SYNOPSIS OF THE BRACHIOPOD GENERA OF THE SUBORDERS ORTHOIDEA AND PENTAMEROIDEA, WITH NOTES ON THE TELOTREMATA.

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Through a long life, the senior author has been gathering a private collection of fossil brachiopods that has now grown into one of the largest in existence. It was used by Hall and Clarke at Albany in the preparation of *Paleontology of New York*, Volume VIII, and later by Beecher in his ordinal studies; and ever since 1904, when Schuchert was appointed professor of paleontology at Yale University, he has been hopeful of basing further generic studies on this collection in collaboration with one of his students. That hope did not materialize, however, until 1928, when the present study was begun with G. Arthur Cooper. We originally hoped that in three years the status of all the Paleozoic genera, then numbering about 425, could be revised, but it soon turned out that we could not finish even those of the order Protremata, which in July, 1928, had reached a total of about 190. We have, however, finished all of the Orthoidea and Pentameroidea, leaving unstudied the very diversified Strophomenacea (with about 110 genera in 1928). Our completed manuscript discusses about 150 genera, and 133 of these, including 36 new ones and about 15 proposed by other authors since 1928, are described in detail with the necessary illustrations.

Since the quarto volume presenting the results of these studies will take at least one, and possibly two, years to reach its final printing, we offer the present synopsis, so that in the meantime students of Paleozoic brachiopods can see at least in a general way what we have accomplished, what new genera we have proposed, and how we arrange the 133 orthoid and pentameroid genera in 26 families with 23 subfamilies.

The genoholotypes of the new genera are based on definite specimens that will be indicated and illustrated in the final memoir. Most of these are in the Schuchert Collection.

Order PROTREMATA Beecher 1891.

Suborder ORTHOIDEA, nov.

The old superfamily Orthacea has now grown to large proportions in the way of genera. These show that among them

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an impunctate (some are exopunctate; see Appendix, 1) or an endopunctate test is of much significance in taxonomy, and the nature of the test has, therefore, been taken as the main basis for separating the new suborder Orthoidea into the superfamilies (1) Orthacea (impunctate) and (2) Dalmanellacea, nov. (punctate). Another superfamily of this suborder is the impunctate (3) Clitambonacea, characterized by spondylia supported on a simple septum (= spondylium simplex; see Appendix, 2), and by more or less prominent deltidia and chilidia.

Out of the Orthacea arose the suborder Pentameroidea, nov., first in the superfamily (4) Syntrophiacea, nov., with more or less wide-hinged shells that are without deltidia and chilidia, and with spondylia like those of the Clitambonacea. The Syntrophiacea gave rise to the more or less rostrate superfamily (5) Pentameracea, characterized by more or less large spondylia supported by a double septum (= spondylium duplex; see Appendix, 2), and prominent cruralia.

These five superfamilies are now represented by the following subdivisions:

	Families	Subfamilies	Genera-Subgenera		Known in 1928
Orthacea	10(5 new)	13(9 new)	100	53(15 new)	52
Clitambonacea	2(1 new)	3(2 new)		12(3 new)	
Dalmanellacea, nov.	8(5 new)	5(2 new)		35(10 new)	
Syntrophiacea, nov.	3(2 new)	0	33	7(2 new)	26
Pentameracea	3	2		26(6 new)	
Totals	26(13 new)	23(13 new)		133(36 new)	78

Superfamily ORTHACEA Walcott and Schuchert 1908

1. Family NISUSIIDAE, nov. *Nisusia* and *Jamesella*, both of Walcott.

2. Family PROTORTHIDAE, nov. *Protorthis* Hall and Clarke and *Loperia* Walcott.

3. Family BILLINGSELLIDAE. *Billingsella* Hall and Clarke.

4. Family EOORTHIDAE, nov. Divided into Orusiinae, nov. (*Orusia* Walcott); and Eoorthinae (*Eoorthis, Otusia,* and ?*Wimanella*, all of Walcott; and the new genera *Bohemiella* and *Oligomys*).

Bohemiella, nov., genoholotype *Orthis romingeri* Barrande, as illustrated by Walcott (1912). It is not a *Billingsella,* as Walcott thought, but has cardinalia foreshadowing the type seen in *Hesperorthis tricenaria* (Conrad) (see family 7).

Oligomys, nov., genoholotype *Orthis exporrecta* Linnarsson, as illustrated by Walcott (1912).

5. Family PLECTORTHIDAE, divided into five subfamilies as follows: Finkelnburgiinae, nov., with *Finkelnburgia* Walcott; Plectorthinae, with *Plectorthis* and *Hebertella* of Hall and Clarke, *Mimella* Cooper, *Schizophorella* Reed, and *Doleroides* Cooper; Cyclocoeliinae, nov., with *Cyclocoelia* Foerste; Platystrophiinae, with *Platystrophia* King and *Mcewanella* Foerste; and Orthostrophiinae with *Orthostrophia* Hall.

6. Family SKENIDIIDAE. *Skenidium* Hall; and *Skenidioides*, nov., based on a new species, *S. billingsi*. The two genera are homoeomorphs, but the latter has large interareas that are not present in *Skenidium,* and lacks the large hinge plate.

Skenidioides billingsi, nov.—This common shell is distinguished from *S. anthonense* (Sardeson) by its larger size, coarser ornamentation, and less proportionate width to length. It occurs in the Black River limestone of Paquette Rapids, Ontario. Holotype, Cat. No. 2013, Schuchert Collection, Peabody Museum, Yale University.

7. Family ORTHIDAE, divided into six subfamilies, all of which are new: Orthinae, with *Orthis* Dalman, *Nicolella* Reed, *Glossorthis* Öpik, and the new genera *Cyrtonotella, Paurorthis,* and *Archaeorthis;* Productorthinae, with *Productorthis* Kozlowski and *Panderina*, nov.; Angusticardiniinae, with *Angusticardinia,* nov.; Taffiinae, with *Taffia* Ulrich and *Eostrophomena* Walcott; Hesperorthinae, with *Schizoramma* Foerste and the new genera *Hesperorthis* and *Dolerorthis;* and Glyptorthinae, with *Glyptorthis* and *Eridorthis* of Foerste, and *Ptychopleurella,* nov.

Cyrtonotella, nov., genoholotype *Orthis semicircularis* (Eichwald). Differs from *Orthis* in being multicostellate.

Paurorthis, nov., genoholotype *Orthambonites parva* Pander. Shells externally like *Dalmanella* but impunctate, with ventral muscle-scars intermediate between those of *Productorthis* and *Orthis,* while the cardinalia are essentially as in the last-named genus.

Archaeorthis, nov., genoholotype *Orthis electra* Billings. Has a *Dalmanella*-like exterior, large ventral muscle-scars, convergent brachiophores, and no cardinal process.

Panderina, nov., genoholotype *Productus abscissus* Pander. Intermediate between *Orthis* and *Productorthis,* but still has a little of the interareas left and has not attained the complete internal expression of the last-named genus.

Angusticardinia, nov., genoholotype *Porambonites recta* Pander. An *Orthis*-like shell that is more or less rostrate and suggests *Rhynchotrema increbescens*. The stock may have given rise to the rhynchonellid *Rhynchotrema*.

Hesperorthis, nov., genoholotype *Orthis tricenaria* Conrad, as described by Hall and Clarke (1892).

Dolerorthis, nov., genoholotype *Orthis interplicata* Foerste. Shell convexity the reverse of that of *Hesperorthis*, with the ventral muscle pattern of that genus. The characters of the dorsal valve are similar to those of *Dinorthis* except for the cardinal process.

Ptychopleurella, nov., genoholotype *Orthis bouchardi* Davidson. Characterized by the subpyramidal ventral valve and long interarea, and by the strongly convex dorsal shell with a deep sulcus bounded by two costae.

8. Family DINORTHIDAE, nov., with *Dinorthis* (divided into the five subgenera *Dinorthis* and *Plaesiomys* of Hall and Clarke, *Pionorthis*, nov., *Retrorsirostra*, nov., and *Marionella* Bancroft), *Valcourea* Raymond, *Multicostella*, nov., *Austinella* Foerste, *Palaeostrophomena* Holtedahl, and *Planidorsa*, nov.

Pionorthis, nov., genoholotype *Orthis sola* Billings as figured by Twenhofel (1927 = 1928, pl. 17). With a biconvex profile.

Retrorsirostra, nov., genoholotype *Orthis carleyi* Hall. With a procline ventral interarea (see Appendix, 3).

Multicostella, nov., genoholotype *Orthis ? saffordi* Hall and Clarke. Differs from *Valcourea* and *Dinorthis* in its subequally convex valves and subequal interareas.

Planidorsa, nov., genoholotype *P. bella*, nov. Shell finely multicostellate, with the outline and profile of *Rafinesquina*.

Planidorsa bella, nov. Shell subalate and widest along the hinge-line. Ventral valve moderately convex, dorsal flat or slightly concave and having a gentle, broad sulcus. Delthyrium open. Dental plates short; adjustor scars wide, adductor scars elongate. Length of shell, 17.5 mm.; width, 25 mm. Holotype, Cat. No. 764, Schuchert Collection, Yale University, from the Chazy at Washburn, Tenn.

9. Family PORAMBONITIDAE, with *Porambonites* Pander and *Noetlingia* Hall and Clarke. These are true but aberrant Orthacea derived out of Orthidae, and not Clitambonacea, as heretofore believed, since the younger characters are obscured by older secondary shell deposits.

10. Family LYCOPHORIIDAE, nov., with *Lycophoria* Lahusen. Also aberrant biconvex orthids.

Superfamily CLITAMBONACEA Schuchert 1929

11. Family DELTATRETIDAE, nov., with *Deltatreta* Ulrich, and a new genus in the United States National Museum.

12. Family CLITAMBONITIDAE, divided into three subfamilies: Plectellinae, with *Plectella* Lamansky and *Ingria* Öpik: Clitambonitinae,[1] nov., with *Clitambonites* Pander, *Vellamo* Öpik, *Orthisina* D'Orbigny, *Hemipronites* Pander, *Polytoechia* Hall and Clarke, and the new genera *Estlandia, Pahlenella,* and *Apomatella:* Gonambonitinae, nov., with *Gonambonites.*

Estlandia, nov., genoholotype *Orthisina marginata* Pahlen. This genus resembles *Gonambonites* externally, but its ornamentation and internal features are those of *Vellamo,* of which it is a convexi-concave development.

Pahlenella, nov., genoholotype *Orthis trigonula* as figured by Pahlen (1877, pl. 4, figs. 22-24). Shell concavo-convex, with a ventral fold and dorsal sulcus; internally the spondylium is supported by a very low and short septum, giving the muscle platform the appearance of a sessile spondylium.

Apomatella, nov., genoholotype *Orthisina ingrica* Pahlen. Devoid of a deltidium and chilidium.

Superfamily DALMANELLACEA, nov.

13. Family DALMANELLIDAE, with *Dalmanella* Hall and Clarke, *Proschizophoria* Maillieux, *Heterorthina* Bancroft, and the new genera *Cariniferella, Aulacella,* and *Levenea.*

Dalmanella emend. Hall and Clarke, in defining this genus, selected as the genotype *Orthis testudinaria* Dalman. This is a Swedish shell, which Dr. A. H. Westergaard says is now known to occur only in basal Silurian strata, but the context of Hall and Clarke's description and their illustrations (Pal. N. Y., vol. 8, pt. 1, 1892, pl. VB, figs. 27-39), show that they were actually using at least two, if not three, older American shells then wrongly placed under the Swedish species. Of these we have selected as the genolectotype of *Dalmanella* the species represented by pl. VB, figs. 27-31, which is now known to be *Orthis rogata* Sardeson 1892 of the Middle Ordo-

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[1] An older term is Orthisininae Waagen 1884, but as *Orthisina* is the least characteristic form of the family, it is not used here.

vician (Trenton) of Minnesota and Wisconsin. *Orthis testudinaria* Dalman belongs in the genus *Wattsella* Bancroft.

Cariniferella, nov., genoholotype *Orthis carinata* Hall as figured by Hall and Clarke (1892). Characterized by the convexi-concave profile and the aberrant sharp fold and narrow sulcus.

Aulacella, nov., genoholotype *Orthis eifelensis* Schnur. Externally much like *Rhipidomella* but with a ventral fold, a dorsal sulcus, and a ventral musculature close to that of *Dalmanella;* the diductor muscles are separated by a low ridge forked in front as in *Cariniferella*, and the cardinalia are also as in that genus.

Levenea, nov., genoholotype *Orthis subcarinata* Hall. Most like *Isorthis* but with dalmanellid characters.

14. Family WATTSELLIDAE, nov., with *Horderleyella* and *Wattsella* of Bancroft, *Idiorthis* McLearn, *Mendacella* Cooper, and the new genera *Parmorthis* and *Fascicostella*.

Parmorthis, nov., genoholotype *Orthis elegantula* Dalman. Separated from *Dalmanella*, *Isorthis*, and other genera by an externally plano-convex contour, combined with certain internal characters.

Fascicostella, nov., genoholotype *Orthis gervillei* Defrance. The peculiar ornamentation separates this genus from all other dalmanellids; internally it is much like *Parmorthis*.

15. Family BILOBITIDAE, nov., with *Bilobites* Linnaeus.

16. Family MYSTROPHORIDAE, nov., with *Mystrophora* Kayser, a punctate homoeomorph of *Skenidium;* and *?Kayserella* Hall and Clarke.

17. Family RHIPIDOMELLIDAE, with *Rhipidomella* Oehlert and its new subgenus *Perditocardinia*, *Thiemella* Williams, and the new genus *Platyorthis*.

Platyorthis, nov., genoholotype *Orthis planoconvexa* Hall. A *Rhipidomella* with a dalmanellid exterior and a plano-convex profile.

Perditocardinia, nov., genoholotype *Orthis dubia* Hall. A subgenus of *Rhipidomella* without interareas or palintrope.

18. Family HETERORTHIDAE, nov., with subfamilies Heterorthinae, nov. (*Heterorthis* Hall and Clarke); and Harknessellinae (*Harknessella* Reed, *Reuschella* and *Smeathenella* of Bancroft).

19. Family SCHIZOPHORIIDAE, with subfamilies Schizophoriinae (*Pionodema* Foerste, *Schizophoria* King, *Orthotichia* Hall and Clarke, and *Aulacophoria*, nov.); Enteletinae

(*Enteletes* Fischer, *Enteletella* Likharev, *Enteletoides* Stuckenberg, *Parenteletes* King MS.,[2] and *Enteletina*, nov.); and Isorthinae, nov. (*Isorthis* Kozlowski).

Aulacophoria, nov., genoholotype *Orthis keyserlingiana* De Koninck. Externally like *Schizophoria*, but has a deep sulcus on the dorsal valve and a high fold on the ventral one, being intermediate externally between *Schizophoria* and *Enteletes*.

Enteletina, nov., genoholotype *Enteletes latesinuatus* Waagen. Externally like *Parenteletes* but internally like *Enteletes*. Equal to Waagen's "dorsosinuates" of *Enteletes*.

20. Family LINOPORELLIDAE, nov., with *Linoporella*, nov., and *?Orthotropia* Hall and Clarke.

Linoporella, nov., genoholotype *Orthis punctata* Verneuil. A dalmanellid with the ornamentation of *Porambonites* but with a cruralium in the dorsal valve.

Suborder PENTAMEROIDEA, nov.

Superfamily SYNTROPHIACEA, nov.

21. Family CLARKELLIDAE, nov., with *Clarkella* Walcott, *Yangtzeella* Kolarova, *Syntrophina* Ulrich, and the new genus *Syntrophioides*.

Syntrophioides, nov., genoholotype *Billingsella harlanensis* Walcott. Differs from *Billingsella* in being externally concentrically marked instead of multicostellate, and in having a different dorsal musculature.

Syntrophina Ulrich 1928,[3] genoholotype *Syntrophia campbelli* Walcott. Like *Syntrophia* externally but without its cruralium simplex and having, instead, divergent discrete brachiophore supports.

22. Family SYNTROPHIIDAE, with *Syntrophia* Hall and Clarke.

23. Family HUENELLIDAE, nov., with *Huenella* Walcott and *Huenellina*, nov.

Huenellina, nov., genoholotype *Huenella triplicata* Walcott. Differs from *Huenella* in having the unique feature of lateral septa developed under the anterior part of the dorsal palintrope.

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[2] *Parenteletes* R. E. King MS. Cheironym. Externally like *Enteletes*, but with the fold on the ventral valve; inside the ventral valve is a V-shaped chamber like that of *Merista*.

[3] The name *Syntrophina* was first used by Ulrich in Weller and St. Clair, Missouri Bur. Geol. and Mines, 2d ser., vol. 22, 1928, p. 74, but without description.

Superfamily PENTAMERACEA Schuchert 1896

24. Family CAMERELLIDAE, with *Camerella* Billings (syn. *Parastrophia*), *Anastrophia* Hall, *Metacamerella* Reed, ?*Branconia* Gagel, and the new genera *Rhynchocamara* (provisionally placed here but may be a rhynchonellid) and *Parastrophinella*.

Rhynchocamara, nov., genoholotype *R. plicata*, nov. Seemingly a camerellid with a rhynchonellid cruralium.

Rhynchocamara plicata, nov. Shells with a camerellid exterior, a spondylium duplex, and a rhynchonellid cruralium. Holotype, Cat. No. 2035, Schuchert Collection, Yale University, from the Middle Ordovician (Central limestone), 3 miles north of Murfreesboro, Tenn.

Parastrophinella, nov., genoholotype *Pentamerus reversus* Billings. A large camerellid with discrete divergent or subparallel septa in the dorsal valve, which do not form a cruralium duplex.

25. Family STRICKLANDIIDAE, with *Stricklandia* Billings. Anomalous among pentamerids in having interareas in both valves, and greatly reduced non-pentameroid internal dorsal features. For the present, however, we believe it more pentameroid than rhynchonelloid.

26. Family PENTAMERIDAE, divided into the subfamilies Gypidulinae, with *Clorinda* Barrande, *Barrandella* Hall and Clarke, *Gypidula* Hall, *Sieberella* Oehlert, *Pentamerella* Hall, ?*Zdimir* Barrande, and ?*Liocoelia*, nov.; and Pentamerinae, with *Pentamerus* Sowerby, *Capelliniella*[4] Strand, *Holorhynchus* Kiaer, *Harpidium* Kirk, *Conchidium* Linnaeus, *Brooksina* Kirk, *Platymerella* Foerste, *Cymbidium* Kirk, *Virgiana* Twenhofel, and the new genera *Pentameroides*, *Lissocoelina*, and *Rhipidium*.

Liocoelia, nov., genoholotype *Pentamerus proximus* Barrande. Reminds one externally of *Clorinda*, but has rhynchonellid cardinalia suggestive of *Camarotoechia*. Accordingly the genus may not belong to the pentamerids.

Lissocoelina, nov., genoholotype *Pentamerus pergibbosus* Hall and Whitfield. A smooth type with the contour and outline of *Conchidium* but with the internal features of *Pentamerus*.

Pentameroides, nov., genoholotype *Pentamerus oblongus subrectus* Hall and Clarke. Externally like *Pentamerus*, but with a dorsal cruralium supported for most of its length by a median septum.

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[4] New name proposed by Strand (1928) to replace *Capellinia* Hall and Clarke, preoccupied.

Rhipidium, nov., genoholotype *Pentamerus knappi* Hall and Whitfield. Shells flattened as in *Pentamerus* but costate like those of *Conchidium*.

Order TELOTREMATA.

Superfamily RHYNCHONELLACEA Schuchert 1896

We also intended to work out all the Paleozoic rhynchonellids but were prevented from doing so by the junior author's acceptance of a curatorship in the United States National Museum. It was apparent to Hall and Clarke (1894) that the rhynchonellids probably arose in the orthids, and this conclusion we are now able to endorse, but with this difference, that the superfamily is apparently of polyphyletic origin. Two of these genetic lines start in closely related families of the Orthacea, one in the large family Orthidae, another more certainly in a similarly large family, the Plectorthidae, but the main rhynchonellid line that goes into *Camarotoechia* is not yet discovered.

Our studies show that the rhynchonellids of the Middle Ordovician are essentially orthids that have become rostrate and paucicostate. The oldest known divergence is in the family Orthidae in the genus *Angusticardinia* of western Russia, shells that are still orthids but seemingly in line to the rhynchonellid *Rhynchotrema*, a stock that died out with the Ordovician. A more vigorous and better determined divergence is in the family Plectorthidae early in the Middle Ordovician, seen earliest in the genus *Protorhyncha* and a little later in *Orthorhynchula*. A third attempt was made in the same family in *Cyclocoelia*, but internally these shells clearly remain orthid, and the divergent stock soon died out. The *Protorhyncha* line may persist into the Silurian. The orthid line that gave rise to *Camarotoechia*-like shells in *Rhynchonella plena* and *R. orientalis* remains unknown, unless it be in the stock that goes from *Plectorthis* into *Protorhyncha* or in another line that goes from *Plectorthis* to *Platystrophia*. If the *Camarotoechia* ancestors arose in the line that goes into *Protorhyncha*, then the former stock added the little chamber in the dorsal cardinalia so characteristic of the genus *Camarotoechia*, but we rather look for another birth and possibly also in the family Plectorthidae. It is this line of rhynchonellids that is thought to persist in the living forms.

Since the fleshy spiral arms of the rhynchonellids (as in living *Hemithiris*), which are inwardly and dorsally directed, have the general shape of the calcareous spiralia in the Atrypacea, it also appears clear that the early and first attempts at brachial skeletons led into these aberrant spire-bearers. The Spiriferacea, however, could not have come out of rhynchonellid ancestors.

Superfamily SPIRIFERACEA Waagen 1883

The calcareous spiralia of the Spiriferacea are laterally directed and could, therefore, not have arisen in the Atrypacea. The shells of the former superfamily, in very young stages, start in smooth rostrate and somewhat lobate shells in which the ventral valve is deeper and more convex. The adult expression of these young shells is best seen in *Cyclospira,* which has laterally directed but very primitive spirals. These spire-bearers in one line retain the rostrate form and, as a rule, have smooth shells (Rostrospiracea), and in the other change all of this into wide-hinged, multicostate shells with large interareas in both valves (Spiriferacea); these characters of the last-named superfamily are either enlargements of ancestral characters or inventions of new ones.

From our studies of the Pentameroidea, we suggest that this line of brachiopods had its beginning in the wide-hinged Syntrophiacea; some, becoming rostrate and subcostate and retaining spondylia of the simplex type, evolved into the Camerellidae. It is out of this family that the Pentameracea may have arisen by specializing in rostration, with the nearly complete loss of interareas, and by enlarging and modifying the internal spondylia and cardinalia. We suggest that it was also in these camerellids that the spire-bearers arose, with laterally directed brachia, complete loss of spondylia, and reduction of the cardinalia to simpler conditions. For want of time we have not traced out these beginnings of superfamily characters, but we want to add here that the Terebratulacea also appear to have their beginnings either in these camerellid-like shells or out of early Spiriferacea through the loss of calcareous primitive spiralia. The oldest known terebratulacean is *Protozeuga* of the Middle Silurian, but its calcareous brachial support (a wide loop) is similar to the one in *Stringocephalus* of the late Devonian, and neither is in the main line of the regulation Paleozoic terebratulids. These latter are the centronellids, first known in the late Silurian (described by Kozlowski from

Poland) and arising out of an unknown stock, but their late appearance in small species may mean that they came out of an early endopunctate member of the Spiriferacea, and this supposition appears to be borne out by the metamorphoses of the loop of *Dielasma*, as made known by Beecher (1893).

APPENDIX.

1. *Punctae.*—Any minute perforations of the test. We divide these into two kinds: *Endopunctae*, perforations of the internal shell layer, never reaching the exterior unless the thin outer shell layer is abraded: these are the typical punctae of the terebratulids and the Dalmanellacea. *Exopunctae*, perforations that indent the external surface of the shell but do not pass through to the interior.

2. *Spondylium* (Hall and Clarke).—A spoon-shaped plate in the apex of the ventral valve of diverse stocks of articulate brachiopods, which serves as the seat of attachment of the muscles. This plate is formed by the convergence of the dental plates and is supported by a more or less high median septum. *Spondylium simplex* (Kozlowski), as in *Clitambonites*, in which the dental plates and the vertical septum are united into a single piece. *Spondylium duplex* (Kozlowski), composed of two pieces, each of which is borne on a separate basal septum, as in *Pentamerus*.

3. *Interareas*, formerly called cardinal areas, are those posterior plane or curved surfaces of the valves lying between the apex and the line of valve junction. The inclination of the ventral interareas is very important in brachiopod description, and terms are necessary to indicate the various positions. In studying the inclination, the ventral valve should be below the horizontal and the beaks (arbitrarily) on the observer's left. The plane of the commissure (the boundary line between the margins of the valves) is then horizontal and the dorsal valve is up. In this orientation the following positions of the interareas may be observed:

Ventral valve: *anacline*, between vertical and horizontal; *orthocline*, horizontal; *apsacline*, between horizontal and vertical, 90°-180° from erect vertical; *catacline*, bent down 90° from the horizontal; *procline*, bent more than 180° from the vertical. In the dorsal valve, the anacline, orthocline, and apsacline conditions are recognized, and, in addition, a *hypercline* position in which the dorsal interarea is curved in an anterior direction more than 90°.

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