MARWICK, 1953, p. 45 *(nom. null.)*]. Large, gently biconvex; length and width subequal; each valve with shallow median sulcus bordered by a distinct ridge on either side; anterior commissure rectimarginate; macro-ornament lacking; micro-ornament consisting of growth lamellae only; pedicle valve interior with distinct dental plates and low median ridge; brachial valve interior with laterally directed spiralia and very large, spoon-shaped, non-striate cardinal process projecting far into pedicle valve; shell substance impunctate. *U.Trias.-L.Jur.*, N.Z.——FIG. 593,*1a,b*. **C. bisulcata*, U.Trias. (Rhaet.); *1a,b*, brach.v., ped.v., ×0.67 (816).——FIG. 593,*1c*. *C. tumida* HECTOR in THOMSON, 1913, U.Trias. (Rhaet.); brach.v. int., ×0.67 (816).

Cryptospirifer GRABAU, 1931, p. 405 [**C. lochengensis*; OD] [=*Lochengia* GRABAU, 1931, p. 478 (type, *L. holoensis*) *(nom. nud.)*]. Original generic description is so all-encompassing as to be meaningless. Type-species has never been illustrated. *Carb.*, China.

TEREBRATULIDA

By H. M. MUIR-WOOD, F. G. STEHLI, G. F. ELLIOTT, and KOTORA HATAI

[British Museum (Natural History); Western Reserve University; Iraq Petroleum Company, Ltd.; Tohoku University]

Brachiopods classed as terebratulids are a long-ranging, distinctive group of the phylum, differentiated by persistent characters of external form, by the punctate nature of their shell, and by internal features, chief of which is the relatively simple calcareous loop extending from the beak region of the brachial valve for support of the lophophore. In outline, the shells most commonly are teardrop-shaped, pointed at the posterior extremity, near which the valves are hinged and where a generally rounded foramen provides for egress of the pedicle, and rounded anteriorly where the valves open widest. The shell surface commonly is smooth, but it may be finely to somewhat coarsely plicate and marked by more or less prominent radially disposed rounded depressions (sulci) and elevations (folds) extending from the beak to the anterior shell margin.

This assemblage of brachiopods ranging in age from Early Devonian to Recent is assigned to the Order Terebratulida which contains three suborders—the Centronellidina, ranging from Lower Devonian to Permian, most primitive and earliest to appear; the Terebratulidina, well represented in the Paleozoic but primarily post-Paleozoic; and the Terebratellidina, sparsely represented in the Paleozoic but important in post-Paleozoic time.

The description of the terebratuloid brachiopods has been divided among authors in such a way that neither taxonomically bounded nor stratigraphically limited segments are separable readily according to authorship without undesirable overlap and offlap. Hence, an editorial organization which assigns precedence to the subordinal groups is adopted, with treatment of stratigraphically differentiated groups held secondary. The contributions of some authors are thus broken into parts, and cross references between chapters are needed in order to avoid repetition. These features should cause little inconvenience, however, to students of the Terebratulida who consult the *Treatise*.

TEREBRATULIDA—MAIN GROUPS

By H. M. MUIR-WOOD & F. G. STEHLI

A brief history of the classification of Brachiopoda given by MUIR-WOOD (1955) indicates subordinal and family-group classification (p. 85-93) extant at the time of her writing. Whereas genera distinguished as terebratulids were divided among four families (Centronellidae, Stringocephalidae, Terebratulidae, Terebratellidae) by SCHUCHERT in 1913, all placed in the single superfamily Terebratulacea, MUIR-WOOD recorded 15 families. Of these, eight (Centronellidae, Rhipidothyridae, Stringocephalidae, Meganteridae, Dielasmatidae, Terebratulidae, Cancellothyridae, Orthotomidae) were included in the superfamily Terebratulacea (also suborder Terebratuloidea) and seven (Zeilleriidae, Megathyridae, Platidiidae, Kraussinidae, Dallinidae, Laqueinidae, Terebratellidae) were assigned to the superfamily Terebratellacea (also suborder Terebratelloidea). All Paleozoic genera were classified as belonging to the Terebratulacea, which therefore was considered to contain the root stocks of the whole assemblage; the exclusively Mesozoic and Cenozoic Terebratellacea evidently comprised forms derivative from terebratulaceans. Descendants of Paleozoic families are an abundant component also of the Terebratulacea in Mesozoic and Cenozoic parts of the geologic column.

A systematic description of the whole assemblage as now distinguished follows.

Order TEREBRATULIDA Waagen, 1883

[*nom. correct.* Moore in Moore, Lalicker, & Fischer, 1952, p. 220 (*pro* order Terebratulacea Kuhn, 1949, p. 105, *nom. transl. ex* suborder Terebratulacea Waagen, 1883, p. 447)]

Punctate articulate brachiopods with functional pedicle, delthyrium more or less closed by deltidial plates or some similar structure; adult loop highly variable but basically centronelliform, terebratuliform, terebratelliform, or some derivative of one of these plans, and arising from cardinalia, or in part from median septum; dental plates present or absent; lophophore trocholophous, schizolophous, ptycholophous, spirolophous, or plectolophous; mantle canals with 2 or 4 main trunks in each mantle; small internal calcareous spicules in some families; Recent forms with pair of nephridia. *L.Dev.-Rec.*

The Terebratulida now are divided into three major groups ranked as suborders. As previously noted, these are named Centronellidina, Terebratellidina, and Terebratulidina. Four groups (Centronellidae, Stringocephalidae, Rhipidothyridae—*recte* Rhipidothyrididae—, Meganteridae—*recte* Meganterididae) formerly classed as belonging within the Terebratuloidea (=Terebratulidina) are the main representatives of the suborder Centronellidina. The Meganterididae, however, are treated as a subfamily of the Centronellidae. An additional family (Mutationellidae) completes the assemblage as currently defined. No genera of the Centronellidina are known to occur in deposits younger than Permian.

Suborder CENTRONELLIDINA Stehli, n. suborder

Archaic terebratuloids which primitively are characterized by centronelliform loop and possibly by crural plates but which, in advanced forms, bear more complex types of loop and may lack crural plates. *L.Dev.-Perm.*

The Centronellidina contain primarily the forms involved in the initial adaptive radiation of the Terebratulida during the Early and Middle Devonian. It includes also a few persistent but relatively unsuccessful stocks that failed to survive the Paleozoic. As appears commonly to be the case, successful descendent lineages which supplanted the Centronellidina became distinct during the Early Devonian, soon after beginning of the radiation. Both the Terebratulidina and Terebratellidina appear to have arisen from the family Mutationellidae, some members of which were characterized by extraordinary diversity of the loop.

The removal of the Centronellidina from the old, more inclusive Terebratuloidea makes the remnant Terebratulidina improved in cohesive attributes and focuses attention on comparing them with the Terebratellidina. Relationships of the two groups, which comprise the entirety of Mesozoic and Cenozoic terebratuloid faunas and their respective lines of descent are too poorly known to warrant any firm conclusions. If classificatory assignments given by Stehli are accepted, the origins of families in each of the three suborders date from the Early Devonian. The seeming disappearance before Triassic time of all genera of the Centronellidina and of the single Paleozoic family (Cryptonellidae) of the Terebratellidina, as contrasted with survival of at least one Paleozoic family (Dielasmatidae) of the Terebratulidina to the Late Triassic (numerous genera) or even Early Jurassic (*Propygope, Pseudokingena*), lacks compelling phylogenetic implications. In the *Treatise,* the Terebratulidina are placed next after the Centronellidina partly because this accords with traditional taxonomic arrangement, preceding the Terebratellidina, and partly because Paleozoic representatives of the former are much more numerous than those of the latter.

Suborder TEREBRATULIDINA Waagen, 1883

[*nom. correct.* MUIR-WOOD & STEHLI, herein (*pro* suborder Terebratulacea WAAGEN, 1883, p. 447)]

Brachial loop primitively and persistently short, of terebratulid, terebratulinid or chlidonophorid type in most forms but neotenously centronelliform or with complex derivative thereof in some Paleozoic forms, loop developed directly from cardinalia; median septum normally lacking; internal spicules usually developed in mantle, body wall, lophophore, and filaments of Recent species. *L.Dev.-Rec.*

The Terebratulidina contain four families (19 genera) which are confined to the Paleozoic (Cranaenidae, Heterelasminidae, Labaiidae, Notothyrinidae). The Dielasmatidae is the only family assemblage known to transgress the Paleozoic-Mesozoic boundary, containing 9 described Paleozoic genera and 15 Mesozoic genera. Eight families are exclusively Mesozoic or Mesozoic-Cenozoic (Terebratulidae, Pygopidae, Cancellothyrididae, Orthotomidae, Cheniothyrididae, Dictyothyrididae, Tegulothyrididae, Dyscoliidae). Genera of this latter group are overwhelmingly Mesozoic in distribution (1 Triassic, 48 Jurassic, 24 Cretaceous—total 73—as compared with 17 recorded from Cenozoic deposits); in addition, the Mesozoic dielasmatids include 14 Triassic forms and one or two Lower Jurassic genera.

Suborder TEREBRATELLIDINA Muir-Wood, 1955

Loop developed in connection with both cardinalia and median septum. *L.Dev.-Rec.*

As presently classified, the Terebratellidina contain the Paleozoic family Cryptonellidae, the Mesozoic superfamily Zeilleriacea, and the Mesozoic-Cenozoic superfamily Terebratellacea. STEHLI considers the Cryptonellidae as probably ancestral zeilleriaceans, but because of doubts expressed by others, this family is not here included in the superfamily. The Zeilleriacea contain the Zeilleriidae (21 genera) and Eudesiidae (1 genus). Assigned to the Terebratellacea are the six families Megathyrididae, Platidiidae, Kraussinidae, Dallinidae, Laqueidae, and Terebratellidae. Genera of this superfamily are chiefly Cenozoic (59 genera); described Mesozoic genera number 26.

For the Terebratulida as a whole, we still lack essential information concerning internal characters, especially of the Triassic genera, and consequently it is not now possible to shape a sound classification or to give a satisfactory outline of evolution. It is noteworthy that no hard and fast break in the sequence of these brachiopods is found at the end of the Paleozoic. Many of the Triassic forms seem to be related more closely to Paleozoic genera than to those of the Jurassic and Cretaceous, but much larger collections of Triassic species and genera need to be made and serial sections of them prepared.

PALEOZOIC TEREBRATULIDA

By F. G. STEHLI

[Contribution number 12 of the Department of Geology, Western Reserve University]

INTRODUCTION

The relatively diverse and abundant living representatives of the Terebratulida are related by a long and excellent fossil record to their first clearly recognizable progenitors in the Early Devonian. The general excellence of the fossil record devolves from a number of fortunate circumstances. First, the Terebratulida, like other articulate brachiopods, construct their shells of relatively stable low-magnesium calcite. Secondly, the two valves do not easily become separated; and in some cases, the hinge teeth are actually swollen within the sockets so that disarticulation without breakage of the hinging mechanism is impossible. Thirdly, these animals appear to have rather continuously occupied widespread and well-preserved environments—though there are numerous exceptions. The Paleozoic portion of the record of the Terebratulida encompasses about 40 percent of their total history and appears to include the origin of the three subordinal groups. Thus, during the Paleozoic, the character of the group and the general course of its future evolution seemingly was established.

Despite the length and excellence of the record of this order of brachiopods and despite the possibilities for comparison offered by still-living forms, it has been the subject of relatively few phyletic studies.

This situation is particularly evident among the Paleozoic representatives of the group. The descriptive studies which must provide the basis for phyletic interpretation have, however, proceeded apace and now provide much of the information necessary for useful phyletic work. The masterly study of CLOUD (1942) stands out as an example of what may be accomplished by a vertical, or phyletic, rather than a horizontal, or faunal, approach to the study of fossils. This work has made known the general course of evolution in the Terebratulida through the end of the Devonian and, thus, treats the primary adaptive radiation of the group. Studies by BOUCOT (1959, 1960), BOUCOT & PANKIWSKYI (1962), and BOUCOT, CASTER, IVES, & TALENT (1963) have materially added to our knowledge of Devonian forms and their geographic and stratigraphic occurrence. Studies by CAMPBELL (1957, 1964) have advanced our knowledge of upper Paleozoic forms from Australia. A series of papers by STEHLI (1956, 1961, 1962) has added information on other Paleozoic forms, especially the relatively stable groups evolved from the primary Devonian radiation and the secondary radiations which occurred within them.

All these studies and a host of others permit us to see with some clarity the general course of evolution within the Terebratulida during the Paleozoic. Major gaps in our knowledge still remain, however, and these relate primarily to three intervals: (1) the Late Silurian, during which time the order probably differentiated from a spiriferoid parental stock (879); (2) the Pennsylvanian, during which our information is markedly less complete than in either the Mississippian or Permian; and (3) the Upper Permian and Lower and Middle Triassic, a time interval relating to which study has been so incomplete that the course of evolution from well-established Paleozoic stocks into those dominating the Mesozoic is frequently unclear.

Classification of any group of fossils is an intensely subjective matter, since one attempts to express phyletic relationships which the available data are usually, if not always, inadequate to support fully. If, within a group, only two genera are known, one is likely to regard them as two points on an evolutionary straight line. As additional genera are recognized, it soon becomes evident that few of the new control points fall on the straight line, which must now be modified into a curve best fitting a scatter of points. With still more information, it is apparent that the best-fitting curve is as woefully inadequate to show the true course of evolution as was the straight line and that a family of curves must be substituted. Our knowledge of evolution within the Paleozoic Terebratulida is not sufficiently complete, as yet, and may never be sufficiently detailed to indicate the true course of evolution from one form to another at the specific and perhaps even the generic level. We can, however, frequently see the general drift of genetic change. Depending upon the group in question, a summation of our data may be as simple and naïve as a straight line between two points, a more realistic fitting of a curve to a scatter of points, or as complex—yet doubtless, still naïve—as a family of curves.

The classification here suggested deals primarily with genera and their arrangement into subfamilial, familial, and superfamilial groupings. Since the genus is a subjective and abstract unit considerably removed from the species or breeding population which forms the reservoir of genetic change, the choice of such a unit is open to attack on genetic grounds. It is justified, however, on practical grounds, since paleontological species are not always well defined or objectively recognized, owing to the fortunes of preservation; the subtlety of many specific characteristics; the arbitrary definition of species as segments of a continuously evolving lineage; the rarity of individuals of some species and the resulting lack of understanding of the range of variation; and perhaps, we must admit, to the description of poor or unrecognizable specimens as the types of new species. The more inclusive generic units characterized by more pronounced characteristics are, at our present state of knowledge, more objectively recognized as units for phyletic study and are thus worked with more easily.

Classification, to be useful, must be flexible and susceptible to change as new data or more logical interpretations indicate the necessity for it. It is clearly recognized that the system here developed for the inclusion of the Paleozoic Terebratulida should and will be ephemeral. Some parts of the classification are regarded as more likely to change than others, because the data upon which they are based are fewer or less readily interpreted. Most likely to change is the concept, here expressed, of relationships between Paleozoic and Mesozoic groups. Not only is information poor for the critical time, but diverse opinions regarding probable relationships have been expressed in the literature (283, 775, 875).

BASES OF CLASSIFICATION

In a group as large and diverse as the Terebratulida, it is inevitable that the skeletal features, most useful in classification, will evolve at different rates in different lineages; and that, even within a single lineage, a given feature may, at different times, be conservative or change rapidly. It is, thus, not possible to present a simple classification based throughout on morphologic features, the variation of which can be assigned significance at any fixed taxonomic level. The features of terebratuloid shells, which have been used in this study, are discussed in some detail below; and some probable evolutionary changes which reflect variation in rates of change in these features are outlined.

EXTERNAL FEATURES

A note of warning should be injected with regard to the study and description of terebratuloid shells. External variation is limited, and both parallelism and convergence are common. Thus, it is absolutely mandatory that the internal structures of all shells be studied, if inordinate taxonomic confusion is to be avoided.

Notwithstanding the risks involved in making taxonomic assignments on the basis of external features alone, there is considerable variation in the shape, size, and ornamentation of terebratuloid shells which is useful in their study. Differences in size can be important, but are notoriously subject to error of interpretation, since environmental factors both during life and after death may have influenced size distributions. Before size may be used as a taxonomic criterion, ontogenetic sequences and the range of variation within and between populations must be known with some certainty.

Variations in shell shape are quite likely to express a true genotypic variation and are, thus, more likely to be taxonomically significant than size alone. Because of the nature of growth of brachiopod shells (686, 875), most changes in shape are simply changes in growth rate or in proportion. These changes generally affect the relations between length, width, and thickness of the shell but also commonly affect the length or attitude of the beak, changes in shell curvature, and the development of major folding (as distinct from a more superficial pattern of radial ornamentation, even though the latter may affect the whole thickness of the shell). Since folding (666b, 686) is apparently related to nature and disposition of the lophophore within the shell and the efficient control of incurrent and excurrent water streams, it may reflect important changes in soft parts and be of considerable taxonomic significance.

External ornamentation of the shell is frequently significant at a surprisingly high taxonomic level, though it can rarely by itself be used with safety. Some of the finer kinds of ornamentation in brachiopod shells reflect the number and pattern of insertion of sensory setae in the mantle margin (Fig. 594,*3a,b*). Change in pattern may, thus, indicate change in an important element of the sensory system of the animal and could be expected to have considerable taxonomic significance. Some of the coarser kinds of ornamentation do not seem to be related to sensory bristles nor can they yet be related with assurance to other soft parts and, thus, may not be significant beyond the lower taxonomic levels (Fig. 594,*5*).

Though the pigments involved in brachiopod coloration are contained in the protein matrix so generously distributed through the shell (Fig. 594,*2*), color patterns are not uncommonly preserved in Paleozoic terebratulids. Color patterns seem significant on the specific level (e.g., among species of *Cranaena* illustrated by Cloud, 1942), but it appears doubtful that they are important in recognizing higher taxa.

The pedicle foramen is of interest because

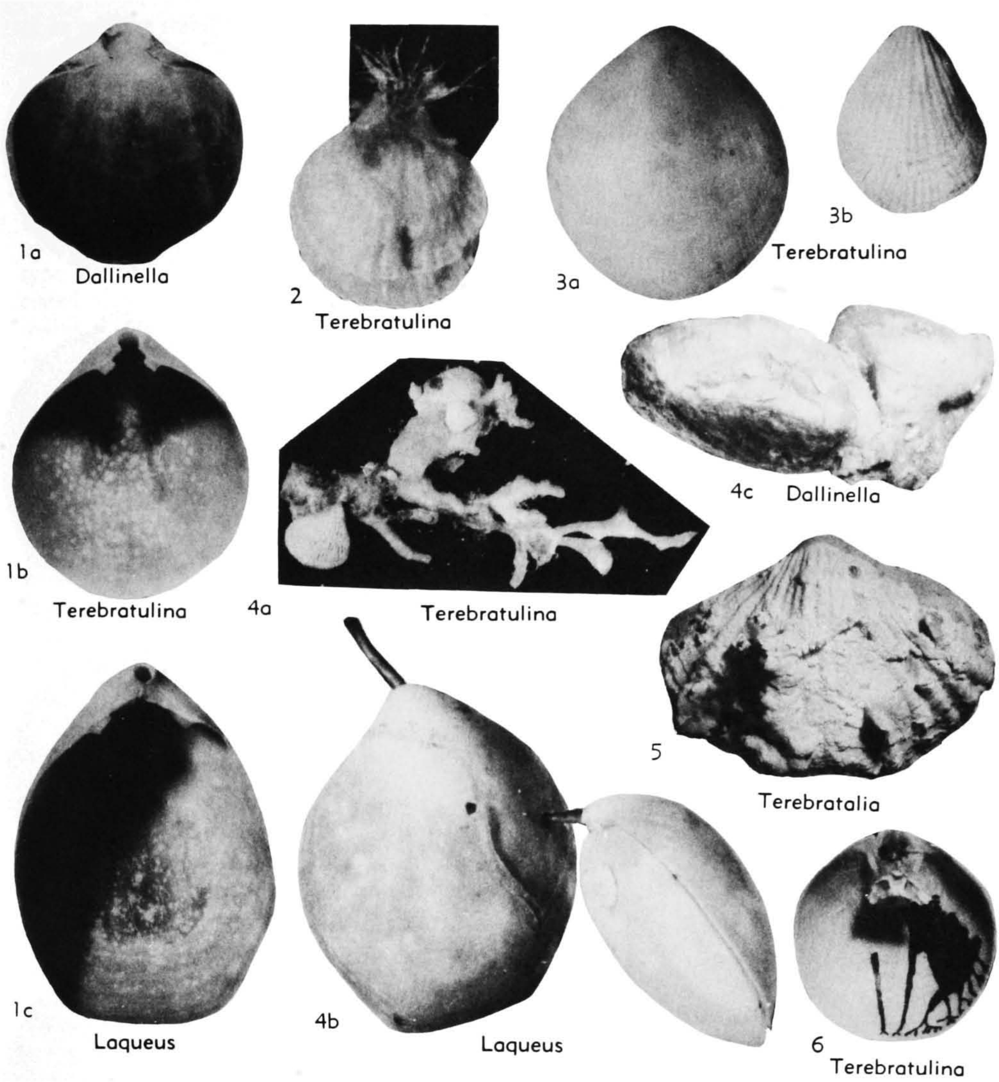

FIG. 594. Morphological features shown by Recent terebratulids from California (Stehli, n). *1.* Pedicle valves showing features of pedicle foramina; *1a, Dallinella occidentalis,* with abraded pedicle foramen seemingly characteristic of terebratulids living closely appressed to surfaces by short attached pedicles, ×1; *1b, Terebratulina crossei,* belonging to a different suborder, also showing effect of characteristic very short pedicle attachment, ×1; *1c, Laqueus californianus,* showing type of pedicle foramen characterizing forms with long pedicle which holds animal well above object of attachment, ×1.——*2.* Completely decalcified specimen of *Terebratulina unguicula* showing threadlike attachment strands of pedicle and extensive organic matrix of shell (pigments responsible for color patterns in brachiopods contained within this organic matrix), ×2.——*3.* Exterior of pedicle valves showing patterns of ornamentation in *Terebratulina*; *3a, T. crossei,* with fine ornamentation of calcareous shell reflecting very fine tactile bristles in mantle, ×1; *3b, T. unguicula,* with relatively coarse pattern of surface which also reflects position of insertion and nature of addition of tactile bristles at edge of mantle, ×1.——*4.* Modes of shell attachment; *4a,* several specimens of *Terebratulina unguicula* attached to coral and showing closely appressed attachment resulting in distinctively abraded pedicle foramen (as in *T. crossei*), ×1; *4b,* specimens of *Laqueus californianus* with long flexible pedicles which appear to correlate with unabraded pedicle foramina such as shown in Fig. *1c,* ×1; *4c,* typical closely appressed attachment of *Dallinella occidentalis,* here attached to a stone, which results in abraded beaks as seen in Fig. *1a,* ×1.——*5.* Exterior of pedicle valve of *Terebratalia transversa caurina* showing abundant growth of calcareous algae on specimen dredged alive (such association very common in this species), ×1.——*6.* Interior of brachial valve of *Terebratulina crossei* showing character of portion of pallial sinus system, ×1.

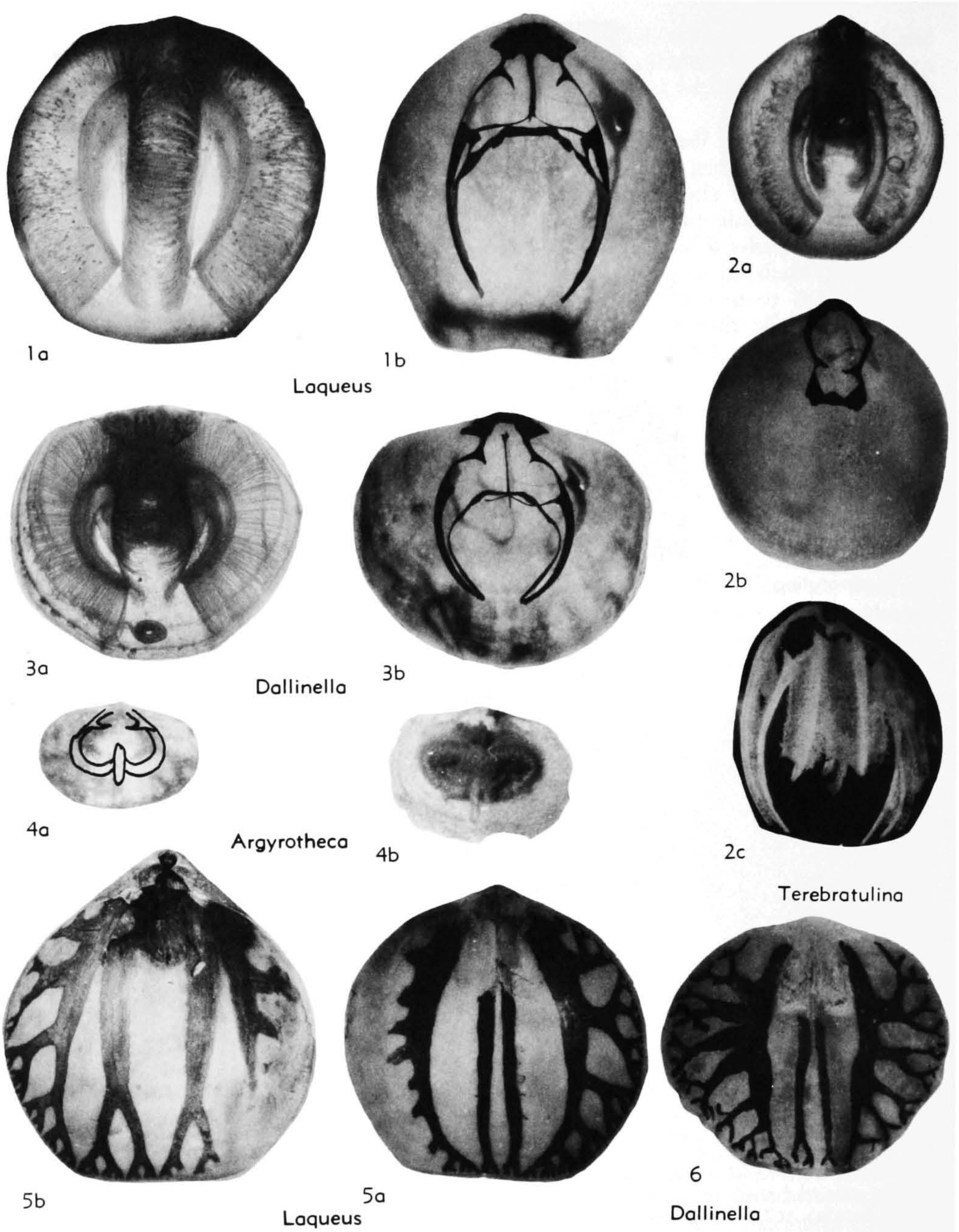

FIG. 595. Morphological features shown by Recent terebratulid brachiopods from California and Bermuda (Stehli, n).——*1. Laqueus californianus* (KOCH) dredged alive off the coast of southern California; *1a,* brachial valve of preserved specimen showing nature and disposition of plectolophous lophophore within shell, its 2 lateral arms each consisting of upper and lower bands with filaments so disposed as to form partially closed tube at either side of shell through which incurrent water streams enter; median, spiral arm also consisting of 2 bands with filaments in form of closed spiral tube of decreasing diameter; excurrent water stream leaves valve at anterior margin in front of spiral arm and between lateral arms (photographed under water and in transmitted light, ×1);*1b,* brachial valve with soft parts removed in order to reveal calcareous brachidium or "long" terebratelliform loop which supports lophophore; mouth of animal

of its relative stability in the Terebratulidina and Terebratellidina of the Paleozoic, its variability in the Centronellidina, and its reflection of the mode of attachment in modern forms. Among Paleozoic and most conservative later Terebratulidina, the foramen is of the type seen in *Lowenstamia* (Fig. 616,*5*); that is, mesothyridid to permesothyridid and labiate to marginate. This type of foramen (almost invariably associated with an internal pedicle collar) remains unchanged in upper Paleozoic terebratuloid lineages, whereas the usually conservative loop undergoes drastic changes and thus the foramen provides means for recognizing affinities despite alteration of the loop. Among the Paleozoic Terebratellidina the foramen is rarely, if ever, likely to be confused with that of the conservative Terebratulidina and accordingly this furnishes a rather accurate means of telling from the exterior whether a shell will bear a long or a short loop. Among the Centronellidina, which were undergoing a major adaptive radiation in the Devonian, the form of the pedicle foramen was not stabilized and varies greatly (167).

An examination of living brachiopods from the Pacific Coast of the United States suggests that forms having long pedicles (similar to those of *Laqueus*, Fig. 594,*4b*) maintained the shell in a position some distance above the attachment object. Presumably, this type of attachment gives the animal considerable flexibility. On the other hand, shells in which the beak is abraded are found to be closely appressed to the attachment object during life (Fig. 594,*4c*). Paleozoic Terebratulidina and Terebratellidina having pedicle openings suggestive of long pedicles and a *Laqueus*-like attachment are common. No forms with pedicles suggestive of closely appressed attachment are known to me from Paleozoic rocks. There remains the large assemblage of Centronellidina with their varied pedicle openings, about which little can, as yet, be said.

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located between crural points along which main bands of lophophore lie, with both main and recurved bands receiving support from brachidium throughout their extent in the lateral arms (brachidium, cardinal plate and median septum artificially darkened, ×1). [Note that no similar supporting structure exists for the spiral arms which receive their only support from the transverse band, characteristically sculptured at its points of contact with the spiral.]——*2. Terebratulina crossei* (Davidson) dredged alive off the coast of southern California; *2a*, brachial valve showing nature and disposition of plectolophous lophophore in shell (spiral arm only slightly developed in this species), terminal ends of filaments damaged, being considerably longer in life; current system in this brachiopod same as that described above for *Laqueus* (photographed under water and in transmitted light, ×1); *2b,* brachial valve after removal of soft parts showing "short" or terebratuliform type of loop, mouth located between crural points on which main bands rest, no solid calcareous support for lateral or spiral arms but modification of transverse band clearly indicating its relationship to spiral arm (loop and cardinal structures artificially darkened, ×1); *2c,* spicular supporting skeleton of lophophore as revealed following solution of that organ with hypochloric acid (resembling long loop in development of supporting structures for bands of lateral arms but surpassing long loop in development as well as support for spiral arms), entire structure organically united to solid calcareous loop and lost upon decay of soft parts, ×1.——*3. Dallinella occidentalis* (Dall) dredged off coast of southern California; *3a,* brachial valve of preserved specimen showing nature and disposition of plectolophous lophophore within shell (photographed under water and in transmitted light, ×1); *3b,* brachial valve following removal of soft parts, with "long" loop and structural relationships of its parts to soft anatomy as described for *Laqueus* (loop reflecting broad short nature of lophophore and close approach of anterior ends of 2 sides of loop showing that spiral arm was only moderately large, not extending between front ends of lateral arms as in *Laqueus*) (loop, septum, and cardinalia artificially darkened, ×1). ——*4. Argyrotheca bermudana* (Dall) collected off Bermuda; *4a,* brachial valve after removal of soft parts, loop (here outlined in ink) of type called centronelliform and while occurring in *Argyrotheca,* as result of paedomorphosis, in all probability very similar in gross morphology to centronelliform loops of ancient terebratulid brachiopods; reduced median septum of *Argyrotheca* occupying position of vertical plate in ancient centronelliform types, ×10; *4b,* brachial valve of preserved specimen showing nature and distribution of schizolophous lophophore which is associated with centronelliform loop in this species (distribution of incurrent and excurrent water streams in forms with schizolophous lophophores not yet understood), schizolophous loop similar to that of *Argyrotheca* probably having been associated with centronelliform loops of ancient terebratuloids (photographed under water in reflected light, ×10).——*5.* Pallial sinus system in *Laqueus californianus*; *5a,* brachial valve showing complete system of right side, system injected with ink and specimen then dried and course of trunks artificially darkened, ×1; *5b,* pedicle valve showing complete system of left side (prepared as above), ×1.——*6.* Pallial sinus system of *Dallinella occidentalis*; brachial valve showing correctly disposition of main trunks and their major branches but inaccurately representing fine terminations which are actually similar to those of *Laqueus,* ×1.

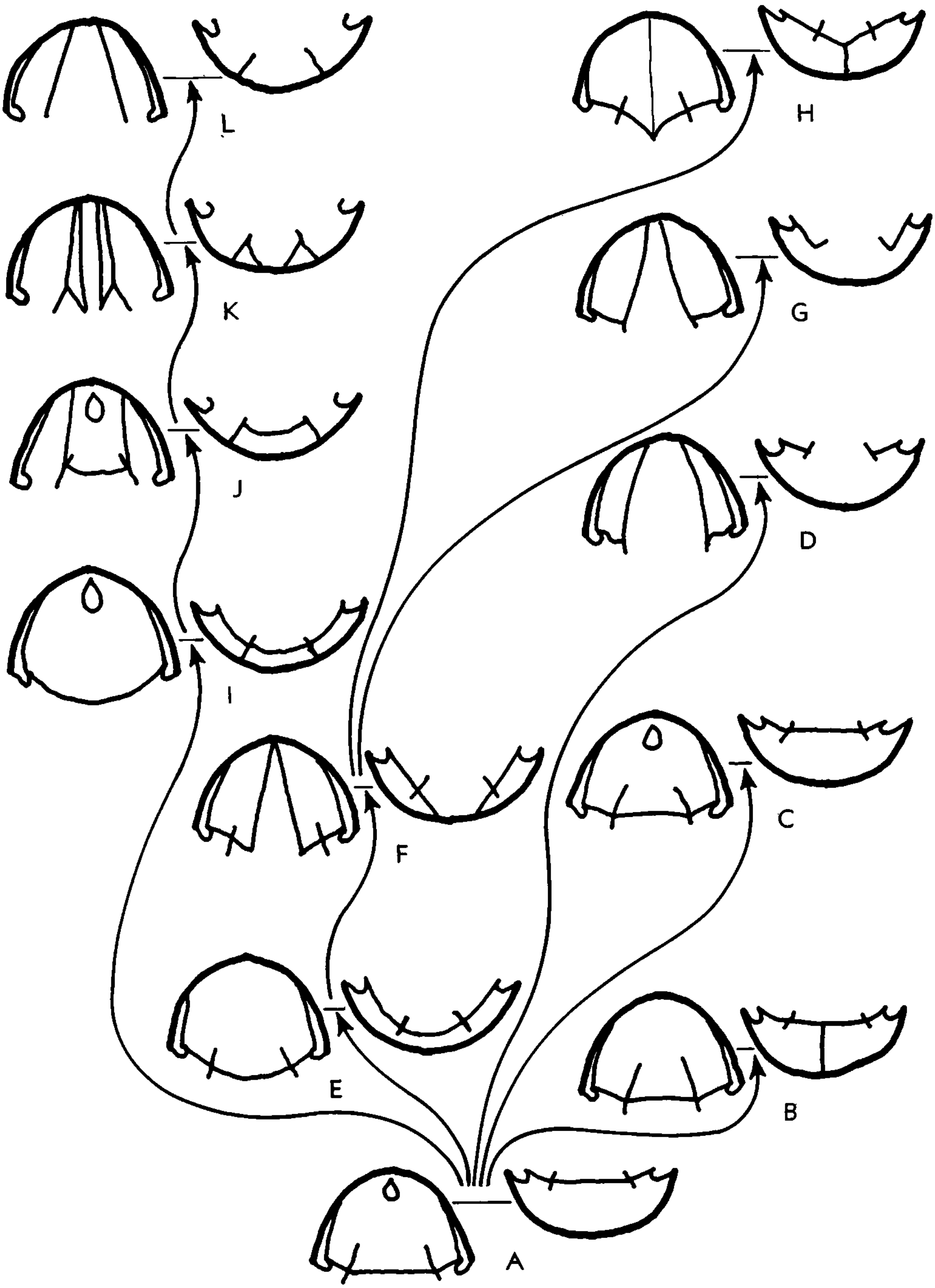

FIG. 596. Evolution of the cardinal plate in Paleozoic Terebratulidina (Stehli, n). In each lettered pair the left figure represents a plan view and the right figure a cross section of the cardinal plate. The sequence *A-I-J-K-L* represents the evolutionary sequence in the Heterelasminidae. Presumably, though not demonstrably, this group arose from the Cranaeninae *(A)* by means of a hypothetical step *(I)*; as first seen in *Afilasma (J)* the basic pattern is established and is altered by simplification in *Beecheria (K)* and *Jisuina (L)*. A somewhat parallel sequence unites the Cranaeninae *(A-E)* with the Dielasmatinae *(F-G, F-H)*.

INTERNAL FEATURES

The internal features of shells of Paleozoic terebratuloids are of extraordinary significance in determining phylogeny and, thus, taxonomic assignments (875). This importance devolves from the intimate relationship which exists between these internal calcareous structures and the associated soft parts. Quite commonly the internal structures are of more significance in phylogeny than any, or even all external features of the shell.

Foremost in terms of interest among the internal structures of the terebratuloid shell is the loop, or calcareous support for the feeding organ, the lophophore. An understanding of the relationship of the loop and lophophore in living terebratuloids sometimes makes it possible to infer from the loops of fossil forms the probable nature of the lophophore in Paleozoic terebratuloids, though a unique conclusion is difficult to reach and diverse opinions exist (686, 775, 879). The loops of Paleozoic terebratuloids fall naturally into three large classes: (1) the short or terebratuliform loop, which characterizes all conservative members of the suborder Terebratulidina (Fig. 595,*2b*); (2) the long terebratelliform (e.g., cryptonelliform) loop, which characterizes normal members of the suborder Terebratellidina (Fig. 595,*1,3*); and (3) the centronelliform loop, which characterizes many members of the Centronellidina, as well as appearing in the ontogeny of Paleozoic members of the Terebratulidina (57a, 191, 775) (Fig. 595,*4a*).

Both the long and the short loop found in living forms can support a very similar (plectolophous) lophophore (Fig. 595,*1-3*), but the degree of support afforded to the lophophore by each kind of loop varies (283, 775, 879). The short loop supports the lophophore only at its base, while additional (probably nonpreservable) support may be furnished by calcitic spicules within the tissues of the lophophore itself (Fig. 595,*2c*). The long loop provides a greater degree of support, since both the ascending and descending bands of the lophophore rest on a calcareous structure. This support may substitute in part for the spicular framework which is its structural equivalent in some short-loop forms but it does not achieve the same level of support since apparently there is no calcareous support of any kind for the spiral arms.

While it is not possible to examine the relationship of the loop and lophophore in the extinct Centronellidina, some paedomorphic living genera of the Terebratellidina have an essentially centronelliform loop. *Argyrotheca* (Fig. 595,*4*) is such a genus, and its centronelliform loop is associated with a bilobed trocholophe (283, 775, 875). It has been assumed on what seem to be reasonable grounds (283, 775, 879), that centronelliform-looped Paleozoic forms also possessed trocholophous or schizolophous lophophores.

During the primary adaptive radiation of the Terebratulida during the Early and Middle Devonian, there was considerable "experimentation" with various arrangements of the loop and lophophore, as may be seen by reference to *Cimicinella* (Fig. 613,*4*) or *Meganteris* (Fig. 607,*2b*). Most genera for which the loop is known, however, seem to have retained a basically centronelliform type. Each of the "successful" stocks which arose from the Centronellidina to found new suborders had evolved a loop which seems designed to support a plectolophous lophophore, though WILLIAMS & WRIGHT (879) agree only insofar as the early Terebratellidina are concerned.

The nature of the transition between the centronelliform loop with its schizolophous or even simpler lophophore and the long or short loop with its possibly plectolophous lophophore can be seen in the ontogeny and phylogeny of various terebratuloids (283, 775, 875, 879). Once the long loop and

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Following full sessility of the central portion of the cardinal plate in *Dielasma (F)* one lineage proceeds in the direction of its reconstruction as in *Dielasmina (H)* while another proceeds toward its further reduction as in *Lowenstamia (G)*. Also derived from the Cranaeninae *(A)* are several lesser lines of modification *(A-B, A-C, A-D)*. Development of a median septum and suppression of the apical foramen resulted in the initiation of the Girtyellinae *(B)*. Virtual stability of the cardinal plate characterizes the Notothyridinae *(C)* despite development of extreme neoteny in the loop. In the Labaiidae *(D)* the central portion of the cardinal plate becomes obsolete, leading to the type of cardinalia found in many Mesozoic Terebratulidina.

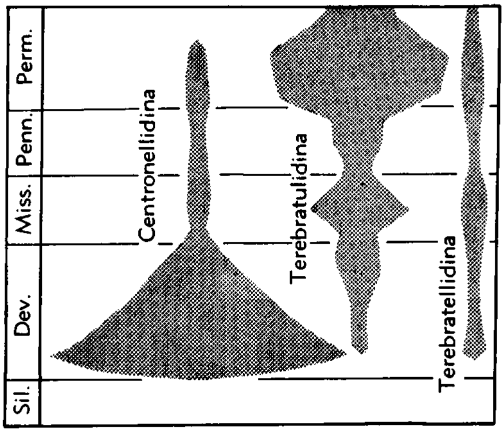


FIG. 597. Generic time-diversity graphs for suborders of Terebratulida during Paleozoic time, based on the known fossil record (Stehli, n).

plectolophous lophophore had become established in the Terebratellidina in the Early Devonian, there was apparently no further change during Paleozoic time. Quite a different situation prevails within the Terebratulidina, however. In this group, it has been shown that the ontogeny of the loop in typical Paleozoic forms includes a centronelliform step, though the adult loop is of the normal short or terebratuliform type (57a). Late in the Paleozoic, the centronelliform loop seemingly was paedomorphically carried on into the adult stage in the members of the family Notothyridae. From the centronelliform adult loop of early members of this family, there arose genera (*Gefonia,* Fig. 619,*5b*; *Timorina,* Fig. 619,*4b*) which seemingly began once more to evolve in the direction of a more complex lophophore, though it appears unlikely that they progressed beyond a zygolophous or incipiently plectolophous stage (775). It is of interest that during this second evolution of the complex lophophore, the supporting loop was developing toward the long, rather than the short, type characteristic of normal members of this suborder. In the case of this interesting family, the characteristics of the pedicle foramen furnish the surest criterion of subordinal affinity, while the usually conservative loop is characteristic only at the family level or below.

Secondly, in terms of interest and significance only to the loop are the structures constituting other parts of the "cardinalia." The more interesting of these structures in the most primitive Terebratulida are as follows: (1) the socket ridges, bounding the sockets on the interior edge; (2) the cardinal plate, which extends between the socket ridges (e.g., *Cranaena,* Fig. 614,*1b*) and functions for the insertion of the dorsal pedicle muscles and commonly bears an apical perforation of unknown function; (3) and the crural plates, which are paired, and which, when present, appear to support the cardinal plate (e.g., *Etymothyris,* Fig. 604,*2b*). The true purpose of the crural plates is not known; and in many cases structures described under this name in the literature are either ridges peripheral to the adductor muscles scars, or structures homologous to the cardinal plate, rather than crural plates. The cardinal plate undergoes interesting modifications in three terebratuloid families—the Dielasmatidae, Heterelasminidae, and Labaiidae. These changes can be interpreted in terms of modification in the place of insertion of the dorsal pedicle muscles and in the case of the Dielasmatidae and Heterelasminidae a striking parallelism is evidenced. Figure 596 shows the course of evolution of the cardinal plate in each of the three families in a diagrammatic fashion. In the Labaiidae, the insertion point of these two muscles moves laterally to a final insertion between

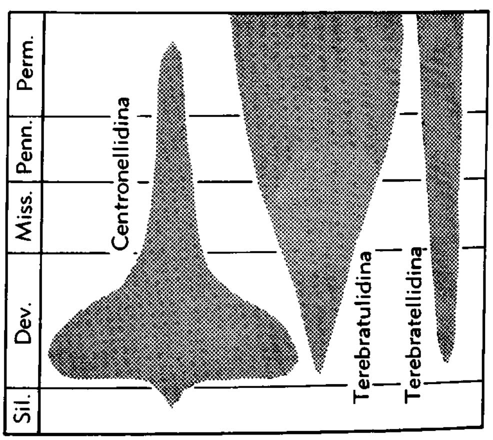


FIG. 598. Generic time-diversity graphs for suborders of Terebratulida during Paleozoic time, smoothed to indicate the probable true nature of the development of each group (Stehli, n).

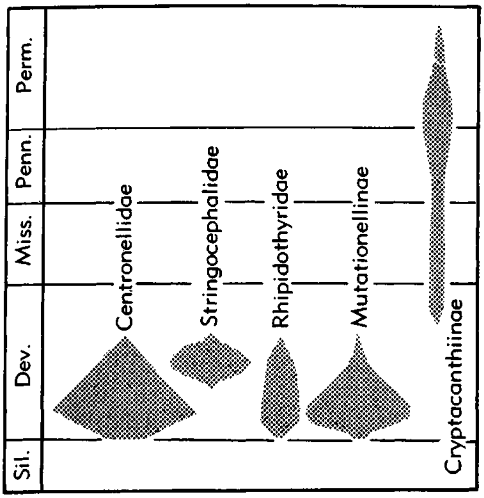


FIG. 599. Generic time-diversity graph showing the development of families of the Centronellidina (Stehli, n). The Mutationellidae is represented by its two important subfamilies, the Devonian Mutationellinae and the post-Devonian Cryptacanthiinae.

the crural bases and the socket ridges, whereupon the apparently functionless central portion of the cardinal plate between the crural bases is lost, as in *Pseudodielasma* itself (Fig. 615,*2b*).

Among members of the Dielasmatidae, the picture is more complex, and the evolutionary sequence must first be picked up in the ancestral family, Cranaenidae. In *Cranaena* itself (Fig. 614,*1b*), the cardinal plate is shown in its primitive condition, extending unsupported between the socket ridges. *Hamburgia* shows the next step, in which the cardinal plate has become apically sessile. In *Dielasma* the cardinal plate is completely sessile in its medial portions and is separated into two sloping plates extending from the socket ridges to the floor of the brachial valve (Fig. 617,*1a,c*). On exceptionally well-preserved silicified material from the Guadalupe Mountains, one can detect the insertion scars of the dorsal pedicle muscles on the floor of the brachial valve between the now separate halves of the cardinal plate. Once the dorsal muscles had become inserted on the valve floor, the two parts of the cardinal plate served only to support the crura (Fig. 617,*1c*) and might be expected to have become obsolete either between the crura and the valve floor, as they seem to in *Lowenstamia,* or between the crura and the socket ridges. Interestingly enough, a reversal of evolutionary direction occurs in *Dielasmina* and some other

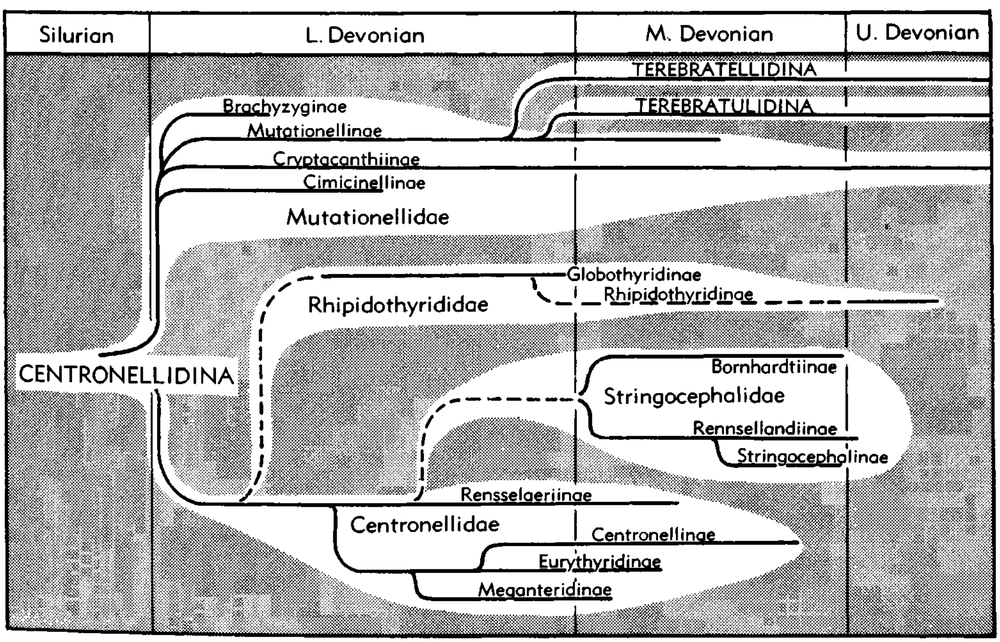


FIG. 600. Phylogeny of the Centronellidina as presently interpreted (Stehli, n).

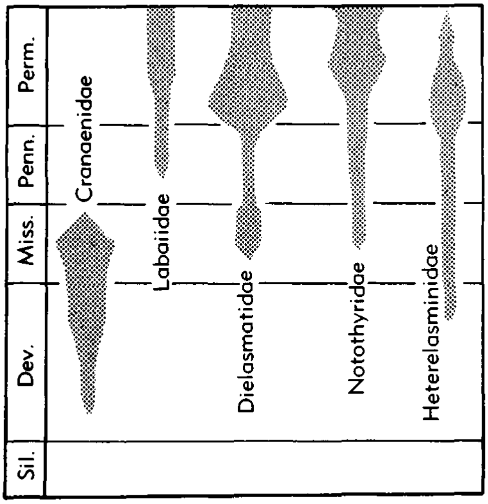


FIG. 601. Generic time-diversity graph showing development of the families of the Terebratulidina during the Paleozoic (Stehli, n).

genera (Fig. 617,7) in which the sessile and separated halves of the cardinal plate become reunited to form a kind of median septum, raising the medially depressed and secondarily entire cardinal plate above the valve floor and carrying with it the insertion of the dorsal pedicle muscles.

Among the Heterelasminidae, a strikingly parallel development occurs, though it leads to a somewhat different end. The genus *Afilasma,* the earliest known, though surely not the earliest member of the sequence, has what was probably once a continuous cardinal plate supported by crural plates, though in this genus it has become obsolete between the crural bases and the socket ridges. In *Beecheria* (Fig. 620,*2*), the portion of the cardinal plate between the crural bases has become medially sessile, much as it did in *Dielasma,* and though no material well enough preserved to show muscle scars has been examined, it is supposed that the dorsal pedicle muscles had, likewise, become inserted on the valve floor so that the remaining portions of the cardinal plate no longer served a useful function. *Jisuina* represents the last structural grade in this sequence (Fig. 620,*5c*), and here it is seen that the remnants of the cardinal plate have, indeed, disappeared, leaving the crural bases now supported only by crural plates.

Internal structures, impressed into the shell, such as the mantle-canal system, which is quite distinctive in modern (Fig. 595, *5a-c*) and many fossil terebratuloid brachiopods (WILLIAMS, 875) are poorly preserved in most Paleozoic Terebratulida and appear to be of little use at the present time in classification.

In the pedicle valve, a pedicle collar is consistently present in the Terebratulidina and absent in other forms (except *Globithyris* among the Centronellidina). Dental plates are commonly suppressed, and it is doubtful if, in most groups, their presence or absence is of more than generic importance.

The above-noted morphological features of the calcareous shells of terebratuloids have been used in recognizing relationships within the Paleozoic members of the order. As in most other things, however, success has been the criterion which has resulted in the award of higher taxonomic status. Thus, while the Centronellidina are an extraordinarily diverse assemblage, the suborder is short-lived and seems quite clearly to represent an early adaptive radiation. This radiation consists of numerous short-lived, adaptive "experiments," many of which lead to forms morphologically more divergent from the earliest Centronellidina than forms placed in other suborders. These "adaptive experiments" which did not encounter lasting success are left to be contained within the Centronellidina. Only those forms which adopted the successful features of the two still-living suborders have received this elevated taxonomic status (Fig. 597-601).

Suborder CENTRONELLIDINA Stehli, n. suborder

A diagnosis of this assemblage is given in the section on Terebratulida-Main Groups (see p. *H*729).

Superfamily STRINGOCEPHALACEA King, 1850

[*nom. transl.* STEHLI, herein (*ex* Stringocephalidae *nom. correct.* DAVIDSON, 1853, p. 51, *pro* Strigocephalidae KING, 1850, p. 141)]

Characters of suborder. *L.Dev.-U.Perm.*

Family CENTRONELLIDAE Waagen, 1882

[*nom. transl.* HALL & CLARKE, 1895, p. 356 (*ex* Centronellinae WAAGEN, 1882, p. 331)]

Externally variable; cardinal plate supported by crural plates and perforate or sessile, loop typically centronelliform but quite variable. *L.Dev.-M.Dev.*

Subfamily CENTRONELLINAE Waagen, 1882

[Centronellinae WAAGEN, 1882, p. 331]

Moderate-sized, smooth, concavo-convex to biconvex; deltidial plates discrete or conjunct; anterior commissure sulcate; without dental plates; hinge teeth large; cardinal plate much thickened, sessile, medially depressed so as to appear almost as 2 plates; ridgelike cardinal process common; loop centronelliform. *L.Dev.-MDev.*

Centronella BILLINGS, 1859, p. 131 [**Rhynchonella glans-fagea* HALL. 1857, p. 125; SD HALL, 1863, p. 45]. Small to medium-sized; concavo-convex to nearly plano-convex, adult shells not known to be biconvex; cardinal plate sessile and so deeply depressed as to appear medially divided; cardinal process small, apically located (380). *L.Dev.-M.Dev.*, N. Am.——FIG. 602,*1*. **C. glansfagea* (HALL), composite figures; *1a*, brach.v. view, ×1.85; *1b,c*, lat. and brach.v. int., ×1.5 (167).

Oriskania HALL & CLARKE, 1893, p. 269 [**O. navicella*; OD]. Moderate-sized, concavo-convex to biconvex, pedicle valve deeper than brachial valve; cardinal plate moderately concave; cardinal process large, elongate (396). *L.Dev.*, N.Am.——FIG. 602,*2*. **O. navicella*, Oriskany, USA(N.Y.); *2a-c*, brach.v., lat., brach.v. int. views, ×2.1, ×1.9, ×1.9 (167).

Subfamily RENSSELAERIINAE Raymond, 1923

[Rensselaeriinae RAYMOND, 1923, p. 467] [includes Amphigeniinae CLOUD, 1942, p. 77]

Small to large, more or less radially ornamented; generally rather strongly biconvex; dental plates obsolete, distinct and separate or distinct and united in spondylium; cardinal plate perforate, supported by crural plates or partly sessile; loop variable but typically centronelliform though modified in some shells by loss of median plate and development of transverse band. *L.Dev.-M.Dev.*

Rensselaeria HALL, 1859, p. 39 [**Terebratula ovoides* EATON, 1832, p. 45 (*non* SOWERBY, 1812, p. 227) (=**Atrypa elongata* CONRAD, 1839, p. 65); SD HALL & CLARKE, 1893, p. 257]. Large, entire shell costellate; elongately subovate to subcircular; subequally biconvex; pedicle valve deeper than brachial valve; anterior commissure rectimarginate; umbonal region of both valves thickened; dental plates obsolescent to obsolete; cardinal plate thickened, sessile except at anterior edge; crural plates much thickened; loop centronelliform, main bands broadly united anteriorly (172). *L.Dev.*, N.Am.——FIG. 603,*1*. **R. elongata* (CONRAD); *1a,b*, brach.v. view, brach.v. int., ×0.9; *1c*, post. int., ×1 (167).

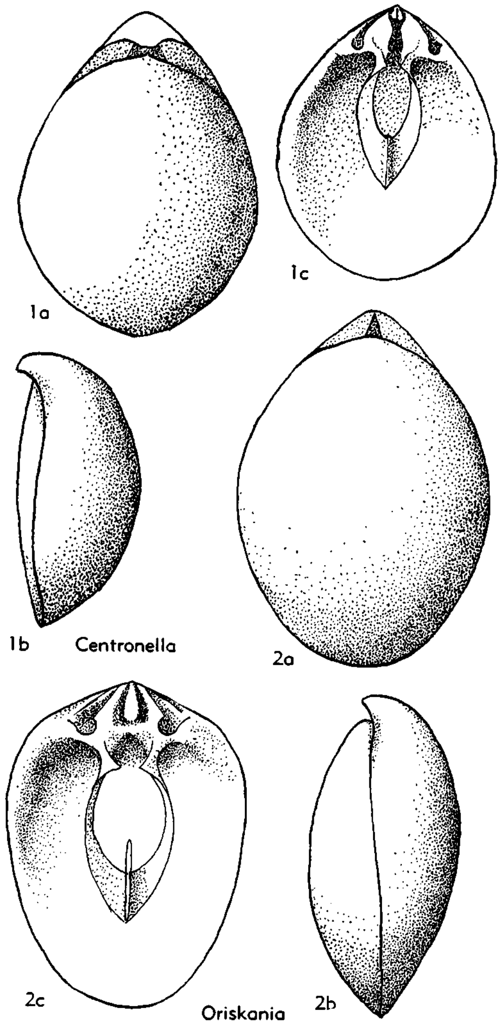


FIG. 602. Centronellidae (Centronellinae) (p. *H*741).

[CLOUD (1942, p. 54) is correct in pointing out that the commonly cited type-species of *Rensselaeria* given as *R. ovoides* (EATON) lacks validity. This is because *Terebratula ovoides* EATON, 1832, must be rejected as a junior primary homonym of *T. ovoides* SOWERBY, 1812, a very different Cretaceous brachiopod. "A species-group name that is a junior primary homonym must be permanently rejected" (Zool. Code, 1961, Art. 59,a). *Atrypa elongata* CONRAD, 1839, is a nominal species included among those originally assigned to *Rensselaeria* by HALL (1859, p. 38) and referred to as "the more common form from the Oriskany

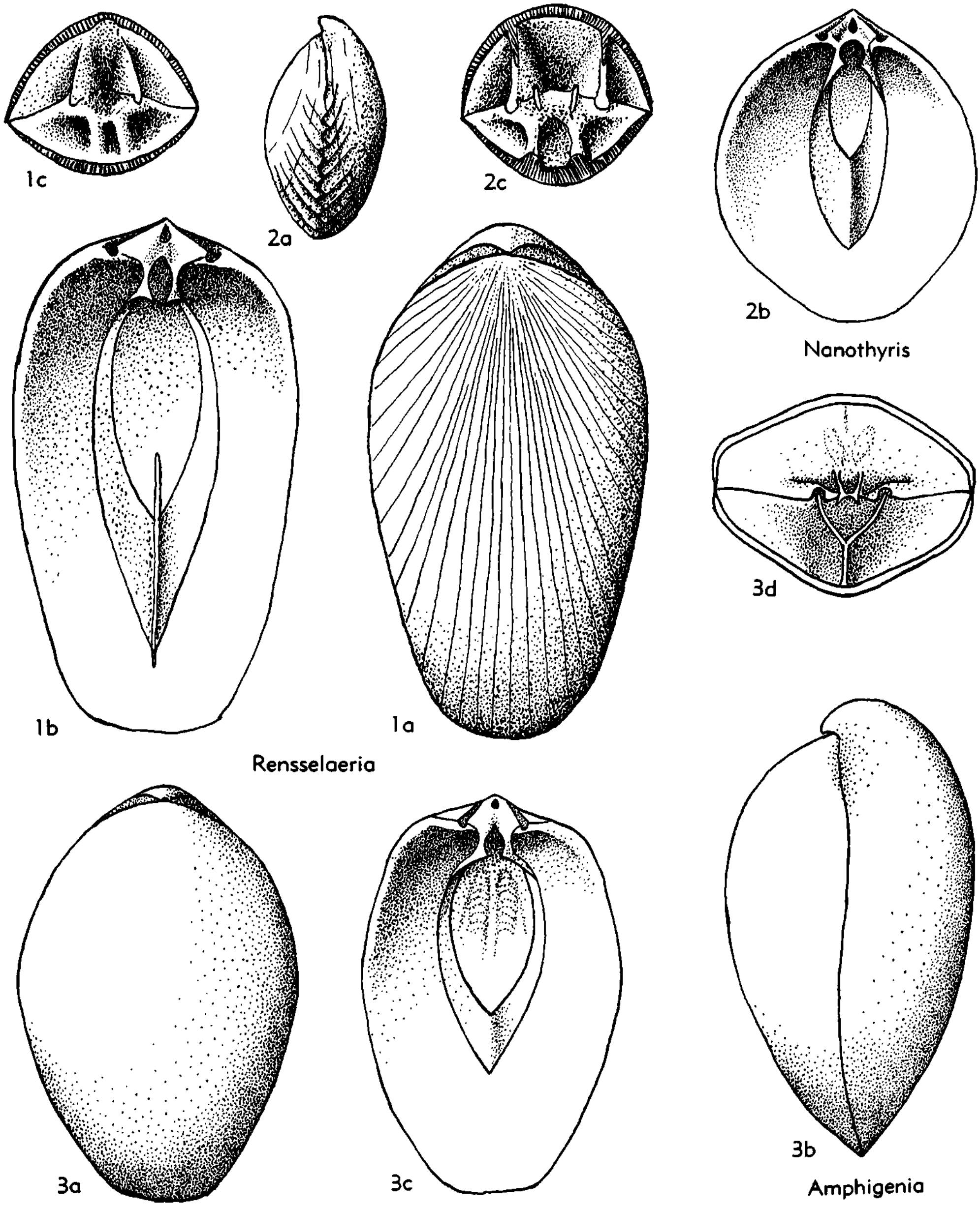


FIG. 603. Centronellidae (Rensselaeriinae) (p. H741-H743).

sandstone" *(loc. cit.)*. Yet he did not definitely indicate an opinion that *A. elongata* is a synonym of EATON'S *T. ovoides*, described as "one of the most common species in the Oriskany sandstone" *(loc. cit.)*, figured as *Rensselaeria ovoides* (HALL, 1859, p. 41). SCHUCHERT (1897, p. 341), CLOUD (1942, p. 56) and others have recognized the two nominal species as subjective synonyms and since *A. elongata* is the oldest available synonym, it must be adopted under its own authorship and date as the type-species of *Rensselaeria* (Art. 60,a).]

Amphigenia HALL, 1867, p. 163 [**Pentamerous elongata* VANUXEM, 1842, p. 132; OD]. Large, entire shell costellate; elongate outline; biconvex; anterior commissure rectimarginate to broadly sulcate; dental plates united adventrally to form spondylium; cardinal plate somewhat thickened, posteriorly sessile; crural plates somewhat thickened; loop centronelliform, union of main bands short (835). *M.Dev.*, N.Am.-S.Am.——FIG. 603, *3*. **A. elongata* (VANUXEM), USA(N.Y.); *3a-c*, brach.v. and lat. views, brach.v. int., ×0.7; *3d*, post. int., ×1.3 (167).

Etymothyris CLOUD, 1942, p. 59 [**Rensselaeria ovoides gaspensis* CLARKE, 1909, p. 238; OD]. Large, entire shell costellate; outline linguloid, commonly deeper than wide; anterior commissure rectimarginate; umbones not thickened; dental plates distinct and separate, subparallel to slightly convergent adventrally; cardinal plate free of valve floor, supported by unthickened crural plates; loop unknown (162). *L.Dev.-M.Dev.*, N.Am.——FIG. 604,*2*. **E. gaspensis* (CLARKE), composite figure; *2a*, brach.v. view, ×0.8; *2b*, post. int., ×1.7; *2c*, brach.v. int., ×1.1 (167).

Nanothyris CLOUD, 1942, p. 45 [**Meganteris mutabilis* HALL, 1857, p. 97; OD]. Small to moderate-sized; umbones smooth, shell margin radially ornamented; anterior commissure rectimarginate, dental plates distinct and separate; cardinal plate thickened slightly or unthickened; loop centronelliform, extending ¾ length of valve; main bands broadly united (380). *L.Dev.*, N.Am.-Eu.-Afr.——FIG. 603,*2*. **N. mutabilis* (HALL), composite figure; *2a*, lat. view, ×4.7; *2b*, brach.v. int., ×6.3; *2c*, post. int., ×8 (167).

Rensselaerina DUNBAR, 1917, p. 466 [**R. medioplicata*; OD]. Medium-sized to moderately large; radial ornamentation mainly on anteromedial region; umbones smooth; anterior commissure rectimarginate; both valves with internally thickened umbones; dental plates weakly developed or obsolete; cardinal plate thickened, partially to almost completely sessile; crural plates secondarily thickened and ill-defined; loop variable, ranging from typical centronelliform pattern to modification in which small transverse band develops (268). *L. Dev.*, N.Am.——FIG. 604,*1*. **R. medioplicata*, composite figure; *1a,b*, brach.v. and lat. views, ×1.9; *1c*, brach.v. int., ×1.8; *1d*, loop, ×2 (167).

Subfamily EURYTHYRIDINAE Cloud, 1942

[*nom. correct.* STEHLI, herein (*pro* Eurythyrinae CLOUD, 1942, p. 60)]

Small to moderate-sized, more or less radially ornamented; typically wider than thick; anterior commissure rectimarginate; lateral margins introverted; deltidial plates conjunct; dental plates obsolescent or obsolete; cardinal plate perforate or not and more or less thickened, almost or completely sessile; with or without pronounced cardinal process; crural plates present or lost by sessility of cardinal plate and secondary thickening; loop centronelliform, long, heart-shaped to subtriangular in outline; main bands broadly united. *L.Dev.*

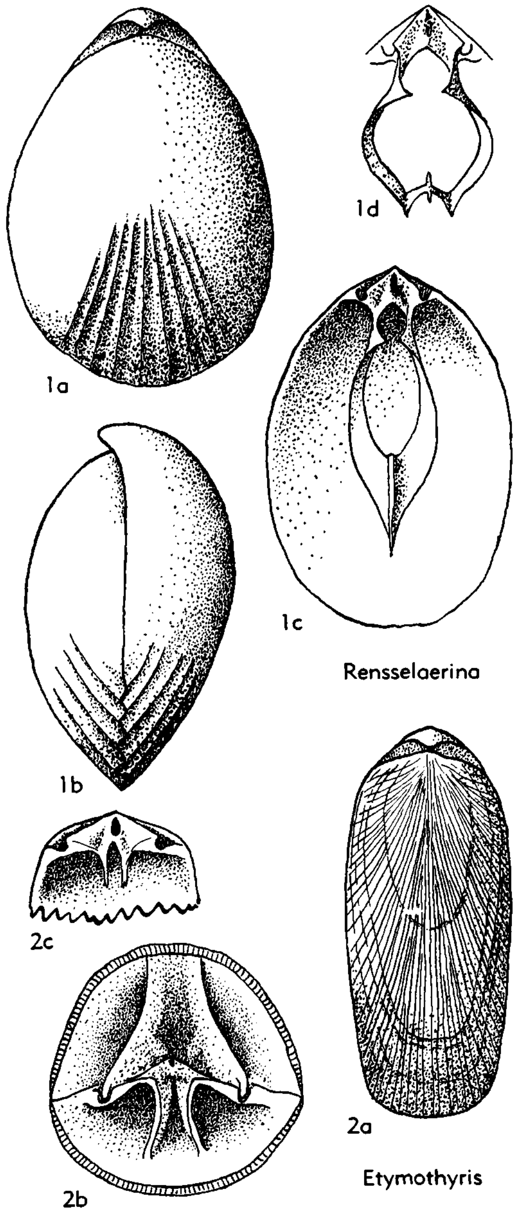


FIG. 604. Centronellidae (Rensselaeriinae) (p. *H*743).

Eurythyris CLOUD, 1942, p. 63 [**Oriskania lucerna* SCHUCHERT in SCHUCHERT & MAYNARD, 1913, p. 390; OD]. Small, much wider than thick; planoconvex, brachial valve almost flat; anteriorly costellate or smooth; dental plates obsolete; cardinal plate imperforate, swollen, sessile; low, linear cardinal process present; crural plates lost due to sessility or faintly visible (732). *L.Dev.*, N.Am.

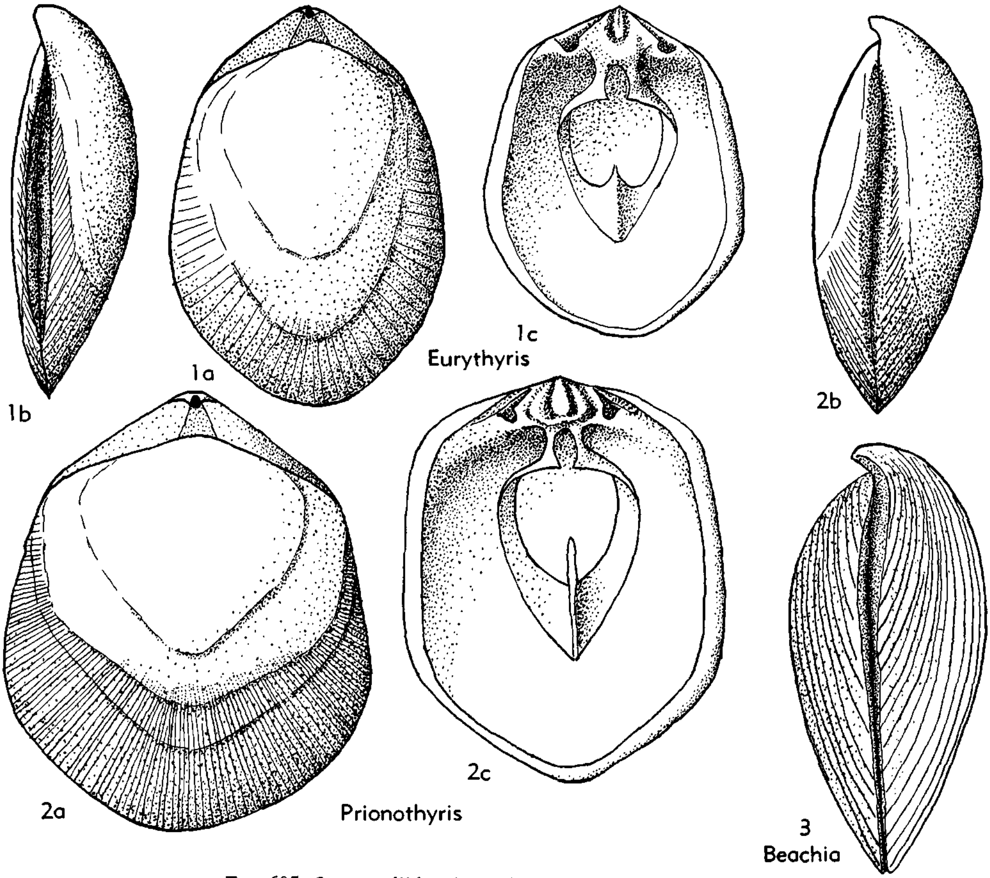


FIG. 605. Centronellidae (Eurythyridinae) (p. *H*743-*H*744).

——FIG. 605,*1*. **E. lucerna* (SCHUCHERT), Oriskany, USA(N.Y.); *1a,b*, brach.v. and lat. views, ×2; *1c*, brach.v. int., ×1.8 (167).

Beachia HALL & CLARKE, 1893, p. 260 [**Meganteris suessana* HALL, 1857, p. 100; OD (M)]. Moderate-sized; subequally biconvex; all or partly costellate; dental plates obsolescent to obsolete; cardinal plate perforate, more or less swollen and sessile, distinct cardinal process lacking; crural plates evident (380). *L.Dev.*, N.Am.——FIG. 605, *3*; 606,*1*. **B. suessana* (HALL), composite figure; 605,*3*, lat. view, ×2.2; 606,*1a,b*, ped.v. and brach.v. ints., ×4; 606,*1c*, ped.v. ext., ×2.7 (Stehli, n).

Prionothyris CLOUD, 1942, p. 66 [**P. perovalis*; OD]. Moderate-sized; anteriorly costellate or smooth; biconvex, wider than thick; dental plates obsolete; cardinal plate imperforate, thick, completely sessile, bearing ponderous, erect cardinal process; crural plates faintly developed or not visible (167). *L.Dev.*, N.Am.-S.Am.-?N.Z.——FIG. 605,*2*. **P. perovalis*, composite figure; *2a,b*, brach.v. and lat. views, ×2.2, ×2; *2c*, brach.v. int., ×2 (167).

Subfamily MEGANTERIDINAE Schuchert & LeVene, 1929

[*nom. correct.* STEHLI, herein (*pro* Meganterinae, *nom. transl.* BOUCOT, 1959, p. 766, *ex* Meganteridae SCHUCHERT & LEVENE, 1929, p. 23)]

Moderate-sized to large, subequally biconvex, subcircular to subelliptical in outline; anterior commissure rectimarginate; pedicle foramen mesothyridid; lateral margins not introverted; dental plates present or absent; hinge teeth large, triangular in cross section; cardinal plate perforate or imperforate, posteriorly to entirely sessile; crural plates present. *L.Dev.*

Meganteris SEUSS, 1855, p. 51 [**Terebratula archiaci* DE VERNEUIL, 1850, p. 40; OD] [=*Megalanteris* OEHLERT, 1887, p. 1319; *Vltavothyris* HAVLÍČEK, 1956]. Large, smooth; dental plates becoming obsolete in adults; cardinal plate sessile but crural plates evident in immature specimens; cardinal process large; loop long, more or less cryptonelliform but with crural points extended probably to support spiral arms of lophophore

(843). *L.Dev.*, Eu.——Fig. 607,2. **M. archiaci* (de Verneuil), composite figure; *2a*, lat., ×0.7; *2b*, brach.v. int., ×1.4 (167).

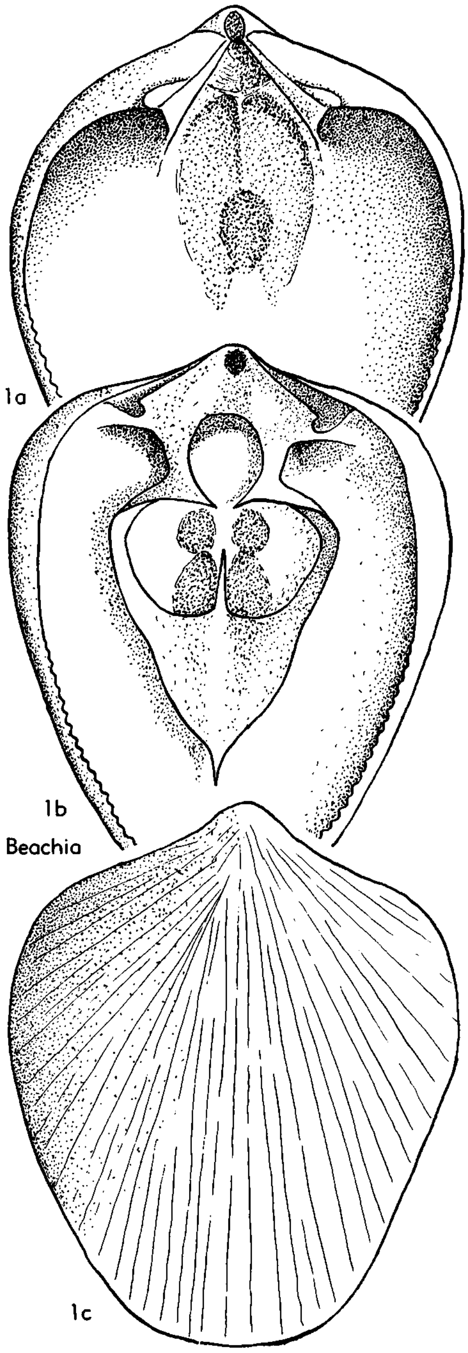


Fig. 606. Centronellidae (Eurythyridinae) (p. *H*744).

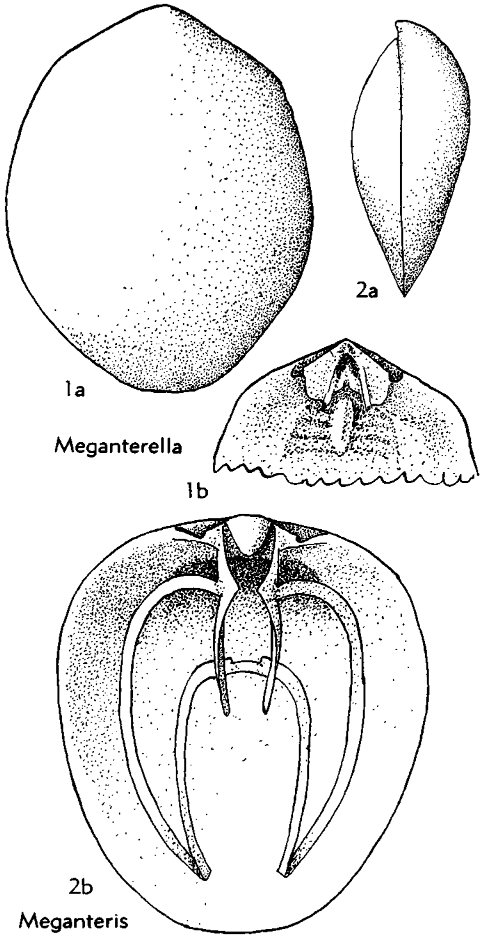


Fig. 607. Centronellidae (Meganteridinae) (p. *H*744-*H*745).

Meganterella Boucot, 1959, p. 767 [**M. finksi*; OD]. Moderate-sized, smooth; biconvex, pedicle valve more convex than brachial valve; dental plates present but short; cardinal plate posteriorly sessile; crural plates present; small cardinal process present in large specimens; loop unknown (101). *L.Dev.*, N.Am.——Fig. 607,*1*. **M. finksi*, Esopus F., USA(N.Y.); *1a*, ped.v. ext., ×2; *1b*, brach.v. int., ×1.7 (101).

Family STRINGOCEPHALIDAE King, 1850

[*nom. correct.* Davidson, 1853, p. 51 (*pro* Strigocephalidae King, 1850, p. 141)]

Large, thick-shelled, some forms asymmetrical, generally unornamented; deltidial plates discrete or conjunct; pedicle foramen hypothyridid to permesothyridid; dental

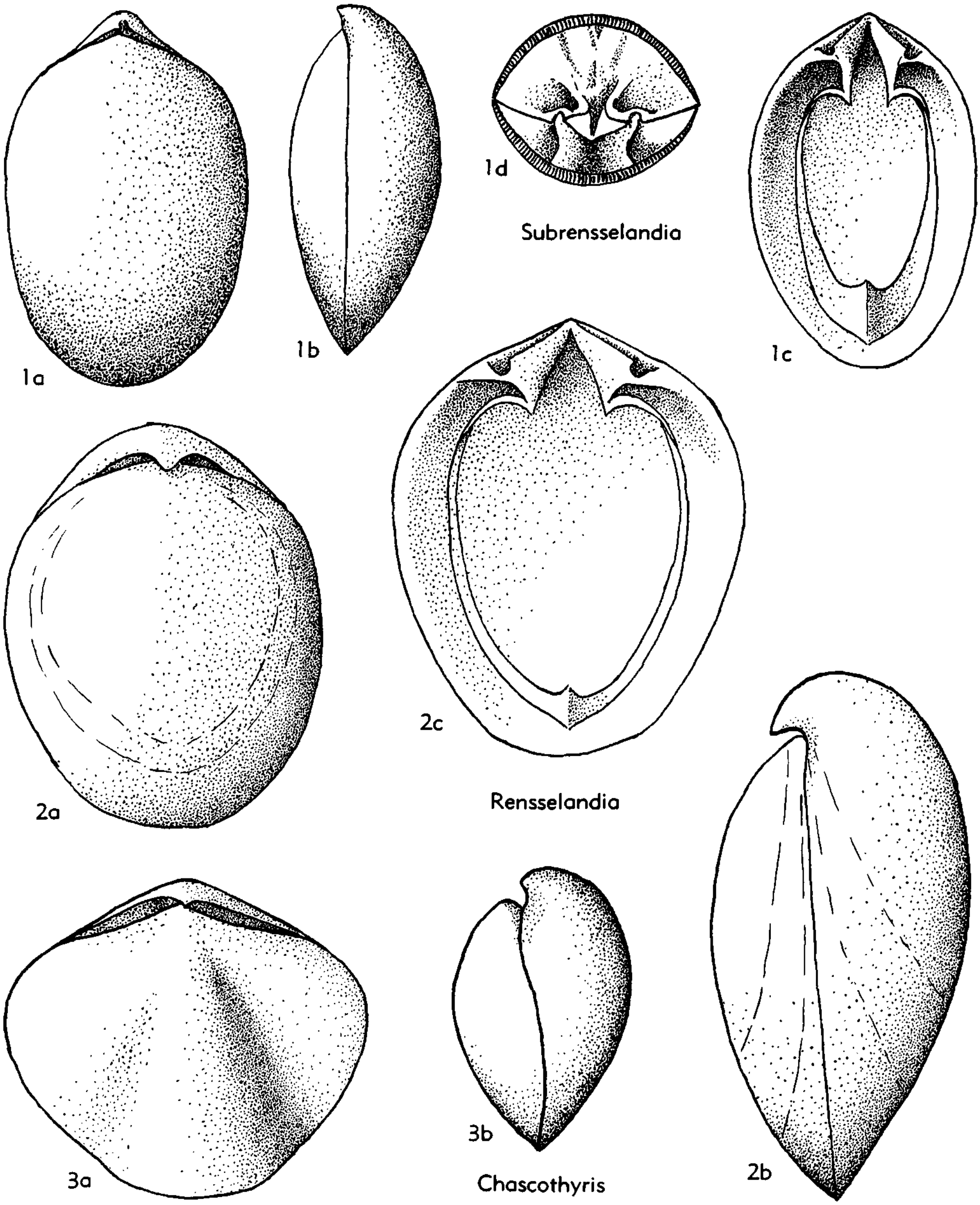


FIG. 608. Stringocephalidae (Rensselandiinae) (p. *H*746-*H*748).

plates obsolescent to obsolete in adults; hinge plates discrete; loop long, centronelliform. *M.Dev.*

Subfamily RENSSELANDIINAE Cloud, 1942

[Rensselandiinae CLOUD, 1942, p. 92]

Moderate-sized to large, symmetrical; deltidial plates discrete; ventral palintrope and beak relatively inconspicuous; cardinal process and median septa absent; hinge plates discrete and (except in *Subrensselandia*) unsupported by crural plates. *M. Dev.*

Rensselandia HALL, 1867, p. 385 [**Rensselaeria? johanni* HALL, 1867, p. 385; SD SCHUCHERT, 1897, p. 271] [=*Newberria* HALL, 1891, p. 236; *Denckmannia* HOLZAPFEL, 1912, p. 115 (*non* BUCKMAN, 1898); *Denckmannella* SCHUCHERT &

LeVene, 1929, p. 120]. Moderate-sized, biconvex, elongate-subovate to subcircular in outline; anterior commissure rectimarginate; hinge plates discrete, crural plates absent; loop long, anteriorly broad; dental plates obsolescent or obsolete. *M. Dev.*, N.Am.-Eu.——Fig. 608,2. **R. johanni* (Hall), Cedar Valley Ls., USA(Iowa); *2a,b,* brach.v. and lat. views, ×0.8, ×1.3; *2c,* brach.v. int., ×1.3 (167). [*See* p. *H*904.]

Chascothyris Holzapfel, 1895, p. 234 [**C. barroisi*; SD Schuchert & LeVene, 1929, p. 40]. Large, generally transverse but exceptionally sub-

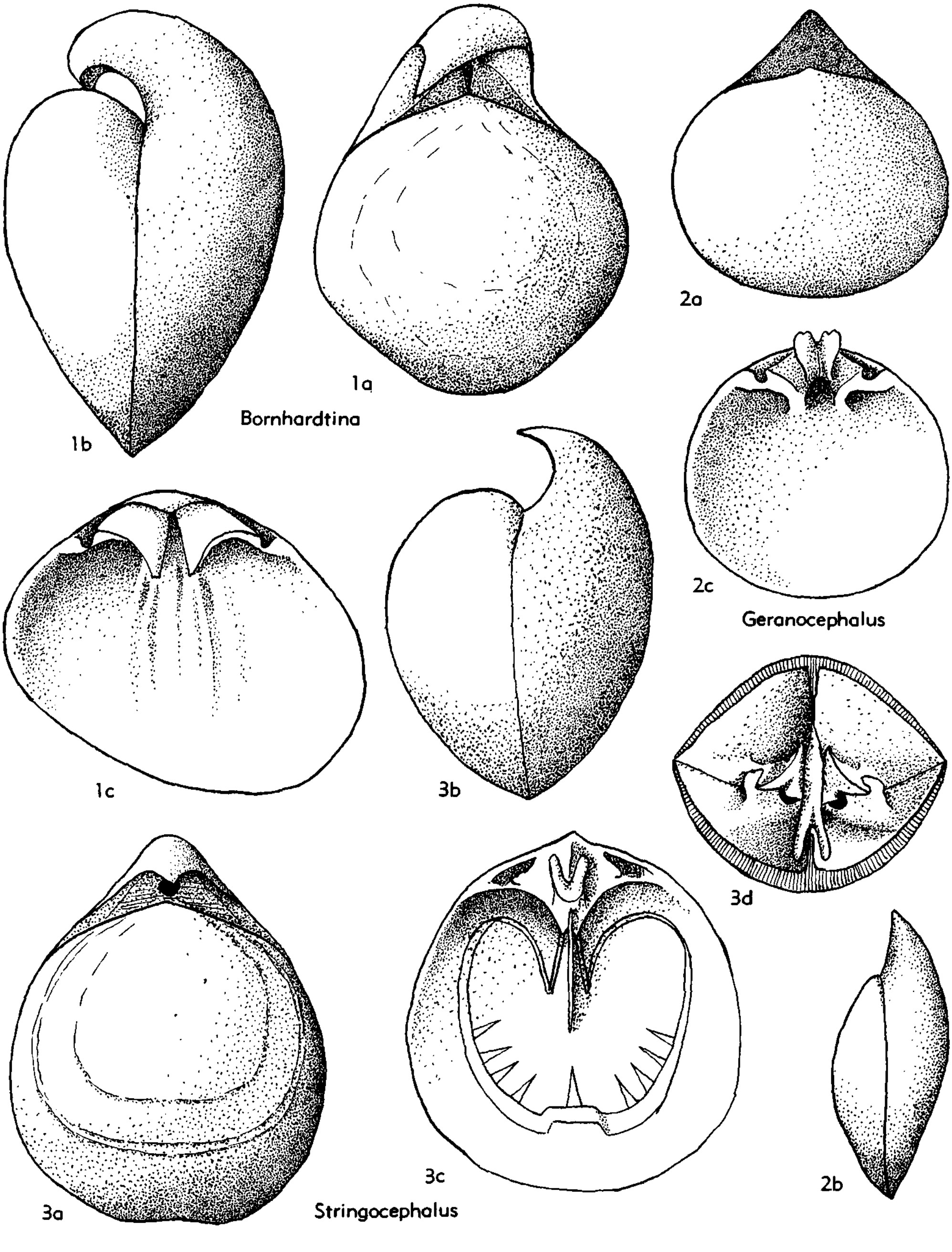


Fig. 609. Stringocephalidae (Bornhardtininae) *(1)*, (Stringocephalinae) *(2-3)* (p. *H*748).

circular; ventral beak short; ventral sulcus and dorsal fold present; hinge plates discrete; crural plates lacking; loop unknown (432). *M.Dev.*, Eu. ——FIG. 608,*3*. **C. barroisi*, Stringocephalus Ls., Ger.; *3a,b*, brach.v. and lat. views, ×0.7, ×0.6 (167).

Subrensselandia CLOUD, 1942, p. 92 [**Newberryia claypolii* HALL, 1891, p. 97; OD]. Moderate-sized; anterior commissure rectimarginate; hinge plates discrete, supported by crural plates; dental plates thin, short, obsolescent (395). *M.Dev.*, N.Am.-Eu.——FIG. 608,*1*. **S. claypolii* (HALL), Montebello Ss., USA(Pa.); *1a,b*, brach.v. and lat. views, ×0.9, ×0.8; *1c*, brach.v. int., ×0.85; *1d*, apical int., ×0.7 (167).

Subfamily BORNHARDTININAE Cloud, 1942

[Bornhardtininae CLOUD, 1942, p. 100]

Large, strongly asymmetrical; ventral beak large and conspicuous; hinge plates discrete, not supported by crural plates; cardinal process and median septa lacking. *M.Dev.*

Bornhardtina SCHULZ, 1914, p. 363 [**B. uncitoides*; SD CLOUD, 1942, p. 101] [=*Rauffia* SCHULZ, 1914, p. 371]. Size and shape variable; ventral beak large, conspicuous; asymmetrical; deltidial plates conjunct; pedicle foramen hypothyridid; anterior commissure rectimarginate; dental plates obsolete; loop incompletely known, but apparently like that of *Stringocephalus* (733). *M.Dev.*, Eu. ——FIG. 609,*1*. **B. uncitoides*, Ger.(Gerolstein); *1a,b*, brach.v. and lat. views, ×0.8, ×0.95; *1c*, brach.v. int., ×0.7 (167).

Subfamily STRINGOCEPHALINAE King, 1850

[*nom. transl.* CLOUD, 1942, p. 104 (*ex* Stringocephalidae KING, 1850, p. 51)]

Large, slightly asymmetrical; ventral beak large, conspicuous; ventral palintrope well developed; deltidial plates conjunct; pedicle foramen hypothyridid; cardinal process and median septa present; crural plates are present and well developed or suppressed. *M. Dev.*

Stringocephalus DEFRANCE in DE BLAINVILLE, 1825, p. 511 [*nom. subst.* SANDBERGER, 1842, p. 386 (*pro Strygocephale* DEFRANCE in DE BLAINVILLE, 1825, p. 511) (ICZN pend.)] [**Terebratula Burtini* DEFRANCE in DE BLAINVILLE, 1825, p. 511; OD (M)] [=*Strygocephalus* DEFRANCE in DE BLAINVILLE, 1827, pl. 53, fig. 1 (obj.)] *Strigocephalus* SOWERBY, 1839, pl. 56, fig. 10 (obj.)]. Subglobular to transversely sublenticular; ventral beak large, sharp, conspicuous, slightly asymmetrical; pedicle foramen hypothyridid; ventral palintrope large; dental plates obsolete; both valves with median septum; cardinal process large, rod-like, terminally bifid, united with primitively discrete crural plates; crural points pronounced; loop long, centronelliform, with posteriorly directed spines (246). *M.Dev.*, Eu.-N.Am.-Asia.—— FIG. 609,*3*. **S. burtini* (DEFRANCE), Ger.; *3a,b*, brach.v. and lat. views, ×0.75; *3c*, brach.v. int., ×0.65; *3d*, apical int., ×1 (*3a-c*, 167; *3d*, Stehli, n).

[The supposition expressed by DAVIDSON (1865, p. 12) that DEFRANCE intended to derive the generic name *Strygocephale* from the Greek words for screech owl *(strix)* and head *(cephala)* but transliterated the components of the name incorrectly cannot be substantiated, though one may agree that either a Greek-derived *Stringocephala* or its Latinized equivalent *Stringocephalus* are properly formed. Unquestionably, *Strygocephale* has priority over the synonyms *Strygocephalus* DEFRANCE, 1827, *Strigocephalus* SOWERBY, 1839, and *Stringocephalus* SANDBERGER, 1842, all of which constitute "unjustified emendations" classed as invalid subsequent spellings according to the Zoological Code (Art. 33,a,ii). It happens that all but universal usage has established *Stringocephalus* as the preferred name in spite of its technical invalidity and beyond doubt stability in nomenclature calls for retaining it. This cannot be done within stipulations of the Code by invoking Art. 33,a,i, which allows correction of an incorrect original spelling, because Art. 32,a,ii excludes incorrect transliteration as emendable. Thus, CLOUD's (1942, p. 106) justification of *Stringocephalus* as a corrected error of transcription must be rejected.——¶*Stringocephalus* may be validated under the Code in two ways, both of which call for appeal to ICZN. (1) Because *Strygocephale*, *Strygocephalus*, and *Strigocephalus* are all "forgotten names" *(nomina oblita)*, unused in more than 50 years, Art. 23,b provides that they may be placed on the Official List of Rejected Generic Names in Zoology, reference to the Commission being made for this purpose. Then, *Stringocephalus* SANDBERGER, 1842, automatically gains place as oldest name for this genus. (2) A more direct and desirable course is to seek action under the plenary powers of ICZN (Art. 78), because this could establish *Stringocephalus* with DEFRANCE, 1825, as author and similarly could reject *Strygocephale*, *Strygocephalus*, and *Strigocephalus* from possibility of being resurrected by anyone. Accordingly, an application to stabilize nomenclature in this way has been filed, for usage alone lacks force in legalizing zoological names.— R. C. MOORE]

Acrothyris HOU, 1963, p. 419, 427 [**A. kwangsiensis*; OD]. Medium-sized to large, oval or elongate-oval in outline; beak protruding, foramen in apex. Pedicle valve with short divergent dental plates; brachial valve with massive bilobed cardinal process. [Data from HOU furnished by M. ROWELL.] *M.Dev.*, S.China.

Geranocephalus CRICKMAY, 1954, p. 157 [**G. inopinus*; OD]. Large, smooth, biconvex; ventral beak large, erect, with broad palintrope; deltidial plates conjunct; pedicle foramen hypothyridid; dental plates present; hinge plates discrete or posteriorly united by large bifid cardinal process; crural plates present; median septa lacking; loop unknown (207). *M.Dev.*, N.Am.——FIG. 609,*2*. **G. inopinus*; composite figure; *2a,b*, brach.v. and lat. views, ×0.8; *2c*, brach.v. int., ×1 (207).

Family RHIPIDOTHYRIDIDAE Cloud, 1942

[*nom. correct.* STEHLI, herein (*pro* Rhipidothyridae CLOUD, 1942, p. 80)]

Small to large, costate to smooth; anterior commissure rectimarginate to gently plicate; pedicle foramen submesothyridid to hypothyridid; dental plates well developed to obsolescent; primitively with discrete hinge plates and crural plates but common-

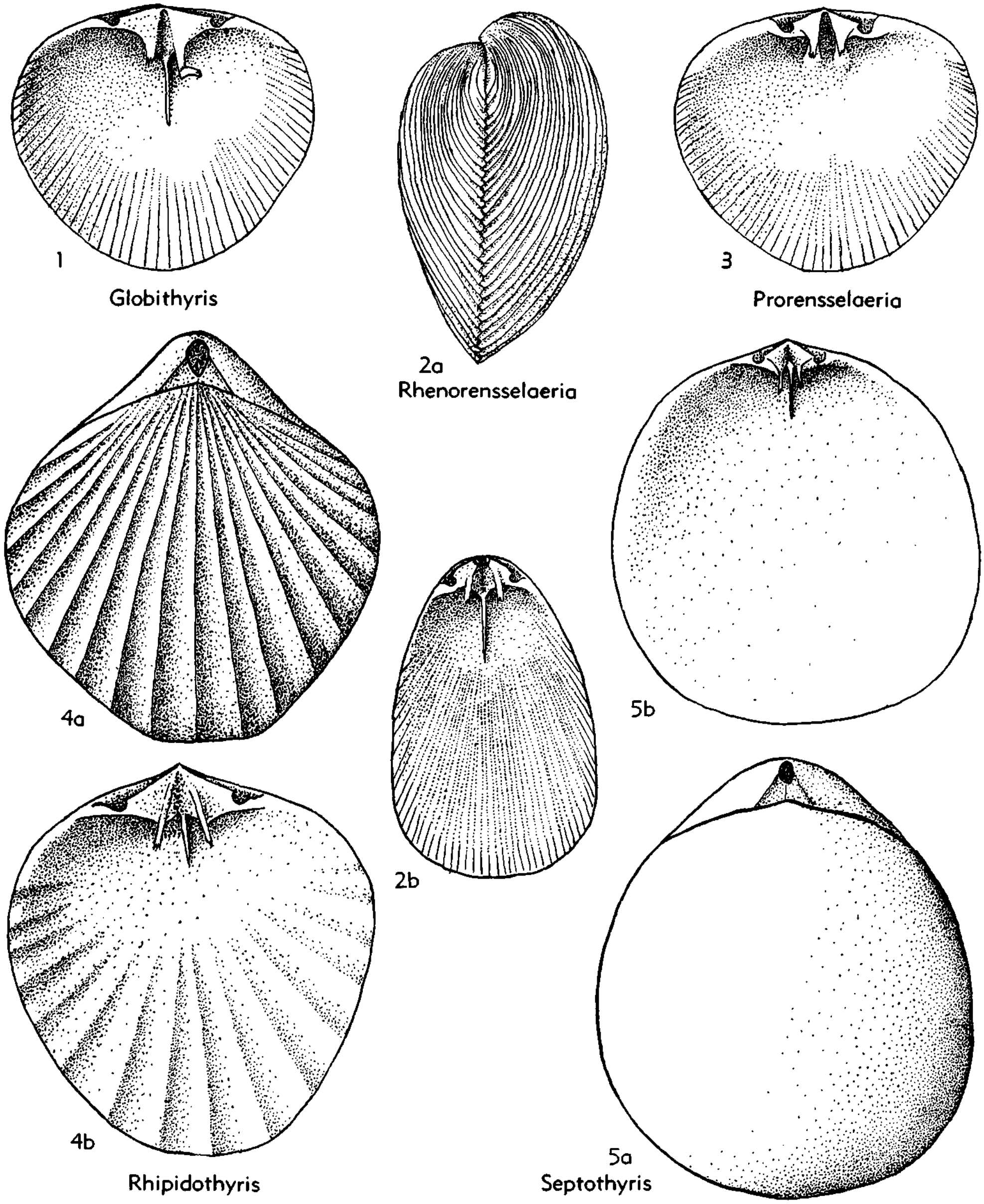


FIG. 610. Rhipidothyrididae (Rhipidothyridinae) *(4-5)*, (Globithyridinae) *(1-3)* (p. *H*749-*H*750).

ly with these structures united to form septalium; nature of loop unknown. *L.Dev.-M.Dev.*

Subfamily RHIPIDOTHYRIDINAE Cloud, 1942

[*nom. correct.* STEHLI, herein (*pro Rhipidothyrinae* CLOUD, 1942, p. 87)]

Small, lenticular, smooth or costate; pedicle foramen submesothyridid; cardinal plate concave, supported by a median septum; dental plates present. *M.Dev.*

Rhipidothyris COOPER & WILLIAMS, 1935, p. 847 [**R. plicata*; OD]. Small, costellate, subcircular to subovate; concave cardinal plate supported for all or part of its length by median septum; loop unknown (198). *M.Dev.*, N.Am.——FIG. 610,*4*. **R. plicata,* composite figure; *4a,b,* brach.v. view, brach.v. int., ×2 (167).

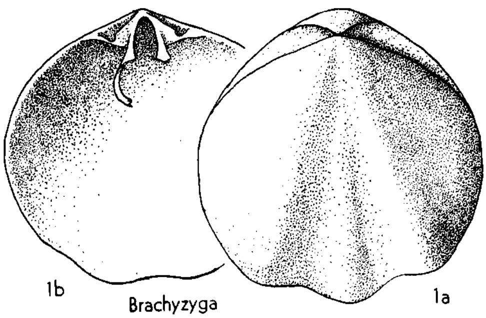


FIG. 611. Mutationellidae (Brachyzyginae) (p. H750).

Septothyris COOPER & WILLIAMS, 1935, p. 849 [**S. septata*; OD]. Small, smooth, subcircular; concave cardinal plate supported throughout its length by median septum or medially sessile so that it appears divided; loop unknown (198). *M.Dev.*, N.Am.——FIG. 610,*5*. **S. septata*, composite figure; *5a,b*, brach.v. view, brach.v. int., ×4.3, ×4 (198).

Subfamily GLOBITHYRIDINAE Cloud, 1942

[*nom. correct.* STEHLI, herein (*pro Globothyrinae* CLOUD, 1942, p. 81)]

Large, subglobular, entirely costate or costellate; pedicle foramen hypothyridid; hinge plates discrete or united with crural plates to form septalium; dental plates present. *L.Dev.*

Globithyris CLOUD, 1942, p. 82 [**Rensselaeria callida* CLARKE, 1907, p. 241; OD]. Large, subglobose; entirely costate; dental plates thin, short to moderately long; pedicle collar present; hinge plates united in septalium. *L.Dev.*, N.Am.——FIG. 610,*1*. **G. callida* (CLARKE), Moose River Ss., USA (Maine); brach.v. int., ×1.3 (167).

Prorensselaeria RAYMOND, 1923, p. 468 [**P. nylanderi*; OD]. Large, moderately convex, costellate; subcircular in outline; dental plates short and thick; hinge plates discrete and supported by discrete crural plates; median septum absent (658). *L.Dev.*, N.Am.——FIG. 610,*3*. **P. nylanderi*, Chapman Ss., USA (Maine); brach.v. int., ×0.85 (167).

Rhenorensselaeria KEGEL, 1913, p. 126 [**Terebratula strigiceps* ROEMER, 1844, p. 58; SD SCHUCHERT & LEVENE, 1929, p. 107]. Moderate-sized to large, strongly convex, elongate in adults, subcircular in juveniles, entirely costate or costellate; dental places short; ventral myophragm prominent; hinge plates united in septalium; well-developed cardinal process present (669). *L.Dev.*, Eu.——FIG. 610,*2*. **R. strigiceps* (ROEMER), Ger.; *2a*, lat. view, ×1.05; *2b*, brach.v. int., ×1.3 (167).

Family MUTATIONELLIDAE Cloud, 1942

[*nom. transl.* STEHLI, herein (*ex* Mutationellinae CLOUD, 1942, p. 114)]

Generally small and considerably variable archaic Centronellidina with or without cardinal plate; without crural plates; loop highly variable, generally centronelliform but in some genera highly variable. *L.Dev.-Perm.*

Subfamily BRACHYZYGINAE Cloud, 1942

[Brachyzyginae CLOUD, 1942, p. 113]

Small, smooth shells with dorsal sulcus and ventral fold; dental plates present; hinge plates discrete, apparently unsupported by crural plates; loop imperfectly known but apparently short. *L.Dev.*

Brachyzyga KOZLOWSKI, 1929, p. 243 [**B. pentameroides*; OD]. Shell with general pentameroid aspect, anterior commissure intraplicate (487). *L.Dev.*, Eu.——FIG. 611,*1*. **B. pentameroides*, Borszczów Stage, Pol.; *1a,b*, brach.v. view, brach. v. int., ×2.9, ×1.3 (487).

Subfamily MUTATIONELLINAE Cloud, 1942

[Mutationellinae CLOUD, 1942, p. 114]

Small to moderate-sized, entirely or partially radially ornamented; deltidial plates discrete or conjunct; pedicle foramen mesothyridid to submesothyridid; dental plates short to obsolete; hinge plates normally joined anteriorly forming perforate cardinal plate but discrete or imperforate in some shells; cardinal process may be present but crural plates absent; loop extremely variable but apparently primitively centronelliform. *L.Dev.-M.Dev.*

Mutationella KOZLOWSKI, 1929, p. 236 [**Waldheimia podolica* SIEMIRADZKI, 1906, p. 177; OD]. Small, subcircular, biconvex to almost planoconvex, entirely and simply costate; hinge plates discrete or united to form perforate cardinal plate; loop extremely variable, ranging from typical rather long centronelliform condition to one approaching short terebratuliform (745). *L.Dev.*, Eu.-N.Am.-S.Am.-N.Z.-Antarctica-Afr. —— FIG. 612,*5*. **M. podolica* (SIEMIRADZKI), Czortków Stage, Eu.(Pol.); *5a,b*, brach.v. and lat. views, ×3.4, ×3.1; *5c*, brach.v. int., ×3.5; *5d*, loop, ×3 (*5a,b*, 167; *5c*, Stehli, n; 5d, 487).

Cloudella BOUCOT & JOHNSON, 1963, p. 113 [*nom. subst. pro Pleurothyris* CLOUD, 1942, p. 123 (*non* LOWE, 1843; *nec* SCHRAMMEN, 1912] [**Renssalaeria stewarti* CLARKE, 1907, p. 239; OD]. Large for subfamily, entirely costellate, subglobose; deltidial plates discrete; dental plates obsolescent to obsolete; cardinal plate free and

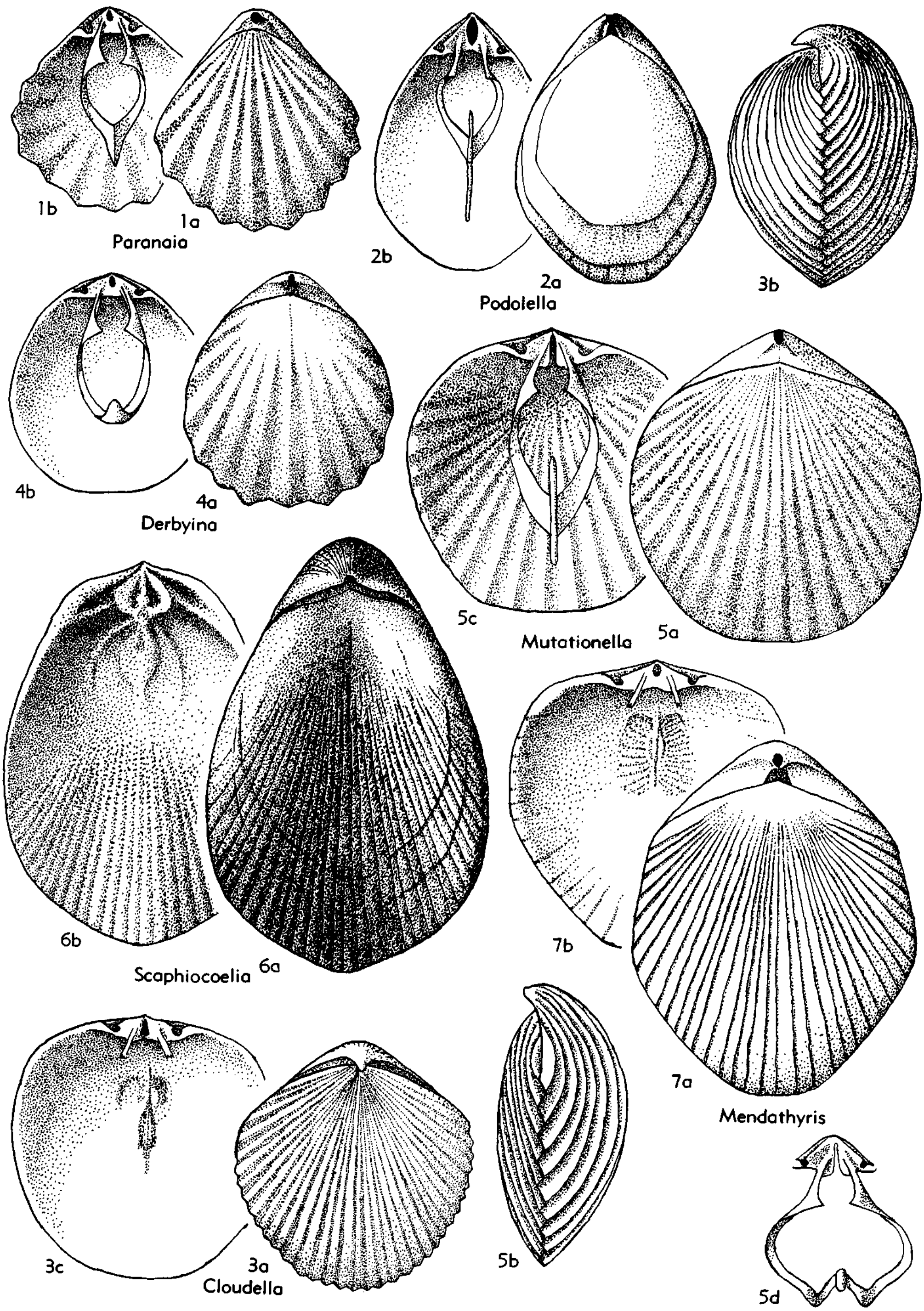


FIG. 612. Mutationellidae (Mutationellinae) (p. H750, H752).

perforate or medially divided; ventral umbones thickened; loop unknown (162). *L.Dev.*, N.Am. ——FIG. 612,*3*. **C. stewarti* (CLARKE), Dalhousie Sh., Can.(N.B.); *3a,b*, brach.v. and lat. views, ×1.4; *3c*, brach.v. int., ×1.7 (167).

Derbyina CLARKE, 1913, p. 210 [**Notothyris? smithi* DERBY, 1890, p. 81; SD CLARKE, 1913, p. 212] [*non Derbyina* GRABAU, 1931]. Small, simply costate; anterior commissure feebly uniplicate; subcircular to slightly elongate; subequally biconvex, pedicle valve deeper than brachial valve; dental plates present; cardinal plate free and perforate; loop moderately long, basically centronelliform but with anterior end turned backward. *M.Dev.*, S.Am.(Brazil-Bol.).——FIG. 612,*4*. **D. smithi* (DERBY), Brazil (Matto Grosso); *4a,b*, brach.v. view, brach.v. int., ×4.6, ×5 (250).

Mendathyris CLOUD, 1942, p. 125 [**Rensselaeria mainensis* WILLIAMS, 1900, p. 80; OD]. Large, subglobular, entirely costellate; anterior commissure rectimarginate; pedicle foramen permesothyridid; palintrope conspicuous; dental plates obsolescent to obsolete; ventral umbone thickened; cardinal plate perforate, thickened and posteriorly sessile; loop unknown (881). *L.Dev.*, N.Am. ——FIG. 612,*7*. **M. mainensis* (WILLIAMS), Chapman Ss., USA(Maine); *7a,b*, brach.v. view, brach. v. int., ×1.9 (167).

Paranaia CLARKE, 1913, pl. 21, fig. 7, 8 [**Centronella? margarida* DERBY, 1890, p. 84; OD (M)] [=*Brasilia* CLARKE, 1913, p. 216 (*non* BUCKMAN, 1898); *Brasilica* GREGER, 1920, p. 70; *Chapadella* GREGER, 1920, p. 70; *Brasilina* CLARKE, 1921, p. 138; *Oliveirella* OLIVEIRA, 1934, p. 167]. Like *Derbyina* except crura shorter and loop with anterior end extended forward (250). *L.Dev.*, S. Am.——FIG. 612,*1*. **P. margarida* (DERBY), Maecuru Gr., Brazil; *1a,b*, brach.v. view, brach.v. int., ×3.4, ×3.5 (250).

Pleurothyrella BOUCOT, CASTER, IVES, & TALENT, 1963, p. 89 [**Scaphiocoelia? africana* REED, 1906, p. 306; OD]. Large, costellate shells resembling *Cloudella*; anterior commissure rectimarginate; biconvex, pedicle valve deeper than brachial valve; cardinal plate bulbous and imperforate in adults; cardinal process present or not; loop unknown (659). *L.Dev.*, Antarctica-N.Z.-Afr.-S.Am.

Podolella KOZLOWSKI, 1929, p. 232 [**P. rensselaeroides*; OD]. Small, terebratuliform; ornamentation restricted to anterior portion of shell; deltidial plates discrete; dental plates present, cardinal plate perforate; with or without crural plates; loop centronelliform, with vertical plate (487). *L.Dev.*, Eu.——FIG. 612,*2*. **P. rensselaeroides*, Borszczów Stage, Pol.; *2a,b*, brach.v. view, brach.v. int., ×3.3, ×3.6 (*2a*, 167; *2b*, Stehli, n).

Scaphiocoelia WHITFIELD, 1891, p. 105 [**S. boliviensis*; OD (M)]. Large, elongate, simply costate shells; brachial valve gently concave and bearing sulcus, pedicle valve strongly convex and bearing fold; internally similar to *Mendathyris* but some species exhibiting cardinal process; loop unknown (864). *L.Dev.*, S.Am.-S.Afr.——FIG. 612,*6*. **S. boliviensis*, S.Am.(Bol.); *6a,b*, brach.v. view, brach.v. int., ×0.8 (Stehli, n).

Subfamily CIMICINELLINAE Stehli, n. subfam.

Moderate-sized, terebratuliform early probable derivatives of Mutationellidae; with crural plates and complex loop. *L.Dev.*

Cimicinella SCHMIDT, 1943 [**Terebratula cimex* RICHTER & RICHTER, 1918, p. 156; OD]. Moderate-sized, smooth; elongate, biconvex; anterior commissure rectimarginate; dental plates present; cardinal plate perforate, supported by inclined crural plates; loop long, recurved bands developing but united with main bands (667). *L.Dev.*, Eu.(Ger.).——FIG. 613,*4*. **C. cimex* (RICHTER & RICHTER); brach.v. int., ×2.2 (719).

Subfamily CRYPTACANTHIINAE Stehli, n. subfam.

Moderate-sized to small, with dorsal sulcus and ventral fold; anterior commissure more or less sulcate; pedicle foramen minute, mesothyridid; dental plates present; cardinal plate extending between socket plates, supported by median septum or not; crural plates absent; loop primitively centronelliform but tending to become long, with recurved branches and somewhat cryptonelliform save for hoodlike transverse band. *?L.Dev., Miss.-U.Perm.*

Cryptacanthia WHITE & ST. JOHN, 1867, p. 119 [**Waldheimia? compacta* WHITE & ST. JOHN, 1867, p. 119; OD]. Small, strongly biconvex with pronounced ventral fold and dorsal sulcus; externally similar to *Glossothyropsis*; loop essentially cryptonelliform but with main bands closely approaching or actually joining for some distance near mid-length before separating farther forward; anterior extremities of loop spinose; dorsal median septum absent; cardinal plate perforate (860). *M.Penn.-L.Perm.*, N.Am.-Eu.-Asia.——FIG. 613,*5*. **C. compacta* (WHITE & ST. JOHN), composite figure; brach.v. int., ×8 (Stehli, n).

Gacina STEHLI, 1961, p. 458 [**G. moorefieldensis*; OD (M)]. Medium-sized; elongately subpentagonal in outline; ventral fold broad at front, narrower and more pronounced near mid-length where margins of valve tend to be flattened; dorsal sulcus extending almost to beak; loop modified centronelliform, main bands uniting near mid-length; vertical plate arising anteriorly and anteroventrally split to form incipient recurved bands; dorsal median septum absent; cardinal plate perforate (779). *?Up.L.Dev., U.Miss.*, N. Am.-Eu.——FIG. 613,*3*. **G. moorefieldensis*, Meramec.(Moorefield F.), USA(Okla.); *3a,b*, ped. v. ext., brach.v. int., ×1.2, ×4.2 (Stehli, n).

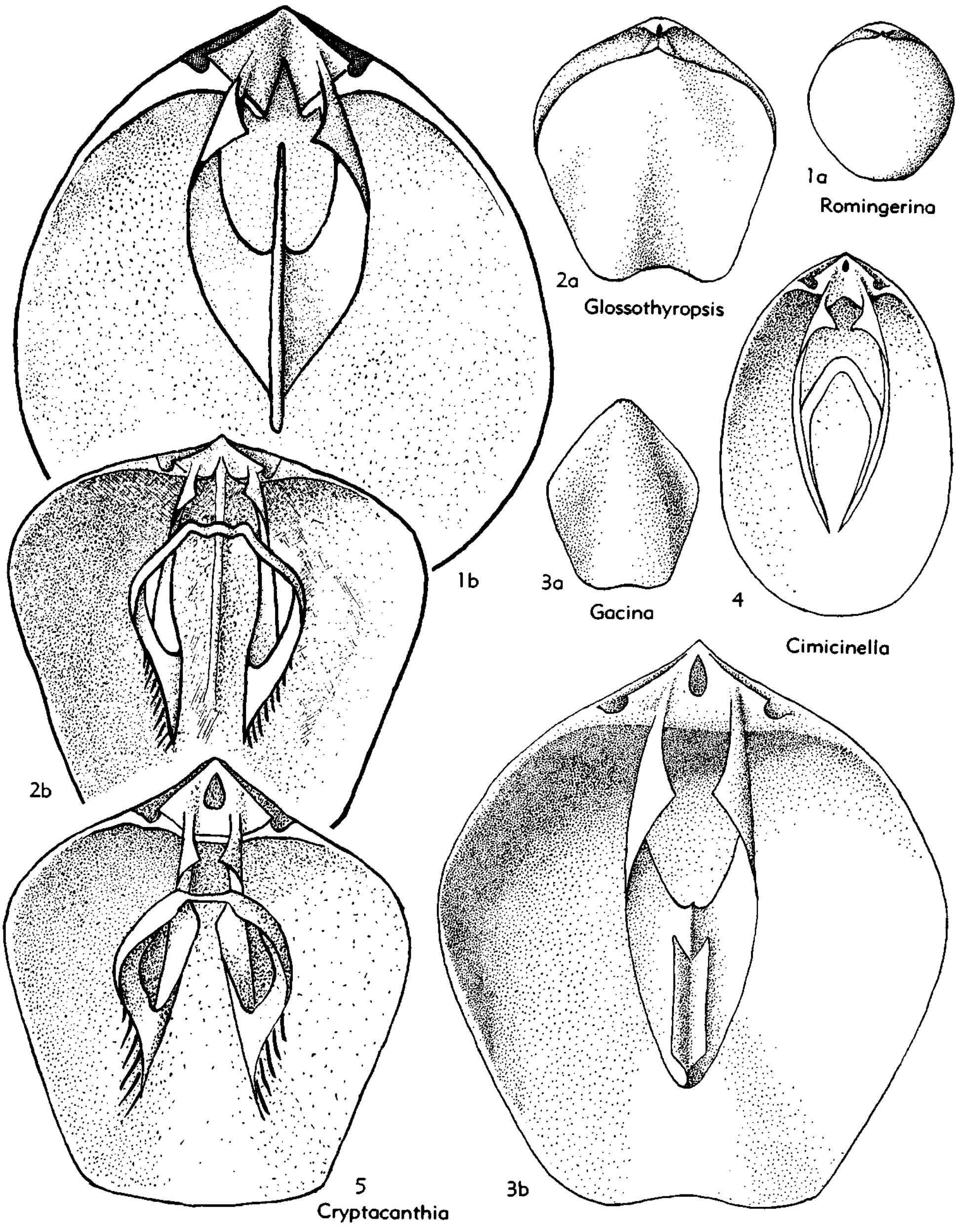


FIG. 613. Mutationellidae (Cimicinellinae) *(4)*, (Cryptacanthiinae) *(2-3,5)*; Family Uncertain *(1)* (p. *H*752-*H*754).

Glossothyropsis GIRTY, 1934, p. 251 [**Cryptacanthia? robusta* GIRTY, 1934, p. 251; OD]. Small to moderate-sized; ventral fold pronounced; dorsal sulcus pronounced or not; cardinal plate more or less massive, imperforate, supported by median septum; loop long, more or less cryptonelliform, main bands widely separated and anteriorly spinose (350). *L.Perm.-U.Perm.*, N.Am.-Eu.-Asia-Australia.——FIG. 613,*2*. **G. robusta* (GIRTY), composite figure; *2a,b*, brach.v. view, brach.v. int., ×3.5, ×6.8 (Stehli, n).

Family UNCERTAIN

Elmaria NALIVKIN, 1947 [**E. glabra*; OD]. Small,

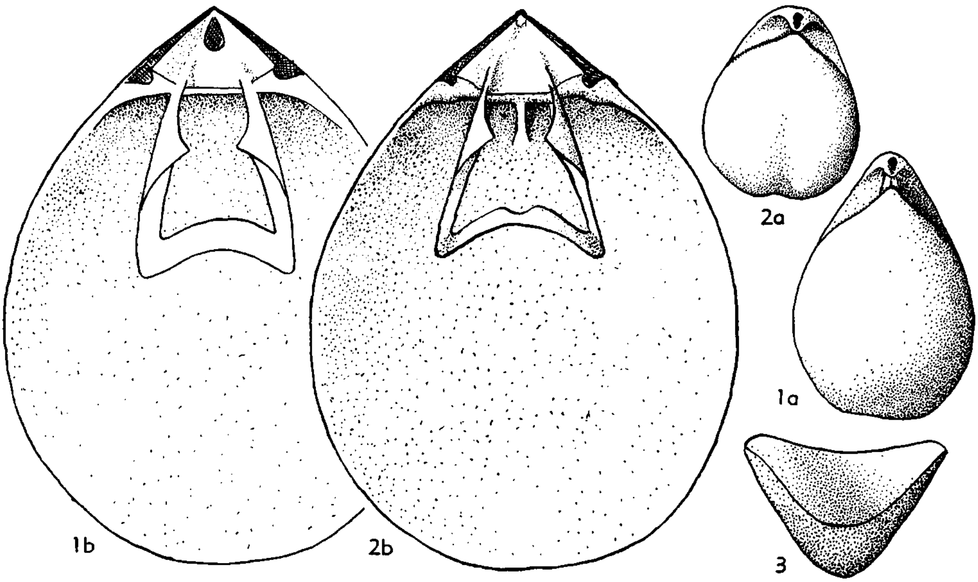


FIG. 614. Cranaenidae (Cranaeninae) *(1,3)*, (Girtyellinae) *(2)* (p. *H*754-*H*755).

rounded to elongate oval, smooth or faintly wrinkled, laterally keel-like, beak sharp; dental plates lacking. *M.Dev.(Givet.)*, USSR.

Romingerina HALL & CLARKE, 1894, p. 272 [**Centronella julia* WINCHELL, 1862, p. 405; OD] [=*Harttina* HALL & CLARKE, 1894, p. 292]. Small, smooth and almost circular in outline; subequally convex, pedicle valve more so than brachial valve; ventral beak short, deltidial plates conjunct; pedicle foramen submesothyridid; small dental plates present or absent; cardinal plate sessile; apparently divided; crural plates seemingly absent; loop long, centronelliform with large vertical plate (890). *L.Miss.-U.Miss.*, N.Am.——FIG. 613,*1*. **R. julia* (WINCHELL), composite figure; *1a,b*, brach.v. view, brach.v. int., ×2, ×8.7 (Stehli, n).

Suborder TEREBRATULIDINA Waagen, 1883

A diagnosis of this assemblage is given in the section on Terebratulida—Main Groups (see p. *H*730).

Superfamily DIELASMATACEA Schuchert, 1913

[*nom. transl.* STEHLI, herein (*ex* Dielasmatinae SCHUCHERT, 1913, p. 402)]

Advanced derivatives of early radiation of Centronellidina which primitively possess short loop, though specialized descendants may have highly complicated loops; generally without true crural plates; pedicle foramen permesothyridid and labiate; pedicle collar present. *L.Dev.-U.Trias., ?L.Jur. (Lias.)*. [Post-Paleozoic forms included in section by MUIR-WOOD, p. *H*762.]

Family CRANAENIDAE Cloud, 1942

[*nom. transl.* STEHLI, herein (*ex* Cranaeninae CLOUD, 1942, p. 131)]

Primitive Dielasmatacea, probably derived from Mutationellidae, possessing cardinal plate extending between socket ridges without support from crural plates and typically perforate but imperforate when plate is apically sessile or median septum is present. *L.Dev.-Miss.*

Subfamily CRANAENINAE Cloud, 1942

[Cranaeninae CLOUD, 1942, p. 131]

Moderate-sized, with terebratuliform loop, cardinal plate extending as apically perforate plate between socket ridges free of valve floor, or as imperforate plate apically united with valve floor; dental plates present. *L. Dev.-U.Miss.*

Cranaena HALL & CLARKE, 1893, p. 297 [**Terebratula romingeri* HALL, 1863, p. 48; OD] [=*Eunella* HALL & CLARKE, 1893, p. 290; *Cranaenella* FENTON & FENTON, 1924, p. 129]. Small to moderate-sized; anterior commissure rectimarginate to slightly uniplicate; both valves transversely con-

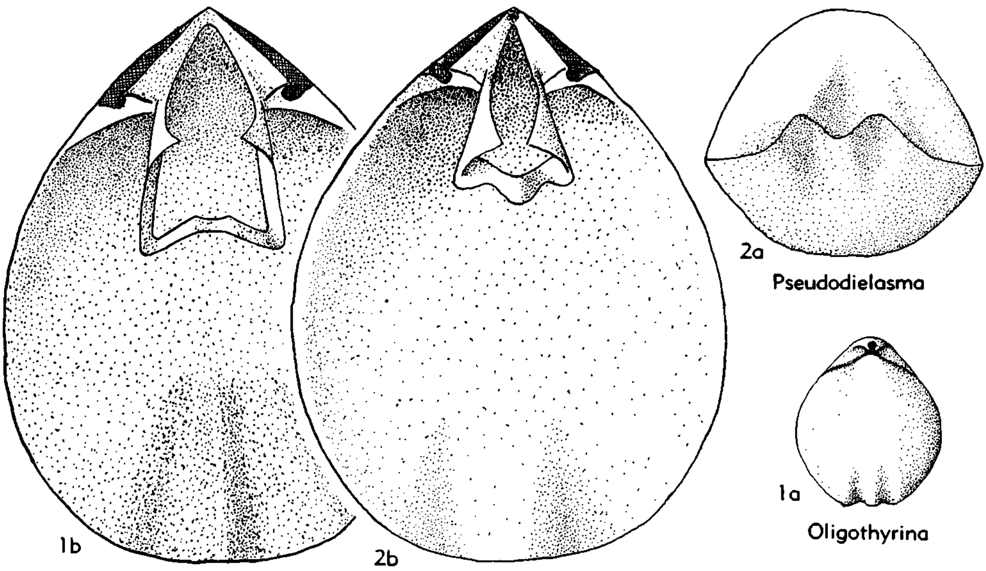


FIG. 615. Labaiidae (p. *H*755).

vex; cardinal plate free and perforate (389). *L. Dev.-U.Miss.*, cosmop.——FIG. 614,*1*. **C. romingeri* (HALL), composite figure; *1a,b*, brach.v. view, brach.v. int., ×1.35, ×3.8 (167).

Hamburgia WELLER, 1911, p. 445 [**H. typa*; OD (M)] [=*Stuartella* BELANSKI, 1929, p. 24]. Externally homeomorphous with *Cranaena*; internally like *Cranaena* except cardinal plate apically sessile and imperforate (857). *U.Dev.-U.Miss.*, N.Am.

Maclarenella STEHLI, 1955, p. 868 [**M. maculosa*; OD]. Moderate-sized; anterior commissure strongly uniplicate; dorsal valve of triangular cross section; ventral valve transversely concave; cardinal plate free and perforate (774). *U.Dev.*, N.Am. (Can.).——FIG. 614,*3*. **M. maculosa*, Waterways F., Alberta; ant. view, ×1.35 (Stehli, n).

Subfamily GIRTYELLINAE Stehli, n.subfam.

Folded or unfolded shells with terebratuliform loop and imperforate cardinal plate supported by median septum; with or without dental plates. *Miss.*

Girtyella WELLER, 1914, p. 442 [**Harttina indianensis* GIRTY, 1908, p. 293; OD]. Small to moderate-sized; anterior commissure rectimarginate or modified by rounded plications; dental plates present (344). *Miss.*, N.Am.-Eu.——FIG. 614,*2*. **G. indianensis* (GIRTY), composite figure; *2a,b*, brach.v. view, brach.v. int., ×2, ×7.5 (Stehli, n).

Harttella BELL, 1929, p. 149 [**H. parva*; OD]. Small, similar to *Girtyella* except in being folded and lacking dental plates (64). *U.Miss.(Meramec.)*, N.Am.

Family LABAIIDAE Likharev, 1960

[*nom. correct.* STEHLI, herein (*pro* Labaidae LIKHAREV, 1960, p. 293)]

Small, terebratuliform looped shells with tendency toward anterior folding; cardinal plate obsolete; crura arising from margins of socket ridges; dental plates absent. *M. Penn.-U.Perm.*

Labaia LIKHAREV, 1956, p. 65 [**L. Muir-Woodae*; OD]. Small, smooth, elongate, unfolded shell suboval and subrhomboidal; pedicle valve with pronounced shoulders in the umbonal region; pedicle interior without dental plates, pedicle collar probably present; brachial interior without cardinal plate; crura arising directly from the socket ridges and giving rise to a short loop. *U.Perm.*, USSR(N.Caucasus).

Oligothyrina COOPER, 1956, p. 525 [**O. alleni*; OD]. Small, with a weakly to strongly intraplicate anterior commissure; folds arising anterior to midlength; transverse band not projecting anteriorly (188). *M.Penn.-U.Perm.*, N.Am.——FIG. 615,*1*. **O. alleni*, composite figure; *1a,b*, brach.v. view, brach.v. int., ×4.2, ×19 (188).

Pseudodielasma BRILL, 1940, p. 317 [**P. perplexa*; OD]. Small, with weakly to strongly sulciplicate anterior commissure; folds arising near the front; loop with medial portion of transverse band projected anteriorly (118). *U.Perm.*, N.Am.-Australia. ——FIG. 615,*2*. **P. perplexa*, composite figure; *2a,b*, ant. view, brach.v. int., ×7, ×19 (*2a*, Stehli, n; *2b*, 118).

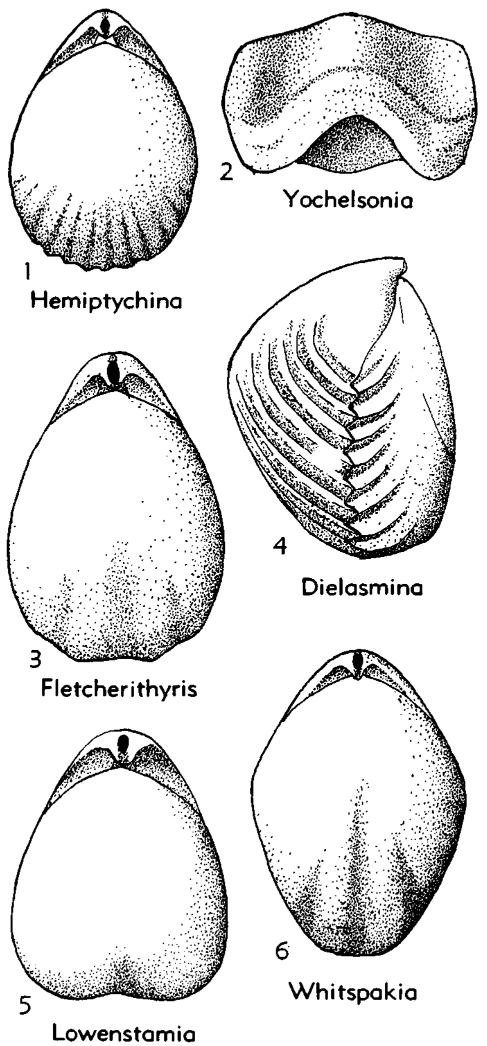


FIG. 616. Dielasmatidae (Dielasmatinae) (p. H756, H758).

Family DIELASMATIDAE Schuchert, 1913

[*nom. transl.* SCHUCHERT & LEVENE, 1929, p. 23 (*ex* Dielasmatinae SCHUCHERT, 1913, p. 402)]

Smooth to plicate, folded or unfolded shells; pedicle valve with or without dental plates; brachial valve with terebratuliform loop and modified cardinal plate which is either divided or supported by septum. *L. Carb.-U.Trias., ?L.Jur.(Lias.).* [Post-Paleozoic forms included in section by MUIR-WOOD, p. H762.]

Subfamily DIELASMATINAE Schuchert, 1913

[Dielasmatinae SCHUCHERT, 1913, p. 402]

Dental plates present or absent; pedicle collar complete; pedicle beak not elongated. *L.Carb.-U.Trias.*

Dielasma KING, 1859, p. 7 [**Terebratulites elongatus* VON SCHLOTHEIM, 1816, p. 27; OD] [=*Dielasmoides* WELLER, 1914, p. 253]. Small to large; normally with dorsal fold, ventral sulcus and uniplicate anterior commissure but in few species with folds anteriorly resulting in sulciplicate commissure; halves of cardinal plate separate or jointed near union with floor of valve; dental plates present (716). *U.Miss.-Perm.*, cosmop.——FIG. 617,*1*. **D. elongatum* (SCHLOTHEIM), composite figure; *1a*, brach.v. int., ×2.4; *1b*, lat. view, ×2.4; *1c*, apical int., ×5.5 (Stehli, n).

Balanoconcha CAMPBELL, 1957, p. 86 [**B. elliptica*; OD]. Medium-sized external homeomorph of *Dielasma*; anterior commissure rectimarginate to slightly uniplicate; cardinal plate as in *Dielasma*; dental plates absent (140). *L.Carb.(Tournais.)*, Australia.——FIG. 617,*4*. **B. elliptica*, composite figure; brach.v. int., ×3 (Stehli, n).

Dielasmina WAAGEN, 1882, p. 335 [**D. plicata*; OD]. Moderate-sized to large, anteriorly ornamented by numerous low plications; anterior commissure rectimarginate; brachial valve geniculated sharply near mid-length; cardinal plate supported by median septum; dental plates present (845). *Perm.*, Pakistan (Salt Range).——FIG. 616,*4*; 617,*7*. **D. plicata*, composite figure; 616,*4*, lat. view, ×1.4; 617,*7*, brach.v. int., ×3 (Stehli, n).

Fletcherithyris CAMPBELL, 1965 [*nom. subst. pro Fletcherina* STEHLI, 1961, p. 452 (*non* LANG, SMITH, & THOMAS, 1955, p. 261)] [**Terebratula amygdala* DANA, 1847, p. 152; OD]. Moderate-sized to large, folded or unfolded, when folded, brachial valve with median sulcus flanked by folds; cardinal plate supported by median septum; dental plates present (223). *L.Perm.*, Australia.——FIG. 616,*3*; 617,*6*. **F. amygdala* (DANA), composite figure; 616,*3*, brach.v. view, ×1.5 (Stehli, n); 617,*6*, brach.v. int., ×3.5 (779).

Hemiptychina WAAGEN, 1882, p. 335 [**Terebratula himalayensis* DAVIDSON, 1862, p. 27; OD] [=*Morrisina* GRABAU, 1931, p. 97]. Moderate-sized, biconvex to subglobular; brachial valve and some pedicle valves geniculate anteriorly; anterior commissure rectimarginate; abundantly plicated anteriorly; halves of cardinal plate separate; dental plates absent (233). *Perm.*, Asia(E.Tethyan area).——FIG. 616,*1*; 617,*5*. **H. himalayensis* (DAVIDSON), composite figure; 616,*1*, brach.v. view, ×1.7; 617,*5*, brach.v. int., ×4 (Stehli, n).

Lowenstamia STEHLI, 1961, p. 460 [**L. texana*; OD]. Small, inflated external homeomorphs of *Dielasma*; halves of cardinal plate separate and

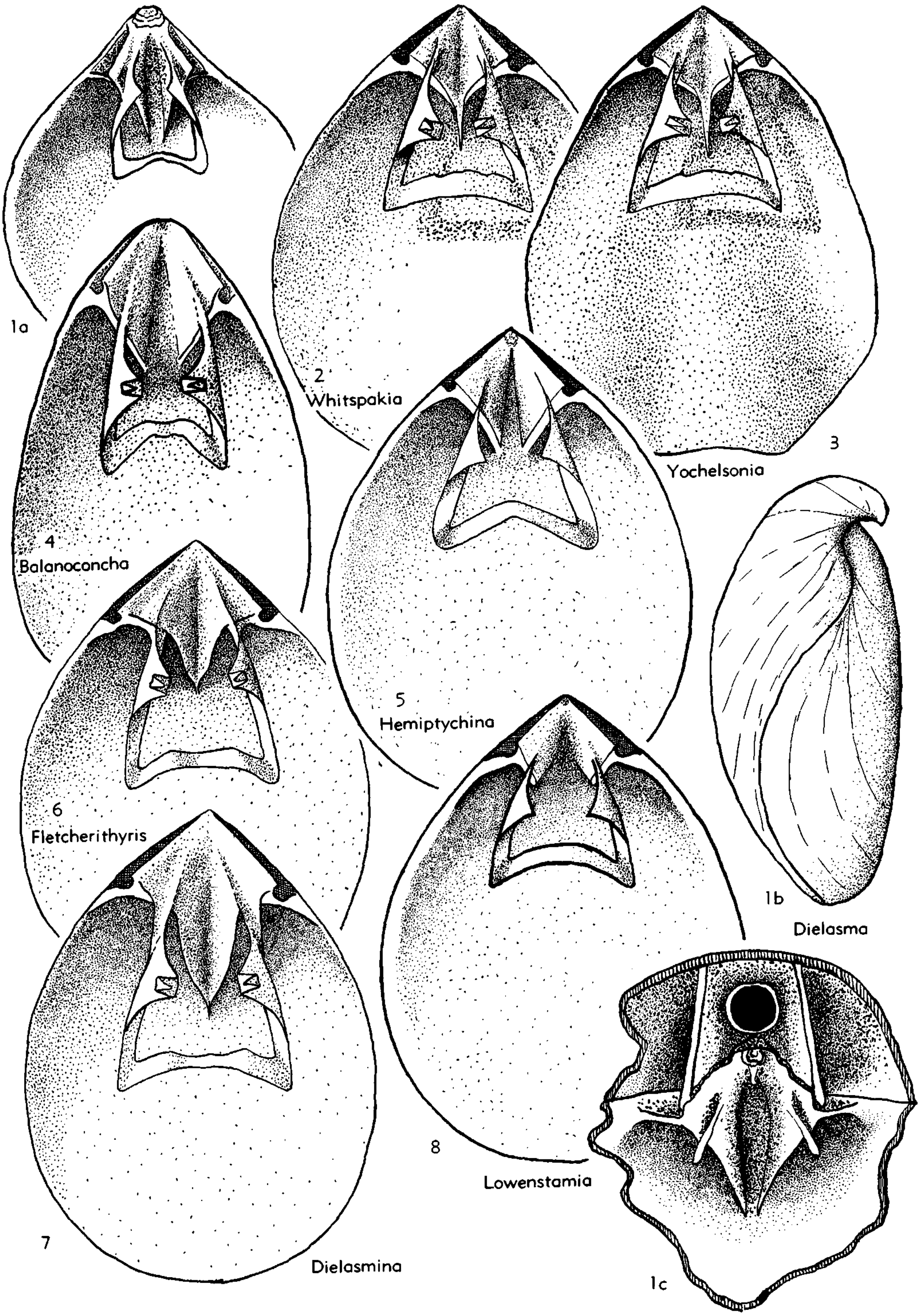


Fig. 617. Dielasmatidae (Dielasmatinae) (p. *H*756, *H*758).

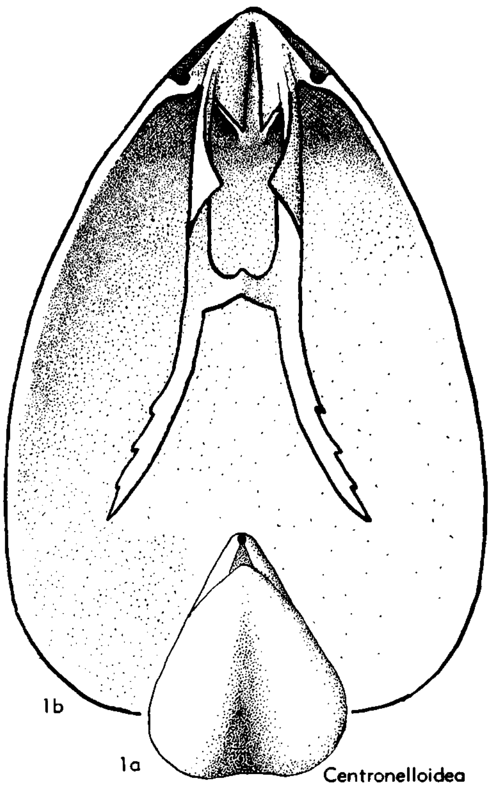


FIG. 618. Dielasmatidae (Centronelloideinae) (p. *H758*).

becoming free of valve floor anteriorly; dental plates absent (779). *L.Perm.*, N.Am.——FIG. 616, *5*; 617,*8*. **L. texana*, Coleman Jct. Ls., USA (Tex.); 616,*5*, brach.v. view, ×3.4; 617,*8*, brach. v. int., ×7.5 ((616,*5*, Stehli, n; 617,*8*, 61).

Whitspakia STEHLI, 1964, p. 610 [**Dielasma biplex* WAAGEN, 1882, p. 249] [=*Pakistania* STEHLI, 1961, p. 462 (*non* EAMES, 1952)]. Medium-sized to large, subpentagonal to oval in outline; anterior commissure sulciplicate; front and sides not geniculate; cardinal plate like *Dielasma;* dental plates present (845). *Perm.*, N.Am.-Eu.-Asia.——FIG. 616,*6*; 617,*2*. **W. biplex* (WAAGEN), composite figure; 616,*6*, brach.v. view, ×1.5; 617,*2*, brach.v. int., ×3 (Stehli, n).

Yochelsonia STEHLI, 1961, p. 454 [**Y. thomasi*; OD]. Small, subtriangular to pentagonal; brachial valve longitudinally flattened, bearing pronounced median sulcus; pedicle valve with high median fold bordered by sulci; front and sides of both valves geniculate; cardinal plate as in *Dielasma*; dental plates present. *U.Perm.*, W.Australia.——FIG. 616,*2*; 617,*3*. **Y. thomasi*; composite figure; 616,*2*, ant. view, ×3.2; 617,*3*, brach.v. int., ×3.5 (Stehli, n).

Subfamily CENTRONELLOIDEINAE Stehli, n.subfam.

Small, somewhat aberrant dielasmatids with sulcate anterior commissure and elongate ventral beak; pedicle foramen permesothyridid but not telate; loop terebratuliform but modified by spinose anterior projections of main bands beyond transverse band; dental plates and partial pedicle collar present. *U.Miss.*

Centronelloidea WELLER, 1914, p. 246 [**Terebratula rowleyi* WORTHEN, 1884, p. 23; OD (M)]. Small, with sulcate anterior commissure; pedicle valve with rounded fold, brachial valve with more pronounced sulcus; ventral beak elongated; cardinal plate medially sessile (894). *U.Miss.*, N. Am.——FIG. 618,*1*. **C. rowleyi* (WORTHEN), composite figure; *1a,b*, brach.v. view, brach.v. int., ×3.6, ×14.5 (858).

Family NOTOTHYRIDIDAE Likharev, 1960

[*nom. transl. et correct.* STEHLI, herein (*ex* Notothyrinae LIKHAREV, 1960, p. 288)]

Folded or unfolded shells with apically perforate cardinal plate extending unsupported between socket plates; loop characteristically centronelliform but exhibiting stages in transformation from terebratuliform to quasicryptonelliform; dental plates absent. *U.Miss.-U.Perm.*

Notothyris WAAGEN, 1882, p. 375 [**Terebratula subvesicularis* DAVIDSON, 1862, p. 27; SD HALL & CLARKE, 1893, p. 275]. Small to moderate-sized with numerous plications toward front; anterior commissure rectimarginate to faintly sulcate; interior as in *Rostranteris* (233). *Perm.*, Eu.-Asia.——FIG. 619,*2*. **N. subvesicularis* (DAVIDSON), composite figure; *2a,b*, brach.v. view, brach.v. int., ×1.35, ×4.4 (845).

Alwynia STEHLI, 1961, p. 464 [**D. vesiculare* DEKONINCK, 1887, p. 30; OD (M)]. Small, with antiplicate anterior commissure; loop basically terebratuliform but modified by close approach of main bands anteriorly and small transverse band (779). *L.Carb.*, Eu.——FIG. 619,*1*. **A. vesicularis* (DEKONINCK), Visean, Eng.(Isle of Man); *1a,b*, ped.v. ext. and ant. views, ×2.4; *1c*, brach.v. int., ×5.3 (Stehli, n).

Gefonia LIKHAREV, 1936, p. 264 [**G. cubanica*; OD]. Small, subpentagonal; anterior commissure basically sulcate but modified by folds into antiplicate condition; loop centronelliform but modified by union of main bands through transverse band anterior to mid-length and their subsequent separation with rise of diverging recurving bands which end without uniting (515). *U.Perm.*, USSR (Caucasus).——FIG. 619,*5*. **G. cubanica*; *5a,b*,

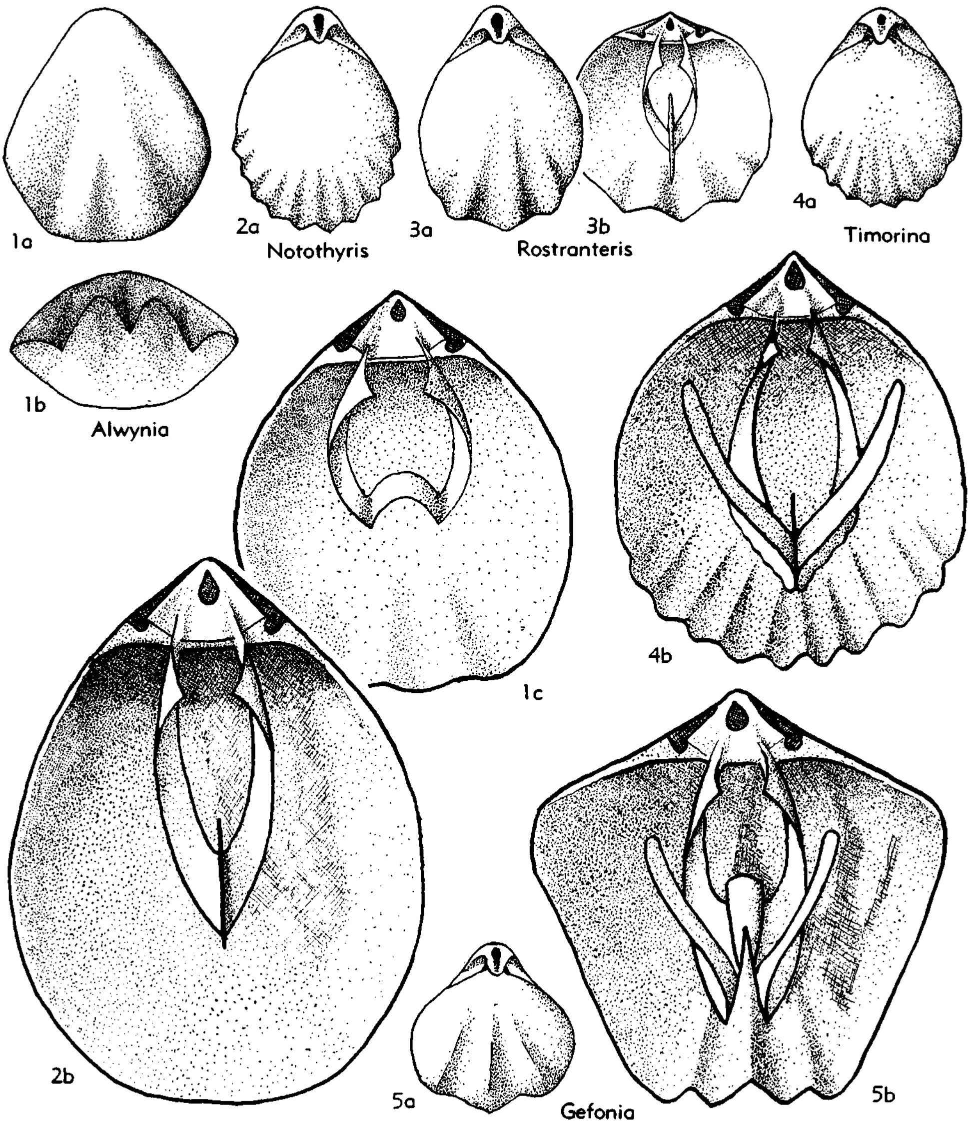


FIG. 619. Notothyrididae (p. *H*758-*H*760).

brach.v. view, brach.v. int., ×1.7, ×5.7 (Stehli, n).

Rostranteris GEMMELLARO, 1898 (1899), p. 306 [**D. adrianense* GEMMELLARO, 1894, p. 5; OD] [=*Mongolina* GRABAU, 1931, p. 105]. Small to moderate-sized, typically with intraplicate anterior commissure, more rarely sulcate; when intraplicate, major folds of pedicle valve may be flanked by one weak fold; loop centronelliform with high median plate extended anteriorly and posteriorly beyond union of main bands (330). *Perm.*, N.Am.-Eu.-Asia.

R. *(***Rostanteris***)*. Distinguished by delicate cardinalia. *Perm.*, N.Am.-Eu.-Asia.——FIG. 619,*3*. **R. (R.) adrianensis* (GEMMELLARO), composite figure; *3a,b,* brach.v. view, brach.v. int., ×1.7, ×2.2 (Stehli, n).

R. *(***Notothyrina***)* LIKHAREV, 1936 [**Notothyris (N.) pontica*; OD]. Very small pedicle valve with 2 strong folds each bordered by weak lateral fold; internal structures except for loop thickened with secondary shell material and identical to *Rostranteris* (515). *U.Perm.*, USSR (Caucasus).

Timorina STEHLI, 1961, p. 465 [**Notothyris minuta* BROILI, 116 (*non* WAAGEN, 1882) =**Timorina*

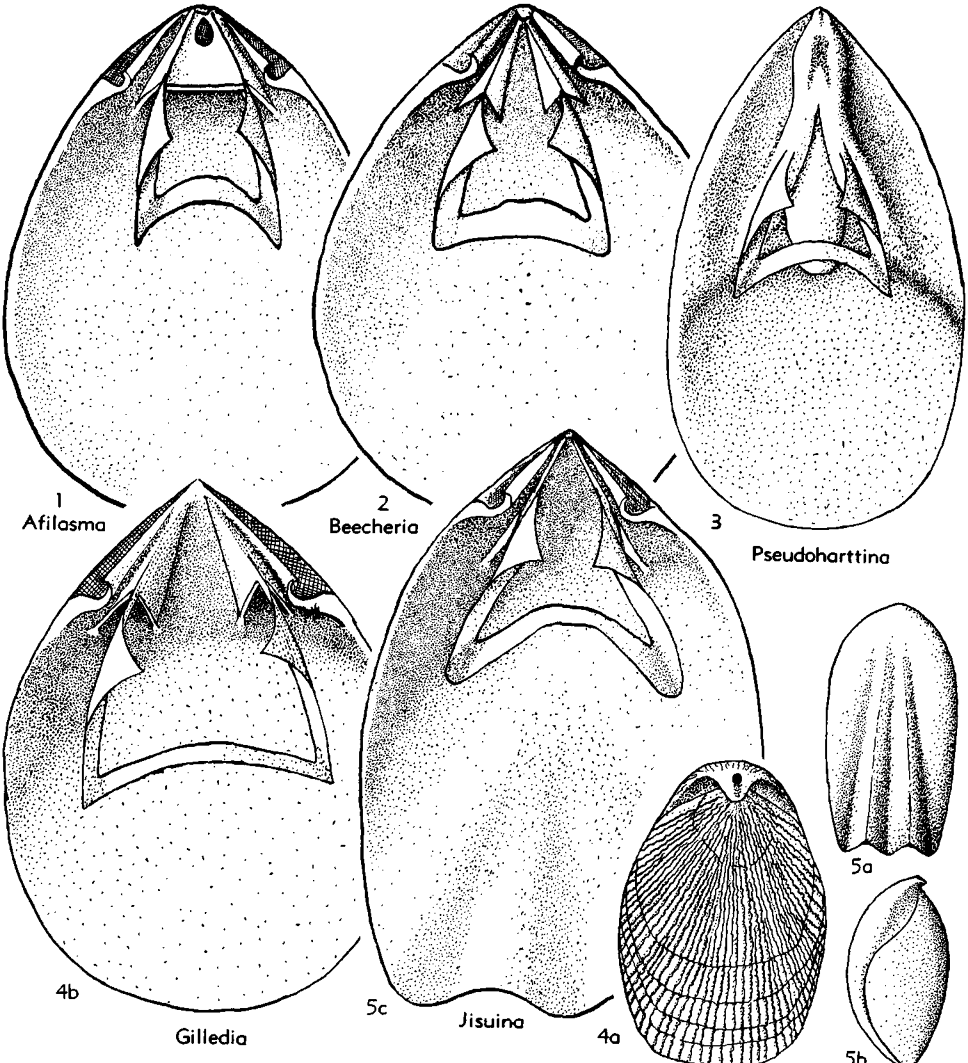


FIG. 620. Heterelasminidae *(1-2,4-5)*; Family Uncertain *(3)* (p. *H*760-*H*762).

broili (recte broilii) STEHLI, 1961, p. 465; OD]. Small, externally resembling *Notothyris* but with median 2, 3, or more plications on pedicle valve raised into slight fold; loop basically centronelliform but modified by origin from median plate of diverging recurved bands which end without uniting (120). *U.Perm.*, Timor.——FIG. 619,*4*. **T. broilii* STEHLI; *4a,b,* brach.v. view, brach.v. int., ×2.5, ×7 (Stehli, n; 799).

Family HETERELASMINIDAE Likharev, 1956

[Heterelasminidae LIKHAREV, 1956, p. 64]

Shells with terebratuliform loop and cardinal plate which is supported by crural plates but obsolete between them and socket ridges, primitively perforate apically and free of valve floor; advanced genera with cardinal plate medially sessile and divided or obsolete; dental plates present or absent. *U.Dev.-U.Perm.*

Jisuina GRABAU, 1931, p. 105 [**J. elegantula*; OD] [=*Heterelasmina* LIKHAREV, 1934, p. 212]. Small to moderate-sized, elongate and straight-sided; anterior commissure truncate to emarginate, primitively uniplicate but usually showing more complex folding; cardinal plate obsolete, crura arising from crural plates; dental plates absent (360). *Perm.*, Eu.-Asia.——FIG. 620,*5*. **J. elegantula*, composite figure; *5a,b,* ped.v. and lat. views,

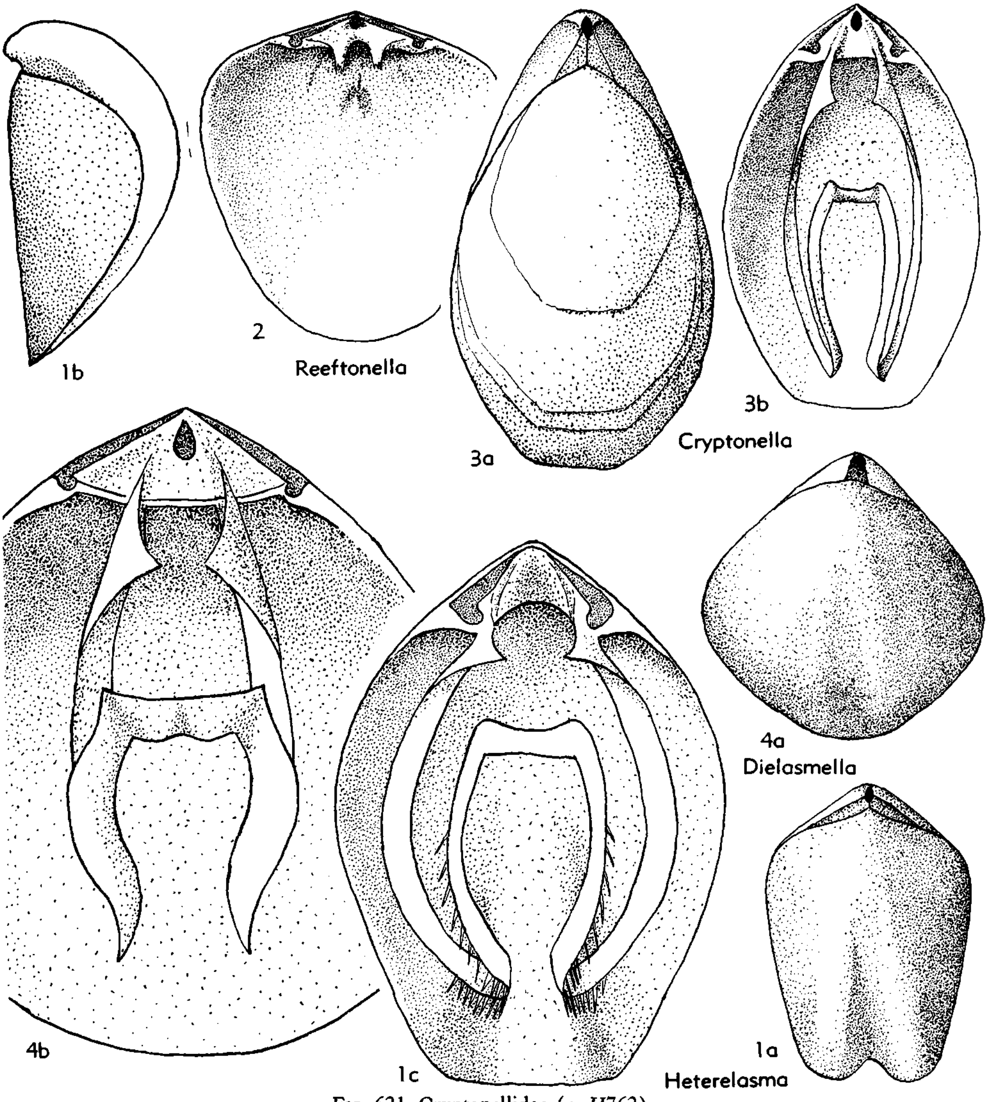


FIG. 621. Cryptonellidae (p. H762).

×1.25, ×1; *5c*, brach.v. int., ×3.9 (Stehli, n).

Afilasma STEHLI, 1961, p. 460 [**A. beecheri*; OD]. Moderate-sized, unfolded, thin; cardinal plate apically perforate, extending free of valve floor between crural plates, obsolete between crural plates and socket ridges; dental plates present; loop unknown but probably terebratuliform. *U. Dev.*, N.Am.——FIG. 620,*1*. **A. beecheri*, Chemung, USA(N.Y.); brach.v. int., ×2.6 (Stehli, n).

Beecheria HALL & CLARKE, 1893, p. 300 [**B. davidsoni*; OD]. Unfolded to uniplicate, small to large; cardinal plate imperforate, medially sessile and divided into 2 plates each extending from valve floor to crural plate and bearing crus; dental plates present. *L.Miss.-U.Perm.*, cosmop.——FIG. 620,*2*. **B. davidsoni*, composite figure; brach. v. int., ×2.6 (Stehli, n).

Gilledia STEHLI, 1961, p. 451 [**Terebratula cymbaeformis* MORRIS, 1845, p. 278; OD]. Large, uniplicate shell ornamented with wavy radial carinae; cardinal plate medially sessile forming 2 plates extending from floor of valve to top of crural plates; internal structures greatly thickened by secondary shell material; dental plates present but massively united wtih sides of valve by secondary shell material (571). *L.Perm.*, Australia-Tasmania.——FIG. 620,*4*. **G. cymbaeformis* (MORRIS), Up. Marine Ser., New S. Wales; *4a,b*, brach.v. view, brach.v. int., ×1.25, ×2.5 (Stehli, n).

Family UNCERTAIN

Pseudoharttina LIKHAREV, 1934, p. 2112 [**P. ovalis*; OD]. Small to moderate-sized; anterior commissure rectimarginate; convexity of valves variable; cardinal plate obsolete; crura arising from socket ridges; dorsal median septum present; all internal structures except loop much thickened; dental plates present but ankylosed to wall of valve (515). *Perm.*, Asia-N.Am.——FIG. 620,*3*. **P. ovalis*, composite figure; brach.v. int., ×4 (Stehli, n).

Suborder TEREBRATELLIDINA Muir-Wood, 1955

A diagnosis of this assemblage is given in the section on Terebratulida—Main Groups (see p. *H*730).

Superfamily CRYPTONELLACEA Thomson, 1926

[*nom. transl.* STEHLI, herein (*ex* Cryptonellinae THOMPSON, 1926, p. 529)]

Generally smooth but rarely costate or costellate anteriorly, folded or unfolded; pedicle foramen mesothyridid to submesothyridid; dental plates present; pedicle collar absent; cardinal plate perforate or not, generally unsupported between socket plates but in few forms supported by small median septum; loop cryptonelliform. *L.Dev.-Perm.*

Family CRYPTONELLIDAE Thomson, 1926

[*nom. transl.* STEHLI, herein (*ex* Cryptonellinae THOMSON, 1926, p. 529)]

Characters of superfamily. *L.Dev.-Perm.*

Cryptonella HALL, 1861, p. 101 [**Terebratula rectirostra* HALL, 1860, p. 88; SD HALL & CLARKE, 1894, p. 861]. Small to moderate-sized; smooth or anteriorly faintly plicate, folded or not; anterior commissure rectimarginate to sulciplicate; pedicle foramen submesothyridid; cardinal plate perforate or imperforate and extending unsupported between socket plates; dental plates present (386). *L.Dev.-Perm.*, Eu.-N.Am.-S.Am.——FIG. 621,*3*. *C. planirostra* HALL, composite figure; *3a,b*, brach.v. view, brach.v. int., ×4.6, ×5.6 (167).

Dielasmella WELLER, 1911, p. 446 [**Eunella compressa* WELLER, 1906, p. 442; OD]. Small, subcircular to pentagonal in outline; both valves shallow; anterior commissure rectimarginate; pedicle foramen mesothyridid; delthyrium incompletely closed below foramen; perforate cardinal plate extending unsupported between socket plates; dental plates present (856). *Miss.*, N.Am.——FIG. 621,*4*. **D. compressa* (WELLER), composite figure; *4a,b*, brach.v. view, brach.v. int., ×4.3, ×11 (858; Stehli, n).

Heterelasma GIRTY, 1908, p. 337 [**H. shumardianium*; OD]. Small to moderate-sized; smooth; uniplicate to sulciplicate; pedicle valve moderately to highly convex longitudinally, brachial valve longitudinally concave to slightly convex; dental plates present; cardinal plate generally imperforate and extending unsupported between socket plates but in some shells supported apically by small medial septum (345). *Perm.*, N.Am.——FIG. 621, *1*. **H. shumardianum*, composite figure; *1a,b*, brach.v. and lat. views, ×3, ×3.4; *1c*, brach.v. int., ×7.5 (*1a*, 345; *1b,c*, Stehli, n).

?**Reeftonella** BOUCOT, 1959, p. 768 [**Meganteris neozelanica* ALLAN, 1935, p. 23; OD]. Moderate-sized; subequally convex, pedicle valve slightly more convex than brachial valve; outline subcircular to shield-shaped; smooth or ornamented with growth lines; anterior commissure rectimarginate; pedicle foramen submesothyridid; dental plates present but becoming obsolescent in adults; cardinal plate perforate, sessile; crural plates absent; loop unknown (18). [Systematic position quite uncertain but possibly belongs to Cryptonellidae.] *L.Dev.*, N.Z.——FIG. 621,*2*. **R. neozelanica* (ALLAN), composite figure; brach.v. int., ×1.15 (Stehli, n).

MESOZOIC AND CENOZOIC TEREBRATULIDINA

By HELEN M. MUIR-WOOD

INTRODUCTION

The present contribution deals with all known genera of the suborder Terebratulidina of Triassic to Recent age and family-group taxa to which they are assigned. Only one of the family assemblages (Dielasmatidae, L.Carb.-U.Trias., ?L.Jur.) includes pre-Mesozoic members. Among the remaining eight recognized families, five (Orthotomidae, L.Jur.; Cheniothyrididae, M.Jur.; Dictyothyrididae, M.Jur.-U.Jur.; Tegulithyrididae, U.Jur.; Pygopidae, ?L.Jur., M.Jur.-L. Cret.) are confined to Mesozoic deposits, and the remaining three (Terebratulidae, U. Trias.-Rec.; Cancellothyrididae, ?L.Jur.-?M. Jur., U.Jur.-Rec.; Dyscoliidae, ?U.Jur., U. Cret.-Rec.) include Mesozoic and Cenozoic genera. The world-wide distribution of the terebratuloid genera in post-Paleozoic formations is little known, mainly owing to lack of requisite information on the internal structures of many species. A majority of short-looped terebratuloids are still referred to as "*Terebratula*," long-looped species being designated as "*Waldheimia*" or "*Zeilleria*," which belong among the terebratelloids. Internal characters have been described by authors generally only when suitable weathered or silicified specimens were available.

Among Tertiary Terebratulacea, the internal characters are little known and relationships of the numerous species inferred from external characters is uncertain. Dissections, where possible, or serial sections will have to be prepared before any attempt can be made to classify these forms or work out their evolution. There are obviously a number of distinct stocks in addition to species of *Terebratula* (s.s.) and fossil species of *Gryphus, Liothyrella, Dallithyris,* and *Abyssothyris.*

The Dyscoliidae, like the Cancellothyrididae, may persist from Upper Jurassic, but most of the Jurassic and Cretaceous Terebratulidae do not survive after the end of the Mesozoic. A few Recent genera, such as *Cnismatocentrum* and *Agulhasia,* have not yet been found as fossils, but most of these genera range back into the Miocene or Pliocene. Some Recent genera are still imperfectly known in regard to their lophophore and its development stages.

PREVIOUS STUDIES

Of the very large number of authors who have described Mesozoic and Cenozoic terebratuloid species or genera it is only possible to mention a few. E. EUDES-DESLONGCHAMPS (1862-85) described and figured many Jurassic species mainly of France, and in 1884 erected the new genera *Flabellothyris, Fimbriothyris, Microthyris, Epicytra,* and *Disculina,* based on external characters.

QUENSTEDT (1868-71) illustrated the internal structure of many species whenever suitably preserved material was available but did not describe many new genera.

DOUVILLÉ (1879) proposed the genera *Dictyothyris, Glossothyris, Coenothyris, Plesiothyris,* and *Aulacothyris,* with reference to internal characters.

DAVIDSON'S Mesozoic volumes (1851-55, 1874-82) portray mainly exteriors, though he illustrated some loops, and also some interiors in his "Introduction" to volume 1 (1853) but did not embark on any generic classification.

ROTHPLETZ (1886) was probably one of the first to employ transverse sections in his descriptions of Lower and Middle Jurassic rhynchonellids of the Alps region, and he published longitudinal sections of terebratuloid species. KITCHIN (1900) also gave a few sections of Jurassic species from Pakistan (Cutch). BITTNER (1890, 1892) described a large number of Triassic species and some new genera.

S. S. BUCKMAN (1918) endeavored to classify Burmese and European (mainly British) species by means of the patterns of dorsal adductor muscle scars studied on internal molds, in addition to beak characters, folding of the shell, and surface ornament, and he described a number of new genera. Mostly internal characters of these brachiopods were not studied by BUCKMAN. The difficulty of preparing suitable internal molds and correctly interpreting the adductor scars shown by them has prevented the development of an acceptable basis of classification by this means.

ROLLIER (1915-1918) redescribed many Jurassic species and gave useful bibliographic references, but did little to advance generic or family classification.

SAHNI (1925, 1929) dissected out the loops of British Upper Cretaceous terebratulids and proposed a number of new genera based on the nature of the loop, form of the cardinal process and adductor muscle scars, and the presence or absence of inner hinge plates. He also pointed out the difference in length of these Upper Cretaceous loops from those of some of BUCKMAN'S Middle Jurassic genera.

THOMSON'S (1927) publication on Tertiary and Recent brachiopods summarized some of BUCKMAN'S work and added much valuable information on fossil and Recent forms which gave a strong impetus to research.

MUIR-WOOD (1934-36) pointed out the importance of serial transverse sections in the identification and classification of genera and species, illustrating this mainly in relation to Jurassic and Cretaceous terebratulacean and zeilleriacean genera; she erected new genera based on external characters, as well as internal ones.

Serial sections of Mesozoic terebratuloids have been used by DAGIS (1958-63) in studying Upper Triassic forms from the Crimea; MIDDLEMISS (1959) in work on British Lower Cretaceous terebratulids, and also TOKU-

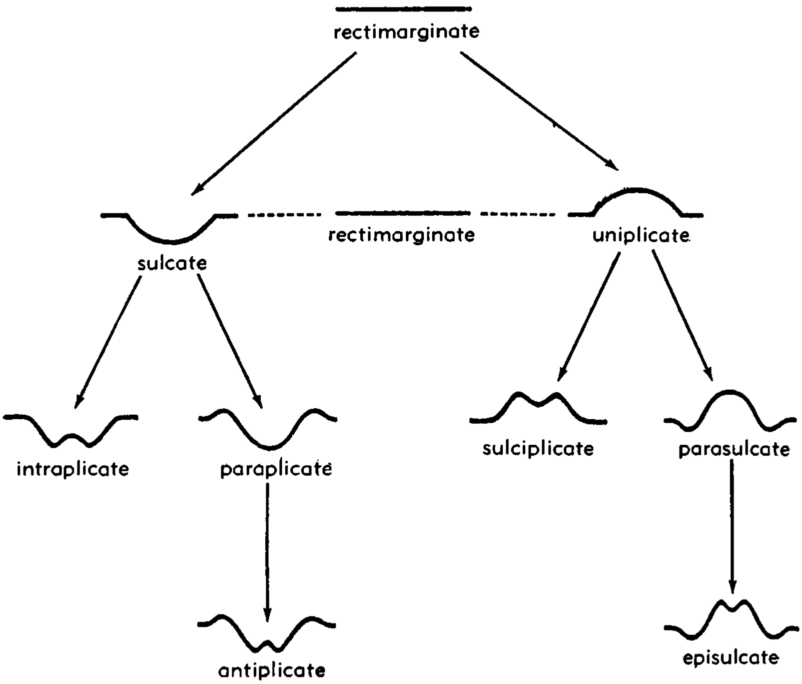


FIG. 622. Diagram showing anterior commissures of Terebratulida (after 810).

YAMA (1958a,b), PROSOROVSKAYA (1962), KYANSEP (1959, 1961) and MAKRIDIN (1960) among others, with the erection of many new genera, most of which require further investigation and research.

A considerable volume of literature relates to Cenozoic terebratuloids; some outstanding publications listed by THOMSON (1927) are works by R. S. ALLAN, C. E. BEECHER, F. BLOCHMANN, W. H. DALL, T. DAVIDSON, E. EUDES-DESLONGCHAMPS, K. HATAI, J. G. HELMCKE, J. W. JACKSON, J. G. JEFFREYS, E. S. MORSE, F. SACCO, C. SCHUCHERT, G. SEGUENZA, and J. A. THOMSON. Further lists of references were given by MUIR-WOOD in 1955 and 1959.

EXTERNAL MORPHOLOGY

The two valves—pedicle (or ventral) and brachial (or dorsal)—may be convex in all growth stages, or the brachial valve may be plane, or concave, or sulcate posteriorly only. The umbonal region is posterior. In *Dictyothyris* a deep ventral median sulcus is bounded by prominent ridges, and a low dorsal median fold is bordered by shallow sulci (**pliciligate** stage).

In the Terebratulacea the anterior commissure may be straight and not deflected either dorsally or ventrally, and is then known as plane or **rectimarginate.** It may be **everted** or dorsally deflected in a single **uniplication.** This may be medianly sulcate, giving a **sulciplicate** stage, or a sulcus may be developed on each side of the uniplica in the **parasulcate** stage. A sulcus may develop medianly in a parasulcation giving an **episulcate** stage. Further development of folds results in the **quadriplicate** stage in *Epithyris.* In some Mesozoic forms the uniplicate stage may be omitted when **biplication** develops directly from a rectimarginate commissure.

The reverse of everted is the **inverted type of folding** when the anterior commissure is deflected ventrally. The opposite of uniplicate is known as **sulcate,** the opposite of parasulcate is **paraplicate,** the opposite of sulciplicate is called **intraplicate; antiplicate** is the reverse of episulcate (Fig. 622).

Multiplication may be opposite in the two valves, but more commonly is alternate and may be superimposed on a uniplicate or sulcate stage. It may arise directly from a smooth stage or be the result of bifurcation of a few existing costae or the intercalation of new costae. In the **semiplicate** stage costae or costellae are developed on the anterior half or third of the shell.

The ventral umbo is erect, suberect, or incurved, massive, tapering, short, or produced. It is normally truncated by the foramen, except in the Orthotomidae, where the umbonal apex is intact and tapering and the delthyrium housing the pedicle lies anterior to the umbo (e.g., *Orthotoma,* Fig. 634,*1e*).

The foramen varies in size from a pinhole in the Upper Cretaceous terebratuloid genus *Gibbithyris* to large and commonly marginate or partly infilled with secondary deposits, or labiate, with a liplike development on the dorsal side of the foramen. Various terms have been applied by authors to the angle of incurvature of the umbo (Fig. 623).

The dorsal umbo is not prominent and may be concealed by incurvature of the ventral umbo.

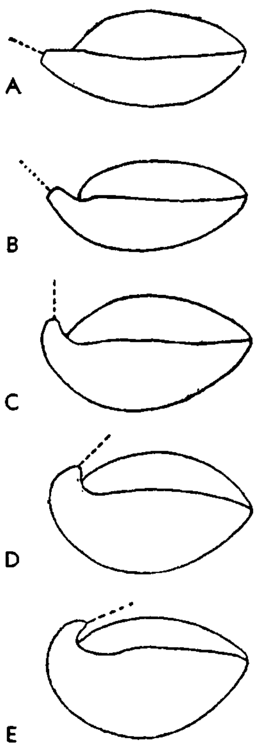


FIG. 623. Diagram showing incurvature of umbo (after 810).——*A*. Nearly straight.——*B*. Suberect.——*C*. Erect.——*D*. Slightly incurved.——*E*. Strongly incurved.

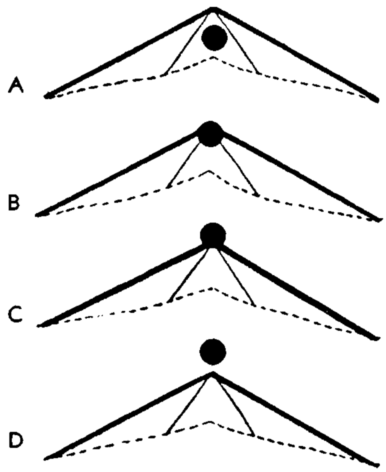


FIG. 624. Diagram showing position of foramen (after 810).——*A*. Hypothyridid.——*B*. Mesothyridid.——*C*. Permesothyridid.——*D*. Epithyridid. [Heavy lines represent beak ridges.]

Beak ridges are more or less angular, curving, linear elevations of the shell extending from each side of the ventral umbo and commonly defining a palintrope. In the Terebratulacea they tend to be short and ill-defined. When the pedicle opening is on the dorsal side of the beak ridges it is known as **hypothyridid** (e.g. *Orthotoma*). It is termed **mesothyridid** when the foramen lies equally on each side of the beak ridges and is partly in the interarea and partly in the umbo; **permesothyridid** when the foramen is mostly within the ventral umbo, and **epithyridid** when the pedicle opening lies wholly within the ventral umbo and beak ridges are on the dorsal side of the umbo (Fig. 624). The beak ridges may project into the foramen or delthyrium as small points or **telae (telate)** or these may be worn away when the condition is known as **attrite.**

The deltidial plates in the Terebratulacea may be fused and form a single plate known as the **symphytium** without trace of median line of junction, whereas in zeilleriacean terebratelloids the deltidial plates may be **conjunct** or fused, or **disjunct** or discrete and not completely fused, when the foramen is referred to as **incomplete.**

The external sculpture (rather misleadingly known as ornament) of most of the terebratuloids consists rarely of radial ridges known as **costae** or **costellae,** or finer radial ornament comprised of **capillae.** When fewer than 15 radial ridges occur in a space of 10 mm., they are referred to as costae; if 15 to 25 are counted in 10 mm., they are referred to as costellae; if more than 25 are present in 10 mm., they are named capillae. [Attention is called to somewhat different definitions of these terms given in the glossary (p. *H*139.—ED.]

Some genera have nodes and spines (e.g., *Dictyothyris*, or concentric rugae or lamellae (e.g., *Cheniothyris, Ornatothyris*), but most Mesozoic and also Cenozoic genera are smooth, with more or less prominent growth lines. Cenozoic Terebratulacea have a smooth shell or one that may be partly or wholly capillate. Most Recent shells are white or cream-colored, lacking the bright colors of many Terebratellacea. *Cnismatocentrum* has a brown shell, while *Cancellothyris* has concentric brown bands.

The Pygopidae (Jur.-L.Cret.) differ from all other Terebratulidina in having a biconvex early stage, then becoming sulco-convex, with the lateral slopes continuing to grow so as finally to converge and fuse, enclosing a median perforation. Some species do not develop the median perforation, but all stages of development of the lateral slopes and their convergence and possible complete fusion can be observed in other species (e.g., *Pygope,* Fig. 678,*1c*). An additional fold in the dorsal sulcus and a sulcus in the ventral fold are characteristic of the Neocomian genus *Pygites* (Fig. 678, *2a,d*).

Specimens are described as small when they are less than 0.75 in. or 20 mm. wide or long; medium-sized when they are 0.75 to 2 in. or 20 to 50 mm. wide or long; and large when they are more than 2 in. or 50 mm. in length or width.

INTERNAL MORPHOLOGY

The two valves articulate by means of **hinge teeth** in the pedicle valve which fit into **sockets** in the brachial valve. In addition accessory articulation is effected by means of **denticula** or toothlike terminations of the palintrope which fit into accessory sockets in the **outer socket ridges,** and also by means of the **denticular cavity** on the outer lateral side of the hinge teeth which articulates with a projection from the outer socket ridges. The **inner socket ridges** may articulate with a depression on the inner face of the hinge teeth, as in many Cenozoic genera. The hinge sockets and teeth may be crenulated. Considerable variation in size and form of the teeth has been observed in different genera, but it is not known how far this can be used as a distinguishing character, and how much variation may occur in subsequent growth stages.

Articulation is also effected by means of the adductor or closing muscles and diductor or opening muscles. The **adductor muscles** leave four scars of attachment on the brachial valve, two placed farther forward and nearer the mid-line of the shell, being known as **anterior adductor scars** and two located behind the others and more laterally, being known as **posterior adductor scars.** In the brachial valve the **diductor muscles** are attached to the hinge plates, or to the cardinal process when this is developed. In the pedicle valve two adductor scars are visible between the broader **diductor scars.** The **pedicle muscles** of attachment are obscure in Mesozoic Terebratulidina, as a rule. Two scars may be detected on the outer lateral side of the diductor scars in the pedicle valve and rarely a single scar more umbonally and centrally placed, as in Recent forms.

In the Cancellothyrididae there are no hinge plates and pedicle muscles are attached to the floor of the dorsal valve.

Mantle canals are marked by furrows on interior surfaces of both valves, or by ridges on internal molds. They represent extensions of the coelom or body cavity into the dorsal or ventral mantles. The four main trunks in the pedicle and brachial valve observed in zeilleriacean terebratelloids are rarely observed in most of the Terebratulacea. In *Ornatothyris,* from the English Cenomanian, the mantle canals bifurcate (Fig. 666,*2f*), whereas in *Gibbithyris* two main nonbifurcating trunks are seen. Bifurcating mantle canals are frequently observed on internal molds of pygopids (Fig. 679,*3a*). In the Terebratulacea a more or less prominent cardinal process is developed. In the Rectithyridinae it is a low, medianly depressed plate, but in the Carneithyridinae it is commonly large and bulbous (Fig. 668,*1d*). In *Plectoidothyris* the cardinal process is prominent and bilobed (Fig. 694).

Hinge plates may be fused, resulting in development of a median hinge trough or septalium, as in most Zeilleriacea, or they may be free, as in most Terebratulacea. In most Mesozoic Terebratulacea only outer hinge plates are found, but in *Neoliothyrina* (Fig. 664) and some Tertiary forms inner hinge plates are present, being separated from the outer hinge plates by the crural bases.

In the Terebratulacea a low ridge may separate the adductor scars; this usually is referred to as the myophragm.

The brachial **loop** in most Jurassic and Cretaceous genera is attached to the hinge plates by the **crural bases,** which may be given off on the dorsal or ventral side of the hinge plates, as shown in serial sections. In the Cancellothyrididae the crural bases are fused with the inner socket ridges and there are no hinge plates. The portions of the loop posterior to the **crural processes** or crural points in the Terebratulidina are known as the **crura.** In front of the crural processes the **descending branches** are usually very short in terebratulids and they unite with the more or less arched **transverse band.**

In Triassic forms the loop is short, usually without crural processes, and centronellid or dielasmatid in form. The descending branches in the centronellid type are united by a median vertical plate which varies in length and position in different genera.

In the Terebratulacea the loops of most genera are imperfectly known, but in the Middle Jurassic loops of two distinct lengths occur, one about half or less of the length of the brachial valve, the other two-thirds of the length of the brachial valve, as in *Plectoidothyris*. In the pygopids the loop is very short, with a slightly arched transverse band. The Upper Cretaceous Carneithyridinae have loops about one-third of the length of the brachial valve. The precise implication of this is unknown. In Cenozoic genera the loop is usually about ¼ or ⅓ of the length of the brachial valve. The lophophore was probably plectolophous in most genera, but may have been schizolophous, ptycholophous or spirolophous in some forms.

The internal morphology as seen in serial transverse sections may be recorded graphically and recorded in generic diagnoses.

The form of hinge plates and inner socket ridges in section is found to be of diagnostic importance and certain terms additional to those proposed by MIDDLEMISS (1959) are needed. The hinge plates may be horizontal or deflected dorsally or ventrally, and may be ventrally convex, or ventrally concave. In some genera they may be rounded U-shaped or sharply V-shaped. When the crural bases are straight, more or less vertical, and at an angle to the hinge plates, they are here called **virgate.** The crural bases may be given off on the dorsal or ventral side of the hinge plates. The hinge plates and inner socket ridges are often indistinguishable in section, or they may be separated by a shallow sulcus. A keel may be developed dorsally below the hinge plates. The hinge plates in section may be thickened or clubbed, may taper medially, or be enlarged only at the tip or piped, or they may be bladelike (Fig. 697). The septalial plates seen in some Triassic genera (e.g., *Rhaetina*) extend from the hinge plates and converge and unite medially with the median septum, if present (Fig. 629). A pedicle collar, or continuation of the deltidial plates on the inner side of the umbo, may be developed in some Terebratulacea.

Additional terms relating to internal and external morphology of terebratuloids have been defined by BUCKMAN (1918), THOMSON (1927), and MUIR-WOOD (1934, 1936). Internal morphology is dealt with more fully in introductory chapters of the brachiopod volume.

HOMEOMORPHY

Homeomorphy occurs repeatedly among the Mesozoic and Cenozoic terebratuloids and constitutes one of the major problems in their identification and classification. It is frequently impossible to identify Mesozoic forms without examining the internal structure and to distinguish between representatives of the Terebratulacea (Terebratulidina) and of the superfamilies Zeilleriacea and Terebratellacea (Terebratellidina). For example, *Sphaeroidothyris* (terebratulacean) is almost identical externally to *Rugitela* (zeilleriacean); also nearly indistinguishable in outer appearance are four Upper Jurassic shells (new terebratulacean

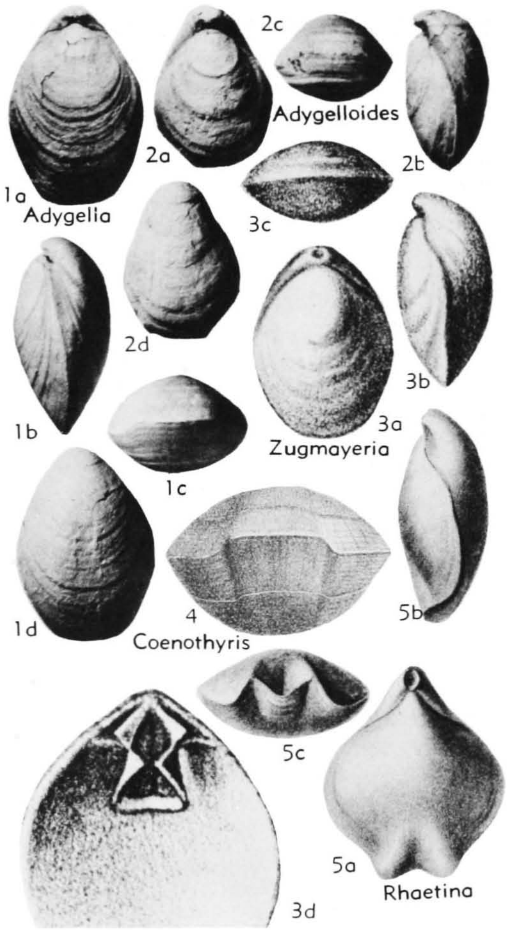


FIG. 625. Dielasmatidae (Dielasmatinae) (p. *H*768-*H*769).

genus with short loop, *Cheirothyris* of the Zeilleriacea, and *Trigonellina* and *Ismenia* of the Terebratellacea) and *Tetractinella,* an Upper Triassic spiriferoid. Homeomorphs abound in the Upper Triassic, and lacking information about internal characters it is almost impossible to distinguish between spiriferoids, rhynchonelloids, zeilleriaceans, and terebratulaceans, all of which may have smooth shells and more or less sulcate brachial valves. The Cenozoic genera, *Dallithyris* (terebratuloid) and *Dallina* (long-looped dallinid), are close homeomorphs in external form.

Suborder TEREBRATULIDINA Waagen, 1883

A diagnosis of this suborder is given in the section on Main Divisions of the Terebratulida (p. *H*730).

Superfamily DIELASMATACEA Schuchert, 1913

[As defined by STEHLI in Paleozoic section, p. *H*754]

Family DIELASMATIDAE Schuchert, 1913

[As defined by STEHLI in Paleozoic section, p. *H*756]

Subfamily DIELASMATINAE Schuchert, 1913

[Dielasmatinae SCHUCHERT, 1913, p. 402] [=Zugmayeridae DAGIS, 1963, p. 171]

Small to medium-sized smooth forms having centronellid loop in early growth stages but later becoming short terebratuliform, with crural processes; pedicle collar developed; beak ridges rounded. Septalial plates uniting with hinge plates and bearing crural bases and cardinal process; dorsal median septum present; with or without dental plates. *L.Carb.-U.Trias.* [Pre-Mesozoic forms included in section by STEHLI, p. *H*756.]

Adygella DAGIS, 1959, p. 25 [**A. cubanica*; OD]. Shell small, valves biconvex, rounded-pentagonal, anterior commissure plane to incipiently uniplicate; umbo short, curved, foramen small, beak ridges obscure, permesothyridid. Loop about 0.3 length of valve, with crural processes and slightly arched transverse band; hinge plates fused; deep septalium supported by short septum; inner socket ridges scarcely distinguishable in section from horizontal hinge plates; no cardinal process; dental plates short, slightly diverging. *?M.Trias., U. Trias.,* Eu.(E.Alps-Caucasus)-?N.Z.——FIG. 625,*1*; 626,*2*. **A. cubanica,* Nor., Causasus; 625,*1a-d,* brach.v., lat. ant., ped.v. views, ×1 (Muir-Wood, n); 626,*2a-v,* transv. secs., ×1.5 (210).

Adygelloides DAGIS, 1959, p. 28 [**A. labensis*; OD]. Resembling *Adygella* externally and in short loop, but differs in more tapering and incurved umbo, and internally in longer dental plates, septalial plates fused posteriorly only, and becoming suspended free in dorsal umbonal cavity, dorsal septum lacking or very short, hinge plates in section not fused, slightly concave ventrally and distinguishable from inner socket ridges. *U.Trias.(Nor.),* Eu.(Caucasus).——FIG. 625,*2*; 626,*1*. **A. labensis*; 625,*2a-d,* brach.v., lat., ant., ped.v. views, ×1 (Muir-Wood, n); 626,*1a-t,* ser. transv. secs., ×1 (210).

Coenothyris DOUVILLÉ, 1879, p. 270 [**Terebratulites vulgaris* VON SCHLOTHEIM, 1820, p. 275; OD]. Medium-sized, sulco- to biconvex, with prominent dorsal fold, anterior commissure uniplicate; umbo erect to slightly incurved, beak ridges angular, telate, permesothyridid, symphytium exposed, pedicle collar developed; shell surface commonly with radial color bands and rare capillae. Loop terebratulid 0.3 length of valve, given off ventrally, with long crural processes; cardinal process short, bilobate; hinge plates ventrally concave in section, supported by strong dorsal septum less than 0.5

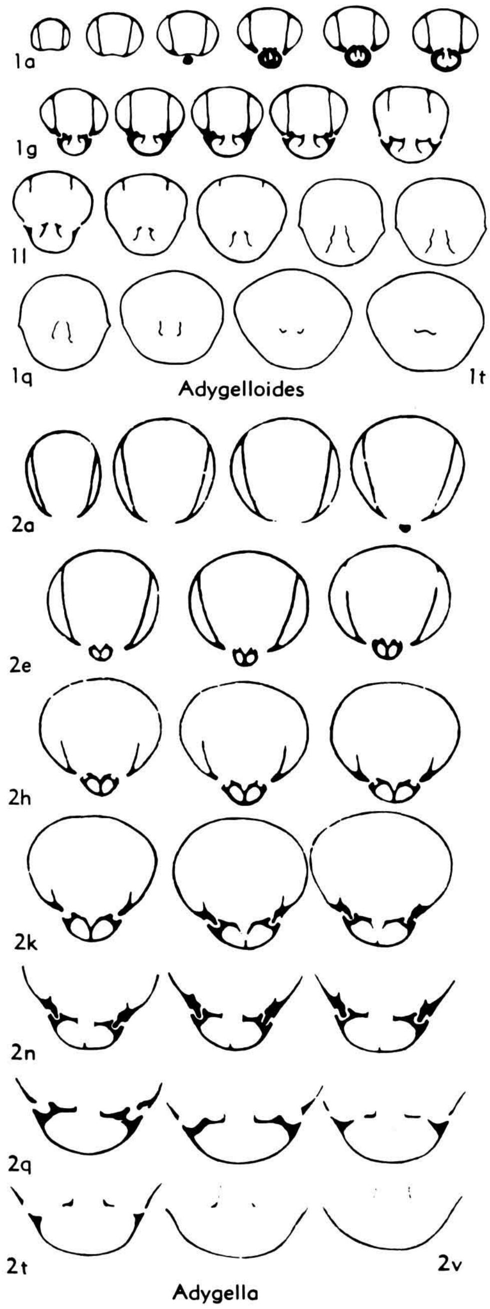


FIG. 626. Dielasmatidae (Dielasmatinae) (p. *H*768).

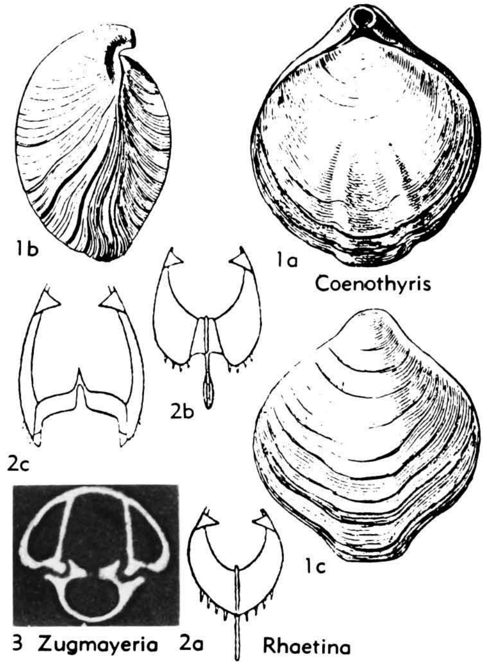


FIG. 627. Dielasmatidae (Dielasmatinae) (p. *H*768-*H*769).

of valve length; crural bases prominent, demarcating rounded septalium; no dental plates. *M.Trias. (Muschelkalk)*, Eu.-Asia.——FIG. 625,*4*; 627,*1*; 628,*1*. **C. vulgaris* (VON SCHLOTHEIM), Ger.; 625, *4*, ant. view, ×1 (651); 627,*1a-c*, brach.v., lat., ped.v. views, ×1 (718); 628,*1a-q*, ser. transv. secs., ×1.3 (651).

Rhaetina WAAGEN, 1882, p. 334 [**Terebratula gregaria* SUESS, 1854, p. 14; OD]. Small to medium-sized, subpentagonal, biplicate, anterior commissure sulciplicate; umbo suberect, deltidial plates exposed, epithyridid. Loop centronellid in early growth stages, later becoming terebratulid; septal plates developed, dorsal septum low or absent; dental plates absent. *U.Trias.(Rhaet.)*, Eu. (Austria - E. Alps-USSR-Caucasus). —— FIG. 625, *5a-c*. **R. gregaria* (SUESS), E.Alps; *5a-c*, brach.v., lat., ant. views, ×1 (791).——FIG. 627,*2*; 629,*1*. *R.* sp., USSR(Caucasus); 627,*2a-c*, immature, advanced immature, and adult loops, ×2 (791); 629,*1a-u*, ser. transv. secs., of immature form, ×3 (210).

Zugmayeria WAAGEN, 1882, p. 334 [**Terebratula rhaetica* ZUGMAYER, 1880, p. 13; OD]. Small, biconvex, elongate, anterior commissure plane or incipiently uniplicate; growth lines prominent; umbo tapering, suberect, beak ridges obscure. Loop short, terebratulid, about 0.3 length of brachial valve; crural processes developed; no dorsal septum; dental plates present. *U.Trias.(Rhaet.)*, Eu. (E. Alps). —— FIG. 625,*3*; 627,*3*. **Z. rhaetica* (ZUGMAYER); 625,*3a-c*, brach.v., lat., ant. views, ×2; 625,*3d*, loop, ×3; 627,*3*, transv. sec., ×3 (all 904).

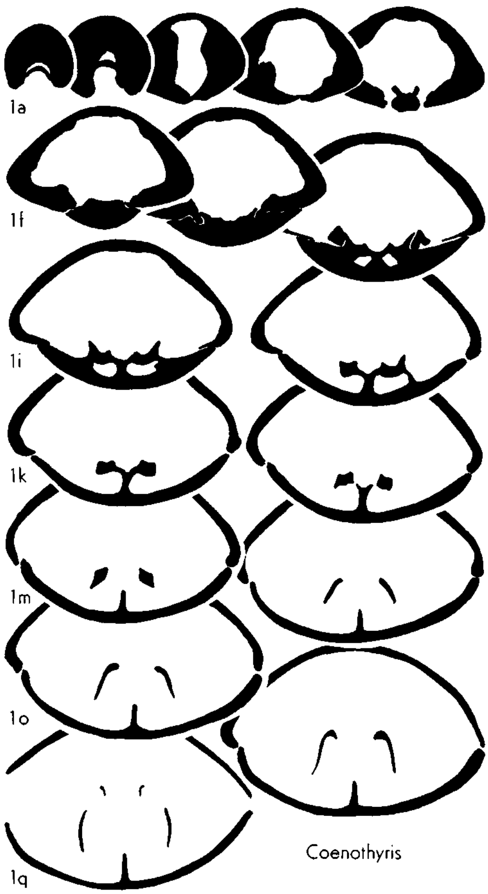


FIG. 628. Dielasmatidae (Dielasmatinae) (p. *H*769).

Subfamily NUCLEATULINAE Muir-Wood, n.subfam.

Loop centronellid or ringlike, crural processes, dental plates and dorsal median septum present or absent; brachial valve deeply sulcate. *U.Trias., ?L.Jur.(Lias.).*

Nucleatula BITTNER, 1888, p. 126 [**Rhynchonella retrocita* SUESS, 1855, p. 29; SD HALL & CLARKE, 1894, p. 858]. Small, concavo-convex, anterior commissure sulcate; umbo acute, incurved, beak ridges ill-defined. Loop barely more than 0.5 length of valve. Free vertical longitudinally ridged and fimbriated median plate projecting beyond loop; crural processes developed; no dorsal septum or ?dental plates; ?punctate in external shell layers only. *U.Trias.(Nor.),* Eu.(Austria-Alps).——FIG. 630,*2*. **N. retrocita* (SUESS); *2a-d,* brach.v., lat., ant., ped.v. views, ×2 (76); *2e,f,* loop, ×1.5 (75).

Dinarella BITTNER, 1892, p. 24 [**D. haueri*; OD]. Small, valves slightly convex, brachial valve with anterior sulcus, pedicle valve with corresponding fold and linguiform extension, anterior commissure sulcate; umbo acute, foramen small, beak ridges angular. Loop short, centronellid, descending branching uniting with median plate free of valve floor, dorsal median septum short, free of loop; dental plates weak; ?punctate in external shell layers only. *U.Trias.(Nor.),* Eu.(Bosnia-E. Alps).——FIG. 630,*3*. **D. haueri, 3a-d,* brach.v., lat., ant., ped.v. views, ×2; *3e,* loop, ×2 (77).

Propygope BITTNER, 1890, p. 210 [**Terebratula (Propygope) hagar*; OD]. Small, aulacothyridid, brachial valve with broad sulcus and long tapering linguiform extension, anterior commissure sulcate; umbo suberect, foramen small, beak ridges ill-defined. Loop almost ringlike, about 0.3 valve length; dorsal septum strong, less than 0.5 valve length; dental plates lacking. *U.Trias. (Carn.-Nor.),* Eu.(E.Alps-Austria-Yugosl.); *?Lias.,* Eu.——FIG. 630,*1*. **P. hagar* (BITTNER), E.Alps; *1a-d,* brach.v., lat., ant., ped.v. views, ×2; *1e,* loop, ×2 (76).

Subfamily JUVAVELLINAE Bittner, 1896

[*nom. correct.* MUIR-WOOD, herein (*pro* Juvavellinen BITTNER, 1896, p. 132)]

Shell biconvex, smooth, loop centronellid or ringlike, no crural processes, dental plates

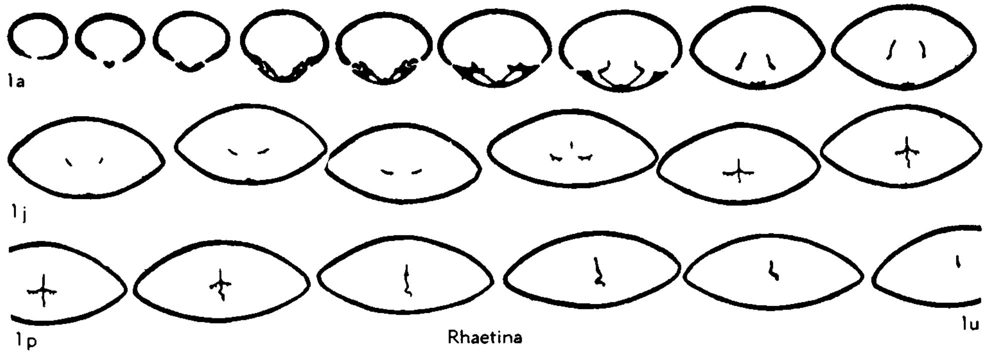


FIG. 629. Dielasmatidae (Dielasmatinae) (p. *H*769).

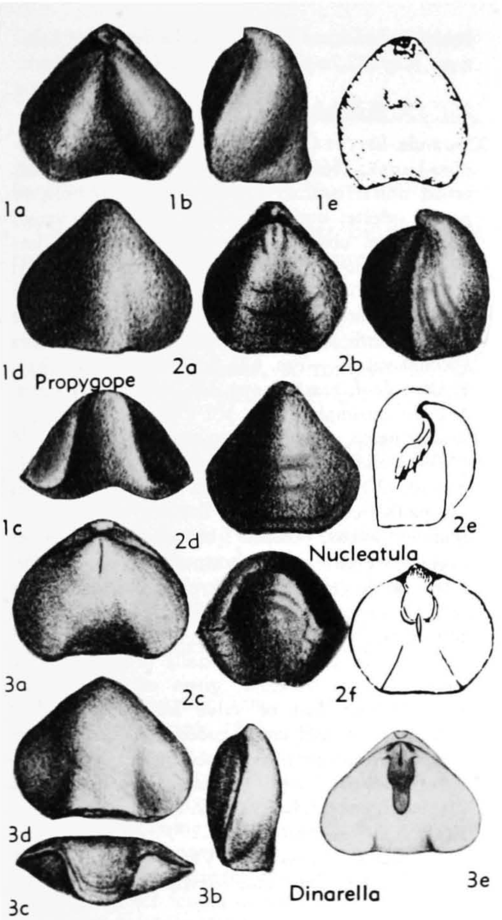


FIG. 630. Dielasmatidae (Nucleatulinae) (p. *H*770).

and dorsal median septum present in some genera. *U.Trias.*

Juvavella BITTNER, 1888, p. 127 [**J. suessi*; OD]. Small, valves biconvex, subtrigonal, shallow ventral sulcus, anterior commissure normally plane or incipiently uniplicate. Loop centronellid, about 0.25 valve length, with short median plate projecting posteriorly, no crural processes; dorsal septum and dental plates lacking. *U.Trias.(Nor.)*, C.Eu.——FIG. 631,*4*. **J. suessi*; *4a-d*, brach.v., lat., ant., ped.v. views, ×1.5 (76); *4e,f*, brach. loop, ×1.5 (75).

Aspidothyris DIENER, 1908, p. 58 [**A. kraffti*; OD]. Small, valves moderately convex, anterior commissure plane or incipiently uniplicate; umbo strongly incurved, almost concealing deltidial plates, other beak characters unknown. Loop centronelliform, with long median plate extending dorsally, dorsal septum about 0.3 length of valve, not supporting loop; septal plates developed, dental plates strong. *U.Trias.(Carn.)*, Asia(Himalayas).——FIG. 631,*3*. **A. kraffti*; *3a-c*, brach.v., lat., ant. views, ×1.5; *3d,e*, loop, ×1.5, ×3 (258).

Cubanothyris DAGIS, 1959, p. 35 [**C. elegans*;

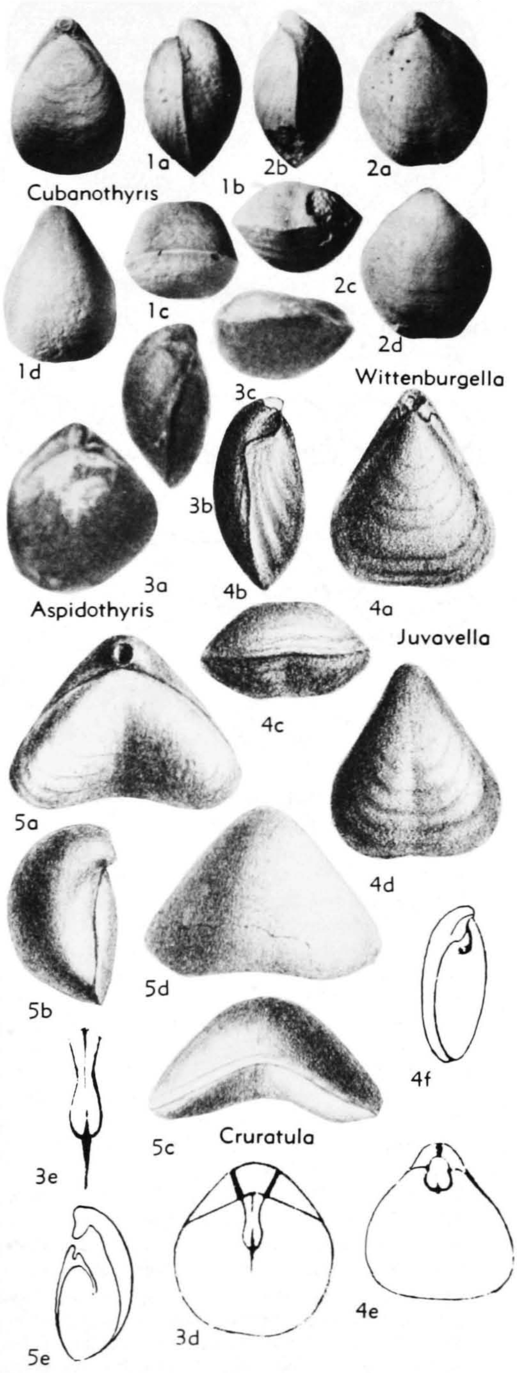


FIG. 631. Dielasmatidae (Juvavellinae) *(1-4)*, (Subfamily Uncertain) *(5)* (p. *H*771-*H*772).

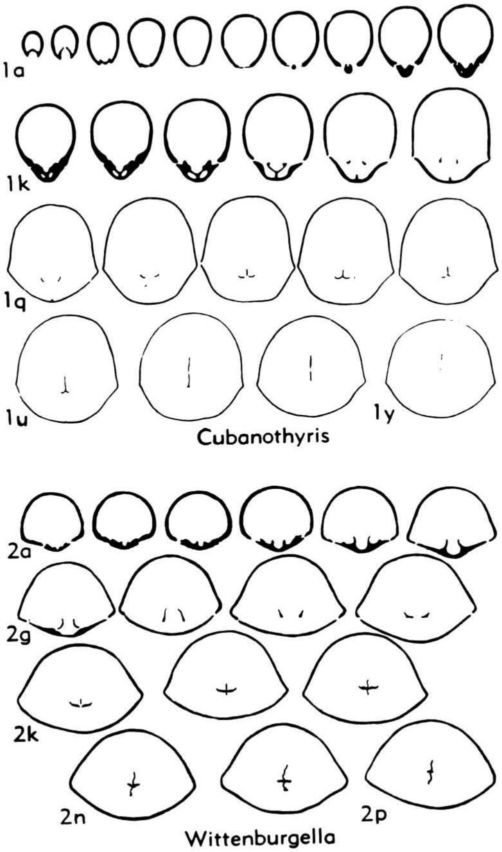


FIG. 632. Dielasmatidae (Juvavellinae) (p. *H771-H772*).

OD]. Biconvex, valves without median sulci, anterior commissure plane. Loop with median centronellid plate extending ventrally; dorsal median septum present, deep septalium; no dental plates. *U.Trias.(Nor.),* Eu.(NW.Caucasus).——FIG. 631,*1;* 632,*1.* **C. elegans*; 631,*1a-d,* brach.v., lat., ant., ped.v. views of holotype, ×1; 632,*1a-y,* ser. transv. secs., ×1 (210).

Juvavellina BITTNER, 1896, p. 132 [**P. kittli*; OD (M)]. Differs from *Juvavella* in greater length of loop, which equals half length of valve, and in incipient sulcation of anterior commissure. *U. Trias.(Nor.),* Eu.(E.Alps).

Wittenburgella DAGIS, 1959, p. 30 [**W. minuta*; OD]. Small, valves biconvex, subpentagonal, anterior commissure incipiently sulcate; umbo short, curved, in contact with brachial valve, mesothyridid. Loop centronelliform, half of valve length, with high median plate extending dorsoventrally; no dorsal septum or dental plates, hinge plates divided, concave ventrally, becoming U-shaped. *U.Trias.(Nor.),* Eu.(NW.Caucasus). ——FIG. 631,*2;* 632,*2.* **W. minuta;* 631,*2a-d,* holotype, brach.v., lat., ant., ped.v. views of holotype, ×2; 632,*2a-p,* ser. secs., ×2 (210).

Subfamily UNCERTAIN

Cruratula BITTNER, 1890, p. 66 [**Waldheimia eudora* LAUBE, 1866, p. 8; OD]. Medium-sized, with broad dorsal median sulcus, anterior commissure gently sulcate; umbo produced, slightly incurved, beak ridges obscure, permesothyridid. Loop imperfectly known, ?short; dorsal septum strong, 0.5 of valve length; dental plates absent or fused with thickened shell wall. Shell surface ?papillate or perforate. *M.Trias.-U.Trias.,* Eu.(E.Alps)-Asia (Himalayas).——FIG. 631,*5.* **C. eudora* (LAUBE), E.Alps; *5a-d,* brach.v. ext., lat., ant., ped.v. views, ×1; *5e,* incomplete loop, ×1 (76).

Pseudokingena BÖSE & SCHLOSSER, 1900, p. 177 [**Terebratulina deslongchampsi* DAVIDSON, 1850, p. 450; OD]. Small, rounded or quadrate, valves unequally convex, some brachial valves with shallow sulcus, anterior commissure plane or slightly waved; umbo short, palintrope well defined, beak ridges hypothyridid. Deltidial plates narrow, disjunct, pedicle collar present; shell surface granular, with 2 sizes of tubercles; inner shell surface capillate, especially around margin; loop short, centronellid, given off from socket ridges, about half of valve length, with short median plate, and crural processes; dorsal septum low, short; hinge plates fused, wide, gently concave ventrally, with median elevation; dental plates absent. *L.Jur.(M.Lias.-U.Lias.),* Eu.(Eng.-Fr.-Italy). —— FIG. 633,*1.* **P. deslongchampsi* (DAVIDSON), M.Lias., Fr.; *1a,* brach.v. ext., ×4; *1b,c,* brach.v. lat., ant. views, ×2; *1d,* ped.v.

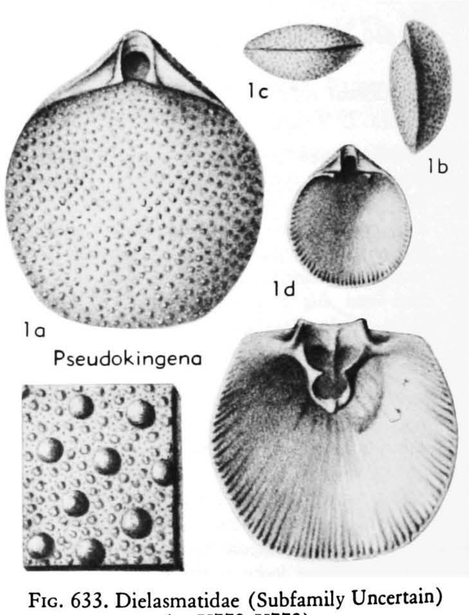


FIG. 633. Dielasmatidae (Subfamily Uncertain) (p. *H772-H773*).

int., ×2; *1e,* brach.v. int. and loop, ×4; *1f,* ornament, enlarged (227).

Superfamily TEREBRATULACEA Gray, 1840

[*nom. transl.* SCHUCHERT & LEVENE, 1929, p. 22 (*ex* Terebratulidae GRAY, 1840, p. 143) (*non* WAAGEN, 1883, as suborder)]

Cardinal process and outer hinge plates commonly developed, inner hinge plates in some genera, or hinge plates absent; dental and septalial plates rarely developed except in early forms; adult lophophore trocholophous, schizolophous, spirolophous, subplectolophous or plectolophous. *U.Trias.-Rec.*

Family ORTHOTOMIDAE Muir-Wood, 1936

[Orthotomidae MUIR-WOOD, 1936, p. 224]

Small shells having short terebratulid loop, dental plates absent; adult shells hypothyridid, with triangular delthyrium bordered by jugate deltidial plates below tapering, acute umbo; shell rarely capillate. *L.Jur. (M.Lias.).*

Orthotoma QUENSTEDT, 1869, p. 315 [**Terebratula heyseana* QUENSTEDT, 1869, p. 315 (*non* DUNKER, 1847) =*Orthotoma spinati* RAU, 1905, p. 54; SD S. S. BUCKMAN, 1918, p. 96] [=*Orthoidea* FRIREN, 1876, p. 1 (type, *O. liasina*)]. Small, valves biconvex, becoming sulco-convex, anterior commissure rectimarginate to sulcate; umbo suberect to incurved, beak ridges angular, defining palintrope. Loop 0.3 length of valve, with low arched transverse band; cardinal process minute, projecting vertically as 2 small ears; hinge plates in transverse section, ventrally convex, dorsally inclined, tapering, not differentiated from inner socket ridges; adductor scars trigonal. *L.Jur.(M. Lias.),* Eu. (Fr.-Ger.).——FIG. 634,*1a-d.* **O. spinati,* RAU, Lias., Ger. (Württemberg); *1a-c,* brach.v., lat., ant. views, ×4; *1d,* loop, ×2.5 (578).——FIG. 634,*1e-q. O. quenstedti,* M.Lias., Ger.; *1e,* umbonal region, ×2.5; *1f,* internal mold with dorsal adductor scars, ×2.5; *1g-q,* ser. transv. secs. at 0.1-0.3 mm. intervals, ×5 (578).

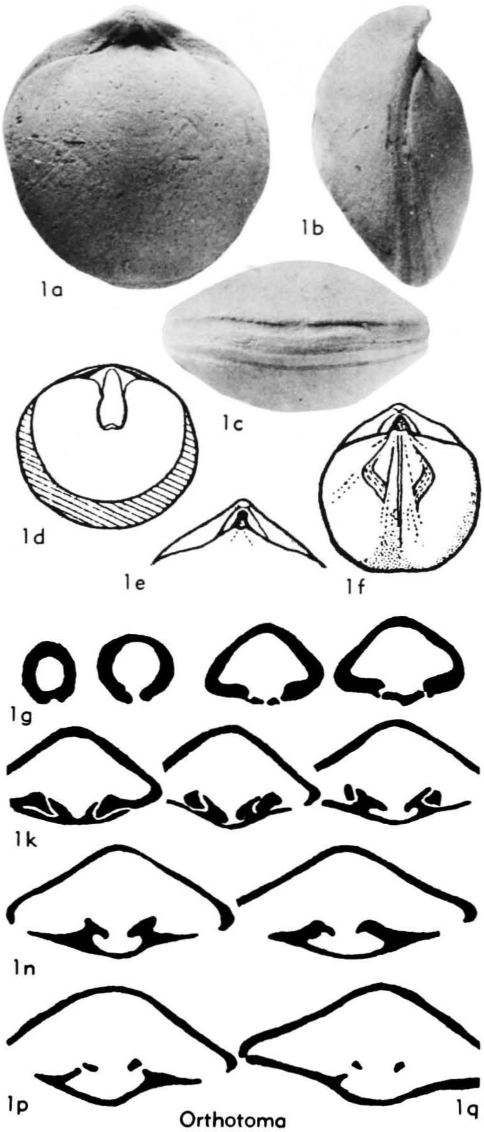


FIG. 634. Orthotomidae (p. *H773*).

Family TEREBRATULIDAE Gray, 1840

[Terebratulidae GRAY, 1840, p. 143]

Valves smooth or with growth lamellae, semiplicate or part capillate; loop terebratulid, crural processes not united to form ringlike loop, outer hinge plates present, and inner hinge plates also in some genera; dorsal median septum and dental plates absent; lophophore plectolophous and filament spicules present in some Recent genera. *U.Trias.-Rec.*

Subfamily TEREBRATULINAE Gray, 1840

[*nom. transl.* WAAGEN, 1883, p. 330 (*ex* Terebratulidae GRAY, 1840, p. 143)] [=Gryphinae SAHNI, 1929, p. 8]

Small to large biconvex shells, or with brachial valve flat or concave, or rarely more convex than pedicle valve; smooth or partly capillate; anterior commissure normally plane, uniplicate or biplicate, rarely sulcate; beak ridges usually obscure, foramen mesothyridid to epithyridid. [Classification under review.] *U.Trias.-Rec.*

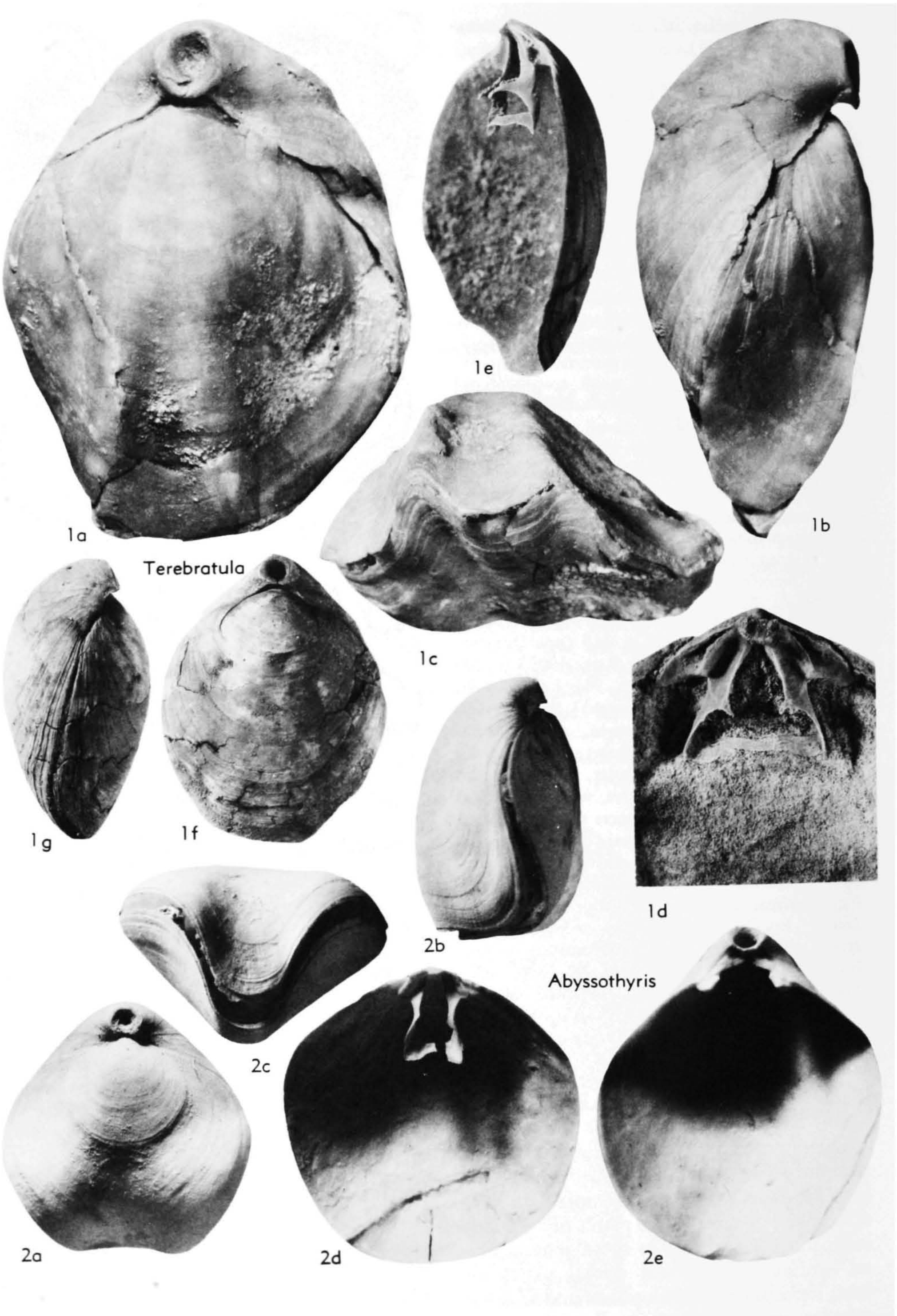


FIG. 635. Terebratulidae (Terebratulinae) (p. H775-H777).

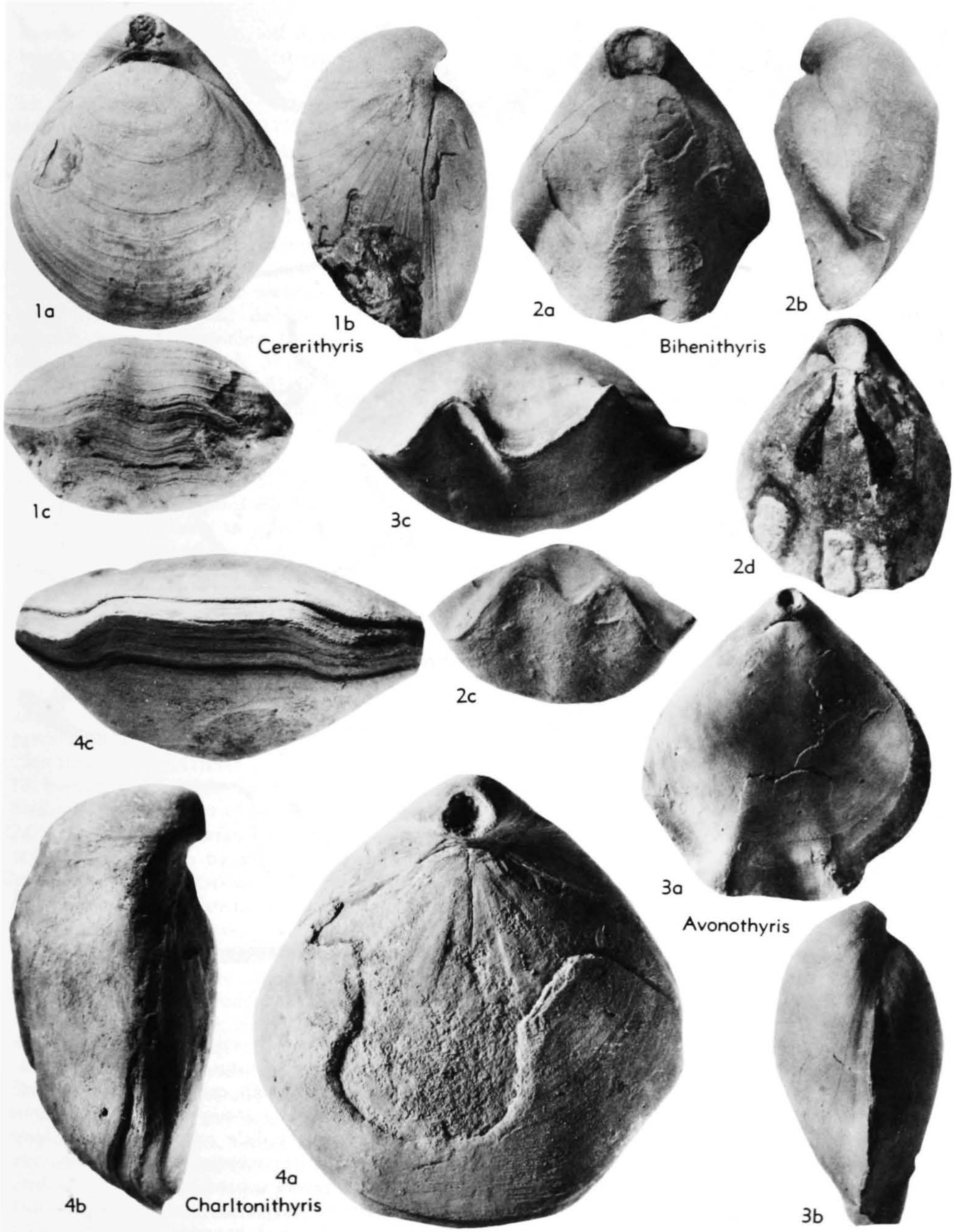


FIG. 636. Terebratulidae (Terebratulinae) (p. *H777*).

Terebratula MÜLLER, 1776, p. 249 [**Anomia terebratula* LINNÉ, 1758, p. 703; SD LAMARCK, 1799, p. 89]. Medium-sized to large, valves biconvex, anteriorly biplicate, anterior commissure uniplicate to sulciplicate; umbo short, massive, suberect to incurved, foramen mesothyridid to permesothyridid, symphytium narrow, commonly concealed, pedicle collar developed; shell smooth but growth lines prominent. Loop broadly triangular, about 0.25 to 0.33 of valve length, with narrow-ribboned, arched, and medianly flattened transverse band, crural bases extending along edge of outer hinge plates, no inner hinge plates, crural processes long, tapering, cardinal process rounded, pos-

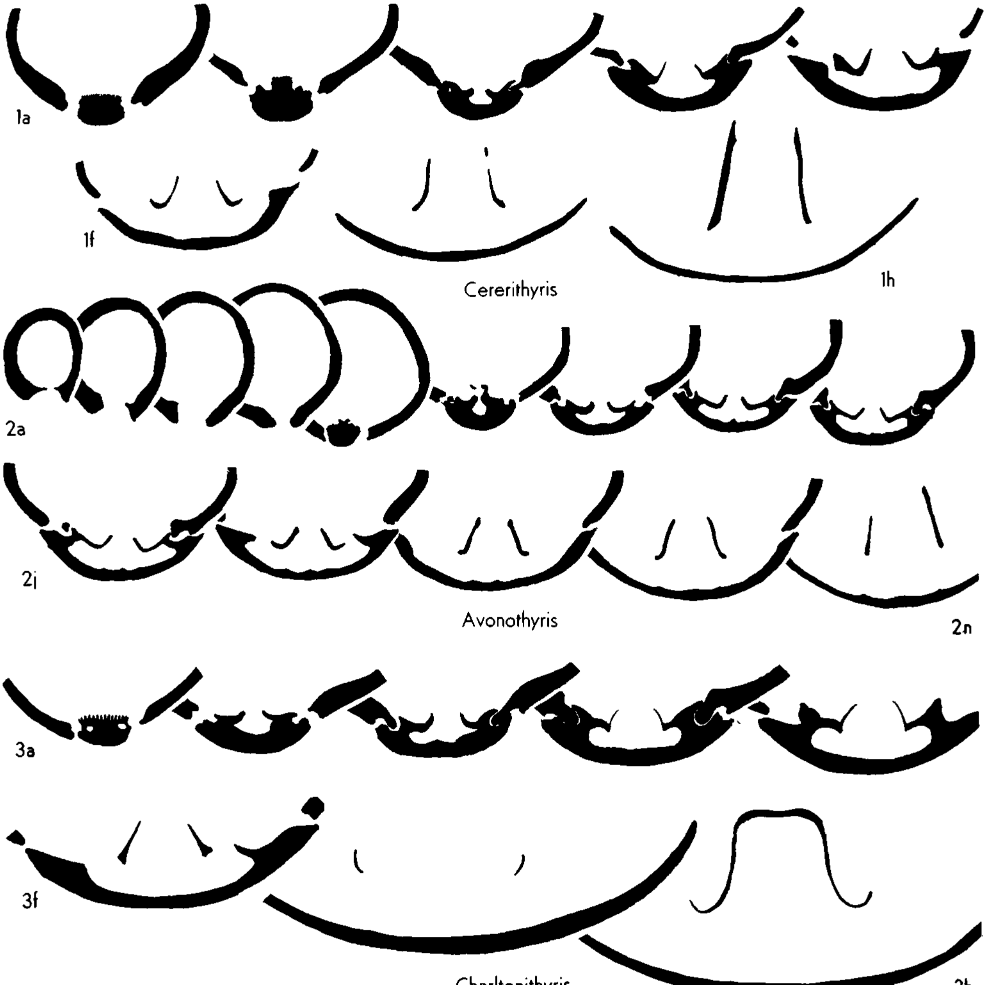


FIG. 637. Terebratulidae (Terebratulinae) (p. *H777*).

teriorly flattened boss, hinge plates concave, separated from prominent socket ridges by deep sulcus, rare short median septum; hinge teeth with swollen bases and posteriorly sulcate. [*Anomia terebratula* LINNÉ was not one of the species listed by MÜLLER in 1776, but was subsequently designated as type-species by LAMARCK in 1799. This case, as interpreted by BUCKMAN (1907) should be put to the ICZN for ratification.] *Mio.-Plio.*, Eu.——FIG. 635,*1a-c*. **T. terebratula* (LINNÉ), Plio. (Asti.), Italy(Rome); *1a-c*, brach. v., lat., ant. views, ×1.5 (696).——FIG. 635, *1d-g*. *T. ampulla* BROCCHI, Plio., Italy; *1d,e*, brach.v. int., lat. view of loop, ×0.9, ×1.5; *1f,g*, brach.v. and lat. views, ×0.8 (696).

Abyssothyris THOMSON, 1927, p. 190, *emend.* MUIR-WOOD, 1960, p. 521 [**Terebratula wyvillei* DAVIDSON, 1878, p. 436; OD]. Small, thin, trilobate, dorsal valve anteriorly sulcate, pedicle valve carinate, anterior commissure ventrally uniplicate (sulcate); shell smooth except for growth lines; umbo short, slightly incurved, epithyridid, symphytium narrow, pedicle collar developed. Loop terebratulid, crura subparallel, crural processes short, blunt, transverse band broad, slightly arched, cardinal process transversely elongate, ridged, outer hinge plates depressed, bounded by elevated socket ridges, no inner hinge plates; lophophore plectolophous with small median coil. [THOMSON (1927) confused the terebratulid genus *Abyssothyris* with the rhynchonellid genus *Neorhynchia* in his original diagnosis. Subsequently *Abyssothyris* was redefined and two homeomorphs disentangled by MUIR-WOOD (1960).] *U.Mio.* or *L.Plio.*, Fiji I.; *Plio.*, Eu.(Italy); *Rec.*, Pac.O. (off S.Australia-N. Guinea-Galapagos I.-Chile).——FIG. 635,*2*. **A.*

wyvillei (DAVIDSON), Rec., off S. Australia; *2a-c,* brach.v., lat., ant. views of lectotype, ×3.1; *2d,e,* Rec., off Chile, brach.v. int. with loop, ped.v. int., ×3.1 (585).

Avonothyris S. S. BUCKMAN, 1918, p. 102 [**A. plicatina*; OD]. Small to medium-sized, biconvex, some sulcocarinate posteriorly, anterior commissure rectimarginate to episulcate; shell surface rarely capillate, growth lines numerous; umbo short, suberect, epithyridid; symphytium narrow, pedicle collar developed. Cardinal process low, lobate with or without posterior umbonal cavity, hinge plates in section dorsally deflected and ventrally concave, tapering, becoming U-shaped; adductor scars narrow, subparallel. *M.Jur.(Bathon.),* Eu. (Eng.-Fr.).——FIG. 636,*3*; 637,*2*. **A. plicatina,* Bradford, Eng. (Wilts.); 636,*3a,b,* brach.v., lat., ×1.25, *3c,* ant. view of holotype, ×1.5; 637, *2a-n,* transv. secs., ×1.8 (136).

Bihenithyris MUIR-WOOD, 1935, p. 110 [**B. barringtoni*; OD]. Medium-sized, biconvex, anterior commissure sulciplicate to episulcate; umbo massive, suberect to incurved, concealing symphytium, epithyridid, pedicle collar developed. Loop short, less than half of valve length; cardinal process short, broad, medianly depressed; no posterior umbonal cavity; hinge plates and inner socket ridges in section posteriorly thickened, gently concave, becoming U-shaped, tapering; dorsal adductor scars posteriorly threadlike, rapidly expanding and diverging. *U.Jur.(Callov.),* Afr. (Somaliland)-Asia(Arabia).——FIG. 636,*2;* 638,*1.* **B. barringtoni,* Somaliland (Madashon); 636,*2a-c,* brach.v., lat., ant. views of holotype, ×1.25; 636, *2d,* int. mold of paratype with adductor scars, ×1.25; 638,*1a-r,* ser. transv. secs., ×1.25 (577).

Cererithyris S. S. BUCKMAN, 1918, p. 109 [**Terebratula intermedia* J. SOWERBY, 1813, p. 48; OD] [=*Cererithyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Medium-sized, sulco- to plano- to biconvex, anterior commissure rectimarginate to uniplicate or sulciplicate; umbo short, stout, foramen marginate to labiate, epithyridid, symphytium well exposed. Loop half of valve length, transverse band with high arch; cardinal process low, short; no posterior umbonal cavity; hinge plates in transverse section not well demarcated from long inner socket ridges, ventrally concave, tapering, becoming V-shaped to U-shaped; adductors long, widely divergent. *M.Jur.(Bathon.),* Eu.——FIG. 636,*1;* 637,*1.* **C. intermedia* (J. SOWERBY), Eng.; 636,*1a-c,* brach.v., lat., ant. views of lectotype, ×1.25; 637,*1a-h,* ser. transv. secs., ×1.8 (136).

Charltonithyris S. S. BUCKMAN, 1918, p. 106 [**Terebratula uptoni* S. S. BUCKMAN, 1895, p. 455; OD] [=*Charltonithyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Medium-sized to large, rounded, plano- to moderately biconvex, anterior commissure rectimarginate to uniplicate, rarely sulciplicate; umbo incurved, slightly carinate, foramen

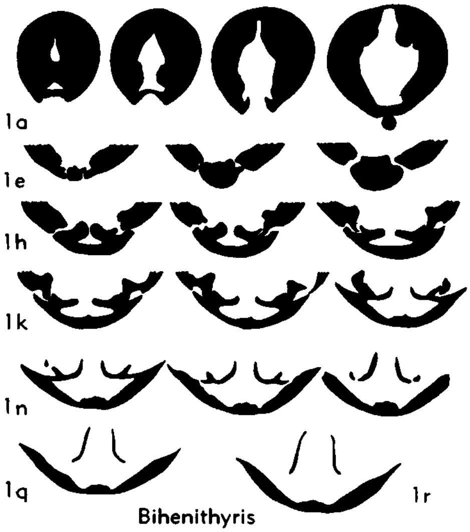


FIG. 638. Terebratulidae (Terebratulinae) (p. *H777*).

large, beak ridges strong, laterally extended, permesothyridid, symphytium exposed. Loop with highly arched, medianly horizontal, transverse band; cardinal process low, short; hinge plates in section dorsally deflected, distinguishable from inner socket ridges, tapering, V-shaped, crural bases virgate, keeled; adductor scars diverging, tapering posteriorly. *M.Jur.(L.-M. Inferior Oolite),* Eu. (Eng.).——FIG. 636,*4;* 637,*3.* **C. uptoni* (BUCKMAN), *M.Inf.Ool.,* Eng.(Glos.); 636,*4a-c,* brach.v., lat., ant. views of paratype, ×1.25; 637,*3a-h,* ser. transv. secs., ×1.8 (127).

Cnismatocentrum DALL, 1920 (1921), p. 321 [**Terebratula (Liothyris) sakhalinensis* DALL, 1908, p. 28; OD]. Medium-sized, stout, biconvex, anterior commissure uniplicate, umbo stout, slightly incurved, symphytium exposed, foramen entire, epithyridid, pedicle collar with short septum; surface smooth or anteriorly capillate, with prominent growth lines. Loop very wide, slender, almost flattened, transverse band in same plane as loop, attached to wall of valve for some distance; crural processes short; cardinal process small, prominent; outer hinge plates narrow; dorsal median septum low; lophophore plectolophous. *Rec.,* Asia(Sakhalin I.-Okhotsk Sea)-N.Am.(Alaska).——FIG. 639,*1.* **C. sakhalinensis* (DALL), off Sakhalin; *1a-d,* brach.v., lat., ant., post. views of holotype, ×1 (427).

Dallithyris MUIR-WOOD, 1959, p. 302 [**D. murrayi*; OD]. Medium-sized to large, subtrigonal to subpentagonal, pedicle valve more convex than brachial; no median fold or sulcus, anterior commissure plane to uniplicate, lateral commissure dorsally convex; umbo short massive, foramen

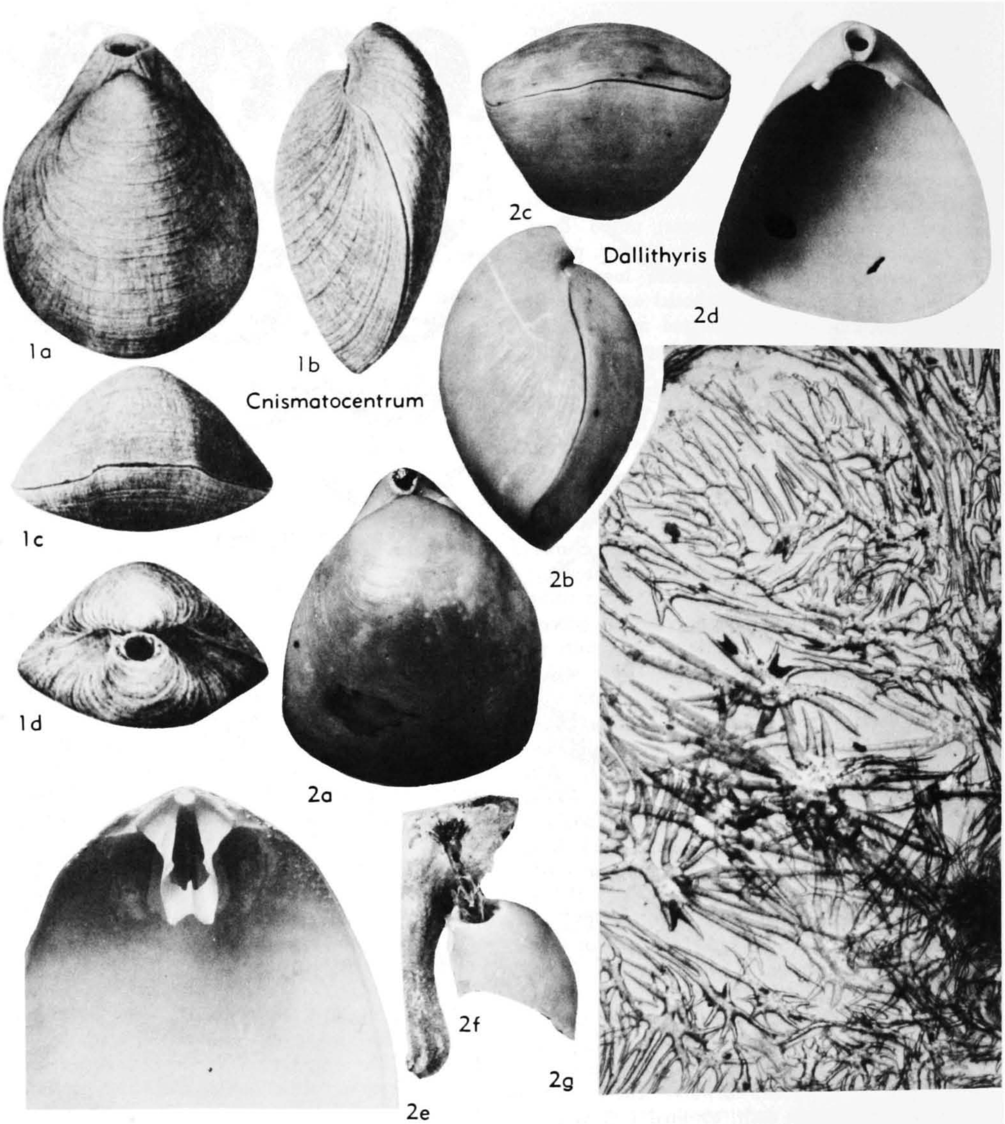


FIG. 639. Terebratulidae (Terebratulinae) (p. *H777-H778*).

epithyridid, symphytium short; pedicle collar short; shell surface smooth or with irregularly developed striations. Loop narrow, transverse band with broad ribbon having sharp median plication; crural bases extending along inner margins of concave outer hinge plates; cardinal process small transverse plate; inner socket ridges narrow, prominent, well demarcated from hinge plates; mantle canals much branched, adductor scars dendritic. *?U.Eoc.*, Eu.(Italy); *Mio.*, S.Eu.; *Rec.*, Carib.-E.Atl.O.-Medit.-Ind.O.(off Maldive I.-Mauritius)-E. Pac. O.(off Japan).——FIG. 639,*2*. **D. murrayi*, Rec., Ind. O. (Maldive Is.); *2a-c*, brach.v., lat., ant. views of holotype, ×1; *2d,e*, ped.v. int., brach.v. int., ×1, ×2; *2f*, attachment by pedicle composed of separate strands, ×3; *2g*, spicules of mantle, ×25 (584).

Epithyris PHILLIPS, 1841, p. 55 [**Terebratula maxillata* J. DE C. SOWERBY, 1823, p. 52; SD BUCKMAN, 1906, p. 321] [*non Epithyris* KING, 1850, p. 146 (=*Dielasma* KING, 1859)]. Medium-sized to large, valves plano- to biconvex, anterior commissure plane to quadriplicate; umbo produced, becoming incurved, beak ridges subangular, epithyridid in adult, symphytium short, pedicle collar present. Loop about half length of valve with high-arched

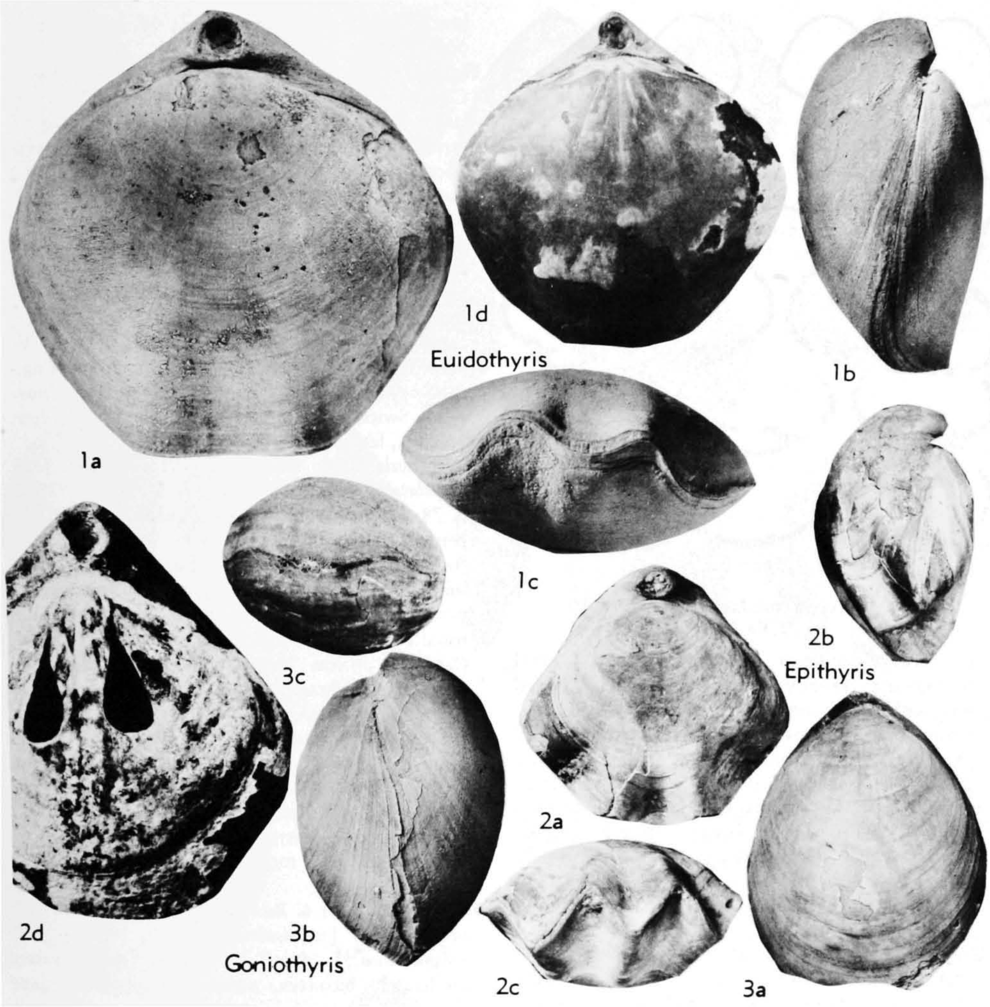


FIG. 640. Terebratulidae (Terebratulinae) (p. *H*778-*H*780).

transverse band; cardinal process small, bilobed; hinge plates in section scarcely demarcated from inner socket ridges, ventrally convex, with slight dorsal deflection, keeled; adductor scars elongate, pear-shaped. *M.Jur.(Bathon.),* Eu.(Eng.-Fr.).——FIG. 640,*2a-c*; 641,*2*. **E. maxillata* (J. DE C. SOWERBY), Fullers Earth Rock, Eng. (Somerset); 640,*2a-c,* brach.v., lat., ant. views of holotype, ×1.2; 641,*2a-j,* ser. transv. secs., ×1.25 (579).——FIG. 640,*2d*. *E. oxonica* ARKELL, Gt. Ool., Eng.; brach.v. int. mold showing adductor scars, ×1.2 (579).

Euidothyris S. S. BUCKMAN, 1918, p. 101 [**Terebratula euides* (broad form) BUCKMAN, 1886, p. 218 (=**E. extensa* BUCKMAN, 1918, p. 101); OD] [=*Euidothyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Medium-sized, valves sulcocarinate posteriorly, becoming biconvex, anterior commissure uniplicate to sulciplicate, umbo produced, laterally constricted, beak ridges long, conspicuous, epithyridid in adult. Loop about half of valve length; cardinal process trilobed, short; umbonal cavity present; hinge plates in transverse section well demarcated from inner socket ridges, V-shaped, tapering, crural bases virgate; adductor scars divergent. *M. Jur. (L. Inferior Oolite),* Eu. (Eng.-Fr.).——FIG. 640, *1*; 641,*1*. **E. extensa* BUCKMAN, Eng.; 640,*1a-c,* brach.v., lat., ant. views of holotype, ×1.5, ×1.2, ×1.2; 640,*1d,* brach.v. int. mold of paratype showing adductor scars, ×1.2; 641,*1a-g,* ser. transv. secs., ×1.25 (136).

Goniothyris S. S. BUCKMAN, 1918, p. 117 [**Terebratula gravida* SZAJNOCHA, 1881, p. 74; OD] [=*Goniothyris* BUCKMAN, 1914, p. 2 *(nom. nud)*]. Medium-sized to large, trigonal, brachial valve highly convex, pedicle valve flat to convex

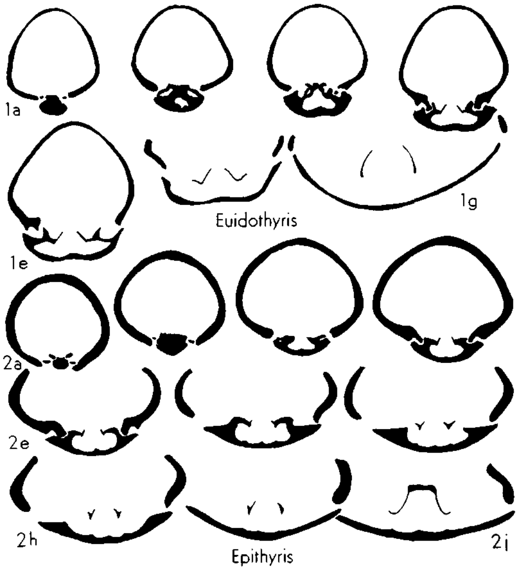


FIG. 641. Terebratulidae (Terebratulinae) (p. *H778-H779*).

or carinate, anterior commissure plane, lateral commissure dorsally curved; umbo very short, foramen apical, epithyridid, beak ridges obscure, symphytium narrow. Loop unknown; cardinal process very small; hinge plates in section slightly convex ventrally and deflected dorsally, keeled; adductor scars almost parallel. *M.Jur.(M. Inferior Oolite),* Eu. (Eng.-Czech.-Aus. - Hung.) —— FIG. 640,*3*. *G. dorsetensis* (ROLLIER) (=*G. gravida* DAVIDSON, 1884, and S. S. BUCKMAN, 1918, *non* SZAJNOCHA, 1881), Blagdeni Zone, Eng.(Dorset); *3a-c,* brach.v., lat., ant. views, ×1.2 (136).

Gryphus MEGERLE VON MUHLFELD, 1811, p. 64 [**Anomia vitrea* BORN, 1778, p. 104; OD (M)] [not preocc. *Gryphus* BRISSON, 1760, not gen.] [=*Liothyris* DOUVILLÉ, 1879, p. 265 (*non* CONRAD, 1875)*; Liothyrina* OEHLERT in FISCHER, 1887, p. 1316]. Small to medium-sized, circular to subpentagonal, biconvex; anterior commissure plane to incipiently uniplicate, lateral commissure vertical; surface smooth, rare fine capillation on flanks and numerous growth lines; umbo short, suberect to incurved, epithyridid, symphytium almost concealed, pedicle collar developed. Loop about 0.25 of valve length, descending branches slightly diverging, transverse band broad-ribboned, ventrally arched; crura very short, crural bases extending along inner margins of slightly concave outer hinge plates, no inner hinge plates; cardinal process small transverse plate, myophragm rare; hinge teeth excavated by posteriorly placed socket, spicules widely distributed, main mantle canals almost straight, branching anteriorly, *?Eoc., Oligo.,* USA; *Mio.-Plio.,* Sicily; *Rec.,* Medit.-Atl.O.—— FIG. 643,*4*. **G. vitreus* (BORN), Rec., Medit.; *4a-c,* brach.v., lat., ant. views, ×1.2; *4d,* brach.v. int., ×1.2 (810).

Heimia HAAS, 1890, p. 87 [**Terebratula mayeri* CHOFFAT in HAAS, 1883, p. 254; OD]. Small to large, valves plano- to incipiently sulco-convex or carinate, anterior commissure sulcate or paraplicate; umbo short, stout, slightly incurved, permesothyridid, symphytium concealed, shell with numerous growth lines or lamellae, and anteriorly thickened. Loop unknown; cardinal process short, prominent; umbonal cavity variably developed; hinge plates in section well differentiated from inner socket ridges, slightly concave ventrally, clubbed, becoming thin, beveled, and rarely V-shaped. *M.Jur.(Bajoc., Inferior Oolite),* Eu.(Eng.-Fr.-Switz.).——FIG. 642,*1*. **H. mayeri* (CHOFFAT), Switz.; *1a,b,* brach.v., ant. views, ×1; *1c-e,* brach.v., lat., ant. views, ×1 (376).

Holcothyris S. S. BUCKMAN, 1918, p. 125 [**H. angulata*; OD] [=*Holcothyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Small to medium-sized, subpentagonal, valves moderately biconvex, with continuous median dorsal furrow and ventral fold or carination, anterior commissure sulcate to paraplicate; umbo massive, short, symphytium usually concealed, epithyridid; shell fully capillate. Cardinal process short, bilobate, medianly depressed; myophragm long; hinge plates in section slightly demarcated from inner socket ridges, slightly concave ventrally, clubbed; adductor scars narrow, tapering posteriorly, widely divergent. *M. Jur. (Bathon.),* Asia (Burma). —— FIG. 642,*2*. **H. angulata,* Namyau F.; *2a-c,* brach.v., lat., ant. views of holotype, showing capillation, ×1; *2d,* brach.v. int. mold showing adductor scars, ×1 (94).

Jaisalmeria SAHNI & BHATNAGAR, 1958, p. 421 [**J. taylori*; OD] [=*Jaisalmeria* SAHNI, 1955, p. 187 *(nom. nud.)*]. Small to medium-sized, valves moderately biconvex, anterior commissure plane to uniplicate, to incipiently biplicate; umbo thin, erect, foramen small, incomplete, beak ridges angular, submesothyridid, deltidial plates disjunct; ornament of fine capillae with intercalations. Loop unknown; fine dorsal median septum; adductor scars narrowly pear-shaped. *U.Jur.(?Portland.),* Asia(India-Pak.).——FIG. 642,*3a-d*. **J. taylori,* India; *3a-c,* brach.v., ant., lat. views, ×1; *3d,* ped.v. ext., ×2 (700).——FIG. 642,*3e,f*. *J. depressa* SAHNI & BHATNAGAR, Pak. (Cutch); *3e,f,* brach.v., ped.v. views showing capillae, ×1 (700).

Juralina KYANSEP, 1961, p. 28 [**J. procerus*; OD]. Medium-sized, pedicle valve much more convex than brachial valve, anterior commissure plane to uniplicate; umbo massive, produced and projecting over brachial valve, beak ridges obscure, mesothyridid, symphytium high, pedicle collar present. Loop about 0.3 of valve length, with arched transverse band; cardinal process prominent, medianly depressed; posterior umbonal cav-

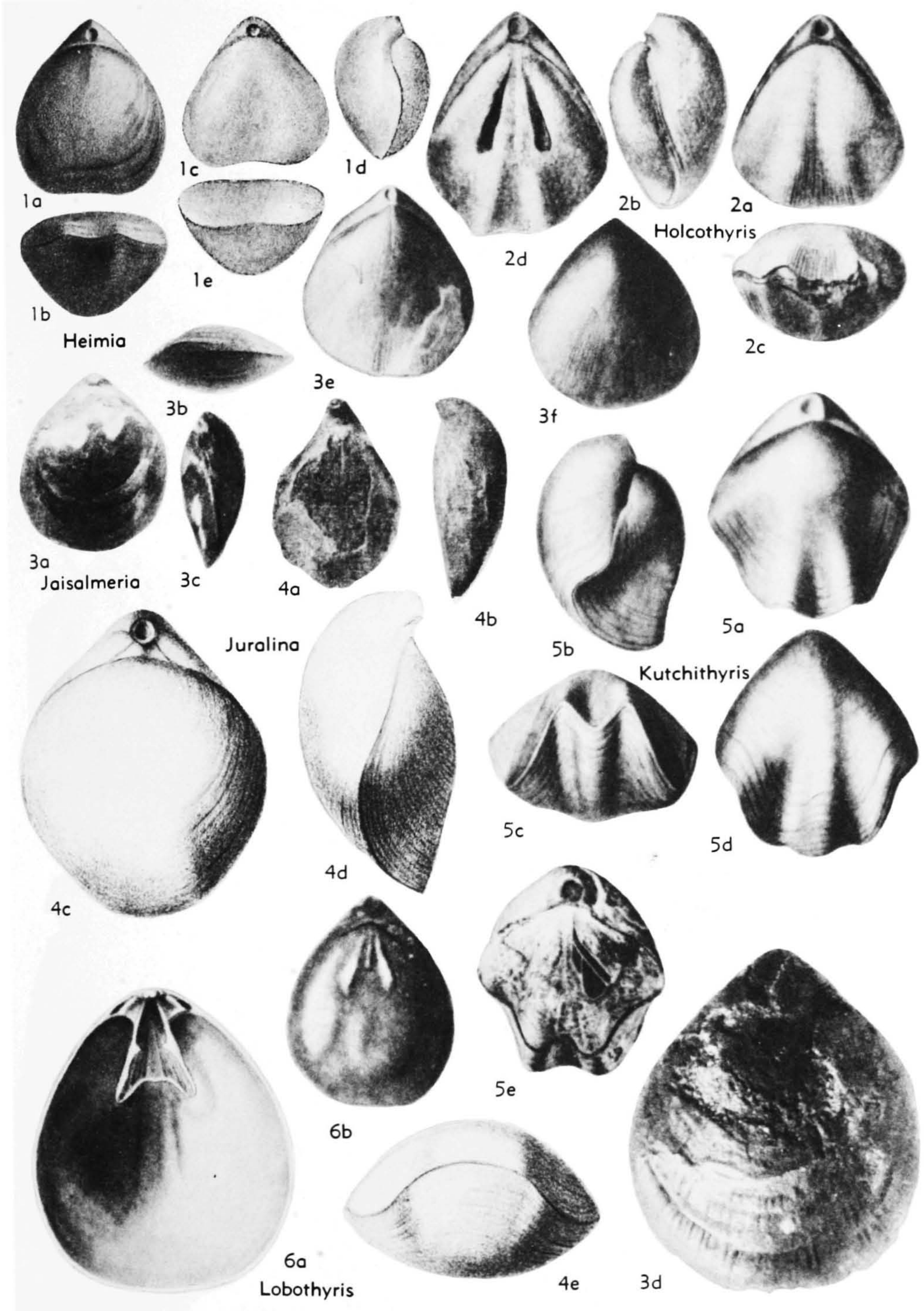


FIG. 642. Terebratulidae (Terebratulinae) (p. *H*780, *H*783-*H*784).

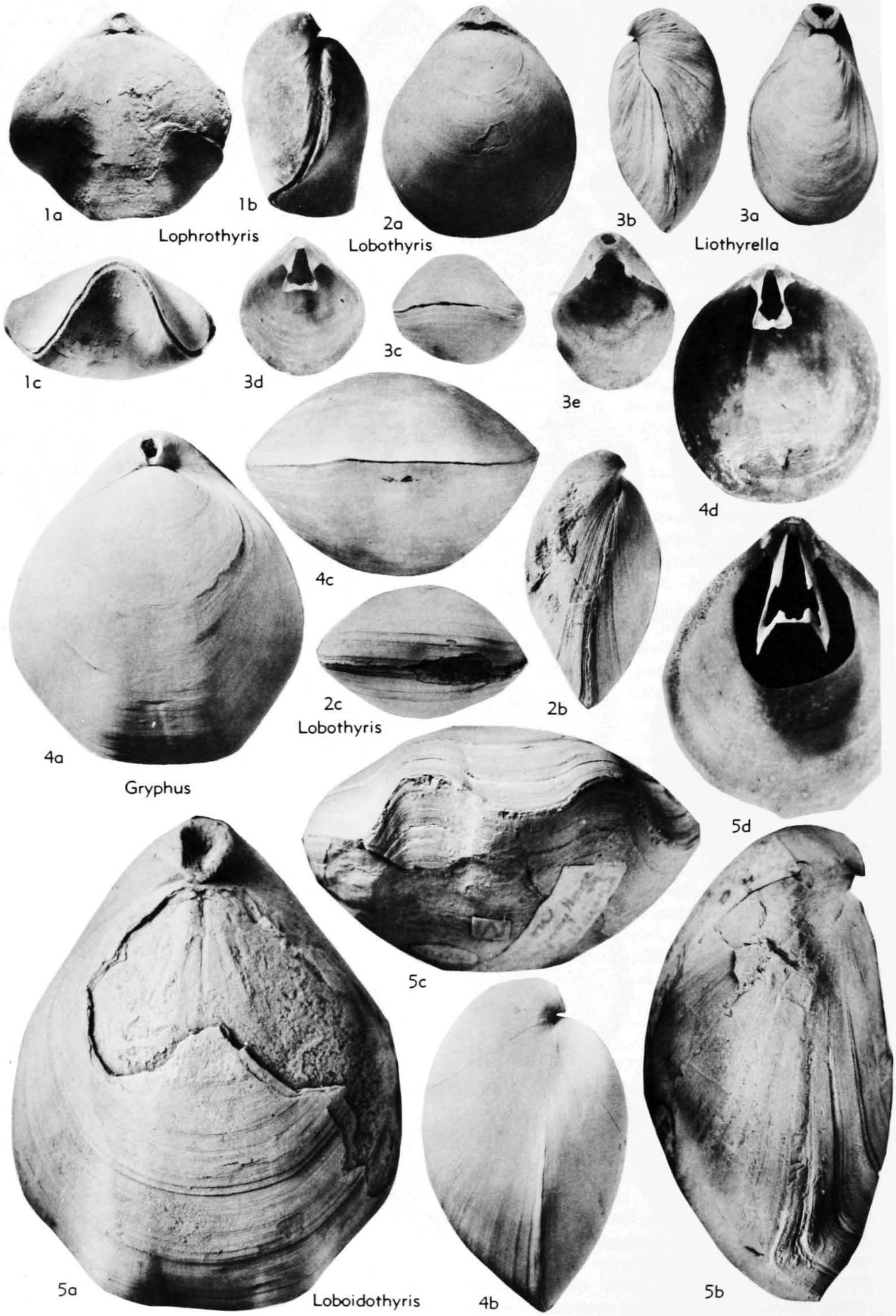


FIG. 643. Terebratulidae (Terebratulinae) (p. *H*780, *H*783-*H*785).

ity present; myophragm low; hinge plates in section not well differentiated from inner socket ridges, ventrally concave, becoming V-shaped, tapering, commonly keeled; adductor scars rounded-trigonal, threadlike posteriorly. *U.Jur. (Oxford.-Kimmeridg.),* W. Eu. - E. Eu. (Caucasus-Crimea).——FIG. 642,*4a,b*; 644,*1*. **J. procerus,* L. Kimmeridg., Crimea; 642,*4a,b,* brach.v., lat. views, ×1; 644,*1a-o,* ser. transv. secs., ×1 (496).——FIG. 642,*4c-e*. *J. cotteaui* (DOUVILLÉ), U.Jur.(U. Oxford.), Fr.; *4c-e,* brach.v., lat., ant. views, ×1 (264).

Kutchithyris S. S. BUCKMAN, 1918, p. 113 [**Terebratula acutiplicata* KITCHIN, 1897, p. 9; OD] [=*Kutchithyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Medium-sized, valves unequally biconvex, biplicate, anterior commissure uniplicate to sulciplicate; umbo short, incurved, obliquely truncate, foramen large, circular, permesothyridid?, symphytium rarely seen; growth lines numerous, shell rarely capillate. Loop about 0.3 of valve length, crural processes long; cardinal process low, short; no posterior umbonal cavity; hinge plates in section not well demarcated from long inner socket ridges, dorsally inclined, gently concave ventrally, clubbed to bladelike; adductor scars sharply divergent, posteriorly threadlike. *U.Jur.(Callov.),* Asia(India-Pak.). —— FIG. 642,*5*; 645,*2*. **K. acutiplicata* (KITCHIN); 642,*5a-d,* brach.v., lat., ant., ped.v. views of lectotype (KITCHIN, 1897, pl. 1, fig. 1a-d) (herein designated), ×1; 642,*5e,* brach.v. view showing adductor scars, ×1; 645, *2a-k,* ser. transv. secs., ×1.3 (136).

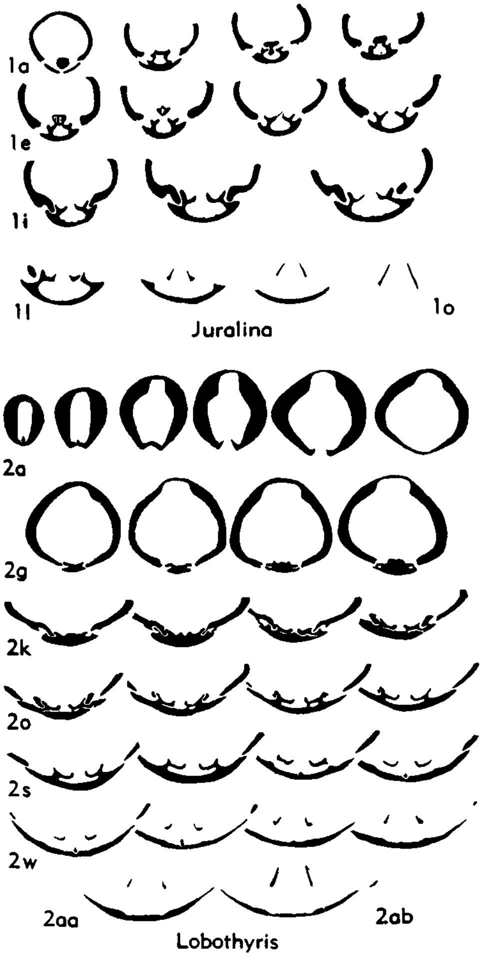


FIG. 644. Terebratulidae (Terebratulinae) (p. *H*780, *H*783-*H*784).

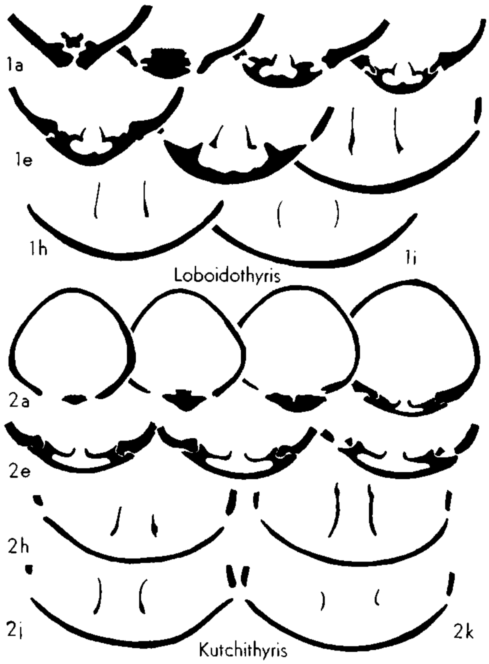


FIG. 645. Terebratulidae (Terebratulinae) (p. *H*783-*H*784).

Liothyrella THOMSON, 1916, p. 44 [**Terebratula uva* BRODERIP, 1883, p. 124; OD]. Small to large, ovate, biconvex; anterior commissure plano- to sulciplicate; umbo short, foramen epithyridid, symphytium narrow, pedicle collar short; shell surface smooth or finely capillate, growth lines prominent. Loop short, broadly triangular, 0.3 length of valve, crural bases in contact with triangular crural processes without any crura; descending branches diverging, transverse band narrow-ribboned, slightly arched ventrally, crural bases extending along margin of concave outer hinge plates; cardinal process low, laterally extended plate; hinge teeth narrow with shallow sulcus. *Mio.-Plio.,* Italy-Alg.-N.Z.-Tasmania-S.Am.; *Rec.,* Arct.-E. Atl.-W. Atl.-S. Ind. O.-Pac.O.(off C.

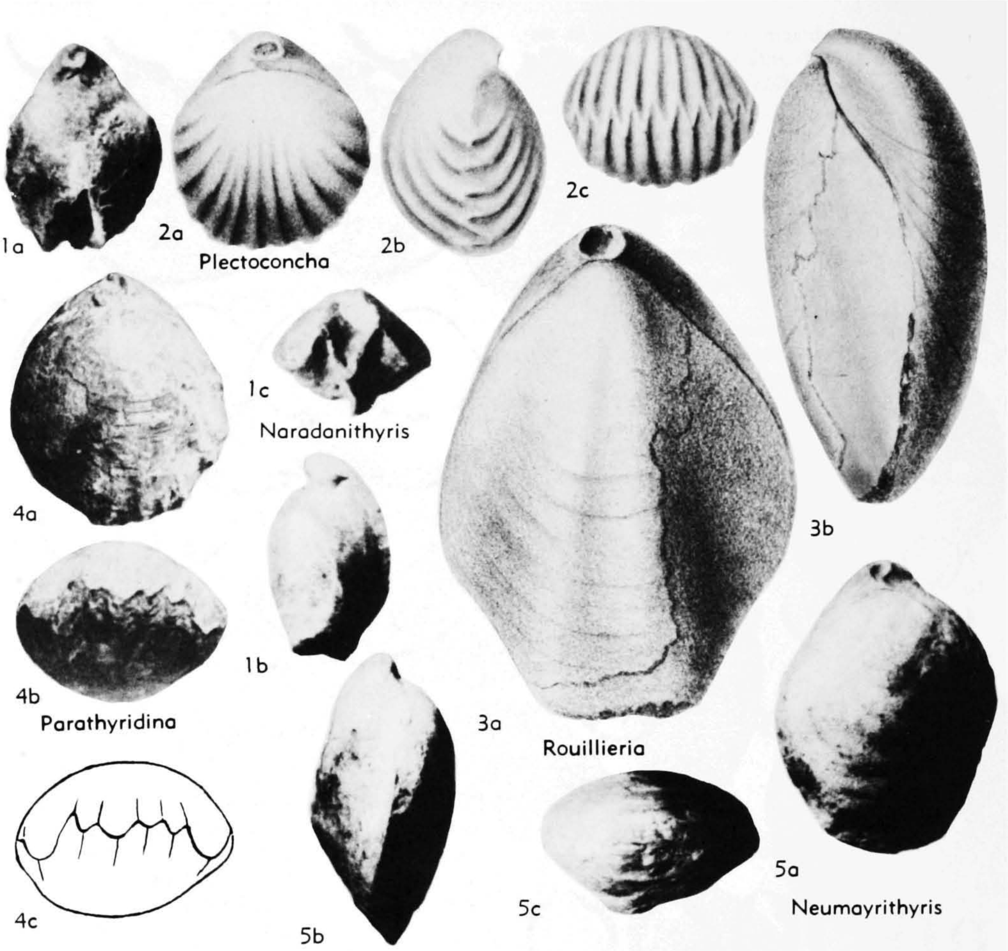


FIG. 646. Terebratulidae (Terebratulinae) (p. H785-H787).

Am.-S.Am.)-Antarctic.——FIG. 643,*3*. **L. uva* (BRODERIP), Rec., off Mexico; *3a-c,* brach. v., lat., ant. views of holotype, ×1.2; *3d,e,* Rec., Falkland I.; brach.v. int. with loop, ped.v. int., ×1.2 (810).

Loboidothyris S. S. BUCKMAN, 1918, p. 112 [**L. latovalis*; OD] [=*Loboidothyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Medium-sized to large, biconvex, anterior commissure uniplicate to sulciplicate; umbo massive, short, foramen large, commonly labiate, epithyridid, beak ridges inconspicuous, symphytium hidden; valves rarely capillate anteriorly. Loop less than 0.5 of valve length; cardinal process low, short, lobate; no posterior umbonal cavity; hinge plates in section almost horizontal, well differentiated from socket ridges, slightly concave ventrally, keeled; crural bases virgate; adductor scars broad, tapering posteriorly, slightly divergent. *M.Jur.(Bajoc.),* Eu.(Eng.-Fr.). ——FIG. 643,*5a-c*. **L. latovalis,* Eng.(Dorset); *5a-c,* brach.v., lat., ant. views of holotype, ×1.2 (136).——FIG. 643,*5d*; 645,*1*. *L. perovalis* (J. DE C. SOWERBY, Fr.(Normandy); 643,*5d,* loop, ×1.2; 645,*1a-i,* ser. transv. secs., ×1.3 (136).

Lobothyris S. S. BUCKMAN, 1918, p. 107 [**Terebratula punctata* J. SOWERBY, 1813, p. 46; OD] [=*Lobothyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Medium-sized, moderately biconvex, anterior commissure uniplicate, rarely sulciplicate; umbo suberect to incurved, epithyridid, pedicle collar with short septum, symphytium short. Loop about 0.3 length of valve; cardinal process small, trilobate; no posterior umbonal cavity; hinge plates and inner socket ridges in section slightly concave ventrally, clubbed, and gently inclined dorsally; adductor scars short, narrow, spatulate, diverging. *L. Jur. (Lias.)-M. Jur. (Bajoc.),* Eu.(Eng.-Fr.-Ger.-Spain).——FIG. 642,*6*; 643,*2*; 644,*2*. **L. punctata* (J. SOWERBY), L.Jur.(M.Lias.), Eng.; 642,*6a,* loop (reconstr.), ×1.5; 642,*6b,* dorsal adductor muscle scars, ×1; 643,*2a-c,* brach.v., lat., ant. views of holotype, ×1.2; 644,*2a-ab,* ser. transv. secs., ×1.25 (576).

Lophrothyris S. S. BUCKMAN, 1918, p. 114 [**L. lophus*; OD] [=*Lophrothyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Small to medium-sized, biconvex, trilobate, anterior commissure markedly uniplicate, rarely sulciplicate; umbo short, symphytium narrow, beak ridges angular, epithyridid. Loop ?with median plication in transverse band; cardinal process low, short; no umbonal cavity posteriorly; hinge plates in transverse section well demarcated from inner socket ridges, gently concave ventrally, fine, tapering, developing slight flange at late stage; adductor scars slightly divergent. *M.Jur.(Bajoc.)*, Eu.(Eng.-Fr.).——FIG. 643,*1*. **L. lophus*, Eng.(Somerset); *1a-c*, brach.v., lat. ant. views of holotype, ×1.2 (136).

Naradanithyris TOKUYAMA, 1958, p. 2 [**N. kuratai*; OD]. Small to medium-sized, ovate to pentagonal, biconvex, anterior commissure angularly biplicate; umbo short, massive, suberect to incurved, in contact with brachial valve, foramen large, rounded, symphytium short, usually concealed, beak ridges obscure, ?mesothyridid or permesothyridid, pedicle collar absent; shell rarely capillate. Internal characters imperfectly known, owing to distortion of shell; loop less than 0.5 of valve length; no median septum; cardinal process short, wide; hinge plates in transverse section dorsally inclined, thickened hammer-shaped, separated from inner socket ridges by shallow sulcus; adductor scars subparallel, long. *M.Jur.(Bajoc.-Bathon.)*, Asia(Japan); *U.Jur.*, Asia.——FIG. 646, *1*. **N. kuratai*, M.Jur., Japan; *1a-c*, brach.v., lat., ant. views of holotype, ×1 (813).

Neumayrithyris TOKUYAMA, 1958, p. 120 [**N. torinosuensis*; OD]. Medium-sized, biconvex, anterior commissure incipiently uniplicate; umbo short, massive, suberect to moderately incurved, beak ridges rounded, permesothyridid. Cardinal process short, medianly depressed; commonly with posterior umbonal cavity; hinge plates in section almost horizontal, scarcely distinguishable from inner socket ridges, fine, tapering, crural bases given off ventrally at angle to hinge plates; no median septum. *M.Jur.*, (Eu.); *U.Jur.(L.Malm.)*, Eu.(Crimea)-Asia(Japan).——FIG. 646,*5*; 647,*1*. **N. torinosuensis*, U.Jur., Japan; 646,*5a-c*, brach.v., lat., ant. views of holotype, ×1.5; 647,*1a-k*, ser. transv. secs., ×2.4 (814).

Oleneothyris COOPER, 1942, p. 233 [**Terebratula harlani* MORTON, 1828, p. 73; OD]. Large, elongate-oval, almost parallel-sided, biconvex; brachial valve less convex than pedicle valve; anteriorly biplicate, anterior commissure uniplicate to sulciplicate; umbo incurved, almost concealing narrow symphytium, foramen large, mesothyridid to permesothyridid; surface smooth except growth lines and rare capillation. Loop about 0.3 of valve length, with inverted V-shaped transverse band ventrally directed; crural processes massive, triangular, crural bases extending along margin of concave outer hinge plates forming prominent

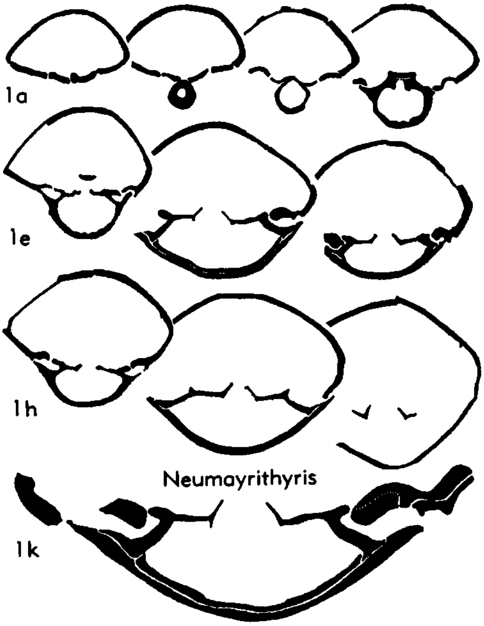


FIG. 647. Terebratulidae (Terebratulinae) (p. *H*785).

ridge, no crura; hinge plates extended anteriorly and joining descending branches of loop; cardinal process large, inner socket ridges elevated. *Eoc.*, USA (N.J.-Ala.-S. Car.-Del.).——FIG. 648,*1*. **O. harlani* (MORTON), N.J.; *1a-c*, brach.v., lat., ant. views, ×1.3; *1d,e*, brach.v. int. with loop and lat. of same, ×0.7; *1f,g*, brach.v. int. with cardinalia, ped.v. int. with massive grooved teeth, ×0.7 (863).

Parathyridina SCHUCHERT & LEVENE, 1929, p. 121 [*pro Parathyris* DOUVILLÉ, 1916, p. 35 (*non* HÜBNER, 1816)] [**Parathyris plicatoides* DOUVILLÉ, 1916, p. 36; OD]. Small to medium-sized, valves biconvex to spherical without prominent fold or sulcus; anterior commissure uniplicate with superimposed alternating costation, costae few, broad, near anterior margin only; umbo short, beak ridges obscure, ?permesothyridid, symphytium narrow. No dorsal median septum or dental plates, loop presumed to be terebratulid, other internal characters unknown. *M.Jur.(Bajoc.)*, Afr.(Egypt).——FIG. 646,*4*. **P. plicatoides* (DOUVILLÉ); *4a-c*, brach.v., ant., views, ×1 (265).

Plectoconcha COOPER, 1942, p. 233 [**Rhynchonella aequiplicata* GABB, 1864, p. 35; OD]. Small to medium-sized, subglobose, anterior commissure incipiently uniplicate, with superimposed alternating multiplication; costae regular, rounded on anterior half of shell; umbo large, incurved, foramen labiate, permesothyridid, deltidial plates not exposed, pedicle collar present. Loop with widely divergent descending lamellae, transverse band slightly arched, crural bases short, crural processes at anterior end of hinge plates, hinge plates divided. *U.Trias.* W.N.Am.(Nev.-Calif.). —— FIG. 646,2. **P. aequiplicata* (GABB), Nev.; *2a-c,* brach. v., lat., ant. views, ×1 (177).

Pseudoglossothyris S. S. BUCKMAN, 1901, p. 240 [**Terebratula curvifrons* DAVIDSON, 1878, p. 153 (*non* OPPEL, 1858, p. 423) (=*Aulacothyris leckhamptonensis* ROLLIER, 1919, p. 347); SD MUIR-WOOD, herein]. Medium-sized, valves plano- be-

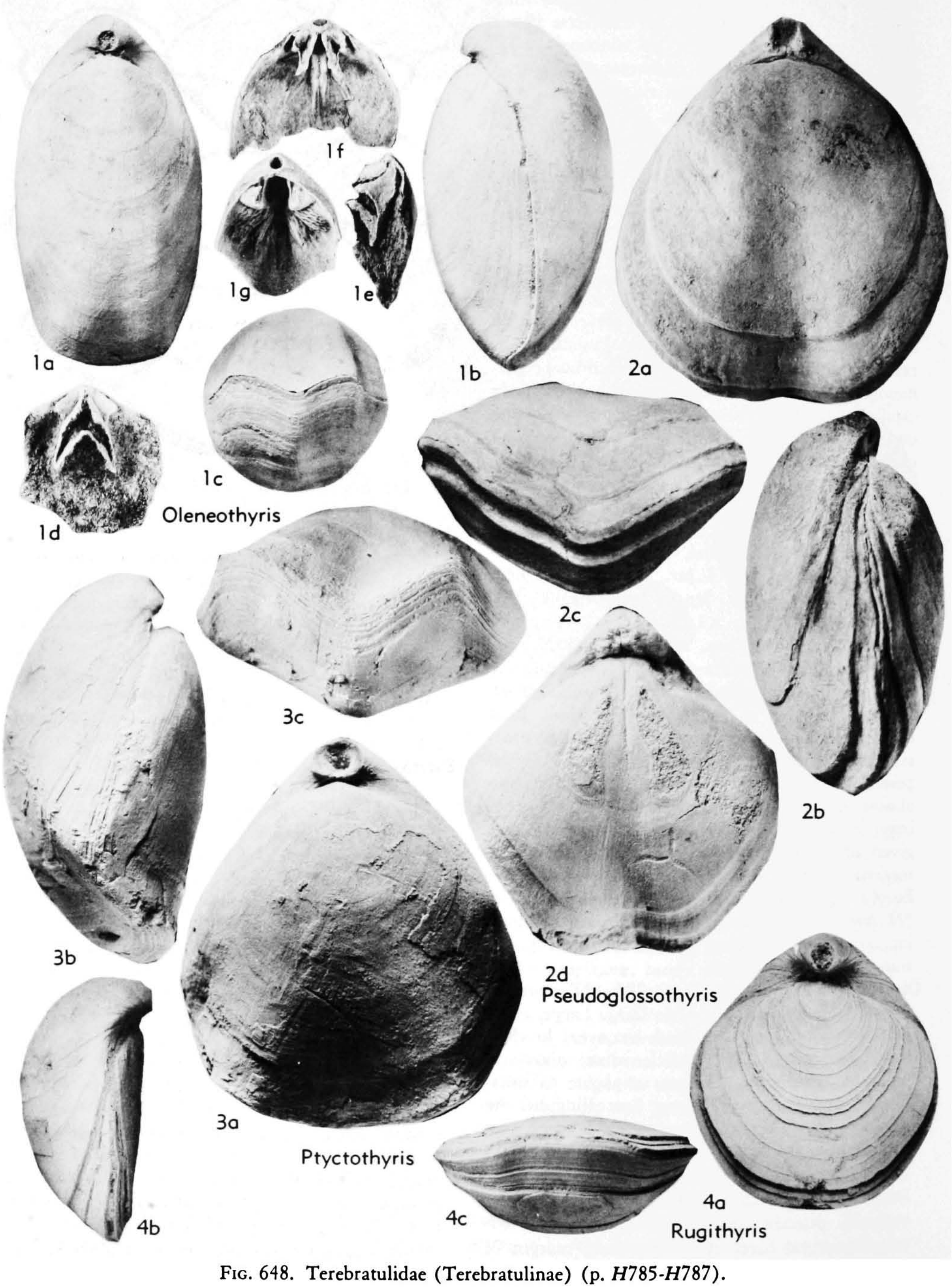


FIG. 648. Terebratulidae (Terebratulinae) (p. *H*785-*H*787).

coming increasingly sulco-convex, anterior commissure sulcate; umbo slightly incurved, foramen telate in some, permesothyridid, symphytium exposed, lamellose anteriorly and rarely striated. Loop about 0.5 of shell length; cardinal process large, prominent, lobate, medianly excavate; no posterior umbonal cavity; hinge plates in transverse section not demarcated from inner socket ridges, almost horizontal, slightly concave ventrally, clubbed, becoming V-shaped; adductor scars long, divergent. *M.Jur.(Bajoc.),* Eu.(Eng.-Fr.).——FIG. 648,*2*; 649,*2*. **P. leckhamptonensis* (ROLLIER), Glos.; 648,*2a-c,* brach.v., lat., ant. views, ×1.3; 648,*2d,* brach.v. int. mold showing adductor scars, ×1.3; 649,*2a-i,* ser. transv. secs., ×1.2 (136).

Ptyctothyris S. S. BUCKMAN, 1918, p. 101 [**Terebratula stephani* DAVIDSON, 1877, p. 12; OD] [=*Ptyctothyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Medium-sized, biconvex, biplicate, with prominent median ventral fold, anterior commissure rectimarginate to sulciplicate, umbo stout, incurved, foramen large, epithyridid, symphytium exposed. Loop about 0.3 of valve length; cardinal process low; no umbonal cavity; hinge plates and inner socket ridges in transverse section dorsally inclined, ventrally concave, clubbed, becoming broad U-shaped, tapering; adductor scars broad, spatulate. *M.Jur.(Bajoc.-Bathon.),* Eu.(Eng.-Fr.). FIG. 648,3. **P. stephani* (DAVIDSON), Bajoc., Eng. (Dorset); *3a-c,* brach.v., lat., ant. views, ×1.3 (136).

Rouillieria MAKRIDIN, 1960, p. 295 [**Terebratula michalkowii* FAHRENKOHL, 1856, p. 228; OD]. Large, subcircular to elongate-oval, biconvex, anterior commissure uniplicate to sulciplicate; umbo short, in contact with brachial valve, foramen large, beak ridges obscure. Cardinal process broad, lamellar, dorsal septum fine, half valve length; adductor scars elongate pear-shaped, somewhat divergent. Other internal characters unknown. *U.Jur. (Volg.)-L.Cret.(L.Valangin.),* Eu.——FIG. 646,*3*. **R. michalkowii* (FAHRENKOHL), L.Volg., USSR; *3a,b,* brach.v., lat. views, ×1 (294).

Rugithyris S. S. BUCKMAN, 1918, p. 127 [**Terebratula subomalogaster* BUCKMAN, 1901, p. 259; OD] [=*Rugithyris* BUCKMAN, 1915, p. 79 *(nom. nud.)*]. Medium-sized, valves sulco- to planoconvex, anterior commissure rectimarginate, uniplicate or incipiently sulciplicate; umbo produced, slightly incurved, beak ridges prominent, permesothyridid, symphytium exposed; growth lamellae numerous, commonly squamose and overlapping. Loop length unknown; cardinal process short, lobate; no posterior umbonal cavity; hinge plates in transverse section mallet-shaped, slightly convex ventrally, rarely keeled; adductor scars short, broad with inner margins parallel. *M.Jur. (Bajoc.),* Eu.(Eng.).——FIG. 648,*4*; 649,*1*. **R. subomalogaster* (BUCKMAN), Eng.(Dorset); 648, *4a-c,* brach.v., lat., ant., views, ×2; 649,*1a-g,* ser. transv. secs., ×1.2 (136).

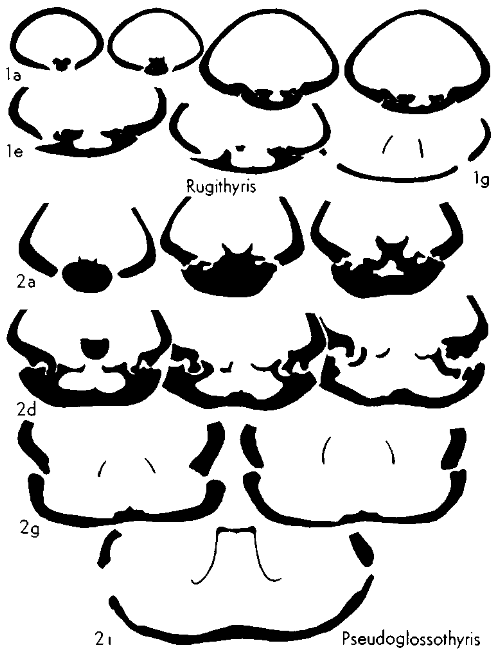


FIG. 649. Terebratulidae (Terebratulinae) (p. *H786-H787*).

Somalithyris MUIR-WOOD, 1935, p. 124 [**S. macfadyeni*; OD]. Medium-sized, biconvex, anterior commissure uniplicate to sulciplicate; umbo short, suberect, symphytium concealed, foramen small, beak ridges obscure, epithyridid, pedicle collar absent; shell rarely capillate. Loop with high-arched transverse band; cardinal process short, bilobed, with shallow umbonal cavity; hinge plates in transverse section wide, not well demarcated from inner socket ridges, concave ventrally and slightly deflected dorsally, tapering; adductors narrow, lenticular, diverging. *U.Jur.(Oxford.),* Afr.(Somaliland).——FIG. 650,*1*; 651,*1*. **S. macfadyeni*; 650,*1a-c,* brach.v., lat., ant. views of holotype, ×1.3; 650,*1d,* adductor scars, ×1.3; 651,*1a-n,* ser. transv. secs., ×1 (577).

Sphaeroidothyris S. S. BUCKMAN, 1918, p. 115 [**S. globisphaeroidalis*; OD] [=*Sphaeroidothyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Small to medium-sized, plano- to biconvex to sphaeroidal, anterior commissure plane, slightly waved or uniplicate; umbo short, incurved, foramen small, beak ridges obscure, epithyridid, symphytium not exposed; growth lines few, prominent. Loop greater than 0.5 length of valve; low septum present; cardinal process prominent, lobate, medianly depressed; hinge plates in transverse section differentiated from inner socket ridges, dorsally inclined, ventrally concave with short U-shaped kink (spoon-shaped); adductor scars spatulate, posteriorly threadlike, not divergent. *M.Jur.(Bajoc.-*

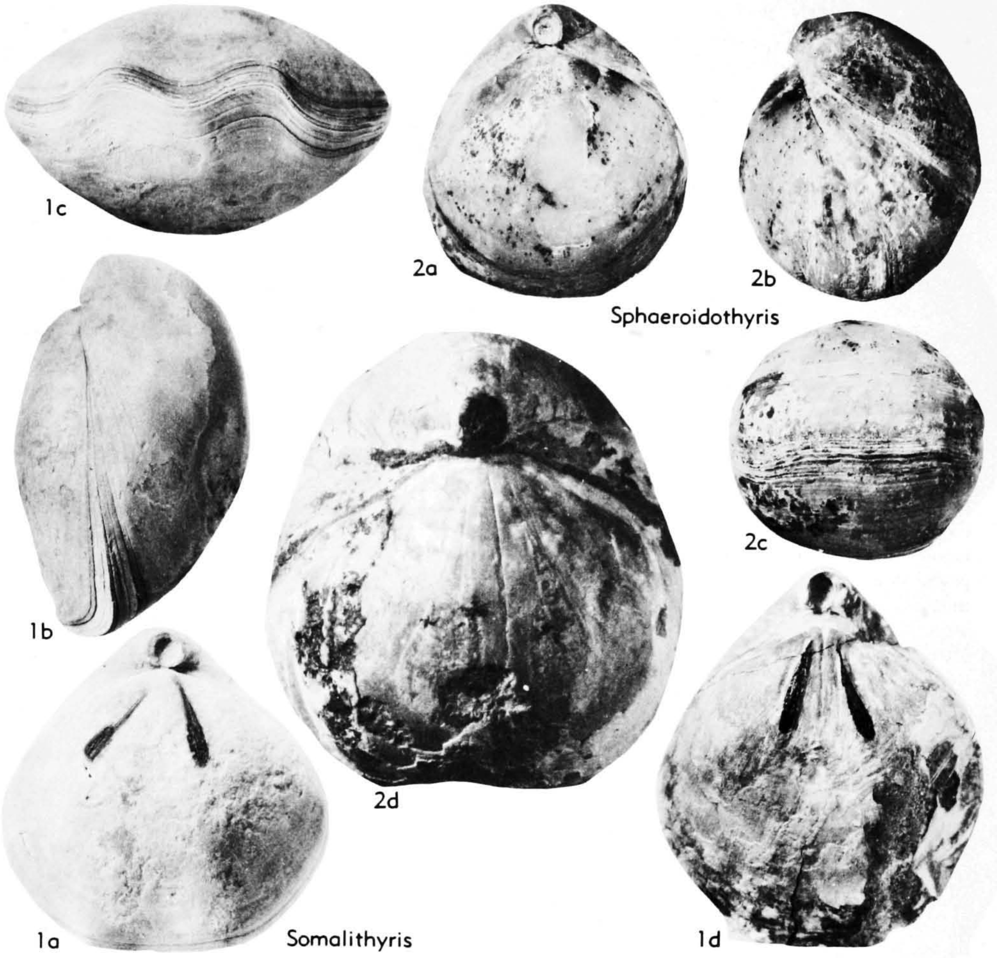


FIG. 650. Terebratulidae (Terebratulinae) (p. *H*787-*H*788).

Bathon.), Eu.(Eng.-Fr.-Ger.), *?U.Jur.*——FIG. 650, *2*; 651,*2*. **S. globisphaeroidalis,* U.Inferior Oolite, Eng.(Somerset); 650,*2a-c,* brach.v., lat., ant. views, ×1.3; 650,*2d,* dorsal view showing adductor scars of holotype (Dorset), ×2; 651,*2a-q,* ser. transv. secs., ×1 (579).

Stiphrothyris S. S. BUCKMAN, 1918, p. 109 [**Terebratula globata* var. *tumida* DAVIDSON, 1878, p. 149; OD] [=*Stiphrothyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Medium-sized, concavo-convex, becoming biconvex to sphaeroidal, biplicate, plications strong, anterior commissure uniplicate to sulciplicate; umbo short, obliquely truncated, incurved in later stages, symphytium usually exposed, beak ridges obscure, permesothyridid to epithyridid, foramen small. Cardinal process prominent, bilobed with median depression; hinge plates thickened, clubbed, slightly concave, scarcely demarcated from inner socket ridges, becoming U- or V-shaped; crural processes short, converging, virgate; adductor scars subparallel. *M.Jur. (Bajoc.)*, Eu.(Eng.).——FIG. 652,*3*; 653,*1*; 657,*2*. **S. tumida* (DAVIDSON), Glos.; 652,*3a-c,* brach.v., lat., ant. views, ×1.2; 653,*1a-h,* ser. transv. secs., ×1.5; 657, *2,* artificial internal mold showing adductor scars, ×1.2 (229).

Stroudithyris BUCKMAN, 1918, p. 111 [**Terebratula pisolithica* BUCKMAN, 1886, p. 41; OD] [=*Stroudithyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Small to medium-sized, valves moderately biconvex, biplicate anteriorly, anterior commissure uniplicate to sulciplicate; umbo short, incurved, beak ridges obscure, epithyridid, symphytium short. Loop less than half of valve length, transverse band highly arched, medianly rounded; cardinal process low; no umbonal cavity; hinge plates in transverse section slightly demarcated from inner socket ridges, concave, clubbed becoming U-shaped, tapering, slightly keeled; adductor scars narrow, tapering posteriorly, slightly divergent. *M.Jur.(Bajoc.)*, Eu. (Eng.).——FIG. 652,*1*; 654,*2*. **S. pisolithica* (BUCKMAN), Glos.; 652,*1a-c*, brach.v., lat., ant. views of paratype, ×1.2; 654, *2*, adductor muscle scars of paratype (after Buckman); ×1 (136).

Taurothyris KYANSEP, 1961, p. 27 [**T. avundaensis*; OD]. Large, moderately biconvex, elongate-oval in outline, anterior commissure plane to incipiently uniplicate; umbo small, tapering, suberect, symphytium well exposed, beak ridges obscure; shell capillate when decorticated. Loop short, triangular; crural bases given off ventrally; cardinal process massive, bilobate, prominent; hinge plates and inner socket ridges in section slightly deflected ventrally and very slightly concave. *U.Jur.(Oxford.)*, Eu.(Crimea).——FIG. 654,*7*; 655,*2*. **T. avundaensis*; 654,*7a-c*, brach.v., lat., ped.v. views, ×1; 655,*2a-h*, ser. transv. secs., ×1.3 (496).

Triadithyris (*see* p. *H*905).

Trichothyris S. S. BUCKMAN, 1918, p. 125 [**Dictyothyris compressa* KITCHIN, 1897, p. 28; OD] [=*Trichothyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Small, valves biconvex, anterior commis-

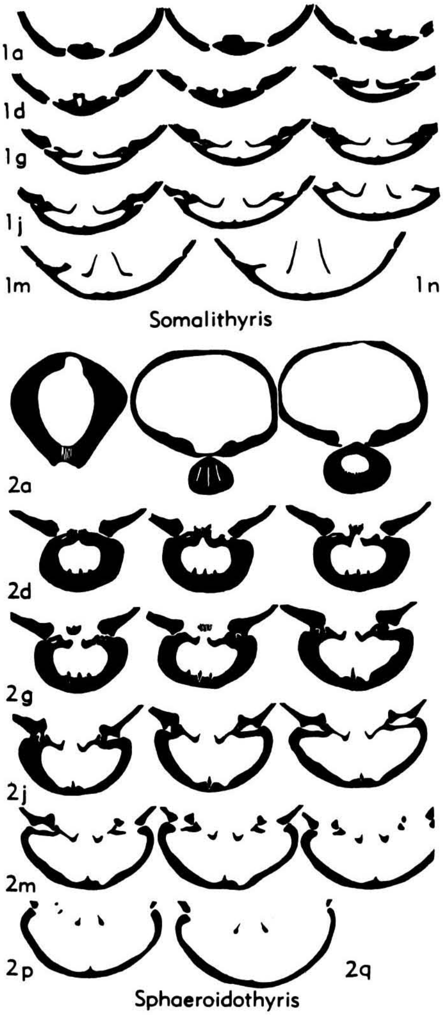


FIG. 651. Terebratulidae (Terebratulinae) (p. *H*787-*H*788).

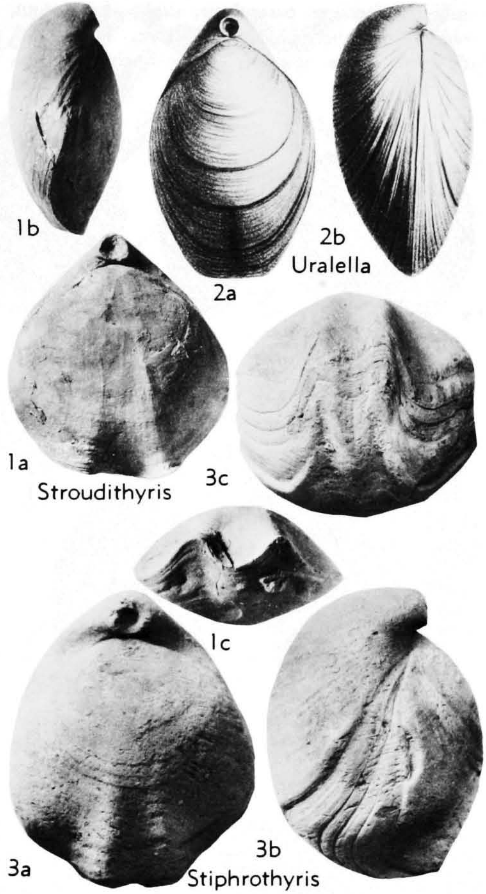


FIG. 652. Terebratulidae (Terebratulinae) (p. *H*788-*H*789, *H*792).

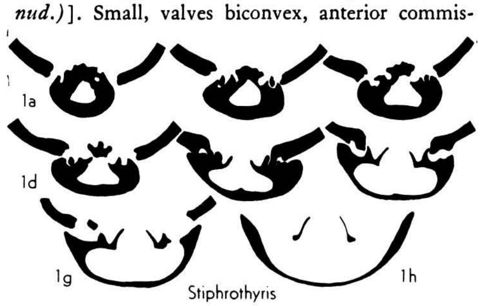


FIG. 653. Terebratulidae (Terebratulinae) (p. *H*788).

sure uniplicate to parasulcate; umbo short, stout, obliquely truncate, foramen large, epithyridid, deltidial plates discrete; shell finely capillate. Loop and internal characters largely unknown; adductor scars broad, inner edges of scars parallel. *U.Jur.(Callov.),* Asia(Pak.).——FIG. 654,*3*. **T.*

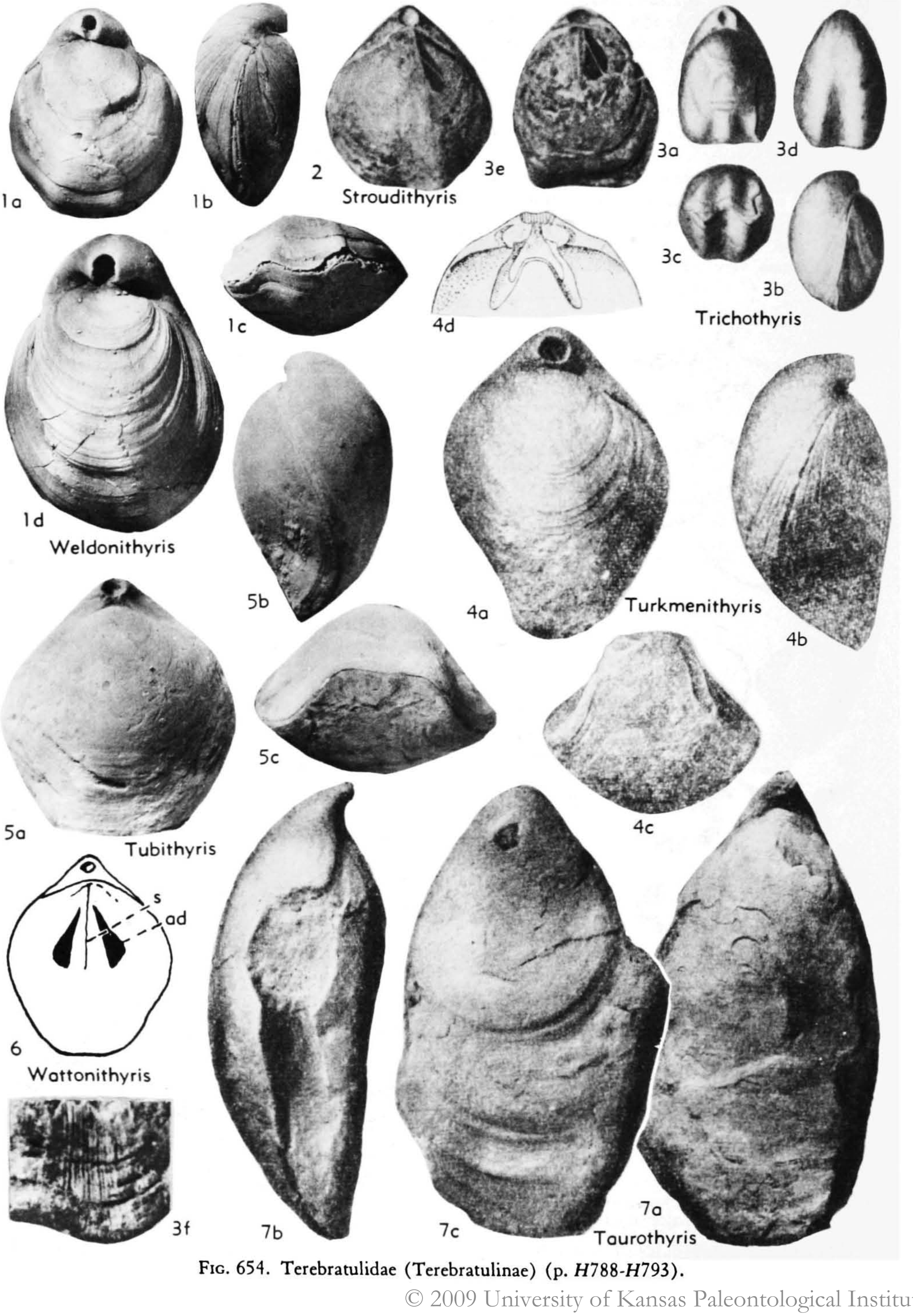


FIG. 654. Terebratulidae (Terebratulinae) (p. H788-H793).

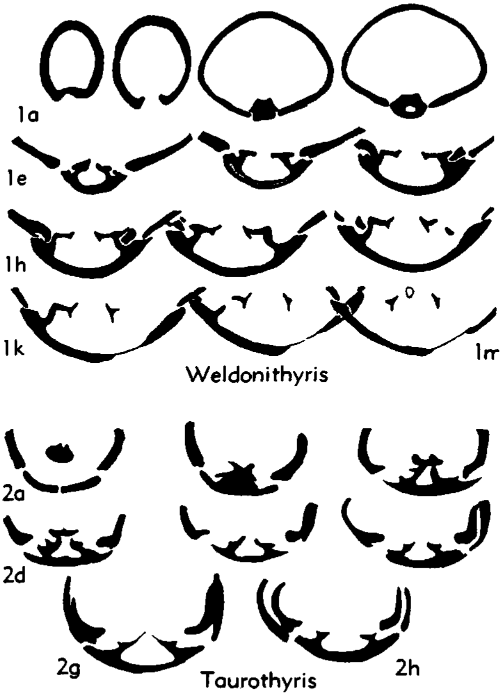


FIG. 655. Terebratulidae (Terebratulinae) (p. *H*789, *H*792-*H*793).

compressa (KITCHIN); *3a-d,* brach.v., lat., ant., ped.v. views, ×1; *3e,* brach.v. int. mold with adductor scars, ×1.5; *3f,* ornament, ×4.5 (136).

Tubithyris S. S. BUCKMAN, 1918, p. 115 [**Terebratula wrighti* DAVIDSON, 1855, p. 20] [*Tubithyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Small to medium-sized, biconvex to spheroidal, anterior commissure uniplicate to sulciplicate; umbo massive, incurved, foramen tubular, telate in young, permesothyridid, beak ridges subangular, symphytium narrow, well exposed; growth lines prominent. Loop about 0.5 of valve length; cardinal process bilobed, prominent, medianly depressed; umbonal cavity present; hinge plates in transverse section slightly demarcated from socket ridges, inclined dorsally, gently concave to markedly V-shaped or broad U-shaped; adductor scars elongate-oval slightly divergent. *M.Jur.(Bajoc.-Bathon.),* Eu.(Eng.-Fr.).——FIG. 654,*5*; 656,*2*. **T. wrighti* (DAVIDSON), Eng.(Glos.); 654,*5a-c,* brach.v., lat., ant. views, ×2; 656,*2a-s,* ser. transv. secs., ×1.4 (579).

Turkmenithyris PROZOROVSKAIA, 1926, p. 108 [**T. krimholzi*; OD]. Medium-sized, biconvex, pentagonal, tapering strongly anteriorly, brachial valve with median fold, pedicle valve with sulcus, anterior commissure markedly uniplicate, lateral commissure deflected ventrally; umbo incurved, usually concealing symphytium, mesothyridid,

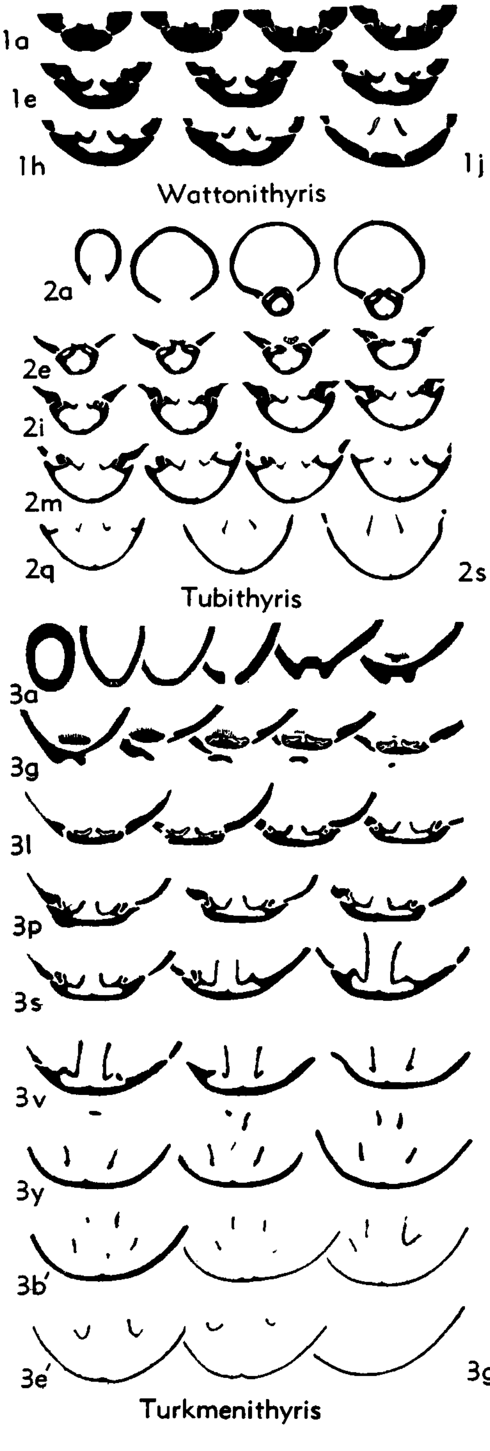


FIG. 656. Terebratulidae (Terebratulinae) (p. *H*791-*H*792).

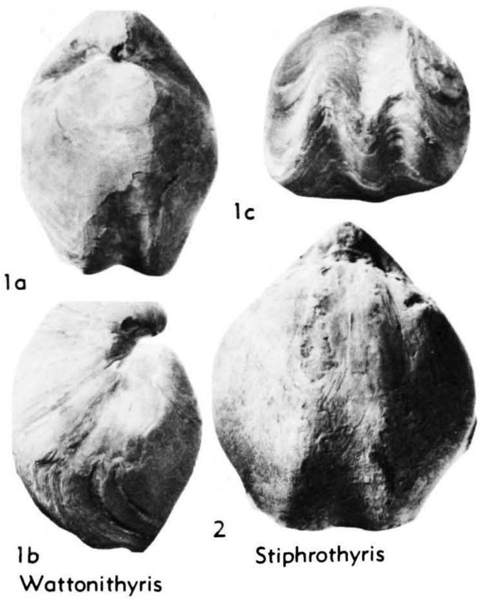


FIG. 657. Terebratulidae (Terebratulinae) (p. *H*788, *H*792).

pedicle collar present; shell smooth with conspicuous growth lines. Loop about 0.3 length of valve, ribbon broad anteriorly; cardinal process broad, bilobed; hinge plates in section tapering, concave ventrally, becoming U-shaped to acutely V-shaped, crural bases virgate. *U.Jur.(Callov.)*, Asia (W. Turkoman).——FIG. 654,*4*; 656,*3*. **T. krimholzi*; 654,*4a-c*, brach.v., lat., ant. views, ×1; 654,*4d*, loop, ×1; 656,*3a-g'*; ser. transv. secs., ×0.85 (649).

Uralella MAKRIDIN, 1960, p. 295 [**Terebratula strogonofii* D'ORBIGNY, 1845, p. 483; OD]. Large, elongate-oval, biconvex, anterior commissure plane; umbo massive, foramen large, marginate, permesothyridid. Cardinal process large, almost quadrate in cross section, dorsal septum strong; dorsal adductor scars narrow, elongate-triangular, strongly converging; other internal characters unknown. *U.Jur.(L.Volg.)*, Eu.(USSR-S.Urals)-Asia (E.Siberia)-Arctic.——FIG. 652,*2*. **U. strogonofii* (D'ORBIGNY), USSR; *2a,b*, brach.v., lat., ×0.6 (624).

Wattonithyris MUIR-WOOD, 1936, p. 91 [**W. wattonensis*; OD]. Small to medium-sized; valves sulco-convex to biconvex to biplicate, anterior commissure uniplicate to sulciplicate, or episulcate; umbo rounded, suberect to incurved, beak ridges rounded, permesothyridid, symphytium short, pedicle collar not observed. Loop equal to or greater than half length of brachial valve; cardinal process small, with shallow median sulcus; normally no posterior umbonal cavity; hinge plates in section ventrally concave, clubbed, not demarcated from inner socket ridges; adductors subcrescentic, diverging. *M.Jur.(Bathon.)*, Eu.(Eng.-Fr.-Switz.).——FIG. 654,*6*; 656,*1*; 657,*1*. **W. wattonensis*, Eng.(Dorset); 654,*6*, brach.v. showing dorsal adductor scars *(ad)*, septum *(s)*, ×1; 656,*1a-j*, ser. transv. secs., ×1.1; 657,*1a-c*, brach. v., lat., ant. views, ×1.3 (579).

Weldonithyris MUIR-WOOD, 1952, p. 130 [**W. weldonensis*; OD]. Small to medium-sized, elongate-oval, valves biconvex, anterior commissure uniplicate to sulciplicate; umbo incurved in adult, beak ridges indistinct, epithyridid, symphytium commonly concealed by labiate foramen; growth

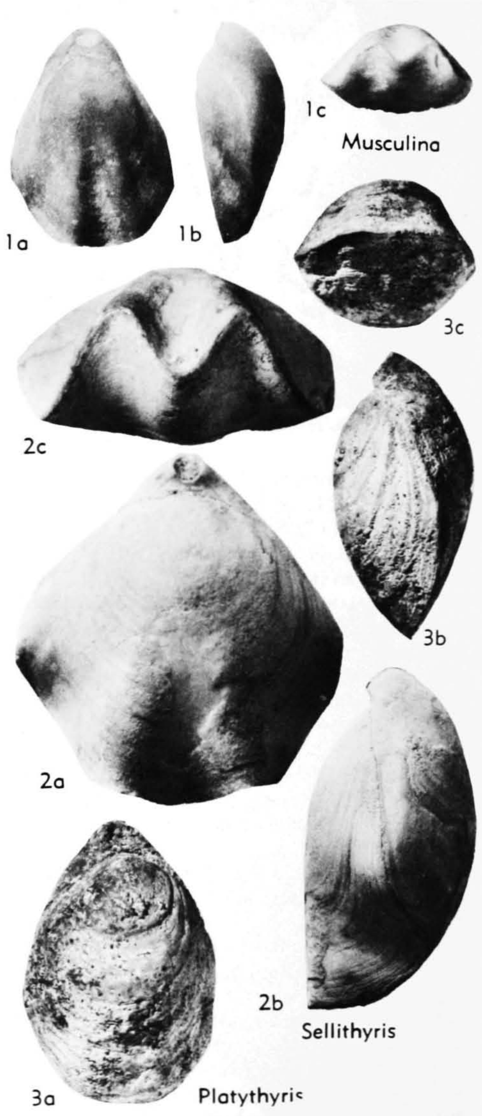


FIG. 658. Terebratulidae (Sellithyridinae) (p. *H*793, *H*795).

lines numerous, few prominent lamellae. Loop about 0.3 length of valve, high-arched, medianly horizontal transverse band; cardinal process low, short, medianly depressed; posterior umbonal cavity present; hinge plates and inner socket ridges in section slightly deflected dorsally, gently concave, keeled; adductor scars slightly divergent, increasing in width. *M.Jur.(Bajoc.),* Eu.(Eng.).——FIG. 654,*1*; 655,*1*. **W. weldonensis*; 654,*1a-c,* brach.v., lat., ant. views of holotype, ×1; 654,*1d,* dors. view of paratype showing lamellae, ×1.5; 655,*1a-m,* ser. transv. secs., ×1.3 (582).

Subfamily SELLITHYRIDINAE Muir-Wood, n.subfam.

Pentagonal, smooth or partly capillate, biplicate shells with low bilobate cardinal process, loop short, broad with low arched transverse band. *L. Cret.-U. Cret.(Ceno-man.).*

Sellithyris MIDDLEMISS, 1959, p. 113 [**Terebratula sella* J. DE C. SOWERBY, 1823, p. 53; OD]. Small to medium-sized, anterior commissure episulcate, lateral commissure with angular deflection ventrally; shell partly capillate; umbo erect to suberect, foramen marginate, mesothyridid to permesothyridid; hinge plates in section ventrally concave to broad U-shaped, tapering, virgate and keeled in some. *L.Cret.(Neocom.)-U.Cret.(Ceno-man.),* Eu.(Eng.-Fr.-Belg.-Ger.-Switz.). —— FIG. 658,*2*; 659,*1*. **S. sella* (J. DE C. SOWERBY), L.Cret. (Apt.), Eng.; 658,*2a-c,* brach.v., lat., ant. views, ×1.5; 659,*1a-j,* ser. transv. secs., ×1.5 (558).

Musculina SCHUCHERT & LEVENE, 1929, p. 120 [pro *Musculus* QUENSTEDT, 1869, p. 4 (*non* RAFINESQUE, 1818)] [**Terebratula acuta* QUENSTEDT, 1869, p. 384; SD S. BUCKMAN, 1907, p. 530 (*non T. acuta* J. SOWERBY, 1816, p. 115) (=**M. biennensis* MUIR-WOOD, n.sp., herein, syntypes figured by QUENSTEDT, 1871 (651), pl. 48, figs. 70-74, Neocom., Bielersee, Switz., as *Terebratula acuta*)]. Resembling *Sellithyris* externally but less pentagonal and having smaller dimensions, biplication developed at earlier stage, brachial valve more convex posteriorly and flattening anteriorly, lateral commissure without angular deflection; shell surface less capillate; sharp beak ridges mesothyridid, larger symphytium bordered by ridges; hinge plates in section rounded V-shaped, slightly clubbed, crural bases virgate. *L.Cret.(Neocom.),* Eu.(Switz.-Spain).——FIG. 658,*1*; 659,*2*. **M. biennensis* MUIR-WOOD, Neocom., Switz.; 658,*1a-c,* brach.v., lat., ant. views, ×2; 659,*2a-i,* ser. transv. secs., ×1.5 (651).

?**Platythyris** MIDDLEMISS, 1959, p. 109 [**P. comptonensis* (=*Terebratula moutoniana* AUCTT., *partim*); OD]. Medium-sized, elongate-oval, tapering anteriorly, anterior commissure rectimarginate to uniplicate, rarely sulciplicate; beak short, suberect, mesothyridid to permesothyridid, symphy-

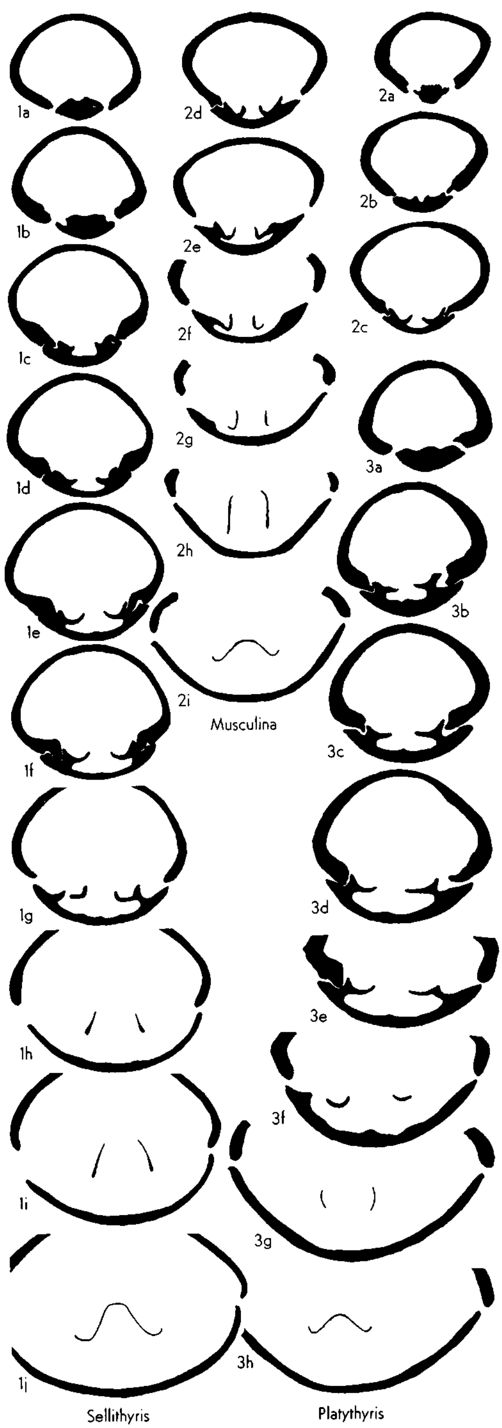


FIG. 659. Terebratulidae (Sellithyridinae) (p. *H*793, *H*795).

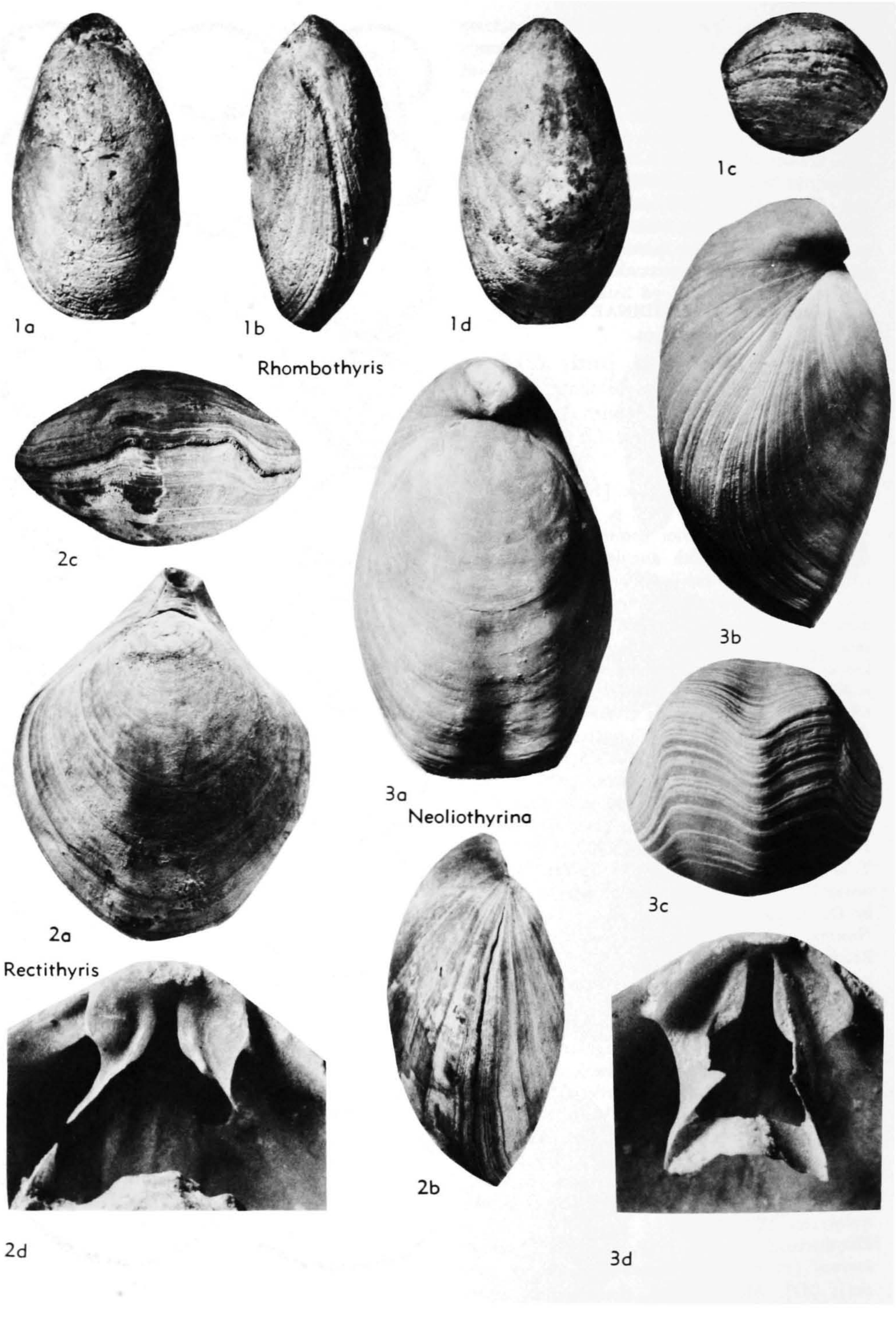


FIG. 660. Terebratulidae (Rectithyridinae) (p. H795-H797).

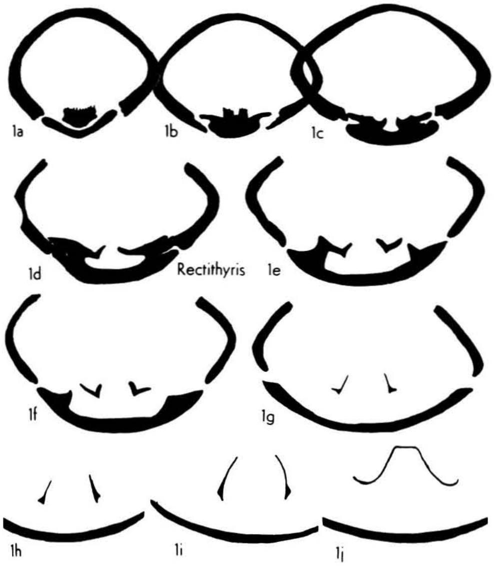


FIG. 661. Terebratulidae (Rectithyridinae) (p. *H*795).

tium very short. Cardinal process oval, low, hinge plates in section horizontal, tapering, well demarcated from socket ridges, loop short narrow, about 0.3 length of valve, with low-arched transverse band; myophragm well developed. *L.Cret.(Apt.),* Eu.(Eng.).——FIG. 658,*3*; 659,*3*. **P. comptonensis*; 658,*3a-c,* brach.v., lat., ant. views, ×1.5; 659,*3a-h,* ser. transv. secs., ×1.5 (558).

Subfamily RECTITHYRIDINAE Muir-Wood, n.subfam.

Medium-sized to large, smooth, biconvex, with numerous growth lines. Cardinal process low oval plate, crural bases extending near inner margins of hinge plates, or narrow inner hinge plates present, loop about 0.3 of valve length, broadly triangular, with high arched transverse band. *L.Cret.-U.Cret.*

Rectithyris SAHNI, 1929, p. 9 [**Terebratula depressa* VALENCIENNES in LAMARCK, 1819, p. 249 (=*T. nerviensis* D'ARCHIAC, 1847, p. 313); OD]. Large, anterior commissure rectimarginate to uniplicate, rarely sulciplicate; umbo erect or curved, foramen large, mesothyridid, symphytium high; hinge plates in section dorsally deflected, slightly concave ventrally, becoming V-shaped, keeled, demarcated from long inner socket ridges by shallow sulcus, transverse band of loop medianly horizontal. *U.Cret.(Cenoman.),* Eu.(Eng.-Belg.-Ger.).——FIG. 660,*2*; 661,*1*. **R. depressa* (VALENCIENNES), Ger.; 660,*2a-c,* brach.v., lat., ant. views, ×1; 660,*2d,* loop, ×3; 661,*1a-j,* ser. transv. secs., ×1.5 (697).

Cyrtothyris MIDDLEMISS, 1959, p. 123 [**Terebratula depressa* var. *cyrta* WALKER, 1868, p. 404; OD]. Medium-sized to large, subcircular to subpentagonal in outline, valves convex, with dorsal fold anteriorly, anterior commissure rectimarginate to markedly uniplicate, rarely sulciplicate; umbo short, suberect, foramen large, circular to labiate,

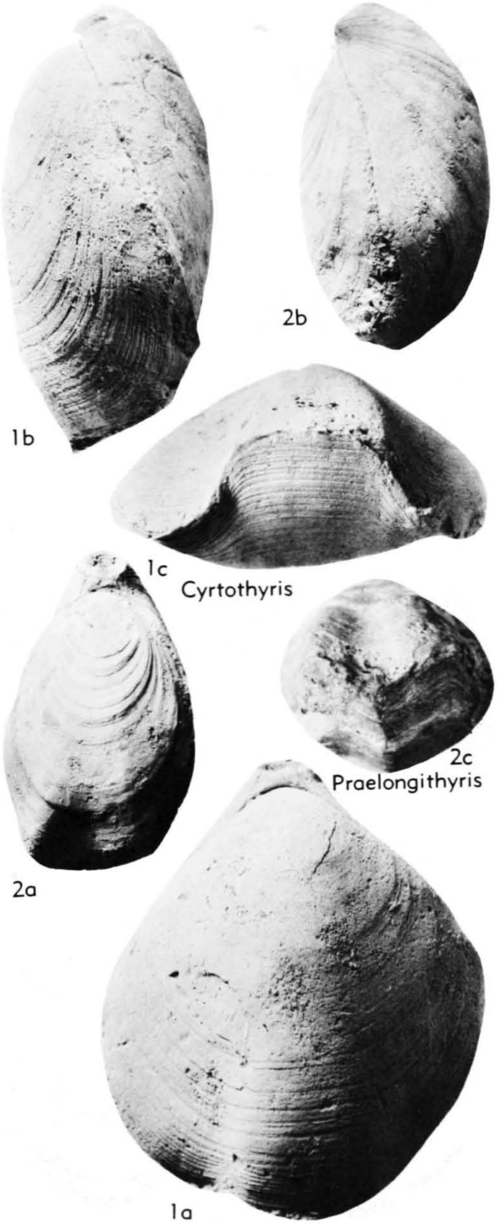


FIG. 662. Terebratulidae (Rectithyridinae) (p. *H*795-*H*796).

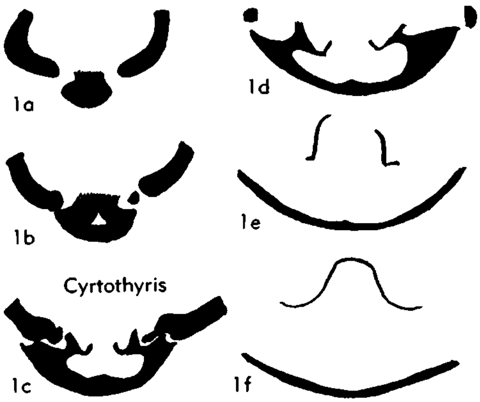


FIG. 663. Terebratulidae (Rectithyridinae) (p. *H*795-*H*796).

mesothyridid, symphytium narrow, exposed. Hinge plates in section dorsally deflected, ventrally concave, slightly clubbed, keeled. *L.Cret.(Apt.),* Eu. (Eng.-Ger.-Switz.).——FIG. 662,*1*. *C. uniplicata* (WALKER), *1a-c,* brach.v., lat., ant. views of holotype, ×1 (558).——FIG. 663,*1*. **C. cyrta* (WALKER), Eng.; *1a-f,* ser. transv. secs., ×1.5 (558).

Neoliothyrina SAHNI, 1925, p. 375 [**Terebratula obesa* DAVIDSON, 1852, p. 53 (*non* J. DE C. SOWERBY, 1823, p. 54=*N. obesa* SAHNI, 1925, p. 375); OD]. Large, anterior commissure plane to biplicate (episulcate); valves with prominent growth lines and rare capillae; umbo massive, short, foramen large, marginate, permesothyridid, symphytium narrow, commonly concealed. Hinge plates in section, well differentiated from socket ridges, asymmetrically developed in some specimens, dorsally deflected, U-shaped, keeled, rarely with slightly concave inner hinge plates. *U.Cret. (Senon.),* Eu.(Eng.).——FIG. 660,*3*; 664,*1,2*. **N. obesa* SAHNI; 660,*3a-c,* brach.v., lat., ant. views, ×1; 660,*3d,* loop, ×3; 664,*1a-k,* ser. transv. secs., ×1.5 (695); 664,*2,* transv. sec. showing inner hinge plate, ×1.5 (75).

Praelongithyris MIDDLEMISS, 1959, p. 134 [**P. praelongiforma* (=*Terebratula praelonga* AUCTT., *partim*); OD]. Medium-sized to large, valves elongate-oval with anterior margin truncate, anterior commissure rectimarginate, sulciplicate only at late stage; umbo massive, erect to suberect, foramen large, circular to slightly labiate, permesothyridid; hinge plates in section ventrally concave, becoming markedly V-shaped, clubbed, and anteriorly keeled. *L.Cret.(Apt.),* Eu.(Eng.-?Ger.).——FIG. 662,*2*. **P. praelongiforma,* Eng.; *2a-c,* holotype, brach.v., lat., ant. views, ×1 (558).

Rhombothyris MIDDLEMISS, 1959, p. 99 [**Terebratula extensa* MEYER, 1864, p. 252; OD]. Medium-sized, elongate-oval, anterior commissure rectimarginate to uniplicate, rarely biplicate; umbo

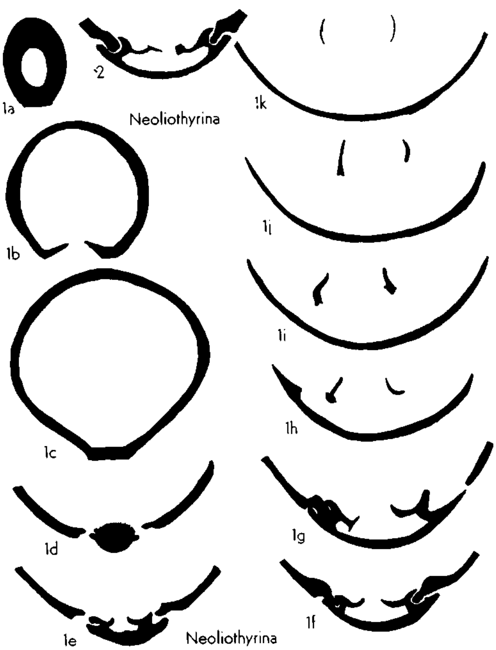


FIG. 664. Terebratulidae (Rectithyridinae) (p. *H*796).

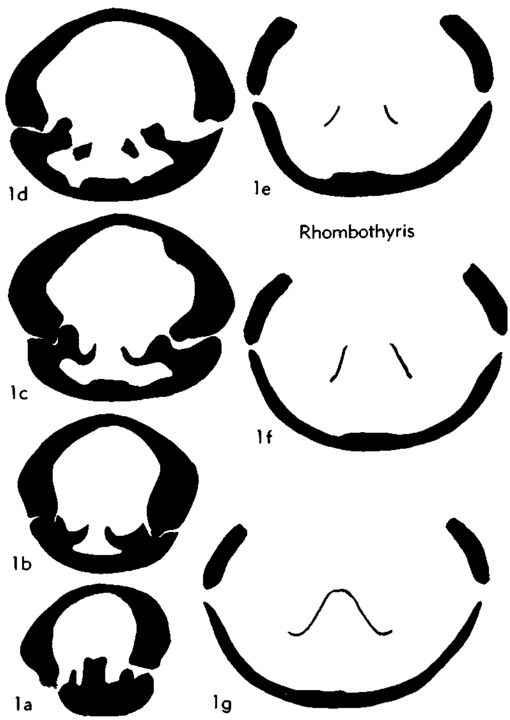


FIG. 665. Terebratulidae (Rectithyridinae) (p. *H*796-*H*797).

very short, suberect, truncated by circular or transversely oval foramen, mesothyridid. Cardinal process oval plate, prominent in some, hinge plates concave in section, clubbed, well differentiated from socket ridges. *L.Cret.(Apt.)*, Eu. (Eng.).——Fig. 660,*1*; 665,*1*. **R. extensa* (Meyer); 660,*1a-d*, brach.v., lat., ant., ped.v. views, ×1.5; 665,*1a-g*, ser. transv. secs., ×1.5 (558).

Subfamily GIBBITHYRIDINAE Muir-Wood, n.subfam.

Shell smooth or with prominent growth lamellae or rugae, and rare capillae. Teeth small, sockets narrow, concealed beneath fused socket ridges and hinge plates, cardinal process low, transversely oval plate; loop about 0.3 of valve length, given off dorsally. *U.Cret.(Cenoman.-Senon.)*.

Gibbithyris Sahni, 1925, p. 372 [**G. gibba*] [=*Kestonithyris* Sahni, 1925, p. 363 (type, *K. inflata*)]. Medium-sized, biconvex, anterior commissure plane to biplicate; umbo incurved, symphytium usually concealed, foramen minute, epithyridid, beak ridges strong; hinge plates in section ventrally convex or horizontal, with pendent dorsally directed crural bases. *U.Cret.(Cenoman.-Turon.-Senon.)*, Eu.——Fig. 666,*1a-e*. *G.*

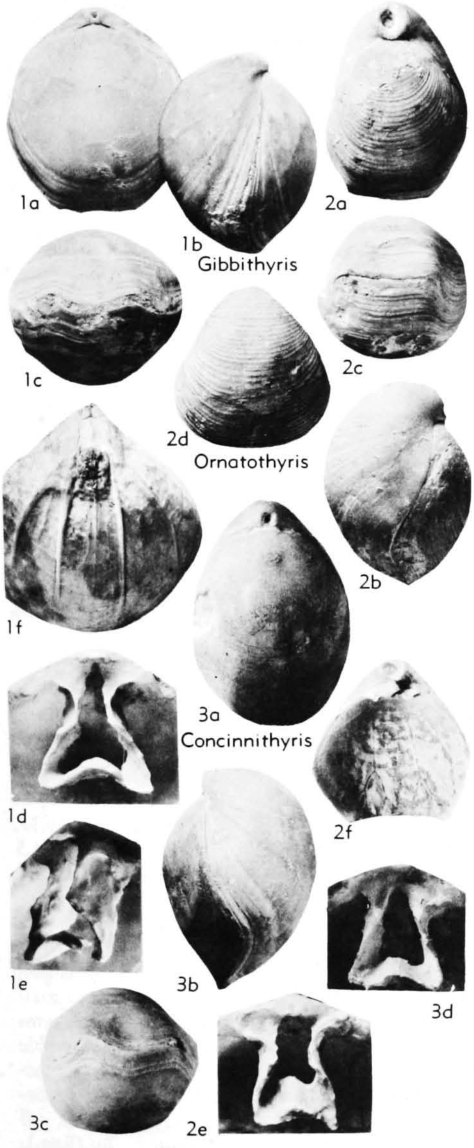


Fig. 666. Terebratulidae (Gibbithyridinae) (p. *H*797-*H*799).

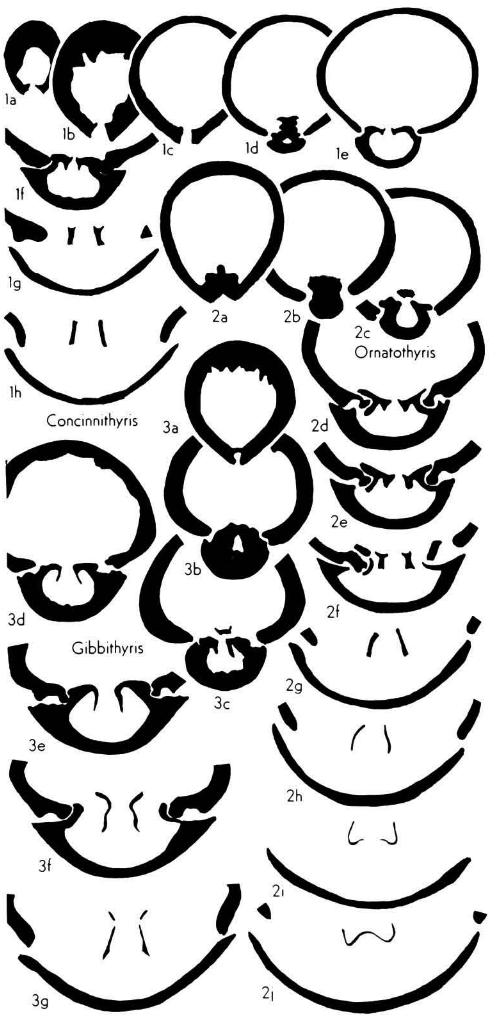


Fig. 667. Terebratulidae (Gibbithyridinae) (p. *H*797-*H*799).

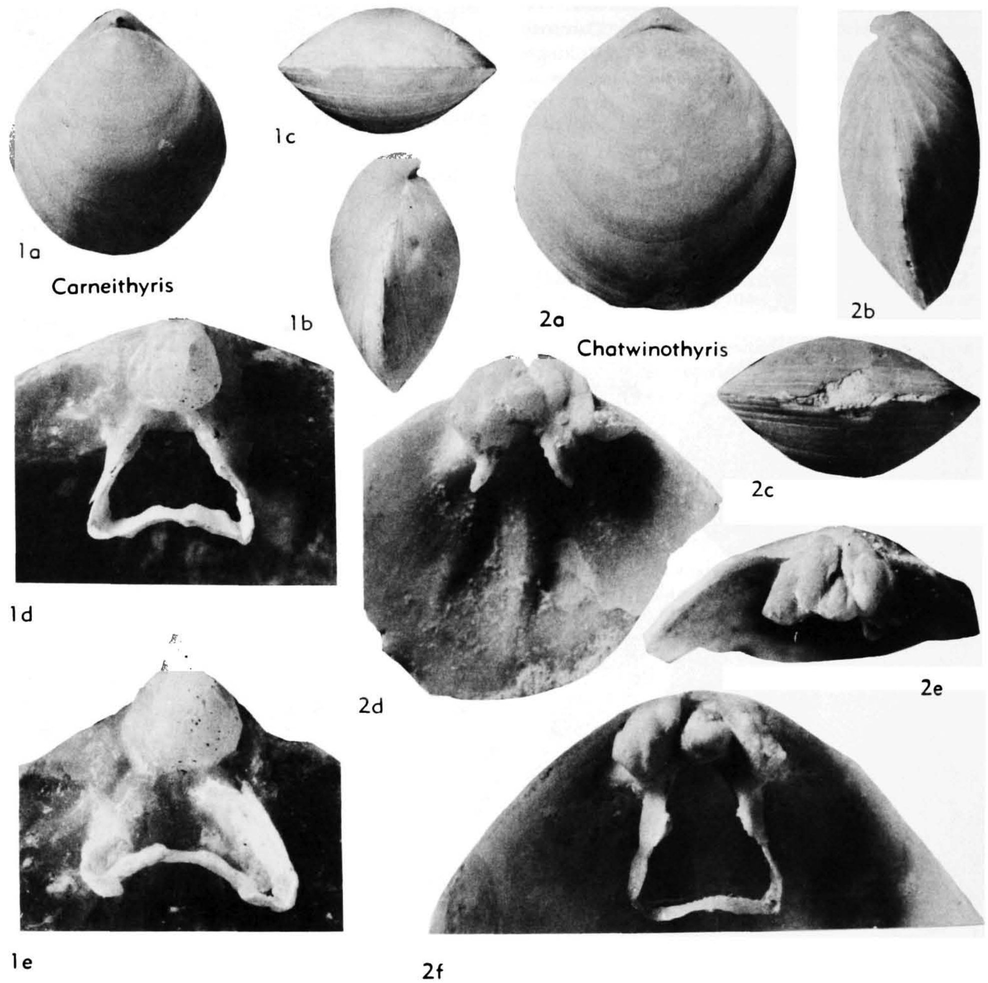


FIG. 668. Terebratulidae (Carneithyridinae) (p. H799).

semiglobosa (J. SOWERBY), Cenoman., Eng.; *1a-c,* brach.v., lat., ant. views of holotype, ×0.9; *1d,e,* loop and cardinalia, front and lat. views, ×1.8 (695).——FIG. 666,*1f*. *G. pyramidalis* SAHNI, Senon., Eng.; ped.v. flint cast with mantle canals, ×0.9 (695).——FIG. 667,*3*. *G. subrotunda* (J. SOWERBY), Turon., Eng.; *3a-g,* ser. transv. secs., ×1.5 (695).

Concinnithyris SAHNI, 1929, p. 11 [**Terebratula obesa* J. DE C. SOWERBY, 1823, p. 54]. Medium-sized, biconvex, anterior commissure plane to uniplicate or incipiently biplicate (sulciplicate); umbo much incurved, symphytium concealed, foramen usually large, epithyridid, beak ridges indistinct; crural bases given off dorsally, hinge plates in section ventrally convex, and dorsally deflected, keeled. *U.Cret.(Cenoman.-Turon.),* Eu. ——FIG. 666,*3a-c*. **C. obesa* (J. DE C. SOWERBY), Cenoman., Eng.; *3a-c,* brach.v., lat., ant. views of holotype, ×0.6 (697).——FIG. 666,*3d*; 667,*1*. *C. subundata* (J. SOWERBY), Turon., Eng.; 666,*3d,* loop, ×1.8; 667,*1a-h,* ser. transv. secs., ×1.5 (697).

Ornatothyris SAHNI, 1929, p. 45 [**Terebratula sulcifera* MORRIS, 1847, p. 254]. Small to medium-sized, plano-convex to biconvex, anterior commissure plane to uniplicate, rarely sulciplicate; ornament of transverse rugae and rare capillae; umbo massive, short, foramen large, circular to labiate, symphytium exposed, beak ridges obscure; mantle canals bifurcating anteriorly, hinge plates in section not demarcated from long socket ridges, dorsally deflected, keeled, crural bases given off dorsally. *U.Cret.(Cenoman-?Senon.),* Eu.(Eng.). ——FIG. 666,*2a-c*; 667,*2*. **O. sulcifera* (MORRIS), Cenoman., Eng.; 666,*2a-c,* brach.v., lat., ant. views of holotype, ×0.6; 667,*2a-j,* ser. transv. secs., ×1.5 (695).——FIG. 666,*2d-f. O. latissima* SAHNI, Cenoman., Eng.; *2d,* ped.v. view, ×0.6; *2e,* loop, ×1.8; *2f,* ped.v. int. with bifurcated mantle canal markings, ×0.6 (695).

Subfamily CARNEITHYRIDINAE Muir-Wood, n.subfam.

Smooth shells, broad, deep sockets, socket ridges, crural bases and hinge plates tending to fuse in more or less prominent ridge, cardinal process bulbous, lobate or reduced, loop one-third length of valve, given off ventrally. *U.Cret.(Senon.-Dan.).*

Carneithyris SAHNI, 1925, p. 364 [**C. subpentagonalis*; OD] [=*Ellipsothyris* SAHNI, 1925, p. 371 (type, *E. similis*); *Magnithyris* SAHNI, 1925, p. 367 (type, *M. magna*); *Ornithothyris* SAHNI, 1925, p. 374 (type, *O. carinata*); *Piarothyris* SAHNI, 1925, p. 370 (type, *P. rotunda*); *Pulchrithyris* SAHNI, 1925, p. 361 (type, *P. gracilis*)]. [These genera are considered to be variants of *Carneithyris* and not distinct genera.] Small to medium-sized, biconvex, anterior commissure rectimarginate to incipiently uniplicate; umbo incurved, foramen variable, commonly pinhole, beak ridges angular, mesothyridid to permesothyridid. Cardinal process large, bulbous, with 2 lateral knobs and median ridge, hinge plates in section inseparable from socket ridges, dorsally deflected, ventrally curved, thickened, crural bases given off ventrally. *U.Cret.(Senon.).*——FIG. 668,*1a-c*; 669,*1. C. carnea* (J. SOWERBY), Senon., 668,*1a-c,* brach. v., lat., ant. views, ×1; 669,*1a-l,* ser. transv. secs., ×1.5 (695).——FIG. 668,*1d,e. C. subovalis* SAHNI, Senon., Eng.; *1d,* card. process and loop, ×2; *1e,* ant. view of loop, ×2 (695).

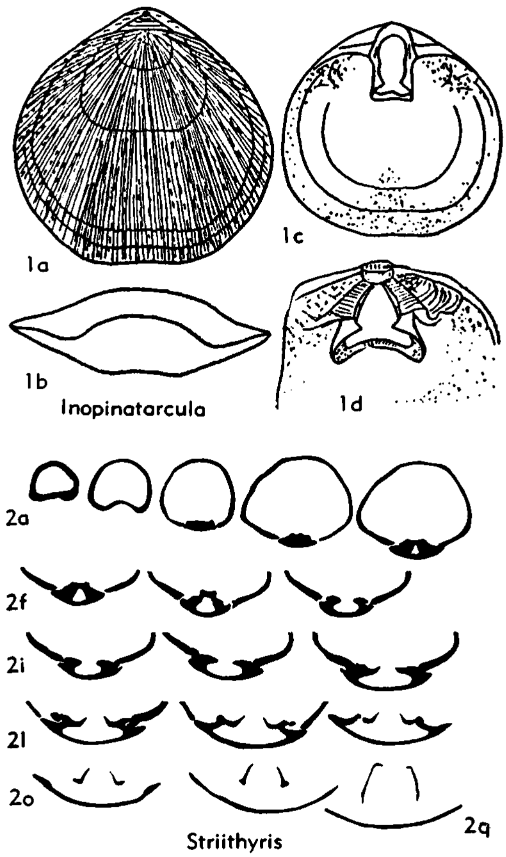


FIG. 670. Terebratulidae (Inopinatarculinae) *(1)*, (Subfamily Uncertain) *(2)* (p. *H*800).

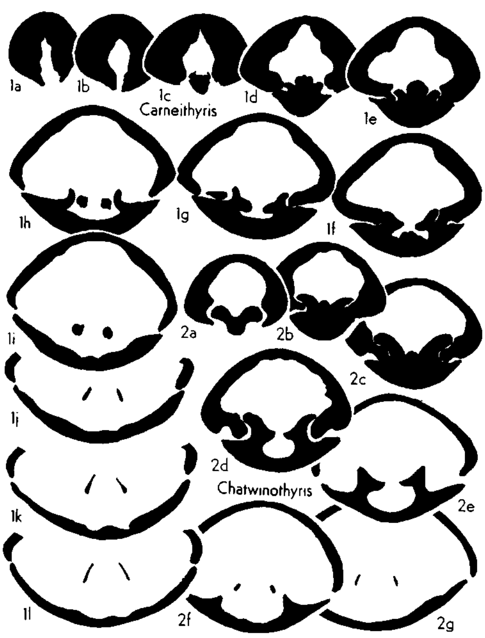


FIG. 669. Terebratulidae (Carneithyridinae) (p. *H*799).

Chatwinothyris SAHNI, 1925, p. 368 [**C. subcardinalis*; OD]. Externally like *Carneithyris,* but differs in having ill-defined beak ridges; socket ridges and hinge plates thickened, fused and forming prominent broad ridge with reduction in size of cardinal process; hinge plates and socket ridges in section ventrally convex, as in *Carneithyris,* but more thickened posteriorly and more deflected dorsally. *U.Cret.(Senon.-Dan.),* Eu.(Eng.-Denm.-Belg.-Ger.).——FIG. 668,*2a-e*; 669,*2. *C. subcardinalis,* Maastricht., Eng.; 668,*2a-c,* brach.v., lat., ant. views, ×1; 668,*2d,e,* brach.v. int. and post. view of thickened cardinalia, ×3; 669,*2a-g,* ser. transv. secs., ×1.5 (695).——FIG. 668,*2f. C. ciplyensis* SAHNI, Belg.; loop, ×3 (695).

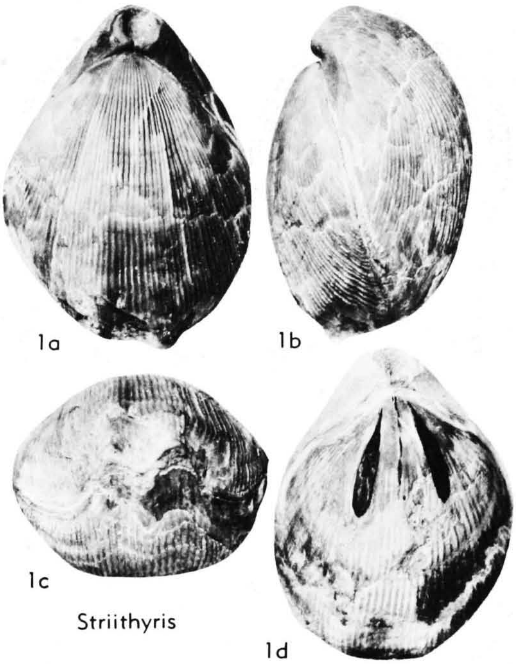


FIG. 671. Terebratulidae (Subfamily Uncertain) (p. H800).

Subfamily INOPINATARCULINAE Muir-Wood, n.subfam.

Capillate and spinose forms with short, wide, terebratulid loop; inner and outer socket ridges and cardinal process present, median septum and dental plates absent. *U.Cret.(Santon.).*

Inopinatarcula ELLIOTT, 1952, p. 2 [**Trigonosemus acanthodes* R. ETHERIDGE, JR., 1913, p. 15; OD]. Medium-sized, thick, valves biconvex, with median fold and sulcus, anterior commissure uniplicate; ornament of capillae bearing fine spines, growth lines few, prominent; umbo short, suberect, foramen minute, permesothyridid, symphytium triangular, transversely rugose; loop about 0.3 length of valve. *U.Cret.(Santon.),* W. Australia.——FIG. 670,*1*. **I. acanthodes* (R. ETHERIDGE); *1a,b,* brach.v., ant. views, ×2; *1c,d,* loop, young and adult, ×4, ×2.25 (281).

Subfamily UNCERTAIN

Striithyris MUIR-WOOD, 1935, p. 129 [**S. somaliensis*; OD]. Medium-sized, biconvex, biplicate anteriorly, anterior commissure rectimarginate to sulciplicate; umbo short, massive, suberect, beak ridges obscure, epithyridid, symphytium short, pedicle collar absent; whole shell finely costellate with numerous intercalations. Loop with broad ribbon and high-arched transverse band; cardinal process low, medianly depressed, with posterior umbonal cavity; hinge plates in section mallet-like, becoming ventrally concave, tapering, not well demarcated from inner socket ridges; adductor scars narrow spatulate, diverging. *U.Jur.(Oxford.),* Afr.(Somaliland).——FIG. 670,*2*; 671, *1*. **S. somaliensis*; 671,*1a-c,* brach.v., lat., ant. views, ×1.3; 671,*1d,* adductor scars, ×1.3; 670, *2a-q,* ser. transv. secs., ×1.25 (577).

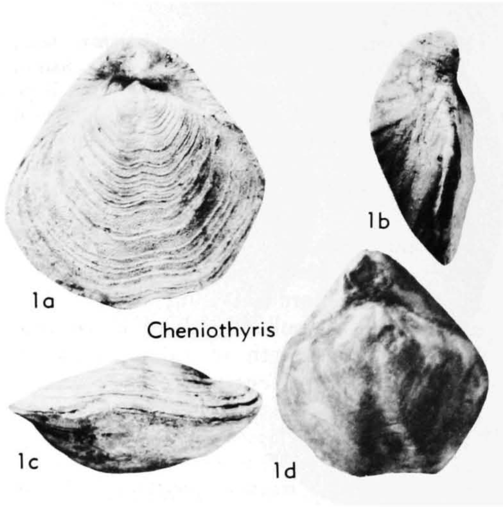


FIG. 672. Cheniothyrididae (p. H800-H801).

Family CHENIOTHYRIDIDAE Muir-Wood, n. fam.

Short-looped forms without dental plates or dorsal septum; shell folding ligate to bilobate, each valve with median furrow, ornament of steplike squamose lamellae with numerous papillae. *M.Jur.(U. Inferior Oolite).*

Cheniothyris S. S. BUCKMAN, 1918, p. 128 [**Terebratula morierei* E. EUDES-DESLONGCHAMPS in DAVIDSON, 1852, p. 256; OD] [=*Cheniothyris* BUCKMAN, 1915, p. 79 *(nom. nud.)*]. Small, subpentagonal to elongate, coarsely punctate, valves moderately biconvex, anterior commissure rectimarginate; umbo incurved, foramen large, beak

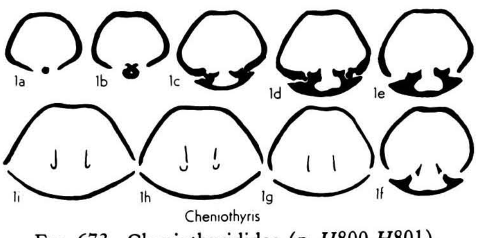


FIG. 673. Cheniothyrididae (p. H800-H801).

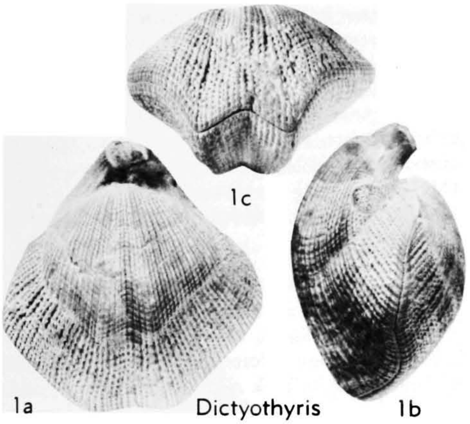


FIG. 674. Dictyothyrididae (p. *H*801).

ridges angular, permesothyridid, symphytium high. Loop about 0.3 length of valve; cardinal process low, short, hinge plates in section thick, squat, somewhat trigonal, ventrally directed and concave. *M.Jur.(U. Inferior Ooolite)*, Eu.(Eng.-Fr.).——FIG. 672,*1*; 673,*1*. **C. morierei* (EUDES-DESLONGCHAMPS), 672,*1a-c*, brach.v. lat., ant. views, ×2.7; 672,*1d*, Eng.(Dorset.); brach.v. int. mold, ×2.7; 673, *1a-i*, ser. transv. secs., ×1.4 (230).

Family DICTYOTHYRIDIDAE Muir-Wood, n. fam.

Short looped forms without median septum or dental plates, shell folding pliciligate, with deep ventral sulcus bounded by strong folds, and low dorsal median fold bounded by shallow furrows; ornament longitudinal and transverse, reticulate, with low nodes or spinules at point of intersection. *M. Jur. (Bathon.) - U. Jur. (Oxford.-?Kimmeridg.)*.

Dictyothyris DOUVILLÉ, 1879, p. 267 [**Terebratulites coarctatus* PARKINSON, 1811, p. 229; OD]. Small to medium-sized, anterior commissure W-shaped; umbo short, becoming incurved, foramen large, permesothyridid, symphytium exposed in some shells. Cardinal process prominent, bilobed, medianly flattened; with posterior umbonal cavity; hinge plates in section scarcely demarcated from socket ridges, slightly convex ventrally, horizontal or slightly deflected dorsally, crural bases given off dorsally; adductor scars large, pear-shaped; *M. Jur. (Bathon.)-U. Jur. (Oxford.-?Kimmeridg.)*, Eu.——FIG. 674,*1*; 675,*1*. **D. coarctata* (PARKINSON), Bathon.(Bradford Cl.), Eng.; 674, *1a-c*, brach.v., lat., ant. views, ×1.8; 675, *1a-h*, ser. transv. secs., ×1.5 (263).

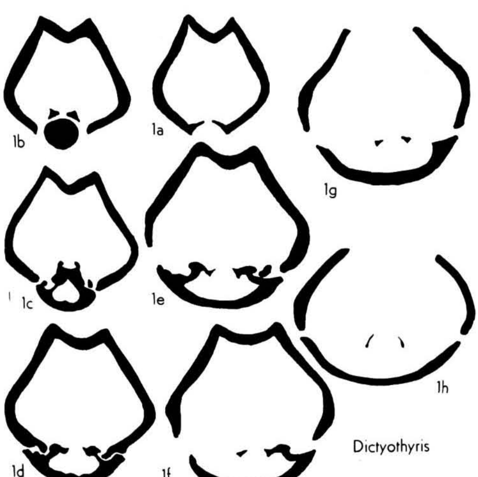


FIG. 675. Dictyothyrididae (p. *H*801).

Family TEGULITHYRIDIDAE Muir-Wood, n.fam.

Shell folding ligate to pliciligate, with sulcus in each valve and additional dorsal median fold, antiplicate anterior commissure, shell surface smooth or capillate, with prominent growth lamellae. *U.Jur.(Callov.)*.

Tegulithyris S. S. BUCKMAN, 1918, p. 123 [**Terebratula bentleyi* DAVIDSON, 1851, p. 58; OD] [=*Tegulithyris* BUCKMAN, 1915, p. 78 *(nom. nud.)*]. Medium-sized, biconvex to sulco-convex, becoming sulcosulcate to pliciligate, dorsal sulcus becoming median fold, and angular folds separating deep ventral sulcus from concave flanks, anterior commissure antiplicate; umbo massive, foramen large, beak ridges long, angular, permesothyridid, symphytium well exposed; shell smooth or rarely capillate, with prominent growth lines. Loop with high-arched, medianly horizontal transverse band; cardinal process short, massive, trilobed; hinge plates in section short, keeled, nearly horizontal. *U.Jur.(Callov.)*, Eu.(Eng.-Fr.-Ger.).——FIG. 676,*1*; 677,*1*. **T. bentleyi* (DAVIDSON), *U.Cornbrash*, Eng.(Bedfordsh.); 676,*1a-c*, brach. v., lat., ant., views, ×1.2; 677,*1a-i*, ser. transv. secs., ×1.5 (136).

Family PYGOPIDAE Muir-Wood, n. fam.

Valves smooth, medium-sized to large, convex, with dorsal median sulcus and ventral fold posteriorly, usually developing as 2 lateral lobes separate in young, but in contact and fusing in adult and enclosing median perforation, anterior commissure plane, lateral commissure vertical or sig-

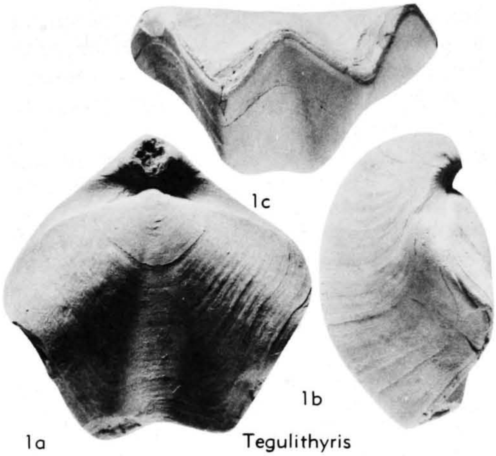


FIG. 676. Tegulithyrididae (p. H801).

moid. Loop very short, with low arched transverse band; no median septum or dental plates; mantle canal markings well defined, with several bifurcations. *?L.Jur.(Lias.), M.Jur.-L.Cret.(Neocom.).*

Pygope LINK, 1830, p. 451 [**Terebratula antinomia* CATULLO, 1827, p. 169 (pl. 5, fig. r) (=*T. deltoidea* VALENCIENNES in LAMARCK, 1819, p. 250); SD BUCKMAN, 1906, p. 445]. Shell rounded-trigonal in outline, lateral commissure almost vertical, perforation central, or valves imperforate. *U. Jur.(Kimmeridg.)-L. Cret.(Neocom.),* Eu.(Fr.-Switz.).——FIG. 678,*1*. **P. deltoidea* (VALENCIENNES), L.Tithon., Fr.; *1a,b,* brach.v., lat. views, ×0.6; *1c,* ped.v. view showing imperfectly fused lobes, ×0.6 (128).

Antinomia CATULLO, 1851, p. 74 [**Terebratula dilatata* CATULLO, 1851, p. 75; SD BUCKMAN, 1906, p. 435]. Differs from *Pygope* in its smaller and more posteriorly placed perforation, sigmoid lateral commissure, and lateral flattening of valves. *U. Jur. (Portland.)-L. Cret. (Neocom.),* Eu.-Arctic.——FIG. 678,*3*; 679,*3a,b*. *A. catulloi* (PICTET), Portland., Italy(Tyrol); 678,*3*, ant. view, ×1.25; 679,*3a,b,* brach.v. int. mold showing mantle canal markings and post. median perforation, lat. view showing commissure, ×1 (642).——FIG. 679,*3c*. *A.* sp., Portland., Italy; long. sec. showing tube lining perforation, ×1 (642).

Linguithyris S. S. BUCKMAN, 1918, p. 99 [**Terebratula bifida* ROTHPLETZ, 1886, p. 114] [=*Linguithyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Small, cordate, posteriorly biconvex, becoming sulco-convex, anterior commissure deeply sulcate medianly, lateral commissure slightly curved; umbo incurved, beak ridges angular, epithyridid, symphytium narrow. Loop about 0.25 of valve length, slightly arched, rounded, transverse band; cardinal process low, short, lobate; hinge plates in transverse section short, slightly concave ventrally, tapering, well demarcated from inner socket ridges; adductor scars short, divergent. *M. Jur. (Bajoc.),* Eu. (Eng.-Ger.-Aus.-Italy). FIG. 679,*4a-c;* 680,*3*. *L. umbonata* BUCKMAN, M. Inferior Oolite, Eng.; 679,*4a-c,* brach.v., lat., ant. views, ×2; 680,*3a-i,* ser. transv. secs., ×1.3 (Muir-Wood, n).——FIG. 679,*4d*. **L. bifida* (ROTHPLETZ), M. Inferior Oolite, Eng.(Dorset); loop, ×1 (136).

Nucleata QUENSTEDT, 1868, p. 25 [**N. collina* (=*Terebratulites nucleata* VON SCHLOTHEIM, 1820, p. 281); OD] [=*Glossothyris* DOUVILLÉ, 1879, p. 267 (obj.)]. Small, valves concavo-convex, anterior commissure sulcate; umbo short, truncated by large foramen, beak ridges obscure, epithyridid, no symphytium. Loop very short, rounded, transverse band not demarcated; cardinal process absent or very short; hinge plates in transverse section hardly demarcated from long inner socket ridges, slightly concave ventrally; adductor scars short, curved, converging. *U.Jur.(Kimmeridg.-Portland.),* C.Eu.-S.Eu.——FIG. 679,*1*; 680,*1*. **N. nucleata* (SCHLOTHEIM), U. Jur. (gamma), Ger. (Bavaria); 679,*1a-c,* brach.v., ped.v. with loop exposed, ant., views, ×2; 679,*1d,* int. mold showing dorsal adductor scars, ×4; 680,*1a-g,* ser. transv. secs., ×1.3 (136).

Pygites S. S. BUCKMAN, 1906, p. 449 [**Terebratula diphyoides* D'ORBIGNY, 1849, p. 87; OD]. Resembling *Pygope* but pedicle valve posteriorly with sulcus in median fold, brachial valve with median fold in sulcus, large central perforation in adult. Cardinal process low; posterior umbonal cavity developed; hinge plates in section dorsally deflected, slightly concave ventrally, tapering, not well demarcated from long inner socket ridges. *L. Cret. (L. Neocom.),* Eu. (Fr.-Switz.)-N. Afr.-

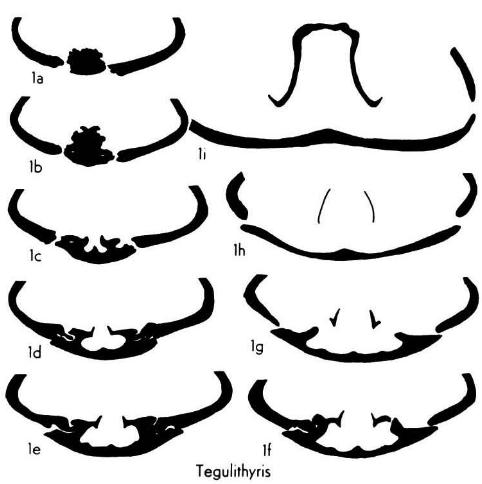


FIG. 677. Tegulithyrididae (p. H801).

Arctic.——Fig. 678,2; 679,2; 680,2. **P. diphyoides* (d'Orbigny), Berrias., Fr.(Ardèche); 678,*2a-d*, brach.v., lat., ant., ped.v. views, showing large median perforation, sulcus in ventral fold, and fold in dorsal sulcus, ×1.25; 678,*2e,f*, ped.v. and brach.v. int. showing short loop, ×1.25; 679,*2a*, ped.v. int. mold showing mantle canal markings, ×1; 679,*2b*, immature shell, ped.v. view, ×1; 679, *2c*, long. sec. showing tube lining perforation, ×1; 680,*2a-i*, ser. transv. secs., ×1.3 (642).

Family DYSCOLIIDAE Fischer & Oehlert, 1891

[Dyscoliidae Fischer & Oehlert, 1891, p. 23]

Brachial loop very short, with inconspicuous crural processes and ventrally convex transverse band; valves biconvex, with incurved lateral and anterior margin or flange in each valve; shell surface smooth or capillate; lophophore in Recent genus a short

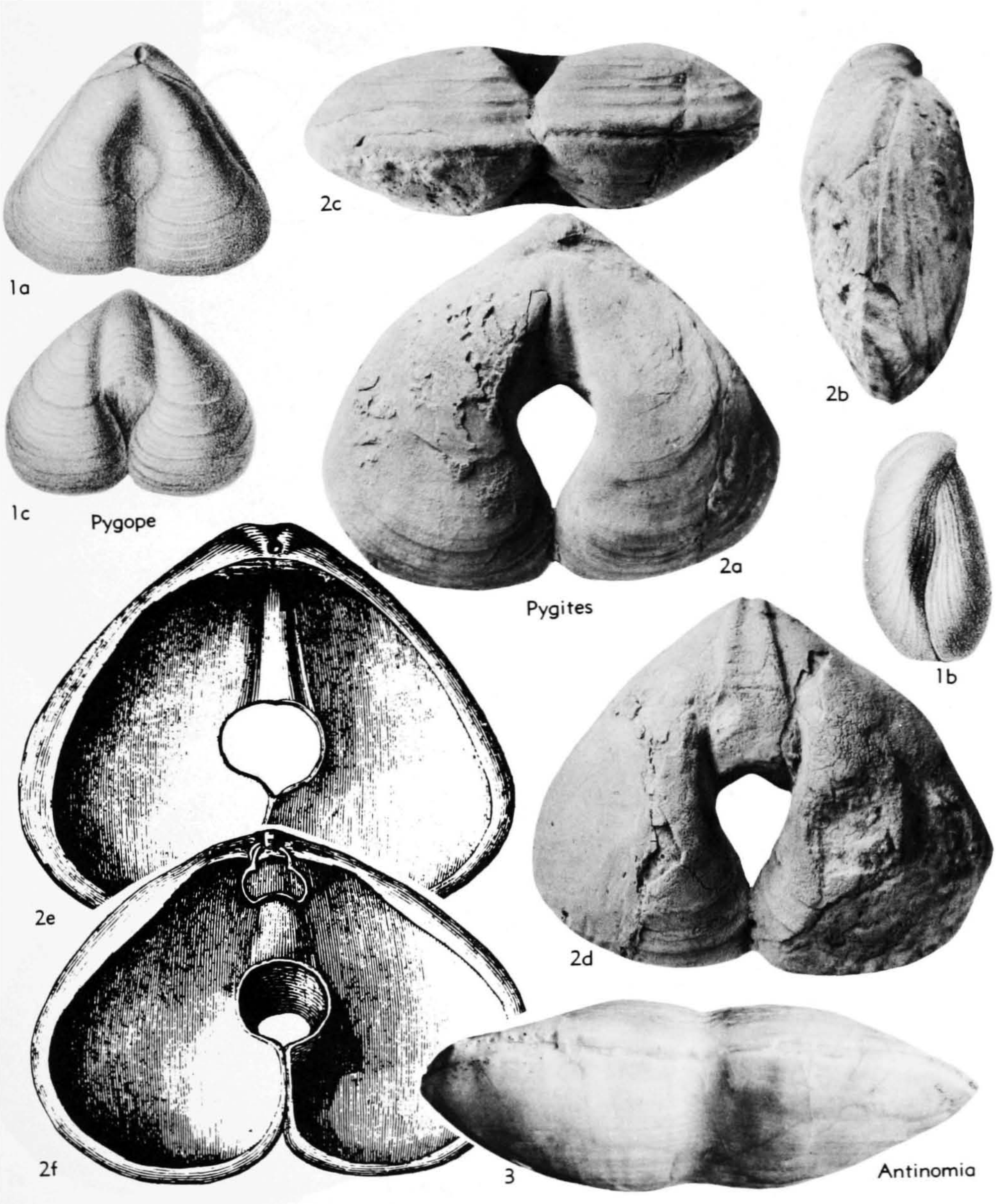


Fig. 678. Pygopidae (p. *H*802-*H*803).

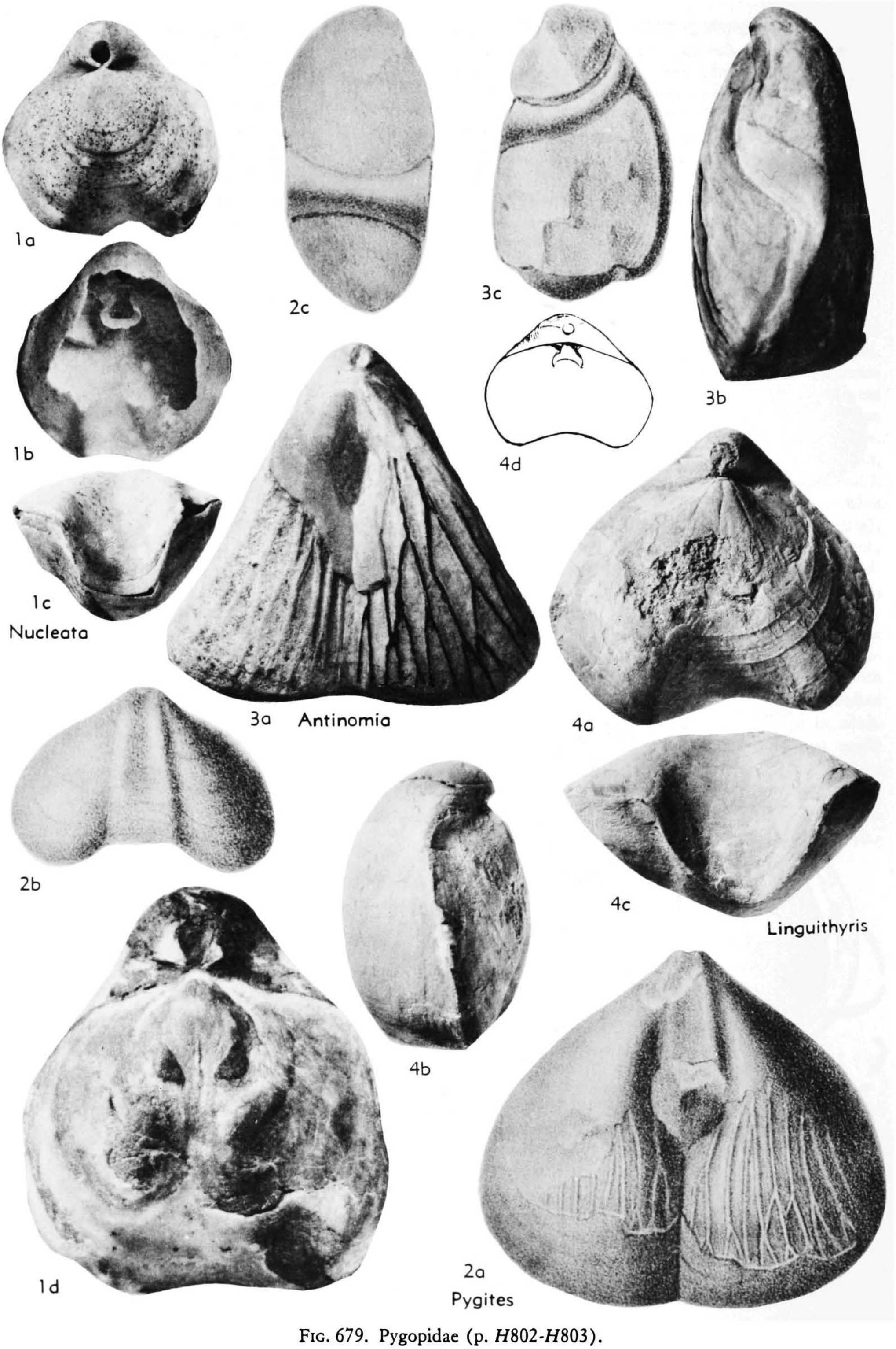


FIG. 679. Pygopidae (p. H802-H803).

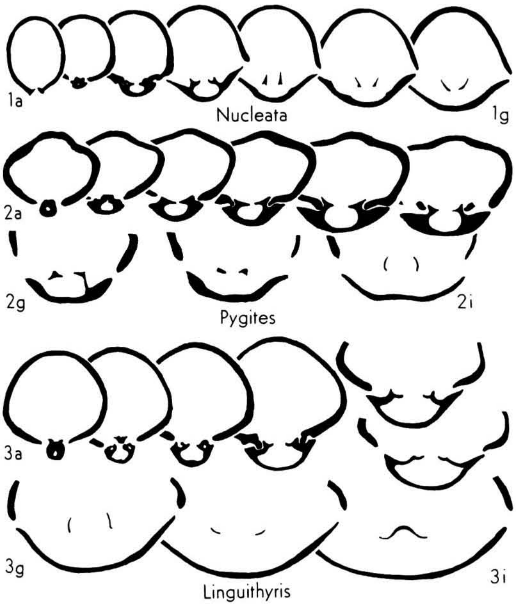


FIG. 680. Pygopidae (p. *H*802-*H*803).

subrectangular disc, concave ventrally, with long centrifugal filaments, spicules abundantly developed. *?U.Jur., U.Cret.(Cenoman.)-Rec.*

Dyscolia FISCHER & OEHLERT, 1890, p. 70 [**Terebratulina wyvillei* DAVIDSON, 1878, p. 436; OD]. Shell thickened, medium-sized to large, subtrigonal; anterior commissure plane to incipiently biplicate; surface smooth or capillate, growth lines prominent; umbo short, foramen nearly apical, epithyridid, symphytium almost concealed; pedicle collar present. Four main mantle canals in each valve, much branched; cardinal process small, transverse, myophragm rarely present; hinge plates divided, narrow. *Plio.*, Eu.(Italy); *Rec.*, Ind. O.-E.Atl.O.(off Afr.-Spain)-Carib.——FIG. 681,*1*; 682,*3a*. **D. wyvillei* (DAVIDSON), Rec., Carib.; 681, *1a-c,* brach.v., lat., ant. views of holotype, ×1; 681,*1d,* same, valves separated showing imperfect loop and mantle canals, ×1; 681,*1e,* brach.v. int. with loop post., ×1; 682,*3a,* brach.v. int. with lophophore, ×1 (642).——FIG. 682,*3b*. *D. johannisdavisi* (ALCOCK), Rec., Ind.O.; brach.v. int. with loop, ×1 (299).

Moraviaturia SAHNI, 1960, p. 19 [**Terebratula*

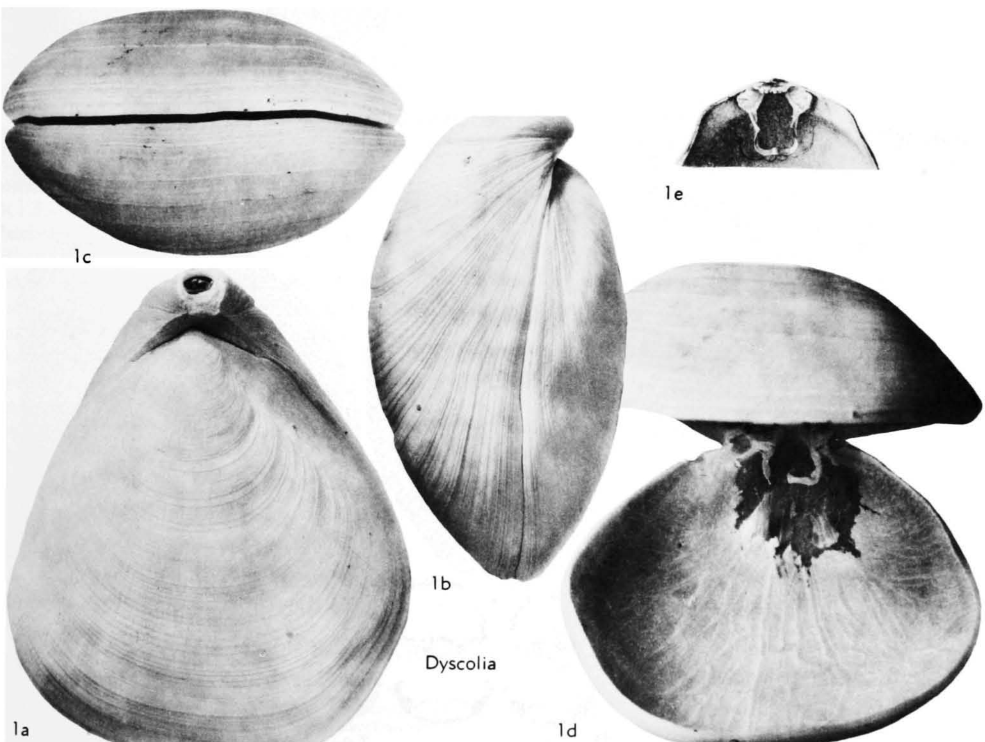


FIG. 681. Dyscoliidae (p. *H*805).

diphimorpha STOLICZKA, 1872, p. 25; OD]. Shell solid, medium-sized, subtrigonal, biconvex, with anterior sulcation in brachial valve; anterior commissure plane, with incurved lateral and anterior margin or flange in each valve; surface capillate, with prominent, steplike, growth lamellae; umbo massive, slightly incurved, symphytium narrow, foramen large, beak ridges obscure. Internal characters unknown, probably dyscoliid. *U.Cret.* *(Cenoman.),* Asia(S.India).——FIG. 682,*1*. **M. diphimorpha* (STOLICZKA); *1a-d,* brach.v., lat., ped.v., ant. views of holotype, ×1 (784).

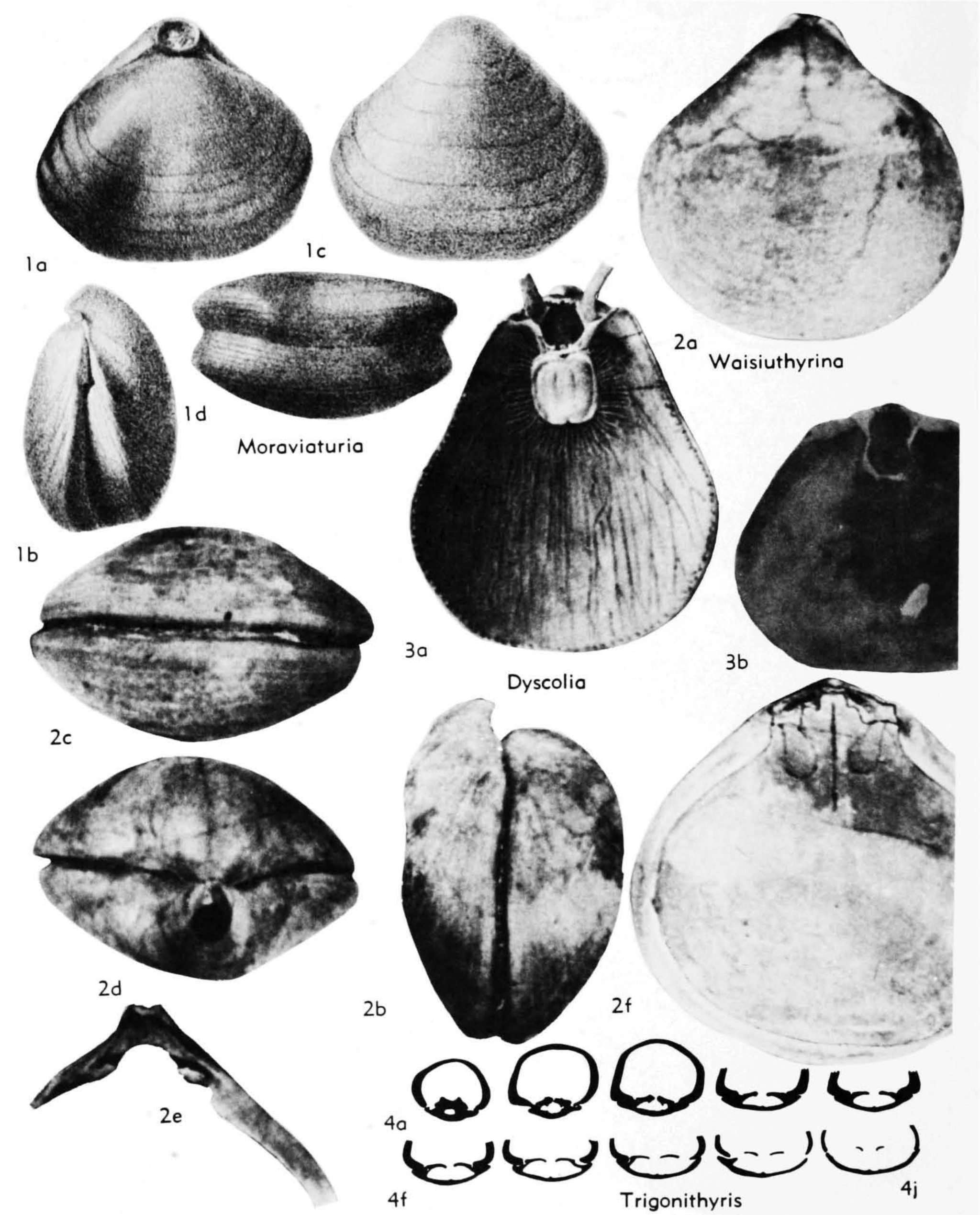


FIG. 682. Dyscoliidae (p. H805-H807).

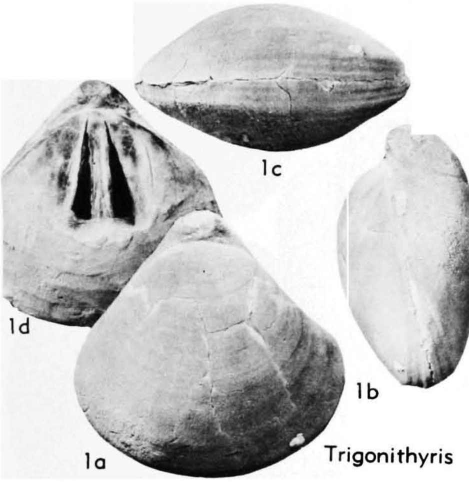


FIG. 683. Dyscoliidae (p. H806-H807).

?Trigonithyris MUIR-WOOD, 1935, p. 131 [**T. eruduwensis*; OD]. Medium-sized, trigonal, biconvex, anterior commissure plane; umbo short, suberect, epithyridid, symphytium short, shell surface smooth, pedicle collar absent. Loop very short, 0.2 length of valve, ribbon narrow, crural bases given off dorsally; cardinal process broad, medianly depressed; with posterior umbonal cavity; hinge plates in transverse section horizontal, becoming very slightly convex ventrally, not differentiated from inner socket ridges; adductor muscle scars subparallel, narrow; teeth crenulated. *U.Jur. (?Oxford.)*, Afr.(Brit. Somaliland).——FIG. 682, *4*; 683,*1*. **T. eruduwensis*; 682,*4a-j*, ser. transv. secs., ×1.25; 683,*1a-c*, brach.v., lat., ant. views, ×1.3; 683,*1d*, dors. adductor scars, ×1.3 (577).

Waisiuthyrina BEETS, 1943, p. 341 [**W. margineplicata*; OD]. Shell thick, medium-sized to large, valves biconvex, with anterior and lateral flanges, subcircular; anterior commissure almost plane; surface smooth except for growth lines; umbo short, erect, foramen mesothyridid or epithyridid, symphytium narrow, pedicle collar absent. Loop unknown, probably dyscoliid; cardinal process transverse, bilobed, myophragm low; hinge teeth small, grooved and articulating with socket ridges; dorsal adductor scars, broad, spatulate, posteriorly placed. *U. Oligo. (?=Mio. - Plio.)*, Asia (E. Ind. - Celebes).——FIG. 682,*2*. **W. margineplicata*, Celebes; *2a-d*, brach.v., lat., ant., post. views of holotype; *2e,f*, ped.v. int., brach.v. int. showing flanges and adductor scars, all ×1 (291).

Family CANCELLOTHYRIDIDAE Thomson, 1926

[*nom. correct.* MUIR-WOOD, herein (*pro* Cancellothyridae, *nom. transl.* MUIR-WOOD, 1955, p. 93 (*ex* Cancellothyrinae THOMSON, 1926, p. 525))]

Valves capillate, brachial loop short, crural processes may unite to form ringlike loop, crural bases attached to socket ridges; hinge plates and median septum only exceptionally developed; adult lophophore spirolophous, plectolophous, or subplectolophous. *?L.Jur.-?M.Jur., U.Jur.-Rec.*

Subfamily CANCELLOTHYRIDINAE Thomson, 1926

[*nom. correct.* MUIR-WOOD, herein (*pro* Cancellothyrinae THOMSON, 1926, p. 525)] [=Terebratulinae DALL, 1870, p. 99 (*partim*)]

Valves biconvex, anterior commissure plane to incipiently sulciplicate; crural processes fused in adult forming complete ringlike loop; foramen hypothyridid, mesothyridid, or epithyridid; lophophore plectolophous. *U.Jur.-Rec.*

Cancellothyris THOMSON, 1926, p. 525 [**Terebratulina hedleyi* FINLAY, 1927 (March), p. 533 (=*Cancellothyris australis* THOMSON, 1927, p. 188), both *nom. subst. pro* **Terebratulina cancellata* KOCH in KÜSTER, 1844, p. 35; (*non* EICHWALD, 1829, p. 276); OD]. Small to medium-sized, ovate to subpentagonal, valves biconvex; anterior commissure uniplicate to sulciplicate; hinge margin terebratulid; surface finely capillate, growth lamellae prominent; umbo short, massive,

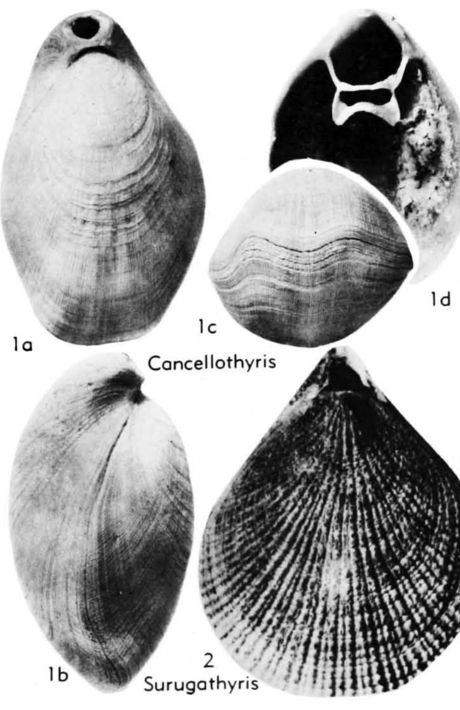


FIG. 684. Cancellothyrididae (Cancellothyridinae) (p. H807-H809).

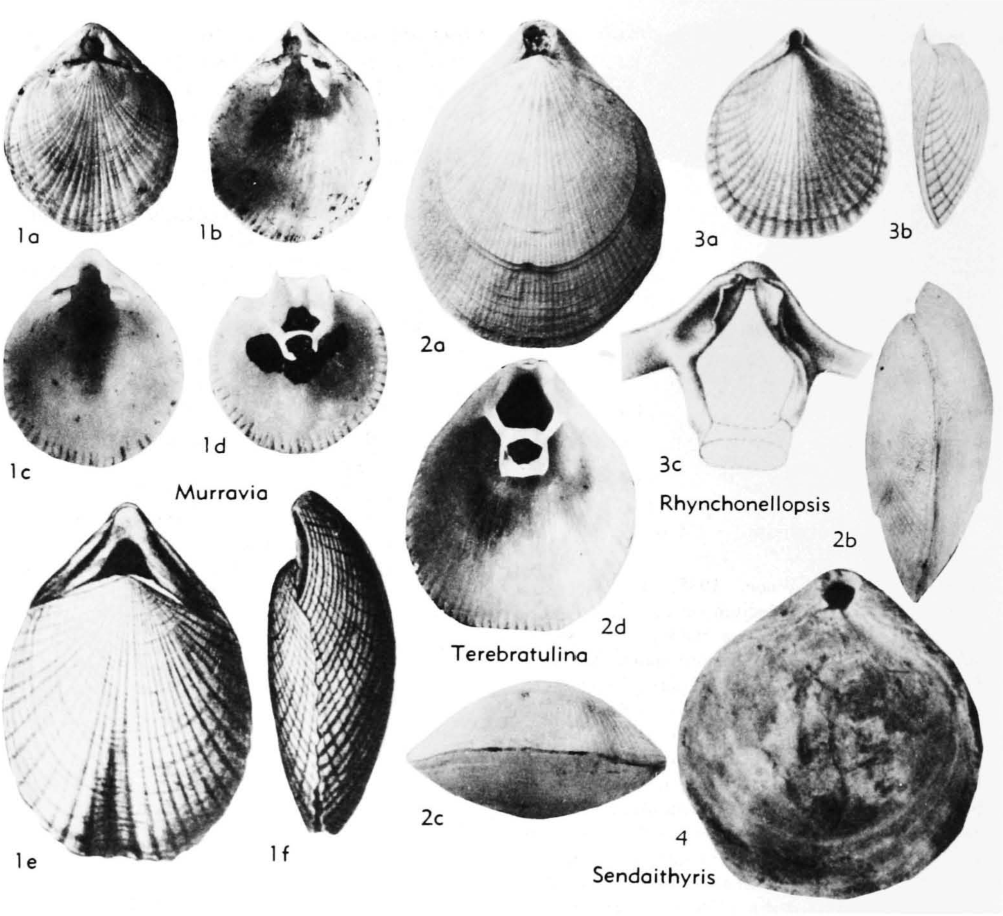


FIG. 685. Cancellothyrididae (Cancellothyridinae) (p. H808-H810).

suberect, foramen large, entire, epithyridid, labiate, symphytium narrow, pedicle collar developed. Loop terebratulinid, transverse band broad, slightly arched ventrally, cardinal process low, bilobed; hinge plates extending posteriorly beyond hinge margin; lophophore plectolophous, median coil long. *Mio.*, N.Z.; *Rec.*, off Australia.——FIG. 684, *1.* **C. hedleyi* (FINLAY), *Rec.*, S.Australia; *1a-c,* brach.v., lat., ant. views, ×1.2; *1d,* brach.v. int. with loop, ×1.2 (810).

Murravia THOMSON, 1916, p. 45 [**Terebratulina catinuliformis* TATE, 1896, p. 130 (footnote), *nom. subst. pro* **Terebratulina davidsoni* ETHERIDGE, 1876, p. 16 (*non* BOLL, 1856, p. 37)]. Shell small, thick, ovate, with wide hinge line, pedicle valve slightly convex, brachial valve almost flat, rarely with shallow anterior sulcus; anterior commissure rectimarginate or incipiently sulcate; surface capillate, crossed by numerous growth lines; umbo slightly produced, deltidial plates disjunct, pedicle collar present, foramen below apex of umbo, hypothyridid. Adult loop annular, terebratulinid; hinge plates narrow, myophragm may be present; cardinal process prominent elongate boss, socket ridges prominent; hinge teeth massive, with sulcus along their inner margin, internal margin of both valves crenulated. *Mio.*, S. Australia-Tasm.-N.Z.; *Rec.*, S. Australia.——FIG. 685,*1a-d.* **M. catinuliformis* (TATE), Mio., Australia (Victoria); *1a-d,* brach.v. view, ped.v. int. with ped. collar, ped.v. int. with hinge teeth, brach.v. int. with loop and septum, ×3 (810). ——FIG. 685,*1e,f. M. exarata* (VERCO), Rec., S. Australia; *1e,f,* brach.v., lat. (holotype), ×6 (810).

Rhynchonellopsis VINCENT, 1893, p. 50 [**Terebratulina nysti* BOSQUET, 1862, p. 349; OD (M)] [*non Rhynchonellopsis* BÖSE, 1894; *nec* DE GREGORIO, 1930]. Small, thick-shelled, rounded, brachial valve highly convex, pedicle valve flat or slightly convex with median sulcus anteriorly; anterior commissure slightly waved dorsally; surface capillate, capillae bifurcating, enlarged by intersecting growth lines; umbo small, short, suberect, beak ridges obscure, foramen incomplete, deltidial plates disjunct. Hinge plates absent, socket ridges

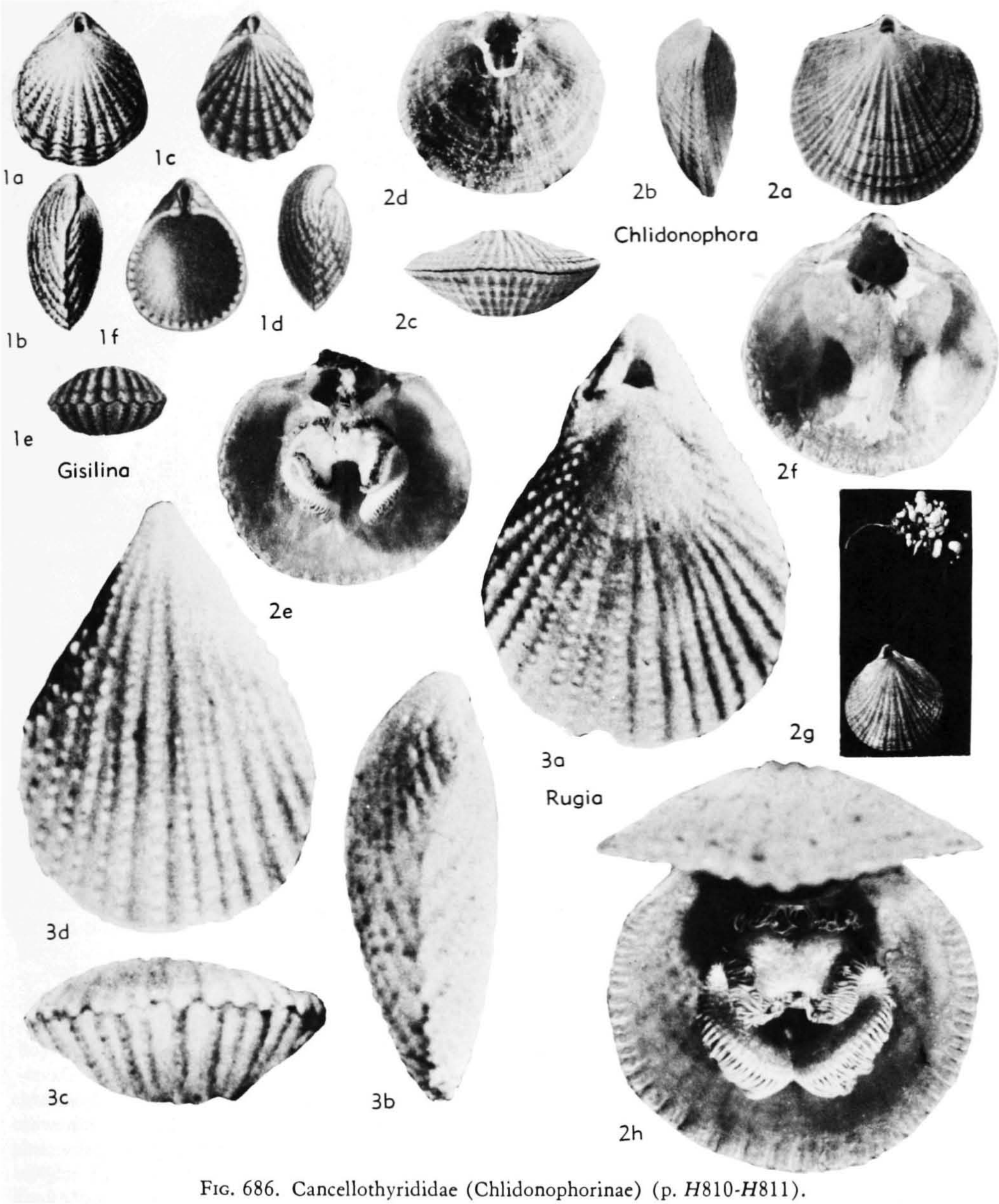


FIG. 686. Cancellothyrididae (Chlidonophorinae) (p. *H*810-*H*811).

prominent and united with crural bases, crura converging, loop probably terebratulinid; inner shell margin crenulated. *L.Oligo.*, Eu.(Belg.-Neth.-Ger.-USSR).——FIG. 685,*3*. **R. nysti* (BOSQUET), Belg.; *3a,b*, brach.v., lat. views, ×3; *3c*, brach.v. int. with loop (restored), ×9 (844).

Sendaithyris HATAI, 1940, p. 253 [**S. otutumiensis*; OD]. Medium-sized, circular, valves almost equally convex; surface smooth. Interior imperfectly known, cardinalia and loop said to be as in *Terebratulina*, but having short bifurcated septum in brachial valve. *Mio.*, Japan.——FIG. 685,*4*. **S. otutumiensis*, Rikuzen; brach.v. view, ×1 (399).

Surugathyris YABE & HATAI, 1934, p. 587 [**S. (Terebratulina) suragaensis*; OD]. Imperfectly known, may be immature form of some species of *Terebratulina*. *Rec.*, Japan.——FIG. 684,*2*. **S. surugaensis*; brach.v. view, ×2.4 (399).

Terebratulina D'ORBIGNY, 1847, p. 249 [**Anomia caputserpentis* LINNÉ, 1767, p. 1153 (*non* LINNÉ, 1758, p. 703) =**A. retusa* LINNÉ, 1758, p. 701; OD]. Small to large, ovate to subpentagonal, slightly auriculate, valves biconvex; anterior commis-

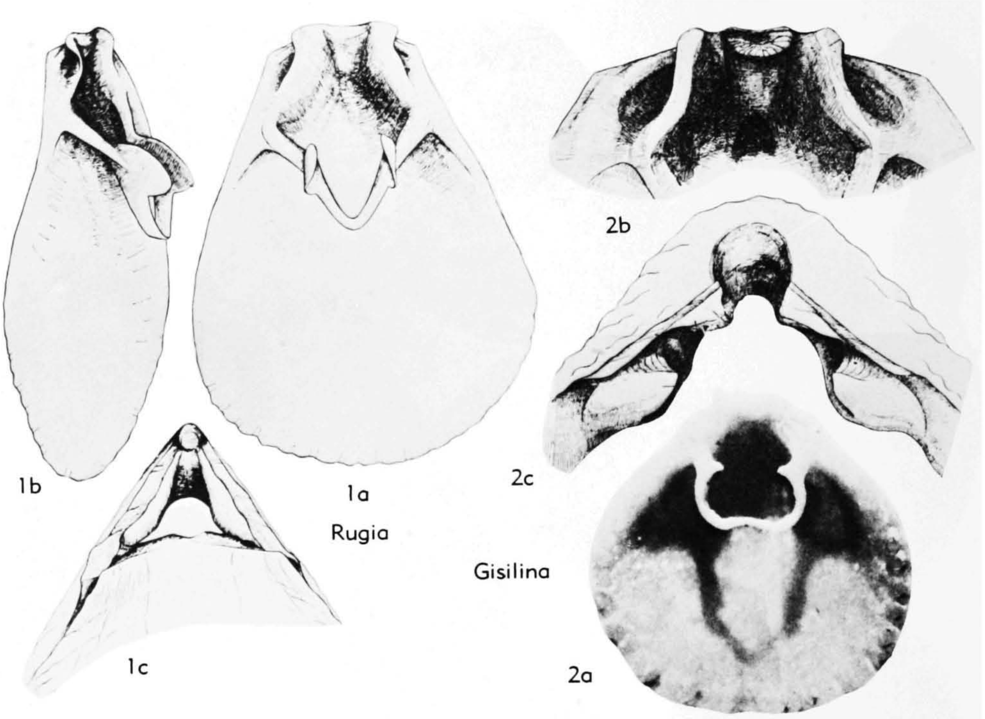


FIG. 687. Cancellothyrididae (Chlidonophorinae) (p. H810-H811).

sure rectimarginate to uniplicate; surface capillate, capillae may be enlarged or granular, with prominent nodules in young; umbo suberect, foramen incomplete, mesothyridid to permesothyridid, deltidial plates disjunct, pedicle collar present. Crura converging, crural processes uniting, forming ringlike loop, transverse band ventrally arched; median septum and hinge plates absent; socket ridges and crural bases fused, forming prominent ridge, hinge teeth without swollen bases, but with sulcus on inner face; lophophore plectolophous, median coil short, spicules abundant. [*Anomia caputserpentis* LINNÉ, 1758, p. 703, is a smooth form, probably a terebratulid, whereas *Anomia caputserpentis* LINNÉ, 1767, p. 1153 (=*A. retusa* LINNÉ, 1758, p. 701) is a capillate terebratulinid. This case should be submitted to ICZN.] *U.Jur.*, Eu.; *Rec.*, cosmop.——FIG. 685,*2a-c*. **T. retusa* (LINNÉ), Rec., off Nor.; *2a-c*, brach.v., lat., ant. views, ×2 (810).——FIG. 685,*2d*. *T. japonica* (G. B. SOWERBY), Rec., Japan Sea; brach.v. int., ×3 (810).

Subfamily CHLIDONOPHORINAE Muir-Wood, 1959

[Chlidonophorinae MUIR-WOOD, 1959, p. 259]

Crural processes converging but not uniting to form ringlike loop, transverse band ventrally arched, lophophore subplectolophous. *U.Cret.-Rec.*

Chlidonophora DALL, 1903, p. 1538 [**Terebratulina? incerta* DAVIDSON, 1878, p. 438; OD]. Small, semicircular, valves moderately biconvex, with shallow ventral sulcus; anterior commissure rectimarginate to incipiently uniplicate; hinge line straight, interarea narrow; umbo small, foramen incomplete, deltidial plates narrow, disjunct, pedicle collar developed. Socket ridges projecting above hinge line and united with transverse cardinal process, myophragm developed; pedicle long, composed of rosette of fibers. *?U.Cret.*, Eu.-N.Am.; *Eoc.*, N.Am.; *Rec.*, Ind.O.-Atl.O. (off Afr.)-Carib.——FIG. 686,*2a-f*. **C. incerta* (DAVIDSON), Rec., N.Atl.O.; *2a-c*, brach.v., lat., ant. views of holotype, ×2.5; *2d,e*, brach.v. int. with loop and lophophore, ×2.5, ×3; *2f*, ped.v. int. showing teeth and mantle canals, ×3 (584).——FIG. 686,*2g,h*. *C. chuni* (BLOCHMANN), Rec., Ind.O.(Maldive Is.); *2g*, brach.v. view with long divided pedicle attached to *Globigerina*, ×2; *2h*, valves opened, showing subplectolophous lophophore, ×10 (584).

Gisilina STEINICH, 1963, p. 735 [**Terebratula gisii* ROEMER, 1840, p. 40; OD]. Small, rounded, auriculate, valves biconvex, with narrow interarea; anterior commissure rectimarginate or incipiently uniplicate; capillae simple, prominent, smooth or enlarged at intersection with growth lines; umbo short, suberect or erect, mesothyridid, deltidial plates disjunct, pedicle collar developed. Loop

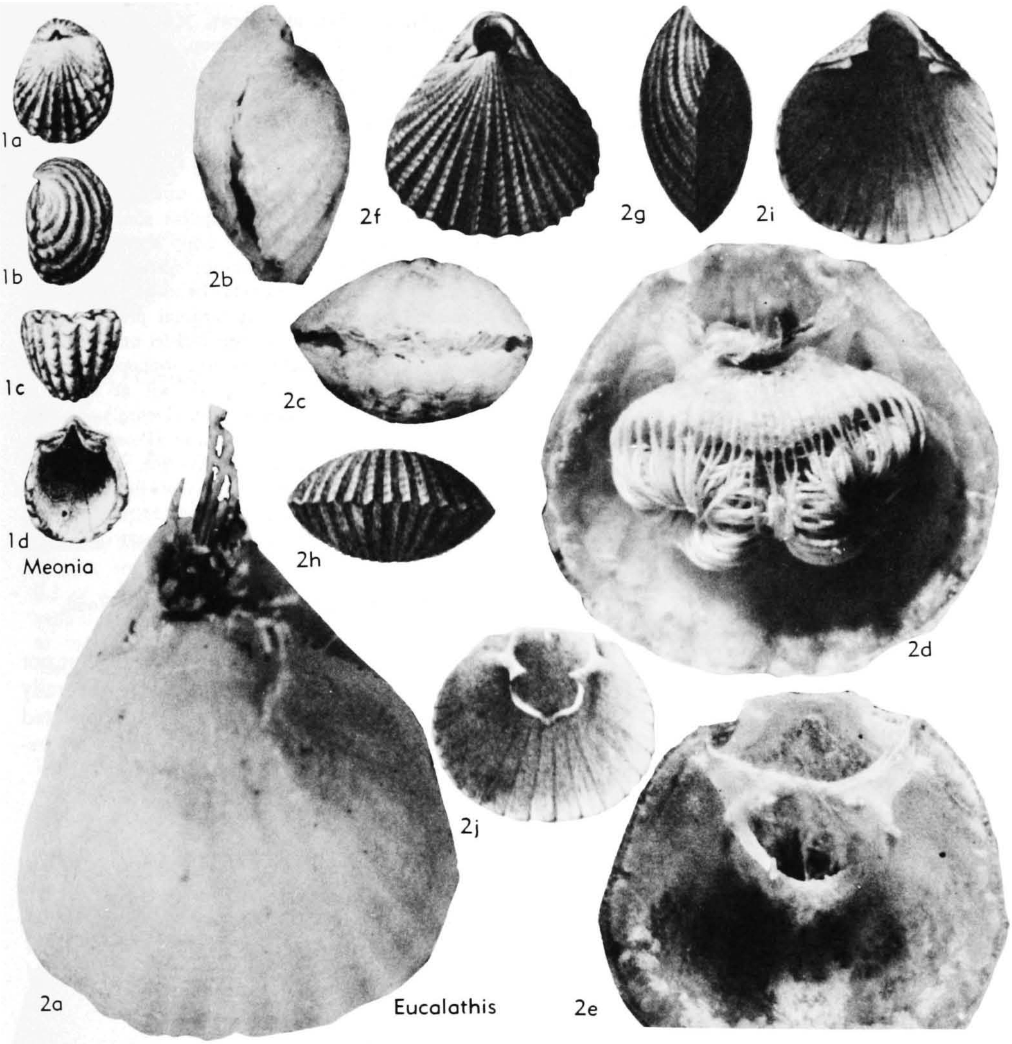


FIG. 688. Cancellothyrididae (Eucalathinae) (p. H811-H812).

chlidonophorid, ventrally directed, crural processes converging, hinge teeth with swollen bases; lophophore from spicule arrangement probably plectolophous. *U.Cret.,* Eu.(Denm.-Ger.-G.Brit.).——FIG. 686,*1*; 687,*2*. **G. gisii* (ROEMER), Rügen; 686,*1a,b,* brach.v., lat. views, ×3; 686,*1c-f,* brach. v., lat., ant., ped.v. int. views, ×4; 687,*2a,* brach. v. int. with loop, ×10; 687,*2b,c,* brach.v. int. with hinge, ped.v. int. post. hinge, both ×11 (584).

Rugia STEINICH, 1963, p 735 [**R. tenuicostata*; OD]. Resembles *Terebratulina* in hinge characters and probable plectolophous lophophore, but differs in small size of adult shells, in having plane commissure, more elongate umbo, long tapering deltidial plates, and long pedicle collar, hypothyridid foramen, more granular shell surface; and in chlidonophorid loop having broad spoon-shaped crural processes ventrally directed and not fused. *U.Cret.(L.Maastricht.),* Eu.(Denm.).——FIG. 686, *3*; 687,*1*. **R. tenuicostata;* 686,*3a-d,* brach.v., lat., ant., ped.v. views, ×20; 687,*1a,b,* brach.v. int. showing loop and crural processes in vent. and lat. views, ×20; 687,*1c,* ped.v. umbo showing deltidial plates, ×20 (782).

Subfamily EUCALATHINAE Muir-Wood, n. subfam.

Crural processes converging or ventrally directed but not united, transverse band with median plication dorsally directed, hinge plates absent, capillae simple, prominent, foramen mesothyridid, lophophore spirolophous. *?U.Cret., Rec.*

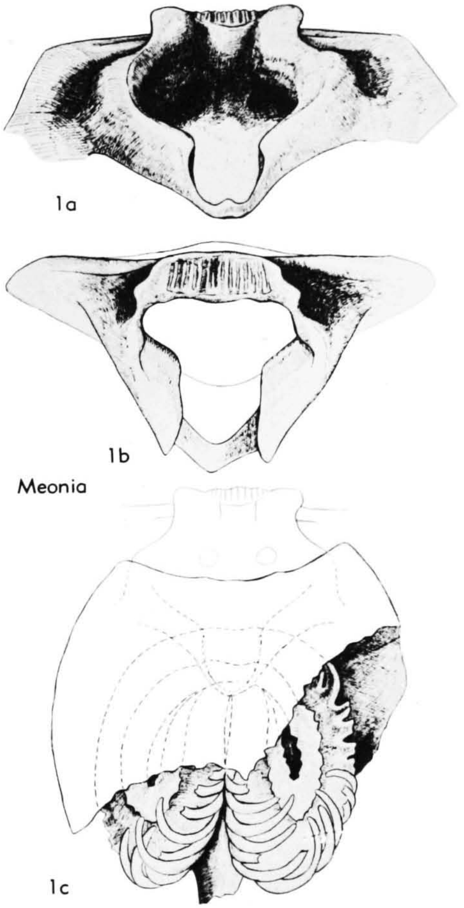


FIG. 689. Cancellothyrididae (Eucalathinae) (p. H812).

Eucalathis FISCHER & OEHLERT, 1890, p. 72 [**Terebratulina? murrayi* DAVIDSON, 1878, p. 437; OD]. Minute, subtrigonal, auriculate, ventribiconvex, anterior commissure rectimarginate, or incipiently uniplicate, hinge straight; surface capillate with rare intercalations or granular, growth lines numerous; umbo short, slightly incurved, obliquely truncate, pedicle collar present, deltidial plates minute, disjunct. Loop chlidinophorid but transverse band dorsally directed, socket ridges as narrow plates uniting with cardinal process, and anteriorly with crural bases; lophophore with 2 single whorl spirals set at angle to plane of symmetry, long filaments. *Mio.*, Eu.(Italy); *Rec.*, Pac.O.-E.Atl.O.-Medit.-Carib. ——FIG. 688,*2a-e*. **E. murrayi* (DAVIDSON), Rec., Pac.O. (off Fiji Is.); *2a-c*, brach.v., lat., ant. views, ×16, ×9, ×9; *2d,e*, brach.v. int. showing lophophore, with loop, ×20 (298).——FIG. 688,*2f-j*. *E. ergastica* FISCHER & OEHLERT, Rec., N.Atl.O.; *2f-h*, brach.v., lat., ant. views, ×4; *2i*, ped.v. int., ×4; *2j*, brach.v. int. with loop, ×4 (298).

Meonia STEINICH, 1963, p. 733 [**Terebratula semiglobularis* POSSELT, 1894, p. 35]. Small rounded shells with straight hinge line and narrow interarea, highly convex pedicle valve and flat or weakly sulcate brachial valve; anterior commissure plane or slightly sulcate; umbo short, foramen small, mesothyridid; capillae simple, granular, numerous growth lines. Loop short, chlidonophorid, ventrally projecting; crural processes scarcely developed, transverse band narrow uniting broader converging crura; cardinal process crenulated; hinge teeth with deep sockets on inner face articulating with socket ridges; lophophore probably spirolophous, with spirals set at angle to plane of symmetry. *U.Cret.*, Eu.(Denm.).——FIG. 688,*1*; 689,*1*. **M. semiglobularis* (POSSELT); 688, *1a-d*, brach.v., lat., ant., ped.v. int. views, ×3; 689,*1a,b*, brach.v. int., post view showing loop, same, more post. view, ×22; 689,*1c*, brach.v. int. with brachial spirals silicified and part of int. restored, ×21 (782).

Subfamily AGULHASIINAE Muir-Wood, n. subfam.

Crural processes short, converging but not uniting, transverse band of loop ventrally arched, cardinal process bilobed, supported by short septum, narrow hinge plates pres-

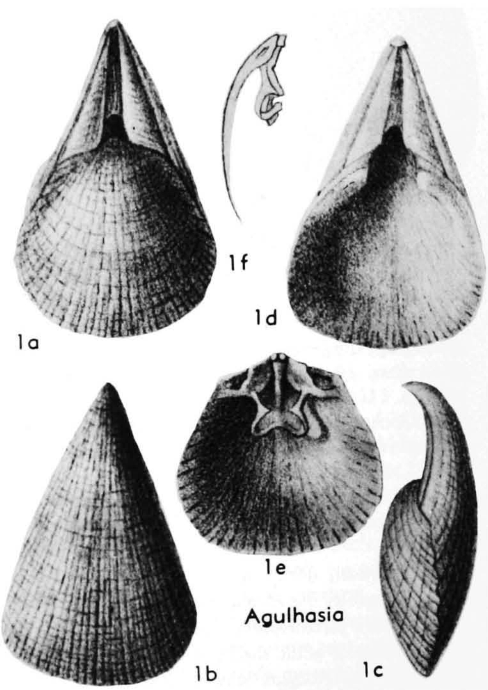


FIG. 690. Cancellothyrididae (Agulhasiinae) (p. H813).

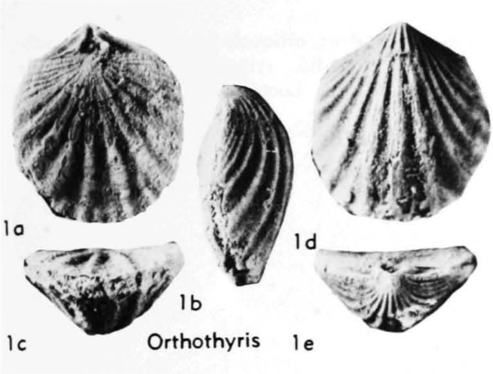


FIG. 691. Cancellothyrididae (Orthothyridinae) (p. H813).

ent, umbo much produced, tapering, with high interarea; shell surface capillate; lophophore subplectolophous. *Rec.*

Agulhasia KING, 1871, p. 109 [**A. davidsoni*; OD]. Minute, rounded trigonal, with produced umbo 0.3 of valve length; valves biconvex, with faint ventral median sulcus, anterior commissure plane to incipiently sulcate; pedicle collar long, deltidial plates disjunct, foramen anterior, hypothyridid. Hinge teeth longitudinally grooved and articulating with socket ridges, internal shell margin strongly crenulated. *Rec.*, Atl.(off S. Afr.).——FIG. 690,*1*. **A. davidsoni*; *1a-c*, brach.v., ped.v., lat. views of holotype, ×8; *1d-f*, ped.v. and brach.v. int., lat. of loop, ×8 (474).

Subfamily ORTHOTHYRIDINAE Muir-Wood, n. subfam.

Small, concavo-convex, costate or costellate, with short, ?terebratulinid loop, and broad, medianly depressed hinge plate. *U. Cret.*

Orthothyris COOPER, 1955, p. 64 [**O. radiata*; OD]. Small, valves with wide straight hinge, slightly biconvex, becoming concavo-convex, anterior commissure broadly sulcate; ornament of coarse simple costae medianly and anteriorly, and mediolaterally directed costellae posteriorly; delthyrium margined by elevated deltidial plates, interarea well developed, beak ridges strong, foramen small. Sockets deep, with erect socket ridges; loop projecting ventrally, attached to socket ridges; interior margin scalloped anteriorly. *U.Cret.*, W. Indies.——FIG. 691,*1*. **O. radiata*, Cuba; *1a-e*, brach.v., lat., ant., ped.v., post. views, ×8 (186).

Subfamily UNCERTAIN

Disculina E. EUDES-DESLONGCHAMPS, 1884, p. 147 [**Terebratula hemisphaerica* J. DE C. SOWERBY, 1826, p. 69; OD]. Small, rounded, valves concavo- to plano-convex, anterior commissure rectimarginate to incipiently sulcate; umbo incurved, foramen large, incomplete, mesothyridid, deltidial plates disjunct, interarea in pedicle valve, pedicle collar present; valves finely capillate and nodose. Loop short, imperfectly known, median hinge trough wtih 2 diverging spinelike processes, possibly representing cardinal process lobes which project slightly above hinge; inner socket ridges prominent; dorsal median septum and dental plates absent. *M.Jur.(Gt. Oolite Ser.)-U.Jur.(U.Oxford.)*, Eu.(Eng.-Fr.).——FIG. 692,*6*. **D. hemisphaerica* (J. DE C. SOWERBY), Bathon., Fr.(Normandy); *6a-c*, brach.v., lat., ant. views, ×4; *6d*, ped.v. view showing 2 diverging processes (possibly cardinal process), and part of right-hand crus, ×4; *6e,f*, brach.v. and ped.v. int., ×2 (254).

Dzirulina NUTSUBIDZE, 1945, p. 188 [**Terebratula dzirulensis* ANTHULA, 1899, p. 70; OD]. Small, subpentagonal, valves unequally biconvex, anterior commissure plane; shell smooth, or capillate near shell periphery; umbo incurved, concealing symphytium, foramen rounded, beak ridges short, angular, permesothyridid. Internal characters imperfectly known, dorsal median septum ?supporting short loop. *L.Cret.(Apt.-Alb.)*, USSR(Caucasus).——FIG. 692,*1*. **D. dzirulensis* (ANTHULA), Alb.; *1a-d*, brach.v., lat., ant., ped.v. views, ×1 (39).

Hesperithyris DUBAR, 1942, p. 78 [**Terebratula renierii* CATULLO, 1827, p. 167, var. *sinuosa* DUBAR, 1942, p. 83; OD]. Small to large, biconvex, anterior commissure uniplicate, umbo massive, incurved, foramen large, symphytium short, beak ridges ?permesothyridid; ornament of few broad subangular costae from umbo, alternating on opposite valves, normally 2 on fold, 1 in sulcus and 2 bounding sulcus. Loop short, imperfectly known; cardinal process large, with short myophragm; adductor scars posteriorly parallel, threadlike, becoming slightly diverging, spoon-shaped. *L.Jur.(Pliensbach.)*, Eu.(Fr.-Spain-Port.-Alps-Italy-Hung.)-N.Afr.; *L.Jur.(Domer.)*, N.Afr.(Morocco)-Asia(Timor).——FIG. 692,*3*. **H. sinuosa* (DUBAR), Morocco; *3a-e*, brach.v., lat., ped.v., ant., post. views, ×1; *3f*, brach.v. int. mold with adductor scars, ×1 (267).

Phymatothyris COOPER & MUIR-WOOD, 1951, p. 195 [*pro Pallasiella* RENZ, 1932, p. 40 (*non* SARS, 1895)] [**Pallasiella kerkyraea* RENZ, 1932, p. 41; OD]. Small to medium-sized, externally resembling athyridid shells, valves concavo-convex, anterior commissure sulcate, umbones swollen, much incurved, that of pedicle valve in contact with brachial valve usually concealing foramen, beak ridges obscure. Loop presumably short but all internal characters unknown. *L.Jur.(M.Lias.-U. Lias.)*, Eu.(Italy-Albania-Corfu-Alps). —— FIG. 692,*2*. **P. kerkyraea* (RENZ), U.Lias., Greece; *2a-d*, brach.v., lat., ant., ped.v. views, ×1 (666).

Plectoidothyris S. S. BUCKMAN, 1918, p. 122 [**Terebratula polyplecta* S. S. BUCKMAN, 1901, p. 242; OD] [=*Plectoidothyris* BUCKMAN, 1914, p. 2

(*nom. nud.*)]. Medium-sized to large, biconvex, brachial valve posteriorly sulcate, anterior commissure plane to uniplicate, becoming multiplicate; umbo short, obliquely truncate, foramen subapical, epithyridid, symphytium short, pedicle collar developed. Loop 0.7 length of valve, with

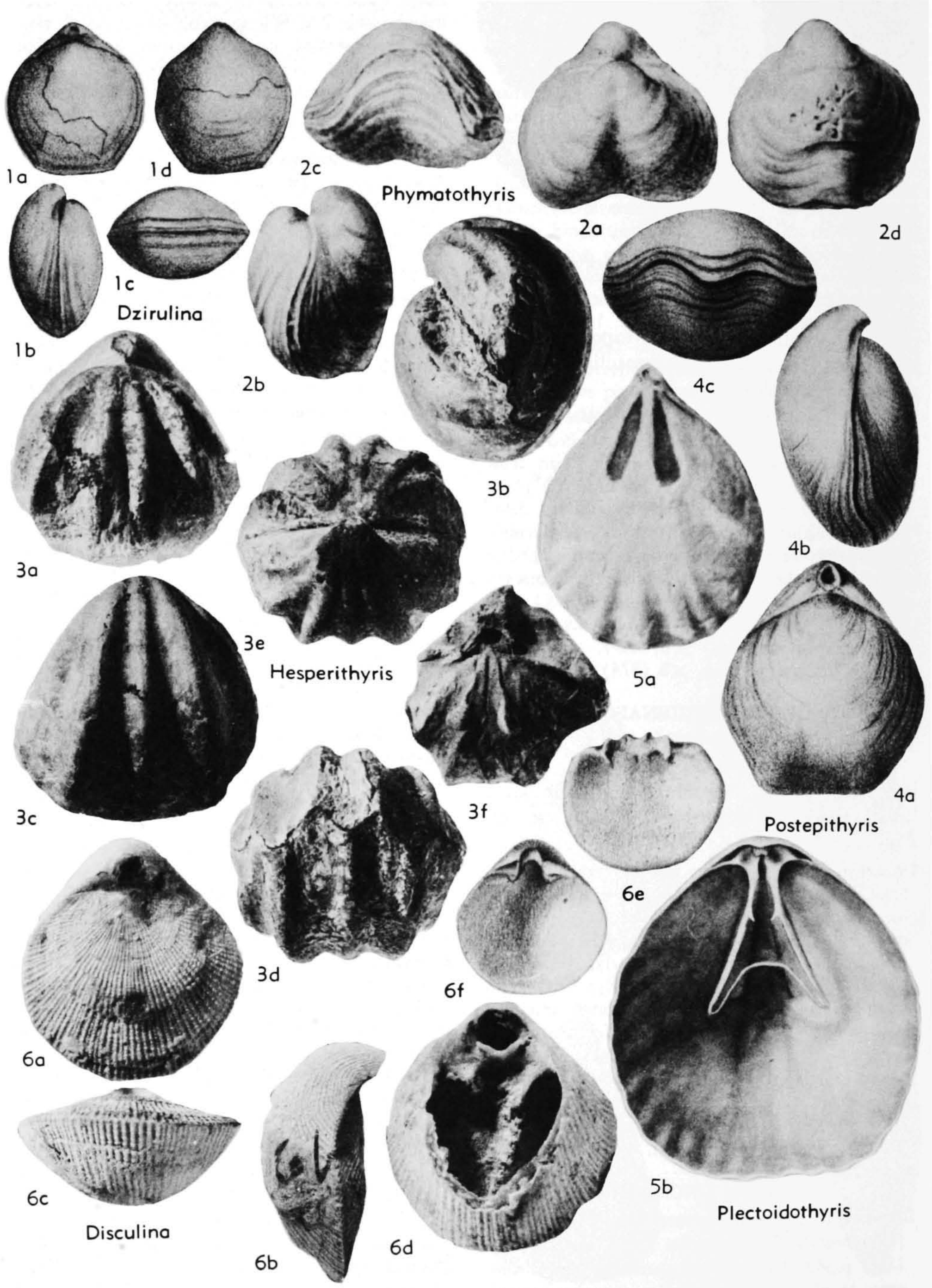


FIG. 692. Cancellothyrididae (Subfamily Uncertain) (p. *H*813-*H*816).

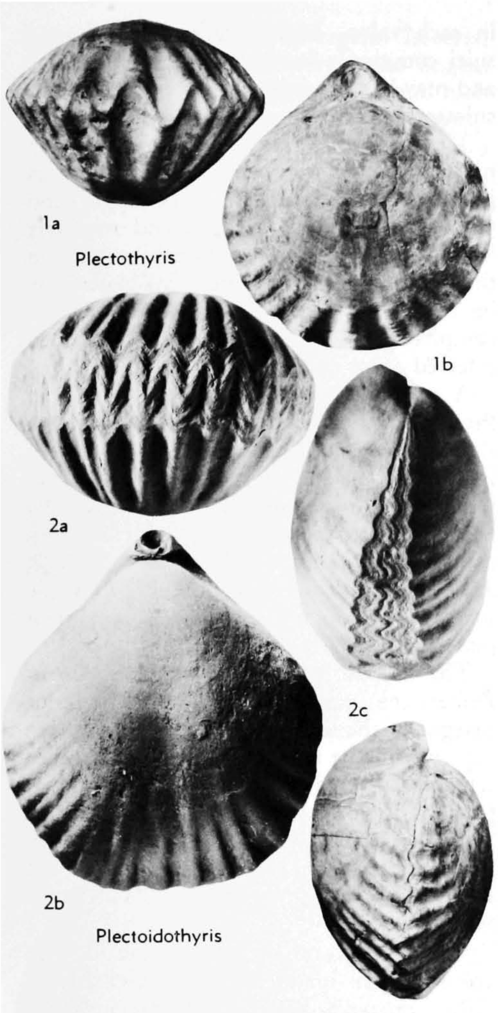


FIG. 693. Cancellothyrididae (Subfamily Uncertain) (p. *H*813-*H*816).

wide ribbon anteriorly; cardinal process prominent, bilobed with deep umbonal cavity; hinge plates and inner socket ridges in section V-shaped, tapering, slightly keeled; crural bases converging; dorsal adductor scars long, narrow, slightly diverging. *L.Jur.(Bajoc.),* Eu.(Eng.-Fr.).——FIG. 692,*5*; 693,*2*; 694,*1*. **P. polyplecta* (BUCKMAN), Glos.; 692,*5a,* dorsal adductor scars, ×1; 692,*5b,* loop (reconstr.), ×1.25; 693,*2a-c,* ant., brach.v., lat. views of holotype, ×1; 694, *1a-w,* ser. transv. secs., ×1 (576).

Plectothyris S. S. BUCKMAN, 1918, p. 121 [**Terebratula fimbria* J. SOWERBY, 1822, p. 27; OD] [=*Plectothyris* BUCKMAN, 1914, p. 2 *(nom. nud.)*]. Medium-sized, plano- to biconvex, anterior commissure plane, multiplicate on anterior 0.3 or 0.5 of both valves; umbo short, stout,

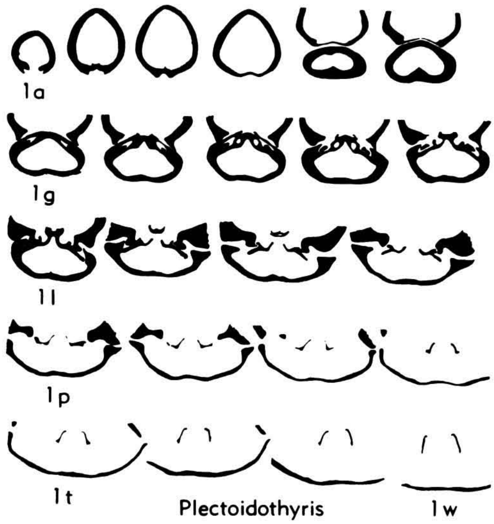


FIG. 694. Cancellothyrididae (Subfamily Uncertain) (p. *H*813-*H*815).

obliquely truncate or incurved, permesothyridid, symphytium short. Loop with high arched medianly horizontal transverse band; cardinal process lobate; posterior umbonal cavity present; hinge plates in section differentiated from socket ridges, very slightly concave ventrally, dorsally inclined, becoming V-shaped; crural bases virgate, converging; adductor scars long, widely divergent. *M. Jur.(Bajoc.),* Eng.——FIG. 693,*1*; 695,*2*. **P. fim-*

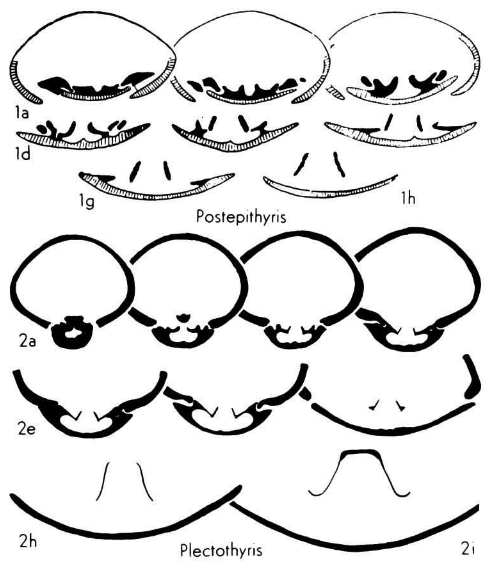


FIG. 695. Cancellothyrididae (Subfamily Uncertain) (p. *H*815-*H*816).

bria (J. SOWERBY), Glos.; 693,*1a-c*, ant., brach.v., lat. views, ×1; 695,*2a-i*, ser. transv. secs., ×1.2 (136).

Postepithyris MAKRIDIN, 1960, p. 294 [**Terebratula cincta* COTTEAU, 1857, p. 137]. Medium-sized, subcircular, moderately biconvex, anterior commissure plane to sulciplicate; umbo massive, suberect to incurved, beak ridges inconspicuous, permesothyridid, symphytium narrow, exposed in some. Loop about 0.5 length of valve, descending branches divergent; cardinal process short, medianly flattened; posterior umbonal cavity variably developed; hinge plates in section ventrally concave, clubbed, becoming V-shaped; adductor muscle scars subparallel, diverging only at extremities. *U. Jur.(U. Oxford.-L.Kimmeridg.)*, Eu.(Fr.-Switz.-USSR).——FIG. 692,*4*; 695,*1*. **P. cincta* (COTTEAU); U.Oxford., Fr.; 692,*4a-c*, brach.v., lat., ant. views, ×1· 695,*1a-h*, ser. transv. secs., ×0.6 (264).

Terebratularius DUMÉRIL, 1806, p. 170 [no type-species] [=*Terebratulier* DUMÉRIL, 1806, p. 171 (vernacular)]. Group name for terebratuloids, considered invalid.

[**Family Uncertain—Magharithyris,** *see* p. *H*904.]

MESOZOIC AND CENOZOIC TEREBRATELLIDINA

By H. M. MUIR-WOOD, G. F. ELLIOTT, and KOTORA HATAI

Terebratuloids included in the Mesozoic and Cenozoic Terebratellidina are divided among two superfamilies, the Zeilleriacea (U.Trias.-L.Cret.) and the Terebratellacea (U.Trias.-Rec.). The general form of the shell of both these assemblages is closely similar to that of the Terebratulidina, chief distinctions being found in the nature of internal features, especially characters of the loop.

ZEILLERIACEA

[Discussion by H. M. MUIR-WOOD]

The external surface of zeilleriacean shells is commonly smooth. In the superfamily both valves may have opposite sulci anteriorly **(ligate)** or longitudinal folds may also be developed **(strangulate).** Folds and sulci are equally developed in the bilobate stage. Prominent anterior carinae occur in *Digonella* and *Obovothyris,* or opposite lateral folds may be developed with no median sulci **(ornithellid).** In *Cheirothyris* four prominent opposite angular ridges are seen in each valve. Multiplication of folds and sulci commonly is alternate (e.g., *Eudesia*) and may be superimposed on a uniplicate or sulcate stage.

The foramen varies in size from a minute pinhole (e.g., *Cincta*) to a large opening, as in several terebratuloids. Beak ridges tend to be angular, well defined, and relatively long, being commonly more evident than in the terebratuloids. The deltidial plates may be conjunct or fused, or disjunct and incompletely fused, the foramen being then referred to as incomplete.

A cardinal process usually is lacking in the Zeilleriacea, but it is present in the genus *Zeillerina* and a complicated process occurs in the Eudesiidae (Fig. 714,*1h*). A septalium of varying form and depth is broadly U-shaped in *Zeilleria* (Fig. 701,*1f*), but deeply V-shaped in *Modestella* (Fig. 709, *3e*). The septalial plates unite with the median septum, which may be a prominent platelike structure.

The descending branches of the loop in Zeilleriacea extend almost to the anterior margin of the shell in some genera and are recurved in the form of ascending branches which are united by a transverse band (Fig. 696). The developmental stages of the loop in zeilleriaceans, if any, still are unknown, and whether the loop is attached to the septum in juvenile growth stages is undetermined.

Various features of internal morphology are important for identification and classification of terebratellid shells, as in other terebratulids, rhynchonellids, and diverse brachiopod groups. Commonly, the only feasible way to determine them is to prepare somewhat closely spaced serial sections, especially of the beak region, and from these such features as hinge plates, socket ridges, median septa, and brachidial loops can be reconstructed (Fig. 697, 698). Serial sections of *Aulacothyropsis reflexa*, an Upper Triassic terebratellacean species, are illustrated here (Fig. 699) for comparison with those of zeilleriaceans. These sections of a Triassic shell are remarkably similar to sections of the Cretaceous terebratellacean *Kingena*, a genus of the Dallinidae.

Dental plates are developed in the pedicle valve of Zeilleriacea. They are usually short and either subparallel or divergent. In serial sections they are often seen to be angled (e.g., *Zeilleria, Cincta*) and one part of each plate is set at an angle to the other, suggesting that they may be composed of two plates, like the adminicula of some spiriferoids. The dental plates in Zeilleriacea tend to split apart, one portion remaining in contact with the teeth and the other attached to the shell wall.

A pedicle collar or continuation of the deltidial plates on the inner side of the

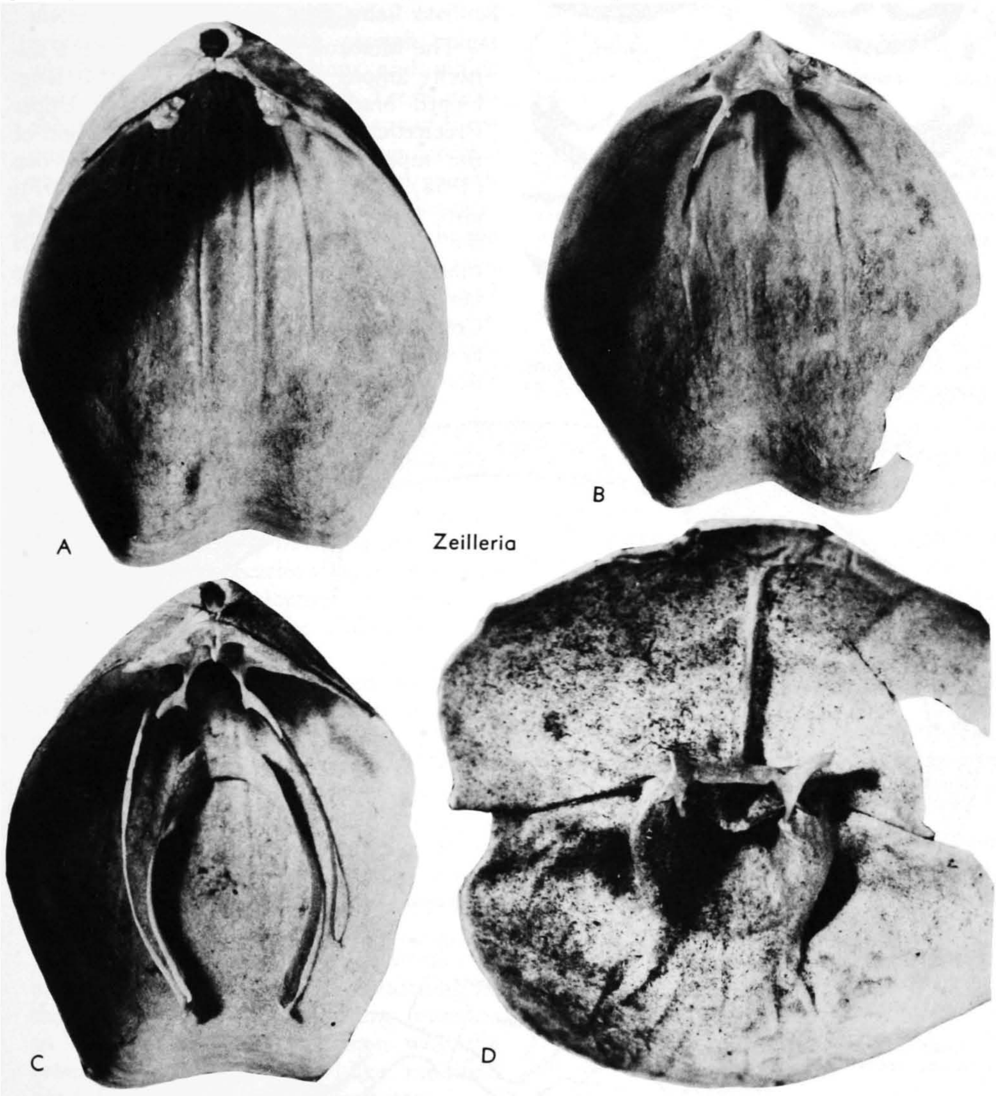


FIG. 696. Internal morphological features of terebratellaceans illustrated by interior of brachial and pedicle valves of *Zeilleria cornuta* (J. DE C. SOWERBY), from the Jurassic (M.Lias.) of northern France (Muir-Wood, n).——*A*. Interior of pedicle valve showing angular beak ridges, conjunct deltidial plates, hinge teeth, and 4 main vascular trunks appearing as deep incisions, ×2.——*B*. Interior of brachial valve showing one hinge socket, inner and outer socket ridges, fused hinge plates and septalium, median septum, crural processes foreshortened, and descending branches of loop; the massive rounded adductor scars are adjacent to 4 vascular trunks, ×2.——*C*. Loop seen in reverse from dorsal side, showing broad transverse band, and fine ribbon of ascending and descending branches, ×2.——*D*. Two valves in contact along hinge, showing teeth embedded in hinge sockets and supported by dental plates; hinge plates appear between dental plates and are supported by strong septum, ×2.5.

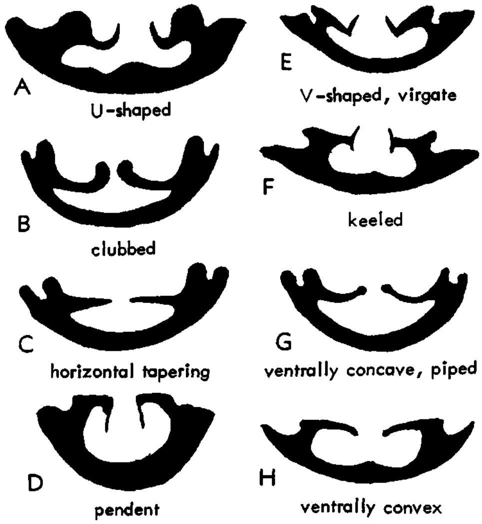


FIG. 697. Diagram showing hinge plates and inner socket ridges in transverse sections (Muir-Wood, n).

umbo may be developed in some Zeilleriacea, and in *Digonella and Obovothyris* it may be supported by a septum.

MESOZOIC TEREBRATELLACEA

[Discussion by G. F. ELLIOTT]

The Mesozoic Terebratellacea form a minority among other contemporaneous long-looped brachiopods, except in the Upper Cretaceous. Current views on the origin of the superfamily are those of MUIR-WOOD (1955), STEHLI (1956), and ELLIOTT (1957); also, I have discussed relationships among the five modern component families. Of these, the Kraussinidae and Platidiidae are not known from the Mesozoic, and the Cretaceous members of the Megathyrididae are mentioned in this volume in the section dealing with the Tertiary and Recent Tere-

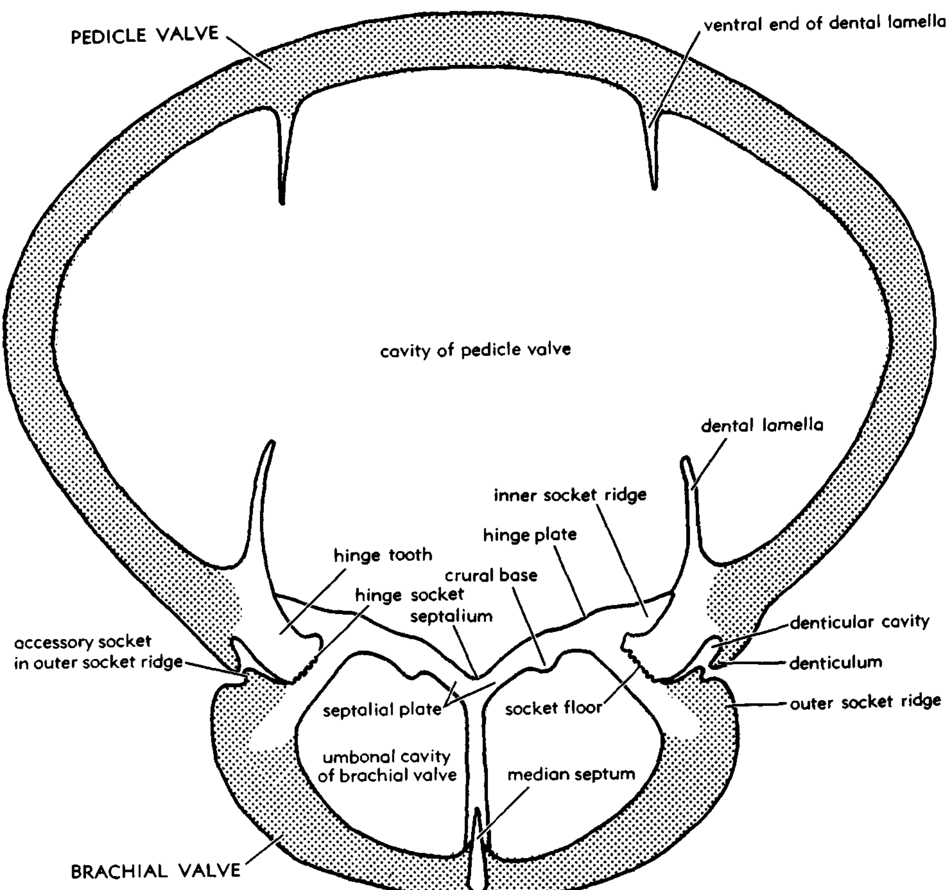


FIG. 698. Diagrammatic representation of transverse section of *Digonella digona* (J. SOWERBY) (after 576).

bratellacea. All of those dealt with in this Mesozoic section are referred to the Dallinidae or Terebratellidae, the former ranging upward from the Upper Triassic, the latter from the Lower Cretaceous. The Dallinidae show hinge teeth supported by dental plates, weak cardinalia with small cardinal processes, and loops with growth stages which commonly are spinous and which show early septal hoods. The Terebratellidae do not have dental plates; many of them possess strong cardinalia with large cardinal processes and their nonspinous loop growth stages show early septal rings. The brachial growth stages of both series are listed in the glossary; a detailed account has been given by ELLIOTT (1953). Reference of the fossil genera to a family is often dependent on suitably preserved growth stages and adult material for dissection. Future work will undoubtedly add to the number of known Mesozoic Terebratellacea and perhaps clarify understanding of their relationships to other brachiopods.

Knowledge of terebratellacean brachial development is largely based on that of Recent species, but occasional good evidence exists of similar development in Mesozoic forms, particularly in the Dallinidae (ELLIOTT, 1947, 1953).

The earliest brachial structure to appear in the Dallinidae is a small median septal pillar, rising from the valve floor. The descending branches develop from the cardinalia, free of the valve floor, and grow anteriorly to meet and fuse with the septal pillar. On the posterior sloping edge of the latter a small cone (hood), open above, closed below, develops. This developmental stage is known as **precampagiform.**

Enlargement of the hood, resorption of its lower (dorsal) closed end, widening of the attachments of the descending branches to the septum, and their fusion with the lower portion of the cowl-like modified hood, leads to the **campagiform stage.**

With continued enlargement of this structure, and alteration in the proportions of its component parts, lacunae or gaps appear by resorption in the sides of the loop, thus individualizing 2 pairs of lateral loop ribbons; this is the **frenuliniform stage.**

With continued enlargement, further resorption removes the posterior lateral rib-

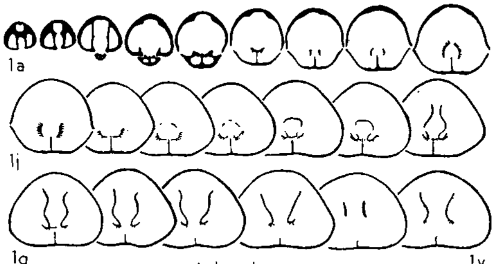


FIG. 699. Serial transverse sections of the dallinid species *Aulacothyropsis reflexa* (BITTNER) (Upper Triassic) belonging to Terebratellacea and resembling the Cretaceous genus *Kingena*, for comparison with sections of zeilleriaceans, ×0.6. [Figures indicate distance in mm. from preceding section; pedicle valve at top.] (Muir-Wood, n).

bons, and the early ascending branches and transverse band appear; this is the **terebrataliiform stage.**

Finally, resorption of the remaining connections from descending branches to the septum leads to the **dalliniform stage,** in which the long loop is wholly free of the valve floor.

The earliest brachial structure to appear in the Terebratellidae is a small high median septum, on which a tiny ring appears at the posterior upper (ventral) angle. Each descending branch, free of the valve floor, grows both from cardinalia and septum, and these portions meet and unite. This developmental step is the **premagadiniform stage** up to completion of the descending branches, when the **magadiniform stage** is attained.

With enlargement of ring and descending branches, proportional changes lead to union of their attachments on the septum, left and right; this is the **magelliform stage.**

With further development, these unions recede from the septum, each being still joined to the latter by connecting bands; this is the **terebratelliform stage,** parallel to the terebrataliiform stage of the Dallinidae.

Finally, resorption of these connecting bands leads to the **magellaniiform stage,** parallel to the dalliniform stage of the Dallinidae.

CENOZOIC TEREBRATELLACEA

[Discussion by KOTORA HATAI]

The surface of brachiopods belonging to Cenozoic Terebratellacea may be marked by concentric growth lines, capillae plications or costae, and in some shells by both concentric and radial sculpture. Other sculpture may be the corrugation or foliation developing from gerontism or by stunted growth. Shells having capillae (e.g., *Terebratalia gouldi*) are thought to have been formed by rows of closely spaced setae on the surface of the mantle. In forms with plications or costae (e.g., *Coptothyris grayi*) the mantle is crenulated or wrinkled along the anterior margin, these corrugations being reflected on the exterior of the shell by radially disposed ridges separated by troughs. The ridges and troughs serve to lock the shells together at the anterior margins of the valves. This kind of sculpture may consist of simple or bifurcated ridges, or of smaller ones alternating with larger ones.

When concentric growth lines are the only markings on the shell surface, they may be quite uniform in size and distribution, or they may be unevenly spaced, with some much stronger than others, and they may show foliation or corrugation at their margins. When both concentric and radial sculpture cover the surface, the former appear as wavy lines crossing the radials, and do not make reticulate sculpture in the Terebratellidae, although reticulation can be observed in forms of other superfamilies.

Terebratellaceans found in Cenozoic deposits, including numerous genera represented in faunas of the present day, are differentiated almost entirely on the basis of their internal characters. Chiefly important are characters of the calcareous loop serving as support of the lophophore. Supplementing discussion given by ELLIOTT in his section devoted to Mesozoic forms, it may be noted that two primary lines of loop development have been recognized by THOMSON (810) in the Terebratellidae and Dallinidae and described by ELLIOTT (275). These are defined as terebratellid and dallinid. The trends of the dallinid type are precampagiform (or preismeniform) to campagiform (or ismeniform) to frenuliniform, terebrataliiform, and dalliniform, then with further modification to laqueiform, and finally to pictothyridiform. That of the terebratellid type is premagadiniform to magadiniform, to magelliform, to terebratelliform, and finally to magellaniiform. No adult brachiopod is known to have either the premagadiniform or precampagiform (preismeniform) type of loop, although the stages are passed. The campagiform stage is represented by the adult loop of *Campages* and *Jolonica*, that of the frenuliniform stage by the adult loop of *Frenulina*, that of the terebrataliiform stage by the adult loop of *Terebratalia, Dallinella, and Japanithyris,* and the dalliniform stage by the adult loop of *Dallina, Coptothyris,* and *Macandrevia.* A modified stage of the dalliniform or laqueiform stage is represented by *Laqueus*, while the more advanced type of loop is represented by the pictothyridiform stage of *Pictothyris.*

Distribution of Cenozoic terebratellaceans partly depends on their mode of life and reproduction. In this group of brachiopods the sperm and ova are discharged into the sea water around the parents, except in *Argyrotheca,* in which the sperms enter with the inhalant water current and early larval development takes place in the brood pouch (263). The fertilized ova develop into ciliated larvae with a feebly free-swimming life of at most a few days before settling and metamorphosis into a tiny fixed brachiopod. The fact that terebratelloids usually occur in patches or clusters may signify that the larvae do not disperse widely, as judged from their absence from large areas of adjacent possible anchorage. Their possession of a pedicle provides them with better chance for survival in waters unaffected by currents or by mud drained in large quantities from the land. Since the migration of terebratelloids is much limited by their very short larval period, the occurrence of identical or closely similar forms in remote areas is significant. Their occurrence in remote areas is related to old migration and a long geological history.

In general, terebratellacean brachiopods can be classed in three broad groups according to their geographical distribution: a world-wide group, a Northern Hemisphere group, and a Southern Hemisphere group. The first group is represented by the families Megathyrididae, Platidiidae and Kraussinidae; the second is represented by the Dallinidae; and the third group comprises the Terebratellidae. The members of the first group are the most primitive in structure and development. The second group comprises geologically oldest members with certain primitive characters when compared with the Terebratellidae.

Cenozoic Terebratellacea are classified in six families and ten subfamilies, as follows: Megathyrididae (U.Cret.-Rec.); Platidiidae (Eoc.-Rec.); Kraussinidae (Mio.-Rec.); Dallinidae (U.Trias.-Rec.) [Dallininae (?L.-Cret., Eoc.-Rec.), Frenulininae (Mio.-Rec.), Nipponithyridinae (Mio.-Rec.)]; Laqueidae (Mio.-Rec.) [Laqueinae (Mio.-Rec.), Pictothyridinae (Plio.-Rec.), Kurakithyridinae (Plio.)]; Terebratellidae (L.Cret.-Rec.) [Terebratellinae (Oligo.-Rec.), Bouchardiinae (U.Cret.-Rec.), Magadinae (U.Cret.-Rec.), Neothyridinae (Oligo.-Rec.)]. The nature of the lophophore, including its spiculation, and the presence or absence of dental plates in general of the six families are indicated in the following tabulation (614):

Lophophore and Dental Plate Characters in Cenozoic Terebratellacean Families

Families	Lophophore in Highest Genera	Spiculation	Dental Plates
Megathyrididae	plectolophous	weak or absent	absent
Platidiidae	plectolophous	strong	present in some
Kraussinidae	plectolophous	strong	absent
Dallinidae	plectolophous	weak or absent (rarely strong)	typically present
Laqueidae	plectolophous	moderate	present
Terebratellidae	plectolophous	absent	absent

The subfamilies are distinguished chiefly by characteristics of the cardinalia, crural bases, median septum and foramen. Of the cardinalia, shape of the hinge platform and presence or absence of a hinge trough are important. Similarly the presence or absence of a cardinal process, degree of development of the dental plates, and strength and type of median septum are important. The loop, important in Recent forms, is rarely seen in the fossils.

Suborder TERCEBRATELLIDINA Muir-Wood, 1955

Diagnosis of this assemblage is given in the section on Terebratulida—Main Groups (p. *H*730).

Superfamily ZEILLERIACEA Allan, 1940

[*nom. transl.* KYANSEP, 1961, p. 80 (*ex* Zeilleriidae ALLAN, 1940, p. 269)] [Materials for this superfamily prepared by H. M. MUIR-WOOD]

Loop long, descending branches spinose, not attached to dorsal median septum in adult, possibly attached in early growth stages, crural bases and loop given off dorsally or ventrally; cardinal process rarely developed; hinge plates fused, shallow septalium, or hinge trough, composed of septalial plates which unite with median septum; dental plates present; shell attached throughout life by pedicle emerging through delthyrium. *Trias.-L.Cret.*

Family ZEILLERIIDAE Allan, 1940

[*nom. correct.* ALLAN, 1940, p. 269 (*pro* Zeillérідés ROLLIER, 1915, p. 14); authorship and date of this family would be ROLLIER, 1915, if generally accepted by paleontologists (Code, Art. II, c, iii) but ALLAN, 1940, has come to be recognized instead]

Valves normally ligate, strangulate, bilobate or quadrilobate, or both valves convex, or brachial valve flat or concave; anterior commissure plane, rarely uniplicate or sulcate; valves normally smooth; deltidial plates conjunct or disjunct, beak ridges commonly angular and persistent, mesothyridid or permesothyridid. *Trias.-L.Cret.*

Zeilleria BAYLE, 1878, expl. pl. 9 (no page number) [**Terebratula cornuta* J. DE C. SOWERBY, 1824, p. 66; SD DOUVILLÉ, 1879, p. 275]. Small to large, biconvex, with no posterior dorsal sulcation, becoming strangulate to bilobate or quadrilobate, anterior commissure plane; umbo suberect to much incurved, beak ridges angular, persistent, demarcating interarea, permesothyridid, pedicle collar not observed. Loop given off dorsally, dorsal septum about 0.3 of valve length; hinge plates and socket ridges in section ventrally deflected and ventrally convex, septalium broad and medianly horizontal, U-shaped; adductor scars subcircular. *?U.Trias., L.Jur., ?M.Jur.*, Eu.(or cosmop.).——FIG. 700,*3a-f*; 701,*1*. **Z. cornuta* (J. DE C. SOWERBY), L.Jur.(M.Lias.), Eng.(Somerset.);700,*3a-c*, brach.v., lat., ant. views, ×1.3; 700,*3d*, dors. adductor scars and vascular trunks, ×1.3; 700,*3e*, brach.v. int. showing cardinalia and median septum, ×2.4; 701,*1a-j*, ser. transv. secs., ×1.2 (263).——FIG. 700,*3f*. *Z. quadrifida* (VALENCIENNES in LAMARCK), M.Lias., Fr.; ext. showing quadrilobation, ×0.7 (263).

Antiptychina ZITTEL, 1880, p. 704 [**Terebratula bivallata* E. EUDES-DESLONGCHAMPS, 1859, p. 200

(p. 7 of sep.); SD EUDES-DESLONGCHAMPS, 1884, p. 268].. Small, smooth, pedicle valve carinate with median sulcus, brachial valve flatter, sulcate, with median fold, anterior commissure antiplicate; umbo fine, tapering, beak ridges long, curving, angular, ?epithyridid. Loop long, both ascending and descending branches spinose, broad transverse band with 2 lateral posteriorly projecting carinae, separated from median lobe by deep concavity. *M. Jur. (Bajoc.) - U. Jur. (Oxford.),* Eu. (Fr.-Ger.-Czech.-Aus.) [Cret. record relates to unnamed terebratulid homeomorph].——FIG. 702,*1*. **A. bivallata* (EUDES-DESLONGCHAMPS), U.Bajoc., Fr.; *1a-d,* brach.v., lat., ant., ped.v. views, ×2; *1e,f,* loop, ×3, ×2.5 (901).

Aulacothyris DOUVILLÉ, 1879, p. 277 [**Terebratula*

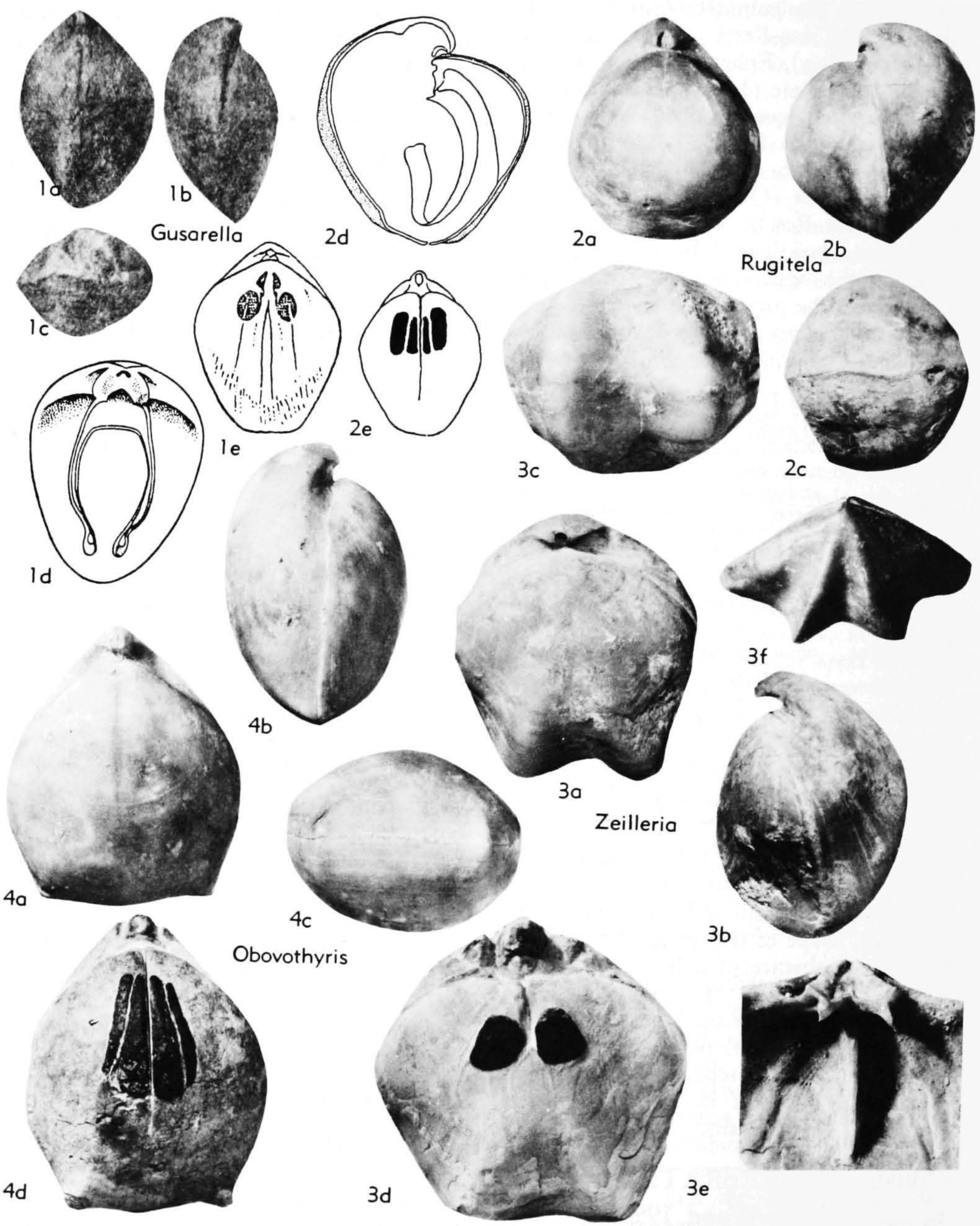


FIG. 700. Zeilleriidae (p. H821, H825-H828).

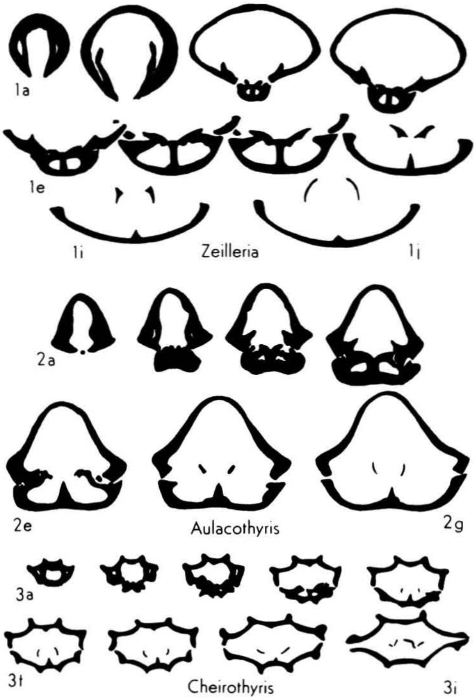


FIG. 701. Zeilleriidae (p. *H*821, *H*822-*H*824).

resupinata J. SOWERBY, 1816, p. 116; OD]. Small to medium-sized, valves concavo-convex or concavo-carinate to plano-convex, anterior commissure normally sulcate; umbo flattened, incurved, with angular, permesothyridid beak ridges, strongly demarcating interarea, pedicle collar not observed. Interior commonly with much callus thickening, crural bases ventrally directed; median septum about half of valve length; hinge plates ventrally curved, not well demarcated from inner socket ridges, septalium shallow, rounded, V-shaped, adductor scars elongate-oval, anterior scars about half size of posterior scars; dental plates short, angled. *?Trias., L.Jur.(L.Lias.), ?U.Jur.*, Eu. ?cosmop.——FIG. 701,*2;* 703,*2*. **A. resupinata* (J. SOWERBY), L.Jur.(M.Lias.), Eng.; 701,*2a-g,* ser. transv. secs., ×1.2; 703,*2a-c,* brach.v., lat., ant. views, ×1.3; 703,*2d,* brach.v. int. mold showing adductor scars, ×1.3 (263).

Camerothyris BITTNER, 1890, p. 318 [**Terebratula ramsaueri* SUESS, 1855, p. 25; SD HALL & CLARKE, 1894, p. 887]. Small, valves strangulate, with deep median sulcus; anterior commissure sulcate; umbo tapering, produced, suberect to incurved, deltidial plates fused, beak ridges rounded. Loop zeilleriiform, dorsal median septum and septalium present; dental plates converging and in some shells uniting with ventral septum. *U.Trias.*, Eu. (E. Alps).——FIG. 705,*7*. **C. ramsaueri* (SUESS); *7a-d,* brach.v., lat., ant., ped.v. views, ×1;*7e-g,* long. secs. showing loop and transv. band, and transv. sec., ×1 (792).

Cheirothyris ROLLIER, 1919, p. 338 [**Terebratula fleuriausa* D'ORBIGNY, 1850, p. 25; OD] [=*Trigonella* QUENSTEDT, 1868, p. 25 (*non* DA COSTA, 1778; *nec* CONRAD, 1837; *nec* HEHL, 1842); *Neotrigonella* COSSMAN, 1910, p. 74]. Small to medium-sized, valves slightly biconvex, pentangular, with 4 prominent carinae, anterior commissure plane; umbo short, broad, foramen large, incomplete, mesothyridid, deltidial plates disjunct. Loop zeilleriiform, given off ventrally with low-arched transverse band, dorsal septum about half of valve length, hinge plates and inner socket ridges in section convex and slightly deflected ventrally, septalium shallow, broad; dental plates short, divergent. [Homeomorph with short loop, no septum or dental plates, as well as 2 terebratelloid homeomorphs *(Ismenia, Trigonellina)* exist in U.Jur.] *U.Jur.(M.-U.Kimmeridg.) (White Jura* ε, ζ, Eu. (Fr.-Switz.-Ger.).——FIG. 701,*3;* 705,*2*. **C. fleuriausa* (D'ORBIGNY), Ger.; 701,*3a-i,*

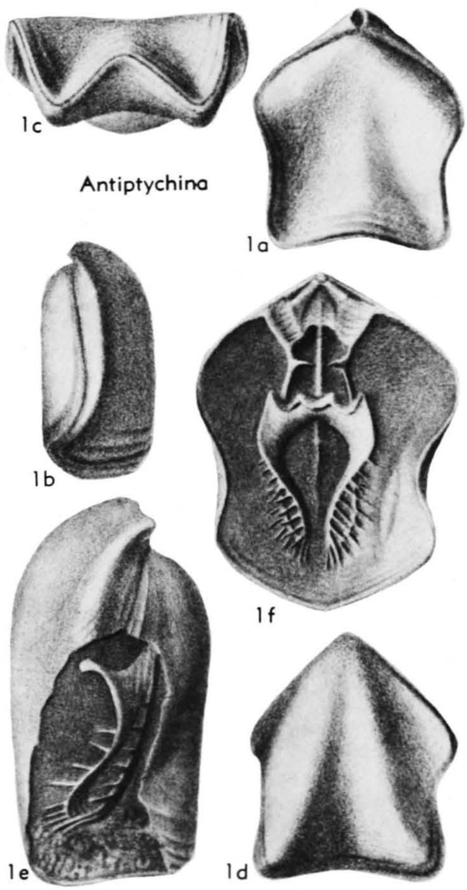


FIG. 702. Zeilleriidae (p. *H*821-*H*822).

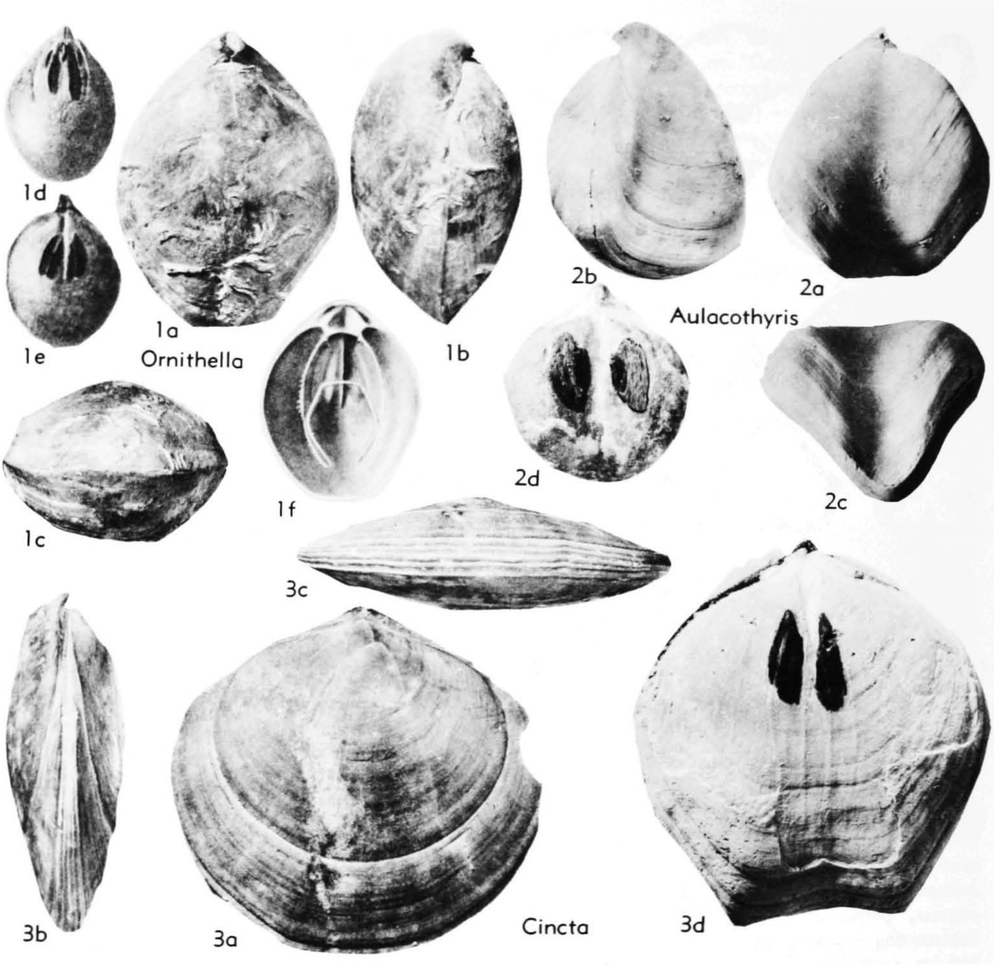


FIG. 703. Zeilleriidae (p. *H*822-*H*824, *H*827).

ser. transv. secs., ×1.2; 705,*2a-c,* brach.v., lat., ant. views, ×2 (672).

Cincta QUENSTEDT, 1868, p. 25 [**Terebratula numismalis* VALENCIENNES in LAMARCK, 1819, p. 249; SD DALL, 1877, p. 20]. Small to medium-sized, subcircular to pentagonal in outline, valves slightly convex, ligate to strangulate, anterior commissure plane; umbo acute, suberect, foramen minute, beak ridges short, angular, curved, mesothyridid; growth lines prominent. Loop given off dorsally, dorsal septum about 0.3 of valve length, hinge plates and inner socket ridges in section ventrally inclined, septalium shallow, rounded V-shaped, becoming deep U-shaped; adductor scars elongate-oval, tapering posteriorly; dental plates angled, convergent, commonly embedded in callus. *L.Jur.(Lias.)-M.Jur.(L.Bajoc.),* Eu.(?cosmop.).——FIG. 703,*3a-c.* **C. numismalis* (VALENCIENNES), L.Lias.(Pliensbach.), Fr.; *3a-c,* brach.v., lat., ant. views, ×1.3 (130).——FIG. 703,*3d*; 708,*1*. *C. pernumismalis* S. S. BUCKMAN, Eng.; 703,*3d,* brach.v. int. mold showing adductor scars and vascular trunks, ×1.3; 708,*1a-g,* ser. transv. secs., ×1.2 (130).

Digonella MUIR-WOOD, 1934, p. 550 [**Terebratula digona* J. SOWERBY, 1815, p. 217]. Small to medium-sized, concavo-carinate posteriorly, becoming biconvex, elongate-oval to sac-shaped in outline, greatest width anteriorly with development of angular carinae; umbo flattened, suberect, beak ridges short, angular, mesothyridid or permesothyridid, telate, pedicle collar with septum. Loop with numerous long spines, given off dorsally, transverse band with posteriorly projecting carinae; dorsal median septum high, platelike, slightly greater than half length of valve, hinge plates in section demarcated from inner socket ridges, slightly concave ventrally; dorsal adductor scars linear, adjacent to septum; dental plates nearly parallel. *M.Jur.(Bathon.),* Eu.(Eng.-

Fr.).——FIG. 705,*5*; 706,*1*. **D. digona* (J. SOWERBY), Gt. Oolite Ser., Eng.; 705,*5a-c*, brach.v., lat., ant. views, ×2; 705,*5d*, dorsal adductor scars, ×1; 705,*5e*, loop (reconstr.), ×1.2; 706,*1a-m'*, ser. transv. secs., ×1.25 (576).

Epicyrta E. EUDES-DESLONGCHAMPS, 1884, p. 275 [**Terebratula eugenii* VON BUCH in DAVIDSON, 1850, p. 72; OD]. Medium-sized, pedicle valve depressed-convex with deep median sulcus, brachial valve highly convex, anterior commissure dorsally arched; umbo short, erect, flattened, foramen small, apical, mesothyridid, beak ridges angular, persistent, delimiting interarea; shell with rarely preserved fine capillation. Loop zeilleriid, given off ventrally, spines not observed, inner socket ridges ventrally directed at high angle, septalium deep, broad, U-shaped, hinge plates keeled, dorsal median septum less than 0.5 of valve length; dental plates short, subparallel. *L.Jur.(M.Lias.)*, Eu.(Fr.).——FIG. 707,*2*; 708,*2*. **E. eugenii* (VON BUCH); 707,*2a-e*, brach. v., lat., ant., ped.v., post. views, ×1; 707,*2f*, umbo, enl., ×2; 708,*2a-h*, ser. transv. secs., ×1.2 (253).

Fimbriothyris E. EUDES-DESLONGCHAMPS, 1884, p. 273 [**Terebratula guerangeri* EUDES-DESLONGCHAMPS, 1856, p. 304; OD]. Small to medium-sized, subpentagonal, laterally compressed, anteriorly truncated, no median fold or sulcus, anterior commissure plane; umbo short, suberect, beak ridges subangular, long, defining narrow interarea, foramen small, permesothyridid, telate, symphytium narrow; costate medianly on anterior half of shell, costae simple subparallel, rare on lateral slopes. Loop zeilleriid, given off dorsally; dorsal median septum about 0.3 of valve length; hinge plates and inner socket ridges in section convex ventrally, septalium deep, becoming broad, shallow U-shaped, septalial plates incompletely fused, leaving small cavity below septalium; dental plates long, slightly divergent. *L.Jur.(M.Lias.)*, Eu. (Fr.)-?Afr. (Morocco).—— FIG. 707,*1*; 709,*1*. **F. guerangeri* (EUDES-DESLONGCHAMPS), Fr. (Sarthe); 707,*1a-e*, brach.v., lat., ant., ped.v., post. views, ×1; 709,*1a-l*, ser. transv. secs., ×1.2 (252).

Flabellothyris E. EUDES-DESLONGCHAMPS, 1884, p. 293 [**Terebratula flabellum* DEFRANCE, 1828, p. 160; OD]. Small, valves slightly convex, flabellate, anterior commissure plane to incipiently uniplicate, multiplicate, ill-defined fold and sulcus; umbo massive, short, foramen large, beak ridges angular, mesothyridid, deltidial plates disjunct to conjunct, commonly concealed, pedicle collar developed. Crural bases given off ventrally; cardinal process present; median septum thin plate supporting hinge plates posteriorly only; hinge plates in section demarcated from inner socket ridges, ventrally directed, slightly concave; dental plates short. [Specimens from L.Jur. and U.Cret. are homeomorphs.] *M.Jur.(Bathon.)*, Eu.(Eng.-Fr.).

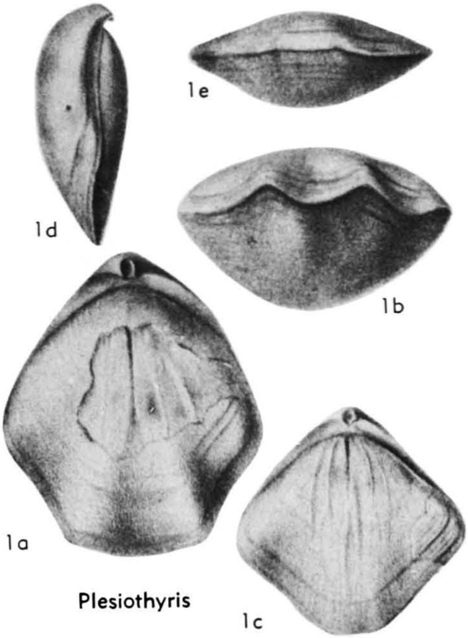


FIG. 704. Zeilleriidae (p. *H*827-*H*828).

——FIG. 705,*8*; 709,*2*. **F. flabellum* (DEFRANCE), Fr.; 705,*8a-c*, brach.v., lat., ant., views, ×4; 709, *2a-h*, ser. transv. secs., ×1.2 (253).

Gusarella PROZOROVSKAYA, 1962, p. 111 [**Zeilleria gusarensis* MOISSEEV, 1944, p. 58; OD]. Medium-sized, biconvex, or pedicle valve carinate, elongate-pentagonal in outline, anterior commissure incipiently uniplicate; umbo moderately incurved, beak ridges angular, ?permesothyridid, pedicle collar absent. Loop long, delicate, transverse band rather posterior; hinge plates W-shaped, resembling those of *Rugitela*, but lacking median septum; dorsal adductor scars large, oval; dental plates short. *U.Jur.(Callov.)*, Asia(W.Turkoman near Caspian Sea).——FIG. 700,*1*. **G. gusarensis* (MOISSEEV); *1a-c*, brach.v., lat., ant. views, ×0.7; *1d*, loop, ×0.7; *1e*, brach.v. int. mold, ×0.7 (649).

Modestella E. F. OWEN in CASEY, 1961, p. 573 [**M. modesta*; OD]. Small, biconvex, cinctiform shells, ligate or strangulate anteriorly, anterior commissure plane; umbo produced, suberect, beak ridges angular, mesothyridid, foramen large, pedicle collar not observed, deltidial plates disjunct to conjunct. Crural bases given off ventrally, dorsal septum half of valve length; hinge plates not distinguishable in section from inner socket ridges, ventrally inclined, septalium exceptionally deep, V-shaped; dental plates short, angled. *L. Cret.(Alb.)*, Eu.(S.Eng.).——FIG. 705,*10*; 709,*3*. **M. modesta*; 705,*10a-c*, brach.v., lat., ant. views, ×3; 709,*3a-h*, ser. transv. secs., ×1.2 (127).

Obovothyris S. S. BUCKMAN, 1927, p. 32 [**O.*

magnobovata; OD]. Small to medium-sized, sulcocarinate, becoming biconvex, subpentagonal, with angular anterolateral carinae; umbo suberect to incurved, beak ridges short, subangular, permesothyridid, pedicle collar with stout septum. Crural bases given off dorsally; dorsal median septum high, slightly greater than half of valve length and supporting hinge plates; septalium very

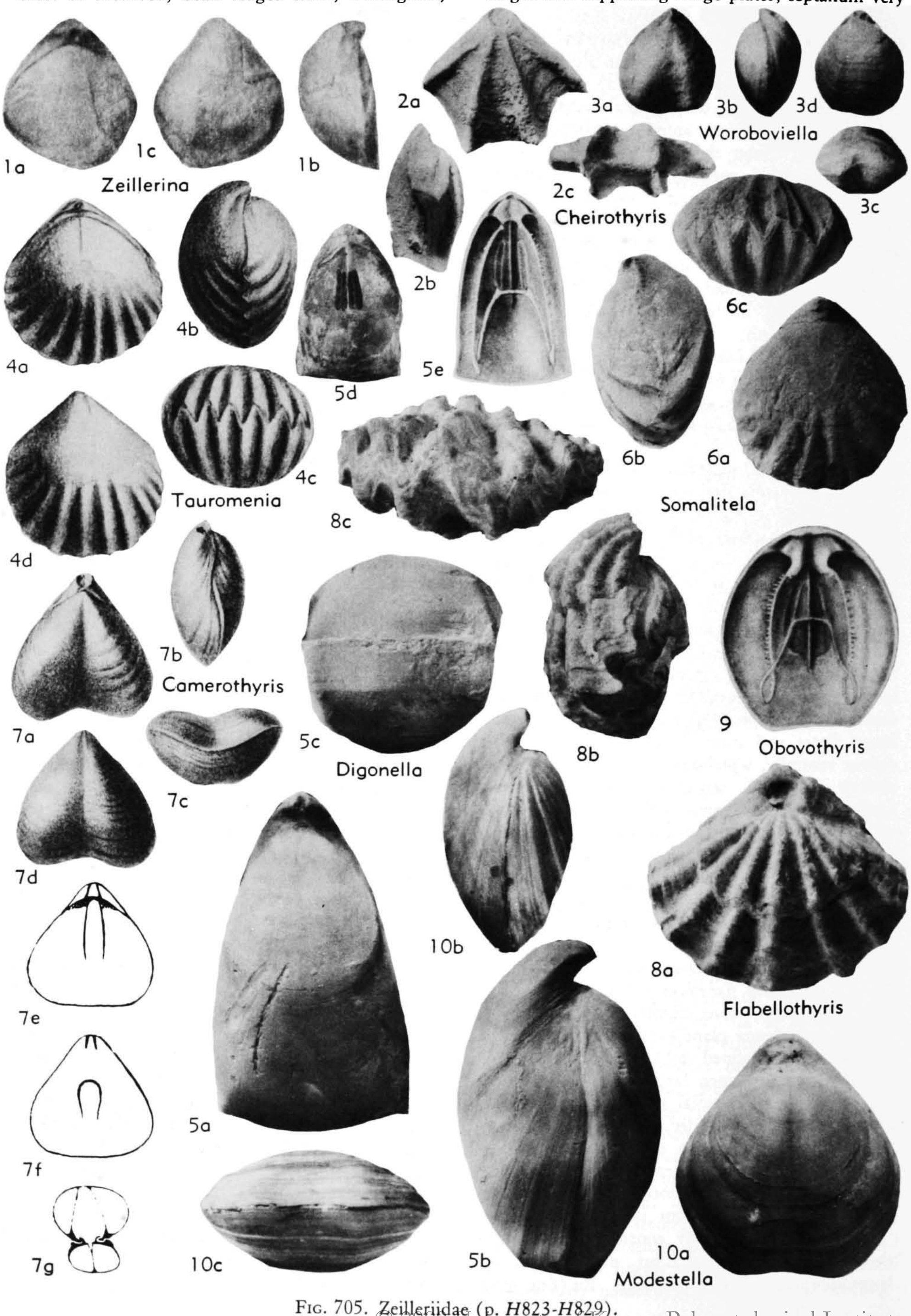


FIG. 705. Zeilleriidae (p. H823-H829).

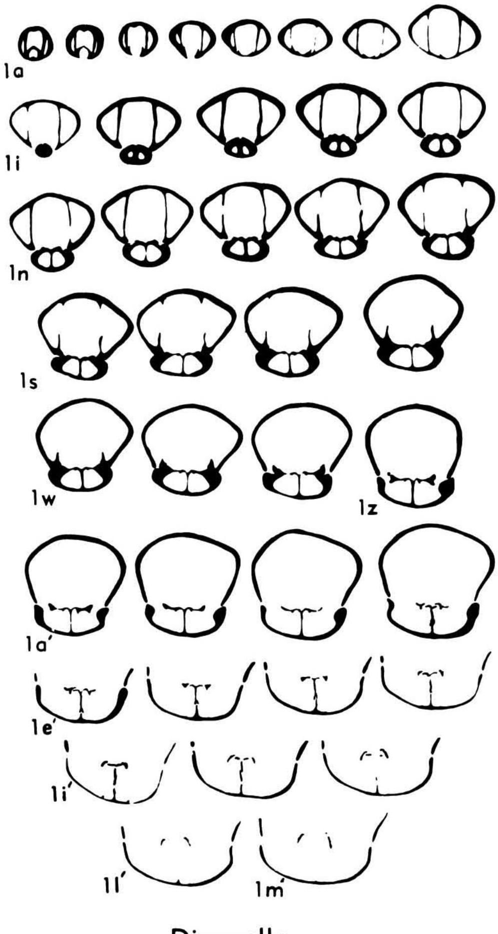


FIG. 706. Zeilleriidae (p. *H*824-*H*825).

shallow, rounded, hinge plates not demarcated from inner socket ridges, slightly convex ventrally; dorsal adductor scars elongate-oval tapering posteriorly; dental plates short, curved. *M.Jur. (Bathon.),* Eu.(Eng.-Fr.).——FIG. 700,*4*; 705,*9*; 710,*1*. **O. magnobovata,* L.Cornbrash, Eng.; 700, *4a-c,* brach.v., lat., ant. views, ×1.3; 700,*4d,* dorsal adductor scars, ×1.3; 705,*9,* loop (reconstr.), ×1; 710,*1a-z,* ser. transv. secs., ×1.2 (576).

Ornithella E. EUDES-DESLONGCHAMPS, 1884, p. 273 [**Terebratula ornithocephala* J. SOWERBY, 1815, p. 227; OD] [=*Microthyris* E. EUDES-DESLONGCHAMPS, 1884, p. 274 (*non* LEDERER, 1863)= *Microthyridina* SCHUCHERT & LEVENE, 1929, p. 120 (type, *Terebratulites lagenalis* VON SCHLOTHEIM, 1820, p. 284)]. Small to medium-sized, biconvex, elongate-oval to pentagonal, ligate or strangulate anteriorly, anterior commissure plane; umbo suberect to incurved, beak ridges short, rounded, permesothyridid, pedicle collar rarely observed. Crural bases given off ventrally; median septum less than half of valve length, supporting hinge plates, which in section are slightly deflected ventrally, becoming gently undulating, with shallow V-shaped septalium commonly filled with callus knob; adductor scars lens-shaped, set at slight angle to septum; dental plates short, curved, converging. *M. Jur.(Bajoc.-Bathon.)-U. Jur.(Callov.), ?Cret.,* Eu.——FIG. 703,*1*; 710,*2*. **O. ornithocephala* (J. SOWERBY), Bathon. (L. Cornbrash), Eng.; 703,*1a-c,* brach.v., lat., ant. views of holotype, ×1.3; 703,*1d,* dorsal adductor scars, ×0.7; 703,*1e,* ventral muscle scars, ×0.7; 703,*1f,* loop (reconstr.), ×0.8; 710,*2a-z, 2a′-b′*, ser. transv. secs., ×1 (576).

Plesiothyris DOUVILLÉ, 1879, p. 275 [**Terebratula (Waldheimia) verneuili* E. EUDES-DESLONGCHAMPS, 1864, p. 268 (sep. publ. 1863); OD]. Medium-sized, pentagonal, moderately biconvex, anteriorly bilobate or quadrilobate, anterior commissure plane or sulciplicate; umbo suberect to incurved, beak ridges angular strong, demarcating interarea, symphytium short. Loop presumed to be

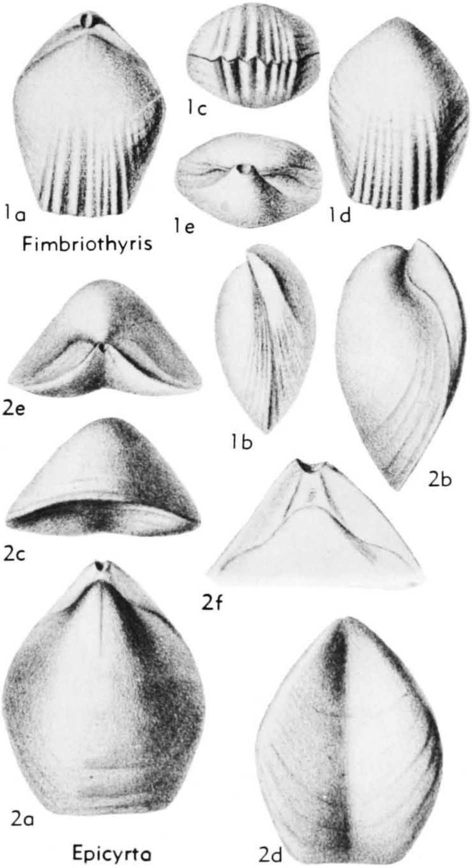


FIG. 707. Zeilleriidae (p. *H*825).

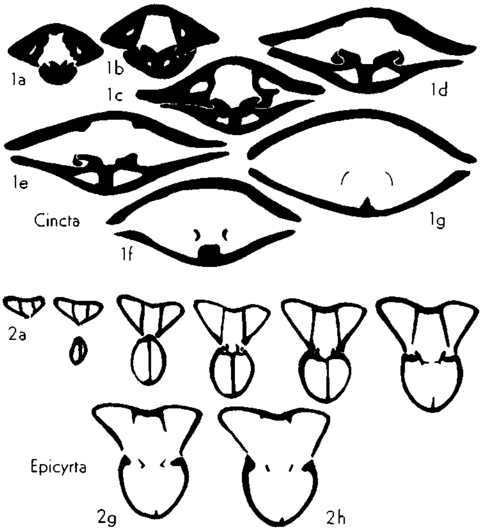


FIG. 708. Zeilleriidae (p. H824-H825).

zeilleriiform; dorsal septum about half of valve length; dental plates present. *L.Jur.*, Eu.(Spain-Fr.).——FIG. 704,*1*. **P. verneuili* (EUDES-DESLONGCHAMPS), M.Lias., Spain; *1a-b*, brach.v., ant., views of adult specimens (lectotype, herein), ×1; *1c-e*, immature specimen, brach.v., lat., ant. views, ×1 (253).

Rugitela MUIR-WOOD, 1936, p. 121 [**Terebratula bullata* J. DE C. SOWERBY, 1823, p. 49; OD]. Medium-sized, elongate-oval, sulcocarinate in early stages, becoming biconvex, commonly globose, anteriorly ligate or bilobate; umbo suberect to incurved, beak ridges short, subangular, mesothyridid, or permesothyridid, telate, pedicle collar rarely observed; shell surface with concentric rugae. Crural bases given off dorsally, loop possibly without spines; median septum long, about 0.7 length of valve, supporting hinge plates posteriorly, septalium shallow, replaced by callus ridge anteriorly; hinge plates and inner socket ridges and median callosity form W-shaped structure; adductor scars elongate-oval; dental plates short and slightly divergent. *M.Jur.(Bathon.), ?L.Cret.(Neocom.)*, Eu.(Eng.-Fr.).——FIG. 700,*2a-d*. **R. bullata* (J. DE C. SOWERBY), M.Jur.(Fullers Earth Rock), Eng.; 700,*2a-c*, brach.v., lat., ant. views, ×1.3; 700,*2d*, long. sec. showing loop, ×1.3 (579).——FIG. 700,*2e*; 711,*2*. *R. cadomensis* (EUDES-DESLONGCHAMPS); 700,*2e*, brach.v. int. mold showing median septum and adductor scars, ×0.7; 711,*2a-k*, ser. transv. secs., ×1.2 (579).

Somalitela MUIR-WOOD, 1935, p. 140 [**S. ambalensis*; OD]. Small, valves biconvex, anterior commissure incipiently uniplicate; umbo flattened, suberect, permesothyridid, telate, deltidial plates conjunct; anterior half of valves with prominent, angular plications. Loop given off dorsally; dorsal septum about half of valve length, supporting hinge plates posteriorly; inner socket ridges not separable from hinge plates, slightly concave ventrally, median callosity replacing septalium and whole structure with flattened W-shaped section; dental plates short. *U.Jur.(?Kimmeridg.)*, Afr.(Somaliland).——FIG. 705,*6*; 711,*1*. **S. ambalensis*; 705,*6a-c*, brach.v., lat., ant. views, ×2; 711, *1a-h*, ser. transv. secs., ×1.2 (577).

Tauromenia SEGUENZA, 1885, p. 253, footnote [**T. polymorpha*; OD] [*non Tauromenia* FUCINI, 1931]. Small, circular to elongate-oval or pentagonal, biconvex, without definite fold or sulcus, anterior commissure plane, multiplicate; umbo small, short, beak ridges angular, impersistent, permesothyridid, deltidial plates conjunct, short; anterior half of valves prominently costate. Loop given off ventrally; dorsal median septum less than half of valve length, supporting hinge plates; inner socket ridges not differentiated from hinge plates, in section slightly convex ventrally with shallow septalium; dental plates short. [Probably same as *Fimbriothyris*.] *?U.Trias.(Rhaet.)*, Eu.(Italy); *L.Jur.(L.Lias.)*, Eu.(Italy-Port.-Spain)-N.Afr.——FIG. 705,*4*. **T. polymorpha*, L.Lias., Sicily; *4a-d*, brach.v., lat., ant., ped.v. views, ×1 (771).

Walkeria HAAS, 1890, p. 102, footnote *(nom. nud.)* (*non Walkeria* FLEMING, 1828). Proposed for forms of *Zeilleria* with spines on both ascending and descending branches of loop. No type-species designated.

Woroboviella DAGIS, 1959, p. 33 [**W. caucasica*; OD]. Small, valves biconvex, with shallow dorsal median sulcus, anterior commissure slightly sulcate; umbo short, curved, mesothyridid. Loop long, with narrow descending branches, broad

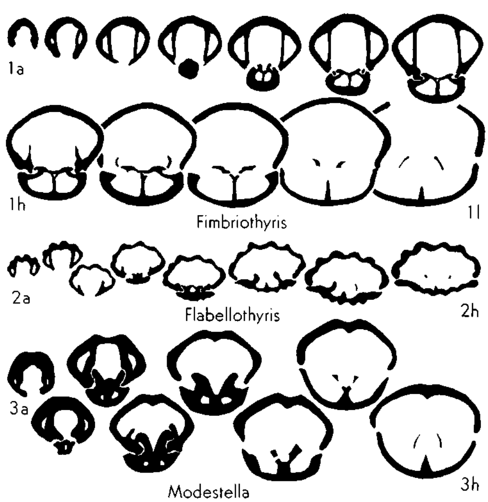


FIG. 709. Zeilleriidae (p. H825).

ascending branches, and narrow convex transverse band; hinge plates and inner socket ridges dorsally inclined, septalium shallow; median sep-

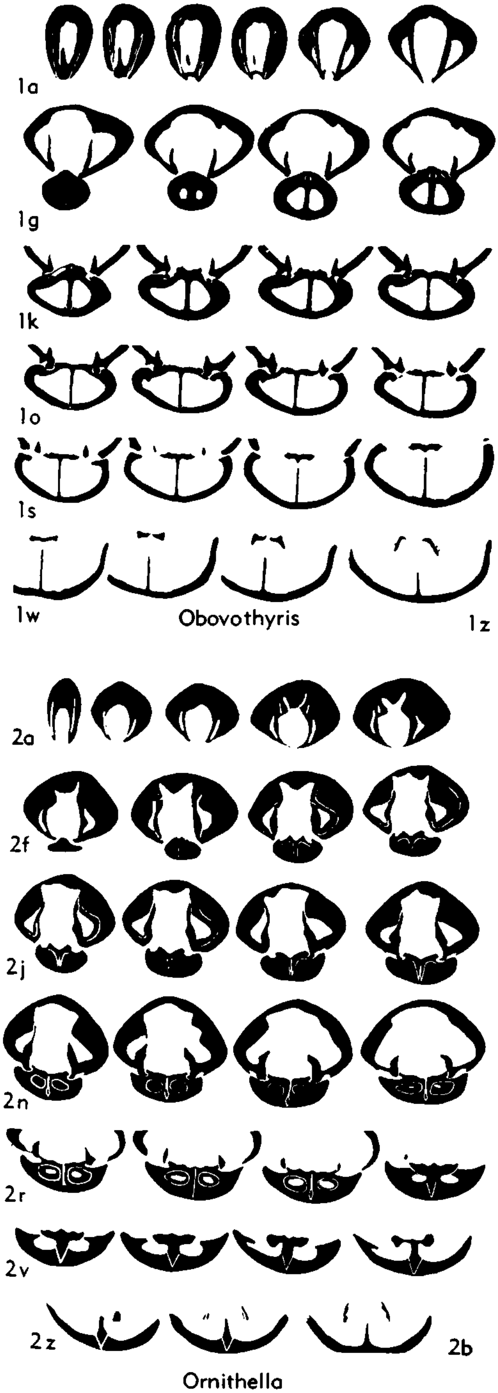


FIG. 710. Zeilleriidae (p. *H*825-*H*827).

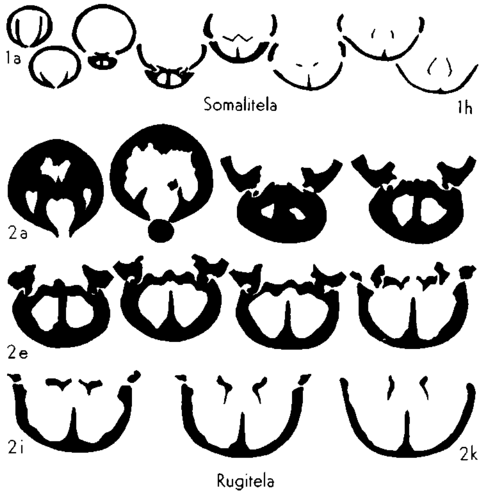


FIG. 711. Zeilleriidae (p. *H*828).

tum 0.3 length of valve, not attached to loop; dental plates short, slightly divergent. *U.Trias. (Nor.),* Eu.(NW.Caucasus).——FIG. 705,*3*; 712, *1*. **W. caucasica,* 705,*3a-d,* brach.v., lat., ant., ped.v. views of holotype, ×1; 712,*1a-u,* ser. transv. secs., ×1 (210).

Zeillerina KYANSEP, 1959, p. 119 [**Zeilleria belbekensis* MOISSEEV, 1934, p. 149; OD]. Differs from *Zeilleria* in its depressed convex, oval-pentagonal valves, anterior commissure incipiently uniplicate; more produced slightly incurved umbo, shorter and less angular beak ridges, development of pedicle collar, cardinal process and no septalium, crural bases given off ventrally; median septum 0.5 to 0.75 of valve length; hinge plates and inner socket ridges in section not differentiated and dorsally deflected; straight dental plates. *U.Jur. (Oxford.-Kimmeridg.),* Eu. (Ger.-Fr.-Switz.-USSR).——FIG. 705,*1*; 712,*2*. **Z. belbekensis* (MOISSEEV), Kimmeridg., Crimea; 705,*1a-c,* brach. v., lat., ped.v. views, ×1; 712,*2a-u,* ser. transv. secs., ×1 (495).

Family EUDESIIDAE Muir-Wood, n. fam.

Loop zeilleriid, given off dorsally; adult cardinal process complicated in structure, hollow, with 2 small cavities, trilobed, prominent, and elevated above fused thickened hinge plates, which commonly are pierced by 3 small cavities; median dorsal septum and dental plates present; shell, biconvex, fully costate or costellate. *M.Jur.(Bathon.).*

Eudesia KING, 1850, p. 144 [**Terebratula orbicularis* J. DE C. SOWERBY, 1826, p. 68 (=**T. cardium* VALENCIENNES in LAMARCK, 1819, p. 255); OD]. Small to medium-sized, elongate-oval, anterior

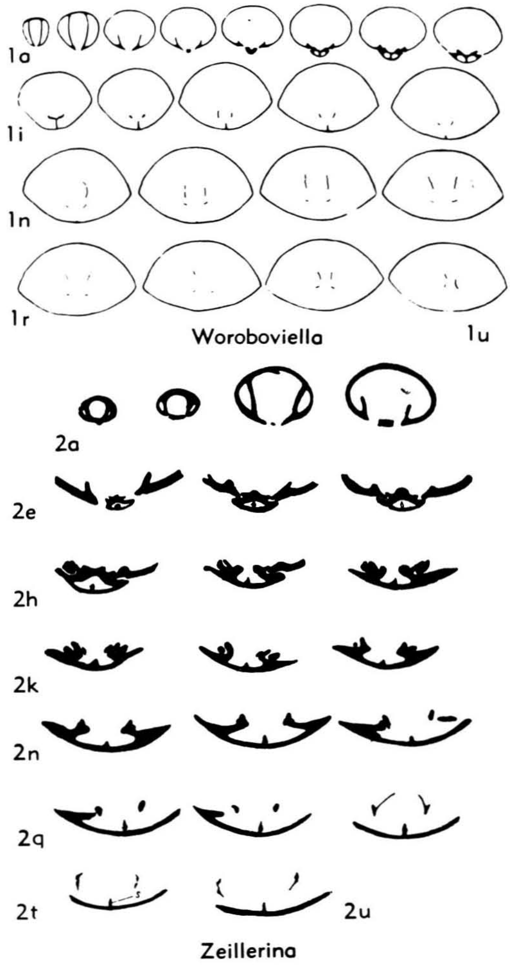


FIG. 712. Zeilleriidae (p. *H*828-*H*829).

commissure plane, multiplicate; umbo short, massive, suberect or incurved, concealing deltidial plates, foramen large, beak ridges obscure, ?mesothyridid, pedicle collar present. Hinge plates in section not distinguishable from inner socket ridges, slightly convex ventrally, keeled, median septum about 0.5 of valve length, supporting hinge plates in some species; dental plates subparallel, short. *M.Jur.(Bathon.)*, Eu.-Asia-Afr.——FIG. 713, *1*; 714,*1*. **E. cardium* (VALENCIENNES), Fr.; 713, *1a-c*, brach.v., lat., ant. views, ×1; *1d*, loop, ?×1.5; 714,*1a-p*, ser. secs., ×1.2 (253).

Superfamily TEREBRATELLACEA King, 1850

[*nom. transl.* ALLAN, 1940, p. 269 (*ex* Terebratellidae KING, 1850, p. 245)] [Materials of this superfamily prepared by G. F. ELLIOTT and KOTORA HATAI as indicated]

Brachial loop long, undergoing development in association with median septum, lophophore up to schizolophous stage, loop in advanced genera developing both from cardinalia and median septum but ultimately becoming free from septum which is partly or entirely resorbed (614). *U.Trias.-Rec.*

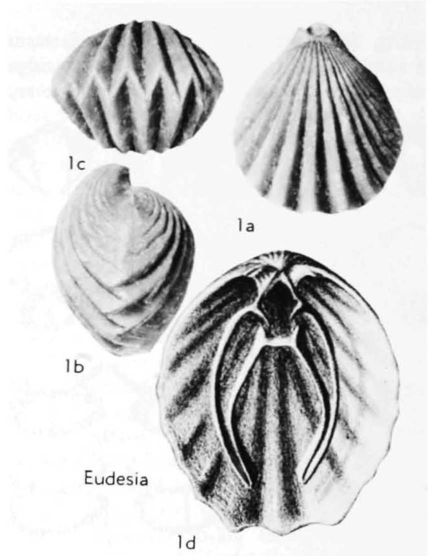


FIG. 713. Eudesiidae (p. *H*829-*H*830).

Family MEGATHYRIDIDAE Dall, 1870

[*nom. correct.* HATAI & ELLIOTT, herein (*pro* Megathyridae ALLAN, 1940, p. 269, *nom. transl. ex* Megathyrinae DALL, 1870, p. 100)] [Materials for this family prepared by KOTORA HATAI and G. F. ELLIOTT, with addition by R. C. MOORE as indicated, diagnosis of family by HATAI]

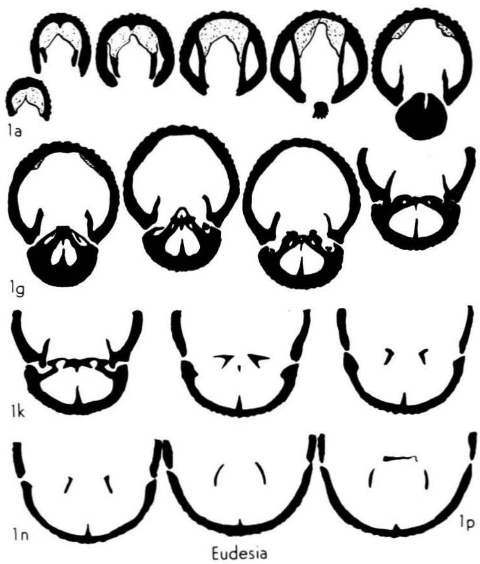


FIG. 714. Eudesiidae (p. *H*829-*H*830).

Loop composed of descending branches only, passing in most advanced genus through stages correlative with *Gwynia, Argyrotheca,* and *Megathiris,* lower genera not completing the series; lophophore trocholophous to ptycholophous; posterior margin strophic or nearly so; spicules absent or very feebly developed; dental plates absent (810). *U.Cret.-Rec.*

Megathiris D'ORBIGNY, 1847, p. 269 [*pro Argiope* EUDES-DESLONGCHAMPS, 1842, p. ix (*non* AUDOUIN in SAVIGNY, 1827)] [**Anomia detruncata* GMELIN, 1792; OD] [=*Megathyris* BRONN, 1848, p. 244 (*nom. van.*); *Argyope* DAVIDSON, 1850, p. 65 (*non* SAVIGNY, 1826)]. Biconvex to multiplicate opposite with 8 to 14 rounded opposite plicae; foramen submesothyridid, deltidial plates disjunct. Hinge teeth small, no dental plates; cardinalia with low hinge platform uniting 2 prominent socket ridges; cardinal process small; 2 lateral septa reaching to near middle of brachial valve; crura short; loop of 2 descending branches free only near crura, attached to sides of median septum; lophophore attached to dorsal mantle, ptycholophous; adductor muscles attached to pedicle valve in front of diductors; ventral pedicle muscles attached to hinge platform (810). *U.Cret.,* Eng.-Fr.; *Eoc.,* Italy; *Oligo.,* Ger.; *Mio.,* Italy; *Plio.,* Eu.; *Rec.,* Medit.-E.Atl. (Guernsey to Madeira and Aegean Sea, 32-260 m.).——FIG. 715,*3.* **M. detruncata* (GMELIN), Rec., Medit.; *3a,* brach. v. int.; *3b,c,* brach.v., ped.v. views, all ×5.4 (244). [HATAI.] [Several species are recorded from Upper Cretaceous strata of Europe (e.g., *M. davidsoni* BOSQUET).—ELLIOTT.]

Argyrotheca DALL, 1900, p. 44 [**Terebratula cuneata* RISSO, 1826, p. 388; OD] [=*Cistella* GRAY, 1853, p. 114 (*non* GISTL, 1848)]. Biconvex to strangulate to oppositely multiplicate, smooth or more commonly multiplicate, punctae rather coarse; beak fairly short, subtruncate; foramen large, submesothyridid but almost hypothyridid; deltidial plates small; pedicle collar well developed, supported by median septum. Cardinal process forming transversely elongate, subrectangular boss that projects slightly behind posterior margin, buttressed by median septum; crura widely separate, short; loop relatively long, formed of 2 descending branches, anteriorly converging to join end of median septum; lophophore large, schizolophous (810). *U.Cret.,* Eu.-N.Am.; *Eoc.,* Eu.-N.Am.-S.Am.-W.Ind.; *Oligo.,* Eu.-Mex.; *Mio.,* Eu.(USSR)-N.Am.-W.Ind.-N.Z.; *Plio.,* Eu.(Eng.-Italy); *Rec.,* Atl.(60-1280 m.)-Pac. (160 m.)-Medit.(60-400 m.).——FIG. 715,*4.* **A. cuneata* (RISSO), Rec., Medit.; *4a,b,* brach.v. int., ped.v. int., ×11 (244). [HATAI.] [Several species from Upper Cretaceous rocks are known from Europe (e.g., *A. megatremoides* BOSQUET) and North America.—ELLIOTT.]

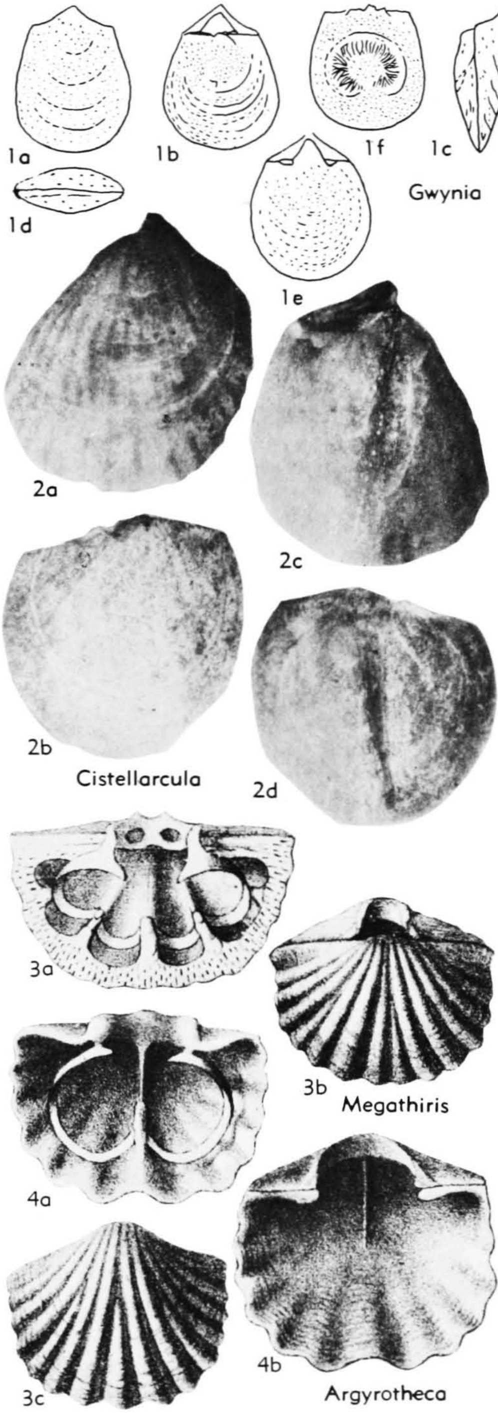


FIG. 715. Megathyrididae (p. H831-H832).

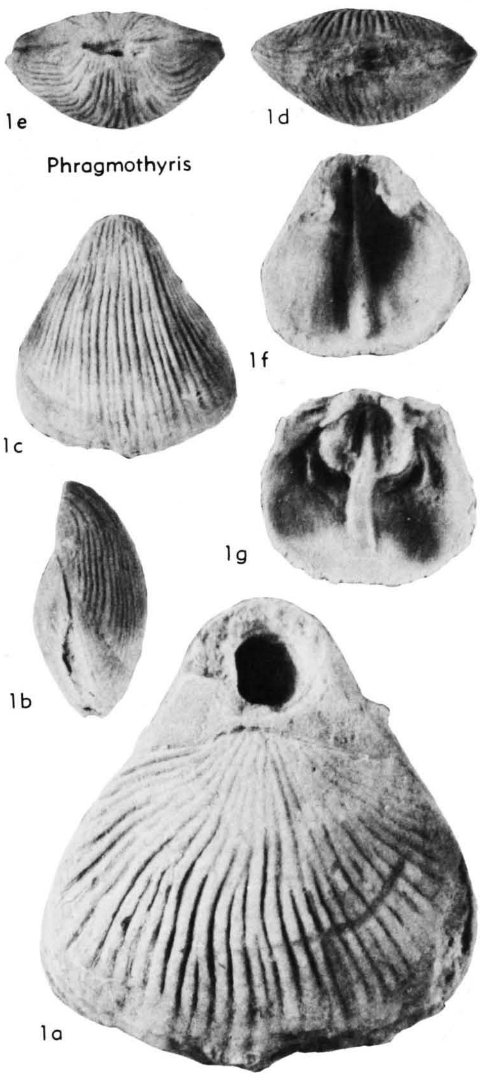


FIG. 716. Megathyrididae (p. H832).

Cistellarcula ELLIOTT, 1954, p. 726 [**C. wrigleyi*; OD]. Elongate, sulcate, low triangular interarea, triangular pedicle opening, pedicle collar supported by median septum. Cardinalia with median trough, high socket ridges and high median septum (284). *Eoc.*, Fr.——FIG. 715,*2*. **C. wrigleyi*; *2a,b*, ped.v. and brach.v. ext., ×5; *2c,d*, ped.v. and brach.v. int., ×5 (284). [HATAI.]

Gwynia KING, 1859, p. 258 [**Terebratula capsula* JEFFREYS, 1859, p. 43; OD]. Pouch-shaped, almost linguloid, minute, biconvex rectimarginate, smooth, thin, punctae rather large and remote; rostrum apicate, foramen delthyridid, deltidial plates rudimentary. Hinge teeth without dental plates, no hinge plates; cardinalia weak, cardinal process minute, lophophore trocholophous, attached to dorsal mantle, no median septum, traces of loop with its lower sides cemented to valve (810). *Pleist.(postglacial)*, Norway; *Rec.*, E.Atl. (16-4,400 m.)-Fr.-Neth.——FIG. 715,*1*. **G. capsula* (JEFFREYS); Rec., E.Atl.; *1a-d*, ped.v., brach. v., lat., ant. views, ×9; *1e,f*, ped.v. int., brach.v. int., ×9 (299). [HATAI.]

Phragmothyris COOPER, 1955, p. 65 [**P. cubensis*; OD]. Small, width ranging to 15 mm., moderately to strongly biconvex, pedicle valve deeper than brachial, anterior commissure rectimarginate to broadly sulcate; surface multicostellate; large submegathyridid foramen, symphytium rarely complete. Hinge teeth large, not supported by dental plates, median ridge extending from beak nearly to front margin; brachial valve with wide, deep sockets bounded by elevated socket ridges; adductor muscle scars on elevated platform, with median septum rising well above it; loop consisting of broad ribbon which extends around muscle platform and unites with floor of valve beneath it. *Eoc.-Oligo.*, Cuba.——FIG. 716,*1*. **P. cubensis*; Eoc., Camaguey Prov.; *1a*, brach.v. view (holotype), ×4; *1b-e*, lat., ped.v., ant., post. views, ×3; *1f,g*, ped.v. int., brach.v. int., ×3 (187). [MOORE.]

Family PLATIDIIDAE Thomson, 1927

[*nom. transl.* ALLAN, 1940, p. 269 (*ex* Platidiinae THOMSON, 1927, p. 215)] [Materials for this family prepared by KOTORA HATAI and G. F. ELLIOTT as indicated, diagnosis of family by HATAI]

Plano-convex, amphithyridid, spiculate forms with loop in most advanced genera composed of descending and ascending branches separately attached to median septum, lophophore plectolophous (810). *Eoc.-Rec.*

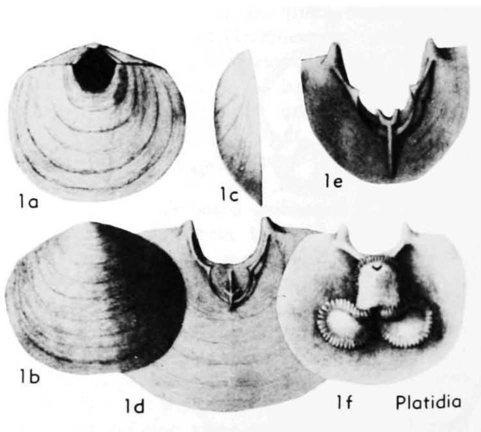


FIG. 717. Platidiidae (p. H833).

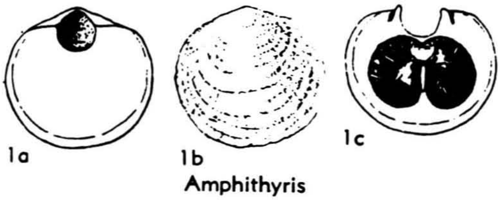


FIG. 718. Platidiidae (p. *H*833).

Platidia COSTA, 1852 (Jan.), p. 47 [**Orthis anomioides* SCACCHI & PHILIPPI, 1844, p. 69; OD]. [=*Morrisia* DAVIDSON, 1852, p. 371 (May)]. Smooth or with radiating lines or spinules on pedicle valve, shell thin and penetrated by minute caeca; deltidial plates narrow, pedicle collar short, sessile. Hinge teeth with feeble dental plates; crura long, converging, crural processes short; descending branches of loop converging. Dorsal pedicle muscles attached to inner side of cardinalia; mantles, body wall, brachial membrane, and bases of filaments strongly spiculate (810). *Eoc.*, N.Am.; *Oligo.*, Ger.-Italy; *Mio.*, Italy-Pol.; *Plio.*, Italy; *Pleist.*, N.Am. *Rec.*, cosmop.(E. Atl., 50-1340 m.; W.Atl.-Carib., 170-1290 m.; E. Pac., 100-400 m.; W.Pac., 130 m.).——FIG. 717, *1*. **P. anomioides* (SCACCHI & PHILIPPI); Rec., E. Atl.; *1a-c*, brach.v., ped.v., lat. views, ×1.2; *1d,e*, brach.v. int., ×1.8, ×1.2; *1f*, brach.v. int. showing lophophore, ×1.2 (810). [HATAI.]

Amphithyris THOMSON, 1918 [**A. buckmani*; OD]. Broadly suborbicular, capillate, punctae fine and dense; hinge line nearly straight. Beak apicate, triangular delthyrium in pedicle valve and semicircular notch in cardinal margin of brachial valve, dorsal umbo being resorbed. Hinge teeth without dental plates or swollen bases; cardinalia with socket ridges only, no loop, median septum fairly high, lophophore schizolophous, supported by spicules (810). *Rec.*, N.Z.-Medit.——FIG. 718,*1*. **A. buckmani*, N.Z.; *1a,b*, brach.v., ped.v. views of whole shell, ×3.5; *1c*, brach.v. int., ×3.5 (299). [HATAI.]

Family KRAUSSINIDAE Dall, 1870

[*nom. transl.* ALLAN, 1940 (*ex* Kraussininae DALL, 1870)] [=Mühlfeldtiinae OEHLERT, 1887] [Materials for this family prepared by KOTORA HATAI]

Spiculate, without dental plates and with zygolophous to plectolophous lophophores, loop in most advanced genera composed of ascending lamellae attached to low median septum and descending lamellae attached to sides of ring formed by ascending lamellae; in more primitive genera ring of ascending lamellae not completed ventrally and descending lamellae not developed at all or only incipiently (810). *Mio.-Rec.*

Kraussina DAVIDSON in SUESS, 1859, p. 210 [*pro Kraussia* DAVIDSON, 1852, p. 369 (**Anomia rubra* PALLAS, 1776, p. 182; SD DAVIDSON, 1853, p. 69) (*non Kraussia* DANA, 1852)]. Biconvex to sulcate, smooth or multicostate, punctae conspicuous; hinge line broad, beak subtruncate, foramen submesothyridid, deltidial plates disjunct; pedicle collar fused to floor in umbonal cavity. Hinge teeth without dental plates; cardinalia with socket ridges projecting behind hinge line, cardinal process small, prominent; dorsal adductor impressions strong, separated by median septum behind brachidium, which consists of 2 stout di-

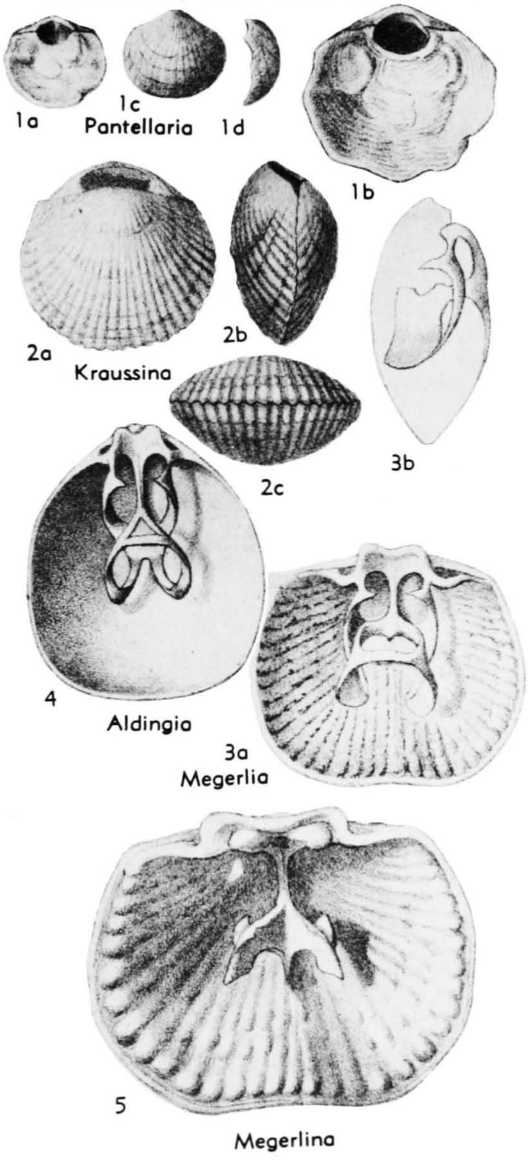


FIG. 719. Kraussinidae (p. *H*833-*H*834).

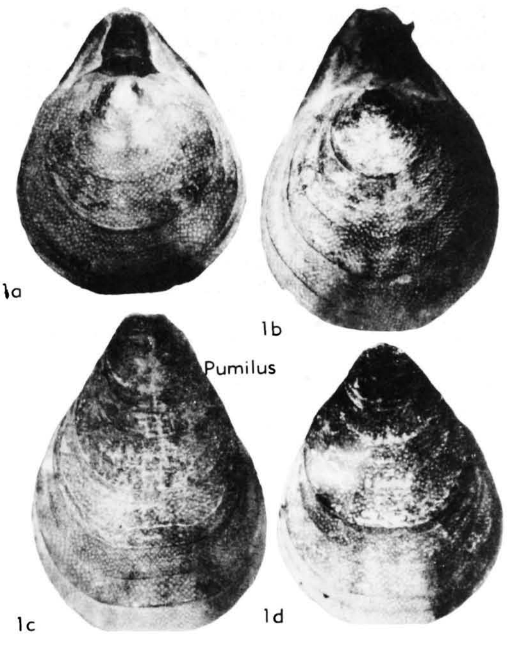


FIG. 720. Kraussinidae (p. H834).

vergent processes extending lateroventrally from median septum; mantle canals of 2 large trunks commencing close to cardinalia, terminating anteriorly close to median line, each canal giving off 6 or 7 branches which bifurcate as they reach shell margin; spicules very small (810). *Rec.*, Ind.O.(20-300 m.).——FIG. 719,2. **K. rubra* (PALLAS), S.Afr.; *2a-c*, brach.v., lat., ant. views, ×1 (244).

Aldingia THOMSON, 1916, p. 501 [**Terebratella furculifera* TATE, 1880, p. 161; OD]. Incipiently sulcate, punctae fine and dense; beak suberect, foramen submesothyridid, deltidial plates almost united. Hinge teeth with swollen bases, grooved for reception of socket ridges; hinge trough moderately large but with median ridge extending anteriorly halfway from umbo. Brachial valve thickened posteriorly to form platform, buttressed by short median septum, crural bases fused with socket ridges; cardinal process low, loop long, reflected, descending branches attached by connecting bands to sides of septum, ascending branches united to top of septal pillar by connecting bands. Ventral muscular impressions strong (810). *Mio.(Janjukian)*, Australia; *Rec.* (220-240 m.), Australia.——FIG. 719,4. *A. willemoesi* (DAVIDSON), Rec., Australia; brach.v. int., ×3 (244).

Megerlia KING, 1850, p. 145 [**Anomia truncata* LINNÉ, 1767, p. 1152; OD] [not preoccupied by *Megerlea* ROBINEAU-DESVOIDY, 1830] [=*Mühlfeldtia* BAYLE, 1880, p. 240]. Incipiently narrowly sulcate, capillate, striae slightly nodulose, interior of valves radially tuberculate; foramen submesothyridid, deltidial plates disjunct, pedicle collar free anteriorly. Pedicle valve with small median septum extending up under pedicle collar but not supporting it; cardinalia consisting of widely divergent socket ridges, excavate below, to inner sides of which crural bases are attached, no cardinal process, loop forming complete ring, on median septum, descending branches extending from cardinalia to ring; filaments long, slender, and numerous. Brachial valve with 2 long central mantle canals and 2 much larger many-branched lateral canals; spicules present both in mantle and arms (810). *Mio.-Plio.*, Italy-Fr.; *Plio.-Rec.*, Gibraltar-Algeria; *Rec.*, Medit.-E.Atl.(60-600 m.)-Ind. O.-Pac.O., Persian Gulf.——FIG. 719,3. **M. truncata* (LINNÉ), Rec., Medit.; *3a*, brach.v. int. showing loop, ×2; *3b*, shell int. lat. showing loop, ×2 (237).

Megerlina EUDES-DESLONGCHAMPS, 1884, p. 243 [**Kraussia lamarckiana* DAVIDSON, 1852, p. 80; OD]. Sulcate, with fine alternate multiplication developing directly upon smooth stage, punctae fine, interior tuberculate; beak suberect, foramen submesothyridid but almost hypothyridid, deltidial plates discrete; pedicle collar anteriorly excavate, embayed in middle. Hinge teeth without dental plates; socket ridges rather stout, giving off on their inner anterior corners 2 spurs which approach septum without joining it and thus enclosing an imperfect hinge trough; cardinal process feeble; median septum with 2 diverging Y-shaped lamellae slightly expanded at their extremities in front and concave toward each other. Spicules stouter than in *Kraussina* (810). *Neog.*, Tasm.; *Rec.*, Australia.——FIG. 719,5. **M. lamarckiana* (DAVIDSON), Rec., Australia (New S. Wales); brach.v. int., ×4.5 (244).

Pantellaria DALL, 1919, p. 251 [**Terebratula monstruosa* SCACCHI, 1836, p. 8; OD]. Differs from *Megerlia* only in possessing amphithyridid instead of submesothyridid foramen, in flattening of brachial valve, and in absence of radial sculpture (221). *Mio.-Pleist.*, Italy; *Rec.*, Medit.-Adriatic-Aegean-Ind.O., E.Atl.(460-2780 m.)-W.Atl.——FIG. 719,1. **P. monstruosa* (SCACCHI), Rec., Medit., *1a,b*, brach.v. view, ×1, ×2; *1c,d*, ped.v., lat. views, ×1 (244).

Pumilus ATKINS, 1958, p. 560 [**P. antiquatus*; OD]. Adult lophophore schizolophous. Beak suberect; foramen incomplete; deltidial plates, narrow, disjunct; pedicle collar well developed. Hinge teeth without dental plates; no cardinal process or loop, median septum of brachial valve low, terminating anteriorly in small protuberance. Spicules present (42). *Rec.*, N.Z.——FIG. 720,1. **P. antiquatus*; *1a,b*, brach.v. views, ×9, ×10; *1c,d*, ped.v. views, ×10, ×9 (42).

Family DALLINIDAE Beecher, 1893

[*nom. transl.* ALLAN, 1940, p. 270 (*ex* Dallininae BEECHER, 1893, p. 391)] [Materials for this family prepared by G. F. ELLIOTT and KOTORA HATAI as indicated, diagnosis of family by ELLIOTT & HATAI]

Loop passing through all or part of precampagiform, campagiform, frenuliniform, terebrataliiform, and dalliniform growth stages, or modifications of these; spicules present in some forms but never abundant; dental plates generally present (810). *U.-Trias.-Rec.*

Subfamily DALLININAE Beecher, 1893

[Diagnosis of subfamily by G. F. ELLIOTT]

Folding sulcate to intraplicate; cardinal process small, loops campagiform, frenuliniform, terebrataliiform, or dalliniform. *L. Cret.-Rec.*

Dallina BEECHER, 1893, p. 377, 382 [**Terebratula septigera* LOVÉN, 1846, p. 29; OD]. Broadly sulcate to intraplicate, with tendency to quadriplication. Beak erect, no beak ridges; foramen large, mesothyridid, attrite; symphytium concave. Hinge teeth supported in young by dental plates which become thin with age and absent in adult; cardinalia with excavate hinge plates supported by median septum, separated into inner and outer parts by crural bases, cardinal process absent or rudimentary, shelflike; loop dalliniform (810). *?Eoc.*, Japan; *Mio.*, Italy-Japan; *Plio.*, Italy-Japan; *Pleist.*, Italy-Japan-Norway; *Rec.*, Atl.O.(40-1560 m.)-Pac.O.(90-210m.)-Medit.——FIG. 721,*3*. **D. septigera* (LOVÉN), Rec., NE.Atl.O.; *3a-d*, brach.v., lat., ped.v., ant. views, ×1; *3e*, brach.v. int., oblique lat. view showing loop, ×1.5 (244). [HATAI.]

Campages HEDLEY, 1905, p. 43 [**C. furcifera*; OD]. Rectimarginate to intraplicate, punctae fine; beak short, suberect to erect; foramen marginate, permesothyridid, symphytium narrow, pedicle-collar short. Hinge teeth strong, without dental plates or swollen bases; cardinalia with excavate hinge plates resting on median septum, cardinal process small, shelflike, loop early terebrataliiform, funnel-like in appearance (810). *Mio.-Rec.*, Japan; *Tert.*, N.Z.; *Rec.*, W.Pac.(140-1400 m.)-Ind.O. ——FIG. 721,*5*. **C. furcifera*, *Rec.*, Australia; *5a*, ped.v. ext., lat. view, ×1.8; *5b*, brach.v. int. showing loop (reconstr.), ×2.5; *5c*, slightly oblique lat. view of loop, ×2.5 (810). [HATAI.]

Chathamithyris ALLAN, 1932, p. 15 [**C. traversi*; OD]. Incipiently sulcate, punctae small and dense. Beak prominent, suberect; foramen mesothyridid, attrite; symphytium rather low. Cardinalia weak, loop terebrataliiform or early dalliniform (16). *Tert.*, N.Z.——FIG. 721,*7*. **C. traversi*, Tert., N.Z.; *7a,b*, brach.v. and lat. views, ×4.6 (16). [HATAI.]

Coptothyris JACKSON, 1918, p. 479 [**Terebratula grayi* DAVIDSON, 1852, p. 76 (=?*Magasella adamsi* DAVIDSON, 1871, p. 54); OD] [=*Thomsonia* JACKSON, 1916, p. 22 (*non* SIGNORET, 1879; *nec* KONOW, 1884); *Pereudesia* DALL, 1920, p. 360 (*nom. subst. pro Thomsonia*); *Cacata* STRAND, 1928, p. 38 (*pro Thomsonia*)]. Widely oval to transverse, hinge line long and little curved, sulcate, test coarsely and irregularly multiplicate, punctate; beak obtuse, foramen large, permesothyridid, deltidial plates conjunct, commonly broken, pedicle collar short, sessile. Hinge teeth with strong dental plates; cardinalia as in *Terebratalia*, median septum reduced, loop dalliniform (399). *Mio.-Rec.*, Japan-Korea.——FIG. 721,*4*. **C. grayi* (DAVIDSON), Rec., Korea Str.; *4a,b*, brach.v. and lat. views, ×1; *4c*, brach.v. int. showing loop (reconstr.), ×1 (244). [HATAI.]

Dallinella THOMSON, 1915, p. 75 [**Terebratalia obsoleta* BEECHER, 1893, p. 382, 392 (=*Terebratella occidentalis obsoleta* DALL, 1891, p. 186); OD]. Differs from *Terebratalia* in having permesothyridid foramen and narrowly intraplicate folding (810). *Mio.-Rec.*(100-220 m.), NW.Am. ——FIG. 721,*6*. **D. obsoleta* (BEECHER), Rec., brach.v. view, ×1 (220). [HATAI.]

Diestothyris THOMSON, 1916, p. 503 [**Terebratula frontalis* MIDDENDORFF, 1849, p. 518; OD]. Narrowly sulcate, thick, smooth, punctae rather large and widely spaced; beak large, obtuse; foramen submesothyridid, attrite; deltidial plates rudimentary; pedicle collar sessile, long, striate. Hinge teeth strong, with ventrally recessive dental plates; cardinalia strong, consisting of strong socket ridges separated by callous deposit; cardinal process low; median septum in front of valve; loop terebrataliiform. Dorsal adductor impressions strong, anterior and posterior muscle impressions lying side by side (810). *Mio.*, N.Am.; *Plio.*, N.Am.-E.Asia; *Pleist.*, N.Am.-Eu.; *Rec.*, N.Pac. [HATAI.]

D. (Diestothyris). Small to medium-sized, distinctly sulcate, foramen moderately large. *Mio.*, N.Am.; *Plio.*, N.Am.-Kamchatka-Japan; *Pleist.*, N.Am.; *Rec.*, N.Pac.-Okhotsk Sea-Japan Sea.——FIG. 722,*2*. **D. (D.) frontalis* (MIDDENDORFF), Rec., N.Pac.; brach.v. int. showing loop (reconstr.), ×2 (244). [HATAI.]

D. (Tisimania) HATAI, 1938, p. 97 [**Diestothyris tisimana* NOMURA & HATAI, 1936, p. 132; OD]. Differs from *D. (Diestothyris)* in large size, rectimarginate to incipient sulcate folding, smaller foramen, cardinalia of *Terebratalia* type, median septum intermediate between *Terebratalia* and *D. (Diestothyris)*, strong muscle impressions separated by septum in brachial valve and lying anterior to septal ridge in pedicle valve (399). *Rec.*, NW.Pac. [HATAI.]

Fallax ATKINS, 1960, p. 72 [**F. dalliniformis*; OD]. Hinge teeth supported by dental plates, pedicle collar sessile, folding sulcate to intraplicate, beak erect, beak ridges rounded. Cardinalia with platform and thick septum, hinge plates excavated, no

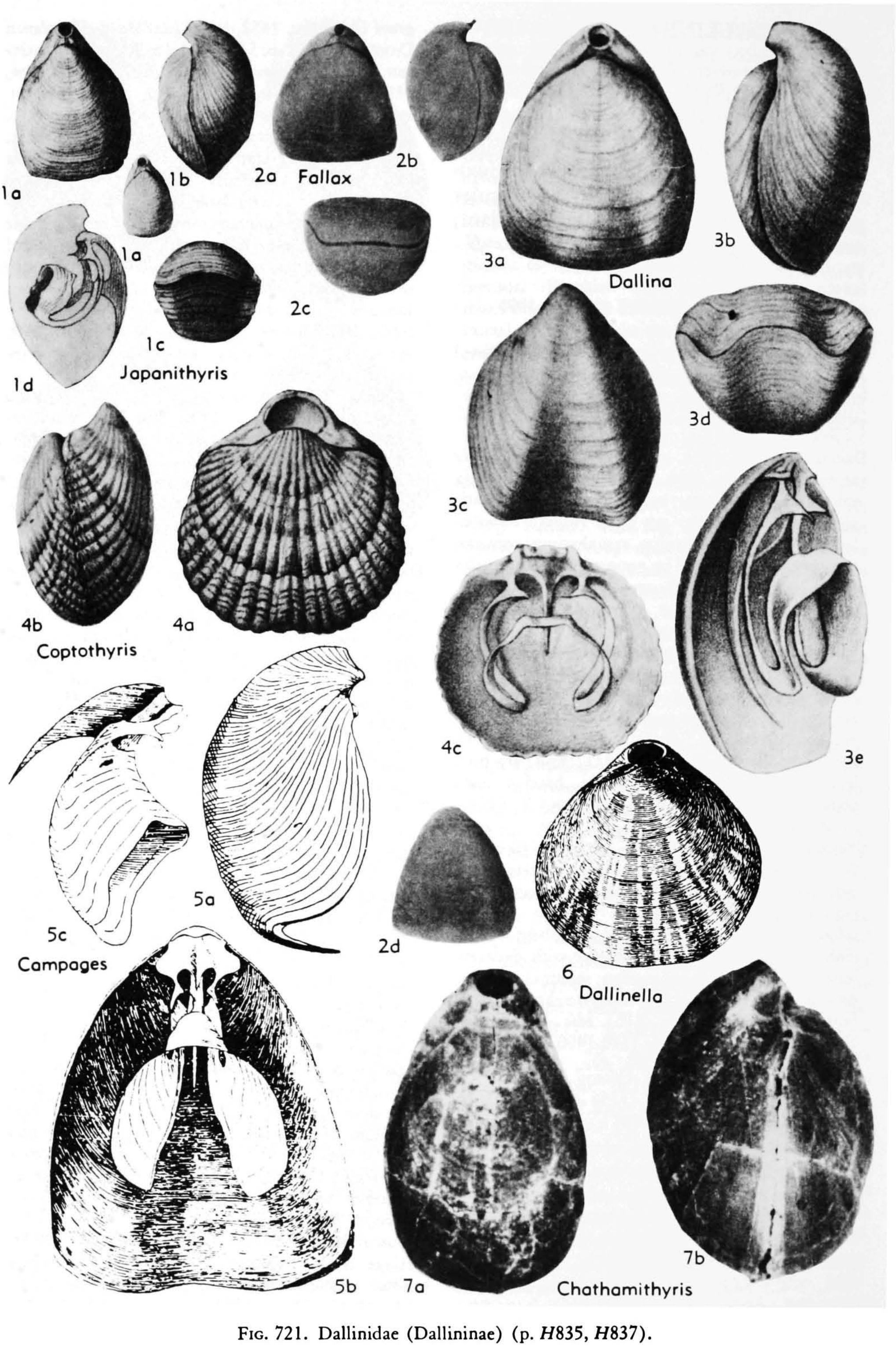


FIG. 721. Dallinidae (Dallininae) (p. H835, H837).

crural bases, no cardinal process, loop campagiform, adult lophophore plectolophous. Spicules abundant, occurring in lophophore, body wall and mantle canals (43). *Rec.*, E.Atl.——Fig. 721,*2*. **F. dalliniformis*; *2a-d*, brach.v., lat. ant., ped.v. views, ×1 (43). [Hatai.]

Glaciarcula Elliott, 1956, p. 285 [**Terebratella spitzbergensis* Davidson, 1852, p. 78; OD]. Small, elongate-pyriform, biconvex, rectimarginate; test thin; ventral beak prominent, incurved, abraded; pedicle-opening elongate-triangular; deltidial plates long, narrow, disjunct; cardinal process minute, crural bases and inner socket-ridges fused, septum passing posteriorly into deep hinge-trough; loop terebrataliiform. *Pleist.*, Scand.; *Rec.*, N.Atl.-?Japan.——Fig. 723,*1*. **G. spitzbergensis* (Davidson), Rec., N.Atl.; *1a,b*, brach.v., lat. views, ×3 (244); *1c*, loop, ×7 (917). [Elliott.]

Japanithyris Thomson, 1927, p. 251 [**Terebratella Mariae* A. Adams, 1860, p. 412; OD]. Like *Dallina* in shape, folding, beak characters, cardinalia, and absence of dental plates, differing only in not having passed the terebrataliiform loop stage and in much smaller adult size; loop less advanced than in *Campages* (810). *Plio.*, Italy; *Pleist.*, E. China Sea (Ryukyu Is.); *Rec.*, Japan.——Fig. 721, *1*. **J. mariae* (A. Adams), Rec., Japan; *1a,a'*, brach. view, ×2, ×1; *1b,c*, lat., ant. views, ×2; *1d*, slightly oblique lat. view of loop, ×2 (244). [Hatai.]

Macandrevia King, 1859, p 261 [**Terebratula cranium* Müller, 1776, p. 249; OD] [not preoccupied by *Macandrewia* Gray, 1860] [=*Frenula* Dall, 1871, p. 55 (type, *F. jeffreysi*); *Waldheimiathyris* Helmcke, 1939, p. 331]. Biconvex, rectimarginate to sulcate, thin, smooth or with fine radial sculpture, punctae minute and rather distant; beak obtuse, suberect to erect; beak ridges ill-defined; foramen ?permesothyridid, attrite; deltidial plates weak. Hinge teeth strong, supported by dental plates, which are united by callus deposit closely applied to floor of valve; crural bases fused with socket ridges, from which 2 hinge plates steeply descend to valve floor, not supported by septum but excavated anteriorly at their sides; loop dalliniform. Diductor muscles attached to small transverse impression over dorsal umbo (810). *Mio.*, Japan; *Plio.*, Italy; *Pleist.*, Norway-Sweden - Italy, *Rec.*, Atl.(10-2,900 m.) - Pac.(240-4,400 m.)-Antarctic(400-2,800 m.).——Fig. 722, *1*. **W. cranium* (Müller), Rec., Atl.; *1a-d*, brach. v., lat., ped.v., ant. views, ×1.2 (*1a,b*, with protruding pedicle); *1e,f*, foramen, ×3 (*1f* showing hinge teeth); *1g*, loop (reconstr.), ×3 (299). [Hatai.]

Pacifithyris Hatai, 1938, p. 98 [**Terebratalia xanthica* Dall, 1920, p. 346; OD]. Differs from *Terebratalia* in having no collar and cardinal process, widely divided crura, crural stems being united to concave platform which is continuous with posterior end of median septum dividing space beneath platform into 2 cavities, lack of septum or mesial ridge between muscle scars (643). *Rec.*, Japan(170 m.)-USSR(Sakhalin Is., 125 m.). [Hatai.]

Pegmathyris Hatai, 1938, p. 225 [**Dallina miyatokoensis* Hatai, 1936, p. 315; OD]. Differs from

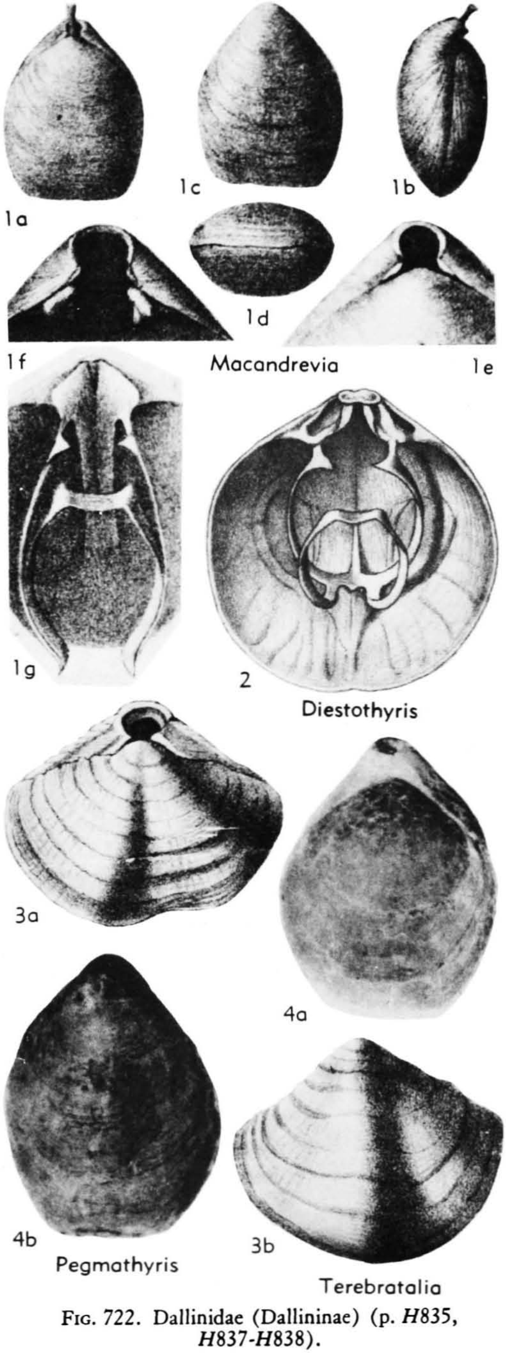


Fig. 722. Dallinidae (Dallininae) (p. *H*835, *H*837-*H*838).

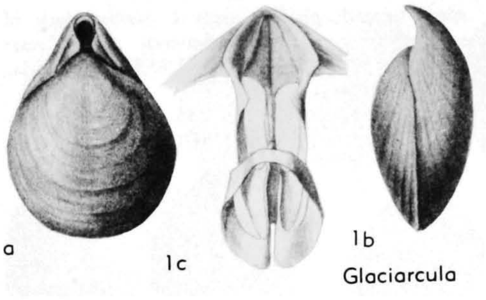


FIG. 723. Dallinidae (Dallininae) (p. *H*837).

Dallina in much thicker test, rectimarginate folding, high symphytium, straighter and stronger beak, stronger median septum, inner hinge plates horizontal instead of inclined, stronger muscle impressions; cardinal process strong (399). *Mio.*, Japan.——FIG. 722,*4*. **P. miyatokoensis* (HATAI); *4a,b*, brach.v. and ped.v. views, ×1 (399). [HATAI.]

Terebratalia BEECHER, 1893, p. 377 [**Terebratula transversa* G. B. SOWERBY, 1846, p. 94 (=*Magasella radiata* DALL, 1877); OD]. Rectimarginate to sulcate, smooth or radial ribs, punctae moderately developed; beak generally suberect, beak ridges usually sharp; foramen mesothyridid, attrite, incomplete or uncommonly complete; pedicle collar short, sessile. Hinge teeth with ventrally recessive dental plates which may be obsolete; cardinalia strong, with callus between socket ridges in umbonal region joined to septum; cardinal process variable, fused with callus; median septum generally stout; loop terebrataliiform. Muscle impressions may be very strong (810). *Oligo.*, W. N.Am.-?Japan; *Mio.-Pleist.*, W.N.Am.-Japan; *Rec.*, N.Pac.(10-1,750 m.).——FIG. 722,*3*. **T. transversa* (SOWERBY), Rec., Can.(Vancouver Is.); *3a,b*, brach.v. and ped.v. views, ×1 (244). [HATAI.]

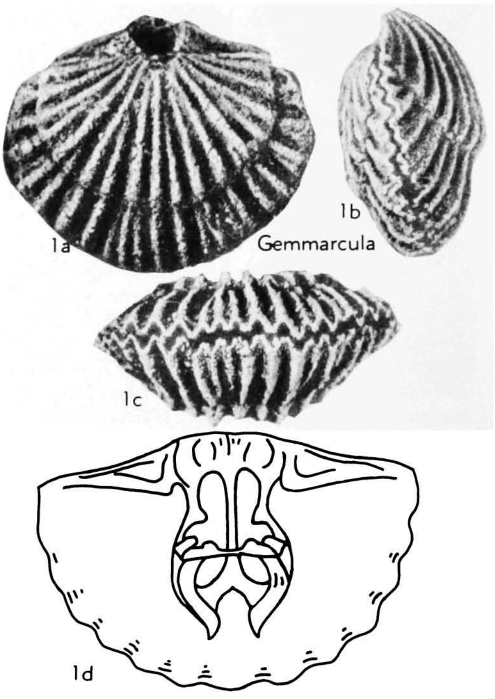
Terebrataliopsis SMIRNOVA, 1962, p. 98 [**T. quadrata*; OD]. Circular to rounded pentagonal, pedicle valve strongly convex, carinate; brachial valve slightly convex, with faint sulcus, commissure rectimarginate to slightly sulcate; umbo overhanging brachial valve, foramen small, beak ridges sharp; hinge line terebratulid. Teeth broad, dental plates divergent; ventral septum fourth of valve length; cardinal process not observed, hinge plate supported by median septum; loop passing through massive campagiform and frenuliniform stages to adult terebrataliiform, with wide, irregular spinous bands. *L.Cret.*, USSR.——FIG. 724,*2*. **T. quadrata*; *2a,b*, brach.v. int. (reconstr.), ×1.25 (748). [ELLIOTT.]

Subfamily GEMMARCULINAE Elliott, 1947

[Gemmarculinae ELLIOTT, 1947, p. 145] [Materials for this subfamily prepared by G. F. ELLIOTT]

Cardinal process large, fused with cardinalia; accessory structures present on all growth stages of terebrataliiform loop. *L.Cret.-U.Cret.*

Gemmarcula ELLIOTT, 1947, p. 145 [**G. aurea* (=*Terebratula truncata* J. DE C. SOWERBY, 1826, p. 71, *non Anomia truncata* LINNÉ, 1767, p. 1152); OD]. Small to medium-sized, biconvex, ovate-quadrilateral, coarsely striate, rectimarginate to parasulcate; umbo short, suberect, markedly truncate; foramen large, vertically ovate, submesothyridid; prominent symphytium, area high; hinge line submegathyridid; pedicle collar present. Pedicle valve with strong median ridge; cardinalia strong, buttressed by median septum, cardinal process transverse and countersunk in cardinal platform, inner and outer socket ridges present;



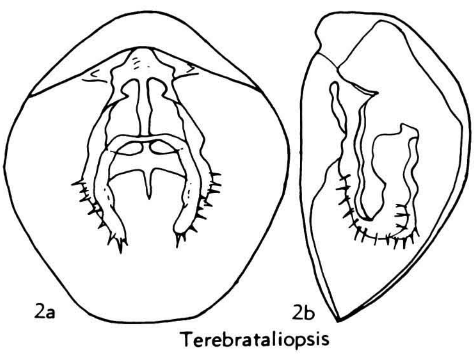


FIG. 724. Dallinidae (Dallininae) *(2)*, (Gemmarculinae) *(1)* (p. *H*838-*H*839).

loop terebrataliiform, with accessory ears, passing through precampagiform to frenuliniform growth stages. *L.Cret.-U.Cret.,* Eu.; *U.Cret.,* N.Am.——FIG. 724,*1a-c.* *G. arizonensis* COOPER, U.Cret., USA(Ariz.); *1a-c,* brach.v., lat. ant. views, ×3.3 (187).——FIG. 724,*1d.* **G. aurea,* L.Cret., Eng., brach.v. int., ×6.5 (276).

Subfamily KINGENINAE Elliott, 1948

[Kingeninae ELLIOTT, 1948, p. 311] [Materials for this subfamily prepared by G. F. ELLIOTT]

Loop development after campagiform passing to kingeniform, modified kingeniform, or belothyridiform. *U.Jur.-U.Cret.*

Kingena DAVIDSON, 1852, p. 40 [**Terebratula lima* DEFRANCE, 1828, p. 156; OD] [=*Kingia* SCHLOENBACH, 1865, p. 296 *(nom. null.)* (*non* THEOBALD, 1910; *nec* MALLOCH, 1921)]. Medium-sized, biconvex, rounded-pentagonal, rectimarginate to slightly ligate; test thin, with tiny external asperities and color-traces; umbo short, suberect, truncated, foramen permesothyridid, deltidial plates disjunct and obscured by beak ridges. Pedicle collar sessile, muscle marks and pallial sinus grooves faint. Cardinalia with inner socket ridges prominent, cardinal process small, transverse, concave hinge trough supported by thin low median septum, loop with very broad hood-like transverse band doubly attached to septum above attachments from descending branches, passing through precampagiform and campagiform growth stages before diverging to kingeniform.

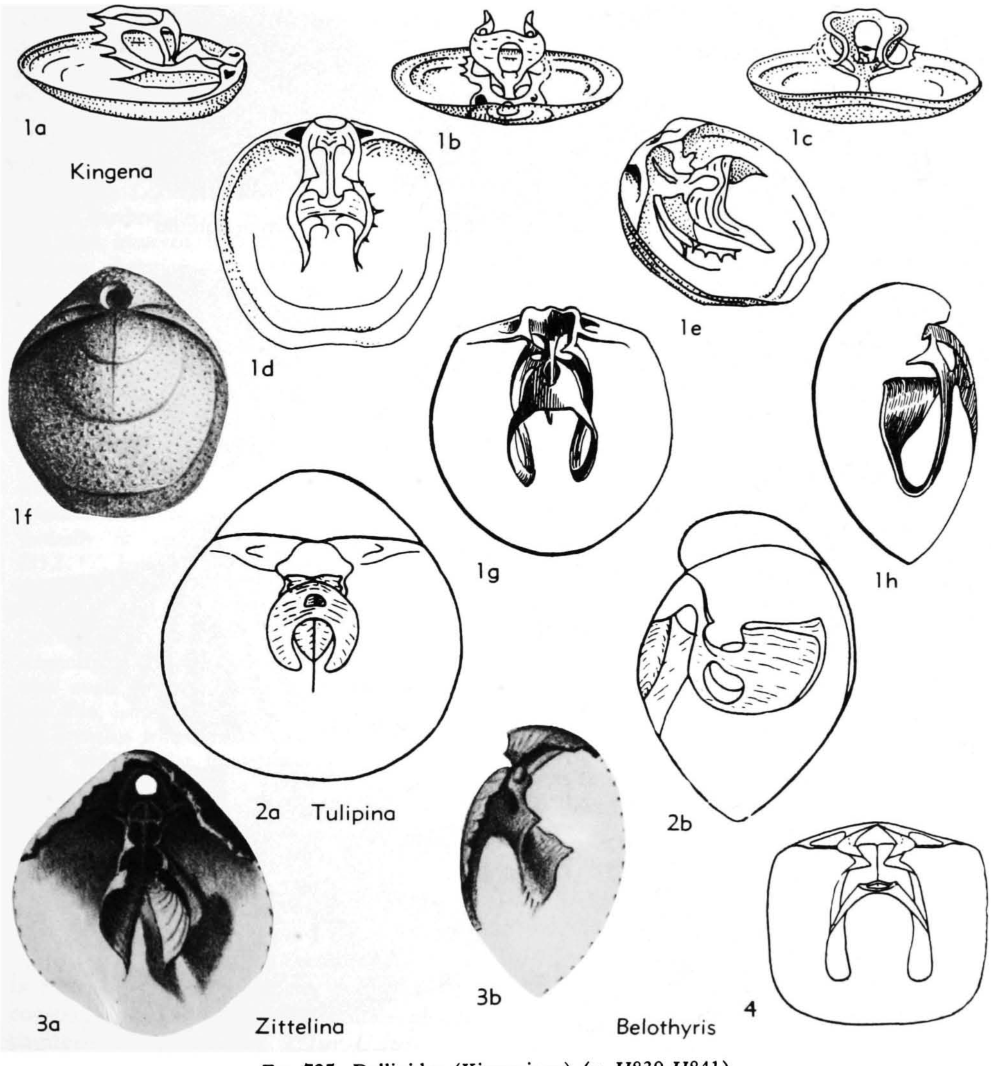


FIG. 725. Dallinidae (Kingeninae) (p. H839-H841).

L. Cret. - U. Cret., Eu.-Asia-Afr.-Australia-N. Am. ——Fig. 725,*1a-e*. *K. mesembrina* (Etheridge), U.Cret., W.Australia; *1a-e,* lat., post., ant., dorsal, oblique of loop, ×4 (281).——Fig. 725,*1f-h*. **K. lima* (Defrance), U.Cret., Eng.; *1f-h,* brach.v. view, brach.v. int., lat. view of loop, ×2 (229).

Belothyris Smirnova, 1960, p. 117 [**B. plana*; OD]. Small, terebratuliform, pentagonal to elongate in

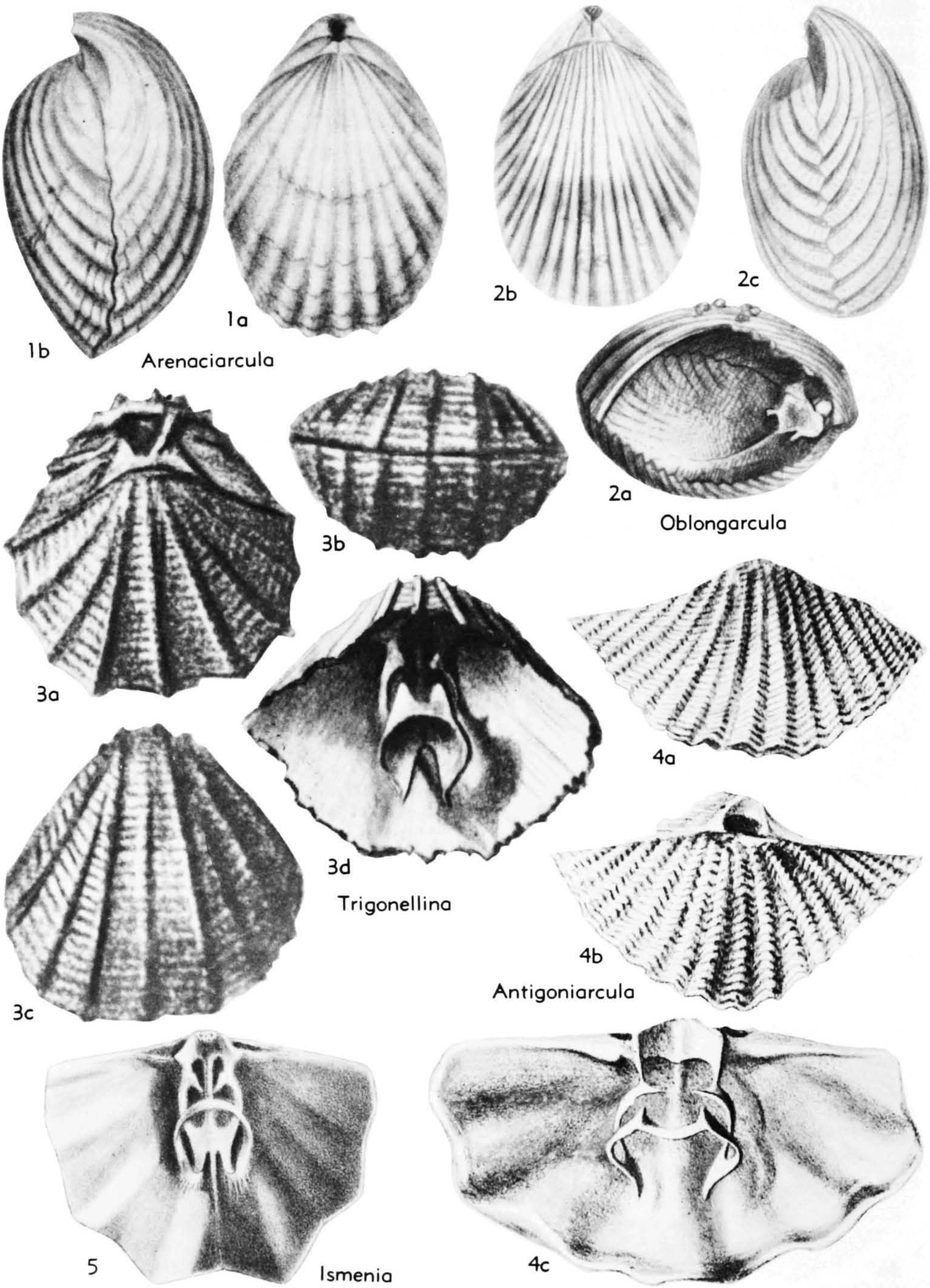


Fig. 726. Dallinidae (Trigonellininae) *(3-5)*, (Subfamily Uncertain) *(1-2)* (p. *H*841-*H*842, *H*844-*H*845).

outline, biconvex, smooth, commissure rectimarginate, folding ligate to strangulate, beak characters similar to those of *Kingena*; test thin, dental plates well developed, curved, teeth massive. Dorsal valve with inner socket ridges and crural bases fused and overhanging concave median hinge trough; thin median septum rising steeply to its apex at about 0.3 of valve length. Loop fairly stout; with conspicuous triangular crura, subparallel descending branches widening at points of recurvature, continuing as broad ascending branches which curve posteriorly and inwardly forming dorsoventrally curved arc, from which 2 short connecting bands are individualized out to apex of median septum; accessory loop structures present. [Thus no connecting bands from septum to descending branches occur, or between ascending and descending branches, and although connection between septum and ascending branches is somewhat reminiscent of that in *Kingena*, proportions of ascending branch structure are quite different and there is no hood.] *L.Cret.*, USSR. ——FIG. 725,*4*. **B. plana*; brach.v. int. (reconstr.), ×1.3 (747).

Tulipina SMIRNOVA, 1962, p. 102 [**Zeilleria koutaisensis* DE LORIOL, 1896, p. 145; OD]. Small, globose, terebratuliform, with shallow dorsal sulcus. Beak incurved, beak ridges rounded, pinhole foramen. Anterior commissure rectimarginate to sulcate. Teeth wide, dental plates close to shell walls, low rounded ventral septum to half valve length. Cardinal process not seen, crural bases massive, septalium deep and cuplike, dorsal median septum formed of 1 median and 2 lateral plates. Loop developing from campagiform hood by frenuliniform resorption during growth to adult loop somewhat like that of *Kingena*, but with different proportions and with transverse hoodlike structure developed dorsally and not vertically or ventrally. *L.Cret.*, USSR.——FIG. 725,*2*. **T. koutaisensis* (DE LORIOL); *2a,b*, brach.v. int. (reconstr.), ×4.5 (748).

Zittelina ROLLIER, 1919, p. 368 [**Terebratula orbis* QUENSTEDT, 1858, p. 639; OD]. Small, smooth, kingeniform. Pedicle collar present. Cardinalia with small central concave hinge platform, septum thin, loop campagiform, with short descending branches fringed with long spines, and large hood with annular flutings, laterally angled and anteriorly produced into gracefully curved projections. *U.Jur.*, Eu.-W.Asia; *?L.Cret.*, Eu.——FIG. 725,*3*. **Z. orbis* (QUENSTEDT), U.Jur., Ger.; *3a,b*, dorsal and lat. views of loop, ×4 (900).

Subfamily TRIGONELLININAE Elliott, n. subfam.

[Materials for this subfamily prepared by G. F. ELLIOTT]

Shell transverse, with costate, scaly surface; cardinalia small; inner socket ridges conspicuous; loops angular, spinose, campagiform to dalliniform. *L.Jur.-U.Jur.*

Trigonellina BUCKMAN, 1907, p. 342 [**Terebratulites pectunculus* VON SCHLOTHEIM, 1820, p. 272; OD]. Small, transverse terebratuliform, test thick, scaly, ornamented by several well-spaced, rounded, opposite carinae, foramen with conjunct deltidial plates, lateral areas delimited by beak ridges, hinge line nearly strophic; small median ridge in ventral umbo. Cardinalia with inner socket ridges prominent, cardinal process small, small cardinal platform buttressed by median septum extending to middle of valve, loop small, campagiform. *U.Jur.*, Eu.——FIG. 726,*3*. **T. pectunculus* (VON SCHLOTHEIM), Ger.; *3a-c*, brach.v., ant., ped.v. views, ×4; *3d*, loop, ×4 (900).

Antigoniarcula ELLIOTT, 1959, p. 146 [**Argiope perrieri* EUDES-DESLONGCHAMPS, 1853, p. 5; OD]. Small, transverse, alate; test costate and scaly,

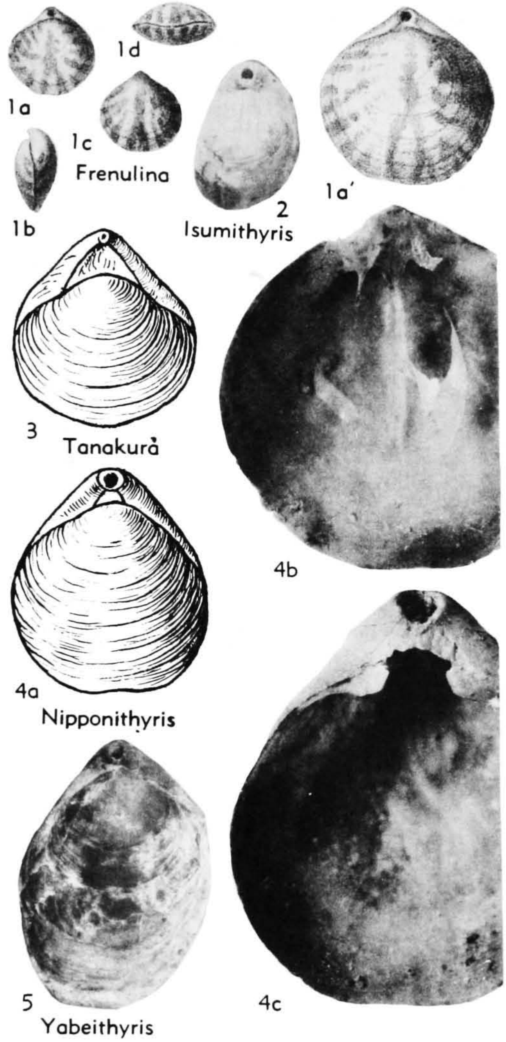


FIG. 727. Dallinidae (Frenulininae) *(1)*, Nipponithyridinae *(2-5)* (p. *H*842-*H*843).

with shallow median sulcus in brachial valve opposed by opposite fold in pedicle valve; foramen large, with narrow deltidial plates and pedicle collar, lateral areas wide and low, hinge line strophic. Brachial valve interior with small hinge plates, delimited by inner socket ridges, supported anteriorly by very short thin median septum, cardinal process small, crura thin and delicate, loop angular dalliniform, anteriorly produced into sharp points. *L.Jur.*, W.Eu.——FIG. 726,*4*. **A. perrieri* (DESLONGCHAMPS), Fr.; *4a,b*, ped.v. and brach.v. views, ×3; *4c*, brach.v. int. showing loop (reconstr.), ×4.5 (256).

Ismenia KING, 1850, p. 81, 142 [**Terebratulites pectunculoides* VON SCHLOTHEIM, 1820, p. 271; OD]. Small, transverse, biconvex, with about 5 prominent alternate rounded carinae on each valve; test thick, scaly; beak blunt, lateral areas low, foramen large, rounded, deltidial plates small; hinge line nearly strophic. Brachial interior with small central cardinalia, prominent inner socket ridges, cardinal platform small, buttressed by median septum, cardinal process transverse, loop terebrataliiform, anteriorly spinous. *U.Jur.*, Eu. ——FIG. 726,*5*. **I. pectunculoides* (VON SCHLOTHEIM), Ger.; brach.v. int. showing loop (reconstr.), ×3 (227).

Subfamily FRENULININAE Hatai, 1938

[Materials for this subfamily prepared by KOTORA HATAI]

Biconvex, rectimarginate to sulcate, deltidial plates conjunct to disjunct, foramen submesothyridid. Cardinal process slender; dental plates present; cardinalia widely divergent; spiculation absent; loop passing through preismeniform stage and attaining frenuliniform stage in adult (399). *Mio.-Rec.*

Frenulina DALL, 1894, p. 724 [**Anomia sanguinolenta* GMELIN, 1792, p. 3347; OD]. Sulcate, thin, smooth, punctae coarse and dense; beak suberect; foramen submesothyridid, attrite; deltidial plates disjunct, appearing conjunct; pedicle collar closely applied to floor of valve. Hinge teeth with dental plates; socket ridges rather strong, united on their inner sides to crural bases; cardinalia divergent clear to apex; cardinal process small, striated over umbo; loop frenuliniform. Muscle impressions feeble (81). *Rec.*, Australia to Ryukyu Is.(E.China Sea).——FIG. 727,*1*. **F. sanguinolenta* (GMELIN), Rec., Hawaiian Is.; *1a-d*, brach.v., lat., ped.v., ant. views, ×1 (*1a'*, ×2) (244).

Jolonica DALL, 1920, p. 366 [**Campages (Jolonica) hedleyi* DALL; OD]. Rectimarginate to weakly sulcate, punctae fine and rather dense; beak rather short; foramen complete; pedicle collar feeble. Hinge teeth with dental plates, leaving narrow area between it and shell wall; pedicle valve with short septal ridge; cardinalia with deep sockets, divergent clear to apex and headed by cardinal process; median septum prominent. Muscle impressions weak (643). *Pleist.*, E. China Sea (Ryukyu Is.); *Rec.*, S. Japan-Philip. Is.(to 640 m.).

Kamoica HATAI, 1936, p. 313 [**Jolonica (Kamoica) iduensis* HATAI, 1936; OD]. Biconvex, rectimarginate, thick, punctae oval, dense; beak suberect; foramen incomplete, ?submesothyridid; deltidial plates disjunct. Hinge teeth strong, with slightly recessive dental plates; cardinalia divergent clear to apex, cardinal process prominent; crural bases united to inner part of divergent socket ridges but separated from them by groove, crura obliquely vertical, slender; median septum fused with weak callus. Muscle impressions weak (399). *Mio.-Plio.*, Japan.

Subfamily NIPPONITHYRIDINAE Hatai, 1938

[*nom. correct.* HATAI, herein (*pro* Nipponithyrinae HATAI, 1938)] [Materials for this subfamily prepared by KOTORA HATAI]

Rectimarginate, sulcate to intraplicate; beak nearly straight to erect, foramen complete, symphytium straight to concave. Hinge teeth strong, pedicle valve with septal ridge; loop not passing terebrataliiform stage in Recent genera; cardinalia with inner hinge plate troughlike or partially filled; cardinal process present in all forms; median septum much thickened. Spicules unknown (399). *Mio.-Rec.*

Nipponithyris YABE & HATAI, 1934, p. 588 [**N. nipponensis*; OD]. Punctae minute and dense. Foramen complete, symphytium solid, concave or nearly straight. Hinge teeth stout, with swollen bases and grooves for reception of socket ridges; pedicle valve with strong septal ridge separating muscle impressions; inner hinge plates deeply sunken, partially excavated beneath, generally calloused; cardinal process small; loop terebrataliiform; crura attached to lower part of socket ridges, short and slender, posterior edge of ascending branches with square notch. Dorsal muscle impressions fairly strong (399). *Mio.-Rec.*, Japan. ——FIG. 727,*4*. **N. nipponensis*, Rec.; *4a*, brach. v. view, ×1; *4b,c*, brach.v. int., ped.v. int., ×2 (399).

Isumithyris HATAI, 1948, p. 498 [**I. kazusaensis*; OD]. Differs from *Nipponithyris* in smaller size, erect beak, mesothyridid foramen, intraplicate folding, shorter symphytium without any mesial ridge, and lack of septal ridge on floor of pedicle valve. Punctae fine and rather dense (401). *Plio.*, Japan.——FIG. 727,*2*. **I. kazusaensis;* brach.v. view, ×2 (280).

Miyakothyris HATAI, 1938, p. 237 [**Nipponithyris subovata* HATAI, 1936; OD]. Differs from *Nipponithyris* in its rectimarginate folding, incipient truncation, very solid and thick test, higher but less incurved beak, suberect position of foramen, stronger cardinalia, and stronger median septum, which is less swollen at bases (399). *Mio.*, Japan.

Tanakura HATAI, 1936, p. 322 [**Magasella fibula*

HAYASAKA, 1921, p. 1 (*non* REEVE, 1861, p. 180) (=*Tanakura tanakura* HATAI, 1936, *nom. nov.*)]. Rectimarginate, punctae fine; beak erect, nearly epithyridid; symphytium concave; pedicle collar sessile. Hinge teeth strong, bases swollen and grooved for reception of socket ridges; septal ridge short; cardinalia with callus between socket ridges uniting with septum; cardinal process trefoil on top; crural bases closely applied to socket ridges. Muscle impressions rather strong (399). *Mio.*, Japan.——FIG. 727,*3*. **T. tanakura* HATAI; brach. v. view, ×2 (244).

Yabeithyris HATAI, 1948, p. 498 [**Y. notoensis*; OD]. Rectimarginate, smooth, rather thick, punc-

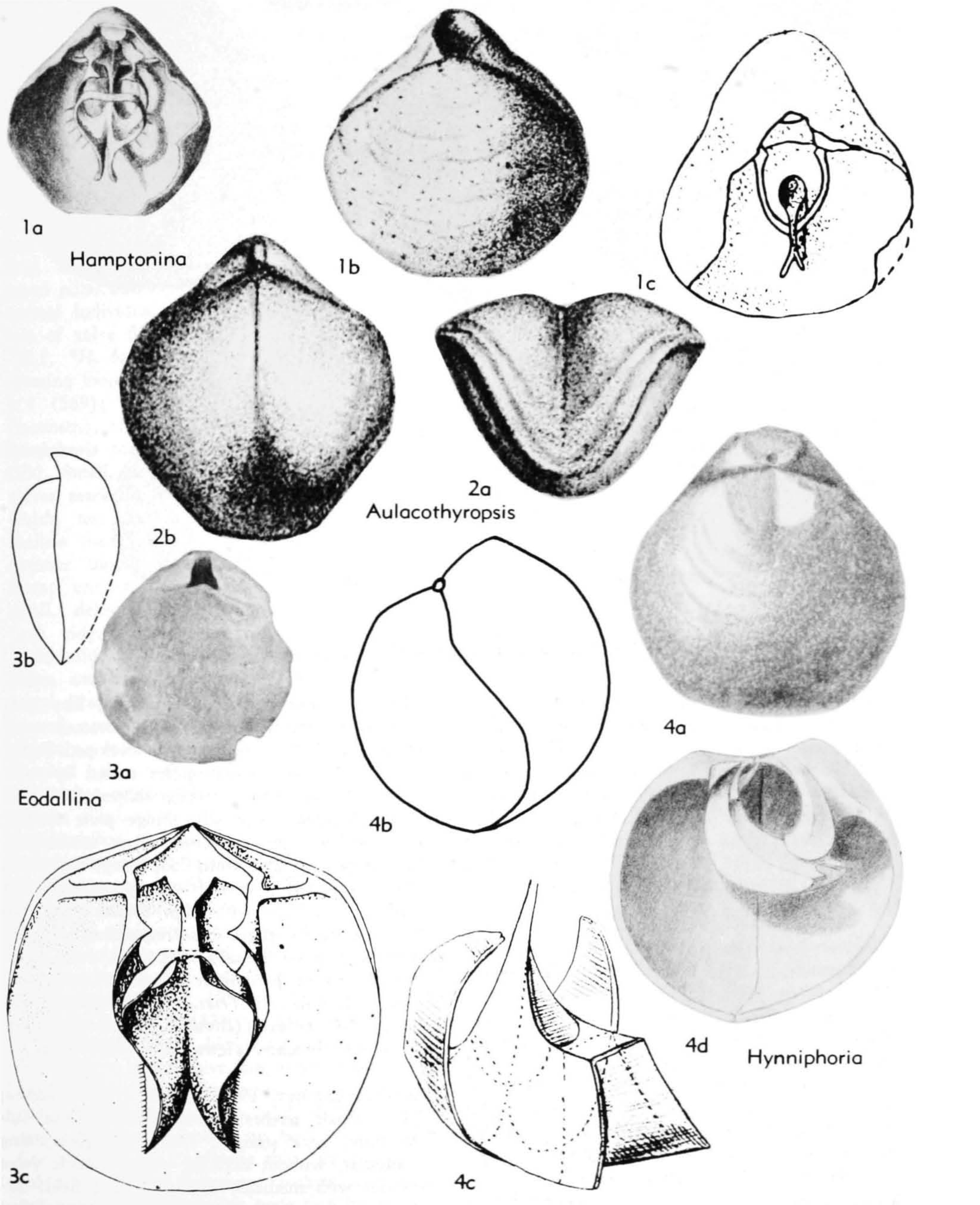


FIG. 728. Dallinidae (Subfamily Uncertain) (p. H844-H845).

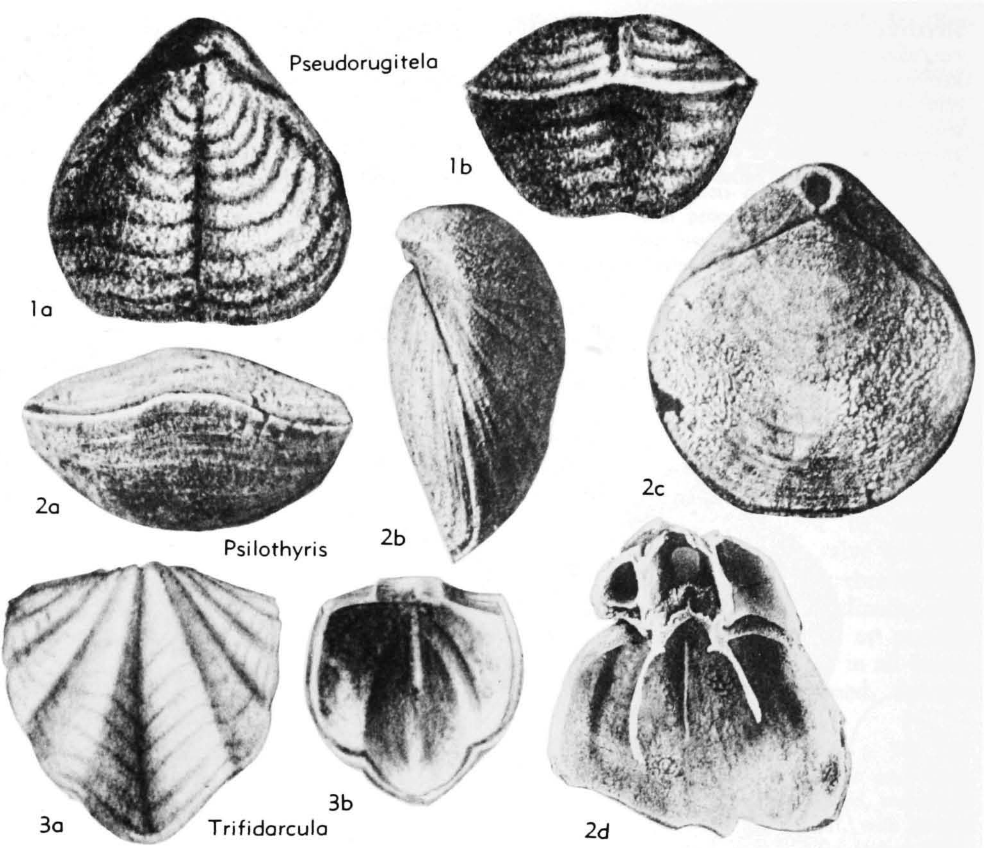


FIG. 729. Dallinidae (Subfamily Uncertain) (p. *H*845).

tae minute, elongate-oval and dense; beak erect; foramen complete; symphytium short, with median raised ridge; pedicle collar indistinct. Hinge teeth with ventrally recessive dental plates; cardinalia with deep trough posteriorly, anteriorly margined by divergent crural bases and prominent median septum; no cardinal process, only small shelflike process over umbo (401). *Mio.*, Japan.——FIG. 727,*5*. **Y. notoensis;* brach.v. view, ×2 (401).

Subfamily UNCERTAIN

[Materials for this assemblage prepared by G. F. ELLIOTT]

Arenaciarcula ELLIOTT, 1959, p. 147 [**Terebratella fittoni* MEYER, 1864, p. 250; OD]. Like *Oblongarcula* but smaller, with fewer and coarser costae, thicker test, commissure uniplicate to parasulcate, dental plates fused to sides of valve, and cardinal platform with well-marked separate raised inner socket ridges, crural bases, and median septal ridge. Loop believed terebrataliiform. *L.Cret.*, W. Eu.——FIG. 726,*1*. **A. fittoni* (MEYER), Eng.; *1a,b,* brach.v. and lat. views, ×3 (557).

Aulacothyropsis DAGIS, 1959, p. 99 [**Waldheimia (Aulacothyris) reflexa* BITTNER, 1890, p. 258; OD]. Terebratuliform, plano-convex, like *Aulacothyris* externally. Umbo short, foramen small, mesothyridid, beak ridges well developed. Pedicle valve with short dental plates united by callus posteriorly; teeth thick, wedge-shaped, not denticulate; brachial valve with hinge plate showing inner socket ridges and crural bases, median septum very long and thin; loop long, descending branches united posteriorly to septum, then proceeding anteriorly with each branch apparently united along its length to corresponding ascending branch; loop set dorsally with thick short spines; possibly an early dallinid (terebrataliiform) pattern. *?M.Trias., U.Trias.,* C.Eu.-USSR.——FIG. 728,*2*. **A. reflexa* (BITTNER), U.Trias., C.Eu.; *2a,b,* ant., brach.v. views, ×3 (76). [See also Fig. 699.]

Eodallina ELLIOTT, 1959, p. 146 [**E. peruviana;* OD]. Small, terebratuliform, shallow dorsal sulcus only; beak straight, entire, pedicle opening triangular, without deltidial plates. Pedicle valve interior with medianly divided muscle field; cardinalia with inner socket ridges enclosing concave hinge plates supported by low median septum, which extends anteriorly past mid-length, supporting spinous modified campagiform loop with short crural points, descending branches broadly attached and hood thinning to narrow transverse band. *U.Trias.*, S.Am.——FIG. 728,*3*. **E. peruviana*; *3a,b*, brach.v., lat. views, ×4; *3c*, brach.v. (reconstr.), ×8 (776).

Hamptonina ROLLIER, 1919, p. 360 [**Terebratella buckmani* MOORE, 1860, p. 441; OD]. Small, terebratuliform, rectimarginate; beak suberect, foramen rounded, small disjunct triangular deltidial plates. Brachial valve interior with inner socket ridges enclosing concave hinge plate, cardinal process small, transverse; septum low posteriorly, rising steeply anteriorly, supporting spinous modified campagiform loop with moderately long crural points, broadly attached descending branches, long anterior spurs and ascending branches modified to backwardly directed ring. Precampagiform growth stages with high septal pillar and nearly vertical hood known; abnormal individuals with short brachial structure free of valve floor known. *M.Jur.*, Eng.——FIG. 728,*1*. **H. buckmani* (MOORE); *1a*, brach.v. int. showing loop (reconstr.), ×4; *1b*, brach.v. view, ×4 (569); *1c*, brach.v. int. of juvenile shell (reconstr.), ×20 (279).

Hynniphoria SUESS, 1859, p. 44 [**H. globularis*; OD]. Small, terebratuliform, globose, with both valves markedly inflated, length about equal to width; test smooth, pedicle valve with broad shallow median sulcus occasioning wide boxlike anterior uniplication, lateral commissures falciform; umbonal areas flattened, foramen very small, deltidial structures small and obscure, beak ridges round and indistinct, hinge line terebratuliform. Pedicle valve interior with dental plates and stout, apparently composite, median septal structure which projects free anteriorly as curved and thickening blade- or scimitar-like structure, extending dorsally into shell cavity. Brachial valve with divided cardinalia, stout inner socket ridges; small, short posterior median septum diminishing rapidly anteriorly; descending branches of loop broad and bladelike, posteriorly attached to septum, then twisting to apparent squarish boxlike campagiform hood with divergent anterior corners. *U.Jur.*, C.Eu.——FIG. 728,*4*. **H. globularis; 4a,b*, brach.v. and lat. views, ×6; *4c*, oblique view of loop (reconstr.), ×10; *4d*, lat. view of shell int. (reconstr.), ×6 (794).

Oblongarcula ELLIOTT, 1959, p. 147 [**T. oblonga* J. DE C. SOWERBY, 1826, p. 68; OD]. Medium-sized, elongate-ovoid, biconvex, commissure rectimarginate to sulcate, test thin, ornamented by fine regular costae bifurcating only near umbo; beak suberect, foramen mesothyridid, deltidial plates conjunct, areas delimited by beak ridges, hinge line terebratulid. Cardinalia thin, platelike, cardinal process raised, transverse, sockets narrow, inner socket ridges enclosing wide thin hinge plate, medium septum thin, supporting hinge plate beneath and extending anteriorly to half of valve length, crura delicate, loop believed terebratelliform. *L.Cret.*, Eu.——FIG. 726,*2*. **O. oblonga* (SOWERBY), Eng.; *2a-c*, shell int. from side, brach. v. and lat. views, ×2 (761).

Pseudorugitela DAGIS, 1959, p. 100 [**Waldheimia (Aulacothyris) pulchella* BITTNER, 1890, p. 200; OD]. Terebratuliform, biconvex, tending to anterior ligation; valve surfaces with strongly developed concentric growth steps. Dental plates thin and parallel; brachial valve hinge plate divided by deep narrow V-shaped hinge trough to which median septum is joined; loop like that of *Aulacothyropsis* but not spinous. *U.Trias.*, C.Eu.-USSR.——FIG. 729,*1*. **P. pulchella* (BITTNER), C.Eu.; *1a,b*, brach.v. and ant. views, ×8 (76).

Psilothyris COOPER, 1955, p. 10 [**P. occidentalis*; OD]. Small to medium-sized, smooth, biconvex, ovate to subpentagonal, rectimarginate to uniplicate; umbo erect, foramen small to large, round, submesothyridid to mesothyridid, deltidial plates disjunct to conjunct, hinge line terebratulid. Cardinalia small, hinge plate undivided, medianly concave; median septum, short, slender, with or without buttressing cardinalia; loop dalliniform, with long crural processes and short crura, passing through precampagiform to terebrataliiform growth stages. *L.Cret.*, Eu.; *L.Cret.-U.Cret.*, N.Am.——FIG. 729,*2*. **P. occidentalis*, L.Cret., USA (Ariz.); *2a-c*, ant., lat., brach.v. views, ×4; *2d*, post. part of shell int. showing crura and loop, ×8 (187).

Trifidarcula ELLIOTT, 1959, p. 147 [**Terebratella trifida* MEYER, 1864, p. 167; OD]. Small, transverse, test thick with 3 principal high-raised, rounded, straight-sided dorsal folds alternating with 2 ventral folds; foramen large, deltidial plates small, area sloping, hinge line megathyridid; pedicle collar present. Cardinal platform small, thick, elements fused, cardinal process small, septum thick, extending anteriorly for half valve length, loop believed terebrataliiform. *L.Cret.*, Eng.——FIG. 729,*3*. **T. trifida* (MEYER); *3a,b*, ped.v. ext., brach.v. int., ×4 (557).

Family LAQUEIDAE Hatai, n. fam.

[=Laqueinidae YABE & HATAI, 1941 (invalid because contains no genus providing stem Laquein-, name being erroneously derived from *Laqueus*)] [Materials for this family prepared by KOTORA HATAI]

Dental plates present, spiculation of mantle canals moderate, loops differing from terebrataliiform and dalliniform loop stages of the Dallinidae in incomplete separation of ascending and descending branches which remain united by interconnecting bands on each side (400). *Mio.-Rec.*

Subfamily LAQUEINAE Hatai, n. subfam.

Biconvex, rectimarginate to ligate or strangulate, smooth, with rather coarse punctae; beak fairly prominent, beak ridges

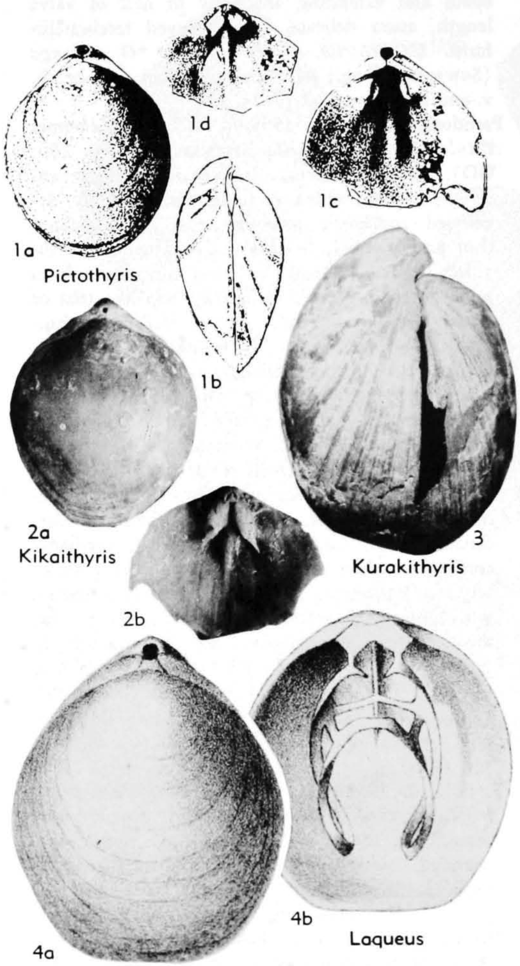


FIG. 730. Laqueidae (Laqueinae) *(4)*, (Pictothyridinae) *(1-2)*, (Kurakithyridinae) *(3)* (p. *H*845-*H*847).

sharp; foramen permesothyridid, slightly remigrant, telate; deltidial plates conjunct, concave. *Mio.-Rec.*

Laqueus DALL, 1870, p. 123 [**Terebratula californiana* KOCH, 1848, p. 38 (=*Laqueus californicus* CARPENTER, 1864) (*non* KOCH, 1848=*L. erythraeus* DALL, 1920); OD]. Hinge teeth with ventrally recessive dental plates; pedicle collar sessile. Cardinalia with inner and outer hinge plates separated by crural bases; inner hinge plates resting on median septum; no cardinal process; loop laqueiform. Muscle impressions not strong. Small spicules present over mantle canals but not extending to body wall or lophophore (810). *Mio.-Rec.*, N. Am.-Japan-N. Pac.O. (30-1,350 m.).——FIG. 730,*4*. **L. californianus* (KOCH), Rec., USA (Calif.); *4a,b,* brach.v. view, brach.v. int. showing loop (reconstr.), ×1 (244).

Subfamily PICTOTHYRIDINAE Yabe & Hatai, 1941

[*nom. correct.* HATAI, herein (*pro* Pictothyrinae YABE & HATAI, 1941)]

Beak suberect; foramen permesothyridid, attrite. Hinge teeth with swollen bases; cardinalia divergent, no inner hinge plates; cardinal process prominent, trefoil on top by enfolding of wings; loop without connecting bands from descending branches to median septum, being more advanced than *Laqueus*; median septum stout (810). *Plio.-Rec.*

Pictothyris THOMSON, 1927, p. 260 [**Anomia picta* DILLWYN, 1817, p. 295; OD]. Biconvex, rectimarginate, smooth, punctate; beak suberect; foramen permesothyridid, attrite; deltidial plates conjunct. Hinge teeth strong, bases swollen, appearing soldered to sides, grooved for reception of socket ridges; cardinalia divergent; clear to apex, headed by bilobed cardinal process; median septum stout; descending branches of lophophore not united to median septum, ascending branches united with descending ones by interconnecting bands at corners of transverse band. Ventral muscle scars separated by septal ridge, dorsal muscle scars separated by median septum (810). *Plio.-Rec.*, Japan-Formosa-Ryukyu Is. (40-160 m.).——FIG. 730,*1*. **P. picta* (DILLWYN), Rec., Japan; *1a,b,* brach.v. and lat. views, ×0.9; *1c,d,* ped.v. int., brach.v. int., ×0.9 (810).

Kikaithyris YABE & HATAI, 1941, p. 491 [**Pictothyris hanzawai* YABE, 1934; OD]. Resembles *Pictothyris* in shape, folding, and cardinalia, differing in very small foramen pierced in strongly incurved beak and by much shorter median septum in brachial valve (400). *Pleist.*, Japan-Ryukyu Is.-Formosa.——FIG. 730,*2*. **K. hanzawai* (YABE), Ryukyu Is.; *2a,b,* brach.v., brach.v. int., ×1 (after 897).

Subfamily KURAKITHYRIDINAE Hatai, 1948

[*nom. correct.* HATAI, herein (*pro Kurakithyrinae* HATAI, 1948)]

Rectimarginate to sulcate; pedicle collar obsolete. Cardinal process indistinct in adult, developing from very weak in young, ventrally recessive dental plates in adult developing from what appear to be swollen bases in young; cardinalia divided into inner and outer hinge plates, former appearing as deep trough bordered by latter, which appear as swollen crural bases, whole excavated beneath and supported by prominent median septum; descending branches of lophophore attached to median septum by short connecting bands in young but becoming free in adult (401). *Plio.*

Kurakithyris HATAI, 1946, p. 98 [**K. quantoensis*;

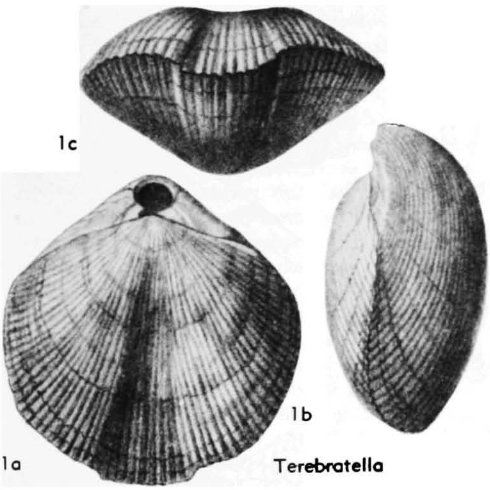


FIG. 731. Terebratellidae (Terebratellinae) (p. *H*847).

OD]. Biconvex, rectimarginate to sulcate; foramen complete, ?permesothyridid; deltidial plates conjunct, median ridge low. Hinge teeth not strong, with ventrally recessive dental plates, no median ridge in pedicle valve; pedicle collar and muscle impressions indistinct; cardinalia weak, divided into inner and outer hinge plates by swollen bases of crural processes, inner hinge plate troughlike, supported by median septum, excavated beneath. Finely punctate (401). *Plio.*, Japan.——FIG. 730,*3*. **K. quantoensis*; lat. view, ×1.8 (401).

Family TEREBRATELLIDAE King, 1850

[Terebratellidae KING, 1850, p. 245] [Materials for this family prepared by G. F. ELLIOTT and KOTORA HATAI as indicated, diagnosis by ELLIOTT & HATAI]

Loop passing through all or part of premagadiniform, magadiniform, magelliform, terebratelliform, and magellaniiform growth stages or modifications of these; dental plates absent; animal nonspiculate (810). *U.Cret.-Rec.*

Subfamily TEREBRATELLINAE King, 1850

[*nom. transl.* DAVIDSON, 1866 (*ex* Terebratellidae KING, 1850, p. 245)] [=Magellaniinae BEECHER, 1893] [Materials for this subfamily prepared by KOTORA HATAI]

Cardinalia weak, lamellar, with excavate hinge plates meeting on septum; loop magelliform to magellaniiform (217). *Oligo.-Rec.*

Terebratella D'ORBIGNY, 1847, p. 229 [**Terebratula chilensis* BRODERIP, 1833, p. 141 (=**Anomia dorsata* GMELIN, 1792, p. 3348; *Terebratula flexuosa* KING, 1835, p. 337; *Terebratula patagonica* GOULD, 1850, p. 347); OD]. Sulcate, smooth or with irregular, somewhat wavy, multiplication developing directly on smooth stage, punctae coarse and dense; beak suberect to erect; foramen submesothyridid to mesothyridid; deltidial plates conjunct or almost conjunct. Hinge teeth without swollen bases; excavated hinge plates meeting on median septum, which is low; lophophore plectolophous, filaments long, slender and close. Muscle impressions not strong (810). *Oligo.-Mio.*, S.Am.-N.Z.; *Mio.*, Australia-N.Z.; *Plio.*, N.Z.; *Rec.*, S.

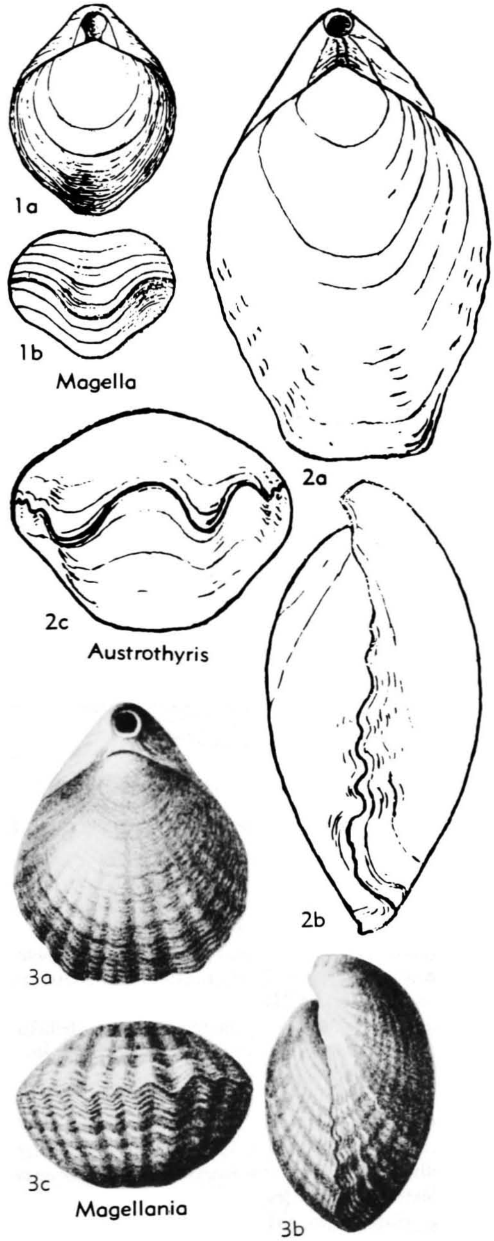


FIG. 732. Terebratellidae (Terebratellinae) (p. *H*848-*H*849).

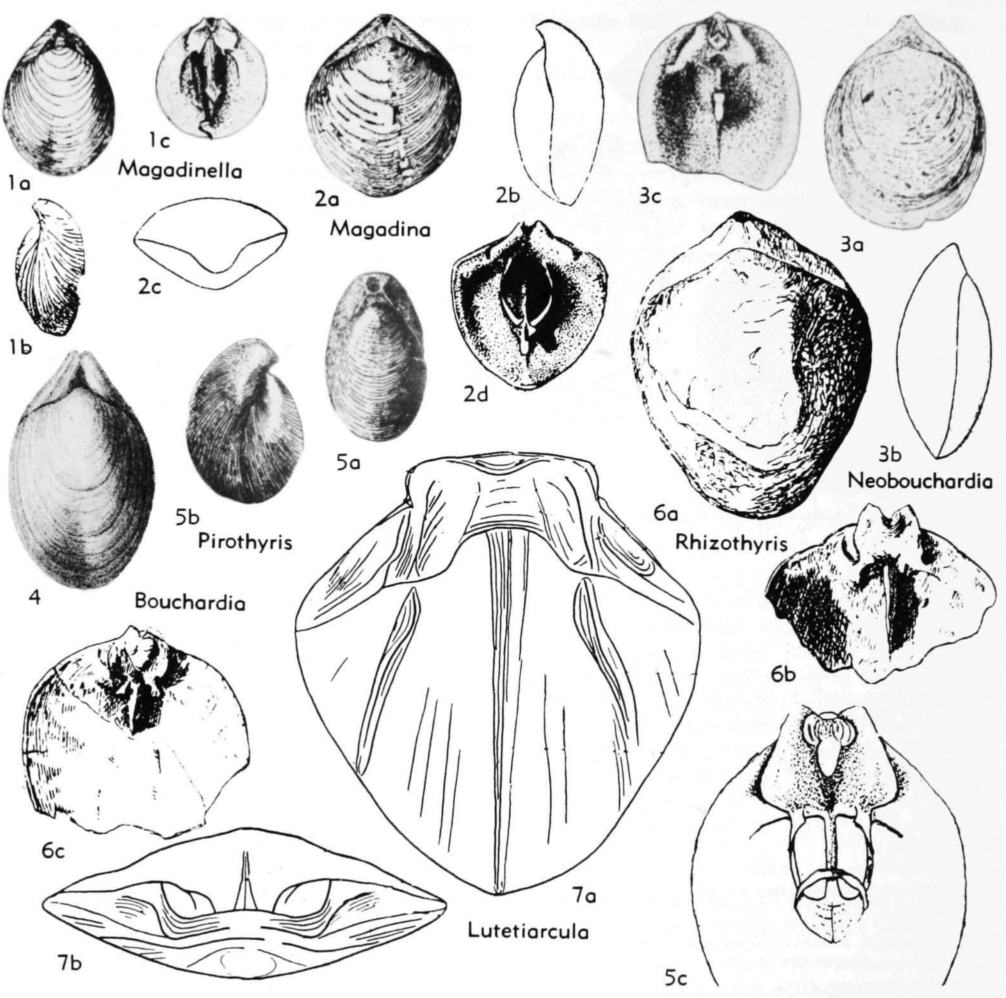


FIG. 733. Terebratellidae (Bouchardiinae) *(3-4)*, (Magadinae) *(1-2,5-7)* (p. H849, H851).

Atl. O. (10-240 m.)-S. Pac. (40-360 m.).——FIG. 731,*1*. **T. dorsata* (GMELIN), Rec., Magellan Str.; *1a-c,* brach.v., lat., ant. views, ×1 (244).

Aerothyris ALLAN, 1939, p. 245 [**Magellania macquariensis* THOMSON, 1918, p. 30; OD]. With internal characters of *Magellania* but differs in being completely smooth, in having discrete deltidial plates and much coarser punctation (24). *Rec.,* Antarctic-S.Pac.O.(600 m.).

Austrothyris ALLAN, 1939, p. 238 [**Waldheimia gambierensis* ETHERIDGE, JR., 1876, p. 19 (=**W. grandis* TENISON-WOODS, 1865)]. Smooth or marginally multiplicate, with intraplicate anterior commissures, differing from *Magellania* in possessing hinge plates adpressed to floor of valve and meeting low on sides of median septum which extends to base of cardinal process, which, while transverse, is supported from floor of hinge trough (24). *Mio.,* N.Z.——FIG. 732,*2*. **A. grandis* (TENISON-WOODS); *2a-c,* brach.v., lat., ant. views, ×1 (24).

Magasella DALL, 1870, p. 134 [**Terebratella Evansii* DAVIDSON, 1852, p. 77 (=*Terebratula sanguinea* LEACH, 1814, p. 76); OD]. Multicostate. *Tert.-Rec.,* N.Z.

Magella THOMSON, 1915, p. 396 [**M. carinata* (=*Terebratella kakanuiensis* THOMSON, 1908, p. 102, *non* HUTTON, 1905, p. 479)]. Sulcate, smooth, thin; beak suberect; foramen submesothyridid, incomplete; deltidial plates discrete, triangular. Hinge teeth without swollen bases; cardinalia weak, with excavated hinge plates; median septum long; crura short; loop magelliform (810). *Oligo.-Mio.,* Antarctic; *Mio.,* N.Z.; *Pleist.,* Antarctic.——FIG. 732,*1*. **M. carinata* (THOMSON), Mio., N.Z.; *1a,b,* brach.v. and ant. views, ×3 (810).

Magellania BAYLE, 1880, p. 24 [*nom. subst. pro Waldheimia* KING, 1850 (*non* BRULLÉ, 1846)] [**Terebratula australis* QUOY & GAIMARD, 1834, p. 551 (=?*T. flavescens* LAMARCK, 1819, p. 246); OD]. Sulcate to intraplicate, smooth to multiplicate, plicae developing on smooth stage, punctae coarse and dense; beak suberect to erect; foramen mesothyridid, attrite; deltidial plates united in symphytium. Hinge teeth without swollen bases; cardinalia weak, hinge plates excavated, meeting on median septum; cardinal process transverse; crura short, crural processes prominent; loop magellaniform, lophophore plectolophous, filaments long, slender, numerous; setae numerous, short. Four main trunks of mantle canals in both ventral and dorsal mantles, all bearing genital glands except 2 inner trunks of dorsal mantle (810). *Oligo.-Mio.,* Australia-S.Am.; *Mio.,* Australia; *Rec.,* S.Pac.O.(12-600 m.)-Antarctic (600 m.).——FIG. 732,*3*. **M. australis* (QUOY & GAIMARD), Rec., *Australia*; *3a-c,* brach.v., lat., ant. views, ×1 (244).

Waltonia DAVIDSON, 1850, p. 474 [**W. valenciennesi* (=*Terebratula inconspicua* G. B. SOWERBY, 1846, p. 339); OD]. Surface smooth. *Tert.-Rec.,* N.Z.

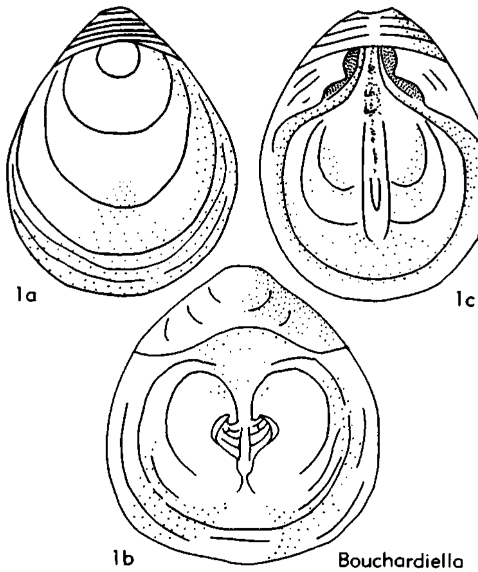


FIG. 734. Terebratellidae (Bouchardiinae) (p. *H*849).

Subfamily BOUCHARDIINAE Allan, 1940

[Bouchardiinae ALLAN, 1940, p. 270] Materials for this subfamily prepared by KOTORA HATAI and G. F. ELLIOTT as indicated, diagnosis by HATAI & ELLIOTT]

Small thick-shelled forms with slightly concave palintrope anterior to sharp beak ridges, lacking grooves which usually mark outlines of delthyrium; cardinalia thick, fused, crural bases uniting in hinge platform; median septum nonbifurcate, no hinge trough; loop premagadiniform (217). *U.Cret.-Rec.*

Bouchardia DAVIDSON, 1850, p. 62 [**Anomia rosea* MAWE, 1823, p. 65; OD] [=*Pachyrhynchus* KING, 1850, p. 70 (*non* WAGLER, 1822, *nec* GERMAR, 1824) (obj.)]. Sulcate, smooth and thick, punctae dense; beak obtuse, not incurved; foramen epithyridid; symphytium slightly concave. Hinge teeth strong, with swollen bases grooved for reception of socket ridges; inner high socket ridges enclosing hinge platform; cardinal process fused with platform; lophophore with no descending branches; pedicle valve with low septal ridge (810). *Oligo.-Mio.,* S.Am.; *Mio.,* Antarctic; *Rec.,* S.Am. (25-120 m.).——FIG. 733,*4*. **B. rosea* (MAWE), Rec., S.Am.; brach.v. view, ×1 (244). [HATAI.]

Bouchardiella DOELLO-JURADO, 1922, p. 200 [**Bouchardia patagonica* IHERING, 1903, p. 210; OD]. Small, biconvex (dorsal umbo flattened), elongate ovoid-pentagonal, test smooth, thick, commissure sulcate, beak short and nearly straight, beak ridges sharp, foramen epithyridid to permesothyridid, symphytium fused in concave area, hinge line slightly sloping. Interior of pedicle valve beak constricted, hinge teeth stout, with grooved swollen bases, muscle marks anterior, divided. Cardinalia with solid platform, prominent socket ridges, cardinal process a subquadrate muscle pit, septum low posteriorly and margined by small cavities in anterior face of platform, then rising steeply anteriorly, as in *Magas,* and bearing 2 curved posteriorly directed plates (retrograde premagadiniform loop). *U.Cret.,* Australia-S.Am. ——FIG. 734,*1*. *B. cretacea* (ETHERIDGE), W. Australia; *1a-c,* brach.v. view, brach.v. int., ped.v. int., ×7.5 (281). [ELLIOTT.]

Neobouchardia THOMSON, 1927, p. 270 [**Bouchardia minima* THOMSON, 1911, p. 260; OD]. Incipiently sulcate, smooth, punctae fine; beak suberect; symphytium with median groove. Cardinal process rounded anteriorly, with posterior tongue and converging lateral wings meeting near umbo; hinge platform pierced by 3 caves, including large and deep central one and 2 smaller lateral ones, separated by 2 small projections (810). *Mio.,* N.Z.-Australia.——FIG. 733,*3*. **N. minima* (THOMSON), Mio., N.Z., *3a,b,* brach.v. and lat. views, ×3; *3c,* brach.v. int., ×3 (810). [HATAI.]

Subfamily MAGADINAE Davidson, 1886

[*nom. correct.* ELLIOTT & HATAI, herein (*pro* Magasinae DAVIDSON, 1886, p. 4)] [Materials for this subfamily prepared by G. F. ELLIOTT and KOTORA HATAI as indicated, diagnosis by ELLIOTT & HATAI]

Brachial valve with stout socket ridges and crural bases, swollen bases to hinge teeth, posterior hinge trough, unbifurcated septum, loop magadiniform to magellaniiform; foramen permesothyridid (217). *L. Cret.-Rec.*

Magas J. Sowerby, 1816, p. 39 [**M. pumilus*; OD]. Small, smooth, unequally biconvex or plano-convex, sulcate, beak entire, incurved, overhanging foramen margined by narrow to triangular deltidial plates, areas delimited by sharp beak ridges, hinge line submegathyridid. Ventral interior with constricted beak area, hinge teeth with swollen bases, short, low, thick median ridge tapering anteriorly and posteriorly with deep muscle areas to left and right. Cardinalia occupying median two-thirds of hinge line, inner socket ridges thick, sunken median cardinal platform with cardinal

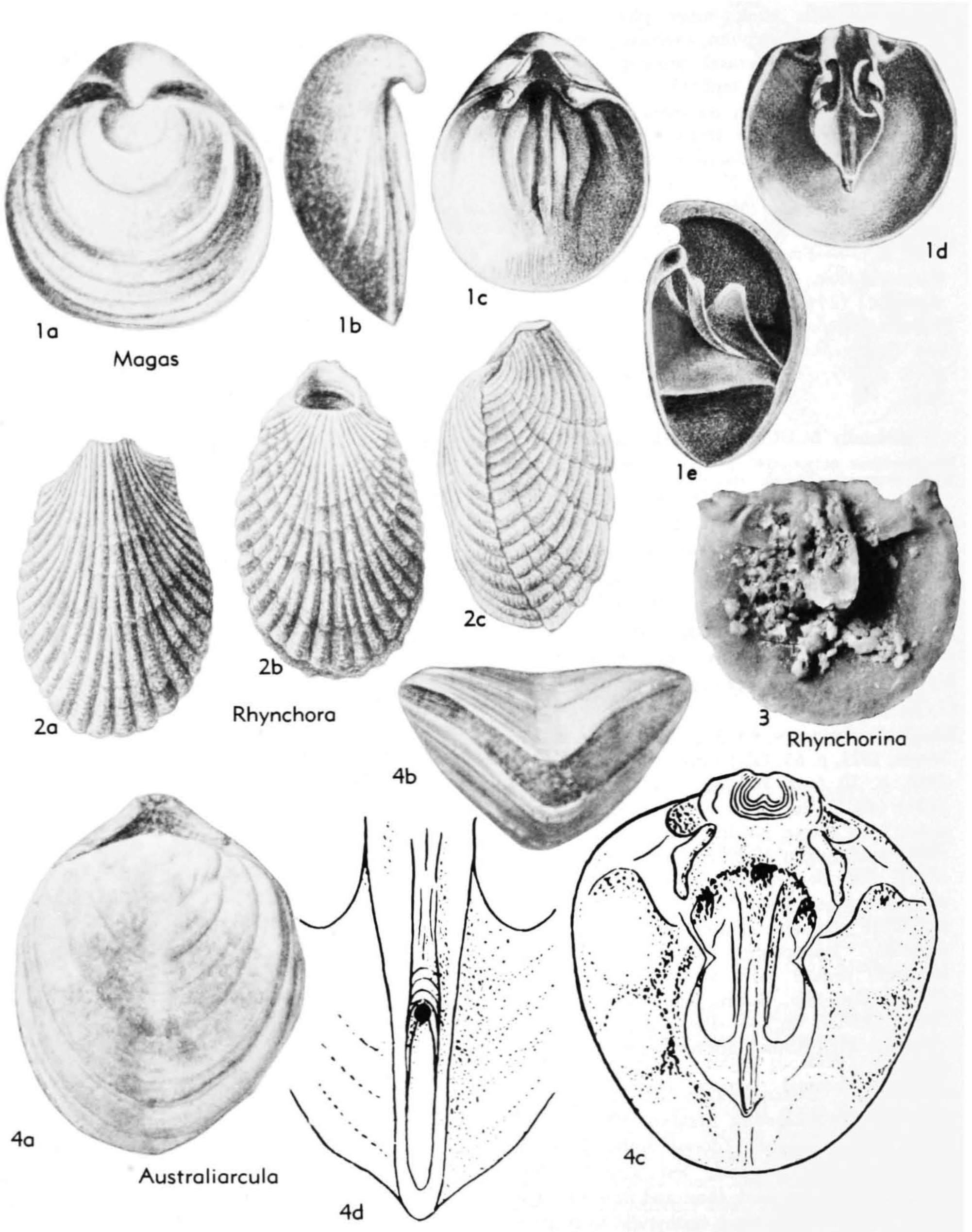


Fig. 735. Terebratellidae (Magadinae) (p. H849-H851).

process raised area on this; septum buttressing cardinalia and rising very high as anteriorly directed pillar, crura short, descending branches narrow, straight, broadly attached to septum beneath 2 posteriorly directed curved lamellae (modified magadiniform loop). *U.Cret.*, Eu.——Fig. 735,*1*. **M. pumilus*; *1a,b*, brach.v. and lat. views; *1c,d*, ped.v. int., brach.v. int. showing loop (reconstr.); *1e*, lat. view of shell int. (reconstr.); all ×4 (229). [Elliott.]

Australiarcula Elliott, 1960, p. 26 [**A. artesiana*; OD]. Small, ovoid, narrowing anteriorly, with median dorsal sulcus matched by ventral keel; test smooth, commissure sulcate. Beak erect, foramen permesothyridid, symphytium concave, beak ridges sharp, hinge line gently sloping. Hinge teeth stout, with grooved swollen bases. Sockets deep, socket ridges strong, cardinal platform solid with posterior muscle pit, septum high anteriorly, loop primitive magadiniform with well-developed descending branches and rudimentary hood. *L. Cret.*, S.Australia.——Fig. 735,*4*. **A. artesiana*; *4a,b*, brach.v. and ant. views, ×3; *4c*, brach.v. int. (reconstr.), ×4.5; *4d*, loop, ×18 (289). [Elliott.]

Lutetiarcula Elliott, 1954, p. 727 [**L. perplexa*; OD]. Biconvex, with solid strong brachial cardinalia, cardinal process low, median septum well developed, extending nearly to anterior margin, curved lateral brachial ridges on valve floor (284). *Eoc.*, Fr.——Fig. 733,*7*. **L. perplexa*; *7a,b*, brach. v. int., post. view of brach.v., ×15 (284). [Hatai.]

Magadina Thomson, 1915, p. 399 [**M. browni*; OD]. Sulcate to intraplicate, smooth, solid, punctae dense; beak erect; foramen permesothyridid; symphytium solid, concave; pedicle collar strong, sessile, uniting at sides with posterior part of bases of hinge teeth, which are strong, with swollen bases, and grooved for reception of socket ridges. Pedicle valve with septal ridge, situated anteriorly; crural bases united with socket ridges; hinge trough short, deep; descending and ascending branches of loop separately attached to septum; lophophore zygolophous, median lobe being uncoiled (810). *Oligo.-Mio.*, Australia; *Mio.*, Australia-N.Z.; *Rec.*, S.Australia(25-400 m.).——Fig. 733,*2*. **M. browni*, Mio., N.Z.; *2a-c*, brach.v., lat., ant. views, ×1; *2d*, brach.v. int., ×1 (810). [Hatai.]

Magadinella Thomson, 1915, p. 400 [**Magasella woodsiana* Tate, 1880, p. 163; OD]. Brachial valve thickened posteriorly and laterally; muscle impressions forming deep pit on each side of median septum; hinge trough moderately large, only partially filled by small, anteriorly directed cardinal process, which is trefoil on top; loop late magelliform or early terebratelliform (810). *Oligo-Mio.*, Australia.——Fig. 733,*1*. **M. woodsiana* (Tate), Mio.; *1a,b*, brach.v. and lat. views, ×1; *1c*, brach.v. int., ×1 (810). [Hatai.]

Pirothyris Thomson, 1927, p. 280 [**Magasella vercoi* Blochmann, 1910, p. 91; OD]. Uniplicate, punctae fine and dense; beak suberect; foramen apparently permesothyridid, attrite. Cardinalia strong, hinge trough deep, large; cardinal process occupying half length of hinge trough; loop magelliform. Ventral muscle impressions extending anteriorly beyond middle of valve, separated by median ridge; dorsal muscle impressions strong (810). *Rec.*, Australia(30-40 m.).——Fig. 733,*5*. **P. vercoi* (Blochmann); *5a,b*, brach.v. and lat. views, ×3; *5c*, brach.v. int. showing loop (reconstr.), ×6 (810). [Hatai.]

Rhizothyris Thomson, 1915, p. 399 [**Bouchardia rhizoida* Hutton, 1905; p. 480; OD]. Incipiently sulcate, punctae dense; beak erect, foramen permesothyridid. Hinge teeth strong, bases swollen, restricting umbonal cavity; ventral muscle impressions strong, separated by septal ridge; sockets large, socket ridges high, overhanging, projecting behind umbo, laterally fused with crural bases; hinge trough with large cardinal process; crura originating just above septum; median septum short, stout, uniting with cardinalia; loop magellaniform (810). *Mio.*, N.Z.——Fig. 733,*6*. **R. rhizoida* (Hutton); *6a*, brach.v. view, ×1; *6b,c*, brach.v. int., ped.v., int., ×1 (810).

Rhynchora Dalman, 1828, p. 135 [**Terebratula costata* Nilsson, 1827, p. 37 (=**Anomites costatus* Wahlenberg, 1821, 1819, p. 62=*Anomia pectinata* Linné, 1758, p. 701)]. Large, thick, pedicle valve deeper than brachial, coarsely costate, sulcate; area nearly at right angles to plane of lateral commissures, foramen very large, vestigial deltidial plates at anterior corners. Hinge teeth large, widely separated, low median pedicle valve ridge fading anteriorly. Cardinalia thick, rounded, elements fused, socket ridges thick and fused with cardinal platform, cardinal process a large, slightly raised median surface area on platform, hollows under cardinal platform beneath crural processes; septum thin, buttressing cardinalia, high posteriorly and diminishing anteriorly to midpoint of valve; loop unknown, believed to be of terebratelliform series. *U.Cret.*, NW.Eu.——Fig. 735,*2*. **R. costata* (Nilsson); *2a-c*, ped.v., brach. v., lat. views, ×1.5 (920). [Elliott.]

Rhynchorina Oehlert, 1887, p. 1326 [**Anomites spathulatus* Wahlenberg, 1821, p. 62; OD]. Similar in size, outline, and area to *Rhynchora*, differing in smooth exterior with concentric growth lines; cardinalia with very wide concave outer hinge plates, marked crural bases with convex inner hinge plates arching over septum and meeting in median ridge which runs back to cardinal process, loop like that of *Magas*. *U.Cret.*, NW.Eu.——Fig. 735,*3*. **R. spathulata*; brach.v. int., ×5 (Elliott, n). [Elliott.]

Subfamily TRIGONOSEMINAE Elliott, n. subfam.

[Materials for this subfamily prepared by G. F. Elliott]

Shell striate to multicostate, sulcate; cardinalia strong, with massive or pillar-like

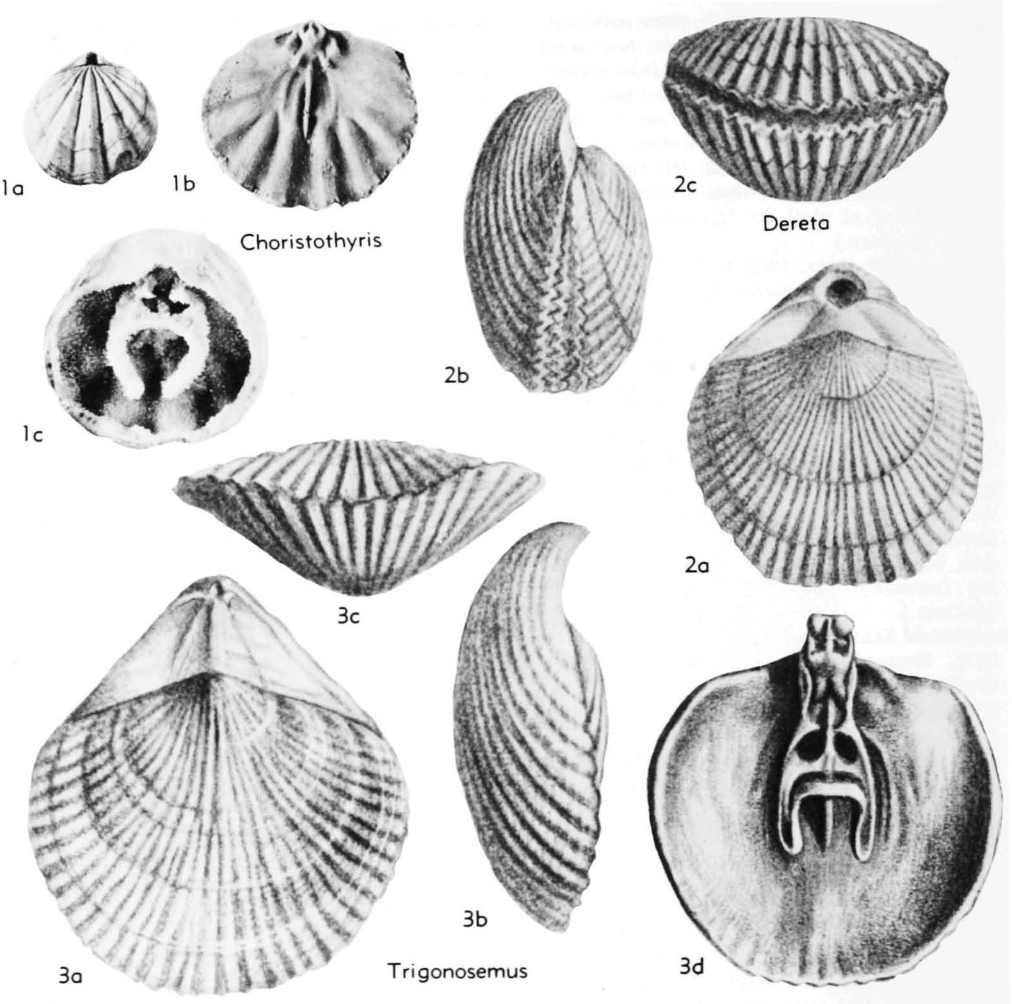


FIG. 736. Terebratellidae (Trigonoseminae) (p. *H*851-*H*854).

cardinal process, and terebratelliform loop. *U.Cret.*

Trigonosemus KOENIG, 1825, p. 3 [**T. elegans*; OD] [=*Delthyridea* M'COY, 1844, p. 150; *Fissirostra* D'ORBIGNY, 1847, p. 269; *Fissurirostra* D'ORBIGNY, 1850, p. 132]. Medium-sized to large, unequally biconvex to plano-convex, terebratuliform, with very high overhanging beak, sulcate, test thick, striate, area very high, smooth, concave, with terminal pinhole foramen, symphytium high and narrow, hinge line submegathyridid. Pedicle valve interior posteriorly constricted, teeth heavy, muscle marks to left and right of median ridge posteriorly. Cardinalia dominated by massive cardinal process with swollen base, sockets to left and right, deep muscle marks to left and right of septum, which is thick buttress posteriorly and extends anteriorly to little more than half of valve length, loop narrow, rather small, terebratelliform. *U.Cret.*, Eu.-W.Asia.——FIG. 736,*3*. **T. elegans,* W.Eu.; *3a-d,* brach.v., lat., ant., brach.v. int. views, ×8 (229).

Choristothyris COOPER, 1942, p. 233 [**Terebratula plicata* SAY, 1820, p. 43; OD]. Small, subcircular, multicostate to plicate, sulcate, test thick; hinge line subterebratulid, beak suberect to erect, foramen large, submesothyridid, deltidial plates small, disjunct. Hinge teeth large, with deep fossettes in supporting callus, ventral muscular area large, flabellate, divided by low stout median ridge. Cardinalia strong, inner socket ridges strong and high; hinge plate small, concave, cardinal process massive, trilobed; median septum high, thin, reaching to center of valve, dividing muscle marks; crural processes long, slender, loop terebratelliform. *U.Cret.*, N.Am.——FIG. 736,*1*. **C. plicata* (SAY), USA(N.J.); *1a,* brach.v. view, ×1; *1b,c,* brach.v. int., int. showing calcite encrusted loop, ×2 (178).

Dereta Elliott, 1959, p. 147 [**Terebratula pectita* J. Sowerby, 1816, p. 83; OD]. Medium-sized to large, transverse terebratuliform, strongly biconvex, test thick, striate, commissure sulcate; foramen round to oval, encroaching slightly on gently incurved beak, lateral areas smooth, bordering symphytium, beak ridges sharp, hinge line subterebratulid. Pedicle collar present, median ridge

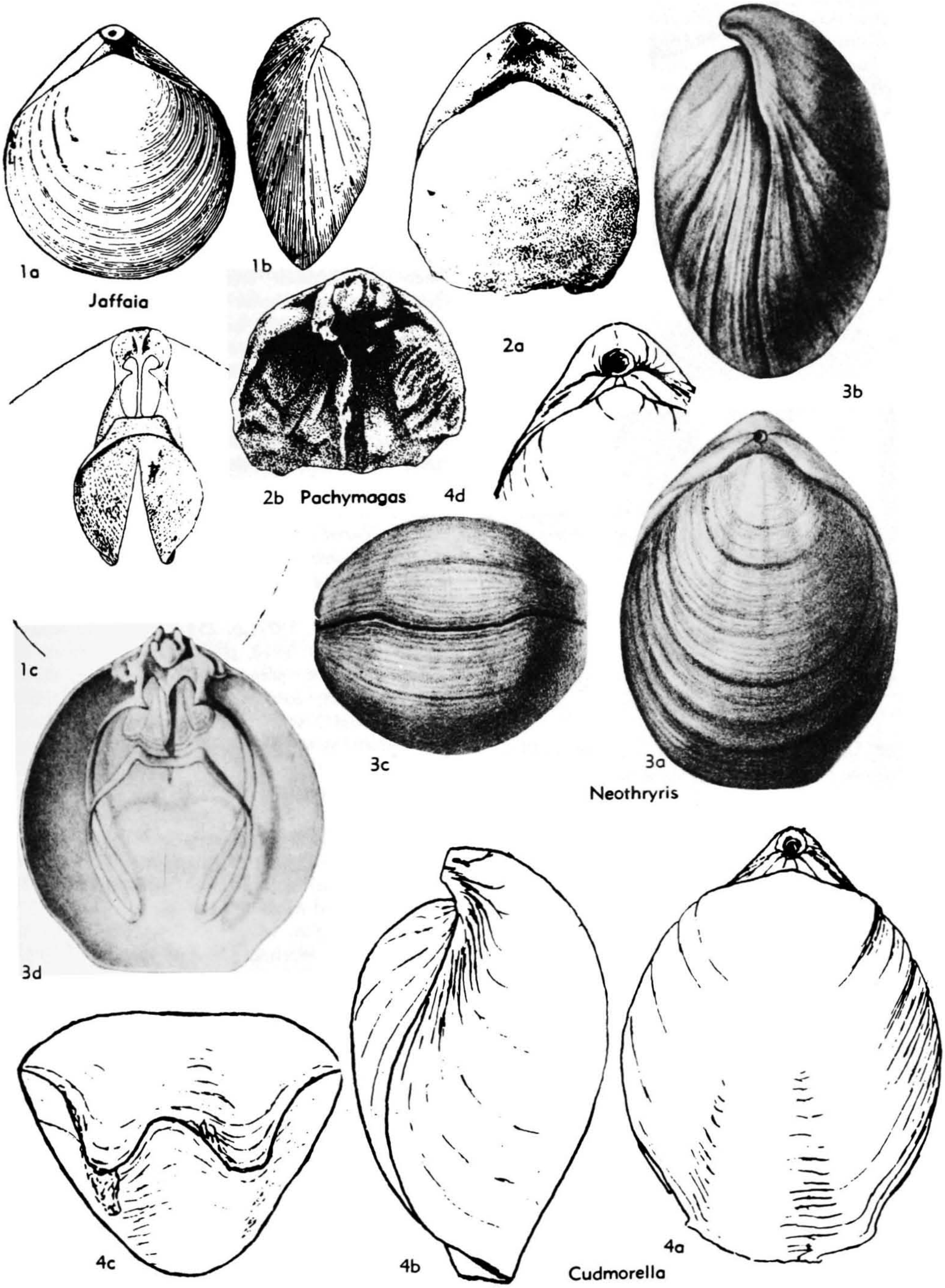


Fig. 737. Terebratellidae (Neothyridinae) (p. *H*854-*H*855).

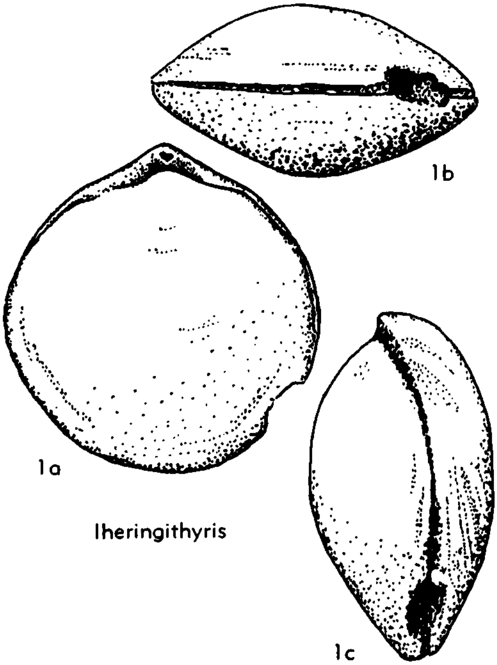


FIG. 738. Terebratellidae (Neothyridinae) (p. H854).

in ventral umbonal area. Cardinal platform small, thick, elements fused, dominated by high narrow pillar-like cardinal process, septum thick, loop believed terebratelliform. *U.Cret.*, Eu.——FIG. 736, *2*. **D. pectita* (SOWERBY), Eng.; *2a-c*, brach.v., lat., ant. views, ×2 (229).

Subfamily NEOTHYRIDINAE Allan, 1940

[Materials for this subfamily prepared by KOTORA HATAI]

Socket ridges, crural bases, and septum thick and solid; cardinalia characterized by distinct hinge trough, and bifurcated septum. Foramen ranging from hypothyridid to permesothyridid, loop from magadiniform to magellaniiform, and folding from sulcate to intraplicate (25). *Oligo.-Rec.*

Neothyris DOUVILLÉ, 1879, p. 274 [**Terebratula lenticularis* DESHAYES, 1839, p. 359; OD]. Sulcate, punctae large, close; beak erect to incurved; foramen mesothyridid, attrite; deltidial plates conjunct. Hinge teeth large, bases swollen. Cardinalia strong; crural bases fused with socket ridges; median septum short, high, bifurcating; hinge trough roomy, but almost completely filled by large cardinal process; loop magellaniiform; crura rather short; crural processes prominent; lophophore plectolophous. Muscle impressions strong (810). *Mio.-Rec.*, N.Z.(30-85 m.).——FIG. 737,*3*. **N. lenticularis* (DESHAYES), Rec., N.Z.; *3a-c*, brach.v., lat., ant., views, ×1; *3d*, brach.v., int. showing loop (reconstr.), enlarged (244).

Cudmorella ALLAN, 1939, p. 242 [**C. tatei*; OD]. Biconvex, intraplicate, punctae fine, dense; beak obtuse, suberect to erect; foramen permesothyridid, attrite; symphytium low, with median ridge. Hinge teeth strong with swollen bases; cardinalia as in *Pachymagas*; socket ridges descending obliquely to hinge trough; crural bases stout; cardinal process small; crura short, thick; median septum short, bladelike, forking to join anterior edge of socket ridges; hinge trough roomy; loop magelliform (24). *Mio.*, Australia.——FIG. 737,*4*. **C. tatei*; *4a-c*, brach.v., lat., ant. views, ×1; *4d*, foramen, enlarged (24).

Gyrothyris THOMSON, 1918, p. 23 [**Gyrothyris mawsoni*; OD]. Incipiently sulcate, obsoletely and rather finely multicostate; beak erect; foramen mesothyridid, attrite; deltidial plates conjunct, concave, almost hidden. Median septum narrowly bifurcating; hinge trough shallow; loop terebratelliform (810). *Mio.*, N.Z., *Rec.*, Antarctic.

Iheringithyris LEVY, 1961, p. 84 [**Magellania ameghinoi* IHERING, 1903, p. 326; OD]. Large, smooth, thick, biconvex shell; circular in outline, commissure rectimarginate, umbo suberect, foramen very small, mesothyridid, deltidial plates discrete, beak ridges sharp. Cardinalia thickened like those of *Pachymagas*, cardinal process large and excavate, septum thick, loop magellaniiform. *Mio.*, Patagonia.——FIG. 738,*1*. **I. ameghinoi* (IHERING); *1a-c*, brach.v., ant., lat. views, ×1 (506a).

Jaffaia THOMSON, 1927, p. 254 [**Magasella jaffaensis* BLOCHMANN, 1910, p. 92; OD]. Biconvex, incipiently sulcate, punctae moderately fine, dense; beak suberect; foramen submesothyridid (almost mesothyridid), attrite; symphytium solid. Cardinalia fairly strong; crural bases and socket ridges united; hinge trough wide; cardinal process triangular, confined to posterior part of hinge trough; crura and crural processes short; descending branches of loop extending beyond their union with septum, ascending branches united with descending branches throughout their entire length, transverse band narrow (810). *Rec.*, Australia (80-500 m.).——FIG. 737, *1*. **J. jaffaensis* (BLOCHMANN); *1a,b*, brach.v. and lat. views, ×1.8; *1c*, brach.v. int., showing loop (reconstr.), ×3.6 (810).

Malleia THOMSON, 1927, p. 283 [**Terebratella portlandica* CHAPMAN, 1913, p. 187; OD]. Planoconvex; beak short; foramen hypothyridid, incomplete; deltidial plates rudimentary. Hinge teeth strong, transversely striated, with swollen bases deeply grooved for reception of socket ridges. Median septum bifurcating as 2 low ridges before reaching cardinalia, enclosed hinge trough with flatly inclined sides; cardinal process swollen above, with 2 lateral wings and median ridge; loop probably magadiniform. Ventral muscle impressions not strong, separated by septal ridge (810). *Mio.*, Australia.——FIG. 739,*1*. **M. port-*

landica (Chapman); *1a,b,* brach.v. and lat. views, ×2; *1c,d,* ped.v. int., brach.v. int., ×1; *1e,* lat. view of loop, ×2 (810).

Pachymagas Ihering, 1903, p. 332 [**Terebratella (Pachymagas) tehuelcha*; OD]. Sulcate to exceptionally intraplicate, punctae large and close; beak suberect to erect, rarely incurved; foramen mesothyridid, attrite; deltidial plates conjunct. Hinge teeth strong, with swollen bases; cardinalia strong; median septum bifurcating rather widely; hinge trough roomy; cardinal process small; loop terebratelliform (810). *Oligo.-Mio.,* Antarctic; *Mio.,* N.Z.; *Oligo.-Plio.,* S.Am.——Fig. 737,*2.* **P. tehuelcha,* Plio., S.Am.; *2a,b,* brach.v. view, brach.v. int., ×1 (810).

Stethothyris Thomson, 1918, p. 23 [**S. uttleyi*; OD]. Beak suberect to incurved; symphytium with median ridge. Hinge teeth small, strong, with swollen bases, posterior thickening of valve restricting beak cavity; cardinalia strong; bifurcating narrow median septum uniting with swollen and rather flattened crural bases beyond points of origin of crura; hinge trough broad and shallow posteriorly, narrow in front; cardinal process slightly raised central boss with 2 lateral wings projecting on each side of umbo; loop magellaniiform. Ventral muscle impressions separated by triangular median ridge (810). *Oligo.-Mio.,* Australia; *Mio.,* N.Z.; *Rec.,* Antarctic(650 m.).——Fig. 739,*3.* **S. uttleyi,* Mio., N.Z.; *3a-c,* brach.v., lat., ant. views, ×1; *3d,e,* ped.v. int., brach.v. int., ×1 (810).

Victorithyris Allan, 1940, p. 289 [**V. peterboroughensis*; OD]. Biconvex, sulcate to intraplicate, smooth, punctae fine and dense; beak suberect to strongly incurved; foramen permesothyridid, attrite. Cardinalia strong, socket ridges distinct or massive; crural bases swollen, massive, or not swollen, forked anteriorly; median septum short, thick, solid, or long and bladelike, thick at base; cardinal process small to large, with wings or bilobed; loop magellaniiform; hinge trough deep to almost completely filled (26). *Tert.,* Australia.——Fig. 739,*4.* **V. peterboroughensis*; *4a-c,* brach.v., lat., ant. views, ×1 (26).

Waiparia Thomson, 1920, p. 380 [**Pachymagas abnormis* Thomson, 1917, p. 412; OD]. Sulcate, smooth, punctae fine and dense; beak subapicate, erect; foramen submesothyridid (almost hypothyridid); deltidial plates conjunct. Hinge teeth strong, bases swollen; cardinalia strong; median septum short, bifurcating widely, fused with socket ridges and crural bases; hinge trough moderately large; cardinal process pyramidal, low; loop presumably terebratelliform (810). *Mio.,* N.Z.——Fig. 739,*2.* *W. intermedia* (Thomson); *2a-c,* brach. v., lat., ant. views, ×1 (810).

Family UNCERTAIN

[Materials for this assemblage prepared by H. M. Muir-Wood and G. F. Elliott as indicated]

Leptothyrella Muir-Wood, herein [*nom. subst. pro Leptothyris* Muir-Wood, 1959 (*non* Conrad in Kerr, 1875, p. 20)] [**Leptothyris ignota* Muir-Wood, 1959, p. 308; OD]. Small, elongate-oval, valves slightly convex, anterior commissure plane; surface smooth; hypothyridid; deltidial plates narrow, bordering open delthyrium. Loop with descending branches attached to high medially developed platelike septum, no ring or hood present (precampagiform stage); cardinal process small, uniting high inner socket ridges, which

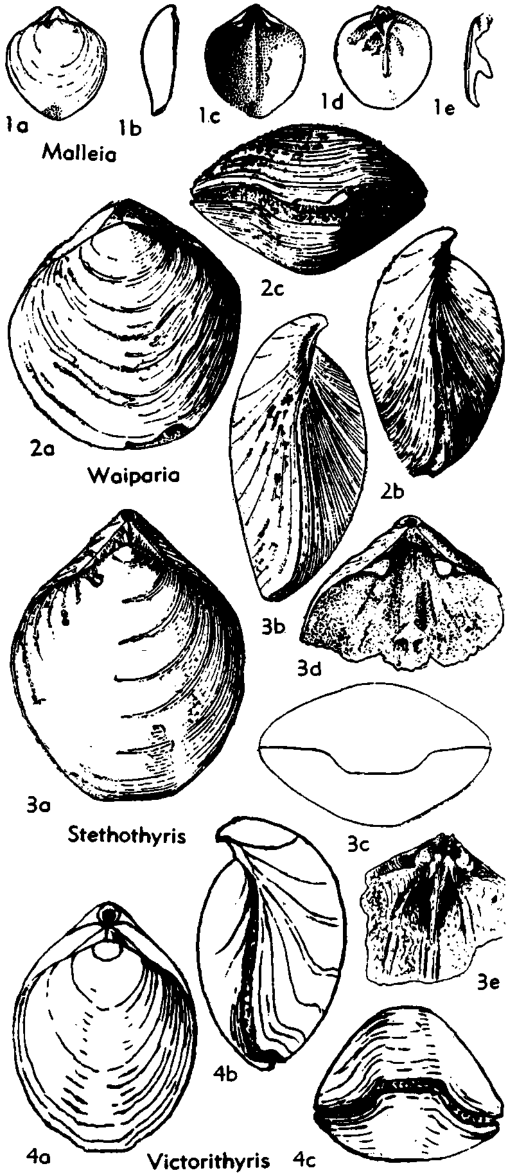


Fig. 739. Terebratellidae (Neothyridinae) (p. *H*854-*H*855).

are continuous with crural bases; hinge plates and dental plates absent; lophophore spirolophous, septum posterior to spirals. *Rec.*, Ind.O. (off Zanzibar)-Gulf of Aden.——Fig. 740,*3*. **L. ignota* (Muir-Wood), Gulf of Aden *(3a,b)*, off Zanzibar *(3c,d)*; *3a,b*, brach.v. and lat. views, ×7; *3c,d*, ped.v. and brach.v. int., ×10 (584). [Muir-Wood.]

Terebrirostra d'Orbigny, 1847, p. 269 [**Terebratula lyra* J. Sowerby, 1816, p. 83; OD] [=*Lyra* Cumberland in J. Sowerby, 1816, p. 84 *(nom. nud.)*]. Biconvex, ornament of wavy radial costae, folding subintertext to ligate, dorsal valve elongate-oval to subtrigonal in outline, pedicle valve resembling brachial valve but with very long curving suberect umbo; anterior commissure rectimarginate or slightly sulcate. Beak ridges angular, deltidial plates fused, dental plates extending whole length of umbo anteriorly curved and uniting with lateral margin. Dorsal cardinalia

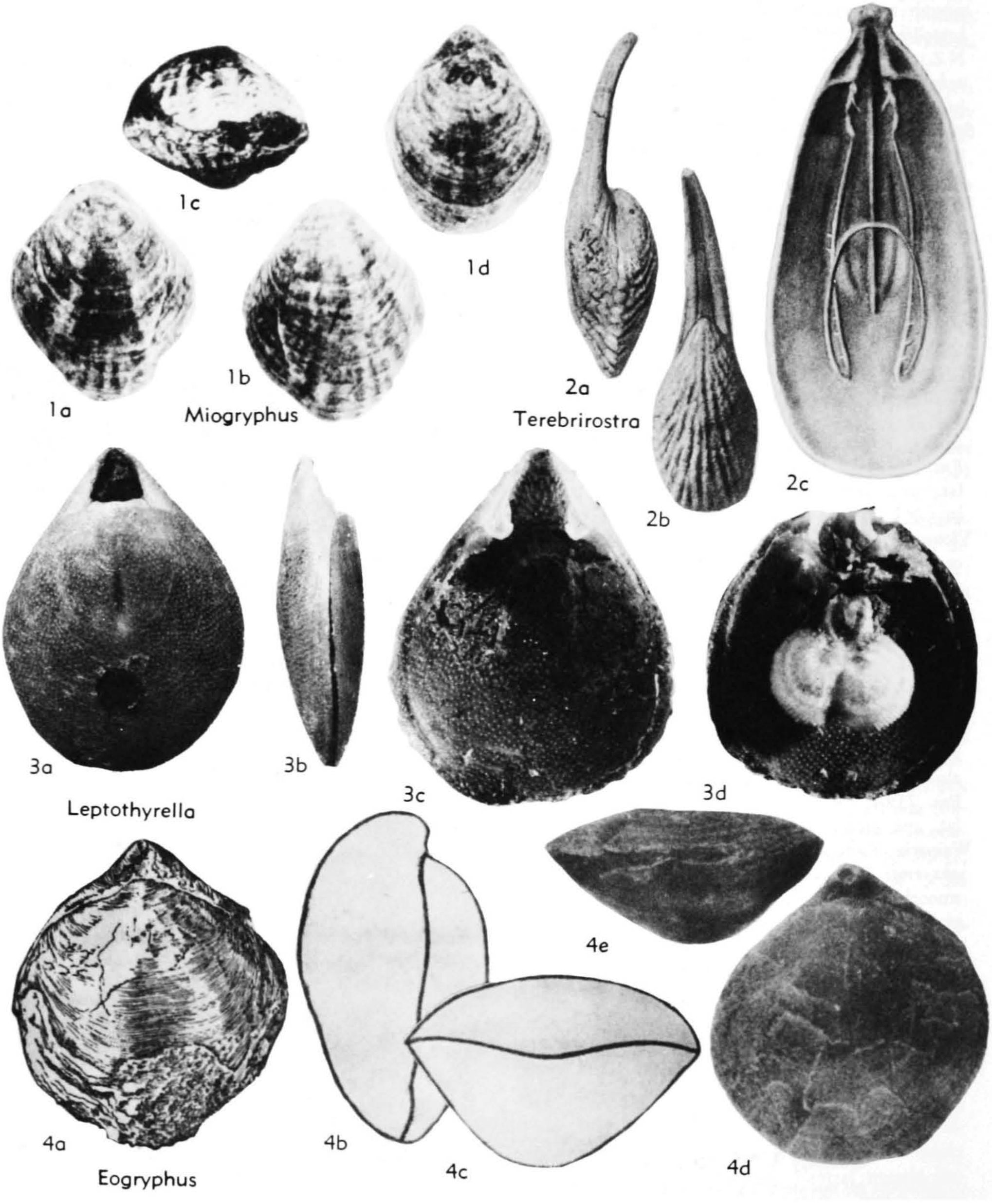


Fig. 740. Family Uncertain *(2,3)*; Family Unknown *(1,4)* (p. *H*855-*H*857).

with large triangular sockets, deep central hinge trough, large conspicuous trilobed cardinal process; long thin median septum extending anteriorly from cardinalia; loop long, thin, spinose, not attached to septum in adult. *L.Cret.*, W.Eu.——Fig. 740,*2a,b*. **T. lyra* (Sowerby), Eng.; *2a,b*, lat., brach.v. views, ×1.5 (576).——Fig. 740,*2c*. *T. incurvirostrum* Lamplugh & Walker, Eng.; brach.v. int., ×2.5 (576). [Elliott.]

Zellania Moore, 1855, p. 111 [**Z. davidsoni*; OD]. Minute, valves smooth or feebly striate, flattish, convex at umbo, outline triangular or shield-shaped, hinge line megathyridid or submegathyridid, pedicle-opening amphithyridid. Brachial valve interior with smooth or granulate margin bounded by inner ridges commencing anterior of sockets and reflexed anteriorly into posteriorly directed septum. *Jur.*, W.Eu.——Fig. 741,*1*. **Z. davidsoni*, L.Jur., Eng.; *1a-c*, brach.v., ped.v., brach.v. int. views, ×30 (568). [Elliott.]

Suborder, Superfamily, and Family UNKNOWN

[Materials for this assemblage prepared by H. M. Muir-Wood]

Eogryphus Hertlein & Grant, 1944, p. 88 [**E. tolmani*; OD]. Medium-sized, circular to ovate, valves moderately convex, brachial valve with shallow median sulcus; anterior commissure incipiently sulcate or rectimarginate; umbo short, slightly incurved, foramen small, permesothyridid; surface smooth. Dorsal septum present, mantle canal impressions straight and evenly spaced; other internal characters unknown. *Eoc.*, USA (Calif.).——Fig. 740,*4*. **E. tolmani; 4a-c*, brach. v., lat., ant. views (holotype); *4d,e*, brach.v. and ant. views (paratype), all ×1 (427).

Miogryphus Hertlein & Grant, 1944, p. 95 [**M. willetti*; OD] Medium-sized, ovate to subpentagonal, biconvex, with low dorsal median fold, with sulcus or flattening of pedicle valve in some specimens; anterior commissure uniplicate to sulciplicate; shell surface smooth or with few anterior radial plications in both valves and prominent growth lines; umbo small, erect, foramen small, ?mesothyridid, symphytium developed. Dorsal median septum present, other internal characters unknown. *Mio.*, USA (Calif.).——Fig. 740, *1*. **M. willetti; 1a-c*, brach.v., ped.v., ant. views (holotype), ×1; *1d*, brach.v. view (paratype), ×1 (427).

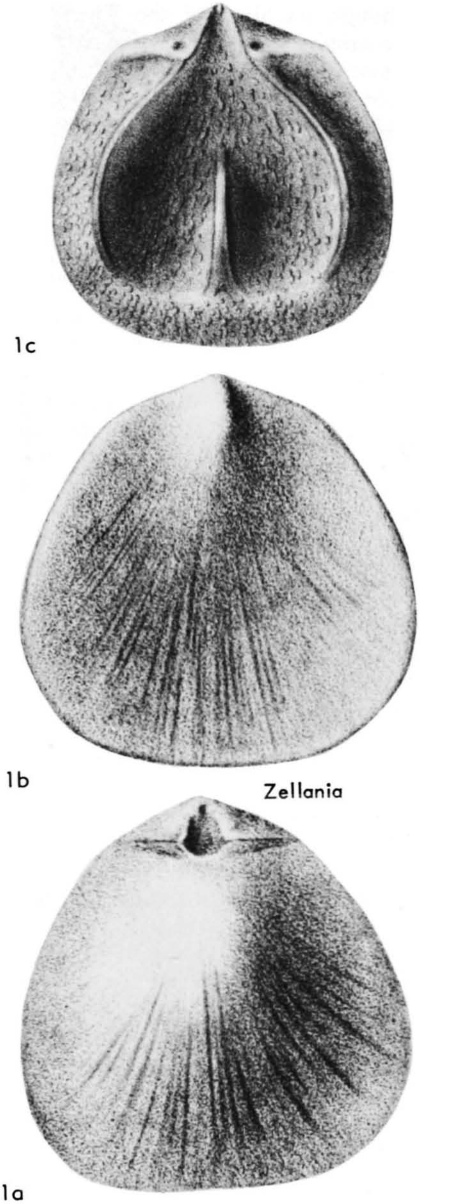


Fig. 741. Family Uncertain (p. *H*857).

ORDER UNCERTAIN—THECIDEIDINA

By G. F. Elliott
[Iraq Petroleum Company, Limited, London]

The Thecideidina are here classed tentatively as a suborder equal to the Strophomenidina. The case for regarding them as highly modified terebratuloids rests on their punctate shell structure and on belief in their profound modification due to neoteny. Pending a better knowledge of the varieties and functions of punctae, and a restudy of the larval development of the living *Lacazella*, it seems best to assign them as is done below.

Although members of the Thecideidina show a profusion of small varied detail, they are remarkably homogeneous, considered as a whole. In the present account the single superfamily is divided into two families, each without subfamilies. BACKHAUS (1959) in his detailed and profound study dealing with the Cretaceous thecideoids only, recognized but one family, with a single subfamily divided into two tribes, each with a single genus and three subgenera. These tribes are based on his interpretation of thecideoid phylogeny within the Cretaceous; they do not correspond to the major divisions defined here. Future studies may show how far this classification can be extrapolated to pre- and post-Cretaceous forms. For the present account all genera so far described are given: the reader is referred to BACKHAUS (44) for the different interpretation of the Cretaceous genera, among which *Parathecidea* BACKHAUS is described here from the type-species.

Suborder THECIDEIDINA Elliott, 1958

[*nom. correct.* ELLIOTT, herein (*pro* Thecideoidea ELLIOTT, 1958, p. 373)]

Small articulates, shell usually attached by cementation, without pedicle, rarely free, outline variable and irregular; valves hinged by teeth and sockets permitting wide opening, usually smooth externally, commonly granular internally; no mantle canal markings or obvious ovarian scars; test thick, fibrous with scattered punctae or densely punctate; high interarea with convex or flat pseudodeltidium; pedicle valve deep, with hemispondylium sessile or supported by septum, 2 diductor muscle-scars prominent; 2 median and 2 lateral adductor muscle scars inconspicuous; brachial valve lidlike, without area, with square cardinal process, inconspicuous median and lateral adductor scars, median septum simple or branched, extending from anterior margin to terminate posteriorly, with or without bridge, with or without brachial ridges. Mantle thin, without marginal setae, spicules present or absent in mantle; lophophore thin, centripetal, schizolophous or ptycholophous; muscles paired, not branching, diductors and median and lateral adductors, muscle scars smooth; marsupium present in some species. *Trias.-Rec.* (max. *U.Cret.*).

Superfamily THECIDEACEA Gray, 1840

[*nom. transl.* TERMIER & TERMIER, 1949 (*ex* Thecideidae GRAY, 1840)]

Characters of suborder. *Trias.-Rec.*

Family THECIDELLINIDAE Elliott, 1958

Small forms with bilobed brachial interiors, relatively simple dorsal septum, lophophore schizolophous. *Trias.-Rec.*

Thecidellina THOMSON, 1915 [**Thecidea barretti* DAVIDSON, 1864; OD] [=*Thecidellella* HAYASAKA, 1938 (type, *T. japonica*]. Similar to *Bifolium*, but test densely punctate, pseudodeltidium fused with interarea, brachial ridges secondarily elaborated by spiny processes which may roof over brachial cavities with transverse bars; spicules present; lophophore schizolophous, with long filaments. [*Thecidellella* resembles *Thecidellina,* but accessory shelly structure ("reversed spondylium" of HAYASAKA) between the bridge and posterior end of the median septum in the brachial valve. The distinction is slight and the structure occurs also in *Thecidellina* spp. (184); *Thecidellella* therefore is considered to be a synonym of *Thecidellina.*] *Tert.,* W.Indies; *Rec.,* W.Indies-Ind.O.-Pac.O.——FIG. 742,*3*. *T. blochmanni* (DALL), *Rec.,* Christmas Is., Ind.O.; *3a,b,* brach.v. int., ped.v. int., ×9 (Elliott, n).

Bifolium ELLIOTT, 1948 [**Thecidea faringdonensis* DAVIDSON, 1874; OD]. Similar to *Moorellina,* but with bridge always present, adult females with marsupial notch; dorsal septum more variable than in *Moorellina,* brachial ridges forming complete lateral subcircular features, spicules not seen. *Cret.,* Eu.-SW.Asia; *Tert.,* Eu.-N.Am.-E.Afr.-N.Z. ——FIG. 742,*1*. **B. faringdonense* (DAVIDSON), L.Cret., S.Eng.(Faringdon); *1a,b,* brach.v. int., ped.v. int., ×20 (Elliott, n).

Moorellina ELLIOTT, 1953 [**Thecidea duplicata* MOORE, 1855; OD]. Similar to *Thecidella,* test fibrous, with scattered punctae or clearly punctate, but with brachial ridges present, varying from pustulose strips to incomplete arcuate lines, and exceptionally in form of posteriorly directed or anteriorly branching ridges; bridge usually developed; spicules present in some. *U.Trias.(Rhaet.)-U.Jur.,* W.Eu.——FIG. 742,*2*. **M. duplicata* (MOORE), M.Jur., S.Eng.(Dundry); brach.v. int., ×16 (Elliott, n).

Thecidella OEHLERT, 1887 [**Thecidea (Thecidella) normaniana*; OD]. Very small, irregularly trigonal to transverse in outline, test apparently fibrous, with scattered punctae, triangular pseudodeltidium present, hemispondylium developed, dorsal median septum simple, wide, variable in outline with denticulate margins, bridge usually absent but exceptionally present, brachial ridges absent. *U. Trias.(Rhaet.)-L. Jur.,* W. Eu.——FIG. 742,*4*.

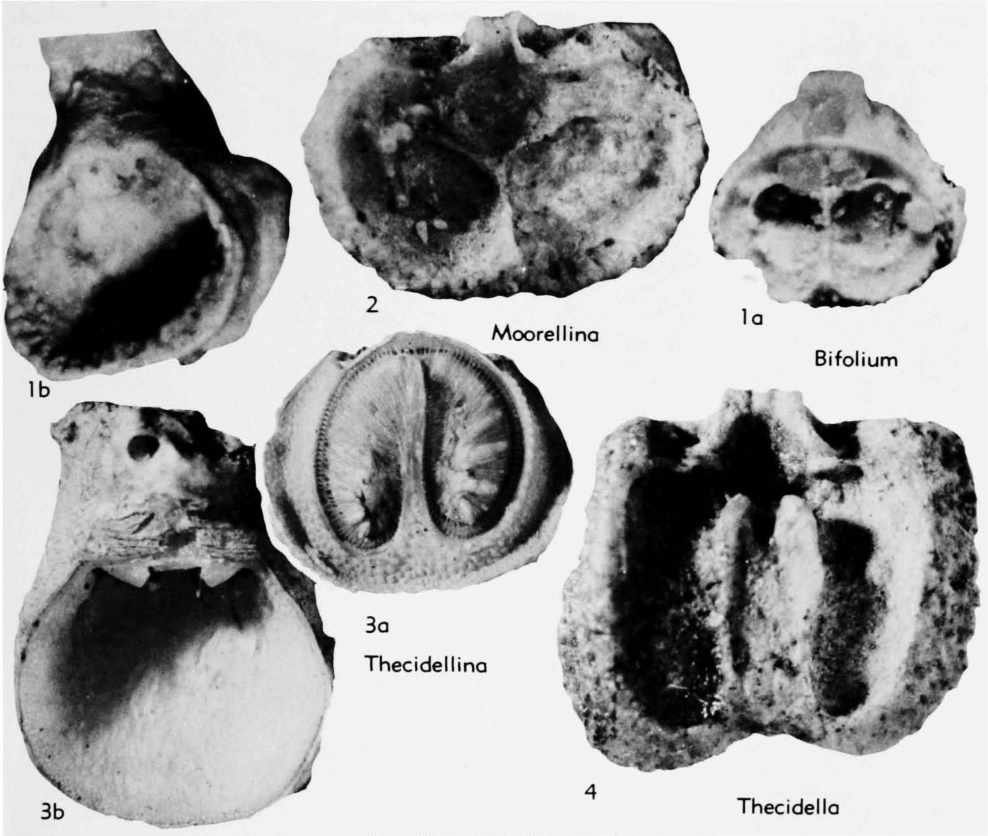


FIG. 742. Thecidellinidae (p. H858).

T. normaniana MUNIER-CHALMAS, L.Jur., Fr. (May); brach.v. int., ×16 (Elliott, n).

Family THECIDEIDAE Gray, 1840

Larger forms with much-divided brachial interiors, only bilobed in adult in single exceptional genus, possible not a thecideid; lophophore ptycholophous. *L.Jur.-Rec.*

Thecidea DEFRANCE, 1822 [**Thecidea radians* (=**Terebratulites papillata* VON SCHLOTHEIM, 1813); OD] [=*Thecidium* SOWERBY, 1823 *(nom. null.)*; *Thecidaea* KEFERSTEIN, 1829, p. 82 *(nom. null.)*; *Thecideum* FISCHER DE WALDHEIM, 1834, p. 279 *(nom. null.)*; *Thecedea* D'ORBIGNY, 1847, p. 249 *(nom. null.)*]. Small, free, symmetrical, beak entire, otherwise terebratuliform, radial ornament, test densely punctate, pseudodeltidium narrow and convex in high area; pedicle valve with internal median ridge, prominent lateral muscle platforms left and right of hemispondylium; brachial valve with very wide granular internal margin anterolaterally, median septum with 2 or 3 curved branches on either side, brachial ridges following course of septa; bridge present. *Cret.*, W.Eu.——FIG. 743,*3*. **T. papillata* (SCHLOTHEIM), U.Cret., N.Fr.(Fréville); *3a-c,* brach.v. ext., ped. v. int., brach.v. int., ×6 (Elliott, n).

Davidsonella MUNIER-CHALMAS, 1881 [**Thecidea sinuata* E. EUDES-DESLONGCHAMPS, 1853; OD]. [*non Davidsonella* WAAGEN, 1885; *nec* FREDERIKS, 1926]. Small, elongate, pseudodeltidium present, test pseudopunctate; pedicle valve deep, anteriorly bilobed by median sulcus; brachial valve with bridge, long median septum terminating posteriorly in sharp point, 2 long deep brachial cavities thus formed roofed over or filled by coarse spicular growth, brachial ridges not present. [This may not be a true thecideid but is conveniently placed here at present.] *L.Jur.*, W. Eu.-N.Afr.——FIG. 743,*2*. **D. sinuata* (DESLONGCHAMPS), L.Jur., Fr.(May); *2a,b,* brach.v. int., ped.v. int., ×4.5 (Elliott, n).

Eolacazella ELLIOTT, 1953 [**Thecidea affinis* BOSQUET, 1860; OD]. Small, irregular or trigonal, high narrow pseudodeltidium, test punctate; internal median ventral ridge spinose; dorsal median septum with few branches, or several branches originating together anteriorly, brachial ridges following course of septal branches; bridge present; spicules present. *Cret.*, W.Eu.——FIG. 743,*1*. **E. affine* (BOSQUET), U.Cret.(Maastricht.),

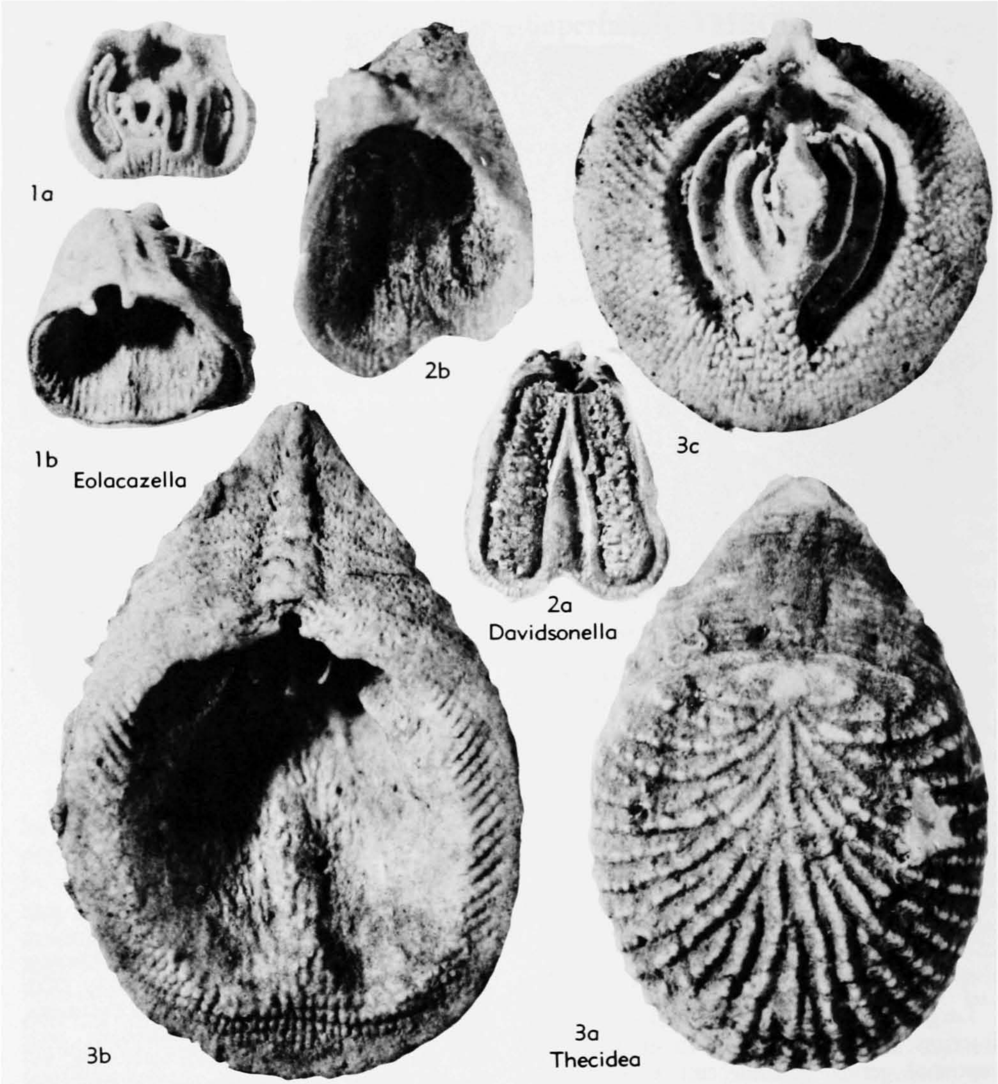


FIG. 743. Thecideidae (p. H859).

Neth.; *1a,b,* brach.v. int., ped.v. int., ×12 (Elliott, n).

Eudesella MUNIER-CHALMAS, 1881 [**Thecidea mayalis* E. EUDES-DESLONGCHAMPS, 1853; OD]. Small, transverse, test apparently fibrous, with scattered punctae, pseudodeltidium present; pedicle valve with hemispondylium; interior of brachial valve lobed by varying number of septa, commonly 6 to 8, extending from valve margin to terminate near visceral cavity, center septum bifurcating in some and uncommonly attached to bridge, if present; brachial ridges not present. *L. Jur.,* W.Eu.——FIG. 744,*1*. **E. mayalis* (DESLONGCHAMPS), Fr.(May); *1a-c,* brach.v. ext., ped. v. int., brach.v. int., all ×6 (Elliott, n).

Lacazella MUNIER-CHALMAS, 1881 [**Thecidea mediterranea* RISSO, 1826; OD]. Small, irregular or trigonal, pseudodeltidium triangular, test densely punctate; interior of pedicle valve granular to spinose except over muscle scars, hemispondylium projecting anteriorly as 2 spurs; brachial valve with trifurcating median septum, brachial ridges arcuate to left and right; mantle thin, coarsely spicular; lophophore ptycholophous, filaments long; paired diductor, median and lateral adductors; body very small, marsupium present in adult females, shells of both sexes similar except for notch in bridge. *Tert.,* Eu.-?Australia; *Rec.,* Medit.-W.Indies-Mauritius.——FIG. 744,*2*. **L. mediterranea* (RISSO), *Rec.,* Alg.(Bône); *2a,b,* brach.v. int., ped.v. int., ×9 (Elliott, n).

Parathecidea BACKHAUS, 1959 [**Thecidea hiero-*

glyphica GOLDFUSS, 1840; OD]. Small, square to elongate, pseudodeltidium merging into area, test thick, punctate; pedicle valve with several irregular longitudinal-radial internal ridges, deep muscle scars, hemispondylium supported by thin septum: brachial valve with bridge present, more numerous septa than in *Thecidiopsis,* extending inward both from valve margins and median septum, brachial ridges interdigitating with septa. *Cret.,* Eu.——FIG. 745,*1.* **P. hieroglyphica* (GOLDFUSS), U.Cret.(Maastricht.), Neth.; *1a,* brach.v. int., ×5; *1b,* ped.v. int., ×4 (44).

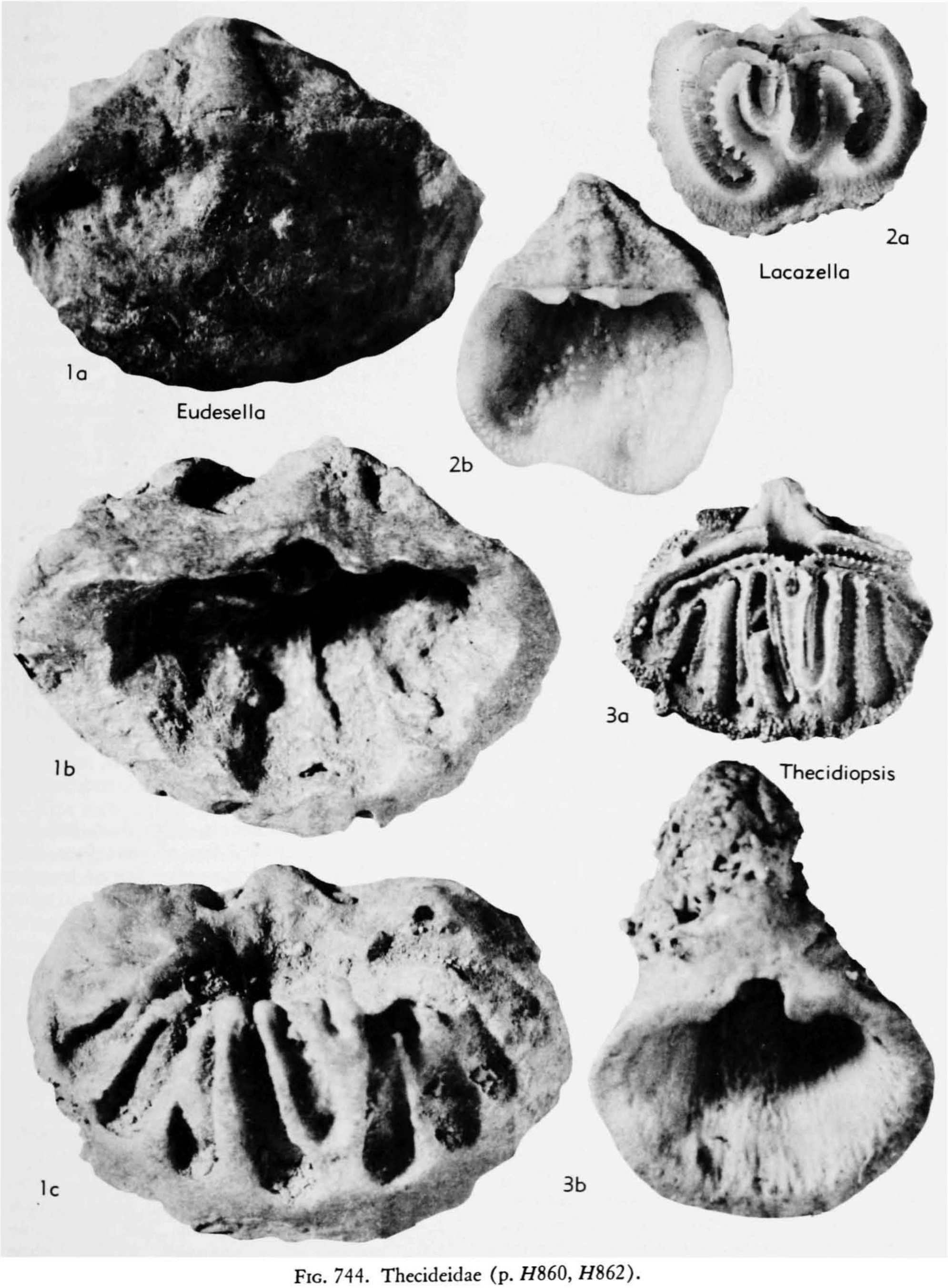


FIG. 744. Thecideidae (p. *H*860, *H*862).

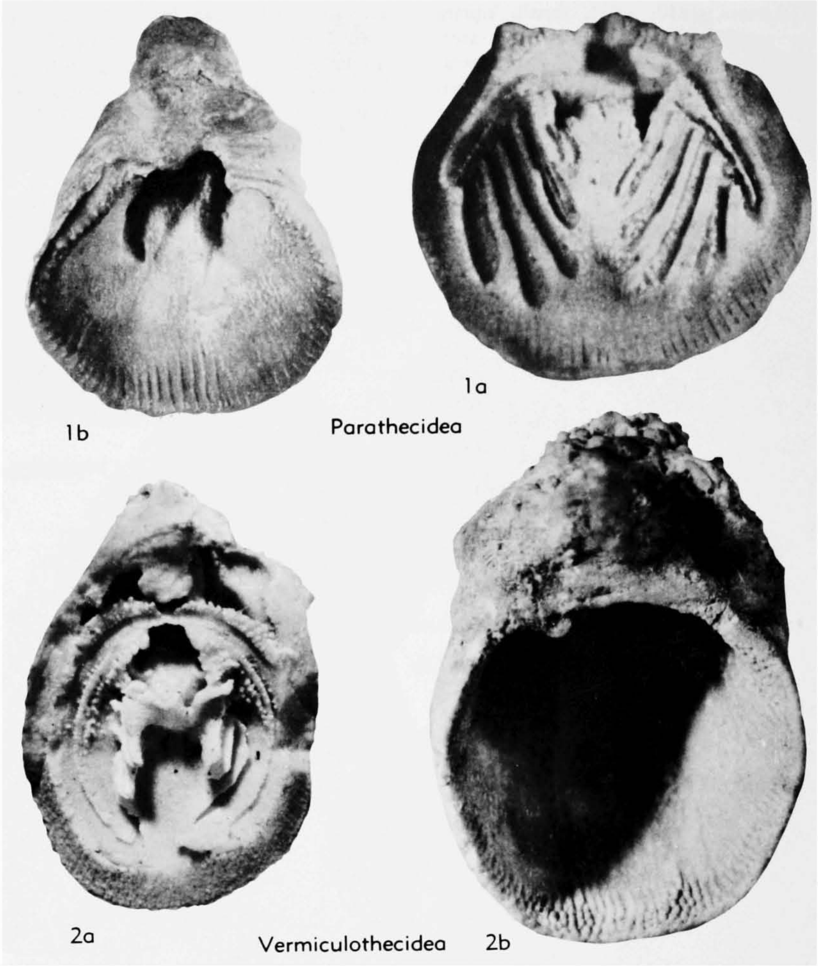


FIG. 745. Thecideidae (p. H860-H862).

Thecidiopsis OEHLERT, 1887 [**Thecidea digitata* G. B. SOWERBY, 1823; OD]. Small, transverse, pseudodeltidium high and narrow, test very thick, punctate; pedicle valve with broad median internal rounded ridge, muscle scars prominent, median supporting septum of hemispondylium conspicuous; brachial valve with bridge, numerous septa (average about 10) extending inward from valve margin, septal terminations rounded; brachial ridges interdigitating with septa. *Cret.*, Eu.——FIG. 744,*3*. **T. digitata* (G. B. SOWERBY), U.Cret. (Maastricht.), Neth.; *3a,b*, brach.v. int., ped.v. int., ×4.5 (Elliott, n).

Vermiculothecidea ELLIOTT, 1953 [**Terebratulites vermicularis* VON SCHLOTHEIM, 1813; OD]. Small, irregularly elongate, test thick, punctate, high narrow pseudodeltidium not sharply delimited; pedicle valve deep, granulation well developed except over ill-defined muscle scars; dorsal valve with high marginal ridge, median septum wide, low, anteriorly attached to valve floor, but posteriorly curving upward free of valve floor, with 4 or 5 anteriorly and upwardly directed branches on either side; branches in form of split tubes, within which corresponding brachial ridges occur, joining posteriorly; bridge present, spicules present. *U.Cret.*, W.Eu.——FIG. 745,*2*. **V. vermicularis* (VON SCHLOTHEIM), Maastricht, Neth.; *2a,b*, brach.v. int., ped.v. int., ×9, ×6 (Elliott, n).

Order, Suborder, and Family UNCERTAIN

Amblotrema RAFINESQUE, ?1831, p. 8 [=*Amblytrema* AGASSIZ, 1847, p. 45 *(nom. van.)*].

Arctitreta WHITFIELD, 1908, p. 57 [**A. pearyi*; OD]. Pedicle valve convex with high interarea, ramicostellate, ventral muscle scar large, suboval; brachial valve unknown. [Three pedicle valves are figured. The delthyrial cover of one is probably a pseudodeltidium comparable with that of the davidsoniaceans: the delthyrium of another is open but underlain by a delthyrial plate like that of the Spiriferidina.] *U.Carb.*, Canada (Cape Sheridan, Grant Land). [WILLIAMS.]

Australostrophia CASTER, 1939, p. 83 [**Leptostrophia?? mesembria* CLARKE, 1913, p. 286; OD]. Semioval, gently plano-convex, finely costellate, interareas low, with well-defined chilidium and pseudodeltidium; teeth elongate ?unsupported, ventral muscle field large, subtriangular with low median ridge; cardinal process bilobed, socket ridges strong, curved. [A few nodes along the posterolateral parts of ventral internal molds suggest that the interarea was penetrated by canals in the manner of Chonetidina, but no septa are found in the brachial valve and at present it is impossible to describe the genus more closely than as belonging to the Strophomenida.] *M.Dev.*, Brazil-Falkland Is. [WILLIAMS.]

Biarea TORBAKOVA, 1959.

Brachiopus RAFINESQUE, ?1831, p. 7.

Branconia GAGEL, 1890, p. 62 [**B. borussica*; OD, M]. *Ord.*, Eu.

Bufocephalus LINNÉ, 1779, p. 49.

Bursula HERRMANNSEN, 1846, p. 148 [=*Bursula* KLEIN, 1753, non. binom.].

Comelicania FRECH, 1901, p. 551 [**Athyris megalotis* STACHE, 1878; SD].

Cornwallia WILSON, 1932, p. 388 [**C. minuta*; OD]. Genus poorly understood, known from single ?pedicle valve. Small, suboval outline, convex, ornament of fine, radiating striae. *U.Ord.*, N.Am.(Can.). [ROWELL.]

Diclipsites RAFINESQUE, ?1831, p. 8.

Diclisma RAFINESQUE, 1820, p. 232.

Didymospira SALOMON, 1895, p. 81.

Diphyites HERRMANNSEN, 1846, p. 390.

Diphytes SCHRÖTER, 1779, p. 411, non-binom.

?Dirinus M'COY, 1844, p. 44 [**D. bucklandi*; OD]. Described as gastropod, may possibly be craniid. Type material lost. [ROWELL.]

Euorthisina HAVLÍČEK, 1950.

Gamdaella MILORADOVICH, 1947.

Gasconsia NORTHROP, 1939, p. 161 [**G. schucherti*; OD]. Very large, approximately semicircular in outline, posterior margin straight. [When erected, provisionally included in the Trimerellidae.] *Sil.* (Gascon & Bouleaux F.), N. Am. (Gaspé). [ROWELL.]

Gaspesia CLARKE, 1907, p. 277 [**Orthis aurelia* BILLINGS, 1874, p. 34; OD]. Semi-elliptical, ?convexo-concave, ?lacking interareas, costate and imbricate; interiors unknown (may not be a brachiopod). *L.Dev.*, Can.(Que.). [WILLIAMS.]

Goniclis RAFINESQUE, ?1818, p. 107.

Hemisterias RAFINESQUE, 1832, p. 122.

?Ivanovia IVANOVA, 1949.

Lamanskya MOBERG & SEGERBERG, 1906, p. 71 [**L. splendens*; OD]. Concavo-convex, geniculate, lustrous but with subdued costellae (probably Strophomenidina). *L.Ord.*, Sweden. [WILLIAMS.]

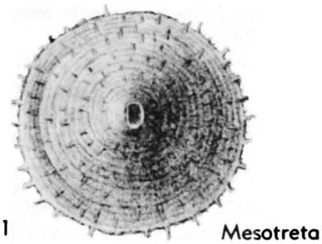


FIG. 746. Family Uncertain (p. *H*863).

Lampas ANON. (HUMPHREY), 1797, p. 45 [=*Lampus* SOWERBY, 1842, p. 169 *(nom. null.)*].

Larium DE GREGORIO, 1930, p. 25 [**L. inventum*; OD]. Biconvex, with subconical pedicle valve, exterior spinose (possibly Productidina, Scaccinellidae). *L.Perm.*, Italy(Sicily). [WILLIAMS.]

Liocoelia SCHUCHERT & COOPER, 1931, p. 248 [**Pentamerus proximus* BARRANDE, 1879; OD]. Similar to *Clorinda* externally but having rhynchonelloid-type of cardinalia suggestive of *Camarotoechia*. *Sil.*, Eu.(Czech.). [SCHUCHERT & COOPER.]

Martinigisis LEBEDEV, 1926.

Megarites RAFINESQUE, ?1820, p. 8.

Mesotreta KUTORGA, 1848, p. 271 [**Siphonotreta tentorium* KUTORGA, 1848; OD]. Genus poorly understood, known only from pedicle valve. Subcircular in outline, known only from pedicle valve. Subcircular in outline, depressed conical, with central apex perforated by foramen; without pseudointerarea. Ornament of concentric growth lines and scattered spines. *Ord.*, Eu.(Est.). ——FIG. 746,*1*. **M. tentorium* (KUTORGA); ped.v. ext., ×1.5 (396). [ROWELL.]

Minororthis IVANOV, 1950 [**M. malivkini*; OD]. Quadrate in outline, biconvex, costellate with strong dorsal median fold (Orthidina). *M.Ord.*, USSR. [WILLIAMS.]

Neogypidula LIKHAREV, 1934, p. 211.

Peridiolithus HUPSCH, 1768, p. 144.

Platilites RAFINESQUE, ?1820, p. 8.

Pleuranisis RAFINESQUE, ?1820, p. 8.

Plicoprothyris DAHMER, 1940.

Pomatospirella BITTNER, 1892, p. 26 [**Spirigera (Pomatospirella) thecidium*; OD]. *Trias.*

Priambonites FISCHER DE WALDHEIM, 1834, p. 289 [*?nom. null. pro Plectambonites* PANDER, 1830].

Reflexa ROTAI, 1931, p. 24 [**R. reflexa*; OD].

Rhynchoferella SPRIESTERSBACH, 1942 [*non* STRAND, 1915, p. 182].

Rictia DE GREGORIO, 1930, p. 27 [**R. simplex*; OD]. [May not be a brachiopod.] *L.Perm.*, Italy(Sicily). [WILLIAMS.]

Selenella HALL & CLARKE, 1894, p. 270 [**S. gracilis*; OD]. [Terebratulida, suborder, superfamily, and family uncertain]. *M.Dev.*, Can.(Ont.).

Socraticum DE GREGORIO, 1930, p. 25 [**S. firmum*; OD]. ?Plano-convex, with subconical pedicle valve, exterior ?spinose (probably Strophomenida). *L.Perm.*, Italy (Sicily). [WILLIAMS.]

Sphenorthis GRUBBS, 1939, p. 554 [**S. niagarensis*; OD]. Subtriangular biconvex, sulcate, hinge line short, curved, delthyrium open, costate, cardinal process absent (possibly Rhynchonellida or Orthida). *L.Sil.*, USA (Ill.). [WILLIAMS.]

Spondylobolus M'COY, 1851, p. 407 [**S. craniolaris*; SD DALL, 1870, p. 164] [=*Spondylobus* DALL, 1870, p. 154 *(nom. null.)*; *Spondilobolus* GORYANSKY, 1960, p. 174 *(nom. null.)*]. Genus poorly understood, possibly not a brachiopod. Shell calcareous. Larger valve subtriangular in outline, with 2 low bosses on either side of beak directed toward opposite valve; smaller valve with apex in posterior quarter of valve. *Sil.*, Eu. [ROWELL.]

Swantonia WALCOTT, 1905, p. 296 [**Camerella antiquata* BILLINGS, 1861, p. 10; OD]. Pedicle valve ovate, moderately convex, beak pointed, incurved; surface bearing 8 to 12 rounded ribs. *L. Cam.*, USA (Vt.). [WALCOTT.]

Syntrophoides SCHUCHERT & COOPER, 1931, p. 247 [**Billingsella harlanensis* WALCOTT, 1905, p. 236; OD]. Differs from *Billingsella* in being concentrically marked externally, instead of multicostellate, and in having different brachial-valve musculature. *M.Cam.*, USA (Tenn.). [SCHUCHERT & COOPER.]

Telistrophis RAFINESQUE, 1832, p. 142.

Thecospirella BITTNER, 1900, p. 46 [**T. loczyi*; OD].

Venezuelia WEISBORD, 1926.

Virbium DEGREGORIO, 1930, p. 25.

Wynnia WALCOTT, 1908, p. 142 [**Orthis warthi* WAAGEN, 1891, p. 102; OD]. Subcircular in outline, biconvex with dorsal median sulcus, delthyrium and notothyrium open; ventral interior with subflabellate muscle field and subparallel *vascula media*; dorsal interior with vaguely impressed adductor scars; other details and exterior unknown (?Orthida). *M.Cam.*, India. [WILLIAMS.]

Yeosinella REED, 1932, p. 193 [**Y. consignata*; OD]. Semioval and mucronate in outline, unequally biconvex with dorsal median sulcus, costate; cardinal process bilobed, sockets widely divergent crenulated; other internal features unknown (probably Orthidina). *?U.Ord.*, Burma. [WILLIAMS.]

GENERIC NAMES ERRONEOUSLY ASCRIBED TO BRACHIOPODA

Arbusculites MURRAY, 1831, p. 147.

Aulacomerella VON HUENE, 1900, p. 209. Mollusk.

Badiotella BITTNER, 1890, p. 94. Mollusk.

Bagenovia RADUGHIN, 1937, p. 301 [**B. sajanica*; OD]. ?Mollusk. [ROWELL.]

Curvulites RAFINESQUE, 1831, p. 4. ?Mollusk.

Delgadella WALCOTT, 1912, p. 560 [**Lingulepis lusitanica* DELGADO, 1904, p. 365]. Trilobite (*Treatise*, p. *O*190). [ROWELL.]

Discinella HALL, 1871, p. 3. Hyolithid operculum (*Treatise*, p. *W*132). [ROWELL.]

Khmeria MANSAY, 1914, p. 53. Coelenterate (*see Treatise*, p. *F*477).

Macquartia ROULLIER & VORINSKY, 1848, p. 271 [*non* ROBINEAU-DESVOIDY, 1830, p. 204]. ?Mollusk.

Neoproductus NIKITIN, 1900, p. 385. Invalid hypothetical genus.

Orthonote CONRAD, 1841, p. 50. Mollusk.

Pectenoproductus LIKHAREV, 1930, p. 438 [**P. proprius*]. Insufficiently known, may be a lamellibranch. *L.Perm.*, Eu. (N.Caucasus). [MUIR-WOOD.]

Protobolella CHAPMAN, 1935, p. 117 [**P. jonesi*] [=*Fermoria* SAHNI, 1936; *Fermoria* CHAPMAN, 1935 *(nom. vet.)*; *?Vindhyanella* SAHNI, 1936]. Problematic, possibly algal (*Treatise*, p. *W*240). [ROWELL.]

NOMINA NUDA

Apleurotis RAFINESQUE, 1819, p. 427 *(?nom. nud.)*.

Brynella BANBROFT, 1933, p. 3 *(nom. nud.)*. [WILLIAMS.]

Clipsilis RAFINESQUE, 1820, p. 5 *(nom. nud.)* [=*Clipsilia* DALL, 1877, p. 20 *(nom. null.)*].

Cranicella RAFINESQUE, 1815, p. 148 *(nom. nud.)*. [ROWELL.]

Delthyridaea M'COY, 1844, p. 150 *(nom. nud.)*. [ELLIOTT.]

Gonotrema RAFINESQUE, 1820, p. 232 *(?nom. nud.)*.

Hunanella GRABAU & TIEN, ?date [**H. antiquatiformis*] *(nom. nud.)* (*fide* LEE, 1939, p. 486). [MUIR-WOOD.]

Marginella GEMMELLARO, 1897, p. 113 *(nom. nud.)* [*non* LAMARCK, 1799, p. 70].

Martinella J. S. LEE, 1939 *(nom. nud.)* [*non* JOUSSEAUME, 1887, p. 173].

Megorima RAFINESQUE, 1818, p. 107 *(nom. nud.)*.

Neoproductella GRABAU & TIEN, ?date *(nom. nud.)* (*fide* LEE, 1939, p. 487).

Obovites RAFINESQUE, ?1820, p. 7 *(?nom. nud.)*.

Oxyrhynchus QUENSTEDT, 1868 [*non* LEACH, 1818, *nec* LAUGIER, 1822; *nec* SCHOENHERR, 1823, etc. *(nom. nud.)*].

Pachiloma RAFINESQUE, ?1820, p. 8 *(nom. nud.)* [=*Plachiloma* FERUSSAC, 1835, p. 23 *(nom. null.)*].

Pleurinia RAFINESQUE, ?1820, p. 8 *(?nom. nud.)* [=*Pleurinea* DALL, 1877, p. 56 *(nom. null.)*].

Praemagas FISCHER & OEHLERT, 1892, p. 751 *(nom. nud.)*.

Stropheria RAFINESQUE, 1820, p. 232 *(nom. nud.)*.

Strophesia RAFINESQUE, ?1820, p. 8 *(?nom. nud.)*.

Styriasis RAFINESQUE, ?1820, p. 8 *(?nom. nud.)*.

Tangkouella GRABAU, 1931 *(nom. nud.)*.

Tectorthis MAILLIEUX, 1940, p. 11 *(nom. nud.)*. [WILLIAMS.]

Trigorima RAFINESQUE, ?1820, p. 7 *(nom. nud.)*.

Trunculites RAFINESQUE, ?1820, p. 8 *(?nom. nud.)*.

Velciella HAVLÍČEK & ŠNAJDR, 1952, p. 258 [**V. pompechiana*; OD] *(nom. nud.)*. [WILLIAMS.]