b. *N. regularis*, holotype, L.Dev.(up. Ems.), N.Spain, E. of Muda; a,b, transv. secs., X6, X4 (Kullman, 1965).

**Catactotoechus** Hill, 1954, p. 10 [*C. irregularis*; OD; *Casel3535, UWA, Perth*]. Solitary, subcylindrical, in early stages with an aulos formed mainly by flexing to contiguity of axial ends of major septa, or from continuation of septal thickening over tabulae in regions of downturnturning, or both, and in some partly also by direct contiguity of thickened axial ends of septa; in later stages aulos is breached and disappears; cardinal septum in shallow fossula; minor septa reduced to thin wall; dissepiments commonly in single incomplete series, each dissepiment connecting two neighboring major septa [see Hill & Jell, 1970b, p. 11]. *U.Dev. (Famenn.), W.Australia.—Fig. 119,1a,b. *C. irregularis*, holotype, Famenn., zone of *Spinulicosta proteus*, Fairfield F., Oscar Hill, Canning Basin; a,b, long., transv. secs., X3, X2 (Hill & Jell, 1970b).

**?Czarnockia** Rozkowska, 1969, p. 67 [*C. obliqua*; OD; *Casel163d, II, 62, IG, Warsaw*]. Corallum curved, cornute, with very oblique, wide calice; major septa long, here and there with axial edges flexed to form discontinuous aulos or terminating on tabulae; minor septa short, not contratangent; septa finely trabeculate; axial tabellae wide, periaxial tabellae developed only on convex side of corallum and curved and nearly at right angles to axial tabellae; no septal flanges; no dissepiments. *U.Dev. (up. Famenn.), Eu.(Pol.).—Fig. 119,5a,b. *C. obliqua*, holotype, Kowala, Holy Cross Mts.; a,b, transv., long. secs., X2 (Rozkowska, 1969).

**?Hillaxon** Rozkowska, 1969, p. 65 [*H. vesiculosis*; M; *Casel2566, PZI, Poznan*]. Solitary, turbinate, with wide, horizontal calice; aulos discontinuous, formed by deflected axial ends of major septa, or here and there by downturnturning to continuity of edges of axial tabellae; septa finely trabeculate, minor septa not contratangent, peripheral parts of both major and minor septa may be discontinuous; aular tabellae flat, periaural tabellae declined toward thick outer wall; normal and lonsdaleoid dissepiments well developed in sides of calice. *U.Dev. (up. Famenn.), Eu.(Pol.).—Fig. 119.
Corallum solitary, subcylindrical, not large; with discontinuous aulos commonly formed by downturned edges of mesa-shaped tabulae resting on tabula next below; major septa attaining axis in earliest stages, but withdrawing and their axial ends joining aulos; cardinal septum may be shorter than others; minor septa very short; commonly reduced to wall; tabulae distant; sporadic dissepiments in some. [The validity of this subfamily rests on the current view that its aulos is basically tabular in origin and not formed by thickening or deflection of axial ends of septa as is assumed in Laccophyllinae. Flügel (1972, p. 79), following Schoupfé & Stacul (1959, p. 293), considers also that a fossorial depression in the tabulae present in Amplexidae is absent in Amplexocariniinae. Allocation of genera between the two subfamilies is somewhat arbitrary, more research being required.] U.Dev.-Perm.

Amplexocarinia Soshkina, 1928, p. 379, as subgenus of Ampexus [*A. muralis; M; 1562, coll. 146, PIN, Moscow] [=Amplexcarinia LANG, SMITH, & THOMAS, 1940, p. 16, nom. van.]. Solitary, small, cylindrical; in young stages major septa attaining axis; in mature stages septa withdrawing from axis, their axial ends joining somewhat discontinuous aulos; cardinal septum may be shorter than others in more or less distinct fossula; minor septa very short, confined to wall; tabulae distant, flat in broad axial parts, with edge downturned and commonly resting on plate next below, thus forming aulos; periaxial tabellae declined abaxially; sporadic dissepiments in some. U.Dev.- Eu.(Pol.); Miss., N.Am.-(Mont.)-U.Carb., Eu.(Spain-Carnic Alps-Chios-Spits.)-Penn., N.Am. (Okla.-Texas); L.Perm., Eu.(Carnic Alps-N. Urals)-Asia(Iran); U.Perm., Asia(Asia M.-Salt R.-Timor).—Fig. 120,3.a-d. *A. muralis, L. Perm.(Artinsk.), N. Urals, R. Shchugor; a-c, holotype, transv., secs., X5; d, paratype, long. sec., X5 (Soshkina, Dobrolyubova, & Porfirev, 1941).

Gorizdronia Rozkowska, 1969, p. 89 [*Nalieokinella profunda Soshkina, 1951, p. 33, non Soshkina, 1939, p. 44, renamed Gorizdronia soshkinae ROZKOWSKA, 1974, p. 531; ?in PIN, Moscow; lectotype by ROZKOWSKA, 1974, p. 531]. Solitary, moderately large, with rejuvenescence; in early stages with short-lasting axial tube (?formed by tabellae); major septa amplexoid, without carinae or flanges, but in some with lateral tabellae; minor septa reduced to wall; tabulae mostly complete low domes with downturned edges and some with axial depression, with accessory, conical tabellae near periphery. U.Dev.(Famenn.), Eu.(Pol.-Urals)-Asia(E.slopes Urals).—Fig. 120,1.a.e. *G. soshkinae ROZKOWSKA, Pol., Kadzelnia, Holy Cross
Nicholsoniella Soshkina, 1952, p. 66 [*N. bashkirica; OD; syntypes in PIN, Moscow]. Solitary, short; tabulae incomplete, tabellae in concave axial series and dissepimentlike periaxial series whose downturned axial parts form aulos [see Rozkowska, 1969, p. 89, 101, from photographs of types]. U.Dev.(Famenn.), Eu.(Urals-Pol.)—Fig. 121,la-g. *N. profunda; a-d, Pol., Kadzielnia I, bed 2, a-c, transv., d, long. secs., X6 (Rozkowska, 1969); e-g, holotype, E. slope of Urals, Verkhneuralsk reg., e,f, transv., g, long. secs., X4 (Soshkina, 1939).
small, erect, conical; with tabular and tabulate axillary space formed by confluence in an aulos of thickened and somewhat withdrawn axial ends of major septa that are contiguous or connected by extensions of thickening over downturnings of the tabulae; cardinal fossula, with shortened cardinal septum, opens into aulos in early stages; minor septa very short except near counter septum, where they may be longer and contraclined; tabulae scanty, horizontal in aulos, periaxial tabellae infrequent, declined abaxially. _L._Perm.(Artinsk.), Eu.(S.Urals).—Fig. 120,2a-e. *P. permiana_, Aktiubinsk reg., R. Sogur-say; _a-d_, holotype, transv. secs., _X3; e_, paratype, transv. sec., _X3 (Soshkina, Dobrolyubova, & Porfiryev, 1941).

Subfamily Uncertain

_Retiophyllum_ Počta, 1902, p. 180 [*R. minum_; OD; _0_; _Tc3/1605, PZI, Poznan_]. Solitary, moderately large, cylindrical; with everted calice and continuous epitheca; in early stages with indistinct aulos in inner part of dissepimentarium, in later stages with an irregular, broad pipe of subglobose, horizontally based dissepiments drawn up laterally against major septa; peripheral dissepiments declined abaxially; tabular floors flat, of numerous tabellae. _U.Dev.(low.Famenn.), Eu.(Pol)._.

Family _KIELCEPHYLLIDAE_ Rozkowska, 1969

[Kielcephyllidae Rozkowska, 1969, p. 105] [=Thecaxyonidae Weyer, 1978, p. 299] Solitary, with everted calice and exert septa, in some with epitheca discontinuously developed in rings; in early stage with an aulos; inner part of dissepimentarium with irregular, broad pipe of dissepiments horizontally based but drawn up laterally against septa; peripheral dissepiments declined abaxially; tabular floors flat, of numerous tabellae. _U.Dev.(low.Famenn.), Eu.(Pol)._.

_Kielcephyllum_ Rozkowska, 1969, p. 106 [*K. cupulatum_; OD; _Tc3/1605, PZI, Poznan_]. Solitary, moderately large, cylindrical; with everted calice and continuous epitheca; in early stage with indistinct aulos in inner part of dissepimentarium, in later stages with an irregular, broad pipe of subglobose, horizontally based dissepiments drawn up laterally against major septa; peripheral dissepiments declined abaxially; axial tabellae flat, close; major septa may be discontinuous; minor septa withdrawn. _U.Dev.(low.Famenn.), Eu.(Pol)._—Fig. 122,1a-c. *K. cupulatum_, holotype, Kadzielnia, Holy Cross Mts.; _a_, diagram, distal end of caliculum, showing archate distal edges of septa, _X1; b,c_, transv., long. secs., _X1 (Rozkowska, 1969).

_Kozłowskinia_ Rozkowska, 1969, p. 114 [*K. flos_; OD; _Tc3/1898, PZI, Poznan_]. Solitary, slender, cylindrical with everted calice and discontinuous epithecal rings; internally like _Kielcephyllum_ but...
Rugosa—Stauriida—Metriophyllina

aulos may continue to calice; septa not or seldom discontinuous, minor septa moderately long; at inner edge of minor septal marginarium, pipe of subhorizontally based dissepiments that may be drawn up against the sides of the septa may develop; peripheral ?dissepiments abaxially declined. U.Dev.(low.Famenn.), Eu.(Pol.).—Fig. 122, 2a-d. *K. flos; a, holotype, Kadzielnia, Holy Cross Mts., transv. sec., ¥2.0; b,d, another specimen, transv., long. secs., ¥2.0; c, third specimen, transv. sec., ¥2.5 (Rozkowska, 1969).


?Family LINDSTROEMIIDAE
Pocta, 1902
[nom. correct. et transl. CHAPMAN, 1925, p. 105, as Lindstroemiinae Pocta, 1902, ex Lindstroemidae Pocta, 1902, p. 181] [=Lindstroemiicae Rozkowska, 1969, p. 32]

Characters as for genus. Dev.


Lindstroemia Nicholson & Thomson, 1876, p. 150, nom. correct. CHAPMAN, 1925, p. 105, ex Lindstroemia Nicholson & Thomson, 1876, p. 150 [*Lindstroemia columnaris; M, figured Nicholson & Etheridge, 1878b, p. 84, fig. 4b, b'; synotypes 1968.15.41-43, RMS, Edinburgh, fide Benton, 1979]. Solitary, small, conical; calice deep; septa joining axially to form “strong twisted pseudocolumnella which projects into floor of calice”; with remote “dissepiments,” and tabulae. [In the only illustrations of what is probably type material, by Nicholson & Etheridge (1878b), the transverse section resembles that of Stereolasma rectum (Hall) except that the cardinal fossula does not invade the columnellar mass; in this respect it resembles Syringaxon Lindström, 1882b. Presence of an aulos is unproven; the longitudinal section, with its slightly oblique calical floor sloping downward toward the concave side of corallum, and absence of calical projection of columnellar mass, differs from that used by Simpson (1900, p. 207) as S. rectum, in which an oblique calical floor, without calicular projection, slopes down toward convex side. Simpson’s longitudinal section seems, however, somewhat inconsistent morphologically with his transverse section. Until the type material is restudied, Lindstroemia Nicholson & Thomson will remain unsuitable as the name genus for a family.] Dev., N.Am.—Fig. 122, 2a,b. *L. columnaris, type material, M.Dev., N.Am.; a,b, transv., long. secs., ¥3 (Nicholson & Etheridge, 1878b).

Family HADROPHYLLIDAE
Nicholson, 1889

[Hadrophyllidae Nicholson in Nicholson & Lydekker, 1889, p. 296]

Small, solitary, top-shaped, turbinate, patellate, or discoid, probably epithecate; septa arranged pinnately about fossula in cardinal quadrants and at angles toward alar fossu-
lae in counter quadrants; cardinal septum may be shorter or thinner or less tall than others; minor septa may be contratingent. [Topotypes of the type species of Hadrophyllum are worn and not thin-sectioned. Pending examination of internal structure, definition of the family can only be tentative.] \( ? \) L.Dev.-M.Dev.

**Hadrophyllum Milne-Edwards & Haime, 1850,** p. lxvii [*H. orbignyi*; OD; syntypes e-139a-c, DE VERNEUIL Coll., EM, Paris]. Small, solitary; patellate, turbinate or top-shaped, probably epithecate; calice ?flat or slightly depressed axially; tip slightly eccentric, toward counter side; cardinal septum thin, may shorten, rising but little above floor of deep adaxially expanding fossula that is bounded by fused axial edges of metasepta of cardinal quadrants; alar septa long, with narrow alar fossulae bounded on counter sides by fused axial ends of metasepta of counter quadrants; minor septa may be contratingent. [Thin sections
required; topotypes appear worn; see also \textit{Weyer}, 1975a, p. 23.] ?L.Dev., M.Dev. (Cowlin.), N.Am. (Ky.-Ind.-Ohio)-?Eu. (Ger.-Spain)-Australia (New S.Wales)-N.Afr. (Alg.).—\textit{Fig. 123,} 2a-d. **H. orbignyi**: \(a, b\), syntype, Jeffersonville Ls., Ind. or Ky., ext. view, \(\times 1.5\), calical view, enl. (Milne-Edwards)
Family COMBOPHYLLIDAE

Weyer, 1975

[Combophyllidae Weyer, 1975a, p. 17]

Solitary, discoid, free, without epipetalous sheath; calice everted, coarse trabeculae diverging fanwise from axis in each septum; outer ends of outwardly diverging trabeculae projecting beyond wall in denticulate ridges; weak axial structure in some; fossula commonly with shortened cardinal septum; no tabulae, no dissepiments. *L.Dev.-M.Dev.*

**Combophyllum** Milne-Edwards & Haine, 1850, p. lxvii [*C. osismorum*; OD; c-102, de Verneuil Coll., EM, Paris; lectotype by Plusquellec & Semenoff, 1973, p. 412] (=Parmassessor Ludwig, 1869, p. 131 [type, *P. ovatus*, SD Flügel, 1970, p. 199; not traced; *M.Dev.*, "Lenneschiefer," Wissenbach, Ger.], see Weyer, 1975a, p. 14, 29; Combophyllum Le Maitre, 1952, p. 44, nom. van.; Ludwigia Weyer, 1975a, p. 29 [type, Combophyllum ibericum Plusquellec in Marin & Plusquellec, 1973, p. 42, OD; t2397, LP, Brest; up.EMS. or low.Couvin., near Cabrero, Teruel, Spain; lacks overhanging extension from axial calicular platform]). Solitary, small, discoid, free, without epipetalous; septal trabeculae coarse and diverging fanwise from axis in plane of wall formed between major and minor septa, and imparting denticulation to calical and basal edges of septa, and carinate to sides of septa; axial part of calice footed by sclerenchyme in which, thin section, axial structure of septal lamellae may be traced, sclerenchyme may be extended into platform overhanging interseptal loculi by thickening to contiguity of parts of major septa axial to ends of minor septa; septa radially arranged in counter quadrants, pinnately arranged to parallel-sided fossula in cardinal quadrants; cardinal septum short; tabulae and dissepiments absent [see Plusquellec & Semenoff, 1973, p. 415; Weyer, 1975a, p. 29]. *L.Dev.-M.Dev.* low. Couvin. Eu. (France-Ger.-Spain)-N. Afr. (Alg.).

---FIG. 124,1-a,f. *C. osismorum*, M.Dev. (Couvin.), France, Le Fret, Brest roadstead; a-c, lectotype, proximal, calical, lat. views, X6.6; d-f, syntype, calical, lateral views showing axial calicular platform, X6.6; f, transv. sec., specimen 3 mm. in diam. (Plusquellec & Semenoff, 1973). ---FIG. 124, g-i. *C. ibericum*, holotype, up.EMs. or low.Couvin., Spain, near Cabrero, Teruel; g-i, proximal, calical, lat. views, X3.8 (Marin & Plusquellec, 1973).
Rugosa—Stauriida—Metriophyllina

Doubtfully Assigned to Suborder Metriophyllina

Lyliophyllum Kelus, 1939, p. 37 [*L. pulcherri-mum; OD; †destroyed by fire in Warsaw, fide Pickett, 1967b, p. 42]. Small, weakly compound, a few conicocylindrical individuals united by lateral processes; calce funnel-shaped, with flattened base; major septa thin, extending over two-thirds distance to axis, minor septa represented by short peripheral ridges. [Internal structure unknown.] M.Dev., Eu.(Pol.).—Fig. 125, 2a,b. *L. pulcherri-mum, syntype, Pol., Kamieniar-nia, Volhynia; a,b, ext. views, ×1 (Kelus, 1939).

Gymnophyllum Howell, 1945, p. 1 [*G. wardi; OD; †58161, PU, Princeton]. Small, discoid, point of attachment central; epitheca absent or present as separated rings only, so that septa are exposed on basal as well as calical surface; major septa long, thick, and contiguous basally and axially, radially or subradially arranged, cardinal fossula commonly inconspicuous; in mature stages axial parts of major septa may be obscured by skeletal thickening layered parallel to base; basally and peripherally major septa appear split? (due to contratingent minor septa or because of weathering along median dense plane); smaller? (tertiary or minor) septa alternate; trabeculae of septa moderately coarse judging from rounded dentations on calical edges, their inclination varying along length of septa [median longitudinal sections required]; tabulae very rare. [See Sutherland & Haugh, 1969, p. 30; Jeffords, 1955, p. 13. Weyer (1975a, p. 19) assigned the genus to his new subfamily Gymnophyllinae of the family Cyathaxoniidae Milne-Edwards & Haime, 1850, with the subfamily diagnosis: discoid, with everted calice, costae, eutheca, and isolated epithecal rings, without archaeotheca and with certain split septa (cardinal, counter, and Km). Use of the terms costae, eutheca, and archaeotheca are not recommended in this Treatise. Weyer’s interpretation, implied in his diagnosis immediately preceding, that there is an axis of divergence of trabeculae or fibers within the radial plates and that an internal discoid wall develops about or in the place containing these axes of divergence, requires proof from median longitudinal thin sections of septa and from tangential sections through the wall between septa. The possibility in Gymnophyllum, as in Ditoedolasma Simpson, 1900, that the strict relationship between median plane of septum and septal groove in epithecal sheath required by Kuhn’s Law does not occur deserves investigation. Compare Sutherland, 1965, pl. 27, 32, with Sutherland & Haugh, 1969, pl. 3.] ?U.Carb., Eu.(USSR, epithecate); M.Penn., N.Am.(Okla.).—Fig. 126, 1a-d. *G. wardi, topotypes, M.Penn.,
and long septa that may have asymmetrical trabecular carinae or in a few be complexly structured; minor septa contrangent in some; tabular floors commonly domes with margins turned out or up, when major septa withdraw somewhat from axis, flat or depressed axially; tabulae commonly incomplete, in many, tabellae of upturned margins may form series outside imperfect axial column of periaxial and axial tabellae; in some, concave tabular floors develop in places; dissepiments commonly small, globose, and interseptal, in some, large lonsdaleoid dissepiments may disrupt septa; cardinal fossula indistinct except in solitary genera. Sil.-L.Dev.

**Entelophyllum** Weidekind, 1927, p. 22 [*Madreporites articulatus* Wahlenberg, 1821, p. 97; SD Lang, Smith, & Thomas, 1940, p. 57; neotype, Cn54823, Hisinger Coll., RM, Stockholm; by Smith & Tremberth, 1929, p. 363] [=Xylodes Lang & Smith, 1927, p. 457 (type, *Madreporites articulatus* Wahlenberg, 1821, p. 97, OD), non Xylodes Waterhouse, 1876, a recent coleopteron; ?Stereoxylosed Wang, 1944, p. 24 (type, Cyathophyllum pseudodianthus Weissermel, 1894, p. 591, OD; not traced; formerly in Ostpreussisches Provinzial-Museum, Königsberg (now Kaliningrad), lectotype by Lang & Smith, 1927, p. 473; Pleistocene drift, Lauth, E. Prussia; Ivanovsky, 1976, p. 165, invalidly named as neotype the holotype of *Stereoxylosed pseudodianthus var. sinensis* Wang, 1945, S1121-3, Geol. Dept. Nation. SW. Assoc. Univ., China, from M.Sil., E. Yunnan; fasciculate with thick, asymmetrically carinate septa; restudy of type required); ?Carinophyllum Strel'nikov, 1964, p. 59 (type, Cyathophyllum conusus Počta, 1902, p. 102, OD; in NM, Prague, lectotype by Pranti, 1940, p. 24; U.Sil., eβ, Tachlowice, Czech.; fasciculate, with thick, asymmetrically carinate septa; restudy of type required). Fasciculate; septa long, radially arranged, smooth or asymmetrically carinate; major septa slightly withdrawn from axis; minor septa may be contrangent in some; tabular floors broad domes commonly with depressed centers and marginal troughs formed by small subhorizontal or concave peripheral tabellae; dissepiments small, globose, numerous, and interseptal; fossula commonly indistinct. Sil., Eu.(U.K.-Nor.-Swed.-Est.-Podolia-Urals)-Asia (Sib. Platf.-C. Asia-China)-Australia (New S. Wales-Queensl.)-N. Am. (Que.-Alaska).

---Fig. 127,2a,b. *E. articulatum* (Wahlenberg), neotype, Gotl.; a.b, transv., long. secs., X3 (Hill, n).—Fig. 127,2c.e. *E. pseudodianthus* (Weissermel), lectotype, Pleist. drift, E. Prussia, Lauth, calical view, X2 (Weissermel, 1894).—Fig. 127,2d.e. *E. conusus* (Počta), syntypes, U.Sil., Czech.; d.e, transv., long. secs., X2 (Hill,

---Fig. 126. Family Uncertain (p. F205).

Wewoka F., Okla., vicinity of L. Okmulgee; a,b, basal, calical views, X1, c, tranv. sec., X1 (Sutherland & Haugh, 1969); d, side view, X3 (Jeffords, 1955).

**Suborder ARACHNOPYLLINA** Zhavoronkova, 1972

[Arachnophyllina Zhavoronkova, 1972, p. 36] [=Evenkiellida Zhavoronkova, 1961, p. 86, order]

Solitary or compound Rugosa; septa commonly long and may be carinate or complexly structured in dissepimentarium with numerous small subglobose normal dissepiments; subordinate lonsdaleoid dissepiments may develop; tabular floors low domes with axial depression, or flat; tabulae commonly incomplete; increase dominantly margina- rial. L.Sil.-M.Dev.

**Family ENTELOPHYLLIDAE** Hill, 1940

[Entelophyllidae Hill, 1940c, p. 410] [=Entelophyllinae Wang, 1950, p. 224; Ramulophyllidae Nikolaeva, 1964, p. 50; Evenkiellidae Soskina in Ivanova et al., 1955, p. 126]

Solitary, fasciculate or cerioid; corallites with moderately wide dissepimentarium.
Fig. 127. Entelophyllidae (p. F206-F209).

Small, cerioid or fasciculate with lateral increase; each calice with flat marginarium and tall columella in center of calical pit; major
Fig. 128. Entelophyllidae (p. F207-F209).
septa thin in tabularium, connected to columella; tabularium sharply bounded from dissepimentarium; tabellae numerous, convex, in conical floors; dissepiments small, horizontally disposed at outer wall, but vertically declined at boundary with tabularium; rodlike columella present from early stages, oval in transverse section and appearing to be thickened end of long cardinal septum [homeomorph of Carboniferous Lithostrotion Fleming, 1828]. L.Sil.-M.Sil. (Wenlock), Asia (Salair-Altay)—N.Am. (Alaska).—Fig. 128,2a,b. *A. silurica*, holotype, Yurman suite, SW. Salair, long., transv. secs., ×3.8 (Markovskiy, 1960).

Evenkiella Sokshina in Ivanova et al., 1955, p. 126 [*E. helenae*; OD; t341, coll. 587, Mosk., Moscow] [=Evenkellina Ivanovskiy, 1976, p. 70, invalid nom. subst. pro Evenkiella Sokshina]. Corallum cerioid, with lateral, nonparrical increase; septa of two orders, variably developed, in early stages very short, in late stages thin, may have irregular londsdaleoid discontinuity, and major septa may almost reach or be somewhat withdrawn from axis; tabularium wide, tabular floors flat, concave or convex, tabulare complete or represented by few large tabellae; dissepiments large, in few series, horizontal at periphery, steeply inclined at boundary with tabularium. S.Il. (L.Sin.-M.Sin. boundary), Asia (W.Sib.Platf.-Uzbek).; ?L.Dev. (Kunzakh), Asia (Tadzhik).—Fig. 128,3a,b. *E. helenae*, holotype, Kochumdek Suite, Gks, W. Sib.Platf., R. Stony Tunguska; a,b, long., transv. secs., ×3.8 (Ivanova et al., 1955).

Kysylagathophyllum Kaplan, 1971b, p. 18 [*K. mitchievetichi*; OD; t14, coll. 10287, TsGM, Leningrad]. Cerioid; increase tabularial, staurioid and quadripartite; peripheral ends of major and minor septa commonly thickened, composed of thick, close tabulae that diverge adaxially in a half-fan; axial ends of major septa thin, reaching or almost reaching axis, which is without columella; tabular floors convex in center and sagging at edges, tabulae commonly incomplete; dissepiments normal, concentric, subglobose, in several series. L.Dev. (Gedinn.), Asia (Kazakh).—Fig. 129,4a,b. *K. mitchievetichi*, holotype, lower part of Pribalkhash horizon, near Kyzyl-Agat; a,b, transv., oblique secs., ×2.7 (Sytova & Kaplan, 1975).

Medinophyllum Sytova in Sytova & Ulitina, 1966, p. 235 (invalid junior synonym, non Medinophyllum Hancock, 1910, an orthopteron) [*M. crispm*; OD; t119, coll. 8732, TsGM, Leningrad]. Solitary, of medium size; septa long, thin adaxially but in wide marginarium each represented by column of naotic tabellae; cardinal and counter septa may unite axially, major septa may reach axis; tabular floors shaped like hat with upturned rim and flatly domed crown, of tabellae, peripheral concave tabellae forming distinct series; dissepimentarium wide, of naotic plates and small globose interseptal plates; fossula indistinct. U.Sil., Asia (C.Kazakh).—Fig. 128,1a,b. *M. crispm*, Akkan horizon, zone of M. crispm crispm, S. flank of Karaganda Basin, Sulu-Medina interfluve; a, syntype, part of transv. sec., ×9.4; b, syntype, long. sec., ×2.8 (Sytova & Ulitina, 1966).

Migmatophyllum Pedder, 1971c, p. 14 [*M. lenzi*; OD; t25867, GSC, Ottawa] [=Petrozium Smith, 1930a, which see]. Fuscitate; increase peripheral and parrical; septa long, commonly dilated and carinate peripherally, elsewhere smooth and only slightly dilated; tabulae probably monancithe; major septa commonly contiguous at axis; tabular floors commonly elevated at axis, sigmoidally descending from it, but in places sagging; tabulae incomplete; dissepiments small, interseptal. U.Sil. (Pridol.), N.Am. (N.Yukon).—Fig. 127,2a,b. *M. lenzi*, holotype, Prongs Cr., F., Prongs Cr.; a,b, transv., long. secs., ×3 (Pedder, 1971c).

Nanshanophyllum Yu, 1956, p. 612 [*N. typicum*; OD; tP8693-5, IGP, Nanking]. Corallum solitary; septa very numerous, dilated and faintly asymmetrically carinate in wide dissepimentarium of small, rather elongate dissepiments; major septa extending unequally into axial region, axial ends may be slightly curving in indistinct groups; cardinal fossula extending into axial region, cardinal septum may attain axis; tabular floors axially depressed with edges turned out or up, each floor of many tabellae [see also Pedder, 1976b, p. 291]. U.Sil., Australia (New W.Sales); M.Sil., Asia (Kansu-Shensi-Hunan); U.Sil. (Pridol.), N.Am. (Devon I).—Fig. 130,5a,b. *N. typicum*, holotype, Kansu, Chiyinkungtai, Chiuchan; a,b, transv., long. secs., ×2 (Yu, 1956).

Ornatothylum Nikolaeva, 1964, p. 57 [*O. ornatum*; OD; tR-8/5747, TsGM, Leningrad] [=Scyphophyllum Strelnikov, 1964, which see]. Solitary, small; calcal platform declined adaxially; septa asymmetrically carinate and somewhat dilated in marginarium, in some more so near its junction with tabularium; major septa long, thinning in tabularium, but axial ends thickened in irregular axial complex forming axial calical boss; minor septa moderately long; tabular floors domes with upturned edges, tabulae incomplete; dissepiments not large, subglobose, interseptal. U.Sil. (Aynasu.), Asia (Kazakh).—Fig. 130,2a,b. *O. ornatum*, holotype, Aynasu horizon, SE. flank of Karaganda Basin, S. of Aynasu K.; a,b, transv., long. secs., ×4 (Nikolaeva, 1964).

Petrozium Smith, 1930a, p. 307 [*P. dewari*; OD; t48,674, GSM, London] [=Migmatophyllum Pedder, 1971c, which see; ?Shensiphyllum Ge & Yu, 1974, which see]. Fuscitate, corallites slender, thin-walled; increase peripheral, nonparrical, with numerous long, thin, asymmetrically carinate seita meeting or almost meeting at axis; tabular floors domed, with edges turned out, tabu-
F210

Coelenterata—Anthozoa

lae commonly incomplete, in places outermost tabellae may form distinct series; dissepimentarium relatively narrow, dissepiments small, interseptal; fossula inconspicuous in late stages. L.Sil. (Llandov.), Eu. (U.K.); ?low. M. Sil., N. Am. (Calif.).—Fig. 130,1a-c. *P. dewari, Pen-
Rugosa—Stauriida—Arachnophyllina

*Prohexagonaria* Merriam, 1973a, p. 50, as subgenus of *Entelophyllum* [*Entelophylloides (Pro-

hexagonaria) occidentalis*; OD; 159410, USNM, Washington] [*Tenuiphylum* Soshkina, 1937, which see]. Ceroid; increase peripheral, nonpar- ricidal; septa thin, with inconspicuous asymmetri-cal carinae, long, some reaching axis; tabularium

tamerus beds, U.K., Morrell’s Wood Brook, near Buildwas; *a,b*, transv. secs., ×3; *c*, long. sec., ×2 (Smith, 1930a).

Prohexagonaria Merriam, 1973a, p. 50, as subgenus of Entelophyllum [*Entelophylloides (Pro-

hexagonaria) occidentalis*; OD; 159410, USNM, Washington] [*Tenuiphylum* Soshkina, 1937, which see]. Ceroid; increase peripheral, nonparricidal; septa thin, with inconspicuous asymmetrical carinae, long, some reaching axis; tabularium

fig. 130. Entelophyllidae (p. F209-F212).
narrow, tabulae incomplete or complete, floors up-arched (no median depression noted); dissemi-
mentarium wide, plates interseptal, globose in most series, in some series a few horizontally elongate [see also Pedder, 1967b, p. 290]. M.Sil. or
U.Sil., Eu.(Gotl.)-N.Am.(Nev.); U.Sil.(Pridol.), N.Am.(Cornwallis I.-Yukon).—Fig. 129,1a-c.*P. occidentalis, holotype, low. beds unit 3, Roberts Mt. F., coral zone C, Nev., NW. side of Roberts Cr. Mt.; a,b, long. secs., ×2.3, ×4.0, c, transv. secs., ×2.0 (Merriam, 1973a).

Ramulophyllum NIKOLAEVA, 1964, p. 52 [*R. heterozonale; OD; †R-2, coll. 5747, TsGM, Leningrad]. Solitary, medium-sized; calice commonly with slightly everted platform and low boss in tabularial pit; septa may be unevenly thickened, asymmetrically carinate or areolate, major septa may be long or abaxially withdrawn; minor septa may be contratingent; tabularium relatively wide, tabular floors domes with edges turned out or up, tabulae incomplete, in some, peripheral concave tabellae form regular series; where major septa withdraw unequally toward periphery of tabularium, tabular floors may sag somewhat irregularly; dissepiments small, globose, interseptal; fossula commonly indistinct. U.Sil.(Aynasu.), Asia (C. Kazakh.)-Eu. (Czech.-Gotl.).—Fig. 129,2a,b.*R. heterozonale, Aynasu horizon, C. Kazakh., R. Aynasu, SE. flank of Karaganda Basin; a,b, transv., long. secs., ×2.7 (NIKOLAEVA, 1964).

Sicyophyllum STRENLIKOV, 1964, p. 56 [*S. clavum; OD; †3, coll. 8503, TsGM, Leningrad] [=?Orratophyllum NIKOLAEVA, 1964, which see]. Small, solitary; septa thickened; in early stages peripheral ends of major and minor septa laterally contiguous in narrow stereozone, in later stages zone of thickening wider but interseptal loculi containing small globose dissepiments appearing between major and minor septa; axial ends of major septa thickened and contiguous or almost so to form incomplete tube around axial space; tabular floors domed, with axial deepening and upturned edges, and of large tabellae; cardinal fossula distinct, may open into axial space. U.Sil. (Pridol.-L.Dev.-Gedinn.), Eu.(N. Urals)?Asia(C. Kazakh.).—Fig. 130,3a-b.*S. clavum, holotype, Bolshezemelskaya Tundra; a,b, transv., long. secs., ×4 (STRENLIKOV, 1964; photographs courtesy S. I. STRENLIKOV).

Shensiphyllum GE & YÜ, 1974, p. 171 [*S. aggregatum; OD; †22140-1, IGP, Nanking] [=?Petrozium SMITH, 1930a, which see]. Fasciculate, corallites slender; septa long, radially arranged and asymmetrically carinate in moderately wide disseipientarium; tabular floors domed with upturned margins, each floor of numerous tabellae; dissepiments small, outermost series horizontally based and globose, inner series obliquely based. M.Sil., Asia(Shensi-Hunan).—Fig. 130,4a,b.*S. aggregatum, holotype, Ningqiang F., Shensi, Ning-qiang; a,b, long., transv. secs., ×3 (GE & YÜ, 1974).

Tenuiphyllum SOSHINA, 1937, p. 31 [*T. ornatum; OD; †346-347 in sample 231, coll. 143, PIN, Moscow] [=?Prohexagonaria MERRIAM, 1973a, which see]. Ceroid, increase peripheral; septa long, thin, major reaching or almost reaching axis; tabular floors tall cones with edges turned up or out and some additional tabellae at axis of corallite; dissepiments inclined, unequal, and rather shallow, some londsaldoid. M.Sil.(up.Wen.-lock.), Asia(E.Urals)-Eu.(Gotl.).—Fig. 129,3a,b.*T. ornatum, holotype, E. Urals, right bank of R. Vya, near Elkino; a,b, transv., long. secs., ×2.7 (Ivanovskyi & Shurygina, 1975).

Trachiphyllum ULTINA, 1975, p. 275 [*T. sho-dolense; OD; †2281, coll. 3294, PIN, Moscow]. Closely phaceloid and in part ceroid; septa long, with corroded lateral faces and thickened peripherally, but thinning and somewhat interrupted at boundary between narrow disseipientarium and tabularium; tabulae incomplete, tabular floors convex, sagging axially and near edges. M.Sil.-U.Sil. (Wenlock.-Ludlov.), Asia(E.Mongolia).

Family EXPRESSOPHYLLIDAE

Strelnikov, 1968

[Expressophyllidae STRENLIKOV, 1968b, p. 71]

Solitary, with moderately wide disseipientarium in which minor septa may be discontinuous in some; major septa unequal, thin and amplexoid in tabularium in some; septal trabeculae uniseriate, directed inward and slightly upward; tabularium wide, tabular floors moderate or shallow domes with flattened or upturned and troughed edges; tabulae complete or incomplete, tabularial fossa more or less distinct, cardinal septum may shorten within it. M.Sil.-U.Sil.; ?L.Dev.

Micula SYTOVA, 1952, p. 133 [*M. antiqua; OD; †neotype 62, coll. 454, PIN, Moscow; SD SYTOVA, 1970, p. 73] [=?Expressophyllum STRENLIKOV, 1968b, p. 72 (type, E. simplex; OD; †1, coll. 9403, TsGM, Leningrad; U.Sil., Durnayu horizon, R. Kozhim, Polar Urals; fide SYTOVA, 1970, p. 72)]. Solitary; calicular platform erect or but slightly declined adaxially; marginarium moderately wide stereozone in which narrow interseptal loculi may develop increasingly in later stages, with small, globose, and concentric or angulate dissepiments; septa thickened in disseipientarium, septal trabeculae directed inward and slightly upward, uniseriate; tabularium wide, tabular floors flattened domes with edges irregularly turned out or up and with elongate subhorizontal tabellae in wide axial zone; cardinal fossula indistinct; one peripheral offset may arise from calice. M.Sil.-U.Sil., ?L.Dev., Eu. (Polar Urals-Vaygach-C.Urals).—
Fig. 131. Expressophyllidae (p. F212-F214).

Fig. 131,1a,b. *M. antiqua*, paratypes, M.Sil. (Wenlock.), W. slope of C. Urals, N. shore of Mikhailovskii pond; 1a,b, transv., long. seccs., X4 (Sytova, 1952).—Fig. 131,1c,d. *M. simplex*
Pseudopi lophyllum


nuyiskiy horizon, Polar Urals, R. Kozhim; c,d, transv., long. secs., X 4 (Strelnikov, 1968b).

Contortophyllum STRELNIKOV, 1968b, p. 77 [*C. tchernol'i; aD; t32, col. 9403, TsGM, Leningrad].

Solitary; each septum a plate with denticulate axial edge and composed of single series of sub­

horizontal trabeculae; in early stages septa thick­

ened peripherally to form narrow irregular stereo­

zone, in later stages dissepimentarium moderately wide, dissepiments curved or angulate in transverse section, small, subglobose; tabularium wide, tabu­

lar floors domed or flat axially and with irregu­

larly troughed edges, tabulae incomplete. U.Sil.,

Eu.(Polar Urals).—Fig. 131,2a-c. *C. tchernovii,

holotype, U.Sil.(Ludlov.), Polar Urals, R. Kozhim;

ar, transv. secs., X 4; c, long. sec., X 4 (Stre­

lnikov, 1968b).

Miculiella IVANOVSKYI, 1963, p. 63 [*M. annae;

OD; t32, coll. 305, IGG, Novosibirsk]. Solitary; septa long, thin, amplexoid in tabularium and not reaching axis, with weak thickening at periph­

ergy; major septa not long, mostly discontinuous longitudinally in angulate dissepimentarium; tabu­

lae broadly and shallowly convex, in places compli­


cated by supplementary tabellae; late stages with many series of long, steeply inclined dissepiments; cardinal fossula deepened in tabularium. M.Sil.,

Asia (Sib. Platf.-Altay-Sayan); ?U.Sil., N. Am.

(Alaska).—Fig. 131,3a,b. *M. annae, holotype, mid.Wenlock., Sib. Platf., R. Moyero; a,b, long.,


Pseudopilophyllum LAVRUSEVICH, 1971a, p. 68

[*Pilophyllum moyerense IVANOVSKYI, 1963, p. 61;

OD; t30, coll. 305, IGG, Novosibirsk]. Solitary; septa thick, thickening decreasing in dissepimentarium in later stages with appearance of numer­

ous small angulate dissepiments; major septa un­

equal, radial, few reaching axis; tabularium wide, tabellae of wide axial region forming domed tabular floors, periaxial tabellae less numerous, mostly declined toward dissepimentarium, a few concave; dissepiments small, unequal, numerous, very steeply declined adaxially; fossula not dist­

inct. M.Sil. (low. Wenlock.), Asia (Sib. Platf.-

Tadzhik.).—Fig. 132,la,b. *P. moyerense (Iva­

novskiy), holotype, R. Moyero, Sib. Platf.; a,b,

transv., long. secs., X 4 (Ivanovskiy, 1963; photo­

graphs courtesy A. B. Ivanovskiy).

Family ARACHNOPHYLLIDAE

Dybowski, 1873

[Arachnophyllidae Dybowski, 1873c, p. 339] [?=Chono­

phyllidae HOLMES, 1887, p. 25; Chonophyllinae STUMM,

1949, p. 48; Arachnophyllinae HILL, 1956b, p. F274; Arach­

nophyllicae IVANOYSKIY, 1963, p. 82]

Solitary, astreoid, aphroid, or thamnas­

teroid; corallites large, commonly with re­

flexed calicular platform and narrow axial calicular pit; septa numerous, minor sub­

equal with major, major septa extending somewhat into narrow tabularium in spe­

cies whose tabular floors are low domes with downturned edges and tabulae com­

monly incomplete, or no longer than minor septa in species whose tabular floors are sub­

horizontal; marginarium wide, with septa complexly modified either into network of very short trabeculae perpendicular to up­

per surfaces of numerous low dissepimental­

like plates, or into columns of naotic dis­

seppiments on which are based very short, thick trabeculae, the columns being sepa­

rated by narrow interseptal loculi with fine dissepiments. L.Sil.-M.Dev.
curvature of dissepiments but not piercing more than one or two successive platforms [see also McLean, 1975b, p. 54]. *L.Sil.(up.Llandov.).* M.Sil. (Wenlock.), Eu. (U.K.-Gotl.-Est.)-N. Am. (Ky.-Ind.-Mich.-Iowa); *U.Sil.(Ludlov.).* N.Am. (Tenn.).—Fig. 133,2a-c. *A. murchisoni* (Milne-Edwards & Haime), Wenlock Ls., U.K., Wenlock Edge; *A. murchisoni*, holotype, low. Is. horizon, C. New S. Wales, Cobblers Cr., Angullong district near Orange; *A. murchisoni*, transv., long. secs. of one corallite, ×3.8 (McLean, 1974c).

*Angullophyllum* McLean, 1974c, p. 27 [*A. warrisi*; OD; ♀P 46177, SU, Sydney]. Ceroid; corallites large; tabularium narrow, with tabular floors domed to flat and axial ends of major septa reaching almost to axis; in wide dissepimentarium, septa represented by short fine trabeculae based on upper surfaces of broad, flat-lying dissepiments, possibly forming network, and seldom piercing more than two successive dissepimentarial platforms. *L.Sil.(up.Llandov.).* Australia (New S. Wales).—Fig. 134,la,b. *A. warrisi*, holotype, low. Is. horizon, C. New S. Wales, Cobblers Cr., Angullong district near Orange; *A. warrisi*, transv., long. secs. of one corallite, ×3.8 (McLean, 1974c).

*Chonophyllum* Milne-Edwards & Haime, 1850, p. lxix [*Cyathophyllum perfoliatum* Goldfuss MS, Milne-Edwards & Haime, 1850, p. lxix; ♀203a,b, Goldfuss Coll., IP, Bonn; nom. subst. pro *Cyathophyllum plicatum* Goldfuss, 1826, p. 59, pl. 18, fig. 5, *non Cyathophyllum plicatum* Goldfuss, 1826, p. 54, pl. 15, fig. 12] [=Craterophyllum Foerste, 1909a, which see; *Naos* Lang, 1926, which see]. Solitary, turbinate; septa dilated wedgewise, thickening toward periphery,
the sclerenchyme with scattered trabecular axes and septa without median dark plane; at periphery thickened septa may be represented by columns of naotic dissepiments; tabularium narrow, nature of tabulae not known; dissepimentarium wide, dissepimentated interseptal loculi narrow. [Until a longitudinal section is described and illustrated, generic and family names have doubtful value.]

*C. perfoliatum*, holotype; transv. sec., ×0.9 (Smith, 1945).

**Crateophyllum** Foerste, 1909a, p. 101 [*Chonophyllum (Crateophyllum) vulcanius*; SD Lang, Smith, & Thomas, 1940, p. 42; =Psychophyllum vulcanius Foerste, 1903, p. 713, t84761, USNM, Washington] [*Chonophyllum Milne-Edwards & Haeke, 1850, which see; ?Naos Lang, 1926, which see.]

Large, solitary, with everted calicular platform; septa long, major and minor subequal, naotic, with indistinct narrow interseptal loculi with fine dissepiments; tabularium narrow, tabulae subhorizontal, complete or incomplete. *U.Sil.*, N. Am. (Tenn.); ?L.Dev.-M.Dev. (Onondaga).--**Fig. 134,2a-c.**

**Idiophyllum** Cao in Li et al., 1975, p. 180 [*Idio­phyllum walli* Etheridge, 1892, p. 169; OD; t4672, AM, Nanking). Like *Naos* Lang, 1926, which see.]

Aphroid or in part thamnasterioid coralla with slender distant tabularia each surrounded by aureole of regularly radial septal segments that may be discontinuously extended to join with those from neighboring corallites in thamnasterioid manner; with horizontal or concave, close tabulae, and with shallowly arched dissepiments; dissepimental floors sag between tabularia, but dissepiments bounding tabularia are steeply inclined. [Possibly spongophyllid.]


In fragmentary condition, with everted calicular platform; septa long, major and minor subequal, naotic, with indistinct narrow interseptal loculi with fine dissepiments; tabularium narrow, tabulae subhorizontal, complete or incomplete. *U.Sil.*, N. Am. (Tenn.); ?L.Dev.-M.Dev. (Onondaga).--**Fig. 134,2a-c.**

**Idiophyllum** Cao in Li et al., 1975, p. 180 [*Idio­phyllum walli* Etheridge, 1892, p. 169; OD; t4672, AM, Sydney] [*Zonophyllax* Wang, 1950, p. 224, *null.]*. Aphroid or in part thamnasterioid coralla with slender distant tabularia each surrounded by aureole of regularly radial septal segments that may be discontinuously extended to join with those from neighboring corallites in thamnasterioid manner; with horizontal or concave, close tabulae, and with shallowly arched dissepiments; dissepimental floors sag between tabularia, but dissepiments bounding tabularia are steeply inclined. [Possibly spongophyllid.]

*U.Sil.* (Ludlow.), Austral. (New S. Wales).--**Fig. 135,1a-c.** *Z. walli* (Etheridge), Yass district; a, transv. sec., b,c, different specimen, transv., long. secs., all ×4 (Hill, 1940c).

**Suborder KETOPHYLLINA**

Zhavoronkova, 1972

[Ketophyllina Zhavoronkova, 1972, p. 54]

Solitary or compound Rugosa; septa commonly thickened and disrupted by lonsdaleoid dissepiments in more or less wide dissepimentarium, where their trabeculae may be multiserial, thinning adaxially into tabularium; tabular floors flat or mesa-shaped or low domes with axial depression, tabulae complete or incomplete; increase predominantly marginal. *U.Ord.-?Carb.*

**Family KETOPHYLLILIDAE**

Leconte, 1952


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Fig. 135. Arachnophyllidae (p. F217).
Solitary or with few offsets, large; except in early stages with dissepimentarium in which large lonsdaleoid plates dominate over small, concentric or angulate interseptal plates; septa long, radially arranged, disrupted by lonsdaleoid dissepiments, may thicken wedgewise toward periphery, major septa may continue into tabularium as low ridges on upper surfaces of tabulae; tabulae flat, with mostly downturned edges, commonly in groups of three or more; cardinal fossula and, in some, alar tabular fossula also present. *Sil.-L.Dev.* (*Geninn*).

**Dokophyllum** WEDEKIND, 1927, p. 48 [*D. annulatum*; OD; tCn54863, 54868, 55001, RM, Stockholm] [=*Omphyma auccct., non RANFI-NESQUE & CLIFFORD, 1820, p. 235, see LANG, SMITH, & THOMAS, 1940, p. 90; *?Heterolasma EHLERS, 1919, which see; Ketophyllum WEDEKIND, 1927, p. 48 (type, *K. elegantulum*, OD; holotype by BIRENHEIDE, 1974b, p. 487, not traced in RM, Stockholm; Mulde Marls, Eksta, Djupvik, Gotl.); *Cetophyllum LANG, SMITH, & THOMAS, 1940, p. 35, nom. van.: Docophyllum LANG, SMITH, & THOMAS, 1940, p. 54, nom. van.*]. Solitary, large, septa long, radial, slightly dilated wedgewise in marginarium that is in late stages lonsdaleoid dissepimentarium with some small concentric or angulate interseptal plates; major septa continued into tabularium as thin, low ridges on upper surfaces of tabulae; tabulae flat with edges turned down or up, grouped; cardinal tabular fossula marked, and in some alar fossula also [see also MINATO, 1961, p. 91]. *M.Sil.-U.Sil.*, Eu. (U. K.-Gotl.-Czech.-Asia (Tadzhik.-Malaysia-China))-N. Am. (Que.-Ky.-Mackenzie distr.);--Fig. 136,la,b. *D. elegantulum* (WEDEKIND), Gotl., Eksta, Djupvik, Gotl.; ab, long., transv. sees., X1 (WEDEKIND, 1927).--Fig. 136,lc,d. *D. annulatum* paratype, Gotl., Visby, N. of Kneippbyn; cd, transv. sees., X1 (WEDEKIND, 1927; photographs courtesy Riksmeuse, Stockholm).

**?Chavsakia LAVRUSEVICH, 1959, p. 35 [*C. chavsakienesi*; OD; t3427/67, LAVRUSEVICH Coll., IG, Dushanbe] [=*Nataliella SYTOVA, 1966, which see*]. Solitary, cylindrical or subcylindrical; with epithelial scales; septa represented by radial ridges on dissepiments, dissepiments in single series of very large plates, subhorizontal except inner parts declining steeply to form boundary with tabularium, tabulae subhorizontal or shallowly concave. [Possibly cystophyllinian.] *L.Dev.* (*Geninn*). Asia (Tadzhik.).--Fig. 136,2a-c. *C. chavsakienesi*, Pholidophyllum beds, Zaveshan-Gissar R., Khivak Suly; ab, transv., long. secs., X1; c, fragment showing epithelial scales and radial ridging of dissepiments, X1 (LAVRUSEVICH, 1959).

**?Dentilasma IVANOVSKY, 1962, p. 128 [*D. honorabilis*; OD; t67, coll. 305, IGG, Novosibirsk].**

Corallum solitary or ?fasciculate; septa very short; dissepimentarium of commonly one series of inclined lonsdaleoid dissepiments; tabulae commonly flat, complete, with supplementary, large, adaxially declined, peripheral tabellae. *L.Sil.* (*up.Llandov.*), Asia (W. Sib. Plaf.).--E. Ursals.-Altay-Kweichow.-Australia (New S.Wales).--[Fig. 137,2a-c. *D. honorabile*, holotype, up.Llandov., W. Sib. Platf., R. Mogokta; ac, transv., b, long. secs., X3 (Ivanovskiy, 1962; photographs courtesy A. B. Ivanovskiy).

**Heterelasma EHLERS, 1919, p. 461 [*H. goerstei*; OD; t7290, UMMMP, Ann Arbor] [=*Dokophyllum WEDEKIND, 1927, which see; Heterelasma LANG, SMITH, & THOMAS, 1940, p. 67, nom. van., *non Heterelasma GRABAU, 1922, p. 41, nec Heterelasma GIRT, 1908, a Palaeozoic brachiopod*. Solitary, large, broadly conical with thin wall extending to form wide, flaring platform to shallow calice; major septa developed as thin radial ridges and minor septa as radial rows of small knobs on upper surface of calical platform; tabulae complete, with wide flat axial part and narrow marginal trough; cardinal septum in tabular fossula; dissepiments ?absent [see EHLERS, 1973, p. 65]. *L.Sil.* (*up.Llandov.* or *M.Sil.* (*low.Wenlock*)), N. Am. (Mich.).--Fig. 137,2a-c. *H. goerstei*, holotype, Manistique F., Mich., 0.5 mi. S. of Gould City; a, calical view, X0.7; b, side view, X0.7 (EHLERS, 1973).

**?Ketophyllumoides LAVRUSEVICH, 1971a, p. 93 [*Keto­phyllum atlassovi CHERNYSHYEVSCH., 1941b, p. 66; OD; t1, coll. 5957, TsGM, Leningrad*. Phaeclloid; septa reduced to thin crests on wall and dissepiments; tabularium wide, tabulae incomplete, ?grouped, horizontal or sagging, with supplementary adaxially declined peripheral tabellae; dissepiments large, lonsdaleoid, in several series; without tabular fossula. *L.Sil.*, Asia (NE.USSR); low.*M.Sil.*, Asia (Tadzhik.).--Fig. 137,1a,b. *K. atlassovi* (CHERSHNYEVSCH.), holotype, Sil., USSR, right bank of R. Khailia, 9.5 km. from mouth, E. Verkhoyanya; ab, transv., long. secs., X3 (CHERSHNYEVSCH., 1941b).

**Nataliella SYTOVA in SYTOVA & ULITINA, 1966, p. 203 [*N. poslawskajaе; OD; t1, coll. 8732, TsGM, Leningrad*] [=*Chavsakia LAVRUSEVICH, 1959, which see*]. Solitary, large, cylindrical; no epithecal scales reported; septa not recorded, very weakly developed; dissepimentarium wide, of large plates with wide subhorizontal peripheral parts and adaxially declined inner parts, supplemented by smaller plates; tabularium narrow, with complete or incomplete subhorizontal tabulae. *U.Sil.* or *L.Dev.* (*Aynast1.*), Asia (C.Kazakh.-?Altay).--[Fig. 136,3a,b. *N. poslawskajaе*, holotype, up. part Aynas horizon, Nurin Syncline, C. Kazakh., left bank R. Medine; ab, transv., long. secs., X3 (SYTOVA & ULITINA, 1966)].

**?Tabularia SOKHINA, 1937, p. 71 [*T. turienisi*; OD; syntypes slides 65, 66, 204, sample 276, coll.
Fig. 136. Ketophyllidae (p. F219-F221).
143, PIN, Moscow]. Solitary; septa thin, with very short, longitudinally continuous part peripherally, remainder amplexoid; tabulae complete and flat, some with slightly downturned edges and weak axial sag; tabular fossula present; marginarium a very narrow peripheral stereozone. M.Sil., Asia (E.Urals).—Fig. 136, 4a-c. *T. turiensis*, left bank of R. Tura near Elkino; a, transv., b, c, long. secs., X4 (Ivanovskiy & Shurygina, 1975).
Donacophyllum

Fig. 138. Kyphophyllidae (p. F223).
Family KYPHOPHYLLIDAE
Wedekind, 1927

[Kypophyllidae Wedekind, 1927, p. 18] [≡Pilophyllidae Hill, 1942b, p. 19; Cyphophyllidae Reym., 1956, p. 37; Kypophyllinae Hill, 1956b, p. 277]

Solitary or fasciculate with nonparriodal peripheral increase; septa long, in some convolute in tabularium, major septa somewhat unequal, one, ?cardinal, may be longer than others and extend to or beyond axis; septa of multiserial small trabeculae, may be periodically thickened; minor septa commonly discontinuous, dissepimentarium commonly lonsdaleoid; but small intersepal dissepiments occur in places; fossula not distinct; tabular floors like hats with flat or upturned brims and shallow axial depression in broad and tall crown; tabulae commonly incomplete. U.Ord.-L.Dev.

Donacophyllum Dybowski, 1873c, p. 336; 1874, p. 460 [≡D. Schrenkii; SD WEDEKIND, 1927, p. 34; +Col1281, EGM, Tallinn] [≡Strombodes Schweigger, 1819, which see, also see Kaljo, 1958b, p. 112; Kypophyllum Wedekind, 1927, p. 19 (type, K. Lindström, OD); +slides Cn54877-9, RM, Stockholm, and 10392-4, WEBEKIND Coll., SM, Frankfurt; M.Sil., N. of Strenkyrke Buk, Gotl.; Cyphophyllum Lang, Smith, & Thomas, 1940, p. 47, nom. van.]. Phaceloid, in type species with periodic rejuvenescence of corallites indicated by expansions and subsequent contractions of dissepimentaria, or solitary; septa thin, not carinate, long major septa not convolute but a little withdrawn from axis, one may be longer; tabular floors domes with axial depression and margins turned out or up, of large tabellae; dissepimentarium moderately wide, with large lonsdaleoid dissepiments as well as small globose intersepal dissepiments; cardinal fossula not distinct. U.Ord.-Eu.(Est.); L.Sil., Eu.(Est.-Sib.-Platf.); Australia (New S.Wales); M.Sil., Eu. (Gotl.); U.Sil., ?Eu. (Podolia)-Asia (Kazakh.-Tadzhik.-Urals)-Australia (New S.Wales).—Fig. 138,1a-d. *D. schrenkii*, monotypic, L.Sil. (Llandow, Ga), Est., Pühhat, a,b, transv. sects., ×2.3; c,d, long. sects., ×2.4, ×2.0 (Kaljo, 1958b).—Fig. 138,1e-g. D. lindstroemi, holotype, Hogklint beds, Gotl., N. of Stenkyrke huk; e,f, transv. sects., g, long. sect., all, ×3.0 (Hill, n; negatives courtesy Riksmuseet, Stockholm; RM Cn54877-54879).

ɔmaidottaphyllum Lavrusevich, 1968, p. 109 [≡M. maikottaense; OD; +4713/5, UpG, Dushanbe]. Solitary, large; with peripheral stereozone interrupted by lonsdaleoid dissepiments; major septa thin and convolute in wide tabularium; with indistinct cardinal fossula; tabulae incomplete; floors domed with subhorizontal edges, and in places with shallow axial depression; cardinal fossula indistinct. U. Sil. (Ludlov.), Eu. (Gotl.-Est.-Pol.-Podolia); ?L. Dev. (Lochkov.), Asia (Tadzhik.-Kazakh.-Salair).—Fig. 138,2a,b. *P. keyserlingi*, holotype, U.Sil., Gotl., Lindeklint; a,b, transv., long. sects., ×2 (Lavrusevich, 1968).

Neokypophyllum Spassky, 1965b, p. 26 [≡N. calcareum; OD; +94, coll. 8732, TsGM, Leningrad]. Solitary, large, turbinate; major septa somewhat withdrawn from axis, subequal; minor septa very short; peripheral ends of septa may be structurally modified; tabulae complete or incomplete, close, thin, each floor shaped like a hat with an upturned brim and an axial depression; lonsdaleoid dissepiments may develop at periphery in late stages; cardinal fossula present. [Only two specimens known.] U. Sil. (Ludlov.), Asia (C. Kazakh.).—Fig. 139,2a,b. *P. sulceniis*, holotype, Akkan horizon, zone of Medinophyllum crispum crispus, 4 km. S. Ak-Shoky Hill; a,b, transv., long. sects., ×2 (Sytova & Ulitina, 1966).

Pilophyllum Wedekind, 1927, p. 34 [≡P. keyserlingi; OD; +11099-11101, WEDEKIND Coll., SM, Frankfurt] [≡Neokypophyllum Spassky, 1965b, which see]. Solitary or (less commonly) fasciculate; marginarium a septal stereozone interrupted by lonsdaleoid dissepiments; major septa thin and convolute in wide tabularium; with indistinct cardinal fossula; tabulae incomplete; floors domed with subhorizontal edges, and in places with shallow axial depression; cardinal fossula indistinct. U. Sil. (Ludlov.), Eu. (Gotl.-Est.-Pol.-Podolia); ?L. Dev. (Lochkov.), Asia (Tadzhik.-Kazakh.-Salair).—Fig. 139,2a,b. *P. keyserlingi*, holotype, U.Sil., Gotl., Lindeklint; a,b, transv., long. sects., ×2 (Sytova & Ulitina, 1966).

Rugosa—Stauriida—Ketophyllina
Fig. 139. Kyphophyllidae (p. F223, F225).
Rugosa—Stauriida—Ketophyllina

Phaceloid, with periodical expansions of lonsdaleoid dissepimentaria bringing neighboring corallites into contact; major septa long, possibly convolute in wide tabularium; immediately after rejuvenescence commonly no dissepimentarium present and minor septa rudimentary; tabular floors domes with edges turned out or up and broad axial depression, tabulae complete or more commonly incomplete. [Neotype required; diagnosis based on Ludlovian specimen figured by Smith (1945, pl. 29, fig. 1,2). See also Lindström, 1896a, p. 631.] ?M.Sil., U.Sil., Eu.(Gotl.).

Donacophyllum DYBOWSKI, 1873c, which sec]. Phaceloid, with periodical expansions of lonsdaleoid dissepimentaria bringing neighboring corallites into contact; major septa long, possibly convolute in wide tabularium; immediately after rejuvenescence commonly no dissepimentarium present and minor septa rudimentary; tabular floors domes with edges turned out or up and broad axial depression, tabulae complete or more commonly incomplete. [Neotype required; diagnosis based on Ludlovian specimen figured by Smith (1945, pl. 29, fig. 1,2). See also Lindström, 1896a, p. 631.] ?M.Sil., U.Sil., Eu.(Gotl.).

Family ENDOPHYLLIDAE Torley, 1933

Solitary, fasciculate or massive; corallites large; major septa long, commonly slightly convolute in wide tabularium and may be somewhat withdrawn from axis; septa in their thickened parts of multiserial small trabeculae; tabular floors low domes or mesas, their peripheral parts projecting subhorizontally or troughlike, and their axial parts rarely depressed; tabulae complete or incomplete; marginarium a septal stereozone commonly disrupted by lonsdaleoid dissepiments, and commonly also a median zone of thinner septa and lonsdaleoid dissepiments and, where minor and major septa are longitudinally continuous, an irregular inner zone of normal concentric interseptal dissepiments; fossula indistinct; increase peripheral and commonly nonpariccidal. L.Sil.?Carb.

Endophyllum MILNE-EDWARDS & HAIME, 1851, p. 393 [*E. bowerbanki; SD SCHLÜTER, 1889, p. 309 (51); †E. bowerbanki; SD SCHLÜTER, 1889, p. 309 (51)]

Family ENDOPHYLLIDAE Torley, 1933

[Endophyllidae Torley, 1933, p. 633] [=Endophyllinae WANG, 1948, p. 29]

Solitary, fasciculate or massive; corallites large; major septa long, commonly slightly convolute in wide tabularium and may be somewhat withdrawn from axis; septa in their thickened parts of multiserial small trabeculae; tabular floors low domes or mesas, their peripheral parts projecting subhorizontally or troughlike, and their axial parts rarely depressed; tabulae complete or incomplete; marginarium a septal stereozone commonly disrupted by lonsdaleoid dissepiments, and commonly also a median zone of thinner septa and lonsdaleoid dissepiments and, where minor and major septa are longitudinally continuous, an irregular inner zone of normal concentric interseptal dissepiments; fossula indistinct; increase peripheral and commonly nonpariccidal. L.Sil.?Carb.

Endophyllum MILNE-EDWARDS & HAIME, 1851, p. 393 [*E. bowerbanki; SD SCHLÜTER, 1889, p. 309 (51); †E. bowerbanki; SD SCHLÜTER, 1889, p. 309 (51)]

Endophyllum bowerbanki MILNE-EDWARDS & HAIME, 1851

Endophyllum bowerbanki MILNE-EDWARDS & HAIME, 1851

Fig. 140. Kyphophyllidae (p. F223-F225).

SMITH, & THOMAS, 1940, p. 89; †176, SCHLÜTER Coll., IP, Bonn; Stringocephalus Ls., Holthausen, Westphalia; =Endophyllum bowerbanki MILNE-EDWARDS & HAIME, 1851), non Nicholsonia DAVIS, 1885, a bryozoan]. Subcerioid, cerioid or tham-
Fig. 141. Endophyllidae (p. F225-F231).
nasterioid; corallites large with marginarium consisting mostly of septal stereozone disrupted by large lonsdaleoid dissepiments but in inner parts of normal dissepimentarium; septa long, in wide tabularium commonly thin and somewhat convolute; in peripheral stereozone septal trabeculae fine and multiseriate; tabulae flat-topped domes with upturned edges, cardinal fossula not distinct [see JELL & HILL, 1970a, p. 6]. ?L.Dev., Australia (Tasm.); M. Dev., Eu. (U. K.-Ger.)-Asia (?Urals - Kazakh. - Kansu - Szechuan - Kweichow-Yunnan)-Australia (New S.Wales-Queensl.); U. Dev. (Frasn.), Eu. (U. K.-Ger.)-Asia (Kuzbas).

--- Fig. 141,3a,b. *E. bowerbanki*, neotype,
Frasn., U.K., Rocky Valley, Torquay; a,b, transv., long. secs., ×2 (Jones, 1929).

*B. isisense*; OD; 4F10385, UNE, Armidale]. Corallum phaceloid but periodically briefly cerioid, thin connecting platforms of cerioid parts being extensions of slender peripheral stereozone bearing few dissepi-
ments; major septa radically arranged, in thickened parts composed of fine multiseriate trabeculae, and in phaceloid parts commonly withdrawn from periphery leaving lonsdaleoid dissepimentarium; minor septa short; tabular floors flat-topped or depressed domes with upturned edges, tabellae large. *M. Dev.* (Givet.), Australia (New S. Wales).

---Fig. 142, a, b. *B. iisense*, holotype, Timor Ls., NE. New S. Wales, Isis R.: a, b, transv., long. secs., X 1.3 (Pedder, Jackson, & Ellenor, 1970).

**Gazellea** Foerste, 1917, p. 199 [*G. johnstoni*; M; 154899, USNM, Washington]. Coralium ceroid or phacelliceratoid; corallites large; marginarium wide, a lonsdaleoid dissepimentarium; calical surface sloping gently from wall; in calice septa in dissepimentarium appear as contiguous thickened crests continuous radially on upper surfaces of dissepiments; major septa thin in tabularium, withdrawn somewhat from axis; tabular floors wide with peripheral trough and wide axial depression [see Stumm, 1968, p. 71]. *M. Sil.*, N. Am. (Ill.)—Fig. 142, a, b. *G. johnstoni*; Niagar dol., Ill., vicinity of Chicago: a, b, side view broken specimen, transv. sec., X 0.7 (Stumm, 1968).

**Iowaphyllum** Stumm, 1949, p. 50 [*Smithia Johanni Hall & Whitfield, 1873, p. 234; OD; 1316, NYSM, Albany*]. Coralium aphroid; corallites with septa attenuate and mostly reaching axis in narrow tabularium, strongly dilated at boundary of tabularium and continuing across dissepimentarium as dilated septal ridges of *endophylloid microstructure* on top surfaces of dissepiments, which except at margin with tabularium are more or less horizontally based; tabulae complete or incomplete, domed, with upturned edges in places. [Possibly archanophyllid. See also Oliver & Galle, 1971a, p. 212; 1971b, p. 81.] *L. Dev.* (Prag.-Zichov.), Eu. (Czech.); *L. Dev.* (Ems.), Australia (New S. Wales); *L. Dev.* (up. Ems.) or *M. Dev.* (low. Eifel.), Asia (Salair); *M. Dev.* (Givet.), N. Am. (Ky.-Mich.); *U. Dev.* (Frasn.), N. Am. (Iowa).

---Fig. 143, 1a-d. *I. johanni* (Hall & Whitfield), holotype, U. Dev. (Frasn.), Lime C. shale, Hackberry Gr., Iowa, Rockford; a, long. sec., X 1.3; b, enl. view of central portion of a, X 6.7; c, transv. sec., X 1.3; d, enl. view of upper left portion of c, X 6.7 (Oliver & Galle, 1971b).

**Klamathastrea** Merrick, 1972, p. 40 [*K. dilleri*; OD; 159546, USMN, Washington]. Ceriod; corallites thin-walled; with wide lonsdaleoid dissepimentarium; septal crests short to absent except in peripheral parts of tabularium; tabulae mostly complete, subhorizontal in broad axial zone, and commonly downturned to form narrow peripheral rim; cardinal fossula not distinct. *U. Sil.*, N. Am. (Calif.)—Fig. 141, a, b. *K. dilleri*, holotype, Gazelle F., Cal., Siskiyou Co.; a, b, transv., long. secs., X 1.5 (Merriam, 1972).

**Mictocyrtis** Etheridge, 1908, p. 20 [*M. endophylloides*; M; 13616, AM, Sydney; lectotype by McLean, 1974b, p. 664]. Aphroid; corallites large; with wide dissepimentarium of coarse lonsdaleoid dissepiments, with traces of septa or septal crests visible only on steeply sloping dissepimentarium wall to tabularium, which is relatively narrow, and in tabularium where septa are more or less amplexoid, leaving small axial space; tabular floors flat, tabulae commonly complete, without axial depression but with downturned peripheral edges. [No cardinal fossula described.] *L. Sil.*, Australia (New S. Wales).—Fig. 144, a, c. *M. endophylloides*, lectotype, Quarry Creek Ls., C. New S. Wales: a, distal view, X 1.0; b, fractured surface showing long. sec. of tabularium, X 1.0; c, drawing from b, X 1.5 (McLean, 1974b).

**Neospongophylloides** Jia in Jia et al., 1977, p. 158 [*Tabulophyllum butovii BULVANCEK, 1958, p. 171; OD; 15318, Coaa, 7761, TSG, Leningrad; *M. Dev.* (Givet.), Lebedyan beds, Sudzhensky mine, Kuzbas]. Phaceloid, corallites with lonsdaleoid dissepimentarium; major septa long, extending almost to axis; minor septa reduced to short projections from wall; tabulae closely spaced, of tabellae in axial and in wide peripheral series, axial series mesa-shaped, periaxial series sagging. *M. Dev.* (Givet.), Asia (Kuzbas-Hunan).

**Sandophyllum** Etheridge, 1899a, p. 154 [*S. davidi*; OD; syntypes F4290, F6040, AM, Sydney]. Phaceloid and periodically briefly cerioid when narrow peripheral stereozone of each corallite expands into thin calical platform meeting similar platforms from its neighbors; major septa may be long and almost meeting at axis where they may be convolute, or somewhat withdrawn from axis; minor septa scarcely extending beyond stereozone; tabulae flattened domes that may sag axially; no dissepiments; cardinal fossula not distinct [see Pedder, Jackson, & Ellenor, 1970, p. 255]. *M. Dev.*, Australia (New S. Wales-Queensld.).—Fig. 143, a, b. *S. davidi*, up. Couvin., Timor Ls., NE. New S. Wales, Isis R.; a, long., transv. secs., X 1.3 (Pedder, Jackson, & Ellenor, 1970).

**Smithiphyllum** Birenheide, 1962a, p. 81 [*Spongophyllum imperfeclum Smith, 1945, p. 55; OD; 16307, GSC, Ottawa*]. Fasciculate or cerioid; corallites with thin, in part rudimentary major and minor septa; with commonly one series only of lonsdaleoid dissepiments that here and there may fail; tabulae very wide, flat, submesa-shaped or slightly waved [see Pedder, 1965b, p. 618]. *L. Dev.*, N. Am. (Nev.); *L. Dev.*, N. Am. (Mich.); *U. Dev.* (Frasn.), N. Am. (NW. Terr.-Alberta-Iowa-Ariz.-Eu.); *U. Dev.* (Famenn.), Eu. (Pol.); *Carb.*, Eu. (Timan).—Fig. 141, 1a-g. *S. imperfeclum* (Smith), U. Dev., Jean Marie R., Mackenzie R.; a-e, transv. secs., a, X 1.5, b-e, X 2.5; f-g, long. secs., X 2 (Smith, 1945).

Fig. 144. Endophyllidae (p. F229-F231).

1940, p. 18; †7042-3, Wedekind Coll., SM, Frankfurt; Frasn. of Grund, Harz); ?Sinosophphyllum Yoh, 1937, p. 56 (type, S. planotubulatum, M; †not traced; M.Dev., Chiao-ting, Kwangsi; see also Fontaine, 1966b, p. 62); ?Diversophyllum Sloss, 1939, p. 65 (type, Zaphrentis traversensis Winchell, 1866, p. 90, OD; †14355, UMM, Ann Arbor, and 2720, Winchell Coll., Alma College, Mich., lectotype by Sloss, 1939, p. 68; Givet. of low cliffs on lake
shore near Petoskey Portland Cement Quarry, lower blue shale of Gravel Point F.). Solitary; major septa long, somewhat withdrawn from axis; minor septa reduced to low ridges on lonsdaleoid dissepiments that disrupt septa in peripheral zone of variable width; neither skeletal thickening nor distinctive fossula, nor cardinal nor counter septa of distinctive length are seen in adult stages of type species; tabularium wide, tabularial floors low to flat-topped domes with edges curved into somewhat asymmetrical peripheral trough, tabulae complete or incomplete [see Hill & Jell, 1970b, p. 63]. ?L.Dev., Australia (Queensl.); M.Dev. (Givet.), N.Am.(Mich.-Nev.)-Asia(Yunnan); U.Dev. (Frasn.), Eu.(Ger.-Russ.Platf.-Urals)-N.Am. (Alaska-Can.-Iowa)-Asia (Armenia-Kazakh.-Kuszbas)-W.Australia.—Fig. 141.a-d. *T. rectum, holotype, U.Dev.(Frasn.), Hackberry Gr., Iowa; a,b, transv., long. secs., X2.0 (Hill, n; photographs courtesy E. C. Stumm); c,d, totype, transv., long. secs., X1.5 (Watkins, 1959a).—Fig. 144, 1a,b. ?T. transversum (Winchell), M.Dev., lower blue shale of Gravel Point F., Mich., quarry of Petoskey Portland Cement Co., Petoskey; a, transv. sec., X1.5; b, long. sec., another specimen, X1.5 (Watkins, 1959a).—Fig. 144,1e,f. ?T. normale (Walther), monotype, Frasn., Grund, Harz; c,d, transv., long. secs., X2.0 (Walther, 1928).—Fig. 144,1e,f. ?T. planotabulatum (Yoh), holotype, M.Dev., Kwangsi, Chaiting; e,f, transv., long. secs., X2.0 (Yoh, 1937).

Yassia Jones, 1930, p. 36 [*Spongophyllum enormes Etheridge, 1913, p. 35; OD; ?F8572, AM, Sydney; lectotype by Hill, 1940c, p. 409] [=Crinophyllum Jones, 1932, p. 61, obj.]. Cerioid, corallites very large with septa developed only as weak crests on dissepiments and tabulae, but traces of their bases contiguous and naotic; tabularium wide, tabulae complete, very shallowly concave; dissepiments very large, steeply inclined near tabularium; cardinal fossula indistinct [see also McLean, 1974b, transv., long. secs., X2.0; Photographs by E. Stumm, 1974; Pedder, 1976a, p. 286]. ?L.Dev.-M.Sil., Asia(Sib.Platf.); U.Sil.(low.Luds.), Australia(New S.Wales); U.Sil.(Fridol.), N.Am.(Yukon).—Fig. 142,1a,b. *Y. enormis (Etheridge), syntypes, Bowspring Ls., New S.Wales, east of town of Walcha, near Boorooma; a,b, transv., long. secs., X1 (McLean, 1974b; photographs courtesy R. A. McLean).

Suborder PTENOPHYLLINA Wedekind, 1927

[nom. correct. Hill, herein, pro Spongophylociea Wedekind, 1927, p. 9] [=Spongophyllina Sparkes, 1965a, p. 85]

Solitary or compound Stauriina with wide dissepimentarium commonly of small, subglobose, normal dissepiments, but in some with lonsdaleoid dissepiments disrupting minor and commonly also major septa; pipes of horseshoe and flat dissepiments lacking; tabularial floors commonly with axial notch or median depression; tabulae complete or incomplete; increase commonly marginal. L.Sil.-U.Dev.

Family SPONGOPHYLLIDAE Dybowski, 1873

[Spongophyllidae Dybowski, 1873c, p. 332] [=Spongophyllina Wedekind, 1922a, p. 3; Spongophyllina Ivanovskiy, 1965a, p. 85]

Phaceloid or massive coralla, corallites slender with slightly thickened wall; major septa thin, straight, with smooth sides, unequal, one or a few reaching to or almost to axis, in places with weak curving of their tabularial parts; minor septa commonly discontinuous longitudinally or withdrawn to wall; tabularium narrow, tabulae flat or concave, moderately widely separated, commonly complete; dissepimentarium commonly of one or few series of large dissepiments, a few or many of which may disrupt major septa. L.Sil.-?M.Sil.-M.Dev.

Spongophyll Milne-Edwards & Haime, 1851, p. 425 [*S. sedgwicki; M; type R4999 and 26300-1, BM(NH), London; by Jones, 1929, p. 89] [=Carlinasatrae Merriam, 1976, which see]. Cerioid; corallites with slightly thickened wall; major septa thin, unequal, one or more almost reaching axis, their tabularial parts and axial edges smooth but may be slightly twirled; minor septa mostly discontinuous longitudinally; withdrawn toward wall; septal trabeculae fine, uniserial, contiguous monacanths; tabularium narrow, of rather widely separated horizontal or slightly sagging tabulae; dissepimentarium commonly of large dissepiments in single series of strongly curved plates, supplemented by smaller plates. [Diagnosis based on neotype. Revision of species referred to genus necessary. See also Birenheide, 1962a, p. 72.] ?M.Sil., U.Sil., Asia(Japan)-Australia(New S.Wales); U.Sil., Eu.(Gotl.); ?L.Dev., Eu.(Urals)-Asia(Urals-Kuzhas)-Australia(Queensl.-New S.Wales)-N.Am.(Yukon); M.Dev., Eu.(U.K.-USSR)-N.Am.(Alaska).—Fig. 145,1a,b. *S. sedgwicki, neotype, beach pebble probably from M.Dev., S. Devon.; a,b, transv., long. secs., X3.3 (Hill, n; photographs courtesy J. S. Jell).

Carlinasatra Merriam in Merriam & McKee, 1976, p. 32 [*C. triscoraroenisis; OD; 1166482, USNM, Washington] [=Spongophyllum Milne-Edwards & Haime, 1851, which see]. Cerioid; corallites slender with moderately thick walls; marginarium wide, of very large, steeply inclined lonsdaleoid dissepiments; tabularium narrow, tabulae complete and sagging, axial ends of major septa of irregular length, discontinuous and pos-
sibly flanged. L.Dev.(Lochkov.), N.Am.(Nev.).

Denayphyllum Merriam, 1973a, p. 56 [*D. denayense; OD; †159407, USNM, Washington] [=Denaphyllum Merriam, 1973a, expl. to pl. 6, nom. null.]. Phaceloid; corallites very slender; wall thin or only moderately thickened; major septa thin, mostly slightly withdrawn from axis; minor septa rudimentary; large globose dissepi-

ments between major septa *(or peripheral tabulæ) forming irregular inner wall, within which are narrow sagging tabulæ. U.Sil.(?Pridol.), N. Am.(Nev.-Yukon).—Fig. 145,1a,b. *D. denayense, holotype, Roberts Mt. F., coral zone C, Unit 3, Nev., Roberts Mt. Cr.; a,b, transv., long. secs., X8.3 (Merriam, 1973a).

?Heterospongophyllum Huang & Kong in Kong &
Huang, 1978, p. 117; [Spongophyllum simplex
Huang & Huang, 1978, p. 117; OD;
†Gcr 957-958, GB, Guiyang; L.Sil., Shiniulan
F, Shiquan, Guizhou (Kweichow). Ceroid;
septa numerous, thin, longitudinally discontinuous,
thin low crests appearing on dissepiments and
wall; tabularium wide, tabular floors flat or
sagging, tabulae complete or incomplete; one to
two large series of lonsdaleoid dissepiments may
be supplemented by smaller dissepiments. [Diagnosis
tentative, from illustrations.] L.Sil., Asia
(Kweichow-Japan).

Neovepresiphyllum in JIA et al., 1977, p. 117
[Spongophyllum immersed Hill, 1942a, p. 254;
OD; †F2413, GSQ, Brisbane; M.Dev., Givet,
Arthur's Cr., Burdekin Downs, Queensl.]. Phace-
loid or ceroid; with a peripheral septal stereozone
in which lonsdaleoid dissepiments are developed,
and an inner dissepimentarium with fine con-
centric dissepiments; tabulae flat or somewhat
concave. M.Dev.(Givet.). Eu.(Ger.)-Australia
(Queensl.).

Family PTEVONYPHILLIDAE
Wedekind, 1923
[nom. transl. Wedekind, 1924, p. 35, ex Ptenophyllidae
Wedekind, 1923, p. 33] [=Stenophyllidae Wedekind, 1925,
p. 1; Actinocystidae Wedekind, 1927, p. 42; Acaothophylli-
Spasskiy, 1965a, p. 85; Lyrielasmatidae Hill, 1939a, p. 220;
Leptoinophyllidae Stumm, 1949, p. 27; Xyriphyllidae (as Xistriphyllidae)
Weidemann, 1922b, p. 51 (type, Mesophyllum [sic] richteri Weidemann, 1922b, p. 51,
pl. 1, fig. 2, SD Stumm, 1937, p. 441; †5269-2571,
8872, Wedekind Coll., SM, Frankfurt; Eifel,
Nimsbachtal, Prüm, Ger.); Neostriphyllidae Wedekind, 1922a, p. 16 (type, N. ultimum, OD;
†4044-4045, Wedekind Coll., SM, Frankfurt;
Givet., "Düsseltal," Bergisches Land, Ger.); Neostriphyllidae
Wedekind, 1923, p. 28 (type, P. pra-
maturum, SD Lang, Smith, Thomas, 1940, p.
110; †364-368, Wedekind Coll., SM, Frankfurt;
Eifel, hairpin curve at Nohn, Hillesheimer Mulde
Ger.; =Cyathophyllum torquatum Schütz,
1884, see above); Rhopalophyllidae Weidemann,
1924, p. 52 (type, Cyathophyllum heterophyllum
Milne-Edwards & Haime, 1851, see above, SD
Hill, 1939a, p. 222); Stenophyllidae Wedekind,
1924, p. 46 (type, A. gerolsteinense, SM, Lang, Smith, &
Thomas, 1940, p. 22; †2282-2291, 8709, 8732,
SM, Frankfurt, lectotype by Birenheide, 1962b,
106; Eifel, Salmer-Weg, Gerolsteiner Mulde
Ger.; =Cyathophyllum torquatum Schützer,
1884, see above); Lonsdaleoidoidea Stumm, 1949,
p. 23; Leptoinophyllidae Stumm, 1949, p. 23;
Mesophyllidae Stumm, 1949, p. 27; Xyriphyllidae (as Xistriphyllidae)
Spasskiy, 1965a, p. 85; Lyrielasmatidae Hill, 1939a, p. 222);
Stenophyllidae Wedekind, 1924, p. 46
(t2569-2571, 8872, WEDEKIND Coll., SM, Frankfurt; Ger.;
Astrophyllum Stumm, 1937, p. 441; t2568-2571,
8872, WEDEKIND Coll., SM, Frankfurt; Ger.;
Astrophyllum Stumm, 1937, p. 441; t2569-2571,
8872, WEDEKIND Coll., SM, Frankfurt; Eifel,
Nimsbachtal, Prüm, Ger.); Neostriphyllidae Wedekind, 1922b, p. 51
(t244, 244a,b, IP, Bonn, lectotype by
Birenheide, 1961, p. 99, Eifel, Gerolsteiner
Mulde, hill to left of Kyllüfer opposite Lissengen,
Ger.; Astrophyllidae Wedekind, 1924, p. 46
Acanthophyllum DybowskI, 1873c, p. 339 [*Cy-
thophyllum heterophyllum Milne-Edwards &
Haime, 1851, p. 367; SD Schützer, 1889, p. 296;
figured syntype, Z47a, MN, Paris] [=Mesophyllum
Wedekind, 1922b, p. 51 (type, Mesophyllum [sic] richteri Wedekind, 1922b, p. 51,
pl. 1, fig. 2, SD Stumm, 1937, p. 441; †5269-2571,
8872, Wedekind Coll., SM, Frankfurt; Eifel,
Nimsbachtal, Prüm, Ger.); Neostriphyllidae Wedekind, 1922b, p. 51
(t244, 244a,b, IP, Bonn, lectotype by
Birenheide, 1961, p. 99, Eifel, Gerolsteiner
Mulde, hill to left of Kyllüfer opposite Lissengen,
Ger.; Astrophyllidae Wedekind, 1924, p. 46
(t2569-2571, 8872, WEDEKIND Coll., SM, Frankfurt; Ger.;
Astrophyllidae Wedekinds. 1922b, p. 51
Rugosa—Stauriida—Ptenophyllina
F233
larial floors concave with median notch or ?trough; tabulae incomplete, commonly close together. ?L.Dev., Australia (Queensl.-New S.Wales)-Asia (NE.USSR); M.Dev. (Couvin.-Givet.), Eu. (U.K.-Belg.-France-Ger.-Czech.-USSR)-Asia (USSR-China-Indoch.)-Australia (Tasm.-Vict.-New S.Wales-Queensl.)-N. Afr. (Alg.-Moroc.)-N. Am.—Fig. 146,3a,b. *A. heterophyllum (Milne-Edwards & Haime), M.Dev., Junkerberg beds, Ger., Eifel.; a, transv. sec., b, long. sec. another specimen, both
**Aphroidophyllum**

**Embolophyllum**

**Fig. 147. Ptenophyllidae (p. F235-F236).**

×1.3 (Birenheide, 1961).—Fig. 146, 3c,d. *A. ultimum* (Wedekind), Givet., “Düsseltal,” Ger.; c, holotype, transv. sec., ×2.0; d, ?paratype, long. sec., ×2.0 (Pedder, 1973).

*Acrophylllum* Sytova, 1968, p. 60 [*A. armatum*; OD; †6, coll. 9743, TsGM, Leningrad] [?*Lyriclasma* Hill, 1939a, which see; ?*Salairophyllum* Besprozvannykh, 1968, which see]. Solitary, slender, small, erect, conical corals with rejuvenescence; calice deep, goblet-shaped, with steep
flanks and wide axial floor; septa of two orders, dilated peripherally to form narrow stereozone; dissepiments globose, commonly in one row; major septa long, straight, unequal, flanged in tabularium; tabulae not revealed. L.Dev. (Gedinn.), Eu. (Podolia).

---FIG. 147, a-e. *A. armatum*, mid. Borschkov, Borschkov, Podolia; a-c, holotype, transv. secs., X4, d, holotype, long. sec., X4, e, paratype, long. sec., X4 (Sytova, 1968).

Aphroidophyllum LENZ, 1961, p. 505 [*A. howelli*, OD; t41224, GSC, Ottawa] [=Taimyrophylum CHERNYSHEV, 1941a, which see]. Compound, mostly aphroid, but at some levels with well-developed naeotic septa of thamniasteroid arrangement; septa with zigzag carinae near inner margin of dissepimentarium and major septa commonly somewhat twirled at axis; tabulae incomplete, closely spaced, generally forming axially depressed tabularial floors [PEDDER, 1971b, p. 46]. L.Dev., N.Am. (Nev.); M.Dev. (Eifel.). --FIG. 147, a,b. *A. howelli*, holotype, Eifel., Hume F., Can., Lac M.Dell. (Eifel.), N.Am. (Yukon-NW. Terr.).

---FIG. 146, a,b. D. helianthoides (GOLDFUSS), holotype, Eifel., Junkerberg Beds, Ger., near Gerolstein; transv. sec., X1.3 (Wedekind, 1924).

---FIG. 146, b,c. D. helianthoides (GOLDFUSS), holotype, Eifel., Junkerberg Beds, Ger., SE. Niesenberg, Prüm, Eifel; b,c, transv., long. secs., X0.7 (Birenheide, 1963a).


Dohmophyllum WEDEKIND, 1923, p. 28 [*D. involutum*, M; t2078, 8903, SM, Frankfurt] [=Trematophyllum WEDEKIND, 1923, p. 27, 35 (type, T. Schulzi WEDEKIND, 1924, p. 76, SD LANG, SM, & THOMAS, 1940, p. 135; t1008, WEDEKIND Coll., SM, Frankfurt; Eifel., Niederehe, Eifel, Ger.). Sparganophyllum WEDEKIND, 1925, p. 13 (type, S. difficile, OD; t4283-4288, WEDEKIND Coll., SM, Frankfurt, lectotype by BIRENHEIDE, 1962b, p. 105; Givet., quarry in Pillinger Bachtal, Sauerland, Ger.); Pseudoptenophyllum WEDEKIND, 1925, p. 60, 78 (type, Cyathophyllum helianthoides GOLDFUSS mutatio philocirica FRECH, 1886, p. 170, M; tQu.-Katalog P1503, C154, HU, E. Berlin, lectotype by BIRENHEIDE, 1963a, p. 421; M.Dev., Mühlberg, Eifel, Ger.). Solitary or weakly phaceloid; corallites large; with strongly widened septal bases; septa numerous, long, thin to strongly thickened; septal trabeculae relatively far apart; lateral septal tubercles irregular, not organized into carinae; axial ends may be somewhat convolute, thickened or crowded; Km elongate in some; dissepimentarium very wide, dissepiments small, numerous; tabularium narrow, tabellae close together, forming irregular floors, without median trough or notch [BIRENHEIDE, 1963b, p. 406; 1972, p. 422; PEDDER, 1971d, p. 39]. L.Dev. (Ems.). Eu. (Urals)-Asia (Tadzhik.-Kuzbas)-Australia (Queensl.-New S.Wales-Vict.). M.Dev., Eu. (Ger.-France-Belg.-U.K.-Czech.-Australia (Turkey-Armenia-Tadzhik.-Kuzbas-NE.USSR)-Australia (Queensl.-New S.Wales)-N.Am. (Yukon-NW. Terr.).

---FIG. 146, a,b,c. *D. helianthoides* (GOLDFUSS), holotype, Eifel., Junkerberg Beds, Ger., SE. Niesenberg, Prüm, Eifel; b,c, transv., long. secs., X0.7 (Birenheide, 1963a).

**Embolophyllum PEDDER, 1967a, p. 10 [*Acanthophyllum asper* HILL, 1940b, p. 252; OD; tF4270, UQ, Brisbane]. Corallum dendroid or phaceloid, corallites large, at first ceratoid to trochoid, later subcylindrical; calice deep, steep-sided; peripheral stereozone thin to moderately thick; septa radial to weakly pinnate in arrangement, typically expanded at peripheral edge and rarely withdrawn from periphery; septal flanges strongly to moderately developed in tabularium; Km may be longer than other minor septa; septa of contiguous monacanthine trabeculae directed inward and upward and also curving slightly toward axis; dissepimentarium wide, dissepiments numerous, small, subglobose; tabulae incomplete, of wide subplanar tabellae, closely spaced and characteristically declined toward axis. ?U.Sil., N.Am. (Calif.); L.Dev., Australia (Vict.-New S.Wales-Queensl.-S.Aust.)-N.Am. (Md.)-Asia (NE.USSR); ?M.Dev., Asia (NE.USSR).--FIG. 147, a,b,c. *E. asper* (Hill), holotype, Ems., New S.Wales, Cave Flat road from Wee Jasper; a,b, transv., long. secs., X2 (Hill, 1940b).

**Grypophyllum WEDEKIND, 1922a, p. 13 [*G. denckmanni*, OD; t3949, WEDEKIND Coll., SM, Frankfurt] [=Hooeiphyllum TAYLOR, 1951, p. 173 (type, Grypophyllum normale WEDEKIND, 1925, p. 22, OD; 13864-3868, 3873, WEDEKIND Coll., SM, Frankfurt; Givet., Hand, near Bergisch-Gladbach, Ger., see ENGEL & SCHOUPEL, 1958, p. 106); ?Neogrypophyllum Jia in Jia et al., 1977, p. 163 (type, N. zhongguoense, OD; H37054, HPRIGS, Yichang; M.Dev., Tianyang Co., Guangxi (Kwangsi)). Solitary, commonly subcylindrical; septa numerous, finely and closely trabeculate, noncarinate, commonly thin; major septa reach axis, may interdigitate or coil slightly in tabularium; dissepimentarium wide and tabularium narrow; minor septa commonly well-developed but very thin to failing in type species; Km more or less significantly lengthened; londsialloid dis-
septiments commonly sparse; tabular floors close together, flat, with median (or axial) depression [Birenheide, 1972, p. 407; Pedder, 1973, p. 99]. M.Dev., Eu. (Ger.-U.K.-Belg.-France-Czech.-Aus.-Urals-N. Zemlya)-Asia (Kuzbas-NE. USSR-Pak.-Kwangsi)-N.Am. (S.Mackenzie); base U.Dev., N. Am. (S.Mackenzie-Alberta).—Fig. 146,2a,b. *G. denckmanni*, holotype, Givet., Ger., Hand; a,b,
Hankaxis Birenheide, 1978, p. 62 [*Cyathophyllum tinocyctis Frech, 1885, p. 28; 30 syntypes, not traced; Frech’s figured syntype is from U. Dev., Frasn., Iberger Kalk, Grund, Ger.]. Solitary; may have single offsets; calical platform wide and flat or everted; calical pit with prominent boss; septa numerous, very long, thickened, major thicker than minor; trabeculae multiserial; with a narrow axial structure of septal lamellae and abaxially declined tabellae, surrounded by periaxial series of less steeply declined tabellae; dissepiments numerous, small, concentric or angulate. U.Dev.(Frasn.), Eu.(Ger.-Eng.).

Hezhangophyllum Kong in Kong & Huang, 1978, p. 124 [*H. variseptatum; OD; HGr 748, 749–751, GB, Guiyang; L.Dev., Hezhang, Guizhou (Kweichow)]. Solitary; septa long, somewhat thickened; major septa with tabularial parts waved and flanged, some may extend to axis and there form a loose coil, minor septa may be discontinuous longitudinally; in places lonsdaleoid dissepiments may develop; tabular floors sagging; tabulae incomplete; dissepimentarium wide, dissepiments small, concentric or inosculating. [Diagnosis tentative, from illustrations.] L.Dev., Asia(Kweichow).

Imennovia Shurygina, 1968, p. 133 [*I. uralica; OD; 784/318, coll. 930, UGUl, Sverdlovsk] [=Imennovia Flügel, 1970, p. 136, nom. null.]. Fasciculate, with lateral increase; corallites large, calice with broad, slightly everted platform and deep axial pit; septa numerous, long, thin, not carinate or flanged, more or less discontinuous longitudinally in peripheral regions; tabular floors inversely conical and close together, of tabellae; dissepiments numerous, horizontally based in wide peripheral zone, steeply declined against tabularium. U.Sil., Asia(N.Urals).—Fig. 146,1a,b. *I. uralica, holotype, up. Ludlov., E. slopes N. Urals, Lower Turinsk distr., R. Malaya Imennaya; a,b, transv., long. secs., X2.7 (Shurygina, 1968).

Lyrielasma Hill, 1939a, p. 243 [*Cyathophyllum subcaespitosum Chapman, 1925, p. 112; OD; P1731, 14065, 15969-15972, NM, Melbourne; non Cyathophyllum subcaespitosum Meek, 1873, p. 470, and in King, 1877, p. 60; =Lyrielasma chapmani Pedder, 1967a, p. 5, nom. subst. ] [=Acmophyllum Sytova, 1968, which see; ?Salaiophyllum Besprozvannykh, 1968, which see]. Solitary? to fasciculate with subcylindrical corallites; increase peripheral, nonpariccidae; wide peripheral stereozone of unequal width; septa radially or pinnately arranged, strongly flanged in tabularium in early stages; septal trabeculae more or less horizontal; dissepiments elongate, steeply inclined and rarely lonsdaleoid, rare or absent in early stages; tabular floors axially depressed, tabellae closely spaced and subplanar. ?U.Sil.(Pridol.), N.Am.(Me.); L.Dev., Australia(Vict.-New S. Wales-Queensl.-Eu.-(Urals-?France-?Carnic Alps)-Asia(Altay-Sayan)-?N.Am.(Me.); M.Dev., Asia (NE.USSR).—Fig. 149,1a-d. *L. chapmani,
Fig. 150. Ptenophyllidae (p. F240, F243).
Neomphyma Soshkina, 1937, p. 76 [*N. originata; OD; t-slides 311-313, 435-436, coll. 143, PIN, Moscow] [≡Paleogrypophyllum Ivaniya, Kosareva, & Fedorovich, 1968, which see]. Solitary (?) (or fasciculate); with narrow peripheral stereozone and wide, commonly lonsdaleoid dissepimentarium; major septa extending unequally to axial region; minor septa thin to absent except in stereozone; tabularium narrow, tabulae concave; dissepiments large, unequal, steeply inclined. [Type species originally described as solitary, redescribed by Shurygina, 1968, p. 136, as fasciculate. See also Ivanovskiy & Shurygina, 1975, p. 34.]

Pseudochonophyllum Soshkina, 1937, p. 59 [*Chonophyllum pseudohelianthoides; Sherzer, 1892, p. 275; OD; t3298, UMMMP, Ann Arbor]. Solitary, rarely with single, small peripheral offset; calcareous platform commonly everted; septa long, C and Km may be longer; major and minor septa dilated, naotic in wide irregular peripheral zone, separated by very small dissepiments; lonsdaleoid dissepiments may disrupt naotic parts of septa; trabeculae of thick septa chonophylloid in arrangement; septa with xystriphylloid flanges in tabularium; tabularium narrow, tabulae close together, incomplete, with axial ?median notch [see Strusz, 1966, p. 563; Oliver & Galle, 1971b, p. 72].

Pseudogrypophyllum Cherepina, 1968, p. 159 [*P. limatum; OD; t3336-76, coll. 801, SNIGGIMS, Novosibirsik] [≡Pseudogyrophyllum Flügel, 1970, p. 226, nom. null.]. Fasciculate, weakly branching; corallites slender, cylindrical, with narrow peripheral stereozone and long unequal septa arranged with indistinct bilateral symmetry; septa composed peripherally of spinose trabeculae with wide bases and thin ends, axially of ?closely contiguous) acicular trabeculae; major septa reaching or almost reaching axis, cardinal septum longest, may join counter septum; tabulae concave; dissepiments large, in a few longitudinal series. [See Cherepina, 1971, p. 89. Holotype possibly stringophyllid.]

Paleogrypophyllum Ivaniya, Kosareva, & Fedorovich, 1968, p. 88 [*P. spiraliforme; OD; t18-1-1a, ?TGU, Tomsk] [≡Neomphyma Soshkina, 1937, which see; Paleogrypophyllum, Paleogrypophyllum Ivaniya, Kosareva, & Fedorovich, 1968, p. 88, Paleogrypophyllum Ivanovskiy, 1973b, p. 279, all nom. null.]. Corallum fasciculate; thin major and minor septa arranged with bilateral symmetry and with slight spiral or geniculate curvature, rarely discontinuous longitudinally; major septa long, unequal, longest attaining axis or median plane; minor septa may be discontinuous longitudinally; tabulae with median concavity, complete and incomplete; dissepiments almost horizontally based or weakly inclined toward axis, convex, arranged commonly in one series. L.Dev., Asia (Mt.Altay); ?L.Dev., N.Am.(Nev.).—Fig. 150,1a-d. *N. originatum, Northern Urals; a,b, holotype, road from Petropavlovsk works to a,b, long., transv. sees., X 1.7 (Ivanovskiy, Shurygina, 1975); c,d, topotypes, transv., long. sec., X 4 (Ivanovskiy & Shurygina, 1975).

Psycracophyllum Pedder, 1971d, p. 47 [*P. lonsdaleiforme; OD; t25845, GSC, Ottawa]. Weakly to moderately dendroid; increase lateral; septa radially to pinnately arranged, thin, smooth to strongly flanged, mostly withdrawn from periphery at all stages; Km may be elongate; minor septa long, commonly almost contringent; tabularium narrow, of closely spaced, thin tabellae, variably inclined; tabular floors irregular, commonly without median or axial notch; dissepimentarium wide, dissepiments large and lonsdaleoid in wide outer zone. M.Dev.(up.Couvin.-low.Givet.), N.Am. (NW.Can.).—Fig. 151,3a,b. *P. lonsdaleiforme; holotype, up.Couvin.-low.Givet., Nahanni F., N. Funeral Ra., SW. Distr. Mackenzie; a,b, long., transv. secs., X 1 (Pedder, 1971d).

Redstonea Crickmay, 1962, p. 7 [*Lyrielasma sperabilis Crickmay, 1962, p. 5; OD; t20709, PRI, Ithaca]. Phaceloid; corallites slender with narrow peripheral stereozone; major septa long, thin, unequal, some longer than radius, convolute in axial part of tabularium; minor septa weak but long, discontinuous longitudinally; tabularial floors commonly tall domes with margins turned out or up and trowghlike, of large tabellae, but in places floors may be subhorizontal; dissepiments large in loculi between major septa, subhorizontal peripherally and steeply inclined at inner edge of dissepimentarium [see also Pedder, 1973, p. 100]. M.Dev., N.Am.(NW.Can.).—Fig. 151,2a,b. *R. sperabilis (Crickmay), holotype, NW.Terr., Imperial Redstone No. 1 Borehole, Redstone R., at 2,680 ft.; a,b, transv., long. secs., X 1.7 (Crickmay, 1962).

Salariphyllum Bessprozvannykh, 1968, p. 111 [*Filiphyllum angustum Zheltonogova, 1961, p. 78; OD; t3106, coll. 1508, ZSGUp, Novokuz-
netsk] [*Lyrielasma* Hill, 1939a, which see, but with closer, subhorizontal tabularial floors; *?Acmophyllum* Sytova, 1968, which see]. *Soli-
tary; septa of both orders dilated and mostly con-
tiguous in wide peripheral stereozone; major septa
sinuous, attaining axis, arranged either bisym-
metrically or twirled; some dissepiments may develop in or adaxial to stereozone; tabular floors close together, flatly concave or convex. ?U.Sil., N.Am.(Alaska); L.Dev.(Gedinn.), Asia(Salair-E. Urals)–?N.Am.(Nev.).—Fig. 151,4a,b. *S. angustum (Zhel’tonogova), holotype, Tomchumysh
beds, below Tomsk, left bank R. Tomchumysh; a,b, transv., long. secs., ×2.7 (Zheltonogova, 1961).

**Shastaphyllum** Merriam, 1972, p. 38 [*S. schucherti*; OD; 1+59457, USNM, Washington] [=Xystrophyllum Hill, 1939b, which see]. Ceroid; corallites thin-walled with numerous thin septa; major septa unequal in length, cardinal extending to axis where it may be joined by others, axial ends of major septa may be slightly thickened; minor septa may be discontinuous longitudinally; dissepsimentarium relatively wide, of normal dissepsiments but including sporadic lonsdaleoid plates; tabularium narrow, tabulae flat or depressed, closely spaced, complete or incomplete. U.Sil. or L.Dev., N.Am.(Cal.).—Fig. 151,la-d. *S. schucherti*, holotype, Gazelle F., Cal., Willow Ck. area, Klamath Mts.; a,d, long., transv. secs., ×2.7 (Merriam, 1972).

**Taimyrophyllum** Chernyshev, 1941a, p. 12 [*T. speciosum*; OD; t3, coll. 5958, TsGM, Leningrad] [=Eddastraea Hall, 1942c, p. 147 (type, Philippastraea grandis Dun in Benson, 1918, p. 379, OD; syntype F69930 thin sections in UQ, Brisbane, rest of type material untraced; M.Dev., Loomberah Ls., Loomberah, New S. Wales); ?Aphrodophyllum Lenz, 1961, which see]. Astroid, thamnasterioid or weakly aphroid; dissepsimentarium wide, of small, highly arched dissepsiments; tabularium narrow, with shallowly concave, axially deepened tabulae and with long septa; the unequal axial ends of major septa arranged in groups in tabularium, straight or convolute, curvature differing in degree from group to group; cardinal septum typically short [Pedder, 1964b, p. 436]. L.Dev., Asia(Taymyr-NE.USSR-Salair)-N.Am.(Yukon); M.Dev., Australia(New S.Wales-Queensl.-N. Am. (NW. Terr.-Nev.)-Asia (Salair). —Fig. 152,1a,b. *T. speciosum*, holotype, base L.Dev., Taymyr, R. Tareia, canyonlike valley 40 km. from mouth; transv., long. secs., ×3 (Chernyshev, 1941a).—Fig. 152,1c,d. *T. grande* (Dun), syntype, M.Dev., Loomberah Ls., New S. Wales, Loomberah; c,d, transv., long. secs., ×2 (Hill, n).

**?Tonkinaria** Merriam, 1973a, p. 51 [*T. simpsoni*; OD; 1+59403, USNM, Washington]. Solitary or with peripheral offsets; corallites ceratoid or trochoid, commonly with flaring calice; septa thinning adaxially, major septa long and unequal, minor septa moderately long; tabulae irregularly concave [imperfectly known]; dissepsimentarium longitudinally elongate, interseptal. L.Dev.(Gedinn.), N.Am.(Nev.).—Fig. 153,la-h. *T. simpsoni*, holotype, Coral Zone “Sil.”E, Nev., Ikes Canyon, Toquima Ra.; a,h, holotype, calical and lat. views, ×1.2 (Merriam, 1972).

**Weissmerelia** Lang, Smith, & Thomas, 1940, p. 139, nom. subst. pro Ptilophyllum Smith & Tremberth, 1927, p. 309, non Ptilophyllum Guérin-Mévelle, 1845, an insect [*Ptilophyllum lindströmi*; OD; 1+24356, BM(NH), London]. Phaceolid, corallites slender; septa thin, carinate; major septa long, unequal, radial or slightly twirled, one, ?cardinal, reaching axis; tabulae incomplete, axially depressed; dissepsimentarium nonparricidal; corallites with thin, somewhat wavy septa, discontinuous peripherally in wide lonsdaleoid dissepsimentarium of large plates; major septa subradial but unequal, some reaching or almost reaching axis, septal spinules or flanges on their tabularial parts sparse and fine; in some corallites septa reduced to crests on dissepsiments; tabularium narrow, tabulae sagging, crowded, complete or incomplete. U.Sil.(Ludlov.), Australia (New S.Wales)-Eu.(Czech.); L.Dev.(Gedinn.), N. Am.(Nev.-Asia (E.Urals).—Fig. 153,1a,b. *T. johnsoni*, holotype, Coral Zone 0, Unit 3 of Roberts Mt. F., Nev., Roberts Ck. Mt.; a,b, transv., long. secs., ×2.7 (Merriam, 1972).

**Toquimaphyllum** Merriam, 1973a, p. 54 [*Australophyllum (Toquimaphyllum) johnsoni*; OD; 1+59420, USNM, Washington]. Ceroid; increase nonparricidal; corallites with thin, somewhat wavy septa, discontinuous peripherally in wide lonsdaleoid dissepsimentarium of large plates; major septa subradial but unequal, some reaching or almost reaching axis, septal spinules or flanges on their tabularial parts sparse and fine; in some corallites septa reduced to crests on dissepsiments; tabularium narrow, tabulae sagging, crowded, complete or incomplete. U.Sil.(Ludlov.), Australia (New S.Wales)-Eu.(Czech.); L.Dev.(Gedinn.), N. Am.(Nev.-Asia (E.Urals).
mentarium wide, peripheral plates large, inter­
septal, horizontally based and flattened. U.Sil.,
Eu.(Gotl.-Podolia).—FIG. 153,2a,b. *W. lind­
stroemi (SMITH & TREMBERTH); Hemse Gr.,
Gotl., Oestergarn; a,b, long., transv. secs., x2.4
(Hill, n; UQ14015).

Windelasma PEDDER, 1978, p. 48 [*W. wer­
neckense; OD; †46087, GSC, Ottawa]. Corallum
cerioid; septa markedly bilateral in arrangement,
thin, commonly somewhat curving or wavy, some
with short vepreculae; major septa long, minor
septa mostly withdrawn toward periphery; dissepi­
ments steeply inclined, a few lonsdaleoid; tabu­
larium elliptical in transverse section, tabular floors
depessed in median plane, tabulae complete or
incomplete. L.Dev.(low. Lochkov.); N.Am.(Yu­
kon).

Xystriphyllum Hill, 1939b, p. 62 [*Cyathophyllum
dunstani ETHERIDGE, 1911, p. 3; OD; †2425, GSC,
Brisbane; lectotype by Hill, 1939b, p. 63]
[=?Entelophyloides RUKHIN, 1938, p. 23 (type,
Columnaria inequalis HALL, 1852a, p. 323, pl. 72,
figs. 3,4, OD; †not traced; L.Dev., Schoharie,
N.Y.), not adequately known from type material;
Kozlowiap/lyllum RUKHIN, 1938, p. 34 (type,
K. pentagonum, OD; †not traced; ?L.Dev., right
bank R. Yasachnaya, below mouth of R. Tarynakh,
NE.USSR), not adequately known from type
material; Pseudospongophyllum ZHMAEV in KRAEVS­
SKAYA, 1955, p. 213 (type, P. massivum, OD; †not
traced; Eifel., Kuzbas); ?Shastaphyl/llm MERRIAM,
1972, which see). Cerioid, with peripheral in­
crease; major septa long, interdigitate or somewhat
convolute in tabularium, ?cardinal septum and, in
some, ?counter septum may be longer than others;
dissepentarium moderately wide and minor septa
may locally thin to disappearance; lonsdaleoid
dissepentiments sparse; tabular floors close together,
slightly concave, with ?median or axial pit [JELL & HILL, 1970d, p. 100]. U.Sil.(Pridol.), N.Am. (Yukon-Mc.-Que.); L.Dev.-low.M.Dev., Australia (Queensl.—New S.Wales-Vict.-Tasm.)-Asia(?Laos.-NE. USSR-Taymyr-Kuzbas-Altay-Salair-Fergana)-Eu. (Ural-Czech.-Minorca)-N.Am. (?N.Y.-Alaska-Yukon).—Fig. 154,1a,b. *Entelophylloides inegalis* (HALL), L. Dev., N.Y., hill slope 1.4 mi. WSW. of Central Bridge, Schoharie; a,b, transv., long. secs., X2.7 (Hill, n; UQF50371).—Fig. 154,1c,d. *Pseudospongophylloides massivum* ZHMAEV, Eifel., SW. margin of Kuzbas, R. Bachat, 2.5 km. above Shindy; c,d, transv., long. secs., X2.0 ( Kraevskaya, 1955).—Fig. 154,1e,f. *X. dunstani* (ETHERIDGE), lectotype, ?Ems., Douglas Ck. Ls., Queensl., Clermont; e,f, transv., long. secs., X2.7 (Hill, n).

Subfamily ACTINOCYSTINAE Wedekind, 1927

Solitary *Ptenophyllidae* with septa strongly flexuous to zigzag and flanged in inner parts of dissepimentarium and in tabularium, thickened in some. *Sil.-L.Dev.*

*Cymatelasma* HILL & BUTLER, 1936, p. 516 [*C. corniculum*; OD; †A7761, SM, Cambridge]. Solitary, small, conical or cornute; septal dilation very marked in young stages, becoming progressively reduced from axis outward during ontogeny; peripheral stereozone present in adult; septa waved parallel to distal edges, and may develop flanges along crests of waves; major septa unequal, septal symmetry as in *Spongophylloides* MEYER, 1881, with elongate Km; tabulae inversely conical, with median trough; dissepiments absent [SCRUTTON, 1971, p. 213]. *Sil.(Wenlock-Ludlov.), Eu.(U.K.-Gotl.); Sil.(Ludlov.), S.Am.(Venez.).*—Fig. 155,1a-d. *C. corniculum*, Woolhope Ls., U.K., Woolhope; a-c, holotype, long., transv. secs., X2.0
Phaceloid or cerioid; corallites with thick walls; septa long and commonly wavy and vertebrate; major septa unequal, cardinal and counter commonly longest; tabulae complete and sagging; an incomplete series of dissepiments may be developed, in some between septa, in others disrupting septa. L.Dev.-M.Dev.

Fasciphylum Schlüter, 1885c, p. 52 [*Fascicularia conglomerata Schlüter, 1881, p. 99, M; †?in Schlüter Coll., IP, Bonn] [=?Battersbyia Milne-Edwards & Haime, 1851, p. 151 (type, B. inaequalis, M; ?R31152, BM(NH), London; Dev., Teignmouth; imperfectly known]; Taziphyllum Tsyganko, 1970, Ref. Zhnrn., 1Ob252, nom. null., see Cotton, 1973, p. 208]. Fasciculate; corallites slender, with narrow peripheral stereozone, with unequal major septa, counter and cardinal being longest, and minor septa moderately long; septa of both orders may be wavy and bear sparse vertebrae; one commonly incomplete series of large, elongate dissepiments may be present between septa; tabulae sagging, commonly complete [Jell & Hill, 1970d, p. 103]. L.Dev.-M.Dev. (Givet.), Eu.(Ger.-Belg.-U.K.-Carnic Alps-Urals)-Asia (Urals-S. Ferghana)-Australia (Vic.-Queensl.); ?M.Dev., Asia (Kwangs).—Fig. 156,2a,b. *F. conglomeratum (Schlüter), Givet., Ger., Eifel; a,b, transv., long. secs., X4, X3 (Schlüter, 1881).

?Crista Tsyganko, 1971, p. 39 [*C. compacta; OD; †MshC142-1, coll. 608, IG, Syktyvkar]. Cerioid or subcerioid, corallites slender; peripheral ends of long major and minor septa thickened and forming moderately wide stereozone; septa thin elsewhere, in places discontinuous longitudinally; ?counter septum may extend beyond axis; septa composed of contiguous trabeculae directed radially upward and inward; tabulae complete, close, horizontal or slightly concave in wide tabularium; one discontinuous series of long dissepiments may develop. M.Dev., Eu.(Polar Urals).—Fig. 156,3a,b. *C. compacta, holotype, Givet., R. B. Nadota, Polar Urals; a,b, long., transv. secs., X4 (Tsyganko, 1971).

Vepesiphylum Etheridge, 1920, p. 61 [*V. falciforme; M; †F17113, AM, Sydney]. Cerioid or fasciculate; corallites slender with moderately thick walls; major and minor septa commonly wavy, both bearing curved vertebrae arranged in rows that curve upward and inward from wall; axial edges of septa spinose; tabular floors concave, of complete tabulae; occasional irregular, large, londsaloid dissepiments in a few; increase lateral, offsets small, in cerioid coralla appearing at corners of parent calices [see Hill, 1940b, p. 263; Pedder, Jackson, & Philip, 1970, p. 219]. L.Dev. (Emms.), Australia (New S.Wales).—Fig. 156,4a,b. *V. falciforme, Taemas Ls. some 500 m. along strike from type locality, New S. Wales, Portion 6, Parish Goodradigbee, Wee Jasper area; a,b, long., transv. secs., X4 (Pedder, Jackson, & Philip, 1970).
Fig. 156. Fasciphyllidae (p. F246-F248).
Family STRINGOPHYLLIDAE

Wedekind, 1922

[nom. transl. Wedekind, 1925, p. 46, ex Stringophyllinae Wedekind, 1922a, p. 3] [=Spongophyllinae Kong in Kong & Huang, 1978, p. 118]

Solitary and phaceloid Rugosa with bilaterally arranged major septa; minor septa commonly only as septal crests, or monacanthine trabeculae on dissepiments between major septa, or failing; monacanths coarse, in single series, contiguous or discrete; marginarium partly or totally of lonsdaleid dissepiments; tabularium predominantly of close, concave or more or less plane [Birenbeide, 1962a, p. 52]. L.Dev.-M.Dev.

Stringophyllum Wedekind, 1922a, p. 8 [*S. normale; SD Wedekind, 1925, p. 64; t4524, 4534, Wedekind Coll., SM, Frankfurt] [≡Spongophylloides Jia in Jia et al., 1977, p. 157 (type, S. tianyangensis, OD; t1V37042, HPRIGS, Yichang; M.Dev., Tianyang Co., Guangxi (Kwangsi)). Solitary corolla; septa consisting of single series of coarse contiguous or discrete monacanthine trabeculae; major septa long and arranged bisymmetrically about counter-cardinal plane; minor septa commonly discontinuous longitudinally, represented by short segments or monacanths based on dissepiments; lonsdaleid dissepiments may disrupt major septa either sporadically or in more or less continuous wide peripheral zone; tabular floors close, depressed toward counter-cardinal plane; tabulae in some complete, more commonly incomplete. L.Dev.-M.Dev.]


S. (Neospongophyllum) Wedekind, 1922a, p. 10 [*N. variabile; SD Wedekind, 1925, p. 52; t3789-3790, Wedekind Coll., SM, Frankfurt; lectotype by Birenbeide, 1962b, p. 121; ≡Spongophyllum buchelelense SCHÜLER, 1889, p. 321, t179, SCHÜLER Coll., IP, Bonn, lectotype by Engel & Schoppé, 1958, p. 96, which see] [=Loeppophyllum Wedekind, 1925, p. 55 (type, L. kerpense, OD; t1634, 8346-8347, Wedekind Coll., SM, Frankfurt; Givet., Kerpen, Eifel, Ger.; ≡Stringophyllum primordiale Wedekind, 1922a, p. 10, t3773, 6055, Wedekind Coll., SM, Frankfur, fide Birenbeide, 1962b, p. 119, 120, Givet., Hand, near Bergisch-Gladbach, Ger.), ≡Loeppophyllum LANG, SMITH, & THOMAS, 1940, p. 79, nom. van.; Schizophyllum Wedekind, 1925, p. 59 (type, Spongophyllum buchelelense SCHÜLER, 1889, see above, OD), non Schizophyllum Verhoeff, 1895, a recent myriapod; Vollbrechtophyllum TAYLOR, 1951, p. 182 (type, Spongophyllum buchelelense SCHÜLER, 1889, see above; OD); Schizophyllum TAYLOR, 1951, p. 182, nom. null.]. With more or less continuous and wide peripheral zone of lonsdaleid dissepiments disrupting both major and minor septa [Engel & Schoppé, 1958, p. 93]. L.Dev.-Eu.(?France); M.Dev., Eu. (Ger.-U.K.-Belg.-France-Ireland-Czech.-N. Afr. (Moroc.).-Australia (Queensl.). —Fig. 157,2a-c. *N. buchelelense (SCHÜLER); a,b, holotype of N. variabile, Givet., Ger., Hand near Bergisch-Gladbach, transv., long. secs., X2 (Wedekind, 1922a, 1925); c, lectotype of N. buchelelense, Givet., Ger., Büchel, Bergisch-Gladbach, transv. sec., X2 (Engel & Schoppé, 1958).

Parasociophyllum Kong in Kong & Huang, 1978, p. 111 [*Cyathophyllum isactis FRECH, 1911; OD; fFRECH's 1911, p. 49 specimen from the up. M. Dev. of Tshon Terek, Tien Shan, C. Asia, appears conspecific with Cyathophyllum isactis FRECH, 1886, p. 189 (75), of which there are about 100 syntypes in ZGI, E. Berlin and Wroclaw (Breslau) Museums, from the Givetian of Bergisch-Gladbach and Sötenich, Ger., and Villmar and Pry between the rivers Sambre and Meuse, Belg.). Like Stringophyllum but phaceloid; minor septa completely withdrawn to wall and major septa may be discontinuous longitudinally in places, so that sparse lonsdaleid dissepiments develop [but see Birenbeide, 1978, p. 154]. M.Dev., Eu.(Ger.-Belg.-Czech.).-Asia (Kweichow-Tien Shan)-Australia (Queensl.).

Melrosia WRIGHT, 1966, p. 265 [*M. rosea; OD; t121104, SU, Sydney] [=Melasmaphyllium Wright, 1966, p. 267 (type, M. mulamuddiensis, OD; t121103, SU, Sydney)]. Ceroid; increase (in M. mulamuddiensis) axial and quadripartite; septa of monacanthine trabeculae that are contiguous or discrete; major septa bilaterally arranged about cardinal-counter plane; minor septa represented mainly by discrete trabeculae based on wall or dissepiments; dissepimentarium with sporadic lonsdaleid dissepiments, or with more or less continuous peripheral zone of lonsdaleid dissepiments; tabular floors concave to flat. L.Dev.-M.Dev., Australia(New S.Wales). —Fig. 157,4a,b. *M. rosea, holotype, Mt. Frome Ls., New S. Wales, N. of quarry NW. of Melrose homestead, near Mudgee; a,b, transv., long. secs., x2.0, x2.4 (Wright, 1966). —Fig. 157,4a,d. M. mulamuddiensis (WRIGHT), holotype, Stuchter's Creek, F., Portion 152, New S. Wales, Parish Broombee,
Fig. 157. Stringophyllidae (p. F248-F250).
Coelenterata—Anthozoa

County Wellington, near Mudgee; c,d, transv., long. secs., X3.0, X2.4 (Wright, 1966).

*Sociophyllum* Birenheide, 1962a, p. 53

*S. longatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn [=Para-

*Spongophyllina* Weidekind, 1922a, but phaceloid [see Pedder, 1964b, p. 444].

*S. elongatum* (Schlüter), lectotype, "Berndorf," ?Givet., presumably within range Ahbach Beds to Curten Beds, Ger., Eifel; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*S. eiongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*S. eiongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*S. eiongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*S. eiongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

Sociophyllum Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).

*Sociophyllum* Birenheide, 1962a, p. 53 [*Spongophyllum elongatum* Schlüter, 1881, p. 213; OD; t2 (=B1), Schlüter Coll., IP, Bonn] [=Para-

*S. typicum* (Schlüter), holotype, mid. M.Oev., Kweichow, 2 km. S. of Silung; a,b, transv., long. secs., X1.5 (Wang, 1948).
FIG. 159. Lykophyllidae (p. F252-F253).
Phaulactis Ryder, 1926, p. 392 [*P. cyathophyloides; OD; +t25469, BM(NH), London; lectotype by Lang & Smith, 1927, p. 489] [=Mesactis Ryder, 1926, p. 390 (type, M. gleevensis, OD; syn-types R25449-25464, BM(NH), London; Brinkmarsh Quarry, Whitfield, Gloucestershire, U.K.); Lykocythisphyllum Wedekind, 1927, p. 69 (type, L. gracile, SD Lang, Smith, & Thomas, 1940, p. 82; +t10366-71, SM, Frankfurt, lectotype by Birenheide, 1974b, p. 480; Llandow, Snäckgårdsbaden, Gotl.); Lykophyllum Wedekind, 1927, p. 68 (type, L. tabulatum, OD; +CN54861, 54867, RM, Stockholm; Västkinde, canal through bog S. of Brisund, Gotl.); ?Neocythisphyllum Wedekind, 1927, which see; Semaicythisphyllum Völlbrecht in Wedekind, 1927, p. 70 (type, Cyathophyllus angustus Londsale, 1839, p. 690, see Lang, Smith, & Thomas, 1940, p. 118, OD; +t6574, Geol. Soc. Coll., GSM, London; Sil., Attwood's shaft, Coal Heath, Licky, Worcestershire, U.K.); Phragmophyllum Schef­ffen, 1933, p. 36, nom. nud. (type, P. currituum, OD, figured but not diagnosed or described; +t73688, PM, Oslo; Llandow, Skoveneng, Nor.); ?Stratophyllum Schef­ffen, 1933, p. 35 (type, S. cavernosum, OD; +t73686, PM, Oslo: Zone 7b, Limastangen, Nor.; insufficiently characterized); ?Hercophyllum Jones, 1936a, which see; Lycocythisphyllum Lang, Smith, & Thomas, 1940, p. 81, nom. van.; Lycophyllum Lang, Smith, & Thomas, 1940, p. 82, nom. van.; Semaicythisphyllum Lang, Smith, & Thomas, 1940, p. 118, nom. van.; ?Pseudoluidiastroemia Ma, 1943, p. 53 (type, P. wedekindii, M; ?not traced; Sil., Gotl.); Prodemophyllum Cotton, 1973, p. 161, nom. subst. pro Desmophyllum Wedekind, 1927, p. 76 (type, D. clarkii, OD; +t10927-10929, Wedekind Coll., SM, Frankfurt; Wenlock, Fårö, NE. of Gotl.). Solitary, in early stages all major septa strongly dilated and contiguous, cardinal septum very long, minor septa very short; in later stages dissepiments first appearing in single series, septal dilatation still pronounced in both cardinal and counter quadrants in tabularium, and cardinal septum shortening so that fossula (on convex side of curved corallum) is marked, while dissepimentarium widens elsewhere, septa being thin in dissepimentarium; dilatation may increase and decrease several times; in late stages cardinal septum may again lengthen but dilatation is slight in both cardinal and counter quadrants; septal arrangement in tabularium irregularly bilateral, each quadrant has individuality in variable curvature and length of major septa; fossula may invade dissepimentarium; tabular floors variable, concave, convex, or subhorizontal, of tabellae; dissepiments small, subglobose, concave toward axis in transverse section and curved or angular [Mi­na­to, 1961, p. 46]. Sil.(Llandow.-Ludlov.-Skl.), Eu.(U.K.-Nor.-Swe.-Poddola)-Asia (Sib. Platf.)-Austr­alia (Queensl.)-N.Am.(Que.).—Fig. 159,3a. *P. cyathophyloides, lectotype, Wenlock., Slite Gr., Gotl., Västergarn; a, transv. sec., X 2.0 (Lang & Smith, 1927).—Fig. 159,3b. *P. angusta (Lons­dale), holotype, U.K., Licky; b, long. sec., X 2.0 (Lang & Smith, 1927).—Fig. 159,3c,d. P. clarkii (Wedekind), holotype, Fårö, NE. of Gotl.; c,d, transv., long. secs., X 1.5 (Wedekind, 1927).—Fig. 159,3ef. P. tabulatum (Wedekind), holotype, Gotl., Västkinde, canal through bog S. of Brisund village; e,f, transv., long. secs., X 2.0 (Hill, n; Cm54867).—Fig. 159,2a,b. *C. camurrum, holotype, Tivolkö Bay, N. Zemyla, low. zone Valnevsk horizon; a,b, transv., long. secs., X 2 (Kra­vtssov, 1966; photographs courtesy A. G. Kravtssov).—Fig. 160,1a-e. *H. shearsbyi (Süssmilch), New S. Wales, Hatton's Corner, Derrengullen Ck., Yass; a-d, transv. secs., X1.5 e, long. sec., X 1.5 (Jones, 1936a).—Fig. 159,1a-e. *H. shearsbyi (Süssmilch), New S. Wales, Hatton's Corner, Derrengullen Ck., Yass; a-d, transv. secs., X1.5 e, long. sec., X 1.5 (Jones, 1936a).—Fig. 159,1a-e. *H. shearsbyi (Süssmilch), New S. Wales, Hatton's Corner, Derrengullen Ck., Yass; a-d, transv. secs., X1.5 e, long. sec., X 1.5 (Jones, 1936a).
Gotl.; cardinal, counter, calical views, a, b, ×1, c, ×2 (Lindström, 1896b).

Neocystiphyllum Wedekind, 1927, p. 77 [*N. Me Coyi; OD; +10933, 10944, Wedekind Coll., SM, Frankfurt] [? = Phaulactis Ryder, 1926, which see, see also Minato, 1961, p. 46]. Like Phaulactis but minor septa withdrawn almost to periphery, leaving wide angulate dissepimentarium;
Coelenterata—Anthozoa

Fig. 161. Lykophyllidae (p. F255).
tabular floors commonly inversely conical, of small glose tabellae. *M.Sil.* Eu. (Gotl.-?Nor.-?Polar Urals).--*Asia (Sib.Platt.).--Fig. 160,2a,b. *N. maccosyoi*, holotype, beds with *Pentamerus tenuistratus*, Färö, near Gotl.; *a,b*, transv., long. secs., ×2 (Wedekind, 1927; photographs courtesy R. Birenheide).

*Onychophyllum* Smith, 1930a, p. 301 [*O. pringlei*; OD; 149070 and PF4694, GSM, London]. Small, solitary, trochoid, calice deep; septa short, thick, irregular, those of cardinal quadrants longer and thinner than those in counter quadrants, with conspicuous axial septum that parts in late stages into long, thin counter septum and short, thick cardinal septum; tabulæ not well known; no dissepiments. [Observations by Dr. J. S. Jell, unpub.] *L.Sil.* (Llandovery); Asia (Tadzhik.).--Fig. 161,1a-h.

*Plasmophyllum* Dybowski, 1873c, p. 340 [*Cystiphyllum brevilamellatum* McCoy, 1850, p. 276; SD Dybowski, 1875, p. 288; A14829, SM, Cambridge] [=*Lamprophyllum* Wedekind, 1927, p. 78 (type, *L. De Geeri*, OD; t11139-11140, We­de­kind Col., SM, Frankfurt; SD Birenheide, 1974b, p. 479; Hablingbo, Petesviken, Gotl.); ?*Slerigo­phyllum* Minato, 1961, which see]. Solitary, cylindrical; major septa withdrawn from axis, somewhat thickened marginal to tabularium, thin with pinnately divergent lateral dissepiments in dissepimentarium; minor septa complete or withdrawn to periphery; dissepiments concentric to angle; tabulæ subhorizontal, of tabellae. *M.Sil.* (We­n­lock), Eu. (Eng.-Gotl.-?Polar Urals); ?*U.Sil.* N.Am. (Alaska).--Fig. 161,3a,b. *P. brevilamellati­num* (McCoy), holotype, Wenlock Ls., Eng., Wenlock; *a,b*, transv., long. secs., ×2 (Lang & Smith, 1927).---Fig. 161,3c,d. *P. degeeri* (We­de­kind), holotype; transv., long. secs., ×2 (Wedekind, 1927; photographs courtesy R. Birenheide).

*Pseudocystiphyllum* Wang, 1947a, p. 179 [*P. lini*; OD; 142181-42182, GSGI, Peking]. Corallum solitary, subcylindrical; septime thin, unequally developed, commonly as septal crests on dissepiments and tabellae; dissepimentarium with large, irregularly londaloid plates; tabulæ convex; dissepiments may occur in calice only. [Until lectotype is restudied and illustrated, generic name (*sensu Smith, 1945, p. 53*) cannot be used with confidence.]*Sil.* Eu. (Gotl.-U.K.).--Fig. 162,1. *P. mitratus* (von Schlotheim), Gotl., Swed.; ext. view, ×1 (Hisinger, 1831).

*Reimanophyllum* Lavrusevich, 1971b, p. 84 [*R. reimani*; OD; 1203/12, ?UPG, Dushanbe]. Phaceloid; increase peripheral and nonparricidal; septime short; tabulæ wide, basin-shaped, complete or incomplete; dissepiments in single series of plates flat peripherally and declined into tabularium. *L.Dev.* (Gedinn.), Asia (Tadzhik.).--Fig. 163,4. *R. reimani*, holotype, up. Argian sub suite, beds with *Chavskia chavskienis*, Turk-parida gully, Zeravshan-Gissar Ra.; transv., long. secs., ×3 (Lavrusevich, 1971b).

*Rukhinia* Strel’nikov, 1963, p. 15 [*R. cuneata*; OD; 120, coll. 654, VNIIGRI, Leningrad]. Soli­tary, cylindrical; major septa long, thick at periphery and thinning toward axis; cardinal septa thin, short, in fossula; axial ends of major septime forming distinctive, loose axial structure in median plane; in late stages septime somewhat thickened in counter quadrants; minor septime very short; dissepiments appearing only in latest stages of develop­ment; tabulæ incomplete, forming floors convex.
peripherally and flat or concave in center; septal microstructure as in Phaulactis. *S. sil. (up. Llandov.), Asia (Sib. Platf.). —Fig. 163, 3a, b. *R. cuneata, holotype, up. Llandov., R. Letney, W. part of Sib. Platf.; a, b, transv., long. secs., X3 (Strel'nikov, 1963).

Ryderophyllum Cherepnina, 1965, p. 31 [*R. kasandiense; OD: †12/10, coll. 518, SNIIGGIMS, Novosibirsk]. Large, solitary, cylindroconical; with numerous long septa locally discontinuous longitudinally and present as crests in dissepimentarium, and in late stages somewhat withdrawn from axis; cardinal septum shortened in fossula; in young stages all septa long, strongly thickened and extending to axis; in late stages reduction of thickening occurs by quadrants, tabularial parts become thread-thin and in dissepimentarium thickening reduces toward axis; tabularium wide, tabular floors broad, low domes, tabulae complete or incomplete; dissepimentarium concentric or anguloconcentric, with scattered lonsdaleoid dissepiments. [Possibly ptychophyllid.] *S. sil.
Lykophyllidae (p. F256-F258).

*R. kasandiense*, R. Kasanda; *a.b*, transv., long. secs., ×1.6 (Cherepnina, 1965).


*S. hesslandi*, OD; †Co3, US, Stockholm [†=Plasmophyllum Dybowski, 1873c, which see]. Solitary, small, curved, trochoid, longer side cardinal; in early stage cardinal septum long, extending to end of counter septum, all septa thickened so as to fill lumen; in next stage septa of counter quadrants

become short and thin, and subsequently those of counter quadrants also shorten; in late stages dissepiments appear, in few series, all septa thin, and sections of tabulae appear. [Only holotype known.] Sil., Eu.(Gotl.).—Fig. 163,la-c. *S. hesslandi, holotype; a-c, transv. secs., X4 (Minato, 1961).

Svetlania Sytova, 1970, p. 76 [*S. tcherkesovae; OD; +76/10316, TsGM, Leningrad]. Solitary, cylindroconical; septa thickened in early stages; major septa withdrawn from axis in late stages; minor septa withdrawn toward periphery, leaving angulate dissepiments; tabularium narrow, tabulae infundibuliform, deeply concave, arranged in series; among them develop convex tabellae; dissepiments elongate and highly inclined, may be thickened. U.Sil.(Greben.), Eu.(Vaygach I).—Fig. 164,2a,b. *S. tcherkesovae, holotype, lower part Grebeni horizon, Belushya Inlet; a,b, transv., long. secs., X3.3 (Sytova, 1970).

¿Zeravshania LAVRIUSEVICH, 1964, p. 25 [*Z. prima; OD; +3498/15, ?UpG, Dushanbe]. Solitary, large; septa long and in early stages strongly thickened, thickening decreasing during ontogeny so that in late stages it is retained only in cardinal quadrants of tabularium; outer lonsdaleoid zone developed in wide dissepimentarium in late stages; tabular floors concave, of tabellae. L.Sil.(up. Llandovery), Asia(Tadzhik.).—Fig. 163,2a,b. *Z. prima, holotype, up. Llandovery, Mt. Daurich, Zeravshan-Gissar Ra.; a,b, transv., long. secs., X1.5 (Lavriusevich, 1964).

Family HALLIIDAE Chapman, 1893


Solitary, curved, conical, with metasepta of cardinal quadrants pinnately arranged about long cardinal septum in elongate fossula on convex side of corallum; metasepta of counter quadrants short, radial near counter septum but sequentially from counter septum curving more toward parallelism with alar septa and distinct alar fossulae; tabular floors commonly somewhat arched, tabulae commonly incomplete; dissepimentarium normal concentric or lonsdaleoid. L.Dev.-M.Dev.

Subfamily HALLINAE Chapman, 1893

[nom. transl. STUMM, 1949, p. 15, ex Halliidae CHAPMAN, 1893, p. 46]

Halliids with normal dissepimentarium of interseptal dissepiments. M.Dev.

Hallia MILNE-EDWARDS & HAIME, 1850, p. lxvii [*H. insignis; OD; + in de Verneuil Coll., EM, Paris]. Solitary, conical, moderately large, with elongate thin cardinal septum in long narrow fossula on longer side of corallum; metasepta of cardinal quadrants thin, arranged pinnately to fossula; minor septa short; septa ?not carinate; dissepimentarium narrow, attitude of tabularial floors not known in type species. [Holotype insufficiently known.] M.Dev.(Givet.), N.Am.(Ohio?Ind.-Mich.).—Fig. 165,3. *H. insignis, holotype, ?Columbus Ls., Ohio, Columbus; ext. view, cardinal septum at top, X0.8 (Milne-Edwards & Haime, 1851).

Aulacophyllum MILNE-EDWARDS & HAIME, 1850, p. lxvii [*Caninia sulcata d’ORBIGNY, 1850, p. 105; OD; +B3157a (=443a), d’Orbigny Coll., MN, Paris; lectotype by THEVENIN, 1906, p. 196]
Rugosa—Stauriida—Lycophyllina

Fig. 166. Halliidae (p. F260).

[="Pinnatophyllum" GRABAU, 1922, p. 13 (type, Cyathophyllum scyphus ROMINGER, 1876, p. 103, OD; *8568, UMMP, Ann Arbor, lectotype by STUMM, 1963b, p. 142)]. Solitary, with septa in cardinal quadrants long and pinnately arranged about fossula on convex side of corallum, and radial and shorter in counter quadrants; septa dilated in early stages, dilatation decreasing from periphery to axis first in counter quadrants, later in cardinal quadrants; tabulae incomplete, tabularial floors commonly somewhat arched; small interseptal dissepiments present. [Thin section study of holotype required; STUMM’s (1963b, p. 140) interpretation followed herein.] M.Dev.
Subfamily PAPILIOPHYLLINAE Stumm, 1949

Halliidae with lonsdaleoid dissepimentarium. L.Dev.-?M.Dev.

Papilophyllum Stumm, 1937, p. 430 [*P. elegansitum; OD; t133476, USNM, Washington]

Halliidae lacking wall and with counter side of corallum attached, commonly to crinoid stalk, by sclerenchyme. M.Dev.

Aspasmophyllum Roemer, 1880, p. 184 [*A. criophillum; M; tnot traced; =A. philoerinum] (sic Roemer, 1883, p. 377). Solitary, curved, trochoid, lacking epithecate wall, attached to foreign body, commonly crinoid stalk, by sclerenchymal outgrowth; cardinal fossula on free side; cardinal-counter plane elongate, cardinal septum long; minor septa very short; major septa commonly thickened distally, in cardinal quadrants pinnately arranged toward cardinal septum; tabulae in proximal parts of corallum. M.Dev. (Eifel-Givet.). Eu. (Ger.)—Fig. 165,2a,b. *A. criophillum, Eifel, Gerolstein; a,b, lat., calical views, X0.8 (Roemer, 1883).

Suborder COLUMNARIINA

Soshkina, 1941

Solitary or compound Stauriida with dissepimentarium of small, subglobose dissepiments that may include a pipe of boshesho dissepiments, in some with a pipe of flat dissepiments around it; tabulae complete or, more commonly, incomplete; increase commonly marginal. M. Sil.-Dev.

**Family ACERVULARIIDAE**

de Fromentel, 1861


Solitary, fasciculate or cerioid; with inner wall formed at or abaxial to boundary between tabularium and marginarium, by dilatation to contiguity of neighboring major and minor septa; septa radially arranged; septal trabeculae directed adaxially upward from thin outer wall and from adaxial side of inner wall, but diverging radially at inner wall so that in narrow zone related to flat dissepiments they proceed longitudinally or even abaxially upward; tabular floors flat or slightly arched upward, or with broad inversely conical depression; tabulae complete or incomplete; in marginarium interseptal loculi may be crossed by subhorizontal plates alone or by one or two series of small globose dissepiments on axial side of both outer and inner walls; fossula not obvious. M. Sil.-U. Sil.

**Acervularia** Schwegger, 1819, table vi [*A. baltica; M; =Madrepora ananas LINNÉ, 1758, p. 797, M; tnot traced] [*Floscularia Eichwald, 1829, p. 188 (type, *F. luxurians*; SD Lang, Smith, & Thomas, 1940, p. 62; †1, coll. 234, LGU, Leningrad, lectotype by Fedorowski & Goryanov, 1973, p. 24; Sil., drift, Lithuania, which is probably *Madrepora ananas LINNÉ*), non Floscularia Cuvier, 1798, a rotifer; Favastraea de Blainville, 1834, p. 686 (type, *Astraea baltica* (Schwegger) de Blainville, 1830, p. 340, *partim*, SD Lang, Smith, & Thomas, 1940, p. 60; †not traced; Sil., Gotl., =Madrepora ananas LINNÉ); *?Arachnium Keyserling, 1846, p. 153, nom. nud. (type, *Corallium arachnion . . . vorticalis of Volkman, 1720, pl. xvii, SD Lang, Smith, & Thomas, 1940, p. 19; †not traced; presumably from drift, Ger., which is probably *Acervularia ananas* (LINNÉ); *Cyathogonium Chapman, 1893, p. 45* (type, *Acervularia ananas* (LINNÉ), SD Stumm, 1949, p. 33); *Rhabdophyllum Wedekind, 1927, p. 42* (type, *R. cylindricum*, OD; †C545946-7, RM, Stockholm, and F10170-1, Wedekind Coll., SM, Frankfurt; M. Sil., Högskl, Gotl.); *Favastraea Lang, Smith, & Thomas, 1940, p. 60, nom. van.; Rhabdophyllum Cotton, 1973, p. 178, nom. nud.]*. Coralium phaeocoleroid with quadriparte parriscal increase; septa finely carinate and dilated near inner ends of long minor septa, forming wall within dissepimentarium, at which sepal trabeculae diverge radically; major septa long; ?third order septa may develop in some; tabular floors weakly uparched or flat or with broad, inversely conical depression; tabulae commonly incomplete; dissepimentarium with three zones, outer comprising two or more series of globose plates, middle zone consisting of flat plates just outside inner wall, and inner zone adaxial to inner wall of globose plates interleafing with tabellae; increase commonly peripheral. M. Sil.-U. Sil., Eu.(U.K.-Gotl.-Est.)-N.Am. (?Ohio).—**Fig. 167,2a,b.** *A. ananas* (LINNÉ), Sil., Gotl., Klinteberg; †, transv., long. secs., ×2.0, ×2.7 (Hall, n; UQF12046).

**Diplophyllum** Hall, 1852a, p. 115 [*D. caespitosum; M; †1696:1, AMNH, New York; lectotype by Oliver, 1963, p. G3]*. Phaeocol, phaeo­ceryoid, or cerioid; inner wall separating marginarium from tabularium, where major and minor septa thicken to contiguity; major septa may be long, or short and subequal to minor; septal trabeculae may diverge radially at inner wall so that narrow zone of longitudinally or even abaxially inclined trabeculae may be found on abaxial side of inner wall; tabularium wide, tabulae mostly complete, flat to gently arched; in marginarium flat plates cross interseptal loculi; increase commonly peripheral or lateral [see Oliver, 1963, p. G1]. M. Sil., N.Am.(N.Y.)-Eu. (Gotl.).—**Fig. 167,3a-d.** *D. caespitosum, Lockport dol., N.Y., Lockport; †, lectotype, transv., long. secs., ×6.7; †, topotype, transv., long. secs., ×6.7, ×2.7 (Oliver, 1963).

Oliveria Sutherland, 1965, p. 32 [*O. planotabulata; OD; †5505, OU, Norman*]. Solitary; septa short, thick, subequal, with multisieriate trabeculae and denticulate distal and axial edges; near inner edge of marginarium, major and minor septa thickened and contiguous forming thick inner wall; minor septa commonly discontinuous between inner and thin outer wall; in median plane of septa, trabeculae directed adaxially upward from outer wall, but within inner wall, at least in minor septa, there may be narrow zone in which trabeculae diverge fanwise and become directed abaxially upward; tabularium wide, tabulae complete and flat or slightly curved upwar or downward; loculi between major septa in marginarium crossed transversely by very thin
more numerous, complete and sagging plates; cardinal fossula not recognized. *U.Sil., N.Am. (Okla.).—Fig. 167,1a-c. *O. planotabulata, holotype, Henryhouse F., Lawrence uplift, Okla.; a, ext. view, X1.3; b,c, transv., long. secs., X4.0 (Sutherland, 1965).

Family COLUMNARIIDAE

Nicholson, 1879

[nom. correct. HILL, 1404, p. 155, ex Columnariidae NICHOLSON, 1878, p. 17] [Columnariidae, Columnarinæ WANG, 1948, p. 27; Columnarinæ STUMM, 1949, p. 28; Columnarinæ IVANOVS KI, 1973a, p. 79] [ROMINGER, 1876,
Corallum fasciculate or cerioid; septa thin, moderately long to long, major septa somewhat amplexoid; narrow disseptimentarium present except in early stages, of unequal small plates in one or a few series; tabularium wide, floors commonly slightly arched but with broad median depression, tabulae commonly complete.  

**Columnaria** Goldfuss, 1826, p. 72 [*C. sulcata; SD McCoy, 1849, p. 121; t242, Goldfuss Coll., IP, Bonn] [=Lithostroma Rafinesque MS in Brongniart, 1829, p. 431 (type, L. incurvata, M; nom. subst. pro Columnaria sulcata Goldfuss, 1826, p. 72, fide Lang, Smith, & Thomas, 1940, p. 78); Columniphylum Quenstedt, 1879, p. 523, as subgenus (type, C. sulcatum, SD Hill, 1961, p. 6; =Columnaria sulcata Goldfuss, 1826).** Corallum cerioid; corallites with very narrow peripheral stereozone which may be ruptured at angles of corallites by lonsdaleoid dissepiments; major and minor septa forming peripheral stereozone composed of short thick trabeculae like superposed tiles directed slightly upward axially; septa commonly subradially arranged, rarely pinnately; major septa may reach axis, attenuate in tabularium; minor septa scarcely projecting from stereozone; one or two series of elongate dissepiments may border tabularium in places; tabulae wide, numerous, incomplete, tabular floors slightly concave or somewhat wavy.  

Possibly Stauriidae.]  

**Planetophyllum** Crickmay, 1960, p. 4 [*P. plan-
etum; OD; †27022, PRI, Ithaca] [*=species group of *Disphysillum* geinitzi *LANG & SMITH*, 1935, p. 570]. Dendroid; corallites slender; major and minor septa very short, subequally spaced; dissepiments normal, in single series; tabulae complete or incomplete, floors horizontal or slightly concave. [Possibly the eridophyllid *Acinophyllum* McLaren, 1959, but presence or absence of septal carinae not noted.] *Dev*, N.Am.(Alberta). – Fig. 168.2a,b. *P. planetum*, paratypes, Alberta, 59°36'N., 111°26'W., Stony Island, Slave R., †1, †2, transv., long., secs., ×2 (Crickmay, 1960).

**Spasskyella** Tsyganko, 1977. p. 41 [*S. pershinae*; OD; †611/1, IG, Sykyvkar; R. Syyuv]. Fuscizone, in places may be catenoid; septa short or stunted, laminar, alternation in length not apparent; tabulae horizontal, a few oblique supplementary tabellae peripherally; dissepimentarium very narrow, of one discontinuous series of very small plates. *M.Dev.* (Givet.), Eu.(Polar Urals).

**Family DISPHYLLIDAE** Hill, 1939

[*Disphyllidae* Hill, 1939a, p. 224] [*=Hexagonidiidae Bulvanker, 1958, p. 178; *Mariosiardiaceae Rozkowska, 1965, p. 261*; *Charactaphyllidae Peder, 1972, p. 698*; *Uraratuiidae Spasskii, Kravtsov, & Tsyganko, 1974, p. 171*] Solitary, fasciculate or massive; septal trabeculae monocanths, commonly arranged in half fans, in some in fans but without pipe of horseshoe dissepiments at zone of divergence in fan, and in some parallel and steeply declined adaxially, waved at border of tabularium; dissepiments small, globose or subglobose; tabularium bizonal, in periaxial zone tabellae commonly large and adaxially declined, in axial zone variably inclined. *U.Sil.-U.Dev.*

**Subfamily DISPHYLLINAE** Hill, 1939


Solitary, fasciculate or cerioid; septa commonly thin, if thickened, attenuating adaxially or, in some, remaining thick in tabularium until late stages; trabeculae monocanths, may be extended into widely separated and somewhat irregular carinae, arranged either in half fans, or parallel and steeply declined adaxially and waved at tabularial borders; dissepiments small, globose to subglobose; tabularium bizonal, axial tabellae flat, convex or concave, periaxial tabellae large and declined adaxially. *Dev*.

Of the genera here included in *Disphyllinae*, *Temnophyllum*, *Alaiophyllum*, *Charactaphyllum* and *Aphraxonia* show septal thickening continuing into outer part of tabularium where parallel trabeculae are waved as in some *Pterorhiza Ehrenberg*, 1834, and may be separable; *Minussiella*, *Pseudocampophyllum* and *Chalcidophyllum* have predominantly concave tabulae and possibly represent another group.

**Disphysillum** de Fromentin, 1861, p. 302 [*Cyathophyllum caespitosum* Goldfuss, 1826, p. 60; SD *LANG & SMITH*, 1934, p. 80; †205, Goldfuss Coll., IP, Bohn; lectotype by *LANG & SMITH*, 1934, p. 80] [*=Cannophyllum CHAPMAN, 1893, p. 45* (type, *Disphysillum goldfussi* Geinitz, 1846, p. 569, *SD STUHM, 1949, p. 33; =Cyathophyllum caespitosum* Goldfuss, 1826, see *LANG, SMITH, & THOMAS, 1940, p. 53*); *Schlueteria* WEDEKIND, 1922a, p. 3 (type, *S. Emiti*, OD; type material two unfigured longitudinal sections labeled "original," from different specimens, 4513-4, WEDEKIND Coll., SM, Frankfurt, figured slide not found; up. Honsel beds, Emiti, near Hagen, Ger.), *non Schlueteria Fritsch, 1887, a crustacean; Megaphyllum Soshkina, 1939, p. 14 (type, *P. pashini*; OD; †slides 237-8, coll. 144, PIN, Moscow; Frasn., near Zykov mine, Pasha distr., C. Urals), *non Megaphyllum Verhoeff, 1894, a myriapod; Pseudostrinophyllum* Soshkina, 1939, p. 36 (type, *P. caespitosum*, OD; †slides 41-42, 124, 125, coll. 144, PIN, Moscow; Frasn., Mt. Etapnaya, Satke region, S. Urals); *Minussiella Bulvanker, 1952a*, which see; *Solominella Ivanyi, 1952, p. 141 (type, *S. soshkinae* [as *soshkini*], OD; †119-6, TGU, Tomsk; Frasn., NW. flanks of Kuzbas, septa diluted to form imperfect marginal stereozone); *Amaphyllum Pedder, 1970*, which see; *Pseudodisphysillum* KONG in KONG & HUANG, 1978, p. 79 (type, *P. jianghaiense*, OD; †Ger 552-553, GB, Guyiang; M.Dev., Dushan F., Jiangzhai, Guizhou [Kweichow]); *Temnophyllidae Luo MS in KONG & HUANG, 1978, p. 76 (T. devoniana hunanensis* Luo MS is cited as type species but is not diagnosed, described, or figured; they describe and figure *T. liumaensis* (C. C. Yu), *T. pingtangensis* Kong sp. nov., and *T. wengdeensis* Kong sp. nov.; M.Dev.-U.Dev., Givet.-Frasn., S.China)] Phaceloid to subcerioid, with lateral or peripheral increase; septa complete, dilated in some, carinae absent or weak; trabeculae monocanths commonly arranged in half fans; dissepiments in several series of small, subequal plates, globose and subglobose, innermost being highly inclined and outermost commonly somewhat peneckielloid; horseshoe dissepiments not developed; tabulae commonly in two series, axial series of flat, concave, or slightly mesa-shaped plates and periaxial series of large, inclined, and dissepimentlike plates [see *HILL & JELL, 1970b, p. 37; Rozkowska & Fedorowski, 1972, p. 296*]. *L.Dev.* (Em.,) Asia (NE.USSR); *M.Dev.-U.Dev.* (Cov.,) Eu.(Belg.); *M.Dev.* (Givet.), Eu.(U.K.-Belg.-Ger.-Pol.-Czech.-Aus.-Asia) (Kazakh-
Fig. 169. Disphyllidae (p. F264-F266, F268-F271).
Argustastrea Crickmay, 1960, p. 10 [*A. arguta; OD: +27036, PRI, Ithaca]. Cerioid, with deep, bell-shaped calice; septa radially arranged, typically noncarinate but may be faintly carinate in dissepimentarium; septa of both orders dilated in outer dissepimentarium, becoming attenuate adaxially; major septa extended almost to axis or withdrawn, leaving wide axial space; trabeculae monocanthans, almost parallel and directed upward and inward from periphery; dissepiments small, subequal, numerous and subglobose, commonly declined at moderate angle toward axis; tabularium variable but commonly biserial with peraxial series of small, adaxially declined plates surrounding series of flat or slightly domed tabellae [Hill & Jell, 1970b, p. 51]. M.Dev., N.Am. (Ont.-NW. Terr.-Ellesmere I.-Mich.); Eu. (Ger.-France-Belg.); Asia (Armenia-Turkey)-W.Australia; U.Dev. (Frasn.). Asia (Kuzbas-Kwantung)-W.Australia-N.Am. (NW.Terr.-Alaska).— Fig. 169,5a,b. *A. arguta, M.Dev., Can., W. end of Carcajou Ridge, NW. Terr.; a,b, transv., long. secs., X2 (Hill & Jell, 1970b).

Aristophyllum Bulvanker, Spassky, & Kravtsov in Ivanovskiy, 1975b, p. 78 [*A. terechovi; OD: +4, coll. 9851, ?TSGM, Leningrad]. Solitary, major septa subequal, not reaching axis, thinning adaxially; minor septa thinner; tabularium wide, with wide axial series of flat, complete tabulae and outer series of inclined, globose tabellae; dissepimentarium moderately narrow, of normal concentric or, in places where minor septa discontinuous, inosculating dissepiments; fossula indistinct. U.Dev. (Frasn.). Asia (Taiymyr-NE.USSR).— Fig. 170,6a,b. *A. terechovi, holotype, R. Dzhdilivyy, R. Belaya Noch, Ormulev Mts.; a,b, transv., long. secs., X2 (Ivanovskiy, 1975b).

*Carotaphyllum Görlich, 1896, p. 163 [*C. typus; OD: ?neotype Tel1/1, Görlich Coll., PZl, Poznan; by Fedorowski, 1967a, p. 216; =Cyathophyllum ceratites Goldfuss sensu Freich, 1886, p. 177 (63)] [=?Kunthia Schützler, 1885a, which see; ?Hunaphrenesis Sun, 1958, which see]. Solitary or with few offsets; septa invariably carinate; septal tabularia ?rhipidacanthine, arranged in broad, asymmetrical fans or half fans; symmetry bilateral in early stages with prominent counter septum, radial later; septa may be somewhat thickened in tabularium; dissepimentarium floors horizontal or peripherally but declined adaxially to tabularium; dissepiments small and globose, no horseshoe dissepiments; tabularium wide, tabular floors horizontal or concave, tabulae incomplete [Fedorowski, 1967a, p. 214; but see also Pickett, 1967b, p. 40]. M.Dev., Eu. (Pol.-?Ursals).— Fig. 170,2a-e. *C. typus, low. Givet., Pol., Skaly; a, transv. sec., early stage, b, transv. sec., late stage, c, long. sec., all X2 (Fedorowski, 1967a).

*Chalcidophyllum Pedder, 1965a, p. 204 [*C. campanense; OD: +F8786, UNE, Armidale]
[?≡Minussiella Bulvanker, 1952a, which see].
Solitary or weakly compound; corallites trochoid to cylindrical; septa smooth, thin, radially arranged; minor septa may be almost completely withdrawn to outer wall, major septa may extend to axis or stop short of it and may be discontinuous in places; dissepiments numerous, unequal, in herringbone arrangement where minor septa are withdrawn; tabulae broad, incomplete, sloping so that floor of tabularium is depressed axially [Pedder, Jackson, & Phillip, 1970, p. 237].
L. Dev. (Siegen.-Ems.), Australia (Vict.-New S. Wales).—Fig. 170,7a,b. *C. campanense, holotype, Bell Point Ls., Vict., Waratah Bay; a,b, transv., long. secs., X1 (Pedder, 1965a).
Charactophyllum Simpson, 1900, p. 209 [*Campo-
phyllum nanum HALL & WHITFIELD, 1873, p. 232; OD; +227, NYSM, Albany. Solitary, small, fossula indistinct; septa of two orders, of uniserial, contiguous monacanths waved at inner boundary of disseipientarium, denticulate and faintly carinate in disseipientarium; major septa dilated in early stages, somewhat amplexoid in successive zones in later stages; dilatation is retained longest in tabularial parts of septa; tabulae horizontal or slightly convex or concave, complete or incomplete; peripheral tabellae commonly large and adaxially declined; disseipientarium may be wide, of small, normal, subglobose disseipments. [Type material requires restudy; see WATKINS, 1959a, p. 82; PEDDER, 1972, p. 698.] *C. nanum (HALL & WHITFIELD), sensu SMITH, 1945, p. 17, WATKINS, 1959a, p. 82, Hackberry Group, Iowa, Rockford; a, long. sec., X1.5; b,c, transv. secs., X1.5; d, part of calical view showing denticulate and carinate septa, X7.0 (WATKINS, 1959a); e,f, long. transv. sec. (sensu SMITH), X3.0 (Hill, n; UQFI0965); g,h, transv., long. secs., X2 (Hill, n; UQFI0962).

Dushanophrentis YÜ, LIAO, & DENG, 1974, p. 224 [*D. cystotabulata; OD; +18755-18758, IGP, Nanking]. Solitary, small, curved trochoid; septa thickened, their axial ends somewhat withdrawn subequally from axis and may join in quadrants; cardinal fossula distinct, cardinal septum may be short; tabularium wide, axial series forming near-horizontal floors, tabulae complete or incomplete;
periaxial tabellae small, subglobose; dissepimentarium narrow, of few series of small, subglobose plates, inner series steeply declined adaxially. *M. Dev. (Eifel.), Asia (Kweichow).—Fig. 169.a,b.

*D. cystotabulata*, holotype, Houyishan F., Kweichow, Dushan; a,b, transv., long. secs., X3 (Yü, Liao, & Deng, 1974).

*Eoglossophyllum* Yü in Wang, Yü, & Wu, 1974, p. 30 [*E. minor*; OD; t12961-23685, IGP, Nanking]. Solitary; small; major septa thickened and withdrawn from axis in tabularium, major and minor septa thin in narrow dissepimentarium of small, subglobose normal dissepiments; tabular floors flat or inclined, tabulae very sparse. *L.Dev., Asia(Kwangsi).—Fig. 170.a,b. *E. minor*, Nahkaoling F., Kwangsi, Liu Jing; a, holotype, transv. sec., X2; b, paratype, long. sec., X2 (Wang, Yü, & Wu, 1974).

*Hemialacophyllum* Kravtsov in Ivanovskiy, 1975b, p. 84 [*H. accuratum; OD; t149/17, coll. 419, IGG, Novosibirsk*]. Solitary; calice deep; septa spindly, thinning toward axis and somewhat dilated at periphery to form narrow stereozone that narrows distally; septal trabeculae directed obliquely upward adaxially, their axial ends may separate slightly; dissepimentarium narrow, of one to three series of small hemispherical dissepiments, outermost series larger and horizontally based; tabularium wide, tabular floors flat or wavy but depressed and with supplementary tabellae peripherally, tabulae incomplete. *L.Dev., Asia(Taymyr-NE.USSR).—Fig. 170,3a-c. *H. accuratum*, holotype, Yunkhodsk beds, R. Tareya, C. Taymyr; a-c, transv., long. secs., X2 (Ivanovskiy, 1975b).

**Hunanophrentis** Sun, 1958, p. 13 [*H. zaphrentoides; OD; t1297, CU, Peking*] [=Ceratophyllum gürich, 1896, which see]. Solitary, curved, conical; septa strongly thickened, arranged with weak convolution about cardinal fossula with cardinal septum shortened in calice; septal thickening decreases first in counter quadrants; minor septa short, dissepimentarium narrow; tabulae large, distant, tabularial floors concave in some places, flat axially. *U.Dev., Asia(Hunan).—Fig. 170, 4a,b. *H. zaphrentoides*, holotype, Shaitenchiao F., Hsianghsian; a,b, transv., long. secs., X1.3 (Sun, 1958).

*Kunthia* Schlüter, 1885a, p. 7 [*K. cratiferiformis*; M; t174a, Schlüter Coll., IP, Bonn; lectotype by Pickett, 1967b, p. 62] [=Ceratophyllum gürich, 1896, which see]. Small, solitary, with inversely conical calical floor, extending almost to apex of cone; cardinal septum on convex side; septa thickened and carinate in inner part of narrow dissepimentarium; tabulae very few, confined to apical region. [Possibly zaphrentid; see Pickett, 1967b, p. 42.] *M.Dev.(Cousin.), Eu. (Ger.-Belg.).—Fig. 171,2a-c. *K. cratiferiformis*, Ger., ESE. of Esch, near Yunkerath, Efelf; a, ext. view, X1; b, calical view, X2; c, oblique lateral view showing calice, X1 (Schlüter, 1889).

**Minussiella** Bulvanker, 1952a, p. 134 [*M. beliakovii* (also spelled beljakovii); OD; t1, coll. 8635, TsGM, Leningrad] [=?Disphyllyum de Fromentel, 1861, which see; ?Chaleidophyllum pedder, 1965a, which see]. Corallum branching, septa unthickened, major septa almost reaching axis or somewhat withdrawn; minor sepa may be withdrawn to wall, leaving herringbone or londskeletal dissepiments; dissepimentarium moderately wide, dissepiments unequal; tabular floors inversely conical or flat, of tabellae [Ivaniya, 1965, p. 167]. *M.Dev. (Eifel.), Asia(Minnissin depression).—Fig. 172,1a-d. *M. beliakovii*, Tashyp suite, Mt. Kulagay; a,b, holotype, transv., long. secs., X3.0 (Hill, n; photographs courtesy E. Bulvanker); cd, topotype, transv., long. secs., X2.5, X2.7 (Ivaniya, 1965).

**Pseudocampophyllum** Ivanovskiy, 1958, p. 343 [*P. eniseicum; OD; tsample 17, slide 30, ?VNIGRI, Leningrad]. Solitary or fasciculate, with parricional or nonparriacial increase; major septa almost straight, complete, somewhat withdrawn from axis; minor septa contraingent, in some may be almost as long as major septa; tabulae slightly concave, complete or incomplete, with auxiliary tabellae peripherally; dissepiments small, subglobose, in places not distinct from auxiliary peripheral tabellae. *M.Dev.(?Givet.), Asia(Minnissin depression).—Fig. 172,1a,b. *P. eniseicum*, Beya Suite, Chayzy-Kozy, W. of Abakan; a, holotype, transv. sec. of fragment of colony, X4; b, another specimen, long. sec., X4 (Ivanovskiy, 1958).

**Spinophyllum** Wedekind, 1922a, p. 5 [*Campophyllum spongiosum* Schlüter, 1889, p. 304; M; 2 syntypes, 174a,b, in Schlüter Coll., IP, Bonn]. Solitary; major and minor septa somewhat thickened and highly and irregularly carinate in dissepimentarium, carinae either irregular yardarm or extending from zigzags, arranged in half fans but flexed at outer part of tabularium; outer series of dissepiments subpeneckielloid, inner series smaller, more or less steeply declined adaxially; tabulae in two series, axial series of horizontal plates and periaxial series smaller and declined adaxially. *M.Dev.(Givet.), Eu.(Ger.).—Fig. 172,3a,b. *S. spongiosum* (Schlüter), W. Ger., Büchel quarry near Herrenbrunden, Bergisch-Gladbach; a,b, transv., long. secs., X3 (Hill, n; UQF50358).

**Temnophyllum** Walther, 1928, p. 120 [*T. lactum*; SD Lang, Smith, & Thomas, 1940, p. 132; t6971-3, Wedekind Coll., SM, Frankfurt] [=?Diplophyllum Soshkina, 1939, p. 39 (type, D. verrucosum; OD; tslides 162-163, 285-286, coll. 144, PIN, Moscow; Frasn., Katov reg., Urals), non Diplophyllum Hall, 1851, p. 399; Temenophyllum Lang, Smith, & Thomas, 1940, p. 131, nom. van.; Pseudozaphrentis Sun, 1958, p. 14 (type, P. difficile; OD; t1299, CU, Peking; U.Dev.,
Shaitienchiao F., Hunan); ?Alaiphyllum Goryanov, 1961, which see; Paracanthus Merriam, 1973b, p. 32 (type, ?Auliphyllum Richardsoni Meek, 1867, p. 81, OD; t14544, USNM, Washington, lectotype by Smith, 1945, legend to pl. 5; ?Givet., The Ramparts, NW. Terr., Can., see Pedder, 1972, p. 701); Prodiplophyllum Cotton, 1973, p. 162, nom. subst. pro Diplophyllum Soshkina, 1939; ?Temnocarinia Yu & Liao MS in Kong & Huang, 1978, p. 98 (Temnoiphyllum (Temnocarinia) involuta Yu & Liao is listed as type, but is not diagnosed, figured, or described; T. (Temnocarinia) abnormis Kong sp. nov., tGcr 653-654, GB, Guiyang; M.Dev., Dushan F., Jiangzhai, Guizhou [Kweichow], is described and figured together with six species previously referred to Temnoiphyllum). Solitary; septa thickened in outer part of dissepimentarium either to contiguity or thinning toward outer and inner edges; in thickened zone monacanthine septal trabeculae are subhorizontal but may be waved at tabularial boundary; dissepiments small, subequal, subglobose, their bases almost vertical in outer parts of dissepimentarium; tabularial floors


Solitary, fasciculate or massive; septa complete, long, may bear lateral dissepiments in outer parts of dissepimentarium; trabeculae commonly arranged in fans; dissepimental floors everted to flat in more or less wide peripheral zone, declined adaxially; dissepiments small, numerous, subglobose to globose; tabularial floors commonly domes with edges turned out or up, tabulae incomplete. \textit{U.Sil.-M.Dev.}

\textit{Paradisphyllum} Strusz, 1965, p. 537 \textit{[P. harundinatum; OD; 13236, SU, Sydney] \textit{[=Ivdelephyllum} Spaskiy, 1971b, which see].} Fasciculate to subcereoid; increase lateral; septa long, fusiform in transverse section, carinate outside zone of greatest dilatation; monacanthine trabeculae arranged in fans or half fans with zone of divergence mediad in dissepimentarium; major septa almost reaching axis, somewhat unequal, counter septum longest; tabularium bizonal, periaxial tabellae flat in transverse section, carinate outside zone of divergence mediad in dissepimentarium; tabellae incomplete, axially series of concave, with change of curvature roughly in medial zone of dissepimentarium; tabular floors with axially uparched series and periaxial narrow concave tabellae where major septa almost reach axis, to subhorizontal or concave when septa are withdrawn from axis. [Possibly the eridophyllid \textit{Prismatophyllum} Simpson; see also Pedder, 1977, p. 173.] \textit{L.Dev.-M.Dev.}, N. Am. (Yukon-Neve.), 174,1a,b. \textit{E. exilis}, L.Dev. (Zlichov), Yukon, near base of Bear Rock equivalent, 65°23' N., 138°24'W.; Ogilvie R.; a holotype, transv. sec., X3.3; b, paratype, long. sec., X3.3 (Crickmay, 1968).} \textit{[=Ivdelephyllum} Strusz, 1965, p. 67, which see; \textit{G. cylindrica}; OD; \textit{?F44193, UQ, Brisbane]}

Guriievskiea Zheltonogova in Zheltonogova & Ivanova, 1961, p. 404 \textit{[?G. cylindrica; OD; \textit{t}in coll. 1508, ZSGUP, Novokuznetsk]}. Solitary or with few offsets; septa radially or bilaterally arranged, thickened in inner dissepimentarium so as to be somewhat fusiform in transverse section, may be weakly carinate; axial ends of major septa carinate, slightly dilated or contiguous laterally; tabularial floor commonly domed, with or without periaxial trough; tabellae numerous; dissepimental floor reflexed, dissepiments numerous, globose, subhorizontally based and commonly large in median parts, those of outer and inner series small; trabeculae monacanthous in which fibers diverge from axis at low angle; monacanthus arranged in broad symmetrical fan in median plane of septum [see Jell & Hill, 1969, p. 11]. \textit{L.Dev.} \textit{(?Siegen.-Ems.)-M.Dev.} (Couvin.-Givet.), Australia (Queensl.); Eu. (Urals)-Asia (Salair-China-Burma).

\textit{Ivdelephyllum} Spaskiy, 1971b, p. 24 \textit{[?Keriphylloides caespitosum Vaganova, 1959, p. 81; OD; \textit{?Fide 29/V43/52, Vaganova Coll., UGUP, Sverdlovsk] \textit{[=Paradisphyllum} Strusz, 1965, which see].} Phaceloid, septa moderately long, with spindlelike thickening as seen in transverse section, and weakly carinate; trabeculae arranged fanwise; thickened peripheral ends of septa form narrow stereozone, cardinal septum may intersect axis, when others may be slightly pinnate toward it; tabulae incomplete, an axial series of concave tabellae and periaxial series of tabellae slightly declined adaxially; dissepiments globose or subglobose, outer zone of dissepimentarium floors somewhat everted. \textit{M.Dev.} (Eifel.), Asia (Urals-Tien Shan).} \textit{[=Ivdelephyllum} Strusz, 1965, which see].

\textit{Martinophyllum} Jell & Pedder, 1969, p. 735 \textit{[M. ornatum; OD; \textit{tF44193, UQ, Brisbane] \textit{[=?Exili-}}
From Crickmay, 1968, which see; ?Xystrigona Yü, 1974, which see]. Cerioid; calicular platform flat or slightly reflexed; septa commonly fusiform, smooth to carinate, may be retiform or cavernous in outer dissepimentarium; trabeculae are monocanthids commonly arranged in broad, symmetrical fans; fibers of trabeculae long, diverging only slightly from axis; dissepiments numerous, small and globose; dissepimentarial floor commonly arched in inner dissepimentarium, sloping steeply toward axis and gradually toward periphery; tabularial floor commonly arched or conical, composed of numerous tabellae. *L. Dev. (Siegen.-Ems.), Australia (Queensl.-New S.Wales-Vict.-Tasm.)-N.Am. (Yukon-Alaska); *M. Dev. (Eifel), Asia (E.Urals-Mt.Altay).—Fig. 175, 3a, b. *M. ornatum, holotype, base of Martin's Well Ls., Pandanus Ck., N.Queensl.; a, b, transv., long. secs., ×3 (Jell & Pedder, 1969).

Radiastrea Stumm, 1937, p. 439 [*R. arachne; OD; 94458, USNM, Washington]. Thamnaster-oid or astreoid; major and minor septa long,
Fig. 174. Disphyllidae (p. F271-F272, F275).
Fig. 175. Disphyllidae (p. F273-F275).
attenuate, major septa almost reaching axis; tabulae complete or incomplete, with narrow axial zone of tabellae forming impersistent axial structure, and periaxial zone of subhorizonal tabellae; dissepsiments numerous, small, horizontally based except at inner margin of dissepsimentarium; trabecular arrangement within septa not known. U.Sil., N.Am.(Can.Arctic); L.Dev.(Ems.); N.Am.(Nev.-Australia(Queens.-New S.Wales); low. M.Dev., N.Am.(NW.Terr.-Nev.-).——Fig. 172,2a,b. *R. arachne, holotype, L.Dev.(Zicht.), basin 50 ft. of Nevada Ls., Nev., Lone Mt., 18 mi. NW. of Eureka; a,b, transv., long. secs., ×2.5 (Hill, n; photographs courtesy W. A. Oliver).

**Xystrigona** Yü in Wang, Yü, & Wu, 1974, p. 33 [*Xystriphylloides (Xystriga) trizonata*; OD; †18711-18712, IGP, Nanking] [=?Marinophyllium JELL & PEDDER, 1969, which see, both lack septal trabeculae ?tufted monacanth common in half fans; dissepsimentarium floors subhorizontal, wide, dissepiments horizontally disposed, but steeply declined outward near periphery and steeply declined axially near inner margin of dissepsimentarium, so that trabeculae are arranged in broad asymmetrical half fan or fan; dissepsiments small, numerous, subglobose and with outer two or three series commonly larger and typically flattened above; tabulae incomplete, horizontal or slightly convex with few supplementary peripheral tabellae [BIRENHEIDE, 1969a, p. 41; HILL & JELL, 1970b, p. 44]. M.Dev.(Givet.-U.Dev.(Frasn.-). Eu.(?U.K.-France-Belg.-Pol.-Urals)-Asia(Kuzbas-Yunnan)-W.Australia-N.Am.(Wash.-NW.Terr.).——Fig. 174,1a,b. *X. trizonata* (Yü), holotype, L. or M.Dev., Shizhao Mbr., Yukiang F., Kwangsi, Liu Jing; a,b, transv., long. secs., ×2.5 (Wang, Yü, & Wu, 1974).

**Xystriphylloides** Yü, Liao, & DENG, 1974, p. 224 [*X. nobilis*; OD; †18705-18706, IGP, Nanking] [=?Kystiphylloides Yü, Liao, & DENG, 1974, p. 224, nom. null.]. Phaceloceroid; corallites slender, with thin wall; major septa long, subequal, commonly straight and radially arranged, in places their axial ends leaving narrow axial space that may be penetrated by straight or curved edges of one or a few of longest septa; minor septa moderately long; dissepiments globose, horizontally based except in innermost series, where they are steeply inclined; tabulae updrawn to axial edges of major septa, incompletely. M.Dev., Asia(Kwangsi-Yunnan-Szechwan).——Fig. 175,1a,b. *X. nobilis*, holotype, Kwangsi, Liu-jeng, Heng-seng; a,b, transv., long. secs., ×2 (Yü, Liao, & DENG, 1974).

Subfamily **HEXAGONARIINAE** Bulvanker, 1958


Cerioi; corallites with closely carinate, long septa fusiform in transverse section; septal trabeculae tufted monacanth common in half fans; dissepsimentarium floors with narrow to wide peripheral flat zone, declining adaxially; peripheral zone may be weakly everted in some; dissepiments subglobose, numerous; tabularial floors flat to upraised axially, tabulae incomplete, peripheral adaxially declined tabellae may occur. M.Dev.(Givet.-U.Dev.(Frasn.-).

**Hexagonaria** GÜRICH, 1896, p. 171 [*Cyathophyllum hexagonum GOLDFUSS, 1826, p. 61; SD LANG, SMITH, & THOMAS, 1940, p. 69; ?ectotype, 270ce, Goldfuss Coll.. IP, Born; by PICKETT, 1967b, p. 58] [=?Polyphyllum de FROMENTEL, 1861, p. 308 (type, Cyathophyllum hexagonum Goldfuss, 1826, SD LANG, SMITH, & THOMAS, 1940, p. 103), non Polyphyllum BLANCHARD, 1850, a coleopteran; Hexagoniella GÜRICH, 1896, p. 500, nom. null.; Hexagoniophyllum GÜRICH, 1908-1909, p. 102, nom. van.]. Cerioi, with septa fusiform in transverse section, thickest in inner parts of dissepsimentarium, radially arranged and typically closely carinate with predominantly yardarm carinae formed by lateral extension of fibers of monocanthine trabeculae; major septa attenuate in tabularium and meeting or leaving space at axis; dissepsimentarium floors horizontal or slightly declined outward near periphery and steeply declined adaxially near inner margin of dissepsimentarium, so that trabeculae are arranged in broad asymmetrical half fan or fan; dissepiments small, numerous, subglobose and with outer two or three series commonly larger and typically flattened above; tabulae incomplete, horizontal or slightly convex with few supplementary peripheral tabellae [BIRENHEIDE, 1969a, p. 41; HILL & JELL, 1970b, p. 44]. M.Dev.(Givet.-U.Dev.(Frasn.-). Eu.(?U.K.-France-Belg.-Pol.-Urals)-Asia(Kuzbas-Yunnan)-W.Australia-N.Am.(Wash.-NW.Terr.).——Fig. 176,1a,b. *H. hexagona* (GOLDFUSS), neotype, probably up. Givet. or low. Frasn. Refrath beds, Ger., Bensberg; a,b, transv., long. secs., ×1.7 (Hill & Jell, 1970b).

**Haplotheca** FRECH, 1885, p. 68 [*Madreporites filatus* von SCHLOTHEIM, 1820, p. 359; OD; †Q kat.A138, p.1530, HU, E. Berlin; lectotype by FRECH, 1885, pl. 4] [=?Mariusastrum ROKOWSKA, 1965, which see]. Cerioi; corallites with moderately thick common walls; septa moderately thick, trabeculae close and extended laterally in dissepsimentarium as yardarm carinae, and curving half-fanwise in median radial longitudinal plane of septa; major septa long, reaching or almost reaching axis; dissepsimentarium wide, dissepiments very small, globose, numerous and more or less horizontally disposed, but steeply declined adaxially near narrow tabularium; tabular floors closely spaced, commonly subhorizontal or convex [HILL & JELL, 1970b, p. 34]. U.Dev. (Frasn.-). Eu.(Ger.-UK.-Urals)-NW.Australia.——Fig. 176,3a,b. *H. filata* (von SCHLOTHEIM), lec-
Coelenterata—Anthozoa

**FIG. 176.** Disphyllidae (p. F275-F276).

1a, Hexagonaria
totype, Iberg Ls., Ger., Winterberg near Grund, Harz Mts.; a,b, transv., long. secs., X2.7 (Hill & Jell, 1970b).

Marisastrum Rozkowska, 1965, p. 262 [Cyathophyllum sedgwicki Milne-Edwards & Haime, 1851, p. 387; OD; +4851, BM(NH), London; lectotype by Soshkina, 1951, p. 96] [Haplothechia Frech, 1885, which see]. Cerioid, septa fusiform and carinate or smooth, each composed of full, more or less symmetrical trabecular fan based on slightly arched (reflexed) dissepimental floors of small dissepiments; no horseshoe dissepiments; tabular floors convex, tabulae incomplete. [See Scrutton, 1967, p. 268. Longitudinal section of lectotype required.] U.Dev.(Frasn.), Eu. (France-U.K.-?USSR-Pol.-?Asia (Kuzbas-NE, USSR).—Fig. 176,2. M. sedgwicki (Milne-Edwards & Haime), lectotype, from ?Frasn. beach pebble, U.K., Torquay; polished transv. sec., X1.7 (Scrutton, 1967).

Subfamily SPONGONARIINAE Crickmay, 1962

Marisastrum Rozkowska, 1965, p. 262 [Cyathophyllum sedgwicki Milne-Edwards & Haime, 1851, p. 387; OD; +4851, BM(NH), London; lectotype by Soshkina, 1951, p. 96] [Haplothechia Frech, 1885, which see]. Cerioid, septa fusiform and carinate or smooth, each composed of full, more or less symmetrical trabecular fan based on slightly arched (reflexed) dissepimental floors of small dissepiments; no horseshoe dissepiments; tabular floors convex, tabulae incomplete. [See Scrutton, 1967, p. 268. Longitudinal section of lectotype required.] U.Dev.(Frasn.), Eu. (France-U.K.-?USSR-Pol.-?Asia (Kuzbas-NE, USSR).—Fig. 176,2. M. sedgwicki (Milne-Edwards & Haime), lectotype, from ?Frasn. beach pebble, U.K., Torquay; polished transv. sec., X1.7 (Scrutton, 1967).

Solitary, phaceloid or cerioid; increase peripheral; septa thin, weakly to strongly carinate, carinae commonly from zigzags but in some of yardarm type; major septa extending but little into tabularium or subequal to minor septa, and with regularly or irregularly spinose axial edges; one or more series of dissepiments may be broadly and subhorizontally based, inner series smaller, more globose and adaxially declined; tabularium wide to moderately wide,
tabulae complete or incomplete, floors flat or weakly concave or convex, or when major septa are long, with axial uplifted zone. Dev.

**Spongonaria** CRICKMAY, 1962, p. 2 [*S. filicata; OD; t27074, PRI, Ithaca] [=**Spongaria** BOLTON, 1974, p. 54, *nom. null.*]. Ceriod; major and minor septa short, equal, thin, some with upturned spines projecting from axial edges; disseipimentarium rather narrow, disseipiments wide and subhorizontally based; tabulae commonly complete, floors horizontal and slightly sagging or slightly uparched. L.Dev., N.Am.(Yukon)-Asia(NE.USSR).—Fig. 177,1a,b. *S. filicata*, holotype, Yukon, 65°30'N., 131°15'W., Houston R.; ab, transv., long. secs., X2 (Hill, n).

**Breviseptophyllum** ERMAKOVA, 1960, p. 85 [*B. kochanensis; OD; † in coll. VNIGNI, Leningrad*]. Phacelocerioid; corallites thin-walled; major septa short, few projecting into tabularium, mostly withdrawn somewhat toward outer wall, thinning adaxially and becoming discontinuous as spinelike projections; minor septa shorter; tabularium wide, tabulae commonly complete, flat, may be supplemented by adaxially declined peripheral tabellae; disseipiments moderately large, in one or a few series; septa short in early stages also. M.Dev. (Eifel.), Eu.(USSR)-Asia(Kwantung).—Fig. 177, 2a,b. *B. kochanense*, holotype, Biya horizon, USSR, borehole 402, core from 3072-8 m., Kokhany, Kuibishev reg.; ab, transv., long. secs., X3 (Ermakova, 1960).

**Disphyllia** HS., 1978, p. 121 [*Disphyllum (Disphyllia) guanxianensis; OD; tScr 587, ?RIGS, ?Chongqing (Chunking); M.Dev., Jiuidianping, Guan Co., Sichuan] [=**Donia** SOSHKINA, 1951, p. 114 (type, D. russiensis, OD; †slide 59, coll. 837, PIN, Moscow), non **Donia** OUDEMANS, 1939, an arachnid]. Ceroid or subceroid; septa confined to disseipimentarium, withdrawn from periphery and axis and thickened spinelwise, or with carinae interrupted by disseipiments and represented by short septal segments or separate trabeculae based on wall or disseipiments; minor septa represented only by ridges on outer wall; tabulae complete or incomplete, flatly convex or concave, supplemented peripherally by tabellae declined adaxially; disseipiments large, in outer series either horizontally based or declined outward, reflecting everted calice [Hill & Jell, 1970b, p. 48]. M.Dev., Asia(Yunnan); M.Dev. (Givet.)-U.Dev.(Frasn.), Eu.(USSR)-Asia(Kwantung-Sichuan)-W.Australia.—Fig. 178,2. *D. russiensis* (Soshkina), holotype, Frasn., Orlov reg., Russ. Platf.; transv. secs., X4 (Soshkina, 1951).

**Tropidophyllum** PEDDER, 1971a, p. 374 [*T. hillae; OD; tF11664, UNE, Armidale*]. Solitary, trochoid to ceratoid; septa radially arranged, faintly to highly carinate; adaxially dilated and with spinose axial edges, markedly withdrawn from axis; septa contiguous in adaxial stere ozone, commonly forming narrow inner wall; trabeculae in half fans, monacanthine, with widely divergent fibers; tabulae broad, horizontal, complete or with peripheral tabellae where tabular floors are concave; disseipiments in a few or several rows, generally adaxially declined, although locally outermost may be larger.
and flat-lying and may be rhomboid. *L. Dev.*, Australia (New S. Wales-Vict.)—Fig. 178.1a-e. *T. hillae*, ?Prag., New S. Wales, Lick Hole F., Kiandra-Ravine road sec.; a-d, holotype, a, part of transv. sec., ×3, b, lower part of a, ×10, c, long. sec., ×3, d, left part of c, ×10; e, para-type, transv. sec., ×3 (Pedder, 1971a).

**Utirattia Crickmay**, 1960, p. 5 [*U. laevigata.*]
Rugosa—Stauriida—Columnariina

Fig. 179. Disphyllidae (p. F278-F279).

OD; †27026, PRI, Ithaca]. Ceroid, septa represented only by peripheral ridges so that corallites have thick, serrated common walls with rare, porelike spaces; alternate ridges (minor septa) are barely perceptible except as longitudinal dark lines in tangential sections of wall; dissepiments arranged in irregular longitudinal series; peripheral series of tabellae declined adaxially, and axial series horizontal or shallowly curved [see Jell & Hill, 1970b, p. 834; see also Oliver & Sando, 1977, p. 422]. M.Dev. (Givet.), N.Am. (NW.Terr.-Nev.)-Asia (Kweichow); U.Dev., Eu. (USSR).—Fig. 179, la-c. *U. laevigata*, holotype, Givet., Hume F., Can., Rainbow Arch, Carcajou R., NW. Terr.; a,b, transv., tang. secs., ×2, c, part of wall in b, showing, between major septal ridges, scarcely projecting minor septal ridges continuous with longitudinal dark lines in wall, ×10 (Jell & Hill, 1970b).

†Variseptophyllum Kong in Kong & Huang, 1978, p. 60 [*V. sinense*; OD; †Ger 449-451, GB, Guiyang; M.Dev., Dushan, S. Guizhou (Kweichow)]. Fasciculate, in places cerioid; major and minor septa subequal, major septa with axial edges (?spinose or amplexoid), barely projecting into wide tabularium with flat tabulae; dissepimentarium of large, globose, subhorizontally based dissepiments peripherally, inner series small, ad-
axially declined. [Diagnosis tentative; from illustrations.] M.Dev., Asia(Kweichow).

Zelolasma Pedder, 1964a, p. 364 [*Diphyllum gemmiforme Etheridge, 1902, p. 253; OD; +F5171, AM, Sydney]. Phaceloid or partly cerioid, with peripheral, parvicidal increase, in some becoming quadripartite; major and minor septa subequal, of uniserial monacanths, smooth to weakly carinate, axial ends may be spinose in wide tabularium; dissepiments globose to rhomboid, variable in size, larger ones subhorizontally based; tabular floors gently sagging or horizontal or weakly convex; tabulae complete or incomplete. L.Dev., Australia(New S.Wales)-Asia(Tadzhik.)-Eu.(Urals)-?N.Afr.(Alg.).—Fig. 180,la,b. *Z. gemmiforme (Etheridge), Cavan Bluff Ls., New S. Wales, near Taemas Bridge, N. bank of Murrumbidgee R.; a,b, transv., long. secs., X3 (Hill, n; UQF45755, UQF49834).
Family PHILLIPSASTREIDAE Hill, 1954

Solitary, fasciculate or massive; septal trabeculae rhipidacanth or tufted monacanth; septal thickening commonly greatest near or at inner boundary of dissepimentarium and coincident with pipe of horse-shoe dissepiments which may be but commonly is not separated from tabularium by one or a few series of small, subglobose, adaxially declined dissepiments; where dissepimentarium remains narrow, flat dissepiments may separate pipe from outer wall; where dissepimentarium is wide, several series of horizontally based to outwardly declined, small, subglobose dissepiments separate pipe from wall but may have one series of flat dissepiments between them and wall; tabularium bizonal or flat-lying or in concave floors and periaxial series commonly like large, subglobose dissepiments and declined adaxially. L.Dev.-U.Dev.

For taxonomic history see Schouppé, 1958, p. 141; Scrutton, 1968, p. 205; Tsiénn, 1968b, p. 595; Jell, 1969, p. 61; and Cherepnina, 1974, p. 198. Subdivision is not yet clear-cut. It may be possible to distinguish four groups: 1) a thamnasterioid subfamily, Phillipsastreinae, containing Phillipsastrea, Keriophyloides, and Bensonastreae; 2) a ceroid, astroid to thamnasterioid unnamed subfamily comprising Trapezophyllum, Stellatophyllum, Sulcorphyllum, Frechastraea, and Scruttonia; 3) the Phacelophyllinae, a group of solitary and phaceloid genera, in which a pipe of horse-shoe dissepiments is always well developed and surrounded by a single series of flat dissepiments; and 4) the Peneckielinae, phaceloid and ceroid, for Peneckielia and Sudetia. Because of the complex intergradations between pairs of members across these group lines, the family is not formally subdivided in this Treatise.
depressed domes with peripheral troughs, of tabellae. *M.Dev., Australia (New S.Wales).---Fig. 181.2a,b. *B. praetor, holotype, Timor Ls., New S. Wales, Portion 133, Parish of Lincoln, County of Brisbane; a,b, long., transv. secs., X 1.5 (Pedder, 1966; photographs courtesy A. E. Pedder).

Keriophylloides Soskina, 1951, p. 102 [*Keriophyllum astreiforme Soskina, 1936b, p. 62; OD; t-slides 134-6, coll. 2869, PIN, Moscow; lectotype by Soskina, 1951, p. 102] [?—Phillippsastrea d'Orbigny, 1849, which see; ?Bensonastraea Pedder, 1966, which see]. Astreoid or thamnasteroid; offsets marginal, not parricidal; calice with everted dissepimentarial platform, well-developed ridge over irregular zone of horseshoe dissepiments around tabularial pit; septa carinate, ?vepreculate and vesiculate, major septa somewhat withdrawn from axis; tabulae flat or slightly concave or convex, complete or with some peripheral, auxiliary tabellae. *M.Dev. (Eifel.), Eu. (N.Urals).
Fig. 182. Phillipsastreidae (p. F284).
——Fig. 181, 1a-c. *K. astreiformis* (Soshkina), holotype, R. Maly Patok; a, transv. sec., diagram, ×3.0 (Soshkina, 1936), b,c, transv., long. secs., ×1.5 (Soshkina, 1951).

**GROUP 2**

Frechastraea Scrutton, 1968, p. 231 [*Cyathophyllum pentagonum* Goldfuss, 1826, p. 60; OD; †206, Goldfuss Coll., IP, Bonn; lectotype by Pickett, 1967b, p. 80] \[Scruttonia Cherep­nina, 1974, which see]. Astreoid, in places thamnasterioid; major and minor septa uniformly thick in dissepimentarium except in narrow stere­zone defining wall to tabularium, attenuate in tabularium; dissepiments small, globose; septal trabeculae arranged in tight fan, axis commonly based on series of dissepiments adjacent to tabularium, which may in places be developed as imperistent pipe of horseshoe dissepiments; dis­sepimentarial floors almost flat, with slight ele­vation at wall surrounding tabularium; tabulae complete or incomplete. M.Dev. (Eifel.), Eu. (Vaygach I.); U.Dev. (Frasn.), Eu.(U.K.-France-Belg.-Ger.-Pol.-?S. Urals-Timan-?Spain)-Asia (Kuz­bas-NE. USSR)-N. Am. (NW. Terr.) ——Fig. 182, 2a-c. *F. pentagona* (Goldfuss), lectotype, Frasn., Belg., Namur reg.; a,b, transv., long. sec., ×4; c, another specimen, long. sec., U.K., road cutting 18 m. W. of Ramsleigh quarry entrance, near Torquay, long. sec., ×6 (a, Pickett, 1967b; b,c, Scrutton, 1968).

Scruttonia Cherep­nina, 1974, p. 202 [*Smithia bowerbanki* Milne-Edward & Haime, 1851, p. 423; OD; †original of Milne-Edward & Haime, 1853, pl. 55, fig. 2, not traced; lectotype by Soshkina, 1951, p. 89] \[Frechastraea Scrut­ton, 1968, which see]. Like Frechastraea but thamnasterioid; septa thickened almost to contigu­ity at inner boundary of dissepimentarium and with carinate trabeculae widely spaced in half fans; dissepimentarium wide with close, flat floors; an imperistent pipe of horseshoe dissepiments may develop in zone of septal thickening against tabularium; tabular floors flat or sagging, tabulae complete or incomplete. U.Dev. (Frasn.), Eu.(U.K.-Ger.-?S. Urals). ——Fig. 182, 1a,b. *S. bowerbanki* (Milne-Edward & Haime), low. Frasn., U.K., Ramsleigh Quarry, Devon; a,b, transv. (peel), long. secs., ×6.4, ×3.8 (Scrutton, 1968).

Stellatophyllum Spassky in Bulvanker et al., 1968, p. 30 [*Stellatophyllum pentagonum* Milne-Edward & Haime, 1853, pl. 55, fig. 2, not traced; lectotype by Soshkina, 1951, p. 89] \[Trapezophyllum Etheri­dige, 1899b, which see; Stellatophyllum Spassky, 1968, which see; Cystitrapezophyllum Jia in Jia et al., 1977, p. 148 (type, *Cystitrapezophyllum pentagonum* Pedder, 1970, p. 242; OD; †F9544, UNE, Armidale; L.Dev., Wee Jasper, New S. Wales)]. Cercoid, increase peripheral; common wall thin, with median dark plane; septa radially arranged, somewhat thickened in zone of horse­shoe dissepiments that divides dissepimentarium from tabularium; major septa subequal, long, may almost reach axis; several series of outwardly de­clined dissepiments are developed peripheral to pipe of horseshoes, and outermost series of dis­sepiments may be narrow and flat; tabulae incom­plete, subhorizontal, may be raised in axial zone. ?L.Dev.-M.Dev., Australia (New S.Wales)-Asia (Kwangsi). ——Fig. 182, 3a-c. *S. brownae*, Sulcor Ls., New S. Wales, near Sulcor quarry, near Attunga; a,b, holotype, transv., long. secs., ×3.8; c, topotype, long. sec., ×3.8 (Hill, n; 7246, 8152, SU, Sydney).

Trapezophyllum Etheridge, 1899b, p. 32 [*Cyathophyllum elegantulum* Dun, 1898, p. 85; OD; †1717, GSV, Melbourne] \[Stellatophyllum Pedder, 1964a, which see; Stellatophyllum Spassky, 1968, which see; Stellatophyllum Spassky et al., 1968]. \[?Cystitrapezophyllum Jia in Jia et al., 1977, p. 148 (type, *Cystitrapezophyllum poculatum* Jia et al., 1977, p. 148 (type, *Cystitrapezophyllum poculatum* Jia et al., 1977, p. 148); OD; †IV37027, HPRIGS, ?Wuhan; M.Dev., Pingnan, Guangxi (Kwangsi); septa discontinuous and dissepiments somewhat globose in outer dis­sepimentarium]. Ceroid; corallites with outer series of flat dissepiments, an inner pipe of small horseshoe dissepiments, and an axial series of wide, complete, slightly concave tabulae; major and minor septa subequal, seldom extending be­yond pipe of horseshoe dissepiments. [In some the flat dissepiments are replaced by a few series of abaxially declined or subhorizontally based globose dissepiments; Hill, 1939a, p. 234.] L. Dev. (?Ems.), Australia (Vict.); M.Dev. (?Couwin.), Australia (New S.Wales)-N. Am. (?Ems.); Eu.(Ger.)-Asia (Kwangsi). ——Fig. 183, 2a-c. *T. elegantulum* (Dun), topotype, ?Ems., Vict., Is. quarry, Loyola, near Mansfield; a,b, transv., long. secs., ×2.7, c, long. sec. showing series of peripheral globose dissepiments in places, flat peripheral dissep­iments in others, ×2.7 (Hill, n; UQF31114, 51725).

**GROUP 3**

Farabophyllum L'vruvevich, 1971b, p. 110 [*F.

Oberkunzendorf), Pol.; =Lithodendron caespitosum GOLDFUSS, 1826, *fide* LANG, SMITH, & THOMAS, 1940, p. 59, but see ROZKOWSKA, 1960, p. 29, and PICKETT, 1967b, p. 31; *Senceliastraea COTTON, 1973, p. 187, *nom. null.*. Dendroid or phaceloid; corallites diverging after increase, may be united by dissepimental tissue in axes of branches; septa fusiform in transverse section, but not carinate; dissepimentarium regular, biserial, with inner row of horseshoe dissepiments arranged in pipe about tabularium, and an outer row of flat dissepiments; in places additional subglobose dissepiments may develop declined inward and outward from pipe; tabulae complete or incomplete, with adaxially declined peripheral tabellae [HILL & JELL, 1970b, p. 27]. *P. dobuchnenensis; OD; *original of ROZKOWSKA figs. 2-4, presumably PZI, Poznan. Solitary, small; lumen almost entirely filled with dilated septa pinnately arranged with cardinal septum greatly reduced in fossula; counter septum elongate; trabeculae ?rhipidacanths, arranged in symmetrical fans in inner dissepimentarium, axis of pipe over horseshoe dissepiments that are almost entirely obscured by septal thickening; some flat dissepiments may be visible at periphery; tabulae rare, complete or incomplete in horizontal or concave floors. *P. dobuchnenensis; OD; *original of ROZKOWSKA figs. 2-4, presumably PZI, Poznan. Solitary, small; lumen almost entirely filled with dilated septa pinnately arranged with cardinal septum greatly reduced in fossula; counter septum elongate; trabeculae ?rhipidacanths, arranged in symmetrical fans in inner dissepimentarium, axis of pipe over horseshoe dissepiments that are almost entirely obscured by septal thickening; some flat dissepiments may be visible at periphery; tabulae rare, complete or incomplete in horizontal or concave floors. 

**Protomageea ROZKOWSKA, 1956, p. 280** [*P. dobuchnenensis; OD; *original of ROZKOWSKA figs. 2-4, presumably PZI, Poznan. Solitary, small; lumen almost entirely filled with dilated septa pinnately arranged with cardinal septum greatly reduced in fossula; counter septum elongate; trabeculae ?rhipidacanths, arranged in symmetrical fans in inner dissepimentarium, axis of pipe over horseshoe dissepiments that are almost entirely obscured by septal thickening; some flat dissepiments may be visible at periphery; tabulae rare, complete or incomplete in horizontal or concave floors. *P. dobuchnenensis; OD; *original of ROZKOWSKA figs. 2-4, presumably PZI, Poznan. Solitary, small; lumen almost entirely filled with dilated septa pinnately arranged with cardinal septum greatly reduced in fossula; counter septum elongate; trabeculae ?rhipidacanths, arranged in symmetrical fans in inner dissepimentarium, axis of pipe over horseshoe dissepiments that are almost entirely obscured by septal thickening; some flat dissepiments may be visible at periphery; tabulae rare, complete or incomplete in horizontal or concave floors. 

**Pterorrhiza EHRENBERG, 1834, p. 312** [*Cyathophyllum marginatum GOLDFUSS, 1826, p. 55; SD LANG, SMITH, & THOMAS, 1940, p. 111; *P. rectum, GOLDFUSS Coll., IP, Bonn; lectotype by BIRENHEIDE, 1969a, p. 42; =Macgeea WEBSTER, 1889, p. 710 (type, *Pachyphyllum solitarium HALL & WHITFIELD, 1873, p. 232, SD FENTON & FENTON, 1924, p. 54; *NYSM, Albany, missing *fide* BIRENHEIDE, 1969b, p. 121; Frasn., Rockford, Iowa); *Pexiphyllum Walther, 1928, p. 128 (type, *P. rectum, SD LANG, SMITH, & THOMAS, 1940, p. 98; *slides 7007-7071, WEDEKIND Coll., SM, Frankfurt, Massenkalk, Deilinghofen and Warrenbeck, Ger., *fide* SCHOPPFE, 1958, p. 224). Solitary or with few offsets, epитеcha not extending quite to rim of calice so that peripheral edges of septa are exposed distally; septa somewhat dilated in moderately wide dissepimentarium, which includes one series of horseshoe dissepiments and one peripheral series of flat dissepiments.
ments, and in places subglobose plates declined from either or both sides of pipe; trabeculae ?rhipidacanthine, arranged in fans over horseshoe dissepiments; tabulæ horizontal or concave, supplemented peripherally by inclined tabellæ [Rozkowski, 1957, p. 102; Pickett, 1967b, p. 28;
FIG. 186. Phillipsastreidae (p. F289).

BIRENHEIDE, 1969a, p. 42; BRICE & ROHART, 1974, p. 47]. M.Dev., Eu.(U.K.-Belg.-Ger.-Pol.)-Asia (Armenia-Afghan.-?Kwangsi); U.Dev. (Frasn.), Eu.(Ger.-France-Pol.-Urals-Timan)-Asia (Armenia-Pak.)-N. Afr.(Alg.)-N. Am.(Iowa-NW.Terr.).—Fig. 185,4a-c. *P. marginata (Goldfuss), ?Frasn., Ger., Bensberg; a,b, syntype, side and calical views, X1.0 (Pickett, 1967b); c, lectotype, transv. sec.
Rugosa—Stau riid a—Cyathophyllina

**GROUP 4**

Peneckiella Soskina, 1939, p. 23 ["Diphyphyllum minus" Roemer, 1855, p. 29; OD; +117, BA, Clausthal-Zellerfeld] (=Peneckiella Stumm, 1949, p. 37, nom. null.; see also under Phacellophyllum Gülich, 1909; ?Sudetia Rozkowska, 1960, which see]. Phaceloid; septa noncarinate but thickened especially at inner edge of dissepimentarium, which is narrow and commonly of one series of globose plates flattened above, each with its inner edge curved down in three-fourths hemisphere to meet plate next below and its outer edge abutting wall at level higher than base of inner edge (peneckiellid) [these have been interpreted by Flügel, 1956b, p. 356, and Schoppfe, 1958, p. 229, as horsehoe plates with their outer ends amalgamate with wall]; rarely one or a few horsehose dissepiments are found; septal trabecular fans may occur with zone of divergence at axis of curvature of upper surface of dissepiments; trabeculae rhipidactanths; tabulae commonly in one series and complete, may be flat-topped domes; peripheral tabellae declined adaxially may occur [Hill & Jell, 1970b, p. 30; Scrutton, 1968, p. 271]. ?L.Dev.(Ems.), Australia (New S.Wales); ?M.Dev.(Givet.), W.Australia-N.Am.(Wash.); U.Dev.(Fam.), Eu.(Ger.-U.K.-Pol.)-W. Australia.

—Fig. 185, a,b. *P. minor* (Roemer), holotype, Frasn., Iberg LS., Ger., Winterburg near Bad Grund; a,b, oblique transv., long. secs., X3, X6 (Scrutton, 1968).

Sudetia Rozkowska, 1960, p. 35 ["S. lateceptata"; OD; +Rozkowska figs. 30-33, PZI, Poznan] (=Peneckjella Soskina, 1939, which see, fide Scrutton, 1968, p. 273]. Dendroid; increase lateral, from connecting process, offset thamno-phyllum or aseptate; corallites with slender stereozone at boundary between tabularium and dissepimentarium, major septa short, scarcely extending beyond stereozone; minor septa shorter, not always projecting beyond wall; one series of penekkellid dissepiments; trabecular fans asymmetrical, with axis of divergence near wall, resting on distal end of penekkellid dissepiment; trabeculae thick; tabulae mostly complete, concave or horizontal. U.Dev.(Fam.), Eu.(Pol.-Urah).

—Fig. 186, a-d. *S. lateceptata*, holotype, Pol., Mokrzeszow (formerly Oberkunzendorf); a, transv. secs., X7.4; b-d, long. secs., X5.0, X5.2, X3.2 (Rozkowska, 1960).

**Suborder CYATHOPHYLLINA**

Nicholson, 1889

Solitary or compound Stauriida with dissepimentarium of small, normal dissepi­ments; in late stages septa attenuate; septa commonly long, carinate or otherwise complexly structured in dissepimentarium; major septa deflected to form aulos in Eridophyllinae; tabular floors variable; flat or low domes that may be axially depressed, or slightly arched axially and bent down at margins; tabulae complete or incomplete.

_Sil.-Dev._; _L.Carb._

**Family ERIDOPHYLLIDAE**
de Fromentel, 1861

[nom. correct. STUMM, 1949, p. 32, in translated form as Eridophyllinae de Fromentel, 1861, p. 301; _pro_ Eridophyllidae de Fromentel, 1861, p. 301] [≡Craspedophyllidae Dybowski, 1873c, p. 339; Crepidophyllidae _YU_, 1934, p. 88, _as_ Crepidophyllidae GRABAU MS]

?Solitary, fasciculate or massive; septa attenuate, of fine, close monacanthine trabeculae and with zigzag to yardarm carinae parallel to curvature of trabeculae; major septa deflected to form aulos in Eridophyllinae and long or short in others; dissepimentarium of one to several rows of globose normal dissepi­ments; tabular floors variable, commonly flat or slightly arched axially and downbent at margins of tabularium; tabulae complete or incomplete [OLIVER, 1974, p. 166]. _U.Sil._- _M.Dev._

**Subfamily ERIDOPHYLLINAE** de Fromentel, 1861


?Solitary, fasciculate or alternately phace10id and cerioid eridophyllids; major septa deflected in tabularium to form perfect or imperfect aulos; septa thin and strongly carinate and major septa may or may not enter aulos [OLIVER, 1974, p. 170]. _U.Sil._- _M.Dev._

**Eridophyllum** MILNE-EDWARDS & HAME, 1850, p. lxxi [*E. seriale_; OD; _in_ DE VERNEUIL Coll., EM, Paris; lectotype by SMITH, 1933, p. 515] [≡Craspedophyllus Dybowski, 1873c, p. 339; generic name and diagnosis only; 1873b, p. 155 (type, _C. americanum_, M; _not_ traced; M.Dev., Columbus, Ohio); Crepidophyllum NICHOLSON & THOMSON, 1876, p. 149 (type, _Diphyphyllum Archiacci BILLINGS_, 1860, p. 260, _SD MILLER_, 1889-1897, p. 190; _not_ found in GSC, Ottawa; Hamilton Sh., Bosanquet, Ont.); Schistotoechiolasma STEWART, 1938, p. 45 (type, _S. typicalis_, OD; †2172, OSU, Columbus; M.Dev., Columbus Ls., Columbus, Ohio); Schistotoechiolasma LANG, SMITH, & THOMAS, 1940, p. 117, _nom. van._]. Phace10id, with connecting processes; septa but slightly deflected, commonly carinate with yardarm carinae; marginarium a wide dissepimentarium with small, mostly globose, equal plates in several series; a thin aulos, breached at the cardinal fossula in some, separating an axial series of horizontal tabellae from a periaxial series of tabellae declined outward [see OLIVER, 1976a, p. 96]. _M.Dev._, N. Am. (Ohio-Ind.-Mich.-Ont.)-N. Afr. (Moric.).—Fig. 187,2a,b. *E. seriale_, Columbus Ls., Ohio, Sandusky; _a_, _b_, _transv._, long. secs., _X2_ (Stewart, 1938).

**Capnophyllum** SUTHERLAND, 1965, p. 28 [*C. hed1undi_; OD; †5474, _OU_, _Norman_]. Solitary, or with imper­istent peripheral increase; major septa subequal, withdrawn somewhat from axis, and in places with their axial ends united to form aulos that may be imper­istent in late stages; minor septa long; both orders carinate, carinae in half fans, from zigzag to yardarm in type; cardinal fossula not apparent; dissepimentarium wide, of small, globose and subglobose dissepi­ments; tabular floors flat; periaxial tabellae outside aulos when present are mostly declined like dissepi­ments toward aulos. _U.Sil._ (Ludlov.), _N.Am._ (Okla._)._—Fig. 188,2a,b. *C. hed1undi_, holotype, Henryhouse F., Lawrence uplift, Okla.; _a_, _b_, _transv._, long. secs., _X4_ (Sutherland, 1965).

**Grewgiphyllum** OLIVER, 1974, p. 170 [*Heliophyllum colligatum BILLINGS_, 1859b, p. 126; OD; †31158, GSC, Ottawa; lectotype by OLIVER, 1974, p. 172] [≡Craspedophyllus Dybowski, 1873c, p. 339, _see_ _Eridophyllum_]. Like _Eridophyllum_ but alternately phace10id and cerioid and with imperfect aulos commonly penetrated by major septa [see OLIVER, 1976a, p. 108]. _L.Dev._ (Em1._)- _M.Dev._ (Eifel.), _N.Am._ (Ont.).—Fig. 188,1a,b. *G. colligatum_ (BILLINGS), lectotype, L.Dev., Bois Blanc F., Ont., Walpole; _a_, _b_, _transv._, long. secs., _X1.0_, _X2.5_ (Oliver, 1974; photographs courtesy W. A. Oliver).

**Tipeophyllum** HILL, 1956a, p. 9 [*Eridophyllum bartrumi ALLAN, 1935, p. 4; OD; _in_ VU coll., Auckland, but part _R25545, BM(NH), London_.]. Phace10id or partly cerioid; corallites with wide dissepimentarium and carinate septa, major septa withdrawn from axis but with their axial edges irregularly carinate, spinose, bent so as to divide tabularium into two regions but not to form persistent aulos; septal trabeculae broad, simple monacanth, carinae of yardarm type or from zigzags; axial tabellae subhorizontal and periaxial tabellae declined adaxially [see also PEDDER, JACKSON, & PHILIP, 1970, p. 230]. _L.Dev._, _N.Z.-Australia_ (New S.Wales)._—Fig. 187,1a,b. *T. bartrumi_ (ALLAN), Reefton Ls., _N.Z._, road cutting, Reefton-Springs Junction road, 3.5 mi. S. of Reefton; _a_, _b_, _transv._, long. secs., _X2_ (Hill, n; UQF 54940).
Subfamily CYLINDROPHYLLINAE Oliver, 1974

[Cylindrophyllinae Oliver, 1974, p. 166] [==Billingsiastraeinae Jell, 1969, p. 68, nom. inval., being based on Billingsiastrae Grabau, 1917b, p. 957, invalid name, fide Oliver, 1974, p. 167, based on probably Silurian coral unrelated to forms on which concept Billingsiastrae auct. has been based]

Eridophyllids lacking aulos. L.Dev.-M. Dev.

Cylindrophyllum Simpson, 1900, p. 217, non Cylindrophyllum Yabe & Hayasaka, 1915, p. 90, a Devonian rugose coral renamed Fletcherina Lang, Smith, & Thomas, 1955, p. 261 [*C. elongatum; OD; †246, NYSM, Albany] [?==Cylindrohelium Grabau, 1910, p. 102 (type, C. profundum, OD; †13085, UMMP, Ann Arbor, lectotype by Oliver, 1976a, p. 68; L.Dev., Lucas Dol., Silica Quarry,
near Sylvania, Ohio; calical molds, unrecognizable). Phaceloid; cylindrical corallites connected by slender lateral processes; major and minor septa attenuate, with weak or strong development of zigzag or subyardarm carinae; major septa not extending to axis; minor septa not long; tabulae commonly complete and subhorizontal, or concave with supplementary tabellae peripherally; dissepi­ments in few series, small, subglobose [see OLIVER, 1976a, p. 68]. L.Dev.(Ems.)-M.Dev.(Givet.), N. Am.(N.Y.-Ont.-Ind.-Ohio-Ky.); M.Dev., S.Am. (Venez.)-?Asia(Viet Nam).—Fig. 189,2a,b. *C.
**Acinophyllum** McLAREN, 1959, p. 22 [*Eridophyllum simcoense* BILLINGS, 1859b, p. 132; **=**; theotype, 31144, GSC, Ottawa; by OLIVER, 1976a, p. 57]. Dendroid or phaceloid with lateral increase; corallites slender, cylindrical, rarely connected by tubular lateral projections from corallite walls; septa weakly dilated and carinate peripherally, commonly with zigzag carinae; septal trabeculae very fine, arranged in half fans; major septa short or long, never extending to axis; minor septa short; tabulatum wide, with well-spaced, more or less horizontal tabulae, commonly complete but sometimes incomplete; dissepimentarium narrow, formed of one or two, rarely more, rows of small, globose dissepiments. [Compare with *Planetophyllum* CRICKMAY, 1960, Columnariina, Columnariidae; see also EASTON & OLIVER, 1973, p. 916]. L.Dev.(Ems.)-M.Dev.(Eifel.), N.Am. (Ont.-N. Y.-Ohio-Mich.-Va.-Ky.-Que.)-S. Am. (Venez.).—Fig. 189,1a,b. *A. simcoense* (BILLINGS), Ems., Bois Blanc F., Ont., Woodstock; a,b, transv., long. secs., ×0.8 (McLaren, 1959).
Asterobilingsia Oliver, 1974, p. 167 [*A. magdaisa; OD; \textit{f}163419, USNM, Washington] \(\equiv\) Asterocyclus Vanuxem, 1842, p. 136 (type, \textit{A. confluens}, M; host or unrecognizable; M.Dev., Onondaga Ls., quarry S. of Chittenango near Perryville, N.Y.; probably based on specimen of \textit{Asterobilingsia magdaisa Oliver}, 1974; Oliver, 1974, p. 168); Billingsiastreae Grabau, 1971b, p. 957 (type, Phillipsiastrea verneulli Milne-Edwards \& Haime, 1851, p. 447, M; figured syntype not found in de Verneuil Coll., EM, Paris; possible syntype in that collection is \textit{Arachnophyllima} probably from the Niag. Hopkinton Dol., \textit{vide Oliver}, 1974, p. 167), Oliver considers generic name unusable in its conventional aspect. Astroid to thamnasterioid; calice with axial pit and broad horizontal or reflexed peripheral platform, commonly with raised zone around pit; septa attenuate, lightly to heavily carinate with zigzag to subyardarm carinae; major septa long, almost attaining axis; minor septa moderately long; dissepimentarium of globose dissepiments horizontally arranged except near tabularia; tabularium narrow, tabular floors closely spaced, more or less horizontal, may have raised axial zone, tabulae complete or incomplete [see Oliver, 1976a, p. 88]. L.Dev.(Ems.)-M.Dev.(Givet.), N.Am.(N.Y.-Ont.-Que.-Mich.).—Fig. 189, 3a,b. *A. magdaisa, paratype, L.Dev., Bois Blanc F., Hagersville, Ont.; transv., long. secs., \(\times3.8\) (Oliver, 1974; photographs courtesy W. A. Oliver, USNM163420).

Prismatophyllum Simpson, 1900, p. 218 [*P. rugosum; OD (\(\equiv\)P. prisma Lang \& Smith, 1935, p. 558, obj.—Ed.); \textit{f}c-142, de Verneuil Coll., EM, Paris; lectotype by Lang \& Smith, 1935, p. 558, lectotype slides R31370, 31371, BM(NH), London]. Cerioid, corallites thin-walled, with long uniformly attenuate septa typically with long, thin, zigzag to subyardarm, widely spaced carinae, weakly to strongly developed, mainly in dissepimentarium; major septa may reach axis or leave narrow axial space, axial ends may coil weakly or not; dissepiments numerous, small, subglobose; tabulae incomplete, more or less horizontal, may have narrow periaxial series of closer, concave tabellae [Hill \& Jell, 1970b, p. 45; Oliver, 1976a, p. 77]. L.Dev.(Ems.)-M.Dev.(Coulon.—Givet.), N.Am.(Ind.-Ky.-Ohio).—Fig. 190, 1a,b. *P. prisma, BM(NH), London, slides of lectotype, M.Dev.(Eifel.), Ind., Charlestown Landing; \(\alpha\beta\), transv., long. secs., \(\times3.4\) (Hill, n).

Family ZAPHRENTIDAE
Milne-Edwards \& Haime, 1850


Solitary, fasciculate or massive; bilateral symmetry distinct; septa long, dilated in

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Fig. 190. Eridophyllidae (p. F294).
early stages, attenuate and zigzag later with, in dissepimentarium, distant carinae yardarm in type or from zigzags; cardinal septum and in some counter septum also may be shorter, axial ends of major septa may be weakly convolute or irregularly curving;
minor septa complete; dissepiments when present globose, small lateral dissepiments also in some; tabular floors commonly low domes; tabulae incomplete, axial tabella may be flat or arranged in concave floors [see Oliver, 1974, p. 171]. L.Dev.-M.Dev.

Zaphrentis Rafinesque & Clifford, 1820, p. 234

[*Z. phrygia; SD Hall & Simpson, 1887, p. xi; type, 5251, UMPM, Ann Arbor; by Stumm, 1965, p. 34; hollow and rather coarsely silicified, section of calice clearly shows both carinae and dissepiments, fide Oliver, 1976, written commun.]

Zaphrentis Hall, 1882, p. 46, t11847, WM, L.Dev.-M.Dev.

opulens, also in some; tabular floors commonly low

Zaphrentis minor septa complete; dissepiments when [see Oliver, 1974, p. 171].

Od; t?13081, 14051, UMMP, Ann Arbor, by STUMM, 1949, p. 12; M.Dev., Detroit R. Ls., Anderdon Mbr., Anderdon Quarry, near Amherstberg, Ont., calical mold in dolomite);

?Heliophrentis Grabau, 1910, p. 95 (type, H. calcicoides; OD; t13123, UMPM, Ann Arbor, lectotype by STUMM, 1949, p. 12; M.Dev., Detroit R. Ls., Anderdon Mbr., Anderdon Quarry, near Amherstberg, Ont., calical mold in dolomite);

?Heliophrentis Grabau, 1910, p. 98 (type, H. alternatum; OD; t13081, 14051, UMPM, Ann Arbor; from same loc. near Amherstberg as Helenterophyllum, also calical molds in dolomite), see STUMM, 1949, p. 12; Fajretinis Cotton, 1973, p. 82, nom. null.]. Solitary, small; fossula long and narrow, on ?convex side; major septa long, pinnate toward fossula and slightly withdrawn from axis, cardinal and counter septa short in late stages; minor septa very short to short; septa with denticate distal edges; dissepiments absent or present in one or two series of small globose plates in distal parts of steeply sloping calical wall, where also yardarm carinae may be present [sensu Oliver, 1960b, p. 17]; tabulae incomplete, tabular floors in axial parts horizontal or distally arched, and peripheral parts depressed [see Oliver, 1960b, p. 17; 1976a, p. 114]. L.Dev.-M.Dev.(Eifel.).

N. Am. (Ind.-Ky.-Ont.),—Fig. 191,4a-c. *Z. phrygia, topotypes, M.Dev., above coral zone, Jeffersonville Ls., Falls of the Ohio; a, transv. sec., ×2.7; b,c, another specimen, long. sec., transv. sec. distal part of calice, ×2.7 (Hill, n; photographs courtesy W. A. Oliver).

Aemulophyllum Oliver, 1958, p. 822, as subgenus of Metriophyllum Milne-Edwards & Haine, 1850, p. lxix [*Heliophyllum exiguum Billings, 1860, p. 261; OD; t3424g, GSC, Ottawa] [=Aemulophyllum Stumm, 1965, p. 23, nom. null.]. Solitary, flattened on lower part of convex, cardinal side; major septa extending to axis where they join and form dense axial structure; minor septa short; cardinal fossula deep, parallel-sided, invading axial structure, with long cardinal septum shortening in calice; marginarium wide, a peripheral stereozoone in which carinate major and minor septa are thickened to contiguity, dissepiments absent; tabulae rising toward axis in early stages. L.Dev.(Eifel.).

Aemulophyllum Hall, 1882, p. 46, t11847, WM, Chicago, fide Stumm, 1965, p. 38, 118, 124, above coral zone, Jeffersonville Ls., Falls of the Ohio); Heliogonium Stumm, 1949, p. 21 (type, Heliogonium confluens Hall, 1876, pl. 26, figs. 3, 4; OD; t14975,1, ANMH, New York; Hamilton Sh., Genesee Valley, N.Y., which may or may not be conspecific, according to Fenton & Fenton, 1938, p. 222, or congeneric with 18974, ?NYSM, Albany, valid lectotype of H. confluens Hall, by Wells, 1937, p. 10, from Ludlowville F., York, N.Y.). Solitary or weakly fasciculate ?(and astreoid); corallites subcylindrical to trochoid, fossula without distinct tabular depression though cardinal septum may be reduced, and in some counter septum may be short also; in early stages septa may be dilated and in lateral contact; in later stages septa attenuate from periphery inward and attenuate portions in wide dissepimentarium are carinate with widely spaced, mainly yardarm carinae; major septa may extend almost to or to axis and may develop slight axial convolution or less regular flexing; minor septa long, complete; tabularium wide, with horizontal, weakly domed or concave tabular floors, tabulae complete or

---Fig. 191,3a-d. *A. exiguum (Billings); a,b, paratype, Onondaga Ls., Falls of the Ohio; c, another specimen, near Louisville, Ky., transv. sec. showing thickened septa carinate in marginarium, ×3.4; d, lower left portion of c, ×16.8 (Oliver, 1958; photographs courtesy W. A. Oliver).

Cyathocylindrium Oliver, 1974, p. 172 [*C. opulent; OD; t172197, USNM, Washington]. Fasciculate; septa numerous, biradially or bilaterally arranged, long or variously withdrawn from axis, attenuate and weakly to strongly carinate, mainly zigzag carinae, some yardarm; cardinal and counter septa commonly shorter than other major septa; dissepimentarium wide, dissepiments numerous, small, globose to subobvoid; tabulae incomplete, tabular floors arched, arch may be depressed medially [see Oliver, 1976a, p. 117]. L.Dev.-M.Dev. (Eifel.).

N. Am. (N.Y.-Ont.-Ky.-N.Y.).—Fig. 191,2a,b. *C. opulent, holotype, M.Dev., Onondaga Ls., Edgewall Ls., N.Y., Thompson's Lake; a, transv., long. secs., ×1.7 (Oliver, 1974; photographs courtesy W. A. Oliver).

Heliophyllum Hall in Dana, 1846b, p. 356, as subgenus of Cyathophyllum [*Cyathophyllum helianthoides Goldfuss, 1826, p. 65, sensu Hall, 1843, p. 209, fig. 4; M; Hall's specimen not traced; =Heliophyllum halli Milne-Edwards & Haine, 1850, p. lxix, obj., unfigured specimen of Milne-Edwards & Haine, 289a, MN, Paris, Dev., Falls of the Ohio) [=Heliophylloides Stumm, 1949, p. 18 (type, Cyathophyllum brevicorne Davis, 1887, pl. 79, fig. 17, OD; t7996, MCZ, Cambridge, SD Stumm, 1949, p. 18; M.Dev.; Jeffersonville Ls., Falls of the Ohio; =Heliophyllum venatum Hall, 1882, p. 46, t11847, WM, Chicago, fide Stumm, 1965, p. 38, 118, 124, above coral zone, Jeffersonville Ls., Falls of the Ohio); Heliogonium Stumm, 1949, p. 21 (type, Heliogonium confluens Hall, 1876, pl. 26, figs. 3, 4; OD; t14975,1, ANMH, New York; Hamilton Sh., Genesee Valley, N.Y., which may or may not be conspecific, according to Fenton & Fenton, 1938, p. 222, or congeneric with 18974, ?NYSM, Albany, valid lectotype of H. confluens Hall, by Wells, 1937, p. 10, from Ludlowville F., York, N.Y.).] Solitary or weakly fasciculate ?(and astreoid); corallites subcylindrical to trochoid, fossula without distinct tabular depression though cardinal septum may be reduced, and in some counter septum may be short also; in early stages septa may be dilated and in lateral contact; in later stages septa attenuate from periphery inward and attenuate portions in wide dissepimentarium are carinate with widely spaced, mainly yardarm carinae; major septa may extend almost to or to axis and may develop slight axial convolution or less regular flexing; minor septa long, complete; tabularium wide, with horizontal, weakly domed or concave tabular floors, tabulae complete or
commonly incomplete; dissepiments numerous, small, globose to subglobose [see Smith, 1945, p. 25; Oliver, 1974, p. 174; 1976a, p. 123]. ?L. Dev. (?Siegen.), Australia (Vic.); L. Dev. (Emtr.), E. N. Am., N. Afr. (Alg.); M. Dev. (Eifel.), E. N. Am., S. Am. (Venez.) - N. Afr. (Mauret.) - Eu. (Spain-?Ger.); M. Dev. (Givet.), E. N. Am., N. Afr. (Moroc.-Spanish Sahara) - Eu. (Spain).—Fig. 192, la-e. *H. hallii; a-c, Milne-Edwards & Haime, 1851, figured specimen, M. Dev. (Eifel.), Falls of the Ohio, a, ext. view, ×1.0, b, long. sec., ×1.5, c, calical platform showing septa and carinae, enl. (Milne-Edwards & Haime, 1851); d-e, Hall’s figured specimen, Hamilton Gr., W. N. Y., long., transv. secs., ×1.0 (Hall, 1876).

?Phymatophyllum Stumm, 1965, p. 41 [*Chono­phylilum nanum Davis, 1887, pl. 80, figs. 11-13; OD; 18179, MCZ, Cambridge; lectotype by Stumm, 1965, p. 41] [?=?Bethanyphylilum Stumm, 1949, Bethanyphylilidae]. Solitary, cerato­tid or trochoid; septa radially arranged, slightly dilated peripherally and extending to axis; sides of septa with closely set ?tubercles with random orientation; minor septa long; tabulae complete or incomplete; dissepiments large, numerous. M. Dev., N. Am. (Ky.-Ind.).—Fig. 191, la-b. *P. nanum (Davis), lectotype, Beechwood Ls., Ind., 2.5 mi. W. of Charlestown; a-b, transv., long. secs., ×2.7 (Hall, n; photographs courtesy W. A. Oliver).

Family CYATHOPHYLLIDAE

Dana, 1846

[Cyathophyllidae Dana, 1846b, p. 115] [?={Mictophyllidae Hill, 1940b, p. 264; ?Stericophyllidae Pedder, 1965a, p. 209]}

Solitary, fasciculate or massive; with thin wall; septa numerous, thin or moderately thick and in many with structural modifications, in many with zigzag carinae; thickening greatest in early stages or lacking; major septa in mature stages reaching axis or leaving axial space, their axial ends may be weakly convolute or flexed; minor septa complete and little shorter than major; cardinal septum shortened, cardinal fossula evident in some; dissepimentarium with few to many series of small dissepiments, sparse lonsdaleoid dissepiments may occur; tabularium moderately wide to wide and predominantly of closely spaced tabulae or tabellae, tabularial floors commonly domed but may be axially depressed or, when septa are withdrawn, flat [Birenheide, 1963a, p. 367; Jell & Hill, 1969, p. 3]. Dev.

Cyathophyllum Goldfuss, 1826, p. 51 [*C. dian­thus; SD Dana, 1846a, p. 183; ?neotype 12239, SM, Frankfurt; by Birenheide, 1963a, p. 377]

Fig. 192. Zaphrentidae (p. F296-F297).

Cyathophyllum

Fig. 193. Cyathophyllidae (p. F297-F298).

[? = Orthocysthus Merriam, 1973b, which see]. Solitary, fasciculate or massive, mature corallites large; septa numerous, long, thin and variously withdrawn from axis, smooth or carinate, more or less fringed, carinae short and commonly alternate; fossula inconspicuous, cardinal septum commonly shorter than other major septa; tabularial floors flat or sagging; dissepimentarium wide, dissepiments numerous, globose and of moderate size [Birenheide, 1963a, p. 369; Jell & Hill, 1969, p. 4]. ?L.Dev., N.Am.(Nev.); M.Dev., Eu.(Ger.-Czech.); Asia (Salair-Dzhung.-S.China); ?Australia (Queensl.).—Fig. 193, a,b. *C. dianthus, neotype, Givet., Loogh Beds, Ger., Hillesheim Basin; a,b, transv., long. secs. ×1.5 (Birenheide, 1963a).

?Acanthophyllia Guo, 1976, p. 94 [*A. delerensis; OD: ?Ru4062, IGMR, Shenyang; M.Dev., Eifel., Inner Mongolia]. Solitary; septa long, may have lateral dissepiments in peripheral regions; minor septa may be constricting; axial ends of major septa turned aside to outline vaguely an axial depression in the tabular floors; tabulae incomplete, dissepiments small, globose, numerous. [Diagnosis tentative, from illustrations.] M.Dev.(Eifel.), Asia (Inner Mongolia).

?Commutatophyllum Kaplan, 1971a, p. 91 [*C. cincinnati; OD: ?1, coll. 9805, TsGM, Leningrad]. Solitary; septa numerous, major septa long, corrugated, curved and weakly convolute in axial zone, where some may join; fossula marked by shortened cardinal septum; septal trabeculae thin, curved in fans; septa carinate in dissepimentarium, thickened in tabularium, especially in cardinal quadrants; minor septa may be constricting; tabular floors shallowly convex, of numerous tabellae; dissepiments small, numerous, arranged concentrically; in early stages septa strongly thickened. U.Dev.(Famenn.), Asia (Kazakh.).—Fig. 194, 2a,b. *C. cincinnati, holotype, C. suleri beds, N. Cis-Balkhash; a,b, transv., long. secs., ×1.5 (Kaplan, 1971a).

Glossophyllum Wedekind, 1924, p. 76 [*G. dohmi; SD Lang, Smith, & Thomas, 1940, p. 63; ?2322, Wedekind Coll., SM, Frankfurt; lectotype by Birenheide, 1969a, p. 40, fn. ?= Cyathophyllum ceratites Goldfuss, 1826, p. 57, ?196a, in Goldfuss Coll., IP, Bonn, lectotype by Birenheide, 1969a, p. 39] [? = Ceratinella Soshkina, 1941, p. 36, fig. 22 (no type species designated, genus compared with another, one species only, C. soetencium (Schlüter), illustrated: *Campophyllum soetencium Schützer, 1889, p. 297; M, syntypes 173, Schützer Coll., IP, Bonn, ?= Cyathophyllum ceratites Goldfuss, 1826; Soshkina's illustrated specimen, slides 373-379, in coll. PIN, Moscow, is from Givetian of Pasha works, C. Urals), non Ceratinella Emerton, 1882, an arachnid; ?Manstypyllum Fontaine, 1961, which see]. Solitary, septa long, noncarinate, withdrawn from axis, cardinal septum short, in fossula; minor septa long; dissepiments small, subglobose; tabulae incomplete, an axial series of grouped, broad, subhorizontal tabellae and a periaxial series of smaller plates declined adaxially; septa somewhat thickened in tabularium in early stages. [Septal characters from lectotype; others based on C. ceratites Goldfuss, 1826; see Birenheide, 1969a, p. 40.] M.Dev., Eu.(Ger.-Urals).—Fig. 195, 2a. *G. dohmi, lectotype, transv. sec., ×1.5 (Wedekind, 1924).—Fig. 195, 2b-d. ?G. ceratites (Goldfuss), lectotype, M.Dev., Eifel; b,c, transv., d, long. secs., ×2.0 (Birenheide, 1969a).
Fig. 194. Cyathophyllidae (p. F298, F304).
Fig. 195. Cyathophyllidae (p. F298-F302).
Fig. 196. Cyathophyllidae (p. F302-F305).
Hetecophaulactis Yü in WANG, Yü, & WU, 1974, p. 30 [*H. semicrassa; OD; †18687-9, 18690, 18695-7, IGP, Nanking]. Solitary, large; septa numerous, in early stages dilated and long, reaching axis, in late stages thin, subradially arranged, crowded, thinning first in counter quadrants; minor septa long and may be contratingent; cardinal fossula moderately deep; tabularium wide, floors subhorizontal, tabulae commonly complete, edges may turn down or up slightly; dissepimentarium wide, of small, subequal, numerous, subglobose dissepiments, moderately to steeply declined from wall. Low.L.Dev. or up.L.Dev., Asia (Kwangsi).—Fig. 195,la-c. *H. semicrassa, holotype, Yukiang F., Shizhou Mbr., Kwangsi, Liujing; a,b, transv., c, long. secs., X 1 (Wang, Yü, & Wu, 1974).

?Houershanophyllum Yü & LIAO in KONG & HUANG, 1978, p. 34 [*H. involutum; OD; †specimen figured pl. 17, fig. 1, IGP, Nanking; ?M.Dev., Dushan, Kweichow]. Solitary; septa numerous, coarse, minor septa short, major septa long and axial ends curved about wide axial space into which cardinal fossula extends; periaxial tabulae in wide tabularium small and declined adaxially, axial tabulae widely spaced and subhorizontal; dissepimentarium narrow, dissepiments normal, small. [Diagnosis tentative, from illustrations; see also Yü & Liao, 1978, p. 146.] M.Dev., Asia (Kweichow).

Loomberaphyllum PEDDER, 1965a, p. 213 [*L. pustulosum; OD; 18796, UNE, Armidale] [=Peripastridium EHRENBERG, 1834, which see]. Solitary, large; septa numerous, thickened, smooth, long major septa attaining axis with some convolution; tabularium wide; tabular floors domes, in places with out-turned edges, of small, subglobose tabellae; dissepimentarium wide, dissepiments steeply declined adaxially, small, subglobose, and equal. L.Dev., ?M.Dev. (Couvin.), Australia (New S.Wales-Vict.).—Fig. 196,3a,b. *L. pustulosum, holotype, Ems. or Couvin., Loomberah Ls., New S. Wales; a,b, transv., long. secs., X1.5 (Pedder, 1965a).

Mansuyophyllum FONTAINE, 1961, p. 100 [*Cyathophyllum annamiticum MANSUY, 1913, p. 9; OD; †861, MANSUY Coll., MSG, Saigon] [=Glossophyllum WEDEKIND, 1924, which see]. Solitary, ceratoid, calice cup-shaped; septa commonly with weak carinae; major septa extending almost to axis, minor septa half as long, but may withdraw toward periphery; dissepimentarium wide, dissepiments small, globose, horizontally based at and near periphery but steeply declined and in herringbone arrangement in inner parts where minor septa are withdrawn; tabularium with axial series of commonly wide, horizontal tabellae, and periaxial series of large, inclined tabellae. M.Dev., Asia (Viet Nam).—Fig. 195,3a,b. *M. annamiticum (MANSUY), Ron; a,b, transv., long. secs., X 2 (Mansuy, 1913).

?Mictophyllum LANG & SMITH, 1939, p. 155 [*M.
Corallum solitary, large; major septa long, faintly convolute in tabularium, in young stages slightly thickened in tabularium, otherwise thin to attenuate; minor septa very short, withdrawn to periphery of wide herringbone dissepimentarium that narrows at wide fossula with shortened cardinal septum; tabularial floors domes with upturned edges, of thin tabellae; dissepiments small, unequal, steeply declined adaxially, not globose [see Pedder, 1965a, p. 202]. U.Dev.(Frasn.), N.Am.(Can.).——Fig. 196,1a,b. *M. nobile*, holotype, up.Frasn., Redknife F., Gorge of Redknife R., NW. Can., Mackenzie reg.; a,b, long., transv. secs., X 1.5 (Lang & Smith, 1939).

Moravophyllum Kettnerová, 1932, p. 27, 79 [*M. ptenophylloides*; OD; tPFKU 19, REMEŠ Coll., Charles Univ., Prague]. Large, solitary; septa numerous and long, in early stages major septa dilated in tabularium in cardinal quadrants, in late stages all septa very thin, major septa directed in small groups toward median plane; tabular floors irregular, tabellae numerous; dissepiments normal concentric or some angulate in transverse section. M.Dev.(Givet.), Eu.(Czech.).—N.Am. (Nev.).——Fig. 197,1a-c. *M. ptenophylloides*, holotype, Celechovice; a, long. sec., X 1.1; b,c, transv. secs., X 1.4, X 1.1 (Kettnerová, 1932).
Orthocytthus Merriam, 1973b, p. 34 [*Prismatophyllum flexum Stumm, 1938, p. 483; OD; †S16219a, USNM, Washington] [=Cyathophyllum Goldfuss, 1826, which see]. Subcereioid or phacelocerioid, mature corallites large; septa numerous, thin, smooth to finely crenulate and weakly carinate; carinae alternate; major septa long, subequal, some reaching or almost reaching axis; minor septa long, complete; tabularium moderately wide; tabular floors slightly convex axially, with periaxial trough; dissepimentarium wide, floors somewhat everted, plates subglobe, subequal. M.Dev.(Eifel.), N.Am.(Nev.).—Fig. 197.2, *O. flexus (Stumm), paratype, unit 4 (=coral zone F) of Nevada F., Nev., Lome Mt.; transv. sec., ×2.8 (Hill, n; photograph courtesy W. A. Oliver, USNM 96219a).

Peripediaeum Ehrenberg, 1834, p. 308 [*Cyathophyllum turbinatum Goldfuss, 1826, p. 56; SD Lang, Smith, & Thomas, 1940, p. 97; †S194, Goldfuss Coll., Ip, Bonn; lectotype by Glinsky, 1961, p. 277] [=Keriothphyllum Wedekind, 1923, p. 27 (type, K. heiligensteinii, M; 12798-2805, Wedekind Coll., Sm, Frankfurt; =Cyathophyllum turbinatum Goldfuss, 1826, fide Birenheide, 1963a, p. 390); Ceriophyllum Lang, Smith, & Thomas, 1940, p. 35, nom. van.; ?LoombaphylHium Pedder, 1965a, which see]. Solitary, fasciculate or cerialoid, with long, smooth to heavily carinate or fringed septa, major septa extending to axis commonly with weak convolution adaxially; carinae commonly alternate; tabular floors horizontal to strongly arched, composed of numerous small, convex tabellae; dissepimentarium wide, may be somewhat everted in some, dissepiments small, globose, numerous [Birenheide, 1963a, p. 389]. M.Dev., Eu.(Ger.-)Asia (Salair-Kuzbas? Altay-Burma-? Yunnan)–N. Am. (NW. Terr.-Nev.).—Fig. 198.1a,b, *P. turbinatum (Goldfuss), Eifel., Ahrdorf Beds, Ger., Hilllesheim Basin; a,b, transv., long. secs., ×1.5 (Birenheide, 1963a).—Fig. 198.1c,d, P. heiligensteinii (Wedekind), monotype, Eifel., Niederehe Beds, Ger., Gerolstein Basin; c,d, tang. long. sec. through dissepimentarium, transv. sec., ×2.0 (Wedekind, 1923).

?Gian南山phylum Kong in Kong & Huang, 1978, p. 56 [*Q. duyuensee; OD; †GCr 421, GB, Guiyang; M.Dev., Duyun, Kweichow]. Solitary; major septa long, somewhat thickened in tabularium, axial ends may curve slightly about axial space; minor septa somewhat withdrawn toward periphery, leaving inosculating dissepiments in inner zone; tabulae subhorizontal, supplemented peripherally by adaxially declined tabellae; dissepiments steeply inclined, small. [Diagnosis tentative, from illustrations.] M.Dev., Asia(Kweichow).

Radiophyllum Hill, 1942b, p. 17 [*Entelophyllum arborescens Hill & Jones, 1940, p. 188; OD; †P16190, SU, Sydney] [=Stathmoelasma Pedder, 1965a, p. 207 (type, S. amplum, OD; †S7878, UNE, Armidale; upper beds of Sulcor Ls., late Ems. or Couvin., near Attunga, New S. Wales), corallum solitary, large; Stathmoelasma Pedder, 1965a, p. 201, nom. null.]. Fasciculate or solitary, mature corallites large; septa numerous, straight or slightly flexuose, commonly thin but may be weakly fusiform in transverse section; carinae absent or alternate and weakly developed; major septa subequal, may reach axis but commonly withdrawn, cardinal septum may be shorter; tabular floors domed when septa are longest, but shaped like hat with central dent and outturned or upturned rim when septa somewhat withdrawn, tabulae commonly incomplete; when septa strongly withdrawn tabulae may be complete and mesa-shaped; dissepimentarium wide, floors fairly steeply declined adaxially, dissepiments subglobe to globose, commonly small and subequal [Strutz & Jell, 1970, p. 122]. ?L.Dev.(Gedinn.), Asia (Kuzbas); L.Dev.(Siegen.-Ems.)–M.Dev.(Couvin.), Australia(New S. Wales-Queensld.)–Asia(Amur R.-Transcauc.).—Fig. 194,1a,b. *R. arborescens (Hill & Jones), toptype, late ?Siegen. or Ems., Garra F., Nora Gr., New S. Wales, near Molong; a,b, transv., long. secs., ×1.5 (Hill, n; photographs courtesy D. Strusz, SU6189).—Fig. 194,1c,d. R. amplum (Pedder), holotype, late Ems. or early Couvin., upper part of Sulcor Ls., New S. Wales, near Attunga; c,d, transv., long. secs., ×1.5 (Pedder, 1965a; photographs courtesy A. H. Pedder).

Sinodisphyllum Sun, 1958, p. 11 [*Disphyllum (Sinodisphyllum) variabile; OD; †S1289, ?CU, Peking; lectotype by Ivanovskiy, 1976, p. 157]. Solitary, moderately large; septa dilated and major septa almost reaching axis in young stages; in late stages septa numerous and thinned, major long but withdrawn from axis, minor shorter, dissepimentarium moderately wide, dissepiments small, subequal, subglobe, becoming steeply declined in inner series; tabulae incomplete, floors flat or somewhat sagging. [Diagnosis based on lectotype; other syntypes not necessarily congeneric, may include Manssopyllum sp.] U.Dev., Asia (Hunan).—Fig. 198.2a-c. *S. variabile, lectotype, Lungkouchung F., Sinodisphyllum Zone, Hunan, Hsianghsiang; a,b, transv., c, long. sec., ×2 (Sun, 1958).

Sterictophyllum Pedder, 1965a, p. 209 [*Cyathophyllum cresswelli Chapman, 1925, p. 111; OD; †P1267, 1270, NM, Melbourne] [=Cavanophyllum Pedder, 1965a, p. 215 (type, Micophyllum trochoides Hill, 1940b, p. 265, OD; †P17110, AM, Sydney; L.Dev., Cavan, near Taemas, New S. Wales]. Solitary, moderately large; major septa mostly extending to axis, somewhat flexed in tabularium and variably dilated peripherally; dissepimentarium floors steeply declined adaxially, dissepiments small, globose; tabularial floors arched, may be flattened axially, of numerous, small tabellae. L.Dev., Australia(New S.Wales-Vict.).—Fig. 196.2a,b. *S. cresswelli (Chapman), Lilydale.

Ls., Vict., Lilydale; a,b, transv., long. secs., X1.5 (Pedder, 1965a).—Fig. 196,2c,d. S. trochoides (Hill), Cavan Bluff F.; c,d, long., transv. secs., X1.5 (Pedder, 1965a).

?Family BETHANYPHYLLIDAE
Stumm, 1949


Solitary, moderately large; calice with moderately steep walls flattening peripherally to form narrow, inwardly sloping peripheral platforms; septa numerous, not carinate but thickened and verpreculate in tabularium, major long, extending nearly to axis, becoming elevated at axial ends to form low calical boss; minor septa half as long; cardinal fossula prominent on convex

**Bethanyphyllum** STUMM, 1949, p. 18 [*Cyathophyllum robustum* HALL, 1876, pl. 22, fig. 1-14; OD; +4954/3, AMNH, New York; lectotype by STUMM, 1949, p. 18] [=?*Phymatophyllum* STUMM, 1965, Zaphrentidae]. Moderately large, solitary, curved, convex side cardinal; calice bell-shaped with moderately steep walls flattening peripherally to form narrow, inwardly sloping peripheral platforms; septa numerous, not carinate, and except in late stages thickened and vepricipitate in tabularium, major long, extending nearly to axis, becoming elevated at axial ends to form low calical boss in some; minor septa half as long; cardinal fossula prominent; tabulae incomplete, axial and periaxial, the periaxial tabellae larger and less steeply inclined, forming in calice periaxial trough around boss. [See also STUMM, 1963b, p. 137. Figures of internal structure of lectotype required.] M.Dev. (Givet.), N.Am.(Mich.).—Fig. 199,2a-c. *T. cysticum* (WINCHELL), Traverse Gr., Gravel Pt. F., up. blue sh., Mich., Bell Quarry; a, transv. sec., X 1; b,c, another specimen, transv. sec., early stage, long. sec., X1 (Sloss, 1939).

**Family CAMPOPHYLLIDAE**
Wedekind, 1922

*[Campophyllidae Wedekind, 1922a, p. 3; incl. Campophyllinae Wedekind, 1922a, p. 3]*

Characters as for genus. M.Dev. or L. Carb.

**Campophyllum** MILNE-EDWARDS & HAIME, 1850, p. lxviii [*Cyathophyllum flexuosum* GOLDFUSS, 1826, p 57; OD; +197a, GOLDFUSS Coll., IP, Bonn; lectotype by HILL & JULL, 1965, p. 207]. Solitary with beaker-form calice; major septa long but amplexoid, with caninioid dilatation in tabularium decreasing with age, and thin and flexuos in dissepimentarium; neither cardinal nor counter septum of distinctive length, and cardinal fossula not strongly marked, wide, parallel-sided and short, with slight tabular depression; minor septa also thin and flexuous but most are contrangent and except in late stages their inner ends are thickened, the thickening continuous with that of their neighboring major septa; tabulae broad and horizontal, with downturned edges; dissepimentarium narrow with steeply declined, small but unequal and not globose dissepiments. [Diagnosis based on lectotype only, from uncertain locality and horizon. See HILL & JULL, 1965, p. 207.]
M.Dev., N.Am.(N.Y.-Ind.-Ky.-Mich.-?Ont.).—Fig. 199,1a-d. *B. robustum* (HALL), lectotype, Hamilton Gr., W. N.Y.; a, transv. sec., X1,0,

b, portion of a, X6.7, c, long. sec., X1,0, d, upper portion of c, X6.7 (Hill, n; photographs courtesy W. A. Oliver).

*Tortophyllum* SLOSS, 1939, p. 54 [*Zaphrentis cystica* WINCHELL, 1866, p. 90; OD; +14355, UMM, Ann Arbor, fide STUMM, 1963b, p. 138, presumably =2724-t in Alma College Coll., Alma; lectotype by Sloss, 1939, p. 55; no locality given, probably from lake-cliffs outcrops of Gravel Pt. F. at Petoskey, Mich.]. Solitary, moderately large; septa numerous, long, major septa attaining axis or nearly so and somewhat convolute in axial region where they form, with axial tabellae, weak axial calical boss; fossula indistinct, minor septa long, dissepimentarium wide, with numerous small dissepiments; tabulae incomplete, axial and peripheral, the peripheral tabellae larger and less steeply inclined, forming in calice periaxial trough around boss. [See also STUMM, 1963b, p. 137. Figures of internal structure of lectotype required.] M.Dev. (Givet.), N.Am.(Mich.).—Fig. 199,1a-c. ·B. robustum (HALL), lectotype, Hamilton Gr., W. N.Y.; a, transv. sec., X3.0; b,c, another specimen, transv. sec., X3.0; d, another specimen, transv. sec., X1.5 (Hill & Jull, 1965).

**Family PTYCHOPHYLLIDAE**
Dybowski, 1873

[Psychophyllidae Dybowski, 1873c, p. 331; incl. Psychophyllinae HILL, 1960b, p. F276; Psychophyllinae IVANOVSKIT,
Solitary, moderately large; tabularium wide, forming low axial boss in calice; fossula long, narrow, invading axial boss and in some, dissepimentarium also; septa numerous, long, attaining axial region and commonly convolute in tabularium; dissepimentarium wide, with numerous small dissepiments; tabular floors low domes, in some with axial depression, tabulae commonly incomplete [see also McLEAN, 1975b, p. 57]. L.Sil.-L.Dev.

*Ptychophyllum* MILNE-EDWARDS & HAIM, 1850, p. lxix [*P. stokesii*; OD; †R25162, BM(NH), London; lectotype by SMITH, 1945, p. 51] [*Implicophyllum* SYTOVA, 1966, which see]. Solitary, turbinate or patellate; calice with wide, commonly everted platform and broad axial boss in tabularial pit; septa numerous, long, may bear lateral dissepiments; tabularial parts of major septa convolute, unequal, longer reaching axis and shorter confluent with longer; tabular floors domes with edges turned out or up; tabulae in-
complete; dissepiments numerous, small, subglobose, interseptal; cardinal fossula long, narrow, inconspicuous, invading tabularium. [SMITH, 1945, p. 51; longitudinal section required; McLEAN, 1975b, p. 57.] L Sil., N.Am.(Mich.-Ont.);ąd Asia (Sib. Platf.-Altay-Sayan-Tadzhik.-Australia (New S.Wales-Queensld.); U Sil., N.Am.(Devon L.).—Fig. 201,1.a,b. *P. stokesi, Manistique-Cordell dol., Mich., Drummond L., L. Huron; a, lectotype, calical view, X1, b, topotype, transv. sec., X1 (Smith, 1945).

?Cyathactis Soshkina in Ivanova et al., 1955, p. 122 [*C. typus; OD; t759, coll. 587, PIN, Moscow]. Solitary; fossula on convex side or somewhere displaced sideways, may invade dissepimentarium; cardinal septum short; septa thin in all stages, numerous, long; major more or less attaining axis and not convolute; minor septa may be contratingent; tabular floors convex in type species with broad, shallow median depression; tabulae incomplete; dissepimentarium wide with numerous subglobose dissepiments, declined adaxially. M Sil., Asia(Sib.Platf.).—Fig. 201,1.a,b. *C. typus; holotype, Gks, R. Stony Tungsuska; a,b, transv., long. secs., X3 (Ivanova et al., 1955).

Implicophyllum Sytova in Sytova & Ultińa, 1966, p. 239 [*I. vesiculosum; OD; t35, coll. 8732, TsGM, Leningrad] [=Psychophyllum Milne-Edwards & Haime, 1850, which see]. Solitary, cylindroconical; calical platform adaxially declined; septa thin, major septa reaching axis and convolute in tabularium; tabulae incomplete, forming wide, broadly convex floors; dissepimentarium not wide, normal, dissepiments steeply declined adaxially. U Sil. or L Dev. (Aynasu.), Asia(Kazakh.).—Fig. 201,2.a,b. *I. vesiculosum, holotype, Aynasu horizon, zone of Nataliella poslavskijae, C. Kazakh., S. flank of Karaganda Basin; a,b, transv., long. secs., X2 (Sytova & Ultińa, 1966).

Suborder STEREOLASMATINA

Hill, new suborder

Solitary small Stauriida without dissepimentarium; fossula on convex side except in Hapsiphyllidae; major septa long, axial edges not lobed, trabeculae fine and distal edges of septa smooth; septa may be rhopaloid in some and may form solid axial structure that commonly does not form boss in calice; septa with subhorizontal flanges in some (Stereolasmatidae); minor septa (except Km in some) short; tabulae declined abaxially; cardinal septum commonly shortened, counter septum long in some. L Dev.-U Perm.

Family STEREOLASMATIDAE

Fomichev, 1953

[nom. correct. Hill, herein, ex Stereolasmatidae Fomichev, 1953a, p. 96]

Solitary, small; major septa long, subequal, subradially arranged, contiguous axially to form commonly solid axial structure that does not project into calice; cardinal fossula on ?convex side, narrowing toward axis but with small parallel-sided part projecting into axial structure; septa with or without horizontal metriophyloid flanges; Km (minor septal pair neighboring counter septum) long and contratingent; remaining minor septa may also be long and contratingent; tabulae declined from axial structure to wall; dissepiments absent. M Dev.; L Carb.-M Carb.

Stereolasma Simpson, 1900, p. 205 [*Stereolasma rectum Hall, 1876, explanation to pl. 19 (part); OD; syntypes 4940/1,2, AMNH, New York, and 3740/1, NYSM, Albany, see STUMM & WATKINS, 1961, p. 446, nom. null.]. Small, ceratoid, erect or slightly curved; major septa thick, long, extending to axis to form axial structure that does not project into calice; minor septa contratingent, Km long, remainder short; cardinal fossula narrowing adaxially and extending into axial structure; septa without flanges; tabulae tall, flat-topped domes, no dissepiments [see STUMM & WATKINS, 1961, p. 445]. M Dev., N.Am.(N.Y.-Ind.-Ky.)-S.Am. (Venez.).—Fig. 202,2.a,b. *S. rectum (Hall); Hamilton Sh., W. N.Y.; a,b, transv., long. secs., enl. (Simpson, 1900).

?Amplexiphylum Stumm, 1949, p. 9 [*Amplexus hamiltoniae Hall, 1876, explanation to pl. 19, fig. 20-23; OD; syntypes, 4973/1-3, AMNH, New York]. Solitary, ceratoid to cylindrical, or irregularly contorted, not large; major septa thick and extending to axis in young stages, thinning and retreating from axis in later stages; cardinal fossula distinguished by short cardinal septum; minor septa very short, no dissepiments; tabulae complete or incomplete, typically horizontal axially and becoming deflected proximally as they approach periphery [see STUMM & WATKINS, 1961, p. 446]. M Dev.(Givet.), N.Am.(N.Y.).—Fig. 202, A. *A. hamiltoniae (Hall), syntype, Hamilton Gr., N.Y.; long. sec., X1.0 (Hall, 1876).

Lopholasma Simpson, 1900, p. 206 [*L. carinatum;
Rugosa—Stauriida—Stereolasmatina

OD; syntypes 291-292, type coll., NYSM, Albany; =Streptelasma rectum HALL, 1876, explanation to pl. 19 (part) [=Lophelasma LANG, SMITH, & THOMAS, 1940, p. 80, nom. van.]. Like Stereolasma but septa flanged. M.Dev.(Givet.), N.Am. (N.Y.); ?L.Carb.(up.Visean) or M.Carb.(low. Moscov.), Asia(China).—Fig. 202,1a.b. *L. carinatum, Hamilton Sh., W. N.Y.; a,b, transv., long. secs., enl. (Simpson, 1900).

Saleelasma WEYER, 1970a, p. 59 [*Zaphrentis delepinii VAUGHAN, 1915, p. 34; OD; Æ111467, SM, Cambridge, and R19567, BM(NH), London; lectotype by WEYER, 1970a, p. 61] [=Drewereelasma WEYER, 1973c, p. 975 (type, D. schindewolfii, OD; ÆX730, SCHINDEWOLF Coll., ZGI, E. Berlin; L.Carb., low.Tournais., Drewer, Rheinisch Schieferegebirge), cardinal septum not shortened in calice]. Small, solitary, with metriophylloid septal flanges and with Km septa long and contrasting in early stages; other minor septa short, not contrasting (in calice at least); major septa axially fused at central base of calice; cardinal septum on convex side of corallum shortened in upper calice but reaching axis in and below base of calice; tabulae strongly domed, with well-developed cardinal fossula; distal septal edges not crenulate. L.Carb.(low.Tournais.-mid.Tournais.), Eu.(Belg.-France-Ger.); L.Carb.(low.Visean-mid. Visean), Eu.(Eng.-Eire).—Fig. 202,5a-c. *S. delepinii (VAUGHAN), Landelles Ls. (Tn2b), Belg., abandoned quarry NNE. of Mévergnies, 3 specimens, a, transv. sec., X 5.8, b, tang. sec., X 9.6, c, long. sec., X 5.8 (Weyer, 1970a).

?Stewartophyllum BUSCH, 1941, p. 393 [*Amplexus intermittens HALL, 1876, explanation to pl. 32, fig. 8-13; OD; syntypes, 4971/1-2, AMNH, New York]. Solitary, subcylindrical to ceratoid, with irregular flangelike expansions; calice relatively flat; major septa thick, extending almost to axis, their ends in contact about irregular narrow axial space in early stage, but withdrawing somewhat in late stages; cardinal fossula weakly to moderately developed, cardinal septum shortened in mature stages; minor septa very short, no dissepiments; tabulae complete or incomplete, relatively flat-topped axially, their peripheral edges may be deflected upward or downward [see STUMM & WATKINS, 1961, p. 447]. M.Dev.(Givet.), N. Am.(N.Y.).—Fig. 202,3a,b. *S. intermittens (HALL); syntypes, Hamilton Gr., W. N.Y.; a,b, ext. views, X 1.0 (Hall, 1876).

Family ANTIPHYLLIDAE Ilina, 1970


Small, solitary, suberect or curved; cardinal fossula on convex side (except position in Actinophrentis not known); major

Family Stereolasmatidae Ilina, 1970

Properties: Large, solitary, suberect or curved; cardinal fossula on convex side; small, with well-developed cardinal fossula; major septa long and contrasting in early stages; other minor septa short, not contrasting (in calice at least); major septa axially fused at central base of calice; cardinal septum on convex side of corallum shortened in upper calice but reaching axis in and below base of calice; tabulae strongly domed, with well-developed cardinal fossula; distal septal edges not crenulate. L.Carb.(low.Tournais.-mid.Tournais.), Eu.(Belg.-France-Ger.); L.Carb.(low.Visean-mid. Visean), Eu.(Eng.-Eire).—Fig. 202,5a-c. *S. delepinii (VAUGHAN), Landelles Ls. (Tn2b), Belg., abandoned quarry NNE. of Mévergnies, 3 specimens, a, transv. sec., X 5.8, b, tang. sec., X 9.6, c, long. sec., X 5.8 (Weyer, 1970a).

Family Stereolasmatidae Ilina, 1970

Properties: Large, solitary, suberect or curved; cardinal fossula on convex side; small, with well-developed cardinal fossula; major septa long and contrasting in early stages; other minor septa short, not contrasting (in calice at least); major septa axially fused at central base of calice; cardinal septum on convex side of corallum shortened in upper calice but reaching axis in and below base of calice; tabulae strongly domed, with well-developed cardinal fossula; distal septal edges not crenulate. L.Carb.(low.Tournais.-mid.Tournais.), Eu.(Belg.-France-Ger.); L.Carb.(low.Visean-mid. Visean), Eu.(Eng.-Eire).—Fig. 202,5a-c. *S. delepinii (VAUGHAN), Landelles Ls. (Tn2b), Belg., abandoned quarry NNE. of Mévergnies, 3 specimens, a, transv. sec., X 5.8, b, tang. sec., X 9.6, c, long. sec., X 5.8 (Weyer, 1970a).

Family Stereolasmatidae Ilina, 1970

Properties: Large, solitary, suberect or curved; cardinal fossula on convex side; small, with well-developed cardinal fossula; major septa long and contrasting in early stages; other minor septa short, not contrasting (in calice at least); major septa axially fused at central base of calice; cardinal septum on convex side of corallum shortened in upper calice but reaching axis in and below base of calice; tabulae strongly domed, with well-developed cardinal fossula; distal septal edges not crenulate. L.Carb.(low.Tournais.-mid.Tournais.), Eu.(Belg.-France-Ger.); L.Carb.(low.Visean-mid. Visean), Eu.(Eng.-Eire).—Fig. 202,5a-c. *S. delepinii (VAUGHAN), Landelles Ls. (Tn2b), Belg., abandoned quarry NNE. of Mévergnies, 3 specimens, a, transv. sec., X 5.8, b, tang. sec., X 9.6, c, long. sec., X 5.8 (Weyer, 1970a).

Family Stereolasmatidae Ilina, 1970

Properties: Large, solitary, suberect or curved; cardinal fossula on convex side; small, with well-developed cardinal fossula; major septa long and contrasting in early stages; other minor septa short, not contrasting (in calice at least); major septa axially fused at central base of calice; cardinal septum on convex side of corallum shortened in upper calice but reaching axis in and below base of calice; tabulae strongly domed, with well-developed cardinal fossula; distal septal edges not crenulate. L.Carb.(low.Tournais.-mid.Tournais.), Eu.(Belg.-France-Ger.); L.Carb.(low.Visean-mid. Visean), Eu.(Eng.-Eire).—Fig. 202,5a-c. *S. delepinii (VAUGHAN), Landelles Ls. (Tn2b), Belg., abandoned quarry NNE. of Mévergnies, 3 specimens, a, transv. sec., X 5.8, b, tang. sec., X 9.6, c, long. sec., X 5.8 (Weyer, 1970a).
septal subequal, biradially arranged, straight or somewhat curved in quadrants, their axial edges uniting near or at axis, singly or in groups, their calcal edges ?smooth; inner end of fossula reaching or almost reaching axis and fossula either lenticular or sphenoid in transverse section (narrowing toward axis); cardinal septum seldom shortened, counter septum long; axial ends of some major septa may be rhopaloid in some; minor septa very short; tabulae declined abaxially; dissepiments in Pseudo-claviphylinae only. L.Carb.-L.Perm.

Subfamily ANTIPHYLLINAE Ilina, 1970

Antiphyllidae without dissepiments. L. Carb.-L.Perm.

Actinophrentis Ivanovskyi, 1967, p. 40 [*A. donetziana; OD; t23, coll. 5030, TSGM, Leningrad] [=?Rotiphyllum Hudson, 1942a, which see; Actinophrentis Fomichev, 1953a, p. 70, nom. nud., see Weyer, 1975b, p. 759]. Solitary, not large, conical; calice moderately deep, position of cardinal fossula not stated; in early stages major septa thickened to contiguity, radially arranged and reaching to or almost to axis; in late stages major septa contiguous only in peripheral stereozone and wide axial structure; fossula narrow, its axial end reaching to or almost to axis, with thinner and somewhat shorter cardinal septum, neighboring septa somewhat curved; tabulae present, minor septa very short, no dissepiments. U.Carb.(C'S), Eu.(Donbas).—Fig. 203,7a,b. "A. donetziana, nom. var.", see WEYER, 1975b, p. 759).

Bradyphyllum Grabau, 1928, p. 35 [*B. belliocostatum; OD; t1567, not traced, ?Peking] [=?Lytylosasas Soshkina, 1925, which see; Brachyphyllum Chi, 1931, p. 6, nom. null.; ?Pseudobradyphyllum Dobrylubova, 1940, which see; ?Proheterelasma Cotton, 1973, p. 162, nom. subst. pro Heterelasma Grabau, 1922, p. 41 (type, Hadrophyllum edwardsianum de Koninck, 1872, p. 52, OD, but see Hudson, 1942a, p. 258; t2 in de Koninck Coll., IRSN, Brussels; L.Carb., Tournai, Belg.; =Zaphrentis omalisii Milne-Edwards & Haim, 1851, p. 337, ?not traced, MN, Paris, L.Carb., Tournai, Belg., fide Caruthers, 1908, p. 25, see also Weyer, 1975b, p. 759), nom. Heterelasma Girty, 1908, a Paleozoic brachiopod]. Small, solitary, fossula on convex side or variable; in early stages septa straight, long, axial parts somewhat thickened and contiguous; insertion of septa in counter quadrants accelerated; in late stages major septa withdrawn somewhat from axis, axial ends of some may cease to be conjoined, and length of cardinal and counter septa may vary from long to short; rhopaloid thickening of axial ends of septa variable; minor septa very short; tabulae domed; no dissepiments. U.Carb.(Moscow), Asia (Kansu); L.Penn., N.Am.(Mont.).—Fig. 203,3a-d. *B. belliocostatum, holotype, M.Carb., Moukou F.Kansu, Moukou, Fm-1-Hsien; a-d, transv. secs., x3 (Grabau, 1928).


Claviphyllum Hudson, 1942a, p. 262 [*Cyathopsis? eruca McCoy, 1851a, p. 167; OD; tA2183a,b, SM, Cambridge; lectotype by HILL, 1938-1941, p. 132] [=?Antiphyllum Schindewolf, 1952, p. 205 (type, A. inopinatum, OD; tK78, M. Schwarzbach Coll., HU, E. Berlin; up. Namur., marine Roemer-Horizon, near Gliwice, up. Silesian coal basin; see Weyer, 1974b, p. 347). Small, solitary, slender; major septa straight; counter septum rhopaloid, longer and thicker than others, extending to axis; alar, counter-lateral, first counter metasepta short; second and third counter metasepta and first and second cardinal metasepta longer and rhopaloid; cardinal septum short and fossula on convex side of corallum; minor septa if long contractent; no dissepiments; tabular floors domes, depressed axially and with edges steeply declined abaxially; tabulae incomplete [see Hudson & Fox, 1943, p. 110]. L.Carb.(Visean), Eu. (Scot.-Eng.).—Fig. 203,2a,b. *C. eruca (McCoy); a, Auchenench, Scot., transv. sec., x2, b, Roughwood, Scot., long. sec., x2 (Hill, 1938-1941).


Lytylosasas Soshkina, 1925, p. 82 [*L. asymmetricum; M; t1803, coll. 146, PIN, Moscow] [=?Bradyphyllum Grabau, 1928, which see; Lytylosasas Lang, Smith, & Thomas, 1940, p. 82, nom. van.]. Solitary, small; major septa thickened, laterally contiguous over much of their length, long, somewhat curved and almost reaching axis, in cardinal quadrants grouped about open fossula that narrows midlength, then widens into axial space around which axial ends of septa of counter-quadrants join; minor septa very short, confined to narrow peripheral stereozone; tabulae convex,
Fig. 203. Antiphyllidae (p. F310-F312).
few. LPerm.(Artinsk.), Eu.(C.Urals).—Fig. 203,1a-c. *L. asymmetricum, holotype, R. Lytva, 6 km. below Alexandrovskiy works; a-c, serial transv. secs., X4 (Soshkina, Dobrolyubova, & Porfirev, 1941).

Pseudobradyphyllum Dobrolyubova, 1940, p. 12 [*Zaphrentis nikitini Shtukenberg, 1888, p. 8; OD; holotype not preserved *ide Dobrolyubova, 1940, p. 19, paratypes 19-22, 24, coll. 321, TsGM, Leningrad] [†Bradyphyllum Grabau, 1928, which see]. Solitary, not large; in early stages long major septa reach axis, in later stages their axial ends become somewhat rhopaloid, and they are unequal, the cardinal and counter septa shortest, and counter-lateral, alar, and first cardinal metaseptha longest; insertion in counter quadrants accelerated; fossula distinct in late stages, variably placed in relation to curvature of corallum; minor septa very short; tabulae convex, may be incomplete; no dissepiments. L.Carb.(Visean).

Rothiphyllum Hudson, 1942a, p. 257 [*Deniphyllum rashianum Vaughan, 1908, p. 459; OD; †T10/1009, TC, Dublin] [†Centrocellusum Thomsson, 1883, p. 452 (157) (type, C. denoshecum, OD GREGORY, 1917, p. 238; †lost by fire, †ide Hill, 1938-1941, p. 126, lectotype by Hudson, 1942a, p. 261; L.Carb., Visce, Charleston, Fileshire); Monophyllum Fomichev, 1953a, p. 110 (type, M. sokolovii; OD; †T70, coll. 5030, TsGM, Leningrad; M.Carb., Ls., Lanesville, Ind.). Small, solitary, corneous, fossula on convex side; major septa dilated, with extra thickening in inner third of their length, joined to form dense axial structure; counter septum longer than others and cardinal septum may withdraw from center of axial structure into which cardinal fossula may expand, narrowing adaxially; alar fossulae not marked; minor septa short; bases of septa dilated and in contact, forming narrow peripheral stereozone; tabulae conical; no dissepiments. L.Carb.(Visean), Eu.(U.K.-Ire.), Asia(Kazakh.); U.Carb.(Moscow.), Eu.(Donbas).

—Fig. 203,3a,b. *P. nikitini (Shtukenberg), toptype, quarry on Gshel R. between Troshkova and Glebova; a,b, transv., long. secs., X2 (Dobrolyubova, 1940).

Rotiphyllum Hudson, 1942a, p. 257 [*Deniphyllum rashianum Vaughan, 1908, p. 459; OD; †T10/1009, TC, Dublin] [†Centrocellusum Thomsson, 1883, p. 452 (157) (type, C. denoshecum, OD GREGORY, 1917, p. 238; †lost by fire, †ide Hill, 1938-1941, p. 126, lectotype by Hudson, 1942a, p. 261; L.Carb., Visce, Charleston, Fileshire); Monophyllum Fomichev, 1953a, p. 110 (type, M. sokolovii; OD; †T70, coll. 5030, TsGM, Leningrad; M.Carb., Ls., Lanesville, Ind.). Small, solitary, corneous, fossula on convex side; major septa dilated, with extra thickening in inner third of their length, joined to form dense axial structure; counter septum longer than others and cardinal septum may withdraw from center of axial structure into which cardinal fossula may expand, narrowing adaxially; alar fossulae not marked; minor septa short; bases of septa dilated and in contact, forming narrow peripheral stereozone; tabulae conical; no dissepiments. L.Carb.(Visean), Eu.(U.K.-Ire.), Asia(Kazakh.); U.Carb.(Moscow.), Eu.(Donbas).

—Fig. 203,3a,b. *P. nikitini (Shtukenberg), toptype, quarry on Gshel R. between Troshkova and Glebova; a,b, transv., long. secs., X2 (Dobrolyubova, 1940).

Hapsiphyllidae with apical part with epithecate wall. M.Dev.-Perm.

Hapsiphyllum Simpson, 1900, p. 203 [*Zaphrentis calciriformis Hall, 1882, p. 33; OD; Simpson's specimens, which may be Hall's syntypes, are probably 11969-11976, NYSM, Albany, †ide B. M. Bell, written commun.; Hall's designated horizon and locality of "Corniferous limestone; Falls of the Ohio" is in error, see Worthen, 1890, p. 76; =Zaphrentis cassedayi Milne-Edwards, 1860, p. 341, †not traced, †Paris, L.Carb., St. Louis Gr., Ind., see Grove, 1935, p. 362; =Enallophyllum Greene, 1901, p. 54 (type, E. grabaui, OD; †23629, Greene Coll., AMNH, New York, lectotype by Stumm, 1948d, p. 73; mid.Miss., Salem Ls., Lanesville, Ind.). Small, solitary, ceratoïd or trochoid; fossula large on concave side, expanded axially, containing cardinal septum long in early stages, short in late stages, and bounded laterally and axially, in early stages at least, by fused axial ends of remaining major septa; minor septa long, contrastingent; tabulae incomplete, floors conical with apex at inner edge of fossula; no dissepiments. M.Dev., Eu.(Spain); Miss., N.Am.(Ind.-Ky.-N.Mex.).—Fig. 204,4a-d. *H. cassedayi
Rugosa—Stauriida—Stereolasmatina

**Fig. 204.** Hapsiphyllidae (p. F312-F314).

*Allotropiophyllum* (Milne-Edwards), Miss., Ind., St. Louis Gr.; a,b, lat., calical views, X4; c,d, transv. secs., X15, X8 (Schindewolf, 1938).—**Fig. 204,4e.** *H. grabani* (Green), lectotype; calical view, X4 (Stumm, 1948d).

*Allophyllum* Schouppé, 1957, p. 362 [*A. grunani*; M; fD5438, NM, Basel]. Solitary, curved, cardinal side concave; cardinal septum short to very short, counter septum long, its adaxial end may be transiently both separate and distally produced as timorphylloid columella; other protosepta not distinct in length or thickness from metasepta.
cardinal fossula closed at least in later young stages due to coalescence of axial ends of neighboring major septa as part of a general axial coalescing, thickening, and immersion in sclerenchyme of axial ends of major septa; rhopaloid thickening of axial ends of septa in cardinal quadrants retained longer than in counter quadrants; all major septa withdrawn somewhat from axis in mature stages; minor septa very short; tabulae subhorizontal, complete; no dissepiments. L.Perm., Asia (Timor).—Fig. 204, a-c.

*Amplexizaphrentis* VAUGHAN, 1906, p. 315, as stages; minor septa very short; tabulae subhorizontal, complete; no dissepiments. L.Perm., Asia (Timor).—Fig. 204, a-c.

**Coelenterata—Anthozoa**

**Allotropiophyllum** GRABAU, 1928, p. 130 [*Amplexis spinous var. sinensis* GRABAU, 1922, p. 64; OD; 2 syntypes of var. *sinensis*, 159-160, Geol. Survey China, Peking; Holotype of species *sinensis*, 1600, IGP, Nanking, selected by GRABAU, 1928, p. 136]. Small, ceratozoid and typically with scattered hollow spines; fossula on concave side, narrowing inward and then expanding into axial space bounded on narrow counter side by conjoined axial ends of septa of counter quadrants, in which septal insertion is greatly accelerated; axial ends of long, thin metasepta of cardinal quadrants may reach across axial space to partial inner wall or may themselves join and extend wall around fossula; cardinal septum short; tabulae rising to wall of fossula; minor septa rudimentary; tabulae commonly complete domes, flat. L.Perms., Chihisia Ls., China, Chihisiaisan, Nanking reg.; a-c, transv. secs., X3 (Schouppé, 1957).

**Amplexizaphrentis** VAUGHAN, 1906, p. 315, as *Amplexis-Zaphrentis* [*Zaphrentis curvulena* THOMSON, 1881, p. 223; SD IJCN Op. 854; †T2106, KM, Glasow; lectotype by HILL, 1938-1941, p. 142; see also SHRETHA, 1966, p. 349; MITCHELL, 1966, p. 83] [=Triplophyllites EASTON, 1944b, p. 35 (type, *T. palmatus*, OD; †3519, IGS, Urbana; L.Carb., Chester, Kinkaid LS., near Cedar Grove Church, Johnson Co., Ill.), may have spinose outgrowths, fossula commonly to one side of concave side, see EASTON, 1975, p. 675, 678, SANDO, 1969, p. 288; *Enniskilenia* KABAKOVICH in SOKHINA, DOROBUYNOVA, & KABAKOVICH, 1962, p. 323 (type, *Zaphrentis enniskileni* MILNE-EDWARDS & HAIME, 1851, p. 334, OD; †35460, Geological Society coll., JGS, Leeds; Carb. Ls., Lough Gill, Co. Sligo, Eire; see LEWIS, 1930, p. 277), =Enniskilenia FLÜEGEL, 1970, p. 102, nom. null.]. Solitary, moderately large, curved trochoid, cardinal side concave; calice deep, slightly thickened, and immersion in sclerenchyme of concave side, narrowing inward and then expanding into axial space bounded on narrow counter side by conjoined axial ends of septa of counter quadrants, in which septal insertion is greatly accelerated; axial ends of long, thin metasepta of cardinal quadrants may reach across axial space to partial inner wall or may themselves join and extend wall around fossula; cardinal septum short; no dissepiments. L.Perm., Chihsia Ls., Nanking, selected by GRABAU, 1928, p. 136]. Small, ceratozoid and typically with scattered hollow spines; fossula on concave side, narrowing inward and then expanding into axial space bounded on narrow counter side by conjoined axial ends of septa of counter quadrants, in which septal insertion is greatly accelerated; axial ends of long, thin metasepta of cardinal quadrants may reach across axial space to partial inner wall or may themselves join and extend wall around fossula; cardinal septum short; no dissepiments. L.Carb., Ls. L 7 , R. Likhaya; see WEYER, 1957, p. 678; SANDO, 1969, p. 288]. Solitary, medium to large, curved conical in early stages, straight cylindrical in adult; with narrow, peripheral stereozone; in early stages septa long, thick, joined at axis, but open fossula on concave side and alar fossulae notable; in adult stages major septa, except short cardinal septum, are subequal, and meet or are joined in axial region only on upper surfaces of tabulae; they then withdraw between tabulae in amplexoid manner; accelerated septal insertion occurs in counter quadrants; minor septa rudimentary; tabulae domed, with flat tops or concave axially; no dissepiments. L.Penn., N.Am.(Texas-Ark.-Utah); *V. cognata* (Hill, 1938-1941), holotype, Low. Marble Falls Is., Texas, San Saba Co.; a.b, transv., c, long. secs., all X1.9 (Mooom & Jeffords, 1945).

**Barytichisma** MOORE & JEFFORDS, 1945, p. 131 [*B. crassum*; OD; †P11908b, UTBEG, Austin] [=Thecothyllum FOMICHEV, 1953a, p. 175 (type, *T. lebedevi*, OD; †126, coll. 5030, TSGM, Leningrad; M.Carb., Ls. L 7, R. Likhaya; see WEYER, 1965, p. 499).]. Solitary, medium to large, curved conical in early stages, straight cylindrical in adult; with narrow, peripheral stereozone; in early stages septa long, thick, joined at axis, but open fossula on concave side and alar fossulae notable; in adult stages major septa, except short cardinal septum, are subequal, and meet or are joined in axial region only on upper surfaces of tabulae; they then withdraw between tabulae in amplexoid manner; accelerated septal insertion occurs in counter quadrants; minor septa rudimentary; tabulae domed, with flat tops or concave axially; no dissepiments. L.Penn., N.Am.(Texas-Ark.-Utah); *U. carb. (Moscow)*, OD.(Donbas).—Fig. 206, a-c.

**Canadiphyllum** SUTHERLAND, 1954, p. 361 [*C. kanoi*; OD; †10566, GSC, Ottawa]. Solitary, small, erect, trochoid; with prominent, long, parallel-sided, deep fossula *(on concave side)* with very short cardinal septum, and bounded by thickened and downturned parts of tabulae; alar fossulae distinct; septa of cardinal quadrants pinuate to or nearly at right angles to the fossula; septa of counter quadrants subparallel to radial; tabulae rising gradually from periphery, slightly domed at edge of fossula, descending sharply into it; minor septa very short or immersed in wall; no dissepiments. U.Miss., N.Am.(B.C.); *L.Carb. (?Grayling)*, Asia (?Taymyr), see ROGOZOV, 1972, p. 54.—Fig. 204.2. *C. kanoi*, holotype, B.C., Halfway River Valley; transv. sec., X3 (Sutherland, 1954).
Clinophyllum Grove, 1935, p. 364 [†Zaphrentis chouteaensis Miller, 1891, p. 10; Mi; +3916, UCGM, Cincinnati; lectotype by Easton, 1944b, p. 47]. Solitary, small to medium-sized, curved, conical; calice commonly deep and very oblique; major septa thick, tapering, long, their axial edges free, becoming amplexoid in late stages; counter septum on concave side, very long, flanked in calice by short minor septa, cardinal septum next longest; alar septa shortest; minor septa rudimentary; tabulae complete, plane, may have downturned edges, depressed at cardinal and alar fossulae (and also at counter septum); no dissepiments. Miss., N.Am.(Mo.-Ind.). —Fig. 207, la-c. *C. chouteaense (Miller), paratypes, Chouteau Ls., Mo., Sedalia; a, ext. view, X2; b,c, other specimens, Chouteau Ls., Mo., near Sedalia; transv., long. secs., X2 (Easton, 1944b).

†Duplophyllum Koker, 1924, p. 21 [†D. zaphrentoides Koker, 1924, p. 21; M, see CHI, 1938, p. 164, LANG, SMITH, & THOMAS, 1940, p. 55; †not traced in TH, Delft (orig. of Koker, pl. 8, fig. 2a); lectotype by SCHOPPÉ & STACUL, 1959, p. 242]. Solitary, cardinal side commonly convex, less commonly concave; septa of quadrants arranged pinnately to shallow cardinal and alar fossulae, their axial ends in late stages may withdraw somewhat to leave open fossula, and cardinal septum may shorten markedly; thickness of major septa variable, may be marked; minor septa variable, may be long, thin, and either contragent, contraclined, or contrajunct, Km longest; tabulae declined abaxially. U.Perm., Asia(Timor). —Fig. 206,3. *D. zaphrentoides Koker, lectotype, Timor, Basilo; transv. sec., ?enl. (Koker, 1924).

Euryphyllum Hill, 1938, p. 25 [†E. reidi; OD; +F3243, UQ, Brisbane] [=Euryphyllum Hill, 1937, p. 150, nom. nud.]. Solitary, commonly small, typically with oblique calical floor; major septa extending to axis and pinnately grouped about long, closed fossula bisected by long cardinal septum on concave side of corallum; alar fossulae present; septa dilated, in early stages laterally contiguous throughout, but with growth dilatation decreases in a widening zone midway between periphery and axis, leaving wide peripheral sterezone, and an axial structure formed by the conjoined axial edges of septa; minor septa very short; tabulae widely separated, complete or incomplete; no dissepiments. Perm., Australia(Queensl.-New S. Wales-W. Australia)-N. Z.-Asia (Timor)-Eu. (W.Urals). —Fig. 207,3a,b. *E. reidi, holotype, Queensl., Cabbage Cr., Springsure distr.; a,b, transv., long. secs., X2 (Hill, 1938).

Famennlasma Weyer, 1973c, p. 684 [†F. rheinanum; OD; +K45, SCHWALM 1899 Coll., HU, E. Berlin]. Solitary, small, conical, ?concave side cardinal, with deep calice; cardinal tabular fossula expanding slightly to merge with axial space,
discontinuous fossular wall being formed by fused, slightly rhopaloid axial ends of somewhat pinnately arranged major septa; cardinal septum shortens distally; counter septum longest; minor septa including Km very short, not contratingent; calical edges of septa finely dentate, septa finely monacanthate; tabulae declined from wall of fossula; no dissepiments.

U.Dev., Eu.(Ger.-Pol.).—FIG. 206,2a,b. *F. rhenanum*, holotype, up. Famenn., Clymenia-Stage or Wockleria-Stage, Ger., Braunau, Kellerwald; a, transv. sec., X 3.8, b, radial long. sec. peripheral, calical part of septum indicating fine monacanths, X 4.7 (Weyer, 1973e).

Longiclava EASTON, 1962, p. 33 [*L. tumida*; OD: +118729, USNM, Washington]. Small, solitary; calice shallow, with deep cardinal fossula on concave side of corallum and prominent, long, rhopaloid counter septum; septal insertion markedly accelerated in counter quadrants; major septa thick, long, but unequal, axial edges fused in groups, the longest in a group joining axial ends of counter septum; cardinal septum short in late stages; minor septa rudimentary. U.Miss., N.Am.(Mont.).—Fig. 207,5a,b. *L. tumida*, Allen F., Mont.; a, topotype (paratype), calical view, X 2; b, holotype, transv. sec., X 3 (Easton, 1962).

Meniscophyllum SIMPSON, 1900, p. 199 [*M. minutum*; OD: +1295, NYSM, Albany; lectotype by EASTON, 1944b, p. 46] [=Heptaphyllum CLARK, 1924, p. -116 (type, H. gracile, OD; +A3382, SM, Cambridge, insufficiently known); ?Caenophyllum CLARK, 1926, p. 85 (type, C. varians, OD; +A3384, SM, Cambridge, insufficiently known)]. Small, cornute; minor septa very short or absent; cardinal fossula on concave side; major septa thickened, axial ends conjunct in fossular wall that is crescentic in transverse section and located eccentrically, on convex side of corallum; four or five septa on concave side longer, thinning axially, and disjunct from fossular wall; tabulae thin; no dissepiments; minor septa rudimentary [see EASTON, 1944b, p. 46].

U.Miss., N.Am.(Mo.-Mexico).—Fig. 207,4a-c. *M. tumidum*, Miss., Mo.; 3 specimens, transv. secs., all X 5 (Easton, 1944b).

Zaphrentites HUDSON, 1941, p. 309, non Zaphrentites von BURNOFF, 1926, p. 150, nom. null. [*Zaphrentis parallelia CARRUTHERS, 1910, p. 533; OD: +GSM PF1256(56567), IGS, Leeds] [=Cytophyllum TOMILASHCHEV, 1933, p. 287, nom. subst. pro Craterophyllum Tomilashchev, 1931, p. 344 (type, C. abyssum, M; ?Yin coll. 2555, TsGM, Leningrad; L.Carb., Kuzbas, Asia), non Craterophyllum FORSTE, 1909a, p. 101, see Arachnophyllina, Arachnophyllidae; Ascophyllina, Ascophyllum FORSTE, 1909a, p. 101; ?L.Carb., Kuzbas, Asia). Small, conical, curved, conical; long, deep fossula on concave side or variable in position and commonly open, with cardinal septum progressively shortening; counter septum long, taller than others; metaseptal arrangement quadripartite, pinnate to counter septum and to fossula; minor septa very short or not projecting from wall; tabulae arched distally; no dissepiments [see EASTON, 1956, p. 26; 1975, p. 676].

Zaphrentis von BURNOFF, 1926, p. 358 [*Zaphrentis tenella MILLER, 1891, p. 621; OD: +3360, UCGM, Cincinnati]. Small, solitary, curved, conical; long, deep fossula on concave side or variable in position and commonly open, with cardinal septum progressively shortening; counter septum long, taller than others; metaseptal arrangement quadripartite, pinnate to counter septum and to fossula; minor septa very short or not projecting from wall; tabulae arched distally; no dissepiments [see EASTON, 1956, p. 26; 1975, p. 676].
major septa pinnately arranged with respect to cardinal and alar fossulae; in later forms and later stages cardinal septum shortened and septa withdrawn from fossula, first in cardinal quadrants, then in counter quadrants, so that radial arrangement supercedes pinnate arrangement; minor septa very short or immersed in wall; tabulae incomplete, floors conical, with highest point at inner edge of fossula. *Meniscophyllum*, *Euryphyllum*, *Zophrentites*.

**FIG. 207. Hapsiphyllidae (p. F315-F317)**

- Major septa pinnately arranged with respect to cardinal and alar fossulae; in later forms and later stages cardinal septum shortened and septa withdrawn from fossula, first in cardinal quadrants, then in counter quadrants, so that radial arrangement supercedes pinnate arrangement; minor septa very short or immersed in wall; tabulae incomplete, floors conical, with highest point at inner edge of fossula. *Meniscophyllum*, *Euryphyllum*, *Zophrentites*.

- **Subfamily ADRADOSIIINAE**

  **Birenheide & Soto, 1977**

  `[Adradosinae Birenheide & Soto, 1977, p. 9]`

  Hapsiphyllidae with apex of corallum lacking wall so that pinnately arranged major septa are exposed; cardinal fossula on concave side with short cardinal septum in calice. *L.Dev.*

  **Adradosia**

  *Birenheide & Soto, 1977, p. 9* [*A. barroisi*; OD; †11271, DPO, Oviedo]. Corallum small, conical, curved or straight; apex without wall, only pinnately arranged septa exposed; cardinal fossula on concave side, closed, with cardinal septum short in calice but long below calice; minor septa short; tabulae normally ascending toward axis, but descending and closer tabulae (or flanges) may also be found. *L.Dev.*, Eu. (Spain).
Family ZAPHERENTOIDIDAE
Schindewolf, 1938


Solitary; fossula on convex side, closed, deep, long, extending to or beyond axis and enclosing somewhat shortened cardinal septum; major septa conjoined by axial ends in fossular wall; alar fossulae notable; tabulae complete or incomplete, declined from inner edge of fossula, or absent; minor septa short, no dissepiments. L.Miss.-L.Penn.; U.Perm.

Subfamily ZAPHERENTOIDINAE
Schindewolf, 1938

Zapherentoididae with distal edges of septa in calice declined adaxially from wall. L.Miss.-L.Penn.; U.Perm.

Zapherentoides Shtukenberg, 1895, p. 38 [*Zaphrentis griffithi Milne-Edwards & Haime, 1851, p. 333; SD Schindewolf, 1938, p. 449; Z220a, Milne-Edwards & Haime Coll., MN, Paris, only specimen known.]. Turbinate, slightly curved; solitary; fossula on convex side, deep, long, extending beyond axis, greatest width in calice midway to axis and enclosing somewhat shortened cardinal septum; alar fossula midiside peripherally; major septa long, somewhat flexuous, unequal, axial ends may unite in pairs; minor septa short; no dissepiments [Easton, 1975, p. 679]. L.Carb. (Visean.), Eu.(Eng.).—Fig. 208,1a-d. *Z. griffithi (Milne-Edwards & Haime), holotype, Eng., "Clifton"; a,b, side, calical views, approx. ×1 (Milne-Edwards & Haime, 1852); c, transv. pep., ×2, d, calical view, ×1 (Easton, 1975).

Ankhelasma Sando, 1961, p. 66 [*A. typicum; OD; †120201, USNM, Washington]. Small, solitary, ceratoid or trochoide; calice deep with well-developed fossula on long, convex side that is flattened in adult; fossula long, extending beyond axis, deep, adaxially gradually widening, bounded laterally by tall, fused axial segments of septa of cardinal quadrants and axially by fused ends of counter septum and septa of counter quadrants; alar fossulae notable; in late stages counter-lateral and alar septa and older metasepta retreat from wall of fossula; some minor septa may be contrangent; tabulae absent; no dissepiments, interserial loculi filled by septal thickening proximally; cardinal septum stunted in early stages, relatively short in late stages. U.Miss.(Meramec.), N.Am.(Utah-Mont.).—Fig. 208,2a,b. *A. typicum; a, holotype, up. Brazer dol., NE. Utah, Crawford Mts., calical view, ×2; b, another specimen, calical view of neanic corallum, diagram. (Sando, 1961).

Baslephyllum Schouppé & Stacul, 1959, p. 270 [*Duncania indica Koker, 1924, p. 11; OD; †11754, TH, Delft]. Solitary, curvate, trochoide, shallow cardinal fossula on convex side; major septa somewhat withdrawn from axis, ending at edge of axial depression in tabulae that slope upward from wall, counter septum longest, cardinal septum half as long as other major septa; minor septa mostly very short, buried in narrow peripheral sterezone; septal insertion slightly accelerated in counter quadrants [Schouppé & Stacul, 1959, p. 270]. U.Perm., Asia(Timor).—Fig. 208,6a-d. *B. indicum (Koker), Basleo; a, holotype, ×1.0 (Koker, 1924); b-d, topotype, transv. secs., ×3.0, ×1.5, long. secs., ×2.0 (Schouppé & Stacul, 1959).

Fasciulaimplexus Easton, 1962, p. 31 [*F. conrotus; OD; †118724, USNM, Washington]. Solitary, with moderately deep calice; cardinal fossula commonly on convex side; major septa thick, long, their axial edges fused in groups in early stages, but free and markedly amplexoid later; cardinal septum shortened in late stages; distal edges of septa smooth; tabular floors tall, flat-topped domes, tabulae complete or incomplete; minor septa very short, no dissepiments. L.Penn., N.Am.(Mont.).—Fig. 208,5a-c. *F. conrotus, Cameron Cr. F.; a,b, holotype, transv. secs., ×3; c, paratype, long. secs., ×3 (Easton, 1962).

Homalophyllites Easton, 1944b, p. 42 [*Lophophyllum calceola White & Whitfield, 1862, p. 305; OD: 2 syntypes, 6365/1, AMNH, New York]. Solitary, curved, conical, commonly with cardinal side convex and flattened at least in apical parts; fossula deep, commonly expanding somewhat adaxially, bounded by fused axial ends of major septa, cardinal septum shortening in late stages; major septa long, may be thickened to contiguity in early stages; minor septa very short; tabular floors declined from axial region; no dissepiments. L.Miss., N.Am.(Iowa-Mo.-Kinderhook.-Osag.).—Fig. 208,3a,b. *H. calceola (White & Whitfield), topotype, Iowa, Burlington; a, flattened convex side, b, calical view, both ×1 (White, 1880).

Sychnoelasma Lang, Smith, & Thomas, 1940, p. 128, nom. subst. pro Verneuilia Shtukenberg, 1895, p. 40, non Hall & Clarke, 1894, a brachiopod [*Verneuilia urbanowiitshi Shtukenberg; M; †coll. 45, LGL, Leningrad].—Fig. 208,3a,b. *H. calceola (White & Whitfield), topotype, Iowa, Burlington; a, flattened convex side, b, calical view, both ×1 (White, 1880).

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Fig. 208. Zaphrentoididae (p. F318-F319).

toid, cardinal side convex; calice moderately deep, bell-shaped; septa numerous, long, commonly thick, their axial ends fused to form thickened wall to cardinal fossula which is long, deepest at peripheral, and widest at axial end; trabeculae moderately coarse; cardinal septum thinning and shortening in later stages of development; minor septa may be long, not contratent; tabular floors convex, sagging deeply in fossula, tabulae complete or incomplete; no dissepiments [see also Sayutina, 1976, p. 113]. L.Carb., Eu.(U.K.-Belg.-Ger.-Russ.Platf.-Donbas-Urals-N.Zem.-Asia (Kuzbas-Kazakh.-NE.USSR); ?Miss., N.Am.—Fig. 208,4a. *S. urbanowitschi (Shtukenberg), basal Visean, Urals; calical view, enl. (Shtukenberg, 1895).—Fig. 208,4b,c. S. konincki (Milne-Edwards & Haime), Belg., Tournai; b,c, transv. secs., X3 (Carruthers, 1908).
Subfamily CUMMINSIINAE Weyer, 1975

Zaphrentoididae with smooth distal edges to major septa arched above top of epitheca. Mss.-L.Penn.

Cumminsia Moore & Jeffords, 1945, p. 164 [*Hadrophyllum aplatum Cummins, 1891, p. 552; OD; 2 figured syntypes, ?Geol. Survey Texas]. Patellate, thick; base commonly nearly flat, epithecate, apex nearly central; distal edges of septa arched above distal edge of epitheca and smooth; counter and alar septa long, cardinal septum short in late stages in steep-sided, deep, long fossula on longer side of corallum; metasepa of counter quadrants making angles to alar septa, those of cardinal quadrants pinnately arranged to alar septa, those of cardinal quadrants pinnately arranged about cardinal septum and long fossula, and those of counter quadrants lengthening and becoming less parallel to alar septa and fossulae with age. In Carboniferous and Permian genera, individual septal monacanths fine and close and septa commonly dilated by growth lamellae in which accretions to individual trabeculae cannot be recognized. U.Sil.-U. Perm.

Family POLYCOELIIDAE de Fromentel, 1861


Corallum predominantly solitary; one or more protosepta longer than other septa and commonly more rhopaloid; cardinal or counter septa or both may be shortened; some metasepta may be longer and more rhopaloid than others; minor septa including Km commonly confined to wall; tabulae declined from axial region; a few with long minor septa and dissepimentarium; in early stages, where known, septa of cardinal quadrants pinnately arranged about cardinal septum and long fossula, and those of counter quadrants lengthening and becoming less parallel to alar septa and fossulae with age. In Carboniferous and Permian genera, individual septal monacanths fine and close and septa commonly dilated by growth lamellae in which accretions to individual trabeculae cannot be recognized. U.Sil.-U. Perm.

Subfamily POLYCOELIIDAE de Fromentel, 1861


Predominantly solitary; cardinal, counter, and two alar septa longer and commonly more rhopaloid than remaining septa; minor septa including Km commonly confined to wall; in early stages, where known, septa of cardinal quadrants pinnately arranged about cardinal septum and long fossula, those of counter quadrants lengthening and becoming less parallel to alar septa with age; tabulae declined abaxially; a few with longer minor septa and dissepimentarium. U.Sil.-L.Dev.; L.Carb.-Perm.

Subfamily POLYCOELIIDAE de Fromentel, 1861


Calophyllum Dana, 1846a, p. 183 [*Turbinolia donatiana King, 1848, p. 6; SM King, 1850, p. 22; *notype by Flügel, 1973c, p. 62; in Hancock Museum, Newcastle-upon-Tyne; Perm., Magnesian Ls., Humbleton Hill, near Sunderland, Eng.; =Caryophyllia quadrifida Housse, 1848, p. 260, nom. obl. (Flügel, 1973c, p. 65)] [=Polycoelia King, 1849, p. 388, obj., non Polycoelia de Fromentel, 1860, a Mesozoic sponge, see ICZN Art. 69(a)(II) and Flügel, 1972, p. 57; ?Phrygano­phyllum de Koninck, 1871, p. 321, nom. nud., 1872, p. 62 (type, P. duncani, M; tα587, IRSN, Brussels; L.Carb., Tournai, Belg.; Phrygano­phyllum Totton, 1930, Zool. Rec., p. 18, nom. null., fide Cotton, 1973, p. 155). Solitary, small; card­inal, counter, and two alar protosepta almost equally spaced, longer and thicker than other ma­jor septa, but in upper third of calice shortened so that all septa appear equal; minor septa con­fined to wall except at calical margin; metaseptal insertion accelerated slightly in counter quadrants; tabulae complete, flat axially, with downturned margins; no dissepiments. Septal plan in early stages of type species not known. Flügel, 1973c, p. 65, indicates that Cyathophyllum profundum Geinitz, 1842, on which Calophyllum (=Poly­coelia) is commonly interpreted, is not conspecific with Calophyllum donatianum. As described from toptypes by Schindewolf (1942, p. 68), C. prof­undum has more and longer metasepta than C. donatianum, and, in its early stages, a marked cardinal fossula extending to axis. Its cardinal septum lies always on concave side of corallum. Russian specimens referred to C. profundum by Ivanovsky (1972, p. 5) have in the midplane of their septa very fine, close trabeculae with ortho­gonal fibers.] ?L.Carb.; Perm., Eu.(Brit.1.-Ger.-USSR)-Asia.—Fig. 210,3a,b. *C. donatianum (King), neotype, Perm., Magnesian Ls., Eng., Humbleton Hill, Co. Durham; a,b, internal molds of calice, ×6.7, ×6.0 (Flügel, 1973c).—Fig. 210,3c. C. profundum (Geinitz), Zechstein, lower part “Rote Faule,” Ger., Eisleben Wolfsschacht, Saxony; transv. sec., ×4.0 (Flügel, 1973c).

Amandaria Lavrushevich, 1968, p. 108 [*A. prima; OD; t8836/245, UpG, Dushanbe] [=Tetralasma Schindewolf, 1942, which see; Amandaria Cotton, 1973, p. 16, nom. null.]. Solitary, very small; in all stages of growth only four septa are well developed—cardinal, counter and alar—and are
unthickened throughout; remaining septa confined to wall or very short; tabulae horizontal, complete; no dissepiments. U.Sil. or L.Dev., Asia (Tadzhik.). —Fig. 211,3a,b. *A. prima*, holotype, L.Dev., Kunzhak horizon, N. slope of Zeravshon Ra., Shishkat ravine, left side; a,b, long., transv. secs., x3 (Lavrusevich, 1968).

fasciculate, with lateral increase. *L. Perm.*, Asia (SE.Pamir).—Fig. 212, 5a, b. \*C. dobrolynbovae (Ilina), holotype, right side of right dry gully of R. Sulistyk, basin of R. Irpimyuz; a, b, transv. secs., X4, X10 (Ilina, 1970).

**Empodesma** Moore & Jeffords, 1945, p. 89 [\*E. imulum; OD; t140334, USNM, Washington] \[*=Sochkieophysillum* Grabau, 1928, which see, fide Fedorowski, 1973, p. 102]. Solitary, conical, slightly curved, calice very oblique; in young stage...
cardinal and counter septa conjoined and alar septa long, other septa angled to cardinal and alar septa, major septa thick with smooth and somewhat swollen axial edges, not in contact, dilatation being great just above tabula; in late stages cardinal septum withdrawn from axis, leaving fossula, variable in position but commonly on convex side of corallum, and septa thin; septal insertion accelerated in counter quadrants; tabulae sagging, complete or incomplete; minor septa rudimentary, no dissepiments. L.Penn., N.Am.(Texas-Okl.).

---Fig. 210,1a-c. \*E. imulum, holotype, Bend., Marble Falls Ls., N. central Texas; a, long, b,c, transv. secs., all ×2 (Moore & Jeffords, 1945).

**Gerthia** Grabauf, 1928, p. 29 [*Polycoelia angusta* Rothpletz, 1892, p. 69; OD; & not traced]. Small, solitaire, slightly curved; cardinal, counter, and two alar septa longer and rhopaloid, strongly thickened toward their rounded axial edges; other major septa unequal, longest commonly occupying median position in each quadrant; septal insertion accelerated in counter quadrants; minor septa moderately long, no dissepiments, marginarium a narrow peripheral stereozone; tabulae thin. [Diagnosis based on Gerth's 1921 descriptions and figures; his specimens may not be conspecific with those of Rothpletz. The genus requires revision.] L. Perm., W.Australia; U.Perm., Asia(Timor).—Fig. 211,2a-c. \*G. angusta (Rothpletz), Timor, Ajer Mati R. near Kupang; a, long, b,c, transv. secs., all ×2 (Rothpletz, 1892).

**Groenlandophyllum** Flügel, 1973b, p. 11 [*Calophyllum (Groenlandophyllum) teicherti*; OD; *H111928, MM, Copenhagen]. Like Calophyllum but lacking epitheca in earliest stages; subpinnate, zaphrentoid arrangement of protosepta and meta-septa replaced in mature stages by radial arrangement in which four protosepta (cardinal, two alar, and counter septa) remain long, others are somewhat reduced; tabulae declined abaxially; no dissepiments. U.Perm., E.Greenl.—Fig. 211,7a-c. \*G. teicherti (Flügel), holotype, *Productus* Ls., Kap Stosch; a-c, transv. secs., ×4 (Flügel, 1973b).

**Hexalasma** Soskchina, 1928, p. 365 \*[H. primititum; M; †498, coll. 146, PIN, Moscow] [=Hexalasma Lang, Smith, & Thomas, 1940, p. 70, nom. van., non Hexalasma Hoek, 1915, a cirripede; ?Pseudocryptophyllum Easton, 1944b, which see]. Solitary, with deep calice; with narrow peripheral stereozone and six protosepta, all reaching axis but in calice much shortened; metasepta confined to wall; counter quadrants equal to or somewhat larger than cardinal; tabulae present in late stages; dissepiments absent [see Sokolov, 1960, p. 55]. L.Perm.(Artinsk.), Eu.(N.Urals); U.Perm., Asia(Timor-NE.USSR).—Fig. 212,3a,b. \*H. primititum, ?syntype, R. Shchugor; a,b, transv. secs., b in calice?, ×2 (Kabakovitch, 1962).

**Huangophyllum** Tseng, 1948, p. 3 \*[H. symmetricum; OD; †6942, not traced, ?Peking]. Solitary, curved trochoid, concave side cardinal; counter and alar septa longest, counter septum may be rhopaloid but does not form separate columnella: cardinal septum short; major septa in all quadrants successively shorter with sequence of insertion, and pinnately arranged to cardinal and alar fossulae; axial ends of major septa of cardinal quadrants free, those of counter quadrants may be conjoined; no dissepiments; in early stages septa meet at axis. Perm., Asia(Szechwan).—Fig. 211,1. \*H. symmetricum, Maokou Ls.; a-d-e-j, series of transv. secs., 2 specimens, ×3 (Tseng, 1948).

**Kinkaidia** Easton, 1945, p. 384 \*[K. trignonidis; OD; †3512, ISGS, Urbana]. Small, curved, ceratoïd; counter and two alar septa long, dominant; cardinal septum short; counter-laterals may be long; metasepta short in young stages; septa may be weakly rhopaloid; minor septa short; tabulae low domes with downturned edges, no dissepiments. Up.U.Miss.(Chester), N.Am.(Ill.-Ark.).—Fig. 211,5. \*K. trignonidis, holotype, Kinkaid Ls., S. Ill., Cedar Grove Church; transv. sec., ×4.5 (Easton, 1945).

**Pleophyllum** LeCorme, 1952 [2nd quarter], p. 468, nom. subst. pro Polycoelia (Weisermelia) Schindewolf, 1942, p. 93, non Weisermelia Lang, Smith, & Thomas, 1940, p. 139, a Silurian rugosan \*[Polycoelia (Weisermelia) compacta Schindewolf; OD; † in Schindewolf Coll., ZCI, E. Berlin] [=Polycoelia (Pycnocelioa) Schindewolf, 1952 (Nov.), p. 165, nom. subst. pro Polycoelia (Weisermelia) Schindewolf, 1942, p. 93 (Schindewolf, 1952, p. 165, stated this is not a synonym of Polycoelia (Tetralasma) Schindewolf, 1942, p. 93, as Wang, 1950, p. 208, claimed, and upheld its validity); Maichelasma Fomichev, 1953b, p. 30 (type, M. magnum, OD; † in coll. 7184, TSGM, Leningrad; U.Perm., Dololinovaya Suite, NE. USSR)]. Solitary, small; cardinal, counter, and two alar septa long, rhopaloid and thickened and laterally contiguous so that tabulae are suppressed; counter-lateral and metasepta equal, short and thick, forming peripheral stereozone in which also short minor septa are confined. L.Carb.(Visean), Eu.(Ger.); U.Perm., Asia(NE.USSR).—Fig. 212,3a,b. \*P. compactum (Schindewolf), holotype, Visean, Ger., Überkehr, Frankenwald; a,b, transv. secs., ×4.0 (Schindewolf, 1942).—Fig. 212,3c,d. P. magnun (Fomichev), holotype, U.Perm., USSR; c,d, transv. secs., ×2.5 (Kabakovitch, 1962).

**Pseudocryptophyllum** Easton, 1944b, p. 34 \*[P. cavum; OD; †unnumbered, Univ. Missouri, Columbia] [=Hexalasma Soskchina, 1928, which see]. Solitary, small; six primary septa in earliest stage, three (cardinal and alars) persistently strongest, longest; counter septum very strong in early stages, rapidly weakening, but persisting into latest stage observed; metasepta and minor septa projecting from wall only in counter quadrants;
tabulae steeply arched with slight axial sag; no dissepiments. L.Miss., N.Am.(Mo.); ?L.Perm., USSR(N.Urals).—Fig. 210,2a-d. *P. cavum, holotype, Chouteau Ls., Mo., Pettis Co.; a-c, transv., d, long. secs., ×3.4 (Easton, 1944b).

*Sassendalia Tidten, 1972, p. 28 [*S. turgidiseptata; OD; tB2.138, G.P.M., Münster; cardinal side concave; major septa dilated, rhopaloid in late stages, dilatation decreasing distally leaving anteperipheral zone of interseptal loculi in addition to cardinal and alar fossulae present from early stages; counter and two alar septa longest and thickest, cardinal septum short; no major septa unequal with some alternation in length; septal insertion accelerated in counter quadrants; minor septa visible in calice; tabulae declined outward from axis; no dissepiments. L.Perm.(Artinsk.), Eu.(Spits.)].—Fig. 210.4. *S. turgidiseptata, holotype, Productus-bearing cherty rocks, Sassendal; transv. sec. through base of calice, ×2.7 (Tidten, 1972).

Sochkhineophyllum Grabau, 1928, p. 75 [*Plerophyllum artiense Soshkina, 1925, p. 91; OD; t809, coll. 146, PIN, Moscow] [=Empodesma Moore & Jeffords, 1945, which see; Sochkhineophyllum Kabakovich, 1962, p. 325, nom. van.]. Solitary, small; counter septum and two alar septa longer and more thickened toward their rounded axial edges than others; cardinal septum short and lying in fossula; septal insertion in counter quadrants accelerated; other major septa unequal, longer ones also becoming rhopaloid; tabulae complete, conical or centrally depressed cones; minor septa very short; no dissepiments. [See also Kabakovich, 1962, p. 325; septal plan in early stages of type species not known.] U.Carb. (Moscow.), Eu.(Spain); L.Perm.(Artinsk.), Eu. (W. Ural)-Asia (China-Japan-?NE. USSR)-N.Am. (Kans.).—Fig. 211,6a,b. *S. artiense (Soshkina), up. Artinsk, W. slopes of N. Urals; a,b, transv., long. secs., ×1.5 (Grabau, 1928).

Stereocorypha Moore & Jeffords, 1945, p. 84 [*S. antennis; OD; tP11931c, UTBEG, Austin]. Solitary, small to medium-sized, slightly curved, conical with cardinal side common concave; major septa long, radial, most or all reaching axis or axial region where they may be conjoined; cardinal septum commonly thinner, shortening during late stages, in obviously marked fossula; insertion in counter quadrants accelerated; minor septa absent or rudimentary; tabulae broadly conical, some incomplete; no dissepiments; septa of early stages greatly thinned. L.Perm., N.Am.(Texas-Okla.).—Fig. 212,1a-c. *S. antennis, holotype, Morrow, base of Marble Falls Ls., Texas, 10 mi. SW. San Saba; a,b, transv., c, long. secs., ×3 (Moore & Jeffords, 1945).

Svalbardphyllum Fedorowski, 1965a, p. 45 [*S. pachyseptatum; OD; t164, Birkenmajer Coll., PZI, Poznan] [=Svalbardphyllum Flügel, 1970, p. 272, nom. null.]. Solitary, ceratoid, longer side cardinal; major septa strongly dilated; cardinal and counter septum shortened; alar septa rhopaloid, very long, may be joined to first metasepta of counter quadrants or with neighboring cardinal metasepta; metasepta pinnately arranged with respect to alar and cardinal septa; cardinal and alar fossulae closed, opening only in calice; minor septa very short; one series of dissepiments developed only in calice; tabulae strongly arched, with downturned edges. [Possibly cyathopсид.] L.Perm., Eu. (Spits.).—Fig. 212.2a-c. *S. pachyseptatum, holotype, up. Treskelodden Beds, Hornsund; a, transv. sec., mature, b, transv. sec. through part of calice, c, long. sec., all ×2 (Fedorowski, 1965a).

Tetralasma Schindewolf, 1942, p. 90 [*Polycoelia (Tetralasma) quadriseptata; OD; t ?, in SCHIndE&WOLF Coll., ZGI, E. Berlin] [=Amandaria LAVRUSEVICH, 1968, which see]. Solitary, small; like Calophyllum, with long (but thin), equally spaced cardinal, counter, and alar septa, and two or three metasepta in each quadrant, but counter-lateral and metasepta become confined to wall in late stages, and the counter, cardinal, and two alar septa remain long almost to calical edge; earliest stages zaphrentoid [see SCHindE&WOLF, 1952, p. 165, and Flügel, 1973b, p. 5]. L.Carb.(low. Visean), Eu.(Ger.); ?Perm., Eu.(Hung.); U. Perm., Greenl.—Fig. 212.4a,b. *T. quadriseptatum, holotype, Erdbach Ls., Ger., Erdbach; a,b, transv. secs., ×4 (Schindewolf, 1942).

Subfamily PROSMILIINAE Ivanovskiy, 1973

[PROsmiliinae Ivanovskiy, 1973a, p. 78].

Solitary Polycoeliidae with dissepimentarium. U.Perm.

Prosmilia Koker, 1924, p. 28 [*Plerophyllum cyathophyloides GERTH, 1921, p. 90; SD LANG, SMITH, & THOMAS, 1940, p. 105; synotypes, 11785-11789, TH, Delft, 28 in WANNER Coll., IP, Bonn]. Solitary; cardinal, counter, and alar septa somewhat thickened, with rhopaloid axial ends; cardinal septum may shorten in late stages; septal insertion accelerated in counter quadrants, counter-lateral and one or more of the metasepta in each quadrant, commonly one toward middle of quadrant, may be longer and stronger than other metasepta; minor septa long, thinner than major; tabulae complete or incomplete, low domes; dissepimentarium moderately wide, dissepiments normal, steep, some elongate. U.Perm., Asia(Timor).—Fig. 213,1a-c. *P. cyathophyloides (GERTH), Basleo; a,b, transv. secs., ×8, ×4; c, another specimen, long. sec., ×3 (Schindewolf, 1942).

Family ANISOPHYLLIDAE

Ivanovskiy, 1965

[Anisophyllidae Ivanovskiy, 1965a, p. 77].
Solitary, small; cardinal and two alar septa long, meeting in axial region, thickened and rhopaloid. *U.Sil.*

*Anisophyllum Milne-Edwards & Haime, 1850,* p. lxvi [*A. agassizi; OD; 1136/1, EM, Paris*]. Solitary, small; cardinal side convex, with deep, oblique calice with pit at end of elongate cardinal septum, which like the two alar septa is rhopaloid and longer and taller than others; these three meeting in axial region, but not forming columnellar boss in calice; counter and counter-lateral septa no longer than metasepta, and minor septa short and ?contractingent; tabulae ?absent [see Amsden, 1949, p. 104; Sutherland, 1965, p. 42; Ilina, 1978, p. 31]. *U.Sil., N.Am.(Tenn.-Okla.)*.—Fig. 214,1. *A. agassizi, Brownport F., Blue Mound glade 30-45 ft. above Dixon-Brownport contact, Tenn., Perryville Quadrangle; lat. view, ×2 (Amsden, 1949).

**Family Plerophyllidae Koker, 1924**

Plerophyllum Hinde, 1890, p. 195 [*P. australe; SD Grabau, 1928, p. 46; †R13984, BM(NH), London; lectotype by Hill, 1937b, p. 49*] [?Timo1'osmilia Koker, 1924, p. 30 (type, Plerophyllum radiciforme Gertl, 1921, p. 92; OD; syntypes, 29, Gertl Coll., IP, Bonn, and 11790, TH, Delft; U.Perm., Baslejo and Oilmasi, Timor; trabeculae in two alternating series)]. Solitary, ceratoid, cardinal side commonly concave; five septa (cardinal, counter-lateral, and alar) larger and more dilated and rhopaloid than other major septa; in early stages septal plan zaphrentoid, and septa may be thickened so that lumen is filled; in later stages axial edges of septa free; distal edges of septa smooth; trabeculae where noted monacanthine; minor septa rudimentary to short; tabulae gently declined from axis; no dissepiments. *L.Perm., Australia (W. Australia-Queensl.); V.Perm., Asia (E.Iran).—Fig. 214,3a-b. ·P. australe, syntype, L.Perm., W. Australia, Irwin R.; a,b, transv. sees., X2.5 (Hinde, 1890).—Fig. 214,3c. ·P. radiciforme Gertl, syntype, U.Perm., Timor, Oilmasi; transv. sees., ×4.0 (Gerth, 1921).

Barbarella Flügel, 1972, p. 65 [*Plerophyllum (Barbarella) stellaforma; OD; †P2704, Ug, Graz*]. Like *Plerophyllum* in having long cardinal, two counter-lateral, and two alar septa, and short counter septum, but lacking epitheca in earliest stages. *U.Perm., Asia (E.Iran).—Fig. 214,6a-b. *B. stellaforma, holotype, low. Jamal F., Kuh-e-Bagh-e-Vang; a,b, side, apical views, enl. (Flügel, 1972).*

Pleramplexus Schindewolf, 1940, p. 401 [*P. similis; OD; †in Schindewolf Coll., ZGl, E. Berlin*]. Solitary; early stages first zaphrentoid, then plerophylloid; cardinal septum shortens early and in late stages all septa become thinner and less rhopaloid and withdraw from contact, leaving widening axial zone free of septa; tabulae commonly complete, declined from inner ends of septa to periphery and into shallow cardinal fos-
sula; minor septa rudimentary to short; no dissepiments. U. Perm., Asia (Timor-NW. Iran-Nakhichev.)-Eu. (Greece).——Fig. 214, 5a-c. *P. similis, Basleos; a,b, holotype, transv. secs., X 4; c, para-type, long. sec., X 4 (Schindewolf, 1942).

Ufimia Shtukenberg, 1895, p. 27 [*V. carbonaria; M; +21 and probably 23/45, Shtukenberg Coll., LGI, Leningrad, plus unnumbered piece in Univ. Kazan; lectotype by Fedorowski, 1973, p. 112] [=Rhopalolaima Hudson, 1936b, p. 93 (type, R. tachyblastum, OD; +54752 and PF1125-9, IGS, Leeds; low. Visian, Butterhaw Quarry, Gargrave,
Coelenterata—Anthozoa

Yorkshire); Rhopalesasma LANG, SMITH, & THOMAS, 1940, p. 115, nom. van.; ?Plerophyllum (Meniscophyllumoides) KULLMAN, 1966, p. 452 (type, M. simulans, OD; %Xoe1300/1492, KULLMAN Coll., GPI, Tübingen; low. Namur, gray marls of Eumorphophyceras Stage, Plorla, Spain; see Weyer, 1973d, p. 675). Solitary, small; in late stages with four septa (alar and counter-lateral) longer, taller, and more rhopaloid than others; early stages zaphrentoid; rhopaloid axial ends of major septa commonly conjunct in axial region in middle stages of development, withdrawing and becoming free axially in late stages, with smooth distal edges; longest and strongest metasepta commonly mid-quadrant; counter and cardinal septa shorten progressively; minor septa rudimentary to short; tabular floors tall, axially depressed; no dissepiments. L.Dev.(up. Ems.), Eu.(Ger.); M.Dev., Eu.(Spain); U.Dev. (Famenn.), Eu.(Ger.-Pol.); L.Carb., Eu.(U.K.-Ger.-USSR); U.Carb., Eu.(Donbas-Spain); Perm., Eu.(Urals)-Asia (Timor-Nakhichev.-NW. Iran); ?Perm. (China).—Fig. 214,4a-b. *U. carbonaria, syntype, L.Carb., USSR, R. Ufa; a, transv. sec. through base of calice, enl.; b, diagram. septal plan drawn from Shukenberg's figure by SCHINDEWOLF (1942), X4 (Shukenberg, 1895).—Fig. 214,4c-d. U. tachylitha (Hudson), holotype ?occurrence; c,d, transv. secs., X5, X2 (Hudson, 1936b).

Subfamily BARYPHYLLINAE Weyer, 1973

[Baryphyllinae Weyer, 1973b, p. 56]

Turbinate, patellate, or discoid Plerophyllidae, with or without epitheca, and with everted calice in which distal edges of septa are arched; an axis of divergence of septal fibers coincides with peak of arch. L.Carb.

Baryphyllum MILNE-EDWARDS & HAIME, 1850, p. lxvi [*B. verneulianum; OD; 3 syntypes, e-148.-a, de Verneuil Coll., EM, Paris]. Small, discoid with small central peduncle of attachment and without epitheca; on calical surface long, stout cardinal septum and alar septa reach axis, but counter septum short and weakly developed; minor sepa lacking; metasepta of cardinal quadrants pinnate to cardinal septum; septa of counter quadrants directed to alar septa; cardinal fossula shallow; no dissepiments. L.Carb.-U.Carb.

Barylasma WYER, 1973b, p. 58 [*Hadrophyllum ovale BASILLER, 1937, p. 198; OD; syntypes, 91059, USNM, Washington]. Solitary, turbine to discoid, with everted calice and epitheca; cardinal, counter-lateral, and alar septa long, counter septum shortened; minor septa weak, may be contra-

tingent; tabulae ?absent; fibers of septum diverging from axis coinciding with peak of arch in distal septal edge, which is smooth. L.Miss., N.Am.(Ala.-Ky.-Tenn.).—Fig. 214,2a-c. *B. ovale (BASILLER), syntype, Osag., Fort Payne chert, Ala., near Florence; a-c, proximal, distal, and lat. views, X1.5 (Bassler, 1937).

Family ENDOTHECIIDAE

Schindewolf, 1942


Solitary, small, with aulos; in late stages alar septa longest, cardinal and counter septa shortened; major septa pinnately arranged in early stages; minor septa short. U.Perm.

Endothecium KOKER, 1924, p. 23 [*E. apertum; SD LANG, SMITH, & THOMAS, 1940, p. 57; 111770, TH, Delft]. Solitary, small; in late stages alar septa outstanding, cardinal and counter septa short, major septa thickened, their inner edges thickened and withdrawn from axis, rhopaloid and forming an aulos; minor septa short; tabulae declined from inner wall to periphery; no dissepiments; in early stages septa pinnately arranged [see SCHINDEWOLF, 1942, p. 168]. U.Perm., Asia(Timor).—Fig. 215,4a-e. E. decipiens KOKER, Basleo; a-b, transv. secs., X9, c, transv. sec., X7, d, long. sec., X6; e, another specimen, transv. sec., X4 (Schindewolf, 1942).

Family ADAMANOPHYLLIDAE

Vasilyuk, 1959

[Adamanophyllidae Vasilyuk, 1959, p. 85]

Solitary or compound, with counter-lateral, alar, and cardinal protosepta longer and thicker than other major septa; in some, cardinal septum shortened in late stages; with dissepimentarium. L.Carb.-U.Carb.

Subfamily ADAMANOPHYLLINAE Vasilyuk, 1959


Solitary or compound Adamanophyllidae in which cardinal septum remains long and tabular floors are concave in late stages. L.Carb.-U.Carb.

Adamanophyllum VASILYUK, 1959, p. 85 [*A. incertum; OD; 135, coll. 1405, IG, Kiev]. Solitary; major septa unequal, cardinal, alar, and counter-lateral protosepta longer and thicker, reaching or almost reaching axis; minor septa much thinner and discontinuous; dissepimentarium wide, with some lonsdaleoid dissepiments disrupt-
ing one or more major septa, more numerous dissepiments that cross loculi between two neighboring major septa, and small dissepiments in two overlapping series in each such loculus; tabulae
**Family PENTAPHYLLIDAE**

Schindewolf, 1942


Solitary, not large; five protosepta (cardinal, alar, and counter-lateral) long and thick and with free axial ends even in earliest stages; counter septum rudimentary and metasepta variously stunted, radially not pinnately arranged; minor septa rudimentary to short; tabulae declined from axial region; no dissepiments. **Dev.-L.Carb.; Perm.**

Validity of this family is still arguable; ILINA (1965, p. 21) and WEVER (1972b, p. 728; 1973b, p. 47) consider its genera to be intergradational also with plerophyllid genera, and place its genera in Plerophyllidae KOKER, 1924. On the other hand, SCHINDEWOLF (1942, p. 171) and FEDOROWSKI (1973, p. 113) considered the tachyelasmoid early stages of HUDSON (1936b, p. 100), subsequently called penta­phyllid by SCHINDEWOLF (1942, p. 59), to be taxonomically important, SCHINDEWOLF as of subfamily value and FEDOROWSKI as of subordinal value. There is the additional difficulty that ontogenesis has not been studied in the type species of either Pentaphyllum or Tachyla­lisma; this Treatise tenta­tively gives family value to Pentaphyllidae.

**Pentaphyllidae** with five protosepta dominant throughout (cardinal, alar, counter-lateral); in some, counter-lateral septa shorter and subequal to metasepta. **Dev.-L.Carb.; Perm.**

**Pentaphyllum de Koninck, 1872, p. 58** [*P. arna­tum; SD Hinde, 1890, p. 195; t+586, IRSN, Brussels; Schindewolf (1942, p. 172) considered, from study of monotypes, that P. arnatum is conspecific with Pentaphyllum caryophyllatum de Koninck, 1872, of which the ontogeny was described by HUDSON (1936b, p. 99)] [Pentaphyllum de Koninck, 1871, p. 321, nom. nud.; Cryptophyllum Carruthers, 1919, p. 439 (type, C. hibernicum, OD; ?PF1090, 1091, IGS, Leeds, lectotype by HUDSON, 1936b, p. 98; L.Carb., low. Calp Series, Bundoran, Donegal Bay, Eire; ?Hep­taphyllum Clark, 1924, p. 416 (type, H. gracile, OD; ?A3382, SM, Cambridge; L.Carb. (Zj), Co. Sligo, Eire; insufficiently known)]. Solitary, small; five septa (cardinal, counter-lateral, and alar) almost reaching axis and thining adaxially; counter septum rudimentary to short; metasepta stunted; minor septa rudimentary except Km, which may be short; tabulae few; early stages pentaphylloid (five long protosepta, counter septum rudimentary; septa subradial not pinnate in plan; metasepta rudimentary to short). **L.Carb., Eu. (Belg.-U.K.-
FIG. 216. Pentaphyllidae (p. F330-F331).

**FIG. 216.** Pentaphyllidae (p. F330-F331).  

**FIG. 217.** a-c. **C. lanescillense**, Salem Ls., Ind., Lanesville; a, b, calical, ext. views, enl. (Miller, 1892).

**FIG. 217.** a-c. **C. lanescillense**, Salem Ls., Ind., Lanesville; a, b, calical, ext. views, enl. (Miller, 1892).

**FIG. 217.** a-c. **C. lanescillense**, Salem Ls., Ind., Lanesville; a, b, calical, ext. views, enl. (Miller, 1892).

**Antikinkaidia** FEDOROWSKI, 1973, p. 115 [*A. triseptata*; OD; †Tc-6/22, PZI, Poznan]. Solitary, small; cardinal and alar septa predominant and except in very late stages joined axially; counter septum rudimentary; counter-lateral septa little if any longer than neighboring metasepta, which are of moderate length; septal insertion accelerated in counter quadrants; axial ends of protosepta and some metasepta may be rhopaloid; cardinal fossula shallow; tabulae present. [Based on one corallite.] U.Dev.(Famenn.), Eu.(Pol.).—Fig. 217,3a-c. *A. triseptata*, holotype, Wocklumeria or Gatten-dorfia Stage, Holy Cross Mts., Dalnia Hill near Kielce; a-c, transv. secs., X 5.0 (Fedorowski, 1973).

**Carinotachylasma** Xu in JIA et al., 1977, p. 123 [*C. shimenense*; OD; †IV38509, HPRIGS, Yichang; L.Perm., Gantxigou, Shimen Xian (county), Hunan]. Like *Tachylasma* but septa with metriophyloid flanges. L.Perm., Asia(Hunan).

**Cystelasma MILLER, 1891, p. 12** [*C. lanescillense*; OD; †not traced]. Solitary, very small, commonly irregularly cylindrical and with talons; cardinal, counter-lateral, and alar septa predominant but short; metasepta and counter septum rudimentary to very short; minor septa not observed; tabulae complete, horizontal; large peripheral longitudinal dissepiments may appear in single series in late stages. [Early stages not described. See STUMM, 1948d, p. 68. L.Carb.(mid.Miss.), N.Am.(Ind.-Ky.).]—Fig. 217,2a,b. *C. lanescillense*, Salem Ls., Ind., Lanesville; a, b, calical, ext. views, enl. (Miller, 1892).

**Oligophyllum** POCTA, 1902, p. 192 [*O. quinqueseptatum*; OD; †unnumbered, BARRANDE Coll., NM, Prague] [=Pentelasma KULLMAN, 1965, p. 133 (type, Oligophyllum (Pentelasma) rari-septatum, OD; †Coe1281/534, KULLMAN Coll., GPl, Tübingen; Ems; Arruz beds, Prov. Palencia, Spain)]. Solitary, small; five septa (cardinal, counter-lateral, and alar) elongate and slightly rhopaloid, counter septum short or stunted; septal plan subradial; metasepta short to stunted, minor septa reduced to moderately thick wall; tabulae absent; no dissepiments [see SCHINDEWOLF, 1942, p. 177; KULLMAN, 1965, p. 122; WEVER, 1973b, p. 52]. L.Dev., Eu.(Czech.-Spain-Ger.); M.Dev. (Eifel.), Eu. (Czech.-Spain.-Ger.)-Asia (Urals-Rudny Altai); †U.Dev.(Famenn.), Eu.(Spain-Ger.-Pol.).—Fig. 217,4a,b. *O. quinqueseptatum*, syntype, L.Dev.(Prag.), Dvorce Ls., Czech., Dvorce; a, b, transv. secs., enl. (Pocta, 1902).

**Pentamblexus** SCHINDEWOLF, 1940, p. 403 [*P. simulator*; OD; † in ?SCHINDEWOLF Coll., ZGI, E. Berlin]. Solitary, small, with deep cardinal fossula on convex side; in intermediate stages of growth, counter-lateral, alar, and cardinal septa longer than counter septum and metasepta, not arranged on zaphrentoid plan, may be thickened so as almost to fill lumen; in late stages all septa thinner and amplexoid; earliest observed stage pentaphyllid; tabulae declined abaxially; minor septa short. L.Dell. (Famentl.), Eu.(Czech.-Spain-Ger.-Pol.); M.Dell. (Eifel.), Eu.(Czech.-Spain.-Ger.)-Asia (Urals-Rudny Altai); †U.Dev.(Famenn.), Eu.(Spain-Ger.-Pol.).—Fig. 217,1a-c. *P. simulator*, holotype, Timor, Bitauni; a, calical view, X 1.0; b, long. sec., X 2.0; c, transv. sec. early stage, X 3.0 (Schindewolf, 1942).

**Tachylasma** GRABAU, 1922, p. 34 [*T. cha*; OD; †142, Geol. Survey China, ?Peking] [=Ufimia SHTUKENBERG, 1895, p. 27, see Plerophyllidae, Plerophyllinae; Tachylasma LANG, SMITH, & THOMAS, 1940, p. 130, nom. van.; ?Prionophyllum SCHINDEWOLF, 1942, p. 209 (type, Pentaphyllum (Prionophyllum) crassiseptatum, OD; †single specimen in ?SCHINDEWOLF Coll., ZGI, E. Berlin; L. Perm., Bitauni, Timor; zigzag lamellation in septa
hern considered diagenetic). Solitary, small, four protosepta (alar and counter-lateral) longest, tallest, and most rhopaloid; counter septum thin but moderately long and rhopaloid, cardinal septum greatly shortened; metasepta unequal, somewhat rhopaloid, those in midquadrant stronger than others; minor septa very short; tabulae sparse; early stages in type species unknown. [Schindewolf (1942, p. 195) noted pentaphylloid early stages in his new Permian tachylasmoid species Pentaphyllum (Tachylasma) variable, and (1942, p. 53) thought it possible that the Permian Tachylasma cha and more probably T. elongatum Grabau, 1922, has this type of early stage, rather than the zaphrentoid early stages found in homeomorphic Ufimia, a supposition that is tentatively accepted in this Treatise.] Perm., Asia(China-Timor).—Fig. 217,5a. *T. cha*, holotype, ?S. China; diagram. transv. sec., X3.0 (Grabau, 1922).—Fig. 217,5b-e. T. variabile (Schindewolf), L. Perm., Bitauni, Timor; b-e, transv. secs., X5.0, X3.8, X2.0, X1.4 (Schindewolf, 1942).—Fig. 217,5f-i. ?T. crassiseptatum (Schindewolf), holotype, Bitauni; f-i, transv. secs., X2.0; i, calic view, X1.5 (Schindewolf, 1942).

Subfamily COMMUTINAE Fedorowski, 1973
[Commutinae Fedorowski, 1973, p. 117]

Pentaphyllidae with irregular aulos formed from axial ends of septa. U.Dev. (Famenn.).

Commutia Fedorowski, 1973, p. 118 [*C. szulczewskii*; OD; fTc-6/33, PZI, Poznan]. Solitary,
small, funnel-shaped; in late stages corallum expands sharply and axial ends of cardinal, alar, and counter-lateral protosepta, and in some a few metasepta, unite to form inner wall that may be impermanent, but counter septum and other metasepta are short; in early slender stages of corallum no aulas is present, and only five protosepta are visible; tabulae concave within aulas, declined abaxially in peripheral regions. U.Dev.(Famenn.), Eu.(Pol.).—Fig. 218,2a-d. *C. szulczewskii, Wocklumeria or Gattendorfia Stage, Holy Cross Mts., Dalnia; a,b, holotype, transv. secs., ×5; c,d, another specimen, transv., long. secs., ×5 (Fedorowski, 1973).

Subfamily DALNIINAE Fedorowski, 1973

Pentaphyllidae with both cardinal and counter septa rudimentary to short. U.Dev. (Famenn.) or L.Carb.

Dalnia Fedorowski, 1973, p. 127 [*D. tetraseptata; OD; fTc-6/68, PZ1, Poznan]. Slender, widening in calice; two alar and two counter-lateral septa appear first and may join at axial edges; cardinal septum appears later and thicker but does not join others; metasepta few and rudimentary to short; counter septum appears late and remains short; tabulae sparse. U.Dev.(up.Famenn.) or L.Carb.(Tournais.), Eu.(Pol.).—Fig. 218,1a-c. *D. tetraseptata, holotype, Wocklumeria or Gattendorfia Stage, Holy Cross Mts., Dalnia; a-c, transv. secs., ×5 (Fedorowski, 1973).

Family LOPHOPYLLIDAE

Grabau, 1928

[Lophophyllidae Grabau, 1928, p. 57] [=Lophophyllididae Moore & Jarzemboski, 1945, p. 92; Lophophyllidinae Wang, 1947b, p. 335; Lophophyllididae Wang, 1950, p. 207; Stereozyllidae Ilina, 1974, p. 215]

Solitary, with calically projecting axial structure composed of medial plate that is prolongation of axial end of counter septum and in earliest stages is commonly continuous also with cardinal septum; axial structure commonly includes also septal lamellae and axial tabellae and all components may be variably thickened; cardinal septum shortens early, in fossula that narrows adaxially; in late stages and in calice, distal notch may separate counter septum from axial structure; septa more or less radially arranged in counter quadrants, where insertion is accelerated, and pinnately arranged in cardinal quadrants; septa commonly thickened, may be rhopaloid; trabeculae may be detectable in median longitudinal section of septa, and are thin and close and distal and axial edges of septa are smooth or only very finely denticulate; tabulae declined from axial structure, complete or incomplete; no dissepiments. L.Carb.-U.Perm.

Lophophyllum Milne-Edwards & Haime, 1850, p. lxvi [*L. konincki; OD; fno. 1 of 6 syntypes, Z37a, MN, Paris; lectotype by Hill, herein]. Solitary, small, with oblique calice; cardinal side convex; with small, laterally compressed, distally projecting columella proximally continuous with both cardinal and counter septa, distally separated from cardinal septum by wide notch; with closed fossula in front of and embracing columella and widening adaxially; major septa (except those that border fossula) reaching columella in proximal parts and arranged with marked bilateral symmetry; in cardinal quadrants they are curved slightly toward axis and fuse variably to delimit fossula; in counter quadrants they are commonly isolated, radial, and shorter; minor septa but little developed; arched tabulae present, but no dissepiments [see Lecompte, 1955, p. 410]. L.Carb. (Tournais.), Eu.(Belg.).—Fig. 219,2a-c. *L. konincki, lectotype, Tournai; a, calical view, ×3; b,c, views of right and left longitudinal fractured surfaces, showing tabula, ×3 (Lecompte, 1955).

Lophamplexus Moore & Jeffords, 1941, p. 90 [*L. eliasi; OD; f42392, KUMIP, Lawrence]. Solitary, conical to subcylindrical; young stages with axial end of counter septum thickened and extended to form columella; short cardinal septum...
Fig. 219. Lophyllididae (p. F333-F336).
in shallow fossula and other major septa equal and at first in contact with, then withdrawing from columella; in later stages failing and septa becoming amplexoid; minor septa rudimentary; tabulae flat-topped domes, complete or incomplete; dissepiments absent. **Penn.-L.Perm., N.Am.** (Ohio-Okla.-Kans.-Mo.); **U.Carb., S.Am.** (Venez.).—Fig. 220,1-a. *L. eliasi*, holotype, Perm. (Wolfcamp.), Kans., near Grand Summit, Cowley Co.; a-c, transv., d, long. secs., X3 (Moore & Jeffords, 1941).

**Lophocarinophyllum** GRABAU, 1922, p. 46 [*Lophophyllum* (Lophocarinophyllum) acanthiseptatum; OD; t147, IGP, Nanking, *fide* catalog, but cited as t146 by IVANOVSKIY, 1976, p. 100, following FOMICHEV, 1953b, p. 38 (work not seen by Hill)]. Solitary, small, curved; with prominent columella formed by distal prolongation of expanded axial end of long counter septum; cardinal septum short in late stages, other major septa subequal, long; septa with subhorizontal flanges; minor septa very short; tabulae ?conical, thin; no dissepiments; in early stages major septa confluent axially in axial structure. **U.Carb.-U.Permiss., Asia** (Shantung, Shensi-Camb.)-**Eu.** (Italy-Aus.-Donbas).—FIG. 220,2a-e. *L. acanthiseptatum*, syntypes, U.Carb., Shantung, Tung Chiang, I-Hsien; a-d, oblique transv., e, long. secs., x2.5 (Grabau, 1922).

**Lophophyllidium** GRABAU, 1928, p. 98 [*Cyclophonia prolifera* MCCHESNEY, 1860, p. 75; OD; *fide* Grabau, 1928, p. 99 (type, Lophophyllum pendulum Grabau, 1922, p. 48, OD; t1584-1586, IGP, Nanking; Perm., Fengcheng, Kiangsi, China, *fide* Grabau, 1922, p. 70; cardinal side concave, structure of large dense columella not clear, ?(of medial plate and radial septal lamellae); until holotype is sectioned and topotypes described name is best not used); ?Malonophyllim OKULITCH & ALBRIGHT, 1937, p. 24 (type, M. texanum, OD; *fide* Grabau, 1928, p. 70; distally structure may be separated from counter septum by septal notch; cardinal septum short except in earliest stages where it may be continuous with long counter septum; remaining major septa subequal, discontinuous with septal lamellae of axial structure, their axial ends may be rhopaloid and...

![Fig. 220. Lophophyllidae (p. F334-F335).](image-url)
they may be thickened to form, around axial structure and touching it or separated from it, a collar discontinuous at open cardinal fossula, to which youngest septa of cardinal quadrants are pinnate and which is commonly on concave side of corallum; tabular floors declined from axial structure to wall, which may be moderately thick, but axial edges of tabulae may also be slightly deflected proximally where they meet the axial structure; no dissepiments [see also Fedorowski, 1974a, p. 441, and FLÜGLER, 1972, p. 74]. Penn.-Perm., N.Am.(Ill.-Ark.-Okla.-Kans.-Ohio-N.Mex.-Texas-Alaska-C. Am.-Guat.)-S.Am.(Peru-Venez.); U. Carb.-Perm., Eu. (Spain-USA-Aus.)-W. Australia-Asia(China-Japan-Viet Nam-Camb.-Burma-Iran).—Fig. 219,4a-d. *L. proliferum (McCHESNEY), neotype, Penn.(Missour.), Ill., near Springfield; a-c, transv., d, long. secs., ×3.0 (Jeffords, 1942).—Fig. 219,4e-f. *L. paolieri (FOMICHEV), holotype; e-f, transv. secs., ×3.0 (Fomichev, 1953a)—Fig. 219,4g-i. L. cambodgense (Fontaine); g-h, holotype, transv. secs., ×3.3, ×9.0; i, another specimen, Phon Takream, long. sec., ×3 (Fontaine, 1960).

**Family TIMORPHYLLIDAE**

Soshkina, 1941

[nom. transl. Hill, 1956d, p. F166, ex Timorphyllinae de SORSKINA in SOKHINA, Dobrotsyurova, & Forštev, 1941, p. 110, as Timorphyllinae, lapsus calami]

Characters of genus. U.Perm.

Timorphyllum** Gerth, 1921, p. 69 [*T. wanneri; M; †H-18, Wanner Coll., IP, Bonn; lectotype by SCHOPPÉ & STACUL, 1955, p. 153]. Solitary, somewhat scolecoid, epitheca almost smooth; with relatively simple axial structure, comprising lathlike columella commonly separated from septa in late stages and buttressed by sharply upturned axial parts of tabulae, a very few radial septal lamellae may appear in some; cardinal septum short, even in earliest known stage, counter septum may remain long but other septa withdraw from axis; septal insertion accelerated in counter quadrants; wall very thin, minor septa represented only by epithelial grooves or rudimentary; tabulae commonly complete, flat, with downturned edges and upraised axial parts; septa thickened in early stages; septal trabeculae very fine, close, arranged fanwise, normal to more or less convex distal edges of septa [see Fedorowski, 1974a, p. 470].

U.Perm., Asia(Timor-China)-N.Am.(Texas).—Fig. 221,4ab. *T. wanneri, Timor; transv., long. secs., ×2 (Schoppé & Stacul, 1955).

**Family VERBEEKIELLIDAE**

Schoppé & Stacul, 1955

[Verbpeekellidae Schoppé & Stacul, 1955, p. 141]

Solitary; with axial column of septal lamellae and axial tabellae; in late stages cardinal septum short and distal parts of other major septa discontinuous with septal lamellae and column; septa may be greatly thickened; metaskeletal insertion somewhat accelerated in counter quadrants; minor septa rudimentary or short; tabular floors convex or conical, drawn up into column, complete or incomplete; no dissepiments. L.Miss.-L.Penn.; U.Penn.-Perm.

**Verbeekilla** Penck, 1908b, p. 187, nom. subst. pro Verbeekia Penck, 1908a, p. 657; non Verbeekia Freitsch, 1877, an echinoderm [*Verbeekia permica; M; †not traced; =Clisiophyllum austrole BRYCH, 1865, p. 85, fide GERTH, 1921, p. 84, †K91.1, BRYCH Coll., HU, E. Berlin, lectotype by Schoppé & Stacul, 1955, p. 143, Perm., Kupang, Timor] [*Wannerophyllum Schoppé & Stacul, 1955, p. 129 (type, Carcinophyllum cristatum GERTH, 1921, p. 82, OD; †H1793, TH,
Fig. 221. Verbeekiellidae (1-3, 5, 6); Timorphyllidae (4) (p. F336-F338).
Delft, lectotype by SCouppé & Stacuc, 1955, p. 162, U.Perms., Basleo, Timer), minor septa project from peripheral stereozone, and cardinal side commonly convex. Solitary, with large axial column of few to numerous septal lamellae (in some with long or short medial plate) and axial tabellae; major septa in late stages discontiguous with column, their distal edges may be convex; cardinal septum shortens; septa may be thickened, especially in cardinal quadrants, and moderately wide peripheral stereozone may form; minor septa may be rudimentary to projecting from stereozone; axial tabellae domes or cones, numerous; pericolumnar tabellae less numerous, abaxially declined and weakly to moderately globose; no dissepiments. *Perm., Asia(Timer-Japan-Nepal-Iran)- Eu.(Urals)-W. Australia-?N.Am.(Texas).—Fig. 221,3a. *V. permica, type material, Ajermarti R. near Kupang, Timor; transv. sec., X2.7 (Gerth, 1921).—Fig. 221,3b,c. V. australis (BEYRICH), lectotype; side, calical views, X1.0 (BEYRICH, 1865).—Fig. 221,3d,e. V. cristata (GERTH), lectotype; calical view, transv. sec., X2.0 (Gerth, 1921).

?Cravenia Hudson, 1928, p. 252 [*C. rhodoides; OD: +R25971-6, BM(NH), London]. Solitary, small, cornute, fossula on convex side, axial structure a large, well-defined column with median plate produced into cusp on cardinal side and continuous in young stages with cardinal septum, which withdraws in late stages; numerous thin septal lamellae radiate with some curvature from median plate; tabellae within column more steeply declined than those between column and wall; septa somewhat dilated in early stages, their bases contiguous to form narrow peripheral stereozone; no dissepiments. [Possibly aukophyllid rather than verbeekellid.] *Carb.-low.(Viscan). Eu.(Eng-Wales-Eire-Urals).—Fig. 221,5a,b. *C. rhoides, holotype, C5, Haw Crag lower quarry, Yorkshire, Bell Busk; a,b, transv. long. secs., X3 (Hudson, 1928).

Leonardophyllum Moore & JEFFORDS, 1941, p. 85 [*L. distinctum; OD: +74161, KUMIP, Lawrence]. Solitary, erect or gently curved, conical to cylindrical; with axial structure that is without well-defined wall but consists of lathlike median plate that is continuous with counter septum and several septal lamellae and sharply updrawn axial parts of conical tabulae plus auxiliary axial tabellae; cardinal septum short in indistinct fossula, remaining major septa withdrawn somewhat from axial structure; minor septa short; no dissepiments. *Perm.(Morrow.), N.Am.(Okla.); U.Perms.(?Virgil.)-L.Perm.(Leonard.). N.Am.(Texas).—Fig. 221,2a,b. *L. distinctum, holotype, L.Perm., Texas, near Leonard M., Glass Mts.; a,b, transv., long. secs., X3 (Moore & Jeffords, 1941).

?Pseudowannerophyllum Flügel, 1975a, p. 113 (49) [*P. differens; OD: +P111, UG, Graz]. Solitary, curved-conical, cardinal side concave; axial structure variably thickened, of median lamella, radially or spirally disposed septal lamella, and axial tabellae, thickening commonly decreasing somewhat distally; cardinal septum long, in long adaxially expanding closed fossula in early stages, in later stages short, in open fossula; peripheral stereozone of moderate thickness, minor septa projecting from it in late stages; pericolumnar tabulae declined abaxially, complete or incomplete and subglobose. [Dense packing of elements in axial structure may indicate relationship to Lophophyllidae.] *Carb.(low.Bashkir.),(Asia(Iran).—Fig. 221,6a-c. *P. differens, Sadar F. I, Cheshmesh-shir, Ozbak-Kuh Ra.; a,b, holotype, transv. secs., X10, X3; c, paratype, long. sec., X3 (Flügel, 1975a).

Zeliaphyllum HERTTSCH, 1936, p. 130 [*Z. suessi; OD: +2070, UG, Graz] [=Zelaeophyllum LANG, SMITH, & THOMAS, 1940, p. 141, nom. van.]. Small, solitary; with axial structure of sparse, irregular, and strongly thickened septal lamellae and tabellae; major septa in late stages widely withdrawn from axial structure; form of tabulae unknown; presence of single series of thickened dissepiments doubtful (possibly tabulae). [*Imperfectly known.]*Perm., Eu.(Carnic Alps).—Fig. 221,1a-d. *Z. suessi, monotype, low. Pseuso-schwagerina Is., Ringmauer, Carnic Alps; a,d, transv. secs., X3 (Heritsch, 1936).


Predominantly large and solitary Stauriida; dissepimentarium wide, commonly with lonsdaleoid dissepiments dominant at least in later stages; tabular fossula distinct, with shortened cardinal septum; counter septum may be elongate; septa thick in early stages, thinning from axis and toward cardinal fossula and amplexoid in tabularium; tabular floors flat with downturned edges but in some axially depressed; tabulae commonly complete. *Carb.-low.*U.Perm.

Family CYATHOPSISIDAE Dybowskii, 1873 [Cyathopsidae Dybowskii, 1873c, p. 331] [=Cyathopsinae Dybowskii, 1873c, p. 331; Caninidice HINT, 1939 in 1938-1941, p. 102; Caninidice FOMINICH, 1953a, p. 213; Dagmaraeophyllidae ROCOV, 1963, p. 51; Cyathopsisae YAMOVSKII, 1965a, p. 53].

Solitary or fasciculate, with open tabular fossula; septa typically dilated and amplexoid in wide tabularium, dilatation decreasing first in counter quadrants; cardinal joined with counter septum in earliest stages, cardinal shortening in late stages but counter commonly remains long; tabulae...
Rugosa—Stauriida—Caniniina

Caninia  
Michelin in Gervais, 1840, p. 485, non Caninia Owen, 1846, a worm [*C. cornucopiae; OD; did disappear during wartime partial destruction of collections at Caen (Semenoff-Tian-Chansky, 1974, p. 174)] [=Cyathopsis d’Orbigny, 1849, p. 12 (type, Caninia cornu-bovis Michelin, 1846, p. 185, M; ? in Michelin Coll., MN, Paris, lectotype by Lang, Smith, & Thomas, 1940, p. 44; L.Carb., Tournai, Belg.), see Carruthers, 1908, p. 159; Peetzia Tolsmachew, 1924, p. 309 (type, P. minor, M; ? in coll. 2555, TsGM, Leningrad; L.Carb., R. Tykta, near Kuznetsk, fide Dobrylyubova & Kabakovich, 1966, p. 73); Disophyllum Tolsmachew, 1924, p. 316 (type, D. symmetricum, SD Tolsmachew, 1933, p. 287; ? in coll. 2555, TsGM, Leningrad; L.Carb., R. Nizhniy Ters, fide Dobrylyubova & Kabakovich, 1966, p. 73); Peetzia Fomichev, 1931, p. 41, 70, nom. null.; ?Kassinella Keller, 1959, p. 90 (type, K. longiseptata, OD; ?0022/16-E, coll. 28, MGU, Moscow; L.Carb., low. Tournais., Kazakh.), non Kassinella Borisyak, 1956, a Paleozoic brachiopod; ?Corphalia Poty, 1975b, Lithostrotionina, Lithostrotionidae, Thy­sanophyllinae]. Solitary, curved, conical, but in some straight or curved and cylindrical in late stages; major septa in early stages long but except for counter septum commonly not reaching axis, dilated, particularly in cardinal quadrants, but in late stages thin and straight or slightly concave toward cardinal septum, axially free, becoming shorter as growth proceeds; cardinal septum short, in open fossula on convex side of corallum; counter septum long; tabulae convex, commonly complete; minor septa short, may be discontinuous, dissepi­mentarium narrow, normal, or, with failure of minor septa, of inosculating dissepiments, or, in zones of rejuvenescence, lonsdaleoid. [Hudson, 1945a, p. 195, states that no zaphrentoid stage occurs in ontogeny of type species.] L.Carb.-U.  
Carb. (Tournais.-Namur.), Eu. (Brit.-Belg.-USSR); N. Afr. (Alg.)-Asia (Kazakh.-Kuzbas-?Taimyr- ?China-NE.USSR); Misss., N.Am.(N.Mex.-Mont.-Mo.).—Fig. 222, la-l. *C. cornucopiae, L.Carb., Belg., Tournai; a, ext. view, b-h, serial transv. secs., i-k, long. secs., l, calic. view, all ×1 (Carruthers, 1908).

Arctophyllum  
Fedorowski, 1975, p. 43 [*Camposphyllum intermediate Toula, 1875, p. 50; OD; ?Toula, pl. 5, fig. 13, UG, Graz] [=Pseudo­zaphrentoides Shukunberg, 1904, which see]. Solitary; major and minor septa continuous, in late stages major withdrawn from axis, cardinal septum short, counter less so; in early stages cardinal and alar septa long, counter short; septal thickening notable in tabularium and especially in cardinal quadrants; fossula deep, open; dissepi­mentarium narrow, without lonsdaleoid dissep­iments; tabulae low domes, flattened axially, complete or incomplete; tabellae broad. Carb., Eu. (N.Zemlya); U.Carb., Eu. (USSR); U.Carb.-L.  
Perm., Eu. (Spits.).—Fig. 223,3a-d. *A. intermediate (Toula); a,b, holotype, Novaya Zemlya, transv. secs., ×2.5; c,d, another specimen, U.Carb. (Gshel.) or L.Perm., Spitsbergen, Bellsund; c,d, transv., long. secs., ×2.0 (Fedorowski, 1975).

Crataniophyllum  
Coelenterata—Anthozoa

Fig. 223. Cyathopsidae (p. F339-F343).
Rugosa—Stauriida—Caniniina

Rathbun, 1912, a crustacean, *nec Craterophyllum* Foerste, 1909a, Stauriida, Arachnophyllina, Arachnophyllidae [*Craterophyllum verticillatum Barbour; M; t5466, UNSM, Lincoln*]. Like Fomichevella, but solitary or with offsets commonly arising laterally in verticils [see Fagerstrom & Eisele, 1966, p. 595]. *U. Penn., N. Am. (Neb.); U. Car., Eu. (SE USSR).*—Fig. 223,a-d. *C. verticillatum* (Barbour), Virgil, Neb., Nechawa; a, ext. view, X1.0; b-d, other specimens, transv., long. secs., X2.0 (Fagerstrom & Eisele, 1966).

Dagmarephyllum Ragozov, 1962, p. 5 [*D. patoki; OD; t7, coll. 8190, TsGM, Leningrad*]. Like *tJerticillatum* long. sees., X2.0 (Fagerstrom & Eisele, 1966).


Kubassophyllum Dobrolyubova in Dobrolyubova & Kabakovich, 1966, p. 165 [*K. tytchense; OD; t2497, coll. 1560, PIN, Moscow*]. Fasciculate; increase both lateral and parriical; septa numerous, somewhat thickened near boundary of dissepimentarium and tabularium; major septa short in all growth stages; cardinal septum shorter; minor septa about half to two-thirds as long as major; dissepimentarium wide, narrowing at cardinal fossula, dissepiments of variable size, some large lonsdaleoid plates near periphery; tabulae wide, flat in wide median part, and with troughed or downturned edges. L. Car. (Visean), Asia (Kuzbas).—Fig. 224,a,b. *K. tytchense*, holotype, Podyakov horizon, R. Tykhka; a,b, transv., long. secs., X2 (Dobrolyubova & Kabakovich, 1966).

Lublinophyllum Khoa, 1977, p. 372 [*L. fedorowskii; OD; t1403.II.140, IG, Warsaw*]. Fasciculate, with marginal increase; minor septa short, longitudinally discontinuous adaxially so that dissepiments may inosculate in places; major septa short, somewhat thickened in tabularium; cardinal septum shortened in late stages, counter septum equal to or longer than others; dissepimentarium sporadically lonsdaleoid; tabulae broad, mesa-shaped. L. Car. (Visean), Eu. (Pol.-Dobnas).

Melanophyllum Gorsky, 1951, p. 40 [*M. keyserlingiophyloides; M; t in coll. 6091, TsGM, Leningrad*]. Solitary; lonsdaleoid dissepiments disrupt both major and minor septa in peripheral parts of dissepimentarium, but only minor septa in inner parts; major septa mostly withdrawn somewhat from axis, but cardinal and counter septa may form continuous septum, and the axial ends of two or three pairs of major septa neighboring the cardinal and counter septa may also join in parallel; tabular floors appear, from transverse section, to be mesa-shaped. Car. (Visean or Namur.), Eu.(N.Zemlya).

Menophyllum Milne-Edwards & Haimé, 1850, p. lxvi [*M. tenuimarginatum; OD; t235A, MN, Paris*]. Note by R. G. Carruthers, 1908, attached (fide MS notes by Stanley Smith of visit to Paris, April 4-12, 1930) to holotype states, “rim is almost completely broken down and some foreign matter adheres to the tip. But I have no hesitation in recognising this as the type Pl. 111, fig. 1a and referring it to *Caninia cornucopiae* Mich.” The holotype (studied by Hill, Sept. 1975) indeed resembles young *C. cornucopiae* between “dumonti” and “nystiana” phases described by Carruthers, 1908, p. 161]. Solitary, small, curved trochoid, with, on convex side, narrow, deep, parallel-sided fossula to which metastepa of cardinal quadrants are pinnately directed, their...
ends fusing in fossular wall; alar fossulae present; cardinal septum shortened; in counter quadrants major septa withdrawn, radial and subequal, counter septum may elongate slightly onto upper sur-
face of tabula that forms flat floor of inner part of counter quadrants of calice; minor septa moderately long. [Further study of ?monotype desirable.] L.Carb.(Tournais.), Eu.(Belg.).—Fig. 223, 2a,b. *M. tenuimarginatum, holotype, Tournais., Tournai; a, lat. view, X1; b, calical view, approx. X3 (Milne-Edwards & Haime, 1851).

**Paracaninia** Chi, 1937, p. 93 [*P. sinensis; OD; not traced, Peking]. Solitary, with spinose processes; major septa thin and long in early stages, short and amplexoid in later stages; cardinal fossula marked by shortened cardinal septum; minor septa short, dissepiments absent; tabulae mesa-shaped, with long downturned edges, complete or incomplete. L.Perm., Asia(China).—Fig. 224, 2a-d. *P. sinensis, holotype, Chihs., up. Wumaling
FIG. 226. Cyathopsidae (p. F344).

Serp., Kiangsi, Wumahuitou, Yungsin distr.; a, ext. view, X1; b-d, transv., long. secs., X2 (Chi, 1937).


Siphonophyllia Scouler MS in McCoy, 1844, p. 187 [*S. cylindrica; M; 180-1925, Griffith Coll., NM, Dublin] [=Paleocaninia Lisitsyn, 1925, p. 56-57, nom. inval. in combinations "Paleocaninia cylindrica" cf. mutation "Vaughan," mutation "Vaughan" and "Paleocaninia cylindrica," genus summarily described as "with wide lonsdaleoid peripheral zone," no citation as new genus or of type species; Palaeocaninia Flügel, 1970, p. 192, nom. null.].

Skolekophyllum Fomichev, 1953a, p. 299 [*Camphophyllum (Skolekophyllum) rotayi; OD; t444, coll. 5030, TsGM, Leningrad].

Family BOTHROPHYLLIDAE

Fomichev, 1953

[Bothrophyllidae Fomichev, 1953a, p. 317]
tear-shaped transverse section; cardinal fossula more or less deep and invading dissepimentarium, with metasepta of cardinal quadrants increasing in length away from it and either radial or with their axial edges curving toward but commonly not closing axial end of fossula; cardinal septum long or short, counter may be long; septa thick in early stages, thinning in late stages first in counter quadrants; minor septa continu-
ous or less commonly discontinuous; dissepimentarium commonly narrow, dissepiments normal concentric, or angulate, sparse transeptal; tabular floors low domes, tabulae complete or incomplete. *Carb.-L.Perm.*

Bothrophylum Trautschold, 1879, p. 30 [*Turbinolina conica* Fischer von Waldeheim, 1830, explanation of pl. of 30, fig. 6, sensu Trautschold, 1879, p. 30; M; fin coll. 83, LGU, Leningrad; lectotype by Dobrolyubova, 1937, p. 57] [=Rossophyllum Shtukenberg, 1888, p. 11 (type, *R. novum*, M; *† in coll. 321, TsGM, Leningrad; M.Carb., Myachkovo; considered by Dobrolyubova, 1937, p. 34, to be young forms of *B. conicum*); Pseudocaninia Shtukenberg, 1888, p. 12 (type, *P. conica* (Fischer von Waldeheim) Shtukenberg, SD Lew, 1921, p. 227; synonyms nos. 28-52, 55-77, coll. 321, TsGM, Leningrad; M. Carb., Myachkovo; see Dobrolyubova, 1937, p. 34, and Fedorowski, 1975, p. 57); Botrophylum Shtukenberg, 1895, p. 56, nom. null.; *Caninophyllum* Lewis, 1929, which see; *Bothroclisia* Fomichev, 1953a, which see; *Siedleckia* Fedorowski, 1975, which see. Solitary, large, with numerous long septa; cardinal and more commonly counter septum may be elongate, and may be conjoined in long, thin, irregular lamina; ends of major septa may be fused in groups axially, forming weak and inconstant axial structure that may be reinforced by axial tabellae; fossula open; septa may be thickened in tabularium, thinning first from counter quadrants; thickened part of cardinal septum may be short; septa thin in dissepimentarium, dissepiments small, normal concentric, anguloconcentric, or replaced by two smaller, inoscillating plates; tabular floors low domes with auxiliary tabellae in inconstant axial structure. [Lectotype needs restudy.] ?*L.Carb.* (Tournais.), Asia(Kazakh.); *L.Carb.* (Visean), Eu.(Brit.-N. Zemlya); *U.Carb.*(Moscow.), Eu.(Spits.-?Spain.-Czech.-USSR); ?Penn., N.Am.—Fig. 227,3a-c. *B. conicum* (Fischer von Waldheim), U.Carb. (Moscow.), Moscow Basin, Myachkovo; *a,b*, transv. secs., *×2.0,* c, another specimen, long. sec., *×1.3* (Dobrolyubova, 1937).

Bothroclisia Fomichev, 1953a, p. 339 [*Bothrophyllum (Bothroclisia) clisiophylloides*; OD; *†293, coll. 5030, TsGM, Leningrad] [=Bothrophylum Trautschold, 1879, which see, see also Fedorowski, 1975, p. 57]. Solitary, conical, not large; in early stages major septa thickened, their axial ends joining in groups from which a few, with long cardinal septum, reach axis and form irregular plexus; in later stages thickening becomes confined to cardinal quadrants, inner ends of major septa may curve and become discontinuous before reaching axis, where narrow and variable axial structure of sparse radial lamellae and axial tabellae may develop; fossula open; tabulae conical, incomplete, rising more steeply in axial structure; dissepimentarium narrow, dissepiments regular concentric or anguloconcentric. *U.Carb.*(Moscow.), Eu.(Donbas).—Fig. 228,2a-c. *B. clisiophylloides*, holotype. *U.Carb.*(Moscow.), Is. Mi, Gelmersenova ravine; *a-c*, transv., long. secs., *×2.1* (Fomichev, 1953a).

Calmussiphylum Vasilyuk, 1959, p. 87 [*C. calmiusis*; OD; *†7, coll. 1405, IG, Kiev]. Solitary, large; septa numerous, long, major septa extending almost to axis except for short cardinal and its neighboring pair in marked, partly closed fossula; minor septa half as long and contrasting or contraject; septa dilated in early stages, dilation decreasing first in counter quadrants in dissepimentarium and tabularium, and then in cardinal quadrants where decrease of thickening through dissepimentarium is gradual; tabular floors domed, tabulae incomplete; dissepiments normal, some transeptal plates developing peripherally in late stages. *L.Carb.*(low.Visean), Eu.(Donbas).—Fig. 228,5a,b. *C. calmiusis*, holotype, R. Kalmius; *a,b*, transv. secs., *×1.7* (Vasilyuk, 1960).

?Caninella Gorskiy, 1938, p. 40 [*C. pulchra*; OD; *†44, coll. 5769, TsGM, Leningrad]. Solitary, large; major septa numerous, long, but leaving small axial space, dilated and lanceolate in transverse section in tabularium, particularly in cardinal quadrants; cardinal septum shortening in open fossula at least in late stages; minor septa commonly withdrawn to peripheral half of wide dissepimentarium; dissepiments numerous, small and rather irregular; some lateral, along sides of septa; tabular floors moderately tall domes with edges turned out or up; tabulae complete or incomplete. ?*Carb.*(in boulders), Eu.(N.Zemlya); ?*U.Carb.*, Eu.(Donbas).—Fig. 228,4a,b. *C. pulchra*, holotype, Novaya Zemlya (boulder in Russian Harbor); *a,b*, transv., long. secs., *×1.7* (Gorskiy, 1938).

Caninophyllum Lewis, 1929, p. 457 [*Cyathophyllum archiaci Milne-Edwards & Haime, 1852, p. 183; OD; *†5462, Geol. Soc. coll., Leeds, and PF 1893-5, IGS, Leeds] [=Bothrophyllum Trautschold, 1879, which see, Fedorowski, 1975, p. 57; Neocaninia Lisitsyn, 1925, p. 56, nom. inval. in combination Neocaninia pattla, no diagnosis, illustration, or citation as new genus or of type species]. Solitary, moderately large; with numerous long septa somewhat thickened in tabularium or only in counter quadrants, thinning and rarely amplexoid toward axis; cardinal septum short, in fossula expanding toward axis, axial ends of neighboring metasepta may curve around fossula but do not meet, fossula marked by depression in tabular floors that projects into dissepimentarium; counter septum may remain long; thin axial ends of major septa may come together in groups at or near axis; dissepiments variable, small, concentric, anguloconcentric, or in places an angulate plate replaced by two inosculating plates; tabular floors flat medianly, with downturned edges. *L.Carb.*, Eu.(Brit.-France-Belg.-USSR)-N. Afr.
Fig. 228. Bothrophyllidae (p. F346-F348).
(Alg.)-Asia(Kuzbas)?Laos?Viet Nam-NE.USSR)-Australia(New S.Wales); U.Carb., Eu.(Donbas-Spits.); U.Carb.-L.Perm., Eu.(Spits.-Urals-Carnic Alps).—Fig. 228,la-c. *C. archiaci (Milne-Edwards & Haime), holotype, L.Carb.(Viscan), Wales, Llanymynech, near Oswestry; a-c, transv. secs., X0.8 (Lewis, 1929).

Gshelia Shuktenberg, 1888, p. 24 [*G. rouilleri; M; t188, coll. 321, TGM, Leningrad; lectotype by Dobrolyubova, 1940, p. 49]. Solitary, large; major septa thick in tabularium, thinning first in counter quadrants; cardinal metasepta pinnate toward cardinal septum, which shortens in fossula about whose inner end new metasepta may curve somewhat; major septa of counter quadrants subradial, and like those of cardinal quadrants withdrawing somewhat from axis; counter septum, and in places, alar septa may be shorter; thick, laminar columnella present in early but not in earliest stages, connected with either counter or cardinal septum or both, becoming free and disappearing in later stages; tabulae incomplete, floors domes whose edges may be troughed; alar fossulae more or less distinct; dissepimentarium narrow, minor septa continuous, dissepiments fine, their distal concavity normal or angulate [see Dobrolyubova, 1940, p. 38]. ?U.Carb., Eu.(Spits.); U.Carb., Eu.(USSR).

—Fig. 227,4a-c. *G. rouilleri, U.Carb.(Gshel.), Moscow Basin; a-c, transv. secs., X2.0 (Dobrolyubova, 1948).

Hornsundia Fedorowski, 1965a, p. 37 [*H. late­septata; OD; t114, PZI, Poznan]. Solitary, large, curved, concave side cardinal; calice oval, deep, oblique; major septa dilated in tabularium, thinning first in counter quadrants, withdrawn from axis in late stages, leaving ovoid or drop-shaped space; in early stages cardinal and counter septa linked; fossula open, deep, in late stages with cardinal septum shortened but longer than neighboring metasepta; dissepimentarium narrow, minor septa may withdraw toward periphery leaving inosculating dissepiments in major septal loculi; tabulae broadly domed, incomplete. [Two specimens only of type species. See also Fedorowski, 1975, p. 31.] L.Perms., Eu.(Spits.).—Fig. 227, 1a-d. *H. late­septata, holotype, 5th coral Is. horizon, up. Treskelodden beds, Vestspits., Hornsund; a-c, transv., d, long. secs., X1.3 (Fedorowski, 1965a).

Pseudotimania Dobrolyubova & Kabakovitch, 1948, p. 8 [*Timania mosquensis Dobrolyubova, 1937, p. 22; OD; t190, coll. 141, PIN, Moscow] [=Timanophyllum Fomichev, 1953a, p. 252 (type, Timania mosquensis Dobrolyubova, 1937, OD)]. Solitary, conicocylindrical; major septa of unequal length and thickness, countert septum in early stages long and nearly united with cardinal, which shortens in later stages, as do the shorter alar septa; major septa pinnate toward cardinal and counter septa; fossula in early stages almost closed when cardinal septum is long, may close when cardinal septum shortens; alar fossulae notable; tabulae complete or incomplete, tabular floors broadly arched with downturned edges deepening into fossula; dissepimentarium narrow, normal concentric, septa thin within it. U.Carb. (Myachkovo-Gshel.), Eu.(Donbas-Moscow Basin-Spits.).—Fig. 227,2a-c. *P. mosquensis (Dobro­lyubova), holotype, Myachkovo horizon, Moscow Basin, near Novinisky; a,b, transv., c, long. secs., X2.0 (Dobrolyubova, 1937).

Siedleckia Fedorowski, 1975, p. 47 [*S. bjorno­yana; OD; tA32129, ?PM, Oslo] [=Bothropyllum Trautschold, 1879, which see]. Solitary, moderately large; septa numerous, thickened in tabularium except in late stages, thickening decreasing first in counter quadrants; ?(lateral metasepta pinnate to alar septa in late neanic stages); cardinal septum shortened early, in open tabular fossula, counter septum variable; septa somewhat withdrawn ?(amplexoid) in late stages; dissepimentarium narrow, with septa thin and minor septa but little withdrawn from tabularium; dissepiments fine and may be angular; tabulae broadly domed and incomplete. [Further study of ontogeny desirable.] U.Carb., Eu.(Bear I.-?USSR).

—Fig. 228,3a-d. *S. bjorno­yana, holotype; a-c, transv., d, long. secs., X1.7 (Fedorowski, 1975).

Timania Shuktenberg, 1895, p. 62 [*T. schmidti; M; 1494-5, coll. 305, TGM, Leningrad; lectotype by Dobrolyubova, 1937, p. 22]. Large, solitary; septa numerous, major septa of counter quadrants thinner and longer than others; fossula deepening and expanding adaxially, with cardinal and some counter metasepta curving more or less sharply toward it; other metasepta withdrawn somewhat from axis and radial or pinnate and somewhat convex toward long, thin counter septum; dissepimentarium wider in counter quadrants; minor septa withdrawn almost to periphery, leaving inosculating dissepiments; lonsdaleoid dissepiments absent or very sparse; tabulae subhorizontal with downturned edges, complete or with auxiliary tabellae peripherally; floor of fossula may be of small tabellae [see Fedorowski, 1975, p. 31]. U.Carb., Eu.(Moscow Basin-Timan).—Fig. 227, 5. *T. schmidti, lectotype, Timan, R. Indiga; transv. sec., X1.3 (Fedorowski, 1975).

Family URALINIIDAE

Dobrolyubova, 1962

[Uraliniidae Dobrolyubova in Soskina, Dobrolyubova, & Kabakovitch, 1962, p. 316] [=Cystophrentidae YO, 1963, P. 338]

Solitary; floor of calice commonly oblique, declined toward fossula on convex side of corallum; septa of counter quadrants markedly more numerous and in late stages thinner than those of cardinal quadrants; septa commonly discontinuous in dissepimentarium, disrupted by transeptal dissepiments...
Fig. 229. Uraliniidae (p. F350-F351).
ments; tabular floors low domes declined into fossula, flattened or depressed in axial region in some; tabulae commonly incomplete. L.Carb.

Uralinia Shtukenberg, 1895, p. 103 [*Heliophyl­lum multiplex Ludwig, 1862, p. 199; SD Lang, Smith, & Thomas, 1940, p. 137; tnot traced] [=Pseudouralinia YÜ, 1931, p. 21 (type, P. tangpakonensis, OD; t4390, IGP, Nanking; L. Carb., 1.5 mi. S. of Kolaoho Bridge, Tu-shan-hsien, Kweichow); Neomicroplasma Roco­zov, 1960, p. 48 (type, N. dobolyuybove, OD; t1, coll. 1936, TsGM, Leningrad; up.Tournais., Polar Urals)]. Solitary, cornute; dissepimentarium of lonsdaleoid dissepiments, commonly wider on counter side than on fossular side; septa represented in dissepimentarium by weak crests and at outer edges of tabularium by thick major septal segments, thinner in counter quadrants; cardinal and alar septa shorter than others, mesosepta neighboring cardinal fossula curving but not meet­ing around inner edge of cardinal septum; tabular floors declined toward or into fossula commonly on convex side of corallum, tabulae incomplete. [In absence of modern published studies of holotype and of Shtukenberg’s specimens, genus is interpreted on Soshkina, 1960, p. 301.] L.Carb. (Tournais.), Eu.(Moscow Basin-Urals-Timan-?N. Zemlya)-Asia(Kuzbas-NE.USSR-Viet Nam-Kweichow-Hunan-Armenia).—Fig. 229,3a,b. *U. multiplex (Ludwig), Tournais., Moscow Basin, Chernyshino; a,b, transv., long. secs., X1.3 (Sosh­kina, 1960).

Bifossularia Dobrolyuba in Dobrolyuba & Kabakovitch, 1966, p. 113 [*Caninia usowii Gabunia, 1919, p. 28; OD; tneotype 233, coll. 1560, PIN, Moscow; by Dobrolyuba in Dobro­lyuba & Kabakovitch, 1966, p. 121]. Solitary, with septa dilated in tabularium, dilatation de-
creasing first in counter quadrants; minor septa short; major septa long, not reaching axis, subequal except that cardinal and counter septa are shorter and lie in deep tabular fossulae; disseipimentarium narrow, septa thin within it, disseipiments small, normal concentric; tabulare complete or incomplete, floors domes with axial depression and upturned edges. L.Carb. (Tournais.-Viscan.), Asia (Kuzbas).

---Fig. 230,3a,b. *B. usowii (Gabunita), neuotype, Vican, Podyakov horizon, R. Tom; a,b, transv., long. secs., x2 (Dubrulovubova & Kabakovich, 1966).

Cystophrentis Yü, 1931, p. 18 [*C. kolahoensis; OD; +4904, IGP, Nanking] [=Keyserlingophyllum Shukutenkov, 1895, which see; Cystophrentis Lang, Smith & Thomas, 1940, p. 48, nom. van.]. Solitary, not large, in early stages septa dilated leaving few interspaces; in cardinal quadrants major septa short and pinnate about fossula with short cardinal septum, in counter quadrants major septa long; counter septum may be very long; minor septa vestigial, as traces on upper surfaces of disseipiments in marginarium that is wider in counter quadrants than in cardinal; lonsdaleoid disseipiments develop in later stages; septa thinning first in counter quadrants; tabulare incomplete, floors declined into fossula on convex side of corallum. [There is no confirmation of Yü’s view (1963, p. 310) that septal insertion occurs in counter sextants; see Papoyan, 1974, p. 205.]

L.Carb. (Tournais.), Asia (China-Japan-NE.USSR-Armenia)-Eu. (Urals).---Fig. 230,la-d. *C. kolahoensis, holotype, Tournais, lower part Kolaoho Is., Kweichow, Kolaoho, Tu-shan-hsien; a-c, transv., d, long. secs., x2 (Yü, 1934).

Enygmophyllum Fominchev, 1931, p. 42 [*E. taidonense; M; + in coll. 2478, TsG*M, Leningrad] [=Aenigmophyllum Lang, Smith & Thomas, 1940, p. 14, nom. van.]. Solitary, large; major septa withdrawn somewhat from axis leaving subcylindrical space in which axial parts of tabular floors are deeply concave; cardinal septum shorter; perialaxial parts of tabular floors variably inclined; minor septa thin, somewhat discontinuous, disseipiments rather elongate, irregular. L.Carb., Asia (Kuzbas)-Eu. (Ural).---Fig. 230,4a,b. *E. taidonense, monotype, Tournais, Kuzbas; a,b, transv., long. secs., x1 (Soshkina, Dubrulovubova & Kabakovich, 1962).

Keyserlingophyllum Shukutenkov, 1895, p. 101 [*Cystiphyllum obliquum Keyserling, 1846, p. 160; SD Lang, Smith & Thomas, 1940, p. 72; + in coll. 46, LGI, Leningrad] [=Humboldtia Shukutenkov, 1895, p. 115 (type, H. roisica, OD; + in coll. 45, MGI, or coll. 305, TsG*M, Leningrad; L.Carb., R. Usva, Perm); ?Cystophrentis Yü, 1931, which see; Humboldtia Cotton, 1973, p. 100, nom. null.]. Solitary, large; in late stages with lonsdaleoid disseipimentarium of small disseipiments bearing major and minor septal crests; major septa long and thickened in tabular, groupined pinnately about short cardinal and long counter septa and less distinctively about alar fossulae, thinning first in counter quadrants; tabular floors deepening into fossula on convex side of corallum, tabellae large [see Dubrulovubova & Kabakovich, 1966, p. 86.]

L.Carb. (Tournais.), Eu. (Urals-France)-Asia (Armenia); L.Carb. (Viscan.), Asia (Iran-Kuzbas)-Eu. (France).---Fig. 229,la-c. *K. obliquum (Keyserling), Tournais., Chernyshino substage; a,b, R. Koshva, transv. secs., x1.3; c, another specimen, R. Voya, left tributary of R. Pechora, long. sec., x1.3 (a,c, Soshkina, 1960; b, Soshkina, Dubrulovubova & Kabakovich, 1962).

Liaridiphyllum Sutherland, 1954, p. 368 [*L. hagel; OD; +10571, GSC, Ottawa]. Solitary, small to medium-sized, trochoid to cylindrical; septa discontinuous, developed as crests on upper surfaces of disseipiments and tabulae, thicker in cardinal than in counter quadrants; cardinal septum short, in fossula, counter septum long; minor septa very weak; tabulae complete or incomplete, gradational with lonsdaleoid plates of disseipimentarium, floors declined into fossula on convex side of corallum. Mid.Miss., N.Am.(NW.Terr.); L.Carb., ?Asia (Tapmyr).---Fig. 230,2a-c. *L. hagel, holotype, Can., Liard Range, NW. Terr.; a,b, transv., c, long. secs., x2 (Sutherland, 1954).

Versiculiphyllum Easton, 1944b, p. 52 [*Chono­phyllum sedaliense White, 1880, p. 157; OD; + probably destroyed by fire, vide Easton, 1944b, p. 53; Ivanovskiy, 1976, p. 181, ?invalidly chose 3506 Geol. Survey Illinois as lectotype] [=Favi­phyllum? Hall, 1852b, p. 407 (type, P. rugosum, SD Sando, 1965b, p. E27; 197768, USNM, Washington, lectotype by Sando, 1965b, p. E28; Utah; Sando, 1965a, p. 55, successfully applied for suppression under plenary powers ZN(S)1662, see ICZN 1968-9, Op. 813); Kakwiphyllum Sutherland, 1954, p. 365 (type, K. dux, OD; +10569, GSC, Ottawa; Kakwa-Jarvis Lakes region, NE. B.C.).] Large, solitary, cylindrical; with numerous septa that commonly reach axis but may be short; septal plan bilateral, plicate or radial; cardinal septum long or short, in more or less marked fossula; counter septum commonly short; septa dilated, in late stages dilatation confined to axial region; minor septa impersistent; disseipimentarium wide, an outer transplanal (lonsdaleoid) zone and an inner zone with anguloconcentric disseipiments; tabular floors deeply concave, tabulae incomplete [see Sando, 1960, p. 179]. Miss., N.Am. (Ill.-Miss. - Iowa - Nev. - Cal. - Ariz. - Mont. - Mex. - Alberta-B.C.-NW.Terr.).---Fig. 229,la-e. *V. sedaliense (White), Chouteau Ls., Ill.; a-d, transv., e, long. secs., x2.7 (Easton, 1944b).---Fig. 229,lf-h. V. dux (Sutherland); f, holotype, B.C., Kakwa-Jarvis Lakes area; transv. sec., x0.7; g,h, another specimen, NW.Terr., Laird region; transv., long. secs., x0.7 (Sutherland, 1954).
Family **ENDAMPLEXIDAE**
Schouppe & Stacul, 1959


Solitary; septa short, unequal, somewhat thickened in tabularium, may be thinner in lonsdaleoid dissepimentarium of irregular width and completeness; septa continuous laminae or each of longitudinally discontinuous leaflike segments; tabulae incomplete, tabellae unequal. *Low.U.Perm.*

**Endamplexus** Koker, 1924, p. 31 [*E. dentatus*; OD; +11783, TH, Delft; lectotype by Schouppe & Stacul, 1959, p. 326] ["Spaniophyllym Schouppe & Stacul, 1959, p. 328 (type, *Endamplexus* (*Spaniophyllym*) makros, OD; +1270, Münster/Westfalen; low.U.Perm., Basleo beds, Basleo, Timor); *Endoamplexus* Lang, Smith, & Thomas, 1940, p. 56, nom. van.]. Solitary, conical to cylindrical; major septa short, thick, irregular, in places separated from wall by irregular lonsdaleoid dissepimentarium or by single lonsdaleoid dissepiments; neither protosepta nor fossula distinct; tabulae irregular. *Low.U.Perm.*, Asia (Timor).—Fig. 231,1a,b. *E. dentatus*, holotype, Basleo; *E. makros* (Schouppe & Stacul), holotype, Basleo; c,d, transv., e, long. secs., X2 (Schouppe & Stacul, 1959).

**Spineria** Schouppe & Stacul, 1959, p. 331 [*Cystiphyllum diplotechone* Koker, 1924, p. 26; OD; +11775, TH, Delft; lectotype by Schouppe & Stacul, 1959, p. 333] ["Cystina Schouppe & Stacul, 1959, p. 334 (type, *Cystiphyllum ultimum* Koker, 1924, p. 25, OD; +11776, TH, Delft, lectotype by Schouppe & Stacul, 1959, p. 334; low.U.Perm., Basleo, Timor)]. Solitary, conical or cylindrical with major septa represented each by radial longitudinal series of discontinuous small leaflike segments developed on wall and on upper surfaces of dissepiments and tabulae; width of dissepimentarium irregular, of sparse or numerous lonsdaleoid dissepiments that are smaller than tabulae, which are large and somewhat irregularly disposed in wide axial region. *Low.U.Perm.*, Asia (Timor).—Fig. 231,2a,b. *S. diplotechone* (Koker), Basleo; a, lectotype, long. sec., X1.0 (Koker, 1924); b, another specimen, calical view, X1.5 (Schouppe & Stacul, 1959).—Fig. 231,2c,d. *S. ultima* (Koker), Basleo; c,d, long. secs., X2.0 (Schouppe & Stacul, 1959).—Fig. 231,2e. *Spineria* sp., diagram. view of two septa, X2.0 (Schouppe & Stacul, 1959).

Suborder **AULOPHYLLINA** Hill, new suborder


Predominantly solitary and large Stauri­ida; dissepimentarium wide, commonly normal concentric or angulate; septa long,
numerous, approaching radial arrangement, may retain thickening from early stages longest in cardinal quadrants of tabularium; commonly with axial structure that may be a platelike columella, or a complex of septal lamellae or septa and tabellae that may include axial or median plate, or a sharply bounded axial column; fossula may indent dissepimentarium; tabular floors declined abaxially; in some with axial structure weakly developed to absent, septa shortened, tabular floors depressed axially, or becoming flat or even sagging. ?U.Dev.-L.Perm.

**Family AULOPHYLLIDAE**

Dybowski, 1873


Solitary or fasciculate; with axial structure either a platelike columella, a vaguely bounded complex with medial plate, septal lamellae, and axial tabellae, or a sharply bounded axial column; major septa long, continuous or not with septal lamellae; minor septa may be discontinuous; tabular floors declined abaxially, commonly of tabellae in axial and periaxial series; fossula commonly with shortened cardinal septum and indenting dissepimentarium that is commonly wide and of concentric or angulo-concentric plates; in early stages cardinal and counter septa conjoined. **L.Carb.-L.Perm.**

The fasciculate and massive corals of the family Lithostrotionidae d'Oberhny, 1852, Lithostrotonina, appear closely related to those of the family Aulophyllidae.

**Subfamily AULOPHYLLINAE**

Dybowski, 1873

[nom. transl. Hint., 1956b, p. F286, ex Aulophyllidae Dybowski, 1873c, p. 332]

Solitary; axial structure a sharply bounded column of fine axial tabellae and commonly without medial plate but with numerous septal lamellae; periaxial tabellae coarse and slightly declined abaxially; fossula with short cardinal septum and indenting moderately wide dissepimentarium with continuous minor septa and fine concentric dissepiments. **L.Miss.-U.Penn.**

**Aulophyllum MILNE-EDWARDS & HAMME, 1850, p. 1xx [*Clisiophyllum prolatum* McCoy, 1849, p. 3; OD; syntypes A1817-9, 2368-9, SM, Cambridge; L.Carb., Derbyshire; =Turbinolia fungites Fleming, 1828, p. 510, tC4366, HM, Glasgow, lectotype by Smith & Lang, 1930, p. 187, L.Carb., E. Kilbride, Scot.]; =Cyclophyllum DUNCAN & THOMSON, 1867b, p. 328, nom. subst. pro Cyclocyathus DUNCAN & THOMSON, 1867a, p. 1 (type, *Aulophyllum bowenbanki* MILNE-EDWARDS & HAMME, 1851, p. 414, SD Gregory, 1917, p. 222; not found in BM(NH), London, nor in MN, Paris; L.Carb., Ire., non Cyclocyathus MILNE-EDWARDS & HAMME, 1850, p. 5iv, a scleractinian; ?Permia Shtukenberg, 1895, p. 26 (type, P. iwanowi, M; in University, Kazan, see Fedorowski, 1971, p. 24; L.Carb., Guhakhi, Urals, USSR); ?Setamainella Minato, 1943, p. 229 (type, S. hayasakai, M; ?R15451, UH, Sapporo; L.Carb., NE. Honshu, Japan; material imperfect); *Berkhia Gorskiy, 1951, which see; ?Staurophyllum Gorskiy, 1951, which see]. Solitary, moderately large; with numerous septa, a regular dissepimentarium with small, normal concentric dissepiments; with axial structure a well-defined and medianly depressed column, cuspidate toward fossula in transverse sections and built up of closely packed lamellae and tabellae without median plate, tabellar floors being close and domes with median depression; major septa may be dilated in tabularium, commonly in cardinal quadrants only; cardinal septum short after early stages, in fossula on convex side of corallum; tabellae between column and marginarium large, widely separated, subhorizontally based or slightly declined outward [see Smith, 1913, p. 58]. L.Carb.-U.Carb.(Visean-Namur.), Eu.(Brit.I.-Belg.-France-Ger.-Pol.-USSR)-N.Afr.(Alg.)-Asia(Turkey-Japan).—Fig. 232, 3a,b. *A. fungites* (Fleming), Pendleian, Namur., Great Ls., Eng., Weardale, Durham; a,b, transv., long. secs., X1.4 (Smith, 1913).

**Aulocliisa Lewis, 1927b, p. 30 [*A. mutata* OD; ?R25866, BM(NH), London]. Solitary, large; with numerous septa and regular dissepimentarium with small, normal concentric dissepiments; with axial structure a moderately well-defined column that is dibunophylloid in early stages, but loses median plate while retaining domed tabellar floors without median depression in late stages; major septa may be dilated in tabularium, more commonly in cardinal quadrants only; cardinal septum short after early stages, in open fossula; tabellae between column and marginarium large, slightly declined abaxially. L.Carb.(Visean), Eu.(Brit.I.-Urals?-N.Zemilya)-N.Afr.(Alg.)-Asia(China).—Fig. 232, 3a-d. *A. mutata*, holotype, D, Isle of Man, Scarlet Point; a,b, transv. secs., X2.8, X1.4; c,d, long. secs., X2.8, X1.4 (Lewis, 1927b).

Berkhia Gorskiy, 1951, p. 77 [*B. elegans* OD; † in coll. 6091, TsGM, Leningrad]; ?=Aulophyllum MILNE-EDWARDS & HAMME, 1850, which
Fig. 232. Aulophyllidae (p. F353-F355).
Solitary; with axial structure of thin septal lamellae and axial tabellae, without median plate; minor septa complete, thin, in moderately wide dissepimentarium with dissepiments angulate in transverse section in late stages, concentric in early stages; periaxial tabellae widely separated, declined abaxially. [See Fedorowski, 1971, p. 30. Longitudinal section required to show presence or absence of tabellar boundary to structure and of median depression in structure.] *Carb. (Barentsov Ser.), Eu.(N.Zemlya).—Fig. 232,1. *B. elegans, holotype, Novaya Zemlya; transv. sec., ×1.9 (Gorskiy, 1951).

**Staurophyllum** Gorskiy, 1951, p. 79 [*S. thomsoni; OD; †? in coll. 6091, TsGM, Leningrad]

[S≈*Amygdalophyllina* Milne-Edwards & Haime, 1850, holotype, 1. Berkha; paratype, transv. sec., ×1.9 (Fedorowski, 1971)].

**Nervophyllum** Vasilyuk, 1959, p. 88 [*N. beschevei; OD; 125, coll. 1,405, IG, Kiev]. Solitary; with axial column consisting of median plate thickened in cardinal half and center from which somewhat irregularly radiate, thin septal lamellae including some related to minor septa, and numerous small tabellae declined abaxially; periaxial tabellae somewhat less steeply declined and more widely separated; major septa thick in outer tabularium and mostly continuous with their corresponding septal lamellae; minor septa thinner, discontinuous in places; cardinal septum thinner, in small, open fossula that indents dissepimentarium slightly; dissepiments fine, mostly normal, concentric. *U.Carb.* (low.Namur.), Eu.(Donbas-Pol.).—Fig. 232,4a,b. *N. beschevei, holotype, limestone D, R. Kalmius; a,b, transv., long. secs., ×1.9 (Vasilyuk, 1960).

**Staurophyllum** Gorskiy, 1951, p. 79 [*S. thomsoni; OD; †? in coll. 6091, TsGM, Leningrad]

[S≈*Amygdalophyllina* Milne-Edwards & Haime, 1850, which see]. Solitary; with axial structure of thin, somewhat irregular septal lamellae directed toward axis, without medial plate, but with more or less crowded axial tabellae; major septa may be connected to septal lamellae, and are somewhat thickened in periaxial tabularium, where periaxial tabellae are declined abaxially and farther apart; cardinal (?) and (alr) fossulae indent dissepimentarium in which minor septa are complete and dissepiments are irregularly concentric. [Not well known; longitudinal section required.] *L.Carb.-U.Carb.*(up.Visean-low.Namur.), Eu.(N.Zemlya).—Fig. 232,2. *S. thomsoni, holotype, I. Berka; transv. sec., ×1.9 (Gorskiy, 1951).

**Zakowia** Fedorowski, 1971, p. 30 [*Z. sanctae­crucensis; OD; †?OS70/366, IG, Kielce]. Solitary; with axial structure formed by thin septal lamellae of which several join at axis, and few axial tabellae, without sharp boundary; major septa thickened in tabularium, especially in cardinal quadrants, and some continuous with lamellae of axial structure; cardinal septum short, in open, parallel-sided fossula that indents dissepimentarium, may be connected by long, thin lamella to axial structure that reaches axis; minor septa may be discontinuous in inner parts of anguloconcentric dissepimentarium. *L.Carb.*(up.Visean), Eu.(Pol.).—Fig. 232,5a,b. *Z. sanctae­crucensis, Holy Cross Mts.; a, holotype, transv. sec., ×1.9; b, paratype, long. sec., ×1.9 (Fedorowski, 1971).

**Subfamily AMYGDALOPHYLLINEAE** Grabau, 1935


Solitary, axial structure a biscuspidate columnella composed of median plate and fused septal lamellae or of median plate and fused thickened axial tabellae; tabular floors tent-shaped, of wide tabellae; cardinal septum short in fossula that indents dissepimentarium with continuous or discontinuous minor septa; septal structural modifications not uncommon. *L.Carb.-U.Carb.*

**Amygdalophyllum** Dun & Benson, 1920, p. 339 [*A. etheridgei; M; †?F1311, AM, Sydney and R22072 BM(NH), London] [≈*Arachnolasmella* Bykova, 1966, which see]. Solitary, large, with large dense columnella composed of median plate and very numerous contiguous septal lamellae; columnella may be cuspidate toward fossula, which is narrow but may expand slightly near cusp; septa numerous, long, somewhat dilated, major septa commonly extending to columnella; dissepimentarium wide, of small, normal concentric plates; tabular floors cones with upturned edges, of tabellae [see also Fedorowski, 1970, p. 566, and Semenoff-Tian-Chansky, 1974, p. 148]. *L.Carb., Australia (New S. Wales-Queensl.); Eu.(?Brit.-I.-Pol.-Urals)-N. Afr. (Alg.)-Asia (Malaya-Sinkiang-NE.USSR?-Japan); U.Carb., Eu.(Spain)-Asia (Yunnan-Kwangsi).—Fig. 233,4a,b. *A. etheridgei, L.Carb., New S. Wales, Babbinboon; a,b, transv., long. secs., ×2.0 (Benson & Smith, 1923).

**Arachnolasmella** Bykova, 1966, p. 120 [*Arachholasma (Arachnolasmella) interruptocolumellatum; OD; †?5140/4°, IG, Alma-Ata] [≈*Amygdalophyllum* Dun & Benson, 1920, which see]. Solitary; with variably developed amygdalophyllloid columnella; tabulae declined tentwise from columnella, may carry crestal septal lamellae to columnella from axial edges of few to many of major septa, which are commonly somewhat withdrawn from columnellar region; minor septa discontinuous in wider part of anguloconcentric dissepimentarium; cardinal septum short, in shallow fossula [see Fedorowski, 1970, p. 566; Suyutina, 1973, p. 98]. *L.Carb.-U.Carb.*(Visean-Namur.), Asia(Kazakh.)-Eu.(Urals).—Fig. 234,4a,b. *A. interruptocolumellatum, holotype, Namur, Dalashkisskian suite, E. Kazakh., Ketmenskiy Ra.; a,b, transv., long. secs., ×2.5, ×2.0 (Bykova, 1966).

**Carruthersella** Garwood, 1913, p. 555 [∗C. com-
Fig. 233. Aulophyllidae (p. F355-F358).
Corruthersello

Arochnolosmella

Rugosa-Stauriida-Aulophyllina

3b

30

Kumponophyllum


pacta; M; †63904 and PF2545-8, IGS, Leeds and R22228-9, BM(NH), London, fide Mitchell & White, 1966, p. 25]. Solitary, small; columella of tightly packed septal lamellae abutting on median plate and some continuous with major septa; septa dilated; dissepimentarium narrow, with lonsdaleoid plates peripherally; tabellae in pericolumnar zone declined abaxially [see also Fedorowski, 1970, p. 563]. *L.Carb. (low. Vis.); Eu. (Eng.-Pol.)-?N.Afr. (Alg.).—Fig. 234, a,b. *C. compacta, holotype, Westmoreland, Meathop, Arnside; a,b, transv., long. secs., ×3.0 (Garwood, 1913).

†Echigophyllum Yabe & Hayasaka in Hayasaka, 1924, p. 20 [*E. giganteum; M; †not traced]. Solitary, cylindrical; with axial structure not solid, composed of numerous, thin and encircling axial tabellae and few or no septal lamellae, and more or less distinct median plate; septa numerous, long, minor complete, tertiary septa may occur; septa with numerous lateral (or acutely angulate) dissepiments in broad marginarium; periaxial tabellae small, arched. [Yamagiwa, 1961, p. 104, compares it with Nagatophilum Ozawa, 1925, Dibunophyllinae.] *L.Carb. or low. or mid. U.Carb., Asia (Japan, Atetsu-Omi).

Kazachiphyllum Bykova, 1966, p. 74 [*K. densicolumellatum; OD; †1703-10, depository not traced]. Solitary, moderately large; major septa thickened in cardinal quadrants only or more strongly than in counter quadrants; cardinal septum short in distinct open fossula that indents dissepimentarium; minor septa withdrawn to peripheral parts of anguloconcentric dissepimentarium; in early stage columella present, consisting of fused axial

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ends of major septal lamellae (medial plate), in later stages plates of columella thin and columnella becoming stellate in transverse section and loculate to acrophyllid, and in latest stages may disappear. [Illustration of longitudinal section required; see also SAYUTINA, 1970, p. 136; 1973, p. 100.] L.Carb.-U.Carb. (Visean-Namur.), Asia (Kazakh.)-Eu. (U.R.S.S.).—Fig. 233,3a,b. *K. denisicolumnellatum*, Visean-Namur.; a, holotype, S. Kazakh., Betpak-Dala, Lake Dzamantuz, early stage, transv. sec., X?1.5; b, another specimen, Kazakh., Ketsmenskiy Ra., late stage, X2.0 (Bykova, 1966).

Kumpanophyllum FOMichev, 1953a, p. 257 [*K. kokinense*; OD; t199, coll. 5030, TsGM, Leningrad] [=Kumpanophyllum THOMAS, 1961, p. 52, nom. null.]. Small, solitary; in early stages major septa thin, long, counter septum connected with thick, dense columnella; in later stages septa short, columnella free, with traces of median plate and radial septal lamellae, with a narrow, normal dissepimentarium and short minor septa; tabulae thickened by more or less contiguous axial lamella and short septa. [Illustration of longitudinal section required; see also SAYUTINA, 1970, p. 136; 1973, p. 100.] L.Carb.-U.Carb. (Visean-Namur.), Europe (U.R.S.S.).—Fig. 234,2a-d. *R. benecompacta*, Visean, Skelterton Ls., Yorkshire; Columellalike axial structure of dilated median plate and radial septal lamellae and tabellae; in early stages median plate continuous with counter septum and all septa dilated, dilatation decreasing in some; cardinal and commonly also neighboring pair of major septa shorter, in fossula on convex side of corallum; in late stages median plate with, concentric or in part angulate dissepiments, minor septa degenerate; tabulae declined from columnella to marginarium; diphymorphic growth phases may occur in which columnella disappears and tabulae flatten. L.Carb. (Visean), Eu. (Brit.I.-Donbas).—Fig. 234,2e,f. *R. infallax* (Hudson & Anderson), paratypes, Mill Gate Plantation; e,f, transv., long. secs., X1.0 (Hudson & Anderson, 1928).

Subfamily CLISIOPHYLLINAE Nicholson, 1889

[Subfamily Clisiophyllinae Nicholson, 1889, p. 291] [=Clisiophyllinae GRABAU in Nicholson in NICOLSON, 1934, p. 102, nom. transl., based on junior homonym; Kolymophyllinae OOFRIELENK, 1974, p. 412].

Solitary, with axial structure of median plate and numerous, commonly convolute septal lamellae and close, steeply declined axial tabellae interfinger with more distant and less steeply declined periaxial tabellae so that structure is not sharply bounded; cardinal septum shortens in fossula that indents moderately wide dissepimentarium, with continuous minor septa and fine, concentric dissepiments. L.Carb.-U.Carb. (L.Miss.-L.Penn.).

Clisiophyllum DANA, 1846a, p. 187 [*Clisiophyllum...
Fig. 236. Aulophyllidae (p. F360).
Coelenterata—Anthozoa

keyserlingii McCoy, 1849, p. 2; SM; ?A2353, SM, Cambridge. Solitary; with numerous septa, normal minor septa in regular dissepimentarium with small concentric dissepiments; with wide axial structure with thin septal lamellae about half as numerous as major septa, typically continuous with major septa and commonly convolute, abutting on short, thickened, medial plate; fossula open, parallel-sided, bounding septa radial; cardinal septum short in late stages; tabularial parts of septa may be thickened, especially in cardinal quadrants; tabular floors conical, tabellae in periaxial series fewer and less steeply inclined than, but interfinger with, those of axial structure [Hill, 1938-1941, p. 58]. L.Carb., Eu.(Brit.-France-Belg.-Ger.-Pol.-USSR)-N. Afr. (Alg.)-Asia (Turkey-?Kazakh.-Kirghiz.-China-Japan)?N. Am. ——Fig. 235,la-d. *C. keyserlingii McCoy, holo-type, Eng., Derbyshire; a-c, transv., d, long. secs., all X1.5 (Hill, 1938-1941).

Axoclesia SEMENOFF-TIAN-CHANSKY, 1974, p. 233 [*A. cuspidiforma; OD: ?2353, SM, Cambridge; ?Not traced] [=?Neoclistophyllum Wu, 1963, which see]. Solitary; like Neoclistophyllum but minor septa discontinuous and crestal on oblique dissepiments; axial column cuspidate with median plate thickened axially and continuous with cardinal septum and in early stages with counter septum also. L.Carb.(low.Visean), N.Afr. (Alg.). ——Fig. 236.2a-b. *A. cuspidiforma, monotypa, Tafialt, Djebel Begaa; a-b, transv., long. secs., X 2.7 (Semenoff-Tian-Chansky, 1974).

Cyathoclisia DINGWALL, 1926, p. 13 [*C. tabernaculum; OD: ?16756, BM(NH), London] [=Clisaxophyllum GRABAU in CHI, 1931, p. 23 (type, Cyathophyllum coniseptum KEYSERLING, 1846, p. 164, OD; ?newtype 304, coll. 2705, PIN, Moscow, by SAYUTINA, 1973, p. 68; Tournais., R. Bolskoy Soplyas, Pechoraland, USSR), non Clisaxophyllum GRABAU in YO, 1934, p. 103, invalid junior homonym; Clisaxophyllum LANG, SMITH, & THOMAS, 1940, p. 38, nom. van.; ?Kolymphophyllum ONOPRYIENKO, 1974, p. 412 (type, K. columnum, OD; ?2/447, SVTGUP, Magadan; up. Tournais., Omolonsk massif, NE. USSR)]. Solitary, moderately large; with axial structure not defined by bounding wall, but projecting from calice as conical structure formed of short, nuclear medial plate, of very crowded, flattened, steeply declined tabellae, and of numerous septal lamellae that are continuous with major septa and somewhat convolute; fossula long, expanding into tabularium, with short or thin cardinal septum; septa may be dilated in tabularium, more markedly in cardinal quadrants; minor septa with long axial parts extending into tabularium and lying closer to counter side of major septa; dissepimentarium rather narrow with normal concentric dissepiments. L.Carb.(up.Tournais.-Visean), Eu.(Brit.-Belg.-Donbas-Tatar. ASSR-Urals-N. Zenyala)-Asia (Kuebas-Armenia). ——Fig. 236.3a-b. *C. tabernaculum, horizon Y, Brit. I., Burrington Combe, Somerset; a, holotype, transv. sec., X1.8; b, another specimen, long. sec., X 3.6 (Dingwall, 1926).

Neoclistophyllum Wu in YO et al., 1963, p. 92 [*Clisophyllum yengtzeense YOH, 1929a, p. 2; OD; ?not traced] [=?Axoclesia SEMENOFF-TIAN-CHANSKY, 1974, which see]. Solitary; septa numerous, thin in dissepimentarium, dilated in outer part of tabularium and thinning adaxially; axial ends of many curve and pass into axial structure; minor septa thin; cardinal fossula parallel-sided to subkeyhole-shaped in transverse section; axial structure sharply bounded in some, "nucleate" by numerous fine septal lamellae abutting on slightly thickened medial plate that commonly attains about one-third diameter of axial structure, and by numerous, steeply conical, axial tabellae; outer tabellae long, declined toward commonly narrow dissepimentarium of normal, small, concentric plates. L. Carb.-U. Carb.(Visean-Namur.), Asia (Kazakh.-China) Eu.(Urals-Donbas-Brit.-?Spain). ——Fig. 236.1a-c. *N. yengtzeense (YOH), syn-types, Visean, Kwangsi, near Luchengg; a-b, transv., c, long. secs., X 2.7, X 2.7, X 1.8 (Yoh, 1929a).

Subfamily DIBUNOPHYLLINAE Wang, 1950
[=Konincikkophyllinae WANG, 1950, p. 211] [=Konincikkophyllinae FOMICHEV, 1953a, p. 351]

Solitary or fasciculate; with axial structure a median plate commonly thickened in axial part, becoming discontinuous first with cardinal then with counter septum, and septal lamellae few to absent; in some, axial tabellae closer and more steeply declined abaxially than, but interfinger with periaxial tabellae; fossula with shortened cardinal septum and indented dissepimentarium, with more or less discontinuous minor septa; septal structural modifications not uncommon. L.Carb.-L.Perm.

anum, SD Gregory, 1917, p. 222; ¶T1026, KM, Glasgow, lectotype by Hill, 1938-1941, p. 75; Thirdpart Quarry near Beith, Ayrshire): Kurnatiophyllum Thomson, 1875, p. 273, misspelling for Kumatiophyllum Thomson, 1876; Aediphyllum Thomson & Nicholson, 1876a, p. 68, nom. null.; Kumatiophyllum Thomson, 1876, p. 166, 1877, p. 250 (type, K. concentricum, SD Gregory, 1917, p. 223; ¶T1038, KM, Glasgow, lectotype by Hill, 1938-1941, p. 76; Langside, near Beith, Ayrshire); Cymateophyllum Thomson, 1878, p. 166, nom. van.; Albertaia Thomson, 1878, p. 165 (type, A. victoria-regia, SD Gregory, 1917, p. 223; ¶T1043, KM, Glasgow, lectotype by Hill, 1938, p. 76; Langside, near Beith, Ayrshire), non Albertaia Dujardin, 1838, p. 881, a rotifer; Histiocephylum Thomson, 1879, p. 323 (type, H. ramsayi, SD Gregory, 1917, p. 223; ¶T448, KM, Glasgow, lectotype by Hill, 1938-1941, p. 77; Brockley, Lanarkshire; Centrephyllum Thomson, 1880, p. 227 (type, C. subcentricum, SD Gregory, 1917, p. 223; ¶T1060, KM, Glasgow, lectotype by Hill, 1938-1941, p. 77; Thirdpart Quarry near Beith, Ayrshire); Centropyllum Thomson, 1883, p. 467, nom. van.; Cymateophyllum Thomson, 1883, p. 471, nom. null.; Centrallemella Thomson, 1901, p. 484, invalid nom. subs. pro Centrephyllum Thomson, 1880; ?Protodibutophyllylum Lissityn, 1925, p. 68 (type, P. simplex, SD Lang, Smith, & Thomas, 1940, p. 106; ¶not traced, see Dobrolyubova in Sohkinia, Dobrolyubova, & Karabov, 1962, p. 327; L.Carb., Novocherkask, USSR); Huna ­noclitia Wu, 1964, p. 69 (type, H. sinensis, OD; ¶13443-7, IGP, Nanking, lectotype by Hill, 1938-1941; ¶not traced, see Dobrolyubova in Sohkinia, Dobro­lyubova, & Karabov, 1962, p. 327; L.Carb., Novocherkask, USSR); Pro­todibunophyllylum Flügel, 1970, p. 220, nom. null.; ?Biphyllum Fedorowski, 1971, which see; ?Kratanophyllum Kro­pacheva, 1972, which see; Proalbertia Cotton, 1973, p. 160, nom. subs. pro Albertaia Thomson, 1878. For discussion of subjective synonymy, see Hill, 1938-1941, p. 66 et seq., and Weyer, 1971a, p. 16. Apparently, no case has been made to ICZN for retention of the name Dibunophyllylum.]. Large, solitary, with variable axial structure typically one-third as wide as corallum and consisting of long medial plate, a few (commonly four to eight) septal lamellae on either side, and numerous axial tabellae declined steeply at its periphery; less commonly lamellae may be convolute, median plate shortens toward fossula, or tabellae, and biradial arrangement is lost; minor septa discontinuous so that dissepiments of wide dissepimentarium inosculate; cardinal septum shortens in open, commonly parallel-sided fossula that indents dissepimentarium; few cardinal septa and median plate continuous [Hill, 1938-1941, p. 65]. L.Carb.-U.Carb.-(Viscan Namur.), Eu. (Brit. I.-Belg.-France-Ger.-Czech.-Pol.-USSR)-Asia (Tai­myr-­China-Sinkiang-Japan)-N. Afr. (Alg.-Moroc.)-N. Am. (N. Scotia-Texas-Ore.); ?Penn., N.Am.(Kans.-Okla.).—Fig. 237, 1a-h. *D. bipartitum (McCoy): a, lectotype of D. muirheadi Thomson, Visean, Ayrshire, Gateside near Beith, transv. sec., ¶1.0 (Hill, 1938-1941); b, lectotype of D. bipartitum (McCoy), Visean, Derbyshire, long. sec., ¶1.0 (Hill, 1938-1941); c,d, lectotype of Aediphyllum hornickianum Thomson, transv., long. secs., ¶1.0 (Thomson, 1883); e,f, lectotype of Kumatiophyllum concentricum Thomson, long., transv. secs., ¶1.0 (Thomson, 1877); g,h, lectotype of Rodophyllum craigianum Thomson, transv., long. secs., ¶1.0 (Thomson & Nicholson, 1876b)._Fig. 237,i,j. D. sinense (Wu), holotype; i,j, transv., long. secs., ¶1.5 (Wu, 1964).

Arachniophyllum Smyth, 1915, p. 558, non Arachniophyllum Lang, Smith, & Thomas, 1940, p. 19, nom. van. pro Arachniophyllum Dana, 1846a, p. 186 [*A. simplex; M; ¶T14/1009, TC, Dublin]. Solitary, small; with dibunophyllloid axial structure and very narrow dissepimentarium commonly of one series of dissepiments and with very short minor septa; major septa thin, long, cardinal septum short in late stages in open, parallel-sided fossula; tabular floors conical. L.Carb.(low.Visean), Eu.(Eire)._Fig. 238,1a-c. *A. simplex, Carlyan Las., CSu, Co. Dublin; a, transv. sec., ¶1.8, b,c, transv. secs., ¶1.5 (Smyth, 1915).

Arachnolasma Grabau, 1922, p. 59 [*Lophophyllum sinense Yabe & Hayasaka, 1920, explanation to pl. 6, fig. 2; ¶not traced] [=Arachnolasma Lang, Smith, & Thomas, 1940, p. 19, nom. van.]. Solitary, large; like Dibunophyllylum but median plate of axial structure stronger, thickened spindlewise in transverse section and retaining contact longer with counter septum; also, septal lamellae of axial structure commonly shorter, weaker, and fewer. L.Carb.(Tourlais.), Asia(Kuzbas); L.Carb. (Visean), Asia (China-Japan-Viet Nam-Kazakh.)-Eu. (USSR-Pol.)-N.Afr. (Alg.).—Fig. 238,4a-c. *A. sinense, monotype, China, E. of Ai-chia-ping, Wei-ning-hsien, Kweichow; a-c, transv. secs., long. secs., ¶1.5 (Yabe & Hayasaka, 1920).

Biphyllum Fedorowski, 1971, p. 119 [*B. vallum; OD; ¶OS-70/1593, IG, Kielce] [=Dibunophyllylum Thomson & Nicholson, 1876a, which see]. Like Dibunophyllylum but with counter septum shortened in late stages equally with cardinal septum, and with inconstant, thickened boundary to axial structure. L.Carb.(up.Visean), Eu.(Pol.).—Fig. 238,4a-b. *B. vallum, holotype, Galezice, Holy Cross Mts.; a,b, transv., long. secs., ¶2 (Fedorowski, 1971).

Caninostroton Easton, 1943, p. 134 [*C. variabilis; OD; ¶UC48367, FM, Chicago]. Fusciplicate, increase peripheral, corallites may be large; with conspicuous fossula invading inner part of dissepimentarium, containing short cardinal septum; septa numerous, long, dilated in tabularium, in dissepimentarium buttressed by numerous semi-
dissepiments; minor septa thinner and discontinuous in inner part of dissepimentarium, where dissepiments then inosculate; tabular floors low domes, tabulae complete or incomplete; an irregular, impersistent axial structure may develop, with few septal lamellae. U.Miss. (Chester.), N.Am. (Ark.-Ill.); ?U.Carb. (Namur.), ?Eu. (Brit.I.). — Fig. 238, a, b. *C. variabile: a, holotype, Pitkin F., uppermost Chester., Ark., Pitkin Bluff, transv. sec., X2; b, another specimen, long. sec., X2 (Easton, 1943).

Copia VASILYUK & KOZYREVA, 1974, p. 31 [*C.
Fasciculate; corallites large; axial structure dibunophylloid but commonly with numerous radial septal lamellae; septa thickened in outer tabularium, particularly in cardinal quadrants, cardinal septum short in distinct fossula, counter septum commonly connected with median lamella; minor septa commonly continuous in wide marginarium.
with normal concentric dissepiments; septa may be complexly structured in dissepimentarium, in some with naotic modifications peripherally; tabular floors dibunophyllloid. *L.Carb.-U.Carb.* (up. Visean-low.Namur.), Eu.(USSR).—Fig. 239, 1a-c. *C. admiranda; a*, holotype, Belgorod Distr.,
Rugosa—Stauriida—Aulophyllina

Voronezh antecilce, S. slope, Rovenki, borehole 507, at depth 386-393 m., Vn. transv. sec., X1.3; b,c, another specimen, Voroshilovgrad Dist., borehole 475, at 480 m., transv., long. sec., X1.3 (Vasil’yuk & Kozyreva, 1974).

Corwenia SMITH & RYDER, 1926, p. 150 [*Longidavia rugosa McCoy, 1849, p. 13; OD; †A1931, SM, Cambridge]. —[Corwenia Weederkind, 1937, p. 64, nom. null.]. Phaceloid, increase peripheral, nonpartricial; corallites with dibunophylloid axial structure of medial plate that may be continuous with cardinal and counter septa, of septal lamellae and axial tabellae; major septa unthickened in axial tabellae less steeply declined abaxially and fewer than those of axial structure; dissepiments overlapping zigzag along planes of minor septal failure; dissepimentarium narrowed at fossula. L. Carb. (up.Visean), Eu. (Br.I.-Belg.-Moscow Basin-Urals)-Asia (Kazakh.). —U.Carb. (Moscow), Eu. (Spain-Donbas); †M. Penn. (Atlas), N. Am. (Alaska). —Fig. 238, 2a-c. *C. rugosa (McCoy), Corwen, Halod-y-calc; a,b, transv., c, long. sec., all X2. (Smith, 1916).

?Cystilophyllum Fomichev, 1953a, p. 274 [*Loophyllum (Cystilophyllum) kalimisi; OD; †213, coll. 5030, TsGM, Leningrad]. Solitary; in early stages with well-developed lamellar columella connected to counter septum, with long thick major septa, cardinal septum being shorter; in later stages major septa unequal and not reaching columella which may be poorly developed, septa thinning first in outer quadrants and cardinal septum shortened; minor septa thin, dissepimentarium with inosculating dissepiments; tabulae arched up to columella. [*Insufficiently known.] U.Carb. (Bashkir.), Eu. (Donbas). —Fig. 239, 2a-c. *C. kalimisi, holotype, Is. G. G. Donbas, near Kislichya Ravine; a,b, transv., c, long. sec., all X2.0 (Fomichev, 1953a).

?Diachophyllum SEMENOFF-TIAN-CHANSKY, 1974, p. 135 [*D. chevalieri; OD; †PARI74/6, MN, Paris]. Like Konickophyllum but tabular floors broad domes with outward turned or upturned edges and with median plate in deep, broad axial depression to periphery of which major septa are withdrawn. [Only two specimens known.] U. Carb. (low. Namur.), N.Afr. (Alg.). —Fig. 239, 4a,b. *D. chevalieri, holotype, Wadi Narkla, Cirque de Tagnana; a, transv. sec., X2.7; b, long. sec., dissepimentarium and right half of tabularium shown, columella at extreme left, X4.4 (Semenoff-Tian-Chansky, 1974).

Eostrotion VAUGHAN, 1915, p. 39 [*Cyathaxonia tortuosa Michelin, 1847, p. 258, sensu Carruthers, 1913, pl. 3, fig. 1, 2; †FOR1969, PF2160-4, IGS, Leeds, here chosen, original of fig. 1, not necessarily the same as Cyathaxonia tortuosa Michelin, 1847, p. 258, of which type specimen is missing from Michelin Coll., MN, Paris, fide Carruthers] [*Konickophyllum Thomson & Nicholson, 1876a, which see]. Solitary, corule; early stages with long thick major septa and cardinal fossula that expands somewhat at inner end and contains long cardinal septum connected to barlike columella; in late stages septa withdraw from columella, which may then weaken; tabulae conical, with some change of curvature near very narrow dissepimentarium; minor septa short. L.Carb. (Tournais.), Eu. (Brit.I.-Belg.). —Fig. 240, 1a-f. *E. tortuosa (Michelin) sens. Carruthers, lectotype, Belg., Cornet Quarry, Tournai; a, side view, b-c, transv., f, long. sec., all X1.0 (Carruthers, 1913).

Faberolasma BYKova, 1974, p. 35 [*F. buconica; OD; †2959/21, 1G, Alma-Ata]. Solitary; septa very long, variably thickened, numerous, subradially arranged, many attaining axis where variable axial structure present; axial structure commonly of simple oval or median-platelike columella in young stages, variably thickened, in late stages with columella inconsistent to indistinct, axial ends of longer major septa or septal lamellae joining or not at axis, and connected by abaxially declined tabellae; fossula variable, shallow, indistinct in dissepimentarium, closed or more commonly open, widening or more commonly narrowing adaxially; length of cardinal septum variable; counter septum commonly connected with axial structure; tabular floors domed, in some with edges turned out, not depressed axially; tabulae incomplete; dissepimentarium wide, dissepiments mostly normal, concentric, some lateral to septa; septal trabeculae may be multiseriatus at peripheral ends of septa. U.Carb. (Ca), Asia (Kazakh.). —Fig. 239, 5a,b. *F. buconium; holotype, Bukonskaya suite, Ca, E. Kazakh., Semipalatinsk distr.; a,b, transv., long. sec., X2.0 (Bykova, 1974).

?Haplolasma SEMENOFF-TIAN-CHANSKY, 1974, p. 196 [*Caninia subibicina McCoy, 1851a, p. 167; OD; †A2358, SM, Cambridge]. —[Haplophylla SEMENOFF-TIAN-CHANSKY in PLUSQUELLEC & SEMENOFF-TIAN-CHANSKY, 1973, p. 434, nom. nud., in binomen H. parvicarinata]. Solitary, moderately large; septa numerous, thin, radial, major septa subequally withdrawn from axis, minor septa complete; tabulae flat with downturned edges; fossula wide, shallow, invading dissepimentarium, with shortened cardinal septum; counter septum may be long; dissepimentarium narrow, normal concentric, dissepiments fine, steeply inclined and subglobose. [Possibly cyathopsid.] L.Carb. (Visean), Eu. (Brit.I.-Moscow Basin-Donbas-7Urals?N.Zemlya)-N.Afr. (Alg.). —Fig. 239, 3a,b. *H. subibicum (McCoy), holotype, low. Visean, Eng., Kendal, Westmoreland; a,b, transv. sec., X2.7, X1.3; c, long. sec., X1.3 (Semenoff-Tian-Chansky, 1974).

Heintzella FEDOROWSKI, 1967b, p. 18 [*H. multisectata; OD; †A25158, PM, Oslo] [*Fischerina Shtukenberg, 1904, p. 107 (type, F. rossica, M;
†not traced, ?Kazan University; ?L.Carb., Vyshniy Velochek, C. USSR; monotype shows irregularly prismatic corallites, presence or absence of fossula not established, possibly *Stylostraea Lonsdale*, 1845, Lithostrotonina, Lithostrotonidae, Thysanophyllinae), *non Fischerina Terquem*, 1878, a foraminifer; ?*Profischerina Cotton*, 1973, p. 162, nom. subst. pro *Fischerina Shukenberg*, 1904].

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Fig. 241. Aulophyllidae (p. F365-F369).

Phaceloid; with poorly developed, irregular and discontinuous axial structure formed only by septal lamellae and auxiliary axial tabellae without medial plate; septa somewhat thickened in tabularium, major septa withdrawn from axial structure; cardinal septum shortened in shallow open fossula that
indents dissepsimentarium slightly; minor septa may withdraw abaxially, so that normal concentric dissepsimentarium becomes anguloconcentric; tabular floors broadly conical, tabulae incomplete. (?)L.Carb.(Visean), Eu.(Moscow Basin-Urals-N. Zemlya); U.Carb., Eu.(N.Zemlya); Penn., N.Am. (Nev.); L.Perm., Eu.(Spits.-Urals).—Fig. 241, 3a,b. *H. multiseptata, holotype, L.Perm., Vestspits., Treskoledden; a,b, transv., long., secs., ×1.3 (Fedorowski, 1967b).—Fig. 241,3c,d. *H. rosica (Shuksenberg), monototype, ?L.Carb., C. USSR, Vyshniy Volochek; c,d, transv., long. secs., ×1.3 (Shuksenberg, 1904).

Katrannophyllum Kropacheva in Degtyarev & Kropacheva, 1972, p. 88[*Dibunophyllum (Katraannophyllum) mielchuo-maclaji; OD; t1, coll. 9548, TsGM, Leningrad] [?=Dibunophyllum Thomson & Nicholson, 1876a, which see; ?Debaphyllum ZHANG in JIA et al., 1977, p. 221 (type, D. multitabellum, OD; ?t196012, GB, ?Nanning; L.Carb., Datang Stage, Debao Co., Guangxi [Kwangsi])]. Solitary, large; septa very numerous and long, like those of Palaeosmilia but some major septa connected with radial lamellae of axial column; minor septa somewhat thinner; axial structure large and dibunophyloid with medial plate, radial lamellae, and very numerous axial tabellae; periaxial tabellae more widely spaced, also declined abaxially; dissepsimentarium wide, with narrow outer zone of lonsdaleoid dissepiments, otherwise dissepiments fine, normal, and concentric or anguloconcentric. [Possibly Clisisphiolineae.] L.Carb.(Visean). Asia(S.Fergana).—Fig. 241,5a,b. *K. mielchomo-claji, holotype, Pumskaya suite, Katran Ra.; a,b, transv., long. secs., ×1.3 (Degtyarev & Kropacheva, 1972).

Koninkophyllidae Gorskiy, 1978, p. 131 [*Lophophyllum (Koninkophyllidae) uralicum; OD; tslide 345, coll. 5766, TsGM, Leningrad]. Like Arachnolasma but compound and phaceloid with major septa numerous, long, axial ends grouped; counter septum continuous with median plate; tabulae koninkophylloid; minor septa and dissepiments unknown. [Insufficiently known.] L.Carb.(Weininger), Asia(Kwangsi).

Lophophrentis CHI, 1935, p. 18 [*L. trilobia; OD; ?5987, IGP, Nanking]. Solitary; cardinal fossula deep, cardinal septum very short, major septa numerous, long, axial ends grouped; counter septum continuous with median plate; tabulae koninkophyllid; minor septa and dissepiments unknown. [Insufficiently known.] U.Carb.(Weininger), Asia(Kwangsi).

Nagatophyllum Ozawa, 1925, p. 78 [*N. satoi; M; syntype IIIa, Ozawa Coll., UT, Tokyo]. Fussicate, corallites large, with axial structure consisting of median plate and axial tabellae arranged in conical floors, with long major and minor septa modified to form columns of naotic dissepiments in wide dissepsimentarium, and with periaxial tabellae sharply concave; fossula marked in periaxial tabularium. L.Carb.-U.Carb., Asia (Japan).—Fig. 241,4a,b. *N. satoi, syntype, Nagato, Tobinosu in Odamura; a,b, transv., long. secs., diagram, ×1.3 (Ozawa, 1925).

Neokoninkophyllum Fomichev, 1939, p. 58 [*N. taniaicum; SD Lang, Smith, & Thomas, 1940, p. 88; 1310, coll. 5030, TsGM, Leningrad]. Solitary, conical, large; may have few offsets; in early stages septa somewhat thickened, fossula indistinct, and thin median plate connected with both cardinal and counter septa, other major septa not reaching axis, and narrow dissepsimentarium; in later stages thickening disappears first in counter quadrants, dissepsimentarium widens and develops anguloconcentric structure as minor septa withdraw to periphery, septa may bear lateral dissepiments, cardinal septum shortens slightly, a thin, weak, platy columella is either retained, now separate and commonly somewhat displaced to side of cardinal septum, with few sparse impersistent septal lamellae, or absent; tabular floors broad cones drawn up sharply at columella. ?L.Carb. (Visean), Eu.(Pol.); U.Carb., Eu.(Donbas)-Asia
Fig. 242. Aulophyllidae (p. F370-F371).
Orygmophyllum FOMICHEV, 1953a, p. 304 [*O. convexum; OD; 1257, coll. 5030, TsGM, Leningrad]. Solitary, conical; septa in early stages thin or but slightly thickened, commonly somewhat bent or wavy, many reaching axis especially in cardinal quadrants, where long, open fossula with thin, cardinal septum may extend to axis; in late stages septa commonly somewhat shortened; dissepimentarium appears early; minor septa weak and withdrawn toward periphery, leaving inosculating dissepsiments; axial structure absent or weak, tabulae flat, complete or incomplete with a peripheral axial series divided from wider axial series by axial ends of major septa. U.Carb., Eu.(Donbas-Spits).—Fig. 242,2a,d.—*O. convexum, holotype, Is. Na., Gshel., Donbas, Aleksandro-Nevsky Farm; a-c, transv., d, long. secs., all X2.5 (Fomichev, 1953a).

Sestrophylum FOMICHEV, 1953a, p. 380 [*S. astraeiforme; OD; ?336, coll. 5030, TsGM, Leningrad]. Solitary, conico-cylindrical, slender, with axial structure of radial lamellae, with or without median plane continuous with both cardinal and counter septa, and steeply declined axial tabellae; with narrow dissepimentarium that appears early; calicular platforms everted in some; major septa commonly reach axial structure, cardinal septum not shortened, so that fossula is not apparent; septa thickened in inner parts of dissepimentarium, thinning adaxially; minor septa weaker; septa may become discontinuous abaxially; periaxial tabellae globose, floors declined slightly abaxially, U.Carb., Eu.(Donbas); Penn., ?N.Am.(Kans.-Texas).—Fig. 240,2a,e.—*S. astraeiforme, holotype, U.Carb., Car.,=?U.SSR, left bank R. Kalmius; a,b, transv., c, long. secs., all X3.0 (Fomichev, 1953a).

Silloniphymm KATO & MITCHELL, 1961, p. 281 [*Rodophyllum simonianum THOMSON, 1874, p. 558; OD; ?T1021, KM, Glasgow; lectotype by HILL, 1938-1941, p. 111]. Solitary, ceratoid to trochoid, with weak axial structure in which medial plate tends to degenerate and thin septal lamellae to become twisted; septa thin in dissepimentarium and dilated but vesiculate in tabularium, small lateral tabellae invested with sclerenchyme appearing to one side of median plane of septum; cardinal septum short in open and parallel-sided fossula that indents dissepimentarium somewhat and lies on convex side of corallum; counter septum also shortened, but less so than cardinal; dissepsiments normal concentric to angulate and irregular; tabulae flat and complete in early stages, later incomplete and declined abaxially. L.Carb. (up.Visean), Eu.(Brit.-?Pol.).—Fig. 241,6a,b.—*S. simonianum (Thomson); a, holotype, Low. Limestone Gr., Lanarkshire, Brokley, near Lesmahagow, transv. sec., X2.0 (Thomson, 1874); b, another specimen, Do, Yorkshire, 3.5 mi. S. of Horton, part of transv. sec. showing lateral tabellae on septa and cardinal fossula, X3.0 (Kato & Mitchell, 1961).

Spirophylum FEDOROWSKI, 1970, p. 570 [*S. sanctae-crucescens; OD; ?OS-70/639, IG, Kielce] [=Mira FEDOROWSKI, 1971, p. 126 (type, M. prima, OD; ?OS-70/2413, IG, Kielce; up. Visean, Galezice, Holy Cross Mts., Pol.), non Mira SCHELLENBERG, 1803, a dipteran; Mirka FEDOROWSKI, 1974b, p. 533, nom. subst. pro Mira FEDOROWSKI, 1971]. Solitary or incipiently compound; with columnella a mediolateral plate that may be augmented by fused axial ends of septal lamellae and may be immersed in wide axial structure of tabellae and commonly convolute lamellae that may be continuous with major septa; the augmented columnella in some disintegrating or simplifying but not disappearing completely; medial plate shortens at counter end; tabular floors declined slightly from medial plate; tabulae incomplete, with outer series of tabellae more steeply declined and more widely spaced; dissepimentarium anguloconcentric at least in inner parts where minor septa discontinuous; lateral dissepiments may be developed. L.Carb. (up.Visean), Eu.(Pol.-Donbas-Urals); U.Carb. (?Namur.-Moscow.), Eu. (Spain).—Fig. 242,1a-e.—*S. sanctae-crucescens, holotype, up. Visean, Ds., Pol., Galezice, Holy Cross Mts.; a-c, serial transv. secs., X1.8; d,e, other specimens, transv., long. secs., X2.0 (Fedorowski, 1970).—Fig. 242,1f,g.—S. primum (FEDOROWSKI), holotype, same locality and horizon; f,g, transv., long. secs., X2.0 (Fedorowski, 1971).

Turbinatocaninia DOBROLYUBOVA, 1970, p. 129 [*Caninia okensis SHUTKUENBERG, 1904, p. 27; in coll. 336, TsGM, Leningrad]. Solitary, moderately large to large; septa numerous; major septa commonly thickened in cardinal quadrants in tabularium, cardinal shortening in wide, open fossula that may indent dissepimentarium; minor septa commonly discontinuous in inner parts of anguloconcentric dissepimentarium; early stages with first dibunophyllum then konickophyllum axial structure that disappears in late stages; tabularium wide, major septa commonly withdrawing abaxially in konickophyllum and late stages, tabular floors updrawn to axial structure in early stages, subhorizontal in late stages. L.Carb.(Visean), Eu.(USSR).—Fig. 241,2a-d.—*T. okensis (SHUTKUENBERG); a, monotype, Lushki on R. Oka, transv. sec., X0.7 (Shuktenberg, 1904); b-d, toptotype, transv., long. secs., X1.3 (Dobrolyubova, 1960).

Yakovleviella FOMICHEV, 1953a, p. 318 [*Y. tschernyschevi; OD; ?t265, coll. 5030, TsGM, Leningrad] [=Yuanophyllum Yü, 1931, which see]. Solitary, conical; in early stages all septa somewhat thickened, cardinal septum not separated from counter septum, remaining septa failing to reach axis, dissepimentarium narrow; in later stages...
septal thickening decreasing, persisting longest in cardinal quadrants of tabularium, fossula wide and open, cardinal septum remaining long and commonly connected to median plate while counter septum shortens; axial tabellae combining with median plate to form axial structure; tabular floors conical, tabulae incomplete; minor septa may withdraw to periphery leaving inosulating dissepiments. U.Carb.(Moscov.), Eu.(Donbas).—Fig. 240,4a-c. *Y. tschernyschewi, holotype, ls. Ma, left bank of R. Kundryuchey; a-c, transv., long. secs., ×2.5 (Fomichev, 1953a).

Yuanophyllinae FOMICHEV, 1953a, p. 278 [*Yuanophyllum gorskyi; OD; t919, coll. 5030, TsGM, Leningrad] {==Koninckophyllum THOMSON & NICHOLSON, 1876a, which see, FEDOROWSKI, 1971, p. 78}. Solitary, conical, not large; major septa long, thin, but commonly not reaching thin, lathlike columella that may become isolated from end of long counter septum, cardinal septum having first withdrawn from its connection with counter septum in early stages; fossula indistinct; dissepimentarium normal concentric, narrow; tabulae elevated toward axial lath. U.Carb.(Moscov., Gihel.), Eu.(Donbas).—Fig. 240,3a,b. *Y. gorskyi, holotype, ls. Ms, Rodnikov ravine; a,b, transv., long. secs., ×2.5 (Sokolov, 1962c).

Yuanophyllum YÜ, 1931, p. 26 [*Y. kansuense; OD; t4882, IGP, Nanking] {==Yakoeleviella FOMICHEV, 1953a, which see; Arachnolasmia BYKOV, 1966, p. 126 (type, Arachnolasma (Arachnolasma) karatavica, OD; t2111/3, IG, Alma-Ata; Namur., Malý Karatau Ra., S. Kazakh.)}. Solitary, moderately large to large; convex side cardinal; with short and commonly thickened medial plate that may be continuous with counter septum; major septa thickened at least in cardinal quadrants of tabularium and withdrawn unequally from medial plate, which shows few or no traces of septal lamellae; cardinal septum short in wide, open fossula that indents dissepimentarium; minor septa may be closer to median plate while counter septum continues into axial structure, may be closer to *Ningphanophyllum, Yü, 1931. Solitary, moderately large to large, curved, convex side cardinal; with very numerous, closely spaced, long major septa commonly thickened only in cardinal quadrants of outer tabularium; minor septa present only as ridges on inner side of wall, or sparsely as crests on anguloconcentric dissepiments of narrow to wide dissepimentarium; tabularium wide with wide, loose axial structure, somewhat irregularly arachnoid and composed of axial ends of septal lamellae of minority of major septa; fossula long, narrow, open and somewhat expanded adaxially, may invade dissepimentarium zone; tabular floors rising from dissepimentarium boundary to eccentric axis or irregular median ridge, except in fossula where they are less steep, subhorizontal, or rising slightly toward periphery [see also KARO, 1959a, p. 279]. L.Carb.(Visean), Asia (Hunan-Sinkiang-?Thailand-Japan).—Fig. 243,2a,b. *H. holotisitabulata, holotype, Visean, Hunan, Haia-lo shi-chiao, Chi-yang-hsien, a,b, transv. secs., ×1.5 (YABE & HAYASAKA, 1920).

Subfamily HETEROCANININAE Hill, new subfamily

Solitary, moderately large to large, curved, convex side cardinal; with very numerous, closely spaced, long major septa, minor septa either complete or developed only as peripheral ridges or septal crest in outer parts of commonly narrow dissepimentarium; septa thickened usually only in cardinal quadrants of outer tabularium; cardinal septum commonly short; tabularium wide, with loose, irregularly arachnoid axial structure without distinct wall, with few septal lamellae or axial ends of septa that may be convolute, with or without small, median, nuclear plate or long, thin, irregular median lamella; tabular floors domed or concave, lacking peripheral troughs and median depression; fossula long, narrow, open and widening adaxially with floor subhorizontal. L.Carb.(Visean).

Heterocaninia YABE & HAYASAKA, 1920, pl. xi, fig. 2a-d [*H. holotisitabulata; M; t47151, TohU, Sendai] {==Kesenella NAKAO & MINATO, 1941, p. 107 (type, Yuanophyllum (Kesenella) yabei, M: syntypes R15442-15450, UH, Sapporo; up Visean, Setamai distr., Kitakami, Japan), see MINATO & ROWETT, 1967a, p. 338, minor septa discontinuously developed and few major septa continuous into axial structure, may be closer to *Kueichouphyllum, YÜ, 1931. Solitary, moderately large to large, curved, convex side cardinal; with very numerous, closely spaced, long major septa commonly thickened only in cardinal quadrants of outer tabularium; minor septa present only as ridges on inner side of wall, or sparsely as crests on anguloconcentric dissepiments of narrow to wide dissepimentarium; tabularium wide with wide, loose axial structure, somewhat irregularly arachnoid and composed of axial ends of septal lamellae of minority of major septa; fossula long, narrow, open and somewhat expanded adaxially, may invade dissepimentarium zone; tabular floors rising from dissepimentarium boundary to eccentric axis or irregular median ridge, except in fossula where they are less steep, subhorizontal, or rising slightly toward periphery [see also KARO, 1959a, p. 279]. L.Carb.(Visean), Asia (Hunan-Sinkiang-?Thailand-Japan).—Fig. 242,3a,b. *H. holotisitabulata, holotype, Visean, Hunan, Hai-lo shi-chiao, Chi-yang-hsien, a,b, long. secs., ×2.0 (YÜ, 1934).
Kazakh.-Armenia)-Eu. (Czech.)-W. Australia.—  Fig. 243, la-c.  *K. sinense; a, holotype, Visian, Jung-tung, Kweichow, Ting-fan-hsien, transv. sec., ×1.5; b,c, another specimen, Visian, Kwangsi, Tang-chia-shih, Hsing-an-hsien, transv., long. secs., ×1.5 (Yü, 1934).

Fig. 243. Aulophyllidae (p. F371-F373).

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Family **EKVASOPHYLLIDAE** Hill, new family

Solitary, curved, convex side cardinal; cardinal septum short, major septa long, numerous, subradial in counter quadrants, in cardinal quadrants pinnate toward long, deep fossula that expands and is deepest adaxially and in some may embrace part of solid columella; axial structure commonly present, columellar in early stages but may be acrophylloid or absent in late stages; tabular floors axially conical where axial structure present, otherwise sagging; minor septa short to moderately long, dissepimentarium narrow to moderately wide. *L.Carb.*

**Ekvasophyllum** Parks, 1951, p. 175 [*E. inclinatum*; OD; †115997, USNM, Washington] [≡Ekwasophyllum Ivanovskiy, 1973b, p. 273, nom. null.]. Solitary, slightly curved, trochoid; septa numerous, tending toward radial symmetry except near prominent fossula, to which they are pinnately arranged; cardinal septum very short, on convex side of corallum in long, deep fossula whose axial end embraces part of rodlike columella commonly slightly compressed laterally; septa thickened in early stages, especially in tabularium and in cardinal quadrants; tabular floors broadly

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Fig. 244. Ekvasophyllidae (p. F373-F374).
conical, with upturned edges, tabulae incomplete; disseipementarium narrow, normal concentric [see ARMSTRONG, 1970, p. 11]. Low.U.Miss.(Mermec.), N. Am. (Utah-?Cal.-Ariz.-B. C.-Alberta-Alaska); L. Carb., ?Asia(Hunan).—Fig. 244, 1a,b. *E. inclinatum, holotype, Brazer Ls., Utah, Leatham Hollow, Wasatch Mts.; a,b, transv., long. secs., ×2 (Parks, 1951).

*Faberophyllum* PARKS, 1951, p. 177 [*F. occulatum; OD; t116001, USNM, Washington*] [=?*Turbophyllum* PARKS, 1951, which see]. Solitary, large, curved, convex side cardinal; septa very numerous, long, tending toward radial symmetry except near prominent fossula, toward which they are pinnaently arranged; early stages evakosphylloid with columnella; in later stages minor septa long, cardinal septum short in deep, narrow fossula commonly closed and not embracing any part of weak axial structure that may consist of thin irregular medial plate with few septal lamellae and tabellae, or may fail; tabular floors sagging but uparched and conical axially when axial structure present; tabulae complete, close together; disseipementarium wide, normal concentric [see ARMSTRONG, 1970, p. 14]. Low.U.Miss.(Mermec.), N. Am. (Utah-?Idaho-B.C.-Alberta-Alaska); L. Carb., ?Asia(Taymyr-Kazakh.-Kuzbas)-?Eu.(Urals).—Fig. 244,3a,b. *F. occulatum, holotype, Brazer Ls., Utah, Wasatch Mts., a,b, transv., long. secs., ×2 (Parks, 1951).

*Turbophyllum* PARKS, 1951, p. 176 [*T. multi­conus; OD; t115999, USNM, Washington*] [=?Faberophyllum* PARKS, 1951, which see]. Like *Faberophyllum* but tabellae drawn up to continuity axially in late stages so that weak acrophylloid axial structure is formed with or without short medial plate. Low.U.Miss.(Mermec.), N. Am. (Utah-Alberta).—Fig. 244,4a,b. *T. multi­conus, holotype, Brazer Ls., Utah, Dry Lake, Wasatch Mts.; a,b, transv., long. secs., ×2 (Parks, 1951).

*Zaphirphyllum* SUTHERLAND, 1954, p. 363 [*Z. disseptum; OD; t10568, GSC, Ottawa*]. Solitary, trochoïd, curved, small to medium-sized; on convex side with prominent, deep fossula that expands and is deepest in axial region; cardinal septum very short; counter septum long with somewhat swollen axial edge in early stages, later shorter, other major septa long with subradial arrangement in counter quadrants, pinnate to fossula in cardinal quadrants; minor septa rather short; disseipementarium narrow with normal, small, concentric dissepiments [see also S E M E N O F F - T I A N - C H A N S K Y, 1974, p. 43]. L. Carb.(mid.Miss.), N. Am. (NW. Terr.-?Mont.); L. Carb.(Visean), ?Asia(Taymyr)-?N.Afr.(Alg.).—Fig. 244,4a-c. *Z. disseptum, holotype, Can., Liard Ra., NW. Terr., a,b, transv., c, long. secs., all ×2 (Sutherland, 1954).

**Family PALAEOSMILIIDAE** Hill, 1940

[Palaeosmiliidae Hill, 1940 in 1938-1941, p. 115]

Solitary, ?fasciculate; cerioid, astreoid, or aphroid, corallites large; septa very numerous, long and subradially arranged, major may withdraw somewhat from axis, cardinal may shorten more than others; cardinal fossula long, narrow, shallow, distinct only in wide tabularium, commonly open and widening adaxially, merging with adaxial depression when septa withdrawn from axis, and with upturned peripheral edges; tabulae incomplete; disseipementarium wide, normal concentric, lateral dissepiments correlated with septal structural complexity, or lonsdaleoid dissepiments may develop. ?U. Dev.-U.Carb.

**Palaeosmilia** MILNE-EDWARDS & HAM, 1848b, p. 467 [*P. murchisoni; SM, MILNE-EDWARDS & HAM, 1848c, p. 261; t48398, BOWERBANK Coll., BM(NH), London*] [=?*Strephodes Modes* MCCOY, 1849, p. 4 (type, S. multilamellatum, M; tA2404, SM, Cambridge, lectotype by GARWOOD, 1913, p. 562; L. Carb., ?Arnside, U.K.); *Clisiophyllites* LOWE-NECK, 1932, p. 98 (type, C. tianschanensis, M; not traced, originally in Bayer. Staatsammlung, Munich, part of which was destroyed during war; Visean, Tianshan, China). Solitary, ?fasciculate, corallites moderately large, with numerous, radially arranged, long septa, wide, regular disseipementarium, and long, shallow fossula narrow at outer part of wide tabularium, widening slightly nearer to axis; tabulae incomplete; tabular floors flattened domes with upturned edges, sagging at axis when major septa somewhat withdrawn; dissepiments numerous, regular, small and globose [see KABAKOVICH, 1952, p. 85]. ?U.Dev., Eu. (Belg.-Ger.)-W.Australia; L. Carb.-U.Carb.(?Tour­nais.-Visean.-Namur.).—Eu. (Brit.-I.-France-Belg.-Ger.-Carnic Alps.-Czech.-Pol.-USSR)-Asia (?Ural­s.AMinor-Taymyr-Kazakh.-Kirghiz.-Kuzbas-Kwei­chow-Kwangsi-Sinkiang-Japan-NE. USSR)-N. Afr. (W.Sahara).—Fig. 245,4a,b. *P. murchisoni, Ds, Somerset, Frome; a, transv. sec., ×1.7 (Yu, 1937); b, another specimen, long. sec., ×1.7 (Hill, n; UQF12443).


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FIG. 245. Palaeosmiilidae (p. F374-F376).

(Qinghoiphyllum Lo, 1962, reference not traced, quoted from Yoh & Wu, 1964, p. 132 [?Q. sinense Lo, 1962; ?OD; [not traced]. Solitary, cylindrical; like Palaeosmilia but with lathlike columella in median plane. [Insufficiently known."

L.Carb. (Visean), Asia (Kweichow).——Fig. 245, 2a,b. ?Q. sinense; transv., long. secs., ×0.8 (Yoh & Wu, 1964).——Fig. 245, 2c. Q. sp., up. Visean, W. Kweichow; transv. sec., ×1.2 (Wu, Chang, & Ching, 1974).

?Family APHROPHYLLIDAE Hill, 1973
[Apiphyllumidae Hill, 1973, p. 135]
Solitary or compound; major septa commonly extending to axial region, axial ends of one to four commonly asymmetrically placed groups of small numbers of neighbors curving toward one another around shorter septum, not necessarily a protoseptum; less commonly major septa somewhat withdrawn from axis and septal grouping not apparent; protosepta and fossula commonly not distinct; irregular axial structure of sparse septal lamellae and axial tabellae may develop; tabulae broadly domed, nearly flat or when major septa are withdrawn from axis, gently sagging; in dissepimentarium septa may be replaced by naoic columns of dissepiments or be discontinuous through peripheral zone of irregular, large lonsdaleoid dissepiments [see also Jull, 1974, p. 7]. *L. Carbo.* (up.Tournais.-Visean).

*Aphrophylum* Smith, 1920, p. 51 [*A. hallense*; M; tF17640, AM, Sydney and A5051, SM, Cambridge]. Cerioid; major septa commonly long and including one, two, or a few pinnate groups in which axial ends curve toward one another about a shorter septum not necessarily a protoseptum, but may be short; an inconstant and irregular axial structure may be present; minor septa well-developed; peripheral parts of septa may be replaced each by column of naoic dissepiments; irregular, unequal lonsdaleoid dissepiments developed peripherally, in variably wide zone; tabulae domed or less commonly mesa-shaped, altering to flat or sagging in corallites with short major septa; increase lateral, rarely parricidal-peripheral; trabeculae monacanthine [see Jull, 1974, p. 8]. *L. Carbo.* (Visean), Australia(New S.Wales-Queensl.).—Fig. 246,4a,b. *A. hallense*, New S. Wales, Halls Cr., about 17 mi. S. of Bingara; *a,b*, transv., long. secs., X1.7 (Jull, 1969b).

*Aphrophylloides* Pickett, 1967a, p. 32 [*A. careyi*; OD; tF7983, UNE, Armidale]. Cerioid or fasciculate; axial ends of some major septa may fuse and participate, with discrete septal lamellae and tabellae, in variable, ill-defined, loose axial structure; minor septa short, dissepimentarium with large, low, lonsdaleoid dissepiments peripherally, and normal concentric dissepiments in inner parts; cardinal and, less commonly, counter septum may be longer than others; naoic modifications of septa may develop; tabular floors tent-shaped, with upturned edges, the axial parts contributing to ill-defined axial structure [Jull, 1974, p. 15]. *L. Carbo.* (Visean), Australia(New S.Wales-Queensl.).—Fig. 247,2a,b. *A. careyi*, holotype, Parish New S. Wales, Babbinboon, Hill 60, Por. 60; *a,b*, transv., long. secs., X2.0, X2.5 (Pickett, 1967a).

Coenaphoria* Jull, 1974, p. 21 [*Orionastraea lonsdaleoides* Hill, 1934, p. 91; OD; tF2938, UQ, Brisbane, part is A5485, SM, Cambridge]. Like *Aphrophylloides* but partly or completely aphyroid and with flat or sagging tabulae in corallites, which commonly have axial structure. *L. Carbo.* (Visean), Australia(Queensl.).—Fig. 246,1a,b. *C. lonsdaleoides* (Hill), holotype, Riverleigh Ls., Latzas Farm, 6.4 km. NW. of Mundubbera; *a,b*, transv., long. secs., X1.7 (Jull, 1974).

Merlewoodia Pickett, 1967a, p. 24 [*M. bensoni*; OD; tF5588, UNE, Armidale]. Solitary, moderately large; septa numerous; major septa reach or nearly reach axis, with slightly enlarged axial ends, but not confluent; cardinal septum short, counter septum long; minor septa short; septa dilated, dilatation may be continuous over dissepiments and tabulae; without axial structure; tabular floors like a low-crowned hat with axial depression and upturned brim; dissepiments lonsdaleoid peripherally; septa may be naoic in places. *L. Carbo.* (Visean), Australia(New S.Wales-Queensl.).—Fig. 246,3a,b. *M. bensoni*, Swains Gully Ls., New S. Wales, Swains Gully, Babbinboon; *a*, holotype, long. sec., X1.7; *b*, paratype, transv. sec., X1.7 (Pickett, 1967a).

*Naoides* Pickett, 1967a, p. 24 [*N. rangariensis*; OD; tF5612, UNE, Armidale]. Solitary, moderately large; major septa long, nearly reaching axis, minor septa short; all septa greatly dilated and laterally contiguous except for sporadic dissepiments, becoming naoic peripherally in late stages; septa of cardinal quadrants pinnate about short cardinal septum; counter septum long; tabular floors shallow domes. [Insufficiently known.] *L. Carbo.* (up.Tournais.-Visean), Australia(New S.Wales).—Fig. 247,3a,b. *N. rangariensis*, holotype, Rangari Ls., Co. Nandewar, Por. 1, Parish Rangari; *a,b*, transv., long. secs., X2.0 (Pickett, 1967a).

Nothaphrophyllum Pickett, 1967a, p. 23 [*N. gregarium*; OD; tF5621, UNE, Armidale]. Phaceoid; septa discontinuous peripherally with lonsdaleoid or some naoic dissepiments; major septa almost reaching axis except for cardinal, which is shorter or ?longer than others; ends of adjacent sepa may be curved around inner end of cardinal septum; without axial structure; minor septa short, may be contrainingent or reduced from periphery, leaving inosculating dissepiments in loculi between major septa; dissepiments steeply inclined; tabulae incomplete, tabular floors flatly domed axially, perixial tabellae variable; increase lateral or, rarely, parricidal-peripheral [see Jull, 1974, p. 22]. *L. Carbo.* (Visean), Australia(New S.Wales-Queensl.).—Fig. 246,2a-c. *N. gregarium*, holotype, New S. Wales, Chatham Quarry, Tarre; *a*, holotype, long. secs., X1.7 (Pickett, 1967a).

Symplectophylluffi Hill, 1934, p. 64 [*S. mutatum*; OD; tF2943, UQ, Brisbane]. Solitary; with axial structure wide and with variable dibuno-
Fig. 246. Aphrophyllidae (p. F376-F377).
phylloid patterns; skeletal thickening may be great, not regular; septa naotic peripherally; tubulae low domes, complete or incomplete; minor septa well developed; fossula commonly not distinct; inner parts of dissepimentarium with normal concentric dissepiments where septa are thin. L. Carb. (Visean), Australia (Queensl.-New S. Wales).—Fig. 247, la,b. *S. mutatum*, holotype, Latzas F., Riverleigh Ls., Queensl., near Mundubbera; a,b, transv., long. secs., X2.0 (Jull, 1969b).
Part F
COELENTERATA
SUPPLEMENT 1
RUGOSA AND TABULATA
By Dorothy Hill

Volume 2

[For table of contents see Volume 1, p. F1-F4]

Suborder LITHOSTROTIONINA
Spasskiy & Kachanov, 1971

[Lithostrotionina Spasskiy & Kachanov, 1971, p. 48]

Compound Stauriida; commonly with axially somewhat thickened lathlike columella continuous in early stages with cardinal and counter septa but later commonly with counter septum only; tabular floors conical; tabulae complete or incomplete; diphymorphs in which columella fails and tabulae flatten are common, some develop an aulos; dissepimentarium commonly normal, concentric with subglobose dissepiments, and minor septa commonly continuous longitudinally; cardinal fossula not distinct. Carb.-Perm.

Family LITHOSTROTIONIDAE
d'Orbigny, 1852

[Lithostrotionidae d'Orbigny, 1852, p. 184] [=Nematophyllinae McCoy, 1851b, p. 33; Stylaxidae de Fromentel, 1861, p. 74, 313 (nom. correct. Hill, herein, ex Stylaxinidae Gertsh, 1921, p. 69, et Stylaxiniens de Fromentel, 1861, p. 74, 313)]

Fasciculate or massive Lithostrotionidae with columella lenticular in section and commonly continuous with counter septum in late stages, with conical, complete or incomplete tabulae and with normal concentric dissepimentarium; diphymorphic corals may occur; cardinal fossula indistinct. L.Carb.-L.Perm.

tabular floors conical, tabulae complete or incomplete when tabellae are commonly in only indistinctly bounded axial and periaxial zones; diphy- morphic corallites may occur in which columella fails and tabulae become domed or flat. *L.Carb.*-*U.Carb.* (*Visean-Namur*), Eu. (Brit.I.-France-Belg.-
Rugosa—Stauriida—Lithostrotionina

Ger.-Pol.-USSR)-N. Afr. (W. Sahara-Alg.)-Asia (Kazakh.-Taiyym-Indoch.-China-Japan-NE.USSR)-Australia (Queensl.-New S.Wales); U.Miss.(Mere mec.-), N.Am.(?Ore.-Alaska).—Fig. 248,2a. *L. striatum*, lectotype, L.Carb., Brit. I.; transv. sec., ×1.9 (Thomson, 1887).—Fig. 248,2b-d. L. arachnoideum (McCoY), lectotype, Eng., Derbyshire; b-d, transv., long. secs., ×1.9 (Hill, n).—Fig. 248,2e, f. L. flemingi (McCoY), lectotype, Eng., Derbyshire; e, f, transv., long. secs., ×1.9 (Hill, n).

Akiyosiphylllum YABE & SUGIYAMA, 1942, p. 574 [*A. stylophorum; M; 16503, TohU, Sendai] [=Cionodendron BENSON & SMITH, 1923, which see; Akiyosiphylllum YAMAGIWA, 1961, p. 109, *van. nom.*]. Fasciculate; corallites slender, with broad, dense columella, with traces of median lamella in counter-cardinal plane, and of tabellar structures; major septa thin in tabularis and extending to columella; minor septa dilated to form imperfect peripheral stereozone with some interspectral loculi containing wide, horizontally based dissepiments; tabular floors conical, of numerous tabellae in places penetrating columella [see MINATO, 1955, p. 167]. *L.Carb.(Visean)*, Asia(Japan). [Originally considered of Permian Yabeina Zone, subsequently (MINATO & KATO, 1957, p. 544) of Nagatophyllum satoi Zone of Visean age (YANAGIDA, 1973, p. 48).]—Fig. 249,3a-e. *A. stylophorum*, holotype, Yamaguchi Pref., Ohkubo, Mine-gun; a, b, transv., long. secs., ×3.0, e-c, transv. secs. columella, enl. (Minato, 1955).

Cionodendron BENSON & SMITH, 1923, p. 165 [*C. columnus*; OD; t51457 and slides AM1137-8, AM, Sydney with parts R21999-22001, BM(NH), London and F45551, UQ, Brisbane] [=Lithostrotion FLEMING, 1828, which see; *Akiyosiphylllum YABE & SUGIYAMA, 1942, which see*]. Fasciculate, corallites slender; with large dense columella consisting of short median plate and thickened axial ends of major septa; tabellae between columella and dissepimentarium trough-like; major and minor septa may be so thickened in dissepimentarium that many interspectral loculi are closed. [Only one specimen known; see JULL, 1969b, p. 122.] *L.Carb.(Visean)*, Australia(New S.Wales).—Fig. 248,1a,b. *C. columnus*, monotype, New S. Wales, Slaughterhouse Cr., near Gravesend; a, b, transv., long. secs., ×2.9 (Benson & Smith, 1923).

Orionastraea SMITH, 1917, p. 294 [*Sarcinula philippsi* McCoy, 1849, p. 125; OD; t21288, SM, Cambridge; lectotype by SMITH, 1917, p. 295]. Astreoid, thamnasterioid, or aphroid; major and minor septa long, may be discontinuous toward periphery; columella formed by dilatation and upgrowth of axial end of long counter septum, may be mainly absent in diphyomorphic species; tabulae conical, complete or incomplete; dissepiments small, normal except peripherally in aphroid forms [see HUDSON, 1929, p. 441]. *L.Carb. (Visean)*, Eu. (U. K.-Eire-Urals-N. Zemlya-Russ. Platf. - Donbas) - Asia (Japan - Hansu) - Australia (Queensl.-New S.Wales); ?L.Carb., N.Am.(New.).—Fig. 249,4a,b. *O. philippsi* (McCoy), Visean, U.K., Cowen, N. Wales; a, b, transv., long. secs., ×4, ×2 (Hudson, 1929).

Schoenocephylllum SIMPSON, 1900, p. 214 [*S. aggregatum*; OD; syntypes 314-315, NYSM, Albany; lectotype by EASTON, 1957, p. 618] [=Paralitho­ strotion GORSKY, 1938, Lonsdaleina, Petalaxidae]. Phacellid, corallites slender, cylindrical, and anchored laterally to another one another by slender, ascending processes; increase lateral, nonparricidal; septa few, minor septa merely ridges on wall; counter septum very long, with axial end enlarged to form lathlike columella; one longitudinal series of dissepiments; tabulae horizontal, or very low cones. [See EASTON, 1957, p. 616; possibly petalaxid.] *S. aggregatum*, N.Am.(Ky.-Ind.-Alberta-B.C.).—Fig. 249,4a,b. *S. aggregatum*, Meramec, St. Louis Ls., Ky., Glasgow Junction, Barren Co.; a, b, transv., long. secs., enl. (Simpson, 1900).

Siphonodendron McCoy, 1849, p. 127, diagnosed and figured but no species named [*S. aggregatum* McCoy, 1851b, p. 108; SD Cut, 1931, p. 26; invalid nom. subst. pro Liodendron pascuiradialis McCoy, 1844, p. 189; t82.1925, GRIFFITH Coll., NM, Dublin; lectotype by HILL, 1938-1941, p. 169; L.Carb., Lower Limestone, Magehamore, Tobercurry, Co. Sligo, Eire] [=Cystidendron SCHINDEWOLF, 1927, p. 149 (type, *Lithostrotion (Cystidendron) flejense*, OD; tL178, ZGf, E. Berlin; L.Carb., Kleff, Ger.; tabulæ incomplete, tabellae in indistinctly bounded axial and periaxial zones); ?Stylostromum CUS, 1935, p. 20 (type, *S. intermedium*, OD; t5991, IGP, Nanking; M.Carb., Weining, Taloshan, Szumenshu, Kwangsi)]. Fasciculate; increase predominantly lateral; corallites with columella thinly lenticular in transverse section, continuous with both counter and cardinal septa or with counter septum only; major septa may be connected with columella by crests on upper surfaces of tabulæ; minor septa short to long; tabular floors conical, tabulae complete or incomplete when tabulæ are commonly in only indistinctly bounded axial and periaxial zones; dissepimentarium normally concentric; diphyomorphic corallites in which columella fails and tabulæ become domed or nearly flat may occur within normal coralla; cardinal fossula not distinct. *L.Carb.-U.Carb.(Visean-Namur.)*, Eu. (Brit. I.-Belg.-France-Ger.-Pol.-USSR)-N. Afr. (W. Sahara-Alg.)-Asia (Turkey-E. Urals-Kazakh.-Kuzbas - Tibet - China - Indoch. - Japan - Taymyr - NE.USSR)-Australia (Queensl.-New S.Wales); U.Miss.(Meramec.-Chester.-), N.Am.(EUSA-W.USA-W.Can.-Alaska); U.Carb., Eu.(USSR-Czech.-)Asia (China).—Fig. 249,1a-c. *S. pascuiradialis* (McCoy), lectotype; a,b, ext. views, ×1; c, transv. sec., ×2 (Hill, 1938-1941).—Fig. 249,1d,e. S.
FIG. 249. Lithostrotionidae (p. F381-F383).
aggregatum, L.Carb., D₂, Merionethshire, Corwen; d.e, transv., long. sects., <X>2 (Hill, n; A1996, SM, Cambridge).—Fig. 129,1f-h. ?S. intermedium (Chi), holotype; ?-h, transv., long. sects., <X>3 (Chi, 1931).

Subfamily DIPHYPHYLLINAE Dybowski, 1873

[Diphyphyllinae Dybowski, 1873c, p. 332]

Fasciculate; weak axial structure sporadically present, either lathlike columella or few, thin, short septal lamellae; tabular floors domes upturned peripherally or mesas, and commonly formed by axial and periaxial series of tabellae; major septa longitudinally continuous to edge of axial series of tabellae, amplexoid adaxially; minor septa short, discontinuously present, either lathlike columella or series of tabellae; major septa longitudinally continuous to edge of axial series of tabellae, amplexoid in axial zone: occasional traces present. Phaceloid, increase peripheral, one to four offsets arising from the one parent calice; tabular floors mesas or domes with upturned edges, commonly in two series of tabellae, an axial series of flat or low-domed plates whose edges may rest on the next below, and a periaxial series of smaller tabellae; axial ends of major septa commonly abutting on discontinuous expanding and contracting wall formed by downturned parts of axial tabellae, and amplexoid in axial zone; occasional traces present of lathlike columella that may be thinly lenticular in transverse section; disseptimentarium with minor septa and normal concentric dissepiments, or in places in some, not developed [see Ivanovskiy & Shurygina, 1975, p. 17].

Diphyphyllum Lonsdale, 1845, p. 624 [*D. concentrum; M; +neotype, 2, coll. 486, IGG, Novosibirsk; by Ivanovskiy & Shurygina, 1975, p. 17; meanwhile, figured syntype, 49470, has been re-discovered in BM(NH), London] [=Depasophyllum Yü, 1934, p. 85 (type, Diphyphyllum (Depasophyllum) hochangpinense Yü, 1934, p. 86, SD Smith & Thomas in Thomas, 1956, p. 181; 15012, Tien Coll., IGG, Nanking), non Depasophyllum Grabau, 1936, p. 43, Stauriina, Pycnostyliina; by down turned parts of axial tabellae, and amplexoid resting on the next below, and, irregularly present, irregular septal lamellae; periaxial tabulae abut axial structure, somewhat declined to narrow dissepimentarium of small plates; major and minor septa present, axial ends of major septa abutting axial structure. L.Carb.(up. Visean), Eu.(Eng.-Wales-USSR)-Asia(Kazakh.).—Fig. 251,la,b. *K. permicum, syntype, Pengin. (fide Yé, 1937, p. 47, 56), northern Kwangsi Prov., 1 li SW. of Ho-Mu-Shih, Jung Hsien; a,b, transv., long. sects., <X>2.0 (Yoh, 1929b).

Nemistium Smith, 1928, p. 114 [*N. edmondsi; OD: +R.25488 and 25489, BM(NH), London]. Phaceloid, increase peripheral; with an axial structure of strongly arched axial tabulae each resting on the arch below, and, irregularly present, irregular septal lamellae; periaxial tabulae abut axial structure, somewhat declined to narrow dissepimentarium of small plates; major and minor septa present, axial ends of major septa abutting axial structure. L.Carb.(up. Visean), Eu.(Eng.-Wales-USSR)-Asia(Kazakh.).—Fig. 251,la,b. *N. edmondsi, Eng., a, Ward Hall East Quarry near Aspatria, W. Cumberland; transv. sec., <X>2.0; b, Eskett Quarry, near Winder Railway Station; long. sec., <X>2.5 (Smith, 1928).

Opiphyllum Kozyrèva, 1973, p. 130 [*O. fomitchevi; OD: +194, coll. 14, DPI, Donetsk] [=Diphyphyllum Lonsdale, 1845, which see]. Fasciculate; tabularium wide with imperceptibly thin lathlike irregular columella and commonly with mesa-shaped tabulae that may sag slightly axially and may have their downturned edges resting on tabula next below or slightly upturned again to meet narrow, concentric dissepimentarium in which are short minor septa; axial ends of major septa withdrawn from axis or amplexoid again to meet narrow, concentric dissepimentarium in which are short minor septa; axial ends of major septa withdrawn from axis or amplexoid above tabular platforms; cardinal fossula inconspicuous. U.Carb.( Bashkir.), Eu.(USSR).—Fig. 251,3a,b. *O. fomitchevi, holotype, horizon b, Donotsovka, borehole no. 117 at depth 369.4-369.8 m., Voronesh anteclise; a,b, transv., long. sects., <X>2.0 (Kozyrèva, 1973).

Tschussowskienia Dobrolyubova, 1936a, p. 48 [*T. captiosa; OD: +1330, coll. 4765, TsGM, Leningrad]. Fasciculate; corallites with imperceptible axial structure of short, irregular septal lamellae, low-domed or mesa-shaped tabulae with peripheral edges

Ravine, e-g, transv., ij, long. sects., <X>2.7 (Hill, n; IGG 486/2, photographs courtesy A. B. Ivanovskiy); h, figured syntype, L.Carb., E. Urals, Chirev, Kamensk, on R. Iset, long. sec., <X>2.7 (Hill, n; BM(NH)49470, photograph courtesy of the British Museum (Natural History), London).

Kwansiphyllum Grabau & Yoh in Yoh, 1931, p. 79, nom. subst. pro Syringophyllum Grabau & Yoh in Yoh, 1929b, p. 2, non Syringophyllum Milne-Edwards & Haime, 1850, a tabulatun [*Syringophyllum permicum Grabau & Yoh in Yoh, 1929b, p. 2; OD: +not traced]. Fasciculate; corallites slender, in type species with connecting tubuli; with thin wall, short tabulate major septa, rudimentary minor septa and complete tabulae; horizontal in center but with peripheral trough; sporadic dissepiments in some. [Insufficiently known; may be diphyomorphic Lithostrothion junceum, fide Kato, 1971, p. 7.] L.Carb.(Visean), Asia(Kwangsiphyllum GRABAU & YOH in YOH, 1931, p. 19, fig. 251,4a,b, K. permicum, holotype, horizon a, Visean, L.Carb., Merionethshire, Corwen; 251,le-j. "K. permicum, holotype, horizon b, Donotsovka, borehole no. 117 at depth 369.4-369.8 m., Voronesh anteclise; a,b, transv., long. sects., <X>2.0 (Yoh, 1929b).

Cambridge).—Fig. 250,1e-j. *D. concentrum; e-g,neotype, base up. Visean, USSR, R. Islet near Kamensk-Uralsk, Chiriev

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Fig. 250. Lithostrotionidae (p. F383).

resting on tabula next below or more commonly reaching dissepimentarium which is very narrow and commonly of one series of small plates with short minor septa; supplementary periaxial tabellae may occur; major septa withdrawn from axis, inner ends resting on tabulae at their change of
FIG. 251. Lithostrotionidae (p. F383-F387).

slope. *U. Carb.-L. Perm.*, Eu. (C. Urals-N. Urals-Spits.)-?Asia(Viet Nam-Japan).—Fig. 251,2a,b.

*T. captiosa*, holotype, U.Carb.(?Gshel.), W. slope C. Urals, Verkhne Chusovskie borehole no. 2 at
Fig. 252. Lithostrotionidae (p. F387).
depth 922.1 m.; a,b, transv., long. secs., \( \times 1.5 \) (Dobrolyubova in Soshkina, Dobrolyubova, & Kabakovich, 1962).

**Subfamily AULININAE Hill, new subfamily**

Fasciculate or massive; axial structure a more or less regular cylindrical aulos; septa thin, major reaching aulos; aular tabulae flat; periaural tabulae declined abaxially, may have upturned edges; dissepimentarium commonly regular with concentric small dissepiments, but lonsdaleoid in places in some; cardinal fossula inconspicuous.

*L.Carb.(Dinant.).-U.Carb.(Namur.)*

Aulina Smith, 1917, p. 290 [*A. rotiformis*; OD; \( \dagger\)R17497, BM(NH). London, and parts A1801-2, A2406, SM, Cambridge] \( [=A. (Pseudoaulina)] \) Minato & Rowett, 1967b, p. 389 (type, *A. se内x* Hill, 1940 in 1938-1941, p. 193, OD; \( \dagger\)ZNI in Neilson Coll., 1911-2010, RSM, Edinburgh; Namur., near Dalry, Scot., for aphoon species). Ceriod, astreoid, thamnasterioid, or aphroid; carinate or zigzag; tabulae as axial series of horizontal tabellae and periaxial series of outwardly declined tabellae; dissepiments small, except peripherally in aphoon forms [Minato & Rowett, 1967b, p. 383]. *L.Carb.-U.Carb.(Visean-Namur.)*, Eu.(U.K.-Eire-France-?Ger.-Donbas-N. Zemlya)-Asia(Kuzbas-China-Viet Nam); U. Miss. (Meramec. or Chester.), N.Am.(Ariz.).—Fig. 252,1a,b. [*A. rotiformis*, Namur., Eq. Linn Spout Ls., Scot., near Dalry; a,b, transv., long. secs., \( \times 3 \) (Hill, 1938-1941).—Fig. 252,1c. *A. se内x*, holotype, Namur., Upper Ls. Ser., Eq., superior beds, Scot., Glencart, near Dalry, transv. sec., \( \times 3 \) (Hill, 1938-1941).

Aulokonicephalium Sand, 1976, p. 432 [*Campsoplygium carinatum* Carruthers, 1909, p. 150; OD; sytypes 1954.6.8-13, RSM, Edinburgh]. Solitary, or rarely weakly fasciculate; with aulos poorly defined and formed mainly by union of deflected axial ends of major septa and partly by tabulae; septa long, aulin, carinace zigzag, tabular floors in aulos commonly flat and horizontal but abaxially declined between aulos and normal concentric dissepimentarium. [Possibly related to Konicephalium Thomson & Nicholson, 1966a (sand, 1976, p. 432.) *L.Carb.-U.Carb.(up. Visean-low.Namur.)*, Eu.(N.Zemyla-Dobas-Eng.)-N. Afr. (Alg.)-Asia (Laos)-Australia (Queensl.).—Fig. 253,2a,b. [*A. carinatum* (Carruthers), syntype, L.Carb., S. Novaya Zemlya, C. Cherney; a,b, transv., long. secs., \( \times 3 \) (Carruthers, 1909).

Aulostylus Sand, 1976, p. 427 [*Aulostylophore tubifera* Hayasaka, 1936, p. 69; OD; \( \dagger\)120247, USNM, Washington]. Ceriod aulate corals with aulos formed by union of deflected axial ends of major septa; longitudinally discontinuous columnella commonly present, axial plate formed by prolongation of one or two major septa; major and minor septa noncarinate or weakly carinate with zigzag carinace; tabular floors in aulos commonly flat and horizontal and may be upturned at columnella, but abaxially declined between aulos and lonsdaleoid dissepimentarium. [Absence of tabellae from axial structure suggests relationship to Aulinae rather than to Petralessidae.] *L.Miss.(Oslag.)*, N.Am.(Mont.-B.C.); *L.Carb.(up.Visean), ?Asia (Kansu).—Fig. 253,3a,b. *A. tubiferus* (Hayasaka), holotype, probably from Lodgepole Ls., Mont.; a,b, transv., long. secs., \( \times 4 \) (Sando, 1976).

Paraulina Kuang in Jia et al., 1977, p. 185 [*P. zhongguoensis*; OD; \( \dagger\)LV16080, GB, Nanping; *L.Carb.*, Lingma, Guangxi (Kwangsi)]. Solitary, with everted calice; sepa long, numerous, may be complexly structured; major septa ending axially at narrow aulos crossed by widely separated, flat tabellae; periaxial tabellae abaxially declined; dissepimentarium wide, dissepiments numerous, small. [Diagnosis tentative, from illustrations.] *L.Carb.*, Asia(Kwangsi).

Solenodendron Sand, 1976, p. 426 [*Aulina horsfieldi* Smith & Yu, 1943, p. 49; OD; \( \dagger\)R34238, BM(NH), London]. Fasciculate aulate corals in which aulos is formed by union of deflected axial ends of major septa; major and minor septa carinate, carinace zigzag; tabular floors flat and horizontal in aulos; declined abaxially between aulos and regular, concentric dissepimentarium; increase marginarian in some, tabular in others. *L.Carb. (up. Tour.-(up. Visean)), Eu.(Brit. I.-France-Urals)-Asia (China-Laos).—Fig. 253,3a,b. *S. horsfieldi* (Smith & Yu), paratypes, L.Carb.(up. Tournais.), Ci, Hawbank Ls., U.K., near Bell Busk, Yorkshire; a,b, transv., long. secs., \( \times 2 \) (Smith & Yu, 1943).

Vesiculobus Sand, 1976, p. 431 [*Aulina vesiculata* Dobrolyubova in Dobrolyubova & Kabakovich, 1966, p. 163; OD; \( \dagger\)115, coll. 1561, PIN, Moscow]. Fasciculate aulate corals; major and minor septa noncarinate or weakly carinate, carinace zigzag; tabular floors in aulos flat, horizontal, but between aulos and dissepimentarium complete or incomplete, flat, concave or convex and commonly abaxially declined; dissepimentarium lonsdaleoid; increase marginarian. *L.Carb.(up.Tournais.)*, Asia(Kuzbas).—Fig. 253,4a,b. *V. vesiculatus* (Dobrolyubova), holotype, R. Malyy Bachat; a,b, transv., long. secs., \( \times 4 \) (Dobrolyubova & Kabakovich, 1966).

Subfamily ACROCYATHINAE Hill, new subfamily

Fasciculate or massive; calices with axial boss formed by axial structure comprising median plate that may be continuous with one, or two opposed, long major septa, short septal lamellae and axial tabellae that

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Fig. 253. Lithostrotonidae (p. F387).
do not form columnar wall but interdigitate with conical tabulae or with periaxial tabulae that are declined abaxially; dissepimentarium more or less lonsdaleoid; cardinal fossula inconspicuous. \textit{L.Carb.-L.Per}m.

\textbf{Acrocyathus} \textit{d'Orbigny, 1849}, p. 12 [\textit{G}.(sic) \textit{floriformis}; \textit{M}; \textit{†B7078} (1140 in \textit{d'Orbigny} Coll.), \textit{MN}, \textit{Paris}] [\textit{=?Chonaxis} \textit{Milne-Edwards \& Haime, 1851}, which see]. Ceroid; axial structure simple, a short lathlike columella commonly not connected to major septum, few, very short amplexoid septal lamellae and commonly without axial tabellae; clinotabulae or clinitabellae \textit{absent}; tabulae convex or conical, complete or less commonly incomplete; dissepimentarium lonsdaleoid; cardinal fossula not conspicuous \textit{[Easton, 1973, p. 130].} \textit{L.Carb.}, \textit{Eu.(Donbas)}; \textit{Miss.}, \textit{N. Am.(Ind.-III.-Alberta-Ariz.-N.Mexico-Alaska)}; \textit{U. Car}b., \textit{Eu.(Spits.)}; \textit{Penn.}, \textit{N.Am.(Alaska)}.—Fig. 254,3a,b. \textit{A. floriformis}, holotype, \textit{Ind.}; \textit{a,b}, transv., long. secs., \textit{X} 1.8 (Easton, 1973).


Fig. 254. Lithostrotionidae (p. F389-F391).
strotion (Eolithostrotonella) sibiricum (Gabuniya, 1919, p. 39) sensu Fomichev was described and figured, no type species being named. Cerioid, with wide lonsdaleoid dissepimentarium; counter and cardinal septa commonly conjoined and slightly thickened to form lathlike columella, remaining major septa directed toward and may reach columnella; diphymorphic corallites moderately com-
common; minor septa commonly represented by short septal crests only; tabular floors conical, tent-shaped, with edges turned out or up, tabulae complete or incomplete, may be domed in diphyrmorphs in longitudinally discontinuous series [DOBROLYUBOVA & KABAKOVICH, 1966, p. 130]. L.Carb.(Tournais.), Asia(Kuzbas); L.Carb.(Vi-

scan), Eu.(Donbas-Urals); U.Miss., ?N.Am. (Alaska).—Fig. 254,2a,b. *S. venukoffi ( Tol-

maiev), lectotype, L.Carb., Kuzbas, Zelenchikha; a,b, transv., long. secs., ×1.3 (Tolmaiev, 1924).

—Fig. 254,2c. S. longiseptum (Lisitsyn), figured syntype, L.Carb., Donbas; transv. sec., ×? (Lisitsyn, 1925).

Subfamily THYSANOPHYLLINAE Hill, new subfamily

Fasciculate or cerioid; weak axial structure sporadically present, either lathlike col-

umella that in some may be continuous with one long major septum (?(cardinal), or few short thin septal lamellae; tabular floors mesa-shaped or but slightly convex to horizontal; tabulae commonly complete; major septa withdrawn from axis; and with minor septa longitudinally discontinuous in lonsdaloid dissepimentarium; cardinal fossula inconspicuous. L.Carb.(U.Miss.); ?U. Carb.; ?LPerm.

Thysanophyllum NICHOLSON & THOMSON, 1876, p. 150 [*T. orientale THOMSON, 1880, p. 257; SD GREGORY, 1917, p. 238; †T1095, THOMSON Coll., KG, Glasgow; lectotype by Hill, 1938-1941, p. 162] [?=?Stylastera LONSDALE, 1845, which see; ?Subhonsdalisa LISITSYN, 1925, p. 68 (type, S. intermedia, M; †? in coll. 6579, TSGM, Leningrad; low. Visean, Donbas; see also VASILYUK, 1960, p. 107); Subhonsdalis Lang, Smith, & Thomas, 1940, p. 68, nom. var.]. Cerioid, corallites large, with long lonsdaloid dissepimentarium; septa withdrawn from axis except for ?cardinal which may be very long, particularly in young stages; weakly developed axial structure may be present sporadically, tabulae complete, commonly flat-topped domes, sometimes slightly sagging [see JULL (1967, p. 623) for hystero-ontogeny]. L.Carb.(Visean), Eu.(Scot.-Donbas-Urals); U.Miss., N.Am. (Alaska)-Asia (Tacmyr.-NE. USSR).—Fig. 255,1a,b. *T. orientale, lectotype, up. Visean, Scot., Aberlady Bay; a,b, transv., long. secs., ×0.5 (Hill, 1938-1941).—Fig. 255,1c.d. ?T. inter-

medium (Lisitsyn), figured syntype, low. Visean, Donbas; c,d, transv., long. secs., cnl. (Lisitsyn, 1925).

?Corphalia POTY, 1975b, p. 111 [*C. mosae; OD; †no holotype designated, PAU, Liège] [=Caninia Michelin in GERVAS, 1840, Caninina, Cyathopsid-

dae, but fossula indistinct and no evidence of long counter or short cardinal septum]. Solitary, subcylindrical; major septa short, subequal; fossula indistinct; minor septa as short projections from wall; dissepiments large, concentric or in places inosculating, or lonsdaloid and disrupting major septa also; tabulae commonly complete and flat or low mesa-shaped. L.Carb.(mid.Visean), Eu.(Belg.).—Fig. 255,4a,b. *C. mosae, syntypes from nominated type locality, Calcaire de Neffe, Awirs Quarry, Meuse Valley; a,b, transv., long. secs., ×4.0 (Poty, 1975b).

Dordolotida SALÉE, 1920, p. 145 [*D. briarti; M; †1/78-Fleron, IG, Louvain; lectotype by Poty, 1975a, p. 93] [?=Pseudodorlodotida MINATO, 1955, which see]. Fasciculate, with marginal increase; axial structure more or less thickened, a medial plate that may be longitudinally discontinuous and may be attached to counter or, less commonly, to cardinal septum; other major septa somewhat withdrawn from axis and may be thickened in tabularium; minor septa weakly developed, commonly discontinuous longitudinally; dissepimentarium mostly lonsdaloid, innermost series of dissepiments thickened; tabulae conical, commonly complete [see also SANDO, 1965b, p. E11; Poty, 1975a, p. 93]. L.Carb.(Visean), Eu. (Belg.-France)-Asia (Anatolia-?Kirgiz.-?China); U.Miss., ?N.Am. (Idaho-Ariz.-Alberta).—Fig. 255,3a,b. *D. briarti, lectotype, Visean, Belg., Sambre à Landéries; a,b, transv., long. secs., ×2.0 (Salée, 1920).

Pseudodorlodotida MINATO, 1955, p. 90 [*Thysano-

phyllum longisepatum YARE & HAYASAKA, 1915, p. 138; OD; †6294 (presently misplaced), TohU, Sendai; Carb., Yang-chia-yu, Nagan-hua-hsien, Han-

nan, China] [=Dorlodotida SALÉE, 1920, which see]. Fasciculate; corallites with lonsdaloid dissepimentarium of one series of large plates, with irregular lathlike columella continuous with counter septum but not everywhere present; other ma-

jor septa somewhat withdrawn from axis; tabulae subhorizontal, drawn up axially to the columella [see also KOZYREVA, 1976, p. 124]. L.Carb. (Visean), Asia(Japan-China); ?U.Carb.(Bashkhir.), Eu.(USSR).—Fig. 256,2a,b. P. kajikii, sym-

types, Onimaru ser., Iwate Pref., Hikoroichi-mura; a,b, transv., long. secs., ×1.6 (Minato, 1955).

Sciophylla HARKER & McLAREN, 1950, p. 31 [*S.

lambarti; OD; †1966, GSC, Ottawa]. Cerioid; corallites with lonsdaloid dissepimentarium of one or few series of large dissepiments with septa developed only as crests on their upper surfaces; without columella; tabulae complete, subhor-

izontal; increase lateral. U.Miss., N.Am.(Yukon-

Alaska-Idaho); L.Carb.(Visean), Asia(Japan).—Fig.

256,1a,b. *S. lambarti, holotype, Yukon-

Alaska boundary; a,b, transv., long. secs., ×1.7 (Harker & McLaren, 1950).

Stylastera LONSDALE, 1845, p. 619, non Sty-

latraea DE FOINEYEL, 1861, p. 223, a Jurassic hexacoral [*S. inconcerata; SD MILLER, 1889, p. 205]; †R17562, BM(NH), London] [?Thysanophyl-
Coelenterata—Rugosa

extending beyond axis as lathlike columnella, where in places it may be joined on upper surfaces of tabulae by short, irregular septal lamellae; other major septa withdrawn somewhat from axis; minor septa discontinuous, developed mostly as septal crests; tabulae conical or domed when columnella present, otherwise flat, complete or incomplete; dissepimentarium lonsdaleoid in places [see Smith & Lang, 1930, p. 185]. ?L.Carb. (Visean), Eu.(Eng.); L.Carb. (Visean), Asia (Taymyr); ?U.Carb. (Namur.), Eu.(Spain); “Carb. limestone,” Asia (E.Urals); ?S.Am. (Peru); L.Perm., Eu.(Spits.).—Fig. 255,2a-d. *S. inconfera, holotype, “Carb. ls.,” E. Urals, Kossachi-Datchi, S. of Miask; a-c, transv., d,e, long. secs., X2.0 (Smith & Lang, 1930).

Subfamily YATSENGIINAE Hill, 1956

[Yatsengiinae Hill, 1956b, p. F291]

Fasciculate or massive; corallites slender, septa few; major septa long, thin, commonly meeting at axis, where cardinal and counter may appear continuous, or major septa may be discontinuous with their septal lamellae; axial structure wide, with numerous abaxially declined tabellae that commonly do not form column wall but intermesh with less steeply abaxially declined periaxial tabellae; dissepimentarium regular; cardinal fossula inconspicuous. U.Carb.-L.Perm.

Yatsengia Huang in Yoh & Huang, 1932, p. 31 [*Waagenophyllum (Yatsengia) asiatica Huang, 1932, p. 56; OD; +3866, IGP, Nanking]. Fasciculate, corallites slender, septa few; major septa long, commonly reaching axis, where cardinal and counter may appear continuous; axial parts of others may become disconnected and form radial septal lamellae in wide axial structure of numerous abaxially declined tabellae that commonly do not form column wall but intermesh with less steeply abaxially declined periaxial tabellae; minor septa short, dissepimentarium narrow; fossula not notable. L.Perm. (Chihs.), Asia (China-Japan-Camb.-Iran-Turkey).—Fig. 257,3a,b. *Y. asiatica (Huang), holotype, Chihsia Ls., Kweichow, 1 mi. W. of Laochialiang, Lipohsien; a,b, transv., long. secs., X4.0 (Huang, 1932).

Arachnastraea Yabe & Hayasaka, 1916, p. 67 [*A. manchurica; OD; ?syntype 8291, TohU, Sendai, metatype, R23722, BM(NH), London] [=Cystophorastraea Dobrolyubova, 1935, p. 32 (type, Phillipisastrea mollis Shukuberg, 1888, p. 25, 45, OD; +91, coll. 321, TsGM, Leningrad); Cystiphorastraea Lang, Smith, & Thomas, 1940, p. 47, nom. van.]. Astroid, in part thamnasterioid or aphroid; septa thin, rarely slightly thickened, meeting conjoined counter and cardinal septa, which are only faintly thickened axially to suggest
median plate; tabulae conical, complete or commonly with auxiliary axial tabellae; dissepimentarium regular; cardinal fossula indistinct [YABE & EGUCHI, 1944, p. 733]. U.Carb., Eu.(Moscow Basin-Donbas-?Spain)-Asia(Manchuria-Korea-Kiangsu-Shantung).—Fig. 257,1a,b. *A. manchurica, metatype, Penchi Ser., S. Manchuria, Hon-kei-ko coalfield; a,b, transv., long. secs., X2.0 (photographs courtesy British Museum (Natural History), London).—Fig. 257,1c,d. A. molli (SHTUENBERG), Myachkovo horizon, right bank of R. Moskva, quarry opposite Sonino; c,d, transv.,
long. secs., ×2.0 (Dobrolyubova, 1935).

**Donophyllum** Fomichev, 1939, p. 59 [*Diphyphyllum* (*Donophyllum*) *diphyphyloideum*; SD Lang, Smith, & Thomas, 1940, p. 54; 199, coll. 5030, TsGM]. Fasciculate, corallites slender; major septa commonly withdrawn from axis, but in some corallites many may run loosely together to axis; without distinct columella; minor septa short, dissepimentarium narrow, of one series of small plates which may be impersistent, or of two or three series of small plates; tabulæ may be subhorizontal with downturned edges where major septa are short, or low cones or domes and complete or incomplete where major septa run together at axis. *U.Carb.*, Eu.(Donbas).—Fig. 257,2a,b. *D. diphyphyloideum*, holotype, ls. Ks, Donetz Basin, Belyansk mine; a,b, transv., long. secs., ×2.0 (Fomichev, 1939).
Family DURHAMINIDAE
Minato & Kato, 1965

[Durhaminidae Minato & Kato, 1965b, p. 28]

Solitary, fasciculate, cerioid, astræoid, thamnasteroid or aphroid; axial structure of median lamella that may become indistinct, irregular septal lamellae, and axial tabellae, some of which may have proximal edges based on the commonly abaxially declined periaxial tabellae; some peripheral supplementary tabellae or clinotabellae may develop; major and minor septa commonly thick in tabularium, thin in commonly herringbone dispesimentarium; third and higher orders of septa absent. L.Carb.-Perm.

Systematic classification adopted herein is that of Minato & Kato (1965b), with few modifications.

**Durhamina** Wilson & Langenheim, 1962, p. 504
[*Londslea cordillerensis* Easton, 1960, p. 580; OD: t1277, USC, Los Angeles]. Fasciculate; with axial structure in early states a medial plate, which may be irregular and discontinuous in later stages; in late stages axial structure is composed of irregularly and loosely disposed and few lamellae and axial tabellae whose proximal edges do not rest on those below to form a column, but interdigitate with abaxially inclined periaxial tabellae; some adaxially inclined peripheral tabellae or clinotabellae may develop; septa somewhat thickened in tabularium, and withdrawn unequally from axial structure; minor septa weakly developed, dispesimentarium narrow, herringbone to londsleoid. Penn.-L.Perms., N.Am.(Nev.-Texas-Alaska)-S.Am.(Peru); U.Carb.-L.Perms., Asia(Japan).—Fig. 258,a,b. *D. cordillerensis* (Easton), holotype, L.Perms., basal ls., Arcturus F., Nev., 2 mi. S. of Ruth; a,b, transv., long. secs., X3.0 (Easton, 1960).

**Amandophyllum** Heritsch, 1941, p. 136 [*Clisio­phyllum carnicum* Heritsch, 1936, p. 122; SD Hill, 1956b, p. F290; tP2076, UG, Graz] [*=Dibunophylloides* Fomichev, 1935a, p. 393 (type, *Cyathocelisia simmetrica* Dobrolyubova, 1937, p. 58, OD: t611, coll. 141, PIN, Moscow; Moscov., Podolsk horizon, R. Volga, downstream from Molokovo)]. Solitary, conical or conico-cylindrical; axial structure forming base in calice and arachnoid, consisting of commonly indistinct median plate, of regularly radiating septal lamellae, of which some may run parallel to median plate, and some may be continuous with septa, and of axial tabellae; major septa slightly thickened in tabularium, thinning toward periphery, minor septa thin to discontinuous leaving concentric or pseudoherringbone dispesiments; lateral dispesiments may occur on major septa; dispesimentarium commonly narrow, indistinct fossula invading it only slightly; periaxial tabellae *(declined abaxially) [see Minato & Kato, 1965b, p. 30]. U.Carb.-L.Perms., Eu.(Moscow Basin); U.Carb.-L.Perms., (Carnic Alps-Donbas)-Asia(Japan); L.Perms., N.Am.(Texas).—Fig. 258,2a. *A. carnicum* (Heritsch), holotype, U.Carb., Carnic Alps, N. of Garnitzen, transv. sec., X3.5 (Heritsch, 1936).—Fig. 258,2b,c. *A. simmetricum* (Dobrolyubova), holotype, M.Carb., Podolsk horizon, Volga R., downstream from Molokovo; b,c, transv., long. secs., X4.0 (Dobrolyubova, 1937).

**Heritschioides** Yabe, 1950, p. 75 [*Waagenophyllum columbicurn Smith, 1935, p. 38; OD: t9059, GSC, Ottawa, part =A6805, SM, Cambridge] [*=Yabeiphyllum Minato & Kato, 1965b, which see]. Fasciculate; closely packed tabellae of large axial structure incompletely differentiated from abaxially declined tabellae; also in axial structure, a short medial plate and imperfectly radiated septal lamellae as numerous as major septa; dispesimentarium irregularly concentric to anguloconcentric, major septa thicker in tabularium, thinning toward periphery; septa not carinate [see Minato & Kato, 1965b, p. 51]. L.Perms.

**H.** (Heritschioides). Tabellae of compact axial structure numerous and steeply declined from medial plate. L.Perms.(Pseudoschwagerina-Parafusilina Z.), N.Am.(B.C.-Ore.-Nev.-Eu.(Urals)-Asia(Japan).—Fig. 259,4a,b. *H. columbicurn* (Smith), holotype, B.C., ridge between Blind and Barslow Crs., 4 mi. E. of Keremeos; a,b, transv., long. secs., X2.4 (Smith, 1935).


**Kleopatrina** McCUTCHEON & Wilson, 1963, p. 299, nom. subj. pro *Ptolemaia* McCUTCHEON & Wilson, 1961, p. 1023, non *Ptolemaia* Osborn, 1908, a mammal [*=Ptolemaia futteraeta*; OD: 130267, MPUC, Berkeley]. Ceroid with moderately thick walls, with small axial structure consisting of median plate, few septal lamellae, and axial tabel-
lac, some of which are based on those next below, others on abaxially declined periaxial tabellae; septa thickened in tabularium and somewhat withdrawn from axial structure (except one long septum that may be continuous with median plate), commonly thin in narrow dissepimentarium of concentric or anguloconcentric plates. L.Per.

(Sakmar.-Artinsk.).


Minata FLÜGEL, 1974, p. 97 [*M. bulla*; OD; tP2680, UG, Graz]. Ceroid; with narrow dibuno-phylloid axial structure not defined by tabellar wall: tabular floors conical, tabulae incomplete; dissepimentarium wide, major and minor septa discontinuous longitudinally in places due to irregular development of lonsdaleoid dissepiments; septa may be somewhat thickened in places, thickening not emphasized in tabularium. ?U. Carb.(?low.Bashkir.), Asia(Iran).—Fig. 260, 2a,b. *M. bulla*, holotype, Sadar F. II, Kuh-e-Cheshmes-Baghia, Ozbak-Kuh Ra.; ab, transv., long. secs., ×1.5, ×1.6 (Flügel, 1974).

?Pamirophyllum PYZHYANOV, 1971, p. 166 [*Dar- wasia (sic) instabilis* (=P. instabilis); OD; tsample 2281-24-6, coll. 705, UpG, Dushanbe] [=Pamirophyllum PYZHYANOV, 1971, p. 165, nom. null.; Darwasia PYZHYANOV, 1971, p. 166, nom. nud., earlier MS name published inadvertently in binomial above]. Compound, with stocky corallum, offsets arising from dissepimentarium of large protocorallite so that first an astreoid region develops, then subastreoid to subphaceloid levels; axial structure commonly comprises median plate that may be connected with long cardinal septa, tabulae [or tabellae—the longitudinal section figured by PYZHYANOV, 1971, is not central], and sparse septal lamellae in places continuous with major septa; major septa long, connected or not with axial structure; minor septa thin and commonly discontinuous in wide dissepimentarium in which unequal lonsdaleoid dissepiments may be few or many; attitude of tabular floors uncertain, probably domed or conical. L.Perm., Asia(Tadzhik.).—Fig. 259,za,b. *P. instabile*, holotype, Karachatyr, low. part Sebisurkh suite, SW. Darvaz, R. Kalay-Kukhna; ab, transv. secs., ×1.2 (PYZHYANOV, 1971).

Protodurhamina KOZREVA, 1978, p. 21 [*P. strelzakensis*; OD; t52, coll. 14, DPL, Donetsk]. Fasciculate, septa short, axial structure variable, from thin columnella to median plate with few
septal lamellae and axial tabellae; tabellae numerous, commonly complete but in places incomplete, tabular floors broadly conical, drawn steeply upward at axis; dissepimentarium narrow. L.Carb. (Serpukhov.-)U.Carb. (Bashkir.), Eu. (USSR).

Protolonsdaleiastraea Gorskiy, 1932, p. 44 [*P. athassarica; OD; ?in coll. 2612, TsGM, Leningrad] [? = Dobrolyubovia Fomichev, 1953a, p. 593, nom. nud.; ?Gorskyia Fomichev, 1953a, p. 593, nom. nud.; Protolonsdaleiastrea Flügel, 1970, p. 221, nom. null.]. Partly cerioid, partly astrœoid or aphroid, with weak axial structure of irregular median lamella, few imperistent short irregular septal lamellae, and in places some axial tabellae steeply declined from median lamella with their proximal edges based on median lamella or on tabula next below; tabulae conical, complete or incomplete; septa commonly thickened especially in tabularium, where major septa somewhat withdrawn from axial structure; minor septa weak, crestal; dissepimentarium wide, herringbone to irregular, in places lonsdaleoid. (?Lower Carboniferous type specimens of type species imperfectly known. The diagnosis given herein follows Soshkina, Dobrolyubova, & Porfirov, 1941, p. 200, and Minato & Kato, 1965b, p. 60, based mainly on Upper Carboniferous and Lower Permian species.] ?L.Carb. (?Tournais.), Asia (W. Kazakh.); U. Carb. (Tricias Z.)-L. Perm. (Arâinsk.), Asia (W. Kazakh.)-Eu. (Ural-Spits.).—Fig. 258, 1a,b. *P. athassarica, holotype, ?Tournais., Kirghiz Steppe, Dzhezky R., Athsassarsky reg.; a,b, transv. secs., X3.0 (Gorskiy, 1932).

?Protowentzelella Porfirov in Soshkina, Dobrolyubova, & Porfirov, 1941, p. 179 [*P. simplex; OD; ?107, NNII, Ufa] [? = Protowentzelella Porfirov, 1937, pl. 2, nom. nud.]. Cerioid; with weak axial structure of thin median lamella, sparse radial lamellae, and in places, axial tabellae; major septa moderately long, cardinal and counter in places may join median lamella; minor septa discontinuous so that dissepiments insoculate in loculi between major septa; tabulae conical, complete or incomplete [see Ivanovskiy, 1976, p. 138]. U.Perm., Eu. (Ural-Spits.).—Fig. 259, 3a,b. *P. simplex, holotype, U. Perm., Mt. Jurak-tau near Sterlitamak; a,b, transv., long. secs., X1.8 (Soshkina, Dobrolyubova, & Porfirov, 1941).

Tanbaella Minato & Kato, 1965b, p. 55 [*Waagenophyllum izuruhenis Sakaguchi & Yamagiwa, 1958, p. 176; OD; ?59026-59028, IAGG, Osaka]. Fasciculate; large axial structure a column bounded by axial tabellae whose proximal edges are based on those below, and with a median plate that may be indistinct, and septal lamellae; periaxial tabellae small, variously inclined, mostly abaxially; dissepimentarium lonsdaleoid in part, septa with thick bases modified naotically. [Only two specimens known.] U. Perm. (Neo-ischwagerina Z.), Asia (Japan).—Fig. 258, 5a,b. *T. izuruhenis (Saka-
Suborder LONSDALEIINA
Spaskiy, 1974

[nom. correct. HILL, herein, ex Lonsdaleina Spaskiy, 1974, p. 153]

Solitary or compound Stauriida; dissepimentarium commonly lonsdaleoid, but in some herringbone to normal concentric; axial structure of septal lamellae including axial or medial lamella and abaxially declined tabellae; tabularial floors between axial structure and dissepimentarium flat, sagging, or adaxially with supplementary clinitabulae or clinitabellae; third or higher orders of septa in some. L.Carb.-U.Perm.

Family AXOPHYLLIDAE
Milne-Edwards & Haime, 1851


Solitary, fasciculate or massive; with wide axial column consisting of median plate commonly continuous with cardinal septum, radial lamellae and axial tabellae; pericolumnar tabulae concave or subhorizontal, commonly complete; dissepimentarium lonsdaleoid with minor septa or both major and minor septa discontinuous and commonly developed as septal crests.
crease lateral, cardinal-counter plane in offsets commonly radial to axis of parent [see Kato, 1966b, p. 100; Jull, 1967, p. 618]. L.Carb., Eu. (U. K.-Belg.-France-Ger.-USSR)-Asia (Kwangsi-Manchuria-Japan).—Fig. 262.3a-d. *A. floriformis* (Martin); a, lectotype of *Cyathophyllum*
crenulare PHILLIPS, Visean, ?Clitheroe, transv. sec., ×1.5 (Kato, 1966b); b,c, neotype of A. floriformis (MARTIN), Visean, Derbyshire, transv., long. secs., ×1.5; d, another specimen, Visean, Derbyshire, long. sec., ×2.0 (Smith, 1916).

Gangamophyllum GORSKIY, 1938, p. 101 [*G. boreale; OD; †not traced, fide DOBROLYUBOVA, 1952a, p. 53] [=Chienchangia LIN & FAN, 1959, p. 113 (type, C. reiformis, OD; †Ch1161, GC, Changchun; Visean, Chinghai]. Large, solitary, cylindrical, in late stages with lonsdaleoid dissepi­mentarium; with wide axial column of irregularly radial septal lamellae and domed tabellae and without median lamella or columella; axial ends of major septa not attaining column; pericolumnar tabulae concave to declined or inclined; no marked fossula [DOBROLYUBOVA, 1952a, p. 53]. L.Carb. (Visean), Eu. (N. Zemlya-Urals-Yugo.-Donbas-Moscow Basin)-Asia (Kazakh.-N. Pamir-China-Japan).

—Fig. 261,la,b. *G. boreale; a, holotype, up. Visean or Namur., N. Zemlya, S. Coast Bogaty I., transv. sec., ×1.7 (Gorskiy, 1938); b, another specimen, R. Oka, Moscow Basin, long. sec., ×1.7 (Dobrolyubova, 1952a).—Fig. 261,lc,d. G. reiforme (LIN & FAN); c, holotype, transv. sec., ×1.7; d, another specimen, long. sec., ×1.7 (Yü et al., 1963).

Lonsdaleia McCoy, 1849, p. 11 [*Erismatolithus madreporites (duplicatus) MARTIN, 1809, p. 20; validated by ICZN Op. 419; †neotype, A2149, SM, Cambridge; by SMITH, 1916, p. 268]. Phaceloid, increase peripheral or lateral, nonparricidal; axial column well-defined, with medial plate derived from cardinal septum, radial lamellae, and
axial tabellae, or less commonly with irregularly curved and thickened lamellae and axial tabellae, or sporadically absent; pericolumnar tabulae slightly concave or slightly declined outward or inward; minor septa commonly weakly developed, disseptimentarium lonsdaleoid; fossula not distinct [Smith, 1916, p. 238]. L.Carb.(Viscan).-U.Carb.(Namur.). Eu. (U.K.-France-Belg.-Moscow Basin-Urals-Donbas-N. Zemlya)-Asia (Japan-China)-N.Am.(Nova Scotia).—Fig. 262,2a-c. *L. duplicata (Martin): a, neotype, Viscan, Derbyshire, top of Crick Hill, SE. of Matlock, transv. sec., X1.5; b,c, another specimen, Viscan, Merionethshire, Hafod-y-calch, Corwen, transv., long. secs., X2.0 (Smith, 1916).

Pareynia SEMENOFF-TIAN-CHANSKY, 1974, p. 240 [*P. splendens; OD; v3, sample 382, PAREYN Coll., LG, Caen, now in MN, Paris]. Solitary, very large; with wide axial column of irregular median and septal lamellae and conical tabellae, very numerous long septa and with disseptimentarium peripherically with elongate, unequal, and closely spaced lonsdaleoid dissepmints commonly with septal crests; cardinal and counter septa may have attenuate connections with median plate; pericolumnar tabellae steeply declined adaxially, numerous. L.Carb.(up.Viscan), N.Afr.(W-Sahara).—Fig. 262,1a,b. *P. splendens, holotype, up. Viscan, piton to E. of Meharez el Kebir; a,b, transv., long. secs., X1.0 (Semenoff-Tian-Chansky, 1974).

Tatjanophyllum KOZYREVA, 1974a, p. 94 [*T. dobrylobovvea; OD; f14/69, DPI, Donetsk] [=Protolonsdalea LISITYN, 1925, see Actinocyathus d’Orbigny, 1849]. Ceriid; corallites with wide axial column of thin irregular septal lamellae and irregular tabellae and commonly lacking median plate and definite column wall; periaxial tabulate flat or concave, incomplete; disseptimentarium wide, lonsdaleoid, of large plates with sparse septal crests, thin major and minor septa longitudinally continuous only in tabularium; fossula not distinguished. L.Carb.(Viscan), Eu. (USSR).—Fig. 261,2a,b. *T. dobrylobovvea, holotype, from horizon V., at depth 178.5 m. in borehole 120, Kulikovka, S. Slope Voronezh anteumn comprising thickened medial plate, in places buttressed by sparse short septal lamellae; tabular floors declined toward columella, ?some clinotabellae present; major septa long, attenuate adaxially, their bases thickened to form, with those of minor septa, very narrow stereozone; minor septa discontinuous, and in places (? where offsets arise) major septa also, so that disseptimentarium becomes lonsdaleoid. U.Carb. (Maping.), Asia(S.China).—Fig. 266,2a-c. *P. wagneri (de Groot), holotype; a-c, transv., long. secs., X3.0 (de Groot, 1963).

Antheria Wu & ZHAO, 1974, p. 273 [*A. polgonalis; OD; +21891-21892, IGP, Nanking]. Ceriid, in places astroide; with axial structure a somewhat thickened lathlike columella continuous with one or two opposing long major septa and in places buttressed by sparse short septal lamellae; tabular floors declined toward columella, ?some clinotabellae present; major septa long, attenuate adaxially, their bases thickened to form, with those of minor septa, very narrow stereozone; minor septa discontinuous, and in places (?) where offsets arise) major septa also, so that disseptimentarium becomes lonsdaleoid. U.Carb. (Maping.), Asia(S.China).—Fig. 263,3a,b. *A. polgonalis, holotype, Maping F., W. Kweichow, Toupo, Weining, a,b, transv., long. secs., X2.0 (Wu, Chang, & Ching, 1974).

Cystolonsdaleia FOMICHEV, 1953a, p. 464 [*Petalaxis (Cystolonsdaleia) lutugini; OD; 1399, coll. 5030, TsGM, Leningrad] [=Actinocyathus d’Orbigny, 1849, Axophyllidae]. Ceriid; with wide lonsdaleoid disseptimentarium, narrow axial column comprising thickened medial plate, in places short thickened radial lamellae, and axial tabellae...
widely spaced and steeply inclined; major septa continuous only in tabularium, extending to axial column, minor septa present only as crests on wall and dissepiments; periaxial tabulae gently inclined, somewhat elevated toward both column and dissepimentarium, with supplementary clinotabellae.

*U.Carb., Eu.(Donbas-Moscow Basin)-Asia*(S.China.).—Fig. 263,la,b. *C. intugini*, holotype, M.Carb.(Moscow.), Is. Lo, Donbas, Fashchevka; a,b, transv., long. secs., ×2.0 (Fomichev, 1953a).

**Huanglongophyllum** (Yü), 1976, p. 228 [*H. simplex*; OD; tKCH090-091, GB, Nanjing]. Fasciculate; with wide lonsdaleoid dissepimentarium in which major septa are markedly less discontinuous longitudinally than minor; major septal ends thickened in tabularium and separated from axial structure in wide axial space; axial structure variable, with more or less constant median plate that may be continuous with one major (cardinal) septum, and with few short irregular septal lamellae; tabular floors flat or somewhat concave but with broad peripheral clinotabellae, and with conical axial tabellae doubtfully present in places.

*U. Carbo.* (Moscow.), Asia (China-Japan).—Fig. 264,2a,b. *H. simplex* (Yü), holotype, Huanglong F., Jiangsu, Wuxian, Wenhua; a,b, transv., long. secs., ×1.8 (Yü, 1976).

**Ivanovia** Dobrolyubova, 1935, p. 35, 45 [*I. podolskiensis*; OD; t106, coll. 140, PIN, Moscow] [=?*Cystophora* Yabe & Hayasaka, 1916, p. 70 (type, C. manchurica, OD; ?syntype, 8262, TohU, Sendai, metatype, R23724, BM(NH), London), *non Cystophora* Nilsson, 1820, a mammal; *Cystophora* Lang, Smith, & Thomas, 1940, p. 47, nom. van., *non Cystophora* Kieffer, 1892, a dipteran; *Langia* Flügel, 1970, v. 2, p. 82, nom. subit. pro *Cystophora* Yabe & Hayasaka, 1916, *non Langia* Moore, 1872, a lepidopteran; *Protoivanovia* Yü, 1977, p. 84 (type, P. regularis, OD; tKCH004-007, GB, Nanjing; U.Carb., Chuanshan F., Jiangsu; medial plate without septal lamellae), Yü, 1976, p. 227, first used the name in the combination *P. intermedia* Yü (tKCH082-084, GB, Nanjing; M.Carb., Moscov., Jiangsu, China), but without diagnosis or designation of type species. Aphroid, with some traces of walls; major septa long, but few reaching columella, dilated in tabularium; minor septa present but not tertiary septa; septa discontinuous in dissepimentarium; axial structures compact, comprising thickened median plate and few short lamellae with few axial tabellae arranged in cones; periaxial tabulae sagging, some peripheral clinotabellae [see Yabe & Eguchi, 1944, p. 470]. *U. Carbo.* (Moscow.), Eu.(Russ.Platf.-Donbas)-Asia (Manchuria-Korea.).—Fig. 265,2a,b. *I. podolskienensis*, syntype, Podolsk horizon, Moscow Basin, Schurovo; transv., long. secs., ×2 (Dobrolyubova, 1935).—Fig. 265,2c,d. *I. manchurica* (Yabe & Hayasaka), metatype, Manchuria; c,d, transv., long. secs., ×2 (Hill, 1956b).—Fig. 265.
Lithostrotionella not be used. See also Easton, 1973, p. 128.] *L. unica*, lectotype, Kung-shan, Hui-ting, Hon-shan, local pronunciation, *fide* I. Hayasaka, written commun., May 4, 1964, to R. K. Jull, wherein also HAYASAKA considered that the original collection from this locality was Chihsian, though it was first tentatively regarded as Carboniferous; oblique sec., X2.4 (Minato & Kato, 1974).

**Lytvophyllum** Dobrolyubova in Soskina, Dobrolyubova, & Porfiryev, 1941, p. 146 [*Thysanophyllum tschernowi* Soskina, 1925, p. 98; OD; 1921, coll. 146, PIN, Moscow, SD Dobrolyubova in Soskina, Dobrolyubova, & Porfiryev, 1941,
Fig. 266. Petalaxidae (p. F401, F406).
Coelenterata—Rugosa

p. 147]. Fasciculate; corallites of variable morphology; thick laminar columella attached to long major septum commonly present; often major septa somewhat withdrawn from axis; dissepimentarium commonly londsoidal with minor septa or both major and minor septa discontinuous; tabulae subhorizontal, complete or incomplete. U.Carb. (Namur.-Bashkir.), Eu. (Donbas); L.Perm., Eu. (Urals).—Fig. 263,2a–c. *L. tscbernowi* (Soshkina), holotype, L.Perm. (Artinsk.), S. Urals, R. Lytsa; *a,b*, transv., *c*, long. secs., ×3.5 (Soshkina, Dobrolyubova, & Porfiev, 1941).

Nephophyllum Wu & Zhao, 1974, p. 272 [*N. simplex*; OD; †21889–21890, IGP, Nanking]. Ceroid or in part aphroid, common wall when present a narrow peripheral stereozone of contiguous septal bases; axial column tube narrow, simple median plate with few short radial lamellae and conical tabellae; pericolumnar tabulae subhorizontal or sagging, with clino-tabellae peripherally; marginarium mainly londsoidal dissepimentarium except in early stages of offsets, where septa longitudinally contiguous and thickened. U.Carb., Asia (Kweichow).—Fig. 266,3a,b. *N. simplex*, holotype, Mapping F., W. Kweichow, Toupo, Weining; *a,b*, transv., long. secs., ×2 (Wu, Chang, & Ching, 1974).

Paralithostrothion Gorski, 1938, p. 66 [*P. jermodaevi*; OD; †83, coll. 5769, TgSM, Leningrad] [=Tschernowphyllum DOBROLYUBOVA, 1958, p. 210 (type, T. podbovienae, OD; †583, coll. 705, PIN, Moscow; L.Carb., Visean, NW. Russ. Platf.); ?Schoenophyllum SIMPSON, 1900, Lithostrothionina, Lithostrothionidae, Lithostrothioninae]. Fasciculate, corallites with connecting processes; major septa long, unequal, one prolonged into axis to form thin, impersistent, lathlike columella which may become discrete, or may overlap second long, opposite, major septum; minor septa may be discontinuous when dissepiments are londsoidal, and each cross one major interseptal loculus; tabular floors concave, tabulae complete or incomplete [see Raskshin, 1965, p. 56]. L.Carb.–U.Carb. (up. Visean–Namur.), Eu. (N.Zemlya-Moscow Basin–C. Urals)-Asia (Kazakh.).—Fig. 266,1a,b. *P. jermodaevi*, holotype, exposure 19, Novaya Zemlya, Russian Harbor N. of C. Shueretsky; *a,b*, long., transv. secs., ×2 (Gorskiy, 1938).—Fig. 266,1c–e. P. podbovienae (DOBROLYUBOVA), holotype, Podbore, Lyobytin distr.; *c*, transv., *d,e*, long. secs., ×4 (DOBROLYUBOVA, 1958).

**Family GEYEROPOHYLLIDAE**

Minato, 1955

[GEYEROPOHYLLIDAE Minato, 1955, p. 159]

Solitary or fasciculate; with axial structure a solid rod in early stages, in later stages with radial septal lamellae, median plate, and axial tabellae; septa bilaterally arranged in early stages, radial in later stages, in some peripherally thickened to form stereozone; septal microstructure dif­fusotrabeculate; cardinal septum united to columellar rod at least in early stages, cardinal fossula indistinct; periaxial tabulae subhorizontal, with clino-tabellae peripherally; dissepimentarium normal, with londsoidal dissepiments in some in later stages; rejuvenescence common [MINATO & KATO, 1975a, p. 5]. U.Carb.–L.Perm.

Geyerophyllum HERITSCH, 1936, p. 131 [*G. carnicium*; OD; †P2077, UG, Graz]. Solitary, with commonly dense axial structure consisting of median plate continuous with longest, probably cardinal, septum, septal lamellae whose outer edges may project but are commonly discontinuous from major septa, and in places tabellae; dissepimentarium wide, commonly londsoidal peripherally, otherwise of normal small concentric plates; minor septa more weakly developed than major; form of tabulae in type material unknown, clino-tabellae present in species subsequently assigned to genus [MINATO & KATO, 1975a, p. 3]. U.Carb., Eu. (Croatia); U.Carb., Eu. (Carnic Alps–Asia (Japan); Penn. (Missour.), N.Am., Kans.; b,c, transv., long. secs., ×1.6 (Heritsch, 1936).—Fig. 267,1a–c. G. sp. cf. G. brollii HERITSCH, Missouri, USA, Kans.; *b,c*, transv., long. secs., ×1.8 (Cocke, 1970).

Amygdalophylloides DOBROLYUBOVA & KABAKOVICEH, 1948, p. 23 [*Amygdalophylloides ivanovi DOBROLYUBOVA, 1937, p. 60; OD; †181, coll. 141, PIN, Moscow] [=Koninckocarina DOBROLYUBOVA, 1937, Koninckocariniidae]. Solitary, small, almost straight; major septa long, reaching or almost reaching thick columella, columella oval in section and in contact with, or formed from axial end of, long cardinal septum; in some, columella may be part of axial structure that includes thick septal lamellae and poorly developed axial tabellae; minor septa may be moderately long and dissepimentarium may be wide, septa thickened peripherally to form narrow stereozone; clino-tabellae wide, may merge with narrow horizontal pericolumnar tabulae; dissepiments normal or somewhat irregular, londsoidal dissepiments sporadic and steeply inclined. U.Carb.(Namur.-Stephan.), Asia (Japan)-Eu.(Moscow Basin–Spain)-Asia (Viet Nam-China); L.Perm., Eu. (Aus.).—Fig. 268,1a,b. *A. ivanovi* (DOBROLYUBOVA), holotype, U.Carb.(Moscow), Myachkovo horizon, Shchurovo; *a,b*, transv., long. secs., ×3.2 (DOBROLYUBOVA, 1937).

Axolithophyllum FOMICHEV, 1953a, p. 413 [*A. mefferti*; OD; †375, coll. 5030, TgSM, Leningrad]. Solitary, widely conical, with solid columella of
simple, cylindrical form in young stages, but more complex in mature stages with thickened medial plate connected with cardinal septum and to which may be attached irregular, short, thick septal lamellae and thin axial tabellae; cardinal septum may shorten in latest stages; tabulæ subhorizontal, with clinitabulæ peripherally; disseipmentarium wide, irregularly lonsdaleoid peripherally, disseipmentarial floors may be somewhat everted; innermost series of disseipments may be thickened; lateral disseipments developed in places; major septa long, nearly reaching columella, thickened wedgewise toward periphery, where in late stages both orders may become naotic; minor septa thinner.  

**U.Carb., Eu.(Moscow Basin-Donbas-Spain)-Asia (S. China-Japan); Penn., N. Am. (Kans.).**—Fig. 268,3a,b.  *A. mefferti*, U.Carb. (Moscov.), Is. in group No. Donbas, Kholodny spring; *a*, holotype, transv. sec., ×2.0; *b*, topotype, long. sec., ×2.0 (Fomichev, 1933a).

**Carinthiaphyllum** HERITSCH, 1936, p. 134 [*G. kahleri*; OD; tP2082, UG, Graz]. Solitary; (or fasciculate) with a columella of variable pattern; a median plate is commonly present, connected with long cardinal septum from which one or more short septal lamellae may radiate irregularly; uncommonly, tabulæ may form briefly a somewhat more complex axial structure; septa thin, long, but mostly not reaching columella, disseipmentarium wide, of small normal concentric plates, lonsdaleoid plates developing peripherally in places; tabulæ of type species imperfectly known [commonly declined adaxially and including clinitabulæ, fide Minato & Kato, 1967, p. 314; see Minato & Kato, 1975a, p. 15].  


**Carniaphyllum** HERITSCH, 1936, p. 131 [*G. gortanii*; OD; tP2071, UG, Graz]. Solitary; with an axial structure attached by its short, thick median plate to probable cardinal septum, and composed of septal lamellae and numerous tabellae; disseipmentarium wide, with minor septa long, thinner than major and in places discontinuous; disseipments small, normal concentric, but somewhat irregular, a few larger lonsdaleoid plates in places; form of tabulæ unknown.  

[See Minato & Kato, 1975a, p. 4, 8; insufficiently known.] **U.Carb.(Coral fauna II), Eu.(Carnic Alps).**—Fig. 267,2.  *C. gortani*, holotype, Auernig Beds; transv. sec., ×2.9 (Heritsch, 1936).

**Darwasophyllum** PYZHANOV, 1964, p. 170 [*D. irregularæ*; OD; sample 19-2-5, coll. 705, UG, Dushanbe]. Fasciculate; corallites with peripheral stereozone disrupted in mature stages by lonsdaleoid disseipments, and with one long major septum (cardinal, fide Rowett & Kato, 1968, p. 37) connected with axial structure consisting of thickened medial plate, thickened irregular septal lamellae, and axial tabellae also somewhat thickened; other major septa unequal, commonly somewhat withdrawn from axial structure; tabulæ declined toward axial structure, complete or incomplete.  

**U.Carb.(Namur.), Asia(Japan); U. Carb.(Bashkîr.-Moscov.), Asia(Tadzhik).**—Fig. 267,3a,b.  *A. mefferti*, U.Carb. (Moscov.), Is. in group No. Donbas, Kholodny spring; *a*, holotype, transv. sec., ×2.0; *b*, topotype, long. sec., ×2.0 (Fomichev, 1933a).

**Fig. 267.** Geyerophyllidae (p. F406-F408).
Fig. 268. Geyerophyllidae (p. F406-F409).

**Amygdalophylloidotes**

Solitary, conical to cylindrical; with solid axial structure consisting of a median plate continuous with cardinal and in places with counter septum also, and a few septal lamellae, some of which may be continuous with the longer major septa; slightly inclined tabulae are supplemented peripherally by some clinotabellae; disseptimentarium more or less lonsdaleoid, minor septa more weakly developed than major [see MINATO & KATO, 1975a, p. 9]. U.Carb. (Weining.), Asia (S.China)-Eu. (Donbas); Penn., N.Am. (Kans.-Iowa).——Fig. 267.a,b. *K. dibunum*, holotype, Laokanchai Ls., Kweichow, Kuanyintung Pass, Lipohsien; ab, transv., long. secs., X1.0 (Chi, 1931).

**Lonsdaleoides** HERITSCH, 1936, p. 128 [*L. boweri*; OD; †P2703, UG, Graz; lectotype by HOMANN, 1971, p. 129]. Fasciculate, with variable axial structure of septal lamellae and tabellae, one lamella being continuous with long protoseptum [counter, *fide* HERITSCH, 1936, p. 129, and...
Homann, 1971, p. 130, but cardinal, *fide* de Groor, 1963, p. 101, and Hayasaka & Minato, 1966, p. 273], but commonly not bisecting opposite half of structure; septa long, thickened, may become naotic peripherally, minor septa weaker; dissepimentarium wide, may develop peripheral lonsdaleoid zone; tabularium of three zones, in axial structure tabellae declined from median lamella; in median zone tabulae concave or flat; in peripheral zone, clinotabellae.

**U.Carb.** (Westphal. D), **Eu.** (Spain); **L.Perm.**, **Eu.** (Carnic Alps).—Fig. 268, 6. *O.L. boswelli*, holotype, L.Perm., low. Schwagerina Ls., Zollner See, Carnic Alps; transv. sec., X2 4 (Heritsch, 1936).

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*Paracar ruthersella* Yoh, 1961, p. 13 [*P. bryocol umbellata*; OD; †not traced]. Fasciculate (?or solitary, *fide* Minato & Kato, 1975a, p. 14); with axial structure a loose aggregate of axial tabellae and irregular lamellae with short median plate; septa slightly thickened, (?) with zigzag carinae; in late stages major septa almost attaining axial structure, (?) (cardinal rather shorter); minor septa short; tabulae mostly complete, tented.

**U.Carb.**, **Asia** (S.China).—Fig. 268, 4a, b. *O. bryocol umbellata*, Maping Ls., S. China, loc. unknown; a, paratype, transv. sec., X1.6; b, holotype, long. sec., X1.6 (Yoh, 1961).

**Family KONINCKOCARINIIDAE**

Dobrolyubova, 1962

[Koninckocarinidae Dobrolyubova in Soshkina, Dobrolyubova, & Kabakovitch, 1962, p. 332]

Like Geyerophyllidae, but with simple, thin, lathlike columella formed by expansion of (?) (or union with) axial end of long cardinal septum [see Minato & Kato, 1975b, p. 23]. **U.Carb.**

**Koninckocarina** Dobrolyubova, 1937, p. 51 [*Koninckocariniella* (Koninckocarina) *flexuosa*; OD; †279, coll. 141, PIN, Moscow] [*?Amygdalo phyllinae Dobrolyubova & Kabakovitch, 1948, Geyerophyllidae*]. Solitary, small, conicocylindrical; cardinal septum very long, axial end slightly expanded to form (?) or unite with) lathlike columnella; other major septa withdrawn unequally from axial region; minor septa long, both major and minor septa discontinuous in irregularly lonsdaleoid dissepimentarium, of steep dissepiments; tabulae slightly concave, with some peripheral clinotabellae [see Minato & Kato, 1975b, p. 23]. **U.Carb.**, **Eu.** (Moscow Basin-Spain)-**Asia** (S.China); **Penn.,** **N.Am.** (Iowa).—Fig. 269, 1a, b. *K. flexuosa*, monotype, **U.Carb.** (Moscow), Podolsk horizon, Moscow Basin, Shchurovo; a, b, transv., long. secs., X3.2 (Soshkina, Dobrolyubova, & Kabakovitch, 1962).

**Family WAAGENOPHYLLIDAE**

Wang, 1950


Solitary or colonial; with an axial column commonly cylindrical, and consisting of median lamella and a few septal lamellae that may be regularly or irregularly disposed and of steeply inclined axial tabellae, their proximal edges commonly resting on the next below; major and minor septa present, and (in Wentzelellinae only) tertiary or higher orders of septa; tabulae annular in narrow adaxial parts between column and axial ends of major septa, segmented and the segments drawn upward very steeply abaxially as clinotabellae in the major intersepalloculi; supplementary, dissepiment-like clinotabellae may occur peripherally; supplementary ring tabellae may also occur; dissepimentarium wide or narrow; either of normal small concentric globose plates or lonsdaleoid or partly lonsdaleoid; narrow peripheral stereozone may develop where septal bases are thickened to contiguity. **U.Carb.**-**U.Perm.**

The classification adopted in this family follows that of Minato & Kato, 1965a, with few modifications. Known material is scanty for several of the taxa.

**Subfamily WAAGENOPHYLLINAE** Wang, 1950

[=Waagenophyllinae Wang, 1950, p. 212]

Waagenophyllidae without tertiary or higher orders of septa. **U.Carb.-U.Perm.**

*Waagenophyllum* Hayasaka, 1924, p. 23, *nom. subst. pro Waagenella Yabe & Hayasaka, 1915, p. 96, non Waagenella de Koninck, 1883, a Car-
Coelenterata—Rugosa

boniferous gastropod [*Lonsdaleia indica* Waagen & Wentzel, 1886, p. 897; SD Grabaub, 1931, p. 42; t3909-3911, GSI, Calcula; lectotype by Hudson, 1958, p. 179] [=Warganella yabe & hayasaka, 1915, p. 96, nom. null.]. Fasciculate, corallites slender, with lateral increase; axial column irregularly cylindrical, consisting of median lamella and a few septal lamellae biradially or irregularly disposed, and of steeply inclined axial tabellae whose proximal edges rest on the next below; major and minor septa not or rarely disrupted by lonsdaleoid dissepiments; no tertiary or fourth order septa; dissepimentarium normal, concentric, of small globose and elongate interseptal plates; a narrow peripheral stereozone may be present; tabulae annular in narrow adaxial part, segmented into steep clinoblastinae, in wider peripheral parts. L.Per.(*Pseudofusulina Z. *)-U.Per.(*Yabeina Z. *), Asia (Pak.-Iran-Nakhichev.-Iraq-India-Burma-Camb.-Laos-Viet Nam-Inner Mongolia-China-Japan)-Eu.(Yugo.)-N.Z.

W. (*Waagenophyllum*). Zone of clinoblastinae wide, dissepimentarium and annular part of tabulae narrow. L.Per.(*Pseudofusulina Z. *)-U.Per.(*Yabeina Z. *), Asia (Pak.-Iran-India-Indonesia-Burma-Camb.-Laos-Viet Nam-Inner Mongolia-China-Japan)-Asia M.-Eu.(Yugo.).--Fig. 270,2a,b. *W. (W.) indicum* (indicum (Waagen & Wentzel)), U.Per., Wargal Ls., Pak., road from Chidru to Musakhel, Salt Ra.; a,b, transv., long. secs., x10, x20 (Waagen & Wentzel, 1886).

W. (*ChaoiphylIIum*) Minato & Kato, 1965a, p. 124 [*W. (C.) chaoi*; OD; t3948, IGP, Nanking]. Solitary; axial column with median plate, septal lamellae (some corresponding to minor septa), and somewhat unequal axial tabellae, the proximal edges of some overlapping several more proximal tabellae; tabulae widely transverse, few peripheral clinoblastinae; dissepimentarium lonsdaleoid in part, minor septa common, septal lamellae thin, extending across major dissepimentarium; dissepimentarium narrow, minor septa discontinuous, confined mainly to bases, dissepiments large, concentric, extending across major interseptal loculi. [Insufficiently known.] L.Per.(*Chih. *), Asia (China).—Fig. 270,4a,b. *W. (C.) chaoi*, holotype, Szechuan, Gnomeishan; a,b, transv., long. secs., x6 (Huang, 1932).


W. (*Liangshanophyllum*) Tseng, 1949, p. 100 [*W. (L.) lui*; OD; t6948, ?Peking]. Axial column with medial plate, biradial lamella, and cone-in-cone tabellae; axial ends of septa variably withdrawn from column so that relative widths of commonly wide annular tabulae and of clinoblastinae vary; dissepimentarium narrow, minor septa short. U.Per., Asia(Shensi).—Fig. 270, 6a,b. *W. (L.) lui*, holotype, Wuchiaping Ls. (in *Palaeofusulina-Reichelina Z.* , fide Minato & Kato, 1965a, p. 128), Liangshan; a,b, transv., long. secs., x2 (Tseng, 1949).

**Akagophyllum** Minato & Kato, 1965a, p. 73 [*Lonsdaleia (Waagenophyllum) indica* var. *akagoensis* OZAWA, 1925, p. 76; OD; type material, thin sections 77-81, 83, 84, OZAWA Coll., UT, Tokyo]. Fasciculate; axial column normal, separated from axial ends of major septa by relatively wide space, so that horizontal parts of tabulae are broad and somewhat irregular, as are clinoblastinae; dissepimentarium wide, in part lonsdaleoid, minor septa long. L.Per.(*Pseudofusulina-Para­fusulina Z. *), Asia(Japan-China-Iran-Tibet).—Fig. 271,3a,b. *A. akagoense* (OZAWA), *Pseudofusulina Z. *, Japan, Kaerimizu, Akiyoski-dai, Yamaguchi Pref.; a,b, transv., long. secs., x2.3, x2.4 (Minato & Kato, 1965a).

**Chielasma** Minato & Kato, 1965b, p. 73 [*Dibunophyllum yui* Chi, 1931, p. 39; OD; t3994, IGP, Nanking]. Solitary; axial column with median plate, septal lamellae (some corresponding to minor septa), and somewhat unequal axial tabellae, the proximal edges of some overlapping several more proximal tabellae; tabulae widely transverse, few peripheral clinoblastinae; dissepimentarium lonsdaleoid in part, minor septa common, septal lamellae thin, extending across major dissepimentarium; dissepimentarium narrow, minor septa discontinuous, confined mainly to bases, dissepiments large, concentric, extending across major interseptal loculi. [Insufficiently known.] U.Carb. (*Weining. *), Asia(S.China).—Fig. 270,1a,b. *C. yui* (Chi), holotype, Weining, Laokachai Ls., Kweichow, N. of Piao-chai, Lipohsien; a,b, transv., long. secs., x2 (Chi, 1931).

**ChihsiaphylIIum** Minato & Kato, 1965a, p. 87 [*Corvencia chihsiaenesis* Yoh in Yoh & Huang, 1932, p. 27; OD; t1175, IGP, Nanking]. Fasciculate; axial column in places may lack both medial plate and septal lamellae, so that superposed axial tabellae resemble an aulos; periaxial tabellae wide, slightly concave, in places with clinoblastinae peripherally; dissepimentarium narrow, minor septa discontinuous, confined mainly to bases, dissepiments large, concentric, extending across major interseptal loculi. [Insufficiently known.] L.Per.(*Chih. *), Asia(S.China).—Fig. 272,3a,b. *C. chihsiiae (Yoh)*, holotype, Chihsia Ls., Chihsia­shan; a,b, transv., long. secs., x1.3, x4.0 (Yoh & Huang, 1932).

**Heritschiella** Moore & Jeffords in Hill, 1956b, p. F310, nom. subst. pro *Heritschia* Moore & Jeffords, 1941, p. 94, non *Heritschia Teppner*, 1922, a mollusk [*Heritschia girtyi*; OD; t5419-1, KUMIP, Lawrence]. Fasciculate; with compact, narrow axial column and wide dissepimentarium; axial column with median plate joined to counter septum, a few radial lamellae, and close, numerous, arched tabellae sloping nearly vertically; periaxial tabellae concave with peripheral clinoblastinae; septa long, numerous, thin in normal dissepiments.
Fig. 270. Waagenophyllidae (p. F409-F410, F412).
mentarium, minor septa weaker; no tertiary septa; dissepiments concentric to oblique and overlapping. LPerm. (Wolfcamp.), N.Am. (Kans.). —Fig. 272, 2a,b. *H. girtyi, holotype, up. Florence Ls., Kans., 2 mi. SW. of Leon; a,b, transv., long. secs., ×2.0 (Moore & Jeffords, 1941).

Huangia Yabe, 1950, p. 76 [*Corwenia chütsingensis CHI, 1931, p. 45; OD; 13998, IGP, Nan- king]. Fasciculate; axial column of median lamella, somewhat irregular septal lamellae, and axial tabellae, but variable in diameter; axial ends of major septa unequally distanced from column, some may be continuous with septal lamellae; annular parts of tabulae of irregular width, and peripheral clinotabellae also variably developed; dissepimentarium includes large lonsdaleoid dis- seplings, minor septa commonly discontinuous, major septa may also be disrupted. [Monotype species requires further study.] U.Carb. (Weining.), Asia (S.China). —Fig. 270, 3a,b. *H. chütsingensis (CHI), holotype, White Ls., Yunnan, Tungshan, Chütsinghsien; a,b, transv., long. secs., ×3 (Chi, 1931).

Ipciphyllum HUDON, 1958, p. 179 [*L. icipi; OD; \textsuperscript{13}R42028, BM(NH), London; =Lonsdaleia indica var. laosensis PATTE, 1926, p. 108, \textsuperscript{17}B, MANSUY Coll., EM, Paris, \textit{fide} FONTAINE, 1961, p. 174, Permian, Pong-Oua, Laos] [\textsuperscript{?}=Aridophyllum ZHAO, 1976, p. 220 (type, \textit{A. anshunensis}, OD; \textsuperscript{13}31636-31637, IGP, Nanking; U.Perm., Anshun, Kweichow]. Cerioid; axial column with thin, irregular, persistent medial plate, radial lamellae,
and prominent conical axial tabellae; septa thin, or somewhat thickened particularly in tabularium, may become discontinuous and crestal in lonsdaleoid parts of wide dissepimentarium with normal concentric or anguloconcentric dissepiments; tabularium occupies greater part of corallite, formed of wide outer zone of elongate almost vertical cystose clinotabellae and of narrow peripheral axial zone of horizontal tabulae. *Perm. (Parafusu­lina-Yabeina Z.), Asia(Turkey-Iraq-Iran-Laos-Viet Nam-S.China-Timor-Japan).—Fig. 272,1a,b, *I. anshunense (Zhao), holotype, U.Perm., low. Wuchiaping F., Anshun; a,b, transv., long. secs., ×2.0 (Zhao, 1976).—Fig. 272,1e,d, *I. laoseense (Patte), holotype, Laos, Hong-Out; c,d, transv., long. secs., ×2.3 (Fontaine, 1961).—Fig. 272, 1ef, *I. ipcs, Perm., Zinnaa Ls., N. Iraq, Chalki; c, holotype, transv. sec., ×3.0, f, paratype, long. sec., ×3.0 (Hudson, 1958).

Paraipiciphyllum Wu, 1963, p. 501 [*P. elegantum; OD; ††4032-10134, IGP, Nanking] [=Paraipici­phyllum Wu, 1963, p. 504, nom. null.]. Like Ipiciphyllum but in places astreoid or thamnasteroid, and zone of clinotabellae very narrow and imperis­ent. *U.Perm. (Neoschwagerina Z.), Asia(Iran-Iraq).—Fig. 272,2a,b, *P. elegantum, holotype, Maokou Suite, China, Tongling distr., Anhui; a,b, transv., long. secs., ×2.7, ×2.0 (Wu, 1963).

Parawentzellophyllum Fontaine, 1961, p. 185 [*Lon­dsdaleia candilera Munsuy, 1913, p. 109; OD; †780, Munsuy Coll., MSG, Saigon]. Cerioid; corallites with thick walls, pierced by canals or gaps that may be associated with discontinuities in dissepimentaria so that tabularia of adjoining corallites are placed in contact; axial column wide; zone of annular horizontal tabulae wide, some being con­tinued as clinotabellae; lonsdaleoid dissepiments may occur in wide dissepimentarium. *Perm. (Parafusulin­a-Yabeina Z.), Asia(Indo-China-Japan).

P. (Parawentzella). Without or almost without lonsdaleoid dissepiments. *Perm., Asia(Laos-Camb-Japan).—Fig. 271,2a-c, *P. (P.) canali­fera; a, holotype, Camb., Phom Bantay Neang, transv. sec., ×2.0; b,c, another specimen, Camb., Phom Kraupet, long., transv. secs., ×2.3 (Fontaine, 1961).

P. (Miyagiella) Minato & Kato, 1965a, p. 168 [*P. (M.) miyagienis; OD; †8272-4, UH, Sapporo]. With walls thick or thin and with lonsdaleoid dissepiments well developed. *U.Perm. (Neoschwagerina Z.), Asia(Japan).—Fig. 271, 1a-c, *P. (M.) miyagienis, holotype, Japan, Iwaiizaki, Kesen-numa city, Miyagi Pref.; a,b, transv. secs., ×1.5; c, long. sec., ×4.4 (Minato & Kato, 1965a).

Parawentzellophyllum Yü, 1977, p. 87 [*P. fangshunense; OD; †KCH027-029, GB, Nanjing]. Massive; in part ceroid with strong walls, in part aphyroid; septa of two orders; axial column with somewhat irregular medial plate and short lamel­lae, tabellae in moderately steep cones; dissepimentarium commonly lonsdaleoid. *U.Carb., Asia(S. Jiangsu).

Pavastehphyllum Minato & Kato, 1965a, p. 64 [*Iranophyllum simplex Douglas, 1936, p. 19; OD; tSIP1514, coll. Anglo-Iranian Oil Co. Ltd., not traced]. Solitary, cylindrical, not large; axial column with medial plate, biradial but irregular septal lamellae, and axial tabellae close and steep­ly declined from medial plate, their proximal edges based on more proximal axial tabellae; periaxial tabellae declined adaxially, incomplete, supple­mented against the column by smaller, more trans­verse tabellae; major septa somewhat unequal and somewhat withdrawn from column; minor septa long, may be discontinuous in part; no third or fourth order septa; dissepiments irregularly cen­tric and small, but sporadic lonsdaleoid plates may occur. *L.Perm.-U.Perm.(Pseudoschwageria­Pseudofusulina Z.), Asia(SW.Iran-Tibet-Burma­Viet Nam-China-Japan)-N.Afr.(Tunisia).

P. (Pavastehphyllum). Corallites small and skeletal plates thin; lonsdaleoid dissepiments sporadic. *L. Perm. (Chkhis)-U. Perm. (Polydiedoxina-Neoschwagerina Z.), Asia(China).—Fig. 273, 5a,b, *P. (P.) simplex (Douglas), holotype, Polydiedoxina-Neoschwagerina Z., Iran, Pavasteh, Bakhtiari Co.; a,b, transv., long. secs., ×3.2, ×2.4 (Douglas, 1936).

P. (Pseudocarniaphyllum) Wu, 1962, p. 335 [*P. orientale; OD; †13760-13762, IGP, Nanking] [=P. (Chuanhanophyllum) Yü, 1977, p. 86, as genus (type, C. typicus; OD, †KCH001-002, GB, Nanjing; U.Carb., low. Chuanchan F., S. Jiangsu, China)]. Dissepimentarium lonsdaleoid, of thin plates; zone of clinotabellae narrow and imperis­ent, of adaxially declined tabellae wide. *L.Perm. (Pseudoschwagerina Z.), Asia(Kwangsi).—Fig. 273,1a,b, *P. (P.) orientale, holotype, Maping Ls., N. Kwangsi, 5-6 km. S. of Desheng, Yishan distr.; a,b, transv., long. secs., ×1.6 (Wu, 1962).

P. (Sakamotosawanella) Minato & Kato, 1965a, p. 66 [*Iranophyllum carinophyloides Douglas, 1936, p. 19; OD; tSIP863, coll. Anglo-Iranian Oil Co. Ltd., not traced] [=Sakamotosawanella Minato, 1944, p. 84, nom. nud.]. Axial structure large, with short medial plate and numerous bi­radially arranged septal lamellae and axial tabellae; septa thickened in tabularium, thin in anguloconcentric dissepimentarium; adaxially de­clined parts of tabulae wide, transverse parts very narrow. *L.Perm., Asia(SW.Iran-Japan­Yunnan)-N.Afr.(Tunisia).—Fig. 273,4. *P. (S.) carinophyloides (Douglas), holotype, Iran, Tapiileh Valley; transv. sec., ×2.4 (Douglas, 1936).

P. (Thomasiphyllum) Minato & Kato, 1965a, p. 67 [*Iranophyllum spongiformum Smith, 1941, p. 6; OD; †17249, GSI, Calcutta]. In wide dis­
Sepimentarium major and long minor septa are each modified to form columns of naotic plates connected by granules arranged in either two or three rows to form two peripheral or two peripheral and one median radial laminae, the peripheral laminae of minor septa simulating third order septa whose axial ends merge with the median lamina. *L. Perm., Asia (Burma-Iran-Kwangsi)-N.Afr. (Tunisia).* —Fig. 274, 2a-c. **P. (T.) spongiformum** (Smith), holotype, Burma, Pon, S. Shan States; ab, transv., long. secs, X1.7, X1.4, c, tang. sec. dissepimentarium, X2.8 (Smith, 1941).

**Pseudohuangia** Minato & Kato, 1965a, p. 89 [*Waagenophyllium chitraticum* Smith, 1935, p. 37; OD; †12856-12859, GSI, Calcutta, and

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Rugosa—Stauriida—Lonsdaleiina

R.27870-1, BM(NH), London. Fasciculate; axial column relatively wide, not sharply bounded, variable in width; some septal lamellae may be in places continuous with major septa; tabulae somewhat declined adaxially, peripheral clinotabellae sparse; dissepimentarium wide, normal, without lonsdaleoid dissepiments, and minor septa long. L. Perm., [Pseudoschwagerina Z.].—U. Perm., [Yabeina Z.], Asia(Pak.-Iran-Turkey-Viet Nam-China).—Fig. 273.2a,b. *P. chitralica (SMITH), holotype, Pak., right bank Yarkhun R., about 2 mi. N. of Baroghil Ailak, Chitral; a,b, transv., long. secs., X1.6 (Smith, 1935).

Yokoyamaella MINATO & KATO, 1965a, p. 135 [*Lonsdaleia (?Waagenophyllum) yokoyamai OZAWA, 1925, p. 72; OD; +III,64, OZAWA Coll., UT, Tokyo; lectotype by MINATO & KATO, 1965a, p. 136]. Cerioid or in part thamnasterioid; septal bases dilated to form peripheral stereozone; axial column with medial plate, few radial lamellae, and numerous conical axial tabellae; tabulae with narrow transverse annuli against the columnella, and wide peripheral clinotabellae; dissepimentarium normal and moderately wide, septa rather thin except at peripheral stereozone; lonsdaleoid dissepiments may develop in angles of corallites prior to appearance of peripheral, nonparricidal offsets. Perm., [Pseudoschwagerina-Yabeina Z.], Asia(Japan)-N.Z.-Eu.(Yugo.-Carnic Alps).

Y. (Yokoyamaella). Cerioid. Perm., Asia(Japan)-Eu.(Yugo-Aus.).—Fig. 273.3a,b. *Y. (Y.) yokoyamai (OZAWA), holotype, L. Perm., Pseudofusulina Z., Japan, Kaerimizu, Akiyoshi-dai, Yamaguchi Pref.; a,b, transv., long. secs., X2.0 (Ozawa, 1925).

Y. (Maoriphyllum) MINATO & KATO, 1965a, p. 143 [*Wentzelellina maoria LEED, 1956, p. 19; OD; +Col264 and slides CI013, 1014, 1017, 1037, NZGS, Auckland, and slides R39602, 39603, BM(NH), London]. Cerioid and in part thamnasterioid; commonly skeletal elements of column also thickened; zone of transverse tabulae very narrow. U. Perm., [uppermost Neoschwagerina Z.-Yabeina Z.], N.Z.-Asia(Japan).—Fig. 274.1a,b. *Y. (M.) maoria (LEED), holotype, Yabeina Z., N.Z., Marble Basin, E. of Tauranga Bay, Whangaroa, Northland; a,b, transv., long. secs., X6.2, X10.4 (Leed, 1956).

Subfamily WENTZELELLINAE Hudson, 1958

[Wentzelellinae Hudson, 1958, p. 184]

Solitary or compound waagenophyllids, with septa of three or more orders; axial column compact, variously of medial plate, conical tabellae, and septal lamellae that may be represented only as crests on tabellae; tabulae horizontal in inner tabularium, replaced outward by clinotabulae that may be nearly vertical and supplemented by elongate clinotabellae; septa may be discontinuous due to lonsdaleoid dissepiments or naotic; peripheral dissepiments may bear septal crests. Perm.
Wentzelella Grabau in Huang, 1932, p. 46 [*Lonsdaleia salinaria Waagen & Wentzel, 1886, p. 895; OD; figured syntype, 3902, 3904-3906, GSI, Calcutta] [=Wentzelella Grabau in Chi, 1931, p. 34, nom. nud.]. Ceroid, with tertiary, and rarely with quaternary septa; septal bases may be thickened to contiguity; axial column of median plate, septal lamellae and axial tabellae drawn up to median plate; width of transversely tabulate and clino-tabulate zones varying with length of minor septa and distance of ends of major septa from column; lonsdaleoid dissepiments absent or present. Perm., Asia(Pak.-Iran-Nakhichev.-Karakorum-Camb.-China-Japan-NE.USSR).

W. (Wentzelella). Without lonsdaleoid dissepiments; quaternary septa absent or poorly developed. U.Perm. (*Pseudoschwagerina-Yabeina Z.), Asia (Iran-Pak.-Indoch.-Tibet-N. China-Japan). ——Fig. 275,2a,b. *W. (W.) salinaria (Waagen & Wentzel), syntype, Wargal Ls., Pak., Salt Ra.; a,b, transv., long. secs., X4.1, X16.6 (Waagen & Wentzel, 1886).

W. (Szechuanophyllum) Wang, 1957 (*Pseudofusulina=Yabeina Z.), Asia (S. China-Karakorum-Manchuria-Japan-NE.USSR). ——Fig. 276,1a,b. *W. (S.) szechuanense (Huang), holotype, LPerm., Chihsia Ls., Szechuan, Gnomeishan, Omeishan; a,b, transv., long. secs., X2.0 (Huang, 1932).

Iranophyllum Douglas, 1936, p. 17 [*I. splendens; OD; +15915, GSI, Calcutta (fide La Touche, Sastry, & Sinha, 1969, p. 61), slide SPR829, coll. Anglo-Iranian Oil Co. Ltd., not traced]. Solitary, with third or higher orders of septa; axial column of median plate, septal lamellae and numerous axial tabellae declined from medial plate; major septa commonly thicker than others, may be withdrawn somewhat from column; wide dissepimentarium, plates in all interseptal loculi small, concentric; lonsdaleoid dissepiments in some; tabulae between axial ends of minor and major septa clino-tabulate; those between axial ends of major septa and column narrow and horizontal. Perm. (*Pseudoschwagerina-Yabeina Z.), Asia(Iran-Pak.-Viet Nam-S.China-Japan).

I. (Iranophyllum). Without or with very rare lonsdaleoid dissepiments. Perm., Asia(Iran-Pak.-Viet Nam-Laos-S.China-Japan). ——Fig. 277,1a,b. *I. (I.) splendens, holotype, Iran, Darreh Duzdun; a,b, transv., long. secs., X2.3 (Douglas, 1936).

† in MANSUY Coll., EM, Paris. *I ranophyllum with lonsdaleoid dissepiments well developed. Perm. (Pseudoschwagerina-Neoschwagerina Z.), Asia (Laos-Japan).—Fig. 277,2a,b. *L. (L.) pongonaense (MANSUY), holotype, Laos, Pong-Oua, near Luang-Prabang; a,b, transv., long. secs., X2.3, X2.0 (Fontaine, 1961).

**Lonsdaleiastraea** Gerth, 1921, p. 77 [*L. vinassai; M; t11792, TH, Delft*]. Thamnasteriod or partly aphroid; with tertiary septa; axial column of median plate, septal lamellae, and axial tabellae variously thickened; tabularium with clinothalamus peripherally and horizontal tabellae next to the column, width of both varying with length of major and minor septa. Perm. (?Parafusulina-Neoschwagerina Z.), Asia (Timor-Japan-?Karakorum).—Fig. 275,4. *L. vinassai*, holotype, Poetain, Timor; transv. sec., X2.1 (Gerth, 1921).

**Polythecalis** Yabe & Hayasaka, 1916, p. 63 [*P. confinis; OD; †not traced*]. Partly aphroid and partly cerioid, with tertiary and quaternary septa; major septa few; dissepimentarium commonly lonsdaleoid, its plates with or without septal crests; isolated segments of common walls consist of contiguous septal bases; axial column with more or less distinct median plate, septal lamellae, and axial tabellae; tabularium with clinothalamus peripherally and in places narrow periaxial hori-
Fig. 276. Waagenophyllidae (p. F416, F420).


P. (Polythecalis) [=Polythecalia Wang, 1950, p. 212, nom. null.]. Partly cerioid and partly

aphroid. Range as for genus.—Fig. 277.4ab.
P. yangtzeensis Huang, holotype, Chihisia Ls., Kweichow, between Chiutsaitung and Singchang, Hsihui-hsien; a,b, transv., long. secs., X2.3 (Huang, 1932).
P. (Chusenophyllum) Tseng, 1948, p. 1 [*C. paeonoidea; OD; 6944, not traced, ?Peking] [=Vesotubularia Yu in Yu & Shu, 1929, p. 50, nom. nud. in binomen V. tungliangensis of which Yu’s intended holotype, 3889, ?IGP, ?Nanking, was validly described and figured as Polythecalis multicystosis var. tungliangensis Huang, 1932, p. 91, from the Chihia Ls. of Tunliangchai, Hupeh]. Aphroid Polythecalis, without corallite walls and with lonsdaleoid disseipments com-
monly bare of septal crests. LPerm., Asia(China).

—Fig. 277,3a,b. *P. (C.) paeonoidea, holotype, uppermost bed of Chihia Ls., China, Kungshan, Nanking; a,b, transv., long. secs., X2.3 (Tseng, 1948).—Fig. 277,3c,d. P. (C.) tungliangensis (Huang), holotype, LPerm., Chihia Ls., Hupeh, Tunliangchai; c,d, transv., long. secs., X3.1, X1.6 (Huang, 1932).

Praewentzelella Minato & Kato, 1965a, p. 179 [*Waagenophyllum magnificum Douglas, 1936,
**Family PSEUDOPAVONIDAE**

Yabe, Sugiyama, & Eguchi, 1943


Solitary or compound; corallites small to medium-sized; axial structure either solid columnellum or short axial column originating from solid columnellum; septa in two or more orders; septa distinctly trabeculate, commonly thickened, may be naotic peripherally; tabulae horizontal near axial structure, declined adaxially peripherally; dissepsimentarium may be wide, interseptal loculi commonly narrow; lonsdaleoid dissepsiments may develop [Kato & Minato, 1975, p. 97].

**U.Carb.** (Mullerella Z.-Fusulina Z.)-?L.Perm.

Subfamily PSEUDOPAVONINAE

Yabe, Sugiyama, & Eguchi, 1943


Pseudopavonidae without tertiary septa. **U.Carb.** (Mullerella Z.-Fusulina Z.)-?L.Perm.

Pseudopavona Yabe, Sugiyama, & Eguchi, 1943, p. 245 [*P. taisyakiana; M; +90872-3, IGP, TohU, Sendai] [=Pseudopavonia Rowett &
Minato, 1968, p. 8, *nom. null.* Thamnasteroid, in places partly aphroid or, where walls are re-tained, pseudomeandroid; with solid columella originating from cardinal septum; major and minor
septa normally thickened; tabulae subhorizontal near columella, adaxially declined near dissepimentarium; dissepiments small, londsdaleoid may occur in places [Kato & Minato, 1975, p. 104]. U.Carb. (Millerella Z.-Fusulina Z.).—Fig. 278, a,b. *P. taisyakulana, U.Carb.; a, Hiroshima Pref., Karamon, Taisyaku, transv. sec., ×2.7, b, Yamaguchi Pref., Shiraiwa, long. sec., ×2.7 (Kato & Minato, 1975).

Amygdalophyllidium Kato & Minato, 1974, p. 189 [*Amygdalophyllidium naosoides Minato, 1951, p. 3; OD; tIV, 2, OZAWA Coll., UT, Tokyo] [=Amygdalophyllidium, nom. nud. in HASEGAWA, 1963, p. 34, fide Kato & Minato, 1975, p. 98]. Solitary; axial column large, of long median plate and numerous, normally contiguous septal lamellae that are not continuous with septa; thick major and very long, contragent minor septa with rhopaloid axial edges, cavernous in mid-length and natic in wide peripheral zone; dissepiments in narrow interseptal loculi subglobose; tabulae declined steeply adaxially [see Kato & Minato, 1975, p. 98]. U.Carb. (Namur.), Asia (Japan).—Fig. 278, a,b. *A. naosoidium (Minato), holotype, prec.-Fusulina Z., low. part of Akiyoshi Ls. Gr., Yamaguchi Pref., Ohkubo; a,b, transv., long. secs., ×2.7 (Kato & Minato, 1975).

Hiroshimaphyllum Kato & Minato, 1974, p. 189 [*Londsdaleoides toriyamai Minato, 1955, p. 165; OD; tIV,7,8, OZAWA Coll., UT, Tokyo]. Fasciculate; axial structure an axial column of numerous septal lamellae, normally not contiguous, a more or less distinct median plate and axial tabulae; major and minor septa thick, long, distinctly trabeculate, rarely natic peripherally, pinnately arranged in early stages, radial in late stages; londsdaleoid dissepiments developing irregularly in peripheral zone; clinotabulate present; offsets arise from periphery of calcifical platforms [see Kato & Minato, 1975, p. 99]. U.Carb. (Namur.), Asia (Japan).—Fig. 278, 5. *H. toriyamai (Minato), holotype, Yamaguchi Pref., Ohkubo; transv. sec., ×2.7 (Kato & Minato, 1975).

Omiphylum Kato, 1967, p. 103 [*O. confertum; OD; t1R13528, UH, Sapporo]. Astreoid; major and minor septa natic throughout wide dissepimentarium in which londsdaleoid dissepiments may occur sparingly; major septa laminar in narrow tabularium and not quite reaching columella which is amygdaloidal in transverse section and formed of ?fibers bi radially arranged with respect to median seam in plane of counter and cardinal septa, with one of which, a long ?counter septum, columella is connected; tabulae ? (declined toward columella). [Only one specimen known.] U.Carb. (Namur.), Asia (Japan).

Ozakiphyllum Kato & Minato, 1975, p. 101 [*O. hayasakai; OD; III, 8-9, OZAWA Coll., UT, Tokyo] [=Ozakiphyllum Kato & Minato, 1974, p. 189, nom. inval.]. Cerioid; with axial structure an axial column of medial lamella and septal lamellae commonly so thickened as to be contiguous, but axial tabulae may appear in occasional interlamellar spaces; long, thick, major and minor septa distinctly trabeculate, radially arranged, their axial ends discontinuous with axial column; dissepiments and clinotabulate present; londsdaleoid dissepiments may occur [see Kato & Minato, 1975, p. 101]. U.Carb. (Namur.), Asia (Japan).—Fig. 278, a,b. *O. hayasakai, holotype, Yamaguchi Pref., Edo; a,b, transv., long. secs., ×2.7 (Kato & Minato, 1975).

Subfamily TAISYAKUPHYLLINAE

Kato & Minato, 1974

[Taisyakuphyllinae Kato & Minato, 1974, p. 189]

Pseudopavonoidae with tertiary or higher orders of septa. U.Carb. (Millerella Z.-Fusulina Z.).

Taisyakuphyllum Minato, 1955, p. 143 [*T. rostelleri; OD; tIV, 5, OZAWA Coll., UT, Tokyo, now in UH, Sapporo]. Solitary or fasciculate with marginal increase; axial column large, of thick, closely spaced septal lamellae and more or less distinct median plate, may be continuous with ?counter septum; septa thick, distinctly and complexly trabeculate, long, contiguous or leaving only narrow interseptal loculi with small dissepiments in wide marginarium; third order septa present; tabularium narrow, tabulae nearly flat, disposed subhorizontally near axial column, clinotabulate present peripherally [see Kato & Minato, 1975, p. 106]. U.Carb. (Millerella Z.-Fusulina Z.), Asia (Japan).—Fig. 278, 6. *T. rostelleri, low. part Omi Ls., Honshu, Fukugakushi, Omi distr.; transv. sec., ×6.7 (Rowett & Minato, 1968).

Ibikiphyllum Kato & Minato, 1974, p. 190 [*Wenzsettella seki Minato, 1955, p. 108; figured syntype 108 in SEKI Coll., TohU, Sendai]. Cerioid; corallites with axial structure of septal lamellae and axial tabulae more or less closely spaced, ? (without medial plate); major, minor, and tertiary septa with thickened bases, forming peripheral trabeculate sterezone, but major and minor septa commonly thinner in inner dissepimented marginarium and tabularium; clinotabulate present [see Kato & Minato, 1975, p. 108]. U.Carb., Asia (Japan-Sinkiang).—Fig. 278, 2. I. denum Kato & Minato, holotype, Fusulina Z., Niigata Pref., Omi; transv. sec., ×2.7 (Kato & Minato, 1975).

?Order HETEROCORALLIA

Schindewolf, 1941


Elongate corallia lacking epitheca, earliest stages with four septa conjoined axially and with new septa formed in adaxial attach-
Fig. 279. Heterophylliidae (p. F424).

ment to these so that the four original inter-
septal loculi remain undivided; tabulae com-
plete domes with steeply sloping to confluent
edges that form narrow layered wall.
The possibility that the Heterocorallia developed from the Rugosa during the Famennian is suggested by the morphology of such genera as Oligophylloides ROZKOWSKA, 1969, p. 161, and Pseudopetria SOSHKINA, 1951, p. 23, which, however, may be incorrectly referred to the Heterophylliidae. BJRENHEJDE, 1965a, p. 33, thought it expedient to consider a new class Eoanthozoa BJRENHEJDE, 1965a, to include the orders Rugosa MILNE-EDWARDS & HAIME and Heterocorallia SCHINDEWOLF. Possibly the Heterocorallia should be regarded as a subclass of Anthozoa rather than as a doubtful order of the Rugosa.

Elongate coralla lacking epitheca and in earliest stages with four septa conjoined axially and with new septa formed in attachment to these so that the four original intersепtal loculi remain undivided; marginarium a narrow trabeculate stereozone; tabulac complete, domes with steeply sloping to vertical and confluent edges forming layered wall. Low.M.Dev.; up.U.Dev.; L. Carb. (up.U.Miss.)-U. Carb. (Namur.).


H. (Heterophyllia). With all four original intersепtal loculi separated by new septa. U.Dev. (Famenn.), Eu. (Pol.); L. Carb. (up.Visean), Eu. (Brit. I.-Belg.-L. Silesia)-N. Afr. (Moroc.-Asia (S. Fergana).—Fig. 279,2a-c. *H. (H.) grandis, up. Visean, Silesia, Altwater; a, b, c, transv. secs., X4, X20, c, long. sec., X2 (Schindewolf, 1941).

H. (Heterophyllidae) SCHINDEWOLF, 1941, p. 295 [*H. (H.) reducta; OD; †in SCHINDEWOLF Coll., ZGI, E. Berlin]. With two of the original intersепtal loculi not separated by new septa or separated by one new septum. L. Carb. (up.Visean), Eu. (Brit.I.-Ger.-L. Silesia)-Asia (Japan); U. Miss., N.Am. (Alaska).—Fig. 279,3a-c. *H. (H.) reducta, paratype, up. Visean, Ger., Rothwaltersdorf; a, transv. sec., X4; b, c, long. secs., X4, X20 (Schindewolf, 1941).

Hexaphyllia SHTUKENBERG, 1904, p. 5 [*H. prismatica; OD; †LGI, Leningrad]. Slender, with only six septa; peripheral stereozone thick. [Possibly early stages of excessively long Heterophyllia.] L. Carb.-?U. Carb. (up.Visean-?Namur.), Eu. (Brit.I.-Silesia-Ger.-Hung.-USSR)-Asia (Japan-Laos-China-Pamir); U. Miss.-L. Penn., N.Am. (Wash.).—Fig. 279,4a,b. *H. mirabilis (DUNCAN); a, up. Visean, Ds., Ger., Rothwaltersdorf, transv. sec., X20; b, up. Visean, Ds., up. Silesia, Altwater; long. sec., X8 (Schindewolf, 1941).

Oligophylloides ROZKOWSKA, 1969, p. 161 [*O. pachytheicus; OD; †Te3/2064, PZl, Poznan] [=Olyphylloides ROZKOWSKA, 1969, p. 161, nom. null.]. Long, slender corallites with talon and smooth thick wall without epitheca; with not more than 12 septa in tabularium; peripheral ends of septa embedded in wall, axial ends of four proto­septa fused axially forming a cross; axial ends of other septa shorter and grouped about and fused
with protosepta; tabulae domed, their fused outer edges forming wall. *U.Dev.(*Famenn.); Eu.(Pol.). — Fig. 280,Ja-c. *O. pachytherea; a,b, Holy Cross Mts., Galezice, transv., long. secs., ×4.8; c, another specimen, Holy Cross Mts., Lagow-Dule, ext. view, ×1.3 (Rozkowska, 1969).

**Pseudopetraia** Soshkina, 1951, p. 23, non *Pseudo­petraia* SCHINDEWOLF, 1924, p. 108, nom. nud., see Lang, Smith, & Thomas, 1940, p. 109 and Kullman, 1965, p. 69 [*P. devonica; OD; tsfle 6662, Soshkina Coll., PIN, Moscow*]. Solitary, small, cylindrical or conical; epithecate; calice deep; wall a narrow peripheral septal sterezone, axial edges of minor septa free, extending but little from it; major septa thin except in stere­zone, axial ends variably confluent in groups, not lobed as in *Palaeocyathus* FOERSTE, 1888, the longest in six groups confluent at axis somewhat as in *Heterophyllia* McCoy, 1849; tabulae domed or conical, complete or with additional tabellae. *M.Dev.(Eiel.); Eu.(Urals).—Fig. 280,2a,c. — *P. devonica*, holotype, western slopes C. Urals, near Pokrovsk Egorshin; a,b, transv., c, long. secs., all ×3.6 (Soshkina, 1951).

**Order and Family Uncertain**

*Astreaophyllum* Nicholson & Hinde, 1874, p. 152 [*A. gracile*; M; ?syntype 518(4), AU, Aberdeen, **fide** Benton, 1971]. Corallum alternately slenderly fasciculate and thamnasterioid; septa long, meeting columnella at axis. [Insufficiently studied.]

M*Sil.(Niagar.); N.Am.(Ont.).—Fig. 281,2a,b. *A. gracile*, Owen Sound; a, side view, enl.; b, caliceal view, greatly enl. (Nicholson & Hinde, 1874).

**Axinura** Castelnau, 1843, p. 49 [*A. canadensis*; M; ?not traced in Castelnau Coll., in EM or in MN, Paris; M; Dev., L. St. Clair, USA]. See EASTON, 1973, p. 130.


**Campactus** Rafinesque & Clifford, 1820, p. 234 [*C. canaliculata*; SD Lang, Smith, & Thomas, 1940, p. 31; ?not traced]. ?Dev., USA(Ky.).

**Cyclicopora** Steininger, 1849, p. 17 [*C. fasciculata*; M; ?not traced]. *Dev.*, Eu.(Ger.). Not illustrated, description inadequate.

**Digonoclisia** Yu, Liao, & Deng, 1974, p. 226 [*D. sinensis*; OD; t8777-9, IGP, Nanking]. Solitary; bilateral symmetry barely distinguishable; with dissepimentarium dominantly of steeply inclined londsdaleoid dissepiments, with a few long, thick segments of septa developed discontinuously, other septa being represented in places by shorter septal crests; tabular floors deeply concave. [See also Yu & Liao, 1978, p. 174; possibly digonophyllid.]

**M.Dev.** Asia(Kweichow). — Fig. 281,3a-c. *D. sinensis*, holotype, Hon-yi Shan F., Kweichow, Hon-yi Shan, Dushan; a,b, transv., c, long. secs., ×2 (Yu, Liao, & Deng, 1974).

**Duncania** de Koninck, 1872, p. 107 [*D. simplex*; OD; ?4585, IRSN, Brussels] [= *Duncania* de Koninck, 1871, p. 322, nom. nud.]. Small, solitary, with long, equal major septa whose axial ends stop equally at edge of cylindrical axial space; cardinal septum shorter; minor septa very short. *L.Carb.*, Eu.(Belg., Dos, near Engis).

**Elasmophyllum** Hall, 1882, p. 38 [*E. attenuatum*; M; ?not traced; no figs. published]. Solitary, ceratoid with concentrically banded epitheca and longitudinal grooves on exterior; septa radially arranged, major septa extending to axis and forming an axial whorl; dissepiments present. [Insufficiently characterized; see Stumm, 1949, p. 26.] *Dev.(Ononad.)*, N.Am.(N.Y.-Can.).

**Ellipsocathus** d'Orbigny, 1849, p. 12 [*Antho­phyllum bicostatum* Golffuss, 1826, p. 46; ?161, Golffuss Coll., IP, Bonn; Dev., Heisterlein, Eifel, Ger.]. Study of holotype required.

**Exostega** Rafinesque & Clifford, 1820, p. 235 [*Turbino/ia (Exo"tega) tecta*; SD Lang, Smith, & Thomas, 1940, p. 59; ?not traced in MN, Paris]. ?Dev., USA(Ky.).

**Gazimuria** Spasskiy, 1960b, p. 106 [*G. ildicanica*; OD; ?31, coll. 8774, TsGM, Leningrad]. Small, solitary, calice deep; with wide peripheral stere­zone of thickened contiguous septa between which a few dissepiments may appear in late stages; major septa may attain axis; tabulae almost hori­zontal or weakly convex, may be incomplete. [Insufficiently illustrated.] *L.Dev.-low.M.Dev.*, Asia(Transbaikal).

**Insoliphyllum** Ermakova, 1957, p. 170 [*I. soshkinae*; OD; ?222, coll. 11, VNIGNI, Moscow]. Dendroid, increase lateral; corallites very slender, major septa discontinuous, ?amplexoid, a few may reach axis; discontinuous columnella may be formed from axial ends of one or more septa; minor septa not observed; tabulae complete, sparse, subhorizontal or rising slightly to col­umnella; no dissepiments. [Possibly a heterocoral.]

*U.Dev.(Frasn.); Eu.(USSR).—Fig. 281,la-d. *I. soshkinae*, holotype, Kirovsk Distr., Sovetsk bore­hole, depth 1,590-1,596 m.; a,b, transv., c,d, long. secs., ×4 (Ermakova, 1957).

**Orthophyllum** Počta, 1902, p. 196 [*O. praecox; SD Smith, 1930a, p. 303; ?not traced, ?NM, Prague]. Solitary, small, erect, conical; major septa thin, somewhat withdrawn from axis; minor septa contracting; tabulae present. [Type ma­terial, *L.Dev.-M.Dev.* from "E. Lochkov" Czech,
Insoliphyllum

**PHINEUS** KOLOSVÁRY, 1951, p. 172, 185, non Phineus Stål, 1862, a hemipteran [*P. confluentiseptatus*; OD; *not traced*]. Solitary, with moderately wide, normal dissepimentarium, major septa extending to axial region. [Insufficiently described.]

Polydilasma HALL, 1851, p. 399; 1852a, p. 112 [*P. turbinatum*; M; *not traced*] [=Polydilasma LANG, SMITH, & THOMAS, 1940, p. 102, *nom. van.*]. Sil. (Niagar.), N.Am.(N.Y.).

Protocyathophyllum THOMSON, 1883, p. 336, *nom. subst. pro* Protocyathus THOMSON, 1880, p. 244, *non* Protocyathus FORD, 1878, an archaeocyathan [*P. quadraphyllum*; OD; *destroyed by fire*]. Indeterminable. L.Carb.(Visc.), Eu.(Scot.).


Schreteria KOLOSVÁRY, 1951, p. 45, 183 [*Schreteria*...
megastoma; M; †not traced]. Solitary, large; septa long, minor septa more than half as long as major; counter septum very long, thicker; dissepimentarium wide; tabularium with numerous tabellae. [Insufficiently known.] U.Carb., Eu. (Hung.).

Vischeria Ivanov in Ivanov & Myagkova, 1955, p. 34 [*V. vischerensis; OD: †39, coll. 2, SGI, Sverdlovsk] [=Xystriphyllum Hill, 1939b, fide YANET, written commun., July 26, 1974]. Cerioid; corallites thin-walled with numerous long thin major and minor septa; tabulae sagging; dissepiments normal. [Types poorly preserved (Ivanovsky, 1965a, p. 97); restudy required.] M.Ord., Eu.(Urals); ?Dev. [fide YANET, 1974, written commun.].

Subclass Uncertain

Decaphyllum Frech, 1885, p. 69 [*D. koeneni; M; †thin section in HU, E. Berlin, remainder not traced, fide Schindewolf, 1942, p. 285; ?Göttingen]. Massive, marginarium of each corallite a wide septal stereozone merging with those of neighbors; in small tabularia, six long septa meet or almost meet at axis (at small columella), with six shorter septa alternating; in larger tabularia eight still shorter septa are present, two in each of the four sextants adjacent to plane of biradial symmetry; septa laterally ridged subhorizontally; tabulae flat. [Insufficiently known. Schindewolf (1942, p. 286) considered it a Mesozoic scleractinian.]

U.Dev.(Fram.), Eu.(Ger.).--Fig. 282, la-d. "D. koeneni, holotype, Grund; a,b, calical views, X3, X6 (Frech, 1885); c,d, Schindewolf's diagram. Interpretation of septal arrangement in tabularia as scleractinian (Schindewolf, 1942)."

Kitakamiphyllum Hill, 1956b, p. F312, nom. subst. pro Maia Sugiyama, 1940, p. 122, non Maia Lamarck, 1801, a crustacean, nec Maia Reichenbach, 1850, ex Brissen, 1760, a bird, nec Maia Frédéricks, 1924, a brachiopod [*M. cylindrica; OD: †161523, TohU, Sendai]. Solitary, wall thickened, scabrous; no septa or septal spines observed; tabulae subhorizontal, commonly complete; no dissepiments. U.Sil., Asia(Japan).--Fig. 281, a,b. *K. cylindrica (Sugiyama), holotype, Kitakami mountainland, Kusayami-zawa at S. foot of Takainari-yama, Hikoroi-ti-mura; a,b, transv., long. secs., X3 (Sugiyama, 1940).

Numidiaphyllum Flügel, 1976b, p. 57 [*N. gillianum; OD: †not traced]. Rugosa with irregularly arranged septa of up to four orders of length and thickness, with four to seven septa predominant and with sagging tabulae; neither dissepiments, columnella, nor fossula present. U.Perm., N.Afr.(Tunisia).--Fig. 283, la-e. "N. gillianum, paratype, Djebel Tebag: a, transv. sec., X2.0, b-e, transv. secs., X1.3 (Flügel, 1976b).

For this genus, Flügel (1976b, p. 55) established the family Numidiaphyllidae, with the following diagnosis (transl.): Rugosa with irregularly arranged septa of up to four orders of length and thickness, with four to seven septa predominant and with sagging tabulae; neither dissepiments, columnella, nor fossula present.

Doubtful Genera

Siphonaxis Dybowski, 1873c, p. 335, 390 [*S. tubiferus; M; †not traced]. Drift, Eu., Ostroiminsk, near Burtnesk Lake, Latvia. Lindström, 1883b, p. 13, writes, "Founded on silicified and altered fragments of an undeterminable coral."

Stegophyllum Scheffen, 1933, p. 34 [*S. dentatum; OD: †not traced]. U.Ord., Eu.(Nor.). Indeterminable.

Strobilasma Scheffen, 1933, p. 32 [*S. dentatum; OD: †not traced]. U.Ord., Eu.(Nor.). Indeterminable.

Nomina Nuda

Agonophyllum Simpson, 1900, p. 203. No species named.


Astroplasmatidae Spasskiy & Kravtsov in Spasskiy, Kravtsov, & Tsyganko, 1971, p. 85, nom. nud.;
applied to Cystiphyllida.

**Asymmetrilamellum** THOMSON, 1901, p. 483. No descriptions or illustrations, but two lower Carboniferous species are mentioned, of which *A. lintoni* was designated "type species" by GREGORY, 1917, p. 223. Material not traced.


**Blothromissum** GRABAU, 1917a, p. 199. In list of new genera in abstract; no species, descriptions, or figures.

**Brochiphyllum** WEDEKIND, 1923, p. 35. No species, briefly compared with *Keriophyllum* WEDEKIND, 1923; not illustrated.

**Calvinastreca** GRABAU, 1917a, p. 199. In list of new genera in abstract, no species, descriptions, or illustration.

**Cantharophyllum** ETHERIDGE, 1900, p. 18. L.Carb., Australia(Queensl.). Conditional name for three lithostrotionid species.

**Chonophylloides** KIAER, 1897, p. 17, 26, 75. In binomen "Chonophylloides rarotubulatus gen. et sp. nov."

**Cocenophyllum** BYKOVA, 1966, p. 12. In faunal list as "Cocenophyllum ? sp."

**Crasophyllum** WANG, 1945, p. 28. One species named, *C. typicum*. M.Dev., Asia(E.Yunnan). No description or figures; entry in table only.


**Cystocentriella** LIN & CHOW, no date, two species listed in *Yi*, 1974, p. 10. No diagnoses, descriptions, or figures; no type species named. Tryplasmatid. U.Ord., China.

**Dansikophyllum** ULITINA, 1963a, p. 15, no type species named. "This widely known genus was described originally under the name *Lyophyllum* WEDEKIND and later under *Cystiphyllides* YOH." ULITINA considered both names preoccupied and proposed *Dansikophyllum* as a replacement name. Later, 1968, p. 59, she considered *Cystiphyllides* YOH, 1937, a synonym of *Cystiphyllides* CHAPMAN, 1893; *Lyophyllum* WEDEKIND, 1925, she placed in synonymy with *Nardophyllides* WEDEKIND, 1925. The name *Dansikophyllidae* ULITINA, 1963a, p. 14, is invalid; it was intended for forms herein placed in *Cystiphyllidae* MILNE-EDWARDS & HAIIME, 1850.


**Lophodibunophyllum** LISTSYN, 1925, p. 68. In combination *Lophodibunophyllum novum*, n. sp.; treated by LANG, SMITH, & THOMAS, 1940, p. 80, as *err.* pro *Lophophyllum* MILNE-EDWARDS & HAIIME, and by SOSHKINA, DOBROLYUBOVA, & KARKOVICH, 1962, p. 345, as Tetracoralla *incertae sedis.*
Merophyllum Grabau, 1917a, p. 199. In list of new genera in abstract; no species named, no description, no illustration.


Pholidasraea Spasskiy & Kraitov in Spasskiy, Kraitov, & Tsygankov, 1971, p. 84, nom. nud.; no species named, no descriptions or illustrations.

Pholidasraeidae Spasskiy & Kraitov in Spasskiy, Kraitov, & Tsygankov, 1971, p. 84; applied to Cystiphyllida.

Pristiphyllum Grabau, 1917a, p. 199. In list of new genera in abstract; no species named, no description, no illustrations.


Siphodon Rafinesque, 1815, p. 136, nom. nud.; Rafinesque & Clifford, 1820, p. 234, conditional name for Turbinokia tubulosa; M; †not traced. N.Am.(Allegheny Mts.).


Stereophyllum Grabau, 1917a, p. 199. In list of new genera in abstract; no species named, no description, no illustration.

Talubasma Shurygina, 1971, p. 102. In binomen "Talubasma oblonga Zhe Lt.," and cited as such again in Pavlova, 1973, p. 35.


Tienophyllum Wang, 1945, p. 29. Four species named. M.Dev., Asia(Yunnan). No species designated as type, no descriptions or figures; diagnoses inadequate.


Unavailable Genus-Group Names


Family, tribe, and species-group names that have become unavailable in the same way are listed by Scrutton (1969, Bull. Zool. Nomencl., v. 25, p. 159-160).

The following generic name was placed on the official list of rejected and invalid names by Opinion 813 of the International Commission on Zoological Nomenclature (Bull. Zool. Nomencl., v. 24, p. 143, June, 1967) and suppressed for the purposes of the Law of Priority but not for those of the Law of Homonymy: Faviphyllum Hall, 1852b, p. 407, together with the specific name rugosum Hall, 1852b, p. 407, as published in the binomial Faviphyllum rugosum.
INTRODUCTION TO TABULATA

MORPHOLOGY

The Tabulata are an extinct, almost entirely Paleozoic order of corals characterized by their exclusively colonial mode of growth and by secretion of a calcareous exoskeleton of slender tubes crossed by many fragile transverse partitions called tabulae. Relative prominence of these tabulae and inconspicuousness of radial longitudinal skeletal elements (septa, spines, and squamulae) are features that suggested the name of the group.

Mechanical and photographic techniques used in the preparation of Tabulata for study are the same as those described for the Rugosa on page F64 of this work. The biometric techniques of statistical analysis and numerical taxonomy are mentioned in the section on Classification.

Morphological terms applied to tabulate corals are printed in boldface type in the introductory text that follows. Most are included in a glossary of morphological terms used in describing both Rugosa and Tabulata (see page F32). The following morphological terms are used exclusively for Tabulata.

- **alveolitoid.** Type of reclined corallite having vaulted upper wall and nearly plane lower one parallel to surface of adherence of corallum, as in Alveolites.
- **canal.** See mural tunnel.
- **cateniform.** Corallum with corallites united laterally as palisades that appear chainlike in cross section, the palisades commonly forming a network.
- **coenenchymal increase.** Type of increase in which offsets arise from coenenchyme, as in Heliolitina and Halysitina.
- **COENENCHYME (coenosclerenchyme).** Common skeletal tissue uniting offsets.
- **cribriform wall.** Irregularly perforate wall.
- **encrusting.** Thin corallum adhering to a surface and following its irregularities.
- **MURAL PORE.** Circular or oval small hole in wall between adjacent corallites, as in Favositina.
- **mural tunnel (canal).** Elongate space extending through thick common wall from mural pore.
- **pore-plate.** Thin diaphragm closing a mural pore.
- **reclined.** Corallite growing and opening obliquely with respect to surface of corallum.
- **septal spine (spine).** Spinelike trabecula projecting free from wall or septal comb, one of a longitudinal series.
- **squamula.** Small plate projecting subhorizontally in eavelike manner from wall of corallite toward axis.
- **terminal calice.** A surface calice that differs structurally from the earlier, vacated calices of deeper levels of the corallum.

FORM OF CORALLUM

The form of the complete, compound skeleton (corallum, pl., coralla) varies widely, depending mainly on the manner of increase and the arrangement and shape of the exoskeletons (corallites) built by the constituent individual polyps of the colony. The polyps are assumed to have been of one kind, with no differentiation of function.

The possibility that more than one kind of polyp was present in the tabulatan colony was first suggested by Nicholson (1875a, p. 248) for *Heliolites*. Following Moseley's descriptions (1877; 1881) and views of the development of the monomorphic alcyonarian *Heliopora*, Nicholson (1879, p. 242) considered two kinds of polyp to be present in this genus, and extended the conception to *Halysites* (1879, p. 230), in which Etheridge (1904, p. 19) thought three kinds were present; fairly wide acceptance of these ideas followed, but Bourne (1895), after detailed studies on *Heliopora*, concluded that its smaller tubuli are not modified zooids but are part of a complex system of coenosarcal solenia, while Lindström (1899, p. 8-18) effectively argued for the coenenchymal nature of the intertabularial skeleton in Heliolitina. Gradually a consensus emerged, expressed by Jones and Hill (1940, p. 192), that dimorphism in Heliolitina could not be accepted. Durden (1966, p. 49), in an abstract, denied that polymorphism was present in the hylisitids, and their interstitial tubuli are herein considered coenenchymal, as they were by Lindström (1873a, p. 17). In some Favositina large corallites appear, surrounded by small corallites, and Moseley (1881, p. 124) suggested that these might have been secreted by autozooids and siphonozooids, respectively. Jones (1936b, p. 4) investigated this condition and found that it was governed by the rate of increase of the corallum.
Fig. 284. Tabulate coral morphology; types of coralla (after Hill & Stumm, 1956).—1. Umbelliferous; Romingeria umbellifer (Billings), M.Dev., Ont.; side of corallum, X 1.—2. Zigzag; Cladochonos brevicollis McCoy, L.Carb., Eng.; side of corallum, X 1.—3. Fasciculate; Syringopora ramulosa Goldfuss, L.Carb., Belg.; side of corallum, X 1.—4. Meandroid; Chaetetipora septosa (Fleming), L.Carb., Wales; transv. sec., X 8.—5. Coenenchymal; Plasmopora petalliformis (Lonsdale), M.Sil., U.K.; surface of corallum, X 1.—6. Ceroid; Favosites gothlandicus Lamarck, Sil., Gotl.; corallum broken along walls of prismatic corallites, X 1.—7. Marginaria in corallites of massive branching coralla; Thamnoptychia ornata (Rominger), M.Dev., N.Y.; 7a, tang., 7b, long. secs., both X 7.
and the rate of growth of the offset. Sokolov (1955, p. 136) gave a similar explanation for Oculipora. Similarly, regularities in location and rate of production of offsets have been described by Oliver (1966, p. 449) in the branching Streptopora flexuosa Hall, but the results of such regularities can scarcely be described as dimorphic. Oliver (1975b) considered dimorphism to be present in his two new genera Lecfedites and Bractea. In both, corallites are of two sizes, large and cylindrical with projecting calical wall, and small and prismatic; squamulae are developed only in the large corallites in Lecfedites, but in Bractea they are found in the smaller corallites also.

The corallites of Tabulata are slender in comparison with those of other Zoantharia, their diameter ranging from approximately 0.2 to 20.0 mm. Maximum diameter of coralla ranges from a few millimeters to two meters or more.

Coralla in which the corallites are not separated by space are massive (Fig. 284, 4-6); those in which corallites are straight or curved cylinders that are not laterally contiguous are termed fasciculate (fruticose, shrubby) (Fig. 284, 1-3). The corallum, whether massive or fasciculate, may be a laminar expansion, thin to almost filmy, or thicker and turf- or sodlike; such coralla result from concentration of the production of offsets (new corallites) in basal and peripheral parts of coralla. The corallum may be domed or hemispherical as a result of the more or less regular production of offsets throughout the corallum, or it may be nodulose, tuberoid, or irregular from the irregular production of offsets. A massive corallum may be slenderly or coarsely branching, the branches being cylindrical (ramose, Fig. 285, 3) or flattened (foliose, Fig. 285, 4), and either separate or joining to form a network (anastomosing, Fig. 285, 3); branches form when production of offsets is localized and continued forward from particular points.

Massive coralla in which the corallites are contiguous and prismatic and have their axes normal to the surface are cerioid (Fig. 284, 6); these characterize the Favositina. If the axes are inclined to the surface so that the upper side of the corallite is vaulted, the corallum is alveolitoid (Fig. 285, 1), as in the Alveolitina; proximally these have a sheet of thin-walled corallites with axes parallel to substrate; meandroid coralla arise when new walls dividing offset from parent fail to develop fully (Fig. 284, 9) as in some Chaetetina. Massive coralla with individual tabularia separated by common skeletal tissue are coenenchymal (or more pedantically, coenosclerenchymal, Fig. 284, 5) as in Heliolitina. Massive coralla that are also branching and in which the corallites each develop distally a marginarium of thickened skeletal tissue distinguish the Pachyporicae (Fig. 284, 7a, b) and some Alveolitina.

In massive coralla all except the calical surface is enclosed in epitheca with transverse growth wrinklings that may appear continuous or discontinuous between neigh-
Tabulata—Morphology

FIG. 286. Tabulate coral morphology; epithecal features.—1. Epithecal scales; Stratophyllum tenue Smyth, L.Carb., Belg.; 1a, part of epitheca showing two scales, X12. 1b, scales showing pattern or ridges, X20 (Smyth, 1933).—2. Epithecal wrinkles continuous in places from corallite to corallite, also calices; Michelinia tenuisepa (Phillips), L.Carb., Eng.; side of corallum, X1 (Hill & Stumm, 1956).—3. Radiciform processes; Michelinia farosa (Goldfuss), L.Carb., Belg.; X1 (de Koninck, 1872).—4. Median suture (dark line) in wall; Favosites sp., Dev., USSR; 4a, transv. sec., 4b, long. sec., both X4 (Dubatolov, 1969); 4c, "F." grandiporus Etheridge, transv. sec. showing "well-developed stellate intermural space" (herein interpreted as secondary alteration of median suture), X20 (Philip, 1960).

boring corallites (Fig. 286,2). SCHOUPPÉ and OEKENTORP (1974, p. 88) interpret it as the sum of the outer layers of the outer walls of all the contiguous peripheral corallites.

Some Palaeacidae have superficial epithecal scales (Fig. 286,1a,b). Michelinia may have radiciform processes consisting of rootlike epithecal outgrowths (Fig. 286,3). Fasciculate coralla in which the corallites are connected by tubuli (Fig. 284,3) characterize the Syringoporicae. In the Thecostegitidae, Chonostegitidae, some Roemeriidae, and some Sarcinulida, the corallites may be connected at intervals by horizontal laminar expansions (Fig. 287,1) with or without...
FIG. 287. Tabulate coral morphology; fasciculate coralla.—1. Coralla connected by horizontal lamellar expansions; \textit{Chonostegites clappi} MILNE-EDWARDS and H\textsc{A}MIE, M.Dev., Ohio; side of weathered corallum showing regularly spaced, flat, coenenchymal extensions connecting the cylindrical corallites, $\times 1$ (Hill \\& Stumm, 1956).—2. Coralla connected by lamellar expansions with halos of tubuli; 2\textit{a,d}, \textit{Thecostegites bouchardi} (Michelin), U.Dev., Frasn., France, Fergues, near Boulogne, \textit{a}, long. sec., \textit{d}, transv. sec., both $\times 4$ (Hill \\& Jell, 1970a); 2\textit{b,c}, \textit{Sarcinula luhai} Sokolov, U.Ord., Est., \textit{b}, transv. sec., \textit{c}, long. sec., both $\times 4$ (Sokolov, 1955).

Associated haloes of tubuli (Fig. 287,2\textit{a-d}).

\textbf{Cateniform} coralla have their corallites united laterally in palisades generally one corallite thick, the palisades forming a network (Fig. 285,2). These characterize the \textit{Halysitina}; in other groups they are uncommon and less regular.

The \textit{Auloporicae} and the proximal parts of many \textit{Syringoporicae} are \textit{reptant} (pro-cumbent, prostrate, Fig. 288,3) and formed
crease; *Pachyfavosites polymorphus* (GOLDFUSS), M.Dev., Ger.; part of corallum broken along walls of prismatic tubes, showing prominent mural pores, enl. (Hill & Stumm, 1956).—3. Reptant retiform corallum; *Aulopora ?repens* MILNE-EDWARDS and HAME, M.Dev., Ger.; upper surface of corallum showing circular calices of branching corallites (reptant on another coral), X 1 (Hill & Stumm, 1956).—4. Lateral increase; *Cladochonous crassus* (McCoy), L.Carb., Eire; long. sec. of branch showing offset fractured along diaphragm, X 11 (Hill & Smyth, 1938).
Fig. 289. Tabulate coral morphology; increase.—1. Axial increase in 1a-c, Alveolitidae, Scoliopora, X30; 1d-f, Agctolitidae, Somphopora, X25 (Sharkova, 1971).—2. Axial intracalicular increase;
of separate or anastomosing chains of conical or cornute corallites that lie parallel to and in many cases are adherent by their basal surface to substrate. Either erect corallites, or slender branches, may arise from the reptant chains, singly or in whorls (verticillate, umbelliferous, Fig. 284,1); arrangement of corallites in the slender branches may be zigzag (Fig. 284,2) or racemose (like grapes on a stalk), or not regular.

**INCREASE**

The compound coralla of Tabulata are believed, by analogy with the compound Scleractinia, to result from asexual (vegetative) reproduction of the polyps of the living colony. In Scleractinia such reproduction is achieved by the budding of new polyps (buds, daughter polyps) from the mother polyp, either within or outside the ring of tentacles (intratentacular or extratentacular budding). For the new corallites formed in the compound coralla of extinct orders, the purely descriptive term offsets is used without genetic significance. Speculation on the kinds of asexual reproduction that gave rise to the new polyps secreting the offsets can thus be kept separate from factual observation.

Until recently few researches have been undertaken specifically on increase in Tabulata, but recent studies have caused considerable questioning of our traditional conceptions (Oliver, 1966, 1968; Webby & Semeniuk, 1969; Sharkova, 1971; Mironova, 1974b; Schouppe & Oekentorp, 1974). The definitions and descriptions that follow are those appropriate to our present knowledge, but will assuredly be modified as results of studies using modern fine-scale serial sectioning techniques become available.

In fasciculate coralla the common form of increase is lateral (Fig. 284,3); the offset is found on one side of a corallite and joint epitheca appears to enclose continuously both corallite and offset; the diameter of the offset at its point of origin is seldom more than half that of the corallite and commonly is much smaller. The rate of expansion and the direction of growth of the offsets affect the form of the corallum. The lumen (space enclosed by the wall, in Tabulata the tabularium) of the offset may be continuous with that of the corallite, or there may be a diaphragm (porous in some) separating the two (Fig. 288,4). Lateral increase is dominant in Auloporicae and Syringoporicae; in the former Hamada (1973, p. 28) described uniserial, unilateral, bilateral, and annular types as basic, with intermediates possible. Stasinska (1974, p. 266) described lateral offsets in some Auloporida as originating on the calicol surface of the wall, i.e., as peripheral intracalicular offsets; perhaps lateral increase is really only an extreme type of peripheral intracalicular increase.

Increase in the cerioid coralla of the Favositida has commonly been described as intermural (or intercalicular or interstitial), but has been considered, and even defined, as lateral increase affected by the conjunction of corallites so that the offset is forced to originate in the median suture between two corallites (Fig. 288,2). However, this is not yet confirmed by modern work. It is perhaps more likely that 'intermural' increase is peripheral intracalicular increase in which the offset arises at the extreme edge of the calice.

**Peripheral intracalicular increase** has been described in Devonian Favositidae by Swann (1947; Fig. 288,1a-d); a new dividing wall encloses an initially very small peripheral part of the calicular platform of a corallite, commonly in the angle where two sides meet, or on a very short side, and may grow distally so that an offset is formed, the corallite continuing with...
scarcely decreased diameter; mural pores may be developed in the new wall almost at its point of origin. Whether the new wall is laid down as a single partition as in peripheral calicular increase in Rugosa, as appears likely from SWANN's figures, remains to be established. SHARKOVA (1971, p. 59) stated that, in Ludlovian Paleofavosites and Favosites, intracalicular increase is effected peripherally, in the corners of corallites, by two laminae that extend, one from each of the opposite sides of the corner or short side, and join to form a dividing wall between corallite and offset (Fig. 288, Ie-i).

Axial (adaxial, septal, longitudinal) intracalicular increase occurs in Chaetetida (Fig. 289,2a,b) and Tetradida (Fig. 289,2c-e), in some Alveolitina and in the coenenchymal tubuli of Heliolitina. In bipartite axial increase, common in Chaetetida, a radial longitudinal lamina grows adaxially from the wall of a corallite to join at the axis with one from the opposite wall. Each of the two subequal corallites so formed are called offsets. Quadripartite axial increase is characteristic of the Tetradida. Increase that has been described as unequal bipartite axial increase occurs in Cryptolithocenariidae (Fig. 289,3), wherein dividing laminae grow out from either side of the angle between two walls, and in this form, which appears almost identical with peripheral intracalicular increase, only the smaller corallite is appropriately called an offset. In Alveolitina axial calicular increase is effected by the adaxial growth and union of opposite or neighboring coarse septal combs, up to three offsets being produced simultaneously, replacing the corallite (Fig. 289,1).

Coenenchymal increase occurs in Heliolitina (LINDSTROM, 1889, p. 19) and in Halyositina. Offsets may arise from coenenchymal tubuli by expansion in diameter and insertion of septal spines (Fig. 289,4f), or by gradual replacement of several tubuli to give a tabularium of normal diameter (Fig. 289,4a-d); other offsets may arise from coenenchymal dissepiments (Fig. 289,4e).

The adjective basal, like the adjective peripheral, should not be used without qualification to denote whether the increase being described is related to position in the corallum as a whole or in the calice of a single corallite.

MIRONOVA (1974b, p. 106) considered that three types of vegetative increase characterize the subclass Tabulata. The commonest is division, typical of Tetradida, where the offsets are equal, but also typical of Favositida, in which it is very unequal. Lateral increase is typical of Auloporida, and coenosarcal (=coenenchymal) increase of Sarcinulida and Halyositida (s.s.), which Mironova combined with Heliolitida in a subclass Heliolitoidea.

Speculations on the nature of the living tabulatan colony include those of PREOBRAZHENSKIY (1974b, p. 89) and BONDARENKO (1971a, p. 22). PREOBRAZHENSKIY considered that there were four types of tabulatan organism: individual (solitary, e.g., Monotabella), temporarily colonial (Fletcheriella), periodically colonial (Syringopora), and truly colonial (e.g., Cladochonus, with polyps somatically connected throughout the life of the colony). BONDARENKO suggested that the light and dark (or clear and dense) zones noted in many heliolitan coralla are to be related to periods of alternating asexual and sexual reproduction in the living colony.

WELLS (1971, p. 748) in assessing what a colony is in anthozoan corals considered that the Rugosa increased asexually exclusively (except for rare abnormalities) by extratentacular budding followed by separation of the corallites as individuals. Extratentacular budding results in complete homeomorphic individuals, organically or structurally united as corms or colonies. Intratentacular budding in Scleractinia gives a compound individual, not a colony. WELLS did not discuss Tabulata specifically. Perhaps one might speculate that in Tabulata, lateral, 'intermural,' peripheral calicular, and coenenchymal increase are found in coralla formed from colonies where asexual reproduction was by extratentacular budding, and that equal or subequal axial calicular increase (except in coenenchyme) was ultimately related to intratentacular budding.

CORALLITES

Each corallite is a slender tube of CaCO\textsubscript{3}. Cross section varies from genus to genus and species to species, and even within spe-
cies; it ranges from round to oval to elliptical; rounded-polygonal to polygonal (with from 3 to 12 sides, commonly 5- to 6-sided); or it may be alveolitoid, ranging from compressed-polygonal to semilunate to crescentic to chinklike. Corallites expand more or less rapidly in diameter and may be erect throughout their length or may curve more or less sharply over part or all of their length.

**CALICE**

The distal surface of each corallite is the calice (Fig. 286,2). It is commonly wider than deep, with a narrow border, steeply sloping sides, and flat or concave base. In corallites with thick walls (wide peripheral stereozones) the border may be wide and but slightly sloping; the border may show septal spines or septal ridges. In corallites that open obliquely, the calice is not round or rounded-polygonal in outline, but is compressed, commonly transversely to a branch, but in some longitudinally; in transversely compressed calices of branches or foliae the lower (outer) lip may be projected beyond the common surface; in alveolitoid calices the upper lip is vaulted and the lower reflects the shape of the surface of adherence of the inclined lower wall (Fig. 285,1). In cerioid coralla the sutural area between neighboring calices may be raised and acute or rounded, or faint to indistinguishable (Fig. 290,1). VOYNOVSKY-KRIGER (1970, p. 106) has distinguished as terminal calices those surface calices that differ structurally from the earlier and vacated calices of deeper levels of the corallum; for instance, constricted terminal calices of Mastopora, and terminal calices with everted margins as in Aulohelia.

**EPITHECA**

In all fasciculate and probably in most cerioid coralla, each corallite is enclosed laterally in a sheath (epitheca) of CaCO₃. The epitheca is commonly without the longitudinal interseptal ridges and septal furrows that are seen in the Rugosa, but they are visible in some (Fig. 290,4), and transverse growth ridges or wrinkles are common. In thin section the epitheca is denser (‘darker’ by transmitted light) than the rest of the wall. The sutural area be-

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Fig. 290. Tabulate coral morphology; epitheca of corallites.---1. Sutural area of favositid, diagram. (Sokolov, 1955).---2. ‘Median suture’ in cerioid corallum; Thamnopora cervicornis (De Blainville), M.Dev., Givet., Eu.; long. sec., X4 (Hill & Stumm, 1956).---3. Epitheca between corallites of cerioid corallum; Favorites gothlandicus Lamark, U.Sil., Podolia; 3a, transv., 3b, long. secs., both X13 (Tesakov, 1971b).---4. Epitheca in fasciculate corallite with traces of longitudinal (?septal) grooves; Syringopora abdita De Verneuil, Dev., France; ext. view, enl. (Milne-Edwards & Haine, 1851).

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of both corallites (Fig. 290,2; 3a,b; see also Fig. 286,4a-c). Inside the epitheca the corallite consists of wall (peripheral stereozone), septal (radial, longitudinal) elements, and tabulae or tabellae (transverse elements). Schouppé and ÖeKentonp (1974, p. 92) use the term epitheca for the entire wall of the corallite, including the crustose sheet for which it is used herein, and which Schouppé and ÖeKentonp consider to be merely the primary layer of the wall, secreted first, its crystallites acting as a "seeding layer" for the main part of the wall. This is consistent with the structure of the epithecate wall described in Scleractinia by Barnes (1972, p. 334), who gives a clearer picture of the relationship to the soft parts.

**WALL AND MURAL PORES**

The wall in the tabulatan corallite is a peripheral stereozone which may be narrow, moderately wide, or wide, and is normally sheathed externally by epitheca. Owing to diagenesis, its original constitution is commonly obscured. It is composite, being composed at least in part of the bases of septal elements, the fibers of which, or the axes or midplanes of which, in some well-preserved material, may be traced to their junctions with the epitheca (Fig. 291,1d); in some genera the septal elements may be so dilated that their bases are contiguous laterally and alone form the wall (Fig. 291,1b,c); in others there appear to be narrow interseptal segments that connect neighboring septal elements and may perhaps be interpreted as independent wall (Fig. 291,1e); in yet others, the bases of septal spines appear not to reach the epitheca but to be separated from it perhaps by an independent wall (Fig. 291,1a); possibly this last appearance is secondary and due to diagenesis.

In some Chaetetida the common wall between neighboring corallites consists of a single series of laterally conjunct longitudinal trabeculae composed of clinogonally radial fibers (Fig. 292,1a-d); in such walls no epitheca, indeed, no suture is visible. However, in other Chaetetida a suture is plainly to be seen (Fig. 292,2a,b). In Trabeclites Flower, 1961, parts of the common wall in some corallites also appear to consist of a single series of longitudinal monacanth; in other parts a median suture is visible, with low septal ridges alternating in position in contiguous corallites. It is possible that longitudinal trabeculae form segments of common wall in some Theciidae.
Spongy (cribriform) walls are found in some Favositina (Fig. 292,3a,b) and regularly arranged mural pores or pore tunnels in others.

The tabularia of neighboring corallites in cerioid coralla may be connected by perforations in the common walls. Such mural pores are commonly round or oval (Fig. 293,6) seen from inside the corallite, but in some (Palaeacis, Fig. 293,5) may be irregular. They are also commonly arranged in longitudinal rows, one to five in a corallite face, those of neighboring rows being opposite or alternate; they may be spatially related to the centers of the faces, or to the edges at the angles between faces. In Paleofavosites they alternate in position from one side of an angle to the other (Fig. 293,la-c) and the edge appears wavy. Pores may or may not have a raised rim or collar (Fig. 293,4) and in some, squamulae (see septal elements) may project from the upper or the lower rim. Many are closed by a filmy longitudinal pore-plate, which may lie in the midplane of the wall or may have its edges on the rim of the pore (Fig. 293,3). SCHOUPPÉ and OEKENTORP (1974, p. 161) consider the diameter of the pores to be constant within a species, measured at the median suture; and (1974, p. 81) that pores were formed at the upper edge of the walls, remaining stationary while the walls grow up and around them, and that they were subsequently sealed by pore-plates. When the wall widens to a thick peripheral stereozone, the pore is lengthened into a mural tunnel (canal). In some, these tunnels are excavated farther by parasites or commensals. In Vaughania Garwood, a peripheral canal (Fig. 293, 2a,b) is reported to encircle the wall just below the calice.

The connecting tubuli of Syringoporicae may be analogous to the mural pores of Favositida. SCHOUPPÉ and OEKENTORP (1974, p. 87) interpret the pores of Favositida as due to upward growth of the wall around short soft-body connecting tubules.
that temporarily connected two neighboring gastrovascular cavities for the transmission of nutrients and stimuli. They suggest that the tubules formed by the fusion of short protrusions from the column walls and subsequent resorption.

**SEPTAL ELEMENTS**

The septal elements of a corallite are radially and longitudinally arranged in the outer parts of the tabularium; they are commonly short (extending but little toward the axis from the periphery), and, being equal, are presumably of one order; nevertheless, in some Theciidae, some Agetolitidae, and some Cyrtophyllidae they may alternate in length, longer and shorter. In many they are 12 in number, and, indeed, 12 is characteristic of Heliolitina and Halysitina; in other suborders the number is commonly variable. Studies are still required to establish whether there is an order of insertion, or whether the symmetry of the Tabulata is radiobilateral rather than radial. Interseptal loculi of different outline and size, like the fossulae due to pinnate septal insertion in Rugosa, are not noted in Tabulata, in which it is commonly assumed that there is no regularity in septal insertion.

The commonest septal element in Tabulata, and, indeed, the type considered characteristic of the order, is the more or less regular longitudinal row of **septal spines**, each of which is assumed in this Treatise originally to have been a monacanthine trabecula. The base of the spine is within the peripheral stereozone and commonly originates against the epitheca, doubtfully against the inner surface of a thin segment of independent wall as suggested by Hamada (1973; Fig. 294, 1) for Halysitidae. The spines are directed adaxially and typically upward, but in some forms horizontally or, rarely, downward (Fig. 294, 2).

In some genera the bases of the spines of a longitudinal row are connected by a low septal ridge (Fig. 294, 1) forming a **septal comb**.

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Fig. 295. Tabulate coral morphology; septal elements.—1. Trabeculate septa; *Coecoseris ungerii* EICHWALD, U.Ord., Est.; 1a, part of distal surface, 1b, transv. sec., 1c, long. sec., all X10 (Hill & Stumm, 1956).—2. Monacanthine trabeculae contiguous to form septum; *Lyopora favosa* McCoy, Ord., Girvan., Scot.; 2a, long., 2b, transv. secs., both X7 (Hill, n; photographs courtesy J. S. Jell).—3. Secondarily altered monacanthate septa of *Thecia* sp.; 3a,b, *Thecia expatiata* (LONSDALE), M.Sil., Eng., 3a, long., 3b, transv. secs., both X7 (Hill, n; photographs courtesy J. S. Jell); 3c, *T. swinderniana* (GOLDFUSS), erratic from Sil., Neth., center of corallite showing effects of diagenesis, X67 (Hill, n; photograph courtesy K. Oekentorp).

Less common in Tabulata is the **septum**, composed of monacanthine trabeculae conjunct except at their axial ends, which give dentate distal and axial edges to the septum; the trabeculae are generally in single series, the axis of each in the midplane of the septum, but in some (Fig. 295,1a-c) the axes may diverge from the midplane.
The fibers of these trabeculae, when retained, are clinogonal at least near the axis, but may curve to become orthogonal at the periphery. Such trabeculae are commonly nearly longitudinal at their bases, but curve adaxially distally. This type of septum is well developed in the Theciidae, the Coccoseridicae, and the Parastriatoporidae. In the first two it is commonly altered by diagenesis to a characteristically mottled secondary texture (Fig. 295,2,3).

Squamulae are tongue-shaped or spoonlike projections from the wall of many late Silurian and early Devonian Favositida (Fig. 296,1,2). They have wide and, in some, thickened bases, and may have curved upper surfaces such that transverse sections of the corallite may show two subparallel lines representing the cut downturned or upturned sides; they are commonly associated with mural pores, when they are developed either as shelf- or eaves- or hoodlike extensions from the upper rim of the pore, or as scooplike extensions from the lower rim; or they may be independent of pores. They are mostly developed in longitudinal rows, and in contiguous corallites are mostly base to base; generally they are directed

Fig. 296. Tabulate coral morphology; septal elements.—1. Squamulae; Squameojavonites; 1a,b, S. squamuliferus (Etheridge), forma bryani (Jones), transv., long. secs., diagram., X20 (Philip, 1960).
—2. Squamulae; Emmonsia emmonsii (Rominger), M.Dev.; 2a, Ohio, transv. sec., X50; 2b, N.Y., long. sec., X25; 2c, Ohio, transv. sec., X25 (Swann, 1947).
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Fig. 297. Tabulate coral morphology; axial structures (Hill & Stumm, 1956).—1. Trabeculae based on tabulae; Billingsaria parva (Billings), M.Ord., N.Am.; 1a, transv., 1b, long. secs., both ×4.—2. Upturned ends of long septal trabeculae; Heliolites barrandei Penecke, U.Sil.-L.Dev., Eu.; 2a, transv., 2b, long. secs., both ×12.

horizontally toward the axis of the corallite, but may be inclined upward.

AXIAL STRUCTURES

Axial structures are exceptional in Tabulata and, where formed, consist merely either of vertical separate trabeculae or spines based on tabulae (Fig. 297,1) or of the upturned axial ends of very long septal trabeculae (Fig. 297,2).

TABULAE, TABELLAE, AND DISSEPIMENTS

Of the horizontal skeletal elements, tabulae extend completely across the corallite and are attached by their edges to the inner surface of the wall. In Tabulata, the entire lumen of the corallite, thus, is the tabularium. Tabulae may be flat, or uparched (convex), or sagging (concave), or they may have shallow peripheral depressions, none of which can be identified as a fossular depression such as may be found in rugosan tabulae. Tabellae are smaller, convex plates, which do not extend completely across the tabularium but whose edges may lie either on the wall or on one another or on tabulae; in some they may be developed only or mainly at the periphery of the tabularium, when they are steeply inclined (Fig. 298,1). Dissepiments are the small plates that are developed as part of the coenenchyme and outside the tabularium; some are similar in size and convexity to tabellae, others are scarcely curved, or horizontal, or inclined.

In the Tabulata the transverse skeletal elements are commonly very thin; when thickened, they show growth lamellae and fibers at right angles to these in the least altered material (see Fig. 304,1). In Favosipora clausa (Lindström) the tabula forming the floor of a calice shows concentric lineation and a central convexity (Stanska, 1967, p. 101); this can be interpreted as indicating centripetal growth like that described for the “primary layer” of the scleractinian dissepiment by Wells (1969, p. 20) and Sorauf (1970, p. 12). The undersurfaces of tabulae in Favositex favosus (Goldfuss) show this centripetal lineation, but their upper surfaces are smooth (Sorauf, 1974, p. 553).

COENENCHYME

Coenenchyme (coenosclerenchyme, cf. coenosarc, the common soft tissue) is the common skeletal tissue between neighboring tabularia in Tabulata, in which there is no line of demarcation between what is proper to one corallite and what is proper to any others. It is characteristic of the Heliolitina and of many Halysitina and is also found in some Sarcinulida and some Syringoporicae.

In the Heliolitina the coenenchyme may be dissepimentate, with trabeculae that may be separate and discontinuous (Fig. 299, 1a-c), or united laterally to form continuous or discontinuous walls of longitudinal tubuli (Fig. 297,2). In the Halysitina it is similar but is confined to the lateral junctions of the corallites in a chain, or to junctions of chains, and it is absent in some (Fig. 289,4e).

In the Sarcinulida (Fig. 299,2a,b) and
some Syringoporicae (Fig. 287,1,2) it may comprise horizontal connecting platforms with which may be associated connecting tubuli or canals.

Spatially the tabulatan coenenchyme is like the dissepsimentaria of plocoid Rugosa (those massive Rugosa in which the common epithecate wall between neighboring corallites is not developed); dissepsimentaria in the Rugosa also surround tabularia, but are developed only when minor septa are present either as plates or septal crests. However, no minor septa are known in Tabulata, so homology cannot be claimed. One may, nevertheless, speculate that both the coenenchyme of Tabulata and the dissepsimentaria of plocoid Rugosa were formed beneath coenosarc such as is present in plocoid Scleractinia, placing the gastrovascular cavities of neighboring polyps in communication.

**MICROSTRUCTURE**

**PRIMARY MICROSTRUCTURE**

In this Treatise it is assumed, on the basis of comparative studies by optical and electron microscopes of scleractinian, rugosan, and tabulatan skeletons, that if interseptal segments of wall exist beneath the epitheca, they are constructed like those parts of the dissepsiments of Scleractinia above the basal layer ('dark line') of the dissepsiment. That is, it is assumed that when first formed they consisted of successive growth lamellae of crystallites of CaCO₃ deposited by composite, planar (one-sided), spherulitic crystallization from a gel secreted by the unfolded basal ectoderm of the polyp. The crystallites as seen in Scleractinia by means of the scanning electron microscope are oriented perpendicular to the secreting ectodermal surface and are grouped in *microtufts*, in each of which they converge proximally, the proximal points of all the microtufts at the base of the tabula being closely spaced (Fig. 300,1). Crystallization is approximately equal at all these points (Bryan & Hill, 1941; Kato, 1963, 1968b; Sorauf, 1970, 1971; Oekentorp, 1972; Jell & Hill, 1974; Schouppé & Oekentorp, 1974; Hill, herein, section on biocrystallization). Through the optical microscope, groups of microtufts, continuing in the same average direction from one growth lamella to another, appear as single *fibers*, the fibers being grouped in tufts or fascicles (sclerodermites) (Fig. 301,1,2). Growth lamellae crossing these fibers may be indi-
Cated by slight tonal changes or by slight breaks in the continuity of fibers at the upper and lower surfaces of the lamellae.

Similarly, it is assumed that those components of the wall that are septal spines (trabeculae, as in most Favositina, Halysitina, Heliolitina, Auloporicae, and Syringoporicae), septal combs (in which the trabeculae of a single longitudinal row are united at their peripheral bases, as in Sarcinulida and some Heliolitina), and septa (in which the trabeculae are contiguous throughout their length as in some Theciidae and in Parastratioporidae) are built of similar successive growth lamellae, but differ in that the composite spherulitic crystallization is localized and very active at a series of points radially arranged with respect to the axis of the corallite (and located in invaginations in basal ectoderm). The apparent centers of radial growth of crystallites move progressively upward on axes aligned from their original positions. A trabecula (spine) represents the accumulated deposition from such a point of calcification (Fig. 302,1). Within each trabecula the crystallites are directed perpendicularly to the surface of the growth lamellae that pass through the trabecula, and presumably, therefore, to the outer surface of the ectoderm in the invagination. The growth lamellae of a septum may thin laterally and become continuous with those of a tabula.

In assuming that the septal spines of Tabulata are fine trabeculae, each originally with an axis of calcification, this Treatise differs from SCHOUPPE and OEKENTORP (1974, p. 167), who, having found no trace of such axes of calcification in their thin sections, consider that the fibers in a spine are based not at the axis of the spine but at its base. I also have no convincing evidence of the presence of axes of crystallization in fine spines such as those of Favosites, Halysites, or Syringopora. In the coarse spines of the sarcinulidans Lyopora and Thecia, axes of calcification do appear to be present (Fig. 295,2,3), as also in the heliolitan Coccoseris ungermi EICHWALD (Fig. 295,1). The similarity in appearance between the holacanths immersed in secondarily lamellar sclerenchyme in the walls of the favositidan Pleurodictyum, many Syringoporicae, and Halysitina, and the holacanths of trabecular origin in the rugosan Tryplasmatidae, is considered presumptive evidence that finer spines also had axes of calcification. The presence of holacanths in the wall tissue of some parts of some corallites in the favositidan Parastratopora and the absence of all traces of them in other parts indicates suppression during diageneis.

Squamulae in some instances show traces of a median 'dark' plane or ?axis (Fig. 296, 2a-c). SCHOUPPE and OEKENTORP (1974, p. 169) consider them to be simply prolongations of fibers based on the inner surface of the epithelial layer of the wall. Perhaps, however, they are of trabecular origin like the peripheral crossbar plates of the contemporary rugosan Digonophyllidae.

Only rarely is it found that fibers and growth lamellae of tabulatan walls are distinguishable with the optical microscope.
FIG. 300. Tabulate coral morphology; ultramicrostructure of recent Scleractinia (Hill, n; SEM photographs courtesy J. S. Jell).—1. Dissepiment; *Favites virens* (DANA), Holo., Great Barrier Reef; 1*a,b*, microtufts seen in etched long. sec. and based on centripetally grown primary (basal) layer, ×160, ×630; 1*c*, undersurface of basal layer of crystallites grown centripetally, ×200.

Mostly, diagenetic processes have obscured them. *Dubatolov* (1971, p. 30, text-fig. 16) has given interpretative diagrams of microstruc-
FIG. 301. Tabulate coral morphology; microstructure of scleractinian dissepiment (Sorauf, 1970). —1. Cladocora caespitosa (Linne), Hol., shore­line, Rovinj, Istrea, Yugo.; 1a,b, underside of dis­sepiment between two septa, showing growth lines, X68, X 136.—2. Manicina areolata (Linne), Hol., Fla., SE. of Big Pine Key; junction of dis­sepiment with wall, X200.

tural types seen in the tabulatan wall through the optical microscope, and of these, the following, reproduced herein as Figure 303, appear to retain at least traces of primary structure: Figure 303,1, radially fibrous with traces of growth lamellae; Figure 303,2, radially fibrous with distinct growth lamellae; Figure 303,3,4, radially fibrous and cryptoradially fibrous without trace of growth lamellae, Figure 303,2-4 being orthogonally fibrous to the epitheca; and Figure 303,5, clinogonally fibrous with faint traces of growth lamellae. Dubatolov termed all these “fribalnyy tip” (fibrous type). If, as this Treatise assumes, axes of calcification were originally present in the septal spines, they have been obscured during diagenesis. Figure 303,6 shows a wall composed of clinogonally fibrous septal trabeculae (monacanths) as in Echyi­pora, which wall, however, Dubatolov called paratrabeculate, following Tong­dzuy (1966a, p. 24).

Seen through the optical microscope, tabulatan tabulae seldom show any distinction between a basal layer and an overlying succession of growth lamellae, unless the plates are thicker than average and well preserved, when the lamellae are seen to consist of fibers arranged perpendicular to the curvature of the plate, like those of Scleractinia (Fig. 300,1a-c). It is assumed in this Treatise that the growth lamellae were deposited by planar, composite, spherulitic crystallization from a gel secreted by unfolded parts of the basal ectoderm of the polyp. They are affected by diagenesis in the same way as the growth lamellae of walls or septa, and develop similar secondary microfabrics, including secondary lamellar structure.

SECONDARY MICROSTRUCTURE

In the Scleractinia the original crystallites are of aragonite, with their c-axes parallel to their length, and are topped by pyramidal faces. The mineral now present in tabulatan skeletons is calcite, with the c-axis, where it has been reported, parallel to the length of the fibers. It is not known whether the original mineral in the tabulatan skeleton was aragonite; it seems possible, as Oeken­torp (1972) has indicated, that it was, and that it has subsequently been transformed to calcite, in a few cases with retention of the fine morphological architecture, but in nearly all with greater or lesser changes to secondary structures.

The microtextures of skeletons of Tabu­lata seem to have been particularly suscep­tible to alteration during diagenesis; it is
Fig. 302. Tabulate coral morphology; ultramicrostructure of recent Scleractinia (Hill, n; SEM photographs courtesy J. S. Jell).—J. Growth lamellae falling from growing points and axes of trabeculae in septum; 

_Verginia scutaria_ LAMARCK, Holo., Great Barrier Reef; med. long. secs., 1a, ×13; 1b, ×47; 1c, ×121; 1d-g, SEM showing microtufts of crystallites of aragonite, 1d, ×400; 1e, ×500; 1f, ×1,470; 1g, ×4,350.
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Even hard to find specimens that are only slightly altered. Discussion of secondary structures may be found in Kato (1968b) and Ökentorp (1972, 1974b), following earlier work on such structures in Rugosa by Hill and Butler (1936) and particularly by Kato (1963).

Among the processes which may cause alteration or suppression of the original so that secondary microstructures are developed are:

1) Replacement of the skeletal mineral by dolomite or by noncarbonate mineral. In Pachyfavosites polymorphus (Goldfuss) in the Eifelian of the Eifel, replacement by dolomite first affects the median sutural region of the wall, and may then encroach along radial fibers into the rest of the wall (Fig. 304,3a-d). Replacement by silica or other noncarbonate mineral commonly destroys the original microstructure.

2) Recrystallization of the original mineral. If it be assumed that the original mineral was aragonite as in Scleractinia, recrystallization may be an inversion to calcite; a fine granular mosaic may first be formed, through which in some places original microstructural features (boundaries between plates, between fibers, or between growth lamellae) may still be retained; where few such traces are retained, the microstructure may be described as cryptofibrous or cryptolamellar; further recrystallization may result in a coarse calcite mosaic in which all traces of the original microstructure are lost.

If it be assumed that the original mineral was calcite, the recrystallization is from the original fibrolamellar fabric to a fine, and later a coarse, granular calcite mosaic.

Diagenesis of skeletal carbonates is far from being fully understood. For a summary of published work see Folk (1965) and Land (1967).

3) Deformation due to pressure. This may occur during mechanical stress, such as diastrophism; the plates of the skeleton may be grossly deformed, and cleavage lamellae may be developed in the wall fabric. Small, crudely rhombic cleavage or fibrous.

Fig. 303. Tabulate coral morphology; wall with traces of primary structures; a, transv. secs., b, long. secs. (diagram, Dubatolov, 1971).—1. Radially fibrous with traces of growth lamellae.—2. Radially fibrous with marked growth lamellae.—3. Radially fibrous without trace of growth lamellae.—4. Cryptoradially fibrous without trace of growth lamellae.—5. Pinnately (clinogonally)
Tabulate coral morphology; secondary wall structures.—1. Secondary lamellar structure, tabulae thickened, showing 'dark' basal layer and light thickening tissue; *Syringopora* sp., U.Dev., W. Australia; X7 (Hill, n).—2. Zigzag (secondarily lamellar) structure; *Syringopora* sp., U.Dev.-M.Dev., Spain; X80 (Oekentorp, 1972).—3. *Pachyfavosites polymorphus* (Goldfuss), M.Dev., Ger.; 3a, showing the recrystallized median sutural region, light-colored in transmitted light, X27; 3b-d, the same affected by dolomitization, 3c,d, show grain enlargement though original fibrolamellar structure is more or less retained, all X80 (Oekentorp, 1972).

Shearing cracks may develop in a corallite wall during preparation of a thin section.

Also, during diagenesis, pressure due to volume change, for instance during inversion from aragonite to calcite, may occur. Oekentorp (1972, p. 55-62; 1974c, p. 321) has suggested such diagenetic pressures as causes of secondarily lamellar structure found in the walls of many *Syringoporicae*, *Auloporicae*, *Halysitina* and *Pleurodictyum*,
in which the septal spines or their axial parts appear as clear calcite thorns (holacanths) surrounded by lamellae that are commonly at an angle to the original growth lamellae (Fig. 304.1). It was this type of secondary structure that Hill (1936, pl. 29, fig. 39) confused with original growth lamellation and called lamellar sclerenchyme. It is better described as secondary lamellation. Oekentorp (1972, p. 55) calls it pseudolamellar, but this term also is ambiguous, for the structure is still lamellar, even if it is secondarily so. Oekentorp offers a similar explanation for zigzag structure, seen, for instance, in the wall of some Syringopora (Fig. 304.2).

The term microlamellar has been applied by Lafuste (1962, p. 105) to the microstructure of the wall in Favositites gothlandicus (Lamarck). This is commonly a fine granular calcite mosaic in which an imperfect concentric platy structure is developed (Fig. 305.5) parallel to the median suture line. This was called “volonistyy” by Chudinova (1959, p. 31) and pseudolamellar by Oekentorp (1972, p. 65). Lafuste considered it primary, but I agree with Oekentorp that it is secondary.

Of Dubatolov’s (1971, p. 30, text-fig. 16) interpretative diagrams of microstructural types seen in Tabulata, the following are herein considered secondary: secondary lamellar structure as in Syringoporaic, Auloporicae, and some Halytisitina (Fig. 305.1); secondary concentric structure, fine in Favositites (Fig. 305.2,5), coarser in Pachypora (Fig. 305.3,6); secondary plicate lamellation as in Plicatomurus (Fig. 305.4). Dubatolov termed all these “lamellyatnyy (plastinchatyy) tip” [lamellar (platy) type].

The normally thin tabulae may be augmented during diagenesis by secondary...
growth, from both upper and lower surfaces, of very fine needles whose distal ends project unequally into the lumen and do not form a level surface like a natural skeletal surface; nor do they show the characteristic yellowish tone of the biofibers; coarser secondary crystals are usually easy to distinguish from the coral fibers. These secondary deposits, like the growth lamellae, are subject to recrystallization to a fine or coarse granular mosaic.

Secondary structures of coral skeletal tissue (sclerenchyme) are variable in the degree to which they replace the original structure in different parts of one corallite, the one corallum, in the one species and the one genus, and in one stratum formed at one time. Nevertheless, our present knowledge suggests that certain genera are predisposed to particular types of secondary structure; this could perhaps be due to some specific character of their original sclerenchyme, such as the spacing of the crystallites, or the molecules of trace elements that they contain, or perhaps to the amount and kind of organic material trapped between the crystallites. Much research is required for a full understanding.

SPECULATIONS ON THE ORIGIN OF TABULAE

In a perceptive review, WELLS (1969, p. 22) discussed the origin of the dense basal layer ('dark line') of dissepiments in Zoantharia, and concluded that it grew centripetally from the margins (either wall or septa or both). As MANTON (1932, p. 165) described it, "A tabula [in the recent scleractinian Pocillopora bulbosa] arises as a thin ring of smooth calcite [sic] about 0.1 mm or less in thickness, projecting directly inwards from the walls of the calyx. Further growth enlarges the flat projection and reduces the central pore leading to the basal part of the calyx. Finally the pore is closed and a horizontal tabula is completed (Pl. 1, fig. 2)." As WELLS observed, after closure is complete, subsequent thickening in most cases obscures the centripetal increments. In this centripetally deposited basal layer (to which, maybe, the normally tenuous tabulae of the Tabulata correspond) the crystallites are deposited with their long axes rudely arranged in the plane of the 300,1e). In any subsequent growth-layering that thickens this sheet, the fibers (groups of microtufts as seen under the electron microscope) are perpendicular to the upper surfaces of the growth lamellae (Fig. 300, 1a,b). SORAUF (1974, p. 553) thought that the concentric lines on the undersurface of the tabulae of Silurian Favosites are daily growth lines and that they might be due to the presence of symbiotic algae (zooxanthellae) in the polypal flesh, with a resultant diurnal differentiation of crystallite growth (rapid and luxuriant during sunlight hours, slower and more orderly during hours of darkness).

In WELLS' view, the spaces beneath tabulae or dissepiments are produced by hydraulic lifting of the secreting surface as a result of the accumulation of fluid, or possibly of gas, which increases pressure in the potential space between a dissepiment and the skeletotrophic tissues ("WEDEKIND'S theory"). The shape of the upper surface of the void is then outlined by centripetally growing corallites, and on this thin sheet (basal dark line) the lighter longitudinally radiating crystallites are deposited. This explanation is perhaps to be preferred to one supposing discontinuous tractive uplift of the polyp (due to the more rapid growth of the septa), followed by deposition of a sheet of skeletal material sealing off the voids (HILL, 1936) or to one supposing upward traction effected by polyp "muscles" (CARLGREN, 1949, pl. 3, fig. 9, 10), though WISE (1970) has noted marks on the sides of septa in some Scleractinia, which he identified as locations of attachment of "desmocytes."

A quite different method for the formation of tabulae and dissepiments has recently been advocated for Tabulata with porous walls by WEYER (1972b, p. 715). He argues that the views of von KOCH (1896, p. 261) and MATTHAI (1914, p. 10) are correct; that is, that centripetal growth of a tabula in a ring-fold of soft tissue extending from the column wall, or from the soft tissue lining an interseptal loculus, cuts off a basal part of the gastrovascular cavity of the polyp; the cut-off part then atrophies below the new skeletal plate. In this method, which receives some support from SORAUF's (1970)
scanning electron microscope investigations, transversely advancing calcareous sheet (Fig. uplift of part or the whole of the polyp would not occur. Specially designed investigations on living Scleractinia should solve this problem.

DEVELOPMENT

ONTOGENY

In the ontogeny, or development of an individual, various stages may be recognized: embryonic, neopionic, neanic (adolescent), ephebic (adult), and geronic (old age); and in the exoskeleton of individual Rugosa, for instance, sequential changes in the skeletal morphology have been so named.

Tabulata being compound exoskeletons of many corallites, their ontogeny must be considered in two ways: the ontogeny of the founding corallite (protocorallite) and the ontogeny of the hysterocorallites (offsets). The development of the colony as a whole (astogeny) is then discussed.

Protocorallites are difficult to identify in large compound coralla with small corallites, and there appear to be no records of studies of the protocorallites of Chaetetida, Tetradiiida, Sarcinulida, Pachyporicae, Alveolitina, Halysitina, or Syringoporicae. In those species of Favositina, Heliolitina, and Auloporicae in which the protocorallite has been studied, it is an inverted cone, slender or wide, more or less curved, adherent or not, and commonly with an oblique calice; it is epithecate and shows growth lines and, in some, longitudinal (? septal) furrows. I have found no descriptions of the arrangement of these furrows, and do not know whether they are pinnate, as in Rugosa, or not. In large-celled Micheliniidae, septal granules arranged in radial rows appear early, but apparently not in the tip of the protocorallites (Beecher, 1891a, p. 207; 1891b, p. 215). In Heliolites interstinctus, Lindström (1899, p. 45) noted that septa first appeared on the adherent side of the protocorallite, and that coenenchyme first appeared subsequently, also on the adherent side. In many Auloporicae (Stumm, 1947), the protocorallite is recognizable, but does not appear to have been studied ontogenetically in thin section.

Jull (1965, p. 206) has indicated that in compound Rugosa, overlapping and perhaps skipping of stages occurs in the ontogeny of hysterocorallites; it might be expected that tabulatan offsets would be similarly affected. But, because of their small size, and the shortness and spinose constitution of their septa, it could be very difficult to ascertain any order of septal insertion. However, Schindewolf (1959, p. 309) reported that the offsets of Pleurodictyum problematicum, which are large, showed a pinnate arrangement of the septa, like that in the cardinal quadrants of rugosans; and that Petridictyum petrii, also with large offsets, showed two cycles of septa, longer and shorter, successively inserted. Plusquellec (1965, p. 44) agreed that cycles of septa could be distinguished in Petridictyum, but found no evidence of pinnate insertion in Pleurodictyum; although in some species, which he attributed doubtfully to that genus, two cycles were present in some, if not all, coralla. This line of investigation deserves intensive study, using modern serial sectioning techniques, for the light it could throw on a possible relationship between Tabulata and Rugosa.

Such a study (Jull, 1976b) indicates that two orders of septa are not recognizable during ontogeny of the offsets of Foersteyphyllum halli (Nicholson), nor is any order of septal insertion evident: septa either emerge singly and randomly around the offset, or more commonly in groups in a particular region; however, in F. vacuum (Föerste), which has even larger corallites than F. halli, septa possibly equivalent to the cardinal and alar septa of Rugosa were noted.

ASTOGENY

The development of a colony (astogeny) similarly may be divided into stages of initiation, immaturity, maturity, and possibly old age, and it may be possible to identify morphological changes in the exoskeletons of compound coralla that may reasonably be equated with such stages. Bondarenko (1971a, p. 22) has attempted such an approximation in the Proporicae. She deduced
five stages: 1) the stage of the protocorallite; 2) the stage of formation of protocoenenchyme from the protocorallite, with horizontal growth dominant; 3) the stage of the immature corallum, with intensive production of offsets that are small and without order in arrangement; the skeletal tissue is 'light-colored' and dissepiments are relatively large; 4) the stage of maturity, with offsets regularly arranged and growing longitudinally; there is repeated alternation of growth zones of 'darker' or denser skeletal tissue with zones of light-colored tissue in which dissepiments are smaller and corallites are larger than in the immature stage; 5) the stage of old age, occurring over either the whole or parts of the corallum; the corallites retain their previous diameter, but the vertical skeletal elements are thickened and the dissepiments are flatter. Bondarenko (1975b, p. 26) equated the dark bands with sexual maturity and the emission of planulae, and the light bands and the immature stage with asexual reproduction by budding.

Zonality in Tabulata had previously been discussed, e.g., by Sokolov (1955, p. 42), Dubatolov (1959, p. 278), Tong-Dzuy (1965, p. 44), and Preobrazhenskiy (1967b, p. 3). Each zone commonly extends throughout the corallum; zones of close spacing of tabulae and with thicker or relatively darker vertical skeletal elements alternate with zones of more widely spaced tabulae and thinner, lighter-colored walls and septa. Such zonality is commonly attributed to periodic seasonal variations of climate and is considered to be without taxonomic significance. Preobrazhenskiy concluded that it may be only indirectly due to seasonal change, in being an expression of cyclical rejuvenation, which itself was probably seasonal, the zones of thickened skeletal tissue indicating sexual maturity and those of thinner tissue, rejuvenescence. He interpreted the peripheral zone of thickening in branches (e.g., in Parastriatopora) as indicative of sexual maturity.

lata as annual, and has used the distance between the bases of consecutive ‘dark’ bands to measure annual skeletal growth. On the assumption that rate of skeletal growth decreases with water temperature, that is, with distance from the equator, he has constructed for each period world maps showing continents arranged in positions to fit these equators.

As Oliver (1968, p. 18) has said, astogeny may also be described in terms of form, increase, pattern, and individual morphology, pattern being the spatial or sequential arrangement of corallites in a corallum. Form and mode of increase may be variable in many species and genera, and even within a single corallum; but other species or genera may have a characteristic form or a characteristic mode of increase or both. Pattern appears to be a more stable character than form, since differing forms may result from similar or identical patterns. However, pattern can also vary within species or genera, particularly where mode of increase is variable. Oliver has given a useful diagram (Fig. 306), showing patterns in Paleozoic coralla.

Krasnov and Preobrazhenskii (1972, p. 137) have discussed patterns formed by areal, axial, and consecutive arrangements of centers of increase, the first leading to convex or hemispherical forms, the second to cylindrical and branching forms, and the third to flat, encrusting, reptant, reticulate, or dichotomous or dendroid coralla.

It is clearly important that descriptive work should include an analysis of pattern within the corallum. A start has been made. Thus, Beecher (1891a, p. 207; 1891b, p. 215), Girty (1895, p. 131), and Smyth (1927, p. 426; 1929, p. 130) have studied species of Micheliiniidae, Favositidae, and Vaughaniidae and Palaeacidae, respectively; Oliver (1966, p. 448) investigated the pachyporican Striatopora flexuosa, Shkrova (1971, p. 56) the alveolitinas Scoliopora and Alveolites, Buehler (1955, p. 11), Hamada (1959a, p. 276), and Webby and Semeniuk (1969, p. 355) some Halyssitina, and Beecher (1903, pl. 5) the autoporican Rormeria.

REGENERATION

Tabulatan coralla, like those of Scleractinia and Rugosa, show evidence of regenerative regeneration of soft parts after localized damage, by a return to normal skeletal secretion above the area where the skeleton showed damage or was prevented from forming. Dubatolov (1961, p. 75) has given a discussion of this phenomenon. In many cases the new skeleton is laid down in the same spatial mode that it would have had if no damage had occurred, although its plates may be somewhat thicker than normal; in others there may be, for a short distance, a disturbance in the normal architecture. Soft foreign bodies may be encapsulated, possibly by epitheca, or possibly by horizontal skeletal tissue. Many coralla show levels where skeletal formation was interrupted except for a small area where it proceeded normally; such negative areas were commonly rapidly covered by intensive basal horizontal increase from the undamaged region, whereupon normal longitudinal growth resumed; this is particularly characteristic for Alveolitidae; the areas of growth above or below the interruption may or may not correspond; whether the new skeletal tissue is epithecate below requires investigation. Periodic rejuvenescence has been mentioned in the section on astogeny.

SYMBIOSIS AND PARASITISM

There are many examples of association of tabulate corals with other organisms in which both associates continue their growth and skeletal formation. Stromatoporoid-tabulatan intergrowths are common, especially those involving Syringopora (Mori, 1970, p. 52). Moyerolites Sokolov, 1955, was subsequently shown to be an intergrowth of Favositae with a stromatoporoid (Sokolov & Tesakov, 1963, p. 58); and Trachypora circulipora Kaysor was shown by Lecompte (1939, p. 148) to consist of a pachyporican and a stromatoporoid overgrowth. Hill (1960, p. 54) thought that Trachyspamia Gerth, 1921, may be an intergrowth between Cladochonus and an encrusting organism, possibly stromatoporoid.
Commensalism with a polychaete worm, *Hicetes innexus* Clarke, has been discussed (Schindewolf, 1959, pl. x) for *Pleurodictyum problematicum*, internal molds of which characteristically show the twisted U-shaped mud-filled tube of the worm in their proximal parts.

A common association in Tabulata, particularly in Favositina, is of fine tubes enclosed in the angles of the walls of Favositae. In his useful review of this group, Oekentorp (1969, p. 177; Fig. 307) considered them to have been produced by commensal worms. *Chaetosalpinx* Sokolov, 1948, is straight, cylindrical, predominantly in the angles of the walls, and without distinct walls of its own, but it may have tabulae; *Helicosalpinx* Oekentorp, 1969, is like *Chaetosalpinx* but spiral and is found in the thick walls of *Pachyfavositae* as well as in *Favositae, Alveolites*, and *Thamnopora*. (Stel, 1976, p. 726, found both these
genera in *Thecia.*) *Phragmosalpinx* Sokolov, 1948, is of straight, cylindrical tubes, with thick walls of their own and occasional transverse plates, and is found in *Favosites.* *Asterosalpinx* Sokolov, 1948, with distinct walls, *Antherosalpinx* Sokolov, 1962b, also with distinct walls, and *Actinosalpinx* Sokolov, 1962b, without walls of its own, are all thick tubes of star-shaped section (*Asterosalpinx* 4-rayed, *Antherosalpinx* 4- to 8-rayed, *Actinosalpinx* 3-rayed), found in the angles of the walls of *Favosites.* The 3-rayed (and 4-rayed) forms have occasioned much discussion, still continuing, as to whether they are proper to the coral, symbionts with the coral, or postmortem or diagenetic structures. Thus, Swann (1947, p. 247) called them “intermural coenozone.” Hill (1950, p. 147) thought some of them to be diagenetic and inorganic; Ross (1953, p. 40) called some of them intermural spaces formed in response to adverse environmental conditions. Sokolov (1948, p. 106; 1962b, p. 47) considered them commensals as did Oekentorp (1969). Possibly some of them are diagenetic, others commensal.

Lamellerima Kim, 1965b, was described as a longitudinal midwall slit in the faces of the corallites, and commonly arcuate in transverse section; not rarely it is oriented across and may cut the wall; he considered it commensal to Alveolitina. Better figures are required.

Another commensal, forming walled, empty tubes of somewhat greater diameter than the above, and not confined to the walls of the favositid but winding somewhat irregularly into two or three neighboring corallites, is *Camptosalpinx* Sokolov, 1948.

Oekentorp (1969, p. 201) described threadlike, forking tubes of smaller dimensions than all of the above in the lumina of *Favosites,* and regarded them as traces, probably of boring (etching) algae, which entered the corallites after the death of the polyps.

**EVALUATION**

**ORIGIN**

The Order Tabulata had its beginnings in possible Precambrian and Cambrian ancestors. Speculation on the origin of the order is still very insecurely based. Composite molds (and casts in part), attributable to four classes of Cnidaria have been described mainly from the Ediacaran of South Australia and considered late Precambrian by Glaessner (but see Cloud, 1968, p. 37; Sokolov, 1972, p. 123). Glaessner (1971, p. 13) has suggested that the Hydrozoa Siphonophora, Hydrozoa Chondrophora, and the Conulata Conulariida all evolved from athecate Hydrozoa, and that Conulariida (Conchopeltidae) gave rise to Scyphozoza in pre-Ediacaran times. He considered that Anthozoa and athecate Hydrozoa had an earlier, common ancestry (Fig. 308). Glaessner and Wade (1966, p. 613) considered the Ediacaran Rangea, Pteridiunum, and Charnia to be Anthozoa Octocorallia; but Pflug (1972, p. 56) suggested that they should be placed in his new phylum Petalonamae Pflug, 1970, and Glaessner in Part A of this *Treatise* treats them as problematical Coelenterata. Thus, no acceptable Precambrian Anthozoa are known at present.

Korde (1963, p. 20; 1971, p. 45) has included some Lower and Middle Cambrian central Asiatic conical and cylindrical fossils with characters suggestive of both scyphozoans and Rugosa in a new cnidarian class Hydroconozoa. These fossils are interpreted as exoskeletons; they range from less than 1.0 cm. to 1.5 cm. in height. *Hydroconus* Korde from the Lower Cambrian of Tuva resembles Rugosa in having septalike structures interrupted by a fossulalike space but has canals in the central part that are thought comparable with the radial canals of the gastrovascular system in Scyphomedusae. Handfield (1969, p. 782) has suggested that his new genus *Tabulaconus,* which comprises small, solitary, broadly conical to cylindrical skeletons of CaCO₃, with a slender, layered wall and crossed by thin, generally complete, but in places incomplete tabulae, belongs to the family Gastroconidae Korde (which lacks axial canals, but which Korde included in the Hydroconozoa). Handfield has doubtfully referred this family and genus to the Antho-
Tabulata-Evolution

Tabulatus Zoantharia. *Tabulacus* differs from solitary Rugosa in being aseptate and from aseptate Tabulata in not being colonial. Its relationship to the Tabulata must remain speculative (Fig. 309).

Jell and Jell (1976, p. 194) have named a new Family Lipoporidae for some lower Middle Cambrian problematica from New South Wales and have doubtfully referred them to the Tabulata. They also referred to this family *Coelenteratella* Korde, 1959, from the lower Middle Cambrian Amgian Stage of the southeast Siberian Platform. *Lipora* Jell and Jell, 1976, is irregularly fasciculate, the individual skeletons being scolecoid, without tabulae or dissepiments, but with repeated rejuvenescence; its calices have 8 or 16 thin, continuous, short to moderately long septal ridges, which do not appear to have spinose distal edges.

Four Cambrian genera with ?calcareous compound skeletons consisting of contiguous, prismatic, very slender tubuli have been described. *Bija* Vologdin (1932, p. 17) from the ?Lower Cambrian of River Lebed in the Altay of central Asia is said to be of aseptate and atabulate tubuli, with doubtfully porous walls, and 0.06 mm. in diameter. *Cambrotrypa* Fritz and Howell (1959, p. 89) from the Middle Cambrian (*Alvertella* Zone) of Montana is described as cerioid, or in part closely fasciculate, of aseptate and atabulate tubuli with relatively thick walls and of 1.0 mm. in diameter. *Cambrophyllum* Fritz and Howell (1955, p. 181) from the Upper Cambrian (*Dresbachian*) of Montana has atabulate thick-walled tubuli elongate in transverse section, with discontinuities in the walls, laminar adaxial extensions from which are interpreted as evidence of adaxial bipartite increase. *Archaeotrypa* Fritz (1947, p. 434), from the Upper Cambrian Dresbachian of the Ram Range of the Rocky Mountains, Alberta, is doubtfully regarded as a cyclostomatous bryozoan, with some walls zigzag in longitudinal section, and is probably not anthozoan. As Sokolov (1962c, p. 208) suggested, the morphology of the first three is like that which might be expected of an ancestor to the Lichenariidae, and indeed to other Tabulata.

*Protoaulopora* Sokolov (1952b, p. 145) from the ?Upper Cambrian of Kazakhstan is of diversely oriented slender tubuli (0.1 mm. in diameter), apparently aseptate and atabulate, with up to three offsets arising simultaneously from the one tube. In spite of their small diameter, Sokolov considered these forms probably ancestral to the Auloporicae.

**AFFINITIES WITH RUGOSA**

Flower (1961, p. 31), in considering possible relationship between Rugosa and Tabulata, included microstructure in the morphological features on which he built his scheme. He considered that the simplest walls and septa are composed of parallel fibers formed normal to the secreting surface, and that development of fibers into trabeculae is a derived condition. A somewhat similar view was expressed by Smirnova (1971, p. 79). Flower held that the primitive corals possessed a radiosibrofibrous wall, and that septa first developed as processes on the inside of the wall; as septa developed in length and prominence, septal trabeculae developed. Thus the rugosan *Palaeophyllum* could have developed from *Lichenaria via Saffordophyllum and Foersteophyllum*, and he also speculated that Strepm...
ultrastructural studies on little altered Early or early Middle Ordovician corals have been supplied, further speculation is supererogatory.

Sokolov (1962c, p. 212; Fig. 311) expressed the view that ancient affinities exist between his anthozoan subclasses Rugosa, Tabulata (including Tetradiina, but excluding Chaetetina), and Heliolitida, and had no doubt that these major branches of Paleozoic corals diverged sharply from one another as far back as the early Paleozoic.

ORIGIN OF THE ORDERS (LOWER AND MIDDLE ORDOVICIAN)

Cryptolithennaria Sokolov (1955, p. 234) is considered by Sokolov and Tesakov (1963, p. 90) to be characteristic of the Chunya Stage at the top of the Lower Ordovician of the Siberian Platform; it is cerioid, of irregularly prismatic corallites with amalgamated common walls like many Chaetetida, and like them has adaxial bipartite increase, which is, however, peripheral and unequal; the tubuli are aspinulate and from 0.3 to 0.5 mm. in diameter. Sokolov at first placed this genus in the Lichenariidae, but later transferred it to a new family Cryptolichenariidae, which he considered to be the oldest Tetradiida. In this Treatise it is regarded as the oldest genus of the Chaetetida. It could also reasonably be considered to be ancestral to the Tetradiida.

In the Lower Ordovician of North America (Canadian “Beekmantown” of the Appalachian Valley and the Pogonip of Nevada and Texas) are species identified as Lichenaria by Bassler (1950, p. 260) and as Lichenaria and Eofletcheria by Duncan (1956, p. 216).

By the end of the Middle Ordovician the subclass Rugosa and all orders of the Tabulata had entered. It is necessary to indicate where the boundary between Middle and Upper Ordovician is drawn in this review, because the interbasinal and intercontinental correlation of the Ordovician graptolite and shelly faunas is still fluid (Williams et al., 1972, p. 9). In the United Kingdom it is drawn at the base of the Dicranograptus clingani Zone and the base of the Longvillian; in the Baltic States, at the base of the Rakvere (E). In the USSR, Nikitin’s
(1971) correlations are used; thus, in Kazakhstan it is drawn at the base of the Anderken horizon; in the Altay, at the base of the Toginian; on the Siberian Platform, at the base of the Dolborian Stage; in northeast USSR at the base of the Kulon and Nalchan suites. In China the boundary is drawn at the base of the Yenwashan and Pagoda limestones; in North America, at the base of the Cincinnatian (base of Eden); and in Australia, at the base of the *Diceranograptus hians* Zone and the Clearview Limestone Member of the Bowan Park Limestone.

Thus, if *Cryptolichenaria* be accepted in the Chaetetida as herein advocated, Chaetetida were already present in the Lower Ordovician. *Chaetetipora* (or *Chaetetella*) is present in the Upper Ordovician Red River Formation of south Manitoba and the Richmondian of Arctic Canada. *Tetradiida* are present in force and cosmopolitan in the Middle Ordovician. *Sarcinulida* appeared in the Middle Ordovician in all present continents. *Billingsaria*, *Nyctopora*, and *Lyopora* at present seem to have entered in that order. *Favositida* were already represented by *Saffordophyllum* in the Chazyan of North America and by *Paleofavosites* at the very top of the Middle Ordovician of the western slope of the Urals (Sokolov, 1951a, p. 38). Of the *Auloporida*, records of "*Aulopora* spp." exist for the Middle Ordovician of New South Wales (Webby & Semeniuk, 1971, p. 247), but descriptions and figures are required.
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<tr>
<td></td>
<td>Ashgillian</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Upper Caradocian</td>
<td>27</td>
</tr>
<tr>
<td>Ordovician</td>
<td>Llandeillian</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Llandvimian</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Arenigian</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Tremadocian</td>
<td>31</td>
</tr>
<tr>
<td>Cambrian</td>
<td>Cm</td>
<td>32</td>
</tr>
</tbody>
</table>

Fig. 311. Evolution: affinities with Rugosa. Phylogenetic scheme of orders and families of Tabulata and Rugosa, by Sokolov (Sokolov, 1962c). *, Stratigraphic scheme of Permian deposits of Timor Island. **, Stratigraphic scheme of Ordovician deposits of North America: R, Richmond; T, Trenton; BR, Black River; Ch, Chazyian; C, Canadian series. Key to numbered branches. Tabulata, 1-30. Order Favositida, 1-11; Suborder Favositina, 1-6; 1, Theciidae, 2, Favositidae, 3, Syringolithidae, 4, Micheliniiidae, 5, Cleistoporoidae, 6, Palaeacidae; Suborder Thamnoporina, 7-9; 7, Pachyporidae, 8, Trachyporidae, 9, Trachypasam-
Syringoporicae are represented by Labyrinthisites in the Middle Ordovician of North America. Praesyringopora Ivanov in Ivanov and Myagkova (1950, p. 16; 1955, p. 28), previously considered Middle Ordovician, is now (F. E. Yanet, written commun. July, 1974) believed to come from post-Ludlovian deposits and may be Syringopora. Heliolitina are represented in the Middle Ordovician Cliefden Caves Limestone of New South Wales by Cocosseris, Heliolites, Propora, and Plasnoporella (Hill, 1957a, p. 101). Halysotheria are represented in the Middle Ordovician of North America by Quepota; Halysotheria first occurs in the Bown Park Limestone of New South Wales in beds correlated with the Didymograptus hians Zone (Webby & Semenik, 1969, p. 357), considered Upper Ordovician herein.

Sokolov (1962c, p. 212; 1971, p. 9) has given considerable thought to the possible interrelations of the major subdivisions of Tabulata. His phylogenetic schemes are chronologically derived and his diagrams show ranges and relative abundance as well as assumed relationships. He placed phylogenetic importance on the development of mural pores and connecting tubuli, considering corallia with such devices to be more advanced than those without such communication. He also placed stress on the development of peripheral stereozones in corallites. He deduced two stems for the Tabulata (without Heliolitina and Chaetida). One was cerioid and imperforate, typified by Lichenaria and the Lichenariidae; the other was fasciculate and incomunicate, typified by Protoaulopora and

**Fig. 312.** Evolution: origin of the orders. Phylogeny of Tabulata (after Bondarenko, 1966b). Key. 1,2. Fruticose type of polypary; 1, without connective structures; 2, with connective structures. 3,4. Massive type of polypary; 3, without connective structures; 4, with connective structures. 5,6. Fruticose-massive polyparies; 5, tolloinoid variant; 6, halysitoid + tolloinoid variant.
**Aulopora.** He thought that, from the first of these, Billingsariidae and Lyoporinae (both regarded as Sarcinulida in this Treatise) evolved near the boundary between Early and Middle Ordovician and that Lyoporinae gave rise to Calapocciinae and Syringophyllinae\(^1\) during the Middle Ordovician. He thought that Tetradiida derived from it *via Cryptolicheinaria* during the Early Ordovician. The cerioid Tabulata with mural pores (e.g., the Favositida) and the fasciculate Tabulata with connecting tubuli (e.g., the Syringoporicae) he thought had a common ancestry within his cerioid incommunicate stock, both groups arising late in Middle Ordovician time. Bondarenko (1966b, p. 14), however, derived the Syringoporicae from the Auloporicae because some Syringoporicae have an early anastomosing, reptant, or auloporoid stage in astogeny (Fig. 312). The Halysitina were thought by both authors to have originated from this same cerioid, incommunicate stock near the end of the Middle Ordovician. Bondarenko considered the Heliolitina to be a separate subclass from the Tabulata, though sharing a common ancestry with the Rugosa.

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\(^1\) The taxonomic names are those applied in this Treatise, unless otherwise indicated.
Sokolov (1962c, p. 275) indicated that one heliolitinan stock, the Coccoseridicae, from which he derived the Helioliticae during the late Middle Ordovician, probably originated in the Early Ordovician. The Proporicae he thought arose in the Middle Ordovician and the Cyrtophyllidae near the end of that epoch. The second fasciculate, incommunicate stem for the Tabulata he conceived as originating in the Cambrian and developing during the Ordovician into the Auloporicae.

**PHYLOGENETIC RANGE DIAGRAMS**

Authors of range diagrams for the genera placed in the suborders and families of Tabulata have shown speculative and very differing phylogenetic lines based on morphological similarities and differences. I have found no diagrams for Chaetetida, Tetradiida, and Sarcinulida, but for the Favositida there are several. Leleshus (1971c, p. 19; Fig. 313) gave a diagram for the order which differs in several important particulars from that given by Sokolov (1962c, p. 212; Fig. 311). For the Favositicae and Favositidae, Dubatolov (1963, p. 167; 1974a, p. 141), Mironova (1965, p. 81; Fig. 314) and Kim (1971c, p. 143) have offered varying views. Schemes dealing with the Pachyporicae of this Treatise have been provided by Chudinova (1959, p. 112) and Dubatolov (1963, p. 173; 1972a, p. 106; see also Dubatolov, 1972b, p. 68). For the Alveolitina, schemes have been drawn up by Dubatolov (1963, p. 180), Chudinova (1964, p. 11), and for a part by Kim (1971b, p. 131); the alternative ultimate derivations suggested are from the problematical Plasmodictyon Wilson, 1926, or from Paleoalveolites Twenhofel, 1914, *via* Subalveolites. The Multisoleniidae are considered by Kim (1971b, p. 127) to have had a common ancestry with the Alveolitina in Plasmodictyon, and by Dubatolov (1963, p. 167) and Leleshus (1971c, p. 19) in Paleoalveolites. Sokolov (1955, p. 146) considered the Theciidae to derive from somewhere close to early Favositidae, whereas in this Treatise they are classified as Sarcinulida. The Agetolitidae, herein doubtfully considered Favositida, are regarded by Kim (1971a, p. 40), on the basis of unpublished ontogenetic studies, as hav-
ing rugosan septal insertion and, therefore, Rugosa.

SOKOLOV (1962c, p. 275) has given a diagram of possible generic relations within the Heliolitina (Fig. 315).

No diagrams seem to have been published
for the Halysitina or the Auloporicae other than the family lineages of SOKOLOV (1962c, p. 212). For part of the group included in this Treatise in Syringoporicae, CHUDINOVA (1971a, p. 106; 1974, p. 112) has outlined a scheme. For the Rocmeriidae, also regarded herein as Syringoporicae, DURATOLOV (1963, p. 169; 1974a, p. 146) and CHUDINOVA (1964, p. 16) have offered diagrams.

RATES OF GROUP EVOLUTION

Rates of group evolution for the Tabulata (except Chaetetida and Heliolitina) and for the Heliolitina have been calculated by LELESHUS (1971c, p. 17). Such rates of evolution, \( E \), he suggested, might be determined for a group given a knowledge of: 1) the number of genera, \( x_2 \), arising in the course of a geological epoch; 2) the duration of the epoch, \( t \); 3) the number of inherited genera, \( x_1 \), i.e., those in existence at the beginning of the epoch; and 4) the phylogeny of the group concerned. He took the duration of periods and epochs from HAMILTON (1965) except for the Silurian, where he followed AFANAS'EV et al. (1964); he used 10,000,000 years as the unit of time. His formula was a simplified and somewhat modified empirical variant of the formula:

\[
E = \frac{x_2}{t \left[ x_1 + \frac{(n_2-y_2)(m-1)}{m} + \frac{(n_2-y_2)(m-2)}{m} + \ldots \right]}
\]

in which \( y_2 \) is the number of inherited genera which gave rise to other genera during the first burst of evolution in an epoch, and \( n_2 \) is the number of new genera so arising; \( y_2 \) and \( n_2 \) refer to the numbers in the second burst of evolution within the epoch, etc.; \( m \) is the number of such bursts. The modification he considered to be desirable because some phylogenetic lines would come to an end within the epoch, and some genera would exist considerably longer than the epoch. The formula thus modified became:

\[
E = \frac{x_2}{t \left[ x_1 + \frac{n_1-y_1}{2} + \frac{n_2-y_2}{4} + \frac{n_3-y_3}{6} + \ldots \right]}
\]

On this basis, he obtained the rates of group evolution shown in Table 2.

<table>
<thead>
<tr>
<th>Geochronological subdivision</th>
<th>Favositida</th>
<th>Tabulata</th>
<th>Heliolitina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triassic</td>
<td>0.00</td>
<td>0.00</td>
<td>...</td>
</tr>
<tr>
<td>Permian</td>
<td>0.20</td>
<td>0.19</td>
<td>...</td>
</tr>
<tr>
<td>Middle-Late Carboniferous</td>
<td>0.30</td>
<td>0.29</td>
<td>...</td>
</tr>
<tr>
<td>Early Carboniferous</td>
<td>0.26</td>
<td>0.29</td>
<td>...</td>
</tr>
<tr>
<td>Late Devonian</td>
<td>?0</td>
<td>0.06</td>
<td>...</td>
</tr>
<tr>
<td>Middle Devonian</td>
<td>0.20</td>
<td>0.23</td>
<td>0.00</td>
</tr>
<tr>
<td>Early Devonian</td>
<td>0.85</td>
<td>0.89</td>
<td>0.38</td>
</tr>
<tr>
<td>Silurian</td>
<td>1.09</td>
<td>1.00</td>
<td>0.84</td>
</tr>
<tr>
<td>Late Ordovician</td>
<td>1.14</td>
<td>0.74</td>
<td>1.03</td>
</tr>
</tbody>
</table>

The validity of the results obtained is affected by the subjectiveness of the phylogenies adopted and of the taxonomic units.

From the figures it would appear that very significant changes in the rates of group evolution both of Favositida and Tabulata (less Chaetetida and Heliolitina) took place at the boundary between Early and Middle Devonian, and that a similar change occurred in the evolution of the Heliolitina between Silurian and Devonian. A sharp reduction of rates of evolution is followed some time later by a sharp reduction in abundance and taxonomic diversity. The highest rates occurred in the periods preceding the acme of the group and in the early stages of its flourishing; and the lowest rates occurred in the late stages of evolution. Thus the Favositida, which arose at the end of the Middle Ordovician, had large numbers of individuals, but still only a small number of taxa by the end of the Late Ordovician. They began to flourish in the Silurian and their acme continued into the second half of the Middle Devonian, at which time the favositids were represented by the largest numbers of species, genera, and families in their history and were greatly predominant in numbers of individuals. At the beginning of the Late Devonian they became far more rare and more uniform; from the beginning of the Famennian on to their extinction in the Early Triassic, they were poor in numbers of both individuals and taxa.

TRENDS IN EVOLUTION

Recognition of evolutionary trends in
Tabulata is a speculative undertaking, is certainly subjective, and has provoked a considerable literature. Parallelism, convergence, and iteration have been noted. The ideas propounded must continue to be tested; they are necessarily closely interwoven with phylogenetic speculation and with deductions on paleoecology. Possible trends involve changes in form of corallum, development of communicating structures between neighboring corallites, development of dissepimental or tubulose coenenchyme, change in form of corallite, development in corallites of a peripheral stereozone, changes in tabulae, and changes in the development of septal elements.

A. Changes in form of corallum.

1) Development of cylindrical branches from cerioid coralla by localization of active increase (e.g., in the Late Ordovician species of Lyopora and Nyctopora) (Bondarenko, 1962, p. 58); this is commonly associated with skeletal thickening and shortening of the distance between tabulae in the peripheral zone of the branches (e.g., Paleo­favosites to Kolymopora in the Late Ordovician, and Paleo­favosites to Paras­triatopora in the Silurian). Leleshus (1972c, p. 42) considered such changes to be adaptive, related to deeper, quieter sea floors, but Preobr­azhenskiy (1967b, p. 3) suggested that the peripheral zone of thickening represented the developmental stage of sexual maturity.

2) Cateniform coralla appeared in unrelated stocks, in some apparently derived from phaceloid coralla, but in many apparently from cerioid coralla (Tesakov, 1965, p. 19; Preobr­azhenskiy, 1965, p. 21; Bondarenko, 1966b, p. 9); paleoecological control has been suggested.

3) Fasciculate to cerioid, and cerioid to fasciculate, coralla. Bondarenko (1966b, p. 11) considered that the cerioid “Lichen­arida” probably developed from the fasciculate auloporoids in the Early Ordovician, as the latter rose above the substrate, like the reptant Mastopora in the Devonian and Aulo­helia in the Permian. But a trend from cerioid to fasciculate is also presumed, as for instance in Lessnikovae in the Ordovician and the Roemeriidae in the Devonian, in which the corallites in at least the peripheral regions of the coralla grow apart and cylindrical.

B. Development of communicating structures between neighboring corallites.

1) Mural pores. Sokolov (1955, p. 281) and Bondarenko (1966b, p. 14) considered that the Favositida arose from the “Lichen­arida” by this trend in the Middle Ordovician; later trends in the Favositida involved the arrangement of the pores in the walls and at the angles between the walls.

2) Connecting tubuli. Sokolov (1955, p. 291) considered that early Syringoporicae arose from cerioid incommunicate “Lichen­arida” by the development of tubuli as the corallum became fasciculate, but Bondarenko (1966b, p. 14) thought they developed from incommunicate Auloporicae.

3) Connecting platforms and connecting channels or tubuli, in the Ordovician Syringophyllidae, Silurian Chonostegitidae, and the Devonian Roemeriidae and Neo­roemeriidae.

C. Development of dissepimental or tubulose coenenchyme, as in some Haly­stinia and in all Heliolitina.

Coates and Oliver (1973, p. 3) have related developments B and C above to the soft parts and expressed them as “develop­ments in coloniality.” They discussed “degrees of integration of individuals within colonies of corals” and gave “scales of inte­gration” based on skeletal features, together with interpretations of the positions of these features on other scales of “tissue level,” “extrapolypoidal skeleton and tissue,” and “polymorphism.” They considered phaceloid coralla with corallites bounded by an imperforate wall to have lower integration of individuals than similar cateniform and cerioid coralla, which were lower than meandroid coralla: all of these had lower integration than phaceloid coralla with a perforate wall (as in Syringopora), and such phaceloid coralla were lower than cerioid coralla with mural pores. All the above were at a lower level than coralla in which separating walls were incomplete or lacking between corallites, such as meandroid coralla, and these they regarded as less integrated than coenenchymate coralla (such as in Heliolitina). They adopted Wells’ postulate (1971, p. 748) that the
homomorphous individuals, organically (by soft tissue) or structurally (by skeletal tissue) united in true colonies, as in phaceloid and cerioid epithetecate Rugosa, resulted from extratentacular budding of the polyps. It may be possible to extend WELLS' postulate to the fasciculate and cerioid Tabulata, except the Chaetetida and Tetradiida. These two orders, with adaxial growth of dividing walls, may have reproduced by intratentacular budding of their polyps; a similar type of increase may be found in Alveolitina, though in these presumably extratentacular budding would have been dominant.

D. Change in form of corallite.
Alveolitoid corallites may be considered to have evolved from prismatic and contiguous or cylindrical corallites by a change of habit from erect to inclined either to the substrate or to the axis of a branch. LELESHUS (1972c, p. 43) considered such changes to have given rise in the Favositida to Alveolitina; in the “Lichenariidae” to Baikitolites; and in the Tetradiidae to Paleoalveolites. These changes may affect the form and habit of the corallum.

E. Development in corallites of a peripheral stereozone (e.g., Favosites to Pachyfavosites and Heliolites to Pachycanalicula; LELESHUS, 1972c, p. 43).

F. Changes in tabulae.
1) Replacement of tabulae by tabellae is found in many unrelated stocks; in some, these tabellae may be confined to a peripheral zone (Hayasakaia).
2) An axial syrinx may develop in unrelated lineages from infundibuliform tabulae (e.g., in Syringolites, presumably from Favosites; and in Syringopora, presumably from Tetraporella or other genera).

G. Changes in the development of septal elements.
1) Microstructure. FLOWER (1961, p. 32) has speculated on the evolution of the septa; he held that the primitive corals possessed a fibrous wall, and that septa first developed as processes on the inside of the wall; that is, as trabeculae that may become contiguous to form the septal plates. SCHOPPE & OKEENTORP (1974, p. 165) speculate, however, that the fine septal spines so characteristic of Middle Paleozoic Tabulata developed in a retrogressive trend by reduction from the coarse laminar or acanthine septa that are commonest in the early Paleozoic.
2) Development of septal plates from septal spines; e.g., in lineages suggested by LELESHUS (1972c, p. 44) from Multisolenia to Antherolites; from ParASTriatopora to Laceripora; from ParASTriatopora to Paleocorolites; and from ParASTriatopora to Theciopora.
3) Development of squamulae; found in many lineages of Favositida in the latest Silurian and Early and early Middle Devonian (YANET, 1971, p. 109).

PALEOECOLOGY

By analogy with living corals it might be supposed that there were deepwater corals as well as reef corals in the Paleozoic; but as far as I am aware there are no published studies proving their existence. The recorded faunas seem without exception to have inhabited epicontinental sea floors or continental shelves or slopes. Accepting then, that the Tabulata were neritic and benthonic, we find that while some are found in the normal argillaceous-arenaceous or volcanic sedimentary facies of the shallow sea floor, they are far more common in carbonate facies, and are particularly abundant in reef facies. However, in the reef facies they are so commonly not the most important frame builders, binders, or dwellers, that it is seldom appropriate to speak of tabulate coral reefs. Nevertheless, Tabulata may be the most common component of some of the biostromes developed in reefal complexes, particularly in those of the Late Ordovician, Silurian, and Devonian.

Paleozoic reefs consist of a framework of animal and algal skeletons that rose above the surrounding sea floor to a greater or lesser height; the interstices of the framework are more or less filled by skeletons of reef-dwelling organisms and by bioclastic and biogenetic carbonates; the framework
may or may not have been rigid due to contiguous growth of its constructors, which may be algae of many kinds, stromatoporoids, tabulate or rugose corals, bryozoans, or sponges; rigidity may be imparted by binding of debris and framework by encrusting skeletons of Bryozoa, stromatoporoids, blue-green or coralline algae, or corals, or by stromatactoids or stromatolites. Bodies so constructed may be bounded laterally by contemporaneous or penecontemporaneous bedded clastics and may then be called bioherms; similarly constructed biostromes that do not rise above the level of their surroundings but are laterally extensive commonly form part of the reef complex, and on the margins of platforms they may greatly increase in thickness to become barrier reefs. Coarse to fine detritus derived from the reefs by wave or current action or by reef-boring organisms may be spread widely between and around the reefs, and forms part of the reef complex. In the forereef areas such bioclastic material may form steeply dipping talus slopes populated by a rich epibiont fauna and flora. In reef-fringed or reef-studded carbonate platforms, intratidal or shallow subtidal mud or sand may be deposited and in some such lagoons with restricted circulation, evaporites may be deposited. Reef growth, even on shallow platforms, is inhibited by influxes of terrigenous sediment.

Some Paleozoic reefs, particularly those of lenticular biohermal form and of considerable height, show vertical zonation that has been explained as due to the upward growth of the reef into zones of wave action at a rate greater than the rate of subsidence of the sea floor (or rise in sea level). Silurian and Devonian examples are quite numerous. Many such reefs began on hard ground made by the skeletons of solitary Rugosa or small tabulate colonies, or by crinoids or crinoidal debris. The first framework organisms based on this hard ground are, in the Silurian, not infrequently Tabulata that form rather loose skeletal networks, such as Syringopora or Halysites. As the reef is traced upward, more massive cerioid coralla such as Favosites and Heliolitina may predominate, and more genera, species, and individuals are present, indicating that the shallow reef environment was more favorable to growth of Tabulata than the earlier nonreef environment. The species characteristic of the different zones may also be found in associated reefal biostromes where the physical conditions and supply of food were similar; controlling physical factors appear to have been turbidity and rate of settling of mud or sand, force and direction of wave or tidal currents, nature of substrate, depth, and, in some places, salinity.

It is clear from the above summary that the reefal facies have multitudinous subfacies, and each is likely to have its own community; and so ultimately the paleoecological study of any reef complex or reef archipelago must be a matter of detailed field, subsurface, and laboratory observations and analyses. However, the most detailed studies of the last decade have devoted acute attention to one aspect only, usually the sedimentological aspect; maximum benefit to the science will not be obtained unless close and skilled taxonomic work accompanies the sedimentology.

An aspect of reef studies that occupies considerable space in the literature is the adaptation of the growth form of a corallum to a particular reef niche. Many generalizations have been made, but owing to the number of controlling factors the number of exceptions to a suggested norm is great. Thus, slenderly branching coralla are not necessarily characteristic of either quiet or deep water; indeed, they may be found in most reef environments except perhaps the reef crest exposed to the full force of breakers. Similarly, stubby or knobby coralla are not necessarily indicative of the surf zone; they may also be found in areas where much mud settles. Although particular species or genera may be found commonly in particular environments, it cannot be assumed that they always indicate that environment.

The biological character of Paleozoic reefs changed during the era. In the Early Cambrian, algae were dominant, with Archaeocyatha their most important associates, both as reef dwellers and builders. In later Cambrian and Early Ordovician time, sponges took the place of the Archaeocytha. In the Middle Ordovician, bryozoans, pelmatozoans, stromatoporoids, and tabulate and rugose corals to a large extent replaced the sponges.
The reef ecology of Ordovician Tabulata is perhaps best exemplified by the Middle Ordovician (Chazyan) mounds, commonly called bioherms, of eastern North America (Pitcher, 1971, p. 1341). Earlier than this epoch only sporadic Tabulata are recorded. These mounds, seldom more than 20 by 30 by 100 to 300 feet and mostly smaller, were built up by bryozoans, stromatoporoids, encrusting Tabulata (Billingsaria), and algae acting mostly as binders. Some corals such as the ceroid Lamottia heroensis and the closely fasciculate Eofletcheria incerta, some bryozoans, and some sponges contributed as frame builders in a few mounds. Few, if any, Ordovician reefs can properly be called coral reefs. However, mounds in the Carters Limestone of Tennessee are interpreted by Alberstadt, Walker, and Zurawski (1974, p. 1171) as “patch reefs” developed in the four stages of reef growth: stabilization; colonization; diversification, chiefly of frame-building corals and stromatoporoids; and domination by stromatoporoids. On the whole, Ordovician Tabulata are found mostly in shallow, subtidal, level-bottom communities on the carbonate platforms, like the Black River Foerstephyllum halli community in New York. A wave-baffle community of Tetradium cellulosum has been described from the shallow calcareous mudflats of the Black Riveran sea floors of New York State (Walker, 1972b, p. 2509). Walker (1972a, p. 82) has also analyzed the various Black River communities in terms of their feeding (trophic) relationships.

In the Upper Ordovician Boda reefs of Sweden (see Jux, 1966a, p. 153), corals lived mainly near the margins of the reefs and appear to have been less important builders than the algae. Lowenstam (1957, p. 232) reviewed the Silurian reefs of North America. He considered that reefs may have begun following localized reduction by weak currents of the amount of mud settling on the sea floor. In one such incident the pioneer reef populations were large boss-shaped specimens of Syringopora (dominant) and Favositess; as reef growth began, lamellar forms of Favosites were the dominant constructors. In this quiet-water stage, the endemic reef elements (stromatactoids and locally stromatoporoids) also participated as trappers and binders. The populations were small, and terrigenous detritus at first commonly outweighed bioclastic debris in filling the interstices of the frame.

The second stage of reef growth was the semirough-water stage, from the depth of the deepest storm wave penetration (that is, with occasional agitation of the water), to about normal surf base. Reef construction during this stage was in the form of an open lacy network; stromatactoids were still dominant, but stromatoporoids increased in importance while Tabulata (Favositess, Halysitess, Heliolites, and Syringopora, their coralla usually being small, low-lying bosses) were now only accessory builders. In general, the upward increase in turbulence was accompanied by a similar increase in numbers of species and individuals of reef dwellers, including those living on the flanks; many Tabulata of considerable size were involved in the later phases of this growth stage; they may be found also in the interreef facies. The fill in the interstices was dominantly bioclastic (Fig. 316).

The rough-water or wave-resistant stage also involved both reef builders (including binders) and reef dwellers. It was profusely populated, abounding in species and individuals, and represented the climax of reef enrichment. Of the reef builders, stromatoporoids greatly increased in proportion to stromatactoids and there was an increase in Tabulata and Rugosa. Tabulata functioning primarily as stabilizing elements for skeletal debris in frame-building zones included Thecia, alveolitids, and, as effective sediment-catching accessories on protected reef surfaces, Fletcheria and Coenites. Lowenstam postulated that sheetlike Thecia partly replaced stromatoporoids on reefs where there was settling of greater amounts of terrigenous matter.

Lowenstam (1957, p. 237) considered the reef corals to have been derived initially from semirough- to rough-water open shelf stocks, and that many of them were morphologically preadapted and able to occupy reef environments with little change. Adjustment in growth form to direct wave impact was mostly by reduction of surface area in the vertical dimension. Many frame
Coelenterata—Tabulata

builders were horizontally expanded; others were bracket-shaped with sturdy low pillars proximally, raising the calical surface sufficiently above the substrate to prevent injury or burial by shifting skeletal sands.

Paleoecological studies on the Silurian reefs of Gotland, Great Britain, and the USSR in general have given similar results; on the whole stromatoporoids, stromatoids, and algae were more important than Tabulata as constructors (builders and binders), but locally Tabulata were dominant. Commonly Tabulata were important reef-dwellers.

MANTEN (1971) considered that in Gotland turbidity and the resultant settling of mud may have had more influence on the composition of reef communities and on the growth-forms of their species than degree of wave action (turbulence) and depth. In this connection, Philcox (1971, p. 338) has related the settling of sediment to variability in the direction and volume of growth of Favosites coralla in an American reef. All Gotland reefs are thought to have developed in less than 50 meters of water, and the Hoburgen (Wenlockian) reefs in less than 30 meters. Scoffin (1971, p. 173) has given an exemplary account of the sedimentology of Wenlockian reefs in Great Britain; these are small (average width 12 m. and thickness 4.5 m.) and the water was probably never more than 30 meters deep, although reefs were not broken up by wave or current action. Very few beds of reef-derived talus occur; reef surfaces were small and convex and reached heights of only 50 centimeters to 3 meters above the seabed (Fig. 317, 318). The Wenlock reefs differ from the average North American and Gotland reefs in that Tabulata, massive and branching Heliolitina and Favosites, and the lettuce-like Halysites are the dominant framework organisms, and the laminar Alveolitidae and Thecia as reef binders were subordinate only to stromatolites.

Naumenko (1970, p. 60) has discussed the tabulate communities of the Llandovery bioherms and perireef and interreef biostromes of the carbonate facies of the Western Sayan in Siberia, and Ivanova, Belskaya, and Chudinova (1964), those of the Silurian and Devonian of the Kuznetsk, Minusinsk, and Tuva basins, and all have
obtained results consistent with those of Lowenstam.

Lithofacies and associated biofacies of Devonian reefs are the subject of a considerable literature. Lecompte (1959, 1960), followed by Tsien (1971, p. 123), studied the Middle and Upper Devonian (Frasnian) reefs of Belgium and Struve (1963, p. 252; Fig. 319) reviewed earlier work on those of the Eifel. Both related their observations to water turbulence, which in turn, particularly in the more rapidly subsiding basins,
was related to bathymetry. Thus, Lecompte's Zone sous-turbulente corresponded to part at least of Lowenstam's quiet-water stage, his Zone sub-turbulente (Wedekind's and Struve's Rasen-Riff, turf-reef, and possibly also their Knollen-Block-Riff) to the semirough-water zone of Lowenstam, and his Zone turbulente (and Struve's Stomatoporiden-Bankrif and possibly also his Knollen-Block-Riff) to Lowenstam's rough-water stage. It was recognized that on the more stable regions that subsided less, water movement would be less, on the whole, particularly in environments protected behind uptops that would take the main force of wave action, and that there turbidity would be varied. Lamellar Alveolites replaced lamellar Thecia in its various niches, and the branching Thamnopora is found in all environments except, very rarely, in the reef core exposed to the maximum break of the waves.

The association of petroleum with Devonian reefs in Canada has led to subsurface studies as well as field studies, and Klován (1964) among others has applied water-turbulence theory in reconstructions of the environments of deposition. After comparing Canadian Devonian reefs with those present-day reefs that have considerable elevation above the floor of the open-marine Yucatan shelf (see Logan, 1969), Embry and Klován (1971, p. 738) have suggested that the boundary between the underturbulent and subturbulent zones represents the threshold at approximately 75 feet, at the base of storm wave action, and that the boundary between subturbulent and turbulent zones represents the threshold to strong normal wave action (rough-water stage) at about 30 feet. The angle of slope of the reef profiles and the width and shallowness of the shelf are factors that could modify the depth of the thresholds in any one part of the reef complex, and might vary the sequence of growth forms or of communities expected (Dolphin & Klován, 1970, p. 289).

The general absence of the stromatoporoids from Carboniferous and Permian reefs together with a great reduction in Tabulata in these two periods, make these reefs very different in aspect from the earlier reefs. But the stromatolites, stromatactoids, bryozonas, and other algae continue as binder-builders, and are accompanied in some Russian reefs by hydractinoids and in some Permian reefs by sponges. In the Carboniferous and Permian atoll of Akiyoshi in Japan, lamellar coralla of Chaetetes, some with hummocky upper surfaces, act as builders and binder-builders.

Tabulata are absent to occasional (Syringopora) in the Early Carboniferous "Waulsortian" reef knoll facies. In the Visean reef complexes developed on the margins of the more stable platforms of Derbyshire, England, algal barrier reefs occur as a dis-
continuous wall-like mass of limestone with abundant stromatolitic algae, sponges, and occasional Chaetetes depressus (and Rugosa); steeply dipping (30°) forereef beds are very fossiliferous; cerioid Michelinia is dominant in a zone not far below the reef crest (=algal barrier reef) (Broadhurst & Simpson, 1973, p. 367); and Chaetetes septosus and Syringopora may be found at somewhat lower levels on the slope.
backreef limestones include some biostromes and grade laterally into the standard shelf limestones; reef dwellers are very numerous and most species occur in the shelf limestones, backreef limestones and biostromes, and forereef beds, including the tabulatans Chaetetes septosus and Syringopora; Rugosa are, however, more important (see WOLFENDEN, 1958, p. 894; STEVENSON & GAUNT, 1971).

In the Middle and Upper Carboniferous of the Moscow Basin (IVANOVA, 1958, p. 62), Chaetetida favored neither the littoral nor the coastal shallow water with terrigenous matter, nor the relatively deep sea floors with the special physicochemical regime that led to dolomite deposition. They were especially characteristic of the shallower and rougher parts of the sea, distant from terrigenous sources, e.g., around shoals or islands; colonies were relatively small, with diameters of from 5 to 20 centimeters, rarely of half a meter, and spherical or ovate; in the shelf zone of the open sea and the inner slopes, colonies were mainly tabular and large. Syringoporoidae favored the quieter conditions of relatively deep water with a normal regime and soft bottom, although they were also distributed in the neritic zone; they flourished in algal bioherms. Auroporicae (including Cladochonidae) are encountered sporadically, encrusting brachiopods and sponges and other corals, and also on boulders and rocky outcrops. They generally inhabited shallow regions with clean mobile water and also the coastal shallows with unstable regime, and were not affected by terrigenous matter.

In the Carboniferous and Permian atoll of Akiyoshi in Japan, OTA (1968, p. 10) and OTA, SUGIMURA, & OTA (1969, p. 7) distinguished five types of limestone in a "true-reef" facies; of these, one has a framework of stromatolites and sheetlike Chaetetes with some Rugosa and some encrusting Foraminifera; another has a framework mainly of dendroid and cerioid Rugosa and hemispherical Chaetetes with minor hexagonellid bryozoans and encrusting foraminifers; the other facies regarded as true reef is bioclastic limestone, largely of crinoid and bryozoan debris, and oolitic limestone (Fig. 320).

Thus Tabulata, like Rugosa, did function as builders and binders in Paleozoic reefs, but they were seldom dominant in these roles; they flourished better in reef environments than in nonreef environments, and they reached their maximum diversity and profusion not far below surf base. Although members of the shelf (?)and upper slope) benthos, they were generally unimportant in argillaceous and arenaceous environments. Whether they had upper and lower critical temperature limits, as do the Scleractinia of today, is unknown.
Considerable biostratigraphic correlation by Tabulata has been undertaken in the USSR, where this aspect of their study has been of great value in geological mapping. An important work by TESAKOV (1978) on the place of Tabulata in biologic and bio-geologic assemblages and their significance in stratigraphy was received too late for inclusion in this review.

SOKOLOV (1962a, p. 53) has discussed the sequence and distribution of tabulate faunas through the Paleozoic of the USSR, using genera only. SOKOLOV and TÉSÁKO (1963, p. 112) exemplified the use of successive faunal assemblages of tabulate species found in the stages and horizons recognized on stratigraphical and other faunal grounds for some sections of the Silurian and Ordovician of the Siberian Platform. The assemblages they listed have proved very useful in correlation; for instance, ROZMAN et al. (1970, p. 223, 228) distinguished successive tabulatan assemblages in sections through the Upper Ordovician of northeastern USSR and correlated them with those of the Siberian Platform and, indeed, of the rest of the USSR and the world. A similar study, based on the Heliolitina of the Ordovician, Silurian, and Lower Devonian of Kazakhstan, has been presented by BONDARENKO (1967).

KLAAMANN (1970b, p. 115) has found that the classical horizons of the Silurian of Estonia are characterized each by an assemblage of tabulate species, and has used the name of one of the more significant species of each such assemblage as a zonal name. Thus in the Llandovery he recognizes in unit G1-5 a zone of *Paleofavosites paulus*, in unit G3 a zone of *Parastriatopora celebreta*, and in unit H a zone of *Mesoravosites obliquus*. In the Wenlockian he recognizes in unit J1 a zone of *Favosites jaanensis* and in unit J2 a zone of *Coeites juniperinus*. In the Ludlovian in unit K1 is the *Parastriatopora commutabilis* Zone and in unit K2 the *Thecia swinderniana* Zone. The Downtonian units K3-4 include the *Favosites eflus* Zone. Several of these Estonian zones are now known in other regions.

HILL (1967) reviewed the sequence and distribution of the Upper Silurian, Lower Devonian, and lower Middle Devonian coral faunas (including Tabulata) of the USSR. For the Devonian, DUBATOLOV (1959, p. 247) has provided a sequence of tabulatan zones based on successive assemblages in the Kuznetsk Basin, and (DUBATOLOV, 1972c) has given a comprehensive and, indeed, indispensable account of the tabulatan biostratigraphy of the Devonian of Eurasia. Some of the zones have proved identifiable in more than one basin or more than one biogeographical province; for instance, the zone of *Favosites regularissimus*, first recognized as the basal zone of the Eifelian Stage as then understood on the eastern slopes of the Urals, has since been identified in the Taymyr Peninsula, the Tien Shan, the Altay, and in the Kuznetsk Basin; it is now correlated with the Upper Emsian or Zlichovian of western and central Europe, though DUBATOLOV (1972c, p. 34) continues to include it in his Middle Devonian; the zonal name is alternative to a binomial in which a geographical name appropriate to the depositional region is coupled with the word "horizon."

Tabulatan biostratigraphy of the Carboniferous and Permian has had comparatively little attention, mostly as a very minor component of joint studies with Rugosa or other invertebrates. Classical work on the Lower Avonian of Hook Head, Eire, by SMYTH (1930) set a useful standard and showed that many of the large-celled favositinans of the epoch had short ranges in time; as he extended his work it became clear that some of them had considerable geographic extension as well and were useful index fossils.

DEGYAREV (1973b, p. 206) included Tabulata in his biostratigraphical account of the Carboniferous corals of the Urals. VASLYUK, KACHANOV, and PYZHYANOV (1970, p. 45) used biostratigraphical data, though only at a generic level, in reviewing the paleobiogeography of the Carboniferous and Permian Coelenterata and so did HILL (1948, 1957b, 1973). Some special studies have been made, for example, by SOKOLOV (1939, p. 411), on the Chaetetina of the Carboniferous of Russia, and by NELSON
FIG. 321. Paleozoogeographic provinces; distribution of selected Middle Ordovician genera (after Kaljo & Klaamann, 1973). Legend: A, North America; Au, Australia; B, Baltic and Scandinavia; C, China; E, Great Britain; G, Greenland; J, Iran; K, northeastern USSR; M, Bohemia and Podolia; P, California; S, Siberia; T, Tadzhikistan; U, the Urals; spotted areas, land; white areas, seas. Where the abbreviated names of genera appear on four different lines, the first line names tabulate corals characteristic for the province, the second line heliolithoids and rugose corals characteristic for the province, the third line genera of restricted geographic range, and the fourth line some additional genera. Abbreviations: Cry, Cryptolithicaria; Cyr, Cryptophyllum; Eof, Eofletcheria; Fav, Favistella; Ken, Kenophyllum; Lam, Lambeophyllum; Les, Lesnikovae; Lic, Lichenaria; Lyo, Lyoporina; Nyc, Nyctopora; Pal, Palaeophyllum; Par, Paratetradium; Pfa, Paleofavosites; Pri, Primitophyllum; Pro, Propora; Protaraea; Ptz, Protosaphrentis; Tet, Tetradium; Tpo, Tetaporella; Try, Tryplasma.
(1962, p. 442) on the Syringoporidaceae of the Lower Carboniferous of southwestern Canada. Late Paleozoic Tabulata are clearly in need of intensive biostratigraphic study and this work should be aided by the bibliographic index of North American rugose and tabulate coral species by Wilson (1974, p. 598), and the checklist of North American late Paleozoic coral species by Sando (1974).

PALEOZOOGEOGRAPHIC PROVINCES

Coral paleozoogeographic provinces have attracted considerable interest lately in debates on continental drift and plate tectonics. Tabulatan studies are areally unbalanced, the amount of detailed work done in the USSR greatly exceeding that in the rest of the world. Nevertheless, it is possible to draw a few inferences of limited value from the presently known distributions of genera, even if there is still much room for argument on both systematics and stratigraphic ranges. Evidence from species would be more valuable, and has been used within the confines of the USSR, but elsewhere the low order of knowledge precludes its use.

Records of Tabulata earlier than Middle Ordovician are too scanty for paleozoogeographic analysis. For the Middle Ordovician, recent analyses exist by Sokolov (1962a, p. 55), Leleushus (1970d, p. 84), and KALJO and KLAAMANN (1973, p. 38). The somewhat inconsistent level of the boundary between Middle and Upper Ordovician leads to uncertainty regarding the first appearance of many genera; perhaps the most pressing of these questions is the age of the Cliefden Caves Limestone of New South Wales, in which many genera of the Heliolitina are at present considered Middle Ordovician, though elsewhere they characterize the Upper Ordovician. KALJO and KLAAMANN considered it possible to distinguish two faunal provinces in the Middle Ordovician, North American-Siberian and Eurasian; but LELESHUS, who used a statistical analysis based on degrees of difference, concluded that only one province was recognizable, the Sibero-American. He noted that there were generic differences between the Ural, the Baltic, and the Australian faunas, but thought them still closely tied to the North American (Fig. 321).

The Upper Ordovician faunas, that is, those correlated with the Upper Caradocian and Ashgillian and including the equivalents of the Baltic unit *F*₂, are much richer, and have been analyzed in the three papers quoted above. KALJO and KLAAMANN distinguished American-Siberian and Eurasian provinces. LELESHUS recognized 1) a Baltic Province comprising the Baltic, Scandinavia, and western Europe, dominated by sarcinulidans and heliolitidans and without cyrtophyllidans and agetolidans, 2) a Central Asian Province (Kazakhstan, the Sayan, the Altay, and China), linked fairly closely with the Baltic but with agetolidans characteristic; 3) a Siberian Province (Siberian Platform, southwest Siberia) with cyrtophyllidans and endemic sarcinulidans; and, most isolated from the Baltic Province but closely linked with it, 4) the Arctic Province consisting of northeastern USSR, Arctic USSR, the Urals, and North America, all with *Trodossontites*. Both authors supplied tables listing genera and their occurrences. Many cosmopolitan genera occur in the Upper Ordovician, *Calapoecia*, *Paleofavosites*, and tetradiids being perhaps the most abundant (Fig. 322). A different analysis for the Upper Ordovician is given by Rozman et al. (1970, p. 268), based on all faunas. ROZMAN distinguished four roughly parallel belts, which he considered of climatic significance. These were 1) Canadian-Siberian, 2) European, 3) Kazakhstan-Appalachian, and 4) Kolymian-Alaskan, arranged more or less symmetrically about the Canadian-Siberian belt, which he considered close to equatorial.

The Lower Silurian tabulatan faunas are very different, due to the extinction of nearly all the earlier endemic genera and of the Tetradiiida, Syringophyllididaceae, Cyrtophyllidaceae, *Coccoecis*, and Agetolitidaceae. LELESHUS as well as KALJO and KLAAMANN regarded them as forming a single worldwide province. By the latest Llandovery, the new families Theciidae, Multisoleniidae, Alveolitidae, and Pachyporidae were cosmopolitan, and the fauna was quite rich.
Fig. 322. Paleozoogeographic provinces; distribution of selected Late Ordovician corals (after Kaljo & Klaamann, 1973). Legend as in Figure 321. Abbreviations: Age, Agetolites; Ams, Amsassia; Arc, Arcturia; Cal, Calostylis; Cox, Coxia; Cry, Cryptolichenaria; Cyr, Cyrtophyllum; Est, Esthonia; Fav, Favistella; Ken, Kenophyllum; Kol, Kolymopora; Lic, Lichenaria; Lyo, Lyopora; Nyc, Nyctopora; Phy, Phytopsis; Pli, Paliphyllum; Pro, Propora; Prt, Proterophyllum; Ptr, Protaraea; Reu, Reuschia; Sar, Sarcinula; Sib, Sibiriolites; Str, Strombodes; Tet, Tetradium; Tol, Tollina; Wor, Wormsipora.
Fig. 323. Paleozoogeographic provinces; distribution of selected Wenlockian corals (after Kaljo & Klaamann, 1973). Legend as in Figure 321. Abbreviations: Ace, Acervularia; Alt, Altaia; Ant, Anthelolites; Ari, Briantelasma; Cam, Camptolithus; Cor, Coronoruga; Cos, Cosmiolithus; Cyl, Cylindrostylus; Cys, Cystihalysites; Dip, Diploepora; Ent, Estelophyllum; Gya, Gyalophyllum; Hat, Hatonia; Hex, Hexismia; Hol, Holmophyllum; Kor, Koreanopora; Lac, Lacertipora; Maz, Mazaphyllum; Mes, Mesosolenia; Nip, Nipponophyllum; Nod, Nodulipora; Pac, Pachypora; Pal, Palaeocorolites; Pla, Plasmodiales; Pls, Plasmodopora; Ppl, Protopophyllum; Rh, Rhizophyllum; Rom, Romingeria; Saa, Saaremollites; Sap, Sapporipora; Sax, Syringaxon; Sch, Schindohalysites; Som, Somphopora; Squ, Squameofavosites; Str, Strombodes, Syr, Syringolites; Tha, Thaumatolites; Wen, Wenlockia; Yas, Yassia.
Nearly all genera continued into the Middle Silurian, but in Lelešhů's view, provinces were not clearly delimited then. Hill (1959, p. 167) considered that although in the Silurian there were suggestions of Asian-Australian and North American provinces, on the whole, the Silurian coral faunas of the world were cosmopolitan. Kaljo and Klaamann maintained that a weak differentiation suggested in the Upper Llandovery became somewhat stronger in the Middle Silurian with weakening of North American connections with Siberia (Fig. 323). Provincial distinction became sharper in the Upper Silurian (including Pridolian), and Lelešhů distinguished four provinces, 1) Baltic, Podolia, Bohemia, and the Soviet Arctic, 2) the Ural, southwestern Siberia, Kazakhstan, and Central Asia, 3) Australia, and 4) North America, whereas Kaljo and Klaamann distinguished only two, European and Asiatic (including the Urals and possibly China).

At the beginning of the Early Devonian, in the Gedinnian, according to Lelešhů, only one world province existed for Tabulata. The Halysitina had become extinct. Lower and Middle Devonian tabulatan faunas flourished, and are the richest of all. Devonian tabulatan biostratigraphy of Eurasia has been considered in detail by Dubatolov (1972c), who used this background to develop his paleozoogeographical and climatic analysis of the Devonian world. Early Devonian provinces he identified are 1) Amazonian, 2) Californo-Canadian (=western North America), 3) Appalachian (=eastern North America), 4) Magribian (North Africa), 5) Mediterranean (=Tethyan; including western and central Europe, Asia Minor, the Pamirs, Iran, and the Himalaya), 6) Ural-Tien Shanian (Urals, Tien Shan, central Asia, Novaya Zemlya, and possibly northwest China), 7) Dzhungaro-Balkhashian (Pribalkhash, Dzungarian Alatau, and possibly China).
8) Altay-Sayanian (Altay, Salair, Kuznetsk Basin), 9) Indigiro-Kolymian (=Taymyr-Kolymian) with distinguishable subdivisions for Tas-Khayakhtakh, Ormulev-Kolyma, and Sette-daban and the Taymyr Peninsula, 10) Mongolo-Okhotskian (Transbaikalia, Far Eastern USSR, East Mongolia, and Japan), 11) Indosinian (southwest China, Indochina), and 12) East Australia (Australia, New Zealand). In the resultant map (Fig. 324), Dubatolov indicated the position he deduced for the equator. The twelve provinces, he considered, might form four groups: Australo-Eurasiatic, Appalachian, North Pacific, and Atlantic.

For the Zlichovian, which he included in the Middle Devonian, he found the same provinces to be present. But for the later Eifelian and Givetian he grouped those entities numbered 4 and 5, above as Mediterranean, 6, 7, 8, and 9 as Uralo-North Asian, and 11 and 12 as Sino-Australian; he did not discuss western North American or South American arrangements. That is, for the Middle Devonian he deduced considerable merging of provinces, large numbers of genera being polyprovincial (Fig. 325). Hill (1957b, p. 49) had earlier indicated a migration of Euraustralasian fauna to Pacific North America at the beginning of the Givetian.

In the Late Devonian (Frasnian), by which time the number of genera and species had greatly decreased with the extinction of the Heliolitina and many families of Favositicae, faunas were dominated by Alveolitidae and Thamnopora, and Dubatolov recognized only two provinces, North American and Australo-Eurasiatic (Fig. 326). During Famennian times Tabulata were very scarce and subsequently remained greatly subordinate to Rugosa.

For Carboniferous and Permian coral provinces, results from Tabulata are combined in the literature with those from the predominant Rugosa. Thus, Hill (1973, p. 133) deduced three provinces for the Lower Carboniferous, those of North Amer-
Fig. 326. Paleozoogeographic provinces; zoogeographic subdivision into regions of the world oceans in the Late Devonian (Frasnian) (after Dubatolov, 1972c). Legend as in Figure 325. Provinces: AEA, Australo-Eurasian; NAM, North American.

ica, Eurasia, and Australia (Fig. 327). The eastern and western ends of the Eurasian Province were distinct, and in the western subprovince is included Nova Scotia and northwestern Africa. However, Vasilyuk, Kachanov, and Pyzhyanov (1970, p. 45) recognized, in Eurasia, in the Tournasian, five provinces: 1) Western European, 2) Eastern European-Siberian (including subprovinces of the Urals, Novaya Zemlya, Siberia, East Siberia, Pamirs, eastern Europe, and Asia Minor), 3) Central Kazakhstan, 4) Kuznetsk, and 5) China. In the Visean, provinces 1, 3, and 5 were still distinguished, but the Eastern European-Siberian grouping was considered to form three provinces: 1) the East European (Moscow Basin, Urals, Novaya Zemlya), 2) the Donetz Basin with Central Asia, and 3) Eastern Siberia, with which the Kuznetsk Province (4 above) was merged, comprising eastern Taymyr, northeastern USSR and the Kuznetsk Basin. In the Namurian, they recognized only two Eurasian provinces, Eastern European-Siberian (central Europe, Moscow Basin, Urals, Novaya Zemlya and East Taymyr) and Mediterranean (Donetz Basin, Asia Minor, central and South Kazakhstan, central Asia, and Pamirs), but the only tabulatan they mentioned was Chaetetes pinnatus.

For the Middle Carboniferous they recognized, like Hill (1957b), two provinces in Eurasia, East European (Urals, Moscow Basin, Novaya Zemlya) and Mediterranean (Spain, Czechoslovakia, Donetz Basin, Tien Shan, Pamirs, China, Japan). The North American Province was still distinctive, as it was also in the Upper Carboniferous. For the Upper Carboniferous the same authors distinguished in Eurasia, the Ural-Arctic (Spitsbergen, Novaya Zemlya, Urals, eastern parts of Russian Platform) and the Mediterranean (Carnic Alps, Donetz Basin, Pamirs, China, Japan) provinces (Fig. 328). No Middle or Upper Carboniferous Tabulata have been recognized in Australia.

For the Permian, Vasilyuk, Kachanov, and Pyzhyanov (1970) considered the Uralo-Arctic Province again to be distin-
FIG. 327. Paleozoogeographic provinces; Lower Carboniferous coral faunal regions and provinces (Hill, 1973).
Fig. 328. Paleozoogeographic provinces; paleobiogeographic regions based on coelenterate faunas in the Moscovian (Vasilyuk, Kachanov, & Pyzhyanov, 1970). Legend: 1, land; 2, sea; 3, alternating marine and continental conditions; 4, boundary between provinces; 5, probable direction of migration. Provinces: I, East European; II, Mediterranean. Subprovinces: IA, Uralian; IB, Moscow Basin; IIA, Central Mediterranean (regions: a, Donbas; b, Pamirs); IIB, Chinese.

guishable, and to include the European Arctic, the western slopes of the Urals and Priurals, and the Moscow Basin; the Mediterranean Province comprised in its central parts the Donetz Basin, Asia Minor, the Pamirs, and in its eastern parts the Primorye, China and Japan, Indonesia, and New Zealand (and presumably Australia). In the Permian the North American coral complex is close to that of the Uralo-Arctic Province (Fig. 329).

More intensive taxonomic work and more work on distributional patterns are required before students of tabulates will be able to make significant pronouncements for or against continental drift or specific uses of plate tectonics theory in paleogeographic reconstructions.
The Tabulata are well served with historical reviews of which the most useful are those of MILNE-EDWARDS (1857a, b, c, 1860), NICHOLSON (1879), POCTA (1902), OKULITCH (1936b) and SOKOLOV (1950a, 1955, 1962c, 1971).

During the eighteenth century, fossils now included in Tabulata were considered to be related to the corals, which at that time were called zoophytes because of the long-noted resemblance of the tentaculate polyps to flowers. During the century in which LINNÉ's "Systema Naturae" appeared, many descriptive studies of living corals were published, revealing their animal nature. During the first half of the nineteenth century pioneers such as LAMARCK and DE BLAINVILLE incorporated the results of such studies in the evolving system of classification of the animal kingdom, thus laying the foundations of the system for corals set out in several works published between 1848 and 1860 by MILNE-EDWARDS & HAIME and by MILNE-EDWARDS, and based primarily on tentacular and mesenterial features.

MILNE-EDWARDS & HAIME referred the bulk of the then known Tabulata to the Zoantharia Tabulata; two, Autopora and Pyrgia (=Cladochonus), comprised their Zoantharia Tubulosa; earlier, MILNE-EDWARDS & HAIME (1850, p. lxxvi) had referred these genera to the Alcyonaria; a few were placed in either the Zoantharia Aporosa or the Zoantharia Perforata (which today together comprise the Zoantharia Scleractinia); one genus, Syringophyllum, they included in the Zoantharia Rugosa; forms without calcareous skeletons comprised their Zoantharia Malacodermata.

After this first phase, ending in 1857, a second phase, one of reappraisal of the Tabulata, followed. MILNE-EDWARDS &
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Coelenterata-Tabulata

HAlME had included a number of recent
genera which, because their tentacles and
mesenteries could be studied, soon betrayed
themselves as other than Tabulata. First,
AGASSIZ (1858) noted the hydrozoan nature
of Millepora, but unfortunately drew the
corollary that all Tabulata were Hydrozoa.
VERRILL (1867, 1870, 1872) did not agree
with such a wholesale transfer, but noted
that the recent Poeillopora was of the
Zoantharia Perforata, and suggested that
the Favositidae were Poritidae and thus
Zoantharia Perforata. In 1872, DUNCAN
discussed these ideas but retained the Zoantharia Tabulata, removing from it to
the Alcyonaria, Chaetetes, Monticulipora,
Dania, Stellipora, and Labechia. LINDSTROM
(1873a, 1876) and DOLLF'USS (1875) entirely
abandoned the Tabulata as a distinct division of corals. LINDSTROM removed Labechia
to the Hydrozoa, and Monticulipora, Fistulipora, and some others to the Bryozoa,
moves which have met with complete acceptance, but the Favositidae he considered
Zoantharia Perforata, the Helioporidae a
special group of uncertain systematic position, and some (Fletcheria, Michelinia, and
Syringopora) he regarded as Zoantharia
Rugosa. MOSELEY (1877, 1881) studied the
recent Millepora and Heliopora, showing
Millepora to be a true hydrozoan and Heliopora an alcyonarian. But he drew the corollary that H eliolites was also dimorphic and
an alcyonarian, and tended to the view
that all Tabulata were Alcyonaria, a view
in general espoused by NICHOLSON (1879)
in a work which was widely accepted as
authoritative and which referred informally
to those tabulatan genera and families that,
by their soft parts, could not be referred to
Hydrozoa or to the Zoantharia Perforata
or Zoantharia Aporosa, or, by their septal
symmetry, to the Zoantharia Rugosa, as the
"Tabulate Corals." NICHOLSON considered
that neither the Auloporidae (=Zoantharia
Tubulosa) nor the Tetradiidae could at
that time be reliably placed in any known
order; the Halysitidae and Theciidae he
thought found their nearest allies in the
Helioporidae (in which he included Heliolites), and he considered them better removed to the Alcyonaria. The Chaetetidae
he judged genuine Actinozoa (=Anthozoa),

and thought they had more affinity with
Alcyonaria than with any other group.
This agnostic attitude became fairly generally adopted and by 1913 VON ZITTEL in
his textbook was treating two groups as
appendices to the Alcyonaria: Heliolitida
and Tabulata, the latter comprising Favositidae, Chaetetidae (including T etradium ),
Syringoporidae, Halysitidae and Auloporidae. However, BOURNE (1895), SARDESON
(1896), and several others advocated including them all in the Alcyonaria.
The third and present phase began in
the 1930's, when a new interest in Tabulata
became manifest. OKULITCH (1935, 1936b),
in considering the Tetradiidae, was impressed by the general similarity between
them and the Chaetetidae and the tubular
coenenchyme of Heliolitidae; he grouped
all these slender corals with adaxial increase
into a new subclass of Anthozoa, the Schizocoralla, of equal value with the Rugosa and
Hexacoralla (=Scleractinia); the remaining
tabulates he referred to the Alcyonaria.
WEISSERMEL (1937), however, maintained
the integrity of the Tabulata. He pointed
out that increase in the corallites of Heliolites was coenenchymal; adaxial division as
in the corallites of Chaetetidae and Tetradiidae occurred only in the coenenchymal
tubuli, and he also noted that Heliolitidae
were constantly 12-septate, whereas the
Chaetetidae and Tetradiidae were dominantly aseptate. He considered heliolitids
to be linked to the other Tabulata through
Proheliolites.
LECOMPTE (1939), after very detailed
study of Middle Devonian tabulates, also
rejected the subclass Schizocoralla. He
treated the Tabulata as a subclass of Anthozoa like Rugosa and Hexacoralla, but described no Heliolitida in this subclass. However, in 1952, he treated the Tabulata and
Heliolitida as two suborders of the order
Madreporaria of the subclass Actinanthides
of the class Anthozoa.
The dominant worker on tabulates in
this phase is SOKOLOV. Beginning with a
detailed study of Carboniferous chaetetids
(SOKOLOV, 1939), he founded a most fecund
Russian school, with large numbers of specialists, who proved the Tabulata to be an
extremely useful group in working out the

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geology of the vast regions of the USSR. Two publications by Sokolov (1950a, 1955) have been particularly influential. He distinguished four groups—Chaetetida, Heliolitida, Tabulata Communicata, and Tabulata Incommunicata. He was impressed by the distinctive features of the Chaetetida: their slender, aporose corallites with adaxial bipartite increase. He compared the uniserial longitudinal monacanthine trabeculae seen in the walls of some and the meandroid habit seen in others with the clinogonally radially fibrous longitudinal columns and irregularity of habit found in the Hydrozoa Stromatoporoida. Believing Chaetetida to be aseptate, he treated them as a distinct group with a closer relationship to the Hydrozoa than to the Anthozoa, tentatively in 1950, more definitely in 1955 and 1962.

The coenenchyme of the Heliolitida, their coenenchymal increase, their fixed number of 12 equal septa, and the trabecular construction of the septa, walls, and longitudinal elements of the coenenchyme, led him to conclude (Sokolov, 1950a, 1955) that this was a distinct group of Anthozoa and in 1962 he adopted Bondarenko's (1958, p. 202) subclass Heliolitoidea for them.

The remainder of the tabulates Sokolov (1950a, 1955) grouped in two divisions of the subclass Tabulata of the class Anthozoa, divisions Communicata and Incommunicata. Under the first he included (1950a) as orders, Favositacea with their mural pores and Syringoporacea (including sarcinulids) with their connecting tubuli or canals or tunnels. Under the second he grouped the orders Auloporacea, Halysitacea, Tetradiacea, and Lichenariacea. Later (1962c, p. 208), however, he omitted the divisional taxa as redundant, stating that these two clearly differentiated groups should not be regarded as phylogenetically valid superorders. Communication between corallites appeared and evolved independently in different phylogenetic branches. He recognized seven orders of Anthozoa, subclass Tabulata.

Sokolov (1971) appeared to feel that there might be value in once more uniting his conceptions of Tabulata and of Heliolitoidea, and more doubtfully, Chaetetoidea, as superorders in a taxon to be rated as a subclass (presumably of Anthozoa), and that might be called either Tabulata or Tabulatomorpha. He noted the common possession of baculi (=longitudinal monacanthine trabeculae) in all three, and the possession of adaxial increase in more of his Tabulata than suspected earlier.

Jones and Hill (1940) in describing the Australian heliolitids, reviewed the Heliolitida and, like Sokolov in 1950 and 1955 and Lecompte in 1952, and for much the same reasons, concluded that they were a group distinct from the rest of the Tabulata. However, Hill & Stumm (1956) were more impressed by their similarities than by their dissimilarities, and reunited the Heliolitidae with the Chaetetidae and the rest of the tabulates in the order Tabulata of the Anthozoa Zoantharia, dividing the order into six families.

Mironova (1974b, p. 110) combined the coenenchymate orders Sarcinulida, Halysitida (s.s.), and Heliolitida into a subclass Heliolitoidea.

In this Treatise, the Heliolitina and the Halysitina are united in the order Heliolitida, and this is united with the orders Chaetetida, Tetradiida, Sarcinulida, and Auloporida (comprising Auloporicae and Syringoporicae) to form the subclass Tabulata of the Cnidaria Anthozoa, for reasons set out below.

**SYSTEMATIC POSITION**

For Tabulata we have only skeletons from which to deduce systematic position. The primary evidence is therefore presented by:

1) The skeleton as a whole. This is calcareous and compound, and thus invites comparison with Cnidaria, Bryozoa, and Archaeocyatha. The distinctive inner and outer walls and porosity of the septa, tabulae, and walls of the latter speak against any assignment of the Tabulata to the Archaeocyatha. Bryozoa commonly show polymorphism, absent in Tabulata, and their zooecia are characteristically more slender than the corallites of Tabulata. Of cnidarians, Scleractinia and Rugosa resemble Tabulata in having fasciculate and massive (dominantly cerioid) coralla; the Tabulata have two genera that are homeomorphs of Octocorallia (=Alcyonaria), Heliolites with the coenothelialian Helipora, and Syringopora.
with the stoloniferan *Tubipora*. There is no real resemblance between Tabulata and the coenostea of the Hydrozoa (Hydractinia and Stromatoporoidea).

2) Microstructure and ultrastructure. Considerable postmortem alteration is characteristic of Paleozoic Tabulata; nevertheless, traces of primary microstructure and even ultrastructure may be found in less altered parts of the skeletons. The currently accepted reconstruction of the microstructure (HILL & STUMM, 1956, p. F446; KATO, 1968b, p. 54) and ultrastructure (OEKENTORP & SORAUF, 1970, p. 292; OEKENTORP, 1972, p. 41) of the thickening of transverse skeletal elements is a fibrous, radiolamellar microstructure and a microtufted radiolamellar ultrastructure; in the longitudinal skeletal elements this is modified into a trabeculate microstructure. These types are known elsewhere at present only in Scleractinia and Rugosa, and perhaps in the Octocorallia (the coenothecalian *Heliopora* only). The ultrastructure of the cyclostomatous and trepostomatous bryozoan wall appears quite different; it lacks trabeculae (unless pseudopunctae represent trabeculae altered by diagenesis) and is more like that in brachiopods, since the growth lamellae consist of layers of platy crystals of calcite alternating with thinner layers of protein or chitin (TAVENER-SMITH & WILLIAMS, 1972, p. 122). Research in biocrystallization is in its infancy, but as far as it has gone, it appears to deny that Tabulata could be Bryozoa, and to affirm that Tabulata could be Anthozoa Zoantharia.

3) The corallite. a) The plates. Longitudinal skeletal elements dividing the individual calcareous conical skeletons radially are known otherwise only in Rugosa and Scleractinia; they are trabeculate in all three; the wall is composite, of trabeculae and nontrabeculate fibroradiate growth lamellae; the tabula in many Tabulata is extremely thin and may correspond only to the base plate of the tabulae of Scleractinia, but in those Tabulata where it is thick the layers of thickening are identical with those of Scleractinia and Rugosa. The septa are all of one order of size in Tabulata, except in some Theciidae and some Cyrtophyllidae, and occasionally in the Micheliniiidae, where longer and shorter septa alternate. Except in Heliolitina and Halysitina, and in some Favositina, where the number is 12, the septa increase in number as the corallite increases in diameter.

b) The symmetry of the corallite. This is indicated by the arrangement of its septal elements, which appears to be radial but could be radiobilateral. A bilateral arrangement is suggested in some, but no order of insertion has yet been determined. The symmetry is consistent with a position within the Anthozoa, or indeed within the Zoantharia, but excludes inclusion of Tabulata in either Scleractinia or Rugosa, although a plane of bilateral symmetry is acquired in the calices of Alveoliticae and some Favositina.

c) Increase. The dominant type of increase in Tabulata is lateral, as it is in the Zoantharia Rugosa. A second type, longitudinal bipartite and quadrupartite increase by the adaxial growth of opposed new walls (Chaetetida and Tetradiida) or septal combs (Alveoliticae) seems peculiar to Tabulata; a similar effect is created in some trepostomatous Bryozoa, but in these the wall dividing a new zooecium from an old one is a complete partition from the beginning.

Thus, from the skeletal characters, it seems appropriate to consider the Tabulata as exoskeletons secreted by polyps and, therefore, to refer them to the Cnidaria Anthozoa. Whether they should be regarded as a subclass of Anthozoa or an order of the subclass Zoantharia is arguable and depends on subjective judgments on the relation of septal elements to presumed mesenteries in the polyps, and on their order of insertion. If we judge that there were six protosepta, related to the first six mesenteric pairs, and that subsequent mesenteries were inserted in pairs, then we would refer the Tabulata to the Zoantharia, for such an arrangement is diagnostic of Zoantharia. This was assumed in the first edition of the *Treatise*; however, a considerable consensus has subsequently developed that it is better to treat the Tabulata as a subclass of Anthozoa as was done by SOKOLOV (1962c), and perhaps first suggested by ABEL (1920). In the absence of studies on septal insertion in the Tabulata, this edition of the *Treatise* joins the consensus.

FLÜGEL (1976a, p. 405) has recently spec-
ulated that the formation of wall pores in Favositidae may be similar to that of astro­
rizae in Sclerospongiae, and that the Favor­
sitidae may thus be considered to be Porifera.

**SUBDIVISIONS**

As set out above in the history of the study of Tabulata, there has been consider­
able discussion and uncertainty on the sys­
tematic position of the various groups which came to be distinguished among them.

Morphologically simplest are the groups represented by *Chaetetes* and *Tetradium*. Their compound skeletons of slender pris­
matic tubes are appropriate to either Tabu­
lata or trepostomatous Bryozoa; or they
might possibly be solenoporacean algae. The microstructure and ultrastructure is insuffi­
ciently known.

In *Chaetetes* itself, illustrations provided by STRUVE (1898) and by LAFUSTE and
FISCHER (1971) show an aporose common wall between tubuli constructed of laterally
contiguous, clinogonally fibrous, longitudi­
nal trabeculae, and no continuous median
suture in the wall. Such a structure is seen
in the recent coenothecalian octocoral *Helio­
pora*; also, each trabecula is like a single
column in some Hydrozoa Stromatoporoi­
de. However, in thick-walled chaetetids, like
*Litophyllum*, the fibers appear to radi­
ate from the entire midplane of the wall.
Septal spinules are present in *Rhaphidopora*
NICHOLSON & THOMSON and in the Cret­
199 (51)]. FISCHER considered that the combination of longitudinal trabeculae and
latilaminae and sometimes meandroid ar­
rangement of tubuli confirmed the place­
ment of Chaetetida by SOKOLOV in the
Hydrozoa next to the Stromatoporoidea.
He considered the spinules of *Acanthochaetetes*
to be pseudoseptal; but they do not appear to me to differ from favositid
spinules, or from those of the Middle De­
vonian *Chaetetes lonsdalei* ETHERIDGE and
FOORD, as figured by LECOMPTe (1939, pl.
21, fig. 1,2). SOKOLOV (1962c) considered that the Chaetetida should be removed from
the Tabulata because they lacked septal ele­
ments and had adaxial longitudinal bilateral
increase which when incomplete gave mean­
droid coralla, and because of the trabecular
structure of the wall, which in some con­
sisted of discrete pillars. However, in my
opinion, chaetetid spinules, though not gen­
eral in occurrence, are like those of Favor­
sitida; adaxial longitudinal increase by
growth of septal combs occurs in Alveo­
liticae, and quadripartite adaxial longitudi­
nal increase by adaxial growth of two pairs
of opposed walls occurs in Tetradiida, which
SOKOLOV regarded as Tabulata; and a tra­
beculate wall structure is seen in parts of
some *Trabeculites*. Although all these fea­
tures serve to unite the chaetetids as a group, they do not show that the group is hydro­
zoan rather than tabulatan.

The Tetradiida are very like the Chaetetida in having slender aporose walls. The
walls are aspinulate and in my experience are so recrystallized that I have not been
able to deduce their original microstructure. Their type of increase differs from that
found in Chaetetina only in being quadri­
partite rather than bipartite. The absence
of mural pores serves to distinguish both
groups from the Favositida, but should
not require their separation from the Tabu­
lata, since an aporose condition is seen in
the walls of early Sarcinulida and in many
Auloporicae.

I regard both Chaetetida and Tetradiida as Tabulata.

The Heliolitina and Halysitina are herein
united in the order Heliolitida of the Tabu­
lata, though JONES & HILL (1940, p. 189)
had earlier considered the Heliolitina to be
a separate zoantharian group apart from the
Tabulata. They have in common 12 equal
septal combs to each corallite and a coenen­
chyme that may be dissepimentate or tubu­
lose or both. Their microstructure is basi­
cally the same as that of the Sarcinulida, the
Favositida, the Auloporida, the Scleracti­
ia, and the Rugosa; their ultrastructure
has not yet been reported. The three super­
families of the Heliolitina are the Helioliti­
cae, the Proporicae, and the Coccoseridicae.

Of the remaining Tabulata, the Sarcinu­
lida, the Favositida, and the Auloporida,
the Sarcinulida as understood herein in­
cludes the Billingsariidae and *Nyctopora*,
both regarded as “Lichenariida” by SOKOLOV
(1962c, p. 247). The “Lichenariida” is re­
jected as an order, not only because the
characters of *Lichenaria* itself require eluci­
The Favositida, the dominant order of Tabulata, are divisible into two major divisions, the Favositina and Alveolitina, which are considered suborders, although there are a few genera such as *Oculipora* whose allocation to one or the other of the suborders is arguable. The ramose Favositina with peripheral stereozones, the Pachyporicae, are herein considered a superfamily rather than a suborder, because there are several genera such as *Kolymopora*, *Pachyfavosites*, and *Striatoporella* with characters placing them between the extreme favositicans and the extreme pachyporicans.

The Auloporida are divisible into two major groups, the Auloporicae and the Syringoporicae, the superfamily status being preferred because of lack of sharp dividing lines between them.

**BIOSTATISTICS AND NUMERICAL TAXONOMY**

The small number and simplicity of the architectural elements of the skeletons of the Tabulata make it very difficult clearly to distinguish one species from another and one genus from another. This same simplicity and scarcity of morphological features, however, make it possible to examine them biometrically and to analyze the results statistically by punch card systems, by electronic calculating machine, and by computer, but so far only a few biostatistical works have appeared. A punched card system to encode data on tabulate coral morphology and to carry written and pictorial data on species has been described by Preobrazhenskiy (1967a, p. 121).

Work so far has concentrated on Favositina. Boroviczeny and Flügel (1962, p. 7) concluded that biometry forms an exact basis for separation and definition of species in *Favosites*. Tesakov (1968, p. 14; 1971a, p. 103), on the other hand, concluded that the quantitative indices of a favositid character depended largely on individual peculiarities of the corallum and on ecological conditions and cannot be used as key criteria in establishing species; he considered the role of numerical indices to be grossly overstated in contemporary practice, but in his diagnoses he included numerical values that indicate the established minimum and maximum limits within which the various formae of a species existed. Lele­shus (1968, p. 50; 1969, p. 50; 1970c, p. 34; 1971b, p. 64) has reported the taxonomic results, for species of *Favosites* and *Paleo­favosites*, of his evaluation of degrees of difference, and of his subsequent comparisons of diagnoses, descriptions, and photographs, taking geochronological and paleogeographical features into consideration.

Biometric work, electronic machine calculations, and computer programming are laborious, but if they can be proved to give results of consistent stratigraphic value, then, no doubt, tabulatan systematists will use them.

**OUTLINE OF CLASSIFICATION OF THE SUBCLASS TABULATA**

The following outline of the subclass Tabulata summarizes taxonomic relationships, geologic occurrence, and numbers of recognized genera and subgenera in each suprageneric group from order to subfamily. A single number refers to genera; where two numbers are given, the second indicates subgenera additional to nominotypical ones.

  - Moskoviinae, 1. Carb.

- **Order Tetradiida, 5.** M.-U.Ord.
  - Paleoalveolitidae, 1. M.Ord.

- **Order Sarcinulida, 28;1.** Ord., M.Ord.-Dev.
  - Theciidae, 9;1. L.Sil.-L.Dev., M.Dev.
Tabulata—Outline of Classification—Ranges of Taxa

Favositidae, 32. M.Ord.-L.Perm.
Favositinae, 15. U.Ord.-M.Dev.
Pseudofavositidae, 2. U.Perm.
Syringolitidae, 2. L.-M.Sil., L.Dev.
Favositids with commensals, 5.
Multisoleniidae, 5. U.Ord.-? L.Dev.
Antherolitinae, 1. M.Sil.
Michelinidae, 14;1. U.Sil.-U.Perm.
Granulidictyinae, 3;1. L.-M.Dev.
Vaughaniidae, 1. L.Carb.
Palaeacidae, 3. L.Sil., L.Dev.
Alveolitidae, 17. L.Sil.-U.Dev.
Alveolinidae, 8. L.Sil.-U.Dev.
Caliaporinae, 6. L.Sil., U.Sil.-M.Dev.
Natalophyllinae, 3. L.-M.Dev.
Family uncertain, 1.
Order Heliolitida, 76. M.Ord.-L.Perm.
Suborder Heliolitina, 65. M.Ord.-M.Dev.
Stelliporinidae, 8. U.Ord.-M.Dev.
Superfamily Proporicae, 32. M.Ord.-L.Dev.
Proheliolitidae, 5. U.Ord., U.Sil.
Pycnothelidae, 1. L. or M.Sil.
Family uncertain, 2.
Kozlowskiocystiidae, 1. M.Dev.
Auloheliidae, 1. U.Perm.
Syringoporidae, 10. U.Ord.-L.Perm.
Periphaceloporidae, 1. M.Dev.
Thecostegitidae, 6. U.Sil.-U.Carb.
Chonostegitidae, 1. L.-M.Dev.
Order uncertain, 2.

RANGES OF TAXA

Only records accompanied by illustrations of type specimens and type species, myself reasonably sure that the generic identifications are correct have been incorporated in the range data that follow the diagnosis of each genus. Nevertheless, these data are still defective. Preparation of the diagnoses from the literature has made it clear to me that the greatest impediments to precise taxonomy are the incompleteness of descriptions and imperfection of illustrations from which I have been able to make and the lack of analyses of variation in topotypes. A very great improvement in our knowledge would result from critical redescriptions and new figures by specialist officers of museums housing such types. Without precise taxonomy, little of real value can be contributed to current debates on plate tectonics and continental drift. Uncritical use of “faunal lists” is merely stultifying.

The stratigraphic distribution of orders, suborders, superfamilies, families, and subfamilies of Tabulata recognized in the Treatise is indicated graphically in the tables that follow (compiled by Jack D. Keim).
Table 3. Stratigraphic Distribution of Tabulata.
### Table 3. (Continued)

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# Table 3. (Concluded)

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SYSTEMATIC DESCRIPTIONS: TABULATA

Subclass TABULATA
Milne-Edwards & Haime, 1850


Corallum compound, with very slender corallites; septa short, equal, in many genera and in all Heliolitina and Halysitina 12 in number, each commonly a radial longitudinal series of spines; walls with pores in many suborders; tabulae commonly complete, funnel-shaped in some; coenenchyme may separate the tabularia in Helio­

lites; holotheca present on encrusting sur­
face; corallites exceptionally slender; where original microstructure of common walls is retained it is tufted, with tufts arranged
clinogonally in single ranks of longitudinal
planes that may or may not be marked by
denser sclerenchyme; tufts aragonitic in Tri­
assic "Bauneid"; walls typically aporose but pores present in Carboniferous Favorisca­
tetidae; septa absent, but septal spines
present in Cretaceous Acanthochaetetes; in­
crease bipartite (and commonly equal), complete, or in meandroid forms, incom­
plete, or also by offsets arising intramurally,
as in Jurassic Bauneia, or basally, as in
Chaeetetella (Chaetetiporella). Paleozoic
range: Ord.; ?L.Sil.-U.Perm. [For post­
Paleozoic range, see page F518ff.]

Systematic Position.—The classification of chaetetoids adopted herein can only be re­
garded as tentative; in hand specimens and
even in thin section they are homomorphic with members of several other orders and
or­
classes, not only of Coelenterata (Tabulata
and Stromatoporoidea), but also of Porifera
(Sclerospongea), Bryozoa (Trepostomata)
and Thal­lophyta (Solenoporaceae). I am regard­ing them as Anthozoa Tabulata for

lack of a better choice. The characters con­sidered proper to the unit can be varied by
the addition or subtraction of individual
genera so as to make any particular place­
ment more or less persuasive.

Axial, bipartite increase, equal and un­
equal, complete and incomplete, is com­
monly regarded as an essential diagnostic
feature; it occurs, with different structural
detail, in some members of the Scleractinia,
Rugosa, and Tabulata Alveolitina, but in
these groups is very subordinate to other
modes. Other modes may perhaps occur
subordinately in Chaetetida, even domi­
nantly in some Mesozoic species, but satis­
factory demonstrations are yet lacking in
Paleozoic genera.

Septa and any plane of symmetry conse­
quently upon their manner of insertion are
commonly considered absent in Chaetetida; yet spines have been described in some De­
vonian forms ("Rhiphidopora" phase of
Pachythecu Schlüter, 1885b) and in the
Jurassic-Cretaceous Acanthochaetetes
Fischer, 1970. This apparent absence of
septa has been regarded as a strong reason
for removing the Chaetetida from the An­
thozoa.
Absent of porosity in the walls distinguishes all except one doubtful Paleozoic family (Desmidoporidæ PresoBrāžHensKrey, 1968) of Chaetetida and some Mesozoic species that I regard as only doubtful members of the suborder. Tabulæ are common to many orders. Latilaminae are notable in many chaetetoids as in many stromatoporoids, tabulatans, polyzoans, and solenoporaceans.

The possible presence of astrorhizæ in Chaetetida has been discussed, most recently by Hartman and Goreau (1972), Stearn (1972), and Cuif et al. (1973). Cuif et al., p. 2475, have described three principal types of astrorhizal structures in Mesozoic species, some of which they refer to the Varioparti­tidae (herein not considered Chaetetida) and others to the Acanthochaetetidae. Star-shaped groupings of corallites dividing by adaxial bipartite increase found in the Late Ordovician Schizolites PresoBrāžHensKrey, 1968, are superficial homomorphs of the astrorhizæ of Stromatoporoidea.

Microstructure may well prove determinant. Unfortunately, the walls appear particularly subject to diagenetic alteration, and very considerable experience of diagenesis in carbonate rocks is essential for the systematist who would use this character successfully. The starting point must be Struve’s (1898) observation that the walls of a specimen referred to the type species of Chaetetes, C. cylindraceus, are of clino­gonally fibrous columns (=baculi, =monacanthine trabeculae). These are described as in a single rank; and as such they resemble the monacanths in parts of the walls of the Ordovician Trabeculites Flower, 1961, and the Silurian Nodulipora Lind­ström, 1873a, in which, however, segments of wall with fibers directed upward and inward from a median plane into the lumina may in part take the place of solely monacanthine walls.

Cuif (1974, p. 142) remarked that the fibers of aragonite in the skeletons of both recent and Triassic sclerosponges are arranged in spherulites, not in trabeculae; their fibers radiate from centers (points), not from axes of calcification; this distinguishes their skeletons from the trabecular skeletons of Tabulata and Rugosa, and from many Stromatoporoida. Chaetetida have trabecular walls, which militates against classifying them as a fossil order of sclerosponges as Hartman and Goreau (1972, p. 145) proposed. It does not appear that fibrous structures such as trabeculae or spherulites occur in Solenoporaceae, in which the walls are presumed to have been originally finely granular, or in Bryozoa.

In none of the thin sections of Chaetetida that I have studied are there any indications of the siliceous spicules identified in the coralline sponge Ceratoporella nicholsoni (Hickson, 1911) by Hartman and Goreau (1970, fig. 17), or of their supposed pseudomorphs in the stromatoporoids Parallelopora mira Newell and Stromatopora japonica Yabe, also figured by Hartman and Goreau (1970, fig. 15, 16); but this is not to say that deliberate search would not find them. Hartman and Goreau (1970, p. 228) drew attention to the virtual identity of surface features and figured transverse sections of the Jurassic genus Vario­pari­etes Schnorf­Steiner, 1963, with those of C. nicholsoni, and noted that serious consideration should be given to the possibility that many genera now assigned to the Chaetetida may indeed be sponges, a possibility emphasized by Stearn, 1972, p. 386. It does not seem to me that evidence has yet been adduced that should cause the transfer of any of the Paleozoic genera listed below under Chaetetida to the Porifera Sclerospongiae Hart­man and Goreau, 1970, p. 228. Should pseudomorphs of siliceous spicules appear in microstudies in the future, transfers might then reasonably be made.

On the whole it seems to me that the Paleozoic genera listed below as Chaetetida share common diagnostic features and that, as presently known, these features associate them more closely with Anthozoa Tabulata than with any of the other suprageneric taxa to which it has so far been suggested that they should be assigned.

Family CHAETETIDAE
Milne-Edwards & Haime, 1850
Ceriod or partly meandroid coralla of very slender corallites; new corallites formed by basal increase—paramount in extensiform coralla, e.g., Chaetetella (Chaetetioporella)—or more commonly by equal or subequal bipartite division effected by growth from the walls of opposed radial longitudinal plates; meandroid areas develop when these dividing walls do not meet at the axis; tabulae thin, septa absent; but spinules present in Cretaceous Acanthochozetetes; mural pores absent; wall microstructure of tufted microfibers; in ceriod (or meandroid) coralla, walls may be amalgamated with or without distinctive median plane, or be constructed of a single series of discrete but contiguous monacanthine trabeculae. U.Ord.; ?Sil.-?L.Dev.; M.Dev.-Perm. [For post-Paleozoic ranges, see pages F519-F520.]

Subfamily CHAETETINAE
Milne-Edwards & Haimé, 1849

[Chaetetinae Milne-Edwards & Haimé, 1849b, p. 290, tribe]

Corallum ceriod, corallites prismatic; walls amalgamated without distinctive median plane, or constructed of a single series of discrete but contiguous monacanthine trabeculae. U.Ord.; ?Sil.-?L.Dev.; M.Dev.-Perm.

Chaetetes Fischer von Waldheim MS in Eichwald, 1829, p. 197 [*C. cylindraceus*; SD Oakley, 1936, p. 441; possibly in Eichwald Coll., L.G.U., Leningrad; Lang, Smith, & Thomas, 1940, p. 35, considered *C. cylindraceus* congeneric if not conspecific with *C. radians* Fischer von Waldheim, 1830 and 1837, p. 160, which was erroneously chosen as type species by Milne-Edwards & Haimé, 1850, p. 131] (Chaetetes Michelin, 1844, p. 112, nom. null.; Chaetetides Strand, 1928, p. 34, nom. nov. pro Chaetetes Fischer von Waldheim, 1837, p. 159, in case this should prove to be different from Chaetetes Fischer von Waldheim MS in Eichwald, 1829, p. 197 (Lang, Smith, & Thomas, 1940, p. 35, considered Chaetetides unnecessary); ?Dania Milne-Edwards & Haimé, 1849b, p. 261 (type, D. huronica, M.; *Stokes* Coll., ?in Paris; Sil., Drummond I., L. Huron, N. Am.), an uncatapulted specimen labeled *D. huronica*, Drummond I., which may have been used for the schematized Milne-Edwards & Haimé, 1851, pl. 18, fig. 2b, was seen in 1975 by Hill in the Milne-Edwards & Haimé Coll. of Tabulata in MN, Paris. It has, however, corallites of very large (up to 6.5 mm.) diameter, whereas Milne-Edwards & Haimé give diameter as scarcely 1 mm.; *Danaia Scudder, 1882, p. 101, nom. null.* Corallum massive, subglobular or hemispherical, commonly showing narrow bands of slower growth along which it readily splits into concentric sheets; corallites radially disposed, regular, long, prismatic; common walls without conspicuous median suture line and composed of longitudinal trabeculae; increase frequent, axial, bipartite and complete; tabulae horizontal; septal spines absent; mural pores absent. ?Sil., N. Am.; M.Dev.-Carb., Eu.-Asia; M.Dev.-Perm., N. Am.; Perm., N. Am.-Asia.

C. (Chaetetes). Corallites polygonal, not rounded-polygonal, in transverse section. ?Sil., N. Am. (Mich.); M. Dev., Asia(Kuzbas-Kazakh.); M. Dev.-Carb., Eu.(USSR-G. Brit.)-Asia(C.Asia-Arctic-China-Japan-Indoch.); M. Dev.-Perm., N. Am.; Perm., N. Am.-Asia (Japan-Karakorum).—Fig. 330,3c. *C. (C.) cylindraceus* M.Carb., environs of Moscow, ext. view, X3 (Eichwald, 1829).—Fig. 330,3a,b. C. (C.) tenuiradiatus Sokolov, Visean (Serpukhov stage), NW part Moscow Basin, R. Prishka; a,b, transv., long. secs., X4.0 (Sokolov, 1955).

C. (Boswella) Sokolov, 1939, p. 411 [*Chaetetes boswelli* Heritsch, 1932, p. 221; OD; ?thin sections, P1019, UG, Graz, specimen destroyed *vide* Heritsch, 1932, p. 221]. Corallum hemispherical, corallites radially arranged; differs from *C. (Chaetetes)* by having irregularly thickened common walls to its exclusively prismatic corallites, which commonly have rounded-polygonal and somewhat corrugated transverse outline interiorly [see also Weyr, 1967b, p. 1156]. M. Dev.(rare)-Carb., Eu.(Serbia-Ger.-Moscow Basin-Dobnas-Ural)-C. Asia.—Fig. 330,2a,b. *C. (B.) boswelli* (Heritsch), L.Carb.(Visean), W. Serbia, Ivovik; a,b, transv. secs., X0.7 (Heritsch, 1932).—Fig. 330,3a,b. *C. (B.) boswelli* Heritsch, 1932, p. 221. Corallum small, sheetlike to lenticular; corallites rather closely tabulate, with incomplete, bipartite increase creating open meandering chambers; walls moderately thick. [Insufficiently known; originally considered stromatoporoid.]. U.Carb.(Wu-shan Ls.), Asia(China, near Liang-ho-k'ou, E.Szechwan).

Chaetetella Sokolov, 1962c, p. 172 [*C. filiformis*; OD; ?type in Mus. Paleont. Lab., L.G.U., Leningrad *vide* Sokolov, 1950b, p. 70] (Chaetetella Sokolov, 1939, p. 411, nom. nud., genus diagnosed but no species described or figured; Chaetetella Sokolov, 1950b, p. 70, nom. nud., type species designated but not described or figured). Corallum thin, in sheets with basal holotheca; increase dominantly basal, offsets arising at periphery of corallum; above base, corallites parallel, very slender, with very sparse axial bipartite increase; mural pores and septal spines absent; tabulae thin, horizontal. U.Ord., Asia(NE.USSR).—N.
Fig. 330. Chaetetidae (p. F508-F511).
Am.(Arctic Can.); M.Dev., Eu.(Urals)-Asia(C. Asia-Kuzbas); Carb., Eu.(Moscow Basin-Donbas-Timan-Urals-Brit. I.-France)-Asia(C. Asia-China); Miss.-Penn., N.Am. [Fide Norford, 1971, p. 4, Arctic Canada Ordovician species is *Chaetetipora.*]

C. (Chaetetella). Corallum cerioid, not meandroid. U.Ord., Asia-?N.Am.; M.Dev., Eu.-Asia; Carb., Eu.-Asia; Miss.-Penn., N.Am.—Fig. 331,1a,b. *C. filiformis*; L.Carb. (Viscan, Oka substage, Mikhaylov horizon), R. Okhomlya, NW. part of Moscow Basin; *a,b* long., transv. secs., ×6 (Sokolov, 1962c).

C. (Chaetetiporella) Sokolov, 1950b, p. 81 [*C. crustacea*; OD; ?coll. 7825, TsGM, Leningrad] [=C. (Chaetetiporella) Sokolov, 1939, p. 411, nom. nud.]. Corallites large, of irregular and meandroid outline in transverse section. L.Carb.(Viscan), Eu.(Moscow Basin, Donbas).—Fig. 331,2a,b. *C. (C.) crustacea; a, Voronezh distr., Zhuravka, long. sec., ×4; b, Kurst distr., Valuyki, transv. sec., ×4 (Sokolov, 1950b).

Kim, & Chow, 1978, p. 235 (type, *S. insolens*, OD; †Gct 554-555, GB, Guiyang; M.Dev., Guanziyao, Guizhou [Kweichow]). Corallum massive, large; common walls of normally prismatic corallites regularly thickened, especially at angle of prisms, so that interior transverse outline is smoothly rounded or oval; mural pores absent; septal spines absent; tabulae horizontal, may be at same levels in neighboring corallites; increase bipartite, equal or unequal, dividing walls growing toward one another from opposite sides of corallite, or of angle between faces of prisms. M.Dev., Australia (New S.Wales-Queensl.) - Eu. (Belg.-Urals-U.K.-Ger.) - Asia (Kazakh.-C. Asia-Kuzbas-Indoch.-Kweichow).---Fig. 330,1a,b. *L. grandis* (Sokolov), Eifel., USSR, Vorkuta; a,b, long., transv. secs., X4.0 (Sokolov, 1955; photographs courtesy J. Jell).---Fig. 330,1c. *L. konincki* (Etheridge & Foord), Burdekin F., N. Queensl., Burdekin Downs, sec., X4.0 (Hill, Playford, & Woods, 1967; UQF6906).

**Pachytheca** Schlüter, 1885b, p. 144, *non Pachytheca* Hooker, 1861, a plant [*P. stellimieans*; M; syntypes B8a,b, 204, Schlüter Coll., IP, Bonn; = *Calamopora stromatoporoides* Roemer, 1883, p. 459] ["=*Rhaphidopora* Nicholson & Foord, 1886, p. 392 (type, *Calamopora erinalis* Schlüter, 1880b, p. 281, OD; syntypes 192, Schlüter Coll. (26), IP, Bonn; M.Dev., Hillesheim syncline, Eifel, Ger.), see Schlüter, 1889, p. 401; *Raphidopora* Yabe, 1910, p. 4, nom. null.; *Rhaphidopora* Stearn, 1972, p. 375, nom. null.]. Massive, tabular; corallum of two growth-types (?layers), one of thin-walled, six-sided very slender prismatic corallites, tabulate and without mural pores [but with septal spines in *Rhaphidopora erinalis* var. *amleata* Nicholson & Foord, 1886, p. 392], the other of similar corallites, with walls so thickened as to fill the lumina with yellow sclerenchyme. [See Yanet, 1965, p. 17. Also see Hartman & Goreau, 1970, p. 228, who drew attention to morphological similarities to *Merlia*, a recent coralline sponge.] M.Dev., Eu.(Eifel, Ger.-U.K.-N.Urals) .---Fig. 331,3a-e. *P. stellimieans*, Ger.; a, ext. view of fragment, showing thick-walled layer above and thin-walled layer below, X1; b, oblique transv. sec. showing thick-walled layer below, thin-walled layer above, X18; c, long. sec. through thick-walled layer, X18 (Schlüter, 1889).---Fig. 331,3d,e. *P. crinalis* (Schlüter), Ger., Soetencich, Eifel; d,e, transv., long. secs., X12 (Nicholson & Foord, 1886).

*Spongiothecopora* Sokolov, 1955, p. 496 [*S. fallax*; OD; †152, coll. 599, VNIIGRI, Leningrad] [= *Spongiothecopora* Sokolov, 1939, p. 410, nom. nud.]. Like *Chaetetes*, with prismatic corallites with axial bipartite increase and tabulae, but walls without trabeculae or median suture line and possessing a fine, irregularly reticulate or spongy structure. [Insufficiently known, one species only.] L.Carb.(Visean), Eu.(Moscow Basin).---Fig. 332. Chaetetidae (p. F511).


**Staphylopora** Le Maitre, 1956b, p. 1654 [*Favosités? chaetetiformis* Le Maitre, 1947, p. 71; OD; †148 (or 149), Le Maitre Coll., GFC, Lille]. Nodular colonies of slender prismatic corallites, increase axial, bipartite, subequal, complete; common walls with median dark plane; septal spines sparse, mural pores sparse, tabulae complete, thin; sparse, rounded cellules (?commensals) present in groups, apparently replacing normal walls. [See Fontaine, 1966a, p. 11. Not well known.] L.Dev.-M.Dev., Australia (Queensl.-New S.Wales); M. Dev. (Eifel.-Givet.). N. Afr. (Moroc.) - Asia (Indoch.).---Fig. 332,1a-d. *S. chaetetiformis* (Le Maitre), holotype, Givet., Moroc., Ouhalane, Tafilelt; a,b, long., transv. secs., diag., gr, grape-like cellules in platoons, la, radial longitudinal lamina indicating axial increase, po, mural ?pore (Le Maitre, 1956b); c,d, long., transv. secs., X8.0, X3.2 (Le Maitre, 1947).
Subfamily CHAETETIPORINAE Sokolov, 1955

[Chaetetiporinæ Sokolov, 1955, p. 99]

Coralla cerioid or in part meandroid; in some common walls a weakly distinctive
Tabulata—Chaetetida

median plane; wall trabeculae may fail to remain contiguous; increase bipartite, may be incomplete, whereby meandroid regions develop; tabulae thin; septa absent; mural pores absent. \*U.Ord.; M.Dev.; Carb.

Chaetetopia Strüve, 1898, p. 93 [\*C. confluens; SD Sokolov, 1950b, p. 62; \*in uncataloged old coll. of Strüve in LGI, Leningrad \*fide Sokolov, 1950b, p. 62] [\*=Fistulimunina Sokolov, 1947b, which see]. Differs from Chaetetes by the irregular curving meandroid cross section of the corallites; increase bipartite, for the most part incomplete; tabulae in meandroid corallites may be incomplete and pass into tabellae. \*U.Ord., N. Am.(Ellesmere I.-Alaska); M.Dev., USSR(URals-Vorkuta-C.Asia); Carb., Eu.(G.Brit.-Ger.-URals-Moscow Basin-Donbas)-Asia(C.Asia-Viet Nam-China).—\*Fig. 333,3a,b. \*C. losoxonema Sokolov, holotype, L.Carb.(up. Visean), Ukrainian SSR, Voroshilovgrad distr., Velikotskoe; a,b, long., transv. secs., \*X4 (Sokolov, 1950b).

Fistulimunina Sokolov, 1947b, p. 957 [\*F. caver­nosa; OD; \*in coll. 7825, TsGM, Leningrad; lectotype by Sokolov, 1950b, p. 103] [\*=Chaetetopia Strüve, 1898, which see]. Corallum convex or encrusting, basal holotheca may be well developed; walls with distinct longitudinal swellings representing trabeculae that may become discrete, and are commonly with axial canal [\*zone of recrystallization]; mural suture may be present; pseudoseptal processes numerous; adaxial increase always incomplete, creating open meandrine chambers; tabulae horizontal or incomplete. [Insuffi­ciently figured.] L.Carb.(Visean), Eu.(Donbas-Moscow Basin).—\*Fig. 333,1a,b. \*F. caver­nosa, R. Don, Kazanskaya; a,b, transv., long. secs., \*X4 (Sokolov, 1947b).

Subfamily MOSKOVIINAE Sokolov, 1955

[Moskoviinae Sokolov, 1955, p. 100]

Coralla subcerioid, corallites cylindropris­matically, with narrow longitudinal spaces where contiguity is incomplete; increase axial bipartite, complete. Carb.

Moskokia Sokolov, 1950b, p. 83 [\*M. distincta; OD; \*in coll. 7825, TsGM, Leningrad] [=Mos­kokia Sokolov, 1939, p. 410, nom. nud., genus summarily described and figured but no species named]. Corallum spherical; corallites radially arranged, partly contiguous, with median suture line, partly free, leaving calices rounded-polygonal; interstitial longitudinal spaces; walls fully inde­pendent, conspicuous median suture line which commonly diverges at corners of corallites; increase axial bipartite, complete; tabular horizontal; septal spines and mural pores absent. [Confirmation that the “interstitial spaces” are not artifacts of diag­enesis of the common wall is desirable.] Carb., Eu.(Moscow Basin-Urals-Timan)-C.Asia.—\*Fig. 332,2. \*M. distincta, holotype, ?U.Carb., Moscow Basin, Voronezh distr., Ol’khovsk reg., Kostovo, transv. secs., \*X4 (Sokolov, 1962c).

Family CRYPTOLICHENARIDAE Sokolov, 1959

[Cryptolichenariidae Sokolov in Sokolov & Mironova, 1959, p. 1190]

Corallum cerioid and nodular or phace­loid with very closely spaced and very slender corallites without connecting tubuli; walls aporose; aseptate; increase axial bipartite, effected by conjunction of opposed axial edges of radial longitudinal laminae arising in symmetrical pairs; tabulae com­plete, commonly horizontal. Ord.

Cryptolichenaria Sokolov, 1955, p. 233 [\*C. miranda; OD; 192, coll. 599, VNIGRI, Leningrad]. Corallum cerioid, rather small, spreading or nodular; corallites slender, radially diverging, of irregularly polygonal or somewhat rounded section; walls fused, of uniform thickness; increase bipartite, two opposed wall processes grow to join one another from either side of an angle of a corallite; septal spines and mural pores absent; tabulae thin, slightly sagging, numerous to absent [see Sokolov & Tesakov, 1963, p. 90]. L.Ord.-(up. Chunya), Asia(N. Sib. Pliat.-?)N.Am.(Can.-Texas-Md.); U.Ord.-(Ashgill.), Eu.(Est.).—\*Fig. 334,1a,b. \*C. miranda, L.Ord.(up. Chunya), USSR, N.Sib.Plat., R. Moyero; a,b, transv., long. secs., \*X8 (Sokolov & Tesakov, 1963).

Amsassia Sokolov & Mironova, 1959, p. 1151 [\*A. radugini Mironova in Sokolov & Mironova, 1959, p. 1152; OD; 1511 A-2, coll. 902, SNIIIGIMS, Novosibirsk]. Corallum phacelo­crioid, lumpy nodular or hemispherical, of medium size; corallites long, uniform, either completely adpressed and of polygonal transverse section, or more or less adjoining and of oval outline with triangular spaces between corallites; walls comparatively thin, quite independent, compact, homogeneous, without pores or connecting tubuli; septa absent; increase bipartite, by conjunction of axial ends of symmetrically arranged wall processes; commonly one of the processes is significantly longer than the other; tabulae horizontal, complete, for the most part rare. [Possibly tetradi­nian]. M.Ord.-U.Ord., Asia(Shoria Mts.-Salair­Altay Mts.-N.Kazakh.).—\*Fig. 334,3a,b. \*A. radugini Mironova, holotype, low. U.Ord.(Amsass Suite), W.Sib., Shoria Mts.; a,b, transv., long. secs., \*X4 (Sokolov & Mironova, 1959).

Porkunites Klammann, 1966, p. 22 [\*Calophyllum amalloides Dybowski, 1873c, p. 377; \*Col1853, Dybowski Coll., EGM, Tallinn]. Corallum phace­loid, increase axial, bipartite, unequal; corallites
irregularly rounded or rounded-elliptical in cross section; commonly two corallites are laterally contiguous or three to five may be united in short ranks; walls thick, aporose, aseptate; tabulae horizontal, sparse. U.Ord.(Ashgill.), Eu.(Est.).—

Fig. 334,2a,b. *P. amaloides* (Dysowski), holo-
type, Porkuni, E.Est., Akhula (=Affel of Dybowskii); a,b, transv., long. secs., ×5 (Klaamann, 1966).

?Family DESMIDOPORIDAE
Preobrazhenskiy, 1968

[Desmidoporidae Preobrazhenskiy, 1968, p. 90]

Corallum ceroid or in part meandroid, may be caespitose in places; corallites rounded-polygonal to meandering in cross section, may be grouped in concentric and radial arrangements in places within the corallum; walls trabecular and nodular or plane in cross section; mural pores present; septal spines absent; increase axial, bipartite by growth of one dividing wall or conjunction of two opposed laminae.

Desmidopora Nicholson, 1886, p. 289 [*D. alveolaris; M; syntypes, C10152, AU, Aberdeen, fide Benton, 1979]. Corallum nodular to spreading; corallites slender; some are rounded-polygonal in transverse section, others in places lack one or more side walls so that they form meandroid series of two or more; walls may appear nodular in transverse section, no median suture line visible; walls with mural pores at angle between faces of corallites; septal elements absent; tabulae complete and horizontal where walls are complete, incomplete in the serially confluent corallites [see Fitz, 1939, p. 512; Tesakov, 1960, p. 48; Preobrazhenskiy, 1968, p. 90]. M.Sil.(Wenlock); M.Dev.(Eifel.).

Nodulipora Lindström, 1873a, p. 9 [M; syntypes, Cn699a, 700a, 1048, 21349, Eng.; syntypes Cn699a, 700a, 1048, 21349, Eng.]. Corallum not large, with tubular holdfasts and basal stolons; ceroid or in places meandroid; calical surface may show stellate channels like astrorhizae; corallites slender, walls moniliform in transverse section; (composed of a single series of longitudinally discontinuous or continuous monacanthine trabeculae); mural pores midwall and at angles; septal spines absent; tabulae thin, horizontal or slightly convex, may be continuous through pores; increase axial, bipartite. M.Sil.(Wenlock.); M.Dev.(Eifel.).

Tiberina Sokolov & Tesakov, 1968, p. 203 [*T. vermiculata; OD; t1, coll. 483, IGG, Novosibirsk]. Corallum fasciculate, phacelocerioid or cerioid; corallites very slender, rounded, alveolitoid or polygonal in transverse section; walls thin, microtexture lamellate; mural pores absent; increase axial and bipartite, by symmetrically growing septal ridges of alveolitoid type, or lateral or peripheral. L.Dev. (Tiverian), Eu. (Podolia)-Asia (Taymyr).—Fig. 336,2a,b. *T. vermiculata, holotype, Chortkov horizon in Ivane Beds, Podolia; a,b, long., transv. secs., ×4 (Sokolov & Tesakov, 1968).

?Family TIVERINIDAE Hill, new family

[Barrandeolitidae Sokolov, 1965, p. 7, nom. nud., based on genus only summarily diagnosed]

Corallum partly fasciculate and partly cerioid (in part alveolitoid) or cerioid and in part alveolitoid; corallites very slender, rounded, alveolitoid or polygonal in transverse section; walls thin, microtexture lamellate; mural pores absent; increase axial and bipartite, by symmetrically growing septal ridges of alveolitoid type, or lateral or peripheral increase may also occur. M.Sil.-L.Dev. (Tiverian).


Tiverina Sokolov & Tesakov, 1968, p. 203 [*T. vermiculata; OD; t1, coll. 483, IGG, Novosibirsk]. Corallum fasciculate, phacelocerioid or cerioid; corallites very slender, rounded, alveolitoid or polygonal in transverse section; walls thin, microtexture lamellate; mural pores absent; tabulae complete, horizontal or oblique; increase axial and bipartite, by symmetrically growing septal ridges of alveolitoid type, or lateral or peripheral. L.Dev. (Tiverian), Eu. (Podolia)-Asia (Taymyr).—Fig. 336,2a,b. *T. vermiculata, holotype, Chortkov horizon in Ivane Beds, Podolia; a,b, long., transv. secs., ×4 (Sokolov & Tesakov, 1968).

?Family LAMOTTIIDAE Sokolov, 1950

[Lamottiidae Sokolov, 1950a, p. 164]
Corallum cerioid, large; corallites slender; walls thin, in some conditions of diagenesis traversed by radial longitudinal planes of clarity; aporose and aseptate; tabulae distant, slightly sagging; increase ?lateral. M.Ord. (top of low. Chazy.).
Lamottia RAYMOND, 1924, p. 76 [*L. heroensis; OD; † not traced in MCZ, Cambridge]. Corallum cerioid, corallites slender, prismatic; walls thin, in some conditions of diagenesis traversed by radial longitudinal light planes, but aporose; aseptate; tabulae distant, slightly sagging; increase lateral (by confluence of supposed mural processes) [see FLOWER, 1961, p. 39, fn.; OKULITCH, 1936a, p. 63]. M.Ord. (low. Chazy.), N.Am. (Vt.-N.Y.).—

**Fig. 337,1a,b.** *L. heroensis*, topotype, top of low. Chazy., Day Point Ls., Vt., 2 mil. SW. of South Hero; a,b, transv., long. secs., X4 (Hill, n; USNM no. 91002).

**Family LICHTENARIIDAE**
Okulitch, 1936

[nom. correct. Sokolov, 1950a, p. 175, pro Lichenariidae Okulitch, 1936a, p. 67] [Lichenariida Sokolov, 1950a, nom. correcti. Bondarenko, 1958, p. 218, pro Lichenariacea Sokolov, 1950a, p. 175, order]

Small cerioid; corallites slender, walls imperforate (*fide* original description, but DUNCAN in FLOWER, 1961, p. 39, footnote, states mural pores near edges of walls in the types); aseptate; tabulae sparse, horizontal and complete; offsets interstitial or arising along periphery from underside of corallites (*fide* original description). M. Ord.

[The name genus of this family is also the name genus of an order; but in view of uncertainty as to presence or absence of pores and of the nature of the increase, whether bipartite as in Chaetetina or lateral or calicular and peripheral as in Favositicae, the ordinal name is not used in this Treatise.]
thin, radially tufted walls (mural pores at angles, *fide* Duncan in Flower, 1961, p. 39, footnote); tabulae sparse, horizontal and complete; septate; offsets arise either interstitially or along periphery from underneath the parent corallite. *M. Ord.* (Blackriver), USA (Minn.).—Fig. 337, 2a-d. *L. typa*, syntypes, Decorah F.; a,c, oblique secs.; b,d, transv. secs. showing mural pores, X 4 (Hill, n; USNM no. 42949). [Research on type material and topotypes required; the “cotytes” figured herein are probably *Paleofavosites Twenhofel*, 1914, p. 24.]

**POST-PALEOZOIC CHAETETIDA**

There are in the Jurassic and Cretaceous, and sparsely in the Triassic and Eocene, fossils which appear in hand specimens to be referable to either Chaetetida, Stromatoporida, or the red algal Solenoporaceae. They are very finely basaltiform and commonly have latilaminar growth. Hudson (1960, bibliography, p. 198) defined a great many genera referable to the Stromatoporida (including the Sphaeractinoidea) and showed that vertical, continuous or discontinuous pillars with clinogonal or orthogonal fibers were characteristic of them, the pillars being connected by vertical screens continuous or discontinuous vertically, and commonly with short segments of these screens developed on the same level throughout the skeleton; thin tabular structures also connected the pillars and screens. Peterhans (1929a, p. 11) had earlier identified a number of genera and species which were reasonably referable to the red algal Solenoporaceae, and his work has been accepted with some reservations by Johnson (1964). These are characterized by thin, commonly

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Tabulata—Chaetetida

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crenulate walls that are discontinuous in horizontal zones, and which have thin tabulalike structures commonly aligned in neighboring "tubuli." Fischer (1970) has recently reviewed the post-Paleozoic "Chaetetidae," with helpful descriptions of type specimens of type species. Cuff et al. (1973) considered that astrorhizae of three kinds occurred in a few different species of Mesozoic Chaetetida.

In my opinion, the following genera may be reasonably referred to the Chaetetida, some doubtfully, as indicated. Because of their age, the post-Paleozoic forms are not included in the stratigraphic distribution chart for the Tabulata.

Family CHAETETIDAE
Milne-Edwards & Haime, 1850

[For synonymy and diagnosis of family, see page F507]

Atrochaetetes Cuff & Fischer, 1974, p. 7 [*A. tamnifer; OD; tin MN, Paris]. Walls moderately thick, aporose; horizontal skeletal elements developed as thick rings of sclerenchyme whose fibers indicate centripetal and distal growth; septal spines not observed; increase commonly peripherally, exceptionally adaxial and bipartite. *Trias. (Carn.), Asia Minor.

Bauneia Peterhans, 1927, p. 389 [*Monotrypa multitabulata Deninger, 1906, p. 63; M; tin Deninger Coll., Univ. Freiburg, Ger.; up.Jur. (Tithon.), Sardinia; =Chaetetes capri 1 de Angelis d'Ossat, 1905, p. 12, fide Fischer, 1970, p. 176; † Royal geological museums (Rome or Naples), Portland.(Tithon.), Capri, Italy] [=Pseudomonotrypa Reshetkin, 1926, p. 58, for two or more species from the Crimean Jurassic; see Yavorskiy, 1947, p. 22. Fischer (1970, p. 174) stated that no type species has been chosen. I have been able to consult neither Reshetkin's nor Yavorskiy's work.]. Corallium large, with indistinct growth latilaminæ; corallites very slender, internal section polygonal to rounded; walls without discontinuities or pores; microstructure fibrous, pinnate in longitudinal section; tabulæ numerous, distally convex, not on same level in neighboring corallites; increase dominantly axial, one to five incipient dividing walls projecting simultaneously into lumen, rarely intermural. *Jur.(up.Lias.-Port­land.), Eu.(Italy-Aus.-Yugo.).

Family ACANTHOSCHAETETIDAE
Fischer, 1970

[Acanthochaetetidae Fischer, 1970, p. 199]

Massive coralla with slender corallites with thick, lamellate walls; septal spines holacanthine; tabulæ complete or incomplete, may be thickened in continuity with sclerenchyme of walls; increase axial, bipartite, subequal; intermural increase rare. *Jur.-U.Cret.-Eoc.

?Blastochaetetes Dietrich, 1919, p. 211 [*Chaetetes capilliformis Michelin of Dietrich; orig. usage? Dietrich based his genus on specimens from the Oxfordian of Chatel-Censoir, Yonne, France, that he referred to Michelin's species; Dietrich's types have been interpreted by Fischer (1970) as a new species of *Bauneia, and if Dietrich's description of his specimens may be taken as his designation of them as types, then Blastochaetetes would become a senior synonym of Bauneia Peterhans, 1927. However, Fischer recognized Chaetetes capilliformis Michelin, 1844, p. 112 († in Michelin Coll., MN, Paris, Oxford, Saint-Mihiel, Meuse, France) as type specimen. Michelin's specimen, judging from Fischer's figures of it, may well be stromatoporoid, though no undoubted astrorhizal tubuli are seen; there seem to be vertical pillars of clinogonial fibers, connected by curtains as in stromatoporoids. Cuff et al. (1973) referred to Blastochaetetes a species to which they ascribed astrorhizae. However, I have not studied the material myself, and I append a translation of Fischer's diagnosis]. Chaetetidae showing discontinuities in the walls, of which the zones of growth are more or less clear and of which the tubes, which may communicate with one another, multiply indifferently by fissiparous division and by intraparietal gemmation (transl. from French). *Trias. (Carn.), Asia Minor; *Jur.(Bathon.)-U.Cret., Eu.(France-Italy).

Pseudoseptifer Fischer, 1970, p. 170, as subgenus of Chaetetes ['*Chaetetes benezczei Haug, 1883, p. 174; OD; † thin sections in Haug Coll., Museum, Strasbourg; up.Lias., environs of Roverè di Velo, prov. Verona, Italy; see Peterhans, 1929d, p. 119]. Corallum large, with indistinct growth latilaminæ; corallites very slender, internal section polygonal to rounded; walls without discontinuities or pores; microstructure fibrous, pinnate in longitudinal section; tabulæ numerous, distally convex, not on same level in neighboring corallites; increase dominantly axial, one to five incipient dividing walls projecting simultaneously into lumen, rarely intermural. *Jur.(up.Lias.-Port­land.), Eu.(Italy-Aus.-Yugo.).
complete, horizontal or concave, some thickened by lamellae in continuity with those of walls; increase by subequal bipartite division by radial longitudinal plates, also, less commonly, intermural. Astorhiza-like convergencies of corallites may also occur. [See also FISCHER & LAFUSTE, 1973, p. 320; CUIF et al., 1973, p. 2475.] U.Jur. (Oxford.)-U.Cret.(Cenoman.), Eu.(Spain.)

Diplochaetetes WIESERMEL, 1913, p. 84 [*D. longitu­bus; M; † not traced, Eoc., Bogenfels, SW. Afr.]. Corallum large, corallites commonly radially disposed, with internal section polygonal to rounded; walls continuous, of growth lamellae parallel to elongation of corallite; tabulae distally concave, may be grouped and complete or incomplete; increase axial, bipartite, one or two dividing laminae occurring simultaneously; wall structure insufficiently known [see FISCHER, 1970, p. 205]. Eoc., SW.Afr.

Septochaetetes RIOS & ALMELA, 1944, p. 24 [*Chaete­tes (S.) eocenus; OD; † Inst. geol. min., Madrid]. Corallum of slender corallites, radially disposed, with internal section polygonal to oval; walls of almost constant thickness, without pores or discontinuities; one to six septal spines (or rudimentary dividing laminae) in any one section; tabulae variable; increase axial, bipartite, and also intermural. [Insufficiently known; see FISCHER, 1970, p. 204.] Eoc.(mid.Lutet.), Eu.(Spain).

**Genera Here Rejected from Chaetetida**

In my opinion the following genera with names suggesting relationship to *Chaetetes* are better referred to the red algal Solenoporaceae because of their fine-textured walls that are commonly crenulate and may have alternating horizontal bands of discontinuity and continuity throughout the skeleton: Parachaetetes DENINGER, 1906, p. 65; Pseudochaetetes HAUG, 1883, p. 175; and Ptychochaetetes KOECHLIN, 1947, p. 4. Three genera founded by SCHNORF-STEINER, 1963, mainly on the microstructure of the walls as apparent in thin sections, were translated as subgenera of the genus *Ptychochaetes* KOECHLIN, 1947, by FISCHER (1970, p. 192), who thought the present appearance of the microstructure of the walls to be original, but in my view it is a result of the action of diagenesis on solenoporacean walls. These are: *Axiparietes* SCHNORF-STEINER, 1963, p. 1125; *Granatiparietes* SCHNORF-STEINER, 1963, p. 1127; and *Varioparietes* SCHNORF-STEINER, 1963, p. 1119. SCHNORF-STEINER founded the family Vario­parietidae SCHNORF-STEINER (1963, p. 1118) for these three genera and *Ptychochaetes* KOECHLIN, 1947. HARTMAN and GOREAU (1970, p. 228) drew attention to the similarity between surface features and thin sections of these forms with the coralline sponges *Ceratoporella* and *Merlia*, and suggested the possibility that the Vario­parietidae and the Paleozoic *Pachytheca* SCHLÜTER, 1885b, may be sponges.

**Order Tetradiida**

*Okulitch, 1936* [*nom. correct. SOKOLOV, 1962c, pro Tetradiina OKULITCH, 1936b, p. 378, order]* [*Tetradiidae* SOKOLOV, 1950a, p. 174, order]*

Corallum compound, corallites very slender, typically quadrate in section; increase axial and quadripartite, four radial longitudinal laminae extend from the walls to meet at axis, whereby four offsets are produced which may or may not separate; walls asperate, aporose; tabulae complete, horizontal, sparse. *M.Ord.-U.Ord.*

**Family Tetradiidae** *Nicholson, 1879*

[Tetradiidae *Nicholson, 1879, p. 23* [*Tetradiidae* OKULITCH, 1935, p. 49]*]

Corallum cerioid, tolloid or phaceloid; holothecate; ceroid coralla may be large and subspherical (or hemispherical and spreading) or may be ramose with calices opening on all surfaces of branches or ramose with calices opening only at distal ends of sticklike branches; corallites quadrate in section, increase axial, quadripartite and complete or incomplete; walls asperate and aporose; tabulae complete, sparse, horizontal. *M.Ord.-U.Ord.*

*Tetradium* DANA, 1846b, p. 701, *non* *Tetradium* SCHMIDT, 1874, which SCHMIDT suggested may be an Ordovician conulariid [*T. fibratum* SIBLEY, 1856, p. 237; SF SAWFFORD, 1856, p. 237, who first referred species to the genus; † not traced] [*=Prismostyills OKULITCH, 1935, p. 62 (type, *Chaetetes columnaris* HARTMAN, 1847, p. 68, OD; † 643/1, AMNH, New York; low.Trenton Ls., Sugar R., Lewis Co., N.Y.; *Prismostyills LANG, SMITH, & THOMAS, 1940, p. 105, nom. van.; Tetradiidae* SOKOLOV, 1950b, p. 174, nom. nud.]* [see SOKOLOV, 1955, p. 246; WEYER, 1967a, p. 924]. Corallum cerioid and subspherical, spreading or ramose; calices may open distally or on all surfaces of branches; prismatic, four-sided slender corallites completely fused one to another; increase axial, four radial longitudinal plates grow
to the axis from opposite faces; short processes for a subsequent division may appear before completion of the earlier division. Pores and septal spines absent; tabulae complete, sparse, horizontal. M. Ord.-U.Ord., cosmop.—Fig. 338,1a-d. *T. fibratum Safford, U.Ord., N.Am., Tenn.; a,b,d, transv. secs., X2.0, X6.0, X4.0, c, long. sec., X4.0 (Bassler, 1932).

The genera Paratetradium, Rhabdotetradium, and Phytopsis have been considered to be synonyms of Tetradium, from which they differ only in growth form (W e b b y & S e m e n i u k, 1971, p. 250); but paleoecological investigations (that could well support this view) have yet to be undertaken.

Paratetradium Sokolov, 1955, p. 249 [*Tetradium halysitoides Raymond, 1913, p. 49; OD; + 7839, Natl. Type Coll., GSC, Ottawa]. Corallum tolinoid, with corallites arranged in chains or irregular networks consisting of two or three or more rows of corallites separated by empty spaces; calices confined to distal ends of rows; corallite walls relatively thin; increase by division, four (or uncommonly two) radial longitudinal plates growing from the wall to join at the axis; no mural pores or septal spines; tabulae rare, thin, horizontal. M.Ord.-U.Ord., Asia(Sib.Platf.)-N.Am.(Ont.-Que.-Tenn.-Ind.-Ky.-Pa.); M.Ord., Australia(New S. Wales); U.Ord., Eu.(Urals).—Fig. 339,2a,b. *P. halysitoides (Raymond), M.Ord.(low.Lowville), Can., Carden, Ont.; a,b, ext. views, X2.1, X1.1 (Raymond, 1913).

Phytopsis Hall, 1847, p. 38 [*P. cellulosum; SD Sokolov, 1955, p. 520; 1339, NYSM, Albany]. Corallum composed of small number of corallites compactly accreted by their walls and growing as long cluster encased in holotheca forking at intervals; walls thick; increase axial quadrifurcate, offsets do not separate; secondary radial longitudinal
plates may be present; tabulae sparse, horizontal [see also Walker, 1972b, p. 2509]. M.Ord. (base) - U.Ord., N.Am. (N.Y. - Okla.); M.Ord., Australia (New S.Wales) - Asia (E.Sib.). — Fig. 339, 1a-e. *P. cellulosum*, M.Ord., N.Y.; a-e, ext. view and natural secs., X7 (Hall, 1847).

**Rhabdotetradium** Sokolov, 1955, p. 247 [*R. nobile*; OD; 191, coll. 599, VNIGRI, Leningrad]. Corallum phaceloid, corallites long and meandering, prismatic, rounded-prismatic, or rarely cylindrical; increase quadripartite, four longitudinal radial plates grow to join at axis and the four corallites thus formed then quickly diverge from one another; rarely bipartite; secondary radial plates seldom seen; walls thin; tabulae rare to absent. M.Ord., N.Am. (Md. - Tenn. - Ky. - Okla. - Va.) - Australia (New S.Wales - Tasm.); U.Ord., N.Am. (Greenl. - Alaska) - Eu. (Est.) - Asia (Sib. Platf. - Taymyr - NE. USSR). — Fig. 338, 2a-b. *R. nobile*, holotype, U.Ord. (Dolbor.), USSR, W. Sib. Platf.,

![Fig. 339. Tetradiidae (p. F521-F522).](image-url)
Family PALEOALVEOLITIDAE
Okulitch, 1935

[Paleoalveolitidae Okulitch, 1935, p. 64]

Corallum with fingerlike outgrowths; corallites with quadripartite axial increase, in axial parts of branches corallites polygonal rather than quadrangular in section; in peripheral parts corallites open obliquely to surface and are alveolitoid in section; walls thin, aporose and aseptate; tabulae thin, complete. M.Ord.

Subfamily BILLINGSARITNAE Okulitch, 1936

[nom. transl. Hill, 1955, p. 246, ex Billingsariidae Okulitch, 1936a, p. 60]


Order SARCINULIDA Sokolov, 1950

[nom. transl. et correct. Sokolov, 1962c, p. 240, pro Sarcinulina Sokolov, 1950a, p. 169, suborder; Sarcinulacea Sokolov, 1955, p. 208, order] [=Lioporin, Sokolov, 1950a, p. 164, suborder; Sarcinulacea Sokolov, 1955, p. 208, order]

Ceriod, ceriod and ramose, phaceloceriod, tinnoid or astreoid coralla with slender corallites; tabularia communicating by more or less rounded interseptal spaces or by connecting canals or channels on coenenchymal platforms; septa short, stout basally, equal or in some alternate in size, each a radial longitudinal palisade of subhorizontal to steeply inclined conjunct or discrete monacanths; tabulae horizontal, (or, in Uralopora, infundibuliform). ?L.Ord.; M.Ord.-Dev.

Subfamily FOERSTEPHYLLINAE Hill, new subfamily

Corallum ceriod; median suture plane commonly distinct; septa very short, subequal, wedge-shaped in transverse section, each consisting of a single series of upwardly inclined conjunct or discrete monacanths; wall pores if present very sparse, simple, very small rounded spaces between neighboring septa; tabulae thin, horizontal. M.Ord.(Chazy.); ?U.Ord.-L. Sil.

Family BILLINGSARIIDAE
Okulitch, 1936

[nom. correct. Sokolov, 1950a, p. 164, pro Billingsaridae Okulitch, 1936a, p. 60]

Corallum ceroid or partly astreoid; corallites slender; septa short, stout, in some alternating in size, each a series of near-vertical large monacanths; communication between neighboring tabularia rare to absent; tabulae horizontal; axial trabeculae may occur, forming discontinuous axial structure. M.Ord.; ?U.Ord.-L. Sil.

Subfamily BILLINGSARIINAE Okulitch, 1936

(=Kentland umbilica, OD; 1501, Geol. Museum, Univ. Wisconsin; M.Ord.; Lowville Ls., Kentland, Ind.). Corallum with digitate outgrowths; corallites in narrow axial parts of branches polygonal more commonly than quadrangular in section; walls thin, aporose and aseptate; tabulae horizontal, complete. M.Ord.

Family PALEOALVEOLITIDAE
Okulitch, 1935

[nom. correct. Sokolov, 1950a, p. 169, pro Paleoalveolites Okulitch, 1935, p. 64]

Corallum with fingerlike outgrowths; corallites with quadripartite axial increase, in axial parts of branches corallites polygonal rather than quadrangular in section; in peripheral parts corallites open obliquely to surface and are alveolitoid in section; walls thin, aporose and aseptate; tabulae thin, complete. M.Ord.

Paleoalveolites Okulitch, 1935, p. 64 [*Tetradium carterense Bassler, 1932, p. 196; OD; ?108,886 (not found), syntypes 78737, USNM, Washington] [=Kentlandia SHROCK in SHROCK & RAASCH, 1937, p. 537 (type, K. imbricata, OD; 1501,Geol. Museum, Univ. Wisconsin; M.Ord.; Lowville Ls., Kentland, Ind.). Corallum with digitate outgrowths; corallites in narrow axial parts of branches polygonal more commonly than quadrangular in section; walls thin, with median dense plane; aseptate and aporose; tabulae flat. M.Ord.(?Louville), N.Am.(Tenn.-Ind.).—Fig. 338,a-c. *P. carterensis (Bassler), Bolanian, low. Carter's Ls., Tenn.; a,b, transv. secs., ?3.7, ?7.4; c, long. sec., ?3.7 (Bassler, 1950).]

Order SARCINULIDA Sokolov, 1950

[nom. transl. et correct. Sokolov, 1962c, p. 240, pro Sarcinulina Sokolov, 1950a, p. 169, suborder; Sarcinulacea Sokolov, 1955, p. 208, order] [=Lioporin, Sokolov, 1950a, p. 164, suborder; Sarcinulacea Sokolov, 1955, p. 208, order]

Ceriod, ceriod and ramose, phaceloceriod, tinnoid or astreoid coralla with slender corallites; tabularia communicating by more or less rounded interseptal spaces or by connecting canals or channels on coenenchymal platforms; septa short, stout basally, equal or in some alternate in size, each a radial longitudinal palisade of subhorizontal to steeply inclined conjunct or discrete monacanths; tabulae horizontal, (or, in Uralopora, infundibuliform). ?L.Ord.; M.Ord.-Dev.

Subfamily FOERSTEPHYLLINAE Hill, new subfamily

Corallum ceriod; median suture plane commonly distinct; septa very short, subequal, wedge-shaped in transverse section, each consisting of a single series of upwardly inclined conjunct or discrete monacanths; wall pores if present very sparse, simple, very small rounded spaces between neighboring septa; tabulae horizontal. M.Ord.(Chazy.); ?U.Ord.-L. Sil.
Fig. 340. Billingsariidae (p. F523-F525).
U.Ord., Asia(Altay).—Fig. 340,3a,b. *F. halli (Nicholson), "holotype," M.Ord.(Trenton.), Can., Petersborough, Ont.; a,b, transv., long. secs., X3.0 (Hill, n; photographs courtesy D. J. McLaren and A. Pedder; no. 6690, 6690a, GSC, Ottawa).

Lessnikovaea SOKOLOV, 1951a, p. 69 [*L. spinosa; OD; t 45, coli. 230, VNIGRI, Leningrad] [=Lessnikovaea SOKOLOV, 1950a, p. 175, nom. nt/d., no diagnosis, no species]. Corallum cerioid, hemispherical; corallites polygonal, with dense median plane in common wall; mural pores absent; commonly eight longitudinal rows of elongate septal spines with blunt ends; tabulae horizontal, sparse; increase intermural. Vp.M.Ord., Eu.(N. Urals).—Fig. 340,2a,b. *L. spinosa, holotype, M.Ord. or base of up.M.Ord., N.Urals, Kozhva reg., R. Kos-yu; a,b, transv., long. secs., X4.0 (Sokolov, 1951a).

Qianbeilites GE & YÜ, 1974, p. 169 [*Q. multitabulatus; OD; t22114-5, IGP, Nanking] [=Foerstephyllum BASSLER, 1941, which see]. Cerioid; corallites large; wall moderately thick; septal spines short, equal, subhorizontal, in numerous longitudinal rows; [no mural pores mentioned in description]; tabulae horizontal, complete, numerous and close. L.Sil., Asia(Kweichow).—Fig. 341,1a,b. *Q. multitabulatus, holotype, Shiqian; a,b, transv., long. secs., X2.6 (Ge & Yü, 1974).

**Family SYRINGOPHYLLIDAE**
Roemer, 1883
[nom. correct. KOKEN, 1896, p. 313, pro Syringophylliden Roemer, 1883, p. 527] [=Sarcinulidae SOKOLOV, 1950a, p. 170; Columnoporidae Lecompte, 1952, p. 517; Coxiidae Preebrazhenskiy, 1974a, p. 46]

Cerioid, phacelocerioid or tollinoid; tabularia communicating by more or less rounded interseptal spaces or by connecting canals or channels, or coenenchymal platforms; septa short, stout basally, each a palisade of subhorizontal to steeply inclined conjunct or discrete monacanths; tabulae horizontal except in *Uralopora*. ?L.Ord.; M.Ord.-L.Sil.

**Subfamily LYOPORINAE**
Kiaer, 1930

Corallum cerioid, phacelocerioid or tollinoid; midwall suture commonly distinct; septa short, thick, contiguous laterally by their bases or throughout to form a peripheral stereozone; each septum a single series of contiguous ?monacanths, more or less steeply inclined upward and inward; wall pores simple, rounded spaces between neighboring septa, arranged in imperfect horizontal rows, somewhat sporadically; tabulae complete, horizontal. ?L.Ord.; M.Ord.-L. Sil.

**Lyopora**
Nicholson & Etheridge, 1878, p. 25 [*Palaeopora? favosa McCoy, 1850, p. 285; M; syntypes A5526, 5527, SM, Cambridge] [=Lyopora LANG, SMITH, & THOMAS, 1940, p. 77, nom. van., non Girty, 1915, a polyzoan]. Massive coralla with prismatic corallites each with a single peripheral ring of about 20 longitudinal rows of slightly inclined thick trabeculae, those of neighboring corallites alternating or opposed; the thick common walls so formed may be pierced in horizontal zones by a row of irregularly rounded pores each caused by a local thinning of two neighboring trabeculae; tabulae distant, slightly sagging [see HILL, 1953, p. 158; Preebrazhenskiy & Klaaman, 1975, p. 133]. M.Ord., Eu.(Scott.-Nor.-Est.)-Asia (Sib. Platf.)-Australia (Tasm.)-N. Am. (Ont.-N.Y.); *U.Ord.(Ashgill.), Asia(Kazakh.-Shoria Mts.)-N.Am.(?Manit.).—Fig. 342,1a,b. *L. favosa (McCoy), M.Ord., Craighead Ls., Scot., Girvan, Ayrshire; a,b, long., transv. secs., X4 (Hill, n; UQF27459).

**Baikitolites**
SOKOLOV, 1955, p. 242 [*B. alveolitoides; OD; † 82 (fide JELL, written commun.), coll. 599, VNIGRI, Leningrad]. Corallum cerioid, digitate, groups of amalgamated corallites sheathed in holotheca being separated from neighboring groups by longitudinal lacunae; increase intermural...
by lateral outgrowth; corallites semicircular or alveolitoid in transverse section; common walls with distinct median plane and of contiguous longitudinal rows of short subhorizontal contiguous trabeculae; mural pores ?absent; tabulae thin, horizontal. U.Ord. (Dolbor.), Asia (Sib.Platf.-Altay).
Tabulata—Sarcinulida

Fig. 343. Syringophyllidae (p. F525-F530).
—Fig. 343, 2a, b. *B. alveolitoides*, holotype, R. Chunya, basin of R. Stony Tunguska; a, b, long., transv. secs., X4 (Sokolov, 1955).

†*Eofletcheria* Bassler, 1950, p. 266 [*Columnaria incerta* Billings, 1859a, p. 428; OD; t1014c, Natl. Type Coll., GSC, Ottawa; lectotype by Sinclair, 1961, p. 14]. Corallum phaceloid, increase lateral; corallites cylindrical, slender; no known connecting processes; walls moderately thick; septa not observed in syntypes; tabulae with upturned
edges and commonly complete, horizontal or gently sagging, rarely slightly domed. F529, N.Am. (Nev.-Utah); M.Ord., N.Am.(Que.-E.USA)-Eu. (Nor.-Est.); low.U.Ord., Eu.(Urals)-Asia(Altay-Shoria Mts.).—Fig. 343,3a,b. *E. incerta (BILLINGS), syntype, Chazy., Que., Mingan Ls.; a,b, transv., long. secs., X3 (Sinclair, 1961). [The genus is tentatively included in the Lyoporinae because, although the syntypes are described as too recrystallized to show original microstructure, the Eurasian species placed in it have radially fibrous walls with small septal trabeculae, the inner ends of which may project as spines into the lumen. It might, also reasonably, be classified in the Auloporida.]

Nyctopora NICHOLSON, 1879, p. 182 [*N. billingsii; M; † thin sections 6689, Natl. Type Coll., GSC, Ottawa; lectotype by JULL, 1976b, p. 459, fide BENTON, 1979]. Corallum cerioid or ?astreoid, corallites small, with peripheral or intermural increase; common wall between corallites commonly zigzag in transverse section, each projection a very short septum; number of septa variable up to nine alternating somewhat irregularly with still shorter septa; each septum a single longitudinal series of conjunct trabeculae steeply inclined distally and adaxially; as many as three septal trabeculae occur in the thickness of the common wall between the angles of two neighboring corallites; very small mural pores, oval or round spaces, occur sporadically between neighboring corallites in horizontal rows; tabulae complete, horizontal or slightly arched or saucered [HILL, 1961, p. 6; see also JULL, 1976b, p. 459]. M.Ord.(Chazy.-Trenton.), N. Am. (Ont.)-Eu. (Baltic)-Australia (New S.Wales)-U.Ord., Asia(Altay-Kazakh.-Shoria Mts.-Sib. Platf.-NE. USSR)-N. Am. (Ariz.)-Eu. (Nor.).—Fig. 344,1a,b. *N. billingsii, holotype, Trenton., Ont., Peterborough; a, long. sec., X11.5; b, transv. sec., X4.0 (Hill, 1961).

Septentrionites PREOBRAZHENSKY, 1965, p. 27 [*S. stellaris*; OD; †2, coll. 8426, TsGM, Leningrad]. Coralium small, like Vacuopora but in addition to narrow longitudinal lacunae at junctions of three or more corallites, smaller lacunae may occur between contiguous side walls, and larger halysoitid lacunae are left between tollinoid chains of corallites. U.Ord., Asia(NE.USSR).—Fig. 346, la-d. *S. stellaris*, base of Iryudi suite, NE.USSR, basin of R. Yasachna, R. Kolyma; a, ext. view, ×1; b,c, holotype, long., transv. secs., ×6; d, oblique sec., ×4 (Preobrazhenskiy, 1965).

?Tollina SOKOLOV, 1949, p. 94 [*Halysites keyserlingi* VON TOLL, 1889, p. 49; M; †not traced; holotype of type species not subsequently described or figured, see PREOBRAZHENSKY, 1965, p. 25]. Coralium cateniform, corallites thick-walled, subquadrate in transverse section with lumina of oval outline and forming simple or multiple ranks enclosing irregular longitudinal lacunae; lyoporid septal structure present in some species; tabulae thin, complete, horizontal, no microcorallites. U.Ord., Asia(NE.USSR-Taymyr-Sib. Platf.-?N. Am. (Alaska).—Fig. 343, la-c. *T. keyserlingi* (VON TOLL), syntype, Arctic NE. USSR, Kotelny L; a, long. sec., ×1; b,c, transv. secs., ×4 (von Toll, 1889).

Trabeculites FLOWER, 1961, p. 61 [*T. keithae*; OD; †674, NMBM, Socorro] [=Transitolites BONDARENKO & MINZHN, 1977, which sec]. Coralium cerioid, corallites large; common wall of each corallite a palisade of commonly contiguous longitudinal and clinogonally fibrous monacanthine trabeculae that may be separated by thinner segments of wall with fibers perpendicular to median plane; mural pores not observed; tabulae thin, with edges commonly upturned slightly. U.Ord., N.Am. (Texas-Akpatok I.).—Fig. 347, la,b. *T. keithae*, holotype, Montoya Gr. (Second Value F.), Texas, El Paso; a,b, long., transv. secs., ×8.8 (Flower, 1961).

Transitolites BONDARENKO & MINZHN, 1977, p. 27 [*T. hongorensis*; OD; †13, coll. 3634, PIN, Moscow; Central Mongolia, Bayan Khongor distr.] [=Trabeculites FLOWER, 1961, which sec]. Coralite walls of one or, occasionally, two series of
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longitudinal contiguous trabeculae, from which septal spines may project adaxially; mural pores not observed; tabulae complete, widely separated, flat, slightly concave or convex. U.Ord.(low. Ashgill.), Asia (Mongolia).

Vacuopora Sokolov & Tesakov, 1963, p. 83 [*Hexismita prisca Sokolov, 1955, p. 456; OD; t107, coll. 559, VNIGRI, Leningrad]. Corallum place-loceroid, corallites prismatic, mostly six-sided, not rarely somewhat rounded, amalgamating so that narrow lacunae are enclosed at junctions of three or more corallites, lacunae being triangular, rounded or irregular in transverse section; wall trabeculate; septal elements and tabulae nycto-poroid [see Preobrazhenskiy, 1965, p. 25]. U. Ord.(Dolbor.), Asia (Kazakh.-Sib.Platt.-Sayan-Al-tay-Shoria Mts.-NE.USSR; L.Sil. ("Raikilla Stage"), Eu.(Est.).—Fig. 344,2a,b. *V. prisca (Soko-lov), holotype, U.Ord.(Dolbor stage), R. Chunya, basin of R. Stony Tunguska; a,b, transv., long. secs., X4 (Sokolov & Tesakov, 1963).

Subfamily CALAPOECINAE Radugin, 1938

Corallum plocoid (astreoid to aphroid); tabularia rounded in transverse section; common walls do not show median suture and ordinarily are formed by contiguity of the 20 to 24 equal short septa of neighboring corallites; each septum a longitudinal row of horizontal septal trabeculae; between the septa occur regular horizontal and longitudinal rows of large pores which pierce the common wall; tabulae numerous, mostly complete and saucered; in aphroid coralla, outward extensions of septa and tabulae enclose elongate, boxlike spaces in superposed horizontal rows. M.Ord.–U.Ord.

Calapoeia Billings, 1865, p. 425 [*C. anticosiensis; SD Lindström, 1883b, p. 7; t2267a-d, Natl. Type Coll., GSC, Ottawa] [=Calapoeinia, in F. E. Schulze et al., 1926-(?)]1929, Nomen-clator animalium generum et subgenerum (Berlin, 5 v.), p. 489, nom. null.; Columnopora Nichol-son, 1874a, p. 253 (type, C. cribriformis, M; tUC216, FM, Chicago, lectotype by Foerste, 1916, p. 293-295; Cincinnati Gr. near Cincinnati, Ohio; Jull., 1976b, p. 463 invalidly named as lectotype 8361, AU, Aberdeen, from Richmondian of R. Credit, Ont., see Benton, 1979); Houghto-na Rominger, 1876, p. 18 (type, H. huronica, SD Bassler, 1915, p. 154; 2 syntypes probably in UMP, Ann Arbor, a, figured, Hudson R. Gr., Drummond's L., Mich., b, up. Cincinnati Gr., Madison, Ind.); Haughtonia Sokolov, 1955, p. 516, nom. null.; Coxia Preobrazhenskiy in Roz man et al., 1970, p. 226, nom. nud.; Coxia Preo-
I.-Alaska-Manit.-Que.-Ont.-Mich.-Ohio) - Eu. (Nor.-Swed.-Est.-Vrals) - Asia (Sib. Platf.-Altay-NE. VSSR)-Australia (New S.Wales).--Fig. 348, la. *C. canadensis* BILLINGS, M. Ord. or V. Ord., Can., Manitoulin 1., L. Huron, ant.; part of weathered specimen, ext. view, enl. (Cox, 1936).--Fig. 348, lb, c. *C. anticostiensis*, holotype, V. Ord., Ellis Bay F., Can., W. shore Gamache Bay, Anticosti 1., Que.; b, c, transv., long. secs., X2 (Cox, 1936).

**Subfamily SYRINGOPHYLLINAE Roemer, 1883**


Corallum hemispherical, nodular or discoid; corallites large, cylindrical with thick walls sharply distinguished from other skeletal elements and epitheca; walls with rings of pores that open into a system of radial canals surrounding corallites and fused to form connective plates arranged in successive levels throughout the corallum; septal trabeculae conjunct or slightly separated, projecting as spines in tabularia; tabulae comparatively rare, commonly on same levels as connective plates, horizontal or inclined, sometimes thickened, may be infundibuliform in some. U. Ord.

*Sarcinula* LAMARCK, 1816, p. 222 [*Madrepora organisum* LINNÉ, 1758, p. 796; SD Dana, 1846a, p. 189; not traced] [=Syringophyllum MILNE-EDWARDS & HAMÉ, 1850, p. lxxii (type, *Madrepora organisum* LINNÉ, 1758, p. 796, OD; not traced)]. Corallites cylindrical, thick-walled, with coarsely wrinkled epitheca and connected by more or less widely spaced platforms, on which pore canals radiate, between extensions of septa, from rings of pores in corallite walls; septal trabeculae closely adpressed, commonly jutting into tabularia as 20 to 24 short ribs that may be spinose axially; tabulae thick, horizontal, here and there somewhat concave. U. Ord., Eu. (Nor.-Swed.-Est.-Asia (China)) - N. Am. (Alaska).--Fig. 350, 2a, b. *S. venusta* SOKOLOV, Pirgu stage Est., near Piirsalu; a, b, long., transv. secs., X4 (Sokolov, 1962c).

*Parasarcinula* SOKOLOV & TESAKOV, 1963, p. 73 [*P. trabeclata*; OD; †41, coll. 260, IGG, Novosibirsk]. Corallum hemispherical and in part fasciculate; corallites large, radially arranged, of rounded section, communicating by hollow, laminar coenenchymal outgrowths which in places are imperfectly developed and transitional into connecting tubuli so that there is irregular development of the horizontal rings of mural pores in the thick walls; septa of monacanthine trabeculae distally and adaxially inclined, and contiguous or separate; tabulae irregularly sagging, in places either infundibuliform or horizontal. ?U. Ord. (?low. Ashgill.), Asia (Sib. Platf.).--Fig. 350, 3a, b. *P. trabeclata*...
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*Uralopora* Sokolov, 1951a, p. 47 [*U. flexibilis*; OD: Ι21, coll. 230, VNIGRI, Leningrad] [=*Uralopora* Sokolov, 1950a, p. 170, nom. nud.]. Cylindrical corallites connected by periodic horizontal expansions of their thick walls; oval mural pores and short canals, arranged in rings at the levels of the expansions, connect neighboring corallites; septal spines short, completely buried in thick wall in longitudinal rows; tabulae infundibuliform, a syrinx developed in places; increase lateral. *U. Ord.* (base), Eu. (Urals).—Fig. 350, 1a,b. *U. flexibilis*, holotype, R. Koyva, W. slope of C. Urals; a,b, long., transv. secs., X 4 (Sokolov, 1951a).

Family THECIIDAE
Milne-Edwards & Haime, 1849


Corallum cerioid or in places astreoid or thamnasterioid; formed of extensiform, su-
perposed layers, with or without hummocks or cylindrical lobes or branches; corallites small, prismatic, with thin or slightly thickened common walls in lower parts of layers and in axial parts of branches; near the distal surface of layers, and in peripheral parts of branches, a stereozone is commonly developed by the thickening to lateral contiguity of the peripheral parts of the septa, which commonly number 6 or 12, in some
5 or 8 to 10. In the nominate genus, septa formed of monacanths directed upward and inward; the monacanths of each septum are contiguous peripherally to form a longitudinally continuous plate, and in these peripheral parts the monacanths are almost vertical, but curve rather sharply toward axial edge where they may project as free spines; in astreoid and thamnasterioid regions, portions of the walls may be represented by additional longitudinal monacanths. Mural pores or pore-tunnels present; tabulae thin, horizontal or curved, and commonly complete. *L.Sil.-L.Dev.; M.Dev.* (rare).

**Thecia** Milne-Edwards & Haime, 1849b, p. 263 [*Porites expatatus* Lonsdale, 1839, p. 687; M; 16572 and PF4624-4626, GSM, London] [="Romingerella" Amsden, 1949, p. 98 (type, *Thecia major* Rominger, 1876, p. 67, OD; syntypes UMMP 8527-8, Ann Arbor; Niag., Charleston Landing, Ind., and Point of Barques, L. Michigan)]. Coralum encrusting or tabular with hummocky or lobate upper surface or branching; cerioid or in places astreoid or thamnasteriod; in early stages and in axial parts of lobes and branches corallites prismatic or with one or more curved sides and moderately thin walls of fibers normal to a wide median dense plane and with but rare traces of septa; in distal parts where corallites are directed perpendicular to the calical surface, septa are commonly 12 and long and greatly thickened and

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each is a plate consisting of a longitudinal row of monacanths contiguous except at axial edge; neighboring thickened septa commonly contiguous in wide peripheral stereozone in which a second order of septa may be developed; in these thickened parts the median dense plane of the common wall is indistinguishable, but a few longitudinal monacanths may be found in its place; these are not
Fig. 353. Theciidae (p. F538-F539).
so numerous as to constitute a coenenchyme; pores are present and may have diaphragms as in favositids; mural pores interseptal; in thickened parts pore-tunnels pass from one tabularium to the next; tabulae thin, complete. L.Sil.-U.Sil., Eur.-Asia-N.Am.

**T. (Thecia).** Thin-walled, weakly septate or aseptate parts of corallum confined to reclined corallites in tabular coralla and to axial parts of branches; free axial parts of septal monacanths very short to absent; mural pores relatively sparse, more or less mid-face; tabulae subhorizontal. L.Sil. (up. Llandovery)-U.Sil. (Ludlov.), Eu. (Balko-Scandia-U.K.-Ural-Podolia)-Asia (Tien Shan-Malaya)-N.Am. (Tenn.-Ind.-Ky.).—Fig. 351,2a-c. *T. (T.) expatiata* (Lonsdale), holotype, M.Sil. (Wenlock Ls.), Eng., Lincoln Hill near Ironbridge, Shropshire; a, ext. view, ×6.5; b, transv. sec., ×4.0; c, long. sec., ×7.5 (Hill, n; GSM, London, no. 6572).—Fig. 351,2d. *T. (T.) swinderniana* (Goldeffus), Wenlock Ls., Eng., Dudley, long. sec., ×4.0 (Hill, n; BM(NH) R26375).

**T. (Anghopea)** Jones, 1936b, p. 18, nom. subst. pro *Laminopora* Jones, 1930, p. 35, non *Laminopora* Michelin, 1842, a brazuiola [*Laminopora hisingeri* Jones, 1930, p. 35; OD; †Cn24437, RM, Stockholm]. Thin-walled weakly septate parts of corallum may occur in proximal or peripheral regions as well as in reclinid and axial parts; stereozone relatively narrow; spines of axial septal edges long and slender; mural pores at angles and mid-face [see also Klaamann, 1970a, p. 66]. L.Sil.-M.Sil., Eu. (U.K.-Gotl.-Nor.-Est.).—Fig. 351,1a,b. *T. (A.) hisingeri* (Jones), Sil., Gotl., Gustavsvik; a,b, long., transv. secs., ×4.0 (Hill, n; BM(NH) R26562).

**Corrugopora** Stearn, 1956, p. 67 [*C. rhaboda*: OD; †T4046, Natl. Type Coll., GSC, Ottawa] [=Hemithecia Leleshus, 1965, p. 106 (type, *H. insolens*, OD; †T18, coll. 9021, TsGM, Leningrad); L.Sil. (up. Llandovery), S. slope Mt. Daurich, Zeravshan Ra., C. Asia]. Corallum cerioid; corallites of common 12 folds into each mature corallite, a short septal plate that may be spinose axially springing or around median zone of folia, thick-walled elsewhere and opening perpendicular to surface; mural pores present; septa thick, commonly six, sphenoid in transverse section. [Diagnosis tentative; from illustrations.] M.Sil., Asia (Shensi).

**Fossilpora** Etheridge, 1903, p. 16 [*F. welling­tonensis*: M.; †F2392 with thin sections Am 129 a, b, c, 276 in AM, Sydney] [=Boreaster Lambe, 1906, p. 323 (type, *B. lowi*, ?M; syntype, 7849, Natl. Type Coll., GSC, Ottawa; U.Sil., Read F., Arctic Can., Beechey I.; see Bolton, 1965, p. 29); Fossilpora LANG, Smith, & Thomas, 1940, p. 62, nom. van.; *Thecia (Neothyecia)* Leleshus, 1965, p. 107 (type, *T. (N.) devonica*, OD; †F. 8332, TsGM, Leningrad; M.Dev., Eifel., C. Asia, S. slope Gissar Ra.).] Corallum lobate, partly cerioid, partly astroid or thamnasterioid; corallites small, prismatic, turning outward from axial parts to open normal to the surface in peripheral parts where thickening of walls and septa is greatly increased; septa six plates, may have spinose axial edges, in some corallites six shorter septa alternate with the six dominant septa; septal plates thickened wedge-wise so as to be laterally contiguous in peripheral parts of corallites, but leaving the unfilled lumen more or less stellate in transverse section; mural pores large, on side walls; tabulae thin, complete. U.Sil., Australia (New S.Wales)-N.Am. (Can. Arctic); L.Dev., Eu. (Carnic Alps-Czech.)-Australia (Vict.); M.Dev. (Eifel.), Asia (Gissar Ra., Kazakh.).—Fig. 353,2a,b. *F. wellingtonensis*, holotype, Sil.-Dev., New S.Wales, Wellington distr.; a,b, transv., long. secs., ×7.6 (Hill, n; AM, Sydney, no. F2392).—Fig. 353,2c,d. *F. devonica* (Leleshus), holotype, M.Dev. (Eifel.), S. slope Gissar Ra., upper reaches of R. Sorbukh, basin of R. Kafirnigan; c,d, transv., long. secs., ×7.6 (Leleshus, 1965; photographs courtesy V. L. Leleshus).

**Fossoporella** Leleshus, 1965, p. 108 [*F. prima*: OD; †F. 8332, TsGM, Leningrad] [=Coro­lites Sokolov in Leleshus, 1961 (not seen); in Kim, 1965b, p. 77, diagnosis only, with name of type species, *C. posneri*, no descriptions or figures or collection numbers of *C. posneri* traced, but Kim (1965b, p. 77) gave descriptions and figures of one new species, *C. hamidulicus* Kim, 1965, and brief outline of its differences from *C. posneri*; see Oekentorp, 1970, p. 162; Corolites Kim, 1965, could presumably be validated with *C. hamidulicus* Kim, 1965, as monotypic species, as suggested by Jeffords (1975, written commun.); 2/31, coll. 8490, TsGM, Leningrad]. Like *Fossilpora* but corallites with 5 septal plates (in some 10, alternately longer and shorter). L.Dev.-M.Dev. (Eifel.), Asia (Ural-Zeravshan Ra.); L.Dev. (Siegen.-Ems.), Australia (Vict.).—Fig. 352,5a,b. *F. prima*, holotype, L.Dev., Kazakh., Shishkat Gorge, Zeravshan Ra.; a,b, transv., long. secs., ×6.7 (Leleshus, 1965; photographs courtesy V. L. Leleshus).

**Kialerites** Stasinis, 1967, p. 62 [*K. norvegicus*: OD; †T45341, PM, Oslo, only specimen known]

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Order FAVOSITIDA
Wedekind, 1937

Corallum cerioid or alveolitoid; corallites erect or reclined; with mural pores; septa represented by septal spines, squamulae or combs; tabulae commonly complete, horizontal; walls (?) sheathed in epitheca) constructed of growth lamellae that may be emphasized by pigment and in which radial fibers, orthogonal or rarely clinogonal to epitheca, may be apparent or in part latent or suppressed during diagenesis. M.Ord.-U.Perm.

Suborder FAVOSITINA
Wedekind, 1937

Corallum cerioid; corallites polygonal in section; walls with mural pores and may be cribriform in some; septa represented by septal spines, squamulae, or ridges; tabulae commonly complete, horizontal. M.Ord.-U.Perm.

Superfamily FAVOSITICAE
Dana, 1846

Corallum cerioid; tabular, hemispherical, nodular, rarely branching or tollinoid; corallites prismatic, calical openings perpendicular to surface; walls thin or moderately thickened, with pores, in some cribriform; septa short, equal, spinose or squamulose, variable in number; tabulae commonly complete, horizontal, rarely infundibuliform. M.Ord.-U.Perm.

Family FAVOSITIDAE Dana, 1846

Corallum cerioid and tabular, hemispherical, nodular, rarely branching or tollinoid;
corallites prismatic, calical openings perpendicular to distal surface; walls with pores round to oval, in regular longitudinal rows; septa short, equal, variable in number, represented by longitudinal rows of discrete spines or by squamulae; tabulae complete, horizontal. *M. Ord.-L. Perm.*

*M. Ord.-L. Perm.*

Mironova (1974a, p. 24) includes only genera with “concentrically lamellate” walls, excluding those with radially fibrous walls. In this Treatise it is considered that ‘concentric’ wall structure is diagenetically produced from normal fibrous walls with growth lamellae, and it is not accepted as a feature of taxonomic import.

Subfamily *FAVOSITINAE* Dana, 1846

[nom. transl. Milne-Edwards & Haime, 1851, p. 230, ex Favositidae Dana, 1846b, p. 116]
Favositidae with septa represented only or overwhelmingly by sepal spines; longitudinal rows of pores commonly mid-face or evenly spaced on faces. U.Ord.-M.Dev.

**Favositidae Lamark, 1816, p. 204** [*F. gothlandicus*; SD Milne-Edwards & Haime, 1850, p. 1x; ?neotype, Ca24435, RM, Stockholm] [?]Brigns de Gregorio, 1930, p. 31; ?Sapporipora Ozaki, 1934, which see; Enfavositites Rukhin, 1937, p. 77, obj.; ?Salaria Chernyshev, 1951, which see; ?Lamellaeoporella Smirnova, 1968, which see; Subfavositites Mironova, 1974a, p. 36 (type, Favo­sitites klaamanni Mironova, 1971, p. 38, OD; ?62, SNIIGGIMS, Novosibirsk; Ludolfo, Podolia; has radially fibrous and cryptofibrous walls)]. Corallum cerioid; tabulate, hemispherical, nodular; corallites prismatic, thin-walled; septa commonly represented by longitudinal rows of spines; tabulae complete, subhorizontal; mural pores on corallite faces, in one to four longitudinal rows, and may have raised rims and diaphragms. U.Ord.(up. Richmond.), N. Am. (Manit.); L. Sil.-M. Dev. (Givet.), cosmop.—Fig. 354,2a,b. *F. klaamanni* Mironova, holotype, Ludolfo, Podolia, left bank R. Dnestra, ca. 2 km. below Sokol; a,b, long., transv. secs., ×3.2 (Mironova, 1971).—Fig. 354,2c,d. *F. gothlandicus*, neotype, U.Sil., (low. Ludolfo.), Mulde Märgelsten, Gotl., shore N. of Fröjel fiskläge; c,d, transv., long. secs., ×5.8, ×6.0 (Jones, 1936b).

**Astrocerium Hall, 1851, p. 399** [*A. venustum* Hall, 1852a, p. 120; SD Miller, 1889-1897, p. 172; syntypes 1470/2, AMNH, New York]. Corallum cerioid, discoid to hemispherical; corallites prismatic, with 12 longitudinal rows of upwardly directed, long, coarse spines, sporadically developed; mural pores typically uniserial and midface [see Stumm, 1965, p. 60]. Sil., N.Am. (N.Y.-Ind.-Ky.-Tenn.-Mich.); ?L.Dev., Asia (N. Cs-Balkhash).—Fig. 355,1a,b. *A. venustum*, Sil., Rochester Sh., N.Y., Lockport; a,b, transv., long. secs., ×6.6 (Hall, 1852a).

?Beiliupora Yu & Deng in Wang, Yu, & Wu, 1974, p. 28 [*B. beilienensis*; M; ?23695-6, IGP, Nanking]. Ramose and reticulate; corallites very fine, diverging from axis of branches to open normal to surface; rounded to polygonal in section with relatively thick walls, thickness increasing distally; mural pores few, rounded to oval; septal spines sparse, some like triangular squamulae; tabulae horizontal or oblique. [Translation uncertain; compare also with Microalveolites Lele­shus, 1972a, a doubtful synonym of Crassialveolites Sokolov, 1955.] Low.M.Dev., Asia (Kwangsi).—Fig. 356,2a,c. *B. beiluensis*, holotype, Bei Liu F., Guang Mbr., Kwangs, Bei Liu; a,b, long, secs., ×2, ×6; c, transv. sec., ×2 (Wang, Yu, & Wu, 1974).

**Crenulipora Le Maitre, 1956a, p. 1340** [*C. difformis*; OD; ?561,a,b, Le Maitre Coll., GFC, Lille]. Corallum simple or branching, branches fingerlike and widened at summit; calices fourto six-sided, of irregular form, with crenulate distal edge; septa represented by spines thick at base, thin distally; tabulae irregular, thin, oblique, complete or incomplete, may bear septal spines on upper surfaces; mural pores present. U.Ord.(up. Richmond.), N. Am. (Manit.); L. Sil.-M. Dev. (Givet.), cosmop.—Fig. 355. Favositidae (p. F541).
Australia (Vict.-New S.Wales) [see also MIRONOVA, 1974a, p. 57]. — Fig. 357, 1a, b. *D. salairicus*, holotype, L.Dev., Salair, R. Pavlova above mouth of Khvoschevki; a, b, transv., long. secs., ×3.3 (Chernyshev, 1951).

Hattonia JONES, 1927, p. 438 [*H. etheridgei*; M; +F7200, UQ, Brisbane]. Corallum cerioid; corallites slender, prismatic, five- or six-sided, walls thin and firmly amalgamated; tabulac occurring commonly in pairs which are regularly spaced and
on same level in contiguous corallites; mural pores small, commonly between the tabulae of a pair [see Pickett & Jell, 1974, p. 715]. U.Sil.(mid. Ludlov.), Australia (New S. Wales); L. Dev. (Gedinn.-Ems.), Australia (New S. Wales-Queensl.).

---Fig. 358, la-c. *H. etheridgei*, holotype, U. Sil., Barrandella sh., New S. Wales, Hatton's Corner, Yass; a,c, transv., long. secs., X4; b, ext. view, X1 (Pickett & Jell, 1974).

**Issolites** Yanet, 1977, p. 20 [*I. fallax*; OD; +135, 136, coll. 1017, UGUp, Sverdlovsk; U.Sil. Ludlov., E. slope C. Ural, left bank R. Is. 600 m. below Obzhorki]. Corallum tumoroid, with large polygonal-rounded corallites separated by one or
two rows of smaller corallites of four- to six-sided section; walls irregularly thickened, with rounded mural pores converted into canals in thickened portions; septal spines present; tabulae numerous, mainly flat. U.Sil.(Ludlov.), Eu.(C.Urals).

Klaamannipora Mironova, 1974a, p. 78 [*Favositites coreaniformis Sokolov, 1952a, p. 53; OD; $\ddagger$in coll. 484, VNIGRI, Leningrad]. Corallum cylindrical, coarsely branching; corallites moderately large, prismatic, diverging slowly at first from axis of branch, opening at surface at right angles; walls thin except for slight thickening in peripheral zone of branch; pores large, uniserial; septal spines present in calices; tabulae flat, commonly on same level in neighboring corallites. U.Sil.(Ludlov.), Eu.(Est.); ?L.Dev., Asia(Salair-NE.USSR).

Fig. 354,la,b, *K. coreaniformis (Sokolov), holotype, Ludlov., Paadla beds, Ks, Est., Saarema (=Oesel); a,b, transv., long. secs., X3.2 (Sokolov, 1952a).
Lamellaeoporella Smirnova in Cherkesova, Smirnova, & Kravtsov, 1968, p. 157 [*L. superba; OD; 14, coll. 9718, TSM, Leningrad] [?=Favosites Lamarck, 1816, which see; ?Pseudopachyfavositites Chi, 1976, p. 107 (type, P. rotundus, OD; 14P_2aZH, IGMR, Shenyang; low. M. Dev., Dong Ujimqin Qi, NE. Inner Mongolia)]. Coral-lem ceroid, of medium size; corallites polygonal in transverse section, with rounded angles and walls showing growth lamellation; mural pores in faces and rarely in angles, without rims but with diaphragms; septa thin, short, laminae with discrete short spines on axial edges; tabulæ complete [see Barskaya, 1975, p. 34]. L.Dev.(Valnevsk horizon), Eu.(N.Zemlya-NE.USSR); low. M.Dev., Asia(Inner Mongolia).--Fig. 359,3a,b. *L. superba, holotype, Tsivolko, E. bank; a,b, long., transv. secs., 10.0 (Cherkesova, Smirnova, & Kravtsov, 1968).

Ozopora Weissermel, 1941, p. 206 [*O. thamno-
poroides; M; tin ZGI, E. Berlin, not traced]. Corallum branching, the branches subcylindrical and each encased in holotheca except at distal end; corallites longitudinally directed within branches and opening only at distal end of each branch; walls thick, with irregularly distributed mural pores; septal spindles in places perceptible within wall tissue; tabulae flat or slightly arched. L.Dev., Eu.(Ger.).

Rudakites Leleshus, 1964b, p. 46 [*R. multiformis; OD; ?2, coll. 8332, TsGM, Leningrad] [?=?Striatoporella Rukhin, 1938, which see]. Cerioid, nodular initially, later with short, thick, dichotomous branches that may in places be laterally contiguous; corallites slender, prismatic, walls thin in axial zone, may thicken slightly toward periphery of branch; corallites longitudinally directed in axis of branch, diverging to open at right angles to surface; septal spines very fine, short; mural pores small, sparse, uniserial, mid-face; tabulae thin, distant; increase calicular, peripheral. L.Dev., Asia (Tadzhik.).--FIG. 356,1a,b. *R. multiformis, holotype, Siegen.-low.Ens., N. slope of Zeravshan Ra., left side of Shishkat Say, right tributary of R. Kashi; a,b, tang., long. secs., X4 (Leleshus, 1964b; photographs courtesy of V. L. Leleshus).

Salaria Chernyshev, 1951, p. 38 [*Favosites (S.) peetzii; OD; ?40, coll. 5725, TsGM, Leningrad] [?=?Favositoides Lamarck, 1816, which see]. Favositoid; corallites thin-walled with concave tabulae grouped in pairs; septal spines numerous; mural pores in one to three longitudinal rows on faces of corallites. [Concave tabulae of holotype are most distinctive; doubling of tabulae possible diagenetically. Considered by Mironova (1974a, p. 52) to have squamulose and referred to Squameofavositidae Chernyshev, 1941a.] L.Dev.(Gedinn.), Asia (Salair).—FIG. 357,2a,b. *S. peetzii, holotype, Salair, R. Pavlova above mouth of Khvoshevki; a,b, transv., long. secs., X3.3 (Chernyshev, 1951).

Sapporipora Ozaki in Shimizu, Ozaki, & Obata, 1934, p. 74 [*S. favositoides; OD; ?not traced] [?=?Favositoides Lamarck, 1816, which see]. Corallum cerioid, corallites small, prismatic, each wall face with one median longitudinal row of large pores; no septal spines recorded in holotype; new corallites commonly arise at junction of four corallites [see Hamada, 1960, p. 169]. ?Sil., Asia (Korea); ?M.Sil.(Wenlock)., Asia (Sib.Platf.-Taymyr-Tarbagatay R.).—FIG. 359,2a,b. *S. favositoides, syntypes, pebble in Ken-niho Is. congl., NW. Korea; a,b, transv., long. secs., X4.0 (Shimizu, Ozaki, & Obata, 1934).

Squameopora Preobrazhenskii, 1967b, p. 8 [*Favositoides hidensis Kamei, 1955, p. 53; OD; ?30119, Geol. Inst., Shinshu Univ., Matsumoto, Japan]. Corallum cerioid, pyriform, club-shaped or branching with subcylindrical to cylindrical branches; corallites prismatic, growing longitudinally and parallel in axial part of branch but turning to open at surface at acute or right angle; walls thin or moderately thick, thickening toward periphery; wall microstructure radiate-fibrous; mural pores without elevated rims, circular, fairly large, biserial, placed toward edges of prism faces; septa [by squamulae or] by spindles buried in sclerenchyme; tabulae complete, transverse. [Hamada (1959b, p. 208) did not mention squamulae as being present in type species, but Preobrazhenskiy included species with them in his genus. Mironova (1974a, p. 49) referred type species to Striatoporella Rukhin, 1938.] L.Dev., Eu.(W.Jap.).--FIG. 360,la-c. *S. hidensis (KAMEI), type material, L.Dev., W.Jap., Ichinotani, Fukuji; a,b, topotype, long. sec., X4.0 (Hamada, 1959b).

Striatoporella Rukhin, 1938, p. 62 [*S. multiporifera; OD; ?tactoeity, 109, coll. 337, IGG, Novosibirsk; SD Dubatolov, 1969, p. 80] [?=?Rudakites Leleshus, 1964b, which see]. Corallum of cylindrical, coarse branches; corallites unequal, irregularly prismatic, directed longitudinally in axial parts of branch, curving outward to open at right angles to surface of branch; walls in axial parts thin, thickening slightly on curving outward; septa represented in peripheral zone by short, thick spines or here and there by squamulose microstructure of wall radial-concentric, favositoid; pores numerous, large; tabulae transverse [see also Mironova, 1974a, p. 49]. L.Dev., Asia (NE.USSR).—FIG. 360,1a,b. *S. multiporifera, neotype, Nelyudim horizon, Kolyma R.; a,b, long. transv. secs., X4 (Dubatolov, 1969).

Subfamily PALEOFAVOSITINAE Sokolov, herein [nom. correct. Sokolov herein, pro Palaeofavositinae Sokolov, 1950a, p. 164, nom. inval., based on Palaeofavositidae Lang, Smith, & Thomas, 1940, p. 94, nom. van.]

Thin-walled Favositidae, dendroid and tabular or hemispherical or in part tollinoid, with uniserial or multiserial ranks; septa represented only by or overwhelmingly by septal spines; with pore rows at extreme edges of faces and commonly alternating in position on either side of angle between faces; in some with pore rows also mid-face. [See Mironova, 1974a, p. 35, for different conception based on microstructural interpretations.] M.Ord.-L.Dev.

Paleofavositidae Twenhofel, 1914, p. 24, Official List of Generic Names, Name No. 2028 [*Favosites asper d'Orbigny, 1850, p. 49; OD; ?GSM3726-3728 (3 parts of corallum), GSM, London, fide Oeikentorp, 1976, p. 169; =Favositoides levis Groupe "de Blainville" Londsole, 1839, pl. 15 bis, fig. 1, non Goldfuss] [=Calamopora Goldfuss, 1829, p. 77, generic name suppressed by Op. 1059, ICZN (Melville, 1976, p. 24 and Corrigenda,
Tabulata—Favositida—Favositina

p. 264) (type, C. alveolaris Goldfuss, 1829, SD King, 1850, p. 26; +254a, Goldfuss Coll., IP, Bonn; glacial drift, Groningen, Holland; fide Oekentorp, 1971, p. 158, congeneric with F. asper d’Orbigny); Palaeofavositida Lang, Smith, & Thomas, 1940, p. 94, nom. van.]. Corallum massive; corallites prismatic, thin-walled; mural pores at edges of faces of prisms, alternating in position on either side of the angle giving characteristic wavy appearance to longitudinal section through an angle; each pore opens into two corallites only (Oekentorp & Schouffé, 1969, p. 89); septa each represented by a longitudinal row of discrete spines directed upward and inward; tabulae thin, commonly complete and subhorizontal. Up.M.Ord.-U.Sil. (low.Llandovery), Eu.(Urals); U.Ord.-U.Sil. (low.Llandovery), Eu.(G.Brit.-Gotl.-Est.-Podolia-Czech.-Asia(N. & Sev.Zemlya-Taymyr-Sib.Platf.-NE. USSR-Afghan.-Uzbek.-Kazakh.-Salair-Altya-Tuva-China)-N. Am. (Arctic-Alaska-Manit.-Ont.-Anticosti-N.Mex.-Texas)-Australia(New S.Wales-Tasm.).—Fig. 361,1a-d. *P. asper (d’Orbigny), holotype, M.Sil. (Wenlock.), U.K., Leinthall Earls, near Ludlow; a, ext. view, X1.0 (Lonsdale, 1839); b, transv. sec., X5.0, c,d, long. secs., X5.0, X10.7, showing tangential section of wall with mural pores (Oekentorp, 1976; photographs courtesy of K. Oekentorp).—Fig. 361, 1e-g. P. alveolaris (Goldfuss), holotype, ?Sil., drift, Holland, Groningen; e, ext. view, X1.0, f,g, transv., long. secs., X5.0 (Goldfuss, 1829; photographs courtesy K. Oekentorp).

Manipora Sinclair, 1955, p. 97 [*M. amicarum; OD; +12382, Natl. Type Coll., GSC, Ottawa]. Corallum cateniform, corallites thin-walled subquadrate in transverse section and forming simple or multiple ranks enclosing irregular lacunae; internal walls in the ranks corrugated, with septal spines projecting from the corrugations; mural pores sparse, commonly near angles of walls; tabulae complete, thin. M.Ord.-U.Ord., N.Am.(Manit.-Texas-N.Mex.-Arctic Can.-N.Greenl.) .—Fig. 362,3a-c. M. magna Flower, U.Ord., Second Value F., Texas, El Paso; a,b, transv. secs., X12.8; c, long. sec., X4.8 (Flower, 1961).—Fig. 362, 3d. *M. amicarum, holotype, Red River F., Selkirk Mbr., Manit., Tyndale; transv. sec., X3.2 (Sinclair, 1955).

Mesofavositida Sokolov, 1951b, p. 59 [*M. dualis; OD; +56, coll. 292, VNIGRI, Leningrad]. Corallum massive, cerioid; corallites thin-walled, prismatic; mural pores on faces as well as at edges of faces of prisms; septal spines present or absent; tabulae subhorizontal. U.Ord.(Ashgill).-U.Sil. (Llandovery), Eu. (Nor.-Est.-G. Brit.-Podolia-Urals)-Asia (N. Zemlya-Taymyr-Sib. Platf.-NE. USSR-Afghan.-Uzbek.-Kazakh.-Salair-NE. USSR) -N. Am. (Alaska)-Australia(Queensl.); L.Dev., Asia(Kazakhstan).—Fig. 362,2a,b. *M. dualis, holotype, U.Ord.(Ashgill.), Est., Porkuni; a,b, transv., long. secs., X3.2 (Sokolov, 1951b).

Saffordophyllum Bassler, 1950, p. 267 [*S. deckeri; OD; syntypes 90998, USNM, Washington]. Corallum cerioid; walls thin, radially fibrous, the fibers directed upward adaxially; walls commonly with 12 longitudinal corrugations, fibers in each projection lengthened to form short, commonly smooth, rarely axially serrated septal ridge; mural pores sparse, bordering angles of corallites; tabulae horizontal, thin [see Flower, 1961, p. 57]. M. Ord.-U.Ord.(mid.-up.Chazy.-Richmond.), N.Am. (Texas-Tenn.-Ohio-Ky.-Que.-Anticosti?Akpatok-C. Calhoun); up.M.Ord., ?Eu.(Est.); U.Ord., Eu. (Nor.)-Australia (Tasm.)-Asia (Altay-Sib.Platf.).—Fig. 362,1a-c. *S. deckeri, syntype, Chazy.,

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Fig. 361. Favositidae (p. F546-F547).

McLish F., Okla., NW. of Bromide; a, long., b,c, transv. secs., ×3.2 (Hill, n; USNM no. 90998).

Subfamily PACHYFAVOSITINAE Mironova, 1965
[Pachyfavositinae Mironova, 1965, p. 85] [≡Favositinae Dana, 1946b, which see]

Favositidae with walls significantly thickened especially in the angles so that tabularium is cylindrical; mural pores present; septal elements spines, or squamulae; tabulae complete, transverse. U.Sil.-U.Dev.

Pachyfavositites Sokolov, 1952b, p. 43, as subgenus of Favorites Lamarck, 1816 [*Calamopora polymorpha var. tuberosa Goldfuss, 1826, p. 74; t259, Goldfuss Coll., IP, Bonn, figured Goldfuss, 1826, pl. 27, fig. 2a; lectotype by Sokolov, 1952b, p. 43]. Corallum of moderate size, nodular or elongate; corallites prismatic with moderately thick, dense walls; lumen rounded or rounded-polygonal in transverse section; pores large and well developed in one or two longitudinal rows to a corallite face; tabulae commonly complete; septal spines may be present. L.Dev.-M.Dev. (Eifel.) and rarely U.Dev. (Franz.), Eu.(Pol.-Czech.-U.K.-France-Belg.-Ger.-Podolia-USSR)-N.Afr.-Asia(China-Viet Nam-Urals-Kuzbas-Altaya-C.Asia-Kazakh.-Kolyma Basin)-Australia (New S. Wales-Queensl.)-N. Am. (?Alaska).
Mesolites Mironova, 1969a, p. 86 [*Pachyfavosites squamatus Dubatolov, 1959, p. 67; OD; t123-z, ?coll. 546, VNIGRI, Leningrad]. Corallum ceroïd; corallites with thick walls, significantly thickened at angles to give cylindrical tabularia; mural pores uniserial; septa represented by squamulae; tabulae complete, commonly transverse. M.Dev., Asia(Al-tay-Salair-E.Sib.); U.Dev., Asia(Kuzbas).—Fig. 363.2a-c. *M. squamatus (Dubatolov), holotype, Frasn., Yaya-Petropavlovsk beds, Kuzbas, right bank R. Kondomy near Osman railway station;
Plicatomurus CHANG, 1959, p. 27 [*P. solidus; OD; †? in MGU, Moscow]. Corallum cerioid, of variable to spherical form; corallites rounded-polygonal or irregular in section; walls in inner parts of corallum thin, in peripheral parts gradually thickened; microstructure of wall concentric, plicate; median suture distinct; pores arranged in the walls in regular longitudinal rows; septal spines with wide bases; tabulae horizontal or curved. [Bedded appearance of wall possibly in part diagenetic.] U.Sil.(or L.Dev.), Asia(Kazakh.).—Fig. 363,1a,b. *P. solidus; holotype, U.Sil. or L.Dev., up. Isen Suite, C. Kazakh.; a, transv. sec corallum, b, ext. view, X2.7, X1.3 (Chang, 1959).

**Subfamily EMMONSIINAE Lecompte, 1952**

[Favositidae Lecompte, 1952, p. 513]

Favositidae with septa represented mainly by squamulae, which may form scoops below or eaves above pores; pore rows commonly evenly spaced on faces. U.Sil.-M. Dev.; L.Carb.-L.Perm.
**Emmonsia** Milne-Edwards & Haime, 1851, p. 152 [*E. hemispherica* (Yandell & Shumard) Milne-Edwards & Haime, 1851, p. 247; SD Roemer, 1883, p. 423]. Corallum cerioid, hemispherical or tuberose; corallites prismatic, walls thin to moderately thick, with squamulae that project almost to axis; favositoid spines rare to ?absent; pores numerous, large, commonly triserial; tabulae thin, subordinate to and commonly suspended from inner ends of squamulae. M.Dev., Asia(Urals-Viet Nam)-N. Am. (N. Y.-Ind.-Ky.-Ohio-Mich.-Ont.). —Fig. 364,1a,b. *E. emmonsii* (Rominger), M.Dev., Ind., Ky., Falls of the Ohio; 1a, b, transv., long. secs., ×5 (Hill, n; UQF4357). [E. hemispherica Milne-Edwards & Haime embraces two forms, *Favosites alveolaris* (Goldfuss) Hall, 1843, p. 158 (renamed *Favosites emmonsii* Hall, 1876, explanation of pl. ix) and *F. hemispherica* Yandell & Shumard, 1847, p. 7; *F. emmonsii* Hall also embraces two forms, Emmonsia emmonsii (Hall) and *Favosites halli* Fenton & Fenton, 1936, p. 27; Fenton & Fenton (1936, p. 23) designated *E. emmonsii* (Hall) restricted Fenton & Fenton (1936, p. 35) as lectotype species of *Emmonsia*, and chose 3426/8, NYSM, Albany, as its lectotype. See Lang, Smith, & Thomas, 1940, p. 56. Stumm, 1965, p. 66, regards *Favosites emmonsii* Rominger, 1876 (p. 27, pl. 7, fig. 1,
Fig. 365. Favositidae (p. F553).
8449, lectotype, UMMP, Ann Arbor, by STUMM, 1965, p. 66) as conspecific with *E. emmonsii* (HALL) as restricted by FENTON, and also as having priority in publication.

Bractea OLIVER, 1975b, p. D6 [*Favosites arbor* DAVIS, 1887, pl. 22; OD; t8496a, MCZ, Cambridge; lectotype by OLIVER, 1975b, p. D7]. Corallum branching or massive; corallites like those of *Lecfedites* OLIVER, 1975b, except that both large and small corallites have squamulae and suspended tabulae in late stages. *L.Dev.(Ems.)-M.Dev.(?low.Eifel.), N.Am.(Ky.).*—Fig. 365, 1a-e. *E. arbor* (DAVIS), lectotype, Ems., Falls of the Ohio, Louisville; a, surface, ×1.0; b,c, transv. secs., ×1.5, ×5.0; d,e, long. secs., ×1.5, ×5.0 (Oliver, 1975b).

**Dendrofavositites** RUKHIN, 1937, p. 11, as subgenus of *Favosites* LAMARCK, 1816 [*Favosites digitatus* ROMINGER, 1876, p. 39; aD; t8484, ROMINGER Coll., UMMP, Ann Arbor; lectotype by STUMM, 1949, card Tabulata 197]. Corallum caespitose, of subparallel anastomosing fingerlike branches; corallite walls stout, outlines of calices polygonal; mural pores large; tabulae present, regular or incomplete and reinforced or replaced by horizontal 'squamulae' arranged in fewer than 12 longitudinal rows on walls. [In opinion of STUMM & TYLER, 1964, p. 26, squamulae are absent.] *M.Dev., N.Am.(Mich.).*—Fig. 364, 2a-c. *D. digitatus* (ROMINGER), Transverse Gr., N. fork Thunder Bay R.; a,b, syntypes, ext. views, ×1; c, lectotype, ext. view, inverted, ×1 (Rominger, 1876).

Emmonsiella KIM, 1971c, p. 141 [*E. ornata*; OD; tsample 6/1b-260, coll. 9490, TSgM, Leningrad]. Corallum favositoid, corallites thin-walled, prismatic, regularly parallel; numerous squamulae developed at successive horizontal levels in the corallites, those of each level in a corallite laterally contiguous so that an annular septal plate is formed with a rounded or stellate (thorny) axial edge; pores well-developed, on the faces of the corallites and between the annular plates, in one or more longitudinal rows; tabulae thin, intersecting, suspended from the axial edges of the annular plates. *U.Sil.(above Ludlov.), Asia* (Turkestan Ra.).—Fig. 364, 4a,b. *E. ornata*, holotype, R. Isfara, Turkestan Ra.; a,b, long., transv. secs., ×6 (Kim, 1971c).

Hamarilopora LE MAITRE, 1956a, p. 139 [*H. minima*; OD; t565,a,b,c, LE MAITRE Coll., GFC, Lille]. Corallum mullike, encircling crinoid stems; corallites prismatic, diverging from crinoid stem to open approximately normal to surface of colony, and of two sizes, the larger surrounded by an aureole of the smaller; walls moderately thick, of fibers normal to median suture; septa represented by spines and by squamulae?; tabulae sparse [mural pores not mentioned]. *L.Dev. (Siegen.)-M.Dev.(low.Eifel.), N.Afr.(Moroc.-Alg.).*—Fig. 365, 3a,b. *H. minima*, low. Eifel., Moroc., Hamar Laghdad, Tafside; a,b, tang., long. secs., ×5 (Le Maitre, 1956a).

Lecfedites OLIVER, 1975b, p. D5 [*Fistulipora candidensis* BILLINGS, 1858, p. 165; OD; t3387, GSC, Ottawa; lectotype by STUMM, 1949, card 236]. Corallites of two sizes; large ones with protruding calical rims and more rounded cross sections and with closely spaced squamulae with suspended tabulae, and small ones with more polygonal cross sections and with complete, widely spaced tabulae but lacking squamulae; all corallites with mural pores and lacking septal spines; early stages of all corallites are reptant with vaulted growth form and thin favositoid walls, later stages erect with thickened walls. *L.Dev.(Ems.)-M.Dev.(low.Eifel.), N.Am.(N.Y.-Ont.-Ky.).*—Fig. 366, 1a-c. *L. candidensis* (BILLINGS); a, lectotype, Ont., near Port Colborne, surface, ×1.0; b,c, another specimen, N.Y., Williamsville, transv., long. secs., ×2.5, ×5.0 (Oliver, 1975b).

Mariusilites MIRONOVA, 1974a, p. 104 [*Calipora chaetetoides* LECOMPTE, 1939, p. 138; OD; t452, Pl. Couvin, 7965, IRSN, Brussels] [*=Squameofavositites* CHERNYSHEV, 1941a, which see]. Subhemispherical; corallites very slender, prismatic, directed perpendicular to surface; walls thin, with...
uniserial pores on prism faces; squamulae commonly opposite on adjacent corallites, subhorizontal, slightly concave upward, bases not or slightly thickened; spines absent; tabulae complete, flat or
slightly concave, not on same levels in adjacent corallites. L.Dev., Asia (Mt. Altay); M.Dev. (Couvin.), Eu. (Belg.).—Fig. 367, 3a, b. *M. chaetoides* (Lecompte), holotype, Couvin, Co2b, Belg.; a, b, transv., long. secs., X8, X4 (Lecompte, 1939).

**Squameofavosites** Chernyshev, 1941a, p. 24 [*Favosites hemisphericus* var. *bohemica* Počta, 1902, renamed *Squameofavosites cechicus* Galle, 1978, p. 47; OD; †47 (PV6,7 in Počta Coll.), NM, Prague; lectotype by Dubatolov & Smirnova, 1964, p. 44; *non Favosites bohemicus* Počta, 1902, p. 241, nec *F. bohemicus* Maurer, 1896, p. 632; see Galle, 1978, p. 49] [=?*Mesosolenia* Mironova, 1960, Multisoleniidae, Multisoleniinae; ?Mariaulites* Mironova, 1974a, which see]. Coralium favositoid, walls of corallites somewhat thickened, squamulae more common than spines and
Fig. 369. Pseudofavositidae (1, 3); Syringolithidae (2) (p. F557).
commonly paired in neighboring corallites and developed as linguiform projections mainly from upper rims of pores and thinning toward axial ends; mural pores in one to four longitudinal rows on each wall-face, commonly large; tabulae mostly complete, but some suspended from squamulae, which they outnumber [see also KRAICZ, 1937, p. 53, and GALLE, 1978, p. 49]. U.Sil.-low.M.Dev., Eu.(Czech.-Podolia-Urals)-Asia(Salair-SW.Kuzbas-Altay-NE. U.SSR Taymyr-Viet Nam)-Australia (Tasm.-Viet.-New S.Wales-Queensl.)-N.Z.-N.Am.-N.Afr.(Moroc.).—Fig. 367,1a,b. *S. bohemica* (Počta), lectotype, Prag., Czech., Koněprusy; a,b, transv., long. secs., ×4 (Hill, n; photographs courtesy W. A. Oliver).

**Sutherlandia** COCKE & BOWSHER, 1968, p. 2 [*S. irregularis*; OD; †5654, OU, Norman]. Spherical corallia commonly adherent to crinoid stems; corallites thick-walled, lumina cylindrical; mural pores large; squamulae numerous, thin, convex or concave upward; faint septal ridges may be present, septal spines absent; tabulae absent [see WEYER, 1972a, p. 33]. L.Carb. (Tourne. –Viséan), Eu.(U.K.-Eire-Ger.)-Asia(China); Misn., N.Am.(Mo.).—U.Carb., Eu.(U.K.)-Asia(China); Penn., N.Am. (Okla.-Kans.).—LPerm.(Artišk.), Eu.(Urals.).—Fig. 367,2a. *S. irregularis*, holotype, Penn., Dewey F., Oklahoma; a, thin. sec., ×6; b, another specimen, same locality, encrusted on bryozoan colony, ×6 (Cocke & Bowscher, 1968).

**Xenocornonnesia** LELESHUS, 1971d, p. 150 [*X. crassima*; OD; †232a/46, coll. 901, UpG, Dushanbe].—Fig. 368,1a,b. *Squamosites Leleshusi*, 1971d, p. 151 (type, *S. nodosus*, OD; †11/23, coll. 901, UpG, Dushanbe; up.L.Dev., Zeravshan Ra.). Corallum cerioid, irregularly spherical or nodular, small; corallites prismatic, with thick walls formed of short radial longitudinal trabeculae; mural pores commonly on the prism faces, a few placed near angles; in places where wall is very thick pores become tunnels; squamulae numerous, tonguelike, very long and thin; tabulae sparse, horizontal or inclined, attached either to wall or to squamulae. Upl.L.Dev., C.Asia.—Fig. 374,1c,d. *X. nodosa* (LELESHUS), holotype, Zeravshan Ra.; c,d, transv., long. secs., ×4 (Leleshus, 1971d).

**Family PSEUDOFAVOSITIDAE** Sokolov, 1950

[nom. transl. MIKONOSA, 1960b, p. 149, ex Pseudofavositinae Sokolov, 1950a, p. 165]

Favositoid colonies; walls may be distally produced at angles between corallites as short, coarse aporose spines; septa 12, lamellar at base, acanthine adaxially; mural pores present; no tabulae known. U.Perma.

**Pseudofavositinae** GERTH, 1921, p. 101 [*P. stylifer*; M; syntypes 33, 34, WANNER Coll., IP, Bonn and 11800, 11801, TH, Delft]. Corallum subcylindrical, cerioid, commonly encircling crinoid walls; walls may be distally produced at angle between corallites as short, coarse, aporose spines; septa 12 (HEHENWARTER, 1951, p. 62), short, lamellar at base, acanthine adaxially; mural pores present between septa and within septal bases between spines; no tabulae. U.Perma., Asia(Timor).—Fig. 369,3a,b. *P. stylifer*, syntypes, Baseio; a, ext. view, X1.3; b, colony with strongly thickened skeleton, X1.3 (GERTH, 1921).

**Stylonitinae** GERTH, 1921, p. 104, non Stylonitina FRIES, 1848, a protozoan [*S. porosus*; M; figured syntype 11802, TH, Delft]. Like Pseudofavositinae but septa number five (or eight), and in each corallite are connected with an axial columella; wall pores occur between septa. [Insufficiently known.] U.Perma., Asia(Timor).—Fig. 369,1a,b. *S. porosus*, syntype, Timor, Noil Tonini; a, ext. view, X4.0; b, ext. view, X2.0 (GERTH, 1921).

**Family SYRINGOLITIDAE** Waagen & Wentzel, 1886

[nom. transl. SOKOLOV, 1950a, p. 165, ex Syringolitinae WAAGEN & WENTZEL, 1886, p. 844]

Tabular to hemispherical coralla with tightly contiguous prismatic corallites, the common walls with pores; septa represented by very short spines developed in radial rows on the upper surfaces of tabulae; tabulae infundibuliform, their downturned axial edges forming a persistent axial tube that may bear spines and be crossed by small, flat tabellae [see HILL & JELL, 1970a, p. 172]. L.Sil.-M.Sil.; L.Dev.

**Syringolites** HINDE, 1879, p. 244 [*S. huronensis*; OD; †R19949, BM(NH), London; lectotype by HILL & JELL, 1970a, p. 173]. Cerioid corallia; corallites small, thin-walled with mural pores; with spines developed in radial rows on upper surfaces of tabulae; tabulae widely spaced, infundibuliform, the axially downturned edges forming a continuous and regular axial tube that is crossed by small, flat or saucered tabellae; axial tube not diverted to open into a mural pore. L.Sil.(Llando­v.), N.Am.(Ont.); L.Sil.-M.Sil., Eu.(Goth.-Est.).—Fig. 369,2a-c. *S. huronensis*, Llando­v., Manitoulin Dol., Ont., near Manitouwanning, Manitou­lin Is., L. Huron; a, calical view, X10.0 (R19984); b, transv. sec., X2.0; c, lat. view, X7.0 (R19947) (Hill & Jell, 1970a).

**Ohnopora** MINATO & MONOURA, 1977, p. 559 [*O. hayasakai*; OD; †R30190-3, UH, Sapporo]. Discoid, corallites commonly rectangular in section, growing and dichotomising radially and hori­zontally; tabulae on same level in neighboring corallites; each corallite has two tubes piercing its
tabulae and growing radially and longitudinally in the corallum, its tubes connected by canals in the mid-planes of the tabulae; common walls may have pores. [Systematic position problematical; horizontal canals in tabulae otherwise unknown in the Tabulata.]

** GENERIC NAMES BASED ON FAVOSITIDS WITH COMMENSALS OR WITH (?) PRIMARY OR DIAGENETIC STRUCTURES AT ANGLES OF JUNCTION OF CORALLITES**

For review of commensalism in favositids see ÖEKTORP, 1969, p. 165; for an interpretation of nodal structures within median suture at angles of junction of corallites, see Flügel, 1973a, p. 54.

*Actinopora* Vinassa da Regny, 1918, p. 98 [Syn.-type species: *A. carnica*, †tununkown, M.Dev., Givigliana, Carnic Alps, favositid, possibly *Favosites*; *Favosites asteriscus* Frech, 1899, p. 196, †tununkown, up.M.Dev., Hwalingpu, Sze-chuan, China, favositid *Squameofavosites* or possibly *Emmonzia*; *Favosites proasteriscus* Charlesworth, 1914, p. 373, †tununkown, L.Dev., Wolayer Thorl, Carnic Alps, favositid, possibly *Favosites*.] [Sokolov (1948, p. 108) referred the commensals of *F. asteriscus* and *F. proasteriscus* to *Asterosalpinx Sokolov*, 1948, p. 106 (type, *A. asteriscus*).]

*Asteriophyllum* V. B. Poirfiiriev, 1937, p. 30 [*A. aenigmaticum*; M; †tununkown; up.L.Dev. or low. M.Dev., E. slopes Urals; favositid, possibly *Favosites*]. [Sokolov named nodal structures at angles of walls *Actinosalpinx uralensis* (Sokolov, 1962b, p. 47); similar structures in *Favosites stellaris* Chernyshev (1937b, p. 80), named *Asterosalpinx asiaticus* (Sokolov, 1948, p. 106), are considered by Flügel (1973a, p. 58) primary trabecular structures distinguishing a valid favositid genus *Asteriophyllum* V. B. Poirfiiriev, 1937.]

*Gephyropora Etheridge, 1920, p. 60 [*Favosites (?) Columnopora] duni*; M; syntypes 4474, 4700, 4784, 4813, 4840, AM, Sydney; L.Dev., Taemas, New S.Wales; favositid, possibly *Favosites*, but see Mironova (1971, p. 41) for different opinion; commensal named *Phragmosalpinx australiensis* by Sokolov (1948, p. 106).]

*Moyero lithes* Sokolov, 1955, p. 157 [*M. sibiricus*; OD; †1154, ROM, Toronto] [=Polysoienia Weissermel, 1939, p. 65, nom. van.]. Corallum ceroid, pseudomeandroid; corallites thin-walled, cylindrop prismatic, each with longitudinal series of rounded, more or less regularly spaced, radial protuberances, each such extension communicating through large mural pore with similar projection from another corallite; pores may be with or without pore diaphragms; midwall pores, or paleofavositoid angle-pores may occur in some; septa when present commonly in 6 or 12 longitudinal series of spines (Multisoleniinae), but in some (Antherolitinae) laminar; tabulae horizontal or oblique, commonly developed between the protrusions. *U.Ord.-L.Dev.*

Subfamily MULTISOLENIINAE Fritz, 1950

[*M. tortuosa*; OD; †1154, ROM, Toronto] [=Polysoienia Weissermel, 1939, p. 65, nom. van.]. Coastal ceroid, pseudomeandroid; corallites thin-walled, cylindrop prismatic, each with up to four longitudinal rows of more or less regularly spaced, rounded, radial protuberances, each meeting a similar one from another corallite in a large pore which may have a pore diaphragm; corallites thus connected normally have no prism face in common; tabulae subhorizontal, complete; septal spines sparse. [Lekshus, 1970b, p. 65, considered 12 specific names to be subjective synonyms of 3 specific names.] *Sil., ?N.Afr.-Eu. (?K.-God.-Est.-Podolia-Czech.)-Asia (Urals-Arctic-Sib. Platf.-Kazakh.-Kuzbas-NE.USSR-China)* Australia (New S. Wales-Queensl.-N. Am. (Ont.-Que.-Manit.-Yukon-Alaska-Mich.).—Fig. 370,1a,b. *M. tortuosa*, M.Sil.(Niag.), Thornloe F., Can., Mann I. (=Burnt J.), L.Timiskaming, Ost.-Que.; a,b, long., transv. secs., X10, X4 (Bolton, 1965).
**Family AGETOLITIDAE** Kim, 1962

Corallum cerioid, corallites small, of uniform size, five- or six-sided, a single longitudinal series of large pores on each side, pores occupying full width of side; in addition in places at angles of corallites radial protuberances (?eaveslike squamulae) may occur with pores at their ends; septal spines numerous, small, triangular (?squamulae); tabulae flat, commonly on one level in neighboring corallites. M.Sil., Eu.(Arctic Ural)-Asia(Sib.Platf.); ?M.Sil., Asia(Shensi); ?U.Sil., Asia(Salar-Sib.Platf.); ?L.Dev., Australia(Vict.-New S.Wales).—Fig. 371, 1a,b. *M. festiva* (Chernyshev), holotype, ?U.Sil., Kuzbas, left bank of R. Chumysh, Mt. Glyaden; a,b, transv., long. secs., X4 (Chernyshev, 1951).

**Priscosolenia** klaamann, 1964, p. 40 [*Multiolienia priscus* Sokolov, 1951b, p. 54; M; t52, coll. 292, VNIGRI, Leningrad] [=Priscosolenia Sokolov, 1962a, p. 58, nom. nud.]. Corallites cylindro-prismatic with thin walls with paleofavositoid angle-pores and in addition, pores at ends of radial protuberances (solenia); septal spines thick, numerous and long, reaching almost to axis, commonly in 12 longitudinal series; tabulae thin, horizontal or inclined and supplemented by oblique tabellae. U.Ord.(?Porkuni Stage), Eu.(Est.).—Fig. 371, 2a,b. *P. prisca* (Sokolov), holotype, Est., Porkuni; a,b, transv., long. secs., X4 (Sokolov, 1951b).

**?Sparisolenia** stasinska, 1967, p. 74 [*S. kiaeri*; OD; t51428, PM, Oslo]. Corallum cerioid, corallites prismatic, rarely pseudomeandroid, slender, thin-walled; radial pore protuberances sparse; septal spines weakly developed; tabulae widely spaced, thin. L.Sil.(?Landov.), Eu.(Nor.).—Fig. 371, 3a,b. *S. kiaeri*, holotype, Ser. 7, Nor., Skien; a,b, transv., long. secs., X4 (Stasinska, 1967).

**Subfamily ANOTHEROLITINAE** Sokolov, 1955

[Anotherolitinae Sokolov, 1955, p. 148]

Corallum cerioid, corallites slender with roundly stellate outline; walls thin, with large pores near or at angles between faces; pores may be at ends of radial protuberances so that corallum appears meandroid in part in transverse section; septa six, laminar basally, ?spinose axially. M.Sil.(?Wenlock.).

**Anotherolites** Sokolov, 1955, p. 148 [*A. septopus*; OD; t30, coll. 599, VNIGRI, Leningrad] [=Spinopora Sokolov, 1950a, p. 164, nom. nud., non Spinopora de Blainville, 1830, a bryozoan; ?Somphoporella Lin MS in Li et al., 1975, p. 204 (type, S. ningqiangensis, OD; tN33-5, AGS, Pe-king; M.Sil., Ningqiang, Shensi)]. Corallum small, hemispherical calices of corallites roundly stellate in transverse section; walls thin, septa six, laminar basally; mural pores large, at edges of faces of corallites, may be on radial protuberances so that corallum appears meandroid in part in transverse section. M.Sil.(Wenlock.), Asia(Kazakh.); ?M.Sil., Asia(Shensi); ?U.Sil., Asia(Pek.; ?L. Dev., Australia(Vict.-New S.Wales).—Fig. 371, 1a,b. *A. septopus*, holotype, Wenlock, C.Asia, Balkhash area; a,b, transv., long. secs., X4 (Chernyshev, 1951).

**?Mesosolenia** mirabilis, 1955, p. 95 [*Favosities festivus* Chernyshev, 1951, p. 26; OD; t11, coll. 5725, TsGM, Leningrad] [=Squameofavositites Chernyshev, 1941a, Favoositidae, Emmonsiinae; ?Mesosoleniella Lin MS in Li et al., 1975, p. 207 (type, M. decorata, OD; tN39-1, AGS, Peking; M.Sil., Ningqiang, Shensi)]. Corallum cerioid, corallites small, of uniform size, five- or six-sided, a single longitudinal series of large pores on each side, pores occupying full width of side; in addition in places at angles of corallites radial protuberances (?eaveslike squamulae) may occur with pores at their ends; septal spines numerous, small, triangular (?squamulae); tabulae flat, commonly on one level in neighboring corallites. M.Sil., Eu.(Arctic Ural)-Asia(Sib.Platf.); ?M.Sil., Asia(Shensi); ?U.Sil., Asia(Salar-Sib.Platf.); ?L.Dev., Australia(Vict.-New S.Wales).—Fig. 371, 1a,b. *M. festiva* (Chernyshev), holotype, ?U.Sil., Kuzbas, left bank of R. Chumysh, Mt. Glyaden; a,b, transv., long. secs., X4 (Chernyshev, 1951).

**Family AGETOLITIDAE** Kim, 1962


Corallum cerioid with pores at angles between two, three, or four corallites, or also on the faces; septa continuous and laminar at their peripheral edges, may be spinose axially; near angles between side walls, septa may be represented by squamulae; tabulae complete, horizontal or convex. [Kim (1971a, p. 40; 1974, p. 121) considers the agetolitids have septal insertion characteristic of the Rugosa, and that the family should be transferred thereto.]

U.Ord.-?L.Sil.-M.Sil.

**Agetolites** Sokolov, 1955, p. 150 [*A. mirabilis*; OD; t17, coll. 599, VNIGRI, Leningrad] [=Hemiagetolites Leleshus, 1963, p. 146 (type, H. sugranicus, OD; t1, coll. 8203, TsGM, Leningrad; U.Ord., up. R. Sugran, Tadzhik.; see Kim, 1965a, p. 51). Corallum hemispherical, nodular, pyriform or cylindrical, cerioid; corallites pris-
mation; common walls with sinuous median suture; septa alternately long and short thin plates with long axial parts spinose; tabulae horizontal, or convex or concave, commonly complete; pores at or near angles between corallites, rounded and numerous, commonly opening simultaneously into three adjacent corallites. U.Ord., Asia(Kazakh.-Tadzhik.-Uzbek.-China)-N.Am.(Alaska); U.Ord.
Tabulata—Favositida—Favositina

or ?L.Sil., Australia (N. Queensland).—Fig. 373, 2a.b. *A. mirabilis*, holotype, Kazakh, SW. foothills Chingiz Ra.; a,b, transv., long. secs., ×3.6 (Sokolov, 1955).

**Agetolitella** Kim, 1962, p. 117 [*A. prima; OD; t1, coll. 8490, TsGM, Leningrad*]. Like *Agetolites* but pores on faces as well as near or through angles between faces; septa not alternating in length; increase intermural. *U.Ord.*, Asia (China-Tadzhik.-Uzbek.).—Fig. 379,1a,b. *A. prima, C.Asia, Zeravshan-Gissar Ra., Tien Shan; a,b, transv., long. secs., ×3.6 (Kim, 1965a).

**Somphopora** Lindström, 1883a, p. 51 [*S. daedalea; M*; tin Richtthofen Coll., HU, E. Berlin]. Like *Agetolites* but corallites relatively small and septa six in number; tabulae thin. *M.Sil.* (Wenlock.), Asia (China).—Fig. 373,3a,b. *S. daedalea*, holotype, Chan-Tien, Szechuan; a,b, transv., long. secs., ×3.6 (Hill, n; photographs courtesy Humboldt University, E. Berlin).

**Family MICHELINIIDAE**

**Waagen & Wentzel, 1886**

[nom. correct. Sokolov, 1950a, p. 165, pro Michelinidae Garth, 1921, p. 112] (nom. transl. Garth, 1921, p. 112, as Micheliniidae, nom. null., ex Micheliniidae Waagen & Wentzel, 1886, p. 843; Micheliniidae Poerta, 1902, p. 64)]


Corallum cerioid, rarely astreoid or in part phaceloid; discoid to hemispherical to tall and subcubindrical; with or without holotheca; corallites large, commonly prismmatic; walls bearing septal ridges or spines or both; mural pores sparse to numerous, regularly or irregularly arranged; tabulae absent to numerous, complete or incomplete. *U.Sil.-U.Perm.*

**Subfamily MICHELININAE**

**Waagen & Wentzel, 1886**


**Michelinia** De Koninck, 1841, p. 29, nom *Michelinia* Ducardin & Hupé, 1862, an echinoid [*Calamopora tenuiseptata* Phillips, 1836, p. 201; SD Milne-Edwards & Haime, 1850, p. lx, lectotype here chosen, R333, W. Gilbertson Coll., BM (NH), London] [≡Conopoterites Winchell, 1856, which see; Enmichelinia yabe & Hayasaka, 1915, p. 59 (type, *Michelinia tenuisepta* (Phillips) de Koninck, 1841, p. 31, SD Lang, Smith, & Thomas, 1940, p. 58); ?Cystomichelinia Lin, 1962a, p. 223 (type, *Michelinia multicystosa* Yoh in Yoh & Huang, 1932, p. 23, OD; t1174, IGP, Nanking; L.Perm., Chihsia Ls., near Nanking; has imperfect series of peripheral tabellae)].

Corallum cerioid with strong holotheca; corallites large and moderately rounded in section to small and polygonal; walls thin to moderately thick with median suture and projecting short septal trabeculae (may be holacanthine); mural pores large, tunnel-like and sparse; tabulae commonly incomplete, somewhat globose, and not forming regular pattern of inclination, some thickened and some carrying septal spinules on upper surface. *L.Dev.-M.Dev., N.Afr. (Alg.-Moroc.)-N.Am. (Ant.-Mich.-Ind.-Ky.); Carb.-Perm., cosmop. except S. Am.—Fig. 372,2a-c. *M. tenuiseptata* (Phillips); a, ext. view, ×1 (Phillips, 1836); b,c, lectotype, Yorkshire, Bolland, transv., long. secs., ×4 (Hill, n; photographs courtesy H. D. Thomas).

Corallum phaceloid in part, cerioid in part; corallites large, walls thin, with infrequent mural pores commonly near angles; tabulae complete or incomplete, tabellae large, subglobose, variably based; septal spines not observed, but epithecal surface shows septal grooves and interseptal ridges. *L. Carb.*, Eu.(Brit.-Belg.)-Asia(Kuzbas); *Miss., N. Am.(Mo.-Ill.-?Mexico).—Fig. 375,2a-c. *B. laca* (McCoy), low. Visicen, Eng., Derbyshire; *a,b, lectotype, transv., long. secs., X1, X2 (Hill, n; photographs courtesy D. E. White, SM A2389, GSM, London); *c, ext. view, X1 (McCoy, 1851b). *Conopoterium Winchell, 1865, p. 111 [*C. effusum*; M; syntypes in UMMP, Ann Arbor] [*—Mi-
chelinia de Koninck, 1841, which see, see also Williams, 1943, p. 61; Conopterium Scudder, 1882, p. 84, *nom. null.*]. Corallum small, subspherical, with holotheca; corallites prismatic or subcylindrical, unequal; walls with rare mural pores; septa represented only by longitudinal striations on walls; tabulae rare; increase lateral and intermural. [Insufficiently known.] U.Dev. (topmost Famenn.) or Miss.(basal). N.Am.(Mo., Louisiana Ls., Clarkville).
Fig. 375. Micheliniidae (p. F561-F562, F565).
Cystodendropora LIN, 1962b, p. 502 [*Michelinia siniztini SOLOV, 1955, p. 354, nom. subst. pro Michelinia cylinrica ILINA, 1939, p. 85, nom. Rominger, 1876, p. 74; OD; *Muzey Moskovskiy geologorazvedchyn institut]. Corallum large, dichotomously branched; branches cylindrical, oriented at right angles to surface of colony; corallites diverging slightly from axis in axial zone of branch, turning sharply perpendicular to surface in peripheral zone; corallites prismatic, thin-walled in axial zone, somewhat thickened in peripheral zone; mural pores small; tabulae complete in axial zone, incomplete with a peripheral series of tabellae in peripheral zone, so that axial parts of calices are sunken. [The Chinese specimens have greatly thickened walls in peripheral zone of branches.] L. Car.b.(Visean), Asia(Kazakh.-?China)-? Australia(Queensl.).—Fig. 376,1.a-c. *C. siniztini (SOLOV), Kazakh., R. Kipchak; a, ext. view, X0.5; b,c, long., transv. secs., X0.8 (ILINA, 1939).

?Dendrozoa FUCHS, 1915, p. 5 [*D. rhenanum; M; tin Fuchs Coll., Museum Preuss. Geol. Landesanst., Berlin (in 1915)]. Corallum plate-like or conical and attached basally, giving off relatively slender branchlike processes; corallites numerous, small, unequal, elongate, conical, in basal portion radiating from a commensal worm tube; mural pores not observed. [Insufficiently known.] L.Dev., Eu.(Ger.).—Fig. 374,1. *D. rhenanum, syntype, Hunsrückische, Bornich horizon, Ger., small hill to S. of Ballelllesweg near Bornich; ext. view, X1 (Fuchs, 1915).

Holacanthopora LE MÂTRE, 1954, p. 1668 [*Michelinia (Ethmooplax) fascialis LE MÂTRE, 1952, p. 80; OD; t;otype, 123, Le MÂTRE Coll., GFC, Lille]. Corallum tall, with subparallel corallites in clumps or branches; corallites subcylindrical, conjunct or in places separate, calices opening at different heights, not all reaching summit of colony; increase lateral; common walls thick, with median suture and commonly with pseudolamellae in which immersed septal spines are holacanthine; mural pores (tunnels) present; tabulae complete or incomplete, numerous. [Thick walls distinguish it from Beaumontia MILNE-EDWARDS & HAIME, 1851.] M.Dev.(low.Eifel.), N.Afr.(Alg.).—Fig. 375,1.a-c. *H. fascialis (Le MÂTRE), Erg Djeremel; a, long. sec., X6 (Le MÂTRE, 1954); b, ext. view, X1; c, transv. sec., X3 (Le MÂTRE, 1952).

Kerforneidictyum LAFUSTE & PLUSQUELLEC, 1976, p. 1699 [*Pleurodictyum kerennei COLLIN, 1912, p. 434; OD; t;ote type by LAFUSTE & PLUSQUELLEC, 1976, p. 1700; "Schistes à nodules calcaires à Aucella ejeiinclis," M.Dev., Eifel, France, "la cave de Quelern, Roscanvel, Brest"] [? = Pleurodictyum GOLDFUSS, 1829, which see]. Like Pleurodictyum but corallum conical, corallites few, peripheral corallites with rounded external walls; of the septa, one to four may be prominent. M.Dev.(Eifel.), Eu.(France-Spain); M.Dev.(Givet.), N.Afr.(Moroc.).

Petricidictyum SCHINDEWOLF, 1959, p. 310 [*Pleurodictyum petrii MAURER, 1874, p. 456; OD; t;ot traced]. Like Pleurodictyum but with central corallite surrounded by corona of up to seven large corallites, in which septal ridges alternate in length like major and minor septa in rugose corals [see PLUSQUELLEC, 1976, p. 32]. L.Dev.(Siegen.)-M.Dev.(Givet.), Eu.(Ger.-France)-N.Afr.(Moroc.-Sahara)-Asia(Altay)-?Australia(Vict.).—Fig. 377,3.a,b. *P. petrii (MAURER), L.Dev., Ger., Erbsloch; a, specimen with 5 corallites, b, specimen with 7 corallites, showing septal ridges alternating in size as in rugose corals, X3 (SCHINDEWOLF, 1959).

Pleurodictyum GOLDFUSS, 1829, p. 113 [*P. problematicum; M; t;ote missing from GOLDFUSS Coll., IP, Bonn] [ =Ligulodictyum PLUSQUELLEC, 1973, p.

154 (type, L. paraligulatum, nom. nov. pro Pleurodictyum ? constantinopolitanum Roemer, var. minor Plusquellec, 1965, p. 45, OD; 1PL183, LP, Brest; mid. Siegen., La Fraternité Finistère France; has inconstant narrow peripheral trough on inner side of calices of offsets); ?Kerfornei­dictyum Lafuste & Plusquellec, 1976, which see]. Corallum cerioid, discoid or a low dome, with flat or slightly concave base covered with concentrically wrinkled holotheca; frequently with tube of commensal worm Hicetes Clarke, 1908; corallites large, commonly short, prismatic, with walls bearing septal ridges or rows of spines, or spinose ridges; walls thick, pierced by numerous mural tunnels; tabulae typically absent, when present complete or incomplete, horizontal, convex or concave [see Plusquellec, 1965, p. 9]. U.Sil. (Ludlov.), N.Am.(Ky.-Tenn.)-Australia(New S. Wales); L.Dev.-M.Dev., Eu.(Ger.-France-Belg.-U.K.)-Asia (Kazakh.-Tuva-Salair-R.Amur-Kolyma
Tabulata—Favositida—Favositina

Basin-NE.USSR)-Australia(New S.Wales-Vict.)-N. Am. (Ind.-Ky.-Mich.-N.Y.)-N.Afr.(Moroc.-Sahaca-Alg.).—Fig. 377.2a,b. *P. problematicum, syn-type, L.Dev.(Eifel. or Nassauian), Ger.; a, ext. view of internal mold of proximal part of decalcified specimen, X1; b, one corallite, enl. (Goldfuss, 1829).

Protomichelinia YABE & HAYASAKA, 1915, p. 61, as subgenus of Michelinia DE KONINCK ["Michelinia (P.) microstoma; SD LANG, SMITH, & THOMAS, 1940, p. 107; †6272, TohU, Sendai] [=Michelinia (Michelinopora) YABE & HAYASAKA, 1915, p. 59 (type, M. (M.) multitabulata, M; syntype?, 8241, TohU, Sendai; Perm., Parafusulina Is., between Sagadachi and Maiya, Moto-yoshi-gun, Miyagi Pref., and Yatsuse near Kes-en-numa, Iwate Pref.; see MINATO, 1955, p. 183).] Corallum cerioid, corallites long, prismatic or subcylindrical; walls thin, with median suture; mural pores large; septal ridges low, may have spinose axial edges; tabulae numerous, low convex, commonly complete. L.Carb., Asia(Oapan); Perm., Asia(China-Japan-Iran-Armen.SSR)-Eu.(Spits.).—Fig. 377,1a,b. *P. multitabulata (YABE & HAYASAKA), ?Perm., Japan, Yatsuse near Kes-en-numa; a,b, transv., long. secs., X4 (Hill, n; UQFI15372).—Fig. 377,1cd. *P. microstoma, syntype, Perm., China, Mei-tse-kou, prov. Hupei; c,d, transv., long. secs., X3 (Yabe & Hayasaka, 1920).

?Tabellaephyllum STUMM, 1948a, p. 41 [*T. peculiariae; OD; †127971, USNM, Washington; =Michelinia expansa White, 1883, p. 158, †UC6687, FM, Chicago, M, Chouteau Ls., Sedalia, Mo.; OLIVER & SANDO, 1977, p. 422, conclude that only two specimens have been referred to T. peculiariae and both are residue specimens of the Mississippian M. expansa White left on the surface of the Frasnian Martin Limestone of Arizona after weathering of the previously overlying Mississippian]. Cerioid; corallites moderately large, with common walls thin and rough and with porelike discontinuities as in Protomichelinia; septal spines not observed; tabular floors concave, tabellae large, in two series, those at periphery like rather flat-laying lonsdaleoid dissepiments. [Relationship to Yavorskia FOMICHEV, 1931 (Cleistoporidae) should be investigated.] Miss., N.Am.(Ariz.-Mo.).—Fig. 378,1ab. *T. expansum (White), holotype of T. peculiariae, residue from weathered Miss. on upper surface of Frasnian Martin Ls., Ariz.; a,b, transv., long. secs., X2 (Stumm, 1948a).

Subfamily GRANULIDICTYINAE Weyer, 1970

[Granulidictyinae Weyer, 1970b, p. 1116]

Flat, discoid, hemispherical to spherical and encrusting cerioid coralla; without holotheca; corallites prismatic with simple mural pores that do not ramify and without tabulae or with tabellae; septa represented by aspinose longitudinal ridges. L.Dev.-M.Dev.
Corallum small, discoid to low hemispherical, without holotheca; corallites relatively few, prismatic, radiating; calical margins polygonal, contiguous; walls smooth or with faint septal ridges, pierced by small, irregularly scattered mural pores; with tabellae [see PLUSQUELLEC, 1970, p. 60]. M.Dev., N.Am.-Eu.

**P. (Procteria)**. Corallites deep, tabellae well-developed, distal part of walls thin. M.Dev., N.Am. (Ind.-Ky.-Ohio-Mich.).—Fig. 379,4. *P. (P.) michelinoidea*, Jeffersonville Ls., Ky., Falls of
Fig. 380. Cleistoporidae (p. F571).
Fig. 381. Cleistoporidae (p. F571-F572).

Ohio R. near Louisville, X2 (Stumm, 1950).

P. (Pachyprocteria) PLUSQUELLEC, 1970, p. 61
[*Procteria papillosa DAVIS, 1887, explanation pl. 41; OD; †lectotype by STUMM, 1950, card 361, original of DAVIS' fig. 19, lost (fide PLUSQUELLEC, 1970, p. 68); neolectotype by PLUSQUELLEC, 1970, p. 68, 8725d, MCZ, Cambridge, 5 unlettered syntypes comprise no. 8725]. Corallites with tabulae absent or sparse; distal part of wall very thick, bearing strong granules, corallites all of one size. M.Dev.(Couvin.)-Eu. (France)-N.Am.(Ind.-Ky.).—Fig. 379,2a,b. *P. (P.) papillosa DAVIS, neolectotype, M.Dev.(Couvin.), Jeffersonville Ls., Ky., Falls of the Ohio; a,b, calical, proximal views, X6 (Plusquellec, 1970).

Family CLEISTOPORIDAE Easton, 1944
[Cleistoporidae Easton, 1944b, p. 57, nom. nov. pro Leptoporidae MILLER, 1891, p. 6, invalid name based on junior homonym] [?f=Riphaeolitinae DUBATOLOV, 1972b, p. 63]

Ceroid or rarely in part fasciculate coralla, commonly discoid; holothecate; walls with favositoid mural pores; ?wall and septa cribriform, in some forming peripheral reticulum around tabulate lumen, in others filling lumen with reticulum that may or may not be interrupted or crossed by tabellae. U.Sil.-M.Dev.; ?U.Dev.; Carb.(M. Penn.).

Cleistopora NICHOLSON, 1888, p. 150 [*Michelinia
**Tabulata—Favositida—Favositina**

*F571*

g**eometrica** Milne-Edwards & Haime, 1851, p. 252; OD; not now missing, MN, Paris] [?==Leptopora Winchell, 1863, p. 3 (type, L. typa, OD; t14253, UMMP, Ann Arbor, lectotype by Easton, 1944b, p. 60), non Leptopora d'Orbigny, 1849, a bryozoan; nSquameophyllum Smyth, 1933b, which see; Paracleistopora Plusquellec, 1973, p. 153 (type, Cleistopora smithi Le Maître, 1952, p. 85, OD; tnot traced, tGFC, Lille; low. Eifel., Erg Jemel, Alg.), wall tissue recrystallized to pseudolamellate-holocanthase condition]; Clei**to**dictyum Plusquellec, 1976, p. 7. L.Dev.-M.Dev. (Cou**vin**), Eu.(France-Ger.-N.Afr.(Alg.); ?L.Miss. ([Tournais.]), N.Am.(Iowa-Ill.-Mo.).—Fig. 380, 2a-c. *C. geometrica* (Milne-Edwards & Haime), France, Viré et Loué, Sarthe; a, calical view, X2.0; b, transv. sec. showing straight mural pores, X4.0; c, long. sec., X12.0 (Smyth, 1933a).

Arapeopl**yllum** Etheridge & Nicholson, 1879, p. 277 [*A. australis*; OD; t19395; AM, Sydney, part of which is 90249, BM(NH), London; thin sections are 1967.66.253-254, RSM, Edinburgh and 1214(3), AU, Aberdeen, fide Benton, 1979, p. 39]. Massive, with slender, tall prismatic corallites; mural pores numerous; septa cribriform, anastomosing in laminar recticum; tabulae few, thin. ?Dev., Australia (N.Queensl.).—Fig. 380, 2a,b. *A. australis*, Is. of Burdekin R., N. Queensl.; a, b, c, transv. secs., X11.0 (Sokolov, 1962c).

*Corallum encrusting; corallites prismatic, walls thick, spongy, pierced by numerous branched, irregular, connective tunnels; tabulae regular, horizontal, continuous into tunnels of walls; septal spines sporadic or absent [see Dubatolov & Tong-Duy, 1965, p. 44]. U.Carb.(Moscov.), Eu.(Donbas)-Asia(Iran-Viet Nam-Kweichow).—Fig. 380, 2a,b. *D. milleporoides*, suite Cs*, Donbas; a,b, transv., long. secs., X11.0 (Sokolov, 1962c).

*Maurenia* Le Maître, 1957, p. 370 [*Squameo**phyllum? arborescens* Le Maître, 1952, p. 87; totypes, 126, Le Maître Coll., GFC, Lille]. Corallum small, discoid, thick; with wrinkled basal holotheca; corallites polygonal, calcilacan tabula with granules or spines, peripherally in radial (septal) rows; basal and common walls of lamellate sclerenchyme, with holocanthine septal spines embedded; lumen with reticulum as in Squameo**phyllum** Smyth, 1933b; pores not mentioned. M.Dev.-low.Cou**vin**, L.Afr.(Alg.).—Fig. 381, 2a,b. *M. arborescens* (Le Maître), low. Couvin., Alg., El Kseib; a, cotype, calical view, X1; b, paratype, long. sec., X5 (Le Maître, 1952).

?Rhiphaeolites Yanet in Sokolov, 1955, p. 169 [*R. sokolovi*; OD; t19394/3, coll. 270, UGUP, Sverdlovsk] [==Rhiphaeolites Yanet in Kipariso**va** et al., 1956, p. 33, nom. null.]. Corallum crustose, with well-developed holotheca; corallites prismatic; in early stages corallites inclined and favositoid; in adult, erect stages, corallites have a wide peripheral stereozone pierced by numerous mural pore tunnels and composed of otherwise contiguous thickened septal bases from which numerous thin septal spines may project adaxially; lumina of irregularly rounded outline; tabulae numerous, commonly irregular and incomplete. [Possibly a theciid; no septal counts available.] U.Sil.-L.Dev., Asia(E.slope,N.Urals).—Fig. 381, 2a,b. *R. sokolovi*, holotype, L.Dev.(Coblenz.), E. slope of N. Urals, near Karpinsky, right bank of R. Toly, 2,180 m. above Toly; a,b, transv., long. secs., X4 (Kipariso**va** et al., 1956).

*Squameophyllum* Smyth, 1933b, p. 171 [*S. spumans*; OD; tR4656, BM(NH), London] [==Cleistopora Nicholson, 1888, which see]. Corallum broadly conical to stalked, holothecate with epithecal scales; corallites prismatic or in places separate and cylindrical; calicles conical, floors of calice granular throughout; lumina of reticulate tissue continuous from base of corallite to floor of calice and without tabulae, its vermiculture passages connected from one corallite to the next by pores which tend to be in horizontal rows and at right angles to the plane of contact of the corallites. L.Carb.(Tournais.), Eu.(Belg.).—Fig. 382, 2a,b. *S. sokolovi*, Tournai; a, holotype, calical view, X2; b, paratype, long. sec., X4 (Smyth, 1933b).

*Stratophyllum* Smyth, 1933b, p. 173 [*S. tenue*; OD; tR14307, BM(NH), London] [==Stratophyllum Scheffen, 1933, a rugosan; Ethmoplax Smyth, 1939, p. 859, nom. van., non Stratophyllum Scheffen, 1933, a rugosan; Ethmopalx Smyth, 1939, p. 859, nom. subst. pro Stratophyllum Smyth]. Corallum small, discoid, holothecate and with epithecal scales; calices shallow, floors flat or convex, granulose; large tabulae or tabulae present with very low convexity and with more or less dense and tall granulation on upper surfaces; peripherally granules conjoin in radial anastomosing ridges; mural pores numerous. [*Mi**chelina* antiqua*] (McCoy) is herein transferred to Yavoriska Fomichev, 1931.] L.Carb.(Tournais),
Yavorskia FOMICHEV, 1931, p. 10 [*Y. barsaensis; M; ?not traced; ?TsGM, Leningrad]. Ceroid, holothecate; calices shallow; corallites prismatic, common walls thin, pierced by numerous circular to irregularly lobate pores, and augmented by more or less thickened and granular septal bases that may anastomose to form a spongy peripheral zone; tabulae numerous, thin, irregular, incomplete, with small tabellae concentrated peripherally [see SAVUTINA, 1966, p. 208]. L.Carb. (Tournais.). Asia (Kuzbas-Urals-N. Zemlya)-Eu. (Eire-Wales-Belg.)-Australia (New S.Wales).—Fig. 382,1a-c. *Y. barsaensis, Kuzbas, R. Taydon; a, transv. sec., ×2; b, long. sec., ×4; c, tang. sec. through common wall, diag. (Sokolov, 1962c).

Family VAUGHANIIDAE
Lecompte, 1952

[Vaughaniidae Lecompte, 1952, p. 515]

Corallum ceroid, discoid or low hemispherical, holothecate and small; corallites large, prismatic, short, atabulate; basal and common walls of dense, radially fibrous tissue, a ring groove or tunnel around base of each corallite where wall joins floor; ring tunnels of neighboring corallites connected by short radial tunnels and opening into lumen by short radial branches. L.Carb. (up.Tournais.).

Vaughania GARWOOD, 1913, p. 564 [*V. cleistoporoides; M; syntypes, 63587-8, 63590, and PF2536, IGS, Leeds]. Discoid, free or attached; epithecate; atabulate; walls and floors of dense fibrous tissue in which neither septa, interseptal loculi, nor tabulae can be distinguished; each corallite with a ring canal around the base where the wall joins the floor; ring canals of neighboring corallites connected by radial canals (mural pores), and opening into calices by branch canals. L.Carb. (up. Tournais.). Eu. (Eng.).—Fig. 383, 3a-c. *V. cleistoporoides, near base of Solenopora subzone, NW. Eng.; a, paratype, long. sec., ×5; b, c, holotype, upper, lower surfaces, ×2 (Smyth, 1933b).

Family PALAEACIDAE Roemer, 1883

[nom. correct. Počta, 1902, p. 64, pro Palaeaciden Roemer, 1883, p. 515] [=Palaeacidae HILL & STUMM, 1956b, p. F466]

Sphenoid or cruciform or crustose coralla with vermiculately porous coenenchyme more or less well developed between calices and corallites and with or without holotheca; calices may be lined by dense sclerenchyme, aperforate or pierced by perpendicular pores; atabulate. L.Carb.

Palaeacis HAIME in MILNE-EDWARDS & HAIME, 1857c, p. 9 [*P. cuneiformis; M; ?MN, Paris]
Fig. 383. Vaughaniidae (3); Palaeacidae (1, 2) (p. F572-F574).

[=Sphenopoterium Meek & Worthen, 1860, p. 447 (type, S. obtusum, OD; 4 syntypes, X-36, Ull, Urbana); ?Helioalcyon Termier & Termier, 1945, p. 70 (type, H. segaudi, OD; 3 figured syntypes, hd2003-M95, SGM, Rabat; up. Viséan, Ain Oulad bei Abed, Oujda reg., Moroc.); Polypatina

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Coelenterata—Tabulata

Corallum sphenoid without holotheca; adherent in young stage with round calices opening along narrow sides and broad end of wedge and set in porous coenenchyme; flat sides of irregularly septate (ridged) and canaliculate coenenchyme; calices lined with ?atrabeculate fibrous tissue pierced by perpendicular pores that may fork; septa ?cribriform; atabulate [see Smyth, 1929, p. 125; Conkin, Bratcher, & Conkin, 1976]. L.Carb.(Tournai.-Visean), Eu.(Brit.I.-Australia(Queensl.); Miss., N.Am.(Ky.-Ind.-Ill.).—Fig. 383,la,b. *P. cuneiformis, St. Louis Gr., Ind., Spergen Hill; a,b, ext. views, X1.5 (Hinde, 1896).—Fig. 383,le. P. axinoides Smyth, C, Eire, Hook Head, Co. Wexford; oblique long. sec., X4.0 (Smyth, 1929).

?Microcyathus Hinde, 1896, p. 447 [*Hydnopora? cyclostoma PHILLIPS, 1836, p. 202; M; 167, YM, York]. Adherent, holothecate, discoid; coenenchyme trabeculate, ridged and irregularly canaliculate; calices lined with nontrabeculate aperforate fibrous tissue; atabulate [see Weyer, 1970b, p. 1118]. L.Carb., Eu.(G.Brit.-Belg.-Silesia); Miss., N.Am.(Ill.-Ind.-Ill.).—Fig. 384,la-e. *M. cyclostoma (PHILLIPS); a,b, Visean, G.Brit., Northumberland, ext. views, X0.6, enl. (Phillips, 1836); c-e, L.Carb.Ls., Fifeshire, c, thin sec., X5, d,e, ext. views, enl. (Etheridge & Nicholson, 1878).

Smythina Weyer, 1970b, p. 1118 [*Palaeacis humilis Hinde, 1896, p. 440; OD; lectotype R2731, BM(NH), London; by D. E. White, herein, from syntypes R2728-2735, 22547-22549, 22221, 22222]. Corallum without holotheca, low, dish-shaped, with four thick-walled corallites arranged in form of cross, with rounded calices set in porous coenenchyme; ornament of slightly wavy longitudinal ?septal ribbing; pores predominantly simple and straight through walls in calical region and on underside, but irregularly reticulate in spongy central zone of upper surface; atabulate. [Weyer's interpretation; D. E. White informs me (pers. commun.) that Hinde's description was based on immature coralla only; he suggests that mature coralla such as GSM8148 (Fig. 389,2d) might be referred to Trachysamadia GERTH, 1921, and that they may be two genera in symbiotic relationship.] L.Carb.(mid.up.Visean). Eu.(Eng.-Ger.).--FIG. 383,2a-e. *S. humilis (Hinde), syntypes, Eng., R. Hodder near Stonyhurst College, Lancashire; a,b, ext. views, X2.0; c, transv. sec., X7.0 (Hinde, 1896); d,e, mature corallum, ext. view, transv. sec., X2.0 (Hill, n; photographs courtesy D. E. White).

Superfamily PACHYPORICAE

GERTH, 1921

[nom. transl. Hill, herein, ex Pachypropodeae GERTH, 1921, p. 105] [=Thamnoporina SOKOLOV, 1950a, p. 166, suborder]

Corallum cerioid and branching, in some astreoid; corallites polygonal or rounded-polygonal in section, with marked peripheral stereozone at least in peripheral parts of branch; width of stereozone increases either gradually throughout growth or suddenly so as to demarcate peripheral from axial zone of branch; original microstructure of stereozones either radially fibrous and growth lamellate, and with either septal spinules or rarely squamulae projecting into tabularium, or consisting of contiguous septal laminae composed of clinogonally fibrous trabecular conjunct basally and free adaxially; diagenesis commonly obscures original microstructure; mural pores or tunnels present; tabulae complete, horizontal, rarely inclined or incomplete. U.Ord.-U.Perm.

In some pachypropids the cerioid corallum may become astreoid peripherally, when calical, extratabularial (stereozonal) platforms and underlying growth lamellae pass from one to the neighboring corallite without change of slope or even with some depression; on some of these a raised calicular ridge forms at the boundary between tabularial pit and stereozone, and the calicular platforms outside this ridge may be ornamented with granules and ridges, some radial. These calicular platform regions are not coenenchymal, and there seems no need
to have a family name “Trachyporidae” or “Dendroporidae” for such forms.

**Family PACHYPORIDAE** Gerth, 1921


Corallum cerioid and branching; corallites polygonal or rounded-polygonal in section and diverging from axis of branch to open commonly normal to surface of branch, but toward apex of branch at acute angle; corallite walls thin and favositoid in axial zone of branch, with peripheral stereo-zones more or less suddenly developed in peripheral zone of branch; original micro-

structure, when retained, shows stereozone consisting of radial fibers deposited in concentric growth lamellae; septal spines or rarely squamulae may project from stereozone into tabularium; mural pores and tabulae present. L.Sil.-U.Perm.

Latency or overtess of radial fibrosity and of growth lamellation is in my view diagenetically controlled; radial or bilateral symmetry of calice appears to be controlled by distance in time and space from apex of growth of branch.

**Pachypora** Lindström, 1873a, p. 14 [*P. lamellicornis*; M; syntypes Cn580, 583-5, 587, 592, 596, 598, 600, 58592, RM, Stockholm] [?Thamnopora Steining, 1831, which see, but is frondescent and digitate, not cylindrically branching; ?Pachypora (Parapachypora) Yang, Kim, & Chow, 1978, p. 193 (type, Thamnopora lamellosa Y unsafe]}
Corallum frondescent; corallites directed longitudinally in median parts of frond and with somewhat thickened walls diverging sharply to open obliquely or perpendicularly to surface of frond; calices polymorphous, alveolitoid to polyhedral; in peripheral parts of fronds walls very thick and growth lamellae ? (pseudolamellae) continuous across median sutures between neighboring corallites; septal spines present in some calices; mural pores arranged in rows parallel to surface of frond; tabulae sparse, thin [see LINDSTROM, 1896b, p. 23].

M.Sil.(low.Wenlock.), Eu.(Gotl.); Sil., Asia(China).--Fig. 386,la,b. ·*P. lamellicornis*, Gotl., near Visby; a,b, long., transv. secs., X4; c, ext. view, d, outline of cross section, ab, of frond, X1 (Lindström, 1896b).

**Acaciapora** Moore & Jeffords, 1945, p. 181 [*Michelinia subcylindrica* Mathier, 1915, p. 97; OD; UC16159, 8 syntypes, FM, Chicago] [=?Sinksia ngopora Chi, 1961, which see; Acaciopora Ivanovsky, 1973b, p. 267, nom. null.]. Corallum ramose, with dichotomous (rarely trichotomous) branching, the branches slender, cylindrical; corallites small, commonly spirally arranged; each proximally directed outward at a low angle to axis of branch, curving rapidly outward distally to open obliquely to surface; walls thin proximally, thickened distally; calices oval, elongated parallel to axis of branch, slightly projecting especially on lower side, separated by schlerenchyme, septa possibly represented by faint ridges; no tabulae, but squamulae present; mural pores fairly numerous [see THOMAS & FORD, 1963, p. 46]. *L.Carb.(Vis­een), Eu.(Eng.); L.Penn., N.Am.(Okla.).--Fig. 385,la.b. ·*A. subcylindrica* (Mathier), L. Penn., Hale F., Okla., Greenleaf L., SE. of Braggs; a,b, transv., long. secs., X6 (Moore & Jeffords, 1945).

**Celechopora** Prádak, 1938, p. 18, as *Celechopora* [*C. kettnerae*; OD; not traced, ?Remész Coll., Univ. Charles, Prague]. Corallum slenderly branching, corallites moderately divergent, opening obliquely; calices may have rhomboid outlines, width greater than height; squamulae present only in distal parts of corallites; septal spines ? absent; tabulae thin, mural pores scarce, walls thick slightly distally; increase adaxial, bipartite. *M.Dev., Eu.(Moravia).--Fig. 386,la.b. ·*C. kettnerae*, Moravia, Chelochovice; a,b, transv., long. secs., X20 (Prádaková, 1938).


**Daljanolites** Leleshus, 1964a, p. 11 [*D. reticu­latus*; OD; ?8, coll. 8332, TsGM, Leningrad]. Corallum reptant, of cylindrical or sublobate separate and anastomosing branches; corallites in axial parts of branch prismatic and very thick-walled, with distinct median sutures and uniserial mural pores and weakly developed septal elements; toward periphery of branch diameter of corallites and radius of their peripheral stereozones increase two to three times, mural pores are absent and
median sutures become indistinct, but 12 laterally continuous septal elements (short plates) bound the very narrow lumen and become discontinuous radially outward; tabulae not distinguishable, presumably due to thickness of stereozone; increase lateral and calicular [see Leleshus, 1972b, p. 26].

U.Sil.(Ludlov.), Asia(Turkestan Ra.).—Fig. 388, la-c. *Pachypora curvata* WAAGEN & WENTZEL, 1886 of GERTH, 1921, which see; ?*Thamnoporella* SOKOLOV, 1955, which see; ?*Sakhapora* KOKSHARSKAYA, 1965b, p. 65 (type, S. verkhojanica, OD; t2170/54-15, IG, Yakutsk; corallites open at low angles to surface). Corallum branching; branches of radially diverging corallites increasing notably in diameter during growth and opening normal to surface of branch; edges of tabularium raised in calice, variable in size and distant; septal spines visible in calices; skeletal thickening great; mural tunnels vermiform, anastomosing; tabulae rare to absent. Perm., Asia(Salt Ra.-Timor=?Yakutia)-Australia(New S. Wales-Queens.-Tasm.-W. Australia).—Fig. 390, 1a-e. *G. acuta* (WAAGEN & WENTZEL), U. Perm.(Basleo.), Timor; a, long. sec., X 1.7, b, ext. view, X 1.3, c, tang. sec., X 2.0 (Gertih, 1921); d, tang. sec., X 50.0, e, long. sec., X 25.0 (Waagen & Wentzel, 1886).

Egosicella DUBATOLOV in SOKOLOV, 1955, p. 190 [*E. sajonoviensis*; OD; t390, coll. 546, VNIGRI, Leningrad] [=*Limaria* STEININGER, 1831, p. 12 (type, L. clathrata, SD LANG, SMITH, & THOMAS, 1940, p. 76; tlost, fide Lecompte, 1939, p. 71; M.Dev., Eifel., Gerolstein), non *Limaria* LINK, 1807 nec Rafinesque, 1815, both bivalves; see Nicholson, 1879, p. 130]. Corallum of procumbent, anastomosing, slender, cylindrical branches; corallites diverge fanwise from asymmetrical axis of branch and open in small, compressed, pocket-like calices commonly arranged in alternating longitudinal rows; corallites irregularly prismatic and thin-walled in axial region, but calices crescentic or oval due to thickening of walls in peripheral regions; septal spinules weakly developed; mural pores few; tabulae transverse [see Mironova, 1968, p. 50]. M.Sil.-U.Sil., N.Am.(Mich.-Ky.-Tenn.-Okla.); L.Dev.-M.Dev., Asia(Kuzbas-Tarbagatay Ra.)-?Eu.(Ger.-Belg.).—Fig. 389, 2a,b. *E. sajonoviensis*, holotype, M.Dev.(Givet., Safonovo beds), Kuzbas, R. Egos, Safonovo; a, ext. view, X 3.0; b, long. sec. of branch, X 4.0 (Sokolov, 1955).
Fig. 388. Pachyporidae (p. F576-F577).
ous, polygonal or rounded polygonal in cross section and curving slowly at first outward from axis of branch to open at surface at an acute or closer to right angle; calices with sharp lower lip and gently sloping, bluntly thickened upper lip; walls thin in axial zone, gradually thickening toward surface of branch; stereozone latently radially fibrous with faintly marked median suture between...
corallites; pores uniserial; small septal spines may be present; tabulae complete, horizontal, or rarely inclined [see Dubatolov, 1969, p. 112]. L.Dev.-M. Dev. (Eifel.), Asia (Kuzbas-NE. USSR-Urals).

---Fig. 391, la,b. *G. yavorskyi* (Dubatolov), Chudinova's holotype, Eifel., Salairka horizon, left bank R. Maly Bachat, 500 to 600 m. E. of bridge over R. Salairka; a,b, transv., long. secs., X1.3, X2.7 (Chudinova, 1964).

**Guanziyaopora** Kim & Yang in Yang, Kim, & Chow, 1978, p. 189 [*G. guanziyaoensis*; OD; tGct 379-380, GB, Guiyang; M.Dev., Guanzhao F., Guanzhao, Puan (Panshui), Guizhou (Kweichow)]. Like *Thamnopora* but in peripheral parts of branches thickening of walls developed in successive, transverse, shelflike annuli. [Diagnosis tentative, from illustrations.] M.Dev., Asia (Kweichow).

**?Guizhoustriatopora** Chow in Yang, Kim, & Chow, 1978, p. 192 [*G. dushanensis*; OD; tGct 382, 383, GB, Guiyang; L. or M.Sil., Shuiyan, Li Shan, Dushan, Guizhou (Kweichow)]. Corallum of cylindrical branches; corallites polygonal in section, diverging slowly from axis and opening somewhat obliquely; walls thickened, thickening but slightly increasing distally; mural pores large; septal spines sparse; tabulae flat or slightly curved. [Diagnosis tentative, from illustrations.] L.Sil. or M.Sil., Asia (Kweichow).

**Heterocoenites** Gerth, 1921, p. 109 [*H. variabilis*; SD Lang, Smith, & Thomas, 1940, p. 68; figured syntypes 39, Wanner Coll., IP, Bonn]. Corallum branching, corallites directed longitudinally in axes of branches, diverging to open at surface.
with polygonal calices in proximal parts, but obliquely and with alveolitoid calices in distal parts; skeletal thickening great, lumina filled in axial regions of branch; septa represented by ridges or rows of small spines, up to eight; one septum larger than others; mural pores sparse, somewhat irregular; tabulae rare. U.Per., Asia (Timor).

---Fig. 389, 1a-c. *H. variabilis*, syntype, Basle., Timor; a, long. sec., X2.3; b,c, ext. views, X2.7, X1.3 (Gerth, 1921).

Hillaepora Mironova, 1960, p. 97 [*H. spica*; OD; t1167-31, coll. 853, SNIGGIMS, Novosibirsk] [? = Cladopora Hall, 1851, which see, but differs in having long, distally produced calical edges;
Hilleaopora Flügel, 1970, p. 132, *nom. null.*. Corallum branching, each slender branch formed of corallites directed upward and outward from axis and opening to surface at acute angle; calices deep, with thin edges that project as pipes high above rest of surface of branch; in axial zone corallites tightly contiguous and polygonal to rounded in section, at surface they separate and attain cylindrical form; walls everywhere thin or but weakly thickened; pores in one longitudinal row to each face of wall; septal spines absent, tabulae sparse. L.Dev. (Cedr.); Asia (Salair). --Fig. 391, 2. *H. spica*, Tom-chumysh beds, “Sukhay suite,” E. Salair, Bachaty; oblique transv. and long. secs., X2.7 (Mironova, 1960).

Pachystriatopora Le Maitre, 1956a, p. 1342 [*P. obliqua*; OD: 1564,a,b, Le Maitre Coll., GFC, Lille]. Corallum of fingerlike branches; calices opening very obliquely to axis and with well-developed upper lip; calical walls with septal ridges separated by deep furrows in which pores are disposed in several rows; pores sparse below calice; sclerenchyme of walls lamellate, septal spines absent; tabulae thin. [Unfigured, insufficiently known.] L.Dev. (up. Ems.)-M.Dev. (low. Eifel.), N. Afr. (Hamar Laghdad, Tafilelt, Moroc.).

Parastratoporella Chudinova, 1959, p. 50 [*Striato-pora immota* Moore & Jeffords, 1945, p. 180; OD: +P.9364, UTBEG, Austin]. Branching corallum with peripheral zone of skeletal thickening; corallites curve evenly outward and increase gradually in diameter from axis to open perpendicular to surface of branch; calices may show septal ridges; corallites polygonal in section and thin-walled in axial region, thick-walled in peripheral region; mural pores present; tabulae complete or incomplete; nature of skeletal thickening insufficiently known. L.Penn., N.Am. (Texas-Oklahoma-Ark.). --Fig. 392, 1a-c. *P. immota* (Moore & Jeffords); holotype, Brentwood Ls., Ark., 1.5 mi.
NE. of Fayetteville; \(a\), calical view, \(\times 2.7\); \(b,c\), transv., long. secs., \(\times 2.7\) (Moore & Jeffords, 1945).

**Protrachypora** Chow in Yang, Kim, & Chow, 1978, p. 195 [*P. yanheensis*; OD: *Get 393-396*, GB, Guiyang; L.Sil., Shiniulan F., Tudiao, Yanhe Xian (co.), Guizhou (Kweichow)]. Corallum ramose, with slender subcylindrical branches with corallites polygonal or subrounded in section in axial part, diverging slightly from axis to open obliquely at surface of branch, their distal parts rounded and not contiguous in section distally; walls moderately thickened, thickening slightly increasing distally; mural pores sparse; septal spines short. [Diagnosis tentative, from illustrations.] L.Sil., Asia (Kweichow).

Coelenterata—Tabulata

Corallum branching; corallites diverge radially from axis of branch and increase rapidly in diameter to open normal to surface, the walls thickening quickly but progressively so that in wide peripheral zone lumina are filled or almost filled; coarse "squamulae" with sharp edges bent strongly inward; perpendicularly on large branches; calices may open obliquely to surface on small branches, gently away from axial longitudinal direction and opening obliquely to surface on small branches, perpendicularly on large branches; calices may show septal ridges. Walls thin in axial region, thickening to become wide stereozone distally, with distinct growth lamellation; corallites polygonal in section but tabularium cylindrical distally because of wall thickening; mural pores common; septal spines may project into lumen; tabulae complete; new corallites originate in one of two positions, either near axis of branch or near boundary between inner thin-walled and outer thick-walled zones; the latter do not produce new corallites. [Many Paleozoic species have been referred to Striatopora but now require revision in light of Oliver's precise study of type species (Oliver, 1966, p. 448).] M.Sil.(Niag.), N.Am.(N.Y.); ?U.Sil., N.Am.(Alaska).—Fig. 393,1a-c. *S. flexuosa, Rochester Sh., N.Y., Lockport; a, lectotype, ext. view, X1; b,c, paratype, transv., long. secs., X10 (Oliver, 1966; photographs courtesy of W. A. Oliver).

Thamnopora Steininger, 1831, p. 10, non Thamnopora Hall, 1883, a Devonian bryozoan [*T. madreporacea; OD; =Alveolites cervicornis de Blainville, 1830, p. 370; lectotype of both species 259a, Goldfuss Coll., IP, Bonn; by Lang & Smith in Hill, 1937b, p. 56; see Lang, Smith, & Thomas, 1940, p. 133] [*=Pachypora Lindström, 1873a, which see; ?Dendrofavosites Rukhin, 1937, Favositaceae, Favositidae, Emmonsiinae; ?Gersholtites Sokolov, 1955, which see]. Corallum ramose, corallites diverge from longitudinal direction in axis of branch so that except near apex of branch calices open perpendicular to surface; walls thickened, width of stereozone increasing distally, forming rounded calical pits; thickening may show growth lamellation, of fibers radiating chonogonally from median suture between corallites; septal spines sparse; mural pores numerous, tabulae thin. Dev., cosmop.—Fig. 395,1a-c. *T. cervicornis (de Blainville), lectotype, M.Dev.(Givet.), Ger., Bensberg; a,b, ext. view, X0.7; b,c, transv. sec., X2.7; c, part of long. sec., X6.0 (Lecompte, 1936).

Thamnoporella Sokolov, 1955, p. 176 [*Striatopora moorei Wells, 1944, p. 260; OD; +19500, OSU, Columbus] [*Thamnoporella Sokolov, 1950a, p. 166, nom. nud.; ?Gersholtites Sokolov, 1955, which see, in which not the median suture between calices, but inner boundary of stereozone, is sharp-edged]. Corallum ramose, branches cylindrical or somewhat compressed; corallites unequal, prismatic, pointing at right angles to surface of branch and with calices sharp-edged at median sutures between neighbors; tabulae present only in axial zone where corallites have relatively thin walls; in peripheral zone lumina filled by skeletal thickening; septal spines commonly in 12 longitudinal rows; mural pores large, canal-like in peripheral zone. M.Penn., N.Am.(Texas).—Fig. 392,2a-d. *T. moorei (Wells), Strawn Gr., 5 ft. above Marble Falls Ls., Texas, about 5 mi. SE. of London, Kimble Co.; a, holotype, ext. view, X1.0; b,c, paratypes, transv., long. secs., X2.7; d, paratype, tang. sec., X4.0 (Wells, 1944).

Thamnoptychia Hall, 1876, explanation to pl. 33
[*Striatopora (Thamnoptychia) limbata Eaton, 1832, p. 39, non Goldfuss, 1826, p. 22; M; †Hall's specimens in AMNH, New York, Eaton's not traced; =Trachypora romingeri Ross, 1953, p. 85, †10590, NYSM, Albany, M.Dev., Kashong Sh., Hamilton Gr., Eleven Mile Cr., N.Y.; =Milliporites vermiculosa Lesueur, 1821, p. 293, †not traced; see Stumm, 1965, p. 70] [=?Trachypora Milne-Edwards & Haime, 1851, p. 305 (type, T. davidsoni, M; †not traced, Dev., Ferques, France), until types can be traced or a neotype named and studied in thin section it is better not to use this name or a family name derived from it. Trachypora has been interpreted by Lecompte (1939, p. 147) as a dendroid tabulatan in symbiosis with a stromatoporoid. Corallum digitate, branching dichotomously; corallites prismatic, directed longitudinally and with slightly thickened walls in axial part of branch, turning sharply at right angles to surface and expanding rapidly in diameter as peripheral stereozone widens almost to fill lumen; septal spines and tabulae present, and mural pores; stereozonal surfaces between openings of lumina with granular and radiating ornament for which no structural cause has yet been found in thin sections of stereozone. L.Dev., N.Afr.
(Moroc.); \textit{M.Dev.} (Givet.), N.Am. (N.Y.-Ont.-Ind.-Mich.-Ky.); ?\textit{U.Dev.}, Eu. (France). — Fig. 395, 2a-c. *\textit{T. romingeri} (Ross), \textit{M.Dev.}, Hamilton Gr., N.Y., Deep Run, Darien Center; a-c, transv., long., tang. secs., dark spots are patches of secondary alteration, \(\times 6.7\) (Hill, n; UQF11979).

Family PARA-STRIATOPORIDAE

Chudinova, 1959


Corallum ceroid, branching; corallites diverging evenly or with sharp change from longitudinal direction in axial zone of branch to open normal to surface of branch; walls favositoid and thin in axial zone, sharply augmented by thickened contiguous septa in peripheral zone; septa laminar at least basally, the lamina may be composed of conjunct trabeculae inclined adaxially upward; mural pores present; tabulae complete and transverse or inclined or incomplete; may be thickened in peripheral zone. \textit{U.Old.-M.Dev.}

\textbf{Parastriatopora} Sokolov, 1949, p. 86 [*\textit{P. rhizoides}; SD Sokolov, 1955, p. 520; †?, VNIIGRI, Leningrad] \(=\textit{favositella Mansuy}, 1912a, p. 77\)
**F. columnaris**, M; +156, MG, Hanoi, lectotype by Tong-Dzuy, 1966b, p. 34; ?M.Dev., Yi leang, Yunnan; *non* Etheridge & Foord, 1884, a bryozoan; see Tong-Dzuy, 1966b, p. 33 and Fontaine, 1954, p. 58). Corallum cylindrical, branching; corallites diverging fanwise from axis and more or less evenly curved and without sudden increase in diameter, to open perpendicularly to surface of branch; calices conical, some with radial striping; walls thin in axial parts of branch but sharply and strongly thickened in peripheral parts of branch where corallites are perpendicular to surface; where diagenesis is slight, peripheral stellate of corallite is seen to consist of contiguous septal laminae each of upward and adaxially directed septal spines (?rhabdacanths) whose axial edges may be free; mural pores well developed, on faces and, in some species, at angles; tabulae flat, complete, may be thickened in peripheral zone. *Sil., Asia* (Sib.Platf.-Sev.Zemlya-N.Zemlya-Korea-Taymyr)-Eu.(Gotl.-Est.)-N.Am.(Alaska); *L.Dev., Australia* (New S. Wales)-Asia (Kuzbas)-N. Afr.
Fomichevia
Coelenterata—Tabulata

Fig. 398. Parastriatoporidae (p. F589).

(Ech)ropora TONG-DZUY in DUBATOLOV & SPASSKIY, 1964, p.-t2'9 [*E. grandiporosa; OD, fully described and figured in DUBATOLOV & TONG-DZUY, 1965, p. 49; t175/25, MG, Hanoi; see also TONG-DZUY, 1967, p. 84]. Corallum dichotomously coarsely branching; corallites curving from longitudinal direction in axial part of branch and turning sharply to lie perpendicular to surface in wide peripheral zone; in axial zone walls thin with homogeneous microstructure; in peripheral zone thick, radial, and laterally contiguous short septal laminae are composed of fibers diverging clinogonally from mid-plane of lamina and median suture of wall; internal surface of stereozone papillate; mural pores large; tabulae horizontal, inclined or weakly curved. L.Dev. or M.Dev., Asia (Viet Nam-NE.USSR).—Fig. 397,2a-c. *E. grandiporosa, Dev.(up.Ems. or low.Eifel.), Viet Nam, near village of Tu San, Ha Giang Prov.;
Yacutiopora

Tabulata—Favositida—Alveolitinina

F589

a,b, tang., long. secs. through peripheral zone, \( \times 10 \); c, long. sec., part of branch, \( \times 4 \) (Tongdzu, 1966a).

**Fomichevia** DUBATOLOV, 1959, p. 119 [*F. salairica*; OD; t428, coll. 546, VNIGRI, Leningrad; briefly compared in 1958 with the diagnosed, described, and figured *F. rozkowskae* STASINSKA, 1958, p. 197, t138, *FZI, Warsaw, Couvin., Pol., Grzegorzowice, Holy Cross Mts.*] [**Fomichevia** DUBATOLOV in STASINSKA, 1958, p. 196, nom. nud.; *Fomichevia DUBATOLOV, 1959, p. 119, nom. van.; ?Pachylites** YANET, 1970, which see]. Corallum small with very slender cylindrical branches; corallites in narrow axial zone prismatic, very slender, almost capillary, with walls somewhat thickened; corallites greatly increased in diameter and sharply bent at inner edge of wide peripheral zone to proceed perpendicular to surface, where calice margin is rounded-polygonal; walls markedly thickened in peripheral zone; mural pores small; tabulae transverse, sparse; septal spines weakly expressed; increase intermural in axial zone of branch. **M.Dev. (Eifel.), Asia(N.E.USSR-Altay)-Australia (New S.Wales-Queensl.); ?M.Dev.(Eifel.), N.Afr. (Alg.).**—**FIG. 398, 1a-c. *Y. dogdensis*, holotype, L.Dev., left bank R. Khohochalo, left tributary R. Dogdo, Tas-Khayakhtakh; a-c, transv., tang., long. secs., \( \times 3.3 \) (Dubatolov & Spasskiy, 1964).

Suborder ALVEOLITINA

Sokolov, 1950


Corallum turflke, nodular or branching; corallites slender, in cross section crescentic, triangular, rounded- or compressed-polygonal or meandroid; corallites commonly incined, with upper wall arched and lower applied to substrate; opening to surface at acute or less commonly almost a right angle, in compressed-rounded calices; walls thin or thick, microstructure radically fibrous (orthogonal or clinogonal) with growth lamella-tion; alternately light and dark pigmented growth zones common; pores uniserial, on narrow sides of corallites; septa represented by spines or squamulae; tabulae horizontal, inclined or somewhat curved. **L.Sil.-U.Dev.**

Family ALVEOLITIDAE Duncan, 1872

[Alveolitidae DUNCAN, 1872, p. 135]

Corallum massive, extensiform, encrusting or branching; corallites slender, long, more or less reclined, thin-walled distally, calices opening obliquely to surface and crescentic or in some compressed-polygonal; walls may be thick proximally; mural pores numerous, large, commonly in one row on narrow sides; septa represented by spines or squamulae; tabulae horizontal or inclined; increase lateral or longitudinal, asso-
Fig. 399. Alveolitidae (p. F591).
associated with development of row of significantly larger spines [see SHARKOVA, 1971, p. 58]. \textit{L.Sil.-U.Dev.}

Subfamily ALVEOLITINAE Duncan, 1872

[\textit{nom. transl.} \textit{WAGEN & WENTZEL, 1886, p. 844, ex Alveoliitidae Duncan, 1872, p. 135}]

Alveolitidae with corallites inclined or reclined, and without squamulae. \textit{L.Sil.-U.Dev.}

\textit{Alveolites} LAMARCK, 1801, p. 375 [\textit{A. suborbi­cularis}; SD Nicholson \& ETHERIDGE, 1877, p. 356; \textit{\textbullet}type, 260m, GOLDFUSS Coll., IP, Bonn; by SMITH, 1933b, p. 138] [\textit{=Billingsia de KONINCK, 1876, p. 75 (type, \textit{A. alveolaris}; M; type material destroyed by fire, insufficiently described; Dev., New S.Wales); \textit{Alveolitella} Sokolov, 1952b, p. 77, as subgenus of \textit{Alveolites} (type, \textit{Alveolites fecundus} Lecompte, 1939, p. 57, OD; \textit{\textbullet}type, IRSN, Brussels, lectotype by Sokolov, 1955, pl. 32, fig. 3; M.Dev., Givet., Belg.), see HILL \& JELL, 1970b, p. 71]. Corallum massive, extendiform, encrusting, in some with irregular or fingerlike outgrowths; corallites reclined, long, curved; calices oblique, crescentic or irregularly angular; walls thin in basal parts of expansion and axial parts of branches, elsewhere evenly thickened, with uniserial pores; septal spines small, thin, commonly one row of larger spines related to longitudinal increase; tabulae thin, complete; increase lateral or longitudinal. \textit{U.Sil. (Ludlov.)}, Eu. (Urals)-NI­Am. (Kazakh.); \textit{L.Dev.-U.Dev.}, cosmop.---Fig. 399, la, \textit{A. suborbi­cularis}, neotype, up.M. Dev. or U.Dev., Ger., Bensberg; transv. secs., \texttimes 10 (Lecompte, 1936).---Fig. 399, lb, c. \textit{A. fecundus} (Lecompte), lectotype, Givet., Belg., Durbuy; \textit{b,c}, transv., long. secs., \texttimes 3 (Lecompte, 1939).

\textit{Crassialveolites} Sokolov, 1955, p. 185 [\textit{Alveolites crassiformis} Sokolov, 1952b, p. 92; OD; 181, coll. 483, VNI­GRI, Leningrad] [\textit{Crassialveol­itella} Chi, 1966, p. 122 (type, \textit{C. difficilis}; L.Dev.-U.Dev., Am.-Asia (Kazakh.); \textit{L.Dev.-U.Dev.}, cosmop.---Fig. 399, la. \textit{A. suborbi­cularis}, neotype, up.M. Dev. or U.Dev., Ger., Bensberg; transv. secs., \texttimes 10 (Lecompte, 1936).---Fig. 399, lb, c. \textit{A. fecundus} (Lecompte), lectotype, Givet., Belg., Durbuy; \textit{b,c}, transv., long. secs., \texttimes 3 (Lecompte, 1939).

\textit{Planalveolites} LANG \& SMITH, 1939, p. 154 [\textit{Alveolit­ella} crassiformis (Sokolov), holotype, M.Dev., \textit{Stringocephalus} beds, USSR, Kursk reg., Starry Osok; a,b, transv., long. secs., \texttimes 4 (Sokolov, 1952b).---Fig. 400, 2a,d. \textit{C. minimus} (Leleshus), holotype, L.Dev. (Siegen-low. Ems.), N. slopes Zeravshan Ra.; c,d, long., transv. secs., \times 10 (Leleshus, 1972a; photographs courtesy V. L. Leleshus).

\textbf{Grandalveolites} MIRONOVA, 1970, p. 127 [\textit{Alveolites straeleni Lecompte, 1939, p. 48; OD; \textbullet}t837, IRSN, Brussels]. Corallum discoid or irregularly hemispherical; corallites large, inclined at acute angle to surface, where they are arranged in chess-board order; in section they are subtriangular or subtrapezohedral, twice as wide as long; walls moderately thickened; commonly a row of strong spines on either upper or lower wall or both; other spines commonly absent; pores numerous, on narrow sides near angles; tabulae transverse or commonly inclined and incomplete. \textit{L.Dev. (up. Ems.)}, Asia (Urals); \textit{M.Dev. (Couvin.)}, Eu. (Belg.)-Asia (Urals-Salair); \textit{M.Dev. (Givet.)}, Asia-N.Am.---Fig. 401, 1a,b. \textit{G. straeleni (Lecompte)}, holotype, Couvin., Belg., Dinant Basin; \textbullet,a, long. sec. in shortest diameter of corallites; \textbullet,b, transv. sec., \times 3 (Lecompte, 1939).

\textbf{Kitakamia} SUGIYAMA, 1940, p. 112 [\textit{K. mirabilis}; OD; 163070, TohU, Sendai] [\textit{Roseoporella} SPIETERSBACH, 1934, p. 485 (type, \textit{R. rhenana}; M; tin ZGI, E. Berlin; low.M.Dev., Mül­henberg beds, Oberhbach, Ger.), see also UNSALANER, 1958, p. 83; \textit{Tetralites} MIRONOVA, 1970, p. 126 (type, \textit{Alveolites tenennisimus} Lecompte, 1933, p. 42; OD; \textbullet}t314, IRSN, Brussels, lectotype by Mironova, 1970, p. 126; U.Dev., Frasn., Belg., Han-sur-Lesse); \textit{Tetralites} CHEKHOVICH, 1971, p. 162 (type, \textit{Alveolites hemisphericus} CHERNYSHYE­V), 1937a, p. 14, OD; \textbullet}type, 8, coll. 11174, TsGM, Leningrad, by Chekhovich, 1971, p. 163; U.Sil., C. Tuva; corallites of neotype commonly chevron-shaped in cross section with septal comb on base wall). Corallum thick-laminar, encrusting; corallites reclined in sheets, in places concentrically arranged around axes of low, distally projecting domes; corallites of successive layers commonly superposed in vertical series, rounded oblong or crescentic in section; pores numerous, small, in side walls at ?crenulate edge with base wall; tabulae thin, transverse; walls moderately thick; septal spines sparse to absent; increase longitudinal, a septal comb or lamina growing upward from base wall. \textit{U.Sil. (Ludlov.)}, Asia (Japan-Tuva-Tarbagatay Ra.; \textit{Asia M.})-Australia (New S.Wales); \textit{M.Dev. (Eifel.)}, Eu. (Ger.-Belg.); \textit{U.Dev. (Frasn.)}, Eu. (Belg.).---Fig. 402, 1a-d. \textit{K. mirabilis}, holotype, U.Sil., \textit{Halysites} L., Japan, Kitakami Mt.; \textbullet,a,b, long. secs., \times 4, \times 6; c,d, tang. secs., \times 4, \times 6 (Sugiyama, 1940).---Fig. 402, 1e-h. \textit{K. hemisphericus} (Chernyshyev), neotype, Ludlov., up. Cherkag suite, C. Tuva; \textbullet,e,f, transv. secs., \times 4, \times 10; g,h, long. secs., \times 4, \times 10 (Chekhovich, 1971).
Fig. 400. Alveolitidae (p. F591, F595).
Planalveolites jOt/gti MILNE-EDWARDS & HAIME, 1851, p. 257; OD; †now missing, EM, Paris. Corallum thin, flat, or one to three layers of large, recumbent corallites, thin-walled and with very oblique calices, the lower wall of which is typically produced considerably beyond the upper; septal spines commonly well developed, numerous, very short; mural pores large and far apart; tabulae thin and flat. M.Sil. (Wenlock.), Eu. (Gotl.)—Fig. 401, 2. *P. jOt/gti (MILNE-EDWARDS & HAIME), †holotype; ext. view, X1 (Milne-Edwards & Haime, 1851).

?Scharkovaelites MIKONOV, 1974a, p. 81 [*Scoliopora septosa SHARKOVA in BARKAYA & SHARKOVA, 1963, p. 156; OD; † in col. MGU, Moscow]. Corallum extensiform, corallites inclined, comparatively large, calices triangular, rounded-quadrangular or crescentic; walls moderately thick, pores on faces and at angles; large septal comb on lower side of corallite, and smaller septal spines mainly on lower side also; tabulae sparse. U.Sil., Asia (Kazakh.).—Fig. 403, 1a, b. *S. septosus (SHARKOVA), holotype, Ludlov., Tarbagatau Ra., left bank of R. Ayaguz, mid. sec.; a, b, transv., long. secs., X5 (Barskaya & Sharkova, 1963).

Subalveolitella Sokolov, 1955, p. 186 [*S. repentina; OD; †54, coll. 599, VNIIGRI, Leningrad].

Fig. 401. Alveolitidae (p. F591-F595).
Corallum elongate finger-shaped or branching or nodulose; corallites slender, in axial zone thin-walled, prismatic and longitudinally directed, in peripheral zone diverging and having markedly thickened walls and opening at surface obliquely in angular-crescentic calices; one row of septal spines, well expressed only in peripheral zone; pores small; tabulae thin.  *L.Sil.* (*Adavere*)-*M.Sil.*

**Fig. 402.** Alveolitidae (p. F591).
Alveolitidae with corallites almost normal to surface or in some inclined, and with squamulae more or less dominant over septal spines. *L.Sil.*; *U.Sil.*-M.Dev.

**Callopora** SCHLÜTER, 1889, p. 353 [*Alveolites battersbyi* MILNE-EDWARDS & HAIMÉ, 1851, p. 257; M; †not traced] (=Taouzia TÉRMIER & TÉRMIER, 1948a, p. 136 (type, *T. chouberti*, M; †not traced; M.Dev., Tafilet, Moroc.), see LE MAÎTRE, 1952, p. 69). Corallum nodose or with thick branches; corallites prismatic, opening almost perpendicular to surface in compressed-polygonal to semilunar, rather deep calices; walls moderately thick, thickening toward periphery of corallum; septal spines absent, but squamulae numerous, commonly back-to-back in neighboring corallites, thick proximally but attenuating distally; mural pores numerous, grouped at angles of walls so that two to three or five corallites open into one another; septal elements not large, squamulae and spines; tabulae thin, horizontal or slightly concave.

Other; possibly better referred to Paleofavositinae. *L.Sil.* (Llandovery), Asia (Ural).—Fig. 405, la, b. *A. tussula*, holotype, Llandovery, low part up. Chergak basin, W. Tuva, Khondelen; a, b, long, transv. secs., X10; b, long, sec., X4 (Chekhovich, 1975).

**Axouolites** SHARKOVA, 1963, p. 117 [*A. notabilis*; OD; †8/iv, MGU, Moscow] (=Borisiolites MIRONOVA, 1970, p. 128 (type, *Pachyfavosites polymorphus* SOLOV, 1925b, p. 44, pl. 9, fig. 1-4; OD; syntypes 24, 25, 27, coll. 483, VNIGRI, Leningrad; M.Dev., Biya and Calceola beds, N. Urals; non Calamopora polymorpha GOLDFUSS, 1826, p. 79).] Corallum encrusting to tabular; corallites reptant initially, then growing abruptly upward as compressed, thin-walled four- or three-sided prisms with rounded angles; walls may be zonally thickened, with growth lamellation parallel to surface of corallum; mural pores mid-face or at angles; minute septal spines present in longitudinal rows; tabulae thin, transverse to wavy. *U.Sil.*, Asia (Kazakh.).—L.Dev., Asia (Kazakh.-Urals)-Australia (Vic.) —Fig. 406, 2a, b. *A. notabilis*, holotype, U.Sil., Dzungarian Alatau, basin of R. Aksu; a, b, transv., oblique secs., X6, X4 (Chekhovich, 1963).

**Oculipora** SOLOV, 1952b, p. 50 (*O. tschotschata*; OD; †34, coll. 483, VNIGRI, Leningrad) (=Oculiporella JIA in JIA et al., 1977, p. 246 (type, *O. elegans*, OD; †IV35033, HPRIGS, Yichang; L.Dev., Xipai F., Xiangzhou Xian [co.], Guangxi [Kwangsi]; branches thick and cylindrical, mural pores uniserial or biserial).] Corallum ceroid;
corallites directed perpendicularly or almost so to surface; large cylindroprismatic corallites evenly scattered among small polygonal corallites of variable outline; walls slightly thickened, median suture indistinct; mural pores large, uniserial, numerous; squamulae few; septal spines coarse, sparse, with upturned ends, may be absent; tabulae complete, transverse or slightly concave, rarely incomplete and suspended from squamulae [see Kim, 1965b, p. 69; Yanet in Dubatolov, Chekhovich, & Yanet, 1968, p. 102]. ?L.Dev., Asia(Urals-Kwangsi); L. Dev.(Favosites regularis-sinus Z.), Asia(Zeravshan Ra.); M.Dev.(Eifel.), Eu.(Urals).——Fig. 407,2a,b. *O. tschotschiae, holotype, M.Dev., Biya beds, W. slopes S. Ural, mouth of R. Arsha, basin of R. Ay; a,b, transv., long. secs., X4 (Sokolov, 1952b).

Squameoalveolites Mironova, 1969a, p. 86 [*Alveolites fornicatus Schlüter, 1889, p. 383, sensu Le Maitre, 1947, p. 76; OD; Le Maitre’s specimen not traced, holotype of Schlüter’s species 1200, Schlüter Coll., IP, Bonn]. Corallum ex- tensiform; corallites inclined; calices oblique and crescentic; walls somewhat thickened; septa represented by spinules and by squamulae that form caves over large mural pores on recumbent walls of corallites; tabulae transverse or inclined. L.Dev., Asia(NE.USSR-Altay)-M.Dev.(Eifel.), Eu.(Belg.- Ger.)-N.Afr.(Moroc.).——Fig. 407,1a,b. *S. fornicatus (Schlüter), M.Dev.(Couvin.), Moroc., Ouïhalane; a,b, long., transv. secs., X4 (Le Maitre, 1947).

Subcaliapora Chekhovich, 1971, p. 159 [*S. mag-
Subcaliapora

Corallum massive, of medium to large size, near-spherical or hemispherical; corallites not large, rounded-polygonal or semilunar, opening at the surface almost at right angles; walls thin or moderately thick, pores large, numerous, uniserial;…
tabulae horizontal, oblique and rarely weakly concave, sometimes suspended from squamulae; squamulae uniserial, may be attended by spines. *Oculipora* tabulae horizontal, oblique and rarely weakly concave, sometimes suspended from squamulae; squamulae uniserial, may be attended by spines. U.Sil.(Ludlov.), USSR(Tuva); L.Dev., USSR(R. Kolyma).—Fig. 406,1a,b. *S. magnifica*, holotype, U.Sil.(Ludlov.), USSR, R. Elegest, Tuva; a, transv. sec., ×10; b, long. sec., ×4 (Chekhovich, 1971).

Subfamily NATALOPHYLLINAE Sokolov, 1950
[Natalophyllinae Sokolov, 1950a, p. 168] [Scolioporinae Lecompte, 1952, p. 513]

Corallum branched or extensiform; corallites conjunct, slender, long, prismatic, opening to surface at or nearly at a right angle; calices of irregular, commonly rectangular
outline, lips not extended; wall thickening considerable but gradual, color banding pronounced, median suture evident proximally; septal spines commonly absent but longi-
tuudinal laminae may effect longitudinal increase; tabulae thin, transverse. \textit{L.Dev.-M. Dev.}

\textbf{Natalophyllum} \textit{Radugin, 1938}, p. 79 \{\textit{N. givetium}; OD; 1243, TGU, Tomsk\} \cite{Radugin1938} [\textit{=Tyrганolithec} \textit{Chernyshev, 1951}, which see]. Corallum coarsely branching; in axial zone of branch corallites rather thick-walled, with median suture, regularly prismatic and longitudinally directed; corallites enter wide peripheral zone by curving sharply almost at right angles, their walls thickening abruptly, and open perpendicularly to surface in compressed and thick-walled calices with weakly developed septal spines; pores small, numerous; tabulae thin. \textit{L.Dev.-M.Dev.}, Asia(Kuzbas-Altay-Sayan-C.Asia-SW.China).—FIG. 408,3a,b. \textit{N. giveticum}, M.Dev.(Givet.), Kuzbas, R. Mozalovski Kitat; \textit{a,b}, long., transv. secs., \times 4 \cite{Chudinova1964}; photographs courtesy I. Chudinova.

\textbf{Scoliopora} \textit{Lang, Smith, \& Thomas, 1940}, p. 118, nom. subst. pro \textit{Plagiopora Gürich, 1896}, 1896, p. 143, \textit{non Plagiopora Macgillivray, 1895}, a Tertiary bryozoan \textit{[=Alveolites denticulatus Milne-Edwards \& Haime, 1851, p. 258; SD Lang, Smith, \& Thomas, 1940, p. 101; \textit{a} fragments, EM, Paris, \textit{fide} Lecompte, 1939, p. 142, but now missing]. Corallum small, branched, corallites irregularly angulate in cross section and relatively thin-walled in axial zone, compressed and thick-walled at periphery where they lie nearly perpendicular to the surface; calices oval, semilunar or irregularly curved, without jutting lip, with \textit{a} to several septal \textit{laminae}; pores large, numerous, commonly on same level in neighboring corallites; tabulae complete, horizontal; increase longitudinal by conjunction of \textit{laminae} in opposite wall or axially with second lamina \cite{Sharkova1971}, p. 58. \textit{M. Dev.}, Eu. (Ger.-Belg.-Asia(Urals-Kuzbas-China)).—FIG. 408,2a-d. \textit{N. denticulata} (Milne-Edwards \& Haime); \textit{a,b}, Givet., Belg., Pl. Saoutour, transv., long. secs., \times 4 \cite{Lecompte1939}; \textit{c,d}, another specimen, Ger., Bensberg, c. ext. view, \times 1, \textit{d}, calical view, enl. \cite{Milne-Edwards1851}.

\textbf{Tyrganolites} \textit{Chernyshev, 1951}, p. 65 \{\textit{T. eugeni}; OD; \textit{f}131, coll. 5725, TsGM, Leningrad\} \cite{Radugin1955} [\textit{=Tyrganolites Sokolov, 1955}, p. 189, nom. van.]; \textit{Natalophyllum Radugin, 1938}, which see]. Corallum extensiform, thick, growth- and color-banded; corallites prismatic, thick-walled, in cross section elongately polygonal, compressed elliptical, bow-shaped, quadrangular or six-sided, with oval calical openings; calices open nearly perpendicular to surface of corallum; mural pores round; tabulae flat; no septal spines. \textit{M.Dev.}(Givet.), Asia(Urals-Kuzbas-Cis Balkhash).—FIG. 408,1a,b. \textit{T. eugeni}, holotype, Tyrgan, Kuzbas, Mt. Kutoba, near Sergeevo; \textit{a,b}, long., transv. secs., \times 4 \cite{Chernyshev1951}.


Corallum slenderly branching or fron­descent, turfile or nodular; not large; calices crescentic, widely spaced, lips may be extended; commonly one to three rows of septal laminae or combs; mural pores sparse, in early stages mainly; tabulae trans­verse or inclined, sparse. \textit{Up.L.Sil.-M.Dev.}

\textbf{Coenites} \textit{Eichwald, 1829}, p. 179 \{\textit{C. juniperinus}; SD Miller, 1897, p. 727; \textit{f}1etotype CO 1777, coll. 92, EGM, Tallinn, by Klaamann, 1964, p. 92\} \cite{Sokolov1955} [\textit{=Platyxum Davis, 1887}, which see; \textit{Coenitioporites Rukhin, 1938}, p. 72 (type, \textit{Coenites (Coenitioporites) kolinaenis}, OD; \textit{f}1enotype Leningrad; \textit{L.Dev.} or \textit{M.Dev.}, Kolyma R.). Corallum of very slender branches; corallites in axial parts of branch prismatic and longitudinally directed, diverging to open at surface at acute angle; walls in axial parts relatively thin, with median suture; as corallites grow, walls quickly and evenly thickened; calices waved transverse slits constricted by thickening of walls, waviness being due to two lateral folds (septal ridges) on lower lip and one, median, on upper lip; mural pores sparse, small, round; tabulae thin, complete, horizontal or inclined. \textit{M.Sil.}, Eu.(U.K.-Est.); \textit{M.Sil.-U.Sil.}, N.Am.(Wis.-Tenn.-Ind.-Ky.); \textit{L.Dev.-M. Dev.}, Asia(Kolyma R.).—FIG. 409,1a,b. \textit{C. juniperinus}, neotype, up.M.Sil.(Pangamie beds, Jaargarahu stage), Est., Saaremaa; \textit{a}, ext. view, \times 6.0; \textit{b}, long. view, \times 10.0 \cite{Klaamann1964}.—FIG. 409,1e,d. \textit{C. sp.}, Wenlock Ls., U.K., Dudley; \textit{c,d}, long., transv. secs., \times 10.0 \cite{Hill1939}.

[I am unconvinced by the arguments of Brood, 1970, p. 473, that \textit{Coenites} is a bryozoan; his "central granulated wall" appears to me to be due to diagenesis of the median suture, a very fine mosaic being formed, as for instance in the septa of the rugosans \textit{Pycnactis} and \textit{Phalectus} from the Gotlandian; his "zooclastic lining of laminated tissue" appears to me to be the diagenetic accentuation of growth laminations of radially fibrous walls such as is found in many Pachy­poridae. \textit{Brood's "lunarium" resembles the thickened proximal calical lip of many branching Alveolitidae. Brood gives no figures of the type species, and his photos of \textit{C. repens} are not prepared from the type specimens.]

forming thin crusts or films, corallites initially thin-walled and recumbent on substrate, then turning with sharply thickened walls to open in narrow, crescentic calices each bordered by smooth, raised
Of late as classified longitudinal trabeculae in Cocco-
C. F602
Platyaxum DAVIS, 1887, explanation to pl. Ix
Hyostragulum MAREK & GALLE, 1976, p. 54
litoidea BONDARENKO, 1958, p. 202, subclass; Protaraeida
214, suborder; Protaraeina LEITH, 1952, p. 791, order;
1920, p. 87, as group, form; increase coenenchymal and in some
or tubulose coenenchyme except in some
order; Halysitacea (as
BONDARENKO, 1958, p. 203, order; Proporida BONDARENKO, 1958, p. 204.
1947c, p. 19, order; Halysitida BONDARENKO, 1958, p. 87, as
Heliolitida BONDARENKO, 1958, p. 202, subclass; Prota-
[Incl. Heliolitida FRECH, 1897, p. 214, nom. correct.]
[=?Coenites
?Coenites EICHWALD, 1829, which see]. Habit
of corallum erect, flattened palmate; corallites thin-
walled, subcylindrical in larger median plane of
fronds, developing thick walls as they proceed
obliquely to open at surface in lunate to subrect-
tangular calices with longer diameter commonly
transverse to corallum; presence of spines, mural
pores and tabulae not definitely established in type
material. L.Dev.(Ems.) or M.Dev. (Con-
wini), N. Am. (Ind.-Ky.-Ont.); ?U.S.(Ludlov.), N.
Am. (Tenn.).—Fig. 409,3a. *P. turgidum, syntype,
M.Dev., coral zone, Jeffersonville Ls., Ind., Falls
of the Ohio; ext. view, X1.0 (Stumm, 1965) —
Fig. 409,3b. P. undosum DAVIS, considered con-
specific with P. turgidum by Stumm, 1965, p. 77;
thin sec. of frond, X1.5 (Stumm, 1965).

Family Uncertain
Hystroagulum MAREK & GALLE, 1976, p. 54 [*H.
mobile; M; + ML130, GI, Prague]. Ceroid, en-
crusting dorsal side of hyolithid shells; corallites
very short on dorsum, longer on sides, perpendicu-
lar to surface of conch; walls thick, mural pores
doubtful; tabulae absent in short corallites on dor-
sum, few and oblique or horizontal in corallites on
sides; median ridge ?(septum) parallel to longi-
tudinal axis of conch projects from inner surface
of encrusting base of each corallite but is not de-
developed on upper surfaces of tabulae. [Tentatively
referred by its authors to Tabulata Alveolitina.]
L.Dev.-M.Dev., Eu.(Czech.).

Order HELIOLITIDA Frech, 1897
[Incl. Heliolitida FRECH, 1897, p. 214, nom. correct. Abel, 1930, p. 87, as group, pro Heliolithoidea FRECH, 1897, p. 214, subordinate; Prota-
raeina LEITH, 1952, p. 791, order; Heliolitidae BON-
DARENKO, 1958, p. 202, subclass; Protaraeida
BONDARENKO, 1958, p. 202, order; Heliolitida
BONDARENKO, 1958, p. 203, order; Protaraeida
BONDARENKO, 1958, p. 204, order; Helysitaceae (as Helysitaceae lapsus calami) SOKOLOV, 1947c, p. 19, order; Helysitaidae BON-
DARENKO, 1958, p. 223, order; Cyrtophyllidae BON-
DARENKO, 1978a, p. 33, order]
Corallum compound, massive or cateni-
form; increase coenenchymal and in some lateral;
tabularia separated by disseptamental or tubulose coenenchyme except in some HalySitina; 12 pectinate septa or 12 rows
of septal spines; tabulae commonly com-
plete, horizontal. M.Ord.-M.Dev.(Givet.).

Suborder HELIOLITINA
Frech, 1897
[nom. correct. Abel, 1920, p. 87, as group, pro Helio-
lithoidea FRECH, 1897, p. 214, subordinate] [?Heliolithidae
WENDELL, 1895, p. 503, group; Heliolitina OKULITCH, 1936b, p. 378, order, Heliolitidae WEDEKIND, 1937, p. 31, pre-
sumably as suborder; Heliolitida JONES & HILL, 1940, p. 197, section; Heliolitidae SOKOLOV, 1958, p. 202, group; Pro-
taraeina LEITH, 1952, p. 791, order; Heliolitoidae BON-
DARENKO, 1958, p. 202, subclass; Protaraeida BON-
DARENKO, 1958, p. 202, order; Heliolitidae BON-
DARENKO, 1958, p. 203, order; Protaraeida BON-
DARENKO, 1958, p. 204, order; Cyrtophyllidae BON-
DARENKO, 1978a, p. 33, order]
Corallum massive, variable in form; with
tabularia surrounded by coenenchyma that
may be tabular, disseptamental or mona-
canthate; tabularia with 12 septa and com-
monly with complete tabulae. M.Ord.-M.
Dev.(Givet.).

Heliolitina previously have been consid-
ered by many as Anthozoa Zoantharia sepa-
rated from the Tabulata (e.g., JONES & HILL,
1940, p. 197) chiefly because their
septa constantly number 12. This is a fea-
ture shared only with the HalySitina, which
have been consistently classified of late as Tabulata. Like most HalySitina, the Helio-
litina have tabularia separated by a coeno-
sclerenchyme. In Heliolitina this is of dis-
septiment like plates in the Proporicae, as in
Cystihalysites, or of thick, clino-
gonally fibrous longitudinal trabeculae in Cocco-
sidericae, as in some species of HalySitina,
or more commonly of tubulose coenoscle-
rencehyme as in the Heliolitidae; tubulose coeo-
sclerenchyme is probably not present in
the HalySitina, though simulated in Soleni-
alysites.

In common with the other Tabulata, the Helio-
litina are compound, their corallites
are slender, their tabulae are commonly
dominant over their septa, their septa are
of one order and are commonly short. The
septa are tabulatan in their construction,
being each a longitudinal row of spines con-
tiguous if at all only at their bases. They
lack the regular mural pores of the Favo-
sitida, but in some Coccosidericae irregular
contiguity of the longitudinal trabeculae
leaves perforations like those of some Sarclinu-
a.

This Treatise sees these common features as
grounds for placing the Heliolitina plus the HalySitina in the Subclass Tabulata,
and for accepting the fixity of septal number and presence of coenosclerenchyme as ordinal characters.

Superfamily HELIOLITICAE Lindström, 1876

[nom. correct. H. Hill, herein, pro Heliolitiae Sokolov, 1955, p. 79, nom. transl. ex Heliolitidae Lindström, 1876, p. 13]

Corallum massive with cylindrical tabulae surrounded by coenenchyme of prismatic tubules with complete or, in some, incomplete diaphragms; tabularia with 12 septal laminae commonly with spinose axial edges, or with 12 longitudinal radial rows of discrete spines, or aspitate; an axial structure may develop by conjunction of septa; tabulae complete, commonly horizontal, but in Saaremolites, strongly convex to conical. *M. Ord.* - *M. Dev.* (Givet.).

Family HELIOLITIDAE Lindström, 1876

[Heliolitidae Lindström, 1876, p. 13, nom. correct. pro Heliolithidae Lindström, 1873a, p. 15, name which has never been generally used, invalid because based on invalid name *Heliolithes*]

Corallum massive with cylindrical tabulae surrounded by coenenchyme of prismatic tubules with complete walls and complete, horizontal diaphragms; tabularia with 12 septal laminae, commonly with spinose axial edges, or with 12 radial, longitudinal rows of discrete spines, or aspitate; an axial structure may develop by conjunction of septa; tabulae complete, commonly horizontal, but in Saaremolites, strongly convex to conical. *M. Ord.* - *M. Dev.* (Givet.).

Heliolites Dana, 1846b, p. 541 [*Astraea porosa* Goldfuss, 1826, p. 64; OD; 1214d, Goldfuss Coll., IP, Bonn; lectotype by Flügel, 1956a, p. 72] [=Palaeopora McCoy, 1849, p. 129 (type, *Astraea porosa* Goldfuss, 1826, p. 64; OD; 1214d, Goldfuss Coll., IP, Bonn; lectotype by Flügel, 1956a, p. 72)]

Corallum massive with cylindrical tabulae surrounded by coenenchyme of prismatic tubules with complete walls and complete, horizontal diaphragms; tabularia with 12 septal laminae, commonly with spinose axial edges, or with 12 radial, longitudinal rows of discrete spines which may be carinate, or aspitate; tabulae complete, commonly horizontal, but in Saaremolites, strongly convex to conical. *M. Ord.* - *M. Dev.* (Givet.).

Helioplasmolites Chekhovich, 1975, p. 11 [*H. naliokini*; OD; sample 503, coll. 18, MGU, Tashkent]. Corallum hemispherical or elongately nodular; tabularia with moderately folded walls, tabulae horizontal; septal elements weakly developed, rarely as long spines; coenenchyme of prismatic tubules with discontinuous walls, or in places of dissepiments forming cystose tissue; auroela absent. *U. Sil.* (Ludlov.), Asia (Tien Shan, S. Ferghana)-Eu. (Czech.);

Ningqiangolites H. F. Chu MS in Li et al., 1975,
Coelenterata—Tabulata

Fig. 410. Heliolitidae (1-3, 5); Taeniolitidae (4) (p. F603-F606).

p. 196 [*N. densitabulatus; OD; †not designated, paratype figured, AGS, Peking; M.Sil., Ningqiang, Shensi]. In Chinese. [Figures are too small to serve as source for diagnosis.] M.Sil., Asia(Shensi).
Fig. 411. Heliolitidae (1, 3); Taeniolitidae (2) (p. F603-F606).
Okopites Bondarenko, 1978c, p. 26 [*O. okopien­sii; OD; †1, coll. 11635, TsGM, Leningrad; U. Sil., up. Ludlow or low. Pridol., Rashkovsk beds, left bank R. Dniester, at Okopy, Podolia]. Tabul­larial walls varying from faintly and irregularly wavy in all stages of astogeny to regularly folded in late stages; septal spines only rarely forming rudimentary septal laminae; tabulae complete, horizontal or arched; coenenchymal tubules variable in section from drawn-out and vermiculate to polygonal, shape not altered in zones of thickening of longitudinal skeletal elements; diaphragms complete, rarely incomplete, horizontal or weakly curved. U.Sil., Eu. (Podolia–Gosl.)–Australia (New S.Wales); L.Dev. (Gedinn., Aynau horizon), Asia (C.Kazakh.).

Pachycanalicula Wentzel, 1895, p. 503 [*Heliolites barrandei Hoernes in Penecke, 1887, p. 271; OD; †not, P577, Ug; Graz; lectotype by Flügel, 1956a, p. 76] [=Heliolites Dana, 1946b, which see, Flügel, 1956a, p. 75, considered type species to be subspecies of Heliolites (Heliolites) porosus (Goldfuss)]. Corallum rounded; corallites cylindrical, relatively thick-walled, well-developed septal spines present or absent; tabulae thin, horizontal; tubules polygonal, relatively thick-walled. L.Dev.–M.Dev., Eu. (E. Alps–Graz–Carnic Alps–France–Urals)–Australia (Queensl.–New S.Wales)–Asia (Kubzas–Salair–Kazakh.–C.Asia–Kolyma Basin).–Fig. 410,5. *P. barrandei (Hoernes in Penecke), lectotype, M.Dev. (†Givet.), Aus., St. Gothart, Graz; long. sec., X4 (Flügel, 1956a).

?Paekelmannopora Weissermel, 1939, p. 94 [*P. macrophalma; OD; †not traced, Em­der Coll., Stuttgart Museum]. Tabularial walls thin, in 12 longitudinal waves, without septal spines; coenenchymal tubules small, thin-walled, irregular and unequal. [Insufficiently known.] U.Sil. or L.Dev. (Gedinn.), Asia M. (Bosporus).–Fig. 410,4a,b. *P. macrophalma, monotype, Kartal; a:b, long., transv. secs., X4 (Weissermel, 1939).

Saaremolites Sokolov, 1955, p. 81 [*S. inversus; OD; †127, coll. 599, VNIGRI, Leningrad]. Like Heliolites but tabulae conical, sharply elevated axially to form distinct acrocolumella. M.Sil. (Wenlock.), Eu. (Est.–Swed.).–Fig. 411,4a,b. *S. inversus, holotype, up.Wenlock., Est. Tagamyzza, Saaremaa; a:b, transv., long. secs., X4 (Sokolov, 1962c).

Family TANEIOLITIDAE Lin & Chow, 1977

[Taneiolidae Lin & Chow, 1977, p. 162]

Walls of tabularia cylindrical or substellate, in places thin and discontinuous; septal spines in not more than 12 longitudinal rows; tabulae complete or incomplete; coenenchyme with thin and discontinuous or meandroid tubes, may appear spongy; dia­phragms of neighboring tubules may be continuous through gaps in walls. [Placed in Protaracida by Lin & Chow, 1977, p. 162.] M.Ord.–U.Ord.; L.Dev.

Taeeniolites Bondarenko, 1961, p. 127 [*T. kelleri; OD; †36/170, MGU, Moscow]. Corallum cylindrical; walls of tabularia and coenenchymal tubules thin and discontinuous, appearing as if constructed of dissociated, curving, ribbonlike segments imparting a spongy aspect; septal spines in not more than 12 longitudinal rows; tabulae complete or incomplete, curved or horizontal; diaphragms of neighboring tubules may be continuous through gaps in walls. U.Ord., Asia (Kazakh.).—Fig. 411,2a,b. *T. kelleri, holotype, Akchaul suite, SE. Kazakh., left bank of R. Karakol, Tarbagatau Ra.; a:b, long., transv. secs., X4 (Bondarenko, 1961).

?Bogimbailites Bondarenko, 1966a, p. 189 [*B. sytovae; OD; †1655/3a–z in coll. 8732, TsGM (not verified), Leningrad]. Corallum nodular; walls of tabularia longitudinally folded; septal spines long, broadened at their bases; tabulae complete or incomplete, horizontal or curved; walls of coenenchymal tubules discontinuous so that in transverse section tubules appear meandroid and coenenchyme spongy; zones of horizontal diaphragms alternating with zones of incomplete, horizontal or curved diaphragms. L.Dev. (Naday­nasu.), Asia (Kazakh.).—Fig. 410,4a,b. *B. sytovae, holotype, L.Dev. (Nadaynasu horizon), Kazakh., 5 km. NE. of ruins of Bogima, C; a:b, transv., long. secs., X4 (Bondarenko, 1966a).

Wormsipora Sokolov, 1955, p. 80 [*Heliolites hirsuta Kier–Stur, 1889, p. 64; OD; figured syn­types Ca38085, 58603, RM, Stockholm; by Sokolov, 1955, p. 476; =Nicholsonia megastoma (McCoy) Kier–Stur, 1889, p. 37, partim, not necessarily Forties megastoma McCoy, 1846, p. 62.) =Nicholsonia Kier–Stur, 1889, p. 37 (type, N. megastoma McCoy of Kier–Stur, 1889, partim; M), non Nicholsonia Schützer, 1885c, p. 53, a De­vonian rugosan, nec dl.]. Corallum nodular, massive; tabularial walls continuous, substellate in transverse section; walls of coenenchymal tubules discontinuous, imparting characteristic shattered appearance; septal spines numerous, strongly curved upward, carinate and not rarely split adaxially; tabulae horizontal or drawn upward axially or weakly sagging; diaphragms of neighboring tubules commonly on same levels. M.Ord. or U.Ord., Australia (Tasm.); U.Ord. (Vormsi Stage), Eu. (Ire.–Swed.–Est.)–Asia (Altay Mts.).—Fig. 412,3a,d. *W. hirsuta (LINDSTROM), U.Ord., Swed., Öland; a, lectotype, side view of weathered corallum, X12; b,d, transv., long. secs., X6; c, long. sec., X12 (Lindström, 1889).

Family STELLIPORELLIDAE Bondarenko, 1971

Corallum of variable form; walls of tabularia longitudinally plicate, rarely almost smooth; septal elements 12, radial longitudinal plates that unite at the axis in pairs or knit, forming either an axial bulkhead, or axial polygonal tubules, or an axial canal; coenenchymal tubules regularly polygonal or meandroid in cross section, with complete, horizontal diaphragms; tabulae complete or incomplete, horizontal, convex, or concave; in a ring around the tabularia are 14 to 25 coenenchymal tubules.

Stelliporella Wentzel, 1895, p. 503 [*S. lamellata; OD; tnot traced]. Walls of tabularia longitudinally plicate; septal laminae knit to form a polygonally tubular axial structure; tabulae horizontal, convex or concave; in a ring around the tabularia are 16 to 22 coenenchymal tubules; coenenchymal tubules polygonal or meandroid in regions of intensive increase, and with horizontal diaphragms [see Bondarenko, 1971b, p. 168]. ?U.Ord., Eu. (Nor.-Swed.); U.Ord. or L.Sil., Asia (Kolyma Basin-Altay-Shoria Mts.); Sil., Eu. (Czech.-Eng.-Nor.-N. Zemlya-Gotl.-Podolia)-Asia (NE. USSR-Tuva)-N. Am. (Tenn.-Alaska).—Fig. 413,1a-c. *S. lamellata, U.Sil. (low.Ludlov.), cø basal Kopanina Beds), Czech., Kozel; a,c, transv. secs., X7, X35; b, long. sec., X7 (Wentzel, 1895).

?Cosmiolithus Lindström, 1899, p. 68 [*C. ornatus; SD Lang, Smith, & Thomas, 1940, p. 41; tfigured syntypes Gn17459, 17460, 56908, RM, Stockholm). Like Stelliporella but corallum encrusting, thin sheet, and longitudinal skeletal elements thickened; septal laminae composed of contiguous monacanths (or elongated ?tufts) directed upward adaxially; coenenchymal tubules of very small diameter. [Bondarenko (1971b, p. 167) and Sokolov (1962c, p. 277) consider this genus to be protaraeican.] L.Sil.(up.Llandolv.)-M.Sil.(Wenlock.), Eu.(Swed.).—Fig. 413,3a-c. *C. ornatus, syntype, L.Sil., Arachnophyllum sh., Gotl., Visby; a, calical view, X11; b,c, transv., long. secs., X12 (Lindström, 1899).

Derivatolites Bondarenko, 1971b, p. 172 [*Heliolites parvistella Roemer, 1861, p. 25; OD; t?in Geol. Museum, WrocÅ‡aw, Breslau]. Corallum round loaf-shaped; walls of tabularia longitudinally plicate; two opposed septal laminae may join axially to form axial bulkhead; tabulae convex; coenenchymal tubules polygonal in section with horizontal or convex diaphragms and may be meandroid in “light” zones and regions of active increase; in ring round tabularium, 18 to 22 tubules. ?U.Ord., Eu.(Gotl.); ?Sil.(glacial boulder), Eu.(Pol.); M.Sil.(Wenlock.), Eu.(Podolia).—Fig. 413,4a.b. *D. parvistella (Roemer), holotype, glacial erratic from Pol., Sadewitz; a, ext. view, X12; b, long. sec., X12 (Lindström, 1899).
**Podolites** BONDARENKO, 1971b, p. 173 [*P. disseptatus*; OD; †113/1-34, MGU, Moscow] [==Podolites IVANOVSKY, 1973b, p. 281, nom null.]. Coralum nodular, tabularia with smooth walls, almost without trace of plication; neighboring septal laminae run together axially in twos, threes, or fours, at the same time forming axial bulkheads; tabulae horizontal; coenenchymal tubules polygonal in section, with horizontal diaphragms; in ring around tabularium, 14 to 16 coenenchymal tubules. ?L.Sil., Asia(Kuzbas); L.Sil., Asia(Kolyma Basin); M.Sil.(Wenlock), Eu.(Podolia)-Asia (China); M.Dev.(Eifel.), Asia(Kazakh.).—Fig. 414,1a-h. *P. disseptatus*, monotype, M.Sil.(Wenlock.), Podolia; a-f, serial transv. secs. through alternating light and dark zones; g-h, transv., long. secs., all X8 (Bondarenko, 1971b).

**Syringoheliolites** BONDARENKO, 1971b, p. 175 [*S. contrarius*; OD; †144/1-278, MGU, Moscow]. Coralum nodular or hemispherical; tabularia with longitudinally plicate walls; neighboring septal laminae join one another to form an axial tube commonly open into one interseptal loculus; between tube and wall are inclined tabellae, within tube, horizontal tabellae; coenenchymal tubules in “light” zones (of rapid growth) meandroid and vermiform in section, with greatly reduced walls; in “dark” zones (of slow growth), polygonal;
diaphragms horizontal; a platelike columella may develop, most clearly in the dark zones. U.Sil. (Ludlov.). Eu.(Podolia).—Fig. 413,2a,b. *S. contrarius, holotype, Malinovets horizon, Podolia, Isakovtsy; a,b, transv., long. secs., ×9 (Bondarenko, 1971b).

Tarbagatailites Bondarenko, 1975a, p. 60 [T. columellus; OD: 119, coll. 10294, TsGM, Leningrad; L.Dev., (Gedinn. or Stegen., ?Kokbaytal or ?Pribalkhash horizon), Mt. Karadzhal, Tarbagatau R.]. Corallum tumoroid; tabularia with longitudinally plicate walls; septal laminae may inosculate in pairs or threes; tabulae complete; coenenchymal tubules polygonal, diaphragms complete and horizontal, but here and there in dark zones may be oblique. ?U.Sil., Australia (New S. Wales-Queensl.)-L. Dev., Asia (Kazakh.)-Eu. (Czech.).—Fig. 414,2a,b

Family PSEUDOPLASMOPORIDAE
Bondarenko, 1963
[nom. transl. herein, ex subfamily Pseudoplasmoporinae Bondarenko, 1963, p. 46]

Corallum of varied form; walls of tabularia smooth (with no trace of facets) or longitudinally folded; septa either laminae or longitudinal rows of spines, or absent; tabulae complete, horizontal; an aureola of 12 tubules around each tabularium, of varied radius; rest of coenenchyme also of tubules with complete and horizontal diaphragms or rarely with oblique and incomplete diaphragms. U.Ord.-L.Sil.; U.Sil.-?M. Dev.

Pseudoplasmopora Bondarenko, 1963, p. 47 [*P. conspecta; OD: 11, coll. 8775, TsGM, Moscow].
Pseudoplasmoporidae in which septa consist of septal spines or are absent, walls of tabularia and tubules are unthickened and diaphragms of tubules are but rarely oblique and incomplete. U.Sil., Asia (C.Kazakh.)-Eu.(Gedinn.)-Australia (New S.Wales-Queensl.)-N.Am.(Tenn.); L.Dev., Asia (C.Kazakh.)-Australia (Vict.-New S. Wales-Queensl.).—Fig. 415,2a,b. *P. conspecta, holotype, L. Dev., Isen Suite, Aynasu horizon, C. Kazakh., 200 km. S. of Karaganda; a,b, transv., long. secs., ×6, ×4 (Bondarenko, 1966a).

Amphilites Bondarenko, 1975a, p. 57 [*A. tarbagataicus; OD: 111, coll. 10294, TsGM, Leningrad; Gedinn., Kokbaytal horizon, Mt. Karadzhal]. Corallum tumoroid; tabularia with smooth walls, septa represented by longitudinal rows of scalelike spines, and complete, horizontal tabulae; coenenchymal tubules differently developed in alternating light and dark zones; in light zones, they are straight-walled and regularly polygonal, relatively large, and 12 in aureole; in dark zones they are irregularly polygonal with curved walls, are nar-
Visbylites Bondarenko, 1963, p. 47 [*Plasmopora stella Lindström, 1899, p. 83; OD; figured syntypes Cn38124, 56555, 56565, RM, Stockholm]. Septa developed as radial longitudinal plates. *U. Ord. (Dulankar), Asia (Tarbagatau Ra., Kazakh.); L.Sil. (up. Llandovery), Eu. (Gotl., Swed.)-N.Am. (Newf.).—Fig. 415, la,b. *V. stella (Lindström), Visby marls, Gotl., Visby; a,b, transv., long. secs., ×6 (Lindström, 1899).
Superfamily PROPORICAE
Sokolov, 1949
[nom. transl. Htt., herein, ex Proporidae Sokolov, 1949, p. 97] [=Proporida Bondarenko, 1958, p. 204, order]

Corallum of variable form; tabularia with walls including 12 septal bases connected either by downturned edges of coenenchymal dissepiments or by independent wall
tissue that may be longitudinally plicate; septal laminae or spines may project into the tabularium from the septal bases, and short laminae may project into the coenenchyme from the septal bases or from the plicate between them; in some, an aureole of 12 tubules with discontinuous walls surrounds each tabularium; tabulae horizontal or convex and commonly complete; coenenchyme of dissepiments pierced by short monacanths or by short discontinuous laminae that but rarely associate to form tubules. 

M.Ord.-?L.Dev.

Family PROPORIDAE Sokolov, 1949

[Proporidae Sokolov, 1949, p. 97] [=Proporinae Hilla, 1951, p. 12]

Tabularia without aureola of 12 coenenchymal tubules and separated by dissepimented coenenchyme with variable development of discrete monacanths. M.Ord.-U.Sil.

Propora MILNE-EDWARDS & HAIME, 1849b, p. 262


*Pinacopora Nicholson & Etheridge, 1878a, p. 52 (type, P. grayi, M; figured syntypes R26857, 26870-26876, fide Benton, 1979, BM(NH), London; L.Sil., Mulloch Hill, near Girvan, Ayshire)

*Stylidium Eichwald, 1855b, p. 3 (type, S. spongiosum, M; not traced; Ord., Kaluga, Mednyk, USSR)

*?Caella STECHOW, 1922, p. 152, nom. subst. pro Calvinita SAVAGE, 1913, p. 65 (type, C. edgewoodensis, OD; not traced; Sil., Edgewood F., ¼ mi. SE. of Gale, Ill.), non Calvinita NUTTING, 1900, a hydrozoan; ?Koreanopora OZAKI, 1934, which see]. Corallum with tabularia separated by dissepimented coenenchyme with variable development of discrete trabeculae and without aureola; each tabularium with 12 longitudinal rows of septal spines; walls of tabularia continuous and circular or crenulate in transverse section; tabulae horizontal or slightly sagging or domed. [For intraspecific variation see Dixon, 1974, p. 568. M.Ord., Australia(New S.Wales); U.Ord., Eu.(Nor.)-Asia(Kazakh.-Altay), N.Am.(Anticosti); Sil.(cosmop.).—Fig. 416,2a,b. *P. tubulata (Lonsdale), M.Sil., Woolhope Ls., 30 ft. above Petalocrinus band, U.K., Woolhope; a,b, transv., long. secs., X4 (Hill, n; GSM54451).]

Batailites CHEKEVICH, 1977, p. 23 [*B. tuvenensis; OD; †7, coll. 10943, TsGM, Leningrad; U.Sil., W. Tuva, R. Pichishuy]. Tabularia each with 12 closely spaced spinose septal laminae forming a discontinuous wall; tabulae weakly concave or flat; coenenchyme of small angular dissepiments and numerous coarse long trabeculae arranged in rows within which they may be in contact. U.Sil., Asia(Tuva).

Diplopora QUENSTEDT, 1879, p. 148 [*Heliolites grayi MILNE-EDWARDS & HAIME, 1851, p. 217, 1854, p. 252; M; t156003, TR2740, Gray Coll., BM(NH), London; Sil., Walsall, U.K.]. Corallum branching; axial part of branch proporoid with slender trabeculae; in coenenchyme; peripheral part with all spaces between tabularia filled by thickening of the trabeculae. [Diagnosis sensu LINDSTROM, 1899, p. 102. U.Ord., Eu.(Nor.); M.Sil.-U.Sil., Eu.(U.K.)-Australia(New S.Wales-Queensl.).—Fig. 417,1. *D. grayi (MILNE-EDWARDS & HAIME), Sil., Eu.; part of long. sec. of branch, X4 (Hill & Stumm, 1956).

Dudconia LELESHUS, 1974b, p. 230 [*D. interrupta; OD; t38457/3, coll. 1057, UpG, Dushanbe]. Corallum small, spherical, hemispherical or irregular; tabularia irregularly cylindrical, walls plicate, partly discontinuous, formed of 12 more or less clearly developed outer and inner longitudinal ribs; 12 septal elements represented by interrupted longitudinal ridges, commonly with spines projecting adaxially; tabulae horizontal, oblique, anastomosing or convex; coenenchyme of imperfect tubules with walls interrupted or of thin isolated segments, crossed by horizontal, oblique, or less commonly convex diaphragms. M. Sil.(low.Wenlock), Asia(Tadzhik.).—Fig. 418,1a,b. *D. interrupta, Zeravshan-Gissar Ra., right bank of R. Dukdon; a, paratype, transv. and oblique sec., X16; b, holotype, transv. sec., X3 (Leleshush, 1974b).

Helenolites CHEKEVICH, 1977, p. 21 [*H. clausus; OD; †3, coll. 10943, TsGM, Leningrad; U.Sil., W. Tuva, R. Pichishuy]. Tabularia stelliform in section, immersed in coenenchyme with distinctively insinuating angular dissepiments and coarse, discontinuous longitudinal trabeculae; septa deeply split, isolated long spines may interdigitate at axis; tabulae weakly concave or flat. U.Sil., Asia(Tuva), Sil., Eu.(Czech.).

Innapora LELESHUS, 1974c, p. 99 [*Propora incredula CHERNHOVA in KOVALEVSKIJ, CHERNHOVA, & CHEKEVICH, 1960, p. 219; OD; †7, coll. 274, UpG, Frunze]. [=Innapora LELESHUS, 1970a, p. 62, nom. nud.]. Irregularly hemispherical or nodulose; tabularia irregularly cylindrical, walls interrupted, commonly 12 separated segments bow-shaped or horseshoe shaped in transverse section spaced around the wall and discontinuous longitudinally also; in places segments may coalesce laterally and wall then appears longitudinally folded as in Rotellites; septal spines small, weakly developed; tabular floors sagging, of numerous tabellae; coenenchyme of dissepiments. U.Sil. (Ludlov.), Asia(S.Tien Shan).—Fig. 419,2a,b. *1. incredula (Chernova), Dylano horizon, N.
slopes Turkestan Ra., left side R. Isfara; a,b, transv., long. secs., X 4.5 (Hill, n; photographs courtesy V. L. Leleshus, sample 222-29, Leleshus Coll., IG, Dushanbe).

**Koreanopora** Ozaki in Shimizu, Ozaki, & Obata, 1934, p. 68 [*K. proporoides*, OD; †not known] [†Propora Milne-Edwards & Haime, 1849b, which see; see also Hamada, 1960, p. 170]. Like Propora but tabularia with crenulate walls and without septal spines; tabulæ subhorizontal but with slight median elevation forming slender, discontinuous columella. ?Sil. (pebble in ls. congl.), Asia (NW. Korea, Ken-niho).—Fig. 417, 3a,b. *K. proporoides*, syntype?; a,b, transv., long. secs., X 3 (Shimizu, Ozaki, & Obata, 1934).

**Rotalites** Leleshus, 1974c, p. 97 [*Propora nuratensis* Chekhovich in Kovalevskiy, Chernova, & Chekhovich, 1960, p. 217; OD; 1508/18, MGU, Tashkent] [=Rotalites Leleshus, 1970a, p. 61, nom. nud.]. Corallum small, hemispherical or
Tabularia closely spaced and rounded, or rounded-angulate in section, separated by coenenchyme of very small dissepiments placed vertically one above another; dissepiments may be substituted by sclerenchyme composed of stout longitudinal trabeculae that correspond to the longitudinal piles of dissepiments; 12 granulated septal riblets present or absent around tabularia; tabulae horizontal or slightly concave or convex. U.Ord.; ?M.Sil.  

Family SIBIRIOLITIDAE Lin, 1977  

Tabularia polygonal, rounded or stelliform in section; walls each composed of 12 longitudinal trabeculae connected by thin wall segments; many trabeculae common to neighboring tabularia; in places tabularia may be separated by narrow zone of coenenchyme which rarely, in late stages, may form pipes around tabularia; tabulae horizontal or concave, dissepiments of coenenchyme closer, flat or concave; new corallites may arise by expansion in diameter of coenenchyme. [See also Bondarenko, 1977, p. 45. Possibly a proheliolitid.] U.Ord., Asia (Sib.Platf.; C. Mongolia).  


?Mongoliolites Bondarenko & Minzhin, 1977, p. 21 [M. paradoxis; OD; t1, coll. 3634, PIN, Moscow; low. Ashgill., S. foot of Khangay Ra., C. Mongolia]. Tabularia polygonal, rounded or stelliform in section; walls each composed of 12 longitudinal trabeculae connected by thin wall segments; many trabeculae common to neighboring tabularia; in places tabularia may be separated by narrow zone of coenenchyme which rarely, in late stages, may form pipes around tabularia; tabulae horizontal or concave, dissepiments of coenenchyme closer, flat or concave; new corallites may arise by expansion in diameter of coenenchyme. [See also Bondarenko, 1977, p. 45. Possibly a proheliolitid.] U.Ord. (low. Ashgill.), Asia (Mongolia).
Family PLASMOPORIDAE
Sardeson, 1896

[Plasmoporidaceae Sardeson, 1896, p. 353]

Corallum of varied form; walls of tabularium cylindrical or longitudinally plicate; septa 12, either laminae, or longitudinal rows of spines or of squamulae; aureole of 12 radially elongate coenenchymal tubules with discontinuous walls surrounds tabularium, and smaller tubuli with more discontinuous walls may develop between aure-
Fig. 420. Plasmoporidaceae (p. F617-F618).
oles; in all tubules, horizontal diaphragms commonly replaced by dissepiments. ?M. Ord.; L.Sil.-L.Dev.

**Plasmopora** Milne-Edwards & Haime, 1849b, p. 262 [*Porites petalli-ormis Lonsdale, 1839, p. 687; M; t6558, Geol. Soc. Coll., GSM, London*]. Plasmoporids with septa consisting of spines, or absent; dissepiments dominant in coenenchyme, penetrated by spinules or rodlets or by longitudinal plates outlining imperfect tubules. ?M.Ord., Australia (New S.Wales); Sil. (up.Llandov.-Ludlov.), Eu. (U.K.-Nor.-Swed.-Est.-Podolia-Czech.)-N.Am. (Ind.-Ky.).—Fig. 420,5ac. *P. petalliformis* (Lonsdale), M.Sil., Eng., Dudley; a, transv., b,c, long. secs., X6 (Lindstrom, 1899).

**Eolaminoplasma** Bondarenko, 1963, p. 50 [*Plasmopora rosa* Lindström, 1899, p. 84; OD; tCn17569, RM, Stockholm]. Walls of tabularia slightly convex outward between the radial walls of the aureolar tubules, which have complete, horizontal or curved tabulae; septa 12, radial longitudinal plates; coenenchyme mixed dissepiment-tubular, the outer edges of dissepiments intersecting in the axial region of the discontinuously walled tubules. U.Sil. (Ludlov.), Eu. (Swed.).—Fig. 420,1a-c. *E. rosa* (Lindström), Gotl., Lindeklint; a, transv., b,c, long. secs., X6 (Lindström, 1899).

**Laminoplasma** Bondarenko, 1963, p. 49 [*Plasmopora calyculata* Lindström, 1899, p. 79; OD; figured syntypes Cn17488, 56523, 58602, RM, Stockholm; =?P. calyculata Lindström, 1883a, p. 59]. Septa are plates, spinose axially; coenenchyme dissepimental, with spinules and small rods within it. L.Sil. (up.Llandov.)-M.Sil. (Wenlock.), Eu. (Gotl.).—Fig. 420,4a-c. *L. calyculatum* (Lindström), ?holotype, L. Sil. (up. Llandov.), Gotl., Visby Marls, Visby; a, transv., b,c, long. secs., X6 (Lindström, 1899).

**Liscomea** Ross, 1961, p. 1017 [*L. insolens*; OD; t12408, SU, Sydney]. Corallum of slender, cylindrical branches; in axial parts of branches corallites prismatic and in contact without coenenchyme, mural pores ?absent; in peripheral parts wide intertabularial areas with thick trabeculae normal to surface that form walls to coenenchymal tubules of which 12 may form an aucreole; tabulae flat. L.Sil. (up.Llandov.), Australia (New S.Wales).—Fig. 420,2a,b. *L. insolens*, holotype, up. Llandov., New S.Wales, Liscome Pools Cr., 18 mi. S. 38° W. from Cowra; a,b, transv., long. secs., X13, X6 (Ross, 1961a).

**Squameolites** Bondarenko, 1963, p. 50 [*S. squamiger*; OD; tlost, was no. 46/3A-G, MGU, Moscow]. Septa represented by squamulae or by lenticular thickenings of the walls of tabularia; coenenchyme mixed dissepimental-tubular; tabulae horizontal, complete; in tubules, dissepimental edges intersect in axial regions of tubules, giving
plaited appearance in longitudinal sections. U.Sil. (Ludlov.), Asia (C.Kazakh.-Tien Shan)-Eu.(Gosl.-Podolia)-Australia (New S.Wales-Queensl.); L. Dev., Asia (Kazakh.).—Fig. 420,3a-c. *S. squamiger*, holotype, top of Isen suite, C. Kazakh., 200 km. S. of Karaganda; a,b, transv., long. secs., X7; c, transv. sec., dark areas are squamulae, X22 (Bondarenko, 1963).

Family PLASMOPORELLIDAE

Kovalevskiy, 1964

[Plasmoporellidae Kovalevskiy, 1964, p. 36] [=Proplasmoporiae Kiaer, 1904, p. 48, nom. inval., no generic name Proplasmopora exists]

Tabularia without aureoles, surrounded by coenenchyme of small globose or subglobose dissepiments on which short spines may be based; tabularia may be bounded by longitudinally plicate and continuous walls, or by discontinuous walls, or by downturned edges of dissepiments; 12 short septal laminae in tabularia; tabulae convex, complete or incomplete. M.Ord.-U.Ord., L.Sil.-M.Sil.

Plasmoporella Kiaer, 1899, p. 34 [*P. convexotabulata* forma typica; M; †13487, PM, Oslo] [=Plasmoporella Kiaer, 1897, p. 10, nom. nud.; ?Mcleodes Flower & Duncan, 1975, which see]. Tabularia without aureoles, separated by finely textured dissepimental coenenchyme; tabularial walls may be replaced by a ring of superposed small dissepiments, or by thin sheets, interrupted by 12 septal laminae whose bases project into the coenenchyme; in some a palisadelike wall may be formed in places by additional trabeculae between the septa; tabulae complete or incomplete, convex; dissepiments small, commonly globose or subglobose and superposed in piles; a columnella may be present, formed of interrupted series of spinelike trabeculae. M.Ord., Australia (New S.Wales), U.Ord., Eu. (Nor.-Urals)-Asia (Kazakh.-Uzbek.-Altay-NE.USSR)-Australia (Tasm.).—Fig. 421,2a,b. *P. convexotabulata*, U.Ord. (5a-b), Nor.; a,b, transv., long. secs., X4 (Hill & Stumm, 1956).

Acdalopora Bondarenko, 1958, p. 215 [*A. sokolovii* OD; †31, coll. 1, MGU, Moscow] [=Acralopora Flügel, 1970, p. 8, nom. null., A. elegantis Kovalevskiy, 1964, p. 46, erroneously cited as type species]. Corallum nodulose; tabularia with longitudinally plicate walls that are contiguous or separated by dissepimented coenenchyme; 12 septa, of contiguous or discrete trabeculae directed upward and adaxially from inwardly projecting plicae, alternate with 12 short plates directed outward from outwardly projecting plicae; tabulae subhorizontal or sagging; dissepiments small, numerous, subhorizontally based. U.Ord., Asia (Kazakh.).—Fig. 421,1a,b. *A. sokolovii*, holo-

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Fig. 422. Plasmoporellidae (p. F619).
Family PROHELIOLITIDAE Kiaer, 1899
[nom. transl. Hill, herein, ex Proheliolitinae Kiaer, 1899, p. 21]

Corallum with tabularia in contact and prismatic or separated in parts of their circumference, commonly by one, two, or three small prismatic tubules crossed by flat diaphragms; each such tubule may widen to form a normal tabularium; in some, tabularia may be separated in late stages by partial rings of coenenchyme in which heliolitoid longitudinal laminae may develop; tabularia with flat tabulae and with 12 septa, each composed of a single series of downwardly directed or subhorizontal spines. U.Ord.; U.Sil.

Proheliolites KIAER, 1897, p. 10; 1899, p. 21
[*Heliolites dubia SCHMIDT, 1858, p. 226; M; tfoot traced in EGM, Tallinn; U.Ord., Lyckholm, Est.; species name considered nomen dubium by Bondarenko, 1977, p. 41]. Genus commonly interpreted on Kiaer's Norwegian material (1899, pl. 3, fig. 5, 6), which has been renamed Protoheliolites norvegicus Bondarenko, 1977, p. 39. See Protoheliolites, below.

?Avicenia LELESHUS, 1974c, p. 94 [*A. aseptata; OD; tsample 96-25, coll. 1057, UpG, Dushanbe]. Irregularly hemispherical to nodular; tabularia cylindrical or prismocylindrical, with complete walls, very closely spaced, some contiguous, others separated by narrow zone of coenenchyme from which new tabularia may arise; septa (absent or represented by very small, sparse spines); tabulae complete, horizontal; coenenchyme of prismatic tubuli of irregular section, crossed by diaphragms and with bipartite increase by growth, from one side, of a dividing wall. Potential number of septa not established; possibly bryozoan. U.Sil. (Up. Wenlock), Asia(S.Tien Shan).—Fig. 423,la,b. *A. aseptata, holotype, lower part of Dalian horizon; a,b, transv., long. secs., X5 (Leleshus, 1974c; photographs courtesy V. L. Leleshus).

Kiaerolites BONDARENKO, 1977, p. 43 [*K. kalsta­densis; OD; t73069-73071, PM, Oslo; =Propora cf. goldfussi BILLINGS of Kiaer, 1932, pl. 14, fig. 1-3, non Billings]. Like Schmidtilites but late stages with longitudinal laminae in coenenchyme (forming heliolitoid tubuli). U.Ord. (up. Caradoc—up. Ashgill.), Eu.(Nord.)

Protoheliolites BONDARENKO, 1977, p. 39 [*P. norvegicus; OD; t74195, 13456-7, PM, Oslo; =Proheliolites dubius of Kiaer, 1899, p. 21, non Heliolites dubia SCHMIDT, 1858, p. 226]. Tabularia in contact and prismatic or separated in parts of their circumference by one, two, or three small prismatic tubules crossed by flat diaphragms; each such tubule may widen to form a normal tabu-
larium; in late stages tubules may widen to form partial ring of coenenchyme around tabularia; tabularia with flat tabulae and with 12 septa each composed of a single series of dominantly downwardly or subhorizontally directed spines. *U.Ord. (up.Caradoc.-Ashgill.), Eu.(Nor.-Swed.-Est.)-Asia (Kazakh.-Tuva-China)-N. Am. (Que.-Ont.-Ohio-Ind.-Ky.-Mich.).—FIG. 421,4a,b. *P. norvegicus, holotype, *U.Ord. (Sa), Nor., Stavnestangen, Ringerike; a,b, transv., long. secs., X4 (Hill & Stumm, 1956).

**Schmidtites** Bondarenko, 1978b, p. 121, nom. subst. pro *Schmidtella* Bondarenko, 1977, p. 42, non *Schmidtella* Ulrich, 1892, an ostracode [*Schmidtella schmidtii; OD; in RM, Stockholm, figured Lindström, 1899, pl. 11, fig. 10-13, as Proheliolites dubius Schmidt, p. 70; *U.Ord. (M. Ashgill., Worms, Est.). Like Proheliolites but tabularia polygonal to stelliform in section; septal spines springing from 12 laminar septal bases; coenenchyme from isolated patches to complete rings around tabularia. *U.Ord. (Ashgill.), Eu.(Est.-Nor.-Sweden.-Ger.)-Asia (Kazakh.-China)-N. Am. (Greenl.).

**Family CYRTOPHYLLIDAE** Sokolov, 1950

[Cyrtophyllidae Sokolov, 1950a, p. 141; Cyrtophyllida Bondarenko, 1978a, p. 33]

Corallum massive, of cylindrical tabularia set in disseIPemented coenenchyme in which typically there are extratabular longi­

dinal septal prolongations of the septa in the form of laminae that are continuous longitudinally or ra­
dially, or of discrete, short monacanths; in some, traces of dividing walls between the disseiments proper to neighboring coral­
lites may be found; walls to tabularia (?and dividing walls) formed by downturned edges of disseiments and tangential exten­
sions from septa; disseiments horizontally based; septa within tabularia more than 12 and commonly alternate in length, of con­
junct or discrete monacanths directed adaxially upward; tabulae convex, horizontal or rarely concave, may bear short spines.?

**Cyrtophyllum** Lindström, 1882b, p. 17 [*C. densum; M; figured syntype(?) Cn55160, 55161, RM, Stockholm]. Tabularia separated by disseipements and the convexity of the tabulae resemble the condition of the Plasmoporel­
lidae; but it differs sharply from all other Heliolitina in having more than 12 septa (see also Fomin, 1971, p. 126). *Karagemia* Dzyubo, 1960a, and *Rhaphidophyllum* Lindström, 1882b, are at least homomorphic with Rugosa in alternation of septal length and in their plocoid and ceroioid coralla.

**Cyrtophyllum** Lindström, 1882b, p. 17 [*C. densum; M; figured syntype(?) Cn55160, 55161, RM, Stockholm]. Tabularia separated by disseipements and the convexity of the tabulae resemble the condition of the Plasmoporel­
lidae; but it differs sharply from all other Heliolitina in having more than 12 septa (see also Fomin, 1971, p. 116). ?M.Ord., Eu.(Urals); ?U.Ord., Asia (W. Sib. Platf.-Taymyr-Altay-Shoria Mts.)-N. Am.(Arctic Can.-Greenl.).—FIG. 424, 3a,b. *C. densum, syntype, Sib., R. Middle Tunguska; a,b, transv., long. secs., X2.0, X2.5 (Lindström, 1882b).

**Karagemia** Dzyubo, 1960a, p. 86 [*K. altaica; OD; 1916/3, coll. 7901, SNIGGIMS, Novosibirsk (holotype of *K. altaica subsp. karagemica); lectotype by Dzyubo, 1960b, p. 452]. Corallum tham­nasteroid or partly asteroid or aphroid; boundary of tabularium strongly marked; septa long, 26 to 32, alternating in size, their tabularial parts com­posed of discrete or contiguous trabeculae that are directed steeply upward and adaxially; in disse­mentarium septa are laminae, continuous or dis­continuous; tabulae subhorizontal, convex or con­
cave; dissepiments small, may be of two inosculating longitudinal rows in an interseptal loculus. U.Ord., Asia (Altay Mts.).—Fig. 424, 2a-d. *K. altaica*, lectotype, Altay Mts., right side of R. Karagem; a, c, transv. secs., ×3.0, ×10.0; b, d, long. secs., ×4.0, ×10.0 (Dzyubo, 1960).

**Raphidophyllum** LINDSTROM, 1882b, p. 14 [*R. constellatum*; M; †Cn55162, 55163, RM, Stockholm]. Corallum cerioid; septa more than 12, each a plate within the narrow marginarium of small regular dissepiments, but within wide tabulatum each is represented by long, separated
spines directed adaxially upward; tabulae flat, complete [see PREOBRAZHESNYK, 1964b, p. 68]. U. Ord., Asia (W. Sib. Platf.-Kolyma Basin)-N. Am. (Alaska).—Fig. 426,1a,b. *R. constellatum, syn-type, R. Middle Tunguska, above last rapids before R. Chuna; a,b, transv., long. sec., X? (Lindström, 1882b).

**Superfamily COCCOSERIDICAE**

**Kiaer, 1899**


Corallum encrusting, laminar or sub-globular, longitudinal skeletal elements commonly greatly thickened and porous or aporose; horizontal skeletal elements thin and sparse to absent; tabularia with 12 contiguous septa composed of monacanths? (or rhabdacthanths) directed upward adaxially and in some so long and thick as to fill the lumina; in some, septa may be short and flat tabulae present; coenenchyme of longitudinal trabeculae commonly so thick that no tubular lumina occur; in others they outline tubules that may be crossed by sub-horizontal diaphragms. _M.Ord._-_M.Sil._

**Family COCCOSERIDIDAE**

**Kiaer, 1899**


Corallum encrusting, laminar or sub-globular; longitudinal skeletal elements greatly thickened and aporose; horizontal skeletal elements thin and sparse to absent; tabularia with longitudinally plicate walls and with 12 contiguous septa composed of monacanthine? (or rhabdacthanthy) trabeculae directed upward adaxially and so thick and long as to fill the lumina with few exceptions; coenenchyme of coenenchymal monacanthes commonly so thick that no tubular lumina occur. _M.Ord._-_U.Ord._

_Coccoseris_ Eichwald, 1855b, p. 2 [*C. ungerni; SD Lang, Smith, & Thomas, 1940, p. 39; tin. Eichwald Coll., LGU, Leningrad; =Lophoseiris ungerni Eichwald, 1855a, p. 466]. Corallum discoid, or extensiform with tumulose surface; calice with 12 contiguous triangular septa, each a single series of contiguous inclined trabeculae, surrounding papillae in axial region; tabulae absent; coenenchyme composed of large contiguous monacanthes. [Sokolov (1955, p. 466) considers this genus may be junior synonym of _Protarea_ Milne-Edwards & Haime, 1851] _M.Ord._, Australia (New S.Wales-?Tasm.); _M.Ord._-_U.Ord._, Eu.(Nor.-Est.); _U.Ord._, N.Am.(Texas).—Fig. 425,1a-d. *C. ungerni (Eichwald), holotype, _U.Ord._ (Vorms.), Est., near Hapsalu; a,b, calicial views, X1, X4; c,d, another specimen, transv., long. secs., X4 (Sokolov, 1962e).

_Acidolites_ Lang, Smith, & Thomas, 1940, p. 13, nom. subst. pro _Acantholithus_ Lindström, 1899, p. 112, non Stimpson, 1858, a crustacean [*Acantholithus late septatus; SD Lang, Smith, & Thomas, 1940, p. 13, figured syntypes Cn56719, 56722, RM, Stockholm] [=Esthonia Sokolov, 1950, p. 140, nom. nud.; Esthonia Sokolov, 1955, p. 77 (type, E. schmidti, OD; t122, coll. 599, VNIGRI, Leningrad; _U.Ord._, Vorms., Est.,) differs only in having coenenchymal tubuli closed by thickening of coenenchymal trabeculae and by absence of horizontal skeletal elements]. Corallum forming successive thin plates; tabularia stellate in section; septa of contiguous thick trabeculae, upturned adaxially and almost filling the tabularium so that tabulae are rare; coenenchymal tubuli with monacanthate walls so thickened that only very narrow axial spaces are left to be crossed by diaphragms. _U.Ord._ (Vorms.), Eu.(Est.-Nord-Irc); _M.Ord._ or _U.Ord._, Australia(Tasm.).—Fig. 425,1a-c. *A. late septatus (Lindström), pebble in Pleistocene moraine, Got', near Kopparsvik, Visby; a, calicial view, b,c, transv., long. secs., X12 (Lindström, 1899).

_PROTAREA_ MILNE-EDWARDS & HAIMÉ, 1851, p. 146 [*Porites vetustus Hall, 1847, p. 71; SD Miller, 1889-1897, p. 201; t7642/1, AMNH, New York; Förester (1924, p. 73) considered Milne-Edwards & Haimé's figured specimen to be conspecific but not conspecific with _Porites_ vetustus Hall] [=Diplastraea Eichwald, 1854, p. 83 (type, _D. diffenius_; SD Lang, Smith, & Thomas, 1940, p. 52; tnot traced; _Ord._, Est., Rakvere); _Protarea_ Lambe, 1899, p. 89, nom. van.; _Tumularia_ Robinson, 1916, p. 163, nom. subst. pro _Stylaraea_ Seebach, 1866, p. 306 (type, _S. roemeri_; M; tnot traced; _Ord._, Est., Rakvere), non Milne-Edwards & Haimé, 1851, a recent hexacoral], see Lindström, 1899, p. 109]. Corallum of thin sheets, commonly encrusting; corallites close, coenenchyme with only very narrow axial spaces to be crossed by diaphragms; _U.Ord._ (Vorms.), Eu. (Est._-Nor.-Irc); _M.Ord._ or _U.Ord._, Australia(Tasm.).—Fig. 425,1a-c. *A. late septatus (Lindström), pebble in Pleistocene moraine, Got', near Kopparsvik, Visby; a, calicial view, b,c transv., long. secs., X12 (Lindström, 1899).
Family PYCNOLITHIDAE
Lindström, 1899
[nom. transl. Sokolov, 1950a, p. 140, ex Pycnolithae Lindström, 1899, p. 105, tribe]

Corallum with longitudinal skeletal elements greatly thickened; tabularia with very short septa and crossed by subhorizontal tabulae; coenenchyme of longitudinal monacanths arranged in somewhat irregular rows radiating from the tabularia and commonly so thick as to fill all spaces between the rows. L.Sil. or M.Sil.

Pycnolithus Lindström, 1899, p. 105 [*P. bifidus; OD; ∆Cn17841, RM, Stockholm]. Characters as for family. L.Sil.(up.Llandov.) or M.Sil.(low. Wenlock.), Eu.(Swed.).—Fig. 425, 2a-c. *P. bifidus, monotype, shore at Visby, not in situ;
Family PALAEOPORITIDAE
Kiaer, 1899
[nom. transl. Sokolov, 1962c, p. 278, ex Palaeoporitinae Kiaer, 1899, p. 18] [=Trochiscolithidae Sokolov, 1950a, p. 139]

Corallum of variable form; longitudinal skeletal elements of monacanths (or rhabdacanths) commonly incompletely contiguous so that walls of tabularia and of tubuli and septa are perforate; septal trabeculae directed upward adaxially, their axial ends forming axial structure in some; tabulae sparse; coenenchymal tubules may be almost closed by thickening of trabeculae of their walls. ?M.Ord.-U.Ord.

Palaeoporites Kiaer, 1899, p. 18 [*P. estonicus; M; figured syntypes A8451, A8452, Kiaer Coll., PM, Oslo]. Nodular; coenenchyme wide, tubulate; septa and walls of coenenchymal tubules of moderately thick trabeculae, imperfectly contiguous so that walls and septa are perforate; second order trabeculae curve outward from median plane of septum; tabulae sparse, thin. ?M.Ord., Australia (New S.Wales); U.Ord. (Porkuni, F.), Eu.(Est.).

— Fig. 426,2a-c. *P. estonicus, Fs, Est., Rös; a,b, transv., long. secs., ×10; c, oblique sec., through 2 septa, ×20 (Kiaer, 1904).

Protrochiscolithus Tvedsdson, 1928, p. 116 [*P. kiaer; M; H3012, H3043, H3093 (=144 in L. Koch Coll.), MM, Copenhagen] [=Protro-
**Tabulata—Favositida—Heliolitina**

*Chicolithus* Kiaer, 1904, p. 49, invalid name based on hypothetical genus; Lang, Smith, & Thomas (1940, p. 107) invalidly recognized *Heliolites? parasitica* Nicholson & Etheridge, 1880, p. 259, as type by OD. Corallum encrusting, thick; coenenchyme narrow; septa, walls of tabularia, and walls of coenenchymal tubules partially perforate and rather thin, formed of slender trabeculae that are incompletely contiguous within a skeletal element; tabulae and diaphragms present [see Flower, 1961, p. 53]. *U. Ord., N. Am. (Greenl.-Manit.-N. Mex.-Texas)-Asia (Altay).—Fig. 426,3a,b. *P. kiaeri*, holotype, C. Calhoun beds, N. Greenl., C. Calhoun; a,b, transv., long. secs., X10 (Hill & Stumm, 1956).

**Trochiscolithus** Kiaer, 1904, p. 13 [*T. micraster* Lindström of Kiaer, 1904, p. 14; M; tCN56613, RM, Stockholm; =Coccoseris micraster Lindström, 1899, p. 109]. Corallum spheroidal to branching; coenenchyme tabular; tabularia with 12 longitudinal rows of upwardly and adaxially directed spines, forming more or less perforate septa; walls of coenenchymal tubules of longitudinal trabeculae and more or less perforate; in proximal or axial parts of corallum, skeletal tissue relatively thin as in *Protrochiscolithus*; in peripheral parts trabeculae so thick as almost to fill all spaces. *U. Ord. (F., F.), Eu. (Nor.-Dalecarlia-Est.).-Asia (Altay).—Fig. 426,1a,b. *T. micraster* (Lindström) Kiaer, U. Ord. (5a), Nor., Stavnestangen, Ringerike; a, transv. sec. of branch showing strongly thickened peripheral part, X4; b, axial part of a, X20, showing only slight thickening (Kiaer, 1904).

**Family Uncertain**

*Pragnellia* Leith, 1952, p. 794 [*P. arborescens*; M; t429P, Manitoba Museum, Winnipeg]. [For discussion of systematic position see Bondarenko, 1969, p. 105. Lin in Lin & Chow, 1977, p. 193, included *Pragnellia* together with a new family Sibiriolitidae Lin in a new order of Tabulata, Pragnellida Lin.]. Polyparium branching by dichotomy; branches of internodes of calcareous skeletal elements and nodes that were not calcareous, possibly proteinous; internodes phalangoid, with 'corallites' lacking distinct walls surrounded by common tissue of loosely packed, prickly rods perpendicular to surface; neither septa nor tabulae noted, but barlike connections are found between rods of common tissue; 'corallites' almost completely filled with sclerenchyme. [Alternation within the branches of calcareous internodes with ?horny nodes recalls that in members of octocorallian Isididae also (see Bayer, 1956b, p. F222), the microstructure of the calcareous parts of the branches is very similar to that of octocorallian Helioporidae. Perhaps *Pragnellia* is an alcyonarian.] *U. Ord. (Richmond.), N. Am. (Manit.-?Texas)-Eu. (W. slope of Urals-?Irec.).—Fig. 427,4a-c. *P. arborescens*, holotype, Manit., Stony Mountain; a, transv. sec. internode, X3.8, b,c, ext. views, X4.7, X0.3 (Leith, 1952).

*Urceopora* Eichwald, 1855b, p. 3 [*U. furcata*; SD Lang, Smith, & Thomas, 1940, p. 137; tnot traced; Ord., Calcaire à Orthocéritates, Nyby,
Estonia]. Sokolov (1962c, p. 281) considered that Urceopora was possibly referable to the Protaracida (herein Coccoseridicae), but that in the absence of the original material this problem cannot be resolved.

Suborder HALYSITINA
Sokolov, 1947

Colonial; corallites thick-walled, arranged uniserially (in ranks that connect with one another to enclose longitudinal lacunae); increase lateral or intermural or from coenenchyme; 12 longitudinal rows of septal spines present or absent; corallites may or may not be separated within ranks, and rank junctions may or may not contain narrow coenenchymal tubular spaces with horizontal or convex diaphragms and commonly without spines on bounding walls. M.Ord.–U.Sil.
Family HALYSITIDAE
Milne-Edwards & Haime, 1849


As with other Tabulata, generic subdivision for this family is difficult because the structures are so simple and degrees of difference are perforce used. Among the characters used have been degrees of difference in the development of coenenchyme and of septal spines, and though their application so far has led to some inconsistencies, their use is continued herein. Members of the family are not without stratigraphic and provincial value.

Subfamily CATENIPORINAE Hamada, 1957

[Cateniporidae HAMADA, 1957b, p. 396]

Halysitidae without coenenchyme between corallites or at junctions of ranks. M.Ord.-U.Sil.

Catenipora LAMARCK, 1816, p. 206 [*C. escharoides; SD Lang, Smith, & Thomas, 1940, p. 33; neotype, 4, BROMELL Coll., PM, Uppsala, by Thomas & Smith, 1954, p. 768] [=Polychalysites CHERRYNEV, 1941a, p. 36 (type, Halysites goslandicus YABE, 1915, p. 34, OD; +4547, TobU, Sendai)]. Corallum halysitoid; corallites of each rank elongate and elliptical or angulate-elliptical in section, without intervening coenenchymal tubules; offsets may arise from either edge of corallite; septal spines in 12 longitudinal rows, commonly well developed; tabulae mostly horizontal. [See Thomas & Smith, 1954, p. 768; KLAAMANN, 1966, p. 29; WEBBY & SEMENIUK, 1969, p. 357. LENZ, 1964, p. 373, illustrates short cylindrical canals connecting lacunae through lines of junction of three ranks.]


Eocatenipora HAMADA, 1957b, p. 398 [*Halysites cylindricus WILSON, 1926, p. 15; OD; +6736, GSC, Ottawa]. Corallum halysitoid; ranks of corallites that are rounded, elliptical, or rounded polygonal in section, may or may not connect to enclose lacunae; some corallites cylindrical and distally without contact with others of a rank; septal spines absent; no coenenchyme known; walls thick, tabulae rather distant. U.Ord.(Richmond.), N.Am. (B.C.); U.Ord.(Ashgill.), Eu.(Nor.-Est.).—Fig. 434,2a-b. *E. cylindrica (WILSON), holotype, U. Ord., Beaverfoot F., Can., B.C.; a,b, long., transv. secs., ×4 (Wilson, 1926).

Quepora SCLLARIN, 1955, p. 96 [*Halysites catenulata var. qubecensis LAMBE, 1899, p. 69; OD; +11305, GSC, Ottawa; lectotype by BUEHLER, 1955, p. 47] [=Catenipora (Holoctenipora) YABE, 1960, p. 83 (type, C. (H.) orientela, OD; +10408-10409, IGP, Nanking; U.Ord., Sinkiang, Dalyan distr., Mon-yuan Prov.).] Halysitoid coralla with thick-walled corallites in short moniliform ranks enclosing small longitudinal lacunae; within ranks, offsets develop between adjacent corallites; septal spines absent to poorly developed; no coenenchyme; tabulae complete, flat [see WEBBY & SEMENIUK, 1969, p. 348]. M.Ord., N.Am.(Que.-N.Green.).


Subfamily HALYSITINAE
Milne-Edwards & Haime, 1849

[Halysitinae MILNE-EDWARDS & HAIME, 1849b, p. 261, tribe] (=Schiddahalysitinae HAMADA, 1957b, p. 401)

Halysitidae with interstitial coenenchymal tubuli between corallites or at junctions of ranks. M.Ord.-?U.Ord.-U.Sil.

Halysites FISCHER von WALTDEIM, 1828, p. 15 [*Tubipora catenulata LINNÉ, 1767a, p. 1270; OD; neotype, 1, BROMELL Coll., PM, Uppsala; by Thomas & Smith, 1954, p. 797] [=Alyssites FISCHER von WALTDEIM, 1813, p. 387, nom. obl.]. Corallum with corallites rounded to elliptical in section, arranged uniserially in ranks that connect with one another to enclose longitudinal lacunae; corallites with thick walls and complete tabulae; septal ridges or septal spines weakly developed to absent; corallites within ranks separated by a single prismatic coenenchymal tubule, which is quadrangular and either square or oblong in section; at connections between ranks is a larger interstitial tubule of less regular section; within ranks, new corallites arise by expansion in diameter of coenenchymal tubule and subsequently a new coenenchymal tubule develops on each side of the offset; other new corallites may arise peripherally from the corallite at the end of a rank, a dividing tubule being subsequently developed; diaphragms in tubules horizontal, complete. M.Ord.(up. Easton.), Australia (New S.Wales)-New Guinea (W.Irian); L.Sil.-U.Sil., cosmop.—Fig. 429,la-e, *H. catenulata (LINNÉ), Sil., Gotl.; a-c, neotype, a, ext. view, ×1, b,c, long., transv. secs., ×4
Acanthohalysites Hamada, 1957b, p. 404 [*Halysites australis* Etheridge, 1898, p. 80; OD; syntypes F4727 (AM690), F3181 (AM691) missing, AM, Sydney] [Klaamann, 1966, p. 59, regards this genus as synonym of *Halysites Fischer von Waldheim, 1828*, from which it differs in having strongly developed septal spinules; it entered later (L.Sil.) than *Halysites* (M.Ord.)]. Corallum halysitoid; corallites elliptical to prismatic in section, with thick walls, commonly with 12 longitudinal rows of septal spinules and with horizontal or slightly curved tabulae; coenenchymal tubules within ranks quadrangular in section, with closely spaced horizontal diaphragms and lacking spines; tubules at junctions of three to four ranks triangular, triradiate, or quadrilateral in section. L.Sil.-U.Sil., Australia (New S.Wales-Queensl.)-Eu. (Gottl.)-Asia (Sev. Zemlya-Japan-China)-N. Am. (Que.-Iowa-Wis.); U.Sil., S.Am. (Venez.).—Fig.
Tabulata—Favositida—Halysitina

429,la,b. *A. australis* (Etheridge), syntype, Sil., New S. Wales, 4 to 5 mi. N. of Molong, at the Bell R.; *a,b*, transv., long. secs., ×4 (Etheridge, 1904).

**Cystihalysites** Chernyshev, 1941b, p. 70 [*C. mirabilis*; OD; τ7, coll. 5957, TsGM, Leningrad]. Corallum halysitoid; corallites without or with sparse septal spinules; tabulae horizontal or concave; coenenchymal tubules with globose to subglobose diaphragms; new corallites in ranks develop within coenenchyme which continues to develop on each side of the offset [see Webby, 1975, p. 33]. *L.Sil.*, Asia (Yakutia)-N.Am.(B.C.); *Sil.*, N.Am.(Utah-Can.); *M.Sil.*, Eu.(Eng.-Goth.); *U.Sil.*, Eu. (Podolia-Nor.)-N. Am. (Tenn.)-S. Am. (Venez.).—FIG. 430,la-d. *C. mirabilis*, holotype, L.Sil., USSR, R. Khandyga, E. Verkhoyanya; *a*, transv. sec., *b-d*, long. secs., enl. (Chernyshev, 1941b).

**Falsicatenipora** Hamada, 1958, p. 98 [*Halysites japonicus* Sugiyama, 1940, p. 131; OD; ǂ39524, TohU, Sendai]. Corallum halysitoid, may be branching, with two to five corallites without interstitial tubules in a rank; ranks connected to enclose small longitudinal lacunae, a triangular tubule at most of junctions of ranks; septal elements absent or weakly developed; tabulae horizontal. *U.Ord.*, N.Am.(Arctic Can.), Australia (Tas.); *M.Sil.-U.Sil.*, Asia (Japan)-Australia (New S.Wales-Queensl.).—FIG. 431,2a,b. *F. japonica* (Sugiyama), U.Sil.(low.Ludlov.), Japan, Higutizawa in Kawaihi, Kitakami Mts.; *a,b*, long., transv. secs., ×2.7 (Sugiyama, 1940).

**Hexismia** Sokolov, 1955, p. 517 [*Halysites compactus* Rominger, 1876, p. 79; OD; ǂ8543, UMMP, Ann Arbor, lectotype by Buehler, 1955, p. 42] [=Hexismia Sokolov, 1949, p. 94, nom. nud.; Densoporites Hamada, 1957b, p. 404 (type, Halysites compactus Rominger, 1876; OD)]. Corallum halysitoid, but with single corallite ranks, each corallite either in contact with several neighboring corallites or connected to them by coenenchymal tubules that may contain subglobose diaphragms or more commonly are almost filled by sclerenchyme (*fide* Buehler, 1955, p. 42); lacunae between ranks smaller than corallites; septa or septal spinules not observed; tabulae may be supplemented by peripheral tabulae. *Sil.*, N.Am.(Mich.); *L.Sil.-M.Sil.*, Asia (Kazakh.).—FIG. 429,2a,b. *H. compactus* (Rominger), lectotype, Sil., loose specimen, Mich., Epoufette Pt., Mackinac Co.; *a,b*, transv., long. secs., ×6 (Buehler, 1955).

**Schedohalysites** Hamada, 1957b, p. 401 [*Halysites orthopteroides* Etheridge, 1904, p. 25; ǂF45929 (AM4004-4005), AM, Sydney] [Possibly junior subjective synonym of Halysites Fischer von Waldheim, 1828; method of insertion of new corallites requires investigation; see Webby & Semeniuk, 1969, p. 355.]. Like Halysites but

Fig. 430. Halysitidae (p. F629-F630).
with interstitial tubules absent in some parts of ranks and in some connections of ranks; septal spines or ridges weakly developed to absent. *S. orthopteroides* (Etheridge); holotype, L. Sil. (up. Llandov.), Quarry Cr. (Ls.), New S. Wales, “Mirrabooka” nr. Orange; *S. norvegicus*, OD; ?U.Sil., Australia (Queensl.)—Fig. 430,3a,b.

*Solenihalysites* Stasinska, 1967, p. 59 [*S. norvegicus*; OD; ?149378, PM, Oslo]. Corallum halyistoid; corallites oval in section with septal spines commonly weakly developed and horizontal tabulae; radially fibrous wall tissue common to neighboring corallites with very narrow, irregular longitudinal spaces imparting a spongy texture and crossed by very sparse, horizontal diaphragms. M. Sil. (Wenlock.)–U. Sil. (Ludlov.), Eu. (Nor.-Swed.)—Fig. 430,2a,b. *S. norvegicus*, holotype, M.Sil., Nor., Holmestrand, Langøy; *S. orthopteroides* (Etheridge, 1904) .

*S. orthopteroides* (Etheridge); holotype, L. Sil. (up. Llandov.), Quarry Cr. (Ls.), New S. Wales, “Mirrabooka” nr. Orange; *S. norvegicus*, OD; ?149378, PM, Oslo]. Corallum halyistoid; corallites oval in section with septal spines commonly weakly developed and horizontal tabulae; radially fibrous wall tissue common to neighboring corallites with very narrow, irregular longitudinal spaces imparting a spongy texture and crossed by very sparse, horizontal diaphragms. M. Sil. (Wenlock.)–U. Sil. (Ludlov.), Eu. (Nor.-Swed.)—Fig. 430,3a,b. *S. orthopteroides* (Etheridge, 1904) .

*B. orthopteroides* (Etheridge); holotype, L. Sil. (up. Llandov.), Quarry Cr. (Ls.), New S. Wales, “Mirrabooka” nr. Orange; *S. norvegicus*, OD; ?149378, PM, Oslo]. Corallum halyistoid; corallites oval in section with septal spines commonly weakly developed and horizontal tabulae; radially fibrous wall tissue common to neighboring corallites with very narrow, irregular longitudinal spaces imparting a spongy texture and crossed by very sparse, horizontal diaphragms. M. Sil. (Wenlock.)–U. Sil. (Ludlov.), Eu. (Nor.-Swed.)—Fig. 430,2a,b. *S. norvegicus*, holotype, M.Sil., Nor., Holmestrand, Langøy; a,b, transv., long. secs., ×6 (Stasinska, 1967).

*?Spumaeolites* Zhizhina, 1967, p. 118 [*S. sokolovi*; OD; ?14724, TsGM, Leningrad]. Tabularia of neighboring corallites separated by coenenchyme of very small globose to subglobose plates as in *Cystihalysites* and throughout the corallum in some *Plasmoporella*, except that up to seven narrow irregular longitudinal lacunae may be left around any tabularium; epitheca? covers dissepimental tissue in lacunae; there are commonly 12 dissepimentate projections into each tabularium; septal elements lacking; tabulae horizontal or slightly saucered. [Only one specimen, placed by Zhizhina (1967, p. 118) in Hexismididae Sokolov, 1950a, p. 174. Nature of lacunae described by Zhizhina (1967, fig. b) suggests origin by boring or commensal; if so, specimen probably a porporican.] *L. Sil. (Llandov.),* Asia (Taymyr).

—Fig. 431,1a,b. *S. sokolovi*, holotype, between Tolmachev (Brody) R. and Bunga R., right side of valley of R. Lower Taymyr; a,b, long., transv. secs., ×2.8 (Zhizhina, 1967).

**Order AULOPORIDA** Sokolov, 1947

*Corallum fruticose with proximal corallites commonly prostrate or adherent; from them erect corallites or branches may arise; corallites tubular, cornute or cylindrical or in places contiguous and prismatic, when mural pores may or may not develop; connecting tubuli present in *Syringoporicae*; septa represented by longitudinal rows of commonly fine spines; tabulae very sparse or even absent to numerous, complete or incomplete, with syrinx in most *Syringoporicae*; increase lateral and commonly basal. *L.Ord.-U.Perm.*
Superfamily AULOPORICAE
Milne-Edwards & Haime, 1851

[=Zoantharia Tubulosa Milne-Edwards & Haime, 1851, p. 310] [=Zoantharia Tubulosa Milne-Edwards & Haime, 1851, p. 159, section; Aulopora Fenton, 1947c, p. 19, order; Aulopora Soko­lov, 1959a, p. 171, suborder; Aulopora Sokolov, 1962c, p. 241, order]

Corallum commonly small, highly variable in form; increase basal, lateral, rarely calicular, peripheral; after increase parent commonly grows but slightly; corallum proximally prostrate; in some only the calices rise above substrate; in others cylindrical corallites rise free of substrate, give rise to no or few further offsets and are not connected by tubuli; in others, free branches arise from the prostrate parts and continue to show lateral increase; commonly the lumen of an offset is continuous with the lumen of the parent at the point of origin; sparse mural pores may be found where adult corallites are contiguous; septa more or less well developed as longitudinal rows of fine spinules; tabulae very sparse or ?ab­sent to profuse, and complete or incomplete, a syrinx may develop in Aulocystidae. L. Ord.-U. Perm.

Family AULOPORIDAE
Milne-Edwards & Haime, 1851

[Auloporidae Milne-Edwards & Haime, 1851, p. 310] [=Auloporiens de Fromentin, 1861, p. 318]

Colonies small, reptant or encrusting with the entire lower surface adherent to substrate; corallites reptant in chains, or anastomosing, more or less closely adpressed and united in a common basal sheet; calices slightly raised and trumpet- or barrel-shaped, with smooth margins; septal spinules present or absent, tabulae absent or sparse and oblique and slightly concave; mural pores present in some; offsets connected laterally with base of calice, in some arising initially from calical surface of thick wall (Stasinska, 1974, p. 266); parent corallites cease to grow after development of offset. L.Ord.-U. Perm.

Aulopora Goldfuss, 1829, p. 82 [*A. serpens Goldfuss, 1829; SD Milne-Edwards & Haime, 1850, p. lxvi; ?original of Goldfuss, 1829, pl. 29, fig. 1b, which is 202, Goldfuss Coll., IP, Bonn, missing ?fide Lecompte, 1936, p. 83; lectotype by Lang, Smith, & Thomas, 1940, p. 24; M. Dev., Bensberg or the Eifel; =Aulopora repens Milne-Edwards & Haime, 1851, p. 312; see Lang, Smith, & Thomas, 1940, p. 24, for discussion of homonymy]. Corallum reptant, low, commonly adherent; corallites corulate, joined in linear chains or anastomosing; calices slightly raised above substrate, conical or barrel-shaped; walls moderately thick; septal spinules present or absent; tabulae commonly absent, or sparse and oblique; increase basal-lateral; offsets originate on calical surface of wall. [Type species insufficiently known.] Ord., Eu.(Baltic)-Asia( ?irkutsk); Sil.-Perm., cosmop. —Fig. 432,la. *A. serpens, lectotype (=?A. repens Milne-Edwards & Haime), M. Dev., Bensberg of the Eifel, Ger.; ext. view, X1.0 (Goldfuss, 1829). —Fig. 432,lb-e. A. ser­pens minor Goldfuss, M. Dev.(Couvin), Pol., Holy Cross Mts.; b, fragment of a colony, X5.0 e, cross section showing radial structure of wall, X30.0, d, e, thin secs. showing formation of young corallites, X30.0 (Stasinska, 1974).

Aulocaulis Fenton & Fenton, 1937b, p. 119 [*Aulopora expansa Fenton & Fenton, 1924, p. 67; OD; ?UC26021, FM, Chicago]. Corallum prostrate, linear or reticulate, adherent; bifurcations of chains not numerous; corallites thin-walled, long and narrowly tubular from base to calice, then expanding abruptly to form circular, vertically directed calices with diameter much larger than that of tubular portions; tabulae few or absent; septal ridges in calice; increase lateral and through base of calice. U.Dev.(Fram.), N. Am.(Iowa-N.Y.)-Australia(W. Australia). —Fig. 432,3. *A. expansus (Fenton & Fenton), holotype, Hackberry Stage; ext. view, X0.9 (Hill & Stumm, 1956).


Aulozoa Grubbs, 1939, p. 549 [*A. constricta; OD; ?UC46024, FM, Chicago]. Corallum attached by limited portions of lower surface; composed of tortuous, tubular corallites of nearly uniform diameter; one to six new corallites may be added within a short distance at any position about the parent, diverging somewhat but growing forward and bending slightly upward near calical end; offsets communicating with parents through small circular orifice at point of origin; calices circular; tabulae lacking; septal spinules few, short. Sil., N. Am.(III.). —Fig. 432,5. *A. con­stricta, holotype, Niag. dol., Ill., Chicago; side view, X4.5 (Grubbs, 1939).

Diorychopora Davis, 1887, explanation to pl. 74.
Corallum of delicate, bifurcating, frondlike stems, each composed of reptant, adherent, biserially arranged, very small corallites attached along one side and very slightly expanding with circular calices directed obliquely to surface of stem; tabulae absent [see Stumm, 1965, p. 81]. Sil., N.Am. (Ind.-Ky.).—Fig. 432,7. *D. tennis*, monotype, Louisville Ls., third quarry on Beargrass Cr., Ky., Louisville; ext. view, X2.0 (Davis, 1887).

*Mastopora* Sokolov, 1952b, p. 155 [*Aulopora compacta* Cherneyshhev, 1941c, p. 122; OD; t11, coll. 121, PIN, Moscow]. Corallum of densely adpressed reptant corallites which fuse into continuous encrusting sheets; successive sheets may form globular masses; increase lateral; offsets originate on calical surface of wall, calices slightly raised, mammilliform, with small aperture; walls thick, mural pores present in some; septal spines may be well developed; tabulae complete, in places
Family BAJGOLIIDAE Hill, new family

Corallum dichotomously branching; corallites prismatic or cylindroprismatic, diverging fanwise from axis of branch to open obliquely to surface; walls thickening evenly and very slightly from axis to periphery of branch; septal spines ? absent; tabulae ? absorpt; ?sparse; mural pores absent. M.Dev.-U.Ord.

Only tentatively included in Auloporiceae; except for the absence of mural pores and tabulae it might be considered ancestral to the Pachyporicae and referred to the Favositina.

Family BAJGOLIIDAE Hill, new family

Corallum dichotomously branching; corallites large, cylindrical; wall moderately thin, concentrically laminated; connecting tubuli absent; septal spines ? absent; tabulae ? absent; mural pores absent. M.Dev.-U.Ord.

Family KOZLOWSKIOCYSTIIDAE Stasinska, 1969

[nom. correct. Hill, herein, ex Kozlowskiocystidae Stasinska, 1969, p. 554, nom. subst. pro Kozlowskiidae Stasinska, 1958, p. 222, founded on invalid generic name]

Corallum encrusting, adherent by entire lower surface; increase intracalicular, peripheral; corallites conical, prostrate, united in dichotomizing chains that do not anastomose; calices raised slightly above substrate; walls thick, distally the stereozone is disrupted by peripheral tabulae, notably on the underside of the corallite; septal spinules sparse to absent; mural pores absent. M.Dev.

Kozlowskiocystaysia Stasinska, 1969, p. 554, nom. subst. pro Kozlowskia Stasinska, 1958, p. 222, non Kozlowskia Frederiks, 1933, a brachiopod [*Kozlowskia polonica Stasinska, 1958, p. 222; OD; †1501, PZI, Warsaw]. Corallum reptant, adherent by entire lower surface; increase calicular, peripheral; corallites conical, prostrate, united in the form of dichotomizing chains that do not anastomose; calices raised 1.5 cm above substrate and wide, with smooth edges; walls thick; stereozone distally disrupted by peripheral tabulae, notably on sides; septal spinules ? absent; tabulae few, irregular, in proximal parts of corallite only. M.Dev. (Couvin.), Eu.(Pol.) — Fig. 433, 1a-b. *K. polonica; a, holotype, Grzegorzowice, ext. view, X 2.0; b, c, ? other specimens, oblique long., transv. secs., X 8.0, X 12.5 (Stasinska, 1958); d-i, serial transv. secs. through corallite showing origin of two new offsets by peripheral increase, X 30 (Stasinska, 1969).

Family FLETCHERIELLIDAЕ Sokolov, 1965

[Fletcheriellidae Sokolov, 1965, p. 7]

Corallum fasciculate; increase lateral; corallites large, cylindrical; wall moderately thin, concentrically laminated; connecting tubuli absent; septal spines short, immersed in sclerenchyme of wall; tabulae numerous, horizontal, in places incomplete, in some, absent. [Description of wall structure suggests Auloporiceae rather than the sarcinulain Lyoporinaceae.] U.Ord.-M.Sil.; M.Dev.
erately thick, mural pores not observed; acanthine septa numerous, the axial ends of spines projecting slightly from wall; tabulae absent. [Diagnosis tentative, translation unsure.] U.Ord. (Ashgill), Asia (Kiangsi).

Neofletcheriella LIN (MS) in Li et al., 1975, p. 219 [*N. cystosa; OD: T9G-79-24, AGS, Peking; M. Sil., Ningqiang, Shensi]. Bushy, corallites large, with thick wall and short septa (spines); tabular floors flat or concave; tabulae mostly complete, a single imperfect series of peripheral dissepiment-like plates in larger corallites. [Diagnosis tentative, from illustrations.] M.Sil., Asia (Shensi).

Pseudofletcheria CHI, 1976, p. 122 [*P. jundihula; OD: TH1137, JGM, Shenyang; low. M.Dev., Dong Ujimqin Qi, NE. Inner Mongolia]. Fasciculate, (without connecting tubuli or mural pores); corallites cylindrical and large, wall thick; septal spines moderately long; tabulae complete, horizontal or oblique or rarely infundibuliform; increase lateral. [Diagnosis tentative; from illustrations.] M.Dev., Asia (Inner Mongolia).
Family PYRGIIDAE de Fromentel, 1861

[nom. correct. HILL, herein, pro Pyrgiens de FROMENTEL, 1861, p. 318] [=Moniloporidae GRABAU, 1899, p. 409; Cladochonidae HILL, 1942d, p. 68; Moniliporidae SOKOLOV, 1950a, p. 171, nom. van.]

Colonies branchlike, small, proximally reptant or slightly raised above substrate; erect branches may arise from basal ring; corallites broadly conical, short, cornute; calices large, funnel-shaped, elevated, with sharp edges; offsets diverge consecutively in opposite directions; total dichotomy sometimes present; wall an epithecate peripheral steroszone with characteristic secondary lamellae or reticulate microstructure; septal spines and tabulae commonly lacking in narrow lumen, but septal ridges may appear in calice; mural pores present in some. U.Sil.; M.Dev.-U.Perm.

Cladochonus McCoy, 1847, p. 227 [*C. tenuicollis; SD MILNE-EDWARDS & HAIME, 1850, p. lxxvi; tA8003, W. B. CLARKE Coll., SM, Cambridge; lectotype by HILL & SMYTH, 1938, p. 128] [=Pyrgia MILNE-EDWARDS & HAIME, 1851, p. 310 (type, P. michelinii, SD HILL & SMYTH, 1938, p. 126; syntypes, 43 fragments, Z168a,b, MN, Paris; L.Carb., Tournai, Belg.); Monilipora NICHOLSON & ETHERIDGE, 1879, p. 293 (type, Jania crassa McCoy, 1844, p. 197, M; t81A,B, 1925, GRIFFITH Coll., NM, Dublin; lectotype chosen and figured HILL & SMYTH, 1938, pl. 22, fig. 1; L.Carb., St. John’s Pt., Co. Donegal, Eire); Monilipora LANG, SMITH, & THOMAS, 1940, p. 86, nom. van.]. Proximal parts of corallum prostrate, annular when attached to crinoid stem; distal parts of corallum erect branches that may fork; corallites commonly opening through wall near base of calice of parent; wall moderately thick, in some states of preservation including holacanthine spines; in other states growth lamellae of sclerenchyme of wall may be slightly separate and connected by granules; tabulae absent or sparse [see ROBERTS, 1963, p. 7; HAMADA, 1973, p. 33]. M.Dev.—U.Dev., Eu.(Ger.)-N.Am.(N.Y.); Carb.—Perm., cosmop.—Fig. 435,2a-e. *C. tenuicollis, lectotype, Carb., New S. Wales, Dunvegan, Paterson R.; a, ext. view, ×2.0; b-e, syntypes, thin secs., ×4.0 (Hill & Smyth, 1938).—Fig. 435,2f. *C. crassus (McCoy), lectotype, ext. view, ×2.0 (Hill & Smyth, 1938).

?Amniopora SOKOLOV, 1955, p. 217 [*A. lata; OD; t77, coll. 599, VNIGRI, Leningrad] [=Amniopora FLÜGEL, 1970, p. 12, nom. null.]. Solitary, very small, broadly conical; base narrow, curved, with one side attached to substrate; calice rising free from substrate, funnel-shaped with sharp edges; wall thick; no tabulae or septal spines. U.Carb.(Moscow).—Fig. 435,5. *A. lata, holotype, up. part Myachkovo horizon, lower reaches of R. Moskva, R. Medvedka; ext. view, ×1.5 (Sokolov, 1955).

Bainbridgia BALL, 1933, p. 239 [*B. typicalis; OD; tUC37782, FM, Chicago]. Corallum of flattened cylindrical branches; corallites short, cornute, uniformly spaced, opening on opposite sides in regular alternation; wall thick, faint radial septal ridges in calices of some; tabulae absent. U.Sil.(lowLudlov.), N.Am.(Mo.).—Fig. 435,3a,b. *B. typicalis, ?holotype; a,b, side view, long. sec., ×5.0 (Hill & Stumm, 1956).

Bibucia ROBERTS, 1963, p. 6 [*S. tubiformis; OD; tF5366, UNE, Armidale]. Corallum branching with slender stems, each stem biserial with two contiguous, opposite, alternating rows of thick-walled, small, trumpet-shaped corallites, the rows connected by mural pores; a new corallite arises from immediately below calice, on upper side of parent; branches arise at irregular intervals and from below calice on under side of parent. [Differs from Bainbridgia BALL, 1933, by presence of mural pores.] L.Carb.(Townai.), Australia(New S. Wales).—Fig. 435,4a,b. *S. tubiformis, holotype, Lewinsbrook, New S. Wales; a,b, ext. view, diagram. long. sec. of stem and branch, ×4.0 (Roberts, 1963).

—Fig. 435,1a-c. *S. palinorum, holotype, Eire, 250 yds. N. of lighthouse, Hook Hd., Co. Wexford; a, ext. view, ×0.8; b, long. sec., ×4.0; c, transv. sec., ×4.0 (Smyth, 1928).

?Family TRACHYPSAMMIIIDAE
Gerth, 1921

Corallum branching; an axial Cladoxochus-like part is surrounded by ?coenenchyme resembling hydrozoan or stromatoporoid. Perm.

**Trachypsammia** Gerth, 1921, p. 113 [*T. dendroides; M; syntypes, 43, WANNER Coll., IP, Bonn, and 11804, TH, Delft; Hehenwarter, 1951, p. 68, invalidly named as holotype 2 specimens from different localities]. Corallum small, branched; corallites not numerous, with elevated calices arranged in two rows on opposite sides of branch; remaining surfaces of branch a characteristic sclerenchyme with surface granules and ridges continued in depth; septal elements (ridges) continued some distance into intercalical sclerenchyme; no tabulae; coenenchyme pierced by canals opening into pores scattered within and outside calices. [Possibly a Cladoxochus in symbiosis with a stromatoporoid or hydrozoan.] U.Perms., Asia (Timor)-Eu.(Sicily).—Fig. 436,1a-d. *T. dendroides*, Basleo., Timor; a, ext. view, ×1.3; b, calice, ×2.7; c, transv. sec. of branch, ×2.7; d, from Bitauni, Timor, tang. sec. of branch, ×1.3 (Gerth, 1921).

**“Dictyopora”** Gerth, 1921, p. 123, *non Dictyopora Steiningier, 1849, p. 10, a bryozoan, nec Dictyopora MacGillivray, 1869, a recent bryozoan [”D. incrustans; M; t52, WANNER Coll., IP, Bonn]. Encrusting; ?corallite openings rimmed by numerous fine ?septal ridges, and separated by skeletal tissue with scattered mural pores; tabulae absent. Perm., Asia (Hatu Dame, Timor).

**Oculinella** Yakovlev, 1939, p. 631 [”O. gerthi; M; ? in coll. 6111, TsGM, Leningrad]. Differs from *Trachypsammia* in having calices more or less evenly spaced over whole surface of branch; calical edges sharp, slightly raised; septal elements not evident; ?coenenchyme with granulated and striated surface. L.Perms.(up.Artinsk.), Eu.(Donbas-Krasnoufimsk).

**Family AULOHELIIDAE** Sokolov, 1950

[Auloheliidae Sokolov, 1950a, p. 172]

Small coralla proximally encircling crinoid stems or encrusting other skeletons, distally with branches rising suberect from the ring; calices circular, margins may rise high above surface of corallum, each surrounded by its own tumid mass of sclerenchyme beyond edge of calice; increase basal. [See Hehenwarter, 1951, p. 80. Further investigation of type material needed to consider possibility of commensalism.] U.Perms.

**Aulohelia** Gerth, 1921, p. 119 [*A. irregularis; SD Lang, Smith, & Thomas, 1940, p. 24; t11809, TH, Delft; lectotype by Hehenwarter, 1951, p. 80]. Characters as for family. U.Perms., Asia (Timor).—Fig. 437,a,b. *A. irregularis*, Basleo; a, ext. view, ×1; b, another specimen, long. sec., ×4 (Gerth, 1921).

**Family ROMINGERIIDAE** Sokolov, 1950

[Romingeriidae Sokolov, 1950a, p. 172]

Corallum small, raised above substrate and variously fasciculate; corallites long, cylindrical, adult diameter uniform; offsets arise in regular verticils of up to 12, or as less symmetrical bundles, and may continue growing in close contact with parent and one another, or may diverge, simultaneously or consecutively; protocorallites vermiform, adherent; isolated mural pores may appear at points of initial contact between corallites and rarely between adult corallites; septal
Fig. 437. Auloheliidae (4); Romingeriidae (1, 2, 5); Palaeofavosiporidae (3) (p. F637-F641).
spinules present; tabulae ?absent or sparse and horizontal or oblique; increase lateral. ?L.Sil.-U.Sil.; M.Dev.; ?L.Miss.-U.Miss.

**Romingeria** NICOLSON, 1879, p. 114, nom. subst. pro **Quenstedtia** ROMINGER, 1876, p. 71, non **Quenstedtia** MORRIS & LYCETT, 1854, a Jurassic bivalve [*Aulopora umbellifera* BILLINGS, 1859b, p. 119; OD; syntypes 3402a-d, GSC, Ottawa]. Corallum shrublike, attached basally; increase lateral, offsets arising from parent in verticils of from 5 to 12, commonly 12; corallites long, cylindrical; mural pores may be present where corallites are contiguous; tabulae complete; septal spinules of variable development, up to 12 longitudinal rows [see BEECHER, 1903, p. 3]. ?L.Sil.(up.Llandov.), Eu.(Est.); M.sil., N.Am.(B.C.-Ind.-Ky.); M.Dev. (Onondag.), N.Am.(Ont.-Ohio-Mich.-N.Y.-Ky.)-?Australia(Queensl.).—Fig. 437,2a-c. *R. umbellifera* (BILLINGS), syntype, “Corniferous Ls.,” Ont., Port Colborne; a,b, ext. views, X1 (Billings, 1859b); c, another specimen, “Corniferous” drift, ext. view, X2 (Rominger, 1876).

**Ainia** LELESHUS, 1974a, p. 593 [*A. varians; OD; +69/25, coll. 1057, UpG, Dushanbe]. Corallum bushy; corallites commonly separated and cylindrical, in places in contact forming either chain or small cerioid segment; walls epithecate, moderately thick; mural pores developed between contiguous corallites; septal elements very weakly developed, fine spines; tabulae thin, complete or rarely incomplete, horizontal or oblique or concave or convex; increase lateral. U.Sil.(Ludlov.), Asia(Tadzhik.). —Fig. 438,1a,b. *A. varians*, holotype, Dalyan horizon, N. slope Turkestan-Gissar Ra., right bank R. Lyaylyak; a,b, transv., long. secs., X2.7 (Lele­shus, 1974a).

**Protopora** GREENE, 1904, p. 169 [*Romingeria cystoides* GRABAU in GREENE, 1901, p. 52; OD; syntypes 23634, 23635, AMNH, New York]. Corallum small, bushy; corallites elongate-conical; increase nonparricidal by verticils of three or more offsets that grow upward closely adherent to parent corallite for most of their length, connected by mural pores; septal spinules ?absent; tabulae unequal. U.Miss., N.Am.(Ind.).—Fig. 437,5. *P. cystoides* (GRABAU), syntype, St. Louis gr. (Warsaw div.), Ind.; ext. view, X? (Greene, 1901).

?**Remesia** KETTNER, 1934, p. 11, as **Remenia**, Eng. transl. KETTNER, 1937, p. 16 [*R. tubulosa*; OD; ?in Remes Coll., Charles Univ., Prague]. Corallum *recumbent, composed of sparse, slender cylindrical corallites, straight or irregularly bent and laterally giving off offsets of somewhat smaller diameter that quickly attain equal diameter; calices slightly raised; walls thick, of lamellate sclerenchyme with septal spinules, tabulae concave, ?may be incomplete. M.Dev.(Givet.), Eu.(Czech.); ?L. Carb., Asia(Szechuan).—Fig. 437,1a-j. *R. tubulosa*, Givet., Celechovice; a-h, fragments, X1 and enl.; i,j, oblique transv., long. secs., X4 (Kettner, 1937).

**?Family PALAEOFAVOSIPORIDAE**

Stasinska, 1976

[Palaeofavosiporidae Stasinska, 1976, p. 365]

Corallites cylindrical, thick-walled and
Fig. 439. Aulocystidae (p. F641-F643).
closely spaced, or thinner walled, contiguous and prismatic with mural pores adjacent to edges of prisms; protocorallite auloporoid; septal spinules short, tabulae not regular, convex, concave, complete or incomplete; offsets arise from wall of parent. [Possibly favositidan.] M.Sil.

Palaeofavosipora STASINSKA, 1976, p. 366, nom. subst. pro Favosipora STASINSKA, 1967, p. 100, non Favosipora MACGILLIVRAY, 1885, a bryozoan [*Fletcheria clausa LINDESTROM, 1866, p. 292; toriginal of figured specimen not identified; material figured LINDESTROM, 1896b, fig. 10-17b, Cn10863-10866, 22046, 55141-55143, RM, Stockholm]. Small; as seen in calice, tabulae show concentric structure with small convexity in center. M.Sil.(Wenlock'), Eu.(Gotl.-Swed.).—Fig. 437, 3a,b. ·P. clausa (LINDESTROM); a,b, ext. view, long. sec. showing mural pores and septal spinules, X4 (Lindstrom, 1896b).

Family AULOCYSTIDAE Sokolov, 1950

[Aulocystidae Sokolov, 1950a, p. 172]

Corallum commonly small, proximally prostrate, distally with branches rising free above substrate; increase lateral, without regularity; corallites of branches cylindrical or subcylindrical, commonly moderately short; without connecting tubuli; calices with infundibuliform or strongly concave floors; tabulae infundibuliform, peripheral tabellae form an axial syrinx that may be crossed by axial tabellae; septal spinulae may be present in wall and on tabellae. L.Sil.; L.Dev.-U.Penn.; U.Perm.

Aulocystis SCHLUTER, 1885b, p. 148 [*A. cornigera; M; syntypes, 215a, SCHLUTER Coll., IP, Bonn] [=Ceratopora GRABAU, 1899, p. 414 (type, C. jacksoni, OD; ?16840CU, fide STUMM, 1965, p. 82; ?New York; M.Dev., Hamilton Sh., Eighteen Mile Ck., Erie Co., N.Y.); ?Drymopora DAVIS, 1887, explanation to pl. 70, fig. 1-4 (type, D. jassicularis, SD BASSLER, 1915, p. 1252; ?8899, MCZ, Cambridge, lectotype by STUMM, 1965, p. 83; Dev., near Louisville, Ky.); Grabaulites SOKOLOV, 1962c, p. 246, nom. subst. pro Ceratopora GRABAU, 1899, p. 414, non Ceratopora HAGENOW, 1851, a bryozoan, nec HICKSON, 1911, a coelenterate; see LAUB, 1972, p. 364]. Corallum proximally prostrate, distally of free branches, each a series of commonly short, cylindrical or subcylindrical corallites each formed as a lateral offset through the wall near base of calice of the one below, commonly without regularity; tabulae infundibuliform, with a syrinx; wall moderately thick; septal spinules in wall and on tabulae; no connecting tubuli. L.Dev., Asia(NE.USSR); M. Dev., Eu.(Ger.)-Asia(Kuzbas)-N.Am.(Ohio-Ont.-
Mich.-N.Y.).—FIG. 439,1a,b,c. *A. cornigera*, syntype, up.M.Dev., Ger., Büchel, Bergisch Gladbach; a, ext. view, ×1.0; b,e, transv., long. fractioned surfaces, ×3.0 (Schlüter, 1889).—Fig. 439,1c,d,f,i. *A. jacksoni* (Grabau); c, holotype, M. Dev., Hamilton Sh., N.Y., Eighteen Mile Cr., N.Y., ext. view, ×1.0; d,f,i, paratype, M. Dev., Marcellus Ls., N.Y., Lancaster; d,f, long., transv. secs., ×5.0; f,i, ext. views, ×1.0 (Grabau, 1999).

Adaveraena KLAMANN, 1969, p. 88, nom. subst. pro Syringocystis KLAMANN, 1966, p. 72, non Syringocystis DENG, 1966, p. 44 [*Syringocystis adaverensis* KLAMANN, 1966, p. 72; +CO1795, coll. 94, EGM, Tallinn]. Corallum rising above substrate as irregular spreading bush; increase lateral, corallites joined only at points of origin of offsets, large, cylindrical, with deep, calice-, cup-, or barrel-shaped calices; wall a thick axial stereozone; septal spinules well developed, mainly in peripheral stereozone, but also on tabulae; tabulae funnel-shaped, or tabulae may form a discontinuous axial syrinx, crossed by sparse, convex tabellae. L.Sil. (up.Llandovery), Eul. (Est.).—Fig. 440,2a,b. *A. adaverensis* (KLAMANN), holotype, W. Est., Pyari; a,b, transv., long. secs., ×3.4 (KLAMANN, 1966).

Adetopora SOKOLOV, 1955, p. 223 [*A. humilis*; OD: +178, coll. 599, VNIGRI, Leningrad] [=Aulocystella KUZINA in SOKOLOV, 1955, which see]. Corallum small, low, compact fruticose; corallites cylindrical, thin-walled, without connecting tubuli; calices deep; tabulae infundibuliform, septal spinules poorly developed to absent; increase lateral, offsets issuing with nearly the full diameter of the parent, which then has limited growth. ?M. Dev. (Givet.), Asia (Kuzbas); U.Carb., Eu.(Urals)-?Asia (C.Asia-Sib.).—Fig. 440,3a,b. *A. humilis*, holotype, U.Carb., basin of R. Chusovoy, W. Urals; a,b, side and calical views, ×1.0 (SOKOLOV, 1955).

Aulocystella KUZINA in SOKOLOV, 1955, p. 222 [*A. syringoporoides*; OD: +not traced] [=Aulocystella KUZINA in SOKOLOV, 1950a, p. 172, nom. nud.; ?Adetopora SOKOLOV, 1955, which see]. Corallum a small cluster of moderately large, radiating and rather widely separated cylindrical corallites with slightly thickened walls; increase lateral; offsets, of same diameter as parent, project widely at first then rapidly become radial to corallum; no connecting tubuli; tabulae of two series, a peripheral series of tabulae forming wide syrinx with their conjoined inner parts and an axial series of narrow, subhorizontal tabellae crossing the syrinx; septal spinules inconstant, present on walls and tabellae. L.Carb. (Viscan), Eu.(Donbas-S. Urals)-Asia (China).—Fig. 440,1a-c. *A. syringoporoides*, Donsbas, right bank of R. Sklevata, below Veselogo farm, Beshesvki reg.; a,b, long., c, transv. secs., ×4.0 (SOKOLOV, 1955).

†Aulostegites LEJEUNE & PEL, 1973, p. 452 [*A. hillae*; OD: +T-H H 189/2, J. Pel Coll., PAU, Liège]. Corallum initially encrusting, of prostate contiguous moderately thin-walled corallites with upwardly directed calices; some corallites grow much taller than others; and at a higher lateral gradient increase by lateral increase to a new expansion of prostrate and contiguous corallites; several such periodic expansions and upgrowth may occur; mural pores sparse; tabulae thin, numerous, deeply concave to infundibular, in places incomplete; septal spinules absent to poorly developed. M. Dev. (Givet.). Eu.(Belg.-Czech.).—Fig. 441,1a,b. *A. hillae*, mid. Givet., Belg., prov. Luxembourg; a,b, transv., long. secs., ×2.7, ×3.7 (Lejeune & Pel, 1973).


Pachyphragma Watkins, 1959b, p. 801 [*Aulopora erecta* ROMINGER, 1876, p. 88; OD: +8560, UMM, Ann Arbor]. Corallum proximally erect and adherent, distally phaceloid, corallites relatively large, cylindrical and closely spaced to contiguous; mural pores and connecting tubuli absent; offsets develop by lateral increase mainly in proximal region; walls thick; tabulae few or numerous, complete or incomplete, arched or depressed; septal spinules variably developed. M. Dev. (Givet.), N.Am. (Mich.).—Fig. 440,6a-c. *P. erectum* (ROMINGER), holotype, Potter Farm F., Mich., Stony Pt., on shore of L. Huron, just S. of Alpena; a, calical view, ×1.0, b,c, transv., long. secs., ×4.0 (Watkins, 1959b).

Plexituba STAINBROOK, 1946, p. 424 [*P. contexta*; OD: +SU120942A (missing), UI, Iowa City]. Corallum erect and proximally adherent; increase lateral through base of calice; corallites crowded in irregular plexus or in chains that do not Anastomose; calices rising somewhat above substrate and not contracting; walls moderately thick, of concentric growth lamellae rarely enclosing septal spinules; dissepimentlike tabellae commonly line wall; no connecting tubuli or mural pores [see LAUB, 1972, p. 366]. M. Dev. (up.Givet.), N.Am.(Manit.); U.Dev. (Frasm.), N.Am.(Iowa).

—Fig. 440,5a-c. *P. contexta*, lectotype, U.Dev., Independence Sh., Iowa, Brandon; a, ext. view, ×1.0, b, transv. sec. showing edges of tabellae, ×5.0, c, transv. sec. showing wall, ×6.0 (Stainbrook, 1946).

increase lateral; without connecting tubuli; with septal spinules more or less in longitudinal rows; tabulae very thin, commonly infundibuliform or concave but also including irregularly disposed dissepimentlike plates; mural pores ?absent. *U. Perm. (Yabeina Z.), Asia (Japan).—Fig. 439,2a,b. *P. kotoi (Yabe & Hayasaka), Kinsyozan, Gifu Pref., Fuwa-gun; a,b, transv., long. secs., X4 (Yabe & Sugiyama, 1941).

?Family SINOPORIDAE Sokolov, 1955
[Sinoporidae Sokolov, 1955, p. 225]

Corallum small, shrublike, with lateral increase moderately common throughout corallum; corallites cylindrical, with thick, peripheral, lamellate stereozone sheathed with transversely wrinkled epitheca; con-
Coelenterata—Tabulata


Corallum small, fruticose; corallites cylindrical, slender, elongate and curved; calices with sharp edges; increase lateral, moderately common throughout corallum; offsets diverging in different directions, diameter of offset at origin almost equal to that of parent; no connecting tubuli; wall an epithecate, lamellate stereozone; tabulae sparse to absent; septal spines absent or weakly developed. [Proximal parts not known.] *L.Sil.* (Llandovery), Eu.(Est.); *U.Carb.* (Medoc); L. Perm. (Wolfcamp-Leonard), N. Am. (Alaska); *Perm.* (W. Serbia)-Asia (China-Japan-Malaya-Iran).—*Fig. 442.1a,b.* *S. dendroides* (You): *a*, holotype, *L.Perm.*, Chihsia *L.*, China, Chi-lung-shan, near Ho-chou, SE. Anhui; ext. view, X 1.0; *b*, paratype, Chihsia *L.*, China, Chuan-shan, Chu-yung-hsien, Kiangsu, thin sec., X 2.7 (You & Huang, 1932).

Rossopora Sokolov, 1955, p. 225 [*R. alta*; OD; syntype 83, coll. 599, VNIK, Leningrad; *≠* Cladoc honus altus Ivanov, in coll., nom. inval.].

Corallum small, shrublike, of several corallites, or partly of contiguous and prismatic corallites, connected by tubuli arranged irregularly or in longitudinal rows, or by horizontal laminar processes with which the tubuli may merge; walls thin to greatly thickened; tabulae infundibuliform, with or without axial syrinx, or concave or horizontal and complete or incomplete; septal spines more or less well developed; increase lateral; offsets may arise also from connecting tubuli. *M. Ord.-Perm.*

For most of the genera in this superfamily, we lack descriptions of the proximal parts of the corallum. Indications are that the families Syringoporidae, Tetraporellidae, and Multithecoporidae may be distinguished by a proximal layer of prostrate corallites from which upright, cylindrical corallites arise. Members of the families Roemeridae and Thecostegitidae, on the other hand, appear to be proximally cerioid. The prox-
imal parts of the Gorskyitidae and Chonostegitidae are not known.

The microstructure of the corallite wall appears to be the same in all the genera herein placed in this superfamily; it may be studied with least difficulty in the thick-walled genera. Inside the epitheca, which is transversely rugose in many, the wall consists primarily of fibers of CaCO$_3$ perpendicular or almost so to the epitheca, and includes septal spinules in longitudinal and radial rows; spinules may project into the tabularium and may also be developed on tabulae; in diagenesis the fibrous nature may be obscured, and additionally, secondary lamellae may result, in which the septal spinules appear as holacanths.

**Family SYRINGOPORIDAE**

*de Fromentel, 1861*


Corallum fasciculate, of cylindrical moderately thick-walled corallites connected by horizontal tubuli or platforms; tabulae commonly infundibuliform or forming axial tube (syrinx) or ?columella; may be supplemented by peripheral tabellae; septa represented by longitudinal rows of spinules, or may be sparse to absent. *U.Ord.-L.Perm.*

**Syringopora** Goldfuss, 1826, p. 75 [*S. ramulosa; SD Milne-Edwards & Haime, 1850, p. lxii; 251, Goldfuss Coll., IP, Bonn] [*Harmodites Fischer von Waldheim, 1828, p. 19 (type, *H. distans* Eichwald in Fischer von Waldheim, fide Lang, Smith, & Thomas, 1940, p. 65; f’in Eichwald Coll., LGU, Leningrad; L.Carb., Archangelskiy on R. Moskva); Caunopora Phillips, 1841, p. 18 (type, *C. placenta*, M, for a commensal relationship between a species of Syringopora and a species of Stromatopora, Lang, Smith, & Thomas, 1940, p. 33, selected the species of Syringopora as type; fnot traced; M.Dev., Torquay and Plymouth, U.K.); ?Syringoalcyon Termier & Termier, 1945, which see; ?Praesyringopora Ivanov in Ivanov & Myagkova, 1950, p. 16 (type, *P. prima*, OD; 128, coll. M-2, SGI, Sverdlovsk; Mme. Yanet in letter 26 July 1974 advises that holotype is very badly preserved and may be Syringopora, and that it comes from post-Ludlovian deposits, R. Boltun,
Fig. 443. Syringoporidae (p. F645-F647).
Tabulata—Auloporida F647

Tabulata-Auloporida F647 tributary of R. Serebryanay, C. Urals). Coralium fasciculate; corallites cylindrical, moderately thick-walled, connected by tubuli without regularity of orientation; septa represented by longitudinal rows of spines or ?absent; tabulae infundibuliform, forming axial syrinx in many corallites; increase lateral or from connecting tubuli. U.Ord., Eu. (Urals); L.Sil.—?U.Carb., cosmop.; ?L.Perm. (Wolfcamp.), N.Am. (Yukon).—Fig. 443,1a-c. *S. ramulosa; a, syntype, L.Carb., Ger., Ohle, ext. view, X1 (Goldfuss, 1826); b,c, another specimen, L.Carb., Moscow Basin, long., transv. secs., X4 (Sokolov, 1935).—Fig. 443,Id.e. S. blanda KLAAMANN, Skal., left bank R. Dnestra, quarry between Dzingorod and Volkovtsy; d,e, long., transv. secs., X4 (Chudinova, 1971b).

?Cannapora HALL, 1852a, p. 43 [*C. junciformis; M; 1473 (3 syntypes), AMNH, New York] [=Cannipora LANG, SMITH, & THOMAS, 1940, p. 31, nom. van.]. Fasciculate, with slender, closely set cylindrical corallites connected at intervals by annulate, sharp-edged ridges on the same levels throughout the corallum, forming platforms; septa spiniform, in up to 12 longitudinal rows; tabulae horizontal; the upright corallites spring from an encrusting basal expansion of prostrate corallites as in Syringopora. [From photographs of syntypes supplied by Dr. W. A. OLIVER, the horizontal ridges may enclose connecting canals and offsets may arise from them; genus may be better placed in Tetraporellidae. See LAMBE, 1899-1901, p. 63.] L.Sil., N.Am. (Ont.-N.Y.).—Fig. 444,1. *C. junciformis, syntype, Clinton Gr., Ont. or N.Y., ext. view, X0.6? (Hill, n; photographs courtesy W. A. Oliver, AMNH1473).

Chia LIN, 1958, p. 483 [*Syringopora tuaeensis CHERNSHEV, 1937, p. 16; ?OD; +10, coll. 11174, T3GM, Leningrad] [=Syringocystis DENG, 1966, p. 44 (53) (type, S. tabulata, OD; +18056-18057, IGP, Nanking; M.Dev., Heitai, China), non Syringocystis KLAAMANN, 1966, p. 72, an auloporid; Syringella NOWINSKI, 1970, p. 540 (type, S. polonica, OD; +Z.Pal.T/V, PZI, Warsaw; Dev., ?Frasn., Pol.).] Corallum fasciculate; corallites sparsely and irregularly connected by tubuli; walls moderately thick; a series of small, discoherentlike plates applied to inner side of wall; tabulae in axial parts of corallites infundibuliform and with distinct axial syrinx with or without transverse tabellae; septal spines may be present; increase lateral. U.Sil., Asia (Tuva); M.Dev., Asia (China); U.Dev. (?Frasn.), Eu. (Pol.); L.Carb., Eu. (Donbas)-Asia (China).—Fig. 445,2a,b. *C. tuaeensis (CHERNSHEV), holotype, U.Sil., Tuva, Elegest R.; a,b, transv., long. secs., X4 (Chudinova, 1937).

Enigmatis CHUDNOVA, 1975a, p. 17 [*E. lectus; OD; +3494/3, PIN, Moscow]. Fasciculate; corallites cylindrical, at base of colony radially arranged, later growth parallel; corallites when separated connected by tubules, when in contact, by mural pores; walls thick; tabulae thin, coarsely cystose, approaching a funnel shape, their proximal edges resting on the one below; with wide, free axial canal in places crossed by horizontal tabellae; septal spines well developed; increase lateral, rarely interstitial from connecting tubuli. U.Carb.—L.Perm. (Sakmar.), Eu.(C.Urals).—Fig. 443,2a,b. *E. lectus, holotype, L.Perm., Up. Tastuba subhorizon, C. Urals, right bank of R. Kosva, W. slopes; a,b, transv., long. secs., X5 (Chudinova, 1975a).

Kueichowpora CHI, 1933, p. 22 [*K. tushanensis; OD; +3138-3140, IGP, Nanking]. Corallum fasciculate, slender; cylindrical corallites commonly bifurcating due to lateral ?(or peripheral) increase; with very rare connecting tubuli; tabellae arranged in a peripheral ring, surrounding an axial tubular space ?(empty or with sparse tabulae); traces of septal ridges or spines absent from type. L.Carb., Asia (China-Transcauc.-?Japan-?Taymyr-?Anato-
Fig. 445. Syringoporidae (p. F647-F649).
Tabulata—Auloporida

K. tushanensis, holotype, Fengnin, Kueichou, Lanchai, Tushanhsien; long. sec., X3 (Chi, 1933).


Pleurosiphonella Chudinova, 1970, p. 105 [*P. crustosa; OD: +369, coll. 2182, PIN, Moscow].

Corallum fasciculate; corallites cylindrical, weakly curving, commonly rather closely spaced; connecting tubuli rare and without orderly arrangement; walls thick, covered with concentrically wrinkled epithea; tabulae deeply infundibuliform, with laterally placed syrinx crossed by rare diaphrags; septal spines seldom seen, increase lateral [see also Nelson, 1977, p. 557]. L.Carb. (Tournais.), Asia M. (Transcauc.)—Australia (New S. Wales)—N. Am. (Alberta-Ida.-Va.-Yukon).—Fig. 444,2a,b. *P. crustosa, Armashkky horizon; a, M. Sari-Pap, long. sec., X6.3; b, holotype, W. part of Urts Ra., transv. sec., X6.3 (Chudinova, 1970).

Syringoalcyon Termier & Termier, 1945, p. 71 [*S. maroccana; M, fin Termier Coll., Paris] [± S. maroccana Goldfuss, 1826, which see].

Like Syringopora but with epithecal scales [see also Termier & Termier, 1975, p. 85]. L.Carb. (Visean), N.Afr. (Moroc.).—Fig. 446,1a—c. *S. maroccana, syntype, Dchar Ait Abdallah; a, long. sec. to show epithecal scales, X6; b, transv. sec., X6; c, long. sec. showing wall, septal spines, and tabulae, X6 (Hill, n; UQF69382).

Syringoalcyon Stumm, 1969, p. 244 [*Syringopora infundibula Whitfield, 1878, p. 79; OD: +34350, MPUC, Berkeley].

Corallum fasciculate with lateral increase; no connecting tubuli known; walls thin; tabulae infundibuliform, “coalescent in groups to form intermittent columnella”; septal spines not observed; one specimen. M.Sil., N. Am. (Wis.).—Fig. 444,3a,b. *S. infundibula (Whitfield), monotype, Niag., Racine dol., Wis., Howley’s Quarry, Milwaukee; a,b, transv., long. secs., X1.9 (Stumm, 1969).

Syringoalcyon Rukhin, 1937, p. 71 [*Syringopora (S.) jerganica; OD: fin LGU, Leningrad].

Corallum fasciculate; slender cylindrical corallites closely and regularly arranged, connected by closely spaced tubules arranged in four mutually perpendicular longitudinal rows in each corallite, and commonly at the same levels in neighboring corallites; tabellae numerous, syrinx seldom noted. (Possibly tetraporellid.) U.Sil., Asia (Turkestan Ra.).—Fig. 445,1a—b. *S. jerganica; R. Sarkent, near depression Ak-su; a,b, transv., long. secs., X2, X7 (Rukhin, 1937).
Corallum with cerioid base from which rise blades of varying thickness, each composed of cerioid axial parts surrounded by fasciculate peripheral parts; corallites thick-walled and without septa; mural pores rare, in cerioid parts; connecting tubuli rare, short, in fasciculate parts; tabulae unequally distributed, straight, oblique, or concave or convex. M.Dev.


**Family TETRAPORELLIDAE** Sokolov, 1950

[ *Tetraporellidae Sokolov, 1950, p. 169]

Corallum of syringoporoid type but formed of prismatic or rounded prismatic corallites, commonly four or six-sided, or subcylindrical; walls thin, or in younger genera slightly thickened; connecting tubuli arranged in longitudinal rows, or in one genus randomly; in prismatic corallites commonly projecting from edges of prism faces; tabulae horizontal, or incomplete, oblique and curved; in younger genera there may be a cylinder of dissepimentlike tabellae around the periphery; infundibuliform tabulae rarely observed; septal spines present or absent. M.Ord.-M.Dev.; L.Carb.; L. Perm.-U.Perm.


**Hayasakaia** LANG, SMITH, & THOMAS, 1940, p. 65, nom. subst. pro *Tetrapora YABE & HAYASAKA*, 1915, p. 87, non *Tetrapora QUENSTEDT*, 1857, a bryozoan [*Tetrapora elegansula* YABE & HAYASAKA; OD; figured synotype 6254, TohU, Sendai (missing)]. Corallum fasciculate with slender corallites of rounded-polygonal section, connected by horizontal tubuli arranged more or less regularly in four longitudinal rows, diagonally placed; septal spines poorly developed to absent; tabulae in two series, axial tabellae subhorizontal or incomplete, and peripheral tabellae in single and in places discontinuous series of small dissepimentlike plates. L.Perm., Asia(China)-Eu. (Spits.); U.Perm., Asia(N.Viet Nam) .—Fig. 448,3a,b. *H. elegansula* (YABE & HAYASAKA), L. Perm., Chihisia Ls., Kweichow, Synan; a,b, transv., long. secs., ×4 (Lin, 1962a).

**Pseudoroemeria** CHEKHOVICH, 1960, p. 43 [*P. atbashiensis*; OD ;+122, coll. 9207, TsGM, Lenin­grad]. Corallum in places fasciculate, of slender corallites with tabularia in communication through connecting tubuli, in places cerioid, with numerous fine mural pores, walls thin; septa represented...
by spinules; tabulae thin, horizontal, oblique or rarely weakly concave, never with axial tube [see Hill & Jell, 1970a, p. 184]. L.Dev. (Gedinn.), Asia (Tien Shan).—Fig. 449, 1a,b. *P. atbashiensis*, holotype, ?Gedinn., Tien Shan, R. Sherikty, Atbashinskiy Ra.; a,b, transv., long. secs., X4 (Chekhovich, 1960).

*Spiroclados* Dubatolov in Avrov & Dubatolov, 1969, p. 25 [*S. avrovi*; OD; t20, coll. 359, IGG, Novosibirsk]. Corallum fasciculate; corallites slen-
Fig. 449. Tetraporellidae (p. F650-F653).
der, tubular, spirally or irregular curved, with transverse tubuli connecting tabularia of neighboring corallites; walls thin; septal spines present; tabulae horizontal, inclined or slightly curved. L.Dev. or M.Dev. (basal Couvin), Asia (S.Altau).

--- Fig. 450, 2a, b. *S. avrovi*, holotype, middle part of Sarymsaktin suite, 450 m. above mouth of R. Okoleekha; a, b, transv., long. secs., X4 (Dubatolov in Ivanovskiy, 1969).

**Syringoporus** Sokolov, 1955, p. 524 [*Syringoporella irregularis* Chernyshev, 1941a, p. 34; OD; t46, coll. 5958, TsGM, Leningrad] [≡*Syringoporus* Sokolov, 1947c, p. 20 and 1950a, p. 169, nom. nud.; 1952, p. 131, nom. inval., no type species named, but *Syringoporella irregularis* referred “most probably” to it]. Corallum fasciculate, corallites cylindrical, close, relatively thin-walled with randomly arranged connecting tubuli; offsets numerous by lateral increase, diverging widely before becoming parallel; tabulae thin, horizontal, complete. *L.Sil.*, Asia (Sev.Zemlya-Sib. Platf.-Kazakh.); *M.Sil.(low.Wenlock.)*, Asia (Tadzhik.).--- Fig. 448, 2a, b. *S. irregularis* (Chernyshev), holotype, Llandov., Severnaya Zemlya, Domashini I.; a, b, transv., long. secs., X4 (Sokolov, 1955, after Chernyshev, 1941a).

**Tetraporinus** Sokolov, 1947c, p. 24 [*T. singularis*; t131b, Coll. A. I. Guseva, location not traced]. Corallum with radiating to parallel subcylindrical to prismatic corallites, slender and four-sided, connected by four mutually perpendicular rows of tubuli; tabulae numerous, commonly incomplete and obliquely inclined to the axis or, rarely, infundibuliform; septal spines weakly developed to absent. *U.Sil.*, Eu. (N. Urals-Vaygach I.-Asia (Tien Shan); *L.Carb.*, Asia (Taymyr-N. Zemlya-N. Viet Nam-Laos-China)-Eu. (Donbas); *L.Perm.(Chihs.)*, Asia (China-Anatolia).--- Fig. 450, 1a, b. *T. singularis*, L. Carb., Taymyr, R. Kharulakh-bigay; a, b, transv., long. secs., X4 (Sokolov, 1955).

**Troedssonites** Sokolov, 1947a, p. 469 [*"Syringopora" conspirata* Troedsson, 1928, p. 134; tH3036 (?) and H3037, =441, 442 in Koch Coll., MM, Copenhagen]. Corallum hemispherical; corallites moderately thick-walled, cylindrical and closely spaced or connected by one to three or, in places, four longitudinal rows of short connecting tubuli, or contiguous in short ranks; tabulae horizontal, commonly complete; septal ridges and spines weakly developed or absent [see Bolton, 1965, p. 24]. *U.Ord.*, N. Am. (Greenl.-Ellesmere I.-Asia (NE. Sib.-SW. China); *?Sil.*, Asia (SW. China).--- Fig. 449, 2a, b. *T. conspiratus* (Troedsson), U. Ord., Cape Calhoun F., N. Greenl.; a, b, transv. secs., X4 (Troedsson, 1928).

**Family MULTITHECOPORIDAE**

Sokolov, 1950

[Allithecoporidae Sokolov, 1950a, p. 169]

Corallum fasciculate; increase lateral, off-
sets commonly slender and horizontal initially; corallites cylindrical, connecting tubuli commonly sparse; walls very thick; septal spines weakly developed, in some in multiples of six; tabulae thin, horizontal or curved. L.Sil.-M.Sil.; L.Dev.-?U. Dev.-U.Per.

**Multithecopora** Yoh, 1927, p. 291 [*M. penchiensis*; OD; †not traced] [†=*Sinopora* Sokolov, 1955, p. 225 (type, *Monilopora dendroides* Yoh in Yoh & Huang, 1932, p. 10, OD; †3928, 3947, IGP, Nanking; L.Per., Chihsia LS., Chi-lung-shan, near Ho-chou, Anhui; see Oekendorf & Kaever, 1970, p. 284)]. Corallum phaceloid to bushy; increase lateral; corallites cylindrical; walls very thick, so that lumen may be only one-third to one-fifth diameter of corallite; connecting tubuli rare; septal spines weakly developed; tabulae thin, horizontal or curved. L.Sil.(Llandovery), Eu.(Nor.); L.Carb., Australia(Queensl.-New S.Wales); U. Carb.(L.Penn.), N.Am.(Yukon-Texas-Nev.); ?U. Carb., Asia(Viet Nam); L.Carb.-U.Carb., Eu. (Donbas-Moscow Basin-Urals-Timan)-Asia(China-C.Asia-Taymyr); ?U.Carb. or L.Perm., Eu.(Spits.). Perm., Asia(China-Japan-Iran-Afghan.)-Eu.(Yugo-Urals)-N.Am.(Yukon).——Fig. 451,1a-c. *M. penchiensis*, holotype, M.Carb., Penchi LS., China, Feng-tien Prov.; a,b, transv., long. secs., X12.5; c, ext. view, X1.7 (Yoh, 1927).

**Cylindrostylus** Sokolov, 1955, p. 225, nom. subst. pro Edwardsiella Rukhin, 1937, p. 64, non Edwardsiella Andres, 1883, a coelenterate [*E. turkmensaica* Rukhin, OD; †?, LGU, Leningrad]. Fasciculate; slenderly cylindrical corallites, closely spaced and commonly contiguous, without connecting tubuli or mural pores; walls very thick, sclerenchyme layered, pierced by longitudinal rows of septal spinules; tabulae complete, sparse, characteristically oblique. M.Sil.(?Wenlock.), Asia (Turkestan Ra.-Zeravshan-Gissar Ra.).——Fig. 452,3a,b. *C. turkmensaicus* (Rukhin), Turkestan Ra., valley of R. Turkmen-Saya; a,b, transv., long. secs., X2 (Rukhin, 1937).

**?Neomultithecopora** Lin, 1963a, p. 593 [*N. syringoporoides*; OD; †sample N zhuan-58-gu-162, location not traced]. Corallum branching, not large; increase lateral; corallites regularly cylindrical, with rare connecting tubuli; epitheca transversely wrinkled; walls thick; tabulae complete, concave or in places infundibuliform, with or without axial syrinx; septal spines in multiples of six in longitudinal rows. [Possibly would be better placed in Roemeriidae, but is not known to be cerioid proximally. See Kachanov, 1967, p. 25.] L.Carb.(Visean), Asia(S.China); Carb.(Visean-Namur.), Eu.(N.Zemlya-Urals).——Fig. 452,2a,b. *N. syringoporoides*, holotype, China, Duan distr., Guangxi Prov.; a,b, transv. secs., X4 (Lin, 1963a).

**Syringoporella** Kettner, 1934, p. 1 [*Syringopora moravica* Roemer, 1883, p. 495; OD; †not traced, ?in Roemer Coll., Univ. Wroclaw (formerly Breslau); Kettner's other figured specimens in Remes Coll., Charles Univ., Prague]. Corallum small; corallites cylindrical, slender, close, thick-
walled, with connecting tubuli; calices narrow, deep, with flat base and commonly with obtuse edges; septal spines absent or poorly developed; tabulae sparse, horizontal; offsets arise by basal lateral increase. *L.Dev., Asia (R.Kolyma); *M.Dev. (*Givet.), Eu. (Czech.-E.Russ.Platf.)-Asia (?Kuzbas); ?U.Dev. (*Frasn.), N.Am. (Alberta); ?Miss., N.Am. (Ind.). —Fig. 452,1a,b. *S. moravica (ROEMER), holotype, Givet., Moravia, Slatinky; a,b, transv., long. secs., ×4 (Kettner, 1937).
Family ROEMERIIDAE Počta, 1904

Encrusting, discoid or branching; corallites adpressed and prismatic with mural pores or canals, but more or less divergent peripherally, where external transverse wrinklings in the thickened walls outline tunnel-like spaces into which wall pores open, so that communication between neighboring corallites is retained; wall microstructure syringoporoid—primarily of 'fibers' of CaCO$_3$ normal to the epitheca, and including septal spinules in longitudinal and radial rows; the spinules may project into the tabularium and may also be developed on tabulae; in diagenesis the fibrous nature may be obscured, and, additionally, secondary lamellation may result, in which the septal spinules appear as holacanths; tabulae thin, horizontal or concave or infundibuliform, with the notches in places elongated proximally to form a syrinx, which may divert from the axis to a mural pore so
that communication is obtained between the tubes of some neighboring corallites. ?L.Sil.; L.Dev.-M.Dev.; L.Carb.; L.Perm.

**Roemeria** Milne-Edwards & Haime, 1851, p. 152, 253 [*Calamopora infundibuliformis* Gol'Dfuss, 1829, p. 78; +258b, Gol'Dfuss Coll., Bonn; lectotype by Chernyshev, 1951, p. 69]. Cerioid coralla with small, prismatic corallites of which some may cease to join tightly at the angles so that the corners are rounded and small spaces are developed; walls somewhat thickened, with sporadic mural pores; septal spines very sparse and slender; tabulae simple, infundibuliform, a slender axial or eccentric syrinx being formed by the proximally produced parts of the funnels [see Jell & Hill, 1970c, p.
Coelenterata—Tabulata

159. M.Dev., Eu.(Ger.)-?Asia(Altay-Sayan).—Fig. 453,1a-c. *R. infundibuliformis* (GOLDFUSS), lectotype, Eifel., Ger.; a,c, transv. secs., X20, X4; b, long. sec., X4 (Jell & Hill, 1970c).

Armalites CHUDINova, 1964, p. 63 [*A. novellus*; OD: t12586, coll. 1396, PIN, Moscow] (=Armalites CHUDINova in DUBATOLOV, 1963, p. 62, nom. nud., type species named but not described, figured, or diagnosed). Dendroid to subcerioid, corallites with peripheral stereozone transversely wrinkled externally; septal spines long, holocanthine, immersed in lamellar sclerenchyme of stereozone in numerous radial longitudinal series and on the tabulae; tabulae thin, infundibuliform with discontinuous syrinx; pore-canals developed when corallites are contiguous, connecting tubules otherwise [see HILL & JELL, 1970a, p. 183]. L.Dev.(Ems.)-M.Dev.(Eifel.).—Fig. 453.2a-c. *A. novellus*, holotype, up. Eifel., Kuzbas, R. Ur; a-c, transv., long. secs., X4 (Chudinova, 1964).

Bayhaium LANGENHEIM & McCUTCHEON, 1959, p. 99 [*B. merriamorum*; OD: t37683, MPUC, Berkeley]. Corallum massively branching; in axial parts of branch, corallites prismatic and thin-walled; in peripheral parts walls thicken and in places corallites may diverge slightly and become cylindrical; wall wrinkled transversely exteriorly to form tunnel-like intercorallite connections into which mural pores open; axial edges of septa project from wall as low ridges; tabulae thin, infundibuliform, somewhat irregular, seldom produced proximally into short axial tubes, grouped in relation to mural pores. L Perm.(Wolfcamp.), N.Am.(Cal.-Nev.).—Fig. 454.2a,b. *B. merriamorum*, holotype, McCloud Ls., Cal., Shasta Co.; a,b, transv., long. secs., X1.8 (Langenheim & McCutcheon, 1959).

Pseudoroemeripora KOKSHARKAYA, 1965a, p. 88 [*P. lenaica*; OD: t07V, coll. 205/17, IG, Yakutsk]. Corallum small, turflike; corallites thick-walled, contiguous and prismatic or somewhat divergent and rounded; mural (and corner) pores in prismatic corallites) rounded, connecting tubules (between divergent corallites) short; tabulae favoritoid (subhorizontal) or syringoporoid (infundibuliform), in places grouped in relation to the pores; septa laminar peripherally, giving off spines axially; increase intercalary and peripheral [HILL & JELL, 1970a, p. 183]. L.Carb., Asia(NE. USSR).—Fig. 454.1a,b. *P. lenaica*, holotype, C. Krestyakh, northern Kharaaulakh, mouth of R. Lena; a,b, transv., long. secs., X4.0 (Koksharkaya, 1965a).

Roemeripora KRAICZ, 1934, p. 45 [*Roemeria bohemia* BARRAND in POCTA, 1902, p. 262; OD: t21, with thin sec. t21, with thin sec. PV2 in Pocta Coll., NM, Prague; lectotype by GALLE, 1974 MS] (=Vaughanites PAUL, 1937, p. 110 (type, Syringopora favorisitodes VAUGHAN, 1915, p. 34, OD: t111401, SM, Cambridge; L.Carb., base of g (sublactis level), Avesnes area, France), non Vaughanites WOODRING, 1928, a Miocene gastropod; ?Roemerolitcs DUBATOLOV, 1963, which see]. Corallum cerioid; corallites prismatic or, when slightly divergent, cylindrical; peripheral stereozone transversely wrinkled externally where corallites are not tightly adpressed; septal spines holocanthine, arranged in lamellar sclerenchyme of stereozone in numerous radial longitudinal rows and on tabulae; tabulae thin, complete, or more commonly incomplete, horizontal, concave or infundibuliform, and grouped in relation to pore-canals (or to connecting tubules that lie on the external wrinklings of the wall); offsets arise from openings of pore-canals [HILL & JELL, 1970a, p. 176]. L.Dev., Eu.(Czech.)-Asia(Kuzbas)-Australia(Vict.-New.S.Wales)-N.Z.; M.Dev. (?low.Couvin.), Australia(Queensl.); M.Dev.(Givet.), Asia(Kuzbas); ?L.Carb., Eu.(Urals-N.Zemlya-Donbas)-Asia(Kuzbas).—Fig. 455.1a,b. *R. bohemia*, Prag., up. Konoprus Ls., Czech., Konoprusy; a, b, lectotype, transv. sec., both X2 (Hill & Jell, 1970a).

Roemerolitcs DUBATOLOV, 1963, p. 58 [*R. batschatensis*; OD: t154, coll. 72, IGG, Novosibirsk] (=Roemeripora KRACZ, 1934, which see, see HILL & JELL, 1970a, p. 183; ?Eorchoemercipora YANG in YANG, KIM, & CHOW, 1978, p. 181 (type, E. syringoporoids, OD: tGct 333, 334, GB, Guiyang; L.Sil., Shintulan F., Fenggang, Guizhou [Kweichow]).] Corallum dendroid, but slender corallites contiguous and partly prismatic in early stage and in patches later; corallites with peripheral stereozone in which septal spines are developed; tabulae very thin, irregularly infundibuliform or concave; axial tubes of neighboring corallites may be continuous through pore-canals or connecting rounded tubes; offsets arise through openings of the pore-canals. ?L.Sil., Asia(Kweichow); M.Dev. (?Eifel.), Asia(Kuzbas).—Fig. 455.2a-c. *R. batschatensis*, holotype, ?Eifel. or tEm., Salairka Beds, Kuzbas, left bank of R. Chernevoy Bachat., near Gurievsk; a-c, thin secs., X4, X4, X10 (Dubatolov, 1963).

Family THECOSTEGITIDAE

de Fromentel, 1861

[nom. correct. Sokolov, 1950a, p. 170, pro Thecostegini de Fromentel, 1861, p. 277] (=Neoeroemericidae RADUGIN, 1938, p. 84)

Encrusting, subhemispherical or ramose; corallites slender, in early parts of colony or axial parts of branch may be adpressed and prismatic, communicating by mural
Fig. 455. Romeriidae (p. F658).
pores; in later parts the corallites diverge but remain subparallel, and are united by irregular tubular or platform-like tabulate expansions through perforations in the wall; these expansions may be contiguous vertically one with another or separated by spaces in which the corallites are not united. Wall microstructure of fibers normal to the epitheca; septal spinules variably developed; tabulae thin, complete or incomplete, horizontal, concave or in places infundibuliform with the median notch drawn down into a short syrinx, which may be continuous with a similar but horizontal tube in the intercorallite expansions; the axial tubes may be crossed by small tabellae; tabellae may be grouped in relation to mural pores. U.Sil.-U.Carb.

Thecostegites Milne-Edwards & Haime, 1849b, p. 261 [*Harmodites bouchardi* Michelin, 1846, p. 185; M; 1Z153 bis b, MN, Paris; lectotype by Lecompte, 1939, p. 171]. Corallum massive and encrusting; corallites slender, cylindrical, thick-walled, united by successive irregular platform-like expansions of tabulate tissue, each expansion in communication with the tabularia through perforations arranged in verticils in the walls of the corallites; the expansions may be epithecate above and below; septal spinules irregular in development; tabulae in lateral expansions as well as in the cylindrical corallites, irregular, horizontal, oblique, concave, or with short axial tubes, which may be extended into the lateral expansions where they lie horizontally, and may be crossed by small tabellae. U.Sil. (?Pridol.) or L.Dev. (Gedinn.), Eu. (Polar Urals); L. Dev. (Gedinn.-up. Isfarian), Asia (Tien Shan)-Australia (Tasm.); M.Dev. or U.Dev., N. Am. (Alaska); M.Dev.-U.Dev., Eu.-Asia; L.Carb. (Tournais.), Asia (Kuzbas).—Fig. 457, 2. *T. bouchardi* (Michelin), Frasn., Belg., Couvin, thin sec., X5 (Lecompte, 1939).

Duncanopora Sando, 1975, p. C25 [*D. duncanae*; OD; ?165184, USNM, Washington]. Alternately phaceloid and cerioid; cylindrical corallites periodically expand to contiguity with neighbors, or are periodically connected by tubuli or by encircling sclerenchyme perforated by tunnels connecting adjacent lumina; increase lateral; septal spines rare, tabulae sparse, commonly complete and horizontal or slightly sagging. U.Carb. (?low. Namur.), N. Am. (Wyo.-Idaho-Utah).—Fig. 458, 1a,b. *D. duncanae*, holotype, Wyo., Moffat Trail Ls. Mbr.; a,b, transv., long. secs., X1.9 (Sando, 1975).

Groseussia Termier & Termier in Groeszsen, Termier, & Termier, 1975, p. 6 [*G. ambigua*; OD; 2 syntypes, cat. nos. not stated, one in Serv. Geol. Belg., other in Lab. Paleont. Louvain-la-Neuve]. Cylindrical tabularia of the corallum with horizontal tabulae and radial longitudinal rows of septal spines projecting adaxially from their porous walls; tabularia connected by transverse platforms and tubuli; connecting platforms may bear spines in radial rows continuous with rows in tabularia. L.Carb. (Tournais.), Eu. (Belg.).

Neoroemeria Radugin, 1938, p. 83 [*N. westibirica*; OD; ?73, ?Tomsk Industrial Univ.]. Corallum massively branching, rarely platelike or encrusting; in axial zone of branch corallites prismatic and adpressed, communicating by mural pores; in peripheral parts of branch corallites diverge and become cylindrical, but neighboring tabularia are in communication through irregular expansions of tubules extending from perforations in the wall, the expansions containing tabulae; septal spines present, tabulae concave, convex, irregularly curving and becoming incomplete, forming in places a very short axial tube; the tabulae may be grouped in relation to the pores [see Hill & Jell, 1970a, p. 185]. M.Dev. (Givet.), Asia (Kuzbas).—Fig. 457, 1a-d. N. gibbosa Chudinova, Kuzbas, R. Mozalovskyi Kitat; a-c, paratype, oblique, sec. of branch, part of long. sec., transv. sec. all X1; d, holotype, part of long. sec., X4 (a-c, Hill, n, photographs courtesy M. Chudinova, Akad. Nauk SSSR 1396/280; d, Chudinova, 1964).

Ortholites Chudinova, 1975b, p. 34 [*O. nexus*;
OD: 13460/1, PIN, Moscow]. Cylindrical or rounded prismatic corallites connected by short, very closely spaced platforms and here and there by connecting tubuli; tabulae thin, infundibuliform, with interrupted axial canals; septal spines well-developed to absent; increase lateral from corallite wall or coenenchymal from connecting platform or tubule. L.Carb.(Tournais.), Asia (Kazakh.).—Fig. 458.3a,b. *O. nexus*, holotype, Tournais., Simorinsky horizon, C. Kazakh., R. Karasu; a,b, transv., long. secs., X3.8 (Chudinova, 1975b).

?Verolites Chudinova, 1975b, p. 35 ["V. rarus; OD: 13460/2, PIN, Moscow]. Corallites cylindrical, cylindroprismatic, thin-walled, connected by numerous short tubules, by sparse connecting platforms, and where corallites are in contact, here and there by mural pores; tabulae thin, infundibuliform, incomplete, or closely spaced, numerous dissepimental plates; septal spines well-developed to absent; increase lateral from corallite walls or coenenchymal from connecting elements.
**Family CHONOSTEGITIDAE**

*Lecompte, 1952*

[Chonostegitidae Lecompte, 1952, p. 521]

Corallum phaceloid and cerioid in fairly regularly repeated alternation, with large pores through thin common walls of cerioid parts; septa represented peripherally by short spines and by other spines on tabulae; tabulae thin, horizontal or low to tall domes, reinforced peripherally and in cerioid parts by large, dissepimentlike plates; in places

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*Fig. 458. Thecostegitidae (p. F660-F662).*

1a

1b Duncanopora

2a

2b Verolites

3a

3b Ortholites

*L.Carb. (Tournais.), Asia (Kazakh.).—Fig. 458, 2a,b. *V. rarus*; holotype, Tournais., Simorinsky horizon, C. Kazakh., R. Karasu; a,b, transv., long. secs., X3.8 (Chudinova, 1975b).*
tabulæ may have an axial notch that may be extended as a short axial tube. \textit{L.Dev.-M.Dev.}


**Family GORSKYITIDAE** Lin, 1963

\textit{[Gorskyitidae Lin, 1963a, p. 586] [\textit{=!Gorskyitidae Lin, 1959, publication not verified]}

Corallum fasciculate; corallites thin-walled and closely spaced, rounded to rounded-polygonal in section and connected by tubuli that may be in haloes and somewhat flattened in horizontal plane; tabulæ numerous and commonly incomplete, of tabellæ that may form concave or infundibuliform floors and in places an axial syrinx; septal spinules present or absent. \textit{L.Sil.; L.Carb.-L.Perm.}

**Gorskyites** Sokolov, 1955, p. 194 [*G. elegans; OD; \textit{t}20, coll. 599, VNIGRI, Leningrad]. Corallum fasciculate, corallites cylindrical and closely spaced; walls thin; corallites connected by scattered thin tubuli of irregular circular or elliptical section, tubuli commonly in groups each forming an open halo about a corallite; septal spines rare to absent; tabulæ numerous, more or less concave, commonly incomplete and declined adaxially. \textit{L.Carb. (Tournais.)}, Asia (S.China)-Eu. (N.USSR).——Fig. 460,3a,b. *G. elegans*, holotype, USSR, Bolshezemel Tundra; \textit{a,b}, transv., long. secs., \textit{X}4 (Sokolov, 1955).

**Fuchungopora** Lin, 1963a, p. 587 [*F. multispinosa; OD; \textit{t}not traced] [\textit{=!Fuchungopora Lin, 1963a, p. 587, \textit{nom. null.}; Fuchungopora Jia et al., 1977, p. 265, \textit{nom. null.}] [It appears that this genus was founded in 1963 in some untraced publication; in the Chinese text of LIN, 1963a, p. 594, the generic name is followed by “1963” and not by the Chinese characters for “new genus.” \textit{F. multispinosa} was presumably described in the untraced paper. \textit{F. multispinosa} is described and figured in LIN, 1963a. A specimen from the Lower Carboniferous of Kwangtung was described and figured as \textit{F. multispinosa} Lin by Jia et al.,
Fig. 460. Gorskyitidae (p. F663-F665).

1977, p. 265). Corallum fasciculate; corallites numerous, closely spaced and of irregularly rounded-polygonal, rarely rounded, cross section; connecting processes common, tubular or laminar; walls thin; tabulae numerous, infundibuliform, with narrow axial syrinx and auxiliary peripheral
tabellae; septal spines present or absent. *L.Carb.*, Asia (S. China).—Fig. 460,1a,b. *F. multitabulata* LIN, Kwangsi, Duan distr.; a,b, long., transv. secs., X4 (Lin, 1963a).

?Meitanopora YANG, 1973, work not traced, quoted in YANG, KIM, & CHOW, 1978, p. 216 [*M. convexocystosa*; OD; †Get 488-490, GB, Guiyang; L. Sil., Shiniulian F., Meitan, Guizhou (Kweichow)]. Fasciculate; corallites large and cylindrical, connected by ?tubular or ?platformlike processes that contain tabellae and may develop on successive levels simultaneously in neighboring corallites; walls moderately thick, septal spines not observed; tabulae like broad dissepiments, thin, closely spaced. [Diagnosis tentative, from illustrations; possibly chonostegitid or thecostegitid.] *L.Sil.*, Asia (Kweichow-Szechuan).

Neosyringopora SOKOLOV, 1955, p. 196 [*N. bulboides*; OD; †59, coll. 599, VNIGRI, Leningrad] [=Cornwalliella HOARE, 1966, p. 148, nom. subst. pro Cornwalliella HOARE, 1964, p. 501 (type, *Cornwalliella tabularia*, OD; †141494, USNM, Washington; Wolfcamp., USA, N. Nev., non *Cornwalliella Wilson*, 1932, a brachiopod)]. Corallum fasciculate; corallites thin-walled and closely spaced, commonly joined by very sparse and short connecting tubuli; tabulae incomplete, of dissepimentlike tabellae based on the walls and oblique to corallite axis; septal spines weakly developed. *U.Carb.*, Eu. (W. slope S. Urals); *L.Perms.*, Eu. (Spits.-Urals)-N. Am. (Devon I.-Nev.).—Fig. 460,2a,b. *N. bulboides*, holotype, Ural Mts., basin of R. Berezova, lower section, Kolvo-Vishera region, W. slopes; a,b, long., transv. secs., X4 (Sokolov, 1955).

Order, Superfamily, and Family Uncertain

Schizophorites GERTH, 1921, p. 122 [*S. dubiosus*; M; figured syntypes 51, WANNER Coll., IP, Bonn]. Small spherical colonies, commonly adherent; calical openings round initially, rectangular or slit-like when more mature, opening normal to surface; proximal parts of corallites with superposed tabulae, distal parts with squamulalike projections from walls, not conjoined to one another; neither septal ridges nor spinules nor mural pores identified. [Insufficiently known.] *U.Perms.*, Asia (Timor).—Fig. 461,1a,b. *S. dubiosus*, syntypes, Basloe; a, ext. view, X1.5; b, long. sec., X4.0 (GERTH, 1921).

Trypanopora SOKOLOV & OBUT in SOKOLOV, 1955, p. 221, nom. subst. pro Spirocytis SOKOLOV & OBUT in SOKOLOV, 1950a, p. 172, nom. nud., non Spirocytis LEGER & DUBOISQ, 1911, a protozoan [*T. terebra*; OD; †80, coll. 599, VNIGRI, Leningrad] [=Cystitrypanopora JIA, 1977, Auloporida, Auloporicae, Aulocystidae]. Associations of gimlet-like, spirally growing ?corallites (possibly solitary) of gradually increasing diameter; walls thin with...
distinct external sheath; tabulae numerous, like vesicles, oblique to infundibuliform; septal spines not observed. [See Pel & Lejeune, 1971, p. 295. May possibly be worms rather than coelenterates.]


UNRECOGNIZABLE GENERA

? Chaetetopsis Neumayr, 1890, p. 28 [*C. crinita; OD; ?no longer in the Neumayr Coll. in Vienna, fide Peterhans, 1929c, p. 81; U. Jur. (Tithon.). IWASO Konpira and Torinosuyama, Japan; Peterhans, 1929c, based his chaetetid interpretation of the genus on the type specimen of Monotrypa limitata Deninger, 1906, p. 64, in the Museum Univ. Freiburg, Ger., U. Jur. (Tithon.), Capri, Italy. A neotype in MN, Paris, named by Fischer, 1970, p. 197, is unsatisfactory in that it comes from a locality not named by Neumayr (Musaki, Japan) and has been greatly altered by diagenesis. From the two thin sections figured by Fischer, its “tubuli” are of the right diameter for chaetetids, but some of the Mesozoic solenoporaceans also have wide cells.

Chonemberla Say, 1824, p. 253 [*C. intricata; M; ?not traced; ?Sil. or ?Dev., N. Am.]. Insufficiently described, nom. obl., see HILL & JELL, 1970a, p. 177. Might possibly be referable to either Syringolites, Roemerea, Roemeripora, or Syringopora.


Cladoporium de Gregorio, 1930, p. 46 [*C. porrectum; M; ?not traced; U. Perm., Sicily]. Insufficiently described and figured.

Clycopora Steininger, 1849, p. 17 [*C. fasciculata; M; ?not traced; M. Dev., Ger., Gerolstein, Efelf. MILNE-EDWARDS & HAIMÉ (1851, p. 427) considered this genus to be a Silurian and a synonym of the rugosan Strombodes Schweigger (1819, table 6). Sokolov (1955, p. 258) listed it in his work on Tabulata but considered its position obscure.

Cylindripora Eichwald, 1829, p. 190 [*C. serpu-loides; M; ?not traced; from Sil. drift near Vilnius, Lith. ] = Cylindripora Lang, Smith, & Thomas, 1940, p. 46, nom. van.). Lang, Smith, & Thomas (1940, p. 46) and Sokolov (1955, p. 258) considered that it may be a bryozoan.

Dendropora Michelin, 1846, p. 187 [*D. explicia; M; ?not traced; Ferques, Marquise, France, horizon uncertain, assumed by de Fromentel (1861, p. 265) to be Dev.]. Insufficiently known. Lang, Smith, & Thomas (1940, p. 49) stated that Dendropora may be a bryozoan; Sokolov (1962, p. 230) interpreted it as Trachyporoidae; Michelin’s illustration shows very slender branches with smooth surface except for distant, somewhat raised ?calical openings. Dendroporidace de Fromentel, 1861, nom. correct. Sokolov, 1950a, p. 167, pro Dendroporidace de Fromentel, 1861, p. 264, is thus insecurely founded.

Dictyostroma Nicholson, 1875d, p. 254 [*D. undulatum; OD; ?syntype 10131, Nicholson Coll., AU, Aberdeen; Sil., Niagara Gr., Louisville, Ky.]. Originally described as a stromatoporoid; but Nicholson (1892, p. 232) stated that it “is certainly not referable to the stromatoporoids,” although “its precise affinities are not absolutely clear.” Rominger (1886, p. 55) considered Dictyostroma to be a synonym of Aleoites. Bassler (1915, p. 428) stated “it is not a stromatoporoid but is a coral closely allied if not identical with Coeniter.” Sokolov (1955, p. 189) doubtfully included it in Coenitinae. [M. Sil. N. Am. (Ky.).] — FIG. 462, 1a-b. *D. undulatum; ?syntype, Niag., Louisville; ab, long., transv. secs., X 2.0 (Hill, n; AU10113).

Latepora Rafinesque, 1819, p. 429 [*L. alba; M; ?not traced; Ohio R., USA] = Lateropora Sokolov, 1955, p. 517, nom. van.). Lang, Smith, & Thomas (1940, p. 75) opined that L. alba is probably conspecific with Michelinia convexa d’Orbigny (1850, p. 107) from the Onondaga Limestone (low. M. Dev.) of Preston Co., Virginia, USA. Until the original material can be reexamined, the genus must remain indeterminate.

Linipora Troost, 1840, p. 64 [*L. rotunda; M; ?not traced; Sil., USA, Brown’s Port, Perry Co., Tenn.] = Linopora Lang, Smith, & Thomas, 1940, p. 77, nom. van.). Bassler (1915, p. 472) stated that L. rotunda Troost is not recognizable.

Milliera Davis, 1887, explanation to pl. 46, non Milleria Hartmann, 1830, a fossil crinoid [*M. laminata; M; ?8357, MCZ, Cambridge, original of Davis, pl. 46, fig. 9; Sil. (up. Niag.), ferruginous clay near Louisville, Ky.]. Bassler (1915, p. 428) considered it a synonym of Dictyostroma Nicholson, 1875d, which (see above) is also incertae sedis.


Oncopora Počta, 1894, p. 226 [*O. paradoxa; M; ?not number, Barrande Coll., NM, Prague; Dev., gi, Karlstein, Czech.]. Referred to Auloporidae by Počta and by Sokolov (1955, p. 215); possibly an association of two organisms, very small solitary corals and a polychaean.

Osculius de Gregorio, 1930, p. 46 [*Favosites (Osculius) decisionis; M; ?not traced; U. Perm., Sicily]. Possibly pachyporid.
Plasmadictyon Wilson, 1926, p. 19 [*P. irregulare; M; t6743, GSC, Ottawa; U.Ord.(Richmond.), N. Am., B.C.] [=Plasmadictyon Sokolov, 1955, p. 520, nom. null.]. Corallum a thin expansion; corallites of irregular size and section, with large mural pores. Sokolov (1955, p. 187) considered it alveolitid.

Pyritonema McCoy, 1850, p. 273 [*P. fasciculus; M; tA6946, SM, Cambridge; Ord., U.K., Tre Gill]. Lindström, 1883b, p. 13, considered the genus synonymous with Heliolites Dana, 1846b, but Hinde, 1888, p. 111, described it as junior subjective synonym of Hyalostelia Zittel, 1879 (Porifera).


**NOMINA NUDA**

Cyathopora Owen, 1844, p. 69, err. pro Cyathophora Michelin, 1843, p. 104. Lang, Smith, & Thomas, 1940, p. 44 state: "Although it might be argued that Cyathopora Owens is not a mistake for Cyathophora but was erected as a new genus by him, nevertheless, in view of the absence of any definite evidence to that effect, and as Owen was not in the habit of creating new genera, we prefer to regard Owen's term as an error for Cyathophora (a Jurassic hexacoral genus). Lind-
ström... [1883b, p. 8] holds this view, and he also states that Meek & Worthen considered the name to have been used by inadvertence. R. S. Bassler (in litt.) also accepts this as the correct interpretation. If, however, it be held that Cyathopora Owen is a new genus, then its genoholotype (by monotypy) is C. iowensis Owen, 1844, p. 69, pl. xi, from the 'Carboniferous Limestone' [Devonian, Hamilton Group], Iowa, U.S.A., and the name replaces Striatopora Hall." This Treatise regards Cyathopora Owen as an incorrect subsequent spelling and therefore not an available name.

Chungoporella LIN MS in Jia et al., 1977, p. 266, as Fungchungoporella. [No type species named, but F. multistabulata (LIN) was described and figured from the Lower Carboniferous of Guangdong (Kwangtung); this species is presumably the species mentioned in comment on Fungchungopora LIN, 1963a, which see. Jia described two other new species from the Middle Devonian of Hunan in the same work.]

Heliolitella LIN MS in Yang, Kim, & Chow, 1978, p. 241 [*H. lankaoensis; OD; not diagnosed, described, or figured; but three other new species, two by Yang and one by Chow, are described and figured from L.Sil., Shiniluan F., Gutzhou (Kwei-chow), China]. L.Sil.-M.Sil., Asia (Kwei-chow-Shensi).

Heliolitella (Lankaolites) LIN MS in Li et al., 1975, p. 199 [*H. (L.) sokolovi, not described or figured]. Only species described is H. (L.) erlangbaensis H. F. CHU MS in YANG, 1978, no description or diagnosis, no illustration.

Jiangshanolites LIN & Chow (no date). In combination J. multistabulatus LIN & Chow in Yi, 1974, p. 6; no diagnosis, description, or illustration, no type species named. M.Ord., China.

Laceriporella Smirnova, 1970, p. 61, no description or diagnosis, no nomination of type species. Figures of L. beluschja are given without explanation or description, and specimen 145, coll. 10336 in collections of TSGM, Leningrad, is catalogued as holotype. U.Sil. (Grebeni horizon), USSR (Belush, Vaygach L.).

Marginofistula LIN MS in Li et al., 1975, p. 217 [*M. eccentrica LIN MS; L.Carb., Hunan; not described or figured; only species described and figured is M. dabashanensis LIN & YEH in Li et al., 1975, p. 217, M.Sil., Ningqiang, Shensi]. Like Syringopora but tabular syrinx commonly eccentric. [Diagnosis tentative; translation not available.] M.Sil., Asia (Shensi); L.Carb., Asia (Yunnan).

Michelinellla Yü & Shu, 1929, p. 50, 106, nom. nud., fide Lang, Smith, & Thomas, 1940, p. 84.

Quadrafavosites Rukhin, 1939, nom. nud., fide Sokolov, 1955, p. 258. The name does not occur in Roman letters in the work cited.

Subagelitella Li, no date. Gen. nov. in Yu, 1974, p. 12, no diagnosis, no description, no illustration, no type species named. U.Ord., China.

Trachypora Milne-Edwards & Haime, 1851, p. 158, 305 [*T. davidsoni; M; tmissing; U.Dev. (Frasn.), Ferques, near Boulogne, France]. Le-compte (1939, p. 147), deduced that the type specimen was an association between an encrusting stromatoporoid and a branching tabulate coral; he compared it with a specimen he figured (1939, pl. 19, fig. 8, 9) as Trachypora circuluspora Kayser, which is such an association between a stromatoporoid and Thamnophora or possibly an aluporoid. The family Trachyporidae Waagen & Wentzel, 1886 (p. 843, as Trachyporinae) is thus insecurely founded.

**TAXA PROBABLY NEITHER RUGOSA NOR TABULATA**


Bija Volodgin, 1932, p. 17 [*B. sibirica; M; fnot traced; L.Cam., USSR, R. Ledbed, Altay]. Numerous, very small, prismatic tubes closely pressed and radiating fanwise, with thin walls and without trace of septa or tabulae. [Doubtfully referred by Volodgin to Alcyonaria. Sokolov (1962c, p. 208) suggested that it showed affinities with Tabulata.]

Bolboporites Pander, 1830, p. 106 [*B. mitralis; SD Bassler, 1915, p. 128; fnot traced; Ord., USSR (near Leningrad). [See Lang, Smith, & Thomas, 1940, p. 27.]

Cambrophyllum Fritz & Howell, 1955, p. 181 [*C. problematicum; OD; t176262, PU, Princeton]. Skeleton compound, hemispherical; increase by adaxial growth of longitudinal laminae; individual skeletons polygonal to rounded in cross section; walls thick, with gaps? (mural pores); septa and tabulae absent. [Sokolov, 1962c, p. 208, considered that Cambrophyllum may be regarded as probable predecessor of Tabulata.] U.Cam. (low. Dreisch.). USA (Mont.).——Fig. 462,2a,b. *C. problematicum, Horseshoe Hills; a,b, holotype, transv., long. secs., X4.0 (Fritz & Howell, 1955).

Cambrophyra Fritz & Howell, 1959, p. 89 [*C. montanensis; OD; t184516, PU, Princeton]. Skeleton compound, of small slender cylindrical to subprismatic tubuli contiguous or closely spaced with walls finely wrinkled transversely and with sparse
connections between tubules; no internal structures. [See also Bolton & Copeland, 1963, p. 1069. Sokolov, 1962, p. 208, described Cambrotropa as "tabulate-like."] M.Cam.(Albertella Zone), N.Am.(Mont.-Alberta-B.C.).—Fig. 462, 3. *C. montanensis*, Silver Hill F, Mont., near Drummond Post Office; syntype, long. view, ×11.4 (Fritz & Howell, 1959).


Coelenterata JELL & JELL, 1976, p. 181, family. Small, solitary or more rarely colonial (dendroid), operculate, calcareous skeletons; individuals conical with smooth to peripherally and biradially corrugated to septate calices; conical aporose wall with a pair of symmetrically placed longitudinal folds at which calical rim may project; circumference increased during growth by insertion of additional fibrous trabeculate material in the four positions adjacent to the two folds; lumen without tabulae or dissepiments; increase peripheral and parricidal; operculum highly variable, its outer surface with concentric growth rings and its inner surface septate with prominent fossula, septa being arranged in two or three orders symmetrically about fossula; may or may not close calice. Low. M.Cam.


Decaphyllum FRECH, 1885, p. 69 [*D. koeneni*; M; tslides in HU, E. Berlin]. See SCHINDEWOLF (1942, p. 285), who considers monotype to be a Mesozoic scleractinian, erroneously labeled as from Upper Devonian of Grund, Harz, Ger.

Disconia WESTPHAL, 1974a, p. 79 [*D. pentamerus*; M; t561/3, UW, Madison]. Removed from the corals and identified as an echinoderm by WESTPHAL, 1974b, p. 1096. M.Ord., N.Am.(Wis.).


Lamellipora OWEN, 1844, p. 70 [*L. infundibularia*; OD; tnot traced] (=Lamellipora LANG, SMITH, & THOMAS, 1940, p. 74, nom. van.). Possibly a stromatoporoid. Sil.(Niag.), N.Am.(Iowa-Wis.).


Lipoporidiae JELL & JELL, 1976, p. 193, family. Small, loosely fasciculate calcareous skeletons; individuals scolecoid, with rejuvenescense rims; calice with narrow rim that may be extended laterally, and is weakly to prominently septate, 8 to 16 continuous ridges extending subradially halfway to axis; wall aporose; lumen without tabulae or dissepiments; increase lateral. Low.M.Cam.

Patina EICHWALD, 1829, p. 186 [*P. lithuana*; M; tnot traced]. Drift, Eu.(Lith.).

Protoaulopora Sokolov, 1952b, p. 145 [*Syringopora ramosa* VoloLDIN, 1931, p. 134; OD; tnot traced] (=Protoaulopora Sokolov, 1950a, p. 171, nom. nud.). Corallum small, in large clusters; corallites minute, slightly conical, prostrate, with slightly raised calices; walls thin; three offsets may arise from a single site; no septa, no tabulae. [See Sokolov, 1962c, p. 243; systematic position and age doubtful.] ?U.Cam., Asia(Kazakh.).—Fig. 462, 4. *P. ramosa* (VoloLDIN), syntype, Chingiz Ra., Kazakh.; random thin sec., ×10.0 (VoloLDIN, 1931).


Spongarium LONSDALE, 1839, p. 696 [*S. edwardsi*; OD; tnot traced]. U.Sil., Eu.(Eng.).

Tabulacous HANDFIELD, 1969, p. 784 [*T. kordæae*; OD; t24709, GSC, Ottawa]. Aseptate cones with tabulae flat and complete or, in places, of large tabellae. ?L.Cam., N.Am.(Alaska); L.Cam., N.Am.(B.C.).
Three indispensable indexes of Paleozoic coral genera with relevant lists of publications are: Lang, Smith, & Thomas, 1940; Flügel, 1970; and Ivanovskij, 1973, with supplement by Bogoyavlenskaya, 1976. For Rugosa only there are also Cotton, 1973, with Supplement I published in 1974 and Supplement II in 1976, and Ivanovskij, 1976. References to senior homonyms that have been applied to organisms other than Paleozoic corals are not included in this list, but those dated before 1966 may be found in contracted form in S. A. Neave, Nomenclator Zoologicus (1939-1975, 7 v., Zoological Society, London). A list of full names of serials abbreviated below is to be found at the end of the Editorial Preface.


Agassiz, Louis, 1846, Nomenclatoris zoologici index universalis: viii + 393 p., Jent & Gassmann (Solduri). [Not seen by author.]


Ball, J. R., 1933, Bainbridge typicales, new gen. & sp. of Siluric Auloporidae: Pan-Am. Geol., v. 59, p. 239-240.


1963, Ordovikskie i siluriyskie korally Gornogo


1944, Parajavosites and similar tabulate corals: J. Paleontol., v. 18, p. 42-49, text-fig. 1-29.


Birenheide, Rudolf, 1961, Die Acanthophyllum-Arten (Rugosa) aus dem Richschnitt Schon­ ecken-Dingdorf und aus Vorkommen in der Eifel: Senckenb. Lethaea, v. 92, no. 1/2, p. 77-146, text-fig. 1-10, pl. 1-7, tables 1-10.

1962a, Revisicon der koloniebildenden Spongophyllidae und Stringophyllidae aus dem Devon: Senckenb. Lethaea, v. 43, no. 1, p. 41-99, text-fig. 1-10, pl. 7-13, tables 1, 2.


1962d, Entwicklung- und umweltbedingte Veranderungen bei den Korallen aus dem Eifeler
Devon: Nat. u. Mus., v. 92, no. 3, p. 87-94, no. 4, p. 134-138, text-fig. 1-12.
1963b, Standortwechsel von Korallen aus dem Eifelmeer: Nat. u. Mus., v. 93, no. 10, p. 405-409, text-fig. 1-3.
1965a, "Heliolitoidea" (Rugosa) aus der Sammlung Wedekind (Rustes coraux et les Kriimutaten): Zur Sammlung Wedekind (Rev. les coraux et les Stromatolitiden):
1965b, Neubeschreibung der rugosen Koralle "Duncanella" pygmaea Schlüter: Fortschr. Geol. Rheinland Westfalen, v. 9, p. 1-6, text-fig. 1, pl. 1-3.
1972, Pternopilidae (Rugosa) aus dem W. deutschen Mitteldevon: Senckenb. Lethaea, v. 53, no. 5, p. 405-437, text-fig. 1-14, pl. 1-5.
Late Stockholm, the calcareous skeleton of the Anthozoa: The Nord, Ann., v. 94, no. 1, the Fiiren. Ordovician corals morphology structure and formation of the family Stelliporellidae: Podklass Heliolitoidea: Ob astogeneticheskom metode izuchenia neordovikskikh korallov SSR, Tr. II Vsesoyuznogo simpoziuma po izucheniyu iskopаемых кораллов SSR, no. 1, p. 166-178, pl. 38, Nauka (Moscow). [Members of the new family Stelliporellidae (helio lithids): in Paleozoic Tabulata and Heliolitoidea of the USSR.]


References


Bricc, Denise, & Rohart, Jean-Claude, 1974, Les Phillippsastraeidae (Rugosa) du Dev ten de Fereques (Boulonnais, France), Premier note, Le genre Macgeea Webster, 1889, Nouvelles observations: Soc. Geol. Nord, Ann., v. 94, no. 1, p. 47-62, text-fig. 1-5, pl. 7-9, table 1-3.


Growth rhythms and the history of the earth's rotation, p. 135-147, text-fig. 1-3, 1 table, J. Wiley & Sons (London).


1908, A revision of some Carboniferous corals: Geol. Mag., dec. 5, v. 5, p. 20-31, 63-74, 158-171, pl. 4-6, diagrams A-F.


1913, Lophophyllum and Cyathaxonia: Revision notes on two genera of Carboniferous corals: Geol. Mag., n.s., dec. 5, v. 10, p. 49-56, pl. 3.

1919, A remarkable Carboniferous coral: Geol. Mag., v. 56, p. 436-441, text-fig. 1-6, pl. 11.

Castelnau, Francis de, 1843, Essai sur le systeme silurien de l’Amérique septentrionale: xv + 56 p., illus., P. Bertrand (Paris).


Chekhovich, V. D., 1955, Novye rodi Helioplasmo­lites: Ego sistematscheskoe polozhenie, stratigraficheskoe znachenie i geograficheskoe rasprostranenie: Akad. Nauk Uzb. SSR, Dokl., v. 10, p. 9-12, text-fig. 1-4. [New genus Helio-
References


1977, Novye vidy pozadneordovikskikh i pozdne-siluriyiskikh geliolitoidy Tur: in G. A. Stukanina (ed.), Novye vidy drevnikh rasteniy i bespozvonochnykh SSSR, v. 4, p. 9-24, pl. 6-8, Nauka (Moscow). [New species of Late Ordovician and Late Silurian Heliolitioidea of Tuva: in New taxa of fossil plants and invertebrates of the USSR.]


1977, Silurian and Devonian corals from Gedinnian deposits of the R. Tarei (southwest Taymyr). [Silurian and Devonian corals of the basin of the R. Tarei (southwest Taymyr).]


1941a, Siluriyiske i nizhnedevonskie korally basseyni reki Tarei (yugo-zapadny Taymyr): Vses. Arktichi Inst., Tr., v. 158, no. 5, p. 9-64, pl. 1-14. [Silurian and Lower Devonian corals from the basin of the R. Tarei (southwest Taymyr).]

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132, pl. 1-3, Akad. Nauk SSSR (Moscow). [Tabulata of the main Devonian field: in Fauna of the main Devonian field.]


Chi Yuan-yi [Tchi Yuan-yi], 1961, Novye videnia Tchinese o~leolitida iz oznovok yu~chnoy Sibiri: Akad. Nauk SSSR, Paleontol. Inst., Tr., v. 73, p. 1-146, text-fig. 1-33, pl. 1-34. [New Devonian Tabulatae from southern Siberia.]


1975a, Revisiya syringopor, opisanbnykh A. A. Stuckenbergom: Akad. Nauk SSSR, Paleontol. Zhurnal, 1975, no. 1, p. 10-21, text-fig. 1, pl. 1, 2. [Revision of the syringoporidae described by A. A. Stuckenberg.]


Clark, A. E., 1924, On Heptaphyllum, a new genus of Carboniferous coral: Geol. Mag., v. 61, p. 416-423, text-fig. 1-12.


Coates, A. O., & Oliver, W. A., 1973, Coloniality in zoantharian corals: in R. S. Boardman, A. H. Cheetham, & W. A. Oliver (eds.), Animal colonies, p. 3-27, text-fig. 1-9, tables 1, 2, Dowden, Hutchinson, & Ross (Stroudberg, Pa.).


Conkin, J. E., Bratcher, T. M., & Conkin, B. M., 1976, Palaeacis cueneformis Haime, 1857, in


1962, New Devonian fossils from western Canada: 16 p., 9 pl., Evelyn de Mille Books (Calgary).

1968, Lower Devonian and other coral species in northwestern Canada: 9 p., 4 pl., Evelyn de Mille Books (Calgary).


[On a new genus of Coelenterata from the Carboniferous deposits of the Donetz coal basin.]


Davis, W. J., 1887, Kentucky fossil corals—A monograph of the fossil corals of the Silurian and Devonian rocks of Kentucky, Part II: Kentucky Geol. Surv., 1885, p. i-xiii, 1-4, pl. 1-139.


1973a, Osnoyne etapy istoricheskogo rasvitiya kamennogolnykh korallov na Urale: Sverdlovsk Gorn. Inst., Tr., no. 93, p. 79-92, 1 diagm. [Principal stages in the historical development of Carboniferous corals in the Urals.]


1974, Late Ordovician Propora (Coelenterata: Helio-...{J. PaleontoI., v. 48, p. 568-585, text-fig. 1-8, pl. 1-3.


1936b, Korally Rugosa srednego i verkhnego karbona i nizhney permii severnogo Urala (123 y list): Akad. Nauk SSSR, Polyanr. Kom., Tr., v. 28, p. 77-158, text-fig. 1-81. [Rugose corals of the Middle and Upper Carboniferous and Lower Permian of the northern Urals.]


1958, Nizhnekamennogolnye kolonialnye chety-
References

179, text-fig. 1-46, pl. 1-67. [Tabulata and biostratigraphy of the Lower Devonian of North-Eastern USSR.]

1971, Takonominischees znachenie mikrostruktury skleletnykh obrazovaniy tabulatyta: in V. N. Dubatolov (ed.), Tabulatyta i geliolitoidei paleozoya SSSR, Tr. II Vsesoyuznogo simpoziuma po izucheniyu iskopaemykh korallov SSSR, no. 1, p. 12-33, text-fig. 1-16, pl. 1-12, Nauka (Moscow). [Taxonomic significance of the microstructure of the skeletal parts of Tabulata: in Paleozoic Tabulata and Helio lithoidea of the USSR.]


Dun, W. S., 1898, Contributions to the palaeontology of the Upper Silurian rocks of Victoria, based on specimens in the collections of Mr. George Sweet, Part 1: R. Soc. Victoria, Proc., n.s., v. 10, p. 79-90, pl. 3.


Dun, P. M., 1868, On the genera Heterophyllia, Battersbyia, Palaeoecyclus and Asterosmilia; the


References

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EICHWALD'S collection is no. 1, Chair of Historical Zoology, University of Leningrad.


In the Moore Ck. and Wooloomooloo, and especially the Devonian of the central regions of the Russian Platform.


Eichwald's collection is no. 1, Chair of Historical Geography, University of Leningrad.


Erickson, C. G., 1831, Symbolae Physicae: Animalia Exertebrata exclusis insectis: 1 vol., 10 pl., ex Officina Academia (Berolini). [Not seen by author.]


Erickson, C. G., 1831, Symbolae Physicae: Animalia Exertebrata exclusis insectis: 1 vol., 10 pl., ex Officina Academia (Berolini). [Not seen by author.]


Coelenterata—Anthozoa

from the Upper Silurian rocks of New South Wales: Aust. Mus., Rec., v. 10, p. 35-37, pl. 4-7.

1917, Descriptions of some Queensland Palaeozoic and Mesozoic fossils, 4: Vetofistula, a new form of Palaeozoic Polyzoa, allied to Rhabdomeson Young & Young, from Reid's Gap, near Townsville: Queensland Geol. Surv., Publ. 260, p. 17-29, pl. 4.


1965b, Lindstroemiiidae and Ampelxocarinidae (Tetra­coralla) from the Middle Devonian of Skaly, Holy Cross Mountains, Poland: Acta Palaeontol. Polonica, v. 10, no. 3, p. 335-363, text-fig. 1-3, pl. 1-6.


1828, Notice sur les polyptères tabipores fossiles: p. 9-23, 1 pl., Imp. de l'Université Impériale (Moscow).

1830, Orystographie du Gouvernement de Moscou:
References


Flügel, Helmut, 1959, Zur Kenntnis der Typen von Favistella (Dendrostella) trigemme trigemme (Quenstedt 1894) und Thamnophyllum trigemimum trigemimum (Dendrostella) trigemme trigemme (Quenstedt 1881) und Thamnophyllum trigemimum trigemimum (Dendrostella) trigemme trigemme (Quenstedt 1881): Neues Jahrb. Geol. Paläontol., Monatsh., 1959, no. 3, p. 113-120.


v. 49, p. 1-80, pl. 1, 2. [New data on Lower Carboniferous corals of the Kuznetsk Basin.]

nou goloy sistemy, p. 50-64, text-fig. 10-12, pl. 6-11, TiNIGRI (Leningrad). [Phylum Coelenterata: in Atlas of index forms of the fossil faunas of the USSR, Middle and Upper Carboniferous systems.]

1953a, Korally Rugosa i stratigrafiya sredne- i vekhnekamennougolnykh i permikh i otlozen-


1955, Nizhniy Karbon, Tip Coelenterata: in L. L. Khal'fin (ed.), Atlas rukovodyeyschikh form isko-
opaemykh fauny i flory zapadnoy Sibiri, v. 1, p. 298-305, pl. 79-80, Gosgeoltekhhizdat (Mos-

Fomin, Yu. M., 1971, Morphologiya i sistematicheskoe polozenie pozdnereordovikskikh korallov semyestva Cyathophyllidae: in V. N. Dubatolov (ed.), Tabulyaty i geliolitoidei paleozoya SSSR, Tr. II Vsesoyuznogo simpoziuma po izucheniyu iskoopemykh korallov, no. 1, p. 116-126, text-
fig. 1-22, pl. 39, Nauka (Moscow). [Morphology and systematic position of Late Ordovician corals of the family Cyathophyllidae.]


1961, Les Madréroparea paleozoiques du Viet-
Nam, du Laos et du Cambodge: Arch. Géol. Viet-
Nam, v. 5, p. 1-276, text-fig. 1-10, pl. 1-35.

1966a, Epibiontes et endobiontes des tabulés dé-

1966b, Quelques Madréroparea dévonians du muniée du Service Géologique de Saigon (Collecte-

1967, Quelques Madréroparea permian du Viet-

Franzefelt, G. H., & Engstrom, J. C., 1970, De-
velopment of the rugose coral Microcyclus discus Meek & Worthen from the Devonian of Illinois and Missouri: J. Paleontol., v. 44, p. 1085-
1091, text-fig. 1-6, pl. 150.

Frech, Fritz, 1885, Die Korallenfauna des Ober-


1911, Das Devon Chines: in Ergebnisse eigener Reisen und darauf gegründeter Studien von Ferdinand Frichern v. Richthoven, Fünfter Band, p. 18-58, Pl. 4-10, Verlag von Dietrich Reimer (Berlin).

Frey, H., & Leuckart, C. G. F. R., 1847, Beiträge zur Kenntnis wirbelloser Thiere mit besonderer Berücksichtigung der Fauna des Norddeutschen Meeres: viii + 170 p., 2 pls., Verlag von Fried-
rich Vieweg and Sohn (Braunschweig).


1950, Multisolenida, a new order of the Schizo-

— & Howell, B. F., 1955, An Upper Cam-
brian coral from Montana: J. Paleontol., v. 29, p. 181-183, text-fig. 1, 2.

1959, Cambrotrypa montanensis, a Middle Cam-
brian fossil of possible coral affinities: Geol. Assoc. Can., Proc., v. 11, p. 89-93, 1 pl.


Gabuniya, K. E., 1919, Materialy k iskucheniyu fauny korallov iz nizhekanennougolnykh otlo-

Galle, Arnošt, 1969, On the genus Helioplasma

[New data on Lower Carboniferous corals of the Kuznetsk Basin.]
References

Kettnerova, 1933 (Anthozoa, Heliolitoidea): Ústred. Ústavu Geol., Věstn., v. 44, p. 167-173, text-fig. 1, 2, pl. 1-4.


Girty, G. H., 1895, Development of the corallum in Favosites forbesi var. occidentalis: in Atlas of index forms of the fossil fauna of the USSR.


— & Wade, Mary, 1966, The Late Precambrian fossils from Ediacara, South Australia: Palaeontology, v. 9, pt. 4, p. 599-628, text-fig. 1-3, pl. 97-103.


1829, Petrefacta Germaniae, I: p. 77-164, pl. xxvi-1, Arnz & Co. (Düsseldorf).


1976, Kamennougolnye i Perm­skie korally Novoy Zemli: in Atlas of index forms of the fossil fauna of the USSR.

1978, Korally sredni­h karbona zapadnogo skloka Urala: 224 p., 43 text-fig., 23 pl., 3 tables, Nauka (Moscow). [Middle Carboniferous corals from the western slopes of the Urals.]


1966, Bulvankeriphyllinae—Novoe podzemystvo kodonophyld (Tetracoralla): Leningrad Univ., Vestn., ser. geol., geogr., no. 3, no. 18, p. 53-59, text-fig. 1, 2. [Bulvankeriphyllinae, a new subfamily of kodonophyld (Tetracoralla).]

— & Lavrusesvich, A. I., 1972, Nekotorye novye predstaviteli jolidofossil Sredney Azii: in
Coelenterata—Anthozoa


Greene, G. K., 1898-1906, Contributions to Indiana palaeontology: v. 1, pt. 1, p. 1-7, pl. 1-3 (1898); pt. 2, p. 8-16, pl. 4-6 (1899); pt. 3, p. 17-25, pl. 7-9 (1899); pt. 4, p. 26-35, pl. 10-12 (1900); pt. 5, p. 34-41, pl. 13-15 (1900); pt. 6, p. 42-49, pl. 16-18 (1901); pt. 7, p. 50-61, pl. 19-21 (1901); pt. 8, p. 62-74, pl. 22-24 (1901); pt. 9, p. 75-84, pl. 25-27 (1902); pt. 10, p. 85-97, pl. 28-30 (1902); pt. 11, p. 98-109, pl. 31-33 (1903); pt. 12, p. 110-129, pl. 34-36 (1903); pt. 13, p. 130-137, pl. 37-39 (1903); pt. 14, p. 138-145, pl. 40-42 (1903); pt. 15, p. 146-155, pl. 43-45 (1903); pt. 16, p. 156-157, pl. 46-48 (1903); pt. 17, p. 168-175, pl. 49-51 (1904); pt. 18, p. 176-184, pl. 52-54 (1904); pt. 19, p. 185-197, pl. 55-57 (1904); pt. 20, p. 198-204, pl. 58-60 (1904); v. 2, pt. 1, p. 1-18, pl. 1-3 (1906); pt. 2, p. 19-32, pl. 4-6 (1906); pt. 3, p. 33-38, pl. 7-9 (1906), Ewing & Zeller (New Albany, Ind.).


Grossens, Eric, Termier, Henri, & Termier, Geneviève, 1975, A-propos d'un Syringoporidéa nouveau du Tn 1b de la région de Dinant: Mémoires pour servir a l'explication des Cartes géologiques et minières de la Belgique, Mém. no. 19, 13 p., 3 fig., 1 pl.


Haeckel, Ernst, 1866, Generelle Morphologie der Organismen: v. 2, Allgemeine Entwickelungsgeschichte der Organismen [Anthozoa, p. 53-56, pl. 3], G. Reimer (Berlin).


Hall, James, 1843, Geology of New-York, v. 4:
Biiie, Moskauer-, Ghel- und Schwammlagen
References


1957b, The sequence and distribution of upper Palaeozoic coral faunas: Aust. J. Sci., v. 19, no. 3a, p. 42-61, 1 text-fig.


Hinde, G. J., 1879, On a new genus of favositic coral from the Niagara Formation (U. Silurian), Manitoulin Island, Lake Huron: Geol. Mag., n.s., dec. 2, v. 6, p. 244-246, text-fig. A-D.


1890, Notes on the palaeontology of Western Australia, 2: Corals and Polyzoa: Geol. Mag., n.s., dec. 3, v. 7, p. 194-204, pl. 8, 8A.


Hladil, Jindrich, 1974, Tabulate corals from the Paleozoic basement of the Carpathian foredeep (Borehole Nitkovice-2): Ústřed. Ústav Geol. Věstn., v. 49, p. 219-221, 1 text-fig., 2 pl.


——, & Pocock, Y. P., 1972, *Sediment rejection by recent scleractinian corals*: A key to palaeoenvironmental reconstruction: Geol. Rundsch., v. 61, p. 598-626, text-fig. 1-10, 1 table.


1942a, *Fascioculophyllum Thomson and other genera of the “Zaphrentis” omaliusi group of Carboniferous corals*: Geol. Mag., v. 79, no. 5, p. 257-263, 2 text-fig.


1974, Morfologiya i osnovnye etapy razvitiya podotryada Polycoelia: v B. S. Sokolov et al. (eds.), Drevnie Cnidaria, v. 1, p. 211-219, text­fig. 1-3, Nauka (Novosibirsk). [Morphology and important evolutionary stages of the suborder Polycoelia: in Ancient Cnidaria.]


1960, O rode Columnaria Goldfuss iz srednego devona Kuzbassa i skhodnykh rodakh iz ordo­vi­ka drugih stran: Akad. Nauk SSSR, Siberiyskoe otd., Inst. Geol. Geofiz., no. 9, p. 36-43, text-fig. 1, 2. [On the genus Columnaria Goldfuss from the Middle Devonian of the Kuzbas and similar genera from the Ordovician of some other countries.]

1965, Devonskie korally Rugosa Sayano­Altaiykh kornny oblasti: Tomsk gos. Univ., Tr., v. 1, 399, pl. 1-103. [Devonian corals (Rugosa) of the Sayano-Altai mountain region.]


Ivanova, E. A., 1958, Razvitie fauny sredn­evkhennomumaygolnogo morya zapadnogo chasti Moskovskoj sineklyzy v svyazi s ego istoriey, Kniga 3: Razvitiy fauny v svyazi s их evolutsiiy, Kniga 3: Razvitie fauny v svyazi s их evolutsiiy: Akad. Nauk SSSR, Paleontol. Inst., Tr., v. 69, p. 1-303, text-fig. 1-77, pl. 1-21, tables 1, 2. [Faunal evolution in the Middle and Upper Carboniferous seas of the western parts of the Moscow syncline in relation to its history, Book 3: Faunal evolution in relation to conditions of existence.]


1959, K voprosu o sistematicheskom polo­zhenii ordoviskikh i siluriyskikh zaphrentoidnykh korr­allov: Akad. Nauk SSSR, Dokl., v. 125, no. 4, p. 895-897, text-fig. 1, 2. [On the question of the systematic position of the Ordovician and Silurian zaphrentoid corals.]


1972, Vnutrivodovaya izmenчивость, morfologiya i ontogenez skeleta Calophyllum profundum (Rugosa) (po materialam iz Kazanskogo yarova Russkoy platformy): Akad. Nauk SSSR, Sibirskoe otd., Inst. Geol. Geofiz., Tr., v. 112, p. 4-9, 115-116, pl. 1-5, 1 table. [Intraspecific variation, morphology and ontogenesis of the skeleton in Calophyllum profundum (Rugosa) (based on material from the Kazan Stage of the Russian Platform.).]


1969, Jell, J. S., Septal microstructure and classification of the Phillipsastridae: in K. S. W. Camp-
<table>
<thead>
<tr>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>bell (ed.), Stratigraphy and palaeontology: Essays in honour of Dorothy Hill, p. 50-73, text-fig. 12-15, pl. 7, 8, Australian National University Press (Canberra).</td>
</tr>
<tr>
<td>1869a, A new genus of Devonian rugose corals: J. Paleontol., v. 43, p. 373-740, text-fig. 1, 2, pl. 95-96.</td>
</tr>
<tr>
<td>1966b, The Lower Carboniferous corals of eastern Australia: in K. S. W. Campbell (ed.), Stratigraphy and palaeontology: Essays in honour of Dorothy Hill, p. 120-139, text-fig. 23-27, pl. 9, 10, Australian National University Press (Canberra).</td>
</tr>
<tr>
<td>1969b, The Lower Carboniferous corals of eastern Australia: in K. S. W. Campbell (ed.), Stratigraphy and palaeontology: Essays in honour of Dorothy Hill, p. 120-139, text-fig. 23-27, pl. 9, 10, Australian National University Press (Canberra).</td>
</tr>
<tr>
<td>1966b, The Lower Carboniferous corals of eastern Australia: in K. S. W. Campbell (ed.), Stratigraphy and palaeontology: Essays in honour of Dorothy Hill, p. 120-139, text-fig. 23-27, pl. 9, 10, Australian National University Press (Canberra).</td>
</tr>
</tbody>
</table>
| 1976b, Review of some species of Favistina, Nyctophyllum, and Calapoecia (Ordovician corals from
North America): Geol. Mag., v. 113, no. 5, p. 457-467, pl. 1-4, text-fig. 1.


1956b, Rody Primitosiphon gen. n. i Leolasma gen. n.: in L. D. Kiparisova et al. (eds.), Materialy po paleontologii; Novye semyestva i rody, Vsesoyuznogo simpoziuma po izucheniyu iskopaemykh korallov SSSR, pt. 2, p. 91-93, pl. 26, Nauka (Moscow). [A new coral of FavoJites (Study on Palaeozoic Rugosa and Stromatoporidea of the USSR.]


1966b, Note on some Carboniferous coral genera: Clitiophyllum, Clitiophyllum (Neoelisophyllum), Zaphrentoides, Stylidophyllum and Actinothyllus: Jpn. J. Geol. Geogr., v. 37, no. 2-4, p. 93-104, pl. 3.
Coelenterata—Anthozoa


King, Wm., 1848, A catalogue of the organic remains of the Permian [sic] of Northumberland and Durham: p. 1-16, the author (Newcastle-upon-Tyne).


Coelenterata—Anthozoa


—, & Spasskiy, N. Ya., 1967, Metodika paleoontologicheskikh isledovanii (primene ne perkhotarnogo metoda pro izucheniyu iskopаемykh korallov SSSR, Tr. II Vsesoyuznogo simpoziuma po izucheniyu iskopaemykh korallov SSSR, no. 3, p. 31-44, text-fig. 1, 2, tables 1-6, Nauka (Moscow). [Paleontological analysis (use of the punchcard method in the study of tetracorals).]


Kühn, Othmar, 1928, Hydrozoa, Fossilium Catalogus 1, Animalia Pars 36: 114 p., W. Junk (Berlin).


1972, Ontogenetic allometries of rugose corals: J. Paleontol., v. 46, p. 75-81, text-fig. 1-6.


1906, Notes on the fossil corals collected by Mr. A. P. Low at Beechy Island, Southampton Island and Cape Chidley, in 1904, Appendix 4: in A. P. Low, Report on the Dominion Governo


1972b, Ergänzung zur Diagnose der Gattung Daljanolites Lelebus, 1964 (Tabulata) [Dopolnenie k diagnosto roda Daljanolites (Coelenterata, Tabulata):] Münsterische Forsch. Geol. Paläontol., no. 24, p. 25-33, pl. 1, 2.


1964, Mural pores in Catenipora from northwestern Canada: J. Paleontol., v. 38, p. 373-374, 1 text-fig., pl. 59.


Li Hui-hsi [Li Huixi], Sung Li-sheng [Song Lisheng], Chou Chih-ch’iang [Zhou Zhiqian]
Coelenterata—Anthozoa


Lin In-Dan & Fan In-Nyan, 1959, Novyy rod chetyryerkhlebeykh korallov Chienchanga (gen. nov.): Nauchnyy Zhurnal Chanchunskogo un-ta, v. 2, p. 105-124, 1 text-fig., pl. 1, 2. [New genus of tetraradiate corals: Chienchanga (gen. nov.). Chinese, Russian transl.]


1870, A description of the Anthozoa perforata of Gotland: K. Svenska Vetenskapsakad., Handl., v. 9 (for 1870), pt. 6, p. 1-12, 1 pl. [Not seen by author.]

1871a, Om operkularbildningen hos några nutida och siluriska koraller: Öfvers. K. Vetenskapsakad., Föhr., v. 27 (for 1870), no. 9, p. 921-926.

1871b, On some operculated corals, Silurian and Recent: Geol. Mag., ser. 1, v. 8, p. 122-126. [Transl. of G. Lindström, 1871a.]

1873a, Några anteckningar om Anthozoa tabulata: Öfvers. K. Vetenskapsakad., Föhr., v. 30, no. 4, p. 3-20.


1882b, Siluriske Korallen aus Nord-Russland und Sibirien: Bih. K. Svenska Vetenskapsakad., Handl., v. 6, no. 18, 23 p., 1 pl.

1883a, Obersilurische Korallen von Tshaw-tien im nordöstlichen Theil der Provinz Sz-Tshwan: in Ferdinand von Richthofen, China, v. 4, Palaeont. Theil, p. 50-74, pl. 5-7, Dietrich Reimer (Berlin).

1883b, Index to the generic names applied to the corals of the Palaeozoic formations: Bih. K. Svenska Vetenskapsakad., Handl., v. 8, no. 9, p. 1-14.


1758, Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis synonymis, locis. Tomus
References


Lisitsyn [Lissitzin], K. I., 1925, Podrazdeleniya Nizhnego Karbona i ikh korolovo-brakhiopodovaya fauna: Donskoi Polytek. Inst. Izv., v. 9, p. 54-68, pl. 1, 2. [Subdivision of the Lower Carboniferous by its coral-brachiopod fauna.]


1865-1866, Corallen aus paläolithischen Formationen: Palaeontographica, v. 14, p. 133-244, pl. 31-72.


1943, The climate and relative position of the continents during the Silurian period as determined by the growth rate of corals: Research on the past climate and continental drift, v. 2, p. 1-115, pl. 1-14, 3 maps, the author (Yungan, Fukien, China).

1956, A re-investigation of climate and the relative positions of continents during the Devonian: Research on the past climate and continental drift, v. 9, p. 1-116, 1 text-fig., pl. 1-70, the author (Taipei, Taiwan).


McCoy [M'Coy], Frederick, 1844, A synopsis of the characters of the Carboniferous limestone fossils of Ireland: p. i-viii + 5-207, pl. 1-29, University Press (Dublin).


1851b, in A. Sedgwick, A synopsis of the classification of the British Palaeozoic rocks . . . with a systematic description of the British Palaeozoic fossils in the geological museum of the Univer-


1963, Kleopatrina, a new name for Ptolemaia McCutcheon & Wilson: J. Paleontol., v. 37, p. 299.


1974c, Cystiphyllidae and Goniophyllidae (Rugosa) from the Lower Silurian of New South Wales: Palaeontographica, Abt. A, v. 147, p. 1-38, text-fig. 1-8, pl. 1-6, 1 table.


Marek, Ladislav, & Galle, Arnošt, 1976, The tabulate coral Hyostragulum, an epizoan with bearing on hyolithid ecology and systematics: Lethia, v. 9, no. 1, p. 51-64, text-fig. 1-10, tables 1, 2.


[New species of fossil plants and invertebrates of the USSR.]


Martin, William, 1809, Petrificta derbientia; or figures and descriptions of petrifactions collected in Derbyshire: p. (1-102), 28 p., 52 pl., D. Lyon (Wigan).


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1960, Ontogenetic study of some Silurian corals of Gotland: Stockholm Contrib. Geol., v. 8, no. 4, p. 38-100, text-fig. 1-31, pl. 1-22.


References


1945, Description of Lower Pennsylvanian corals from Texas and adjacent States: Univ. Texas, Publ. no. 4401, p. 77-208, text-fig. 1-214, pl. 14.


Münster, Georg Graf Zu, 1839-1846, Beiträge zur Petrefactenkunde: no. 1, i-vii, 1-124, pl. 1-18 (+1) (1839a); no. 2, p. 1-88, pl. 1-29 (1839b); no. 3, p. 1-132, pl. 1-20 (1840); no. 4, p. 1-152, pl. 1-16 (1841); no. 5, p. 1-131, pl. 1-15 (1842); no. 6, p. 1-100, pl. 1-14 (1843); no. 7, p. 1-66, pl. 1-9 (1846), Buchner (Bayreuth).


1974, Variations of morphological structures during the ontogeny of Lower Palaeozoic rugose corals: in B. S. Sokolov et al. (eds.), Drevnie Cnidaria, v. 1, p. 151-161, text-fig. 1-5, Nauka (Novosibirsk). [English, Russian summary.]

1975, New Lower Palaeozoic stenopelmatomid corals from Scandinavia: Nor. Geol. Tidsskr., v. 55, no. 4, p. 335-359, text-fig. 1-17.


1852, Cours élémentaire de paléontologie et de géologie stratigraphique: v. 2, no. 1, 382 p., 392 text-fig., Victor Masson (Paris).


New South Wales, J. Proc., v. 108, p. 147-156, text-fig. 1-5, tables 1, 2.


1939, Bojocyclus, nov. gen., novy korál z vapencu Hlučočeských (gy): Priroda, v. 32, pt. 3, p. 104-107, text-fig. 1a, b. [Bojocyclus, gen. nov., new coral from the Hlučočepy Ls.]

1940, Výskyt rodu Xyloides Lang & Smith (Rugosa) v českém Siluru: Česke Akad. Věd Umění, Třída II, Rozpr., v. 50, no. 3, p. 3-13, text-fig. 1-12, pl. 1-3. [The coral genus Xyloides Lang & Smith (Rugosa) in the Czechoslovakian Silurian.]


1965, K voprosu o filogenii nekotorykh tsepochnyk korallkov verkhneyho ordovika: in B. S. Sokolov & V. N. Dubatolov (eds.), Tabulatormorfnye korally ordovika i silura SSSR, Tr. 1 Vsesoyuznogo simpoziuma po izucheniyu iskopaemykh korallkov, pt. 1, p. 21-28, pl. 5-8, Nauka (Moscow). [On the problem of the phylogeny of some chain-corals of the Upper Ordovician.]


1968, Pozdneorovishskie desmidoporiy Omulevskikh gor (bassey v. Kolymy): Akad. Nauk SSSR, Paleontol. Zhurnal, 1968, no. 4, p. 89-93, text-fig. 1, 2. [Late Ordovician desmidoporidae from the Ormulez Mountains (Kolyma River basin).]


1974b, O koloniyakh tabulyat: in B. S. Sokolov et al. (eds.), Vremennyye razrez y mezhdru rodami Sarcinula, Calapoeia and Lyopora (Tabulata): Eesti NSV Tead. Akad., Toim., Keemia, Geol., v. 24, no. 2, p. 130-136, 2 pl. [Relations between the genera Sarcinula, Calapoeia and Lyopora (Tabulata).]


1857, Der Jura: part 4, p. 577-823, pl. 73-100, H. Laupp (Tübingen).


Radugin, K. V., 1938, Coelenterata srednego devona okrestnostey s. Lebedyanskogo: Tomskago Ind. Inst., Izv., v. 56, no. 6, p. 49-109, text-fig. 1, 2, pl. 1-5. [Middle Devonian Coelenterata of the environs of Lebedyansk.]

Rafinesque, C. S., 1815, Analyse de la nature ou tableau de l'univers et des corps organisations: 224 p., the author (Paleorno.).


v. IX. [Russian; not seen by author, quoted from Fischer, 1970, p. 68.]


1962, Novyy rod korallov Rugosa iz nizhnego turne Priipolyarnogo Urala: Nauchno-issled. Inst. Geol. Arkutki (NIIGA), Sbornik stey po pale­ontologii i biostratigrafi, no. 27, p. 5-10, pl. 1, 2. [New genus of rugose coral from the lower Turnaisian of the Polar Ural.]


**Rothpletz, A., 1892, Die Perm­-­Trias­-­Jura­formationen auf Timor und Rotti im indischen Archipel: Palaeontographica, v. 39, p. 57-106, text­fig. 1-4, pl. 9-14.


1975b, Provinciiality of Late Paleozoic invertebrates of North and South America and a modified intercontinental reconstruction: Pac. Geol., v. 10, p. 79-94, text­fig. 1-3.


1957, Considerations on Middle and Upper Devo­nian Thamnophyllidae Soshkina in Poland: Acta
References


1869, Geology of Tennessee: Tennessee Gen. As-


1960, Blastogeny and individual variations in tetra-

colony from sOltt/lern Hall,

Marisastridae n. fam. and Marisastra n. gen. (Devonian corals): Acta Palaontol. Polonica, v. 5, no. 1, p. 3-64, text-fig. 1-43.


1965a, Faviphyllum rugosum Hall, 1852 (Antho-


1975, Coelenterata of the Aridland Formation (Miss-


—, Bamber, E. W., & Armstrong, A. K., 1975, Endemism and similarity indices: Clues to the


Sayutina, T. A., 1966, Suborder Acrophyllina: in Nizhnellamennougoinye korally, p. 111-123, text-fig. 1-4, pl. 1,2. [Lower Carboniferous Tabulata from Kuznetsk Basin (brief description).]


1927, Prinzipienfragen der biologischen Systematik: Paläontol. Z., v. 9, p. 122-166, text-fig. 1.


1820, Die Petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung seiner Sammlung . . . erläutert: Ixii + 437 p., Becker (Gotha).


1885c, Dünn- und Zoanschiffe von Zoaantharia rugosa, Zo-
antharia tabulata und Stromatoporiden aus dem paläontologischen Museum der Universität Bonn, Aussteller Professor Dr. C. Schletter in Bonn: p. 52-56, Catalogue de l'Exposition géologique, Congrès géol. int., 3rd sess. (Berlin).


Shimizu, Saburo, Ozaki, Kin-emon, & Obata, 1953, Principles of invertebrate paleontology: [Types of vegetative reproduction in the Altay-Sayan mountain region and the Urals.]


Shuktenberg [Stuckenbery], A. A., 1888, Korally i mishkani verkhnego yarusa srednerusskogo kamennougalnogo izvestnyaka: Geol. Kom., Tr., v. 5, no. 4, p. 1-54, pl. 1-4. [Corals and bryo­zoans of the upper strata of the central Russian Carboniferous limestone.]

1895, Korally i mishkani kamennougalnogkh otlo­zheniy Urala i Timana: Geol. Kom., Tr., v. 10, no. 3, p. 1-244, pl. 1-24 (incl. German transl.). [Corals and bryo­zoans of the Carboniferous deposits of the Urals and Timan.]

1898, Obschaya geologicheskaya karta Rossii, Litt. 127y: Geol. Kom., Tr., v. 16, no. 1, p. 1-362, text-fig. 1, pl. 1-5. [General geological map of Russia, Sheet 127u.]

1904, Korally i mishkani nizhnegoty otsele sredneruss­kogo kamennougalnogkh izvestnyaka: Geol. Kom., Tr., n.s., v. 14, p. 1-109, pl. 1-9. [Corals and bryo­zoans of the lower part of the central Russian Carboniferous limestone.]

References


1925, On a meandrine form of Chaetetes: Geol. Mag., v. 62, p. 319-322, pl. 14, 15.


1933b, On certain Carboniferous corals with epithe- cal scales: R. Irish Acad., Proc., v. 41 (B), no. 13, p. 171-178, pl. 9, 10.


Sokolov, B. S., 1939, Stratigraficheskoe znachenie it tipy Chaetetidae karbona SSSR: Akad. Nauk SSSR, Dokl., v. 23, no. 4, p. 409-412. [Strati­ graphical importance and types of Chaetetidae of the Carboniferous of the USSR.]


1947b, Noyey rod Fistulimurina gen. nov. iz gruppy Chaetetida: Akad. Nauk SSSR, Dokl.,
v. 66, no. 9, p. 957-960, text-fig. 1-3. [New genus Fistulimurina n. gen. of the group Chaetetida.]


1949, Tabulata i Heliolitida: in Atlas rukovodstvujushchikh form iskopaemykh faun SSSR, II: Silurijskaya sistema: p. 75-98, text-fig. 2-20, pl. 6-10, Gosgeoltekhiizdat (Moscow). [Tabulata and Heliolitida: in Atlas of the index forms of the fossil fauna USSR.]

1950a, Sistematika i istoriya razvitiiya paleozoiskikh korallov Anthozoa Tabulata: Vopri. Paleontol., v. 1, p. 134-210, text-fig. 1-5. [Systematics and history of the development of the Paleozoic corals Anthozoa Tabulata.]


1960, Perm'kie korally yugo-vostochnoy chastii Omolonskogo massiva (e obschim obzorom pterofilloidnykh rugoz): Paleontol. Sb., v. 2, VNIGRI, Tr., v. 154, p. 38-77, text-fig. 1, 2, pl. 1-3. [Permian corals of the southeastern parts of the Omolon massif (with general review of pterofilloid Rugosa).]


1965a, Tabulatomorfnye korally ordovika i silura SSSR: Tr. I Vesovyuznego simpoziuma po izucheniyu iskopaemnykh korallov, pt. 1, 138 p., illus., Nauka (Moscow). [Tabulatomorph corals of the Or­ dovician and Silurian in the USSR.]

1965b, Tabulatomorfnye korally devoni i karbona

1960, Turenykie korally Rugosa i ikh vaziomootno-
cheniya s devonskimi: Akad. Nauk SSSR, Komil
1-12, pl. 1-6 (Syktyvkar). [Tournaisian rugose corals and their interrelations with the De-
vonian ones.]

—, Dobrolyubova, T. A., & Porfiryev [Por-
firiev], G. S., 1941, Permkie Rugosa evropesko-
chasti SSSR: Paleontologiya SSSR, Monogr., v. 5,
pt. 3, no. 1, 304 p., 44 text-final., 63 pl. [Permian Rugosa of the European parts of the USSR.]

——, —, & Kabakovivitch, N. V., 1962, Pod-
klass Tetracoralla, Chetyryekhluchevye korally: in Yu. A. Orlov (ed.), Osnovy Paleontologi,
B. S. Sokolov (ed.), v. 2, Gubiki, arkheotsiaty,
chishechnopolstnye, chervi, p. 286-356, text-final.

Sowerby, James, 1814, The mineral conchology of
Great Britain: v. 1, pt. 13, p. 153-168, pl. 68-
73, B. Meredith (London).

Spaskiy, N. Ya., 1955, Korally Rugosa i ikh
znachenie dlya stratigrafii srednego devona
zapadnogo sklona Urala: Vses. Neft. Nauchno-
isled. Geol.-Razved. Inst. (VNIGRI), Tr., n.s.,
v. 90, p. 91-167, text-final. 1, pl. 1-27. [Rugose corals and their significance for the stratigraphy of the Middle Devonian of the western slope of the Ural.s.]

1959, Korally Rugosa v nizhnem i srednem devone
Urala: Leningrad Gorn. Inst., Zap., v. 36, no. 2,
p. 15-47, text-final. 1-26, 3 tables. [Rugose corals from the Lower and Middle Devonian of the Ural.s.]

1960a, O verkleye granite eyelskogo yarusa na
Urale po faune chetyryekhluchevykh korallov: Leningrad Gorn. Inst., Zap., v. 37, no. 2, p. 83-
98, text-final. 1-4. [On the upper boundary of the Eifelian Stage in the Ural.s, based on the tetracoral fossil fauna.]

1960b, Devonskie chetyryekhluchevye korally verkh-
noev Amura i voshtochnogo Zabaykalya: Lening-
rad Gorn. Inst., Zap., v. 37, no. 2, p. 99-107,
pl. 1-6. [Devonian tetracoral corals of the Upper Amur and eastern Transbaykalya.]

1960c, Devonskie chetyryekhluchevye korally Rud-
nogovo Altaya: in Paleontologichesko obosnovanie
stratigrafiyi paleozoika Rudnogo Altaya, v. 3, 143
p., 1 text-final., 35 pl., Gosgeoltekhiizdat (Moscow). [Devonian tetracoral corals of the Rudny Altay: in Paleontological basis of the Paleoicz stratig-
raphy of the Rudny Altay.]

1964, Rodovye soobshchestva kak pokazatel uro-
enny razvitiya (na primere chetyryekhluchevykh kor-
allov devona): in Voprosy zakonomernostey i
form razvitiya organichekogo mira, Tr. VII sess.
Vses. Paleont. Obschh., p. 57-62, text-final. 1-6. [Generic associations as an index of level of
development (exemplified by Devonian tetradi-
rate corals): in Questions of regularities and of
forms of development of the organic world.]

1965a, Osnovy sistematiyi devonskih chetyryekh-
luchevykh korallov: in B. S. Sokolov & A. B.
Ivanovskyi (eds.), Rugozy paleozoika SSSR, Tr.
I Vesoyuznogo simpoziuma po izucheniyu isko-
paemykh korallov SSSR, v. 3, p. 80-90, text-

1965b, Rannevedonskie i eyelskie chetyryekh-
luchevye korally Zhungarskogo Alatau: Lening-
rad Gorn. Inst., Zap., v. 49, no. 2, p. 18-30,
text-final. 1-5. [Early Devonian and Eifelian
tetracoral corals of the Zhungarian Alatau.]

1967, Puti rasprostraneniya devonskih chetyryek-
luchevykh korallov: Leningrad Gorn. Inst., Zap.,
v. 53, no. 2, p. 51-68, 1 text-final., 12 tables. [Migration routes of Devonian tetracoral cor-
als.]

1968, Zakonomernosti prostranstvenno-vremennogo
rasprostraneniya rodov i vidov (na primere
chetyryekhluchevykh korallov devona): Ezheg.
Vses. Paleontol. O-va, v. 18, p. 3-14, text-final. 1-4,
table. [Regularities in the space-time distribu-
tions of genera and species (exemplified by De-
vonian tetracoral corals).]

1969, Podklass Tetracoralla ili Rugosa: in E. A.
Modzalevskaya (ed.), Polevoy atlas silurskykh,
devonskikh i rannekamennougolnykh faun Dalnego
Vostoka, p. 27-34, 5 text-final., pl. 6, 7, 27-31,
Nedra (Moscow). [Subclass Tetracoralla or
Rugosa: in Field atlas of the Silurian, Devonian,
and Early Carboniferous of the Far East.]

1971a, Opredelitel rodov devonskih chetyryekh-
luchevykh korallov, osnovannyy na kodirovani-
priznakov: in A. B. Ivanovskyi (ed.), Rugozy
i stomatoporoidei Paleozoika SSSR, Tr. II Vesoyu-
znogo simpoziuma po izucheniyu iskopaimykh
corallov SSSR, no. 2, p. 56-71, tables 1-3 and
key. [Determination of genera of Devonian
tetracoral corals based on the encoding of fea-
tures.]

1971b, Dva novykh devonskih roda kolonialnykh
tetrakorallov Uralo-Tyanshanskoy provintsii:
Leningrad Gorn. Inst., Zap., v. 59, no. 2, p. 23-
25. [Two new Devonian genera of colonial
tetracoral of the Ural—Tian-shan province.]

1974, Dialeklichesko edinstro prostranstven-
vremennogo zakonomernostey evolutsii (na
primere chetyryekhluchevykh korallov): Lening-
rad Gorn. Inst., Zap., v. 67, no. 2, p. 127-135,
text-final. 1-4, tables 1-6. [Dialectical uniformity of
space-time regularities of evolution (exempli-
fied by tetracoral corals).]
References


[New species of Devonian tetraradial corals of the USSR: in New species of fossil plants and invertebrates of the USSR.]


———, & Tsyganko, V. S., 1971, Kolonialnye tistimorfy: in Mezhdunarodnyy paleontologicheskii simposium po korallam (Coelen­terata), Tezisy Dokladov, p. 84-85 (Novosibirsk). [Colonial cystimorphs: in International paleontological symposium for corals (Coelenterata).]


1849, Die Versteinerungen des Uebergangsgebirges der Eifel: 34 p., F. Lintzsche (Trier).


Strand, Embrik, 1928, Miscellanea nomenclatorica zoologica et palaeontologica I-II: Arch. Naturgesch., v. 92 (1926), no. 8, p. 30-75.


ture of the septal system in some tetracorals. 


1966, Spongophyllidae from the Devonian Garra Formation, New South Wales: Paleontology, v. 9, pt. 4, p. 544-598, text-fig. 1-20, pl. 85-96.


1938, Upper Middle Devonian rugose corals of the Nevada Limestone: J. Paleontol., v. 12, p. 478-485, pl. 58, 59.


1948d, A revision of some Mississippian tetracoral genera: J. Paleontol., v. 22, p. 68-74, pl. 17.


1968, A redescription of the Middle Silurian com-


1964, On the occurrence of the unusual tabulate coral Antholites speciosus Davis in the Devonian of New York: J. Paleontol., v. 38, p. 1000-1001, text-fig. 1A-D.


Sutherland, P. K., 1954, New genera of Carboniferous tetracorals from western Canada: Geol. Mag., v. 91, no. 5, p. 361-371, text-fig. 1-3, pl. 9, 10.


[?Tetracorals of the Skalian and Borschchovian horizons in Podolia: in Silurian-Devonian fauna of Podolia.]


[Tetraporals of the Grebeni horizon of Vaggach: in Stratigraphy and fauna of the Silurian deposits of Vaggach.]

1971, O range semeystva n tetrakorallov: Vopr. Paleontol., v. 6, p. 15-18. [On the range of families in the tetracorals.]


[Some late Eifelian Rugosa from Transcaucasia: in New species of Paleozoic bryozoans and corals.]


1975, Nouvelles données sur le tabulé énigmatique Syringogalcyon Termier & Termier, 1945: Geol. Paleontol. J., v. 9, p. 85-93, text-fig. 1-5, pl. 1, 2.


Thevenin, Armand, 1906-1907, in Marcellin Boule, Types du Prodrome de Paléontologie stratigraphique universelle de d’Orbigny: Ann. Paléont., v. 1 (1906), Silurien supérieur [corals], p. 167-169 (7-9), pl. 12, 13 (3, 4); Devonien [corals], p. 196 (16), pl. 21 (5); Carboniférien [corals], pl. 22 (6); v. 2 (1907), Devonien [corals], p. 89 (17); Carboniférien [corals], p. 90 (18) (complete work by Boule: 1906-1923), Masson et Cie (Paris).


Thomson, James, 1874, Descriptions of new corals from the Carboniferous Limestone of Scotland: Geol. Mag., v. 11, p. 556-559, pl. 20.

1875, Descriptions of new corals from the Carboniferous Limestone of Scotland: Geol. Mag., n.s., dec. 2, v. 2, p. 273 (abstr.).


1882, On a new family of rugose corals, including the genera Cyclophyllum, Aulophyllum, and on


Tolmachev [Tolmachoff], I. P., 1924, Nizhekanennougolnaya fauna Kuznestkogo uglenosnogo basseyna: Geol. Kom., Materialy po obshchey i prikladnoy geol., v. 25, pt. 1, p. 4-1-320+1-12, pl. 1-5, 8-11, 18-20. [Lower Carboniferous fauna of the Kuznetsk coal basin.]


1933, New names for two genera of Carboniferous corals: Geol. Mag., v. 70, p. 287.

Tomes, R. F., 1887, On two species of Palaeozoic Madreporaria hisberto not recognized as British: Geol. Mag., dec. 3, v. 4, p. 98-100, text-fig. 1, 2.


Trost, Gerard, 1840, Organic remains discovered in the state of Tennessee by G. Troost, all of which are in his cabinet: 5th Geol. Rep. to 23rd General Assembly, Tennessee, p. 45-74 (Nashville).

Tseng Ting Chien, 1948, Two new genera of Permian corals: Palaeontol. Novit., no. 3, p. 1-6, text-fig. 1, pl. 1, 2.


Tsyganko [Cyganko], V. S., 1967, O poyavlenii osevoy kolonny u devonskikh koralov: Akad.


Ünsalaner, Cahide (Ünsalaner-Kiragli), 1951, Some Upper Devonian corals and stromatoporoids from South Anatolia: Türkiye Jeol. Kurumu, Bül., v. 3, no. 1, p. 131-146, pl. 1, 2 (English, Turkish summary).


1963b, Novye sredne-devonskie vidy semeystva Zono­phyllidae and Digonophyllidae v Zakavkazye: Akad. Nauk SSSR, Paleontol. Zhurnal, 1963, no. 4, p. 30-38, text-fig. 1-3, pl. 4. [New Middle Devonian species of the families Zonophyllidae and Digonophyllidae from Transcaucasia.]

1968, Devonskixh korally tisitifilidy Zakavkazya: Akad. Nauk SSSR, Paleontol. Inst., Tr., v. 113, p. 1-100, text-fig. 1-21, pl. 1-20, tables 1, 2. [Devonian corals: Cystiphyllidae of Transcaucasia.]


1974, Razvitiya korally na rubezhe rannego i
References F729


1972b, Community ecology of the Middle Ordovician Black River Group of New York State:

rgangsgebirge aus dem Rheinischen Dachschliefer . . .": Ber. Offenbacher Ver. Nat., p. 37, 1 Abb., Offenbach. [Not seen by author.]


Volger, O., 1860, Teleostetus pramaeveus Volger. "Erste Spurn eines Graenthesches im Ueber-
Coelenterata—Anthozoa


1947b, Notes on some Permian rugose corals from Timor: Geol. Mag., v. 84, p. 334-344, text-fg. 1-4, pl. 9.


1957, Upper Palaeozoic tetracorals from the Sanchiang province of East Tibet and Teli-in-ha district of Tungan: Palaeontol. Novit., no. 10. [Not seen by author.]


1959b, Middle Devonian anuloporid corals from the Traverse Group of Michigan: J. Paleontol., v. 33, p. 793-808, pl. 108-111.


1975, Patterns of increase in coenosoidal haliotid corals: Alcheringa, v. 1, no. 1, p. 31-36, text-fg. 1-5.


1922b, Beiträge zur Kenntnis der Mesophyllen: Paläontol. Z., v. 4, p. 48-63, pl. 1, 2.


1932, Die Lymphyllidae . . . : Palaeontographica, v. 76, pt. 4-6, p. 95-120, pl. 9-14.


1913, in J. Böh m & W. Weissermel, Ueber tertiäre Versteinerungen von den Bogenfelsern Diamantjeldern, II. Tabulaten und Hydrozoen, Beitr. zur Geol. Erforschung der Deutschen Schutzgebiete, Heft 5, 111 p., 84 pl. [Not seen by author.]


References


1944, New tabulate corals from the Pennsylvaniaian of Texas: J. Paleontol., v. 18, p. 259-262, pl. 40, 41.


1967, Corals as bathometers: Mar. Geol., v. 5, p. 349-365, text-fig. 1-11, 1 table.


1973, What is a colony in anthozoan corals?: in R. S. Boardman, A. H. Cheetham, & W. A. Oliver, Animal colonies, p. 29, Dowden, Hutchinson, & Ross (Stroudsburg, Pa.).
grauwacke (Unterdevon) des Unterharzes: Z. Geol. Wiss., v. 1, no. 1, p. 45-65, text-fig. 1-7, pl. 1, 2.


1974b, Das Rugosa-Genus Antiphylmus Schindele, 1920 (Unternamur, Oberschlesisches Stein­kohlenbecken): Čas. min., geol. v. 19, no. 4, p. 345-365, text-fig. 1-8, pl. 1.


1880, Contributions to invertebrate paleontology, nos. 2-8: U.S. Geol. Surv. Territor., 12th Annu. Rep., pt. 1, p. 3-171, pl. 11-42. [Advance printing of 1883 publication; not seen by author.]


1904, Description of a new genus and species of rugose corals from the Silurian rocks of Manitoba: Ottawa Nat., v. 18, p. 113-114.


1866, The Grand Traverse region: iv + 97 p.,
Microstrukturnye osobennosti stenok eyal-
skich i zhihestikikh tabulat i khzetetid Urala: 
in B. S. Sokolov and V. N. Dubatolov (eds.), 
Tabulatomorfnye korally devoni i karbona SSSR, 
Tr. I Vsesoyuznogo simpoziuma po izucheniyu 
iskopamykh korallov, pt. 2, p. 12-24, text-fig. 
1-8, pl. 4, 5, Nauka (Novosibirsk). 
[Micro-
structural wall features of Eifelian and Givetian 
tabulates and chaetetids in the Urals.] 

1970, Nekotorye vetvisty te tabulat i iz siluriyskikh 
oltosheniy vostochnogo sklona Urala: 
in G. G. Astrovna & I. I. Chudinova (eds.), Novy ve 
paleoziyskikh mshanok i korallow, p. 87-96, 
text-fig. 1-4, pl. 24, 25, Nauka (Moscow). 
[Some branching tabulate corals from Silurian 
deposits of the eastern slope of the Urals: In 
New species of Paleozoic bryozoans and corals.] 

1971, Parallellism v razvitii siluriyskikh i devon-
skich tabulat Urala: 
Mehdzhunarodny paleontologicheski simpozium po korallam (Coelenterata), 
Tezisy Dokladov, p. 109-110 (Novosibirsk). 
[Parallelism in the development of Silurian and Devonian Tabulata from 
The Urals: In International paleontological symposium 
for corals (Coelenterata).] 

1972, Gruppa Chaetetida, Podklass Tabulata: in 
A. I. Khozalevich (ed.), Kishhechnopolostnye i 
brakhipody zhivetskikh otlozheniy vostochnogo 
sklona Urala, p. 43-98, pl. 13-34, text-fig. 1-18, 
Nedra (Moscow). 
[Group Chaetetida, subclass Tabulata: in Coelenterata and Brachiopoda of 
The Givetian deposits of the eastern slopes of 
The Urals.] 

1977, Novyje tabulat i geliolitoidei silura vosto-
chnogo sklona Urala: in V. P. Sapelnikov & B. I. 
Chuvasov, Paleontologiya nizhnego paleozoya 
[New Silurian Tabulata and Gelinolitoidea 
from the eastern slope of the Urals: In Paleontology 
of the Lower Paleozoic of the Urals.] 

Yang Shengwu, Kim [Jin] Chunyai, & Chow 
Palaeontology of the Southwestern Regions of 
China, Guizhou [Kweichow], v. 1, Cambrian-
Devonian, compiled and written by the Guizhou 
[Kweichow] Stratigraphy and Palaeontology work 
team, p. 161-251, pl. 56-93, Geological Publishing 
House (Peking). [Chinese.

Yavorskiy, V. I., 1947, [Quelques Hydrozoaires, 
Tabulés, et Algues paleozoiques et mésoiques]: 
Paleontol. SSR, Monogr., v. 20, no. 1, 30 p., 
12 pl. [Russian. Not seen by author; quoted 
from Fischer, 1970, p. 69.] 

Yi Nung [Lin Baoyu], 1974, Preliminary study on 
stratigraphical distribution and zoogeographical 
province of Ordovician corals of China: Acta 
Geol. Sinica, 1974, no. 1, p. 5-22, text-fig. 1, 2, 
5 tables. [Chinese, English abstr.] 

Yoh, S. S., 1927, On a new genus of sisyphoral 
coral from the Carboniferous of Chili and 
v. 5, no. 3-4, p. 291-293, pl. 1. 

1929a, On a new species of cistiohyalid coral from 
Lower Carboniferous of central Kwangsi Pro-
vince: Kwangtung and Kwangsi, Geol. Surv., 

1929b, Some new corals from the Tetrapora bed of 
North Kwangsi Province: Kwangtung 
Kwangsi, Geol. Surv., Spec. Publ., no. 2, p. 1-13, 
pl. 1, 2. 

1931, A new generic name for the coral Systeroporo-
llidum Grabau and Yoh, 1929: Am. J. Sci., 
dec. 5, v. 21, p. 79. 

1937, Die Korallenfauna des Mitteldevons aus der 
Provinz Kwangsi, Siidchina: Palaeontographica, 
v. 87, Abt. A, p. 45-76, pl. 4-9. 

1959, Some new coral species from the Ordovician 
of Kweichow Province, southwestern China: 
Peking, Natl. Univ., Acta Sci. v. 4, p. 404-414, 
pl. 1-4. [Not seen by author.] 

1961, On some new tetracorals from the Carbonif-
erous of China: Acta Palaeontol. Sinica, v. 9, 
no. 1, p. 1-17, pl. 1-3. [Chinese, English abridgement.

---, & Huang T. K., 1932, The coral fauna of the 
Chikia Limestone of the Lower Yangtze 
Valley: Palaeontol. Sinica, ser. B, v. 8, no. 1, 
p. 72, pl. 1-10. 

Yoh Sen Shing, & Wu Wang Shih, 1964, [Corals 
(Tetracorals)]: 234 p., 243 text-fig., 5 pl., 

Yonge, C. M., 1930, Studies on the physiology of 
corals, I, Feeding mechanisms and food: Great 
Barrier Reef Expedition 1928-29, Sci. Reps., v. 1, 
p. 13-57, text-fig. 1-34, pl. 1, 2. British Museum 
(Natural History) (London). 

1940, The biology of reef-building corals: Great 
Barrier Reef Expedition 1928-29, Sci. Reps., v. 1, 
p. 353-391, pl. 1-6, British Museum (Natural 
History) (London). 

v. 169, p. 329-355, text-fig. 1-5. 

Yü C. C., 1931, The correlation of the Fengninian 
System, the Chinese Lower Carboniferous, as 
based on coral zones: Geol. Soc. China, Bull., 
v. 10, p. 1-30, text-fig. 1-5. 

1934, Lower Carboniferous corals of China: 
1-211, pl. 1-24. 

1937, The Fengninian corals of south China: Nan-
kung Inst. Geol. Paleontol., Mem., v. 16, p. 1-111, 
pl. 1-12. 

1963, O svazyi rodov Cystophrentis s shestiluchecami 
korallami i ustanovlenie otryada Mesocorallia 
Yü (ord. nov.) i semyeystva Cystophrentidae Yü 
(fam. nov.): Acta Palaeontol. Sinica, v. 11, no. 
3, p. 307-318, text-fig. 1-5, pl. 1. [On the con-
References


Zhurnal, 1967, no. 3, p. 118-120, text-fig. 1. [Spumacoelites gen. nov. (Tabulata) from the Llandovery of the Taymyr.]


APPENDIX: New Taxa Noted after Completion of MS

The following taxa of rugose and tabulate corals, which came to the author’s notice after the manuscript had gone to press, are listed in alphabetical order. Names considered valid are in bold face type; those considered invalid are in italic. Works not included in the appendix reference section are in the main References.


Astrophyllina ZHAO & WANG in WANG, 1978, p. 179 [*A. shiqianense, OD; +Gcr 1201, 1202, GB, Guiyang; U.Perm., China, Wuguxi, Daozhen, Keqiao, Sichuan (Szechwan)]. Cerioid; major and minor septa thin and discontinuous in wide dissepimentarium, major septa extending irregularly almost to axial region; tabulae thin, tabular floors slightly sagging; ?(no axial structure). [Diagnosis tentative, from illustrations.] L.Sil., Asia (China). Subclass Rugosa, order Stauriida, suborder Strep­telasmatina, family Strep­telasmatidae, ?subfamily Dinophyllinaceae.

Changiangophyllina FAN, 1978, p. 166 [*C. hexagonale; OD; +Scr 202, IGMR, Chengdu; L.Perms., Changjianggou, Shansi, Guanyuan, Sichuan (Szechwan)]. Cerioid; major and minor septa thin and discontinuous in wide dissepimentarium, major septa extending irregularly almost to axial region; tabulae thin, tabular floors slightly sagging; ?(no axial structure). [Diagnosis tentative, from illustrations.] L.Perm., Asia (China). Subclass Rugosa, order Stauriida, suborder Lonsdaleiina, family Petalaxidae.

Chuanbeiphyllum HE, 1978, p. 138 [*C. hongyansiense, OD; +Scr 626, IGMR, Chengdu; U.Dev., China, Hongyansi, Guanyuan, Sichuan (Szechwan)]. Questionably a synonym of Philipp­astraea d’Orbigny, subclass Rugosa, order Stauriida, suborder Lonsdaleiina, family Waagenophyllidae, subfamily Waagenophyllinaceae.

Clitostracion NAKAI, 1980, p. 140 [*A. yoko­ku­rae­na; OD; +R30420, UH, Sapporo; Visean, 600 m. NW. of Buntoku, Ochi-cho, Takaoka-gun, Kochi Prefect.]. L.Carb.(up.Visean), Asia (Japan). Subclass Rugosa, order Stauriida, suborder Lontostracionia, family Waagenophyllidae, subfamily Waagenophyllinaceae.

Crassicyclus SOTO, 1978, p. 426 [*C. deniseptatus; OD; +17118, DPO, Oviedo; low. Gitvet, La Vecilla, Léon, Spain]. Solitary, discoid, small; epithecal base with central apex; calice with shallow axial depression and cardinal fossula; septa coarse, arranged in quadrants, distal edges sharp or spiny, minor septa ?contratent. [M.Dev. (Gitvet.), Eu.(Spain). Subclass Rugosa, order


Stauriida, suborder Metriophyllina, family Hadrophyllidae.

**Cystomichelinia (Protocystomichelinia)** Yang, 1974, work not traced, quoted in Yang, 1978, p. 196

(type, *C. (P.) stenocystosa*; OD; tGct 40, 41, GB, Guiyang; L.Carb., China, Pingxi, Chaihung, Weibao Shan, Yunnan). Questionably a synonym of *Michelinia de Konincki*, subclass Tabulata, order Favosita, suborder Favositina, superfamily Favovitaceae, family Melicheliniae, subfamily Melicheliniae.

Debnikella Rozkowska, 1979, p. 25 [*D. formosa*; OD; tTc/15, University Adam Mickiewicz, Poznan; Frasn., stratum with *Phillipsa*, Dębik, Zarnówczany Dól, Silesia-Cracow upland]. "Large solitary corallite. Septa numerous, radially arranged with fan-shaped trabeculae of the rhipidalcanthine type; dissepimentarium everted, broad, without horseshoe dissepiments; tabulae incomplete, tabularium distally concave." Subclass Rugosa, order Stauriida, suborder Columnarina, family Diphyllidae.


Entelophyllia He, 1978, p. 111 [*E. dandedouguensis*; OD; tScr 356, IGMR, Chengdu; U.Sil., Dandedougu, Yiwa, Gansu (Kansu)]. Solitary; septa numerous, radially arranged, major somewhat withdrawn from axis, minor long; tabularium wide, tabular floors flat with downturned edges; dissepiments normal-concentric. [Diagnosis tentative, from illustrations.] U.Sil., Asia (China). Subclass Rugosa, order Stauriida, suborder Arachnophyllina, family Entelophyllidae.

**Favosichaetetes** Yang, 1978, p. 225 [*F. multi- porous*; OD; tGct 175, 176, GB, Guiyang; L.Carb., Huishui, Guizhou (Kweichow)]. Cerioid; side walls with large, oval pores; adaxial increase marked, bipartite, tripartite, or quadripartite. [Diagnosis tentative, from illustrations.] L.Carb., Asia (China). Genus of Favosichaetetidae Yang, 1978, see this appendix.

**Favosichaetidae** Yang, 1978, p. 225, Corallites very slender; side walls with large, oval pores; tabulae very thin; increase bi- to quadripartite. [Diagnosis tentative, from illustrations.] L.Carb. Subclass Tabulata, order Chaeataidaet.

Fedorowskicyathus Rozkowska, 1979, p. 36 [*F. similis*; OD; tTc/38, University Adam Mickiewitz, Poznan; Frasn., *Palmatolepis gigas* Zone, Kowala II road cut, Holy Cross Mts., Pol.]. "Solitary corallite with two orders of septa in the lumen; major septa twisted, commonly reaching the corallite axis; minor septa enter the tabularium; dissepiments elongated, flattened, axially inclined; tabularium domed, tabulae arranged in systems." Subclass Rugosa, family uncertain.


Gubbera Wright, 1979, p. 135 [*G. regina*; OD; tP88212, SU, Sydney; L.Dev., Sutcher Creek F., near Mudgee, New S. Wales] [=?*Cystiphyllum (Zonophyllum) Wedekind*, which see]. Subclass Rugosa, order Cystophyllida, family Cystophyllidae.

**Guizhouchaetetes** Yang, 1978, p. 228 [*G. furcatus*; OD; tGct 178, 179, GB, Guiyang; L.Carb., Miaoian, Wangdang, Guiyang, Guizhou (Kweichow)]. Cerioid; side walls with large, oval pores; adaxial increase marked, bipartite, tripartite, or quadripartite. [Diagnosis tentative, from illustrations.] L.Carb., Asia (China). Genus of Favosichaetetidae Yang, 1978, see this appendix.

Hemiplasmopora Osipanova, 1979a, p. 17 [*H. communica*; OD; 12727, coll. 3690, UpG, Dushanbe; low. Wenlockian, bed K, Zeravshan Ra.]. Hemispherical or tumoroid; tabularia closely spaced, with aureole of 12 coenenchymal tubules, or contiguous in places; septal elements fine spines or tubercles; tabulae curved, flat, or incomplete; in early stages of growth of corallum and in "light" zones in late stages, coenenchyme may be of proporoid dissepiments; elsewhere it is of plasmoporoid tubuli with continuous but zigzag walls. M.Sil. (Wenlock.), Asia (Tadzhik.). Subclass Tabulata, order Heliolitida, suborder Heliolititina, superfamily Proporicoi, family Plasmoportidae.

**Hexaphyllia (Crepidophyllia)** Y0 et al., 1978, p. 51 [*H. (C.) renuosa*; OD; tC65225, 65226, GC, Changchun; L.Carb., Visan, China, Yamansu, Hamai distr., E. Xingjiang (Sinkiang); inner ends of six septa conjoined in auloslike structure]. Add to synonymy of *Hexaphyllia Sutukenberg*, subclass Rugosa, order Heterocorallia, family Heterophyllidae.


**Kenelasma** Sytova, 1979b, p. 166 [*Kenophyllum holophragmoides* Ivanovskiy, 1963, p. 25; OD; t16, coll. 41, SNIIIGM, Novosibirsk; U.Ord.,
low beds Dolbor horizon, R. Stolbovaya, Sib. Platf.]. Trochoid or turbinate, large, only major septa noted; septa thick, long, reaching axis where they combine with thick tabulae to form axial complex; tabulae convex, fossula present. U.Ord., Asia (Sib. Platf.). Subclass Rugosa, order Stauriida, suborder Steptelastmatina, family Steptelastmatidae.


Kowalaeephyllum Rozkowska, 1979, p. 39 [K. excelsum; OD; †TeI/47, University Adam Mickiewicz, Poznan.; Frasn., Palaeotomas gigas Zone, Kowala II road cut, Holy Cross Mts., Pol.]. "Chonophyllloid corallites with axial bosses, and everted calicular platforms; septa in the lonsdaleoid dissepimentarium interrupted, naotic; in the inner dissepimentarium and in tabularium lamellar, rotated around the corallite axis; dissepiments elongated, flattened; tabulae incomplete, domed; lateral surfaces foliated; monacanths uni- and multiserial." U.Ord. (Frasn.), Eu. (Pol.-Belg.). Subclass Rugosa, order Stauriida, suborder Ketophyllina, family Endophyllidae.


Longmenshanophyllum He, 1978, p. 150 [type, L. gansuense, OD; †Scr 678, IGMR, Chengdu; L. Dev., China, Ganxi, Beichuan, Sichuan (Szechwan)]. Questionably a synonym of Ornatoophylllum Nikolaeva, subclass Rugosa, order Stauriida, suborder Arachnophyllina, family Enteophyllidae. Adds L. Dev. to genus range.

Majiaobaphyllum Fan, 1978, p. 190 [M. pracepsum; OD; †Scr 104, IGMR, Chengdu; L. Carb., Majaoba, Jiangyu, Sichuan (Szechwan)]. Solitary; septa long; axial structure of median plate and numerous irregular septal lamellae and conical tabellae; dissepiments lonsdaleoid; long cliniotabellae present between axial structure and dissepimentarium. [Diagnosis tentative, from illustrations.] L. Carb. (Visean), Asia (China). Subclass Rugosa, order Stauriida, suborder Lonsdaleina, family Axelophyllidae.


Mesoadeleolites Lin in Kim, 1978a, p. 75 [type, Subadaleolites ellipticus Lin & Yeh, 1975, work not traced, OD; †not traced; Sil., China]. Questionably a synonym of Subadaleolites Sokolov, subclass Tabulata, order Favoritida, suborder Alveolitina, family Alveolitidae, subfamily Alveolitinae.

Metamsassia Kim, 1978a, p. 86 [M. songpanensis; OD; †Scr 132, IGMR, Chengdu; M. Dev., Caotanggou, Huanglong, Songpen, Sichuan (Szechwan)]. Like Amassia but cerioid. [Diagnosis tentative, from illustrations.] M. Dev., Asia (China). Adds M. Dev. to range of Cryptolichenariidae. Subclass Tabulata, order Chaetetida, ?family Cryptolichenariidae.

Metasinopora Kim, 1978b, p. 148 [type, M. xinshaniae, OD; †Scr 187, IGMR, Chengdu; L. Perm., China, Chechuan, Xiushan co., Rongxi, Sanbai]. Questionably a synonym of Sinopora Sokolov, subclass Tabulata, order Auloporida, superfamily Auloporaceae, ?family Sinoporidae.

Molophyllum Onoprienko, 1979, p. 28 [M. adapertum; OD; †18, coll. 1408, BPI, Vladivostok; L. Carb., Toursnais, bed 21b, Ushurakchan horizon, Omolon massif, NE. USSR] [=Palaeosmilia Milne-Edwards & Haeime, which see]. Subclass Rugosa, order Stauriida, suborder Aulophyllina, family Palaeosmilidae.

Navoites Leleushus & Osipova, 1979a, p. 150 [N. simmetricus; OD; †64-42, coll. 1271, UpG, Dushanbe; Ashgill., Zeravshan Ra.]. Small, conical; tabularia widely separated, each with aureole of 12 tubuli similar in size to or smaller than other coenenchymal tubuli; septa 12, laminar processes commonly continuous with walls between the 12 aureolar tubuli; tabulae flat, curved, convex or seldom concave or inosculating; tubuli with continuous straight longitudinal walls and with flat or curved diaphragms. U.Ord. (Ashgill.), Asia (Tadzhik.). Subclass Tabulata, order Heliolitida, suborder Heliolitina, superfamily Helioliticae, family Pseudoplasmoporidae.


Nitkowiepora Hladil, 1980, p. 102, nom. subst. pro Crasialveolitella Hladil, 1974, p. 219, non Ch., 1966, p. 122 [N. orbicularis; OD; †sample 1 and thin section 12,388, Geol. Surv., Brno; up.
Cravenia regul 1974, p. 168, aD; YU, Eu.(USSR-Pol.). Subclass Rugosa, order pronini LELESHUS, subclass Tabulata, order Helio YII (Scr 86, IGMR, aD; tC65230, 65231, GC, Changchun; L. HUDSON, subclass Rugosa, KIM, 1978a, p. 37 [type, SOSHKINA, 1951, p. 61; Ysl. 1965, work not traced, et al., '...].


Parasiphonophylla ONOPRIENKO, 1979, p. 34 [*P. smirnovi; OD; t24, coll. 1408, BPI, Vladivostok; L.Carb., Tournais., Voronkhardemdy section, bed 5a, Omolon massif, NE. USSR] [=Kusbasroolest phyllum Dobrolyubova, which see]. Subclass Rugosa, order Stauriida, subclass rugosa, family Cyathopsidae.

Parathyssanophyllum FAN, 1978, p. 186 [*P. concavatabulatum; OD; t(Scr 81, IGMR, Chengdu; L.Carb., Majiaoba, Jiangyu, Sichuan)]. Like Dorlodotia but solitary. L.Carb.(Visean), Asia (China). Subclass Rugosa, order Stauriida, subclass Rugosa, order Heterocorallia, family Lithostrotionidae, subfamily Thyasphanellidae.

Pentaphyllia YU et al., 1978, p. 55 [type, P. regulare, OD; t(C65230, 65231, U.C., Changchun; L.Carb., Visean, China, Yansan, Hamai distr., Xingjiang (Sinkiang); septa five in tabularium)]. Add to synonymy of Hexasyphylla Sithucken, subclass Rugosa, order Heterocorallia, family Heterophyllidae.

Piceaphyllum ROZKOWSKA, 1979, p. 34 [*Neostringophyllum proninii SOHSHINA, 1951, p. 61; OD; t'sl. 9570; PIN, Moscow; Frasn., Pokrovsk, Central Ural]. "Subcylindrical corallites having peripheral ends of septa radially split, forming reticulose; minor septa locally reduced to short ridges, replaced by angulate dissepiments; tabulae horizontal; trabeculae charactephylloid." U.Dev. (Frasn.), Eu.(USSR-Pol.). Subclass Rugosa, order Stauriida, subclass Rugosa, order Heterocorallia, family Diaphylidae.

Plasmoporella (Mianyangophora) KIM, 1978a, p. 93 [type, P. (M.) mianyangensis, OD; tScr 146, IGMR, Chengdu; M.Sil., China, Mianyang, Chandi, ?Sichuan]. Questionably a synonym of Innapora LELESUS, subclass Tabulata, order Heliolitida, subclass Heliolitina, superfamily Proporicae, family Proporidiae.

Polygonaria FAN in WANG, 1978, p. 133 [*Donophyllium (Polygonaria) regularis; OD; t(Sscr 145, IGMR, Changdu; L.Carb., Songpan, Sichuan); [=Polygonalia FAN, 1978, p. 171, nom. nud.]. Ceroioid; major and minor septa long, major extending almost to axis; tabular floors updrawn axially to form weak axial structure lacking columnella; dissepimentarium with sporadic lonsdaleoid dissepiments. [Diagnosis tentative, from illustrations.] L.Carb.(Visean), Asia (China). Add L. Carb. to subfamily Yatsenginidae range. Subclass Rugosa, order Stauriida, subclass Lithostrotiina, family Lithostrotiidae, subfamily Yatsenginidae.


Protocaricinophyllum FAN, 1978, p. 186 [*P. zongchanggouense; OD; t(Scr 86, IGMR, Chengdu; Visean, Zongchanggou, Jiangyu, Sichuan)]. Solitary, with lonsdaleoid dissepimentarium; major septa withdrawn from thin medial plate; tabular floors low cones, somewhat updrawn at medial plate. [Diagnosis tentative, from illustrations.] L.Carb.(Visean), Asia (China). Subclass Rugosa, order Stauriida, subclass Lithostrotiina, family Lithostrotiidae, subfamily Thyasphanellidae.

Protocystiphyllum Hs, 1978, p. 159 [type, Cysticonophyllum crassum GE & YU, 1974, p. 168, OD; t22095, IGP, Nanking; L.Sil., China, Hubei]. Questionably a synonym of Cystiphyllum Lonsdale, subclass Rugosa, order Cystiphyllida, family Cystiphyllidae.

Pseudolacera KIM, 1978a, p. 37 [type, P. daguianeus, OD; tScr 2, IGMR, Chengdu; M. Sil., China, Daguan, Yunnan]. Add to synonymy of Palaecorolites LELESUS, subclass Tabulata, order Sarcinula, family Theciidae.

Rachaniephyllum ROZKOWSKA, 1979, p. 45 [*R. andreae; OD; t1429.11.21, IG, Warsaw; Frasn., Lublin reg., borehole Rachanie IG-1, depth 1,805 m.]. "Phaceloid, laterally offsetting coralla with underdeveloped septa of two orders located on the external wall and on horizontal elements; spine-like monacanths; dissepiments elongated, flattened, deeply inclined axially; tabulae glose or plate-like, mainly concave." Subclass Rugosa, order Cystiphyllida, ?family Cystiphyllidae.

Ramiphylum WU & ZHANG, 1979, p. 32 [*R. firmatum; OD; t47313, IGP, Nanking; latest L. Carb., Xuchika F., Batang co., Sichuan (Szechuan)]. [=Amygdalophyllum DUN & BENSON, which see]. Subclass Rugosa, order Stauriida, subclass Aulophyllina, family Aulophyllidae, subclass Amygdalophyllinae.

Redstoneainae PEDDER, 1980, p. 608. Subclass
Rugosa, order Stauriida, suborder Ptenophyllina, family Ptenophyllidae.


Sichuanastrella HE, 1978, p. 134 [type, Billingsastrea (Sichuanastrella) cissispatula, OD; tScr 623, IGMR, Chengdu; M. Devon, China, Shawozi, Ganxi, Beichuan, Sichuan]. Questionably a synonym of Scruttonia CHEREPNINA, subclass Rugosa, order Stauriida, suborder Columnariina, family Alveolitidae. Adds M. Devon to genus range.

Smithicyathus ROZKOWSKA, 1979, p. 18 [*Phillipsastrea cincta SMITH, 1945, p. 43; OD; 19244, GSC, Ottawa; U. Devon, 5 mi. above falls, Redknife R., NW. Terr., Can.]. “Fan-shaped trabeculae of the rhipidacanthine type supplement the Smith's (1945: 43) diagnosis.” Phillipsastrea in which many of the corallites are separated by epitheca and which has very abbreviated septa, complete tabulae, and horse-shoe dissepiments. U. Devon. (Frasn.), N. Am. (NW. Terr.-E.). Subclass Rugosa, order Stauriida, suborder Columnariina, family Alveolitidae.

Sokoloviella SYTOVA, 1979a, p. unknown [*S. delicata; OD]. Work not seen by author. Subclass Rugosa.

Spongialveolites IJEN, 1980, p. 151 [*Alveolites intermixtus LECOMTE, 1939, p. 50; OD; tIGS 254, IRSN, Brussels; M. Devon, Co2d, pl. Couvin 8708]. Subclass Tabulata, order Favositida, suborder Alveolitina, family Alveolitidae.

Tabulophyllidae OSOPFRIECK, 1979, p. 6, synonym of Endophyllidae TORLEY, subclass Rugosa, order Stauriida, suborder Ketophyllina.


Trigonella ROZKOWSKA, 1979, p. 24 [*T. sandaliiformis; OD; tTcl/13, University Adam Mickiewicz, Poznan; Frasn., Palmaulepis gigas Zone, Jazwica quarry, Holy Cross Mts., Pol.]. “?Mari- sastrid corallite with Calceola shape; major septa long, spine-shaped in the dissepimentarium, thin in the tabularium; minor septa contrangent; cardinal septum short, thick; cardinal fossula triangular, open; counter septum elongated; dissepimentarium everted; tabularium broad, concave; fine structure of septa trabecular with fan-shaped trabeculae of the rhipidacanthine type.” Subclass Rugosa, order Stauriida, suborder Columnariina, family Disphylidae.


Yabanophyllum HE, 1978, p. 108 [*Y. irregularis; OD; tScr 529, IGMR, Chengdu; U. Shil., Yema, Yanbian, Sichuan]. Solitary; septa numerous, long, may be weakly convolute and somewhat thickened in tabularium; minor septa discontinuous in late stages; tabular floors irregularly arched; dissepimentarium wide, floors steeply inclined, dissepiments everted, inosculating in late stages. [Diagnosis tentative, from illustrations.] U. Shil., Asia (China, Guizhou-Sichuan). Subclass Rugosa, order Stauriida, suborder Alveolitina, family Alveolitidae.

Zhushanophyllum HE, 1978, p. 170 [*Z. yangpoensis; OD; tScr 738, IGMR, Chengdu; mid. L. Shil., Yangpo, Zhuchan, Hebei]. Phaceloid, septa acanthine, not reaching axis; minor septa distinctly shorter than major; tabulae flat, mesa-shaped or sagging, closely spaced; narrow dissepimentarium

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REFERENCES


1979b, Novye pozdnereordovikskie proporidy (Heliolitidea) sredney Azii: Akad. Nauk SSSR, Paleontol. Zhurnal, 1979, no. 4, p. 19-24, text-fig. 1, pl. 2. [New Late Ordovician proportions (Heliolitidea) from Central Asia.]


Sytova, V. A., 1979a, Nekotorye rugozy (koraly) iz siluaniyskih otlozhiy opornogo razresa "Eliget" (Tuva): Vopros. Paleontol. (Lenin-
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grad Gos. Univ.), v. 8, p. 29-37, 114-121. [Some Rugosa from the basal Silurian “Eligest” section (Tuva); from Referatny Zhurnal, not seen.]


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Italicized names in the following index are considered to be invalid; those printed in roman type, including morphological terms, are accepted as valid. The names of all taxa above the rank of superfamily are distinguished by the use of full capitals, and authors' names are set in large and small capitals. Page references having chief importance are in boldface type.

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