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ORBITOID FORAMINIFERA OF THE GENUS ORTHOPHRAGMINA
FROM GEORGIA AND FLORIDA

PAPERS BY

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CONTENTS.

	Page.
The stratigraphic position and faunal associates of the orbitoid Foraminifera of the genus <i>Orthophragmina</i> from Georgia and Florida, by C. W. Cooke	109
Introduction.....	109
Localities on Chipola River.....	109
Localities on Flint River.....	110
Locality on Suwannee River.....	112
Faunal associates of species of <i>Orthophragmina</i>	112
Orbitoid Foraminifera of the genus <i>Orthophragmina</i> from Georgia and Florida, by J. A. Cushman.....	115

ILLUSTRATIONS.

PLATES XL-XLIV. Species of <i>Orthophragmina</i>	119-124
FIGURE 19. Map showing position of stations on Chipola River, Fla., and Flint River, Ga., at which specimens of <i>Orthophragmina</i> were collected.....	111
20. Map showing position of station 7348, Troy Springs, on Suwannee River, Fla.....	114

THE STRATIGRAPHIC POSITION AND FAUNAL ASSOCIATES OF THE ORBITOID FORAMINIFERA OF THE GENUS ORTHOPHRAGMINA FROM GEORGIA AND FLORIDA.

By CHARLES WYTHE COOKE.

INTRODUCTION.

The present short paper is designed to furnish information regarding the stratigraphic relations of the species of *Orthophragmina* described by Mr. Cushman in the succeeding paper and to enumerate the other organisms found in association with them, and thereby make evident the value of these species in the investigation of problems of geologic correlation. Evidence, chiefly paleontologic, presented in a recent paper¹ in my opinion shows that the Ocala limestone is of upper Eocene age. The occurrence of *Orthophragmina* at numerous exposures which are referred to the Ocala on the basis of physical and faunal resemblance is in accord with the deduction from other paleontologic data and corroborates the reference to the upper Eocene of the part of the formation in which they are found.

The orbitoid Foraminifera described by Mr. Cushman in the accompanying paper were obtained from the Ocala limestone in three regions—on Chipola River at Marianna, Jackson County, Fla.; at several localities on Flint River, Ga., between the crossing of the Seaboard Air Line Railway in Sumter County, about 8 miles west of Cordele, and Bainbridge, Decatur County; and on Suwannee River in Suwannee County, Fla. The positions of the stations have been plotted on the maps, text figures 19 and 20. Some of these occurrences are believed to represent the upper part of the Ocala limestone, but the exact stratigraphic position of most of them in the formation has not been definitely ascertained. The collections obtained on Flint River above Albany (characterized by the presence of *Orthophragmina flintensis* Cushman) represent a horizon lower in the formation than those

obtained at the other localities cited in this paper.

The following is a list of the species of *Orthophragmina* described by Mr. Cushman, with the station numbers of the localities at which they were found:

- Orthophragmina flintensis* Cushman, n. sp. 7115, 7116, 7117, 7119, 7237.
- Orthophragmina floridana* Cushman, n. sp. 6768.
- Orthophragmina americana* Cushman, n. sp. 3387, 6768.
- Orthophragmina mariannensis* Cushman, n. sp. 3387, 6768.
- Orthophragmina mariannensis* var. *papillata* Cushman, n. var. 6768, 7126, 7129, 7191, 7192.
- Orthophragmina georgiana* Cushman, n. sp. 3387, 7097, 7099, 7126, 7348.
- Orthophragmina vaughani* Cushman, n. sp. 3387.

LOCALITIES ON CHIPOLA RIVER.

Stations 6768, 7191, 7192.—The following sections at Marianna are quoted from my paper on the age of the Ocala limestone:²

Section on the west bank of Chipola River at the wagon bridge one-half mile east of Marianna, Fla.

Marianna limestone:	Feet.
5. Alternating hard and softer beds of light-colored limestone, very hard and compact in places, locally semicrystalline. The lower portion contains a considerable amount of glauconite. The upper portion has been quarried for building stone and contains <i>Orbitoides</i> , <i>Pecten poulsoni</i> (var.?), <i>Clypeaster rogersi</i> , and casts of other fossils. The floor of the bridge is 9 feet above the base of this bed.....	33
Ocala limestone:	
4. Concealed.....	3
3. Hard creamy-white semicrystalline limestone, apparently a more indurated phase of bed No. 1. Contains <i>Orbitoides</i> (stellately marked species), <i>Arca</i> , <i>Glycymeris</i> , <i>Amusium ocalanum</i> , <i>Plicatula</i> (Ocala species), <i>Venericardia</i>	1½
2. Concealed.....	4

¹ Cooke, C. W., The age of the Ocala limestone: U. S. Geol. Survey Prof. Paper 95, pp. 107-117, 1915.

² Idem, p. 109.

Ocala limestone—Continued.	Feet.
1. Soft cream-colored porous limestone or marl, composed largely of Foraminifera loosely packed together. Contains <i>Nummulites</i> , <i>Orbitoides</i> (stellately marked species), Bryozoa, <i>Amusium ocalanum</i> , <i>Cardium</i> . Extends beneath water in the river.....	5

The intervals concealed at the bridge are exposed near the mouth of the cavern about 200 yards below the bridge, where the following supplementary section was observed:

Section 200 yards below the wagon bridge east of Marianna, Fla.

Marianna limestone:	Feet.
5. White limestone, the same as bed No. 5 of the section at the bridge.....	33

Ocala limestone.	
4. Soft cream-colored limestone with several species of <i>Orbitoides</i> and some Bryozoa.....	1
3. Hard semicrystalline pinkish limestone with large <i>Orbitoides</i> , <i>Flabellum</i> , and <i>Amusium ocalanum</i>	6½
2. Soft granular cream-colored limestone, much like No. 1 of section at bridge but with fewer Foraminifera. Contains <i>Orbitoides</i> (stellately marked species), <i>Flabellum</i> , Bryozoa, <i>Terebratulina lachryma?</i> , <i>Natica</i> , <i>Arca</i> , <i>Pecten indecicus</i> , <i>Amusium ocalanum</i> , and <i>Plicatula</i> (Ocala species).....	3
1. Concealed to water level in Chipola River....	3

From bed 1 of the first section (station 6768) Mr. Cushman records *Orthophragmina floridana*, *O. americana*, *O. mariannensis*, and *O. mariannensis* var. *papillata*. The last-named variety occurs also in bed 3 of the first section (station 7192) and in bed 2 of the second section (station 7191).

LOCALITIES ON FLINT RIVER.

Station 7237.—Small quarry on the Averitt property, 300 or 400 yards southwest of the corner of lots 7 and 26, half a mile east of Huguenen Ferry and 1 mile south of Daphne station, Crisp County.

The rock at this locality is a soft white limestone containing *Orthophragmina flintensis* Cushman, numerous Bryozoa, and an undetermined pecten, probably *Amusium ocalanum* (Dall). An analysis of the limestone from this locality given by Brantley¹ shows 85 per cent calcium carbonate. Better exposures of this rock occur in a sink about 300 yards east of the quarry, where 23 feet of soft argillaceous white limestone containing small specks of glauconite is overlain by 18 feet of reddish sandy loam. The course of an underground stream that flows through this sink can be

traced northwestward by means of long, narrow, slot-shaped sinks which expose it at intervals to Gum Creek.

Station 7115.—East bank of Flint River at bend to west 6 miles below Burke Ferry and about 6 miles above the bridge of the Georgia Southwestern & Gulf Railway near Warwick, Worth County.

The material exposed consists of white, compact limestone rising 5 feet above water level and overlain by flint boulders, sand, and gravel. *Orthophragmina flintensis* and *Operculina* sp. were collected here.

Stations 7116, 7117.—Bluff on the west bank of Flint River about 1¼ miles above the bridge of the Georgia Southwestern & Gulf Railway near Oakfield.

The section at this locality is as follows:

<i>Section on Flint River near Oakfield.</i>	
	Feet.
3. Covered slope to top of hill.....	22
2. Hard ledges of compact white semicrystalline limestone (station 7117).....	3
1. Compact white limestone, mostly soft but with harder places. Contains (station 7116) <i>Orthophragmina flintensis</i> and <i>Laganum? crustuloides</i> (Morton)? To water level at 4-foot stage.....	20

From bed 2 were collected the following:

Foraminifera:

Orthophragmina flintensis Cushman.

Bryozoa:

Several species.

Echinodermata:

Laganum? crustuloides (Morton)?

Mollusca:

Ostrea sp.

Pecten perplanus Morton.

Pecten suwaneënsis Dall.

Station 7119.—East bank of Flint River, about 16 miles above Albany, in Worth County, near the Dougherty County line.

The rock here consists of 5 feet of limestone, the upper part white, and the lower part gray, overlain by flint fragments. It contains *Orthophragmina flintensis* Cushman, *Operculina* sp., and *Pecten suwaneënsis* Dall.

Station 7126.—East bank of Flint River at Dry Bread Shoals, Mitchell County, 8½ or 9 miles below Newton.

The following species were collected from lumps of hard limestone excavated from the channel:

Foraminifera:

Orthophragmina mariannensis var. *papillata* Cushman.

Orthophragmina georgiana Cushman.

¹ Brantley, J. E., Limestones and marls of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 21, p. 158, 1916.

Anthozoa:

Trochoseris n. sp.

Echinodermata:

- Cidaris georgiana Twitchell.
- Laganum? crustuloides (Morton)?
- Oligopygus haldermani (Conrad).

Mollusca:

- Mitra sp.
- Chama sp.
- Limopsis sp.
- Barbatia sp.

Mollusca—Continued.

- Ostrea trigonalis Conrad.
- Amusium ocalanum (Dall).
- Pecten perplanus Morton.
- Spondylus sp.
- Plicatula, Ocala sp.
- Mya? sp.
- Venericardia vicksburgiana Dall.
- Venericardia sp.
- Crassatellites sp.

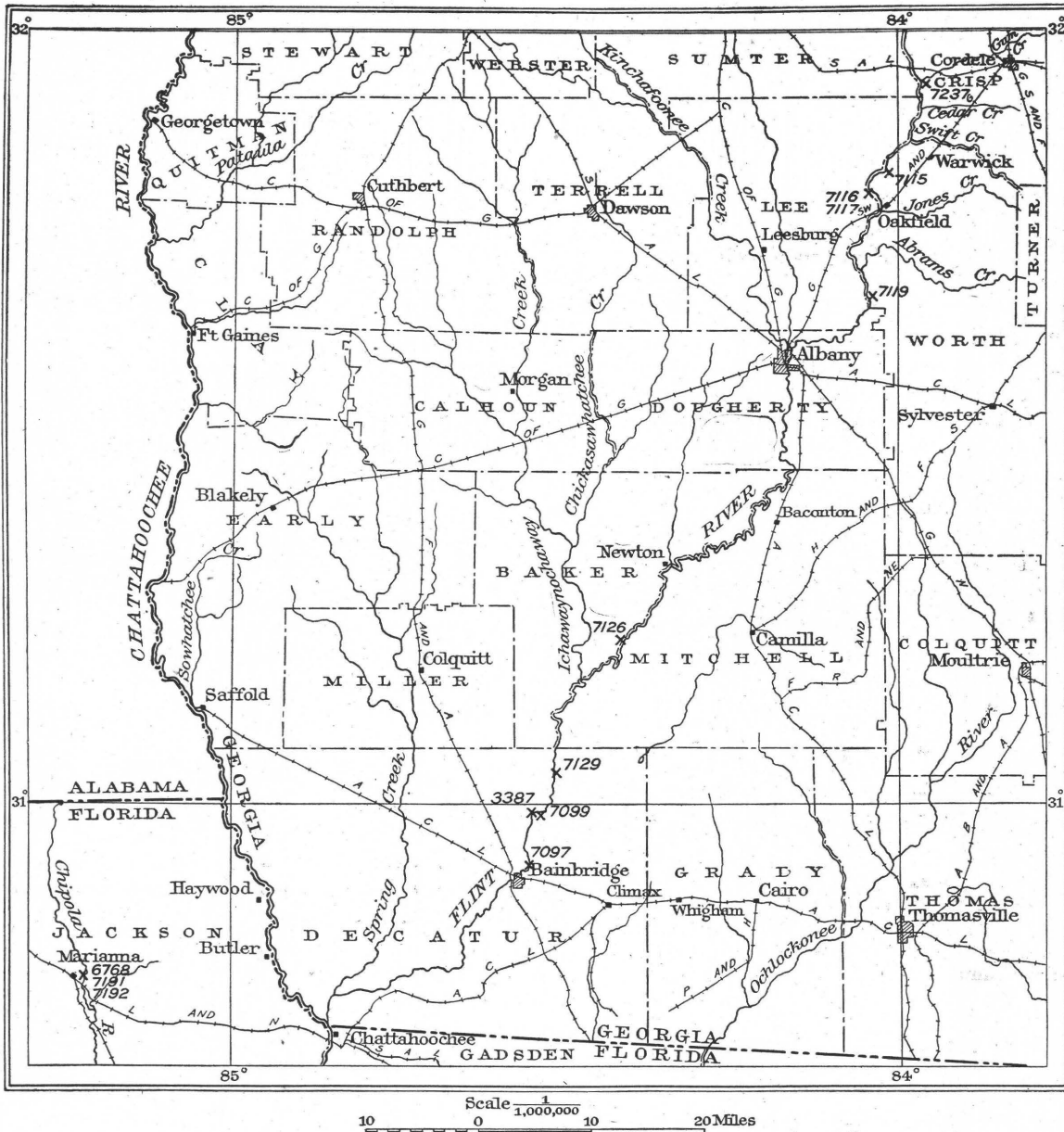


FIGURE 19.—Map showing position of stations on Chipola River, Fla., and Flint River, Ga., at which specimens of *Orthophragmina* were collected.

Station 7129.—East bank of Flint River 1 mile below Windell's Landing and about 15 miles above Bainbridge, in Decatur County.

Orthophragmina mariannensis var. *papillata* Cushman and an undetermined species of

Pecten were found in 5 feet of irregularly weathered pinkish limestone.

Stations 3387, 7097, 7099.—Species of *Orthophragmina* have been obtained from the Ocala limestone at three localities near Bainbridge,

the stratigraphic relations of which are nearly identical. The Ocala limestone is the oldest formation in the vicinity of Bainbridge, and all the exposures of it appear to represent a single horizon. It is a soft, coarsely granular white to yellow limestone and is composed largely of tests of Foraminifera and Bryozoa, which on exposed surfaces have become firmly cemented or "casehardened" into a brittle semicrystalline limestone but which when freshly exposed are only slightly coherent. The rock appears to lie very nearly horizontal, but the upper surface is exceedingly irregular and jagged, with pinnacles extending in places to 20 feet above water level. The irregularity is due in part to erosion prior to the deposition of the overlying materials and in part to subsequent solution.

The Ocala is overlain unconformably by a complex series of red and variegated sands and carbonaceous clays containing chert fragments with impressions and siliceous pseudomorphs of mollusks and corals of earliest Chattahoochee age. The Ocala itself appears to have been subjected in less degree to the silicifying agencies, for chert fragments carrying Ocala fossils are occasionally found. The accidental inclusion of some of these fragments in the collections of the coralliferous chert has unfortunately been interpreted as a mingling of the Ocala and Chattahoochee faunas.¹

The following species have been identified in the Ocala limestone from localities near Bainbridge:

Station 7099. East bank of Flint River, half a mile above Red Bluff:

Foraminifera:
Orthophragmina georgiana Cushman.

Bryozoa:
Many species.

Echinodermata:
Oligopygus haldermani (Conrad).
Agassizia conradi (Bouvé).

Stations 3387, 6159, 7098. Red Bluff, Flint River, 7 miles above Bainbridge:

Foraminifera:
Orthophragmina americana Cushman.
Orthophragmina mariannensis Cushman.
Orthophragmina georgiana Cushman.
Orthophragmina vaughani Cushman.

Bryozoa:
Many species.

Echinodermata:
Oligopygus haldermani (Conrad).
Laganum? crustuloides (Morton)?
Cassidulus (Pygorhynchus) georgiensis Twitchell.
Agassizia conradi (Bouvé).

¹ Dall, W. H., A contribution to the invertebrate fauna of the Oligocene beds of Flint River, Ga.: U. S. Nat. Mus. Proc., vol. 51, p. 488, 1916.

Station 3387, 6159, 7098, Red Bluff, Flint River, etc.—Con.

Mollusca:
Pecten perplanus Morton.
Pecten indecisus Dall.
Pecten suwaneeensis Dall.
Amusium ocalanum (Dall).

Station 7097.—Bluff on east bank of Flint River near the old factory three-fourths mile northeast of the Atlantic Coast Line Railway station at Bainbridge:

Foraminifera:
Orthophragmina georgiana Cushman and many others.

Bryozoa:
About 34 species, most of them new.

Echinodermata:
Cidaris georgiana Twitchell.
Cassidulus (Pygorhynchus) conradi (Conrad).
Oligopygus haldermani (Conrad).
Agassizia conradi (Bouvé).
Eupatagus carolinensis Clark?

Mollusca:
Ostrea, 2 sp.
Pecten perplanus Morton.
Amusium ocalanum (Dall).
Plicatula, Ocala sp.
Cardium sp.

LOCALITY ON SUWANNEE RIVER.

Station 7348.—Left bank of Suwannee River 84½ miles above its mouth, 9 miles above Branford, and about 1 mile above Troy Springs. (See fig. 20.)

There is at this place a small exposure of cream-colored orbitoidal limestone containing *Orthophragmina georgiana* Cushman, *Pecten perplanus* Morton, and *Pecten indecisus* Dall. The exposure is believed to represent a horizon well up in the Ocala limestone but not the topmost.

FAUNAL ASSOCIATES OF SPECIES OF ORTHOPHRAGMINA.

The species which have been found associated with each species of *Orthophragmina* are listed below:

Orthophragmina flintensis Cushman.
Operculina sp.
Laganum? crustuloides (Morton)?
Ostrea sp.
Pecten perplanus Morton.
Pecten suwaneeensis Dall.
Amusium ocalanum (Dall).
Orthophragmina floridana Cushman.
Orthophragmina americana Cushman.
Orthophragmina mariannensis Cushman.
Orthophragmina mariannensis var. *papillata* Cushman.
Flabellum sp.
Terebratulina lachryma (Morton)?
Pecten indecisus Dall.
Amusium ocalanum (Dall).
Plicatula, Ocala sp.

- Orthophragmina americana Cushman.
- Orthophragmina floridana Cushman.
- Orthophragmina mariannensis Cushman.
- Orthophragmina mariannensis var. papillata Cushman.
- Orthophragmina georgiana Cushman.
- Orthophragmina vaughani Cushman.
- Flabellum sp.
- Oligopygus haldermani (Conrad).
- Laganum? crustuloides (Morton)?
- Cassidulus (Pygorhynchus) georgiensis Twitchell.
- Agassizia conradi (Bouvé).
- Terebratulina lachryma (Morton)?
- Pecten indecisus Dall.
- Pecten perplanus Morton.

- Orthophragmina mariannensis Cushman—Continued.
- Terebratulina lachryma (Morton)?
- Pecten indecisus Dall.
- Pecten perplanus Morton.
- Pecten suwaneensis Dall.
- Amusium ocalanum (Dall).
- Plicatula, Ocala sp.
- Orthophragmina mariannensis var. papillata Cushman.
- Orthophragmina mariannensis Cushman.
- Orthophragmina floridana Cushman.
- Orthophragmina americana Cushman.
- Orthophragmina georgiana Cushman.
- Flabellum sp.
- Trochoseris n. sp.
- Cidaris georgiana Twitchell.
- Oligopygus haldermani (Conrad).
- Laganum? crustuloides (Morton)?
- Terebratulina lachryma (Morton)?
- Pecten perplanus Morton.
- Pecten indecisus Dall.
- Amusium ocalanum (Dall).
- Spondylus sp.
- Plicatula, Ocala sp.
- Venericardia vicksburgiana Dall.
- Orthophragmina georgiana Cushman.
- Orthophragmina americana Cushman.
- Orthophragmina mariannensis Cushman.
- Orthophragmina mariannensis var. papillata Cushman.
- Orthophragmina vaughani Cushman.
- Trochoseris n. sp.
- Cidaris georgiana Twitchell.
- Oligopygus haldermani (Conrad).
- Laganum? crustuloides (Morton)?
- Cassidulus (Pygorhynchus) conradi (Conrad).
- Cassidulus (Pygorhynchus) georgiensis Twitchell.
- Agassizia conradi (Bouvé).
- Eupatagus carolinensis Clark?
- Ostrea trigonalis Conrad.
- Pecten suwaneensis Dall.
- Pecten perplanus Morton.
- Pecten indecisus Dall.
- Amusium ocalanum (Dall).
- Spondylus sp.
- Plicatula, Ocala sp.
- Venericardia vicksburgiana Dall.
- Orthophragmina vaughani Cushman.
- Orthophragmina georgiana Cushman.
- Orthophragmina americana Cushman.
- Orthophragmina mariannensis Cushman.
- Orthophragmina mariannensis var. papillata Cushman.
- Oligopygus haldermani (Conrad).
- Laganum? crustuloides (Morton)?
- Pecten perplanus Morton.
- Pecten indecisus Dall.
- Pecten suwaneensis Dall.
- Amusium ocalanum (Dall).
- Cassidulus (Pygorhynchus) georgiensis Twitchell.
- Agassizia conradi (Bouvé).

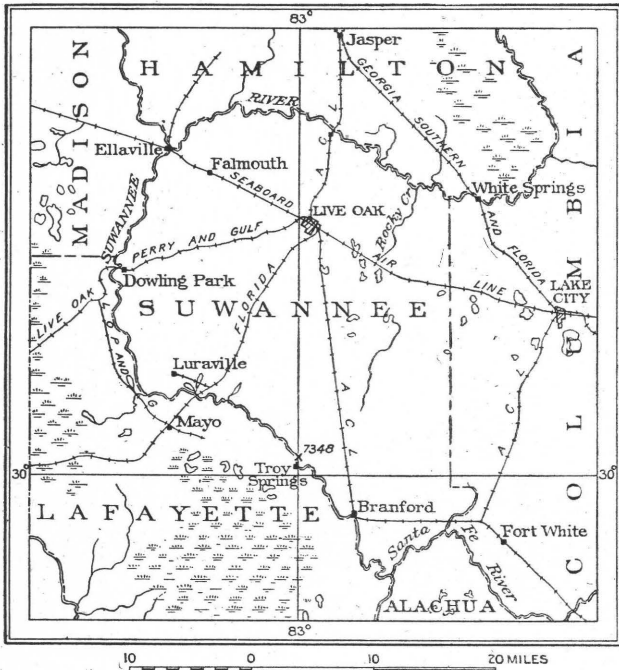


FIGURE 20.—Map showing position of station 7348, Troy Springs, on Suwannee River, Fla.

- Pecten suwaneensis Dall.
- Amusium ocalanum (Dall).
- Plicatula, Ocala sp.
- Orthophragmina mariannensis Cushman.
- Orthophragmina floridana Cushman.
- Orthophragmina americana Cushman.
- Orthophragmina mariannensis var. papillata Cushman.
- Orthophragmina georgiana Cushman.
- Orthophragmina vaughani Cushman.
- Flabellum sp.
- Oligopygus haldermani (Conrad).
- Laganum? crustuloides (Morton)?
- Cassidulus (Pygorhynchus) georgiensis Twitchell.
- Agassizia conradi (Bouvé).

ORBITOID FORAMINIFERA OF THE GENUS ORTHOPHRAGMINA FROM GEORGIA AND FLORIDA.

By JOSEPH AUGUSTINE CUSHMAN.

The larger orbitoid Foraminifera of the Western Hemisphere are very inadequately known, yet their occurrence in great numbers has been noted in many papers during the last three-quarters of a century. *Lepidocyclina mantelli* (Morton), the type species of that genus, was described by Morton in 1833.

As now known the orbitoid Foraminifera found in beds below the Miocene are grouped largely in three genera, the grouping depending upon the internal structure of the test. In these groups there is a central plane of chambers, known technically as "equatorial chambers," and a mass of more irregularly placed chambers on each side, making up the thickness of the test, known as "lateral chambers." In transverse (vertical) section the equatorial chambers show slight differences, but when cut horizontally, or in the plane in which they lie, those of *Lepidocyclina* typically have a hexagonal form, those of *Orthophragmina* are elongated rectangular, and those of *Orbitoides* are diamond shaped. Because in general *Orbitoides*, with some modifications to be noted in a future paper, is Cretaceous, *Orthophragmina* Eocene, and *Lepidocyclina* Oligocene, much importance is attached to these organisms in the investigation of problems of geologic correlation.

The specimens described here belong to the second of the genera mentioned, *Orthophragmina*. Although not limited to this genus, the stellate form or stellately marked surface is rather characteristic of a number of the species. Bagg¹ and Cooke² have referred to "stellately marked" orbitoid Foraminifera, all of which have proved on examination to be *Orthophragmina*. Two of the species here de-

scribed are circular and not stellately marked, but the others are distinctly stellate, either in form or markings.

After a careful study of the species all seem to be new, although one or two of them are somewhat related to certain European species, as is noted in the descriptions. The specimens as a rule occur in soft chalky limestone and do not section well to show the finer structure of the interior.

Data in regard to material are included in the description of each species.

Orthophragmina flintensis Cushman, n. sp.

Plate XL, figures 1, 2.

Test small, circular, about 5 millimeters in diameter; central portion thickened, gradually sloping to the periphery; surface slightly pustulate but not papillate, almost smooth, the raised pustules generally in concentric lines.

Horizontal section shows very narrow rectangular equatorial chambers and the embryonic chambers consisting of a small circular chamber nearly surrounded by the elongate second chamber (Pl. XL, fig. 2).

Type specimen from U. S. G. S. collection 7117, from Ocala limestone in bluff on west bank of Flint River $1\frac{3}{4}$ miles above the Georgia Southwestern & Gulf Railway bridge near Oakfield, Lee County, Ga.; upper bed, No. 2 of section; C. W. Cooke, collector.

Other specimens of this same species from the Ocala limestone are in collections 7116, same locality, No. 1 of section; 7115, east bank of Flint River at bend to west 6 miles below Burke Ferry and about 6 miles above the Georgia Southwestern & Gulf Railway bridge near Warwick, Worth County, Ga., C. W. Cooke, collector; 7119, east bank of Flint River about 16 miles above Albany, in Worth County, Ga., C. W. Cooke, collector; 7237,

¹ Veatch, Otto, and Stephenson, L. W., Preliminary report on the geology of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 26, p. 320, 1911. Identification by R. M. Bagg.

² Cooke, C. W., The age of the Ocala limestone: U. S. Geol. Survey Prof. Paper 95, p. 109, 1915.

small quarry on Averitt plantation, 300 or 400 yards southwest of corner of lots 26-27, and half a mile east of Huguenen Ferry, Crisp County, Ga.; C. W. Cooke and J. E. Brantley, collectors.

Material from station 7237 may possibly not be the same, but the horizontal section, which alone was visible, is very similar. The species seem to be fairly common in the fine-grained white Ocala limestone along Flint River at these localities.

***Orthophragmina floridana* Cushman, n. sp.**

Plate XL, figure 3.

Test circular, much flattened, of medium size, 10 to 14 millimeters in diameter, central region very slightly raised and umbonate, thence flattened to the periphery, whole test very thin; surface ornamented throughout with fine but distinctly raised papillæ almost spinose, arranged in concentric lines parallel with the peripheral margin.

Equatorial chambers in horizontal section very narrowly rectangular.

Type specimen from U. S. G. S. collection 6768, from soft white Ocala limestone on Chipola River at wagon bridge half a mile east of Marianna, Fla.; No. 1 of section; C. W. Cooke, collector. This species is abundant at this locality.

In many respects this species resembles *O. archiaci* Schlumberger, but it is a little larger and more flattened, and its surface ornamentation is somewhat different. It is evidently, however, an American relative of this French species.

***Orthophragmina americana* Cushman, n. sp.**

Plate XL, figure 4; Plate XLI, figure 1; Plate XLII, figure 1.

Test large, as much as 45 millimeters in diameter; peripheral margin with a series of projecting angles corresponding to the peripheral terminations of the radiately arranged raised ornamentation or thickenings; peripheral margin very thin, especially at the reentrants between the projecting angles; central region with a thickened umbo about 2 millimeters in diameter, from which radiate the thickened riblike raised areas running from the umbo to the ends of the peripheral angles, highest near the umbo and decreasing in height and increas-

ing in width toward the periphery; nearly 20 radiating ribs in all, some starting from the umbo, others initiated later, not as branches of previous ones but arising in the intermediate area, usually more or less irregular, the angle with the adjacent ones at either side not usually the same; surface comparatively smooth, very slight traces of papillæ, usually inconspicuous or lacking.

In vertical section the equatorial chambers are rectangular, the area of the raised radial portions consisting of more numerous lateral chambers in the columns, curving about the axis of the rib at either side, those of the intermediate depressed areas parallel with the equatorial belt of chambers and fewer in number.

In horizontal section the equatorial chambers are rectangular, four to five times as long as wide, those of the axis of the radial portions narrower than those of the intermediate depressed areas.

Type specimen from U. S. G. S. collection 6768, Ocala limestone on Chipola River at wagon bridge a quarter of a mile east of Marianna, Fla.; No. 1 of section; C. W. Cooke, collector.

A specimen referred to this species is from station 3387, Ocala limestone at Red Bluff, on Flint River 7 miles above Bainbridge, Decatur County, Ga.; T. W. Vaughan, collector, 1900.

In some respects this species resembles *O. patellaris* Schlotheim, but it is nearly three times as large and has much finer and clearer-cut radial arms and smaller umbo as well as angular periphery. It is more like *O. munieri* Schlumberger, but it is nearly four times as large and the number of ribs is greater and they do not branch as in *O. munieri*.

O. americana is one of the largest species of the genus.

***Orthophragmina mariannensis* Cushman, n. sp.**

Plate XL, figure 5; Plate XLII, figure 2; Plate XLIV.

Test flattened, conspicuously stellate in outline, the angles extending out acutely with curved reentrants, of medium size, mostly 15 to 18 millimeters in diameter; central region raised, umbonate, from which extend eight to eleven (typically eight) raised ribs, running to the peripheral angles; umbo and ribs finely papillate; depressed areas between, flat and rather remotely and finely papillate except

toward the periphery, where the papillae are slightly more conspicuous.

Horizontal section showing much elongated, rectangular equatorial chambers, the lateral chambers irregularly polygonal in section.

Vertical section with the embryonic chambers very unequal, distinct pillars between the vertical rows of lateral chambers, increasing in diameter peripherally.

Type specimen from station 6768, Ocala limestone on Chipola River at wagon bridge half a mile east of Marianna, Fla.; No. 1 of section;¹ C. W. Cooke, collector. Abundant.

One specimen from U. S. G. S. station 3387, Ocala limestone at Red Bluff, on Flint River 7 miles above Bainbridge, Decatur County, Ga.; T. W. Vaughan, collector, 1900.

O. mariannensis somewhat remotely resembles *O. lanceolata* Schlumberger, but it is much larger and has a greater number of ribs, and its surface ornamentation is different.

***Orthophragmina mariannensis* Cushman, n. sp., var. papillata Cushman, n. var.**

Plate XLIII, figure 1; Plate XLIV.

Variety differing from the typical form of the species in the much more prominent, higher ribs, which are semicylindrical and very strongly papillate; number of ribs also slightly greater than in the typical form; a few specimens have 8, but 9 to 12 or even 16 ribs are more frequent.

Occurs in Ocala limestone, with the typical form, at the type locality, U. S. G. S. station 6768, on Chipola River at wagon bridge half a mile east of Marianna, Fla.; No. 1 of section; No. 3 of section at station 7192; C. W. Cooke, collector.

Specimens also from stations 7126, Ocala limestone, east bank of Flint River at Dry Bread Shoals, 8½ or 9 miles below Newton, in Mitchell County, Ga., from lumps blasted from the channel, C. W. Cooke, collector; and 7129, Ocala limestone, east bank of Flint River a mile below Windell's landing, about 6 miles above Red Bluff, Ga.; C. W. Cooke, collector.

There is a single specimen, an impression only, from station 7191, from Ocala limestone at mouth of small cavern about 200 yards southwest of bridge over Chipola River east of Marianna, Fla.; No. 2 of section; C. W. Cooke and W. C. Mansfield, collectors.

This variety for the most part is that referred to by Cooke in his paper cited above. It is recorded there under the name "*Orbitoides*, stellately marked species."

***Orthophragmina georgiana* Cushman, n. sp.**

Plate XLI, figures 2, 3; Plate XLII, figure 3; Plate XLIII, figures 2, 3.

Test typically almost square in outline, the angles slightly projecting and the sides slightly concave near the angles, convex in the center, small, diameter usually about 6 millimeters for the adult specimens, diagonals of the square occupied by raised radial areas with a central umbonate mass of a little more than a millimeter in diameter, intermediate triangular areas flat and thin; entire surface with very numerous, evenly distributed, prominent papillae, those of the central umbo and the middle line of the radial ridges slightly larger than those of the rest of the surface.

Type specimen from U. S. G. S. collection 3387, Ocala limestone at Red Bluff, on Flint River 7 miles above Bainbridge, Decatur County, Ga.; T. W. Vaughan, collector, 1900. It has also been collected in the Ocala limestone at the following stations: 7097, east bank of Flint River above the old factory, at bend three-quarters of a mile northeast of the Atlantic Coast Line Railway station at Bainbridge, Ga., C. W. Cooke and W. C. Mansfield, collectors; 7099, east bank of Flint River about half a mile above Red Bluff, Decatur County, Ga., C. W. Cooke, collector; 7126, east bank of Flint River at Dry Bread Shoals, 8½ or 9 miles below Newton, in Mitchell County, Ga., from lumps blasted from the channel, C. W. Cooke, collector; 7348, left bank of Suwannee River about a mile above Troy Springs, Fla., C. W. Cooke, collector.

In its general form this species is very much like *O. stellata* D'Archiac as figured by Schlumberger, but it does not seem to have the characteristic increase in width of the equatorial band of chambers toward the periphery in the vertical section along the ray that occurs in that species. On the contrary, in *O. georgiana* the equatorial chambers seem to decrease in width toward the periphery, in this being more like those of *O. lanceolata* Schlumberger. In *O. georgiana* also the radial ribs incline to a thickening in the center.

¹ Cooke, C. W., The age of the Ocala limestone: U. S. Geol. Survey Prof. Paper 95, p. 109, 1915.

***Orthophragmina vaughani* Cushman, n. sp.**

Plate XLIII, figures 4, 5.

Test flattened, small, 8 to 10 millimeters in diameter, quadrate or octagonal in outline, stellate; main ornamentation consisting of a central raised umbonate portion with four radiating raised areas to the main angles of the test, broad and rather low, about halfway to the periphery considerably increasing in height and width, finely papillate toward the center, much more coarsely so toward the periphery; inter-

mediate spaces much depressed, with a smooth U-shaped area near the inner angle next to the raised portions; the peripheral part raised and strongly papillate, the peripheral portion of this raised area at the margin strongly convex or even bluntly angled.

The ornamentation of this species is unique.

Type specimen and others from U. S. G. S. station 3387, Ocala limestone, Red Bluff, on Flint River 7 miles above Bainbridge, De- catur County, Ga.; T. W. Vaughan, collector, 1900.

PLATES XL-XLIV.

PLATE XL.

***Orthophragmina flintensis* Cushman, n. sp. (p. 115).**

FIGURE 1. Sectional view of type specimen, $\times 20$, showing proloculum and second chamber which nearly encircles it, and the annular rings of narrowly rectangular chambers. U. S. G. S. station 7115.

FIGURE 2. Accidental section of another specimen, $\times 20$. U. S. G. S. station 7119.

***Orthophragmina floridana* Cushman, n. sp. (p. 116).**

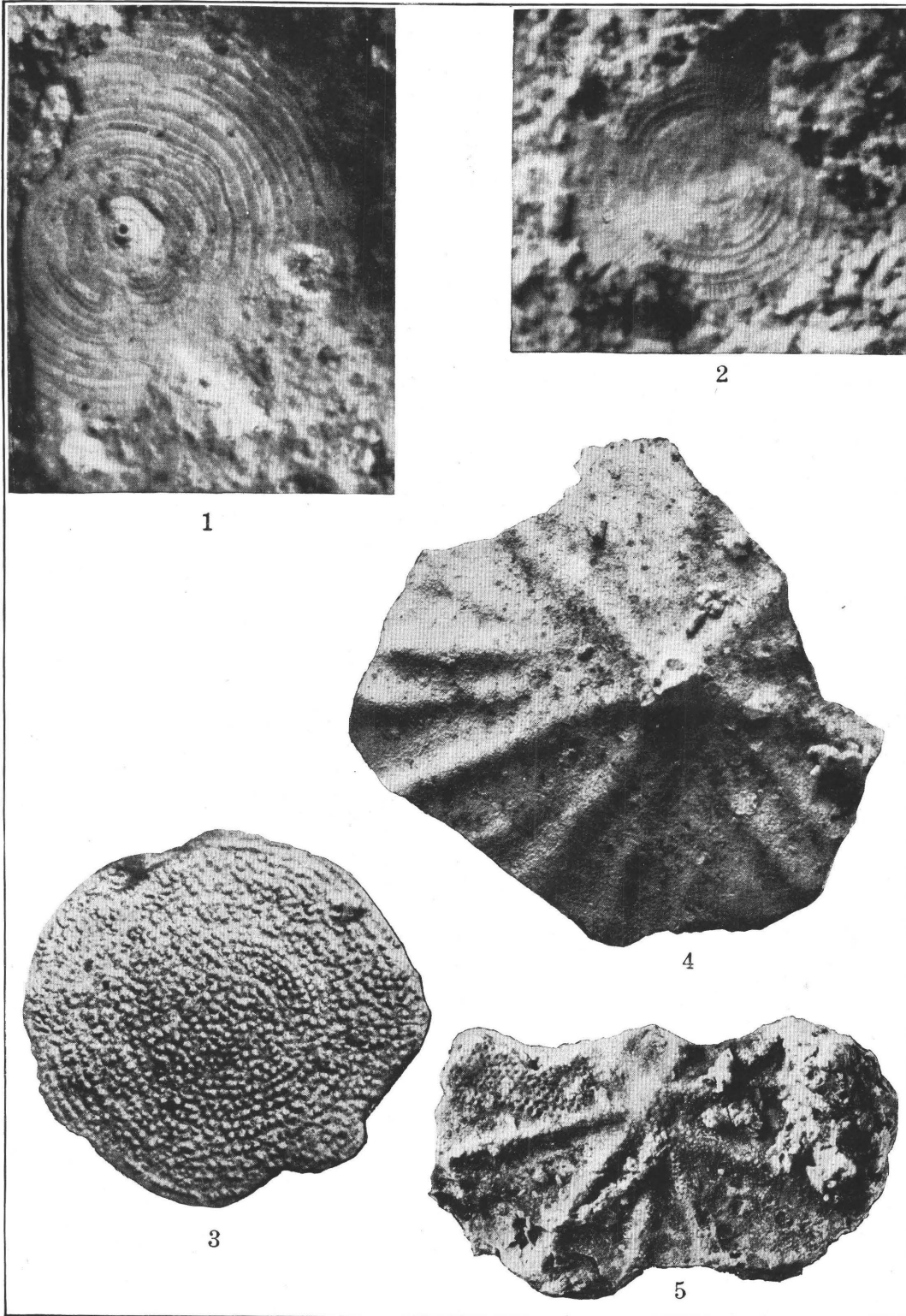
FIGURE 3. Surface view of type specimen, $\times 8$. U. S. G. S. station 6768.

***Orthophragmina americana* Cushman, n. sp. (p. 116).**

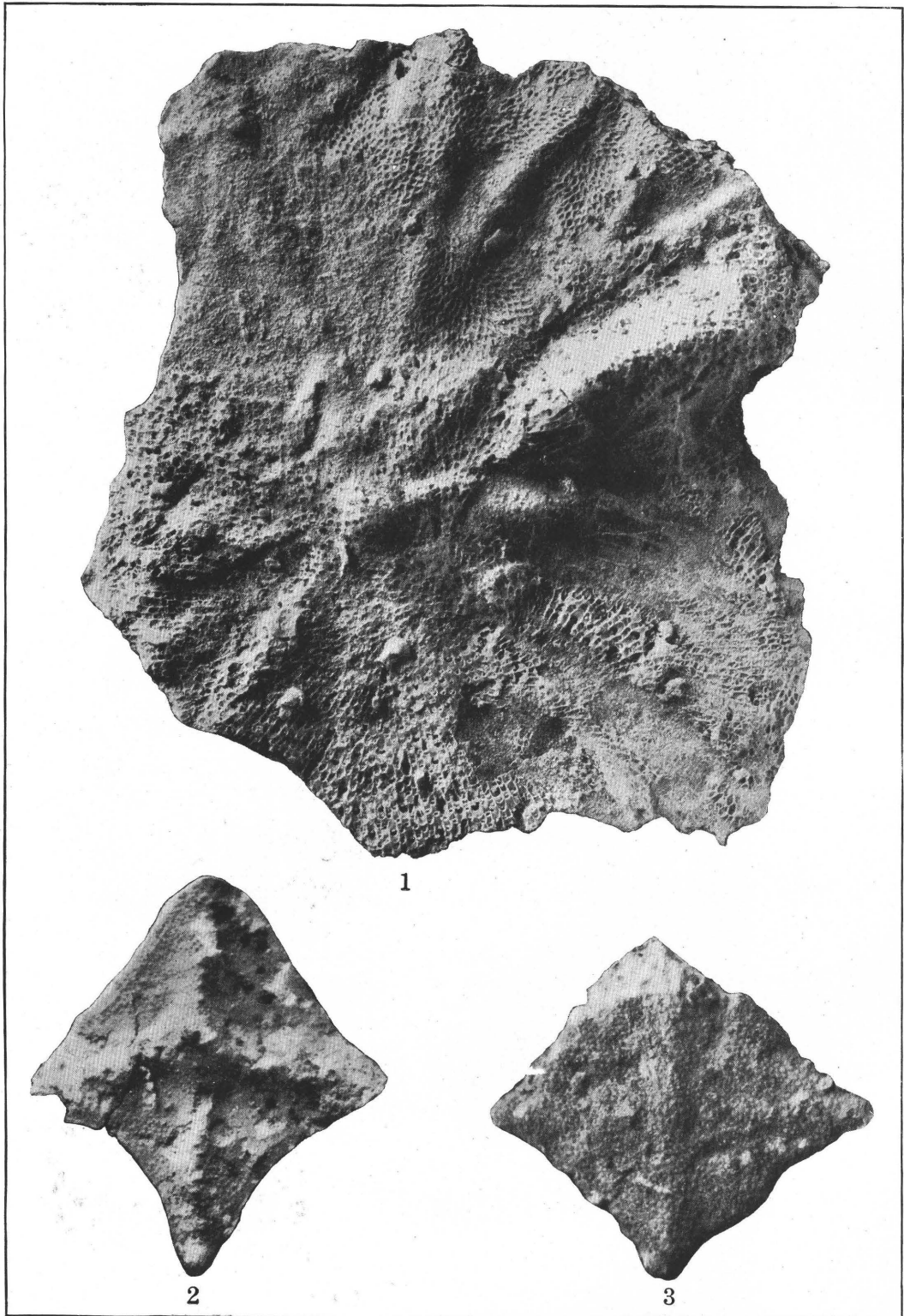
FIGURE 4. Type specimen, $\times 4$. Central portion prominently elevated. U. S. G. S. station 6768.

***Orthophragmina mariannensis* Cushman, n. sp. (p. 116).**

FIGURE 5. Incomplete specimen, $\times 4$. From Marianna, Fla.



SPECIES OF ORTHOPHRAGMINA.



SPECIES OF ORTHOPHRAGMINA.

PLATE XLI.

***Orthophragmina americana* Cushman, n. sp. (p. 116).**

FIGURE 1. Surface view of a specimen, $\times 4$, largely covered with an incrusting bryozoan. U. S. G. S. station 6768.

***Orthophragmina georgiana* Cushman, n. sp. (p. 117).**

FIGURE 2. Specimen viewed from the exterior, $\times 8$. U. S. G. S. station 7097.

FIGURE 3. Specimen with a more papillate surface, $\times 8$. U. S. G. S. station 7099.

PLATE XLII.

***Orthophragmina americana* Cushman, n. sp. (p. 116).**

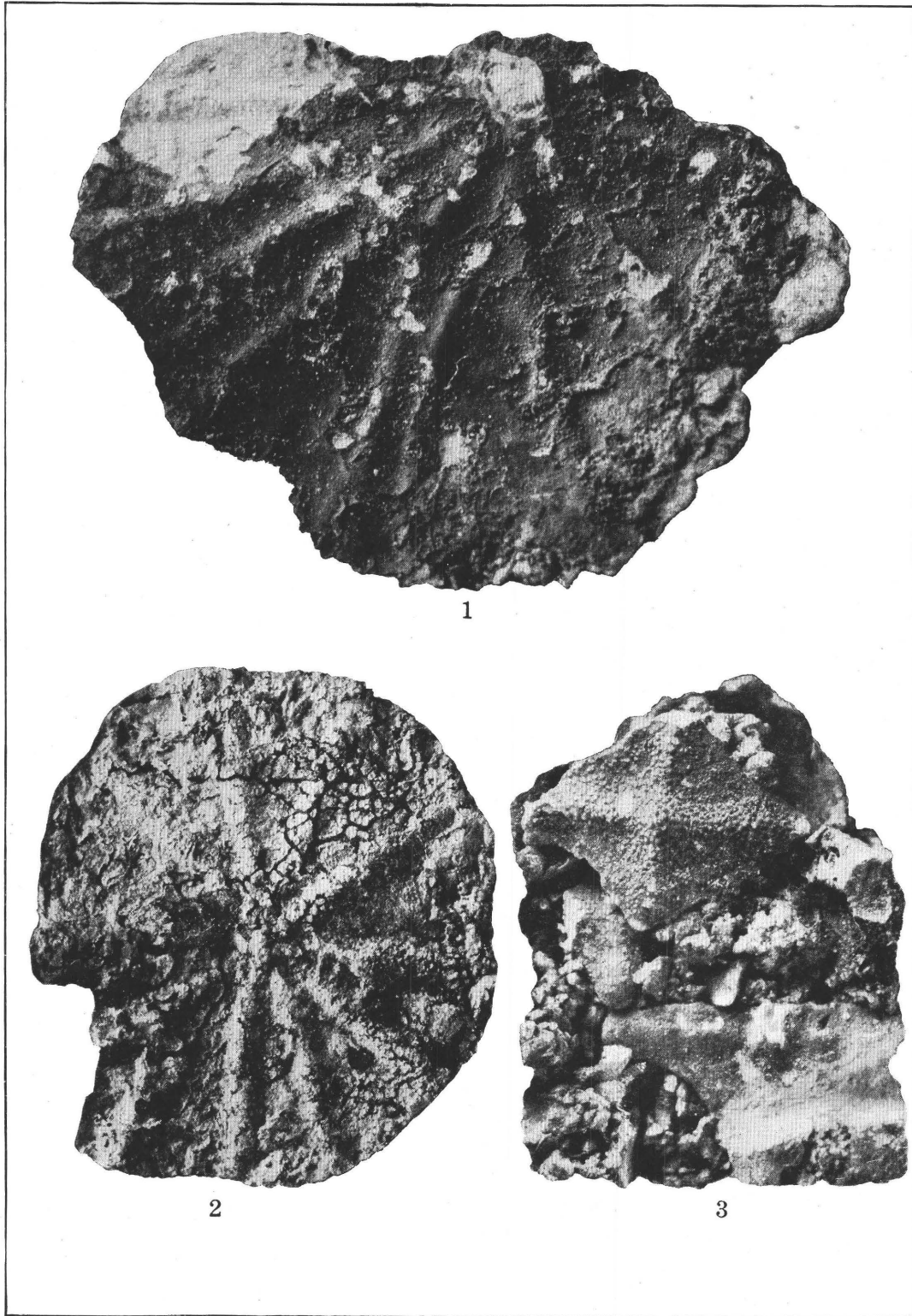
FIGURE 1. Surface view of one-half of a very large specimen, $\times 4$. U. S. G. S. station 3787.

***Orthophragmina mariannensis* Cushman, n. sp. (p. 116).**

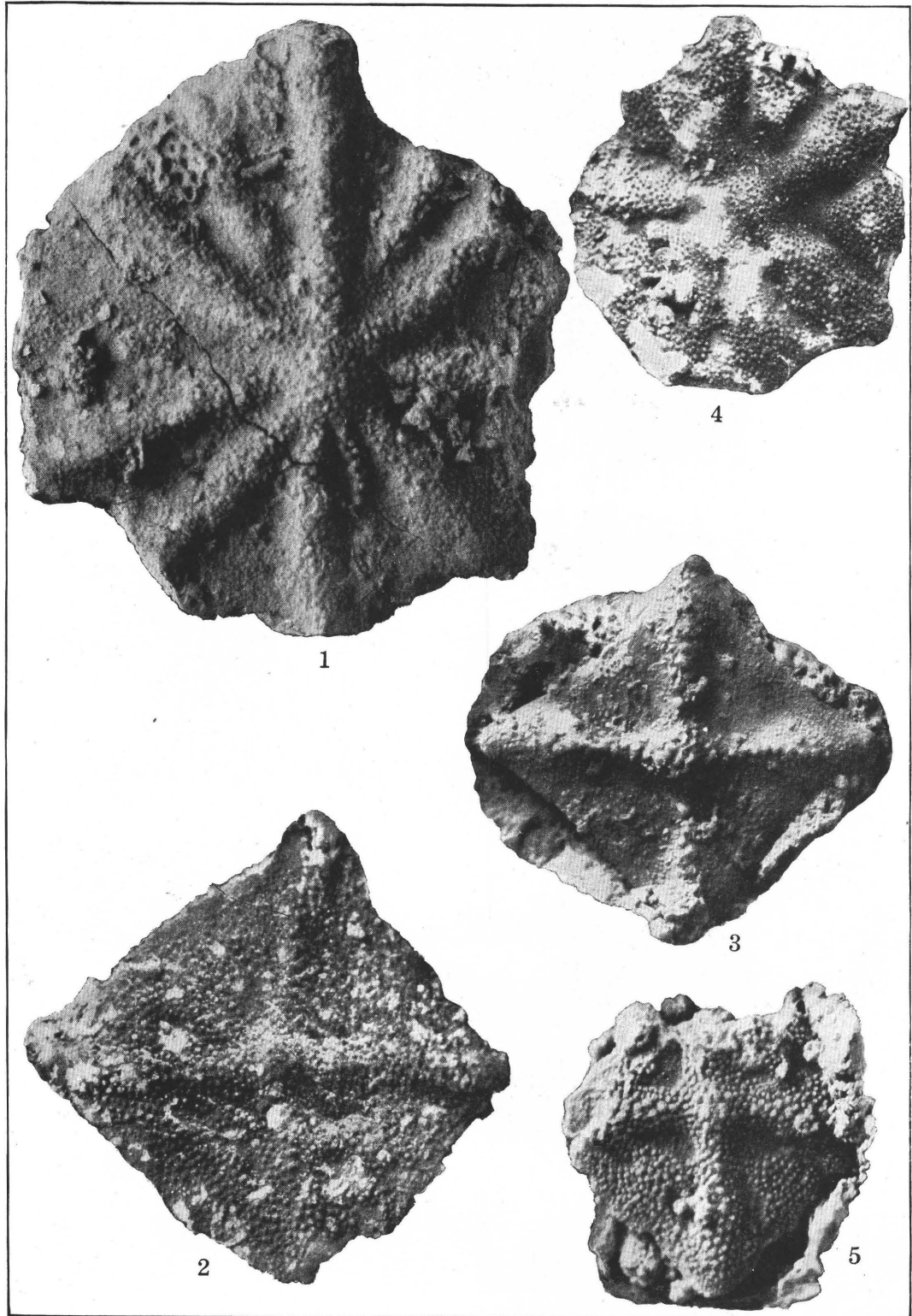
FIGURE 2. Surface view of specimen, $\times 4$. U. S. G. S. station 7191.

***Orthophragmina georgiana* Cushman, n. sp. (p. 117).**

FIGURE 3. Portion of rock fragment with two specimens, the upper one much more papillate than the lower. U. S. G. S. station 7126.



SPECIES OF ORTHOPHRAGMINA.



SPECIES OF ORTHOPHRAGMINA.

PLATE XLIII.

***Orthophragmina mariannensis* var. *papillata* Cushman, n. var. (p. 117).**

FIGURE 1. Surface view of a fairly complete specimen, $\times 6$. U. S. G. S. station 7126.

***Orthophragmina georgiana* Cushman, n. sp. (p. 117).**

FIGURE 2. Surface view of a nearly complete specimen of the papillate form, $\times 8$. U. S. G. S. station 3387.

FIGURE 3. Surface view of type specimen, $\times 8$. U. S. G. S. station 7348.

***Orthophragmina vaughani* Cushman, n. sp. (p. 118).**

FIGURE 4. Surface view of type specimen, $\times 8$. U. S. G. S. station 3387.

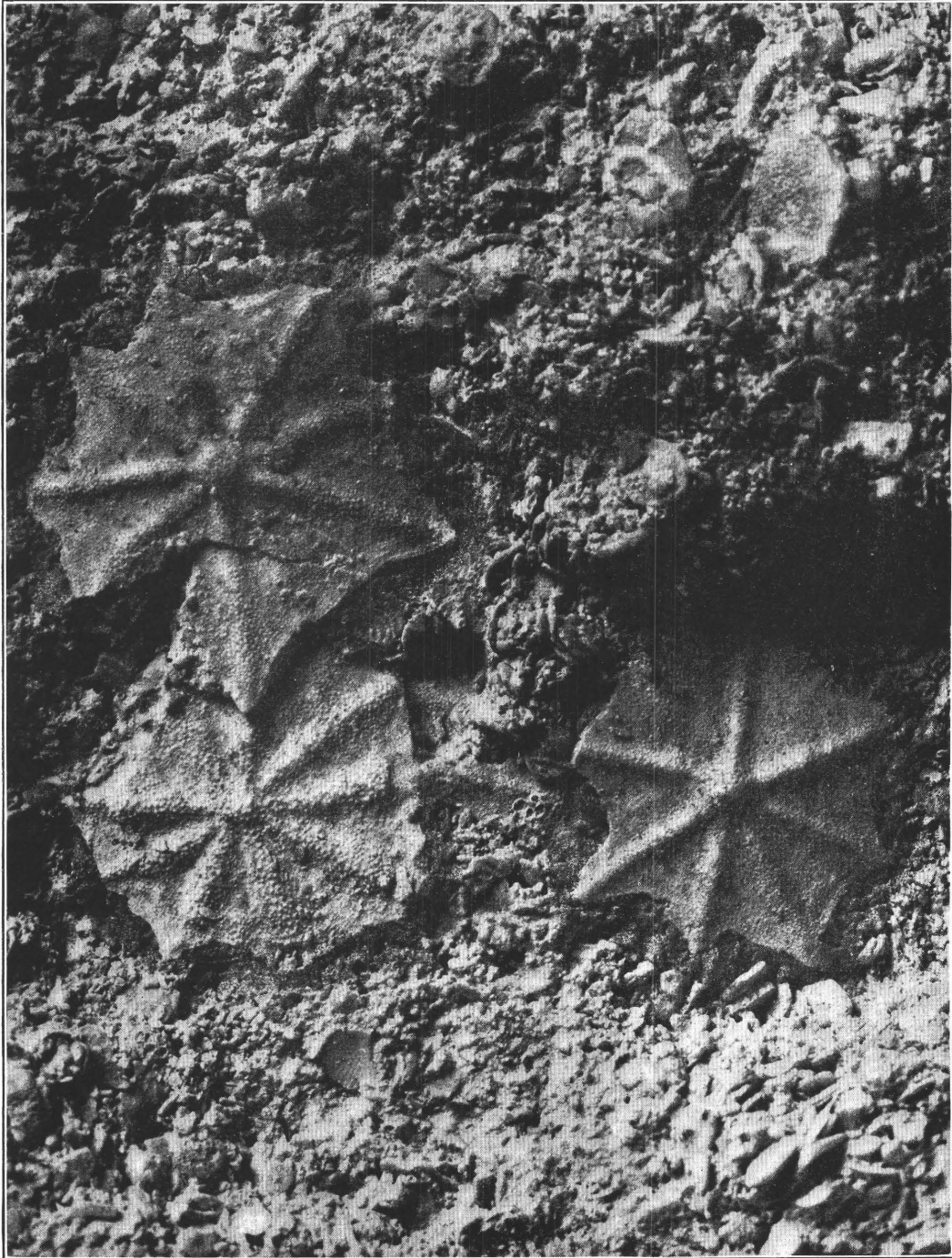
FIGURE 5. Surface view of a less fully developed specimen from the same station, $\times 8$.

PLATE XLIV.

Orthophragmina mariannensis and var. *papillata* Cushman, n. sp. and n. var. (pp. 116, 117.)

Rock specimen from Marianna, Fla., showing two specimens of the typical form of the species and one of the variety at the lower left, $\times 4$. U. S. G. S. station 6768.





SPECIES OF ORTHOPHRAGMINA.