CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

THE UNIVERSITY OF MICHIGAN

VOL. XIX, No. 4, pp. 37–45 (2 pls.) SEPTEMBER 18, 1964

REDESCRIPTION OF SYNTYPES OF THE BRYOZOAN SPECIES *RHOMBOTRYPA QUADRATA* (ROMINGER)

BY

ROGER J. CUFFEY and T. G. PERRY

MUSEUM OF PALEONTOLOGY
THE UNIVERSITY OF MICHIGAN
ANN ARBOR

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

Director: LEWIS B. KELLUM

The series of contributions from the Museum of Paleontology is a medium for the publication of papers based chiefly upon the collections in the Museum. When the number of pages issued is sufficient to make a volume, a title page and a table of contents will be sent to libraries on the mailing list, and to individuals upon request. A list of the separate papers may also be obtained. Correspondence should be directed to the Museum of Paleontology, The University of Michigan, Ann Arbor, Michigan.

VOLUME XIX

VOL. XIX, No. 4, pp. 37–45 (2 pls.) SEPTEMBER 18, 1964

REDESCRIPTION OF SYNTYPES OF THE BRYOZOAN SPECIES *RHOMBOTRYPA QUADRATA* (ROMINGER)

BY

ROGER J. CUFFEY[1] and T. G. PERRY[2]

ABSTRACT

The characteristics, including the internal structures, of the syntypes of the trepostome bryozoan *Rhombotrypa quadrata* (Rominger) are described on the basis of newly prepared thin sections and quantitative measurements. One of the syntypes is selected as lectotype of the species, the other syntypes consequently becoming paralectotypes.

CONTENTS

INTRODUCTION

CARL ROMINGER (1866, pp. 115–16) described a new trepostome bryozoan, to which he gave the name *Chaetetes quadratus,* from the Richmondian (Upper Ordovician) rocks of southeastern Indiana. Rominger neither sectioned nor illustrated the specimens on which he based this species. H. A. Nicholson (1881, pp. 179–82, Text-fig. 36) first described and illustrated the internal structure of the species now known as *Rhombotrypa quadrata,* presumably on the basis of specimens which were not primary type materials.

The species under study had been assigned by various authors (Bassler, 1915, pp. 1115–16) to the genera *Chaetetes* Fischer *in* Eichwald, *Monticulipora* d'Orbigny, and *Monotrypella* Ulrich, until Ulrich and Bassler (1904, p. 44) made *C. quadratus* of Rominger the type species of their

[1] Graduate student, Department of Geology, Indiana University, Bloomington
[2] Professor of Geology, Department of Geology, Indiana University, Bloomington

new genus *Rhombotrypa*. The species, first recognized by Rominger, has since been found abundantly in Richmondian rocks of eastern North America.

Rominger based *Chaetetes quadratus* on at least 16 specimens (fragmentary zoaria), which are therefore syntypes of *Rhombotrypa quadrata* (Rominger). We have prepared thin sections from 11 of these previously unsectioned primary types and describe herein their internal structure; we believe that the 5 nonsectioned specimens are conspecific with those from which thin sections were made. Furthermore, we select one of the original syntypes as lectotype; the remaining syntypes of Rominger become paralectotypes.

ACKNOWLEDGMENTS

We are grateful to Dr. Lewis B. Kellum and Dr. Erwin C. Stumm of the Museum of Paleontology, The University of Michigan, for lending us the primary types and granting permission to prepare thin sections from them. Technologic facilities, including photography by Mr. George Ringer of the Indiana Geological Survey, were provided by Indiana University.

SYSTEMATIC DESCRIPTION

Phylum ECTOPROCTA (= BRYOZOA Auct.) Nitsche, 1869
Class GYMNOLAEMATA Allman, 1856
Order TREPOSTOMATA Ulrich, 1882
Family Amplexoporidae Miller, 1889
Genus *Rhombotrypa* Ulrich and Bassler, 1904
Rhombotrypa quadrata (Rominger)
(Pl. I, Figs. 1–7; Pl. II, Figs. 1–8)

Chaetetes quadratus Rominger, 1866, pp. 115–16 (not illustrated).

Monticulipora (Monotrypa) quadrata (Rominger), Nicholson, 1881, pp. 179–82, Text-fig. 36 (first illustration of internal structure).

Rhombotrypa quadrata (Rominger), Foerste, 1924, p. 106, Pl. 9, Fig. 2. Dyer, 1925, p. 54, Pl. 4, Fig. 5, Pl. 6, Fig. 4. Bassler, 1953, pp. G109-G110, Text-fig. 73, 5a-e. Utgaard and Perry, 1964 (in press).

ORIGINAL DESCRIPTION

Rominger's (1866, pp. 115–16) original description of the species follows:

> In the blue limestone of Madison and Richmond, Ind., a well marked form of Chaetetes is found in abundance, which I do not see described. I propose for it the name *Chaetetes quadratus*.
>
> It grows in coarse ramifications, with an even or slightly monticulose surface. Tube orifices vary in size in different specimens from one-fourth to one-third of a

millimeter; those on the maculae are somewhat larger; they are contiguous, polygonal or quadrate, separated by thin walls. Intertubular cells entirely wanting.

The quadrate tube form is particularly obvious on the terminal surface of branches, or on transverse sections. On the sides of the branches the quadrate tube form gives the surface a fanciful appearance, which I cannot better explain than by comparing it with certain decorations of watch cases, consisting of concentric circle lines crossing each other.

REVISED DESCRIPTION

External features.—Zoarium ramose, cylindrical to noticeably compressed, and ranging from 5 mm in diameter to compressed forms having maximum and minimum diameters of 26 and 20 mm, respectively, in sections perpendicular to branch length. Zooecia angular, generally hexagonal to rhombic in outline, and approximately uniform in size. Monticules low or nearly flush with surface, gently rounded, composed of somewhat larger and thicker-walled zooecia than are intermonticular regions, and spaced 2½ to 4½ mm apart measuring from center to center.

Tangential section.—Zooecial apertures angular (hexagonal to rhombic) to subcircular in outline, generally more angular in intermonticular regions or in deep sections and more nearly circular in thick-walled zooecia having well-formed zooecial lining (cingulum); most commonly 8 entire zooecia and part of a ninth in a 2-mm distance measured parallel to branch length and 11 entire zooecial apertures in a 1-sq mm. area in intermonticular regions (Table I). Interapertural wall thickness in intermonticular areas 0.01 to 0.06 mm, in monticules 0.05 to 0.12 mm, and as little as 0.005 mm in deep sections near base of peripheral region. Zooecial walls composed of concentrically arranged, somewhat crumpled, dark- and light-colored laminae of variable thickness, amalgamate or integrate, the latter having straight well-developed to most inconspicuous line of demarcation (divisional line); amalgamate and integrate wall structure found within same specimen (Pl. II, Figs. 6–7). Zooecial lining (cingulum) conspicuously formed in some thick-walled zooecia (especially in monticules), of variable thickness within a single zooecium, composed of laminae like those in rest of zooecial wall but somewhat lighter in color, and separated from remainder of zooecial wall by very thin zone of darker-colored laminae. Small zooecia, simulating mesopores in size, sparsely developed in monticules and very rarely noted in intermonticular areas. Mesopores absent. Minute calcite-filled voids triradiate, triangular, square, or rarely circular in outline and somewhat reminiscent of mural lacunae (Boardman, 1960, p. 29) located at nearly all junction points of 3 or 4 contiguous zooecia; such voids rarely inflecting and very rarely surrounded by extremely thin zone of dark-colored laminae. Acanthopores absent. Monti-

cules composed mainly of thick-walled zooecia somewhat larger in size than those in intermonticular areas (Table I) and sparsely occurring smaller zooecia.

TABLE I

ANALYSIS OF MEASUREMENTS OF TAXONOMIC CHARACTERS ON PRIMARY TYPES OF *Rhombotrypa quadrata* (ROMINGER)

	Specimens Measured	N_s	N_m	M_x	M_d	M_o	$R(X_s–X_l)$	σ	α_3	K
Maximum apertural diameter of intermonticular zooecia (mm)	Lectotype	1	20	.218	.218	.211 .229	.07(.17–.24)	.016	−1.03	+1.45
	Paralecto-types	9	180	.214	.214	.210	.10(.16–.26)	.021	−0.21	−0.44
	"Syntypes"	10	200	.214	.214	.210	.10(.16–.26)	.020	−0.27	−0.35
Maximum apertural diameter of monticular zooecia (mm)	Lectotype	1	12	.304	.305	.250 .300 .320	.11(.25–.36)	.034	−0.14	−0.87
	Paralecto-types	9	129	.298	.294	(.264) .299 (.340)	.16(.24–.40)	.036	+0.62	−0.20
	"Syntypes"	10	141	.298	.295	(.265) .300 (.340)	.16(.24–.40)	.036	+0.56	−0.28
Zooecia in 2 mm	Lectotype	1	10	7.4	7.3	7.3	1(7–8)	0.5	+0.41	−1.83
	Paralecto-types	9	87	8.3	8.3	8.2	3(7–10)	0.6	+0.04	−0.23
	"Syntypes"	10	97	8.2	8.2	8.1	3(7–10)	0.7	−0.03	−0.36
Entire zooecia in 1 mm^2	Lectotype	1	5	10.8	10.8	10.5	2(10–12)	0.7	+0.34	−1.15
	Paralecto-types	9	45	10.7	10.6	10.7	7(8–15)	1.6	+0.53	0.00
	"Syntypes"	10	50	10.7	10.6	10.7	7(8–15)	1.5	+0.54	+0.18

NOTE.—"Syntypes" includes lectotype and paralectotypes. N_s, number of specimens measured; N_m, number of measurements; M_x, arithmetic mean; M_d, median; M_o, mode, (M_o), subordinate or local mode; R, range, X_s, smallest measurement, X_l, largest measurement; σ, standard deviation; α_3, skewness; K, excess.

Transverse section.—Zooecia typically rhombic in outline, thin-walled, lacking zooecial linings, and essentially uniform in size. Calcite-filled minute voids at nearly all junction points of adjoining zooecia and very rarely inflecting. Monticules composed of irregularly rhombic or angular zooecia somewhat larger than those in intermonticular areas.

Longitudinal section.—Zooecia straight or gently curved in axial region and bending sharply outward at base of peripheral region to intersect zoarial surface at nearly right angles; introduction of new zooecia in colony as illustrated (Pl. I, Fig. 7). Zooecial walls thin in axial region, thickening gradually from outermost part of axial region into lowermost portion of peripheral region, thick through most of peripheral region but thinning somewhat immediately below zoarial surface; thickness of each individual wall somewhat variable in thicker-walled part of peripheral region; wall structure most similar to "atactotoechid wall structure" of Boardman (1960, pp. 32–33); dark line of demarcation between adjacent zooecia straight to somewhat undulatory and commonly well developed but locally absent; zooecial walls composed of gently curved, commonly somewhat crumpled laminae divergent from line of demarcation (or its position where absent) at low angles, arranged with their convex surface toward the interior of the zooecia and toward zoarial surface, and locally bending abruptly at edge of wall to continue into diaphragms. Zooecial lining developed in middle part of peripheral region in zoaria having comparatively thick peripheral zone and composed of laminae like those forming rest of zooecial wall, except those in zooecial lining locally more crumpled and extend into diaphragms somewhat thicker than average. Diaphragms formed by continuation of laminae composing zooecial walls, most commonly straight and perpendicular to zooecial walls, locally straight and oblique to walls, curved (having surface toward zoarial exterior most commonly concave but, in a few diaphragms, convex), and rarely cystiphragmlike; diaphragms very rare in most of axial region, spaced about ½ to 3 zooecial diameters apart in outermost portion of axial zone or subperipheral region, and ⅛ to 1, most commonly ¼ to ½, zooecial diameter apart in peripheral region; compared with zooecial wall, diaphragms in subperipheral region very thin and usually thin in peripheral region but locally of medium thickness in middle part of peripheral zone, particularly where associated with zooecial linings. Mesopores absent. Clear, calcite-filled minute tubes having considerable longitudinal extent and parallel to zooecial walls where plane of section includes intersection of 4 adjacent zooecia, as interpreted with aid of tangential section. Acanthopores absent.

Remarks.—Bassler (1915, pp. 1115–16) presents an extensive synonymy for *Rhombotrypa quadrata;* we do not repeat this synonymy as Bassler's compilation can be obtained readily. We do cite in synonymy, however, post-1915 papers that concern the species.

The most noticeable character of *R. quadrata* is undoubtedly the well-marked rhombic outline of its zooecia as seen in transverse section.

Both the generic and trivial names of the species allude to its rhombic zooecia.

Cumings (1912, p. 364, Pl. 22, Fig. 40), in discussing the astogenetic development of *R. quadrata,* noted the presence of structures, which he termed acanthopores, among the earlier formed zooecia of the zoarium. We were not able to verify Cumings' observation, as none of the primary types preserves the first-formed zooecia of the colony.

As has been noted by other workers (Lee, 1912, p. 145; Cumings and Galloway, 1915, pp. 359–61, 365; Boardman, 1960, pp. 25–26), the distinction between integrate and amalgamate walls, commonly used to define the two suborders of trepostomatous bryozoans, is not a practical taxonomic character as both of the foregoing types of wall commonly are noted within the same species and even within the same zoarium. Some of the primary types of *R. quadrata* have predominantly amalgamate zooecial walls (for example, 25169I); others (as 25169A) have integrate walls; and still others contain both wall types (for example, 25169B, Pl. II, Figs. 6–7).

Like many other trepostomes which are based on fragmentary zoaria, the peripheral region shows considerable range in thickness dependent on the life position of the zoarial fragments within their respective colonies (Boardman, 1954, p. 322). As in other trepostomes, some zoaria (as 25169F) show successively developed superposed zones which have closely spaced diaphragms and comparatively thick zooecial walls; the development of such zones or layers may result from temporary cessation of zoarial growth because of unfavorable environmental conditions.

Table I presents a statistical analysis of approximately five hundred measurements, which were made by Perry, of taxonomic characters on the primary types. Extended discussion of the computed statistical constants can be found in Richardson (1944). Examination of Table I indicates the following conclusions: (1) Measurements of taxonomic characters render a significantly more precise concept of the species than does a description which is essentially qualitative; (2) For ramose trepostomes, like *Rhombotrypa quadrata,* 10 measurements of a particular taxonomic character on each of 10 specimens adequately portray that feature; and (3) Measurements on a single zoarial fragment, although approximately indicating the average value for the taxonomic characteristics of a species, do not describe adequately the intraspecific variability (namely, distribution patterns of the measurements) of those characteristics.

Occurrence.—Upper Ordovician, Cincinnatian Series, Richmond Group, Indiana (according to label written by Rominger; a subsequently made

label by R. S. Bassler gives the horizon as Whitewater Formation and the locality as Richmond, Indiana).

Types.—Museum of Paleontology, University of Michigan: lectotype, 25170B; figured paralectotypes, 25169A–B, 25169G; unfigured but sectioned paralectotypes, 6685, 25169C–F, 25169H–I, 25170A; unfigured and unsectioned paralectotypes, 25169J–L, 25170C.

LITERATURE CITED

BASSLER, R. S. 1915. Bibliographic Index of Ordovician and Silurian Fossils. U. S. Nat. Mus., Bull. 92, 2 Vols., 1521 pp., 4 pls.

——— 1953. Bryozoa. Pt. G of MOORE, R. C., ed., Treatise on Invertebrate Paleontology. Lawrence, Kansas: University of Kansas Press, 253 pp., 175 text-figs.

BOARDMAN, R. S. 1954. Morphologic Variation and Mode of Growth of Devonian Trepostomatous Bryozoa. Science, Vol. 120, No. 3112, p. 322, 1 fig.

——— 1960. Trepostomatous Bryozoa of the Hamilton Group of New York State. U. S. Geol. Surv., Prof. Paper 340, 87 pp., 22 pls., 27 text-figs.

CUMINGS, E. R. 1912. Development and Systematic Position of the Monticuliporoids. Geol. Soc. Amer., Bull., Vol. 23, pp. 357–70, Pls. 19–22.

——— and GALLOWAY, J. J. 1915. Studies of the Morphology and Histology of the Trepostomata or Monticuliporoids. Geol. Soc. Amer., Bull., Vol. 26, pp. 349–74, Pls. 10–15.

DYER, W. S. 1925. The Stratigraphy and Paleontology of Toronto and Vicinity; Pt. 5, The Paleontology of the Credit River Section. Ontario Dept. Mines, Ann. Rept. 32, Vol. 32, Pt. 7, pp. 47–88, 7 pls.

FOERSTE, A. F. 1924. Upper Ordovician Faunas of Ontario and Quebec. Geol. Surv. Canada, Mem. 138, 251 pp., 46 pls.

LEE, G. W. 1912. The British Carboniferous Trepostomata. Geol. Surv. Gt. Brit., Mem., Paleontology, Vol. 1, Pt. 3, pp. 135-95, Pls. 14–16.

NICHOLSON, H. A. 1881. On the Structure and Affinities of the Genus *Monticulipora* and Its Sub-Genera, with Critical Descriptions of Illustrative Species. Edinburgh and London: William Blackwood & Sons. 240 pp., 6 pls., 50 text-figs.

RICHARDSON, C. H. 1944. An Introduction to Statistical Analysis, 2d ed. New York: Harcourt, Brace, and Co., 498 pp.

ROMINGER, CARL. 1866. Observations on *Chaetetes* and Some Related Genera, in Regard to Their Systematic Position, with an Appended Description of Some New Species. Acad. Nat. Sci. Philadelphia. Proceedings for 1866, pp. 113–23.

ULRICH, E. O., and BASSLER, R. S. 1904. A Revision of the Paleozoic Bryozoa (Trepostomata). Smithsonian Misc. Coll., Vol. 47, pp. 15–55, Pls. 6–14.

UTGAARD, JOHN, and PERRY, T. G. 1964. Trepostomatous Bryozoan Fauna of the Upper Part of the Whitewater Formation (Cincinnatian) of Eastern Indiana and Western Ohio. Indiana Geol. Surv., Bull. (In press.)

Submitted for publication, January 24, 1964

PLATES

EXPLANATION OF PLATE I

(All figures are of lectotype, 25170B)

PAGE

Rhombotrypa quadrata (Rominger) 38

FIG. 1. Transverse section showing rhombic zooecia and monticule (upper right quadrant). × 20.

FIG. 2. Transverse section displaying voids at junction angles of contiguous zooecia. × 60.

FIG. 3. Tangential section revealing zooecial wall structure, zooecial linings, and voids (upper right quadrant) simulating mural lacunae. × 60.

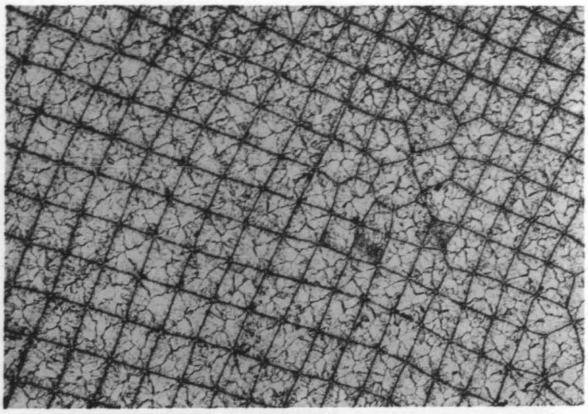
FIG. 4. Tangential section showing monticule (lower left quadrant) composed mainly of thick-walled zooecia larger than those in intermonticular areas but also including rare zooecia of smaller than average size. × 20.

FIG. 5. Zoarial fragment displaying ramose form and low monticules on right branch. × 2.

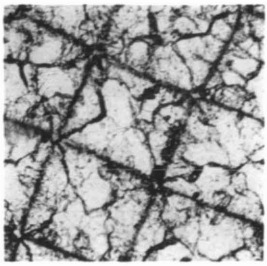
FIG. 6. Longitudinal section revealing line of demarcation of moderate development, zooecial linings composed of laminae continuing into thickened diaphragms (zooecium above center), and wall laminae proceeding into diaphragms of average thickness (zooecium below center). × 60.

FIG. 7. Longitudinal section exhibiting peripheral region of moderate thickness, manner of introduction of new zooecia, and closely spaced diaphragms confined to peripheral region. × 20.

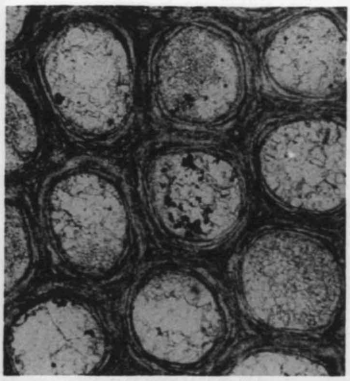
PLATE I



1

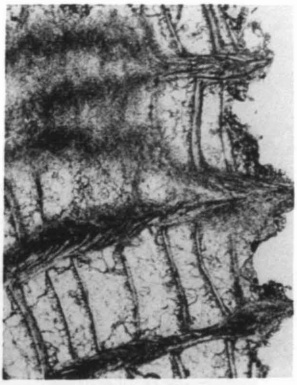


2

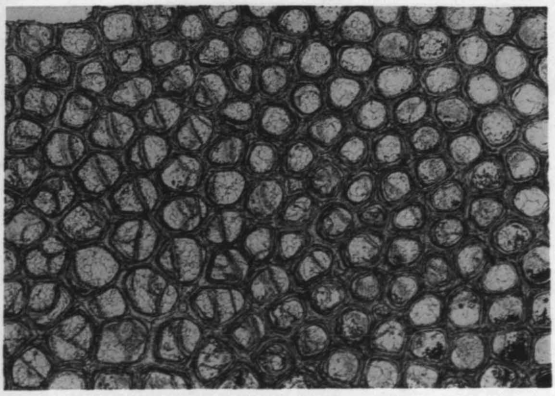


3

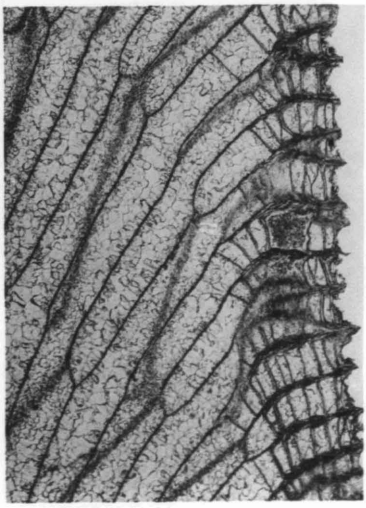
5



6

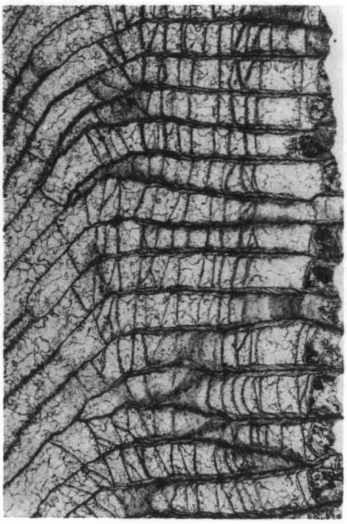


4



7

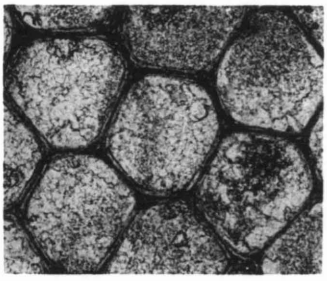
PLATE II



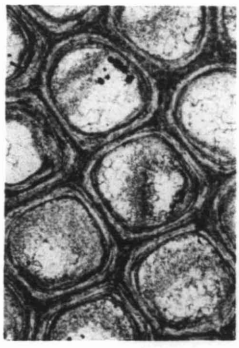
1

2

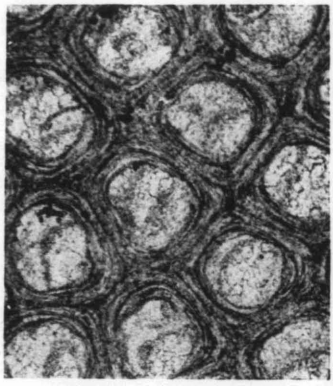
3



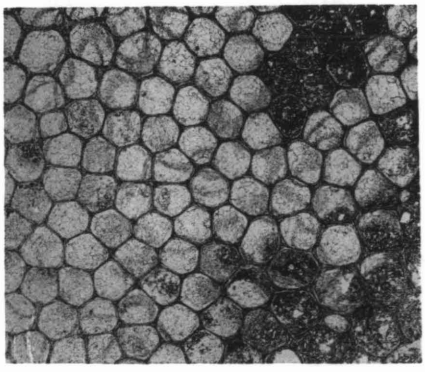
4



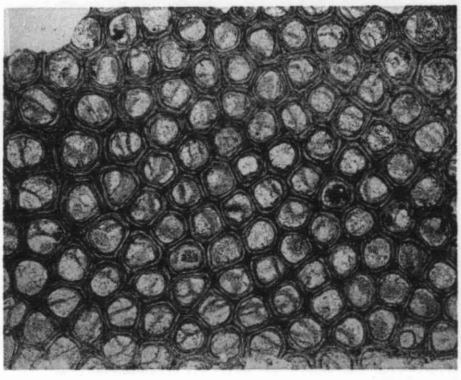
6



7



5



8

EXPLANATION OF PLATE II

(All figures are of paralectotypes)

PAGE

Rhombotrypa quadrata (Rominger) 38

FIG. 1. Longitudinal section showing thick peripheral region containing closely spaced diaphragms and slight variations in thickness of zooecial walls. 25169A. × 20.

FIG. 2. Longitudinal section revealing well-developed line of demarcation in zooecial walls, zooecial lining (on upper side of central zooecium), and continuation of wall laminae into diaphragms. 25169A. × 60.

FIG. 3. Longitudinal section showing laminae in zooecial walls and somewhat undulatory line of demarcation (in wall of lower zooecium). 25169A. × 60.

FIG. 4. Tangential section showing thin-walled zooecia revealing line of demarcation in their walls and minute voids (lower left quadrant) at junction points of adjacent zooecia. 25169G. × 60.

FIG. 5. Tangential section showing thin-walled zooecia of average size and rarely (lower right corner) of below average size. 25169G. × 20.

FIG. 6. Tangential section exhibiting clearly defined line of demarcation and thick-walled zooecia. 25169B. × 60.

FIG. 7. Tangential section in which line of demarcation is lacking or poorly and locally developed. 25169B. × 60.

FIG. 8. Tangential section showing thick-walled zooecia and portion of monticule (left center) composed of large and thick-walled zooecia. 25169B. × 20.