

NUMERICAL TAXONOMY AND PHYLOGENY
OF PALEOZOIC FASCICULATE
BRYOZOANS (ECTOPROCTS)

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
THRASOS EFTAXIADIS
1973



ABSTRACT

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By

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The operational taxonomic whole of this study consists of Paleozoic stenolaemate bryozoans having a fasciculate mode of growth; the operational taxonomic units are 398 zoaria that include representatives of 123 genera and type specimens of 87 genera.

R-mode analysis clusters the original 150 binary skeletal characters into 98 clusters at the 0.40 level of Jaccard's coefficient. Q-mode analysis of single exemplars of each genus using only independent, determinate, nonecophenotypic and nonsubjective characters and all combinations of two clustering methods and two binary coefficients of association shows that the use of Jaccard's coefficient and the weighted pair-group clustering method produces a classification that is more closely correlated to the familial classification of the standard treatises than any other numerical method. This classification provides 18 families at the 0.21 level of Jaccard's coefficient; with one exception, all of these originated in the Arenig, suggesting that the phylogeny of this group follows the pattern of great morphologic diversity at its onset, and later standardization of the successful groups.

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By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

College of Natural Science

Department of Geology

1973

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Dedicated to my wife, Bonnie,
for her understanding and support
throughout this study.

ACKNOWLEDGMENTS

I acknowledge the assistance of Sam B. Upchurch and Harold W. Scott. I am indebted to Robert L. Anstey for his support and assistance throughout this study. I thank Alan S. Horowitz, Robert V. Kesling, and Charles Waterston, curators of the Indiana University Paleontological Collection, University of Michigan Paleontological Museum, and Royal Scottish Museum, respectively, for the use of specimens in their custody.

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INTRODUCTION

The vast numbers of named paleontological taxa requiring evaluation and possible revision, as well as the need to manipulate large numbers of specimens, necessitate fast, reliable, and objective systematic procedures. The abundance or scarcity of suitable material, state of preservation, diversity of techniques, different understanding of biological concepts, inability to digest the voluminous literature, and zealous new-taxa-hunting have resulted both in the creation of superfluous taxa and in the submergence of other genetically distinct taxa. With reproducibility and objectivity as its aims, numerical taxonomy promises to be a useful tool in clarifying the existing complex of subjective classifications. Numerical taxonomy is the "numerical evaluation of the affinity or similarity between taxonomic units and the ordering of these units into taxa on the basis of their affinities" (Sokal and Sneath, 1963, p. 48).

In order that the manipulation of phenetic data obtained from the study of organisms be reproducible (i.e., given the same operational taxonomic units (OTU's) and characters, duplicate results can be produced) the following taxonomic steps must be made explicit (Kaesler, 1969b, p. 89):

- 1) Selection of characters for use in the study;
- 2) Weighting of characters;
- 3) Choice of coefficient to be computed from numerical phenetic data;

- 4) Selection of method of cluster analysis;
- 5) Determination of levels of similarity for subgrouping in a hierarchical classification.

This study utilizes a standard list of characters to be described for each specimen, weights characters by means of a multi-step screening process, selects a similarity coefficient and clustering method based in accordance with standard taxonomies, and examines the resultant hierarchical clusters for discontinuities between taxonomic levels.

As in the study of other organic groups, the systematics of Paleozoic stenolaemate bryozoans have varied because of input by such factors as:

- 1) Establishment of taxa in the early years of paleontology, when preparation techniques were not well developed.
- 2) Nomenclature based on morphology affected by environmental pressures, resulting in ecophenotypic variation in morphology both within and between genetic populations.
- 3) The assumption that either no variability existed within a taxon, or that it was accidental and not of genetic significance.
- 4) Emphasis placed by various authors on very few characters, or groups of characters, to the exclusion of many others.
- 5) Lack of recognition of the correlation between characters, and the resultant bias in classification.

Attempts to standardize the systematics of bryozoans by utilizing quantitative treatments were not made before 1960. A review and discussion of biometric procedures applied to taxonomic studies

of Paleozoic bryozoans has been given by Anstey and Perry (1970). Numerical taxonomy has become increasingly important in all areas of invertebrate paleontology; several studies using fifteen or more phenetic characters published between 1968 and 1973 (Table 1) show this.

This study recognizes more complete morphological variation by utilizing and statistically treating more characters from a larger sample of the operational taxonomic whole (OTW) than have previous works. The objectives of this study are:

- 1) The recognition, screening, and establishment of a large set of morphological diagnostic characters applicable to numerical treatment of fasciculate stenolaemate bryozoans using the exemplar method (Sokal and Sneath, 1963, p. 161);
- 2) Comparison of conventional classifications at the genetic level with numerical ones derived by several methods utilizing the above set of characters;
- 3) Construction of the phylogeny of the genera using the outcome of the numerical taxonomy coupled with stratigraphic range information.

Table 1. Summaries of some studies on numerical taxonomy in invertebrate paleontology (1968-1973).

Author and Date	Type of Analysis	Number of Characters	Type of Organisms	Type of Coefficient	Method of Clustering
Cheetham, 1968	Q-mode	23	bryozoans	Correlation; distance	WPGMA; ¹ UPGMA ²
Boardman, Cheetham and Cook, 1969	Q-mode	15	bryozoans	Distance	WPGMA
Kaesler, 1969a	Q-mode	50	ostracods	Correlation; distance	Single Linkage; Complete Linkage; WPGMA; UPGMA; Spearman's
Kaesler, 1969b	Q-mode	63	foraminifers	Distance	UPGMA
Bretsky, 1971	Q-mode	45	pelecypods	Correlation; distance	WPGMA
Brood, 1972	Q-mode	53	bryozoans	Association (S.M.) ³	WPGMA; UPGMA

Powers and Rohlf, 1972	Q-mode	60	scleractinian corals	Correlation; distance	UPGMA
Anstey and Perry, 1973	Q-mode R-mode	80	bryozoans	Association (S.M.)	Single Linkage
Corneliusson and Perry, 1973	Q-mode	100	bryozoans	Association (S.M.)	UPGMA
Delmet and Anstey (in press)	Q-mode R-mode	19	bryozoans	Correlation; distance	UPGMA
This study	Q-mode R-mode	150	bryozoans	Association (S.M.; Jaccard)	WPGMA; UPGMA

¹WPGMA--weighted, pair-group method by arithmetic averages

²UPGMA--unweighted, pair-group method by arithmetic averages

³S.M.--simple matching coefficient (Sokal and Mitchener's coefficient)

STUDY METHODS

Selection of Specimens

The OTW (operational taxonomic whole) of this study, as sampled by 398 OTU's (operational taxonomic units), consists of the Paleozoic stenolaemate bryozoans of North America (with the exception of certain families listed below). The class Stenolaemata (Phylum Ectoprocta) includes the members of the Orders Cyclostomata, Cystoporata, Trepostomata, and Cryptostomata having cone or tube-shaped zooecia, terminal apertures, and an increase of zooecial length during ontogeny (Boardman and Cheetham, 1969, p. 208). They conform to the double-walled concept (Borg, 1926, p. 594), having an outermost membranous layer protecting an outer coelomic space, both of which are continuous over the upper surfaces of the zoarium. This study excludes members of the families:

Phylloporinidae
Fenestellidae
Acanthocladiidae
Arthrostylidae
Phaceloporidae
Diastoporidae
Tubuliporidae
Reptariidae
Crownoporidae

because of their nonfasciculate arrangement of zooecia. The term fasciculate is here used to mean parallelly arranged zoecia, normally with a well defined endozone and exozone, and all apertures exposed perpendicularly or slightly obliquely to the surface of the well

calcified, stony zoarium. Although this usage is not in conformity with morphological standardly used nomenclature, it conveys the major unifying characteristic of the OTW more clearly than any other available term.

Character states of the 398 OTU's were determined from thin-sections of the zoaria, which were obtained from the following paleontological collections:

<u>Collection</u>	<u>Code</u>
Nicholson Collection, Royal Scottish Museum, Edinburgh	N
Museum of Paleontology, University of Michigan, Ann Arbor	UM
Paleontological Collection, Michigan State University, East Lansing	MSU
Paleontological Collection, Indiana University, Bloom- ington	all others

All OTU's are type specimens described and/or figured in 42 separate publications; 42 nontype specimens coded as MSU and NT are hereby elevated to hypotype status (Appendices I, II). Appendix I provides a code number, the most recently assigned generic name, specific name, author, date of naming, code or catalog number of specimen used in the publication or by the repository, and its nomenclatorial status; Appendix II lists the OTU's in alphabetic order by genus and species.

The OTU's include specimens having varying degrees of nomenclatorial status, according to the Rules of the International Commission on Zoological Nomenclature (1964). The nomenclatorial status levels are simplified as follows:

<u>Nomenclatorial</u> <u>Status</u>	<u>Type</u> <u>Designation</u>
1	Holotype, Cotype, Lectotype, or Paratype of type species
2	Homeotype of type species
3	Hypotype of type species
4	Nontype representative of type species
5	Holotype, Cotype, Lectotype, or Paratype of nontype species
6	Homeotype of nontype species
7	Hypotype of nontype species
8	Nontype representatives of nontype species
9	Specimens not identified to species level

Two hundred forty-six generic names of Paleozoic stenolaemate bryozoans (excluding certain families listed above) distributed in North America were found through a search of the literature up to 1973. Of them, 123 are represented by the OTU's (half of the total names in the OTW); 18 genera are represented by the primary types of their type species. Only one OTU was finally selected to represent each generic name in Q-mode clustering (Appendix II). This was done in accordance with the exemplar method (Sokal and Sneath, 1963, p. 161) which suggests the use of "a single representative of the polymorphic group," in this case the genus, "in the expectation that the variance of the polymorphic forms within their taxon is less than the variance among the taxa of the study; thus, the error introduced by choosing a single representative of a taxon should not be large enough to seriously affect

the estimation of the similarity among the taxa of the study; if this were not so it would raise the question of the validity of the represented taxon." Paleontology, as well as much of neontology, always has and always will deal with individual specimens as part of its operant methodology, rather than populations. Fossils are rarely, if ever, collected as populations; paleontological methods must be capable of identification of individuals. In each case the exemplar was the OTU with the highest nomenclatorial status among all those available under the same generic name.

Selection of Skeletal Characters

Choice of characters has been a major reason for subjective variation in assignments of taxa. This effect can be minimized by measuring or coding a large number of different types of characters and treating them numerically. Sokal and Sneath (1963, p. 92) make two suggestions for selecting characters:

1) Choose "all kinds of characters from all parts of the body and from all stages of the life cycle of the organisms." Even though the nonspecificity hypothesis suggests that characters from any part of the organism can characterize the organism, this cannot be established a priori for every group.

2) "Use all characters varying within the group studied, not merely conventional diagnostic ones."

One of the controversies in numerical taxonomy is the problem of the number of characters that should ideally be used. A minimum of 60 has been suggested by Michener and Sokal (1957) and as many as

1,000 are needed according to Steyskal (1968) for insects. In testing for a reasonable number of characters, Sokal and Sneath (1963) observed that as the number of characters increased, the rate of decrease of the confidence bands became negligible after the number of characters approached 100. Sokal, Camin, Rohlf, and Sneath (1965) claim numerical taxonomy based on 100 characters to be far more legitimate than conventional taxonomy utilizing few characters. In paleontology, taxonomists are naturally limited as to the nature and number of characters they can use because of the varying quality of preservation of their material. Partially or poorly preserved specimens, in addition to the lack of soft morphological, physiologic and behavioral characteristics, have forced researchers to use generally less than 100 characters (Table 1 lists numbers of characters used in paleontological studies).

In accordance with the philosophy of Sokal, Camin, Rohlf, and Sneath (1965), this study utilized a preliminary list of 150 two-state skeletal characters (Table 2). Because of the emphasis of treatment at the generic rather than the specific level, quantitative characters emphasizing the morphological and structural elements of variability within genera and, therefore, more applicable for description and differentiation at the specific level, were avoided in favor of qualitative and semi-quantitative ones.

Eighty of the 150 characters of skeletal morphology closely resemble those used by Anstey and Perry (1973, p. 11) for the study of Ordovician trepostomes. The remaining characters were compiled to describe the skeletal morphology of post-Ordovician trepostomes as well as nontrepostome members of the OTW. These characters were

selected both by examination of the published literature dealing with the classification of the OTW, and by direct observation of the OTU's.

The 150 two-state characters were recorded as true (1) or false (0) for each OTU. Provision was made for characters that were missing, uncodable, or inapplicable due to damaged or poorly preserved specimens or other reasons; such characters were scored indeterminate (2). A number of multistate characters were treated as a series of two-state characters as suggested by Sokal and Sneath (1963, p. 76) and Anstey and Perry (1973, p. 10).

The list of 150 characters was initially used with the understanding that subsequent treatment (R-mode) would filter out indeterminate, highly correlated (redundant), ecophenotypic, and highly subjective characters, and establish a residual set that would ideally be determinate, independent, and diagnostic.

Table 2. Characters of fasciculate tubular paleozoic bryozoans.

I. CHARACTERS OF ZOARIAL GROWTH

A. Zoarial Shape

1. Zoarium pseudoramose, axial region hollow or filled by clear calcite or detritus and bounded by basal lamina (epitheca) of colony
2. Zoarium frondescant (foliaceous)
3. Zoarium composed of vertical, radiating biofoliate leaves
4. Zoarium articulated, having two or more segments connected by nodes
5. Zoarial segments having a tapered base

B. Budding Patterns

6. Zooecia radiating from a central longitudinal axis
7. Zooecia arising from both sides of a median lamina (mesotheca)
8. Zooecia of hemispherical colony having radial growth from a single point of origin, not laminate (parallel from basal layer) growth
9. Zooecia arranged in longitudinal rows, parallel to long axis of zoarium
10. Zooecia arranged in diagonal rows, oblique to long axis of zoarium
11. Zooecia arranged in radiating rows with depressed areas or grooves separating each linear series
12. Zooecia arranged in intersecting spirals (Fibonacci or sunflower pattern)
13. Budding of new zooecia mostly limited to base of colony
14. Intercalated budding particularly prominent in vicinity of endozone-exozone boundary
15. Zoarial growth characterized by numerous rejuvenated zones (recurrent mature zones) or zones of iterative budding, commonly containing brown bodies just posterior to planes of rejuvenation

Table 2. Continued.

C. Nonzooidal Colony Structures

16. Zoarial base heavily calcified, lacking apertures
17. Noncelluliferous surfaces of zoarium striated
18. Noncelluliferous ridges (carinae) parallel to long axis of zoarium
19. Noncelluliferous ridges perpendicular to long axis of zoarium
20. Zoarial surface subdivided into polygonal areas separated by noncelluliferous ridges
21. Longitudinal ranges of zooecia separated by continuous dark line in wall
22. Zooecial apertures separated by parallel series of long dark lines in wall
23. Dark longitudinal range boundaries containing mural tubules
24. Dark lines in wall forming unbroken polygons around each zooecial aperture

D. Maculae

25. Open mesopores or vesicles forming distinct central cluster in maculae
26. Maculae composed entirely of mesopores or alveoli; surrounding megazooecia absent
27. Macular center depressed below general level of zoarial surface; walls considerably thickened
28. Macular center noncelluliferous because of greatly thickened wall material
29. Maculae highly elevated, sharply conical in cross-section (visible along margins of longitudinal section)
30. Elongate maculae tapered at proximal end
31. Macular mesopore clusters stellate
32. Maculae forming bands perpendicular to long axis of zoarium

Table 2. Continued.

- 33. Maculae forming bands oriented obliquely to long axis of zoarium

II. CHARACTERS OBSERVABLE IN TANGENTIAL SECTION

A. Zooecial Apertural Outlines

- 34. Circular or elliptical to subpolygonal, having rounded corners
- 35. Polygonal, having angular corners
- 36. More elongate than equidimensional
- 37. Wedge-shaped (cuneiform) or subtriangular
- 38. Rhombic or quadrate
- 39. Pentagonal or hexagonal
- 40. Invaginated, having a kidney, peanut or dumb bell shape
- 41. Petaloid
- 42. Quadrate in axial region (as seen in transverse or deep tangential sections)

B. Zooecial Size and Spacing

- 43. Maximum intermacular diameter generally greater than 0.15 mm
- 44. Maximum intermacular diameter generally greater than 0.20 mm
- 45. Maximum intermacular diameter generally greater than 0.25 mm
- 46. Minimum intermacular diameter generally greater than 0.20 mm
- 47. Maximum interzooecial void distance generally greater than one zooecial diameter
- 48. Zooecia isolated or nearly isolated by mesopores or alveoli in intermacular areas

Table 2. Continued.

C. Wall Structure

- 49. Dark divisional line in wall in thick-walled areas between adjacent zooecial apertures
- 50. Wall amalgamate, having broad nonlaminated central area in wall in thick-walled areas between adjacent zooecial apertures
- 51. Apertural walls lined by sharply differentiated peristome or cingulum
- 52. Maximum wall thickness between adjacent zooecial apertures generally greater than 0.04 mm
- 53. Numerous double-funnel shaped mural pores between adjacent apertures; wall laminae flexed into mural pores
- 54. Straight-sided pores between adjacent apertures; wall laminae not noticeably flexed
- 55. Dark granules in wall forming distinct bands around zooecial apertures
- 56. Short dark lines (pustules) radially arranged in wall perpendicular to zooecial apertures
- 57. Zooecial apertures surrounded by minute pores in wall (mural tubules)

D. Lunaria

- 58. Lunaria slight outcurvings of zooecial walls, not prominent
- 59. Lunaria highly curved, prominent
- 60. Lunarial spurs (pseudosepta) present
- 61. Lunarial deposit sharply differentiated from laminae of zooecial wall
- 62. Lunaria having thin dark colored zone on inner side that is continuous with zooecial wall
- 63. Rodlike cores present in some lunarial deposits
- 64. Lunarial margins bearing knoblike or spinose projections

Table 2. Continued.

- 65. Lunarial margin bearing a longitudinal median ridge (lunarial carina)

E. Intrazooecial Structures

- 66. Edges of highly crescentic diaphragms appearing in most zooecial apertures
- 67. Edges of nearly straight but slightly crescentic cystiphragms or hemiphragms appearing in most zooecial apertures
- 68. Multiple nested cystiphragms appearing in single zooecial aperture
- 69. Numerous small blisterlike cystiphragms present in each zooecial aperture
- 70. Cystiphragms making zooecial apertures strongly V-shaped (or cuneiform) rather than rounded
- 71. Single cystiphragms very large, generally constricting more than one third of zooecial aperture
- 72. Edges of obliquely oriented diaphragms or hemiphragms appearing in most zooecial apertures
- 73. Foramina of ring septa appearing in zooecial apertures
- 74. Foramina of ring septa kidney-shaped in outline
- 75. Septa projecting radially into zooecia, not associated with inflecting acanthopores
- 76. Zooecial walls bearing knoblike projections or spines

F. Mesopores

- 77. Generally more than three mesopores, vesicles, or incipient zooecia in direct contact with each zooecial aperture
- 78. Small clusters of numerous mesopores present between adjacent zooecial apertures

Table 2. Continued.

G. Acanthopores

- 79. Small dark spots observable at junction angles of integrate-walled zooecial apertures
- 80. Acanthopores at junction angles of most adjacent zooecial apertures
- 81. Acanthopores numerous, ringing zooecial apertures
- 82. Acanthopores in continuous longitudinal rows between zooecial ranges
- 83. Centered acanthopores common along zooecial walls
- 84. Acanthopores commonly inflecting zooecial walls
- 85. Acanthopores differentiated into two distinct size classes (endacanthopores and exacanthopores, or megacanthopores and micracanthopores)
- 86. Lumen diameter generally greater than one-half acanthopore diameter
- 87. Generally more than two acanthopores associated with each zooecial aperture
- 88. Acanthopore diameter (of larger class if bimodal) generally greater than 0.03 mm

III. CHARACTERS OBSERVABLE IN LONGITUDINAL SECTION

A. Zooecial Geometry

- 89. Zooecia in exozone inclined at less than 60 degrees to zoarial surface
- 90. Zooecia displaying conspicuous bend at endozone-exozone boundary
- 91. Zooecia displaying flat base (keel) in cross-section of recumbent portion
- 92. Zooecia displaying indentations (sinuses) in cross-section of recumbent portion

Table 2. Continued.

B. Wall Structure

93. Zooecial walls crenulated in endozone
94. Zooecial walls crenulated in exozone
95. Monilae present
96. Spacing between successive monilae greater than zooecial diameter
97. Tubules (minutopores) present in zooecial wall
98. Mural lacunae (spherical disruptions) present in zooecial wall
99. Zooecial walls granular appearing, may be poorly laminated locally
100. Wall laminae sharply arched, resembling inverted V's, not broadly convex outward (as seen in thick-walled regions or monilae)
101. Zooecial walls generally amalgamate, lacking divisional line
102. Amalgamate wall structure, area of central flexure broad with respect to total wall thickness
103. Amalgamate wall structure, portions of wall laminae parallel to zooecial length extending posteriorly for a distance greater than one zooecial diameter
104. Diaphragm laminae continuous across two or more adjacent mesopores or zooecia, representing an unconformity in laminae deposition
105. Zones of wall laminae separated anteriorly and posteriorly by growth unconformities, the laminae of which do not pass into any diaphragms
106. Diaphragm (or cystiphragm or hemiphragm) laminae forming linings inside zooecial walls passing upward beneath one or more diaphragms and merging anteriorly with mural laminae, producing a structure resembling a stack of nested tumblers

Table 2. Continued.

- 107. Lunarial deposits containing tabulate longitudinal tubelike structures
- 108. Mesotheca lamellate, having same structure as zooecial walls
- 109. Clear hyaline layer in center of mesotheca
- 110. Mesotheca containing median tubules
- 111. Median tubules ovate in cross-section, not circular
- C. Diaphragms
 - 112. Diaphragms present in endozonal portions of most zooecia
 - 113. Diaphragms present in exozonal portions of most zooecia
 - 114. Distance between successive diaphragms in exozone generally less than one zooecial diameter
 - 115. Depth of living chamber generally greater than one zooecial diameter
 - 116. Most diaphragms oriented obliquely to zooecial walls
 - 117. Most diaphragms slightly curved, concave outward
 - 118. Most diaphragms slightly curved, convex outward
- D. Cystiphragms
 - 119. Cystiphragms present in most zooecia in exozone
 - 120. Cystiphragms not isolated, present in overlapping series
 - 121. Cystiphragms present in vertical series but no overlapping
 - 122. Cystiphragms commonly hemispherical and completely recurved to zooecial wall
 - 123. Straight half diaphragms abutting cystiphragms
 - 124. V-shaped or U-shaped cystiphragms linked by inclined semidiaphragms
 - 125. Fringed cystiphragms present

Table 2. Continued.

E. Hemiphragms

- 126. Hemiphragms present in exozonal portions of most zooecia
- 127. Thin partial diaphragms abutting hemiphragms
- 128. Hemiphragms projecting from only one side of zooecial wall
- 129. Hemiphragms or hemisepta hooked or curved, projecting posteriorly (heterophragms)
- 130. Inferior hemiseptum present on distal wall
- 131. Superior hemiseptum present on proximal wall

F. Other Intrazooecial Structures

- 132. Infundibular (funnel-shaped) diaphragms present locally
- 133. Ring septa present in exozone
- 134. Foramina of ring septa offset distally in zoarium
- 135. Intrazooecial tubes present in exozone
- 136. Intrazooecial spines delicate and thin, not blunt and thick
- 137. Spines projecting from only one side of zooecial wall
- 138. Spines most numerous in vicinity of endozone-exozone boundary
- 139. Spines generally having lobate extremities

G. Mesopores and Vesicles

- 140. Mesopores tubular, not vesicular or cystose
- 141. Mesopores lacking diaphragms (metapores or exilapores)
- 142. Clustered mesopores, only having vesicular structures
- 143. Most mesopores (or exilapores) moniliform
- 144. Beaded mesopores (or incipient zooecia) common in posterior portion of exozone

Table 2. Continued.

- 145. Mesopores or vesicles generally overgrown by wall laminae anteriorly
- 146. Distance between successive mesopore diaphragms or vesicle plates generally less than tube diameter
- 147. Vesicles roofed by arched, imbricate plates, not by horizontal plates having zigzag boundaries with adjacent series of vesicles
- 148. Perforate tabulae (ring septa) present in mesopores or incipient zooecia

H. Acanthopores

- 149. Tabulae present in acanthopores
- 150. Acanthopores showing growth discontinuities or rejuvenation

ANALYSIS OF DATA

The data matrix derived from 398 OTU's coded for 150 characters was used for R-mode and Q-mode comparisons (Appendix III). In the Q-mode analysis the OTU's are compared with each other on a two-by-two basis; in the R-mode the characters are compared with each other on a two-by-two basis. Matrices of coefficients of associations were calculated to show the two-by-two similarity among OTU's (Q-mode) and characters (R-mode), respectively. Both Jaccard's coefficient of association and the simple matching (Sokal and Michener's) coefficient (Sokal and Sneath, 1963, p. 133) were used to compare pairs of OTU's on the basis of the character states; the coefficients can be formulated as follows (Cheetham and Hazel, 1969, p. 1131):

$$\text{Jaccard's coefficient} = \frac{M_{JK}}{M_{JK} + M_{Jk} + M_{jK}}$$

$$\text{Simple Matching (Sokal and Michener's)} = \frac{M_{JK} + M_{jk}}{M}$$

Where:

- MJK.....Present in both units compared
- MJk.....Present in first but not second
- MjK.....Present in second but not in first
- Mjk.....Absent in both
- M.....Total present in all units

The calculation of the matrices of coefficients and their subsequent clustering into hierarchical groupings were performed by program CLUST3, a cluster analysis program coded in Fortran IV by Bonhan-Carter (1967) and revised for use in the CDC 6500 computer at

Michigan State University. Clustering was accomplished by means of the average linkage weighted and unweighted pair-group methods. Dendograms of clustering were plotted by inserting computer-punched clustering coordinates from CLUST3 into program DNPLLOT coded in Fortran IV by Bonham-Carter (1967) and revised for the CDC 3600 computer at Michigan State University. The sequence of steps utilized in this study is shown in Table 3.

Table 3. Sequence of steps used in this study.

1. Select specimens to be coded, using largely type specimens, drawn from as many different genera of the OTW as available.
2. Formulate initial list of taxonomic characters, using the published literature and direct examination of the OTU's.
3. Code specimens for each character.
4. Eliminate characters scored as 0 in all specimens.
5. Cluster specimens using simple matching coefficient and all characters remaining.
6. Retain one specimen from each cluster above the 0.90 level of simple matching coefficient.
7. Cluster characters into groups using independent specimens.
8. Retain one character from each group higher than 0.40 level of Jaccard's coefficient.
9. Eliminate ecophenotypic and highly subjective characters.
10. Select exemplars of generic names, choosing OTU's having the highest nomenclatorial status.
11. Cluster exemplars of generic names using remaining characters, by four clustering methods:
 - a) Jaccard's weighted
 - b) Jaccard's unweighted
 - c) Simple matching weighted
 - d) Simple matching unweighted
12. Compare phenograms from step 11 with standard classifications (Bassler, 1953; Astrova, 1960) and calculate coefficients of association among all classifications.
13. Cluster all OTU's using the clustering method most likely correlated to standard classifications.
14. Using the phenogram from step 13, and stratigraphic range information, construct phylogenetic diagrams.

R-MODE ANALYSIS

Raup (1972, p. 38, fig. 2-3) suggests that morphology is controlled by genetic constraints as well as functional, structural, ecophenotypic, and chance factors. Therefore, "such apparently straightforward problems as defining taxonomic characters and recognizing homologies depend on correct recognition of causative factors. Purely ecophenotypic variation must be recognized, for example, before meaningful taxonomic characters can be assigned. If similarities due to structural phenomena are not recognized false homologies may be established." Anstey and Delmet (1973) and Delmet and Anstey (in press) have shown that complexes of specific characters in bryozoans do not always have genetic affinities but can result from single causes. For "higher taxonomic levels" Sokal and Sneath (1963, p. 125) suggest that "analysis of R-type matrices should lead to information on phylogenetic factors at work within the group studies."

The morphological analysis in this study reduces the original set of characters into a smaller basic set of variables. To determine the interdependence of the 150 characters and the overall phenetic variation within the OTW, a preliminary Q-mode analysis of all of the OTU's was carried out using all available characters. Subsequent screening out of correlated specimens above the 0.90 level of the simple matching coefficient established a residual group of independent specimens for R-mode analysis. Because of limitations in program

memory, the preliminary Q-mode screening had to be carried out iteratively; the 398 OTU's were first arbitrarily divided into three groups of 156 OTU's or less each. For each group coefficients of association were clustered into phenetic groupings using the unweighted pair-group method. Only one OTU in each group that clustered at the level of 0.90 or higher was retained in the sample; OTU's having the highest nomenclatorial status were preferentially selected. This preliminary Q-mode treatment was repeated for the remaining OTU's in successive runs until a single group of less than 156 OTU's could be clustered together, and those independent at 0.90 or less were retained (Figure 1). During this process, six characters were scored as 0 in all OTU's and were deleted from the list of 150 (Table 4).

The group of OTU's independent at the 0.90 level of the simple matching coefficient thus exhibits the total phenetic variability within the OTW, and was used in the R-mode analysis. Jaccard's coefficient was used in the R-mode analysis; character correlations based on mutual absence of structures or mutually negative character states, are not genetically meaningful. Examination of the 150 X 150 matrix of coefficients based on 120 independent OTU's indicated that 15 characters were scored as 0 in all 120 specimens; these characters were temporarily deleted and only 135 characters were clustered using the average linkage, unweighted pair-group method (Figure 2). The inclusion of correlated attributes would place undesirable emphasis on certain portions of the organisms' morphology; such attributes are affected by single causes and they are, therefore, of low taxonomic significance. An abrupt change in the number of stems in the phenogram at the level of

Table 4. Characters eliminated from initial set of 150.

1) Redundant (all scored as 0) in all OTU's:

19	69	75	125	134
135				

2) Correlated with other characters above the 0.40 level of Jaccard's coefficient:

2	43	71	90	120
3	45	74	91	129
6	46	77	92	138
7	50	78	97	139
8	52	80	101	149
14	59	83	113	
21	61	84	115	
34	63	87	119	

3) Highly subjective in coding:

12	16	17	27	51
55	99			

4) High ecophenotypic variation:

15	104	106	132	150
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Figure 1. Q-mode (Simple Matching coefficient) phenogram of 120 OTU's using 150 characters, clustered by the average linkage un-weighted pair-group method.

Coded OTU's

H086
 P017
 B7
 U01
 P020
 N2
 P016
 H02
 C019
 C036
 L02
 C05
 C027
 C020
 U04
 C1
 C046
 C010
 P01
 P04
 C04
 H3
 N007
 N018
 P040
 C06
 C018
 C030
 P011
 N00
 N08
 U03
 C02
 N02
 N02
 N08
 C2
 P01
 P01
 P02
 H020
 P01
 H016
 C031
 N01
 N1
 U17
 N00
 U16
 C030
 A14
 C070
 U19
 C046
 U10
 N10
 N127
 A2
 C06
 C026
 C026
 C01
 B2
 U14
 U15
 C016
 C01
 C03
 C02
 C07
 U07
 N00
 A5
 C013
 C10
 A1
 C03
 N126
 C010
 P01
 C010
 C06
 C0A3
 C020
 N04
 C026
 P07
 C026
 P01
 C025
 C07
 C010
 C010
 C026
 C026
 B11
 C020
 U012
 N04
 N04
 N04
 U019
 U01
 N04
 N04
 U014
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 B3
 C02
 C019
 N01
 N05
 N04
 U1A
 U01

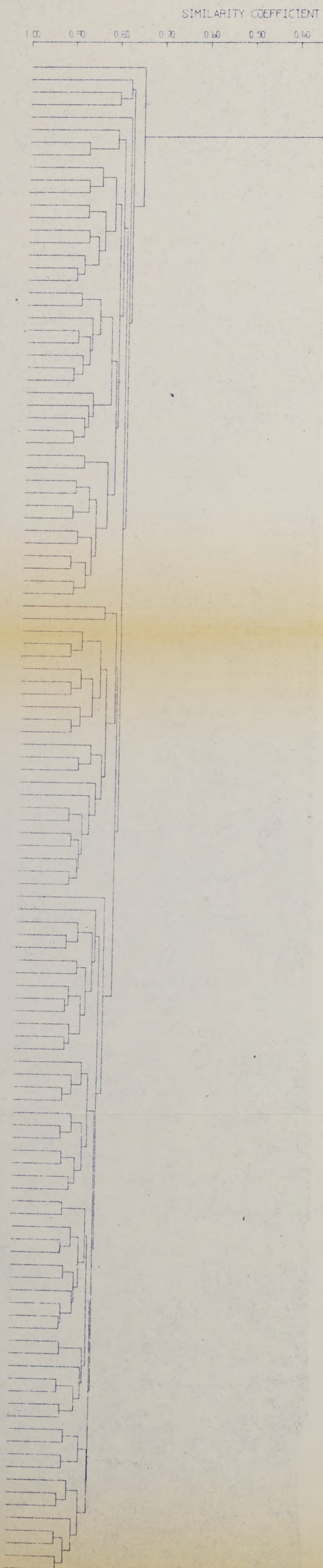




Figure 2. R-mode (Jaccard's coefficient) dendrogram of 135 characters using 120 OTU's; by the average linkage unweighted pair-group method. Subsequently eliminated characters are indicated by asterisks.

CHARACTER NUMBERS (TABLE 2)



0.40 was noted and only one character was retained from each cluster above this level; the character joining each cluster at the lowest level was retained while the others were eliminated. Thirty-seven characters above the 0.40 level were deleted (Table 4). The choice of the 0.40 level assures elimination of correlated characters with minimal loss of phenetic information. In addition, characters 15, 104, 106, 132, 150 (also in Table 4) were excluded from the list of diagnostic characters because of the high ecophenotypic variation. These are either characters whose development is known from a priori evidence to be highly ecophenotypic in nature, or which display high variability within a thin section or between sections cut from the same zoarium. Other characters which could also have been placed in this category have been previously eliminated. Additionally, several characters were observed to vary when coded by two or more different workers from the same thin sections and, thus, are judged to be of little value because of the subjectivity inherent in coding (Table 4).

This screening process resulted in a residual set of 95 skeletal characters that should be of high value in classification and identification. The number of characters in this set is larger than any previously used in the numerical taxonomy of bryozoans, and similar in size to those suggested by numerical taxonomists. This set can be further reduced by retaining one character from more inclusive clusters of characters. It was previously indicated that morphology can be attributed to few factors. As individual causes of morphology become known (e.g., the effect of zooecial budding and packing on aspects of morphology (Delmet and Anstey, in press)) the possibility of identifying

organisms by very few diagnostic independent characteristics, is increasing.

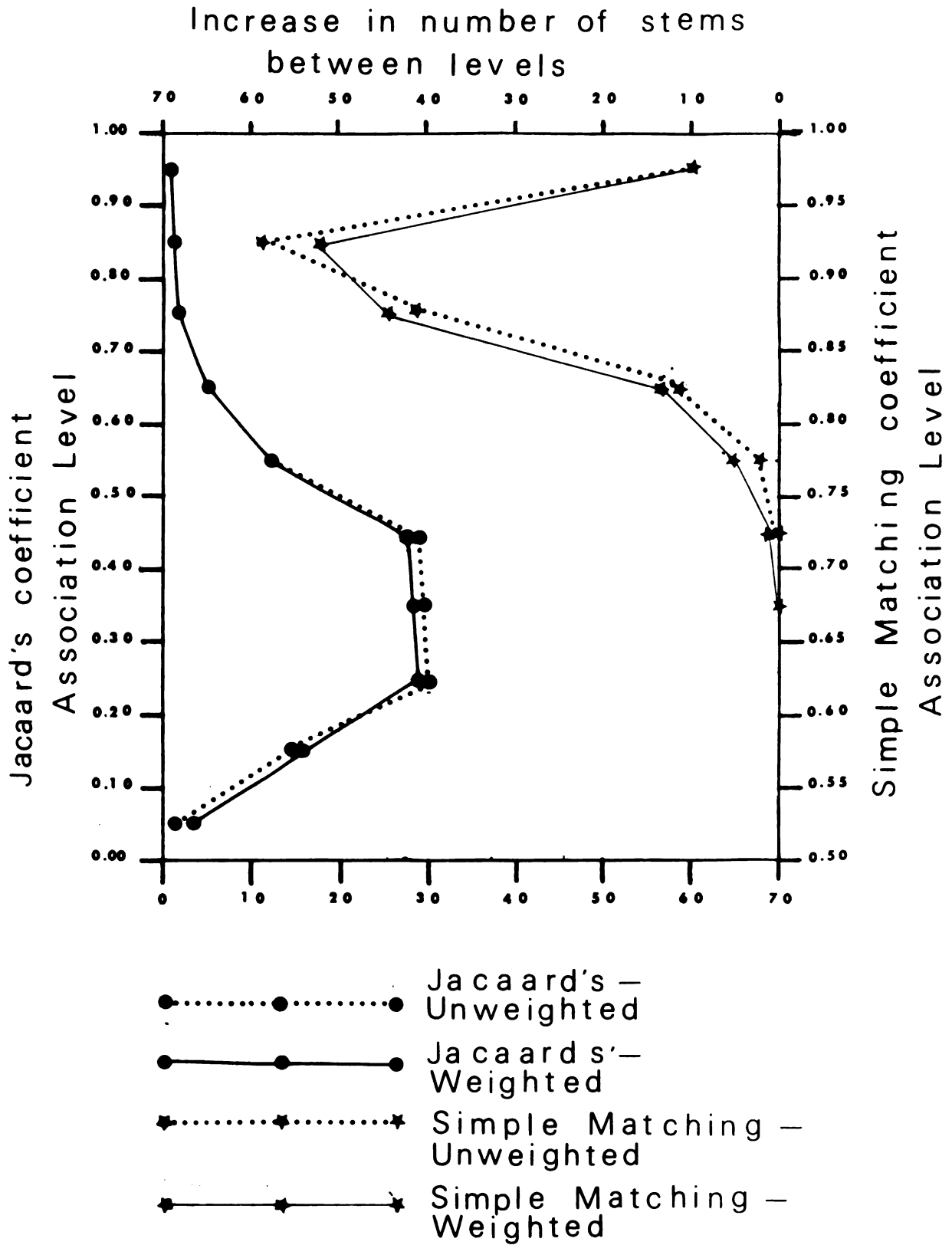
Q-MODE ANALYSIS

The objectives of the Q-mode comparisons using 95 characters are 1) Q-mode comparison and clustering of exemplars of all generic names present in the OTW by four different methods, 2) comparison of the above four phenograms with each other, and with conventional classification, and 3) Q-mode analysis of the OTW and examination of selected portions of it.

Generic Classification

A list of 123 genera was compiled; exemplars of generic names among the OTU's were selected having the highest nomenclatorial status (Appendix II). In order to determine the coefficient and clustering method that closely approximate conventional classifications, four Q-mode comparisons of the 124 exemplars were computed using both the simple matching and Jaccard's coefficients of association, and were clustered by both the weighted and unweighted pair-group methods using linkage by arithmetic averages. The changes in the number of clusters at each 0.10 association interval reveal the absence of hierarchical levels in each classification (Figure 4), as each phenogram shows only a unimodal level of clustering. The peaks of these modes, at 0.93 for the simple matching coefficient, and 0.35 for Jaccard's coefficient, are the levels at which classification would be most effective. Inasmuch as the OTU's are genera, then the

Figure 3. Change in number of clusters versus association level in phenograms of 123 clustered genera based on 95 characters.



clusters obtained at these levels should correspond to families. Any suprafamilial taxa within the OTW would have to be established on a purely arbitrary basis, and suggests the absence of clearly defined superfamilies, orders, or subclasses within the OTW.

Comparison of Classifications

The four phenograms were compared with conventional classifications and with each other. The classifications of 123 generic names into families by Bassler (1953) and Astrova (1960) both contained 18 families each containing two or more genera. Accordingly, 18 groups (phena) were established in each of the four Q-mode phenograms by identifying the levels of association above which 18 phena containing more than one genus occurred; these levels were 0.21 in Jaccard's weighted, 0.24 in Jaccard's unweighted, 0.87 in simple matching weighted, and 0.88 in simple matching unweighted phenograms. Consequently, 21 genera occupying single-genus clusters in one or more of the six classifications were excluded from the comparisons (Table 5).

The comparison of classifications was, thus, based on a residuum of 102 generic names in 18 phenons (families). This was accomplished by calculating coefficients of association between Q-mode matrices generated by each classification. To illustrate this, assume hypothetical genera A, B, C, D, E clustered in two modes as follows:

<u>Classification X</u>			<u>Classification Y</u>		
Clusters	1	2	Clusters	1	2
Genera	<u>A B</u>	<u>C D E</u>	Genera	<u>A B C D</u>	<u>E</u>

Table 5. Monogeneric family-level pheno for six classifications.

Genus	Jaccard's Unweighted	Jaccard's Weighted	S.M.* Unweighted	S.M.* Weighted	Astrova (1960)	Bassler (1953)
Atactopora	X		X	X		
Badogliopora			X			
Balticoporella			X			
Batostoma			X			
Cadornipora	X	X	X			
Cheilotrypa			X			
Cyclopore					X	X
Dichotrypa	X	X				
Eridocampylus	X		X			
Gortanipora			X	X		

1.--Reduce each classification to a nominal level, so that each genera scored as "1" for one cluster and "0" for all others:

<u>Data Matrix X</u>		
Genera	Clusters	
	1	2
A	1	0
B	1	0
C	0	1
D	0	1
E	0	1

<u>Data Matrix Y</u>		
Genera	Clusters	
	1	2
A	1	0
B	1	0
C	1	0
D	1	0
E	0	1

2.--Calculate Q-mode association matrix for the genera using Jaccard's coefficient:

<u>Coefficient Matrix X</u>				
	A	B	C	D
B	1			
C	0	0		
D	0	0	1	
E	0	0	1	1

<u>Coefficient Matrix Y</u>				
	A	B	C	D
B	1			
C	1	1		
D	1	1	1	
E	0	0	0	0

3.--Calculate the number of matches and mismatches between cells of coefficient matrices X and Y:

2 positive matches (P.M.)
 2 negative matches (N.M.)
 6 mismatches (M.M.)

Similarity level (simple matching coefficient) between classification X and Y = $\frac{P.M. + N.M.}{P.M. + N.M. + M.M.}$ =

$$\frac{4}{10} = 0.40$$

To compare the six classifications, coefficient matrices were calculated by program CLUST3; simple matching coefficients between pairs of the coefficient matrices were then calculated (Table 6).

First, the two conventional classifications of the sample of 102 genera are very highly correlated (0.97) with each other. Secondly, all four of the numerical classifications are highly correlated with

Table 6. Simple matching coefficients of association among classifications.

	Astrova (1960)	Bassler (1953)	S.M.* Unweighted	S.M.* Weighted	Jaccard's Unweighted
Bassler (1953)	5103/5253 0.97				
S.M. Unweighted	4635/5253 0.88	4642/5253 0.88			
S.M. Weighted	4641/5253 0.88	4648/5253 0.88	4998/5253 0.95		
Jaccard's Unweighted	4719/5253 0.90	4705/5253 0.90	4882/5253 0.93	4818/5253 0.92	
Jaccard's Weighted	4737/5253 0.90	4717/5253 0.90	4783/5253 0.91	4649/5253 0.90	4942/5253 0.94

*S.M.--simple matching coefficient

the conventional ones, at the 0.90 and 0.88 levels of simple matching coefficients. This suggests that numerical methods closely duplicate conventional systematics. This is not unexpected because the characters used are basically the same as those in the standard classifications. The effect of numerical work is simply to refine a classification system using objective, standardized, and reproducible procedures. No great differences should be expected as long as the character base remains the same. The two treatises are highly correlated, because the later one (Astrova, 1960) developed historically from the earlier one (Bassler, 1953). Thirdly, the comparisons among different numerical methods (Table 6) show that the choice of coefficient has a greater effect than the choice of clustering method. Comparisons using Jaccard's coefficient of association are more closely correlated to conventional systems than those using the simple matching coefficient. In every comparison, the weighted method gave results slightly closer to the conventional than the unweighted method. The closest match between numerical and traditional methods is between Astrova (1960) and the Jaccard-weighted method.

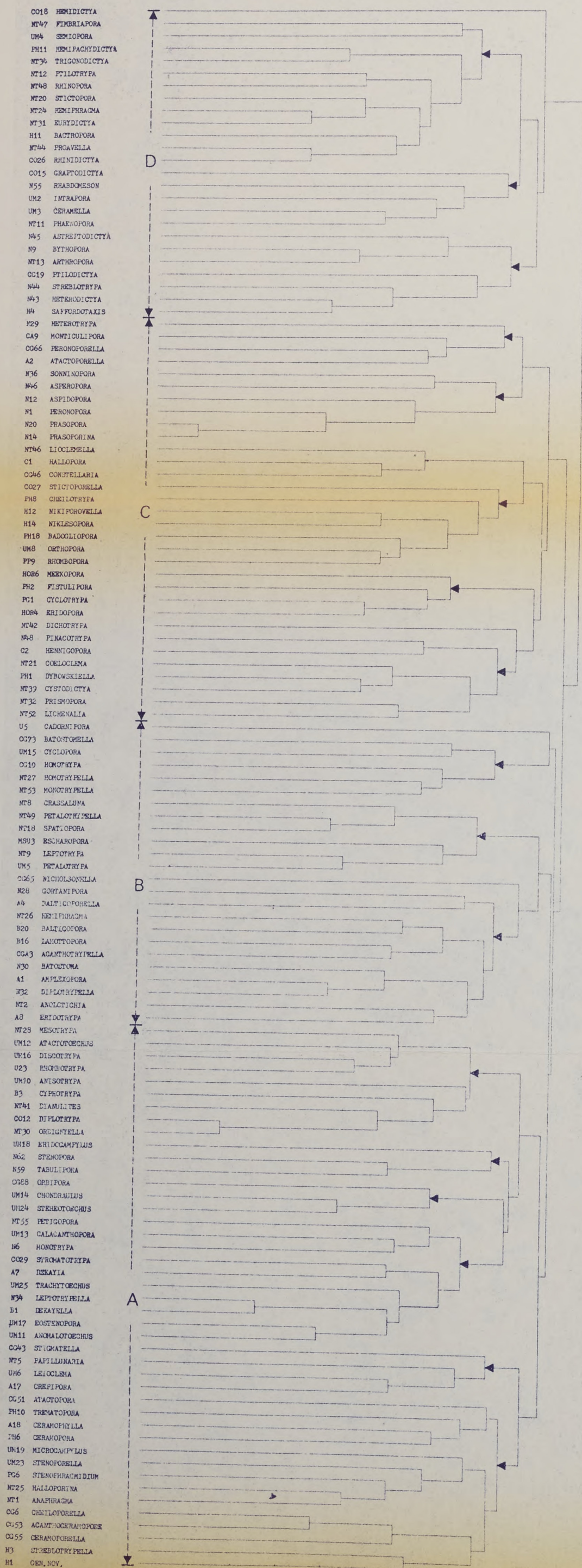
Analysis of all OTU's

Due to computer limitations, the entire sample was subdivided into homogeneous subsamples containing less than 156 OTU's each. Major generic clusters of the Jaccard's weighted phenogram (Figure 4) were divided into subsamples A, B, C, and D composed of 43, 24, 32, and 24 generic names, respectively. The remaining OTU's were clustered with the exemplars of their respective generic names, thus forming subsamples

Figure 4. Q-mode phenogram of 123 genera based on Jaccard's coefficient, clustered by the average linkage weighted pair-group method. Eighteen phenons containing more than one genus are identified. Sample is divided into subsamples A, B, C, and D to be used in the final Q-mode analysis of the OTW.

SIMILARITY COEFFICIENT

1.00 0.90 0.80 0.70 0.60 0.50 0.40 0.30 0.20 0.10 0.00

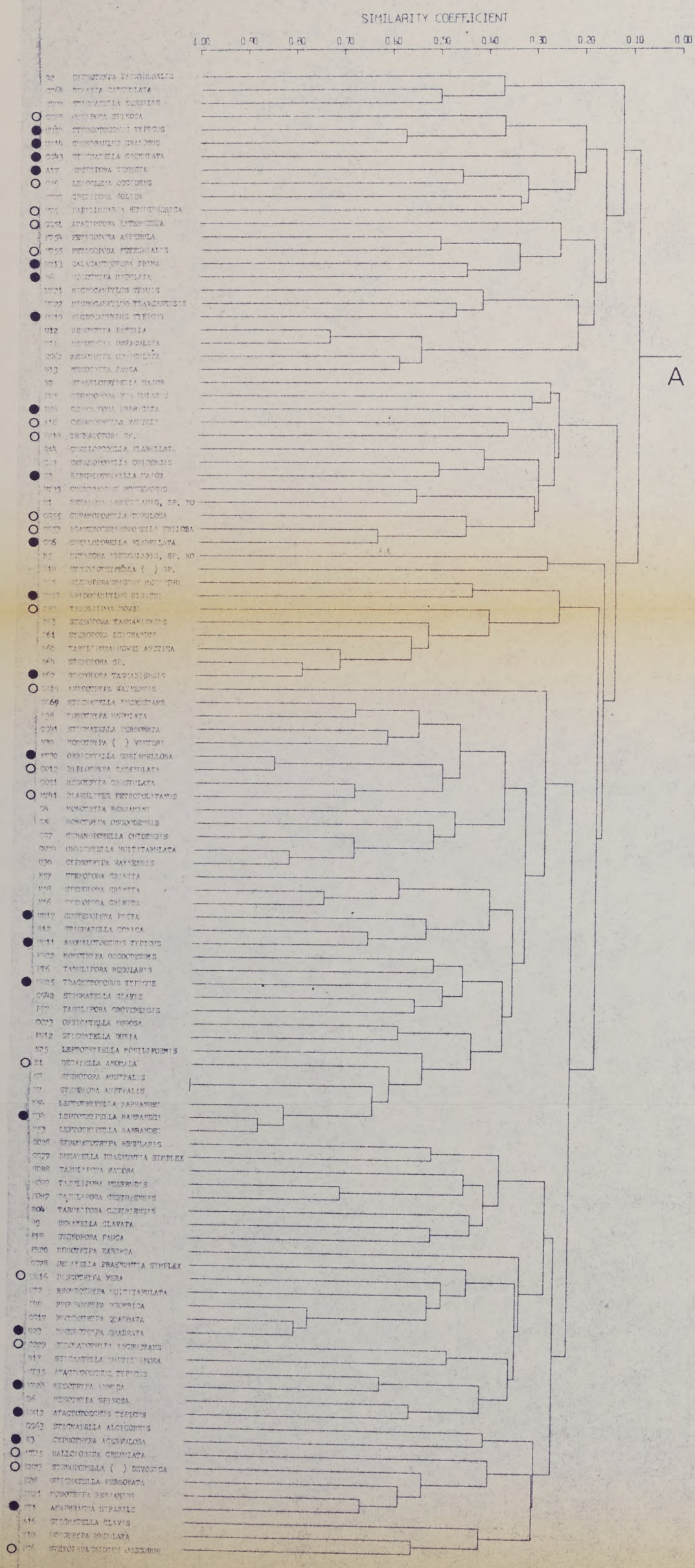




of 111, 96, 146, and 45 OTU's, respectively, which were then clustered using Jaccard's coefficient and the weighted pair-group method (Figures 5, 6, 7, and 8).

Examination of phenograms in Figures 5, 6, 7, and 8 indicate that 50 percent of 257 subgeneric taxa represented by type species in the OTW cluster together around the type species of their genus; the remaining 50 percent were clustered independently of their type species in clusters of one or more subgeneric taxa. Of 141 subgeneric taxa, not represented in the OTW by the type species of their genera, 53 percent were clustered around their generic representatives.

Figure 5. Final Q-mode phenogram of subsample A of OTW.



A



Figure 6. Final Q-mode phenogram of subsample B of OTW.

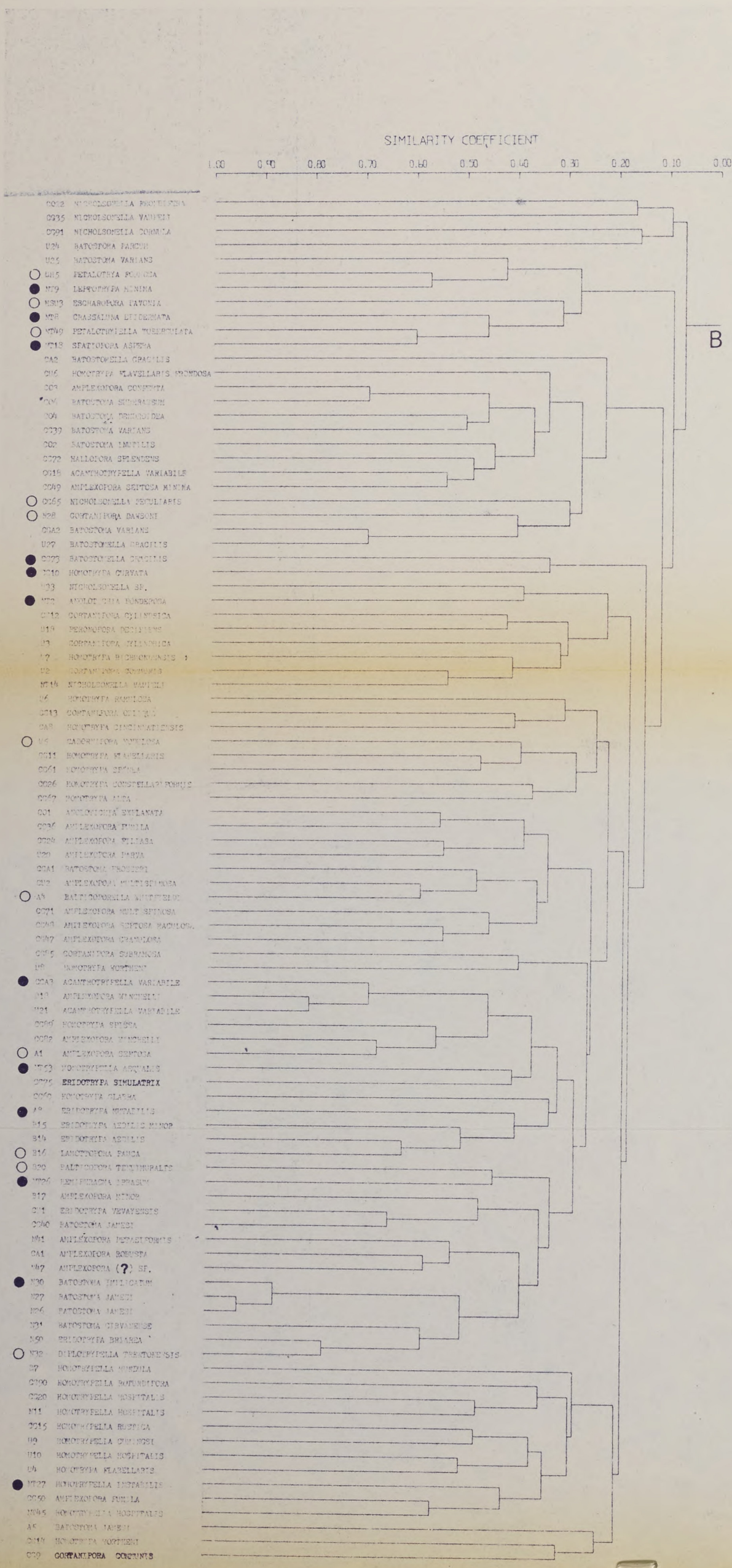




Figure 7. Final Q-mode phenogram of subsample C of OTW.

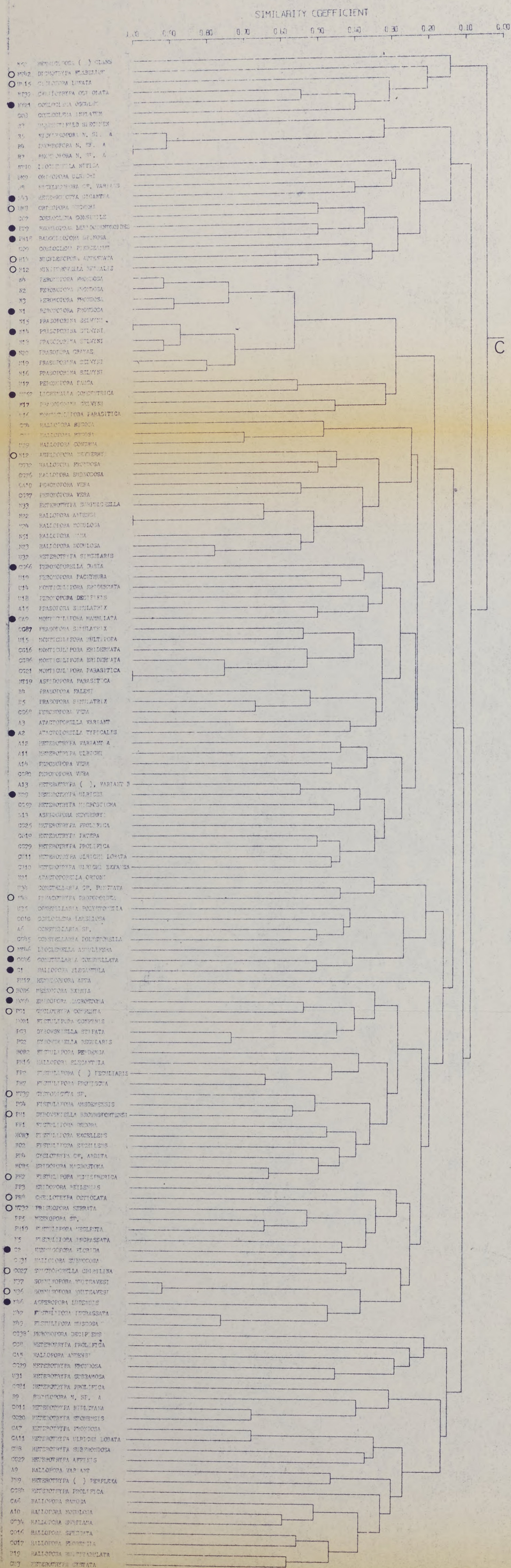
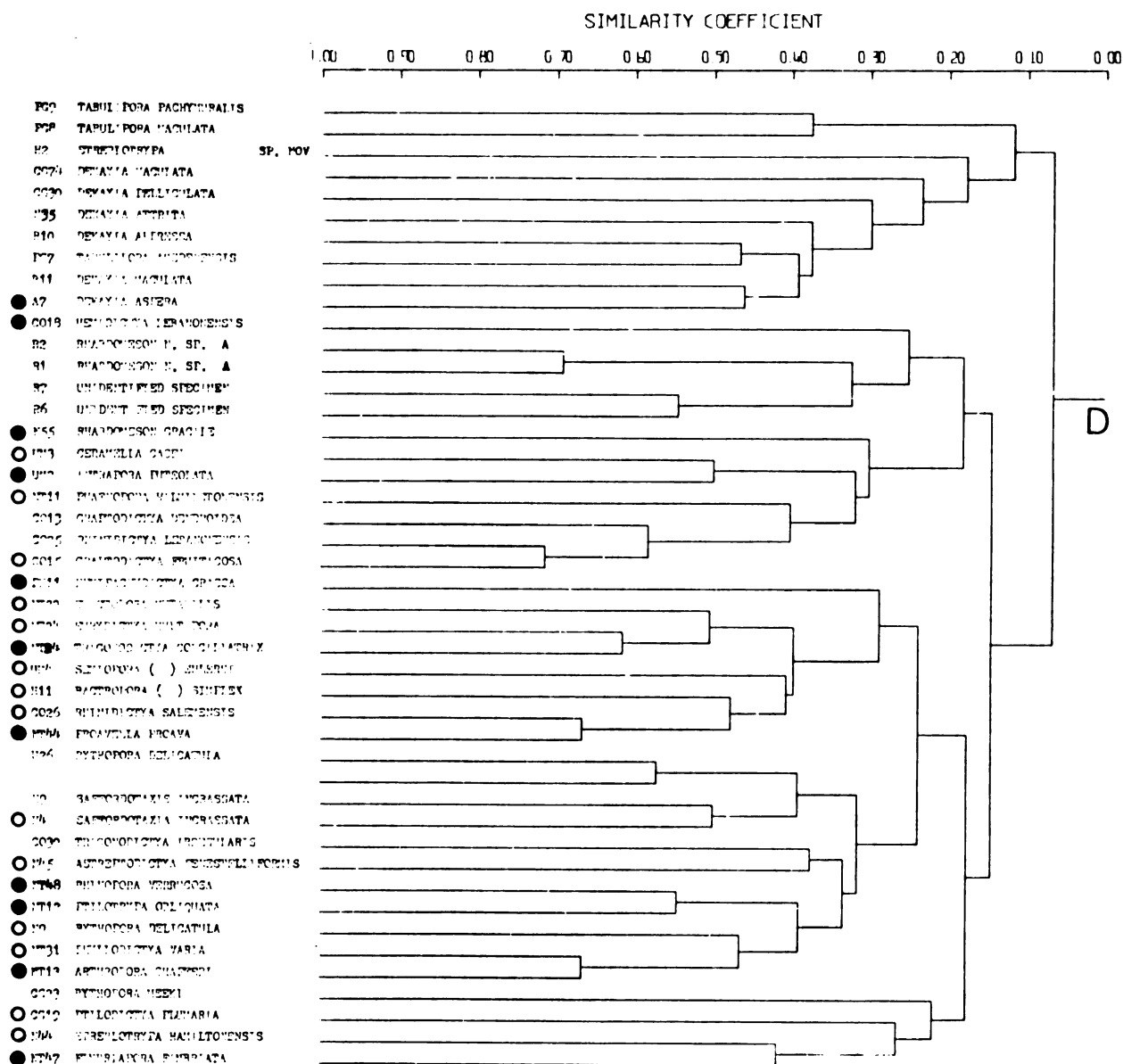




Figure 8. Final Q-mode phenogram of subsample D of OTW.



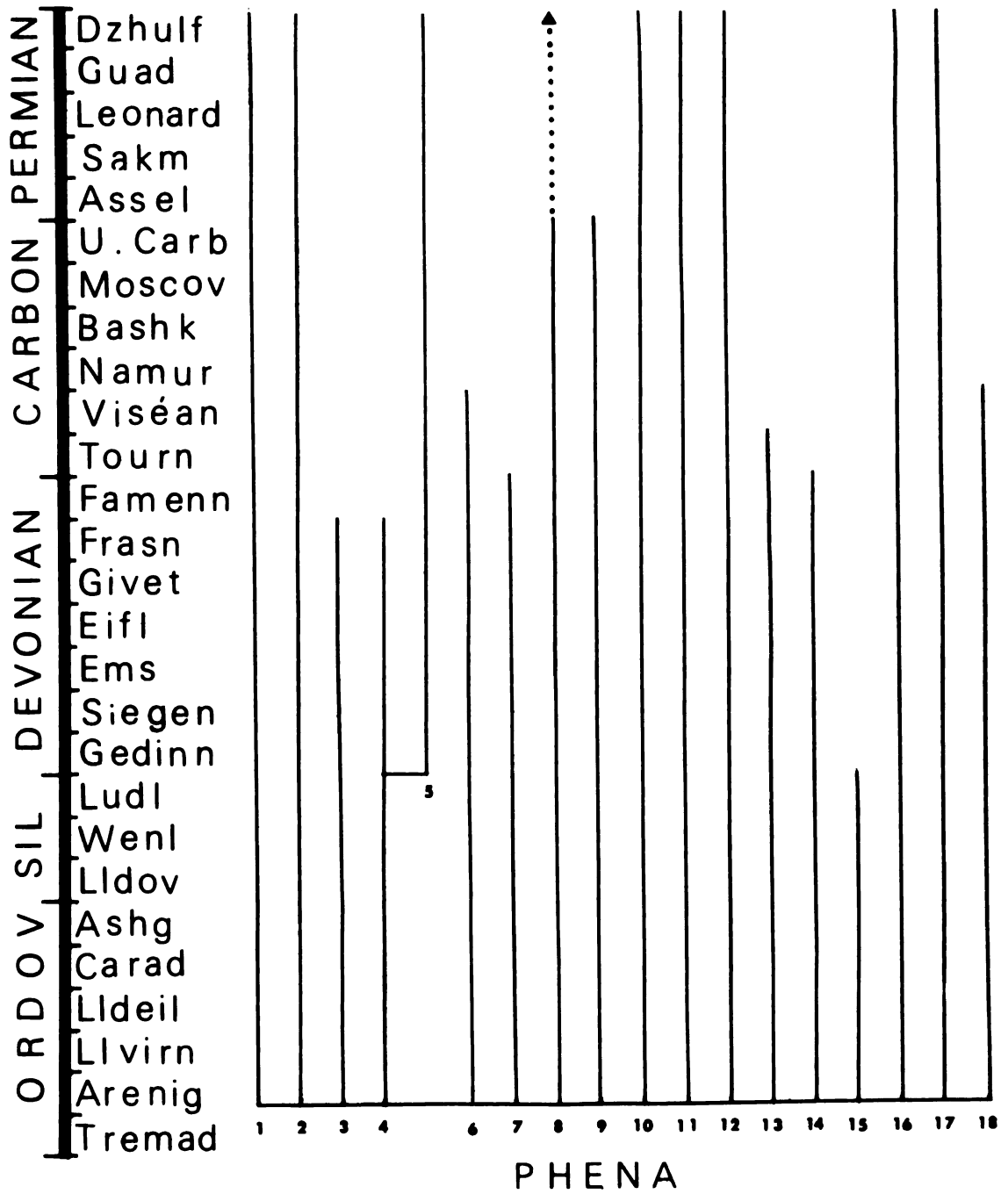
PHYLOGENY

The phylogenetic relationships among any set of taxa in the OTW can be established by utilizing their phenetic similarities and their stratigraphic ranges. The phylogeny at the 18 phenon level (Figure 9) was constructed in this study through the information contained in the phenogram of clustered generic names by the Jaccard's-Weighted method. Geological range data (first and last appearance) of the genera were provided in the Fossil Record (Larwood, et al. in Harland, 1967), Bassler (1953), Astrova (1960), as well as several other publications. The mode of joining main lineages by shorter-living and/or later-appearing groups, was determined by their phenetic difference from their surrounding main lineages. Appendix IV lists genera belonging to each phenon and their stratigraphic ranges.

The lineages thus established show that all 18 phena except one appeared in the Areginian Epoch. The appearance and immediate diversification of these bryozoan groups, as in many other organic groups, conforms to the evolutionary pattern of early experimentation in mechanical design, and later standardization (Carboniferous) of the most successful designs discussed by Gould (1970, p. 111). Thirteen of the 18 phena were present in the Carboniferous, while 8 persisted through the Permian.

The phylogeny shown in Figure 9 resembles the phylogenetic relationships of 11 families proposed by Ross (1964, p. 928). In

Figure 9. Phylogeny of 18 family-level phena.



addition, it is similar to the general distribution of lineages shown in Astrova (1960, p. 30), and Ryland (1970, p. 133).

Examination of this group of bryozoans at the generic level, to the full potential of the available data, will be undertaken in the near future.

CONCLUSIONS

The numerical study of 398 members of Paleozoic stenolae-mate bryozoans (excluding certain families) indicates that:

By R-mode analysis of 150 skeletal characters originally selected to describe the members of the OTW, a set of 95 determinate, independent and diagnostic morphological characters was obtained.

Classifications by numerical procedures obtained by utilizing the above 95 characters are highly correlated with classifications obtained by conventional methods.

Of all combinations of computing and clustering methods used, classifications derived by Jaccard's coefficient of association and clustered by the weighted pair-group method proved to be closest to the conventional.

In the Q-mode analysis of all OTU's, most of the type species of genera clustered independently of each other. Approximately half of the OTU's were clustered around the type species of their genus.

Construction of the phylogeny indicated the presence of 17 lineages all originating at the beginning of the Arenigian Epoch, a pattern best explained by the theory of early diversification and later standardization, conforming to the phylogenetic model of Ross (1964).

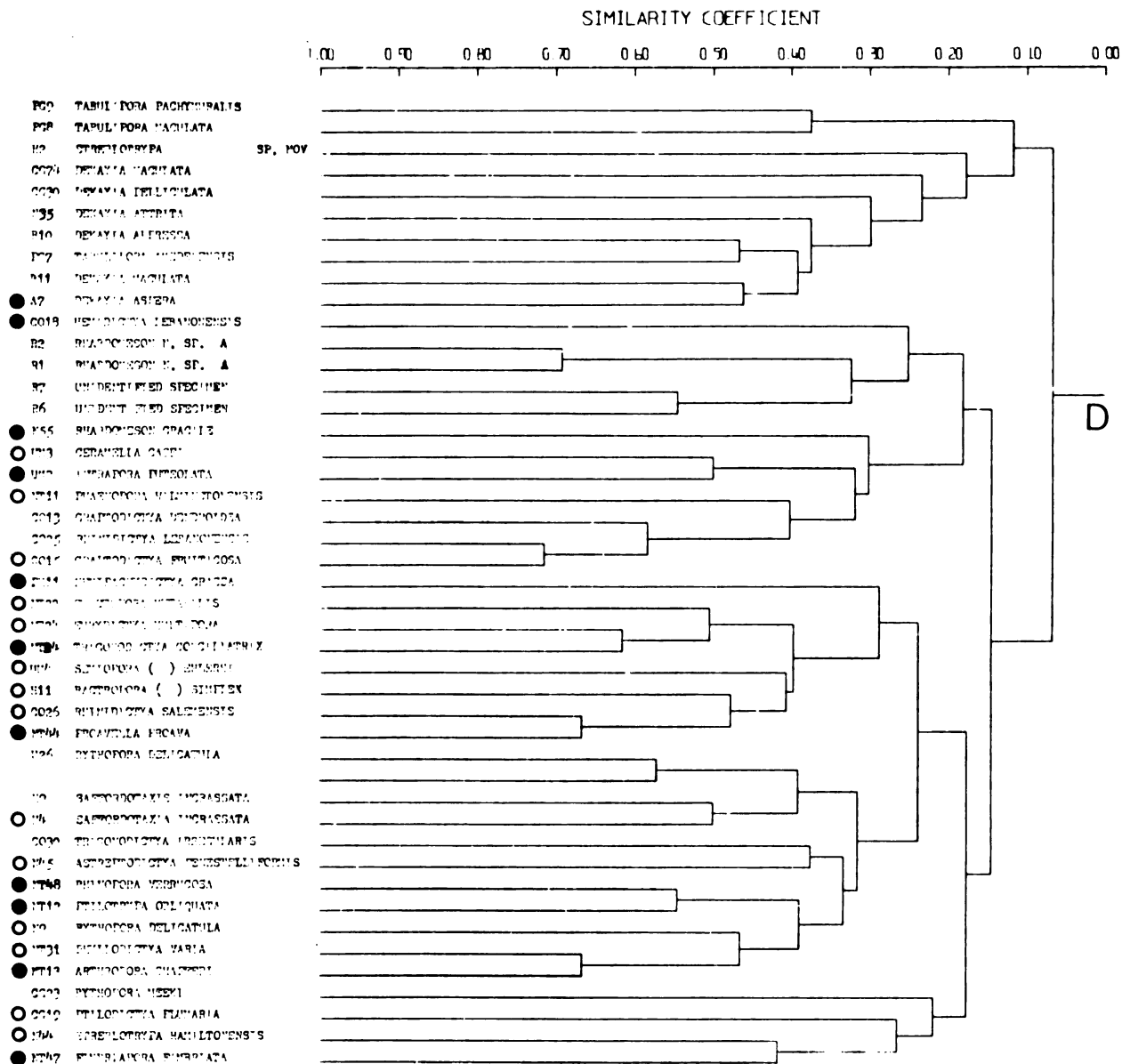
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Figure 8. Final Q-mode phenogram of subsample D of OTW.



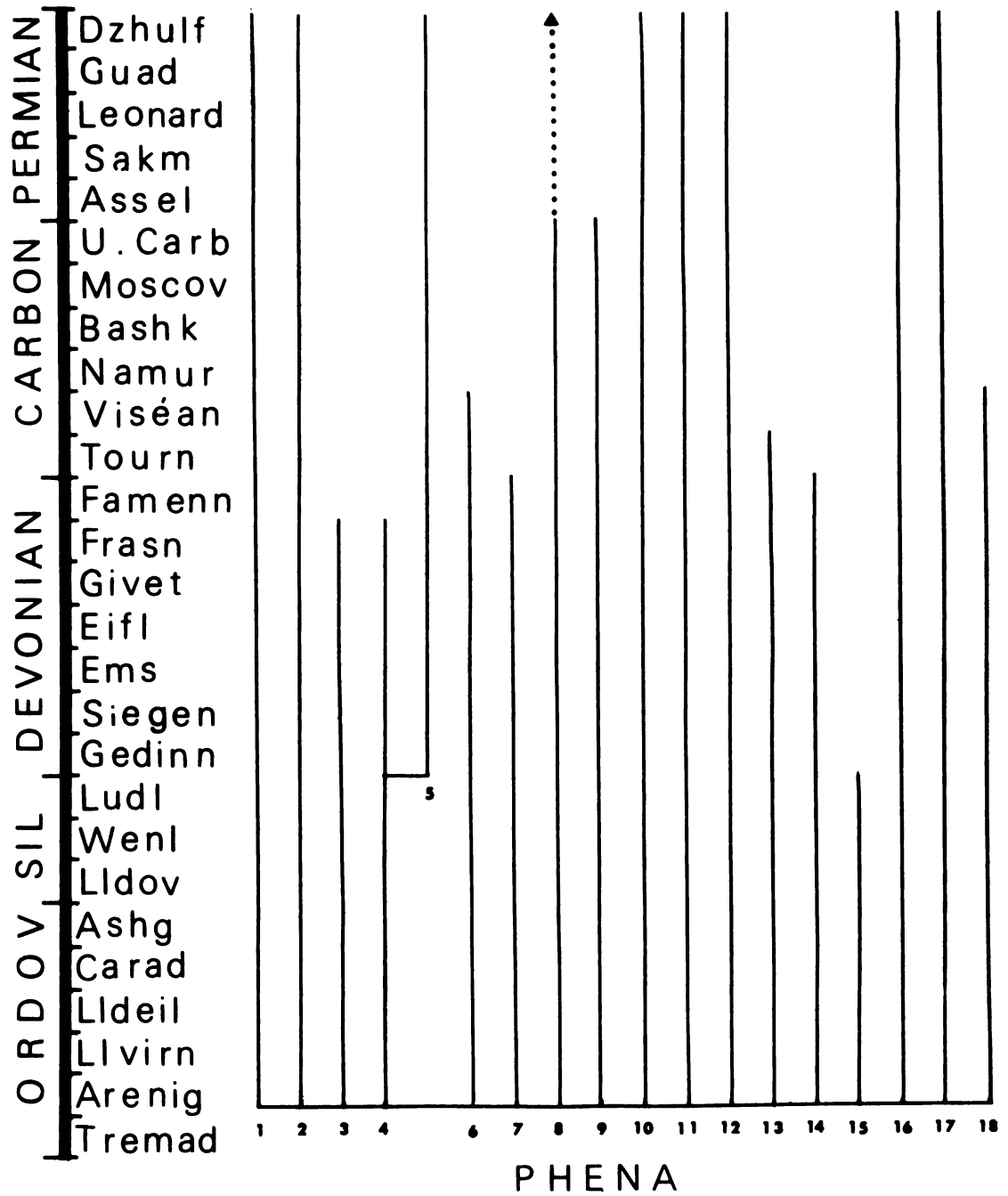
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APPENDIX I

List of OTU's arranged by publication where described.

SPECIMENS IN OTH ARRANGED BY PUBLICATION WHERE DESCRIBED.

CODE	GENUS AND SPECIES	AUTHOR	YEAR	MUSEUM, OR ORIGINAL PUBLICATION NO.	NUM STAT.
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ANSTEY, R.L., AND PERRY, T.G.. 1973

EDEN SHALE BRYOZOANS. A NUMERICAL STUDY (ORDOVICIAN, OHIO VALLEY)

MICH. STATE UNIV., PUBL. OF THE MUSEUM, PALEONTOLOGICAL SER., V.1, NO.1, PP. 77-78

A1	AMPLEXOPORA SEPTOSA	ULRICH	1879	8973-11001	6
A2	ATACTOPORELLA TYPICALIS	ULRICH	1883	8977-16009	2
A3	ATACTOPORELLA, VARIANT	ANST+PERRY	1973	8974-2004	9
A4	BALTICOPORELLA WHITFIELDI	(JAMES	1881)	8976-30010	6
A5	BATOSTOMA JAMESI	NICHOLSON	1874	8976-5008	7
A6	CONSTELLARIA SP.	ANST+PERRY	1973	8974-1002	9
A7	DEKAYIA ASPERA	M-E+H.	1851	8971-3005	3
A8	ERIDOTRYPA MUTABILIS	ULRICH	1895	8974-1004	3
A9	HALLOPORA, VARIANT	ANST+PERRY	1973	8975-44004	9
A10	HALLOPORA NODULOSA	(NICHOLSON	1874)	8975-41024	7
A11	HETEROTRYPA ULRICHI	NICHOLSON	1881	8975-28005	3
A12	HETEROTRYPA, VARIANT A	ANST+PERRY	1973	8976-7004	9
A13	HETEROTRYPA (), VARIANT B	ANST+PERRY	1973	8972-3006	9
A14	PERONOPORA VERA	ULRICH	1888	8971-3003	6
A15	PRASOPORA SIMULATRIX	ULRICH	1886	8974-1007	7
A16	STIGMATELLA CLAVIS	(ULRICH	1883)	8974-1012	6
A17	CREPIOPORA VENUSTA	(ULRICH	1878)	8975-17037	4
A18	CERAMOPHYLLA VAUPELI	(ULRICH	1890)	8975-17016	8

BROWN, G.D., JR.. 1965

TREPOSTOMATOUS BRYOZOA FROM THE LOGANA AND JESSAMINE LIMESTONES (MIDDLE ORDOVICIAN) OF THE KENTUCKY BLUEGRASS REGION.

J. PALEONTOLOGY, 39(5) 974-1006, PL. 111-198, 2 ; IG1.

B1	DEKAYELLA ANOMALA	BROWN	1962	8232-3	5
B2	CYPHOTRYPA PACHYMURALIS	BROWN	1965	8238-1	5
B3	CYPHOTRYPA ACERVULOSA	(ULRICH	1895)	8243-1	3
B4	PRASOPORA FALESI	(JAMES	1884)	8233-1	7
B5	PRASOPORA SIMULATRIX	ULRICH	1886	8232-2	6
B6	MESOTRYPA SPINOSA	ULRICH	1895	8235-1	7
B7	HOMOTRYPELLA MUNDULA	ULRICH	1895	8242-2	7
B9	DEKAYELLA CLAVATA	FRITZ	1957	8236-8	7
B10	DEKAYIA APPRESSA	ULRICH	1883	8234-1	7
B11	DEKAYIA MACULATA	JAMES	1881	8232-10	7
B12	STIGMATELLA CONICA	BROWN	1965	8235-3	5
B13	STIGMATELLA MULTISPINOSA	BROWN	1965	8241-2	5
B14	ERIDOTRYPA AEDILIS	(EICHWALD	1855)	8233-5	7
B15	ERIDOTRYPA AEDILIS MINOR	(ULRICH	1895)	8234-2	7
B16	LAMOTTOPORA PAUCA	BROWN	1965	8233-7	5
B17	AMPLEXOPORA MINOR	BROWN	1965	8241-3	5
B18	AMPLEXOPORA WINCHELLI	ULRICH	1886	8237-1	7
B19	HALLOPORA MULTITABULATA	(ULRICH	1886)	8233-9	7
B20	BALTICOPORA TENUIMURALIS	(ULRICH	1893)	8232-12	7

CAMERON, D.K., JR.. 1954

BRYOZOAN FAUNA OF THE JEFFERSON LAKE SECTION

(UNPUBLISHED A.M. THESIS). BLOOMINGTON, INDIANA UNIVERSITY, 35P., 10PLS.

CA1	AMPLEXOPORA ROBUSTA	ULRICH	1883	6-1,2	8
CA2	BATOSTOMELLA GRACILIS	(NICHOLSON	1874)	6-3	4
CA3	CERAMOPORELLA OHIOENSIS	(NICHOLSON	1875)	7-3	8
CA4	CHEILOPORELLA FLABELLATA	(ULRICH	1879)	7-4	4
CA5	HALLOPORA ANDEWSI	(NICHOLSON	1874)	8-1	8
CA6	HALLOPORA RAMOSA	(D'ORBIGNY	1850)	8-4	8
CA7	HETEROTRYPA FRONDOSA	(D'ORBIGNY	1850)	9-1	4
CA8	HOMOTRYPA CININNATIENSIS	BASSLER	1903	10-1,2	8
CA9	MONTICULIPORA MAMMULATA	D'ORBIGNY	1850	10-4	4
CA10	PERONOPORA VERA	ULRICH	1888	10-5	8
CA11	HETEROTRYPA ULRICHI LOBATA	(CUMINGS	1902)	9-3,4	8

CORNELIUSSEN, E.F., AND PERRY, T.G., 1973

MONOTRYPA, HALLOPORA, AMPLEXOPORA AND HENNIGOPORA (ECTOPROCTA) FROM THE BROWNSPORT FORMATION (NIAGARAN), WESTERN TENNESSEE.

J. PALEONTOLOGY, 47(2) 151-220, 34 FIGS., 21 TABLES, 10 PLS.

C1	HALLOPORA ELEGANTULA	(HALL	1852)	13110-495	2
C2	HENNIGOPORA FLORIDA	(HALL	1852)	13101-107	2
C4	MONOTRYPA BENJAMINI	BASSLER	1906	131061520	6
C5	MONOTRYPA OSGOODENSIS	BASSLER	1906	13127-204	6

CORYELL, H.N., 1921

BRYOZOAN FAUNA OF THE STONES RIVER GROUP OF CENTRAL TENNESSEE

INDIANA ACAD. SCI. PROC., 1919, PP. 261-340, 3 FIGS., 14 PLS.

C01	ANOLOTICHTIA EXPLANATA	CORYELL	1921	9240-23	5
C02	BATOSTOMA INUTILIS	CORYELL	1921	9246-3	5
C03	AMPLEXOPORA CONFERTA	(CORYELL	1921)	9249-9	5
C04	BATOSTOMA DENDROIDEA	CORYELL	1921	9246-1	5
C06	BATOSTOMA SUBERASSUM	CORYELL	1921	9242-7	5
C07	COELOCLEMA CONSIMILE	CORYELL	1921	9241-17	5
C08	COELOCLEMA INFLATUM	CORYELL	1921	9240-20	5
C09	COELOCLEMA PIERCEANUM	CORYELL	1921	9238-14	5
C010	COELOCLEMA LAMELLOSA	CORYELL	1921	9241-10	5
C011	HETEROTRYPA RIDLEYANA	(CORYELL	1921)	9245-6	5
C012	DIPTOTRYPA CATENULATA	CORYELL	1921	UNNUMBERED HOLOTYPE	5
C013	GRAPTODICTYA DENDROIDEA	CORYELL	1921	9237-13A, B	5
C015	GRAPTODICTYA FRUITICOSA	CORYELL	1921	9237-12A, B	5
C016	HALLOPORA SPISSATA	CORYELL	1921	9244-18	5
C017	HALLOPORA FLORENCIA	CORYELL	1921	9240-13	5
C018	HEMIDICTYA LEBANONENSIS	CORYELL	1921	9248-25A, B	1
C019	HETEROTRYPA PATERA	CORYELL	1921	9242-4	5
C020	HETEROTRYPA STONENSIS	CORYELL	1921	9242-5	5
C021	MESOTRYPA CRUSTULATA	CORYELL	1921	9236-24	5
C022	NICHOLSONELLA FRONDIFERA	CORYELL	1921	9244-3	5
C023	ORBIGNYELLA NODOSA	CORYELL	1921	9248-16	5
C024	ORBIGNYELLA MULTITABULATA	CORYELL	1921	9244-17	5
C025	RHINIDICTYA LEBANONENSIS	CORYELL	1921	9247-9	5
C026	RHINIDICTYA SALEMENSIS	CORYELL	1921	9245-7	5
C027	STICTIPORELLA CRIBILINA	CORYELL	1921	9242-13	5
C028	STROMATOTRYPA REGULARIS	CORYELL	1921	9245-16	5
C029	STROMATOTRYPA INCRUSTANS	CORYELL	1921	9245-14	5
C030	TRIGONODICTYA IRREGULARIS	CORYELL	1921	9245-11A, B	5

CUMINGS, E.R., 1901

A SECTION OF THE UPPER ORDOVICIAN AT VEAVY, INDIANA

AM. GEOLOGIST, V. 28, PP. 361-381, 2 PLS.

CU1	BATOSTOMA VEVAYENSE	(CUMINGS	1901)	9014-14	5
CU2	AMPLEXOPORA MULTISPINOSA	CUMINGS	1901	9006-23	5
CU3	HETEROTRYPA CYSTATATA	(CUMINGS	1901)	9012-17	5

CUMINGS, E.R.. 1902

A REVISION OF THE BRYOZOAN GENERA DEKAYIA, DEKAYELLA AND HETEROTRYPA OF THE CINCINNATI GROUP.
AM. GEOLOGIST, V. 29, PP. 197-217, 12 PLS.

CU6	HOMOTRYPA FLABELLARI FRONDOSA	CUMINGS	1902	9027-17, 20	6
CU8	HETEROTRYPA SUBFRONDOSA	(CUMINGS	1902)	9028-8, 9024-6	5
CU10	HETEROTRYPA ULRICHI EXPANSA	(CUMINGS	1902)	9027-12, 9028-11	5
CU11	HETEROTRYPA ULRICHI LOBATA	(CUMINGS	1902)	9026-19, 20	5

CUMINGS, E.R.. 1908

THE STRATIGRAPHY AND PALEONTOLOGY OF THE ORDOVICIAN ROCKS OF INDIANA.
32ND ANNUAL REPORT OF THE DEPT. OF GEOLOGY AND NATURAL RESOURCES OF INDIANA
PP. 605-1188. PLS. 1-50

CG4	HALLOPORA RUGOSA	(M-E.+H.	1851)	1.33A3-1	7
CG5	HALLOPORA RUGOSA	(M-E.+H.	1851)	1.41E7, 85-15	9
CG6	CHEILOPORELLA FLABELLATA	(ULRICH	1879)	27-14	3
CG7	CERAMOPORELLA OHIOENSIS	(NICHOLSON	1875)	10-3	7
CG8	HETEROTRYPA PROLIFICA	ULRICH	1890	93-24	7
CG9	GORTANIPORA COMMUNIS	(BASSLER	1903)	32-7	7
CG10	HOMOTRYPA CURVATA	ULRICH	1882	8-15	3
CG11	HOMOTRYPA FLABELLARI	ULRICH	1890	65-14	7
CG12	GORTANIPORA CYLINDRICA	(BASSLER	1903)	84-11	7
CG13	GORTANIPORA OBLIQUA	(ULRICH	1882)	1-18	7
CG14	HOMOTRYPA WORTHENI	(JAMES	1882)	86-3	7
CG15	HOMOTRYPELLA RUSTICA	ULRICH	1893	50-11	8
CG16	MONTICULIFORA ERIDERMATA	ULR+BASSL.	1904	85-11	7
CG17	RHOMBOTRYPA QUADRATA	(ROMINGER	1866)	65-4	7
CG18	ACANTHOTRYPELLA VARIABILE	(ULRICH	1890)	81-14	7
CG19	PTILODICTYA PLUMARIA	JAMES	1878	50-20	7
CG20	HOMOTRYPELLA HOSPITALIS	(NICHOLSON	1881)	32-16	7
CG21	MONTICULIPORA PARASITICA	ULRICH	1882	65-18, 19	7
CG23	BYTHOPORA HEEKI	(JAMES	1878)	32-5	7
CG24	AMPLEXOPORA FILIASA	(D'ORBIGNY	1850)	87-25	7
CG25	HETEROTRYPA PROLIFICA	ULRICH	1890	32-18	7
CG26	HOMOTRYPA CONSTELLARIFORMIS	CUMINGS	1908	81-16	5
CG27	HETEROTRYPA AFFINIS	(ULRICH	1879)	83-7, 8	7
CG29	HETEROTRYPA FRONDOSA	(D'ORBIGNY	1850)	8-4	7
CG30	DEKAYIA PELLICULATA	ULRICH	1883	12-4	7
CG31	HALLOPORA SUBNODOSA	(ULRICH	1890)	79-18	7
CG32	HALLOPORA FRONDOSA	(CUMINGS	1908)	85-17	5
CG34	HALLOPORA SUBPLANA	(ULRICH	1882)	23-15	7
CG35	NICHOLSONELLA VAUPELI	(ULRICH	1883)	8-9	7
CG37	PERONOPORA VERA	ULRICH	1888	13-6	7
CG38	PERONOPORA DECIPIENS	(ROMINGER	1866)	2-14	7
CG39	BATOSTOMA VARIANS	(JAMES	1878)	67-2	7
CG40	BATOSTOMA JAMESI	NICHOLSON	1874	21-5	7
CG41	STIGMATELLA PERSONATA	ULR+BASSL	1904	86-1	7
CG42	STIGMATELLA CLAVIS	(ULRICH	1883)	6-4	7
CG43	STIGMATELLA CRENULATA	ULR+BASSL	1904	89-14	3
CG44	ATACTOPORELLA MUNDULA	(ULRICH	1879)	5-21	7
CG45	CONSTELLARIA POLYSTOMELLA	NICHOLSON	1875	65-6	7
CG46	CONSTELLARIA CONSTELLATA	(DANA	1846)	10-20	3

CUMINGS, E.R. AND GALLOWAY, J.J.. 1912
A NOTE ON THE BATOSTOMAS OF THE RICHMOND SERIES
INDIANA ACAD.SCI.PROC., 1911, PP.147-167

CGA1	BATOSTOMA PROSSERI	C.+G.	1912	9116-17	5
CGA2	BATOSTOMA VARIANS	(JAMES	1878)	9112-22	7
CGA3	ACANTHOTRYPELLA VARIABLE	(ULRICH	1890)	9117-23	3

CUMINGS, E.R. AND GALLOWAY, J.J.. 1913
THE STRATIGRAPHY AND PALEONTOLOGY OF THE TANNERS CREEK SECTION OF THE
CINCINNATI SERIES OF INDIANA.
INDIANA DEPT.GEOL.AND NAT.RESOURCES, 37TH ANNUAL REPORT, PP.353-478

CG36	AMPLEXOPORA PUMILA	C.+ G.	1913	79-6	5
CG47	AMPLEXOPORA GRANULOSA	C.+ G.	1913	9109-14	5
CG48	AMPLEXOPORA SEPTOSA MACULOSA	C.+ G.	1913	9149-1	5
CG49	AMPLEXOPORA SEPTOSA MINIMA	C.+ G.	1913	9162-2	5
CG50	AMPLEXOPORA PUMILA	C.+ G.	1913	9107-23	5
CG51	ATACTOPORA INTERMEDIA	C.+ G.	1913	9157-22	5
CG53	ACANTHOCERAMOPORELLA TRILOBA	(C.+ G.	1913)	9167-18	5
CG55	CERAMOPORELLA TUBULOSA	C.+G.	1913	9158-2	5
CG59	HETEROTRYPA MICROSTIGMA	C. + G.	1913	9122-23	5
CG60	HOMOTRYPA GLABRA	C.+G.	1913	9165-6	5
CG61	HOMOTRYPA SPINEA	C.+G.	1913	9165-1	5
CG62	MESOTRYPA ORBICULATA	C.+ G.	1913	9134-9	5
CG63	STIGMATELLA ALCICORNIS	C.+ G.	1913	9155-18	5
CG64	DEKAYIA CATENULATA	(C.+ G.	1913)	9131-15	5
CG65	NICHOLSONELLA PECULIARIS	C.+ G.	1913	9133-4	5
CG66	PERONOPORELLA DUBIA	C.+ G.	1913	9133-24	1
CG67	HOMOTRYPA ALTA	C.+G.	1913	9163-23	5
CG68	PERONOPORA VERA	ULRICH	1888	9147-16	7
CG69	STIGMATELLA INCRUSTANS	C.+ G.	1913	9107-17	5
CG70	STIGMATELLA SESSILIS	C.+ G.	1913	9146-8	5
CG80	PERONOPORA VERA	ULRICH	1888	9147-14	7

CUMINGS, E.R. AND GALLOWAY, J.J.. 1915
STUDIES OF THE MORPHOLOGY OF THE TREPOSTOMATA OR MONTICULIPOROIDS
BULL.GEOL.SOC.AM., V.26, PP.349-374, PLS.10-15

CG71	AMPLEXOPORA MULTISPINOSA	CUMINGS	1901	9126-21	7
CG72	HALLOPORA SPLENDENS	(ULRICH	-)	9230-8	7
CG73	BATOSTOMELLA GRACILIS	(NICHOLSON	1874)	9139-7	3
CG74	DEKAYIA MACULATA	JAMES	1881	9145-9	7
CG75	ERIDOTRYPA SIMULATRIX	(ULRICH	1890)	9129-12	7
CG76	HALLOPORA SUBNODOSA	(ULRICH	1890)	9128-16	7
CG77	DEKAYELLA PRAENUNTIA SIMPLEX	ULRICH	1893	9198-16	7
CG78	DEKAYELLA PRAENUNTIA SIMPLEX	ULRICH	1893	9188-21	7
CG79	HETEROTRYPA PROLIFICA	ULRICH	1890	9168-21	7
CG81	HETEROTRYPA PROLIFICA	ULRICH	1890	9101-20	5
CG82	AMPLEXOPORA WINCHELLI	ULRICH	1886	9188-20	7
CG84	HETEROTRYPA PROLIFICA	ULRICH	1890	9102-13	5
CG85	GORTANIPORA SUBRAMOSA	(ULRICH	1886)	9186-9	7
CG86	MONTICULIPORA ERIDERMATA	ULR+BASSL.	1904	50-23	7
CG87	PRASOPORA SIMULATRIX	ULRICH	1886	9114-16	7
CG88	ORBIPORA SPINOSA	(ULR+BASSL	1904)	9177-18	7
CG89	HOMOTRYPA SPISSA	C.+G.	1915	9210-16	5
CG90	HOMOTRYPELLA ROTUNDIPORA	C.+ G.	1915	9210-1	5
CG91	NICHOLSONELLA CORNULA	C.+ G.	1915	9150-5A,8	5

DEISS, C.F..1927

ANISOTRYPA WAYNENSIS, A NEW BRYOZOAN FROM THE WARSAW FORMATION OF KENTUCKY
CONTR. FROM THE MUSEUM OF GEOLOGY, UNIV. OF MICHIGAN, V.2, NO.14, PP.237-239, 2 PL

UM10	ANISOTRYPA WAYNENSIS	DEISS	1927	9643	5
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DUNCAN, H..1939

TREPOSTOMATOUS BRYOZOA FROM THE TRAVERSE GROUP OF MICHIGAN
CONTR. FROM THE MUSEUM OF PALEONTOLOGY, UNIV. OF MICHIGAN, V.5, NO.10, PP.171-280.

UM11	ANOMALOTOECHUS TYPICUS	DUNCAN	1939	19801	1
UM12	ATACTOTOECHUS TYPICUS	DUNCAN	1939	19809	1
UM13	CALACANTHOPORA PRIMA	DUNCAN	1939	19849	1
UM14	CHONDRAULUS GRANOSUS	DUNCAN	1939	19850	1
UM15	CYCLOPORA LUNATA	DUNCAN	1939	19878	5
UM16	DISCOTRYPA VERA	DUNCAN	1939	19877	5
UM17	EOSTENOPORA PICTA	DUNCAN	1939	19856	1
UM18	ERIDOCAMPYLUS ULRICHI	DUNCAN	1939	19879	1
UM19	MICROCAMPYLUS TYPICUS	DUNCAN	1939	19873	1
UM21	MICROCAMPYLUS TENUIS	DUNCAN	1939	19871	5
UM22	MICROCAMPYLUS TRAVERSENSIS	DUNCAN	1939	19872	5
UM23	STENOPORELLA () DEVONICA	DUNCAN	1939	19874	5
UM24	STEREOTOECHUS TYPICUS	DUNCAN	1939	19881	1
UM25	TRACHYTOECHUS TYPICUS	DUNCAN	1939	19875	1

FENTON, C.L. AND FENTON, M.A..1924

THE STRATIGRAPHY AND FAUNA OF THE HACKBERRY STAGE OF THE UPPER DEVONIAN
CONTR. FROM THE MUSEUM OF GEOLOGY, UN. OF MICHIGAN, V.1, 260 P., 5 FIGS., XLV PLS.

UM5	PETALOTRYPA FORMOSA	FENTON+F.	1924	8050	5
UM6	LEIOCLEMA OCCIDENS	(HALL+WHITE 1873)		8062	7
UM8	ORTHOPORA BUCHERI	FENTON+F.	1924	8079	5
UM9	ORTHOPORA ULRICHI	FENTON+F.	1924	8082	5

HUFFMAN, S.F..1970

RHABDOMESID ECTOPROCTS (BRYOZOA) FROM THE EDWARDSVILLE MEMBER, MULDRUGH
FORMATION (MISSISSIPPIAN) AT CRAWFORDSVILLE, INDIANA.
PH.D. THESIS, INDIANA UNIV., 172 P., 11 PLS., 3 FIGS., 44 PLATES

H1	METAPORA, GEN. NOV., SP. NOV.	HUFFMAN	1970	8288-17515A, B	RLA	4
H2	STREBLOTRYPA, SP. NOV.	HUFFMAN	1970	8288-12500C	TE	5
H3	STREBLOTRYPELLA MAJOR	(ULRICH 1888)		8288-14512A	RLA	2
H4	SAFFORDOTAXIS INCRASSATA	(ULRICH 1888)		8288-20501, 1A		6
H5	METAPORA, GEN. NOV., SP. NOV.	HUFFMAN	1970	8288-17515A, B	TE	4
H7	STREBLOTRYPELLA MAJOR	(ULRICH 1888)		8288-14512A	TE	2
H8	NICKLESOPORA CF. VARIANS	ULRICH	1890	8288-15511A		8
H9	SAFFORDOTAXIS INCRASSATA	(ULRICH 1888)		8288-20501A		8
H10	STREBLOTRYPELLA () SP.	HUFFMAN	1970	8288-9506A		9
H11	BACTROPORA () SIMPLEX	ULRICH	1890	8288-7501C		8
H12	NIKIFOROVELLA SPIRALIS	(ULRICH 1890)		8288-1505C		8
H14	NICKLESOPORA ATTENUATA	ULRICH	1890	8288-5506C		8

LONSDALE, W.. 1844

DESCRIPTION OF SIX NEW SPECIES OF CORALS, FROM THE PALEOZOIC FORMATION OF
VAN DIEMEN'S LAND.

IN DARWIN, ##GEOLOGICAL OBSERVATIONS OF THE VOLCANIC ISLANDS##1ST EDITION,
APPENDIX, PP.161-169

N62	STENOPORA TASMANIENSIS	LONSDALE	1844	1967.66.291-292	3
N63	STENOPORA TASMANIENSIS	LONSDALE	1844	1967.66.293-299	3
N64	STENOPORA SP.	NICHOLSON		1967.66.300-3-2	9

LONSDALE, W.. 1845

##FOSSIL CORALS##. IN P.E.OE STRZELECKI, ##PHYSICAL DESCRIPTION OF NEW
SOUTH WALES AND VAN DIEMEN'S LAND##, PP.262-264, LONDON

N56	STENOPORA CRINITA	LONSDALE	1845	1967.66.244-246	5
N57	STENOPOPA CRINITA	LONSDALE	1845	1967.66.247-248	5
N58	STENOPORA CRINITA	LONSDALE	1845	1967.66.249-250	5

MCNAIR, A.H.. 1937

CRYPTOSTOMATOUS BRYOZOA FROM THE MIDDLE DEVONIAN TRAVERSE GROUP OF MICHIGAN
CONTR. FROM THE MUSEUM OF PALEONTOLOGY, UN. OF MICHIGAN, V.5, NO.9, PP.103-170
14 PLS., 1 FIG.

UM2	INTRAPORA PUTEOLATA	HALL	1883	17114	3
UM3	CERAMELLA CASEI	MCNAIR	1937	17124,5	5
UM4	SEMIOPORA () EHLERSI	MCNAIR	1937	17159,60,61	5

NICHOLSON, H.A.. 1874

IN 3 PUBLICATIONS

N1	PERONOPORA FRONDOSA	(NICHOLSON 1874)		1967.66.412	1
N2	PERONOPORA FRONDOSA	(NICHOLSON 1874)		1967.66.415,414	1
N3	PERONOPORA FRONDOSA	(NICHOLSON 1874)		1967.66.419	1
N4	PERONOPORA FRONDOSA	(NICHOLSON 1874)		1967.66.423,424	1
N5	FISTULIPORA INCRASSATA	(NICHOLSON 1874)		1875.1.51	5
N9	BYTHOPORA DELICATULA	(NICHOLSON 1874)		1968.15.325	5
N21	ATACTOPORELLA ORTONI	(NICHOLSON 1874)		1967.66.429-432	5
N22	HALLOPORA ANDEWSI	(NICHOLSON 1874)		1967.66.433,434	5
N23	HALLOPORA NODULOSA	(NICHOLSON 1874)		1967.66.450,541	5
N24	HALLOPORA NODULOSA	(NICHOLSON 1874)		1967.66.450,541	5
N25	LEPTOTRYPELLA MONILIFORMIS	(NICHOLSON 1874)		1967.66.450,451	5
N26	BATOSTOMA JAMESI	NICHOLSON 1874		1967.66.462,463	5
N27	BATOSTOMA JAMESI	NICHOLSON 1874		1967.66.464	5
N31	BATOSTOMA GIRVANENSE	(NICHOLSON 1874)		1967.66.475	5
N34	LEPTOTRYPELLA BARRANDEI	(NICHOLSON 1874)		1967.66.478,479	1
N35	DEKAYIA ATTRITA	(NICHOLSON 1874)		1967.66.482-484	5
N40	RHOMBOTRYPA RHOMBICA	(NICHOLSON 1874)		1967.66.526,527	5
N42	FISTULIPORA INCRASSATA	(NICHOLSON 1874)		1967.66.331-337	7
N44	STRELOTRYPA HAMILTONENSIS	(NICHOLSON 1874)		1967.66.222	5
N48	PINACOTRYPA PROPORIDEA	(NICHOLSON 1874)		1967.66.300-305	5
N53	LEPTOTRYPELLA BARRANDEI	(NICHOLSON 1874)		1967.66.359	1
N54	LEPTOTRYPELLA BARRANDEI	(NICHOLSON 1874)		1967.66.361	1

NICHOLSON, H.A.. 1875

IN 4 PUBLICATIONS

N6	MONOTRYPA UNDULATA	(NICHOLSON 1875)		1879.58.29A	1
N10	MONOTRYPA UNDULATA	(NICHOLSON 1875)		1967.66.553,554	2
N12	ASPIDOPORA NEWBERRYI	(NICHOLSON 1875)		1967.66.388,389	5
N13	ASPIDOPORA NEWBERRYI	(NICHOLSON 1875)		1967.66.390	5

N33	HETEROTRYPA SUBPULCHELLA	NICHOLSON 1875	1967.66.477	5
N38	MONOTRYPA UNULATA	(NICHOLSON 1875)	1967.66.518,519	1
N43	HETERODICTYA GIGANTEA	NICHOLSON 1875	1967.66.341-344	1
N45	ASTREPTODICTYA FENESTELLIFORMIS	(NICHOLSON 1875)	1967.66.331,332	5
N50	ERIDOTRYPA BRIAREA	(NICHOLSON 1895)	1967.66.543-545	5

NICHOLSON, H.A.. 1879

ON THE STRUCTURE AND AFFINITIES OF THE TABULATE CORALS OF THE PALEOZOIC PERIOD, WITH CRITICAL DESCRIPTIONS OF ILLUSTRATIVE SPECIES.
EDINBURGH, 1879, 342 PP., 15 PLS. (BRYOZOA, PP. 253-327, PLS. XII-XV)

N36	SONNINOPORA WHITEAVESI	(NICHOLSON 1879)	1967.66.508,509	5
N37	SONNINOPORA WHITEAVESI	(NICHOLSON 1879)	1967.66.510,511	5
N39	MONOTRYPA () WINTERI	(NICHOLSON 1879)	1967.66.520-523	5

NICHOLSON, H.A.. 1881

ON THE STRUCTURE AND AFFINITIES OF THE TABULATE CORALS OF THE PALEOZOIC PERIOD
WILLIAM BLACKWOOD AND SONS, EDINBURGH AND LONDON

NICHOLSON, H.A.. 1881

ON THE STRUCTURE AND AFFINITIES OF THE GENUS MONTICULIPORA AND ITS SUB-GENERA
W. BLACKWOOD AND SONS, EDINBURGH AND LONDON

N11	HOMOTRYPELLA HOSPITALIS	(NICHOLSON 1881)	1967.66.403-405	5
N14	PRASOPORINA SELWYNI	(NICHOLSON 1881)	1967.66.391,392	1
N15	PRASOPORINA SELWYNI	(NICHOLSON 1881)	1967.66.393,394	1
N16	PRASOPORINA SELWYNI	(NICHOLSON 1881)	1967.66.395,396	1
N17	PRASOPORINA SELWYNI	(NICHOLSON 1881)	1967.66.397,398	1
N18	PRASOPORINA SELWYNI	(NICHOLSON 1881)	1967.66.399,400	1
N19	PRASOPORINA SELWYNI	(NICHOLSON 1881)	1967.66.401,402	1
N28	GORTANIPORA DAWSONI	(NICHOLSON 1881)	1967.66.465,466	5
N29	HETEROTRYPA ULRICHI	NICHOLSON 1881	1967.66.468-470	1
N30	BATOSTOMA IMPLICATUM	(NICHOLSON 1881)	1967.66.471-473	1
N32	DIPLOTRYPELLA TRENTONENSIS	(NICHOLSON 1881)	1967.66.476	5
N41	AMPLEXOPORA PETASIFORMIS	(NICHOLSON 1881)	1967.66.539,540	5
N59	TABULIPORA HOWSI	(NICHOLSON 1881)	1967.66.257-270	5

NICHOLSON, H.A.. 1883

CONTRIBUTIONS TO MICROPALAEONTOLOGY.-ON STENOPORA HOWSII, NICHOLSON, WITH NOTES ON MONTICULIPORA () TUMIDA, PHILLIPS, AND REMARKS ON TABULIPORA URII, YOUNG. ANNALS AND MAGAZINE OF NATURAL HISTORY (5), NO. 12, PP. 285-297, PL. X

N60	TABULIPORA HOWSI ARCTICA	(NICHOLSON 1883)	1967.66.271-277	5
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NICHOLSON, H.A.. 1884

CONTRIBUTIONS TO MICROPALAEONTOLOGY.-NOTES ON SOME SPECIES OF MONTICULIPOROID CORALS FROM THE UPPER SILURIAN ROCKS OF BRITAIN
ANNALS AND MAGAZINE OF NATURAL HISTORY (5), NO. 13, PP. 117-127, PL. VII

N46	ASPEROPORA LUDENSIS	(NICHOLSON 1884)	1967.66.277-284	4
N47	AMPLEXOPORA () SP.	NICHOLSON	1967.66.277,278	9
N51	HALLOPORA NANA	(NICHOLSON 1884)	1967.66.564,565	5
N52	HENNIGOPORA () GLANS	(NICHOLSON 1884)	1967.66.569-571	5

NICHOLSON, H.A., AND ETHERIDGE, R.J.. 1877

ON PRASOPORA GRAYAE, A NEW GENUS AND SPECIES OF SILURIAN CORALS
ANNALS AND MAGAZINE OF NATURAL HISTORY (4), NO. 20, PP. 388-392

N20 PRASOPORA GRAYAE NICH.+ETH. 1877 1967.66.406,407 1

NICHOLSON, H.A. AND ETHERIDGE, R.J.. 1886

ON THE TASMANIAN AND AUSTRALIAN SPECIES OF THE GENUS STENOPORA, LONSDALE.
ANNALS AND MAGAZINE OF NATURAL HISTORY (5), XVII, PP. 173-187, PLS. III, IV

N7 STENOPORA AUSTRALIS NICH+ETHER 1886 1968.15.235-239 5
N8 STENOPORA AUSTRALIS NICH+ETHER 1886 1968.15.240-243 5
N61 STENOPORA LEICARDTI NICH+ETHER 1886 1967.66.278-285 5

NICHOLSON, H.A. AND FOORD, A.H.. 1885

ON THE GENUS FISTULIPORA, MCCOY, WITH DESCRIPTIONS OF SEVERAL SPECIES
ANNALS AND MAGAZINE OF NATURAL HISTORY (5), XVI, PP. 496-517, PLS. XV-XVIII

N49 FISTULIPORA MUSCOSA NICH+FOORD 1885 1967.66.316-319 5

PERKINS, R.D., PERRY, T.G. AND HATTIN, D.E.. 1962

SOME BRYOZOANS FROM THE BEIL LIMESTONE MEMBER OF THE LECOMPTON LIMESTONE
(VIRGILIAN) OF KANSAS
STATE GEOL. SURVEY OF KANSAS, BULL. 157, PART 5, PP. 1-25, FIG. 1, PLS. 1-5

PP1 FISTULIPORA DECORA (MOORE+DUD 1944) 6780A, B 7
PP2 FISTULIPORA () PECULIARIS PERK+PERRY 1962 6800-A, B, C 5
PP3 ERIDOPORA BEILENSIS PERK+PERRY 1962 6801 5
PP5 MEEKOPORA SP. PERK+PERRY 1962 6806 9
PP6 TABULIPORA REGULARIS PERK+PERRY 1962 6807A, B 5
PP7 TABULIPORA GROVERENSIS PERK+PERRY 1962 6809 5
PP8 STENOPORA PAUCA PERK+PERRY 1962 6810A, B 5
PP9 RHOMBOPORA LEPIDODENDROIDES MEEK 1872 6812 3

PERRY, T.G. AND GUTSCHICK, R.C.. 1959

BRYOZOANS FROM THE AMSDEN FORMATION, SOUTHWEST MONTANA
J. PALEONTOLOGY, 33(2) 313-322, PLS. 46-48

PG1 CYCLOTRYPA CONFERTA PERRY+GUTS 1959 5499 5
PG2 DYBOWSKIELLA REGULARIS PERRY+GUTS 1959 5505 5
PG3 DYBOWSKIELLA STIPATA PERRY+GUTS 1959 55-2 5
PG4 FISTULIPORA AMSDENENSIS PERRY+GUTS 1959 5501 5
PG5 STENOPHRAGMIDIUM MEGISTUM PERRY+GUTS 1959 5515 5
PG6 STENOPHRAGMIDIUM OBSCURUM PERRY+GUTS 1959 5514 5
PG7 TABULIPORA AMSDENENSIS PERRY+GUTS 1959 5506 5
PG8 TABULIPORA MACULATA PERRY+GUTS 1959 5512 5
PG9 TABULIPORA PACHYMURALIS PERRY+GUTS 1959 5509A, B 5

PERRY, T.G. AND HATTIN, D.E.. 1958

ASTOGENETIC STUDIES OF FISTULIPOROID BRYOZOANS
J. PALEONTOLOGY, 32, PP. 1039-1050, 3 TABLES, PLS. 129-131, 1 FIG.

PH1 DYBOWSKIELLA BROWNSPORTENSIS PERRY+HATT 1958 5490 5
PH2 FISTULIPORA HEMISPHERICA (ROEMER 1860) 5485-3, 3T1 5
PH4 CYCLOTRYPA CF. ADDITA MOORE+DUOL 1944 5489-T1, L2 7

PERRY, T.G. AND HATTIN, D.E.. 1960
 OSGOOD (NIAGARAN) BRYOZOANS FROM THE TYPE AREA
 J. PALEONTOLOGY, 34(4) 695-710, PLS. 85-90

PH5	CERAMOPORA VESICULARIS	PERRY+HATT	1960	5561-128A,B,C	5
PH6	CERAMOPORA IMBRICATA	HALL	1852	5560-	3
PH7	FISTULIPORA PROMISCUA	PERRY+HATT	1960	5562-	5
PH9	HETEROTRYPA () PERPLEXA	PERRY+HATT	1960	5567-78	5
PH10	TREMATOPORA SP.	(PERRY+HATT	1960)	5574-30A,B	9
PH8	CHEILOTRYPA OSTIOLATA	(HALL	1852)	5566-	7
PH11	HEMIPACHYDICTYA CRASSA	(HALL	1852)	5578-75	3
PH12	STIGMATELLA DUBIA	PERRY+HATT	1960	5570-7	5
PH16	HALLOPORA ELEGANTULA	(HALL	1852)	5573-58	3
PH17	HENNIGOPORA APTA	PERRY+HATT	1960	5572-18	5
PH18	BADOLIOPOORA SPINOSA	(BASSLER	1906)	10620-89	4
PH19	FISTULIPORA NEGLECTA	PERRY+HATT	-	10620-6	8
PH20	MONOTRYPA EXSERTA	PERRY+HATT	1960	5580-42	5
PH21	MONOTRYPA BENJAMINI	BASSLER	1906	5577-79	7
PH22	MONOTRYPA OSGOODENSIS	BASSLER	1906	5576-300	7

PERRY, T.G. AND HOROWITZ, A.S.. 1963
 BRYOZOANS FROM THE GLEN DEAN LIMESTONE (MIDDLE CHESTER) OF SOUTHERN INDIANA
 AND KENTUCKY
 INDIANA GEOL. SURVEY BULL. 26, 51 PP., 9 PLS., 15 TABLES

HOR1	FISTULIPORA CONFINIS	PERRY+HORO	1963	6042	5
HOR2	FISTULIPORA PERDENSE	PERRY+HORO	1963	6040A,B	5
HOR3	FISTULIPORA EXCELLENS	ULRICH	1884	6083	7
HOR4	ERIDOPORA MACROSTOMA	ULRICH	1882	6077	3
HOR5	ERIDOPORA MACROSTOMA	ULRICH	1882	6628	3
HOR6	MEEKOPORA EXIMIA	ULRICH	1889	6075	7
HOR7	TABULIPORA CESTRIENSIS	ULRICH	1890	6644	7
HOR8	TABULIPORA RAMOSA	(ULRICH	1890)	6657	7
HOR9	TABULIPORA FENERUDIS	PERRY+HORO	1963	6044A,B,C	5

PHILLIPS, J.. 1841
 FIGURES AND DESCRIPTIONS OF THE PALEOZOIC FOSSILS OF CORNWALL, DEVON, AND
 WEST SOMERSET.
 LONDON 1841, 231 PP., 60 PLS. (BRYOZOA, PP. 20-27, PLS. 9-13)

N55	RHABDOMESON GRACILE	PHILLIPS	1841	1967.66.327	3
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RENZETTI, PHYLLIS.. 1961
 FAUNA OF THE THREEFORKS SHALE (DEVONIAN) OF SOUTHWESTERN MONTANA
 PH.D. THESIS, INDIANA UNIV., 342 P., 76 PLS., 27 FIGS., 28 TABLES

R1	RHABDOMESON N.SP. A	RENZETTI	1961	6102-2	5
R2	RHABDOMESON N.SP. A	RENZETTI	1961	6102-3	5
R3	RHOMBOPORA N.SP. A	RENZETTI	1961	6104-1	5
R4	RHOMBOPORA N.SP. A	RENZETTI	1961	6105	5
R5	NICKLESOPORA N.SP. A	RENZETTI	1961	6107-1	5
R6	UNIDENTIFIED SPECIMEN	RENZETTI		6103-10	
R7	UNIDENTIFIED SPECIMEN	RENZETTI		6103-12	
R8	UNIDENTIFIED SPECIMEN	RENZETTI		6103-13	
R9	RHOMBOPORA N.SP. A	RENZETTI	1961	6103-13	5

RODRIGUEZ, J.. 1960

INDIANA INVERTEBRATE FAUNA OF THE GOLCONDA FORMATION (MISSISSIPPIAN, MIDDLE CHESTER) OF INDIANA, WESTERN KENTUCKY AND SOUTHERN ILLINOIS
UNPUBLISHED PH.D. THESIS, INDIANA UNIV.

R02	FISTULIPORA EXCELLENS	ULRICH	1884	110	8
R04	TABULIPORA CESTRIENSIS	ULRICH	1890	92	8

UTGGARD, J. AND PERRY, T.G.. 1964

TREPOSTOMATOUS BRYOZOAN FAUNA OF THE UPPER PART OF THE WHITEWATER FORMATION (CINCINNATIAN) OF EASTERN INDIANA AND WESTERN OHIO.
INDIANA DEPT. CONSERV. GEOL. SURVEY BULL. 33, 111 PP., 23 PLS., 1 FIG.

U1	GORTANIPORA AUSTINI	(BASSLER	1903)	8252-1A, 2A	6
U2	GORTANIPORA COMMUNIS	(BASSLER	1903)	8252-5A	6
U3	GORTANIPORA CYLINDRICA	(BASSLER	1903)	8252-7A	9
U4	HOMOTRYPA FLABELLARIIS	ULRICH	1890	8252-14A	7
U5	CADORNIPORA NODULOSA	(BASSLER	1903)	8252-39A	7
U6	HOMOTRYPA RAMULOSA	BASSLER	1903	8252-42A	7
U7	HOMOTRYPA RICHMONDENSIS	BASSLER	1903	8252-57A, 58B	7
U8	HOMOTRYPA WORTHENI	(JAMES	1882)	8252-61A	7
U9	HOMOTRYPELLA CUMINGSI	UTG+PERRY	1964	8252-84A	5
U10	HOMOTRYPELLA HOSPITALIS	(NICHOLSON	1881)	8252-102A	7
U11	MESOTRYPA ORBICULATA	C.+ G.	1913	8252-131A	6
U12	MESOTRYPA PATELLA	(ULRICH	1890)	8252-136A	6
U13	MESOTRYPA PAUCA	UTG+PERRY	1964	8252-128A, B	5
U14	MONTICULIPORA ERIDERMATA	ULR+BASSL.	1904	8252-138A, B	7
U15	MONTICULIPORA MULTIPORA	DYER	1925	8252-148A, B	7
U16	MONTICULIPORA PARASITICA	ULRICH	1882	8252-153A	7
U17	PERONOPORA PAUCA	UTG+PERRY	1964	8252-156A	5
U18	PERONOPORA DECIPIENS	(ROMINGER	1866)	8252-164A, B	3
U19	PERONOPORA PACHYMURA	UTG+PERRY	1964	8252-170A	5
U20	AMPLEXOPORA PARVA	UTG+PERRY	1964	8252-174A	5
U21	ACANTHOTRYPELLA VARIABILE	(ULRICH	1890)	8252-180A	3
U22	RHOMBOTRYPA MULTITABULATA	UTG+PERRY	1964	8252-185A, B	5
U23	RHOMBOTRYPA QUADRATA	(ROMINGER	1866)	8252-198A	3
U24	BATOSTOMA PARCUM	UTG.+PERRY	1964	8252-204A	5
U25	BATOSTOMA VARIANS	(JAMES	1878)	8252-208A	7
U26	BYTHOPORA DELICATULA	(NICHOLSON	1874)	8252-217A	7
U27	BATOSTOMELLA GRACILIS	(NICHOLSON	1874)	8252-222A	3
U28	STIGMATELLA PERSONATA	ULR+BASSL	1904	8252-263A	7
U29	HALLOPORA CONGRUA	UTG.+PERRY	1964	8252-288A	5
U30	CYPHOTRYPA WAYNENSIS	UTG.+PERRY	1964	8252-240A	5
U31	HETEROTRYPA SUBRAMOSA	(ULRICH	1879B)	8252-248A	7
U32	HETEROTRYPA SINGULARIS	ULRICH	1890	8252-247A	7
U33	NICHOLSONELLA SP.	UTG+PERRY	1964	8252-286A	9
U34	CONSTELLARIA CF. PUNCTATA	(WHITFIELD	1882)	8252-285	9
U35	CONSTELLARIA POLYSTOMELLA	NICHOLSON	1875	8252-281	7

NONTYPE SPECIMENS IN MICHIGAN STATE UNIVERSITY PALEONTOLOGICAL COLLECTION.

MSU3	ESCHAROPORA PAVONIA	(D'ORBIGNY	)	19AB15	8
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NONTYPE SPECIMENS, IDENTIFIED BY CUMINGS AND GALLOWAY. INDIANA U. PALEO. COLLECT

NT1	ANAPHRAGMA MIRABILE	ULR+BASSL	1904	174-25, 23	4
NT2	ANOLOTICHIA PONDEROSA	ULRICH	1890	173-24, 25	4
NT5	PAPILLUNARIA HEMISPHERICA	(ULRICH	1890)	173-21	8
NT8	CRASSALUNA EPIDERMATA	(ULRICH	1890)	173-7, 8	4

NT9	LEPTOTRYPA MINIMA	ULRICH	1883	172-23	4
NT10	LIOCLEMELLA NITIDA	(ULRICH	1890)	177-10	8
NT11	PHAENOPORA WILMINGTONENSIS	ULRICH	2893	174-19	8
NT12	PTILOTRYPA OBLIQUATA	ULRICH	1890	173-20, 22, 23	4
NT13	ARTHROPORA SHAFFERI	(MEEK	1872)	109-19	4
NT14	NICHOLSONELLA VAUPELI	(ULRICH	1883)	113-15/73-7	8
NT16	PTILODICTYA PLUMARIA	JAMES	1878	117-1	8
NT18	SPATIOPORA ASPERA	ULRICH	1883	116-2	4
NT19	ASPIDOPORA PARASITICA, SAME AS	CG21			
NT20	STICTOPORA MUTABILIS	ULRICH	1886	203-22	
NT21	COELOCLEMA OSCULUM	(HALL	1876)		4
NT22	CREPIOPORA SOLIDA	ULRICH	1890	143-5	8
NT24	EURYDICTYA MULTIPORA	(HALL	1851)	221-18	8
NT25	HALLOPORINA GRENULATA	(ULRICH	1893)	197-4	8
NT26	HEMIPHAGMA IRRASUM	(ULRICH	1886)	186-11, 4, 1	4
NT27	HOMOTRYPELLA INSTABILIS	ULRICH	1886	191-19	4
NT28	MESOTRYPA CF. INFIDA	(ULRICH	1895)	193-24	4
NT30	ORBIGNYELLA SUBLAMELLOSA	ULR+BASSL	1904	199-9	4
NT31	PHYLLDICTYA VARIA	ULRICH	1893	203-19	8
NT32	PRISMOPORA SERRATA	(MEEK	1875)	195-3	8
NT34	TRIGONODICTYA CONCILIATRIX	(ULRICH	1886)	195-4 * 221-24	4
NT35	ATACTOTOECHUS TYPICUS	DUNCAN	1939	206-23	4
NT37	CHEILOTRYPA OSTIOLATA	(HALL	1852)	270-16	8
NT38	CHONDRAULUS PONDEROSUS	(ROMINGER	1892)	281, 2	8
NT39	CYSTODICTYA SP.	ULRICH	1882		9
NT41	DIANULITES PETROPOLITANUS	DYBOWSKI	1877	239-9	8
NT42	DICHOTRYPA FLABELLUM	(ROMINGER	1866)	270-20	8
NT44	PROAVELLA PROAVA	(EICHWALD	1840)	234-8	4
NT45	HOMOTRYPELLA HOSPITALIS	(NICHOLSON	1881)	277-12	8
NT46	LIOCLEMELLA ANNULIFERA	(WHITFIELD	1878)	272-16	8
NT47	FIMBRIOPORA FIMBRIATA	(JAMES	1878)	268-3	4
NT48	RHINOPORA VERRUCOSA	HALL	1852	267-7, 8	4
NT49	PETALOTRYPELLA TUBERCULATA	(M.E. + H.	1851)	272-15	8
NT52	LICHENALIA CONCENTRICA	HALL	1852	FAR HOLE.SER.3(2)	4
NT53	MONOTRYPELLA AEQUALIS	ULRICH	1882	SER.2(10), 1.33A3	4
NT54	PETIGOPORA ASPERULA	ULRICH	1883	1.33A3	8
NT55	PETIGOPORA PETECHIALIS	(NICHOLSON	1875)	16-24, 1.38BC.	8

APPENDIX II

List of OTU's alphabetically arranged.

LIST OF OTU'S USED IN THIS STUDY.

ASTERISKS IDENTIFY REPRESENTATIVES OF GENERA.

CODE	GENUS AND SPECIES	AUTHOR	YEAR	MUSEUM, OR ORIGINAL PUBLICATION NO.	NUM STAT.
*CG53	ACANTHOCEPAMOPORELLA TRILOBATA	(C. + G.	1913)	9167-18	5
*CGA3	ACANTHOTRYPELLA VARIABILE	(ULRICH	1890)	9117-23	3
CG18	ACANTHOTRYPELLA VARIABILE	(ULRICH	1890)	81-14	7
U21	ACANTHOTRYPELLA VARIABILE	(ULRICH	1890)	8252-180A	3
C03	AMPLEXOPORA CONFERTA	(CORYELL	1921)	9249-9	5
CG24	AMPLEXOPORA FILIASA	(D'ORBIGNY	1850)	87-25	7
CG47	AMPLEXOPORA GRANULOSA	C. + G.	1913	9109-14	5
B17	AMPLEXOPORA MINOR	BROWN	1965	8241-3	5
CU2	AMPLEXOPORA MULTISPINOSA	CUMINGS	1901	9006-23	5
CG71	AMPLEXOPORA MULTISPINOSA	CUMINGS	1901	9126-21	7
U20	AMPLEXOPORA PARVA	UTG + PERRY	1964	8252-174A	5
N41	AMPLEXOPORA PETASIFORMIS	(NICHOLSON	1881)	1967.66.539.540	5
CG50	AMPLEXOPORA PUMILA	C. + G.	1913	9107-23	5
CG36	AMPLEXOPORA PUMILA	C. + G.	1913	79-6	5
CA1	AMPLEXOPORA ROBUSTA	ULRICH	1883	6-1,2	8
*A1	AMPLEXOPORA SEPTOSA	(ULRICH	1879)	8973-11001	6
CG48	AMPLEXOPORA SEPTOSA MACULOSA	C. + G.	1913	9149-1	5
CG49	AMPLEXOPORA SEPTOSA MINIMA	C. + G.	1913	9162-2	5
CG82	AMPLEXOPORA WINCHELLI	ULRICH	1886	9188-20	7
B18	AMPLEXOPORA WINCHELLI	ULRICH	1886	8237-1	7
N47	AMPLEXOPORA () SP.	NICHOLSON		1967.66.277,278	9
*NT1	ANAPHRAGMA MIRABILE	ULR + BASSL	1904	174-25,23	4
*UM10	ANISOTRYPA WAYNENSIS	DEISS	1927	9643	5
C01	ANOLOTICHTIA EXPLANATA	CORYELL	1921	9240-23	5
*NT2	ANOLOTICHTIA PONDEROSA	ULRICH	1890	173-24,25	4
*UM11	ANOMALOTOECHUS TYPICUS	DUNCAN	1939	19801	1
*NT13	ARTHROPORA SHAFFERI	(MEEK	1872)	109-19	4
*N46	ASPEROPORA LUDENSIS	(NICHOLSON	1884)	1967.66.277-284	4
*N12	ASPIDOPORA NEWBERRYI	(NICHOLSON	1875)	1967.66.388,389	5
N13	ASPIDOPORA NEWBERRYI	(NICHOLSON	1875)	1967.66.390	5
NT19	ASPIDOPORA PARASITICA, SAME AS	CG21			
*N45	ASTREPTODICTYA FENESTELLIFORMIS	(NICHOLSON	1875)	1967.66.331,332	5
*CG51	ATACTOPORA INTERMEDIA	C. + G.	1913	9157-22	5
*CG44	ATACTOPORELLA MUNDULA	(ULRICH	1879)	5-21	7
N21	ATACTOPORELLA ORTONI	(NICHOLSON	1874)	1967.66.429-432	5
*A2	ATACTOPORELLA TYPICALIS	ULRICH	1883	8977-16009	
A3	ATACTOPORELLA, VARIANT	ANST + PERRY	1973	8974-2004	9
NT35	ATACTOTOECHUS TYPICUS	DUNCAN	1939	206-23	4
*UM12	ATACTOTOECHUS TYPICUS	DUNCAN	1939	19809	
*H11	RACTROPORA () SIMPLEX	ULRICH	1890	8288-7501C	8
PH18	BANOGLIOPORA SPINOSA	(BASSLER	1906)	10620-89	4
*B20	BALTICOPOPA TENUIMURALIS	(ULRICH	1893)	8232-12	7
*A4	BALTICOPORELLA WHITFIELDI	(JAMES	1881)	8976-30010	6
C04	BATOSTOMA DENDROIDEA	CORYELL	1921	9246-1	5
N31	BATOSTOMA GIRVANENSE	(NICHOLSON	1874)	1967.66.475	5
*N30	BATOSTOMA IMPLICATUM	(NICHOLSON	1881)	1967.66.471-473	1
C02	BATOSTOMA INUTILIS	CORYELL	1921	9246-3	5
N26	BATOSTOMA JAMESI	NICHOLSON	1874	1967.66.462,463	5
N27	BATOSTOMA JAMESI	NICHOLSON	1874	1967.66.464	5
A5	BATOSTOMA JAMESI	NICHOLSON	1874	8976-5008	7
CG40	BATOSTOMA JAMESI	NICHOLSON	1874	21-5	7
U24	BATOSTOMA PARCUM	UTG. + PERRY	1964	8252-204A	5

CGA1	BATOSTOMA PROSSERI	C.+G.	1912	9116-17	5
C06	BATOSTOMA SUPERASSUM	CORYELL	1921	9242-7	5
U25	BATOSTOMA VARIANS	(JAMES	1878)	8252-208A	
CGA2	BATOSTOMA VARIANS	(JAMES	1878)	9112-22	
CG39	BATOSTOMA VARIANS	(JAMES	1878)	67-2	7
CA2	BATOSTOMELLA GRACILIS	(NICHOLSON	1874)	6-3	4
★ CG73	BATOSTOMELLA GRACILIS	(NICHOLSON	1874)	9139-7	3
U27	BATOSTOMELLA GRACILIS	(NICHOLSON	1874)	8252-222A	3
★ N9	BYTHOPOPA DELICATULA	(NICHOLSON	1874)	1968.15.325	5
U26	BYTHOPOPA DELICATULA	(NICHOLSON	1874)	8252-217A	7
CG23	BYTHOPOPA MEEKI	(JAMES	1878)	32-5	7
★ U5	CADORNIPOPA NOJULOSA	(BASSLER	1903)	8252-39A	7
★ UM13	CALACANTHOPORA PRIMA	DUNCAN	1939	19849	1
★ UM3	CERAMELLA CASEI	MCNAIR	1937	17124,5	5
★ A18	CERAMOPHYLLA VAUPELI	(ULRICH	1890)	8975-17016	8
★ PH6	CERAMOPORA IMBRICATA	HALL	1852	5560-	3
PH5	CERAMOPORA VESICULARIS	PERRY+HATT	1960	5561-128A, R, C	5
CA3	CERAMOPORELLA OHIOENSIS	(NICHOLSON	1875)	7-3	
CG7	CERAMOPORELLA OHIOENSIS	(NICHOLSON	1875)	10-3	
★ CG55	CERAMOPORELLA TUBULOSA	C.+G.	1913	9158-2	5
CA4	CHEILOPORELLA FLABELLATA	(ULRICH	1879)	7-4	4
★ CG6	CHEILOPORELLA FLABELLATA	(ULRICH	1879)	27-14	3
NT37	CHEILOTRYPA OSTIOLATA	(HALL	1852)	270-16	8
★ PH8	CHEILOTRYPA OSTIOLATA	(HALL	1852)	5566-	
★ UM14	CHONDRAULUS GRANOSUS	DUNCAN	1939	19850	1
NT38	CHONDRAULUS PONDEPOSUS	(ROMINGER	1892)	281,2	8
C07	COELOCLEMA CONSIMILE	CORYELL	1921	9241-17	5
C08	COELOCLEMA INFLATUM	CORYELL	1921	9240-20	5
C010	COELOCLEMA LAMELLOSA	CORYELL	1921	9241-10	5
★ NT21	COELOCLEMA OSCULUM	(HALL	1876)		4
C09	COELOCLEMA PIERCEANUM	CORYELL	1921	9238-14	5
★ CG46	CONSTELLARIA CONSTELLATA	(DANA	1846)	10-20	3
U35	CONSTELLARIA POLYSTOMELLA	NICHOLSON	1875	8252-281	
CG45	CONSTELLARIA POLYSTOMELLA	NICHOLSON	1875	65-6	
U34	CONSTELLARIA CF. PUNCTATA	(WHITFIELD	1882)	8252-285	9
A6	CONSTELLARIA SP.	ANST+PERRY	1973	3974-1002	9
★ NT8	CRASSALUNA EPIDEPMATA	(ULRICH	1890)	173-7,8	4
NT22	CREPIPOPA SOLIDA	ULRICH	1890	143-5	8
★ A17	CREPIPOPA VENUSTA	(ULRICH	1878)	8975-17037	4
★ UM15	CYCLOPOPA LUNATA	DUNCAN	1939	19878	5
PH4	CYCLOTRYPA CF. AROITA	MOORE+DUOL	1944	5489-T1, L2	7
★ PG1	CYCLOTRYPA CONFERTA	PERRY+GUTS	1959	5499	5
★ B3	CYPHOTRYPA ACERVULOSA	(ULRICH	1895)	8243-1	3
B2	CYPHOTRYPA PACHYMURALIS	BROWN	1965	8238-1	5
U30	CYPHOTRYPA WAYNEENSIS	UTG.+PERRY	1964	8252-240A	5
★ NT39	CYSTONICTYA SP.	ULRICH	1882		9
★ B1	DEKAYELLA ANOMALA	BROWN	1962	8232-3	5
B9	DEKAYELLA CLAVATA	FRITZ	1957	8236-8	7
CG77	DEKAYELLA PRAENUNTIA SIMPLEX	ULRICH	1893	9198-16	7
CG78	DEKAYELLA PRAENUNTIA SIMPLEX	ULRICH	1893	9188-21	7
B10	DEKAYIA APPRESSA	ULRICH	1883	8234-1	7
★ A7	DEKAYIA ASPERA	M-E+H.	1851	8971-3005	3
N35	DEKAYIA ATTRITA	(NICHOLSON	1874)	1967.66.482-484	5
CG64	DEKAYIA CATENULATA	(C.+G.	1913)	9131-15	5
B11	DEKAYIA MACULATA	JAMES	1881	8232-10	7
CG74	DEKAYIA MACULATA	JAMES	1881	9145-9	7
CG30	DEKAYIA PELLICULATA	ULRICH	1883	12-4	7
★ NT41	DIANULITES PETROPOLITANUS	DYROWSKI	1877	239-9	8
★ NT42	DICHOTRYPA FLABELLUM	(ROMINGER	1866)	270-20	8
★ C012	DIPLOTRYPA CATENULATA	CORYELL	1921	UNNUMBERED HOLOTYPE	5
★ N32	DIPLOTRYPELLA TRENTONENSIS	(NICHOLSON	1881)	1967.66.476	5

★ UM16	DISCOTRYPA VERA	DUNCAN	1939	19877	5
★ PH1	DYBOWSKIELLA BROWNSPORTENSIS	PERRY+HATT	1958	5490	5
PG2	DYBOWSKIELLA REGULARIS	PERRY+GUTS	1959	5505	5
PG3	DYBOWSKIELLA STIPATA	PERRY+GUTS	1959	55-2	5
★ UM17	EOSTENOPORA PICTA	DUNCAN	1939	19856	1
★ UM18	EPIDOCAMPYLUS ULRICHI	DUNCAN	1939	19879	
PP3	ERIDOPORA BEILENSIS	PERK+PERPY	1962	6801	5
★ HOR4	ERIDOPORA MACROSTOMA	ULRICH	1882	6077	3
HOR5	ERIDOPORA MACROSTOMA	ULPICH	1882	6628	3
B14	ERIDOTRYPA AEDILIS	(EICHWALD	1855)	8233-5	7
B15	ERIDOTRYPA AEDILIS MINOR	(ULRICH	1895)	8234-2	7
N50	ERIDOTRYPA BRIAREA	(NICHOLSON	1895)	1967.66.543-545	5
★ A8	ERIDOTRYPA MUTABILIS	ULRICH	1895	8974-1004	3
CG75	ERIDOTRYPA SIMULATRIX	(ULRICH	1890)	9129-12	7
CU1	ERIDOTRYPA VEVAYENSIS	CUMINGS	1901	9014-14	5
★ MSU3	ESCHAROPORA PAVONIA	(D'ORBIGNY	)	19A915	8
★ NT24	EURYDICTYA MULTIPORA	(HALL	1851)	221-18	8
★ NT47	FIMBRIAPORA FIMBRIATA	(JAMES	1878)	268-3	4
PG4	FISTULIPORA AMSDENENSIS	PERRY+GUTS	1959	5501	5
HOR1	FISTULIPORA CONFINIS	PERRY+HOPO	1963	6042	5
PP1	FISTULIPORA DECORA	(MOORE+OOD	1944)	6780A,B	7
R02	FISTULIPORA EXCELLENS	ULRICH	1884	110	8
HOR3	FISTULIPORA EXCELLENS	ULRICH	1884	6083	7
★ PH2	FISTULIPORA HEMISPHERICA	(ROEMER	1860)	5485-3,3T1	5
N5	FISTULIPORA INCRASSATA	(NICHOLSON	1874)	1875.1.51	5
N42	FISTULIPORA INCPASSATA	(NICHOLSON	1874)	1967.66.331-337	7
N49	FISTULIPORA MUSCOSA	NICH+FOORD	1885	1967.66.316-319	5
PP2	FISTULIPORA () PECULIARIS	PERK+PERPY	1962	6800-A,B,C	5
HOR2	FISTULIPORA PERDENSE	PERRY+HORO	1963	6040A,B	5
PH7	FISTULIPORA PROMISCUA	PERRY+HATT	1960	5562-	5
PH19	FISTULIPORA NEGLECTA	PERRY+HATT	-	10620-6	8
U1	GORTANIPORA AUSTINI	(BASSLER	1903)	8252-1A,2A	6
U2	GORTANIPORA COMMUNIS	(BASSLER	1903)	8252-5A	6
CG9	GORTANIPORA COMMUNIS	(BASSLER	1903)	32-7	7
U3	GORTANIPORA CYLINDRICA	(BASSLER	1903)	8252-7A	9
CG12	GORTANIPORA CYLINDRICA	(BASSLER	1903)	84-11	7
★ N28	GORTANIPORA DAWSONI	(NICHOLSON	1881)	1967.66.465,466	5
CG13	GORTANIPORA ORLIQUA	(ULRICH	1882)	1-18	7
CG85	GORTANIPORA SUPPAMOSA	(ULRICH	1886)	9186-9	7
CO13	GRAPTODICTYA DENDROIDEA	CORYELL	1921	9237-13A,B	5
★ CO15	GRAPTODICTYA FRUITICOSA	CORYELL	1921	9237-12A,B	5
N22	HALLOPORA ANDEWSI	(NICHOLSON	1874)	1967.66.433,434	5
CA5	HALLOPORA ANDEWSI	(NICHOLSON	1874)	8-1	8
U29	HALLOPORA CONGRUA	UTG.+PERRY	1964	8252-288A	5
★ C1	HALLOPORA ELEGANTULA	(HALL	1852)	13110-495	2
PH16	HALLOPORA ELEGANTULA	(HALL	1852)	5573-58	3
CO17	HALLOPORA FLORENCIA	CORYELL	1921	9240-13	5
CG32	HALLOPORA FRONDOSA	(CUMINGS	1908)	85-17	5
B19	HALLOPORA MULTITABULATA	(ULRICH	1886)	8233-9	7
N51	HALLOPORA NANA	(NICHOLSON	1884)	1967.66.564,565	5
N23	HALLOPORA NODULOSA	(NICHOLSON	1874)	1967.66.450,541	5
N24	HALLOPORA NODULOSA	(NICHOLSON	1874)	1967.66.450,541	5
A10	HALLOPORA NODULOSA	(NICHOLSON	1874)	8975-41024	7
CA6	HALLOPORA RAMOSA	(D'ORBIGNY	1850)	8-4	8
CG4	HALLOPORA RUGOSA	(M-E.+H.	1851)	1.33A3-1	7
CG5	HALLOPORA RUGOSA	(M-E.+H.	1851)	1.41E7, 85-15	9
CO16	HALLOPORA SPISSATA	CORYELL	1921	9244-18	5
CG72	HALLOPORA SPLENDENS	(ULRICH	-)	9230-8	7
CG31	HALLOPORA SUBNODOSA	(ULRICH	1890)	79-18	7
CG76	HALLOPORA SUBNODOSA	(ULRICH	1890)	9128-16	7
CG34	HALLOPORA SUBPLANA	(ULRICH	1882)	23-15	7

A9	HALLOPORA, VARIANT	ANST+PERRY 1973	8975-44004	9
★ NT25	HALLOPORINA CREMULATA	(ULRICH 1893)	197-4	8
★ CO18	HEMIDICTYA LEBANONENSIS	CORYELL 1921	9248-25A,B	1
★ PH11	HEMIPACHYDICTYA CRASSA	(HALL 1852)	5578-75	3
★ NT26	HEMIPHAGMA IRRASUM	(ULPICH 1886)	186-11,4,1	4
PH17	HENNIGOPOPA APTA	PERPY+HATT 1960	5572-18	5
★ C2	HENNIGOPOPA FLOPIDA	(HALL 1852)	13101-107	2
N52	HENNIGOPOPA () GLANS	(NICHOLSON 1884)	1967.66.569-571	5
★ N43	HETERODICTYA GIGANTEA	NICHOLSON 1875	1967.66.341-344	1
CG27	HETEROTRYPA AFFINIS	(ULRICH 1879)	83-7,8	7
CU3	HETEROTRYPA CYSTATIA	(CUMINGS 1901)	9012-17	5
CA7	HETEROTRYPA FRONDOSA	(D'ORBIGNY 1850)	9-1	4
CG29	HETEROTRYPA FRONDOSA	(D'ORBIGNY 1850)	8-4	7
CG59	HETEROTRYPA MICROSTIGMA	C. + G. 1913	9122-23	5
CO19	HETEROTRYPA PATERA	CORYELL 1921	9242-4	5
PH9	HETEROTRYPA () PERPLEXA	PERRY+HATT 1960	5567-78	5
CG8	HETEROTRYPA PROLIFICA	ULRICH 1890	93-24	7
CG25	HETEROTRYPA PROLIFICA	ULRICH 1890	32-18	7
CG79	HETEROTRYPA PROLIFICA	ULRICH 1890	9168-21	7
CG81	HETEROTRYPA PROLIFICA	ULRICH 1890	9101-20	5
CG84	HETEROTRYPA PROLIFICA	ULRICH 1890	9102-13	5
CO11	HETEROTRYPA RIDLEYANA	(CORYELL 1921)	9245-E	5
U32	HETEROTRYPA SINGULARIS	ULRICH 1890	8252-247A	7
CO20	HETEROTRYPA STONENSIS	CORYELL 1921	9242-5	5
CU8	HETEROTRYPA SUBFRONDOSA	(CUMINGS 1902)	9028-8,9024-6	5
N33	HETEROTRYPA SUBPULCHRELLA	NICHOLSON 1875	1967.66.477	5
U31	HETEROTRYPA SUBPAMOSA	(ULRICH 1879B)	8252-248A	7
A11	HETEROTRYPA ULRICHI	NICHOLSON 1881	8975-28005	3
★ N29	HETEROTRYPA ULRICHI	NICHOLSON 1881	1967.66.468-470	1
CU10	HETEROTRYPA ULRICHI EXPANSA	(CUMINGS 1902)	9027-12,9028-11	5
CU11	HETEROTRYPA ULRICHI LOBATA	(CUMINGS 1902)	9026-19,20	5
CA11	HETEROTRYPA ULRICHI LOBATA	(CUMINGS 1902)	9-3,4	8
A12	HETEROTRYPA, VARIANT A	ANST+PERRY 1973	8976-7004	9
A13	HETEROTRYPA (), VARIANT B	ANST+PERRY 1973	8972-3006	9
CG67	HOMOTRYPA ALTA	C.+G. 1913	9163-23	5
CA8	HOMOTRYPA CINCINNATIENSIS	BASSLER 1903	10-1,2	8
CG26	HOMOTRYPA CONSTELLARIFORMIS	CUMINGS 1908	81-16	5
★ CG10	HOMOTRYPA CURVATA	ULRICH 1882	8-15	3
U4	HOMOTRYPA FLABELLARIIS	ULRICH 1890	8252-14A	
CG11	HOMOTRYPA FLABELLARIIS	ULRICH 1890	65-14	
CU6	HOMOTRYPA FLABELLARIIS FRONDOSA	CUMINGS 1902	9027-17,20	
CG60	HOMOTRYPA GLABRA	C.+G. 1913	9165-6	5
U6	HOMOTRYPA RAMULOSA	BASSLER 1903	8252-42A	
U7	HOMOTRYPA RICHMONDENSIS	BASSLER 1903	8252-57A,589	
CG61	HOMOTRYPA SPINEA	C.+G. 1913	9165-1	5
CG89	HOMOTRYPA SPISSA	C.+G. 1915	9210-16	5
U8	HOMOTRYPA WORTHENI	(JAMES 1882)	8252-E1A	
CG14	HOMOTRYPA WORTHENI	(JAMES 1882)	86-3	
U9	HOMOTRYPELLA CUMINGSI	UTG+PERRY 1964	8252-84A	5
N11	HOMOTRYPELLA HOSPITALIS	(NICHOLSON 1881)	1967.66.403-405	5
U10	HOMOTRYPELLA HOSPITALIS	(NICHOLSON 1881)	8252-102A	
CG20	HOMOTRYPELLA HOSPITALIS	(NICHOLSON 1881)	32-16	
NT45	HOMOTRYPELLA HOSPITALIS	(NICHOLSON 1881)	277-12	8
★ NT27	HOMOTRYPELLA INSTABILIS	ULRICH 1886	191-19	4
B7	HOMOTRYPELLA MUNDULA	ULRICH 1895	8242-2	
CG90	HOMOTRYPELLA ROTUNDIPORA	C.+G. 1915	9210-1	
CG15	HOMOTRYPELLA RUSTICA	ULRICH 1893	50-11	8
★ UM2	INTRAPORA PUTEOLATA	HALL 1883	17114	3
★ B16	LAMOTTOPOPA PAUCA	BROWN 1965	8233-7	5
★ UM6	LEIOCLEMA OCCIDENS	(HALL+WHITE 1873)	8062	7
★ NT9	LEPTOTRYPA MINIMA	ULRICH 1883	172-23	4

★ N34	LEPTOTRYPELLA BARRANDEI	(NICHOLSON 1874)	1967.66.478,479	1
N53	LEPTOTRYPELLA BARRANDEI	(NICHOLSON 1874)	1967.66.359	1
N54	LEPTOTRYPELLA BARRANDEI	(NICHOLSON 1874)	1967.66.361	1
N25	LEPTOTRYPELLA MONILIFORMIS	(NICHOLSON 1874)	1967.66.450,451	5
★ NT52	LICHENALIA CONCENTRICA	HALL 1852	FAR HOLE.SER.3(2)	4
★ NT46	LIOCLEMELLA ANNULIFERA	(WHITFIELD 1878)	272-1E	8
NT10	LIOCLEMELLA NITIDA	(ULRICH 1890)	177-10	8
★ HOR6	MEEKOPORA EXIMIA	ULPICH 1889	6075	7
PP5	MEEKOPORA SP.	PERK+PERRY 1962	6806	9
C021	MESOTRYPA CRUSTULATA	CORYELL 1921	9236-24	5
★ NT28	MESOTRYPA CF. INFIDA	(ULPICH 1895)	198-24	4
U11	MESOTRYPA ORBICULATA	C.+ G. 1913	8252-131A	6
CG62	MESOTRYPA ORBICULATA	C.+ G. 1913	9134-9	5
U12	MESOTRYPA PATELLA	(ULPICH 1890)	8252-136A	6
U13	MESOTRYPA PAUCA	UTG+PERRY 1964	8252-128A,8	5
B6	MESOTRYPA SPINOSA	ULRICH 1895	8235-1	7
H1	METAPORA, GEN.NOV., SP.NOV.	HUFFMAN 1970	8288-17515A,8	RLA 4
H5	METAPORA, GEN.NOV., SP.NOV.	HUFFMAN 1970	8288-17515A,8	TE 4
UM21	MICROCAMPYLUS TENUIS	DUNCAN 1939	19871	5
UM22	MICROCAMPYLUS TRAVERSENSIS	DUNCAN 1939	19872	5
★ UM19	MICROCAMPYLUS TYPICUS	DUNCAN 1939	19873	1
C4	MONOTRYPA BENJAMINI	BASSLER 1906	131061520	6
PH21	MONOTRYPA BENJAMINI	BASSLER 1906	5577-79	7
PH20	MONOTRYPA EXSERTA	PERRY+HATT 1960	5540-42	5
★ N6	MONOTRYPA UNDULATA	(NICHOLSON 1875)	1879.58.29A	1
C5	MONOTRYPA OSGOODENSIS	BASSLER 1906	13127-204	6
PH22	MONOTRYPA OSGOODENSIS	BASSLER 1906	5576-300	7
N10	MONOTRYPA UNDULATA	(NICHOLSON 1875)	1967.66.553,554	2
N38	MONOTRYPA UNDULATA	(NICHOLSON 1875)	1967.66.518,519	1
N39	MONOTRYPA () WINTERI	(NICHOLSON 1879)	1967.66.520-523	5
★ NT53	MONOTRYPELLA AEQUALIS	ULPICH 1882	SER.2(10),1.33A3	4
U14	MONTICULIPORA ERIDERMATA	ULR+BASSL. 1904	8252-138A,8	7
CG16	MONTICULIPORA ERIDERMATA	ULR+BASSL. 1904	85-11	7
CG86	MONTICULIPORA ERIDERMATA	ULR+BASSL. 1904	50-23	
★ CA9	MONTICULIPORA MAMMULATA	D+ORRIGNY 1850	10-4	4
U15	MONTICULIPORA MULTIPORA	DYER 1925	8252-148A,8	7
U16	MONTICULIPORA PARASITICA	ULRICH 1882	8252-153A	
CG21	MONTICULIPORA PARASITICA	ULRICH 1882	65-18,19	7
CG91	NICHOLSONELLA CORNULA	C.+ G. 1915	9150-5A,8	5
C022	NICHOLSONELLA FRONDIFERA	CORYELL 1921	9244-3	5
★ CG65	NICHOLSONELLA PECULIARIS	C.+ G. 1913	9133-4	5
CG35	NICHOLSONELLA VAUPELI	(ULRICH 1883)	8-9	7
NT14	NICHOLSONELLA VAUPELI	(ULRICH 1883)	113-15/73-7	8
U33	NICHOLSONELLA SP.	UTG+PERRY 1964	8252-286A	9
★ H14	NICKLESOPORA ATTENUATA	ULPICH 1890	8288-5506C	8
H8	NICKLESOPORA CF. VARIANS	ULRICH 1890	8288-15511A	8
R5	NICKLESOPORA N.SP. A	RENZETTI 1961	6107-1	5
★ H12	NIKIFOROVELLA SPIRALIS	(ULPICH 1890)	8288-1505C	8
C024	ORBIGNYELLA MULTIFABULATA	CORYELL 1921	9244-17	5
C023	ORBIGNYELLA NODOSA	CORYELL 1921	9248-16	5
★ NT30	ORBIGNYELLA SURLAMELLOSA	ULR+BASSL 1904	199-9	4
★ CG88	ORBIPOA SPINOSA	(ULR+BASSL 1904)	9177-18	7
★ UM8	ORTHOPORA RUCHERT	FENTON+F. 1924	9079	5
UM9	ORTHOPORA ULRICH	FENTON+F. 1924	8082	5
★ NT5	PAPILLINARIA HEMISPHERICA	(ULRICH 1890)	173-21	8
U18	PERONOPORA DECIPIENS	(ROMINGER 1866)	8252-164A,8	3
CG38	PERONOPORA DECIPIENS	(ROMINGER 1866)	2-14	7
★ N1	PERONOPORA FRONDOSA	(NICHOLSON 1874)	1967.66.412	1
N2	PERONOPORA FRONDOSA	(NICHOLSON 1874)	1967.66.415,414	1
N3	PERONOPORA FRONDOSA	(NICHOLSON 1874)	1967.66.419	1
N4	PERONOPORA FRONDOSA	(NICHOLSON 1874)	1967.66.423,424	1

U19	PERONOPORA PACHYMURA	UTG+PERRY	1964	8252-170A	5
U17	PERONOPORA PAUCA	UTG+PERRY	1964	8252-156A	5
A14	PERONOPORA VERA	ULRICH	1888	8971-3003	6
CA10	PERONOPORA VERA	ULRICH	1888	10-5	8
CG37	PERONOPORA VERA	ULPICH	1888	13-6	7
CG68	PERONOPORA VERA	ULRICH	1888	9147-16	7
CG80	PERONOPORA VERA	ULRICH	1888	9147-14	7
★CG66	PERONOPORELLA DORIA	C.+ G.	1913	9133-24	1
★UM5	PETALOTRYPA FORMOSA	FENTON+F.	1924	8050	5
★NT49	PETALOTRYPELLA TUBERCULATA	(M.E.+ H.	1851)	272-15	8
NT54	PETIGOPORA ASPERULA	ULRICH	1883	1.33A3	8
★NT55	PETIGOPORA PETECHIALIS	(NICHOLSON	1875)	16-24, 1.389C.	8
★NT11	PHAENOPORA WILMINGTONENSIS	ULPICH	2893	174-19	8
★NT31	PHYLLODICTYA VARIA	ULRICH	1893	203-19	8
★N48	PINACOTRYPA PPOPOROIDEA	(NICHOLSON	1874)	1967.66.300-305	5
B4	PRASOPORA FALESI	(JAMES	1884)	8233-1	7
★N20	PRASOPORA GRAYAE	NICH.+ETH.	1877	1967.66.406,407	1
A15	PRASOPORA SIMULATRIX	ULRICH	1886	8974-1007	7
B5	PRASOPORA SIMULATRIX	ULRICH	1886	8232-2	6
CG87	PRASOPORA SIMULATRIX	ULRICH	1886	9114-16	7
★N14	PRASOPORINA SELWYNI	(NICHOLSON	1881)	1967.66.391,392	1
N15	PRASOPORINA SELWYNI	(NICHOLSON	1881)	1967.66.393,394	1
N16	PRASOPORINA SELWYNI	(NICHOLSON	1881)	1967.66.395,396	1
N17	PRASOPORINA SELWYNI	(NICHOLSON	1881)	1967.66.397,398	1
N18	PRASOPORINA SELWYNI	(NICHOLSON	1881)	1967.66.399,400	1
N19	PRASOPORINA SELWYNI	(NICHOLSON	1881)	1967.66.401,402	1
★NT32	PRISMOPORA SERRATA	(MEEK	1875)	195-3	8
★NT44	PROAVELLA PROAVA	(EICHWALD	1840)	234-8	4
★CG19	PTILODICTYA PLUMARIA	JAMES	1878	50-20	7
NT16	PTILODICTYA PLUMARIA	JAMES	1878	117-1	8
★NT12	PTILOTRYPA ORLIQUATA	ULRICH	1890	173-20,22,23	4
★N55	RHABDOMESON GRACILE	PHILLIPS	1841	1967.66.327	3
R2	RHABDOMESON N.SP. A	RENZETTI	1961	6102-3	5
R1	RHABDOMESON N.SP. A	RENZETTI	1961	6102-2	5
C025	RHINIDICTYA LERANONENSIS	CORYELL	1921	9247-9	5
★C026	RHINIDICTYA SALEMENSIS	CORYELL	1921	9245-7	5
★NT48	RHINOPORA VERRUCOSA	HALL	1852	267-7,8	4
★PP9	RHOMBOPORA LEPINODENDROIDES	MEEK	1872	6812	3
R3	RHOMBOPORA N.SP. A	RENZETTI	1961	6104-1	5
R4	RHOMBOPORA N.SP. A	RENZETTI	1961	6105	5
R9	RHOMBOPORA N.SP. A	RENZETTI	1961	6103-13	5
U22	RHOMBOTRYPA MULTITABULATA	UTG+PERRY	1964	8252-185A,8	5
CG17	RHOMBOTRYPA QUADRATA	(ROMINGER	1866)	65-4	7
★U23	RHOMBOTRYPA QUADRATA	(ROMINGER	1866)	8252-198A	3
N40	RHOMBOTRYPA RHOMBICA	(NICHOLSON	1874)	1967.66.526,527	5
★H4	SAFFORDOTAXIS INCRASSATA	(ULRICH	1888)	8288-20501,1A	6
H9	SAFFORDOTAXIS INCRASSATA	(ULRICH	1888)	8288-20501A	8
★UM4	SEMIOPORA () EHLERSI	MCNAIR	1937	17159,60,61	5
★N36	SONNINOPORA WHITEAVESI	(NICHOLSON	1879)	1967.66.508,509	5
N37	SONNINOPORA WHITEAVESI	(NICHOLSON	1879)	1967.66.510,511	5
★NT18	SPATIOPORA ASPERA	ULRICH	1883	116-2	4
PG5	STENOPHRAGMIDIUM MEGISTUM	PERRY+GUTS	1959	5515	5
★PG6	STENOPHRAGMIDIUM OBSCURUM	PERRY+GUTS	1959	5514	5
N7	STENOPORA AUSTRALIS	NICH+ETHER	1886	1968.15.235-239	5
N8	STENOPORA AUSTRALIS	NICH+ETHER	1886	1968.15.240-243	5
N56	STENOPORA CRINITA	LONSDALE	1845	1967.66.244-246	5
N57	STENOPORA CRINITA	LONSDALE	1845	1967.66.247-248	5
N58	STENOPORA CRINITA	LONSDALE	1845	1967.66.249-250	5
N61	STENOPORA LEICARDOTI	NICH+ETHER	1886	1967.66.278-285	5
PP8	STENOPORA PAUCA	PERK+PERRY	1962	6810A,8	5
★N62	STENOPORA TASMANIENSIS	LONSDALE	1844	1967.66.291-292	3

N63	STENOPOREA TASMANIENSIS	LONSDALE	1844	1967.66.293-299	3
N64	STENOPOREA SP.	NICHOLSON		1967.66.300-3-2	9
★ UM23	STENOPORELLA () DEVONICA	DUNCAN	1939	19874	5
★ UM24	STEREOTOECHUS TYPICUS	DUNCAN	1939	19881	1
★ NT20	STICTOPORA MUTABILIS	ULRICH	1886	203-22	
★ CG27	STICTOPORELLA CRIBILINA	CORYELL	1921	9242-13	5
CG63	STIGMATELLA ALGICORNIS	C.+ G.	1913	9155-18	5
CG64	STIGMATELLA CATENULATA	C.+ G.	1913	9131-15	5
A16	STIGMATELLA CLAVIS	(ULPICH	1883)	8974-1012	6
CG42	STIGMATELLA CLAVIS	(ULPICH	1883)	6-4	7
B12	STIGMATELLA CONICA	BROWN	1965	8235-3	5
★ CG43	STIGMATELLA CPENULATA	ULR+BASSL	1904	89-14	3
PH12	STIGMATELLA DUBIA	PERRY+HATT	1960	5570-7	5
CG69	STIGMATELLA INCRUSTANS	C.+ G.	1913	9107-17	5
B13	STIGMATELLA MULTISPINOSA	BROWN	1965	8241-2	5
U28	STIGMATELLA PERSONATA	ULR+BASSL	1904	8252-263A	7
CG41	STIGMATELLA PERSONATA	ULR+BASSL	1904	86-1	7
CG70	STIGMATELLA SESSILIS	C.+ G.	1913	9146-8	5
★ N44	STREBLOTRYPA HAMILTONENSIS	(NICHOLSON	1874)	1967.66.222	5
H2	STREBLOTRYPA, SP. NOV.	HUFFMAN	1970	8288-12500C TE	5
★ H3	STREBLOTRYPELLA MAJOR	(ULRICH	1888)	8288-14512A RLA	2
H7	STREBLOTRYPELLA MAJOR	(ULRICH	1888)	8288-14512A TE	2
H10	STREBLOTRYPELLA () SP.	HUFFMAN	1970	8288-9506A	9
★ CO29	STROMATOTRYPA INCRUSTANS	CORYELL	1921	9245-14	5
CO28	STROMATOTRYPA REGULARIS	CORYELL	1921	9245-16	5
PG7	TABULIPORA AMSDENENSIS	PERRY+GUTS	1959	5506	5
RO4	TABULIPORA CESTRIENSIS	ULPICH	1890	92	8
HOR7	TABULIPORA CESTRIENSIS	ULRICH	1890	6644	7
PP7	TABULIPORA GROVERENSIS	PERK+PERRY	1962	6809	5
★ N59	TABULIPORA HOWSI	(NICHOLSON	1881)	1967.66.257-270	5
N60	TABULIPORA HOWSI ARCTICA	(NICHOLSON	1883)	1967.66.271-277	5
PG8	TABULIPORA MACULATA	PERRY+GUTS	1959	5512	5
PG9	TABULIPORA PACHYMURALIS	PERRY+GUTS	1959	5509A,B	5
HOR9	TABULIPORA PENERUDIS	PERRY+HORO	1963	6044A,B,C	5
HOR8	TABULIPORA RAMOSA	(ULRICH	1890)	6657	7
PP6	TABULIPORA REGULARIS	PERK+PERRY	1962	6807A,B	5
★ UM25	TRACHYTOECHUS TYPICUS	DUNCAN	1939	19875	1
★ PH10	TREMATOPORA SP.	(PERRY+HAT	1960)	5574	9
★ NT34	TRIGONODICTYA CONCILIATRIX	(ULRICH	1886)	195-4 * 221-24	4
CO30	TRIGONODICTYA IRREGULARIS	CORYELL	1921	9245-11A,B	5
R6	UNIDENTIFIED SPECIMEN	RENZETTI		6103-10	
R7	UNIDENTIFIED SPECIMEN	RENZETTI		6103-12	
;7	UNIDENTIFIED SPECIMEN	RENZETTI		6103-12	

APPENDIX III

OTU's coded for 150 characters.

ANOMALOTOECHUS

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ANOLÖTICHTIA

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ARTHROPODA

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ASPIDOPORA

[illegible]

ASPEROPORA

[illegible]

ASTREPTODICTYA

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ATACTOPORA

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ATACTOTOECHUS

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ATACTOPORELLA

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BACTROPCRA

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BA DOGLIOPORA

[illegible]

BALTICOPORA

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BALTICOPORELLA

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BATOSTOMA

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BATOSTOMELLA

[illegible]

BYTHOPORA

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CADORNIPORA

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CALACANTHOPORA

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CERAMELLA

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CERAMOPHYLLA

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CREPIPORA

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CYCLOPORA

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CYCLOTRYP A

[illegible]

CYPHOTRYPA

[illegible]

CYSTODICTYA

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DEKAYELLA

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DEKAYIA

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DIANULITES

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DICHOTRYPA

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DIPLÒTRYPA

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DIPLOTRYPELLA

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DISCOTRYPA

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```

DYBOWSKIELLA

[illegible]

EOSTENOPORA

[illegible]

ERIDOCAMPYLUS

```
0000010000000010277000000000000000010000100011000001010000000000000000000000000001
1010101001001000000001010000000001011000000000101100000000000000000000UM18
```

ERIDOPORA

```

1000000002092000000000002200000010010000011101000100000010201100000000001100
000000000022220000010000200200000000000000000000000000000000000000000000PP3
02000200000020200000000922020000100106000110011010000001000100000000000000001100
000000002222000000101000200200011210000000000000000000000000000000000000H0R5
00000100010001020000000100000100000010000011191101000001000000000000000000000000
00000000010000000000010000000010000200100000000000000000000000000000000000000000H0R4

```

ERIDOTRYPA

[illegible]

ESCHAROPORA

[illegible]

EURYDICTYA

```
01000010100010021000000000C00000010100000100010100100000200000000000000000001
```


[illegible]

01000010010000120000000000000001010000010000001110000000000000000000000000
1110011020210000000010000001110112000000000000000000000000000000C018

```
010000101000290000001100C000000001010000001100001011000000000000000000000000  
000000000010000000100000001010000000000000000000000000000PH11
```

```
0000010000000102000000000000000001000000011000010010030000000000000010000000001001
000100110100100000010000010000001100000000001001000000000010000010000NT26
```

```
000001000001001000000000C0090000010000100111000000000010100100000000000001000
0000000C00110000010000000070000181000000000900000000000000000000000N52
10000000000099000000000000100100001109900010001101390000000000000000000001000
00010910001110000010010000000201111000000000000000000000001111000PH17
10000000000020020000000000000001000001011001122010000000000000000000000000
```


00010110011122000012200000000000001000000000000000000000000000022000C2

HETERODICTYA

```
01002010110009000000000000000000101010000111000011100010000000000000000100000000  
00000000111200000000111010022201010000000001001000000000000000000000N43
```

HETEROTRYPA

[illegible]

HOMOTRYPA

```
00000100000101012000000000000000001100100010000001000000000000000100100000000
000000001122000001000001000000111001100100000000000000001000010000CA8
```


[illegible]

```
0000000000000112000000700000000901000010101000010100000000000000000000001100  
001100100022000000001000100000021010100000000000000000000000000010000000000UW6
```

```
0000010010002202110200000000000010100000010000001110000000000000000000000002001
0000012010220000000010100000010020100000000000000000000000002000000000NT10
000001000000011200000000000000000100001000000011010000000000000000000000000001000
00000000102200000002200000000002001000000000000000000000000000001000000000NT46
```

```
01000011000011000007000000000000000000100001001100110001000000100000000000000000000  
000000000111000000010000900100003010300000000000000000000000000000000000000000000PP5  
0100001100000000000000000100901009100010000100110101010000000101100000000000000001100  
0000000010110000020000002009100110210011001100099000000000000000000000000010001000HOR6
```

[illegible]

```
0000010022020012000000000000000001010000011000101010000000000000000000000001101
101010100122000000101000000000010010000000000000010000000011000000001H1
00000100000000020000000000000000071000000011000001010000000000000000000000001000
100000100122100000110100000000100100000000000000100000000000000000000000000H5
```

[illegible]

```
00000000000011000000000000000000001000010001111000100000000000C000000000000000000
00000000000111000000010001000000011010000000000000000000000000000000C5
```

[illegible]

```

0000000000001001000000000100000000100000000100000010000000000000000001001000001000
0000001000110000000120000000000001101101010010000000000000000010000000000CG16
000000000000100000000000000000000000000000000000000000000000000000000000000000001
101000100012000000201000000000111010100100000000000000000000000000000000CG21
0000020200012202000000010000000001000000001000000010000000000000000000000000000100
101000100022000000100000000000111200011001000000000000000000000000000000CG86
000000000000110000000000000000000000000000000000000000000000000000000000000000000
000000000011100000000100000000000000000000000000000000000000000000000000U16
100000000001020000000000000000000000000000000000000000000000000000000000000000000
0000000001222000001000000000000011010101011000000001000000010002010000U15
0000100000112100000000001000001100000001000000100000010000000010000100000000
000000000122000000010000000000110110001011000000000000000000000000000001010000U14
000000000000100000000000000000000000000000000000000000000000000000000000000000000
0000000000022001000100020200000111100011011000000000000000000000000000000000000CA9

```

```
0000010000000202000000000000000001000001010000202010000000000000000000000001
101110110122000000102022200000210200000000000000000000002202220002C022
0000010000000102000000000000000001000000000000010100000000000000000000000001
101000100122000001001000100000001010100000000000000000000010001000000CG35
0000010000000102000000000001000010000001010000001010000000000000000000000001
0010001001000000000001000100000010111000000000000000000111100000000CG91
0000010010000100000000100001000010100000110000101100000000000000000000000001000
000000000100110000100000000000011011000000000000000000000000000001000010000U33
0000010000000112000000000000000001000000010000010010000000000000000000000001001
0011001001000000000010000000000000010000000000000000000000000000000000000CG65
010000000001010000000001001000000100000000000000000000000000000000000000000001
1010001001221100000100000000000010000000000000000000000000000000000000000NT14
```

[illegible][illegible]

[illegible]

ORBIGNYELLA

[illegible]

ORBIPORA

```
0000010000000102000000000000000001000011001000000110000000000000000000000001
0011011001001000010010001100000101010000000000000000000000000000000000CG88
```

ORTHOPORA

```
0000010001000102000000700000000001010000000001001010000000000000000000000000000001  
001000111009000000001010900000021000100000000000000000000000000000UM9  
0100022010001^02000000000000000000101000001100100101000000000000000000000000000000  
001000111112000000001000000000000010900000000000000000000000000000002UM8
```

PAPILLUNARIA

```
000020020001200200000000100000000103011010111100010000000111021000000000000000
00000000000221000000110001100000110100000000000000000000000000000000000000NT5
```

PERONOPORA

```

01000010000120000000000000000000001000100011100010100000000000000010011100001001
00010010011100000000010010002002110000110000000000000100000001000111001A14
0120001000010100000000000100000000100000001000010100000000000000000000000001101
000100100111000000000100110010001101001100100000000000000000000100011000CA10
010000100001010200000000002100000100000000100000010000000000000000000000000110
0001000101110000000001002200100021010001110100000000000000000000010001000000CG38
01000010000001020000000010000000010000000010100010000000000000000000000000010001101
00110010011120000001000100100001010001100100000001000000010000010000CG37
010000100000010200000000000000000000000000000000000000000000000000000000000101000001101
0001001001120000000010020101000111100011001000000001000000010100010000CG63
01000010000020000000000000000000000000000000100011000001100000000000000001001100001000
00110010011200000100100101010002110001100000000001000000010000010000CG80
010000100001001000000000100000000100000000100000001100000000000101001000001001
0011001001110000000010010100111000100011011000000001000000010100010001N2
010000000001000000000000010000000001000000001000000101000000000000010100100001001
001100100111000000001001010000000010001101100000000000000000000010100010001N3
0100001000010010000000001000000001000000001000000110000000000010100100001001
001100100111000000001000101000110001000110110000000000000000010100010001N4
010001000001100100000000000000000010000100010000001010000000000000000000000110000001
0001001101110000000010001101000110110011001000000001000000001000000U19
0010001000001020000000001000100100010001000000101000000000000000000000010001001
0001011001110000000010010100100110101011001000000001000000010000010000U18
01000010000110000000000000200000010000000110000100000000000000000000000000001000
00000000011000000011000020000001010001100100000001000000010100010000U17
01000010000100100000000100000000100000000100000011000000000000010100100001001
0011001001110000000010010100100000100011011000000001000000010100010001N1

```

PERONOPORELLA

```
01000000000022000000000000000000000010100000010100000000000000000000100000001  
0011001000222000000010700100000211110011001000000000000000010000010000CG66
```

PETIGOPORA

[illegible]

```
0100001001000102000000001000100001000100001000000111001000000000000000000010000
0000000011120000000010000001000000100000000000000000000000000000000000CG19
010000100100210000000000000000000000000010100000010000010110010000000000000000000000000
0000000012210000000010100001000000100000000000000000000000000000000000NT16
```

[illegible]

STENOPHRAGMIDIUM

00000000000132020000000001000000100001000100000010000000000000000000000000011
 111110110022001000011010020000002010000000000101000000000000000000000001PG5
 000000000001100100000000020000000110001000110000100000000000000000000000000010
 0000000000111000000110000000000001000000000101000000000011000000000PG6

STENOPORA

00000100010001120000000000000000101000000111000011000000000000000000000000001
 111011110122000000001100100000000010000000000000000000000000000000000001N63
 000001000001011200000000000000001010000011110001010000000000000000000000000001
 101010110122001000010001000000001000000000000000000200000000000000000001N64
 000000000001201200000000000000001000010001110001010000000000000000000000000011
 0000001100220010000110001000000000100000000000000000000000000000000000000N57
 0000000000012012000000001000000000100010001111001000000000000000000000000000011
 0000000010022001000001000100000000100000000000000000000000000000000000000N58
 0000000000012012000000001000000000100010001111001000000000000000000000000000011
 00000000002200110001000010000000010000000000000000000000000000000000000001N56
 000001000001001200000000000000001000010001101000101000000000000000000000000001
 000000110111001000001011100000011010000000000000000000000000000000000000022N7
 0000010000010012000000000000000010000100011010001010000000000000000000000000001
 001000110122001000001011100000011010000000000000000000000000000000000000022N8
 000001000001011200000000000000001010010001111000111000000000000000000000000001
 10100111011100110000110010000000010000000000000000000000000000000000000001N61
 000001000001000200000000010000000101011000111100010100000000000000000000000001
 00000011102210000101000020000000001000000000000000000000000000000000000001PP8
 000001000001221200000000000000001010000001111001010000000000000000000000000001
 10101111012200100000100010000000010000000000000000000000000000000000000001N62

STENOPELLA

000000010000010200000000000000001000010001101001200000000000000000000000000020001
 000100100220000000001010000000021010100000000000000000000000000100011000000001UM23

STEREOTOECHUS

000000020001011200000000000000001000000001000000100000000000000000000000000001
 1010011002200000000100110000002111010000000000000000000000000000200000000000000UM24

STICTOPORA

010000101000100210001110000000000101000000100010012100000220000000000000000000001
 10000110101000000001001000010000001000000000000000000000000000000000000000NT20

STICTOPORELLA

010000100000010200000000000000000101000000100001011100000000000000000000000001100
 11100010011110000000101002010000101010000000000000000000000000000000000000CG27

STIGMATELLA

10000000000010000000000001000000010001000110000000000000000000000000000000000001
 0001001000110000001000000000002101001A16
 0000000000001001000000000000000010000100011010001000000000000000000000000000001
 000100110011001100001000100000001010012
 0000000000001002000000000000000000001000101011000010100000000000000000000000001001
 00010010102200000001000000000011021001B13
 00000100000020020000000000000000000100010001100000100000000000000000000000000001
 000000110022100000001000200000001000CG41
 100000000001220200000000000000000001000100011000001000000000000000000000000000000
 000100111022100000010001000000200100CG42
 0000010000000000000000001000000000100010001111001000000000000000000000000000001
 00010110110010000012000000000000001000CG63
 0000000000001000000000000000000000010001000111100100000000000000000000000000001
 0001001101110000001000000000000100CG69
 000000000001100000000000000000000001000010001100000010000000000000000000000000001

[illegible]

STREBLOTRYPA

```
00000100100201920700000100000000010000000000011001000300000000000000000000000001000
00000000001001000000010010070000000001007000000000000000000000000000000011000100000H2
0000021201100000000000000000000000000101010000000000011000000000000000000000000000000
00000000010120000000001100000100000010000000000000000000000000000000000000000000000N44
```

STREBLOTRYPELLA

[illegible]

STROMATOTRYPA

[illegible]

TABULIPORA

```
00000100000111120000000000000000010100100011110001110000000000000000000000000001
10101011012200100000100010000000001000000000000000010000000000000001N60
000000000001100000000000C100000001000010001111000101000000000000000000000000001
000100110U111010010010010000000110200000000000000000000000000000000000PP6
00000100000101000000000001000000010001000111100100000000000000000000000000000001
000100110100111000000001100000001000000000000000000000000000000000000000PP7
00000100000101020000000000202000010000100011000001010000000000000000000000000001
00000011110011000001001000000001111000000000000000010000001000000000HOR8
10000000000100020000000002202000011000100011000010010000000000000000000000000001
000100110111010000100011000000010000000000000000000000000000000000000000HOR9
100000000101000000000000000000000001000110001110001000000000000000000000000000001
000000111022001000011000100000021100000000000000000000000000000000000000R04
10000000000110000000000000100000010000100011110010000000000000000000000000000001
0011001101111000000010011000000011000000000000000000000000000000000000HOR7
0000010000010112000000010000000100001000111100010100100000000000000000000000001
1010101101100010010010011100000010100000000000000000000000000000000000N59
00000000000110100000000000000000010000100111100010000000000000000000000000000011
00000011001110000000100000000011000000000000000000000000000000000000PG8
100000000001100000000000000000000010001100011000010110000000000000000000000000010
0000000000111000000100010000000110001000000000000000000000000000000000PG9
0000000100010112000000010000000100010001111000100000000000000000000000000011001001
0001001100221010000010001000000111000000000000000000000000000000000000PG7
```

TRACHYTODECHUS

```
00000001000102120000000000000000010000100011100010000100000000000000000000000000
```

FRAGMENTED

```
000000110222111100001002100000011011010000000000000000000000000000UM25
```

TREMATOPORA

[illegible]

TRIGONODICTYA

```
010001000100100200000000000000001010000001110001011000000000000000000000000000
0000000000110000000100102000100010110000000000000000000010000110000C030
001000101000100200031100000000000101000000110010101100000000000000000000000000
111000100112000000010000000101000010000000000000000000000000000000000000000000
```

UNIDENTIFIED

```
0000010090010010000000000000000001019010001101000111000000000000000000000001
10100110012290000000100010000001901900000900900000190000000000000000000R5
000001001109900000000000000000000101001000190003010109000000000000000000000001
101001100122000000001090100000010000000000000000010000000000000000000001R7
```

APPENDIX IV

Arrangement of genera into 18 phena. Stratigraphic ranges compiled from Bassler (1953), Astrova (1960), Larwood, et al., in Harland (1967) and other publications.

ARRANGEMENT OF GENEPA INTO 18 PHENA.
 STRATIGRAPHIC RANGES COMPILED FROM BASSLER(1953), ASTROVA(1960), LARWOOD, ET.AL.,
 IN HARLAND (1967), AND OTHER PUBLICATIONS.

PHENON 1	
STREBLOTRYPELLA	L.CARBO
CERAMOPORELLA	ORDO-SIL
ACANTHOCERAMOPORELLA	M.ORDO-U.ORDO
CHEILOPORELLA	ORDO
ANAPHRAGMA	ORDO
HALLOPORINA	ORDO
STENOPHRAGMIDIUM	CARBO
STENOPORELLA	MISS
MICROCAMPYLUS	M.DEV
CERAMOPORA	ORDO-DEV
CERAMOPHYLLA	ORDO
TREMATOPORA	ORDO-DEV
ATACTOPORA	ORDO

PHENON 2	
CREPIPORA	ORDO-SIL
LEIOCLEMA	ORDO-PERM
PAPILLUNARIA	M.ORDO-U.ORDO
STIGMATELLA	ORDO-DEV

PHENON 3	
ANOMALOTOECHUS	M.DEV-U.DEV
EOSTENOPORA	M.DEV
DEKAYELLA	ORDO-SIL
LEPTOTRYPELLA	DEV
TRACHYTOECHUS	M.DEV
DEKAYIA	ORDO
STROMATOTRYPA	ORDO
MONOTRYPA	ORDO-DEV
CALACANTHOPORA	M.DEV
PETIGOPORA	ORDO

PHENON 4	
STEREOTOECHUS	M.DEV-U.DEV
CHONDRAULUS	M.DEV
ORBIPORA	ORDO

PHENON 5	
TABULIPORA	DEV-PERM
STENOPORA	CARBO-PERM
ERIDOCAMPYLUS	M.DEV

PHENON 6	
ORBIGNYELLA	ORDO-SIL
DIPLOTRYPA	ORDO-DEV
DIANULITES	ORDO
CYPHOTRYPA	ORDO-DEV
ANISOTRYPA	MISS
RHOMBOTRYPA	ORDO-DEV
DISCOTRYPA	ORDO-DEV
ATACTOTOECHUS	DEV
MESOTRYPA	ORDO-SIL

PHENON 7

ERIDOTRYPA	ORDO-DEV
ANOLOTICHA	ORDO-SIL
DIPLOTRYPELLA	ORDO
AMPLEXOPORA	ORDO-SIL
BATOSTOMA	ORDO-SIL
ACANTHOTRYPELLA	ORDO
LAMOTTOPORA	ORDO
BALTICOPORA	ORDO
HEMIPHAGMA	ORDO
BALTICOPORELLA	ORDO
GORTANIPORA	ORDO
PHENON 8	
PETALOTRYPA	ORDO-CARBO
LEPTOTRYPA	ORDO-M. CARBO
ESCHAROPORA	ORDO-CARBO
SPATIOPORA	ORDO-SIL
PETALOTRYPELLA	
CRASSALUNA	U.ORDO
PHENON 9	
MONOTRYPELLA	ORDO-CARBO
HOMOTRYPELLA	ORDO
HOMOTRYPA	ORDO-SIL
CYCLOPORA	DEV-MISS
BATOSTOMELLA	ORDO
PHENON 10	
LICHENALIA	SIL-DEV
PRISMOPORA	DEV-PERM
CYSTODICTYA	DEV-PERM
DYBOWSKIELLA	PERM
COELOCLEMA	ORDO-SIL
HENNIGOPORA	SIL
PINACOTRYPA	DEV
PHENON 11	
ERIDOPORA	DEV-PERM
CYCLOTRYP	SIL-PERM
FISTULIPORA	ORDO-PERM
MEKOPORA	SIL-PERM
PHENON 12	
RHOMBOPORA	ORDO-PERM
ORTHOPORA	SIL-DEV
BADOGLIOPORA	ORDO
NICKLESOPORA	CARBO-L. PERM
NIKIFORCVELLA	CARBO-L. PERM
CHEILOTRYP	U.ORDO-PERM
STICTOPORELLA	ORDO-DEV
PHENON 13	
CONSTELLARIA	ORDO
HALLOPORA	ORDO-L. CARBO
LIOCLEMELLA	ORDO-SIL
PHENON 14	
PRASOPORINA	ORDO
PRASOPORA	ORDO
PERONOPORA	ORDO
ASPIDOPORA	ORDO-SIL

ASPEROPORA
SONNINOPRA

SIL-DEV
M.ORDO

PHENON 15
ATACTOPORELLA
PERONOPCRELLA
MONTICULIPORA
HETEROTRYPA

ORDO-SIL
ORDO
ORDO-SIL
ORDO-SIL

PHENON 16
SAFFORDOTAXIS
HETERODICTYA
STRELOTRYPA
PTILODICTYA
ARTHROPORA
BYTHOPORA
ASTREPTODICTYA

MISS
ORDO-DEV
DEV-PERM
ORDO-DEV
ORDO
ORDO-DEV
ORDO-SIL

PHENON 17
PHAENOPORA
CERAMELLA
INTRAPORA
RHABDOMESON
GRAPTODICTYA

ORDO-DEV
DEV
DEV
MISS-PERM
ORDO-SIL

PHENON 18
RHINIDICTYA
PROAVELLA
DACTROPORA
PHYLLODICTYA
EURYDICTYA
STICTOPORA
RHINOPORA
PTILOTRYPA
TRIGONODICTYA
HEMIPACHYDICTYA
SEMIOPORA
FIMBRIAPORA
HEMIDICTYA

ORDO-SIL
ORDO
DEV-MISS
ORDO
ORDO
ORDO
SIL
ORDO
ORDO-SIL
ORDO-SIL
DEV
ORDO

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