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THE TYPE SPECIES OF *SPINOCYRTIA* FREDERICKS  
AND NEW SPECIES OF THIS BRACHIOPOD GENUS  
FROM SOUTHWESTERN ONTARIO

BY  
GEORGE M. EHLERS and JEAN D. WRIGHT



From the  
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# CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

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## VOLUME XIII

1. The Type Species of *Spinocyrtia* Fredericks and New Species of this Brachiopod Genus from Southwestern Ontario, by George M. Ehlers and Jean D. Wright. Pages 1–32, with 11 plates.

THE TYPE SPECIES OF *SPINOCYRTIA* FREDERICKS  
AND NEW SPECIES OF THIS BRACHIOPOD GENUS  
FROM SOUTHWESTERN ONTARIO

BY

GEORGE M. EHLERS and JEAN D. WRIGHT

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INTRODUCTION

THIS paper contains emended descriptions of the genus *Spinocyrtia* Fredericks and its type species and describes new species of this brachiopod genus from the Middle Devonian Hamilton strata exposed in Bosanquet Township, Lambton County, and West Williams Township, Middlesex County, in the southwestern part of Ontario, Canada. Most of the material submitted in a thesis by the junior author in fulfillment of the requirements for the degree of Master of Science at the University of Michigan is included.

The rock exposures of Bosanquet and West Williams townships and their fossils are mentioned in many of the older geological reports. Some of the place names in this literature are obsolete and are, doubtless, confusing to a reader not familiar with the history of the region. "Widder, C. W." refers to a village in a part of Canada at one time known as "Canada West"; it was situated in the present township of Bosanquet. Before the days of the railroad, Widder flourished but, after the Grand Trunk Railway by-passed it in 1859, the village of Thedford grew up around the depot, built more than a mile to the west, and Widder dwindled to a few farmhouses. In these earlier papers a mill, variously called Bartlett's (Nicholson, 1874, p. 16), Marshall's, and Marsh's Mill (Stauffer,

1915, p. 156), is noted. This mill was located on the Ausable River (the "Rivière aux Sables" of Whiteaves, 1898, p. 361), about two miles north-east of Arkona, Bosanquet Township, and its site is in a region now known locally as "Hungry Hollow."

#### *Previous Work*

Nicholson (1875, p. 82) identified a brachiopod, discovered near Ravenswood, Bosanquet Township, in strata now considered to be within the Ipperwash limestone, as *Spirifera granulifera* (Hall) [= *Spinocyrtia granulifera* (Hall)]. Stauffer (1915, faunal lists, pp. 171, 181) reported the occurrence of *Spirifer granulosus* (Conrad) [= *Spinocyrtia granulosa* (Conrad)] in the Ipperwash limestone and from strata now placed in the Hungry Hollow formation. Cooper and others (1942, p. 1767) comment on the "large *Spirifer granulosus*" that is found in the Ipperwash limestone.

The new species of *Spinocyrtia* described herein were collected from the Arkona shale, the Widder formation, and the Ipperwash limestone. The specimens of *Spinocyrtia* that were obtained from the Hungry Hollow formation are too fragmentary or too poorly preserved to permit description.

#### *Material*

The neotype of *Spinocyrtia granulosa* (Conrad) is in the collection of the Buffalo Museum of Science. Hypotypes of this species and all specimens from Ontario studied are catalogued and deposited in the Museum of Paleontology of the University of Michigan.

#### *Acknowledgments*

The authors wish to express their indebtedness to all who aided them in the preparation of this paper. Thanks are extended to the New York State Museum and the Buffalo Museum of Science for the loan of specimens from New York for comparative study; to the American Museum of Natural History for permitting the junior author to examine their type specimens of *Spinocyrtia*; and to Raymond R. Hibbard of Buffalo, New York, and Mr. and Mrs. Charles Southworth of Thedford, Ontario, for gifts of brachiopods of this genus.

The help of Dr. G. Arthur Cooper of the United States National Museum, Dr. Erwin C. Stumm and Dr. Robert V. Kesling of the Museum of Paleontology of the University of Michigan, and Irving G. Reimann, Prefect of Exhibits of the University Museums of the same university, is much appreciated. Mrs. Assya Humecky of the Slavic Languages and

Literatures Department of the University of Michigan kindly translated two Russian descriptions, and William H. Buettner and John K. Brigham assisted in the preparatorial and photographic work.

The authors are indebted to Dr. Lewis B. Kellum, Dr. Chester A. Arnold, and Dr. Robert V. Kesling for a critical reading of the manuscript.

#### DESCRIPTION OF STRATA

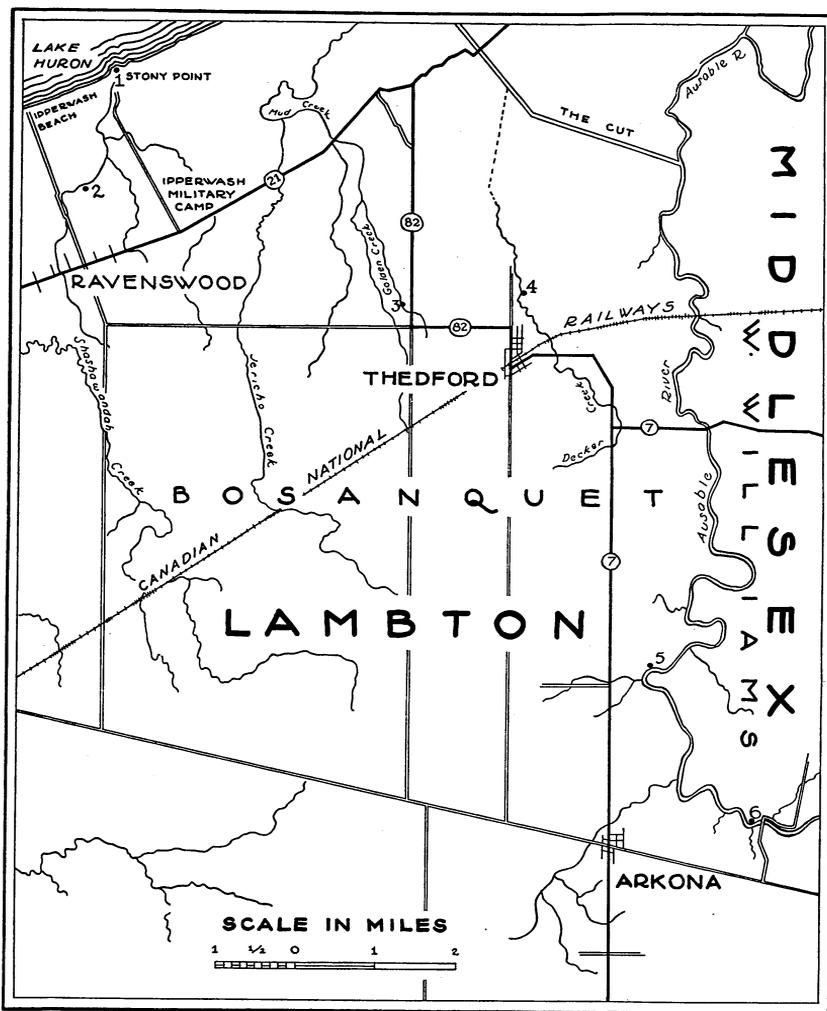
The Middle Devonian Hamilton group in southwestern Ontario has been divided into five units which, in ascending order, are the Arkona shale, the Hungry Hollow formation, the Widder shale, the Petrolia shale, and the Ipperwash limestone (see Cooper and others, 1942, Chart No. 4). These units, except for the Petrolia shale, are exposed at many places in Lambton and Middlesex Counties near the villages of Thedford and Arkona and in some of the fields and roadside ditches between Thedford and the shore of Lake Huron (see Map 1). The Petrolia shale, according to Stauffer (1915, p. 11) is a "soft blue shale . . . not well exposed anywhere within the province."

Grabau called the bluish shales that form the lowest unit of the Hamilton group in Bosanquet and West Williams townships the "Arkona beds," after the village of that name (1917, p. 341). This unit is now referred to as the Arkona shale. The type section of the Hungry Hollow formation is in the bluffs that line the Ausable River at the place known locally by that name (Cooper and Warthin, 1941, p. 260). To the argillaceous limestone and shale forming the rise of ground at the site of the former village of Widder, Stauffer (1915, p. 10) gave the name "Widder beds." The thick shale noted in the borings of many wells near Petrolia he designated (p. 11) the Petrolia shale and the top limestone of the Hamilton group in this region he named the Ipperwash limestone from an exposure near Ipperwash Beach on the shore of Lake Huron.

#### LIST OF LOCALITIES

##### LOCALITY

1. Shore of Lake Huron at Stony Point, Provincial Park, Bosanquet Township, Lambton County, Ontario, at the end of the Military Road. Limestone, gray to buff gray, weathers light buff; some layers with glauconite and limonite. Considered by Stauffer (1915, p. 180) to be a part of the Ipperwash limestone, Middle Devonian Hamilton group.
2. Field near Ravenswood, Bosanquet Township, Lambton County, Ontario, about four-tenths mile northeast of the Ipperwash Beach road and about nine-tenths mile northwest of Highway 21. Limestone, dark gray, finely crystalline; overlain by brown limonitic shale; shale overlain by much-weathered, thin-bedded, coarsely crystalline limestone. Ipperwash limestone, Middle Devonian Hamilton group.



MAP 1. Localities in Lambton and Middlesex counties, Ontario, where specimens of *Spinocyrtia* were collected.

3. Bed of Golden Creek on the farm of Eldon Laird, west side of Highway 82, about  $1\frac{1}{4}$  miles west and three-quarters mile north of Theedford, Bosanquet Township, Lambton County, Ontario. Limestone, argillaceous, buff gray. Probably near top of the Widder formation, Middle Devonian Hamilton group.
4. Bank of Decker Creek near the Tile Yard, about one mile north of the center of Theedford, Bosanquet Township, Lambton County, Ontario, and about one-eighth mile east of a road leading north from Theedford. Limestone. The "Encrinal limestone" of the Hungry Hollow formation, Middle Devonian Hamilton group.

5. Bank of the Ausable River at No. 4 Hill, about 2½ miles north of Arkona, Bosanquet Township, Lambton County, Ontario, and about one-half mile east of Highway 7. Shale, gray, 1 to 2 inches thick. Part of the Arkona shale, about 28 feet below bottom of the "Encrinal limestone" of the Hungry Hollow formation, Middle Devonian Hamilton group.
6. North bank of the Ausable River at Hungry Hollow, West Williams Township, Middlesex County, Ontario, about 2 miles east and about one-quarter mile north of the center of Arkona. Shale, calcareous, light gray. The "Coral zone" of the Hungry Hollow formation, Middle Devonian Hamilton group.
7. Shore of Lake Erie, near Eighteen Mile Creek, Erie County, New York. Shale, dark gray. The *Stropheodonta demissa* bed near top of the Wanakah shale member of the Ludlowville formation, Middle Devonian Hamilton group.
8. Bed of Smoke Creek, a short distance upstream from Berg Road, 1½ miles south of Reserve, Erie County, New York. Shale, dark gray. The *Stropheodonta demissa* bed near top of the Wanakah shale member of the Ludlowville formation, Middle Devonian Hamilton group.

## SYSTEMATIC DESCRIPTIONS

## Phylum BRACHIOPODA

## Class ARTICULATA

## Order TELOTREMATA

## Superfamily Spiriferacea

## Family Spiriferidae King 1846

## Subfamily Spiriferinae Schuchert 1913

Genus *Spinocyrtia* Fredericks 1916

*Spinocyrtia* Fredericks, 1916, p. 18.

*Type species*.—*Delthyris granulosa* Conrad, 1839, p. 65, by designation of Fredericks, 1916, p. 18; 1926, p. 411.

*Previous work*.—The name *Spinocyrtia* was proposed by Fredericks (1916, p. 18) for spiriferids having both a granulose surface and a delthyrial plate. Fredericks' original description is in Russian; a translation follows:

*Ostiolatae*:

*C. unicipinae*. *Spinocyrtia* nov. nom. Shell adorned by simple spines. (Cyrtia-like, but spinose). Type specimens: *Spinocyrtia granulosa* Conrad and *Spinocyrtia arrecta* Hall.

In studying the monograph of Hall and Clarke [Palaeontology of N. Y., Vol. VIII, Pt. II], we find a whole group of examples which illustrate the representatives of *Spiriferi Ostiolati*, having a structure consisting of a number of bumps or of single spines, which are: *Sp. macrothyris* Hall (Pl. XXXIII, Figs. 16–18), *Sp. Marcyi* Hall (Pl. XXII, Figs. 10–14), *Sp. granulosis* Conr. (Pl. XXIII, Figs. 1–15; Pl. XXIX, Figs. 9–12), *Sp. asper* Hall. (Pl. XXV, Figs. 20–25); also, among the representatives of *Sp. fimbriati unicipinei* there is one which has a delthyrial plate,—this is *Sp. arrectus* Hall (Pl. XXXIII, Figs. 24–27). The presence of the above-mentioned peculiar structure

(bumps or single spines) allows us to separate these species into a distinct group which corresponds to *Delthyris* in the *Aperturatae*, and to give it a special name—*Spinocyrtia*.

Fredericks subsequently (1926, p. 411) designated *Delthyris granulosa* Conrad the type species of his genus. Stainbrook (1943, pp. 419–21) gave a detailed description of *Spinocyrtia*, which he considered to be a subgenus of the genus *Spirifer* Sowerby. G. Arthur Cooper (in Shimer and Shrock, 1944, p. 323) regarded *Spinocyrtia* as a genus.

*Description*.—Shell small to large, biconvex, spiriferoid; anterior commissure strongly sulcate. Sulcus of pedicle valve and fold of brachial valve with median depression, on each side of which one or more demissicostae<sup>1</sup> may be discernible. Surface of shell, lateral to sulcus and fold, costate; each costa narrow, high, and rounded in umbonal region, becoming wide, low, and flattened towards the front margin; the costae that bound sulcus bifurcating in mature shells of some species. Each valve covered with many radiating microfila, crossed by a large number of extremely fine, closely spaced growth lines, on which tear-shaped granules are aligned.

Pedicle valve with moderately high, slightly concave interarea, indistinctly divided into a wide inner part and two narrow outer parts; inner part transversely and longitudinally striate; outer parts transversely striate. Beak prominent, incurved. Delthyrium open. Interior with simple teeth and strong dental plates. Delthyrial plate occupying apical part of delthyrial cavity. Myophragm prominent with specific differences in shape. A low, narrow ridge extending anteriorly from myophragm. Muscle-scar area subrhombic in outline, depressed; diductor scars large, with prominent ridges and grooves; adductor scars very narrow and smooth.

Brachial valve with very narrow interarea, inconspicuous beak, and very wide notothyrium. Interior with wide, deep dental sockets, and thick socket plates. Cardinal process low; myophore curved, with fine vertical striations. Median ridge low and narrow. Muscle-scar area subpyriform in outline; anterior adductor scars depressed below level of posterior adductor scars; surface of scars with ridges and grooves.

*Spinocyrtia granulosa* (Conrad)

(Pl. I, Figs. 4–9; Pl. II, Figs. 1, 2; Pl. III)

*Delthyris granulosa* Conrad, 1839, p. 65.

*Spirifera granulifera* Hall, *partim*, 1867, Pl. 36, Figs. 1–3, 5–10; ?Figs. 11–13.

*Spirifer granulosus* (Conrad), Hall, 1894, Pl. 28, Fig. 11; ?Figs. 12, 13; Hall and Clarke, 1894, Pl. 23, Fig. 1; ?Figs. 2–15; Schuchert, *partim*, 1897, p. 391; Grabau,

<sup>1</sup> Demissicosta (New term: Lat. *demissus*, low; *costa*, rib): A very low, gently convex rib, that occurs on the fold and sulcus in brachiopods. It is apparently formed in the same manner as a costa.

- 1899, pp. 210-11, Fig. 118; ?specimen from which illustration of ornamentation was made; Grabau and Shimer, 1909, p. 328, Fig. 417.
- Spinocyrtia granulosa* (Conrad), Fredericks, 1916, p. 18; Fredericks, 1926, p. 411; Shimer and Shrock, 1944, p. 323, Pl. 123, Figs. 6-8.
- non Delthyris granulifera* Hall, 1843, pp. 206-7, No. 85, Figs. 1, 1a; ?Figs. 1b-d; No. 47, Figs. 1, 1a; ?Figs. 1b-d.
- non Delthyris congesta* Hall, 1843, pp. 206-7, No. 85, Figs. 2, 2a; No. 47, Figs. 2, 2a.
- non Spirifer granulifera* Hall, 1857, pp. 163-64.
- non Spirifer arata* Hall, 1857, p. 161.
- non Spirifer granulifera* Hall, *partim*, 1867, p. 225, Fig. 29; Pl. 36, Fig. 4.
- non Spirifer congesta* Hall, 1867, p. 225.
- non Spirifer arata* Hall, 1867, p. 235.
- non Spirifer clintoni* Hall, 1867, p. 225.
- non Spirifer granulifera* var. *clintoni* Hall, 1867, Pl. 37, Figs. 1-4.
- non Spirifer granulosus*, var. *clintoni* Hall, Grabau, 1899, p. 211, Fig. 118A.

*Original description* (Conrad, 1839, p. 65).—

Shell trigonal, ventricose, with very numerous minute elevated punctae; ribs numerous, convex, the interstices not deeply impressed; inferior valve bilobed; beak elevated, incurved, foramen large; superior valve with a wide medial [medial] convex depressed rib, with a narrow groove down the middle; umbo prominent, summit rounded. Length  $1\frac{3}{4}$  inches. *Locality*: uncertain, but belongs to the shales of No. 7.

*Emended description*.—Shell large, biconvex, spiriferoid; cardinal extremities acute, slightly extended. Hinge line straight; greatest width along hinge line. Surface of shell lateral to fold and sulcus marked by costae, 23 on each side of fold and sulcus in largest specimen examined; costae separated by narrow furrows. Each costa high and rounded in the umbonal region, becoming low, gently convex, and wider towards the anterior margin. Entire surface of costae, furrows, fold, and sulcus covered with numerous radiating microfila, which are crossed by a small number of prominent, distantly spaced growth lines and a much larger number of extremely fine, closely spaced growth lines. Tear-shaped granules aligned on the microfila, their anterior ends large, and abutting on growth lines; granules minute on the posterolateral areas adjacent to the cardinal extremities, not interrupting the continuity of the microfila; granules large and numerous on anterior and anterolateral parts of the shell, at most places interrupting the continuity of the microfila; granules in sulcus with distinct linear arrangement. Surface of posterolateral part of shell with a few wrinkles or rugae arranged nearly parallel to growth lines.

Pedicle valve moderately convex. Sulcus deep, concave, with broad, rounded tongue. Sulcus with shallow median depression; a very slightly convex demissicosta approximately the width of the median depression, on each side of median depression; a second narrower, very gently convex demissicosta lateral to each of these demissicostae. Each of the costae

bounding the sulcus high and rounded in the umbonal region, becoming lower anteriorly and bifurcating approximately at mid-length of shell; the bounding costae with greater convexity than the pair of demissicostae lying on each side of the median depression. Lateral slopes gently curved. Beak prominent and incurved. Interarea moderately high, slightly concave, crossed by transverse growth lines and indistinctly divided into an inner and two outer parts; the inner part also bearing longitudinal striations. Delthyrium open, approximately as high as wide. Interior with simple teeth, and stout dental plates reaching floor of valve; a deep concavity situated beneath palintrope lateral to each plate. Delthyrial plate occupying apical part of delthyrial cavity, lying below edges of delthyrium; its upper surface flat; its anterior surface deeply concave towards front. Myophragm a thick V-shaped ridge, the sides of which embrace a deep elongate pit. A low, narrow median ridge extending anteriorly from myophragm; ridge separates posterior parts of diductor muscle scars and posterior parts of adductor muscle scars. Muscle-scar area subrhombic in outline, depressed. Diductor muscle scars large, marked with prominent ridges and grooves; ridges and grooves of posterior part of each directed posteriorly, posterolaterally, and laterally; ridges and grooves of anterior part directed anterolaterally and anteriorly. Adductor muscle scars very narrow and relatively smooth, adjacent to median line of valve, in large part lying in front of low, narrow median ridge. Genital impressions lateral to muscle-scar area. A row of pits in floor of valve along margins adjacent to the anterolateral edges of the valve; each pit marks the position of an intercostal furrow.

Brachial valve more convex than pedicle valve. Fold prominent, moderately high, rounded, with a relatively shallow median depression; indistinct demissicostae discernible in some specimens on each side of fold lateral to depression. Lateral slopes gently convex to flat, concave between umbonal region and cardinal extremities. Umbonal region elevated above hinge line. Beak inconspicuous. Interarea very narrow. Notothyrium very wide. Interior with relatively wide and deep dental sockets; socket plates thick. Cardinal process low; gently curved myophore in apical part of notothyrium marked by fine vertical striations. Median ridge low, narrow, rounded, extending forward from base of cardinal process to point slightly in front of anterior adductor muscle scars. Muscle-scar area subpyriform in outline. Anterior adductor muscle scars deeply depressed below level of posterior adductor muscle scars. Each posterior muscle scar semiovate in outline; surface with prominent anterolaterally directed ridges and grooves. Anterior adductor muscle-scar area obovate in outline; most of surface of each scar with low, closely spaced, laterally directed narrow ridges and

shallow grooves; surface of extreme anterior part with few, very indistinct, anteriorly directed ridges and grooves.

Type	Measurements (in mm.)				
	Length	Length of Brachial Valve	Mid-Width	Hinge Width	Thickness
Neotype No. E-9572	48.5	39.3	61.9	69.5	35.4

*Remarks.*—The specimens on which Conrad based his species, *Delthyris granulosa*, are lost and there is little likelihood of their ever being found. Although Conrad's description (1839, p. 65), which was unaccompanied by illustration, is brief, it includes one diagnostic character, "a narrow groove down the middle" of the fold. At the end of his description he gives the occurrence of the species as "*Locality*: uncertain, but belongs to the shales of No. 7." A "Table of formations, showing the order of superposition, and some characteristic fossils of the Transition strata," which precedes the description (pp. 62–63), has no reference to shales in unit 7, but it indicates the presence of "dark coloured shales" containing typical Hamilton fossils in unit 8 overlying unit 7. Since brachiopods of the genus *Spinocyrtia* occur in the dark-colored Hamilton shales of New York State, probably the specimens identified by Conrad as *Delthyris granulosa* came from the shales of unit 8 instead of from "the shales of No. 7." In the authors' opinion, therefore, the neotype of *Spinocyrtia granulosa* (Conrad) should be a specimen from the Hamilton shales possessing "a narrow groove" in the brachial fold as specified by Conrad.

From an examination of Hall's descriptions and some of his types in the American Museum of Natural History, it is evident that Hall included several species in his *Spirifer granulifera* that are not conspecific. In 1867, Hall (p. 225) listed as synonymous with *Spirifera granulifera* his species *Spirifer congesta* and *Spirifer clintoni*. *Spirifer congesta*, according to Hall, is "a specimen of this species [*Spirifera granulifera*] having a short hinge-line and very obtuse cardinal extremities, a narrow area, incurved beak, and a mesial fold simply flattened instead of the usual groove." In discussing *Spirifer clintoni*, he stated that "the plications and sinus have a sharper and more angular expression [than *Spirifera granulifera*]." These two species are obviously not conspecific with *Spirifera granulifera* Hall. In 1857 Hall (p. 161) described *Spirifer arata*. Later (1867, p. 235) he discarded this name, because he had become convinced that it was a junior synonym of *Spirifera granulifera* Hall.

The problem is whether or not Conrad's *Delthyris granulosa* is the same as Hall's *Spirifera granulifera*. Hall and Clarke (1894, p. 29) con-

sidered *Spirifera granulifera* a synonym of *Spirifer granulosus* (Conrad). Conrad's description of a spiriferid with a narrow median depression in the fold cannot possibly agree with the description of Hall's *Spirifera granulifera*. *Spirifera granulifera*, as can be seen from Hall's description and illustrations (1843, pp. 206-7, No. 85, Figs. 1, 1a; No. 47, Figs. 1, 1a), has a wide and deep median depression in the fold.

Conrad's description of *Delthyris granulosa* fits most closely specimens of *Spinocyrtia granulosa* from the *Stropheodonta demissa* bed of the Wanakah shale member of the Ludlowville formation of the Hamilton group in western New York. He may very well have had material from this stratigraphic position and location. The specimen selected as a neotype comes from the *Stropheodonta demissa* bed and was found on the shore of Lake Erie near Eighteen Mile Creek, a locality known to many of the early collectors.

Many shells of *Spinocyrtia granulosa* (Conrad) from the *Stropheodonta demissa* bed of the Wanakah shale of New York are drilled with circular borings approximately one millimeter in diameter and have auloporoids attached along the anterior and anterolateral margins. Since auloporoids occur on the shells of species of *Spinocyrtia* from the Hamilton deposits of Ontario, it is possible that some degree of commensalism between various species of *Spinocyrtia* and *Aulopora* existed.

*Occurrence.*—Localities 7 and 8.

*Types.*—Conrad's type is missing. Neotype No. E-9572, Buffalo Museum of Science; collected by Fred W. Wattles, Jr. Hypotypes Nos. 32459 and 32460.

### ***Spinocyrtia mourantae*, sp. nov.**

(Pl. I, Figs. 1-3; Pl. IV, Figs. 1-4; Pl. V, Figs. 1, 2)

*Description.*—Shell small, biconvex, spiriferoid; cardinal extremities acute to slightly extended. Hinge line straight; greatest width in undistorted specimens along hinge line. Surface of shell lateral to fold and sulcus marked by low rounded costae, 16 on each side of fold and sulcus of most specimens examined, separated by narrow furrows. Each costa high and rounded in the umbonal region, becoming low, gently convex, and wider towards the anterior margin. Entire surface of costae, furrows, fold, and sulcus covered with numerous radiating microfila, which are crossed by a small number of prominent, distantly spaced growth lines and a much larger number of extremely fine, closely spaced growth lines; minute tear-shaped granules aligned on microfila, producing a finely granular or beaded appearance where surface is unweathered.

Pedicle valve moderately convex. Sulcus broad, shallow, subangular, with a broad, rounded tongue. Sulcus with a relatively broad, flat median depression; a wide, very gently convex demissicosta faintly discernible on each side of median depression. Lateral slopes gently curved. Umbonal region prominent. Beak inconspicuous, very slightly incurved. Interarea moderately wide, flat to slightly concave, striated transversely and longitudinally. Delthyrium open, large, approximately as high as wide. Interior unknown.

Brachial valve more convex than pedicle valve in most specimens. Fold broad, low, not much elevated above the level of the costae, with a very poorly indicated but apparently wide median depression. In all specimens examined, lateral limits and depth of median depression of fold almost obliterated by fractures of the shell and partial absorption of shell material by encrusting auloporoids. Lateral slopes gently convex to flat, slightly concave near cardinal extremities. Umbonal region elevated above hinge line. Beak inconspicuous. Interarea very narrow. Interior unknown.

Type	Measurements (in mm.)				
	Length	Length of Brachial Valve	Mid-Width	Hinge Width	Thickness
Paratype No. 31527	23.3	18.0	28.4	30.7*	14.5*
Paratype No. 31528	27.5	21.3	35.0	38.0*	20.0*
Paratype No. 31529	30.0	23.5	34.1	34.1	23.0
Holotype No. 31530	30.0	24.0	37.5	39.4*	25.0

\* Measurement estimated.

*Remarks.*—Complete specimens of *Spinocyrtia mourantae* are rare. All examples known to the authors are very poorly preserved; the surfaces of many are weathered to such an extent that very little ornamentation remains. Many of the shells are riddled with borings and are encrusted with *Aulopora* sp. and/or bryozoa. The species is small for the genus. It is distinguished by a shallow subangular sulcus with a relatively broad, flat median depression and has a broad, very low fold, which appears to have a wide median depression.

*Spinocyrtia mourantae* is named in honor of Mrs. Charles Southworth (née Mourant) of Thedford, Ontario, who found the holotype while on a collecting trip with her husband.

*Occurrence.*—Locality 5.

*Types.*—Holotype No. 31530; paratypes Nos. 31527, 31528, and 31529.

**Spinocyrtia parvigranulata**, sp. nov.

(Pl. IV, Figs. 5-11; Pl. V, Fig. 3)

*Description*.—Shell of medium size, biconvex, spiriferoid; cardinal extremities extended. Hinge line straight; greatest width along hinge line. Surface of shell lateral to fold and sulcus marked by costae, 17 to 20 on each side of fold and sulcus in specimens examined; costae separated by narrow furrows. Each costa high and rounded in the umbonal region, becoming low, gently convex and wider towards the anterior margin. Entire surface of costae, furrows, fold, and sulcus covered with many radiating microfila, which are crossed by a small number of rather prominent, distantly spaced growth lines and a much larger number of extremely fine, closely spaced growth lines. Small tear-shaped granules aligned on these microfila; granules spaced relatively far apart.

Pedicle valve moderately convex. Sulcus broad, shallow, concave, with long, rounded tongue. Sulcus with shallow median depression; a wide, gently convex demissicosta faintly discernible on each side of median depression. Each of the costae bounding the sulcus high and rounded in the umbonal region, becoming low and gently convex anteriorly, and bifurcating in the umbonal region in older specimens. Lateral slopes gently curved. Beak prominent and incurved. Interarea moderately high, slightly concave, crossed by transverse growth lines, and indistinctly divided into a wide inner part and two narrow outer parts, the inner part bearing also longitudinal striations. Delthyrium open, approximately as high as wide. Interior with simple teeth and laterally concave dental plates reaching floor of valve; a deep concavity situated beneath palintrope lateral to each plate. Delthyrial plate occupying apical part of delthyrial cavity, lying below edges of delthyrium; its upper surface slightly concave and its anterior edge deeply concave towards front. Myophragm thick and semi-conical, lying considerably below level of the delthyrial plate, its posterior part situated under and behind the concave edge of the delthyrial plate. No median ridge indicated in specimens available. Muscle-scar area apparently subrhombic, its outline very indistinct due to imperfect preservation. Surface characteristics of muscle scars unknown.

Brachial valve more convex than pedicle valve. Fold broad, very high, rounded, with very narrow, shallow median depression that disappears anteriorly in older shells; an indistinct demissicosta discernible in some specimens on each side of fold near anterior margin of shell. Lateral slopes gently convex to flat, slightly concave near cardinal extremities. Umbonal region elevated above hinge line. Beak inconspicuous. Interarea very narrow. Notothyrium very wide. Interior with relatively wide and deep

dental sockets; socket plates thick. Cardinal process low; myophore curved, surface badly weathered. Median ridge long, narrow, extending forward to anterior margin of muscle-scar area. Muscle-scar area subpyriform. Anterior adductor muscle scars depressed below level of posterior adductor muscle scars. Each posterior muscle scar semiovate; surface of scar with anterolaterally directed ridges and grooves. Other details of interior unknown due to imperfect preservation. Parts of spiralia observed in some specimens.

Type	Measurements (in mm.)				
	Length	Length of Brachial Valve	Mid-Width	Hinge Width	Thickness
Paratype No. 32456	25.0	20.1	32.6	41.0*	17.0
Holotype No. 32457	39.5	31.5	48.2	59.0*	30.7
Paratype No. 32753	41.0	32.3	51.4	58.0	29.5

\* Measurement estimated.

*Remarks.*—All known examples of this species are poorly preserved. The shells are, in large part, silicified and the minute structures of the shell, both external and internal, have been obliterated in the course of silicification and by subsequent development of Beekite rings. Discovery of well-preserved specimens that show details of the structure more clearly may necessitate a modification of the above description.

*Spinocyrtia parvigranulata*, sp. nov., is distinguished by a broad, shallow, concave sulcus with a shallow median depression, a broad, very high, rounded fold with a very narrow, shallow median depression, extended cardinal extremities, and granules of small size.

*Occurrence.*—Locality 3.

*Types.*—Holotype No. 32457; paratypes No. 32456, 32458, and 32753 (not illustrated).

### *Spinocyrtia tumidigranulata*, sp. nov.

(Pl. VI, Figs. 1-4; Pl. VII)

*Description.*—Shell of medium size, biconvex, spiriferoid; cardinal extremities extended. Hinge line straight; greatest width of shell along hinge line. Surface of shell lateral to fold and sulcus marked by rounded costae, 16 to 19 on each side of fold and sulcus, separated by relatively deep and wide furrows. Each costa high and rounded in the umbonal region, becoming less convex and wider towards the anterior margin. Entire surface of costae, furrows, fold, and sulcus covered with many radiating microfila, which are crossed by a small number of prominent, distantly

spaced growth lines and a much larger number of fine, closely spaced growth lines; relatively large, tumid, tear-shaped granules aligned on microfila, producing a coarsely granular appearance where surface is unworn.

Pedicle valve moderately convex. Sulcus broad, shallow, subangular, with a broad, rounded tongue. Sulcus with a narrow, relatively deep median depression; a demissicosta, about four times as wide as median depression, on each side of median depression; a second demissicosta, approximately twice the width of the median depression, lateral to each of these demissicostae. Each of the costae bounding the sulcus high in the umbonal region, becoming lower anteriorly, and bifurcating at a point about one-third the length of shell from the beak; these bounding costae with greater convexity than the pair of demissicostae lying on each side of median depression. Lateral slopes gently curved. Beak slightly incurved. Interarea moderately high and slightly concave, crossed by transverse growth lines which are ill-defined due to poor preservation; interarea indistinctly divided into an inner and two outer parts, the inner part bearing longitudinal striations as well as the transverse growth lines. Delthyrium open, approximately as high as wide. Structures of interior of the valve unknown.

Brachial valve more convex than pedicle valve. Fold prominent, moderately high, rounded, with a narrow, relatively deep median depression; a narrow, very slightly convex demissicosta barely discernible in some specimens along each lateral margin of fold. Lateral slopes gently convex, concave between umbonal region and cardinal extremities. Umbonal region elevated above hinge line. Beak inconspicuous. Interarea very narrow. Notothyrium apparently wide, very poorly preserved in specimens examined. Structures of interior of the valve unknown.

Type	Measurements (in mm.)				
	Length	Length of Brachial Valve	Mid-Width	Hinge Width	Thickness
Holotype No. 32668	30.4	23.9	42.5	50.4	22.0

*Remarks.*—*Spinocyrtia tumidigranulata* is characterized by its width, which, in relation to its length, is greater than in other species of the genus. It is further distinguished by having high costae, separated by relatively deep and wide furrows, and large tumid granules.

*Occurrence.*—Locality 1, in beds of glauconitic limestone.

*Type.*—Holotype No. 32668.

**Spinocyrtia carinata**, sp. nov.

(Pl. VI, Figs. 5-11; Pl. VIII, Figs. 1, 2)

?*Spirifer huroniensis* Castelnau, 1843, p. 41, Pl. 12, Figs. 6, 6a-c.

*Description.*—Shell of medium size, biconvex, spiriferoid; cardinal extremities angular or slightly extended. Hinge line straight; greatest width in most specimens along hinge line, in others at mid-length. Surface of shell lateral to fold and sulcus marked by costae, 17 to 20 on each side of fold and sulcus in specimens examined; costae separated by relatively shallow and narrow furrows. Each costa high and rounded in the umbonal region, becoming low, gently convex, and wider towards the anterior margin. Entire surface of costae, furrows, fold, and sulcus covered with many radiating microfila, which are crossed by a small number of prominent, distantly spaced growth lines and a much larger number of extremely fine, closely spaced growth lines. Tear-shaped granules aligned on the microfila, their anterior ends large and abutting on growth lines; granules minute on the posterolateral areas adjacent to the cardinal extremities, not interrupting the continuity of the microfila; granules large and numerous on anterior and anterolateral parts of the shell, at most places interrupting the continuity of the microfila; granules in sulcus with distinct linear arrangement.

Pedicle valve moderately convex. Sulcus deep, subangular, with long, acutely terminated tongue. Sulcus with median depression; a broad demissicosta on each side of the median depression; in sulci of specimens better preserved than those available another demissicosta may be present lateral to this one. Lateral slopes gently curved. Beak prominent and incurved. Interarea moderately high, slightly concave, with poorly preserved transverse and longitudinal striations. Delthyrium open, approximately as high as wide. Interior with simple, broad teeth and thick dental plates. Delthyrial plate occupying apical part of delthyrial cavity, lying below edges of delthyrium; its upper surface slightly concave; its anterior face concave towards front. Myophragm thick and semiconical. A low, narrow median ridge extending anteriorly from apex of semiconical myophragm for a distance equal to about one-half the length of the muscular area. Muscle-scar area subrhombic and deeply depressed, deepest just in front of the anterior face of the delthyrial plate; variable in width. Diductor muscle scars large, marked with prominent ridges and grooves. Adductor muscle scars very narrow and relatively smooth, extending from a point lateral to apical part of myophragm to anterior margin of muscle-scar area. Large, variously-shaped protuberances on anterior and lateral margins in many specimens.

Brachial valve more convex than pedicle valve, gibbous in old specimens. Fold prominent, very high, carinate, with a narrow, shallow median depression. Lateral slopes gently convex to flat, slightly concave near cardinal extremities. Umbonal region elevated above hinge line. Beak inconspicuous. Interarea very narrow, poorly preserved in specimens available. Notothyrium very wide. Interior with wide and deep dental sockets; socket plates thick. Cardinal process low; gently curved myophore in apical part of notothyrium marked with fine vertical striations. Median ridge low and narrow, extending forward from base of cardinal process to point slightly in front of anterior adductor muscle scars. Muscle-scar area subpyriform. Anterior adductor muscle scars depressed below level of posterior adductor muscle scars. Each posterior adductor muscle scar hemicordate in outline; surface of scar with prominent anterolaterally directed ridges and grooves. Anterior adductor muscle-scar area obovate; surface of each scar with many low, closely spaced narrow ridges and shallow grooves; ridges and grooves anterolaterally directed in smaller, posterior part of scar; ridges and grooves subparallel, laterally directed in the much larger anterior part of scar.

Type	Measurements (in mm.)				
	Length	Length of Brachial Valve	Mid-Width	Hinge Width	Thickness
Holotype No. 32669	37.5	28.7	43.0	42.0*	28.2

\* Measurement estimated.

*Remarks.*—It is impossible to determine whether *Spinocyrtia carinata*, sp. nov., is the same species Castelnau (1843, p. 41, Pl. 12, Figs. 6, 6a-c) described as *Spirifer huroniensis*. His original description is insufficient for specific identification and the illustrations which accompany it are of two or three poorly preserved specimens and show no details of structure. Castelnau gave the locality from which his specimens of *Spirifer huroniensis* were collected as the "bords du lac Huron," but one is unable to learn from the text which shore may have been intended. The formation from which Castelnau's specimens came is also unknown and his types are lost. It seems advisable, therefore, to describe *Spinocyrtia carinata* as a new species and place *Spirifer huroniensis* in doubtful synonymy.

*Spinocyrtia carinata* is distinguished by a deep, subangular sulcus with a median depression, and a prominent, carinate fold having a narrow, shallow median depression.

*Occurrence.*—Locality 1, represented by many specimens in a glauco-

nitic limestone. The species is associated with *Spinocyrtia tumidigranulata*, specimens of which are relatively scarce.

*Types*.—Holotype No. 32669; paratypes Nos. 32670–32674.

***Spinocyrtia ravenswoodensis*, sp. nov.**

(Pl. IX, Figs. 1–9; Pl. X, Figs. 1–8; Pl. XI, Figs. 1, 2)

*Spirifera granulifera* Nicholson, 1875, p. 82.

*Description*.—Shell of medium size, biconvex, spiriferoid; cardinal extremities acute, slightly extended. Hinge line straight; greatest width along hinge line. Surface of shell lateral to fold and sulcus marked by costae, 18 on each side of fold and sulcus in most specimens; costae separated by narrow furrows. Each costa high and rounded in umbonal region, becoming low, gently convex, and wider towards anterior margin. Entire surface of costae, furrows, fold, and sulcus covered with many radiating microfila, which are crossed by a small number of prominent, distantly spaced growth lines and a much larger number of extremely fine, closely spaced growth lines. Tear-shaped granules abutting on the growth lines and aligned on the microfila.

Pedicle valve moderately convex. Sulcus deep, subangular, with long, acutely rounded tongue. Sulcus with deep, wide median depression extending from beak to anterior margin; a slightly convex demissicosta on each side of the median depression. Beak prominent and incurved. Interarea moderately high, concave, crossed by transverse growth lines, and divided into an inner part and two outer parts, the inner part bearing also longitudinal striations. Delthyrium open, approximately as high as wide. Interior with broad, simple teeth and stout dental plates; a deep concavity situated beneath palintrope lateral to each plate. Delthyrial plate occupying apical part of delthyrial cavity and lying below edges of the delthyrium; its upper surface slightly concave; its anterior face deeply concave towards front. Myophragm, convex and semiconical, lying considerably below level of the delthyrial plate; its posterior part situated under and behind the concave edge of the delthyrial plate. A low, narrow median ridge extending anteriorly from myophragm and separating posterior parts of diductor muscle scars. Muscle-scar area subpyriform and depressed. Muscle scars large; surface markings of scars poorly preserved. Genital impressions lateral to muscle-scar area.

Brachial valve more convex than pedicle valve, gibbous in mature specimens. Fold low, rounded, with a deep and relatively wide median depression extending from beak to anterior margin. Lateral slopes gently

convex to flat, slightly concave near cardinal extremities. Umbonal region elevated above hinge line. Beak inconspicuous. Interarea very narrow. Notothyrium very wide. Interior with relatively wide and deep dental sockets; socket plates moderately thick. Cardinal process low with myophore. Median ridge low and narrow, extending forward from base of cardinal process to point even with front of anterior adductor muscle scars. Muscle-scar area subpyriform. Anterior adductor muscle scars depressed below level of posterior adductor muscle scars. Each posterior muscle scar semiovate; surface of scar with prominent anterolaterally directed ridges and grooves. Anterior adductor muscle-scar area obovate; surface of each scar marked with low, closely spaced, laterally directed narrow ridges and shallow grooves. Parts of spiralia observed in some worn specimens.

Type	Measurements (in mm.)				
	Length	Length of Brachial Valve	Mid-Width	Hinge Width	Thickness
Paratype No. 32676	34.3	25.4	43.5*	49.0*	28.0
Holotype No. 32682	40.0	30.6	52.7	54.0*	31.5
Paratype No. 32683	42.7	33.0	51.4*	52.0*	38.4

\* Measurement estimated.

*Remarks.*—The brachiopods that Nicholson (1875, p. 62) stated were collected by Mr. George Jennings Hinde from the "Hamilton Formation of Ravenswood" and which he identified as *Spirifer granulifera* (Hall) [= *Spinocyrtia granulifera* (Hall)], came from the same locality and strata as the specimens of *Spinocyrtia ravenswoodensis* described here. The specimens studied, and also with little doubt those examined by Nicholson (1875, p. 62), resemble examples of *Spinocyrtia granulifera* Hall from the *Pleurodictyum* beds of the lower part of the Wanakah shale member of the Middle Devonian Ludlowville formation of western New York. *Spinocyrtia ravenswoodensis*, however, differs from *S. granulifera* in having full-grown shells of smaller size, and about three-fourths as many costae, narrower and shallower median depressions in the fold and sulcus, a relatively deeper sulcus, and the tongue of the sulcus more acutely rounded.

*Occurrence.*—Locality 2, strata of a small exposure of the Ipperwash limestone, which is at least 15 to 20 feet higher stratigraphically than the beds of Ipperwash limestone cropping out on the Lake Huron shore at Stony Point (Locality 1).

*Types.*—Holotype No. 32682; paratypes Nos. 32675–32681, 32683.

*Spinocyrtia* sp.

A few other examples of *Spinocyrtia* were found in the Hungry Hollow formation, some embedded in the uppermost part of the "Encrinal limestone" (Locality 7) and one free in the "Coral zone" member, which lies above it (Locality 8). The specimens, however, are too fragmentary or too poorly preserved to permit description.

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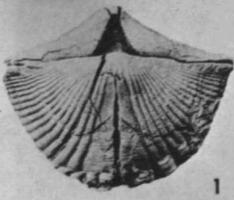
**PLATES**

## EXPLANATION OF PLATE I

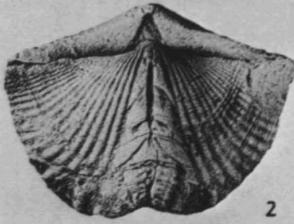
(All figures  $\times 1$ )

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|---|------|
| <i>Spinocyrtia mourantae</i> , sp. nov. ....  | 10   |
| <p>FIGS. 1-2. Brachial valves and parts of pedicle valves of two fairly well-preserved but partly crushed shells. Corallites of <i>Aulopora</i> sp. attached to anterior and anterolateral margins of brachial valves. Paratypes Nos. 31527 and 31528. Locality 5. See also Plate V, Figure 1.</p>  |      |
| <p>FIG. 3. Brachial valve and part of pedicle valve of slightly distorted and worn shell showing poorly defined median depression of fold. Paratype No. 31529. Locality 5. See also Plate V, Figure 2.</p>  |      |
| <i>Spinocyrtia granulosa</i> (Conrad) .....   | 6    |
| <p>FIG. 4. Brachial valve and part of pedicle valve of neotype showing outline of shell, relatively shallow median depression of fold, surface configuration of costae and growth lines. Three small circular holes in brachial valve made by unknown boring organisms. Neotype No. E-9572, Buffalo Museum of Science. Locality 7. See also Plate II, Figures 1, 2.</p> |      |
| <p>FIG. 5. Pedicle valve of neotype showing sulcus with bounding costae, high and rounded in umbonal region and low and gently convex in anterior region. Note bifurcation of bounding septa of sulcus, shallow median depression of sulcus, and very low demissicostae on sides of sulcus lateral to median depression. See also Plate III.</p>                        |      |
| <p>FIG. 6. Anterior view of neotype showing profiles of pedicle and brachial valves, height of fold, depth of sulcus, demissicostae of sulcus, and growth lines.</p>  |      |
| <p>FIG. 7. Side view of neotype showing thickness of shell, convexity of valves, height of fold, and curvature of interarea of pedicle valve.</p>   |      |
| <p>FIG. 8. Interior of pedicle valve showing teeth, delthyrium, delthyrial plate, myophragm, low median ridge, muscle scars, genital impressions lateral to muscle-scar area, and pits in floor of valve along margins adjacent to lateral edges of shell. Hypotype No. 32459. Locality 8.</p>  |      |
| <p>FIG. 9. Interior of brachial valve showing dental sockets, muscle scars, socket plates, and low, rounded median ridge. Hypotype No. 32460. Locality 8.</p>   |      |

PLATE I



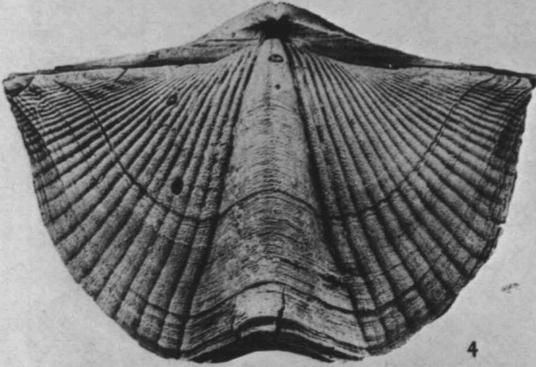
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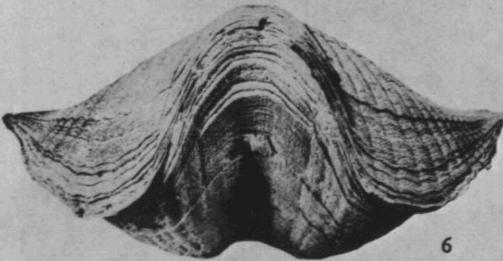
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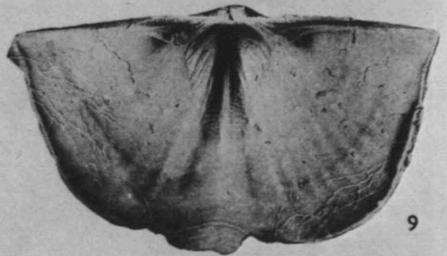
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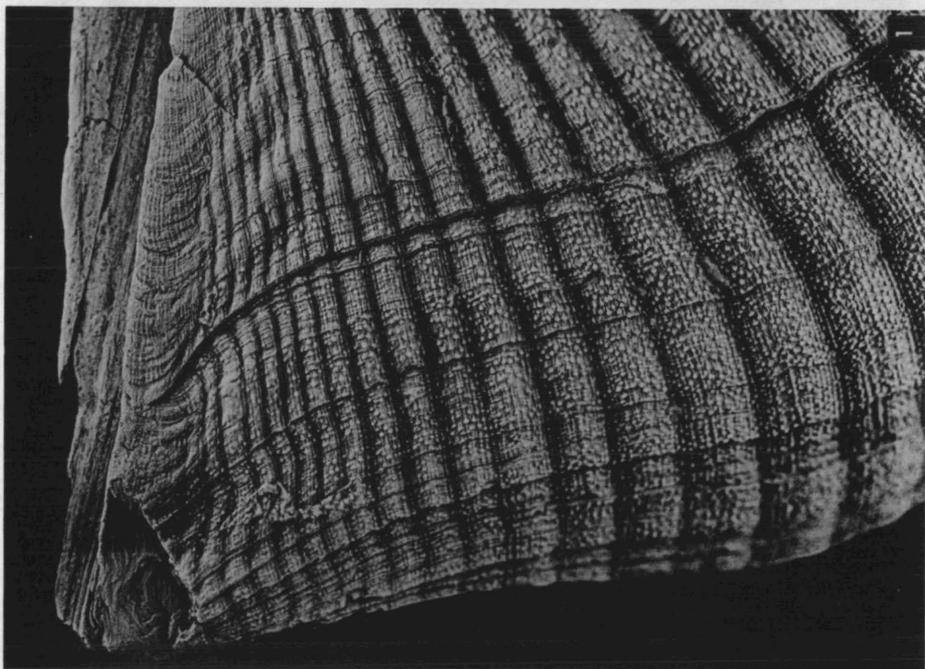


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9

PLATE II



## EXPLANATION OF PLATE II

(All figures  $\times 5$ )

- |  | PAGE |
|--|------|
| <i>Spinocyrtia granulosa</i> (Conrad) .....  | 6    |
| <p>FIG. 1. Exterior of posterolateral part of brachial valve and part of interarea of pedicle valve. Posterior margin of brachial valve lacks costae and is marked by curved growth lines, microfila, and very few tear-shaped granules. Anterior to margin are three broad wrinkles or rugae nearly parallel to growth lines. Microfila with few granules shown best anterior to posterior margin of brachial valve in upper right. Continuity of microfila interrupted by numerous large granules on wide parts of costae. Transverse striations of the interarea of the pedicle valve well illustrated; a few worn longitudinal striations of the interarea poorly indicated near right. Neotype No. E-9572, Buffalo Museum of Science. Locality 7.</p> |      |
| <p>FIG. 2. Exterior of part of brachial valve of neotype. Anterior edge of fold shown near lower left. Shallow median depression of fold represented by darkened area on top of fold near upper left. Illustrates very well few prominent, distantly spaced growth lines, numerous fine, closely-spaced growth lines, form and location of tear-shaped granules, and relationship of granules to microfila. Prominent growth line nearest to the upper right is part of conspicuous growth line shown trending diagonally upward from the lower right corner in Figure 1.</p>  |      |

## EXPLANATION OF PLATE III

(Figure  $\times$  5)

	PAGE
<i>Spinocyrtia granulosa</i> (Conrad) .....	6

Anterior part of the sulcus of neotype. Shallow median depression of sulcus poorly indicated by wide band (approximately 25 mm. wide near anterior edge) slightly darker than either of two bands lateral to it. Each of these bands, slightly narrower than the median depression, is a very slightly convex demissicosta, which is limited laterally by a furrow, seen as a narrow but conspicuous dark band. Lateral to each furrow is a second demissicosta that is less in width than the one between the furrow and the median depression. Lateral to each narrower demissicosta are two poorly indicated costae derived by bifurcation of the costa, bounding one side of the sulcus posterior to the mid-length of the shell. Furrows between second demissicosta and bifurcated costa not well defined. Figure also illustrates character of growth lines and tear-shaped granules, and linear arrangement of granules along interrupted fila. Neotype No. E-9572, Buffalo Museum of Science. Locality 7.

PLATE III

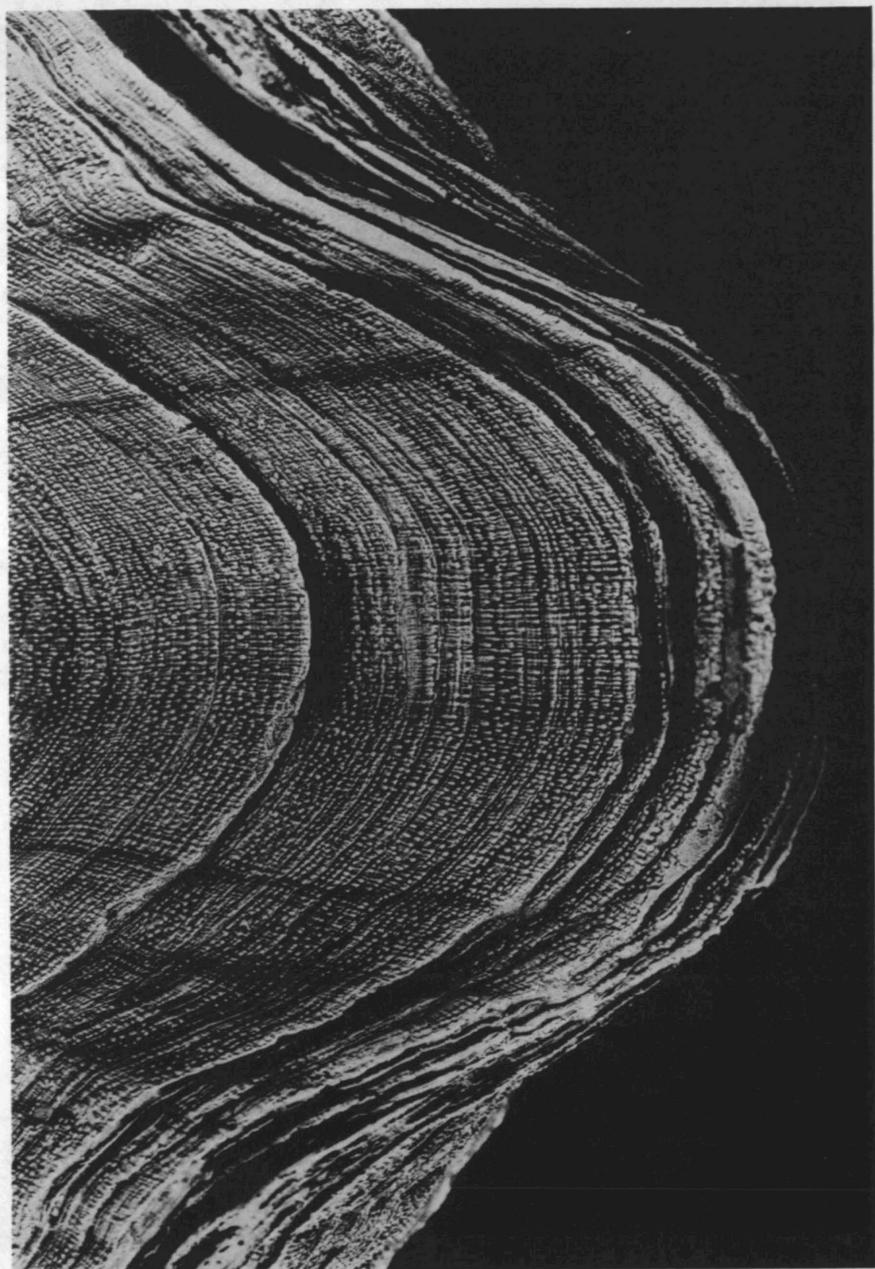
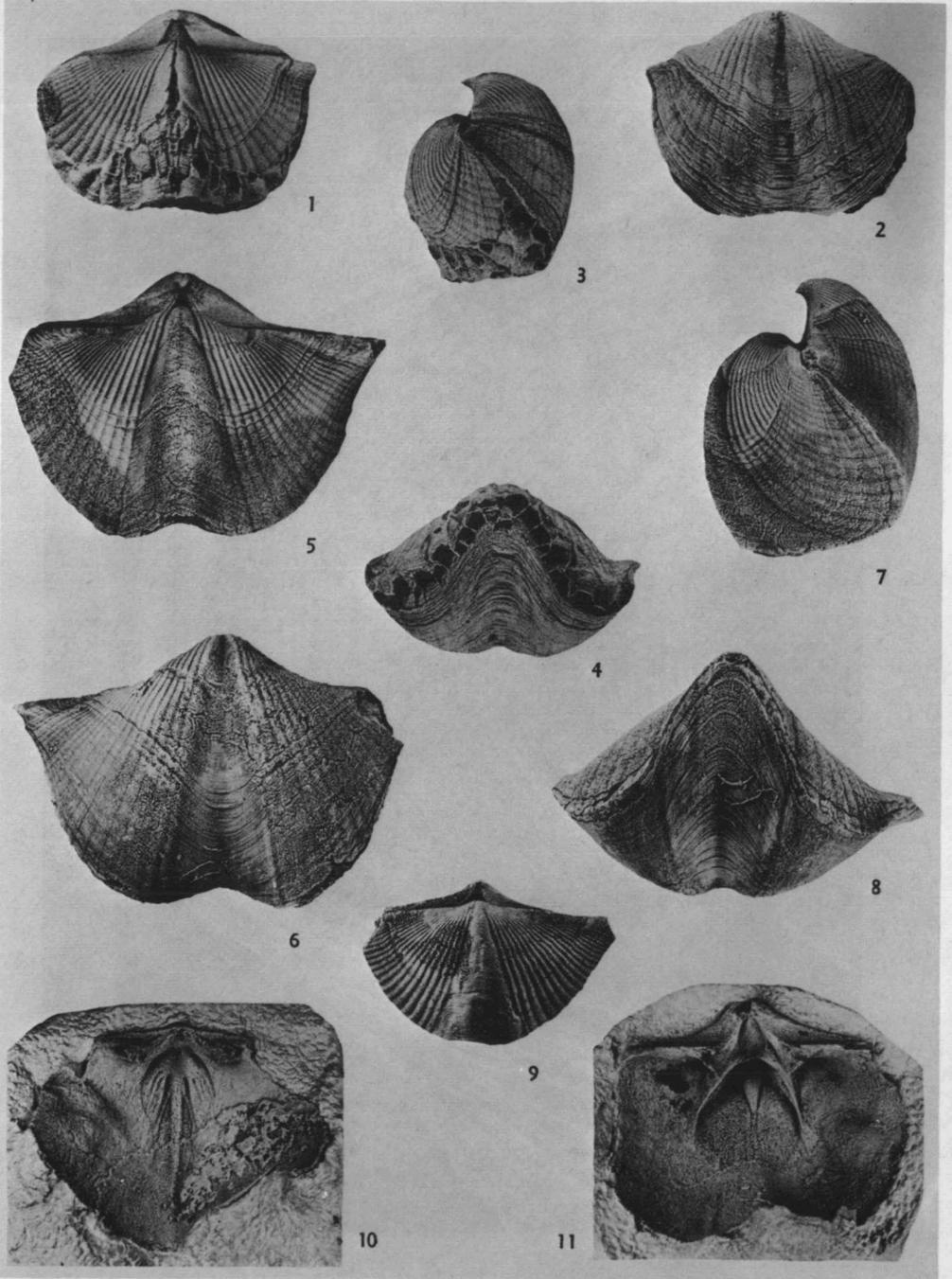


PLATE IV



## EXPLANATION OF PLATE IV

(All figures  $\times 1$ )

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| <i>Spinocyrtia mourantae</i> , sp. nov. ....   | 10   |
| FIG. 1. Brachial valve and part of pedicle valve of holotype, which is well preserved except for fractures along crest of fold. Corallites of <i>Aulopora</i> sp. attached to anterior and anterolateral margins of brachial valve. Holotype No. 31530. Locality 5.  |      |
| FIG. 2. Pedicle valve of holotype showing sulcus with relatively wide, shallow median depression.  |      |
| FIG. 3. Side of holotype showing thickness of shell, convexity of valves, low fold, and curvature of interarea of pedicle valve.   |      |
| FIG. 4. Anterior view of holotype showing profiles of brachial and pedicle valves, sulcus, and apertures of corallites of <i>Aulopora</i> sp.  |      |
| <i>Spinocyrtia parvigranulata</i> , sp. nov. ....  | 12   |
| FIG. 5. Brachial valve and part of pedicle valve of holotype showing outline of shell, interarea and delthyrium of pedicle valve, costae, and narrow, shallow median depression of fold. Dark, rough-appearing areas, marginal to anterior and anterolateral edges of brachial valve, were produced by development of Beekite rings. Holotype No. 32457. Locality 3.           |      |
| FIG. 6. Pedicle valve of holotype showing character of costae in umbonal region and on lateral slopes, sulcus, and partial destruction of valve surface by Beekite rings.  |      |
| FIG. 7. Side view of holotype showing thickness of shell, convexity of valves, high fold, and curvature of interarea of pedicle valve.   |      |
| FIG. 8. Anterior view of holotype showing profiles of brachial and pedicle valves, fold, and sulcus. Attached to sulcus are cyclostomatous bryozoa.  |      |
| FIG. 9. Brachial valve and part of pedicle valve of a young specimen showing the outline and a fairly well-preserved median depression in the fold. Paratype No. 32456. Locality 3. See also Plate V, Figure 3.  |      |
| FIG. 10. Interior of a plaster-embedded, incomplete brachial valve showing imperfectly preserved dental sockets and socket plates, outline of muscle-scar area, adductor scars, and long, narrow median ridge. Paratype No. 32458. Locality 3.   |      |
| FIG. 11. Interior of plaster-embedded, incomplete pedicle valve showing partly broken teeth and dental plates, delthyrium, delthyrial plate, thick semiconical myophragm, and very poorly preserved muscle-scar area. This valve and one in Figure 10 were conjoined and subsequently separated in order to observe their internal structures. Paratype No. 32458. Locality 3. |      |

## EXPLANATION OF PLATE V

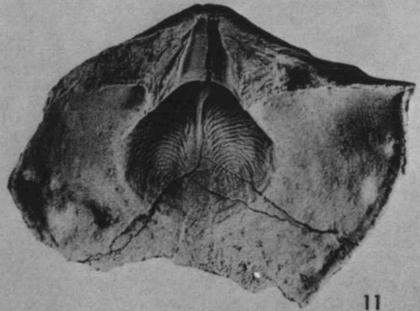
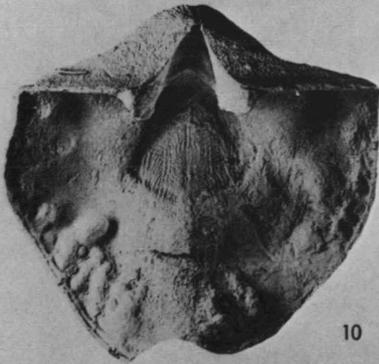
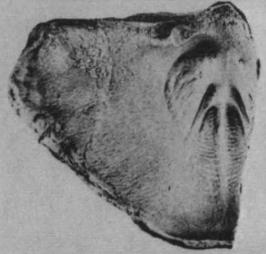
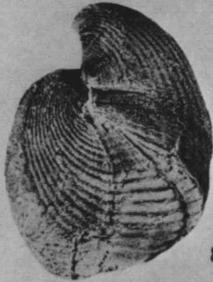
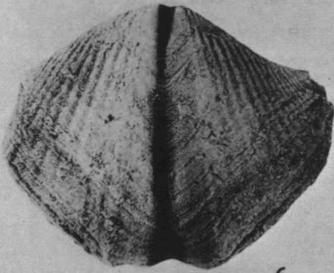
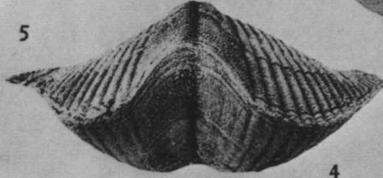
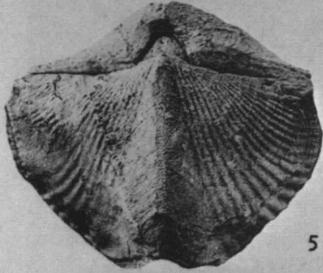
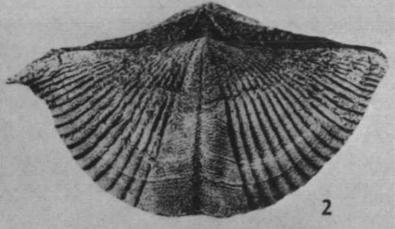
(All figures  $\times 5$ )

	PAGE
<i>Spinocyrtia mourantae</i> , sp. nov. ....	10
FIG. 1. Exterior of nearly one-half of a brachial valve, showing growth lines and minute granules. Five corallites are shown on anterior margin of valve. Paratype No. 31527. Locality 5.	
FIG. 2. Exterior of a brachial valve, showing location of granules with reference to growth lines. Small part of fold is at right. <i>Hederella</i> sp. is shown at left and <i>Ascodictyon</i> sp. at upper right. Paratype No. 31529. Locality 5.	
<i>Spinocyrtia parvigranulata</i> , sp. nov. ....	12
FIG. 3. Exterior of part of paratype, showing fold with median depression, small distantly spaced granules interrupting continuity of microfila, and growth lines. Beekite rings are recognizable in upper right. Paratype No. 32456. Locality 3.	

PLATE V



PLATE VI



## EXPLANATION OF PLATE VI

(All figures  $\times 1$ )

- |   | PAGE |
|---|------|
| <i>Spinocyrtia tumidigranulata</i> , sp. nov. ....  | 13   |
| FIG. 1. Pedicle valve showing costae, furrows, and sulcus with narrow median depression and demissicostae. Cardinal extremity at right deformed apparently during life of animal. Holotype No. 32668. Locality 1. See also Plate VII.   |      |
| FIG. 2. Brachial valve and part of pedicle valve of holotype. Brachial valve shows relatively high costae and deep furrows, and narrow and relatively deep median depression of fold. Part of pedicle valve shows interarea and delthyrium.   |      |
| FIG. 3. Side view of holotype, showing thickness of the shell, convexity of valves, height of fold, and curvature of interarea of pedicle valve.  |      |
| FIG. 4. Anterior view of holotype, showing profiles of valves, low fold, and broad, shallow sulcus with median depressions.   |      |
| <i>Spinocyrtia carinata</i> , sp. nov. ....   | 15   |
| FIG. 5. Brachial valve and part of pedicle valve of a slightly corroded, small, adult shell. Outline characteristic of many shells of this species. Brachial valve exhibits costae, furrows, and carinate fold with a narrow, shallow, median depression. Pedicle valve shows delthyrium and considerably worn interarea. Holotype No. 32669. Locality 1.   |      |
| FIG. 6. Pedicle valve of holotype, showing growth lines, sulcus, and corroded costae. Dark band in bottom of sulcus is wider than the median depression of the sulcus.  |      |
| FIG. 7. Anterior view of holotype, showing profiles of valves, high carinate fold, and sulcus.  |      |
| FIG. 8. Side view of holotype, showing thickness of shell, convexity of valves, height of fold, and curvature of interarea of pedicle valve.  |      |
| FIG. 9. Interior of incomplete brachial valve. Dental sockets and socket plates, subpyriform outline of muscle-scar area, shape and surface markings of adductor muscle scars, and low, narrow, median ridge well defined. Myophore of cardinal process is indistinct. Paratype No. 32670. Locality 1.  |      |
| FIG. 10. Interior and parts of exterior of pedicle valve. Interarea much corroded, showing indistinct, poorly preserved transverse and longitudinal striations. Delthyrium, delthyrial plate, teeth, dental plates, and outline of muscle-scar area well shown. Myophragm, most of surface markings of muscle scars, and median ridge missing or poorly indicated. Tuberosities in floor of valve consist of calcium carbonate secreted by mantle of brachiopod in sealing off boring sponges or other parasitic organisms. Paratype No. 32671. Locality 1. |      |
| FIG. 11. Interior of incomplete, partly crushed pedicle valve, showing delthyrial plate, myophragm, median ridge, outline of muscle-scar area, surface markings of muscle scars, and tuberosities in floor of valve. Outline of muscle-scar area wider than that shown in Figure 10. Paratype No. 32672. Locality 1.  |      |

## EXPLANATION OF PLATE VII

(Figure  $\times$  5)

	PAGE
<i>Spinocyrtia tumidigranulata</i> , sp. nov .....	13
View of part of brachial valve and the beak of the pedicle valve of the holotype, showing rounded fold with narrow median depression, costae and furrows, tumid granules, and growth lines. Alignment of granules on microfila is best shown in intercostal furrows and on side of fold nearer to the left in figure. Holotype No. 32668. Locality 1.	

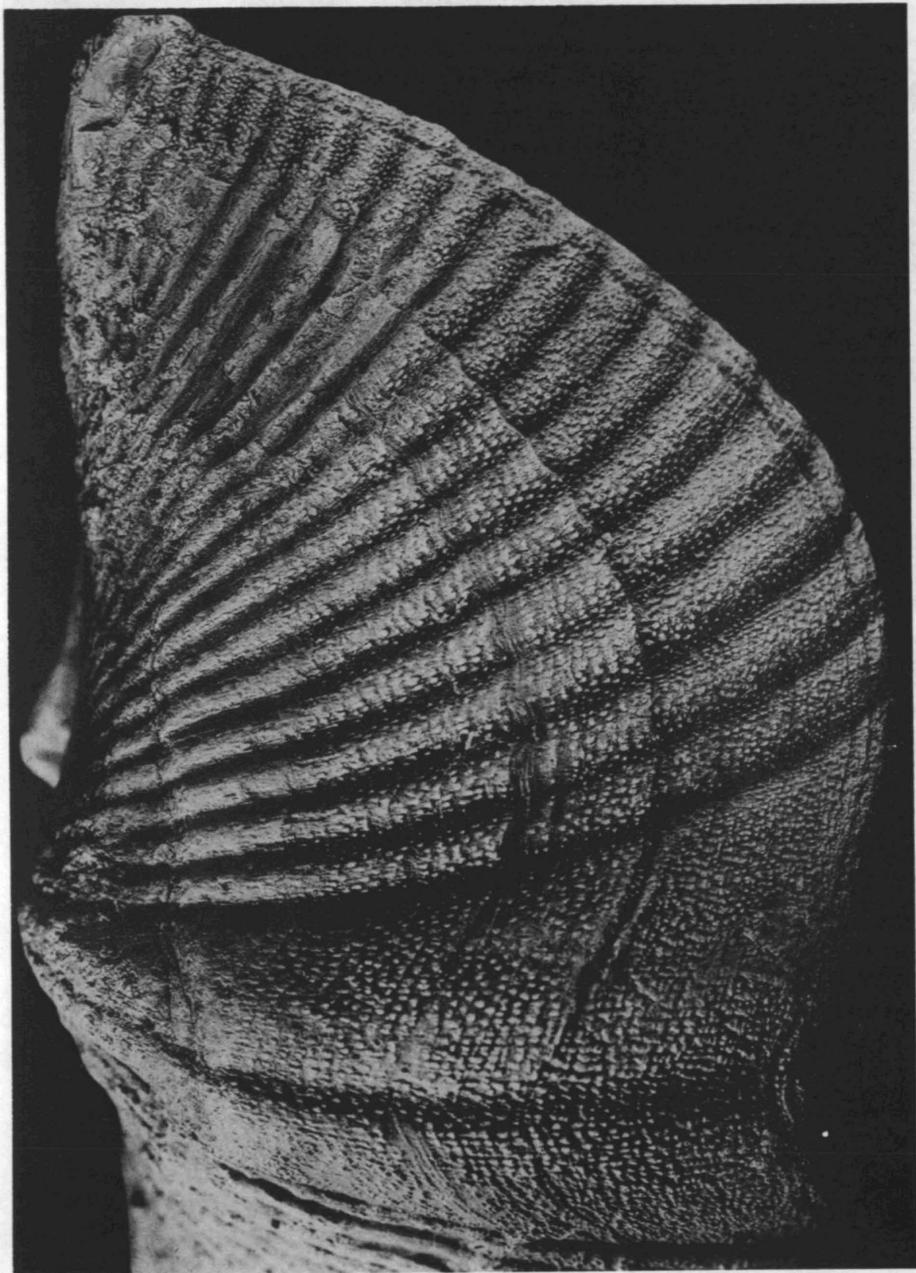
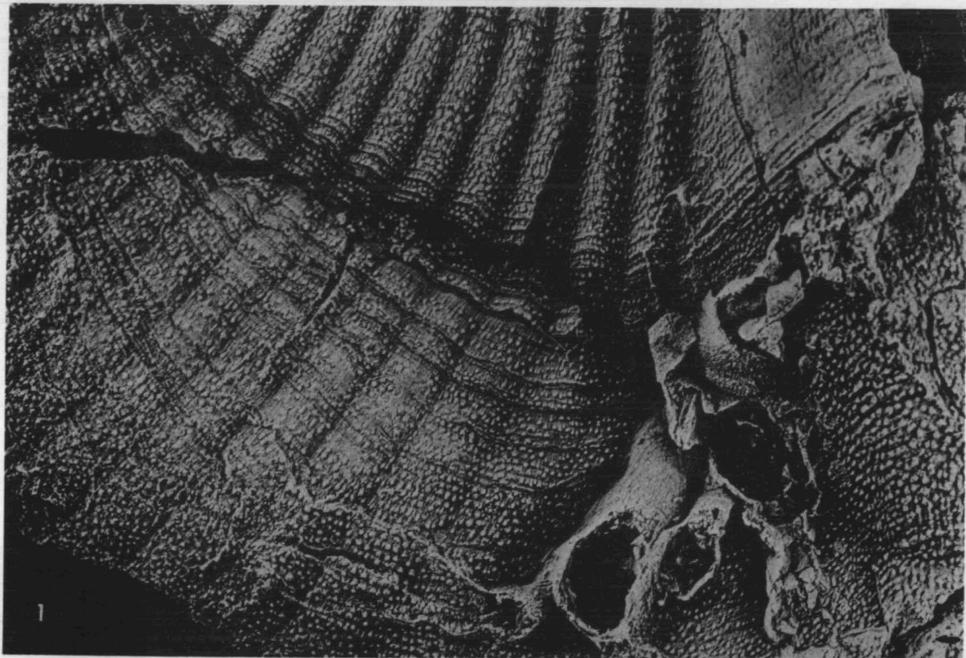


PLATE VIII



## EXPLANATION OF PLATE VIII

(All figures  $\times 5$ )

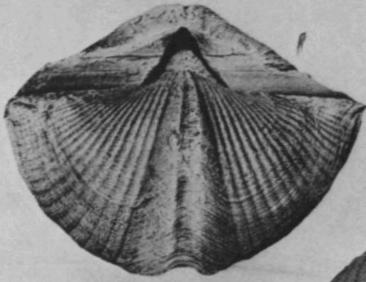
	PAGE
<i>Spinocyrtia carinata</i> , sp. nov. ....	15
FIG. 1. Part of fractured brachial valve, showing size and shape of granules and location of granules with reference to growth lines. An auloporoid is attached to broken fold and adjacent costae at right. Paratype No. 32673. Locality 1.	
FIG. 2. Part of crushed and slightly corroded brachial valve, showing interruption of microfila by aligned granules. Fold is shown in right half. Paratype No. 32674. Locality 1.	

## EXPLANATION OF PLATE IX

(All figures  $\times 1$ )

- |   | PAGE |
|---|------|
| <i>Spinocyrtia ravenswoodensis</i> , sp. nov. ....  | 17   |
| FIG. 1. Brachial valve and part of pedicle valve of imperfect shell, showing umbonal region, transversely striated interarea, and delthyrium of pedicle valve and fold with deep median depression, costae, furrows, and growth lines of brachial valve. Paratype No. 32675. Locality 2. See also Plate XI, Figures 1, 2. |      |
| FIG. 2. Pedicle valve of paratype No. 32675, showing median depression of sulcus (dark band).   |      |
| FIG. 3. Brachial valve and part of pedicle valve of imperfect shell, showing umbonal region, interarea, and delthyrium of pedicle valve and fold with median depression, costae, and furrows of brachial valve. Paratype No. 32676. Locality 2.   |      |
| FIG. 4. Anterior view of paratype No. 32676, showing profiles of valves, low rounded fold, and sulcus. Few, indistinct diagonal light lines on oval, worn area to left of sulcus are parts of a spiralium.  |      |
| FIG. 5. Brachial valve and posterior part of pedicle valve of an incomplete shell, showing one acute, extended cardinal extremity, costae, furrows, and well-defined, deep, median depression of fold. Paratype No. 32677. Locality 2.  |      |
| FIG. 6. Interior of incomplete pedicle valve, showing interarea with few transverse striae, delthyrium, delthyrial plate, teeth, dental plates, worn myophragm and median ridge, and muscle scars. Paratype No. 32678. Locality 2.  |      |
| FIG. 7. Interior of incomplete and much worn pedicle valve, showing myophragm, median ridge, muscular area, surface markings of muscle scars, and genital impressions. Paratype No. 32679. Locality 2.  |      |
| FIG. 8. Latex impression from a natural mold of interior surface of incomplete brachial valve, showing outline of muscle-scar area, some surface markings of the adductor scars, and prominent, low, narrow median ridge. Paratype No. 32680. Locality 2.   |      |
| FIG. 9. Interior of incomplete brachial valve, showing beak, wide notothyrium, myophore of cardinal process, dental sockets, socket plates, outline of muscle scars, and narrow (but poorly lighted) median ridge. Paratype No. 32681. Locality 2.  |      |

PLATE IX



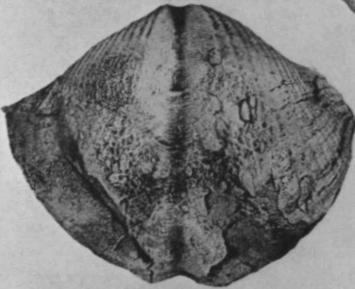
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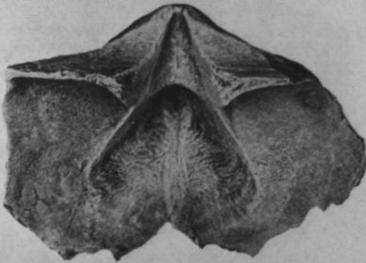
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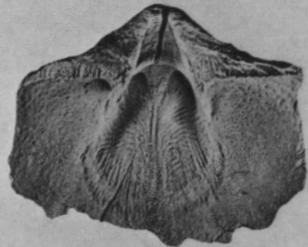
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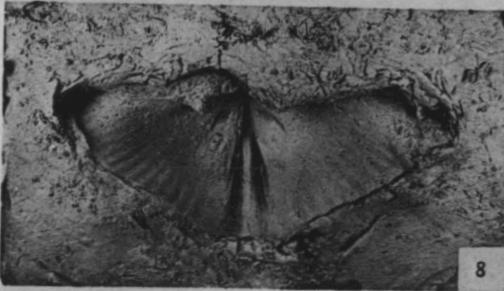
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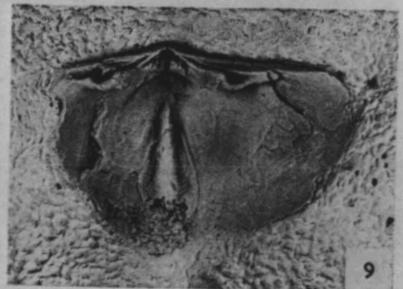
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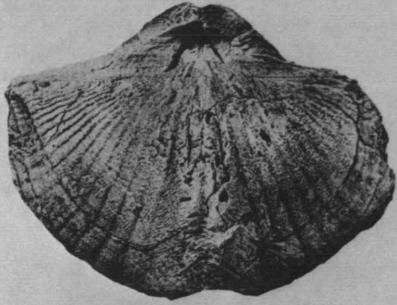


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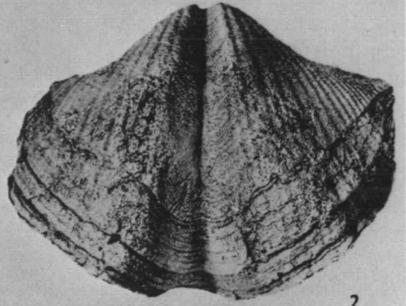


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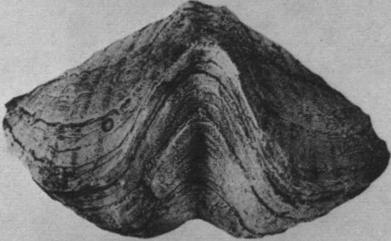
PLATE X



1



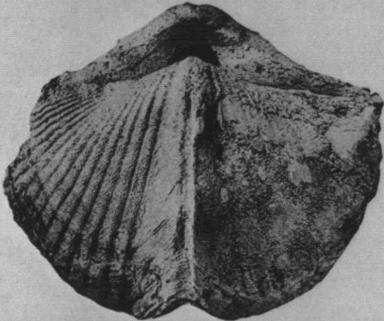
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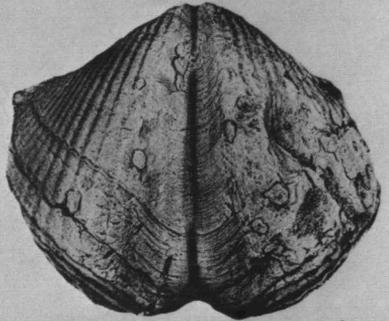
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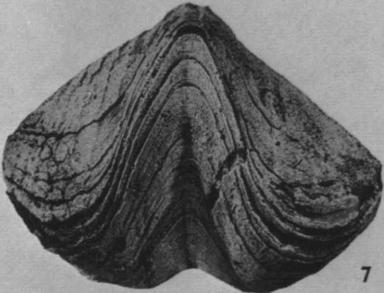
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5



6



7



8

## EXPLANATION OF PLATE X

(All figures  $\times 1$ )

- |  | PAGE |
|--|------|
| <i>Spinocyrtia ravenswoodensis</i> , sp. nov. ....   | 17   |
| FIG. 1. Brachial valve and part of pedicle valve of partly weathered shell, showing beak, umbonal region, transversely striated interarea, and delthyrium of pedicle valve and costae, furrows, and fold of brachial valve. Holotype No. 32682. Locality 2.  |      |
| FIG. 2. Pedicle valve of holotype, showing high umbonal region, sulcus, and (poorly lighted) median depression of sulcus.  |      |
| FIG. 3. Anterior view of holotype, showing profiles of valves, low rounded fold, sulcus, and growth lines.   |      |
| FIG. 4. Side view of holotype, showing thickness of shell, convexity of valves, and curvature of interarea of pedicle valve.   |      |
| FIG. 5. Brachial valve and part of pedicle valve of a partly weathered gerontic shell, showing high umbonal region, delthyrium, and two parts of interarea (at left of delthyrium) of pedicle valve and fold with deep median depression, costae, and furrows of brachial valve. Paratype No. 32683. Locality 2. |      |
| FIG. 6. Pedicle valve of paratype No. 32683, showing umbonal region, sulcus, and well-defined, relatively deep median depression of sulcus.  |      |
| FIG. 7. Anterior view of paratype No. 32683, showing profiles of valves and low rounded fold. The conspicuous tongue of the sulcus and the thick closely spaced growth lines are gerontic characteristics.   |      |
| FIG. 8. Side view of paratype No. 32683, showing thickness of shell, convexity of valves, and curvatures of interareas of valves. Also shown is the great depth of the brachial valve, a characteristic feature of gerontic shells of this species.  |      |

## EXPLANATION OF PLATE XI

(All figures  $\times 5$ )

	PAGE
<i>Spinocyrtia ravenswoodensis</i> , sp. nov. ....	17
FIG. 1. Part of brachial valve of a paratype, showing median depression of fold (a dark band near right side) and relatively small size of granules, best illustrated on costae at lower left. Paratype No. 32675. Locality 2.	
FIG. 2. Another part of brachial valve of paratype No. 32675, showing median depression of fold (dark band near left side) and relationship of granules to microfila and growth lines.	

PLATE XI

