

**STATE OF FLORIDA
DEPARTMENT OF CONSERVATION
Florida Geological Survey**

GEOLOGICAL BULLETIN No. 28

**STRATIGRAPHIC AND PALEONTOLOGIC STUDIES
OF WELLS IN FLORIDA—No. 4**

City of Tallahassee water well No. 6
Dale Mabry Field water well "B"
Ravlin-Brown, V. G. Philips No. 1 well

By
W. STORRS COLE, Ph.D.
OHIO STATE UNIVERSITY

**TALLAHASSEE, FLORIDA
1945**

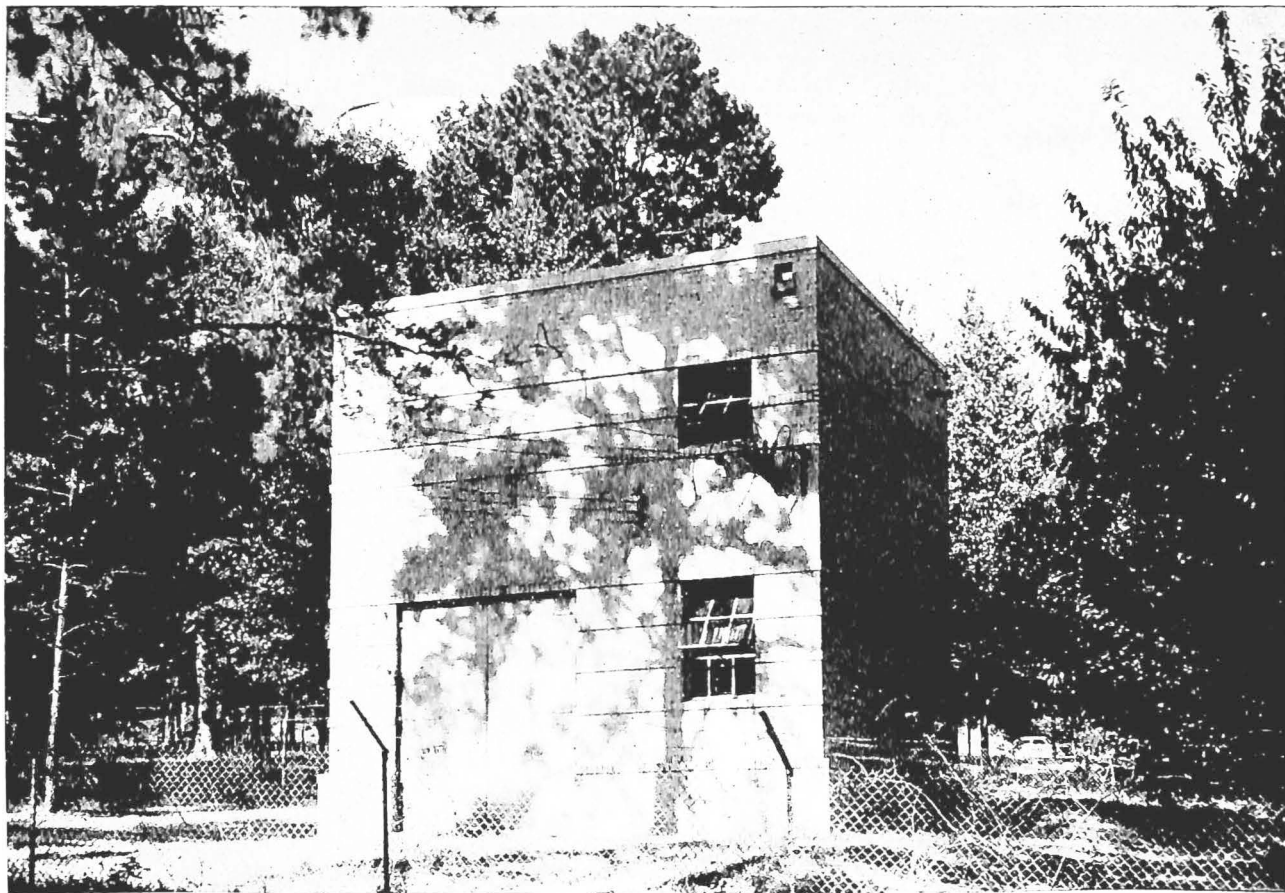


PHOTO BY S. MONTY DOUGLASS, CITY OF TALLAHASSEE, POLICE DEPT.

Pumping station City of Tallahassee water well No. 6 in Lafayette Park

**STATE OF FLORIDA
DEPARTMENT OF CONSERVATION**

Florida Geological Survey

S. E. RICE, *Supervisor of Conservation*
HERMAN GUNTER, *Director, Geological Survey*

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LETTER OF TRANSMITTAL

HONORABLE S. E. RICE

Supervisor of Conservation

Florida State Board of Conservation

Sir:

I have the honor to transmit a report entitled STRATIGRAPHIC AND PALEONTOLOGIC STUDIES OF WELLS IN FLORIDA—No. 4, by Dr. W. Storrs Cole of Ohio State University, Columbus, Ohio, to be published as Geological Bulletin No. 28.

This is the fifth of the series of bulletins setting forth the results of Dr. Cole's studies of samples from wells in Florida. This bulletin considers the cuttings from two water wells—City of Tallahassee well No. 6 and Dale Mabry Field water well "B" and the cuttings and cores from a test for oil, namely, the Ravlin-Brown V. G. Philips No. 1 well in Wakulla County. The general area in which these wells are located is one which has offered considerable difficulty in studying cuttings and arriving at definite conclusions as to the geologic age to which they should be assigned. Some of these difficulties may be because of the paucity of data available for study. But the area has been subjected to weathering agencies, particularly solution. On this account determination of the micro-fossils frequently can not be made, or if made only with doubt and reservations. With the accumulation of data the problems which now give concern may be solved and it is therefore hoped that those who drill wells in this region will arrange to preserve cuttings from the surface to the completed depth of the well. The region is one that offers difficulties both from a geologic and structural point of view and much light can be given through the saving of data from wells, particularly those of a few hundred feet in depth. The present study by Dr. Cole indicates the difficulties and confirms the opinion that the area might very appropriately be termed one of transition between those of the predominant clastic character of the north and the almost entirely calcareous character of the peninsula.

The report, too, contributes definitely to the larger problem of structure and stratigraphy of the whole State of Florida.

Let me thank you for the cordial cooperation you have always shown in the investigations made by the Geological Survey. Your uniform courtesy has made our work lighter and one of pleasure.

Respectfully submitted,

HERMAN GUNTER, *Director*
Geological Survey

Tallahassee, Florida

October 19, 1944

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STRATIGRAPHIC AND PALEONTOLOGIC STUDIES OF WELLS IN FLORIDA—No. 4

City of Tallahassee water well No. 6
Dale Mabry Field water well "B"
Ravlin-Brown, V. G. Philips No. 1 well

W. STORRS COLE
OHIO STATE UNIVERSITY

INTRODUCTION

Four bulletins¹ in which an attempt has been made to present a detailed analysis of selected wells in Florida have been published. This bulletin in which three wells in the vicinity of Tallahassee are analyzed is the fifth in the series. The locations of the wells studied for this bulletin are shown in Figures 1 and 5.

Samples from the City of Tallahassee water well No. 6 (W-453) were studied first. The Miocene and Oligocene portions of this well were normal and did not present any particular problems, but the final samples from this well contained specimens of larger Foraminifera representing upper Eocene species which have not been reported previously from the upper

Eocene of Florida. Although these species conclusively demonstrate that this well penetrated the upper Eocene, the exact stratigraphic relationship of this zone to other well known zones in the upper Eocene could not be ascertained. Therefore, Mr. Gunter suggested that the samples from the Dale



Figure 1. Location of City of Tallahassee well and Dale Mabry Field water well "B".

¹ Cole, W. Storrs, *Stratigraphy and Micropaleontology of Two Deep Wells in Florida*, Florida Geol. Survey Bull. 16, pp. 1-73, 12 pls., 3 text figs., 1938.

_____, *Stratigraphic and Paleontologic Studies of Wells in Florida*, Florida Geol. Survey Bull. 19, pp. 1-91, 18 pls., 3 text figs., 1941.

_____, *Stratigraphic and Paleontologic Studies of Wells in Florida—No. 2*, Florida Geol. Survey Bull. 20, pp. 1-89, 16 pls., 3 text figs., 1942.

_____, *Stratigraphic and Paleontologic Studies of Wells in Florida—No. 3*, Florida Geol. Survey Bull. 26, 168 pp., 29 pls., 5 text figs., 1944.

Mabry Field water well "B" (W-95) should be examined as they might yield more information.

Unfortunately, the Dale Mabry Field water well "B" was not drilled deep enough to furnish the desired information, but a very large and well preserved fauna of larger Foraminifera was found in the Oligocene portion of this well. In order that this fauna might be recorded the decision was made to study this well in detail.

Mossom² indicates that the top of the Ocala limestone should be encountered at approximately 450 feet below sea level in the vicinity of Tallahassee. The data available to Mossom were quite meager and poor. The present study shows that at Tallahassee the top of the upper Eocene occurs at approximately 220 feet below sea level. Whether the upper Eocene represents the Ocala or a new formation in this area will be discussed later in this bulletin.

All of the types and other specimens described or identified from these wells are filed in the Florida Geological Survey Museum at Tallahassee, Florida.

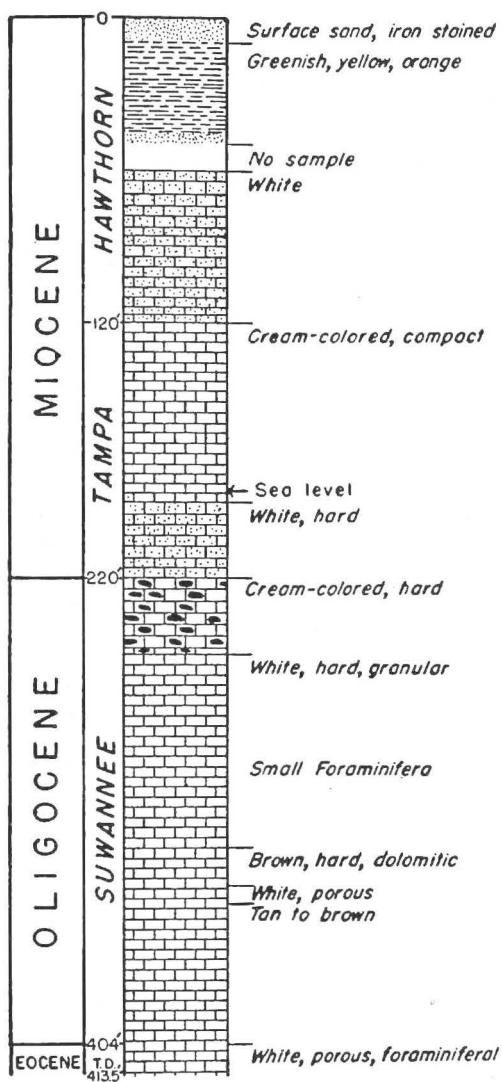
ACKNOWLEDGMENTS

It is a distinct pleasure to acknowledge the assistance that has been received during the progress of this study. Mr. Herman Gunter has given many valuable suggestions and his constant encouragement has been a source of inspiration during the tedious phases of this problem. Dr. T. Wayland Vaughan examined certain specimens and wrote detailed opinions, many of which are quoted in later sections. The U. S. Geological Survey and Dr. John W. Wells took the excellent photomicrographs of the external views. Mr. James R. Galbraith Jr. described most of the samples from the City of Tallahassee water well. The writer made the thin sections and took the photomicrographs of these.

CITY OF TALLAHASSEE WATER WELL NO. 6 (W-453)

The city of Tallahassee drilled a well for an additional supply of potable water in Lafayette Park in Tallahassee, Leon

² Mossom, Stuart, A Review of the Structure and Stratigraphy of Florida, 17th Ann. Rept., Florida Geol. Survey, map facing p. 256, 1926.



LEGEND



Sandstone



Limestone



Flint



Clay



Arenaceous limestone

0 50 100 feet
Vertical scale

Figure 2. Log of City of Tallahassee water well No. 6

County, Florida. The exact location of this well is section 30, Township 1 N., Range 1 E., about 4100 feet northeast of the post office and the elevation of the well is 186.6 feet above sea level.

This well was started on June 19, 1939. It was drilled at first to a depth of 310 feet and later deepened to 413.5 feet. The drilling was done by the Gray Well and Pump Corporation of Jacksonville, Florida. Mr. Miller Walston, city engineer of Tallahassee, presented to the Florida Geological Survey 72 samples which were given the file number W-453. A driller's log was not furnished to the Survey.

STRATIGRAPHY

The formations penetrated by this well are shown graphically on Figure 2. The section to a depth of 404 feet is correlated with known surface units, but the remainder of the well (404 to 413.5 feet) is not correlated definitely with surface formations of Florida because a fauna appears which has not been recognized previously in the state.

MIOCENE

HAWTHORN FORMATION.—The geologic map of Florida³ shows that the area in and adjacent to the city of Tallahassee is underlain by the Hawthorn formation. Cooke and Mossom⁴ state:

"Although nearly all of Leon County is underlain by sandy limestone of Hawthorn age, the unaltered rock is exposed at few places. Nearly everywhere the formation is so deeply weathered that practically all its lime has been removed by solution, leaving behind loose sand or friable sandstone and sandy clay."

The first sample at 10 feet contains iron stained sand and some particles of weathered clay. The first sandy limestone is encountered at a depth of 60 feet. Although shell fragments appear at a depth of 100 feet, the first identifiable Foraminifera were not encountered until the depth of 130 feet was reached.

The Hawthorn formation in this area is composed of an upper zone composed of argillaceous sandstones and greenish

³ Cooke, C. Wythe and Mossom, Stuart, Geology of Florida, Florida Geol. Survey, 20th Ann. Report, map in pocket, 1927-28.

⁴ *Idem*, p. 123.

to yellowish-brown clays, certain of which resemble fuller's earth. The lower 60 feet of the Hawthorn is dominated by a white, arenaceous limestone, some beds of which contain shell fragments.

TAMPA LIMESTONE.—At a depth of 130 feet a few specimens which are referred to *Peneroplis proteus* d'Orbigny were recovered. In the next sample at 140 feet abundant specimens of *P. proteus* d'Orbigny were found in association with *Sorites* sp. Normally, *Archaias floridanus* (Conrad) accompanies these species, but in this well *A. floridanus* was not recovered from any of the samples.

The top of the Tampa limestone is placed at 120 feet rather than 130 feet at which depth Foraminifera appear because of the lithologic change which occurs at 120 feet. The sample at 110 feet contains numerous fragments of a white, soft, arenaceous limestone, but at 120 feet cream-colored hard compact limestone is encountered. This limestone continues to a depth of 190 feet.

White, hard, arenaceous limestone is found between 190 to 210 feet. At 220 feet the sample contained abundant gray to brown flint fragments. This sample is believed to mark the top of the Oligocene. If this is correct, the Tampa limestone in this area would have a thickness of about 100 feet.

OLIGOCENE

SUWANNEE LIMESTONE.—The sample at 220 feet which contained the flint had a fauna of smaller Foraminifera. Unfortunately, these were preserved so badly that identifications were impossible. At 230-240 feet specimens were recovered which were identified as *Rotalia mexicana* Nuttall, variety *mecatepecensis* Nuttall (see figure 10, plate 11). In the study of the City of Quincy water well (W-4)⁵ the appearance of this species was considered to be indicative of the top of the Oligocene.

It would appear that *Rotalia choctawensis* Cushman and McGlamery⁶ is related closely to *R. mexicana* Nuttall, variety

⁵ *Op. cit.*, (Bull. 26), p. 14.

⁶ Cushman, Joseph A. and McGlamery, Winnie, Oligocene Foraminifera from Choctaw Bluff, Alabama, U. S. Geol. Survey Prof. Paper 189-D, p. 110, pl. 27, fig. 4, 1938.

mecatepecensis Nuttall.⁷ Galloway and Heminway⁸ figure *R. choctawensis* from the San Sebastian formation which they assign to the middle Oligocene and *R. mexicana*, variety *mecatepecensis* from the Ponce formation which is assigned in part to the upper Oligocene and in part to the lower Miocene.

The *Lepidocyclina* (*Lepidocyclina*) *waylandvaughani* zone of the Meson formation exposed in a quarry on the golf course of the Huasteca Petroleum Company at Tampico, Mexico contains numerous specimens of *R. mexicana*, variety *mecatepecensis* as well as *Elphidium rota* Ellis, a species described from beds of Chickasawhay age of Wayne County, Mississippi.⁹ It would appear that both *R. choctawensis* and *R. mexicana*, variety *mecatepecensis* are Oligocene species.

Although the sample taken at 240-250 feet contained a few specimens assigned to *Elphidium rota* Ellis in addition to more specimens of *R. mexicana*, variety *mecatepecensis*, a moderately complete fauna was not found until the sample at 280-290 feet was examined. This fauna indicates definitely Oligocene age for this sample.

The sparingly fossiliferous zone from 220 feet to 280 feet is included in the Oligocene and assigned to the Suwannee limestone, but study of other wells may cause this portion of the well to be classified in a different manner.

Between 324 and 404 feet specimens of *Lepidocyclina* were found at 349, 354 and 356 feet. At 362 feet there were found specimens representing *Coskinolina floridana* Cole and *Dic-tyoconus cookei* (Moberg). At depths of 365 and 370 feet these species occurred in abundance. The individual specimens were well preserved.

C. floridana and *D. cookei* occur in two zones in Florida, namely, in the middle Eocene as indigenous specimens and in the Oligocene as reworked specimens although there is a difference of opinion with regard to the origin of the Oligocene specimens.¹⁰

⁷ Compare illustrations given of *R. choctawensis* with those of *R. mexicana*, variety *mecatepecensis* in Jour. Pal., vol. 6, pl. 4, figs. 11, 12, 1932.

⁸ Galloway, J. J. and Heminway, Caroline E., The Tertiary Foraminifera of Porto Rico, New York Acad. Sci., Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, part 4, pp. 379-381, pl. 19, figs. 2a-c; pl. 19, figs. 4a-c, 1941.

⁹ Ellis, A. D. Jr., Significant Foraminifera from the Chickasawhay Beds of Wayne County, Mississippi, Jour. Pal., vol. 13, pp. 423-425, pl. 48, 1939.

¹⁰ For a detailed discussion of this problem, see Florida Geol. Survey Bull. 19, pp. 13-16.

The section assigned to the Suwannee limestone in this well has a thickness of about 184 feet.

UPPER EOCENE

At 404 feet there appears a white foraminiferal limestone which contains many specimens of *Helicolepidina paucispira* Barker and Grimsdale and abundant specimens of a new variety of *Lepidocyclina* which is closely related to *L. (Nephrolepidina) sanfernandensis* Vaughan and Cole. Neither *H. paucispira* nor *L. sanfernandensis*, variety *tallahasseeensis*, n. var., have been reported from Florida.

H. paucispira is known from Mexico¹¹ where it occurs near the base of the upper Eocene in the Tampico Embayment and from the upper Eocene of Trinidad.¹² *L. sanfernandensis* is known only from its type locality at San Fernando, Trinidad, in deposits assigned to the upper Eocene.¹³

In all the wells so far examined, except the City of Quincy water well (W-4),¹⁴ the upper Eocene has been recognized by the appearance of a typical Ocala fauna of larger Foraminifera. In the City of Quincy water well (W-4) only smaller Foraminifera were present, but the species represented were types which characterize the Jackson deposits of the Gulf Coastal Plain. Therefore, it was logical to use the formational name Ocala for this portion of the section in the City of Quincy water well (W-4).

Although the section from 404 to 413.5 feet (the last sample) in the City of Tallahassee well represents the upper Eocene, there is considerable doubt concerning the exact correlation because the two species present have not been recognized previously in Florida, nor is there evidence of their relationship to known Ocala and Jackson faunas. The most conservative treatment of this section is to assign it to the upper Eocene without a specific formational designation.

¹¹ Barker, R. Wright and Grimsdale, T. F., A Contribution to the Phylogeny of the Orbitoidal Foraminifera with Descriptions of New Forms from the Eocene of Mexico, Jour. Pal., vol. 10, pp. 243, 247, 1936.

¹² Vaughan, T. Wayland and Cole, W. Storrs, Preliminary Report on the Cretaceous and Tertiary Larger Foraminifera of Trinidad, British West Indies, Geol. Soc. Amer. Sp. Paper No. 30, p. 76, 1941.

¹³ *Idem*, p. 74.

¹⁴ *Op. cit.*, (Bull. 26) pp. 12-18.

Future work may indicate that this is a phase of the Ocala, or that it represents the appearance of a new unit of upper Eocene age.

PALEONTOLOGICAL RECORD (W-453)

- 130 feet
Peneroplis proteus d'Orbigny
- 140 feet
Peneroplis proteus d'Orbigny
Sorites sp.
- 160 feet
Peneroplis proteus d'Orbigny
Sorites sp.
- 220–230 feet
 Smaller Foraminifera (badly preserved; not identified)
- 230–240 feet
Rotalia mexicana Nuttall, variety *mecatepecensis* Nuttall
- 240–250 feet
Elphidium rota Ellis
Rotalia mexicana Nuttall, variety *mecatepecensis* Nuttall
- 280–290 feet
Amphistegina cf. *A. chipolensis* Cushman and Ponton
Asterigerina sp.
Discorbis subaraucana Cushman
Elphidium rota Ellis
Eponides ellisorae Garrett
Lepidocyclina (*Eulepidina*) *favosa* Cushman
Nonion sp.
Operculinoides vicksburgensis Vaughan and Cole
Planorbulina larvata Parker and Jones
Rotalia mexicana, variety *mecatepecensis* Nuttall
Reussia spinulosa, variety *glabrata* (Cushman)
- 290–300 feet
Discorbis sp.
subpatelliformis Cushman and McGlamery
- 319 feet
Cibicides mexicanus Nuttall
pseudoungerianus (Cushman)
Discorbis subaraucana Cushman
Eponides ellisorae Garrett
Lepidocyclina (*Eulepidina*) *undosa* Cushman
Nonion advenum (Cushman)
grateloupi d'Orbigny
Nonionella oligocenica Cushman and McGlamery
Rotalia byramensis Cushman
- 324 feet
Lepidocyclina (*Eulepidina*) *undosa* Cushman (very abundant)

- 349 feet
Lepidocyclina (*Nephrolepidina*) *suwanneensis* Cole, n. sp.
(*Eulepidina*) *favosa* Cushman
- 354 feet
Lepidocyclina (*Nephrolepidina*) *suwanneensis* Cole, n. sp.
- 356 feet
Lepidocyclina (*Nephrolepidina*) *suwanneensis* Cole, n. sp.
- 362 feet
Coskinolina floridana Cole
Dictyoconus cookei (Moberg)
- 365 feet
Coskinolina floridana Cole (abundant)
Dictyoconus cookei (Moberg) (abundant)
- 404 feet
Gypsina sp.
Lepidocyclina sanfernandensis, variety *tallabasseensis* Cole, n. var.
- 405-413.5 feet
Gypsina sp.
Helicolepidina paucispira Barker and Grimsdale
Lepidocyclina sanfernandensis, variety *tallabasseensis* Cole, n. var.

DALE MABRY FIELD WATER WELL "B" (W-95)

The United States Army drilled at the Dale Mabry Field a water well, samples from which were presented to the Florida Geological Survey. The location of this well is about 3.5 miles west-southwest of Tallahassee, Leon County, Florida in the NE $\frac{1}{4}$ of the NW $\frac{1}{4}$ of section 4, Township 1 S., Range 1 W. The elevation of this well is 86.1 feet above sea level.

The well was started on December 9, 1940 and drilled to a depth of 239 feet by December 26, 1940. The drilling was done by the Stevens Southern Company of Jacksonville, Florida. In December of 1942 this well was deepened to a depth of 316.5 feet by the Layne-Atlantic Company.

STRATIGRAPHY

The formations penetrated by this well are shown graphically on Figure 3. All of the formations are correlated with known outcropping units.

MIOCENE

HAWTHORN FORMATION.—The well started in the Hawthorn formation which underlies most of Leon County. The first 45 feet of material is an argillaceous sand, the grains of

which are coated with a reddish stain. Below this reddish zone there occurs a section in which the individual grains are covered by a yellowish film of staining material.

A bed of greasy, yellowish gray fuller's earth intervenes in the sandstone section at 45 feet. Below this there occurs a bed of yellow-stained sandstone similar to that above the fuller's earth except the lower sandstone is slightly indurated.

This sandstone is followed by another bed of fuller's earth with the first limestone appearing at a depth of 65 feet. In the sample taken at 70 feet there are many large, rounded pebbles of an orange-colored quartzite, many of which have a diameter of one-half inch or more. This same sample contains fragments of a white, arenaceous, silicified limestone.

Below this zone of quartzite pebbles there are two samples which contain a gray to white, arenaceous, dense, greasy clay which resembles fuller's earth. At a depth of 90 feet the sample contains a mixture of this clay and fragments of a white, dense, hard limestone.

TAMPA LIMESTONE.—At 100 feet a light brown, dense limestone, certain fragments of which show numerous sections of smaller Foraminifera, appears. This limestone continues to a depth of 139 feet, except for the appearance of two beds of clay at 117 feet and 137 feet. This clay may represent the filling of cavities in the limestone rather than actual beds as shown on the graphic log (See Figure 3).

In this interval (100 to 139 feet) there were not any fossils which could be identified definitely. Many of the fragments show that the limestone was composed largely of the tests of miliolid types of Foraminifera. An occasional small fragment of an echinoid was encountered in these samples.

The lithologic character and the stratigraphic position indicate that this portion should be assigned to the Tampa limestone. Normally, either *Archaias floridanus* (Conrad) or *Peneroplis proteus* d'Orbigny occur near the top of the Tampa limestone.

OLIGOCENE

SUWANNEE LIMESTONE.—At 139 feet a cream-colored foraminiferal limestone was encountered. This limestone con-

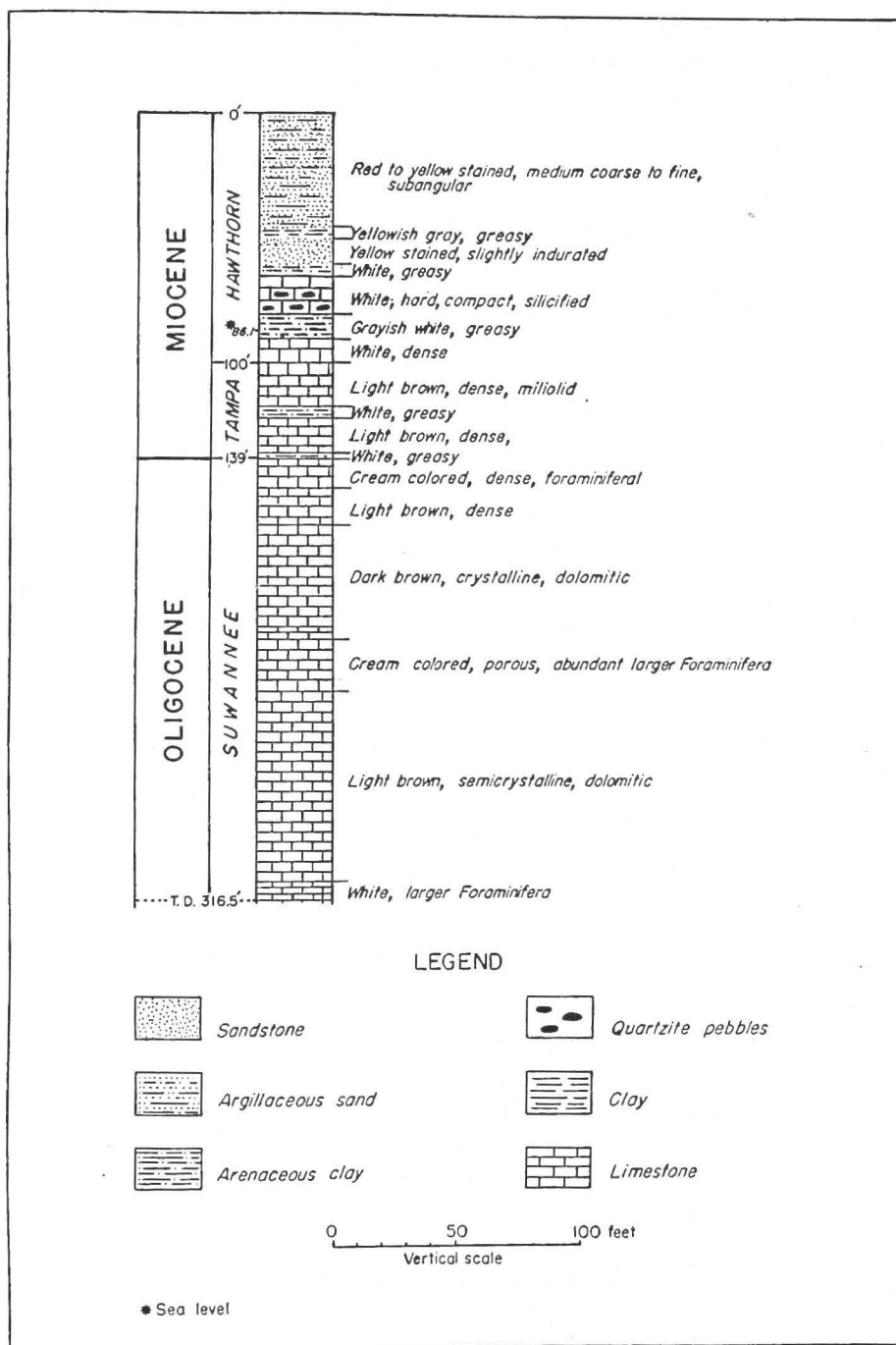


Figure 3. Log of Dale Mabry Field water well "B"

tains abundant smaller Foraminifera, but most of them are so badly recrystallized that specific identifications are impossible. However, several specimens of *Elphidium rota* Ellis and a few questionable specimens of *Rotalia mexicana* Nuttall, variety *mecatepecensis* Nuttall were found. Associated with these there are numerous specimens representing the genera *Amphistegina* and *Asterigerina*. This sample represents the top of the Suwannee limestone.

The Suwannee limestone in this well is in part a cream-colored, dense, foraminiferal limestone and in part a light to dark brown, semi-crystalline, dolomitic limestone. There are three fossiliferous zones which yield identifiable fossils. The first of these includes the samples from 139 to 150 feet; the second, the samples from 212.6 to 232 feet and the third, the final sample at 308 to 316.5 feet.

The smaller Foraminifera recovered at 139 feet are discussed above. At 144 and 150 feet rather numerous specimens of *Operculinoides vicksburgensis* were found, with two specimens of *Lepidocyclina* at 144 feet.

The interval between 212.6 and 232 feet contains abundant and fairly well preserved specimens of *Lepidocyclina*. In addition, numerous specimens of *Coskinolina* and *Dictyoconus* were found from 226 to 232 feet.

The index species of *Lepidocyclina* in this interval are: *L. (Eulepidina) favosa* Cushman, *L. (Eulepidina) undosa* Cushman, *L. (Lepidocyclina) yurnagunensis* Cushman and its variety *morganopsis* Vaughan, and *Lepidocyclina gigas* Cushman.

These species have been reported from an outcrop near Duncan Church, Washington County, Florida¹⁶ and from numerous other localities in Washington County.¹⁰ These species, moreover, have a wide distribution elsewhere as they are known from Cuba, the Antigua formation of Antigua, the Meson formation of Mexico, Moneague formation of Jamaica, the limestone on Cayman Brac, Cayman Islands and numerous localities in Trinidad, British West Indies.

¹⁶ Cole, W. Storrs, Oligocene Orbitoids from near Duncan Church, Washington County, Florida, Jour. Pal., vol. 8, No. 1, pp. 21-28, pls. 3, 4, 1934.

¹⁰ Vernon, Robert O., Geology of Holmes and Washington Counties, Florida, Florida Geol. Survey Bull. 21, pp. 55-66, 1942.

The last sample (308-316.5 feet) contains numerous specimens of orbitoidal Foraminifera. The state of preservation of these specimens is decidedly different from that of the specimens encountered in the zone from 212.6 to 232 feet. The specimens from the upper zone were not replaced, whereas those in the last sample were. The specimens of the upper zone were light brown to cream-colored, whereas those of the last sample were white. Therefore, these specimens in the last sample were in place and do not represent cavings from above.

The species identified from the last sample represent well established Oligocene species with the exception of two specimens assigned to *Helicolepidina paucispira* Barker and Grimsdale. This genus is known only from the Eocene and this species has been reported from upper Eocene localities outside of Florida.

The most abundant specimens in this sample (308-316.5 feet) have been identified as *Lepidocyclina* (*Lepidocyclina*) *parvula* Cushman. There were rather numerous specimens of *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis* Cushman, variety *morganopsis* Vaughan, one specimen of unquestionable *Lepidocyclina* (*Eulepidina*) *undosa* Cushman and a large microspheric individual (figure 7, plate 9) from which a vertical thin section was made. This specimen is referred to *Lepidocyclina* (*Eulepidina*) *favosa* Cushman.

As the dominant species in this sample are Oligocene forms, the question arises concerning the two specimens of *Helicolepidina paucispira* Barker and Grimsdale. The presence of the specimens may be explained in two ways: 1. they represent reworked Eocene material in the base of the Suwannee limestone, 2. the drill had just entered the upper Eocene and these specimens were recovered.

Either explanation is possible as the top of the upper Eocene must be close to the bottom of this well, if, in fact, the bottom of the well is not actually in the topmost upper Eocene. The City of Tallahassee water well (W-453) has 184 feet between the top of the Suwannee limestone and the top of the upper Eocene. The Dale Mabry Field water well "B" (W-95) has penetrated 177.5 feet of Suwannee limestone if it is assumed that all of the interval represented by the final sample is Oligocene.

feet of Tampa limestone and 177.5 feet of Suwannee limestone in which formation drilling stopped.

The relationship of certain points in these wells to sea level is illustrated by the following:

Well number	W-95	W-453
Top of the Tampa limestone - - -	— 13.9'	+ 66.6'
Top of the Suwannee limestone - - -	— 52.9'	— 33.4'
Top of the upper Eocene - - -	Below —230.4'	—217.4'
First appearance of <i>O. vicksburgensis</i> - - -	— 57.9'	— 93.4'
Abundant <i>L. undosa</i> - - -	—125.9'	—137.4'
First appearance of <i>L. undosa</i> - - -	—125.9'	—132.4'

The City of Tallahassee water well is structurally slightly higher than the Dale Mabry Field water well if the formational boundaries are used. If fossil zones in the Suwannee limestone are used, the Dale Mabry Field water well would appear to be structurally higher.

DESCRIPTIONS OF SPECIES

FAMILY VALVULINIDAE

Subfamily EGGERELLINAE

Genus COSKINOLINA Stache, 1875

Coskinolina floridana Cole

Plate 2, Figures 3, 4

1928. *Coskinolina cookei* Moberg (part), Florida Geol. Survey 19th Ann. Rept., pp. 166-168, pl. 3, fig. 6 (not figs. 1-5, 7-8).
 1941. *Coskinolina floridana* Cole, Florida Geol. Survey Bull. 19, pp. 24, 25, pl. 3, figs. 1-7; pl. 4, figs. 1-9; pl. 5, figs. 1-5, 11; pl. 18, fig. 9.
 1942. *Coskinolina floridana* Cole, Florida Geol. Survey Bull. 20, p. 21, pl. 4, figs. 4, 5.

Entirely typical specimens were found. The axial section is typical of *Coskinolina* as the chamberlets are not subdivided, but the horizontal section is similar to the primitive types of *Dictyoconus* as a single vertical plate is present in the chamberlets.

First appearance: At a depth of 362 feet in the City of Tallahassee water well (W-453) and abundant at 365 feet; at a depth of 226 feet in the Dale Mabry Field water well "B" (W-95).

Occurrence: Suwannee limestone.

Genus *Dictyoconus* Blanckenhorn, 1900*Dictyoconus cookei* (Moberg)

Plate 2, Figures 1, 2

1928. *Coskinolina cookei* Moberg, Florida Geol. Survey 19th Ann. Rept., pp. 166-168, pl. 3, figs. 1-5, 7-8 (not fig. 6).
 1941. *Dictyoconus cookei* (Moberg). Cole, Florida Geol. Survey Bull. 19, pp. 26, 27, pl. 3, figs. 11-13; pl. 5, figs. 6-10, 12, 13; pl. 6, figs. 1-8; pl. 18, fig. 12.
 1942. *Dictyoconus cookei* (Moberg). Cole, Florida Geol. Survey Bull. 20, pp. 24, 25, pl. 3, fig. 10; pl. 4, fig. 8.

D. cookei and *Coskinolina floridana* occur in association, but are readily recognized from each other as *D. cookei* has larger, broader and lower cone than *C. floridana*. The axial sections of *D. cookei* have the marginal chamberlets subdivided by a single horizontal plate.

First appearance: At a depth of 362 feet in the City of Tallahassee water well (W-453) and abundant at 365 feet; at a depth of 226 feet in the Dale Mabry Field water well (W-95).

Occurrence: Suwannee limestone.

FAMILY CAMERINIDAE

Subfamily CAMERININAE

Genus *Operculinoides* Hanzawa, 1935*Operculinoides vicksburgensis* Vaughan and Cole

Plate 1, Figures 12, 13; Plate 5, Figures 1-10; Plate 11, Figures 4, 5

1936. *Operculinoides vicksburgensis* Vaughan and Cole, Proc. U. S. Nat. Museum, vol. 83, No. 2996, pp. 490, 491, pl. 36, all figs.
 1939. *Operculinoides vicksburgensis* Vaughan and Cole. Barker, Proc. U. S. Nat. Museum, vol. 86, No. 3052, p. 318, pl. 12, fig. 6; pl. 18, fig. 2; pl. 19, figs. 8, 9.
 1939. *Operculinoides muiri* Barker, *idem*, pp. 312, 313, pl. 14, fig. 4; pl. 20, fig. 1; pl. 22, fig. 1.
 1944. *Operculinoides vicksburgensis* Vaughan and Cole. Cole, Florida Geol. Survey Bull. 26, pp. 49, 50, pl. 3, figs. 7, 10; pl. 6, figs. 1-5, 11, 12, 15, 17, 18; pl. 19, fig. 11.

Numerous specimens which seem to represent this species were found in the Dale Mabry Field water well (W-95). Measurements are given in Table 1 of 7 thin sections prepared from these specimens. These specimens have a thickness through the center in excess of that given by Vaughan and

Cole in the type description of *O. vicksburgensis*. In this feature these specimens resemble *O. muiri* Barker which was described from Mexico.

In the discussion of specimens assigned to *O. vicksburgensis* from the City of Quincy well (W-4) Cole stated that *O. muiri* was probably the same as *O. vicksburgensis*. Vaughan in commenting on this proposed combination wrote:¹⁷

"The types of this species (*O. vicksburgensis*) and of Barker's *O. muiri* are in the U. S. National Museum; and I have again compared them. *O. muiri* is not merely thicker than *O. vicksburgensis*, it has a marginal keel which I have not seen in the latter species."

Later, Cole wrote Barker requesting a few topotype specimens of *O. muiri* for comparison with the Florida material. Barker replied that most of his material was not available, but that he had found a small sample of the type material (collection of E. Gevaerts no. 269) from which he was sending 9 specimens. In this letter Barker stated:¹⁸

"they are by no means as large or as typical of the species as the original lot I picked from the sample."

From the material which Barker so obligingly sent, a median (figure 7, plate 5) and a transverse (figure 8, plate 5) section were prepared. A keel was not observed on any of the specimens. The Mexican specimens were compared with a large suite of *O. vicksburgensis* from the Byram marl which had been arranged from thin, compressed individuals (figure 4, plate 5) to thick, lenticular individuals (figure 1, plate 5). The Mexican specimens fitted into the series and at no point could the series be broken into two separate and distinct species.

Although some doubt must exist because direct comparisons with the type specimen of *O. muiri* have been impossible, there is no evidence available to the writer to cause him to change his previous conclusion that only one species is represented by *O. muiri* and *O. vicksburgensis*.

The thin sections which were studied are illustrated and measurements of these are presented in Table 1.

¹⁷ Letter dated March 24, 1944.

¹⁸ Letter dated June 6, 1944.

TABLE 1 — PART 1
Measurements of *Operculinoides vicksburgensis* and *Operculinoides muiri*

LOCALITY	<i>Operculinoides vicksburgensis</i>						
	W-95						
	144 feet			150 feet			
Height	2.1+ mm.	1.5 mm.	1.5 mm.	2.14 mm.	1.4+ mm.	2.24 mm.	1.5 mm.
Width	—	—	1.4 mm.	—	—	2.1 mm.	1.4 mm.
Thickness	0.98 mm.	0.7 mm.	—	0.96 mm.	0.72 mm.	—	—
Number of whorls	—	—	2 $\frac{3}{4}$	—	—	4 $\frac{1}{2}$	2 $\frac{3}{4}$
Number of chambers in final volution	—	—	16	—	—	26	16
Internal diameters of initial chamber	—	—	100×120 μ	80 μ	100×120 μ	—	100 μ

TABLE 1 — PART 2
Measurements of *Operculinoides vicksburgensis* and *Operculinoides muiri*

LOCALITY	<i>Operculinoides vicksburgensis</i>					<i>Operculinoides muiri</i>	
	BYRAM, MISSISSIPPI				AFTER VAUGHAN AND COLE	MEXICO	
Height	2+ mm.	2.7 mm.	2.7 mm.	2.36 mm.	1.2-3.0 mm.	2.02 mm.	2.0 mm.
Width	—	2.3 mm.	—	2.28 mm.	1.3-3.1 mm.	—	1.86 mm.
Thickness	0.38 mm.	—	1.0 mm.	—	0.3-0.6 mm.	0.78 mm.	—
Number of whorls	—	3 3/4	—	4 1/4	3 3/4-4	—	3 3/4
Number of chambers in final volution	—	25	—	23	18-26	—	17
Internal diameters of initial chamber	70 μ	—	—	90 $\times$ 100 μ	60 μ	100 $\times$ 110 μ	80 $\times$ 100 μ

A few specimens which were found in the City of Tallahassee water well (W-453) are identical to those studied in detail from the Dale Mabry Field water well (W-95). The specimens from the former well are illustrated by a vertical and a horizontal thin section. The specimen from which the vertical section was made had a diameter of 1.9 mm. and a thickness of 0.7 mm. The horizontal section represents a specimen with a diameter of 2.6 mm. There are 24 chambers in the final volution with $4\frac{1}{2}$ whorls comprising the test.

First appearance: At a depth of 144 feet in the Dale Mabry Field water well (W-95); at a depth of 280-290 feet in the City of Tallahassee water well (W-453).

Occurrence: Suwannee limestone.

FAMILY ORBITOIDIDAE Schubert

Subfamily ORBITOIDINAE

Genus LEPIDOCYCLINA Gümbel, 1870

Subgenus LEPIDOCYCLINA Gümbel, 1870

Lepidocyclina (Lepidocyclina) parvula Cushman

Plate 7, Figures 2-13; Plate 11, Figures 1, 2

- 1919. *Lepidocyclina parvula* Cushman, Carnegie Inst. Washington Publ. 291, p. 58, pl. 3, figs. 4-7.
- 1928. *Lepidocyclina* aff. *L. morgani* Lem. and R. Douvillé. Cole, Bull. Amer. Pal., vol. 14, No. 53, pp. 22, 23, pl. 4, fig. 9. (not Lemoine and R. Douvillé, 1904).
- 1930. *Lepidocyclina (Lepidocyclina) parvula* Cushman. Cole and Gillespie, Bull. Amer. Pal., vol. 15, No. 57b, p. 3, (list), pl. 1, figs. 4, 5.
- 1930. *Lepidocyclina* sp., Cole and Gillespie, *idem*, p. 3 (list), pl. 1, fig. 9.
- 1933. *Lepidocyclina (Lepidocyclina) parvula* Cushman. Vaughan, Smithsonian Miscell. Coll., vol. 89, No. 10, pp. 16, 17, pl. 7, figs. 1-5; pl. 8, figs. 3-5; pl. 9, figs. 1-4; pl. 10, figs. 1-6.
- 1938. *Lepidocyclina (Lepidocyclina) parvula* Cushman. Cole, Florida Geol. Survey Bull. 16, p. 46, pl. 11, figs. 2-5.
- 1944. *Lepidocyclina (Lepidocyclina) parvula* Cushman. Cole, Florida Geol. Survey Bull. 26, pp. 72, 73, pl. 3, fig. 4; pl. 19, figs. 1, 2, 7; pl. 20, figs. 1, 2; pl. 22, figs. 1-11.

Numerous specimens were found in the last sample (308-316.5 feet) in the Dale Mabry Field water well (W-95) which are assigned to this species. The surface ornamentation is variable as some specimens have rather small papillae (figure 2, plate 11), but others have very large, prominent papillae (figure 1, plate 11).

Vertical sections (figures 9, 10, 12, 13, plate 7) made from Mexican specimens assigned to *L. parvula* Cushman are introduced for comparison. In these specimens the lateral chambers are not as appressed as those in the Floridian specimens. In certain respects the lateral chambers of the Floridian specimens resemble those of *L. supera* (Conrad) as *L. supera* has low, appressed lateral chambers with thick roofs and floors.

Although these specimens do possess lateral chambers which resemble those of *L. supera*, the other features are similar to those found in *L. parvula*, particularly the very strong development of the pillars. The vertical sections of microspheric individuals are not at all suggestive of *L. supera*, but are very similar to many vertical sections of *L. parvula*.

First appearance: At a depth of 308-316.5 feet in the Dale Mabry Field water well (W-95).

Occurrence: Suwannee limestone.

Lepidocyclina (Lepidocyclina) yurnagunensis Cushman

Plate 6, Figures 5, 6

1919. *Lepidocyclina canellei* var. *yurnagunensis* Cushman, Carnegie Inst. Washington Publ. 291, p. 57, pl. 12, figs. 7, 8, text-fig. 6.
1926. *Lepidocyclina yurnagunensis* Cushman. Vaughan, Geol. Soc. London, Quart. Jour., vol. 82, p. 391, pl. 25, figs. 2-6.
1934. *Lepidocyclina (Lepidocyclina) yurnagunensis* Cushman. Cole, Jour. Pal., vol. 8, No. 1, pp. 24, 25, pl. 3, figs. 4-6; pl. 4, figs. 8, 9.
1941. *Lepidocyclina (Lepidocyclina) yurnagunensis* Cushman. Vaughan and Cole, Geol. Soc. Amer. Sp. Paper No. 30, p. 72, pl. 38, all figs.

This is a widely distributed species. The diamond-shaped equatorial chambers are characteristic. It was described from Cuban specimens, but has been reported from Antigua, Jamaica, Trinidad and the Cayman Islands.

First appearance: At a depth of 212.6 feet in the Dale Mabry Field water well (W-95).

Occurrence: Suwannee limestone

Lepidocyclina (Lepidocyclina) yurnagunensis,
variety *morganopsis* Vaughan

Plate 6, Figures 1-4, 7, 8

1933. *Lepidocyclina yurnagunensis*, var. *morganopsis* Vaughan, Washington Acad. Sci. Jour., vol. 23, No. 7, p. 354.

1933. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis*, var. *morganopsis* Vaughan. Vaughan, Smithsonian Miscell. Coll., vol. 89, No. 10, pp. 22, 23, pl. 11, figs. 5-9; pl. 23, figs. 1-3.
1934. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis*, var. *morganopsis* Vaughan. Cole, Jour. Pal., vol. 8, No. 1, pp. 25, 26, pl. 3, figs. 1-3.
1941. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis*, var. *morganopsis* Vaughan. Vaughan and Cole, Geol. Soc. Amer. Sp. Paper No. 30, p. 72, pl. 39, figs. 1, 2.

This variety occurs with typical specimens of *L. yurnagunensis* at all the localities from which it has been reported. The equatorial thin sections of specimens of *L. yurnagunensis* and its variety *morganopsis* exhibit the same features, but the vertical sections are different in that the variety possesses very heavy pillars, whereas the pillars are weak or absent in *L. yurnagunensis*.

First appearance: At a depth of 216.6 feet in the Dale Mabry Field water well (W-95).

Occurrence: Suwannee limestone.

Subgenus NEPHROLEPIDINA H. Douvillé, 1911

Lepidocyclina (*Nephrolepidina*) *leonensis* Cole, n. sp.

Plate 5, Figures 11-17; Plate 11, Figure 3

Test of medium size, evenly lenticular or with an inflated central area bordered by a narrow rim; the central area of the test is covered with distinct papillae which have a diameter of about 240 μ . The rim is without papillae. Rather deep, polygonal pits occur between the papillae with shallower depressions on the rim. From most of the papillae radiate narrow prolongations which form the boundaries of the pits. The largest specimen has a diameter of about 7 mm.

The embryonic chambers are nephrolepidine in type although one specimen which had the external appearance of the others had embryonic chambers of eulepidine type (figure 14, plate 5).

The equatorial chambers vary in shape from rhomboid to short spatulate.

The lateral chambers are arranged normally in very regular tiers although there is occasionally an overlapping from one tier to the next by certain chambers. The three tiers adjacent

to the equatorial layer are composed of small, appressed chambers with thick roofs and floors. The other lateral chambers are open with the chamber cavity as high or higher than the adjacent floors are thick.

Distinct heavy pillars are present, irregularly spaced and concentrated in the inflated portion of the test.

Measurements of 2 vertical and 2 horizontal sections follow:

Diameter	-	-	-	-	-	3.7 mm.	4.5 + mm.
Thickness	-	-	-	-	-	1.8 ± mm.	1.9 mm.
Number of lateral chambers on each side of the equatorial layer						11	11
Embryonic chambers:							
Internal length	-	-	-	-	-	600 μ	480 μ
Internal height	-	-	-	-	-		420 μ
Thickness of surrounding wall	-	-	-	-	-	40 μ	40 μ
Height of equatorial layer (including floor and roof):							
At center	-	-	-	-	-	140 μ	120 μ
At periphery	-	-	-	-	-	140 μ	180 μ
*Lateral chambers:							
Internal length	-	-	-	-	-	140-300 μ	140-200 μ
Internal height	-	-	-	-	-	40 μ	40 μ
Thickness of floors and roofs	-	-	-	-	-	30-50 μ	20-40 μ
Surface diameter of pillars	-	-	-	-	-	180-240 μ	160-240 μ

* At periphery and directly over embryonic chambers

Diameter	-	-	-	-	-	4.4+ mm.	3.2+ mm.
Embryonic chambers:							
*Length across both chambers	-	-	-	-	-	680 μ	540 μ
Diameters of initial chamber	-	-	-	-	-	380x580 μ	380x460 μ
Diameters of second chamber	-	-	-	-	-	300x700 μ	160x560 μ
Width of bounding wall	-	-	-	-	-	60 μ	60 μ
Diameters of equatorial chambers near the periphery:							
Radial	-	-	-	-	-	100 μ	100 μ
Tangential	-	-	-	-	-	100 μ	80 μ

* Internal measurements

Type locality: Dale Mabry Field water well "B" (W-95) at depths of 226 and 228 feet.

Cotypes: (Florida Geol. Survey Cat. No. S-3009).

Occurrence: Suwannee limestone.

This species is related to *Lepidocyclina* (*Nephrolepidina*) *tournoueri* Lemoine and R. Douvillé. To show the relationship between the two species a vertical and a horizontal section of *L. tournoueri* are illustrated (figures 18, 19, plate 5). These specimens were collected at Arbol Grande, near Tampico, Mexico.

L. tournoueri has equatorial chambers which are much more elongate than those of *L. leonensis*. The floors and roofs of the lateral chambers in *L. tournoueri* are much thinner than those of *L. leonensis*, the lateral chambers near the equatorial layer in *L. tournoueri* are not appressed like those in *L. leonensis* and the pillars in *L. tournoueri* are much smaller.

The external appearance of *L. leonensis* is similar to that of *Lepidocyclina* (*Nephrolepidina*) sp. figured by Vaughan.¹⁰ The embryonic chambers of the two species are very similar, but the equatorial chambers of *L. (Nephrolepidina)* sp. are decidedly hexagonal in shape, and those of *L. leonensis* are rhomboid to short spatulate.

Lepidocyclina (*Nephrolepidina*) *sanfernandensis* Vaughan and Cole,
variety *tallabasseensis* Cole, n. var.

Plate 1, Figures 16, 17; Plate 2, Figures 5-7; Plate 3, Figures 1-6

MEGALOSPHERIC FORM.—Test of medium size, slightly selfiform, central part inflated, without or with a rim. The test of some specimens slopes regularly from the central area to the periphery, but in others the inflated central portion is surrounded by a relatively wide flange which is distinct from the central inflated portion of the test. Normally, distinct papillae are present in the inflated area of the test, but are lacking on the flange. The papillae are developed best on those specimens which possess a distinct central area and bordering rim

¹⁰ Vaughan, T. Wayland, Studies of American Species of Foraminifera of the Genus *Lepidocyclina*, Smithsonian Miscell. Coll., vol. 89, No. 10, p. 35, pl. 2.1, fig. 2; pl. 32, fig. 1, 1933.

as the specimens which slope regularly from the central area to the periphery have weakly developed papillae. The dimensions of five typical megalospheric specimens are given in Table 2.

The embryonic chambers are large, of nephrolepidine type, the larger chamber slightly embracing the smaller. The outer wall is very thick, but the wall between the chambers is thin. In certain horizontal sections the outer wall of the embryonic chambers has a fringed appearance due to the presence of radially arranged alternating light and darker areas. Measurements of the embryonic apparatus are given in Table 3.

The equatorial chambers vary in size and shape, but normally they are short spatulate with the radial and tangential diameters nearly equal. An average chamber of this type has diameters of about 120 μ . Other chambers are slightly more elongate tangentially than radially, and certain chambers are the reverse of this.

Measurements of five transverse thin sections are given in Table 2. There is considerable variation in cross-section shape from robustly lenticular individuals with a distinct flange (figure 7, plate 2) to compressed lenticular specimens which lack a rim (figure 5, plate 2). The lateral chambers are arranged in rather regular tiers. In some specimens these chambers are appressed with very low chamber openings, but in others the chamber cavity is rather high.

The pillars are variable in their development and regularity. Some specimens have very large, strong pillars, but others are virtually devoid of this feature. However, some pillars are found in every specimen examined.

MICROSPHERIC FORM.—Test of large size with a diameter from 16 to 25 mm. and thickness of 4 to 6.5 mm. Average specimens have an inflated central portion which is surrounded by a wide rim, but a few individuals slope regularly from the apical portion to the periphery. Most specimens are distinctly selliform, but a few are flat. Papillae are present in the inflated portion in most specimens, but an occasional individual apparently does not possess papillae. The strength of the papillae is variable from specimen to specimen.

TABLE 2

Measurements of vertical sections of *Lepidocyclina sanfernandensis* var. *tallabasseensis*, n. var.

SPECIMEN	1	2	3	4	5
Diameter	8.8 mm.	7+ mm.	4.5+ mm.	5+ mm.	5.4 mm.
Thickness	4.24 mm.	2.4 mm.	2.8 mm.	2.3 mm.	2.46 mm.
Width of flange	about 1.8 mm.	about 1.0 mm.	none	about 0.7 mm.	about 0.9 mm.
Height of equatorial layer:					
At center	100 μ	80 μ	60 μ	60 μ	80 μ
At periphery	200 μ	130 μ	80 μ	140 μ	120 μ
Lateral chambers:					
Number at center on each side of the equatorial layer	26	12	17	14	18
Internal height	30-40 μ	40 μ	20-40 μ	40-80 μ	20 μ
Internal length	200 μ	140-160 μ	100-160 μ	120-220 μ	100-200 μ
Thickness of the floors and roofs	30-40 μ	40 μ	40-60 μ	20-40 μ	20-40 μ
External diameters of pillars	140-300 μ	140-180 μ	300-360 μ	100-200 μ	100-260 μ

TABLE 3

Measurements of the embryonic apparatus of
Lepidocyclina sanfernandensis var. *tallabasseensis*, n. var.

HORIZONTAL SECTIONS

SPECIMEN	1	2	3
Internal diameter across both chambers at right angles to the partition between the chambers	0.86 mm.	0.68 mm.	1.0 mm.
Maximum internal width of the larger chamber parallel to the partition between the chambers	0.94 mm.	0.66 mm.	0.96 mm.
Internal width of the smaller chamber between the points of the embracing chamber	0.78 mm.	0.6 mm.	0.84 mm.
Internal diameter of the smaller chamber at right angles to the partition	0.5 mm.	0.38 mm.	0.61 mm.
Internal diameter of the larger chamber at right angles to the partition	0.36 mm.	0.3 mm.	0.4 mm.
Thickness of the outer wall	50 μ	60 μ	100 μ

VERTICAL SECTIONS

SPECIMEN	1	2	3	4
Internal length across both chambers	0.82 mm.	0.70 mm.	0.72 mm.	0.88 mm.
Internal length of the larger chamber	0.48 mm.	0.42 mm.	—	—
Internal length of the smaller chamber	0.34 mm.	0.26 mm.	—	—
Maximum height	0.4 mm.	0.5 mm.	0.36 mm.	0.66 mm.
Thickness of the outer wall	80 μ	80 μ	60-80 μ	80 μ

The equatorial chambers have the same shape, size and arrangement as those of the megalospheric generation.

The lateral chambers occur in rather regular tiers when pillars are present, but in the areas between pillars the lateral chambers overlap from one tier to another. Adjacent to the equatorial layer the lateral chambers are very appressed, but near the periphery of the test they are open with a distinct cavity. In general, the roofs and floors of the lateral chambers have the same thickness as the height of the chamber opening in the peripheral area of the test.

Pillars are irregularly developed, some extending from the equatorial layer to the surface of the test, but others go only a portion of this distance.

Type locality: City of Tallahassee water well (W-453) at a depth of 407 feet.

Cotypes: (Florida Geol. Survey Cat. No. S-3011).

First appearance: At a depth of 404 feet in the City of Tallahassee water well (W-453) and abundant at 406 feet.

Occurrence: Upper Eocene.

DISCUSSION.—These specimens were referred to *L. sanfernandensis* Vaughan and Cole²⁰ during the preliminary study. The size, shape and arrangement of the features of the equatorial sections prepared from the Florida specimens is very similar to those illustrated by the Trinidad specimens. (Compare figure 5, plate 3 with Vaughan and Cole's illustration, figure 2, plate 43, Geol. Soc. Amer. Sp. Paper No. 30). Certain differences, however, were apparent in the general size of the test and in the vertical sections. Therefore, Cole sent Vaughan the Florida specimens so that direct comparison could be made with the types of *L. sanfernandensis*. Vaughan²¹ very kindly made the comparison and wrote as follows:

"The specimens from the Florida well (W-453) have both embryonic and equatorial chambers very similar to those of *L. sanfernandensis*. There are several differences between the Florida specimens and those from Trinidad.

²⁰ Vaughan, T. Wayland and Cole, W. Storrs, Preliminary Report on the Cretaceous and Tertiary Larger Foraminifera of Trinidad, British West Indies, Geol. Soc. Amer. Sp. Paper No. 30, pp. 73, 74, all figs., pls. 42, 43, 44, 1941.

²¹ Letter dated May 15, 1944.

"All of the Florida specimens, except one, are distinctly undulate, some of them almost selliform. None of the specimens from Trinidad is markedly undulate. Another difference is that the megalospheric form of the Florida specimens is much more inflated than any of the megalospheric forms of the Trinidad specimens.

"The roofs of the lateral chambers in the vertical section of the Florida specimens are decidedly thicker than those of the Trinidad specimens."

Vaughan and Cole jointly and separately have demonstrated the variability which may occur in a species of *Lepidocyclus*; and Vaughan²² has stated that

"it is obvious that to attach a different specific name to every variant in a lot of *Lepidocyclus* is an absurdity."

The differences between the type specimens of *L. sanfernandensis* and the specimens under discussion from Florida are not major ones, yet they are sufficient to cause one to hesitate before applying the same specific name to the specimens from the two widely separated localities. Vaughan²³ in another letter gave his views which are reproduced to demonstrate the perplexities which are encountered:

"I scarcely know what to say about a name for the specimens of *Lepidocyclus* from the Florida well (W-453) you recently sent me. If you refer the specimens to *L. sanfernandensis* I think that they should be given a varietal designation to indicate the difference between them and typical *L. sanfernandensis*. If you should apply a new specific name, the resemblance to *L. sanfernandensis* should be made clear. In general, I would rather apply a species name which may later become a synonym rather than confuse two different species under one name."

For the present it seems desirable to utilize the first suggestion of Vaughan rather than the second one which he recommends more strongly. A varietal designation given to the Florida specimens expresses the close relationship that exists with typical *L. sanfernandensis*, but at the same time indicates that there are minor differences.

Lepidocyclus (*Nephrolepidina*) *suwanneensis* Cole, n. sp.

Plate 4, Figures 5, 8-10, 12; Plate 7, Figures 1, 14; Plate 11, Figures 6, 7, 11

Test compressed lenticular; average size specimens have a diameter of 2.1 to 2.4 mm. and a thickness of 1.2 to 1.6 mm. The diameter of the largest specimen measured is 4.2 mm.

²² Vaughan, T. Wayland, Studies of American Species of Foraminifera of the Genus *Lepidocyclus*, Smithsonian Miscell. Coll., vol. 89, p. 7, 1933.

²³ Letter dated May 24, 1944.

The surface of the specimens available is smooth, without ornamentation, but this condition is caused undoubtedly by the state of preservation. As an initial surface is ground on the specimens in the preparation of horizontal thin sections, numerous white pillars were observed which contrasted with the tan color of the remainder of the test. Uneroded specimens would possess small papillae well distributed over the surface of the test.

The embryonic apparatus is nephrolepidine in type as illustrated by two horizontal sections (figure 9, plate 4 and figure 14, plate 7). In the horizontal section chosen for a paratype (figure 9, plate 4) the internal diameter across both chambers at right angles to the partition between the chambers is 0.6 mm.; the maximum internal diameter of the larger chamber parallel to the partition between the chambers is 0.64 mm.; the internal width of the smaller chamber between the points of the embracing chamber is 0.5 mm.; the internal diameter of the smaller chamber at right angles to the partition is 0.34 mm.; the internal diameter of the larger chamber at right angles to the partition is 0.26 mm. and the thickness of the outer wall is $50\ \mu$. Two other horizontal sections have the partition between the chambers destroyed. The internal diameters of the combined embryonic chambers are 0.5 by 0.46 mm. and 0.54 by 0.52 mm. These specimens have slightly smaller embryonic apparati than the specimen described first.

The three horizontal thin sections have equatorial chambers with curved outer walls and pointed inner ends adjacent to the embryonic apparatus. In the section with the greatest diameter these inner annuli grade outward to chambers of short spatulate shape. Average chambers in the inner annuli have a tangential diameter of 100 to 120 μ and a radial diameter of 60 to 80 μ . The spatulate chambers of the outer annuli have a tangential diameter of about 80 μ and radial diameters of 120 to 140 μ .

The embryonic chambers as viewed in three vertical thin sections have internal lengths of 0.58 mm., 0.64 mm., and 0.66 mm. The internal heights of these same embryonic chambers are 0.36 mm., 0.48 mm., and 0.42 mm.

The equatorial layer has a height of 140 μ at the center of the test and a height of 160 μ at the periphery. These measure-

ments include the floors and roofs. There is practically no increase in height of the equatorial layer from the center of the test to the periphery.

The lateral chambers are low, appressed with thick roofs and floors. The roofs and floors are gently curved so that they have a convex side towards the periphery of the test and a concave side directed toward the equatorial layer. They occur in more or less regular tiers, with but a slight amount of overlapping. There are about 9 layers of lateral chambers to a tier on each side of the equatorial layer at the center of the test. The periphery has two or more layers of lateral chambers on each side of the equatorial layer. An average lateral chamber at the periphery of the test and over the center has an internal height of about 20 μ and a length of about 140 μ to 160 μ . Floors and roofs have a thickness of about 40 μ .

Wedge-shaped pillars are present. They vary considerably in size, some have a surface diameter of as much as 280 μ , but others have a surface diameter of as little as 160 μ .

Material available: Nine thin sections, three of which were made from specimens recovered at a depth of 349 feet, four from specimens from 354 feet and two from specimens from 356 feet in the City of Tallahassee water well (W-453) and six thin sections made from specimens from the Dale Mabry Field water well (W-95).

Type locality: City of Tallahassee water well (W-453) at a depth of 354 feet.

Holotype: Transverse section (Florida Geol. Survey Cat. No. S-3007); *paratype:* Median section (Florida Geol. Survey Cat. No. S-3008).

Subgenus EULEPIDINA H. Douvillé, 1911

Lepidocyclina (*Eulepidina*) *favosa* Cushman

Plate 4, Figures 3, 4, 7, 11; Plate 8, Figures 1, 2; Plate 9, Figures 1-7;
Plate 10, Figures 1-9; Plate 11, Figure 9

1919. *Lepidocyclina favosa* Cushman, Carnegie Inst. Washington Publ. 291, p. 66, pl. 3, figs. 1b, 2; pl. 15, fig. 4.

1919. *Lepidocyclina crassata* Cushman, *idem*, pp. 61, 62, pl. 11, figs. 4, 5.

1920. *Lepidocyclina chattahoocheensis* Cushman, U. S. Geol. Survey Prof. Paper 125, p. 65, pl. 23, figs. 1-4; pl. 24, figs. 1, 2.

1924. *Lepidocyclina* (*Nephrolepidina*) *crassata* Cushman. Vaughan, Geol. Soc. Amer. Bull., vol. 35, p. 798, pl. 34, figs. 3, 4.
1924. *Lepidocyclina* (*Nephrolepidina*) *chattahoocheensis* Cushman. Vaughan, *idem*, p. 798, pl. 34, fig. 2.
1924. *Lepidocyclina* (*Eulepidina*) *favosa* Cushman. Vaughan, *idem*, p. 799, pl. 34, fig. 8.
1924. *Lepidocyclina* (*Eulepidina*) *formosa* Schlumberger. Vaughan, *idem*, p. 799 (not Schlumberger, 1902).
1926. *Lepidocyclina* (*Eulepidina*) *formosa* Schlumberger. Vaughan, Quart. Jour. Geol. Soc. London, vol. 82, p. 395 (not Schlumberger, 1902).
1926. *Lepidocyclina* (*Nephrolepidina*) *undosa* var. *tumida* Vaughan, *idem*, pp. 395, 396, pl. 24, figs. 3-5.
1926. *Lepidocyclina* sp. cf. *L. marginata* (Michelotti). Vaughan, *idem*, pp. 398, 399, pl. 26, figs. 1, 2 (not Michelotti, 1841).
1930. *Lepidocyclina* (*Nephrolepidina*) *crassata* Cushman. Cole and Gillespie, Bull. Amer. Pal., vol. 15, No. 57b, p. 3 (list), pl. 1, figs. 6, 7.
1933. *Lepidocyclina* (*Eulepidina*) *favosa* Cushman. Vaughan, Smithsonian Miscell. Coll., vol. 89, No. 10, pp. 37-41, pl. 17, figs. 1-3; pl. 18, figs. 1-4; pl. 19, figs. 1-4; pl. 20, figs. 1-3; pl. 21, figs. 1, 3, 4 (probably); pl. 29, fig. 4.
1933. *Lepidocyclina* (*Eulepidina*) *favosa* Cushman. Gravell, Smithsonian Miscell. Coll., vol. 89, No. 11, p. 32, pl. 5, fig. 11; pl. 6, fig. 2.
1934. *Lepidocyclina* (*Eulepidina*) *favosa* Cushman. Cole, Jour. Pal., vol. 8, No. 1, p. 27, pl. 4, figs. 2, 3, 12.
1941. *Lepidocyclina* (*Eulepidina*) *favosa* Cushman. Vaughan and Cole, Geol. Soc. Amer. Sp. Paper No. 30, p. 75, pl. 40, figs. 1-4.
1944. *Lepidocyclina* (*Eulepidina*) *favosa* Cushman. Cole, Florida Geol. Survey Bull. 26, p. 74, pl. 3, fig. 14; pl. 19, fig. 6; pl. 20, figs. 3-9.

Vaughan²⁴ has stated "This is an amazingly variable species." In a detailed and well illustrated analysis Vaughan²⁵ proved that *L. crassata*, *L. chattahoocheensis* and *L. favosa* belonged to one species. Previously, Vaughan²⁶ had erected the variety *tumida* of the species, *L. undosa* Cushman. At this time Vaughan²⁷ wrote, "There is some similarity between *L. favosa* and the extreme forms of *L. undosa* var. *tumida*."

As thin sections were made from the specimens from the Dale Mabry Field water well (W-95), certain of the speci-

²⁴ Vaughan, T. Wayland, Studies of American Species of Foraminifera of the Genus *Lepidocyclina*, Smithsonian Miscell. Coll., vol. 89, No. 10, p. 38, 1933.

²⁵ *Idem*, pp. 37-41.

²⁶ Vaughan, T. Wayland, Species of *Lepidocyclina* and *Carpenteria* from the Cayman Islands, and their Geological Significance, Quart. Jour. Geol. Soc. London, vol. 82, pp. 395, 396, 1926.

²⁷ *Idem*, p. 395.

mens were recognized as *L. undosa* var. *tumida* (figure 6, plate 10) and others were tentatively named *L. favosa* (figure 4, plate 10). As more specimens were studied and sectioned, it became evident that there was complete gradation between the individuals to which were assigned the name *L. undosa* var. *tumida* and those which were named *L. favosa*.

Moreover, examination and comparison of the type figures of *L. undosa* var. *tumida* (see figures 4, 5, plate 24, Quart. Jour. Geol. Soc. London, vol. 82, 1926) with an illustration of *L. favosa* Cushman (see figure 1, plate 19, Smithsonian Miscell. Coll., vol. 89, No. 10, 1933) failed to reveal any significant character which would serve to separate *L. undosa* var. *tumida* from *L. favosa*.

It has been recognized a long time that the embryonic chambers of *L. undosa* grade from nephrolepidine to eulepidine. It would seem that the same feature is present in *L. favosa*.

A number of vertical and horizontal sections are presented to illustrate the writer's concept of forms that should be referred to *L. favosa* from this well. Study of these photographs as well as those given by other workers will serve to emphasize the amazing variability of this species, yet there is complete gradation from one form to another.

First appearance: At a depth of 144 feet in the Dale Mabry Field water well (W-95); abundant at a depth of 212.6 feet; at a depth of 280-290 feet in the City of Tallahassee water well (W-453).

Occurrence: Suwannee limestone.

Lepidocyclina (Eulepidina) undosa Cushman

Plate 1, Figures 14, 15; Plate 2, Figure 8; Plate 8, Figure 7; Plate 11, Figure 8

1919. *Lepidocyclina undosa* Cushman, Carnegie Inst. Washington Publ. 291, p. 65, pl. 2, fig. 1a.

1924. *Eulepidina raulinii* H. Douvillé, France Soc. Géol. Mém., n.s., vol. 1, No. 2, p. 49, text fig. 47 (not P. Lemoine and R. Douvillé).

1924. *Lepidocyclina (Nephrolepidina) undosa* Cushman. Vaughan, Geol. Soc. Amer. Bull., vol. 35, pp. 798, 820, pl. 34, figs. 5-7.

1926. *Lepidocyclina (Nephrolepidina) undosa* Cushman. Vaughan, Geol. Soc. London, Quart. Jour., vol. 82, pp. 393-395, pl. 24, figs. 1, 2.

1928. *Lepidocyclina (Nephrolepidina) undosa* Cushman. Vaughan, Jour. Pal., vol. 1, No. 4, pp. 294, 295, pl. 48, fig. 3.

1930. *Lepidocyclus* (*Nephrolepidina*) *undosa* Cushman. Cole and Gillespie, Bull. Amer. Pal., vol. 15, No. 57b, p. 3, pl. 1, figs. 1, 2.
1932. *Lepidocyclus* (*Eulepidina*) *undosa* Cushman. Gorter and van der Vlerk, Leidsche Geol. Med., Deel 4, Aflev. 2, p. 110, pl. 15, figs. 1-4.
1933. *Lepidocyclus* (*Nephrolepidina*) *undosa* Cushman. Gravel, Smithsonian Miscell. Coll., vol. 89, No. 11, pp. 30, 31, pl. 6, fig. 4.
1934. *Lepidocyclus* (*Eulepidina*) *undosa* Cushman. Cole, Jour. Pal., vol. 8, No. 1, p. 26, pl. 4, figs. 4, 5, 10, 11, 13, 14.
1938. *Lepidocyclus* (*Eulepidina*) *undosa* Cushman. Cole, Florida Geol. Survey Bull. 16, p. 48, pl. 11, figs. 6, 7.
1941. *Lepidocyclus* (*Eulepidina*) *undosa* Cushman. Vaughan and Cole, Geol. Soc. Amer. Sp. Paper No. 30, pp. 75, 76, pl. 34, fig. 5; pl. 41, figs. 1-3.
1944. *Lepidocyclus* (*Eulepidina*) *undosa* Cushman. Cole, Florida Geol. Survey Bull. 26, pp. 74, 75, pl. 19, fig. 9; pl. 22, fig. 12.

This species is widely distributed and relatively easy to recognize. In Florida it has been found in the Port St. Joe well T.3 at a depth of 1017-1035 feet and in the City of Quincy water well (W-4) at a depth of 615 feet. It occurs at the surface at Duncan Church, Washington County, Florida. Vernon²⁸ lists this species at numerous localities where the Suwannee limestone is exposed at the surface.

This species occurs in great abundance in certain samples from the City of Tallahassee water well (W-453). Figure 14, plate 1 illustrates a transverse section of a specimen with very few layers of lateral chambers on each side of the equatorial layer, but figure 15 of this same plate shows a transverse section of a mature individual with a number of layers of lateral chambers on each side of the equatorial layer.

First appearance: At a depth of 319 feet in the City of Tallahassee water well (W-453); at a depth of 212.6 feet in the Dale Mabry Field water well (W-95).

Occurrence: Suwannee limestone.

Lepidocyclus gigas Cushman

Plate 8, Figures 5, 6

1919. *Lepidocyclus gigas* Cushman, Carnegie Inst. Washington Publ. 291, p. 64, pl. 1, figs. 3-5; pl. 5, fig. 4.

²⁸ Vernon, Robert O., Geology of Holmes and Washington Counties, Florida, Florida Geol. Survey Bull. 21, pp. 55-66, 1942.

1920. *Lepidocyclina gigas* Cushman, var. *mexicana* Cushman, U. S. Geol. Survey Prof. Paper 125, p. 63, pl. 19, fig. 5; pl. 20, figs. 1, 2; pl. 21, figs. 1-3.
1926. *Lepidocyclina gigas* Cushman. Vaughan, Quart. Jour. Geol. Soc. London, vol. 82, p. 396, pl. 25, figs. 1a, 1b.
1933. *Lepidocyclina gigas* Cushman. Vaughan, Smithsonian Miscell. Coll. vol. 89, No. 10, pp. 41, 42, pl. 22, figs. 1-4.
1934. *Lepidocyclina gigas* Cushman, var. *duncanensis* Cole, Jour. Pal., vol. 8, No. 1, pp. 27, 28, pl. 3, fig. 16; pl. 4, fig. 1.

The varietal names *mexicana* and *duncanensis* were used by Cushman and Cole to designate specimens which possessed minor differences. As extreme variation occurs in the species of larger Foraminifera, these varietal names do not serve any useful purpose. Moreover, it is now rather evident that *L. gigas* is the microspheric form of *L. undosa*. Vaughan expressed this opinion as early as 1924.²⁰

First appearance: In the Dale Mabry Field water well (W-95) at a depth of 220.6 feet.

Occurrence: Suwannee limestone.

Lepidocyclina sp.

Plate 8, Figure 3

A single specimen representing a microspheric individual was found at 218.6 feet in the Dale Mabry Field water well (W-95). This specimen was made into a vertical section. A description of this specimen follows:

Test small, inflated with a narrow rim; diameter 3.2 mm.; thickness 1.24 mm.; width of rim about 0.6 mm.

The equatorial layer has an internal height of about 30 μ at the center of the test and an internal height of about 80 μ at the periphery of the test.

At the center of the test there are 10 lateral chambers to a tier on each side of the equatorial layer. These chambers are arranged in rather regular tiers. The equatorial layer is covered by at least one layer of lateral chambers at the periphery. The lateral chambers are low, slit-like between thick floors and roofs. A typical lateral chamber has an internal length of 80 μ ,

²⁰ Vaughan, T. Wayland, American and European Tertiary Larger Foraminifera, Geol. Soc. Amer. Bull., vol. 35, p. 799, 1924.

an internal height of 20 μ . Floors and roofs have a thickness of 30 to 40 μ .

Pillars are irregularly developed and concentrated in the inflated portion of the test. They may have a surface diameter of as much as 180 μ .

First appearance: In the Dale Mabry Field water well (W-95) at a depth of 218.6 feet.

Occurrence: Suwannee limestone.

There is a slight resemblance between this vertical section and one published by Gravell³⁰ (*Lepidocyclina* sp. indet. [b]).

Subfamily HELICOLEPIDINAE Tan

Genus HELICOLEPIDINA Tobler, 1922

Helicolepidina paucispira Barker and Grimsdale

Plate 1, Figures 1-11; Plate 4, Figure 1; Plate 8, Figure 4

1936. *Helicolepidina paucispira* Barker and Grimsdale, Jour. Pal., vol. 10, p. 243, pl. 31, figs. 11, 12; pl. 33, figs. 4-6; pl. 36, figs. 1, 3; pl. 38, fig. 4.

1941. *Helicolepidina paucispira* Barker and Grimsdale. Vaughan and Cole, Geol. Soc. Amer. Sp. Paper No. 30, p. 76, pl. 45, fig. 2.

Test of megalospheric individuals small, robustly lenticular, with or without a narrow encircling rim. Surface ornamentation consists of a central apical group of small papillae beyond which a reticulate mesh is developed to the periphery of the test.

Test of microspheric individuals is large, robustly lenticular, with a flange surrounding the central inflated portion. An apical crown of papillae is well developed and the papillae are larger than those developed by the megalospheric generation. The rim is smooth, pitted or covered by a reticulate mesh.

Measurements of 6 horizontal sections (Table 4) and of 7 vertical sections are given (Table 5).

The embryonic apparatus is followed by a trochoid spire of $1\frac{1}{4}$ to $1\frac{1}{2}$ coils in both the megalospheric and microspheric generation. This spire apparently does not reach to the periphery of the test. The chambers of the spire are more nearly

³⁰ Gravell, Donald W., Tertiary Larger Foraminifera of Venezuela, Smithsonian Miscell. Coll., vol. 89, No. 11, pp. 29, 30, pl. 6, fig. 3, 1933.

TABLE 4
Measurements of horizontal sections of *Helicolepidina paucispira*

A-FORM				B-FORM		
DIAMETER	1.0 mm.	1.1 mm.	1.1 mm.	2.4 mm.	2.7 mm.	1.7 mm.
Embryonic apparatus:						
*Diameter of initial chamber	80 μ	100 μ	80 μ	—	—	—
*Diameter of second chamber	35x80 μ	40x80 μ	40x100 μ	—	—	—
Total length of both chambers	160 μ	200 μ	160 μ	—	—	—
Thickness of bounding wall	20 μ	20 μ	18 μ	—	—	—
Equatorial chambers:						
*Tangential diameter (periphery)	60-100 μ	60-100 μ	60-100 μ	100-140 μ	100-160 μ	80-140 μ
*Radial diameter (periphery)	40 μ	40 μ	40 μ	60-80 μ	60-80 μ	40-60 μ
Number of coils in spiral portion	1+	1¼	1¼+	1¼	1½	1½

*Internal measurement

TABLE 5
Measurements of vertical sections of *Helicolepidina paucispira*

	A-FORM					B-FORM	
Diameter	1.0 mm.	1.0 mm.	1.2 mm.	0.9 mm.	1.0 mm.	2.66 mm.	2.8 mm.
Thickness	0.54 mm.	0.6 mm.	0.5 mm.	0.62 mm.	0.6 mm.	1.28 mm.	1.4 mm.
Embryonic apparatus:							
Height	140 μ	160 μ	140 μ	180 μ	—	—	—
Length	200 μ	160 μ	190 μ	160 μ	—	—	—
Equatorial layer:							
Height (center)	100 μ	80 μ	80 μ	100 μ	100 μ	60 μ	100 μ
Height (periphery)	120 μ	100 μ	100 μ	120 μ	120 μ	160 μ	200 μ
Number of lateral chambers over center of test	4	5	5	5	5	6	6
Lateral chambers:							
Height	30 μ	30-40 μ	30 μ	30-40 μ	20 μ	20 μ	20-30 μ
Length	60-80 μ	40-100 μ	80-100 μ	80 μ	60 μ	40-100 μ	80-140 μ
Thickness of floors	20-30 μ	40-60 μ	20 μ	30-40 μ	30 μ	70 μ	60-100 μ
Surface diameter of pillars	160 μ	160 μ	none	very weak	80 μ	none	none

square than the normal equatorial chambers, but the more distal chambers of the spire grade into the typical equatorial chambers.

The equatorial chambers have curved outer walls and truncated inner ends, or are rudely hexagonal. Most of the chambers are more elongate tangentially than radially. In some sections the chambers are arranged in a distinct radial manner and in all cases increase regularly in size toward the periphery.

The lateral chambers are low, compressed, between rather thick roofs and floors, although there is considerable difference between individuals. Pillars are normally present but this feature is not constant between individuals.

First appearance: At a depth of 405 feet in the City of Tallahassee water well (W-453); at a depth of 308-316.5 feet in the Dale Mabry Field water well (W-95).

Occurrence: Upper Eocene.

Appearance elsewhere: This species was described from the upper Eocene of Mexico, and Vaughan and Cole³¹ figure one horizontal section assigned to this species from Trinidad.

³¹ Vaughan, T. Wayland and Cole, W. Storrs, Preliminary Report on the Cretaceous and Tertiary Larger Foraminifera of Trinidad, British West Indies, Geol. Soc. Amer. Sp. Paper No. 30, p. 76, pl. 45, fig. 2, 1941.

PLATES 1-11

PLATE 1

All specimens from the City of Tallahassee water well; 1, 2, 7, at a depth of 412 feet; 3, 4, 6, 8, 9, 11, 17, at a depth of 407 feet; 5, 10, 16, at a depth of 406 feet; 12, 13, at a depth of 280-290 feet; 14, 15, at a depth of 324 feet.

Figures 1, 2, X 9

Figures 3, 6, 8, 12-17, X 15

Figures 4, 5, 7, 9-11, X 40

FIGURE

- 1-11. *Helicolepidina paucispira* Barker and Grimsdale; 1, exteriors of five megalospheric specimens; 2, exteriors of two microspheric specimens; 3, median section of a microspheric individual; 4, 5, median sections of two megalospheric individuals; 6, 8, transverse sections of two microspheric individuals; 7, 9-11, transverse sections of four megalospheric individuals.
- 12, 13. *Operculinoides vicksburgensis* Vaughan and Cole; 12, transverse section; 13, median section.
- 14, 15. *Lepidocyclina (Eulepidina) undosa* Cushman; transverse sections of two megalospheric specimens.
- 16, 17. *Lepidocyclina (Nephrolepidina) sanfernandensis* Vaughan and Cole, variety *tallahasseeensis* Cole, n. var.; transverse sections of two megalospheric individuals; 16, the pillars are well developed and the lateral chambers are appressed; 17, the pillars are weakly developed and the lateral chambers are open.

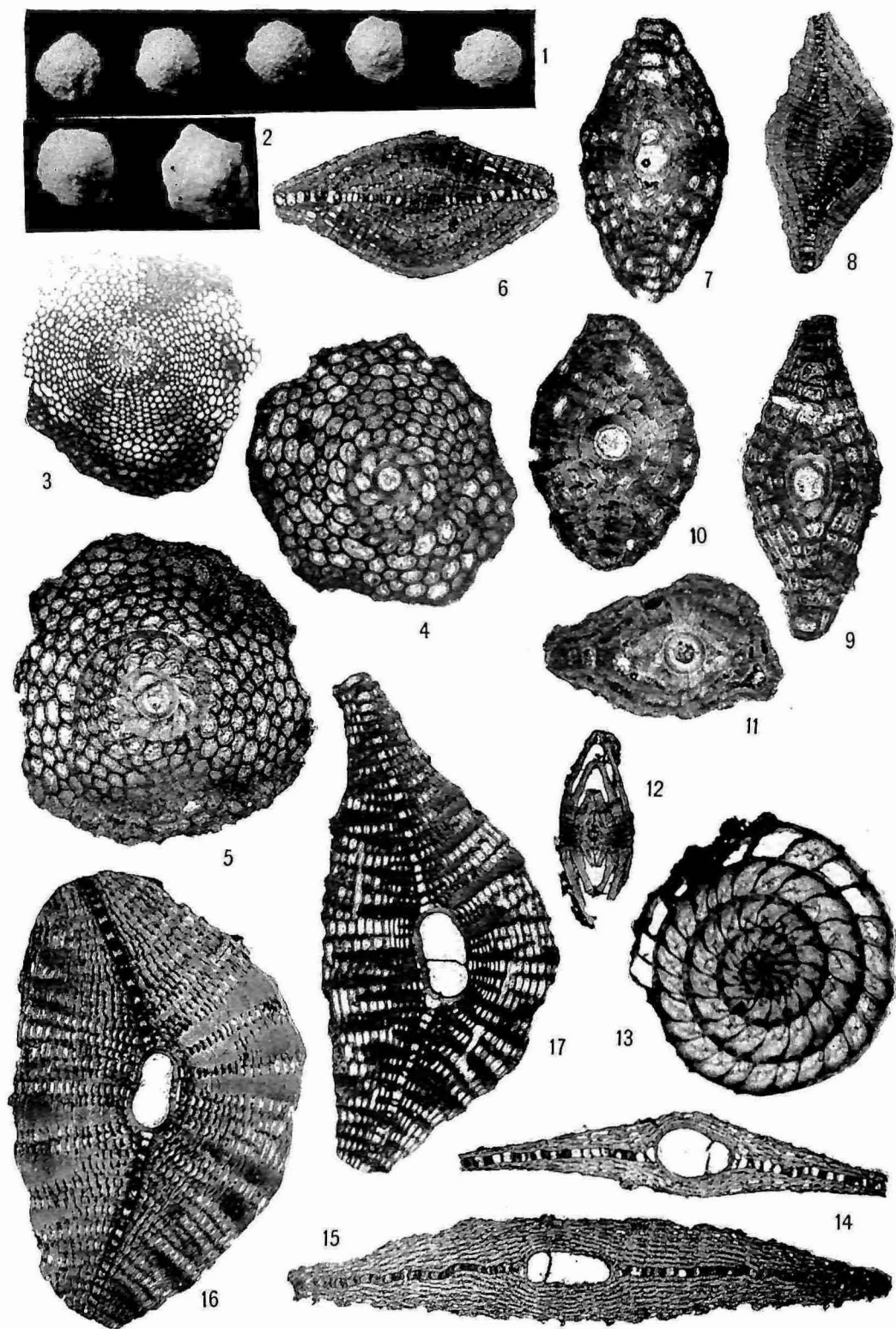


PLATE 2

All specimens from the City of Tallahassee water well; 1-4, at a depth of 370 feet; 5, 7, at a depth of 407 feet; 6, at a depth of 413 feet; 8, at a depth of 324 feet.

Figures 1-4, X 40

Figures 5-8, X 15

FIGURE

- 1, 2. *Dictyoconus cookei* (Moberg); 1, axial section; 2, horizontal section.
- 3, 4. *Coskinolina floridana* Cole; 3, axial section; 4, horizontal section.
- 5-7. *Lepidocyclina* (*Nephrolepidina*) *sanfernandensis* Vaughan and Cole, variety *tallahasseeensis* Cole, n. var.; transverse sections of three megalospheric specimens to illustrate the difference in inflation between individuals; 5, cotype.
8. *Lepidocyclina* (*Eulepidina*) *undosa* Cushman; median section of a megalospheric individual.

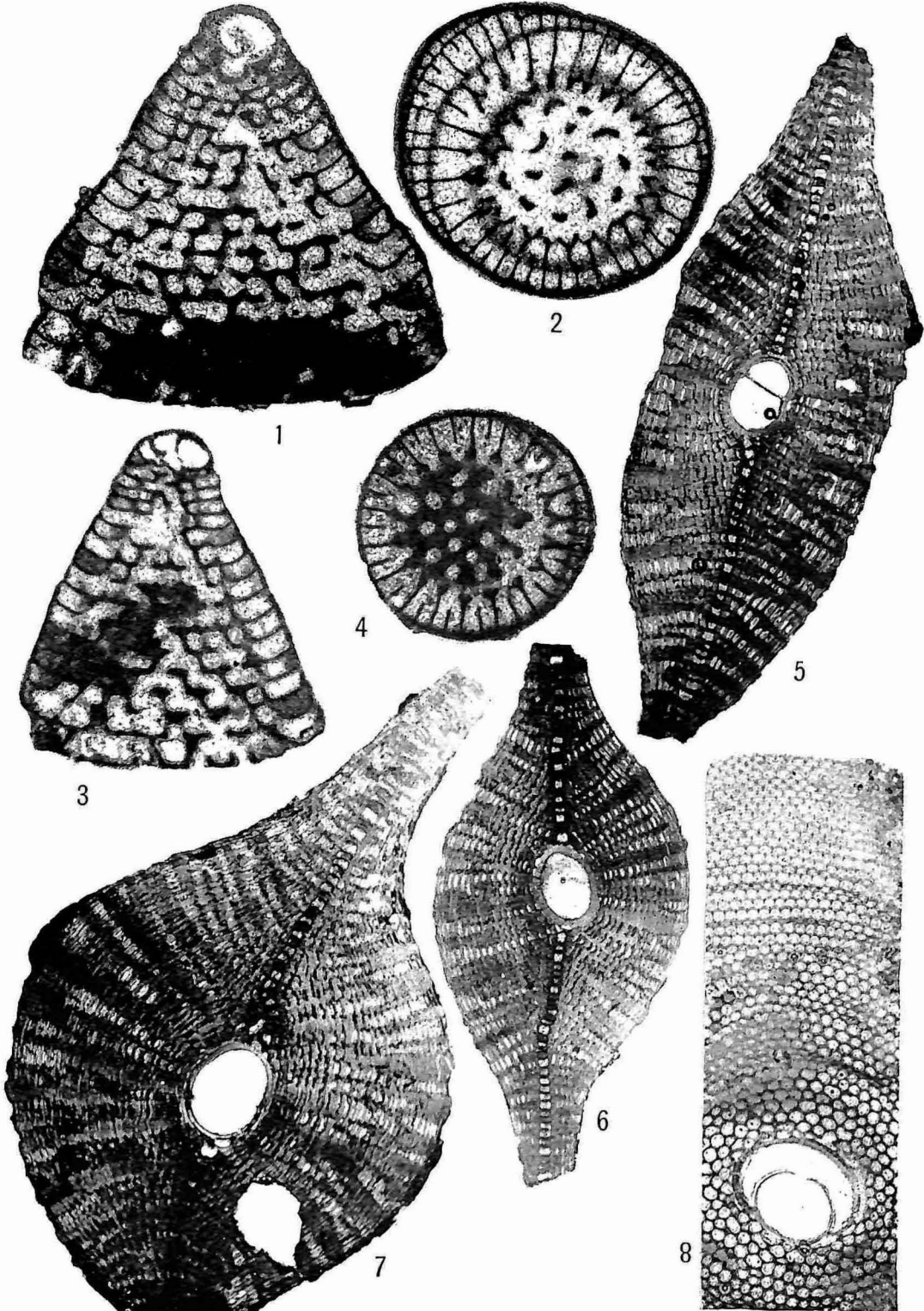


PLATE 3

All specimens from the City of Tallahassee water well; 1, 6, at a depth of 406 feet; 2, at a depth of 413 feet; 3-5, at a depth of 407 feet.

Figure 1, X 1.5

Figure 2, X 2.3

Figure 3, X 2

Figures 4, 5, X 15

Figure 6, X 9.3

FIGURE

- 1-6. *Lepidocyclina* (*Nephrolepidina*) *sanfernandensis* Vaughan and Cole, variety *tallahasseeensis* Cole, n. var.; 1, 2, exteriors of four microspheric specimens; 3, exteriors of seven megalospheric specimens, cotypes (F. G. S. No. S-3011); 4, 5, median sections of megalospheric specimens; 4, the embryonic chambers have a very thick outer wall; 5, cotype, this section is virtually identical to the type median section of *L. sanfernandensis* Vaughan and Cole (see figure 2, plate 43, Geol. Soc. Amer. Sp. Paper No. 30); 6, transverse section of a microspheric individual.

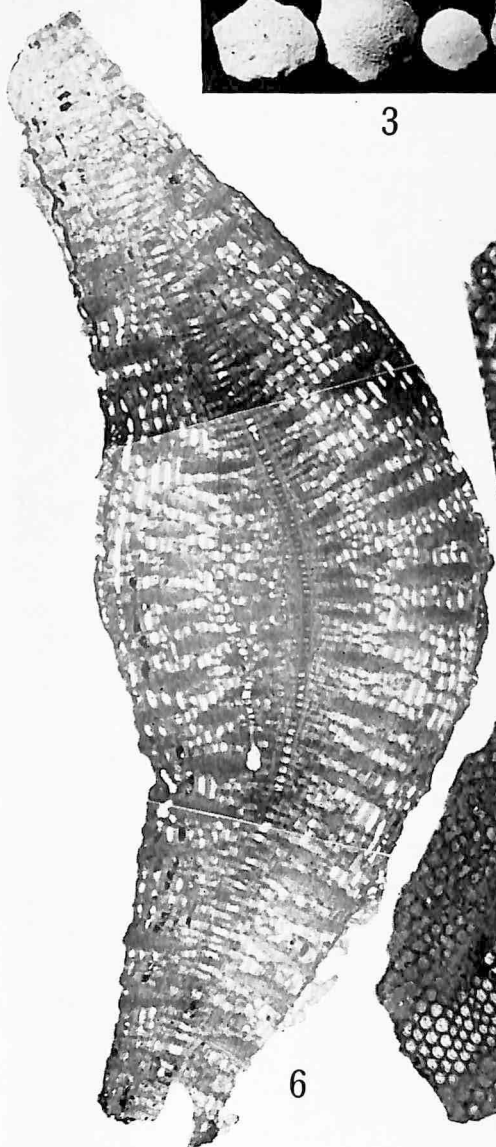


1

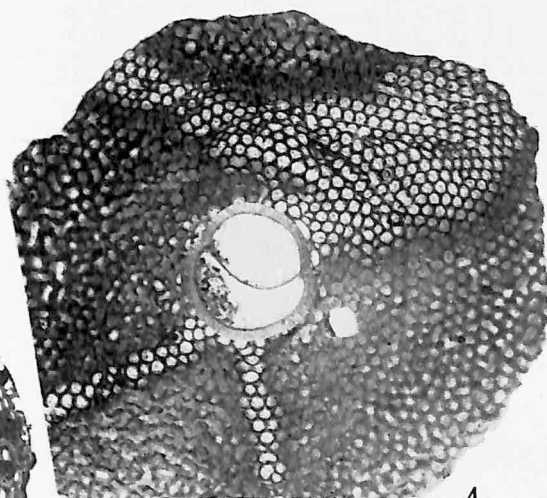
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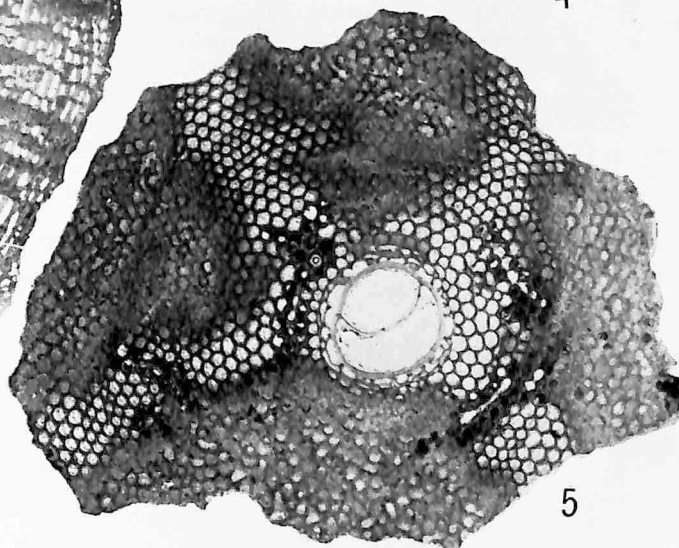
3



6



4



5

PLATE 4

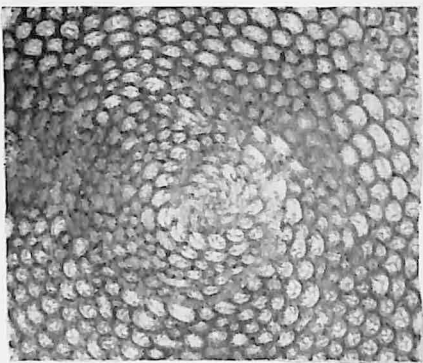
All specimens from the City of Tallahassee water well; 1, at a depth of 407 feet; 2, 6, at a depth of 130 feet; 3, 7, at a depth of 280-290 feet; 4, 11, at a depth of 349 feet; 5, 9, 10, 12, at a depth of 354 feet; 8, at a depth of 356 feet.

Figures 1, 2, 6, X 40

Figures 3-5, 7-12, X 15

FIGURE

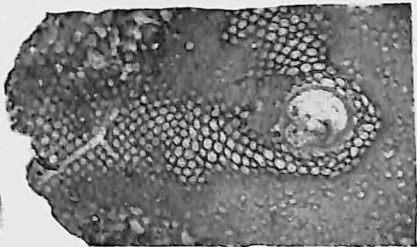
1. *Helicolepidina paucispira* Barker and Grimsdale; central portion of a median section of a microspheric individual to illustrate the initial spiral and equatorial chambers.
- 2, 6. *Peneroplis proteus* d'Orbigny; 2, transverse section; 3, median section.
- 3, 4, 7, 11. *Lepidocyclina (Eulepidina) favosa* Cushman; 3, 11, median sections of megalospheric individuals; 4, 7, transverse sections of megalospheric individuals.
- 5, 8-10, 12. *Lepidocyclina (Nephrolepidina) suwanneensis* Cole, n. sp.; 5, 12, transverse sections; 5, holotype (F. G. S. No. S-3007); 8-10, median sections; 9, paratype (F. G. S. No. S-3008).



1



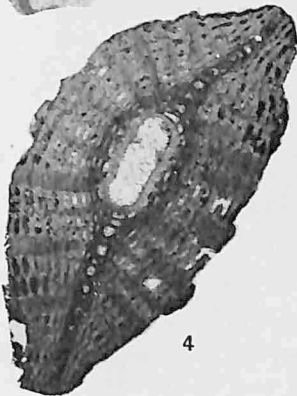
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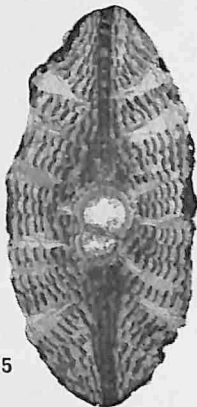
3



6



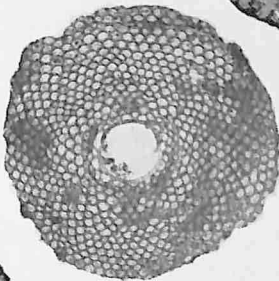
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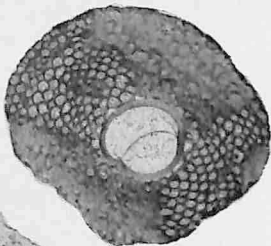
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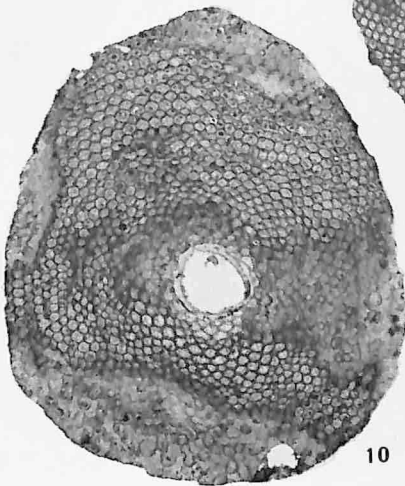
7



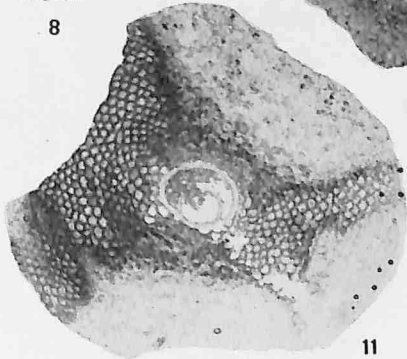
8



9



10



11



12

PLATE 5

Figures 1-4, of specimens from the Byram marl near Byram, Mississippi. Figures 5, 6, 9-17, of specimens from the Dale Mabry Field water well; 5, 9, at a depth of 144 feet; 6, 10, at a depth of 150 feet; 11, 13, 15, 16, at a depth of 226 feet; 12, 14, 17, at a depth of 228 feet.

Figures 7, 8, of specimens from Alazan formation, southern Miahupam, Vera Cruz, Mexico, collection of E. Gevaerts No. 269, donated by Dr. R. Wright Barker; collection of W. Storrs Cole.

Figures 18, 19, of specimens from Arbol Grande near Tampico, Tamaulipas, Mexico; collection of W. Storrs Cole.

All figures, X 15

FIGURE

- 1-10. *Operculinoides vicksburgensis* Vaughan and Cole; 1, transverse section of a robustly lenticular individual of the type *O. muiri* Barker; 2, median section of an individual similar to the one illustrated by figure 1; 3, median section of a compressed, fragile specimen; 4, transverse section of an individual similar to the one illustrated by figure 3; 5, 6, median sections of robustly lenticular individuals; 7, 8, topotype (?) (see text) specimens of *O. muiri* Barker introduced for comparison; 7, median section; 8, transverse section; 9, 10, transverse sections of robustly lenticular individuals.
- 11-17. *Lepidocyclina* (*Nephrolepidina*) *leonensis* Cole, n. sp.; 11-13, vertical sections of megalospheric individuals; 14-17, horizontal sections of megalospheric individuals; 13, 16, cotypes (F. G. S. No. S-3009).
- 18, 19. *Lepidocyclina* (*Nephrolepidina*) *touroueri* Lemoine and R. Douvillé; 18, horizontal section; 19, vertical section; introduced for comparison with *L. leonensis* Cole, n. sp.

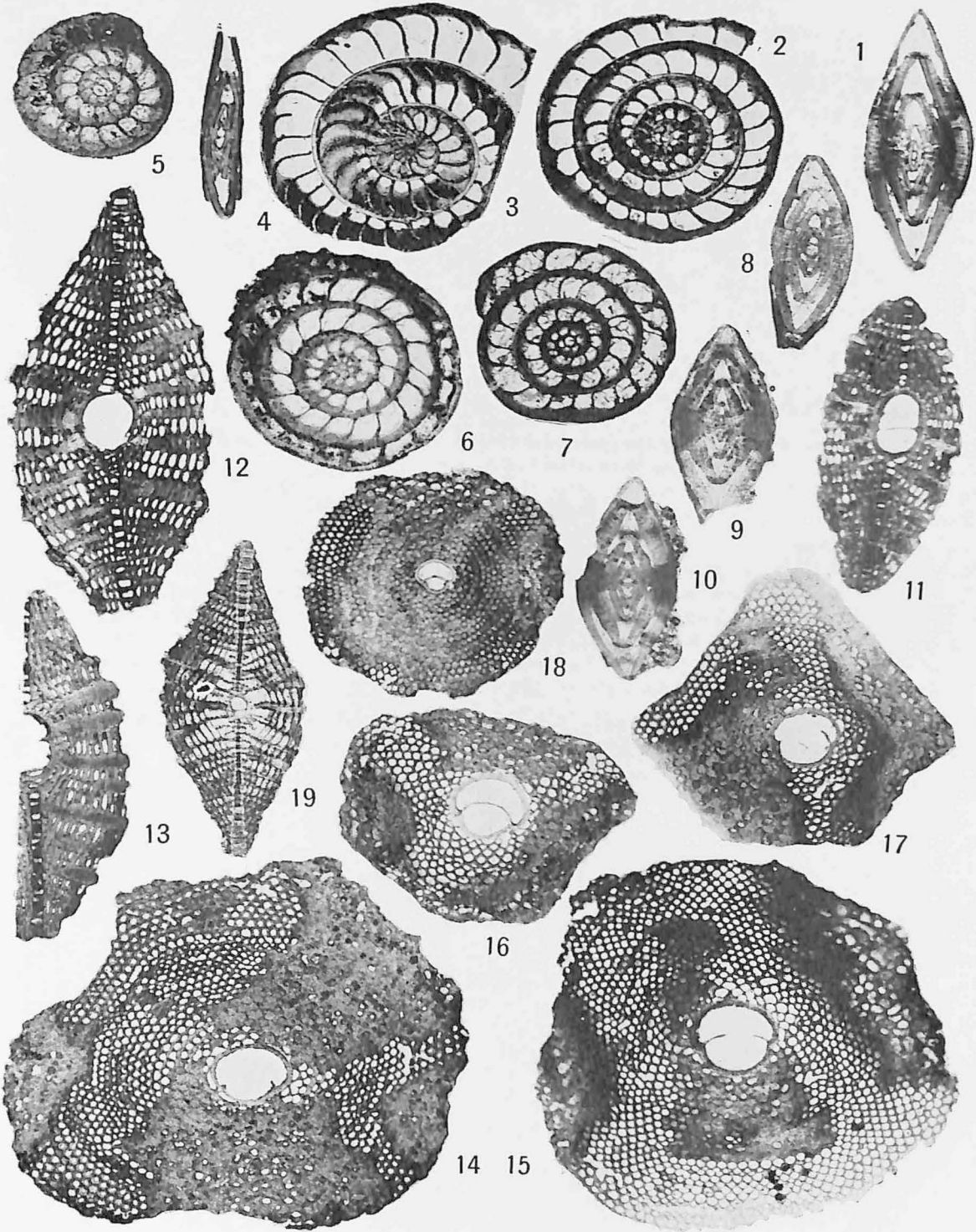


PLATE 6

All specimens from the Dale Mabry Field water well; 1, 5, at a depth of 220 feet; 2-4, 8, at a depth of 308-316.5 feet; 6, at a depth of 224.6 feet; 7, at a depth of 216.6 feet.

All figures, X 40

FIGURE

- 1-4, 7, 8. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis* Cushman, variety *morganopsis* Vaughan; 1-4, vertical sections to illustrate the variability in strength of the pillars; 7, portion of a horizontal section of a microspheric individual to show the initial coil and the rhomboid equatorial chambers; 8, horizontal section of a megalospheric individual.
- 5, 6. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis* Cushman; 5, vertical section of a megalospheric individual; 6, horizontal section of a megalospheric individual.

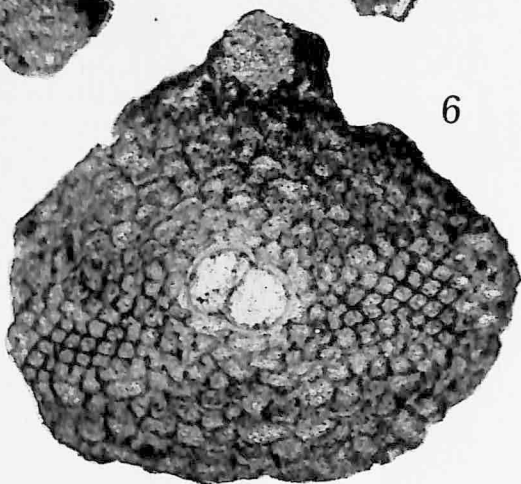
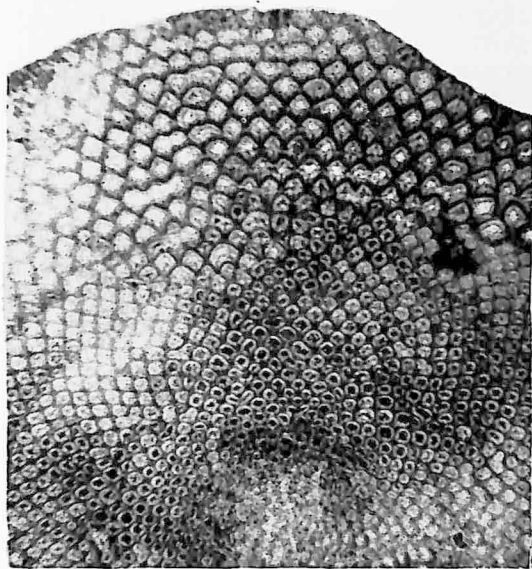
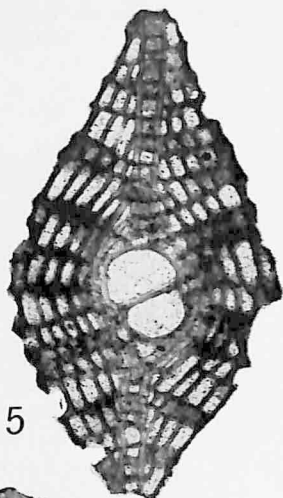
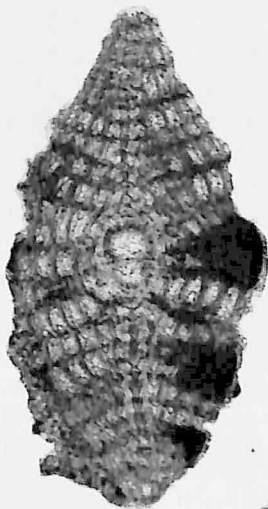
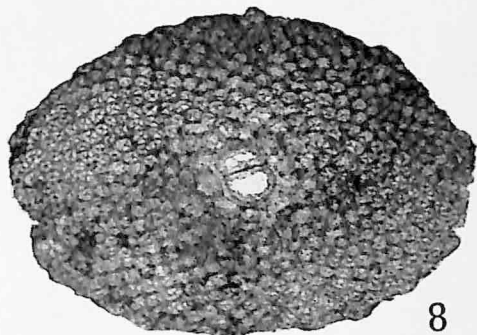
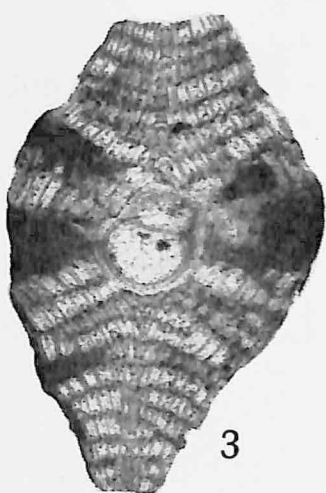
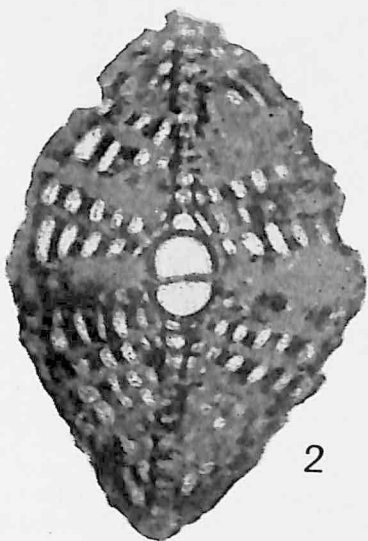
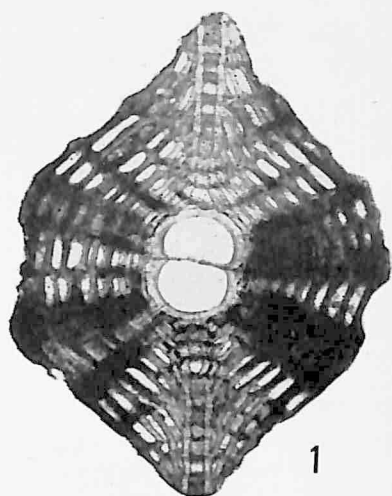


PLATE 7

Figures 1-8, of specimens from the Dale Mabry Field water well; 1, at a depth of 220.6 feet; 2-8, at a depth of 308-316.5 feet.

Figure 9, of a specimen from a quarry on the Huasteca Petroleum Company's golf course, Tampico, Mexico; collection of W. Storrs Cole.

Figures 8-13, of specimens collected between kilometer posts 17 and 18 on the Aguila Petroleum Company's narrow-gauge railroad between Potrero and Tanhuijo, Mexico; collection of W. Storrs Cole.

Figure 14, of a specimen from the City of Tallahassee water well at a depth of 349 feet.

Figures 1, 3-13, X 15

Figures 2, 14, X 40

FIGURE

- 1, 14. *Lepidocyclina* (*Nephrolepidina*) *suwannensis* Cole, n. sp.; 1, vertical section of a megalospheric individual showing appressed lateral chambers between thick roofs and floors; 14, portion of a horizontal section of a megalospheric individual to illustrate the nephrolepidine character of the embryonic chambers and the shape of the equatorial chambers which are normally short spatulate.
- 2-13. *Lepidocyclina* (*Lepidocyclina*) *parvula* Cushman; 2-4, vertical sections of megalospheric individuals which have elongate, appressed lateral chambers; 5, vertical section of a microspheric individual with strongly developed pillars; 6, 7, horizontal sections of megalospheric individuals; 8, vertical section of a microspheric individual with weakly developed pillars; 9-13, comparison specimens from Mexico; 9, vertical section of a microspheric individual with strong pillars irregularly spaced; 10, 12, 13, vertical sections of megalospheric individuals to illustrate the variation between individuals; 11, horizontal section of a megalospheric individual.

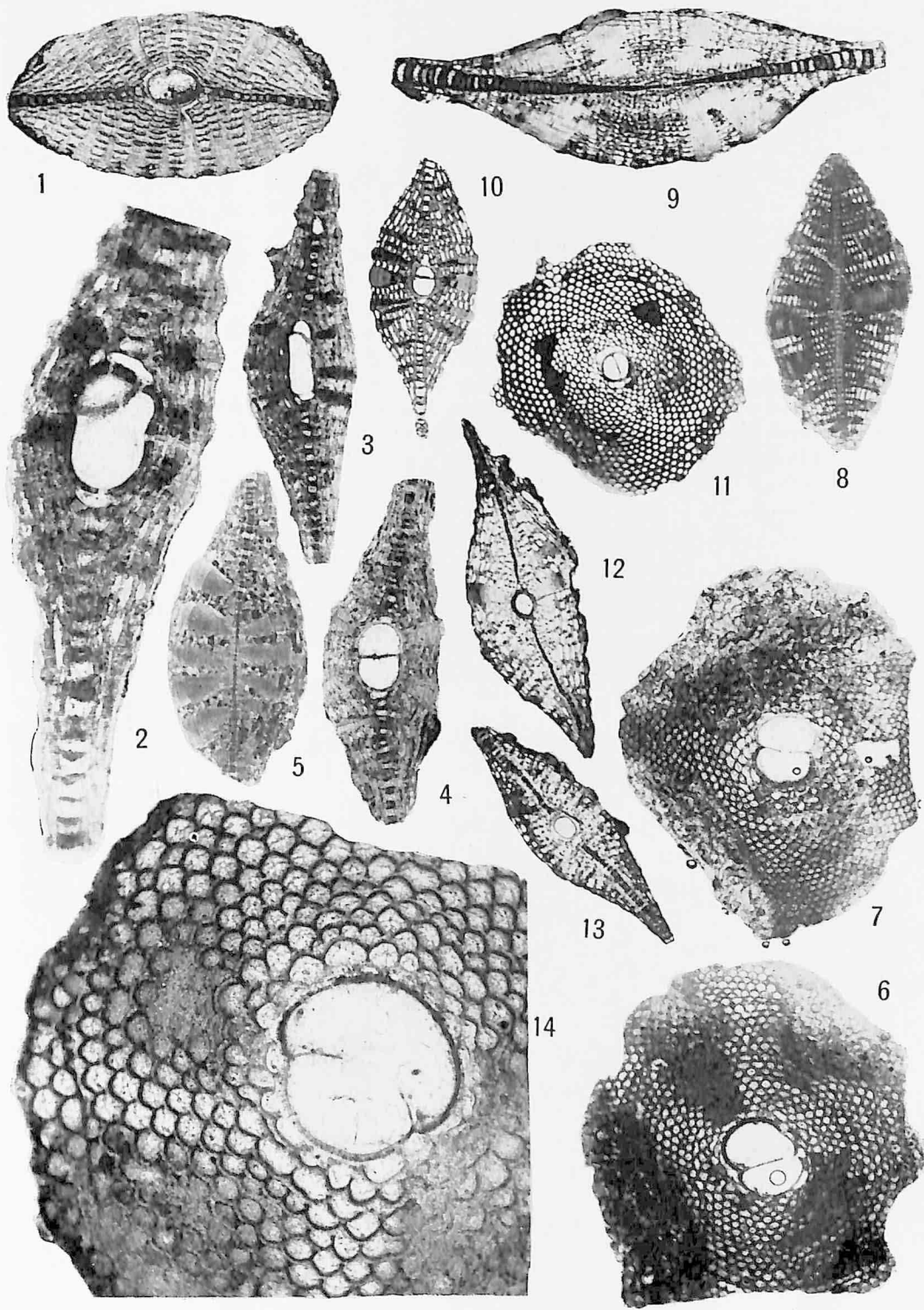


PLATE 8

All specimens from the Dale Mabry Field water well; 1, at a depth of 214.6 feet; 2, at a depth of 144 feet; 3, at a depth of 218.6 feet; 4, at a depth of 308-316.5 feet; 5, 6, at a depth of 220.6 feet; 7, at a depth of 224.6 feet.

All figures, X 15, except figure 4 which is X 40

FIGURE

- 1, 2. *Lepidocyclina (Eulepidina) favosa* Cushman; 1, oblique section from a fragment of the specimen illustrated by figure 9, plate 10, to show the equatorial chambers and the zone of the lateral chambers; 2, oblique section of a megalospheric individual to illustrate embryonic chambers, equatorial chambers and the zone of the lateral chambers.
3. *Lepidocyclina* sp.; vertical section of an unidentified species illustrated for future reference.
4. *Helicolepidina paucispira* Barker and Grimsdale; horizontal section of a megalospheric individual.
- 5, 6. *Lepidocyclina gigas* Cushman; 5, portion of the same individual illustrated by figure 6 to illustrate the equatorial chambers of a microspheric specimen; 6, vertical section.
7. *Lepidocyclina (Eulepidina) undosa* Cushman; vertical section of a typical megalospheric individual.

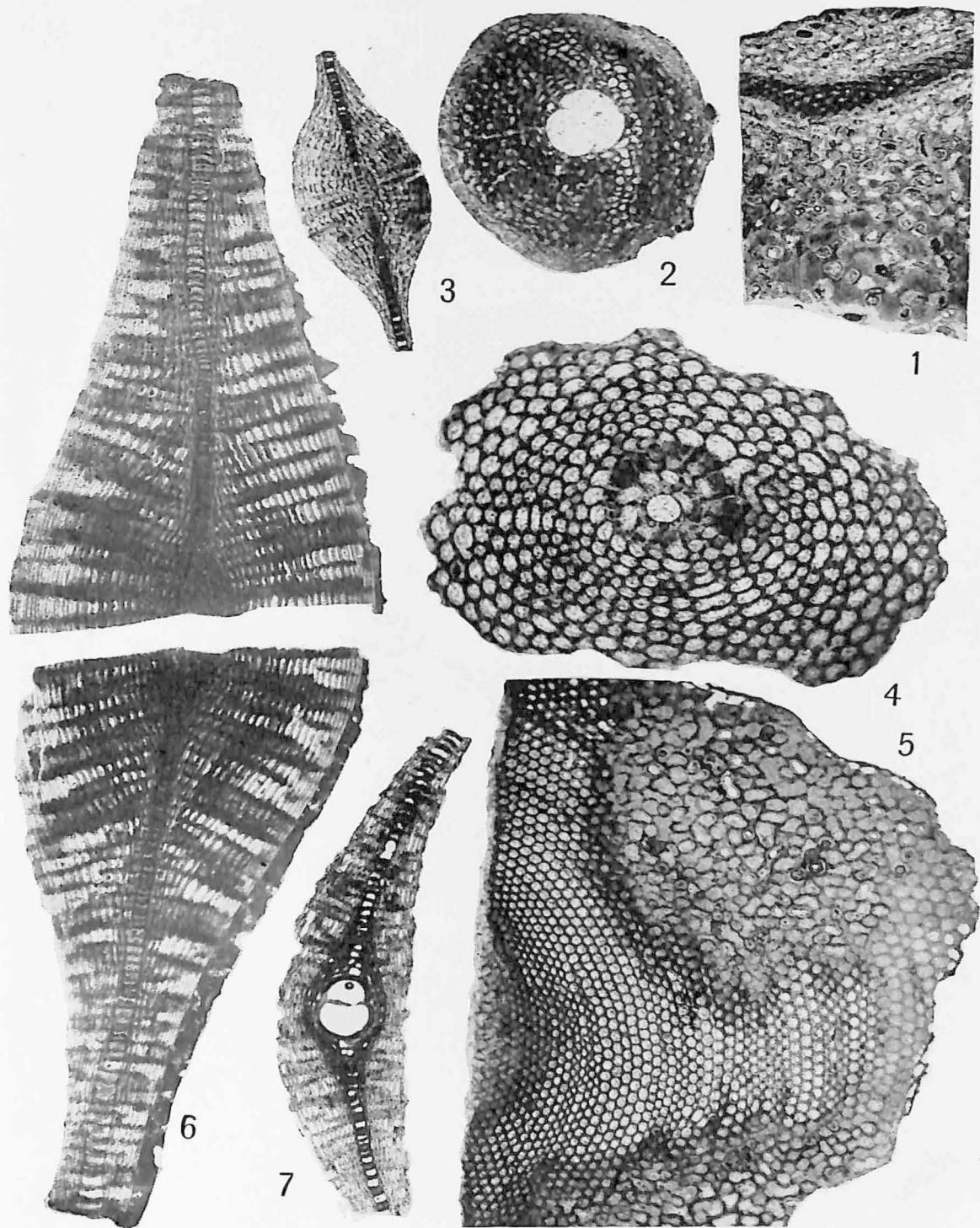


PLATE 9

All specimens from the Dale Mabry Field water well; 1, at a depth of 218.6 feet; 2, 3, 5, at a depth of 220.6 feet; 4, at a depth of 214.6 feet; 6, at a depth of 216.5 feet; 7, at a depth of 308-316.5 feet.

All figures, X 15

FIGURE

- 1-7. *Lepidocyclina (Eulepidina) favosa* Cushman; 1-4, horizontal sections of megalospheric individuals; 5, vertical section of a megalospheric individual; 6, 7, vertical sections of microspheric individuals. The thin sections illustrated by figures 2 and 5 were made from specimens which had the same external appearance. The thin section illustrated by figure 3 was made from a specimen similar to the one illustrated by the vertical section, figure 6, plate 10. The specimen illustrated by figure 7 was injured during the growth period as the equatorial layer and lateral chambers show by their peculiar bending on the left hand side.

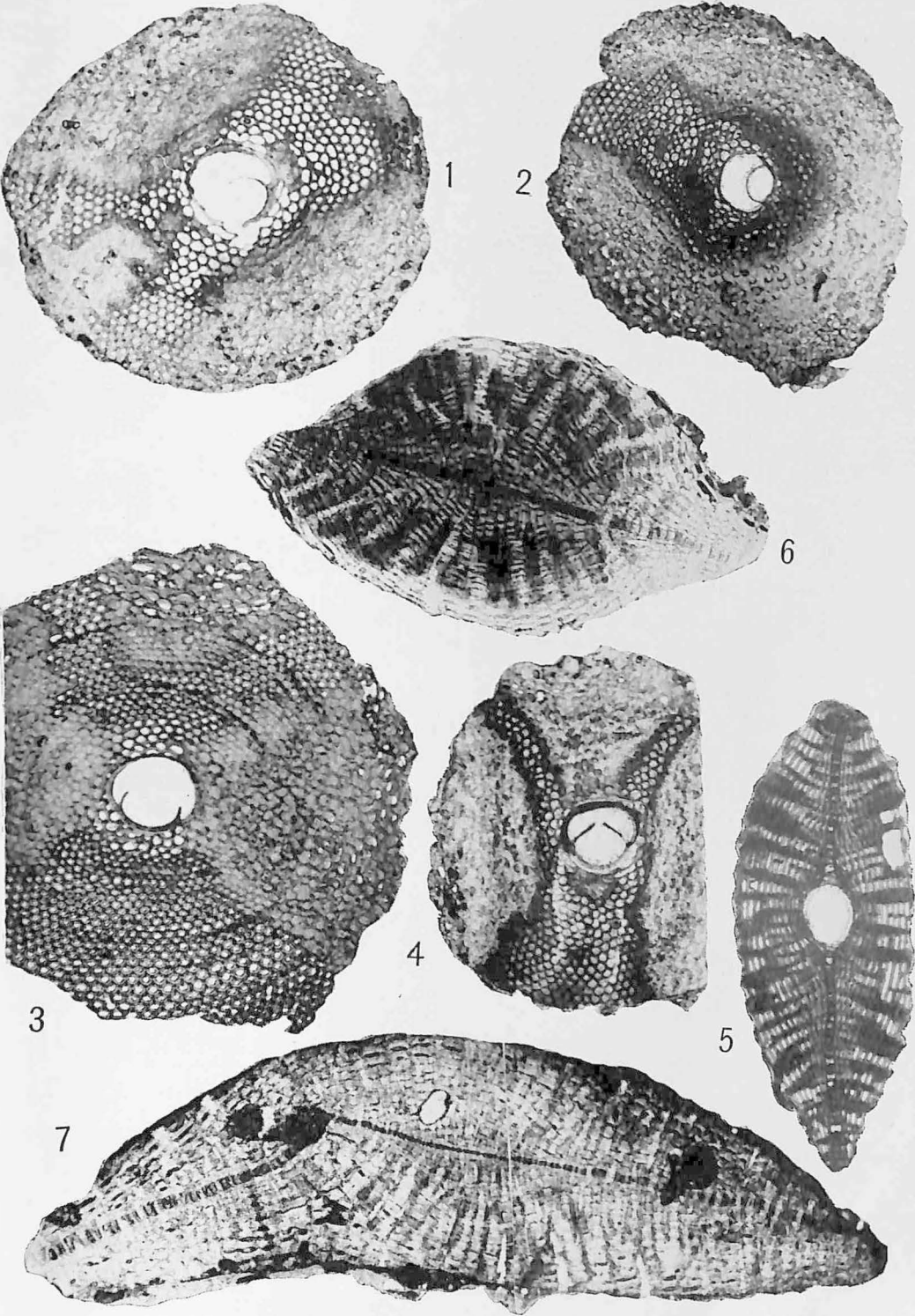


PLATE 10

All specimens from the Dale Mabry Field water well; 1-3, 6, at a depth of 218.6 feet; 4, at a depth of 220.6 feet; 5, at a depth of 144 feet; 7, at a depth of 212.6 feet; 8, 9, at a depth of 214.6 feet.

All figures, X 15

FIGURE

1-9. *Lepidocyliina (Eulepidina) favosa* Cushman; 1-6, vertical sections of megalospheric individuals to demonstrate the variability in shape; 7-9, vertical sections of microspheric individuals.

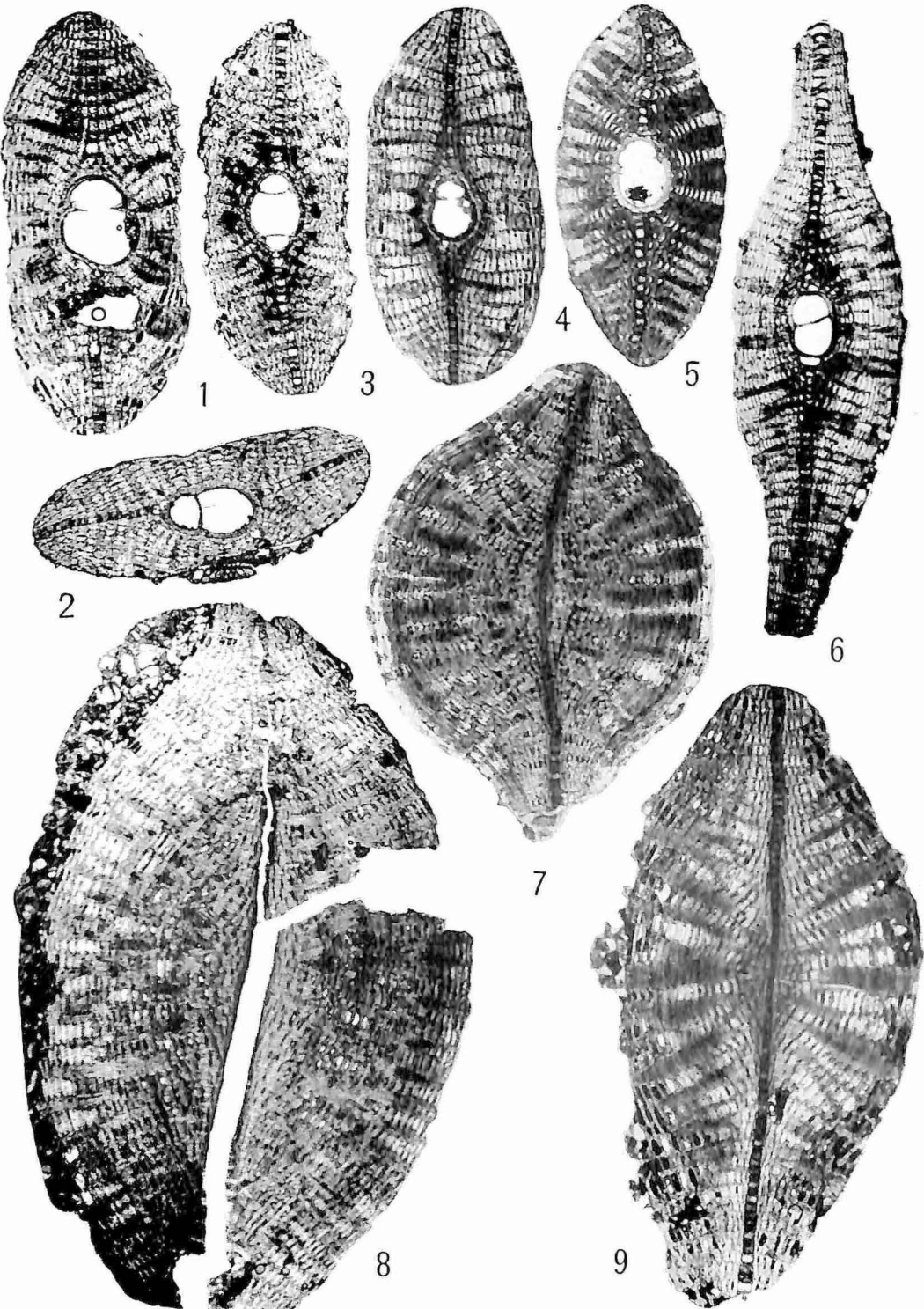


PLATE 11

Figures 1-4, 6-9, 11, of specimens from the Dale Mabry Field water well; 1, 2, at a depth of 308-316.5 feet; 3, at a depth of 228 feet; 4, 6, at a depth of 144 feet; 7, 11, at a depth of 220.6 feet; 8, at a depth of 212.6 feet; 9, at a depth of 216.6 feet.

Figure 5, of a specimen from the City of Tallahassee water well at a depth of 356 feet.

Figure 10, of specimens from well No. 1 (W-12) of the Bonheur Development Company, located at Burns, Wakulla County, Florida, at a depth of 325 feet.

Figures 1, 3, 8, 9, X 5

Figures 2, 4, X 10

Figures 5, 6, X 40

Figures 7, 11, X 15

Figure 10, X 20

FIGURE

- 1, 2. *Lepidocyclus* (*Lepidocyclus*) *parvulus* Cushman; 1, external view of a specimen with well-developed papillae; 2, external view of a specimen with small papillae.
3. *Lepidocyclus* (*Nephrolepidina*) *leonensis* Cole, n. sp.; external view of a cotype (F. G. S. No. S-3009) to show the well-developed apical crown of papillae surrounded by a rim which is without papillae. This specimen was ground on one side to expose the embryonic and equatorial chambers.
- 4, 5. *Operculinoides vicksburgensis* Vaughan and Cole; 4, external view; 5, transverse section.
- 6, 7, 11. *Lepidocyclus* (*Nephrolepidina*) *suwanneensis* Cole, n. sp.; 6, portion of a vertical section, greatly magnified, to illustrate the embryonic and lateral chambers; 7, 11, vertical sections.
8. *Lepidocyclus* (*Eulepidina*) *undosa* Cushman; external view.
9. *Lepidocyclus* (*Eulepidina*) *favosa* Cushman; external view showing the inflated central portion of the test bordered by a wide rim. This specimen is similar to the one from which the vertical section, figure 6, plate 10, was made.
10. *Rotalia mexicana* Nuttall, variety *mecatepecensis* Nuttall; series of specimens to illustrate ornamentation and degrees of serration of the periphery. These specimens are called *Anomalina* (?) by Mossom (Florida Geol. Survey 17th Ann. Rept., p. 213). This sample contained the most numerous and best developed specimens so far observed.



1



4



6



2



7



8



3



9



5



10



11

RAVLIN-BROWN, V. G. PHILIPS No. 1 WELL (W-440)
TEST FOR OIL

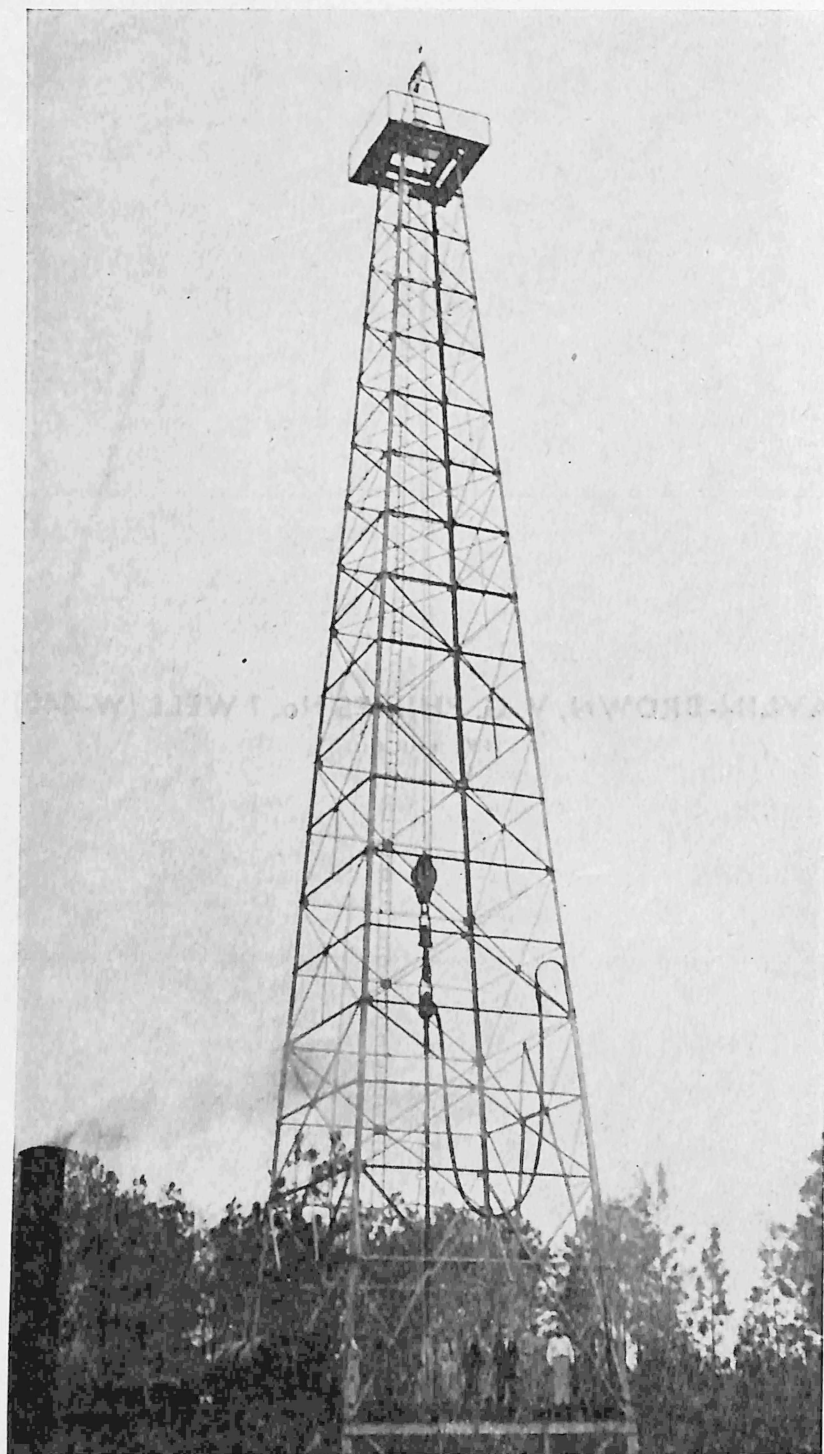


PHOTO COURTESY OF JUDGE RIVERS BUFORD

Figure 4. Drilling rig, Ravlin-Brown, V. G. Philips No. 1 well

INTRODUCTION

The Ravlin-Brown, V. G. Philips No. 1 well (W-440)³² is the eleventh well to be analyzed since the initiation of the project in 1936, to determine the subsurface stratigraphy and micropaleontology of critical areas within Florida.

The location of the V. G. Philips No. 1 well (W-440) is shown on Figure 5. This well lies between two areas which were reported in previous bulletins; the Granberry No. 1 well³³ in Jackson County in the northern portion encountered formations which are similar to those of Alabama, whereas the Suwannee Petroleum Corporation's Sholtz No. 1 well and the Florida Oil Discovery Company's Cedar Keys No. 2³⁴ well in Levy County in the southern portion penetrated formations which are similar to those of peninsular Florida. It was thought that a study of the samples from the V. G. Philips No. 1 well (W-440) might produce valuable information concerning the gradation from the clastic facies of the Eocene of Alabama to the limestone facies which characterizes the Eocene of peninsular Florida.

As will be demonstrated subsequently, the section from the top of the Paleocene down is rather similar to that found in the Granberry No. 1 well, but the portion representing the upper, middle, and lower Eocene is composed of limestones similar to those which characterize the upper, middle, and lower Eocene of peninsular Florida. Although a small Ocala fauna is recognized in the upper Eocene, the middle Eocene



³² Florida Geological Survey file number for this set of samples.

³³ *Op. cit.*, (Bull. 16), pp. 19-36.

³⁴ *Op. cit.*, (Bull. 20)

fauna is identical to a fauna³⁵ described from the Southern States Oil Corporation No. 1 well in Jefferson County, Florida.

The Calhoun Gas and Oil Company's No. 1 well in Calhoun County³⁶ was completed at a depth of 1320 feet in gray, calcareous, glauconitic sand which is known now to represent the middle Eocene. The change from these middle Eocene sands to limestones occurs somewhere between Calhoun and Wakulla Counties. A well in Liberty County should exhibit an interesting middle Eocene section.

It may be noted here that at a depth of 995-1000 feet in the Calhoun Gas and Oil Company's No. 1 well *Discocyclina* (*Asterocyclina*) *monticellensis* Cole and Ponton and *Lepidocyclina* (*Pliolepidina*) *ariana* Cole and Ponton were found. In this same well specimens of *Lepidocyclina* (*Polylepidina*) *antillea* Cushman (formerly called *L. gardnerae* Cole) occur at 1020-1030 feet in association with *Operculinoides sabinensis* Cole.

All types and other specimens from this well are filed in the Florida Geological Survey Museum at Tallahassee, Florida.

ACKNOWLEDGMENTS

It is a distinct pleasure to acknowledge the assistance which the writer has had in the preparation of this bulletin. Mr. Herman Gunter has continued his interest and support besides permitting free access to the tremendous reservoir of information concerning the geology of Florida which he has amassed through the years. Mrs. Helen Jeanne Plummer examined and discussed the smaller Foraminifera of the Paleocene and Upper Cretaceous with the writer during a visit which he made to Austin in September 1944. Mrs. Plummer's intimate knowledge of the Foraminifera of these ages assisted greatly in the preparation of the faunal lists of this portion of the well. Mr. W. E. Wrather, Director of the U. S. Geological Survey, permitted his technicians to prepare the excellent photomicrographs of the external views. Dr. Lloyd Henbest loaned topotype specimens of *L. macdonaldi* Cushman from the U. S. National Museum collection for com-

³⁵ Cole, W. Storrs and Ponton, Gerald M., New Species of *Fabularia*, *Asterocyclina* and *Lepidocyclina* from the Florida Eocene, Amer. Midland Nat., vol. 15, No. 2, pp. 138-147, 2 pls., 1934.

³⁶ Mossom, Stuart, A Review of the Structure and Stratigraphy of Florida, Florida Geol. Survey 17th Ann. Rept., pp. 206, 207, 1926.

parison with the specimens assigned to this species. A preliminary description of the samples prepared by Sidney A. Stubbs and Robert O. Vernon for the Florida Geological Survey was of considerable value in directing special attention to certain critical samples. The thin sections and photomicrographs of these were made by the writer.

PREVIOUS STUDIES OF WELLS IN WAKULLA COUNTY

In 1919 Cushman³⁷ published a brief account of the Bonheur Development Company well No. 1, located at Burns Station, Wakulla County, Florida. The samples from this well were collected at wide and irregularly spaced intervals. Although Cushman did not give any specific identifications in this article, he lists a number of genera which were found in the samples.

In 1921 in a brief article Cushman³⁸ identified certain of the specimens from the Bonheur Development Company well No. 1 specifically and figured one specimen from the depth of 325 feet.

Mossom³⁹ in 1926 gave a description of the lithologic character of the samples from the Bonheur Development Company well No. 1 and listed by genera only some of the Foraminifera found. The only definite stratigraphic conclusion reached by Mossom was that certain specimens at a depth of 700 feet resembled *Operculinoides willcoxi* (Heilprin) and, therefore, indicated that the Ocala limestone had been penetrated at this depth.

Certain samples from this well were examined by the writer. The following species were identified:

50 feet

Lepidocyclina (*Lepidocyclina*) *yurnagunensis* Cushman

150 feet

Lepidocyclina (*Lepidocyclina*) *parvula* Cushman

supera (Conrad)

yurnagunensis Cushman, variety *mor-*
ganopsis Vaughan

³⁷ Cushman, Joseph A., The Age of the Underlying Rocks of Florida as Shown by the Foraminifera of Well Borings, Florida Geol. Survey 12th Ann. Rept., pp. 82-84, 1919.

³⁸ Cushman, Joseph A., Foraminifera from the Deep Wells of Florida, Florida Geol. Survey 13th Ann. Rept., pp. 40, 42, 44, 53, 54, 59, pl. 1, fig. 5, 1921.

³⁹ Mossom, Stuart, A Review of the Structure and Stratigraphy of Florida, Florida Geol. Survey 17th Ann. Rept., pp. 213-216, 1926.

- 180 feet
Rotalia mexicana Nuttall, variety *mecatepecensis* Nuttall⁴⁰
Lepidocyclina (*Lepidocyclina*) *yurnagunensis* Cushman
- 325 feet
Dictyoconus cookei (Moberg)
Elphidium rota Ellis
Rotalia mexicana Nuttall, variety *mecatepecensis* Nuttall (very abundant)
- 700 feet
Camerina vanderstoki (Rutten and Vermunt)
Lepidocyclina (*Pliolepidina*) *cedarkeysensis* Cole
- 1820 feet
Lepidocyclina (*Pliolepidina*) *ariana* Cole and Ponton

Figures are given of certain of these specimens on plate 22. The specimens identified as *Rotalia mexicana* Nuttall, variety *mecatepecensis* Nuttall are illustrated by figure 10, plate 11 of this bulletin.

The re-examination of the upper samples from the Bonheur Development Company well No. 1 shows that the section encountered from 50 feet (the first sample) to a depth of 325 feet is definitely Oligocene in age and correlates with the Suwannee limestone. The first Eocene species is *Camerina vanderstoki* (Rutten and Vermunt) at a depth of 700 feet.

Recently P. L. Applin and E. R. Applin⁴¹ presented an interpretation of the section exhibited by certain wells in Florida. The formations which they recognize in the V. G. Philips No. 1 well (W-440) and the depths at which these occur follow:

Miocene	undivided	Surface to 390(?) feet
Oligocene	undivided	390(?) to 750 feet
Eocene	Upper	Ocala limestone 750 feet to 920 feet
	Late Middle	Avon Park limestone 920 feet to 1200 feet
		Tallahassee limestone 1200 feet to 1750 feet
	Early middle	Lake City limestone 1750 feet to 2122 feet
	Lower	Beds of Wilcox age 2122 feet to 2665 feet
Paleocene		Beds with Tamesí fauna 2665 feet to 2715 feet

⁴⁰ This species was called *Rotalia armata* d'Orbigny by Cushman, Florida Geol. Survey 13th Ann. Rept., p. 54, 1921.

⁴¹ Applin, Paul L. and Applin, Esther R., Regional Subsurface Stratigraphy and Structure of Florida and Southern Georgia, Amer. Assoc. Petrol. Geol. Bull., vol. 28, No. 12, p. 1736, fig. 23, 1944.

Upper Cretaceous	{	Beds of Navarro age	2715 feet to 2745 feet
		Beds of Taylor age	2745 feet to 3482 feet
		Beds of Austin age	3482 feet to 3672 feet
		Tuscaloosa formation	3672 feet to 4270 feet
Lower Cretaceous		undivided	4270 feet to bottom

Reference to the graphic log (figure 6) shows that the interpretation here presented is considerably different from that given in the preceding table. It may be helpful to state here one difference and the evidence on which this is based.

The index Foraminifera for the Avon Park limestone are stated by the Applins to be *Coskinolina floridana* Cole and *Lituonella floridana* Cole. As the Avon Park limestone is placed between 920 and 1200 feet, it is difficult to reconcile this fact with the fauna which occurred in the samples between 945 and 1050 feet in the set examined in the preparation of this bulletin. This fauna represents a typical Ocala fauna, therefore, this interval is included in the upper Eocene rather than assigned to the middle Eocene as the Applins have done.

RAVLIN-BROWN, V. G. PHILIPS NO. 1 WELL (W-440)

The Ravlin-Brown, V. G. Philips No. 1 well (W-440) is located in the center of the NW $\frac{1}{4}$ of section 14, Township 3S., Range 1E., near Wakulla, Wakulla County, Florida. (see figure 5) The elevation of the well head is 28 feet above sea level. Drilling began April 8, 1942 and was completed March 26, 1943 at which time the well was abandoned at a depth of 5766 feet. The Florida Geological Survey received 498 samples which represent the interval from 399 to 5746 feet.

STRATIGRAPHY

The formations encountered in the V. G. Philips No. 1 well (W-440) and their lithologic characteristics are shown on figure 6.⁴²

⁴² The depths marked on the samples and used throughout this article are in error between the depths of 2505 and 4002 feet. This error was discovered during a Schlumberger run which proved that the well had reached a depth of 3920 feet although the driller was recording a depth of 4002 feet at this point. The amount of error was 82 feet. A check on the amount of casing used indicated that the error occurred somewhere above 2500 feet. Therefore, all depths given between 2500 and 4000 feet should have 80 feet subtracted from them in order to give as close an approximation as possible to the true depth.

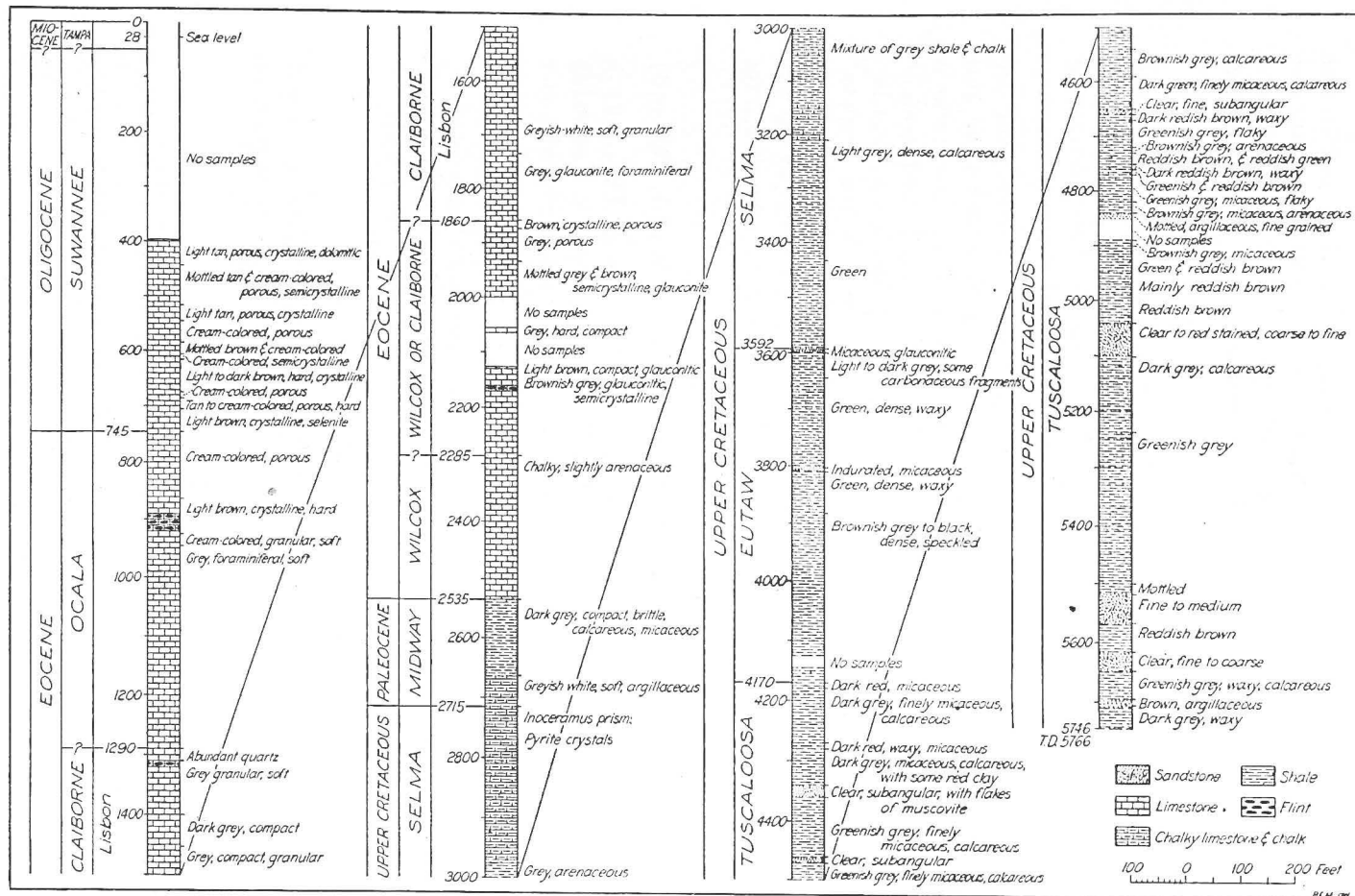


Figure 6. Log of Ravlin-Brown, V. G. Philips No. 1 Well

MIOCENE

TAMPA LIMESTONE.—The geological map of Florida⁴³ shows the area adjacent to Wakulla to be underlain by the Tampa limestone which is covered by undifferentiated Pleistocene and Recent. Cooke and Mossom⁴⁴ state,

"Tampa limestone lies near the surface over all of the eastern part of Wakulla County."

Mansfield⁴⁵ lists a number of stations in Wakulla County at which he found Tampa faunas.

Inasmuch as the first sample from the V. G. Philips No. 1 well (W-440) was taken at a depth of 399 feet, information concerning the thickness of the Tampa limestone could not be ascertained from this well. However, the first sample at 50 feet in the Bonheur Development Company well No. 1 (W-12) contained *Lepidocyclina*. Certain of these specimens were identified as *L. (Lepidocyclina) yurnagunensis* Cushman, a species found in the Suwannee limestone⁴⁶ on the outcrop. A horizontal section of one of these specimens is illustrated as figure 2 on plate 22.

The Tampa limestone in the V. G. Philips No. 1 well (W-440) would be relatively thin as the data from the Bonheur Development Company well No. 1 suggest that the Tampa limestone has a thickness of less than 50 feet in this portion of Wakulla County.

OLIGOCENE

SUWANNEE LIMESTONE.—Reliance must be placed on the samples from the Bonheur Development Company well No. 1 for the age and characteristics of the upper portion of the section assigned to the Oligocene. In this well characteristic Oligocene Foraminifera were found at 50 feet, 150 feet, 180 feet, and 325 feet. The fauna recovered from these samples

⁴³ Cooke, C. Wythe and Mossom, Stuart, Geology of Florida, Florida Geol. Survey 12th Ann. Rept., map in pocket, 1929.

⁴⁴ *Idem*, p. 92.

⁴⁵ Mansfield, W. C., Mollusks of the Tampa and Suwannee Limestones of Florida, Florida Geol. Survey Bull. 15, pp. 25, 26, 1937.

⁴⁶ Cole, W. Storrs, Oligocene Orbitoids from near Duncan Church, Washington County, Florida, Jour. Pal., vol. 8, No. 1, pp. 21-28, pls. 3, 4, 1934; Vernon, Robert O., Geology of Holmes and Washington Counties, Florida, Florida Geol. Survey Bull. 21, p. 63, 1942.

indicates that the well penetrated rocks which should be correlated with the Suwannee limestone.

The first sample from the V. G. Philips well No. 1 (W-440) was taken at 399 feet, the second covered the interval from 399 to 409 feet after which the samples were taken so that they covered approximately 10 foot intervals. The sample at 399 feet contained larger Foraminifera representing three genera. All of the specimens were smoothed on the surface and gave the appearance of having been eroded.

Four specimens were found which were identified as *Dictyoconus cookei* (Moberg). It has been noted previously that at 325 feet in the Bonheur Development Company well No. 1 (W-12) *D. cookei* (Moberg) occurred with the Oligocene species *Rotalia mexicana* Nuttall, variety *mecatepecensis* Nuttall. The other specimens found in the 399 foot sample in the V. G. Philips well No. 1 (W-440) represented the genera *Heterostegina* and *Lepidocyclina*. There were very few specimens of *Heterostegina*, but *Lepidocyclina* occurred in considerable abundance.

The surface ornamentation of the *Heterostegina* was completely destroyed, but moderately satisfactory thin sections could be made (figures 9, 10, plate 15). Cushman⁴⁷ reports the occurrence of *Heterostegina ocalana* Cushman at a depth of 50 feet in the Bonheur Development Company well No. 1 (W-12). The specimens from 399 feet in the V. G. Philips well No. 1 (W-440) may represent the same species which Cushman had from the Bonheur Development Company well No. 1 (W-12). The specimens from the V. G. Philips well No. 1 (W-440) are referred to *Heterostegina texana* Gravell and Hanna although some doubt must be entertained concerning the validity of this identification because of the poor state of preservation of the specimens.

The *Lepidocyclina* associated at 399 feet in the V. G. Philips well No. 1 (W-440) with *D. cookei* (Moberg) and *H. texana* Gravell and Hanna have many features similar to specimens referred to *L. (Pliolepidina) ariana* Cole and Ponton. Inasmuch as *D. cookei* and *L. ariana* are considered to be indigenous to the middle Eocene, this sample would appear to contain a mixed fauna of one Oligocene and two Eocene species.

⁴⁷ *Op. cit.*, (13th Ann. Rept.) p. 40.

The samples from 409 feet to 516 feet are devoid of significant Foraminifera, but the sample recovered at 516 to 546 feet contains a well developed and easily identified fauna. Specimens obtained from this sample represent the following: *Discorinopsis gunteri* Cole, *Dictyoconus americanus* (Cushman), *D. cookei* (Moberg) and *Eodictyoconus cubensis* (Cushman and Bermudez). In the samples representing the next 68 feet such characteristic species as *Eponides gunteri* Cole, *Lituonella floridana* Cole and *Pseudochrysalidina floridana* Cole are found. The preliminary examination suggested that the top of the middle Eocene occurred at 516 feet and that the Ocala was not present in this area. However, as deeper samples were examined, the preliminary conclusions concerning the middle Eocene age of the section starting at 516 feet became questionable.

Examination of the samples from 745 to 1030 feet revealed a number of species which are confined to the upper Eocene. The following were recorded between these depths: 1. at 745-755 feet *Camerina vanderstoki* (Rutten and Vermunt); 2. at 945-955 feet *Camerina moodybranchensis* Gravell and Hanna; 3. at 975-985 feet *Operculinoides willcoxi* (Heilprin); 4. at 985-995 feet *Operculina barkeri* Vaughan and Cole; 5. at 995-1005 feet *Lepidocyclina* (*Lepidocyclina*) *mortoni* Cushman; 6. at 1015-1016 feet *Camerina jacksonensis* Gravell and Hanna and 7. at 1018-1030 feet *Operculinoides vaughani* Cushman.

Thus, the distribution of the various species in this well, if taken with their known ranges in other wells, would suggest that the middle Eocene overlies the upper Eocene. Four interpretations might be offered to explain this anomalous situation: 1. the samples were mixed, 2. a fault occurred, 3. previous interpretations of age have been erroneous, 4. the middle Eocene forms have been reworked into younger deposits.

Analysis of the samples from the Bonheur Development Company well No. 1 offered rather conclusive proof that the samples from V. G. Philips well No. 1 (W-440) were in proper sequence and had not been mixed. The distribution of specimens as "cavings" in the samples from the V. G. Philips well No. 1 (W-440) was supplemental proof that these samples had not been mixed.

There is no evidence from surrounding areas or in the known geologic history of the Coastal Plain or peninsular Florida to suggest that the inversion of the faunas was produced by translocation of the rock units.

The third possibility involves first that some of the faunas previously considered middle Eocene in age are in reality upper Eocene in age and second that there are recurrent faunas in Florida which occur in the middle Eocene and Oligocene. It is well established from previous work⁴⁸ that certain middle Eocene species occur in the Oligocene of Florida. Never, however, have so many middle Eocene species been found in the Oligocene as were recovered from this well.

Although it has been suggested above that interfingering might be the explanation and that in the area of the V. G. Philips well No. 1 (W-440) the Ocala fauna extends as a tongue into faunas previously classified as indigenous to the middle Eocene, there is no proof to substantiate this contention from the other areas examined in detail in Florida.

The information which has been collected to date indicates that such occurrences of middle Eocene species above upper Eocene faunas is most reasonably explained by reworking of middle Eocene deposits during Oligocene times. The section in the V. G. Philips well No. 1 (W-440) between 516 feet and 745 feet is placed in the Oligocene.

Historically, it is of interest to note that Mossom⁴⁹ in discussing the Bonheur Development Company well No. 1 states: "The presence of the *Dictyoconus* sp. does not tell a great deal. Vaughan states that this genus has been found in surface samples at Live Oak and in many wells it has been found in the Ocala."

It must be emphasized again that the occurrence of a middle Eocene species or even a rather complete middle Eocene fauna in Florida must be viewed with suspicion in determinations of age.

UPPER EOCENE

OCALA LIMESTONE.—The top of the upper Eocene occurs at a depth of 745-755 feet with the appearance of *Camerina vanderstoki* (Rutten and Vermunt). The species of upper

⁴⁸ *Op. cit.*, (Bull. 19) pp. 11-16, 19, 20.

⁴⁹ *Op. cit.*, (17th Ann. Rept.) p. 215.

Eocene age and the depths at which they were recovered have been recorded previously in discussing the Oligocene and need not be repeated here. It may be noted, however, that the top portion of the section assigned to the upper Eocene is relatively barren of fossils. It is not until the depth of 945 feet is reached that abundant specimens are found.

Between 975 and 1030 feet there are abundant specimens of representative species which occur in the Ocala limestone or its equivalent elsewhere in Florida and the Coastal Plain. The base of the upper Eocene is not defined clearly in this well as a fauna of unmistakable middle Eocene age does not appear until the depth of 1757 feet is reached.

The most definite lithologic break below 1030 feet occurs at 1290 feet. This point is tentatively chosen to mark the base of the upper Eocene. If this is correct, the Ocala limestone in this area would have a thickness of 545 feet which seems to be excessive. The problem encountered in the V. G. Philips well No. 1 (W-440) is similar to that found in the City of Quincy water well (W-4) in which it was concluded that the Ocala limestone might have a thickness of 690⁺ feet.⁵⁰

MIDDLE EOCENE

LISBON FORMATION⁵¹.—There is only one faunal zone which contains larger Foraminifera in the section assigned to the middle Eocene. This zone which is first discovered at a depth of 1757 feet contains *Discocyclina* (*Asterocyclina*) *monticellensis* Cole and Ponton, *Fabularia vaughani* Cole and Ponton and *Lepidocyclina* (*Pliolepidina*) *ariana* Cole and Ponton. This fauna is identical to the one reported at a depth of 1740 feet from the Southern States Oil Corporation well No. 1 (W-19), located one and a half miles north of Monticello, Jefferson County, Florida.

⁵⁰ *Op. cit.*, (Bull. 26), pp. 16, 17.

⁵¹ Article 17 of the "Classification and Nomenclature of Rock Units" (see: Geol. Soc. Amer. Bull., vol. 44, pp. 440-441, 1933) states: "Subsurface units shall be given formal names only where names are necessary for adequate presentation of the geologic history of the region." In the remarks under this article the following appears: "When it becomes possible to correlate a named subsurface unit with a named surface unit, the name of the surface unit is to be applied, even though the subsurface name has priority."

Careful consideration of the problems of correlation indicate that these are wise considerations to govern the creation of new names for subsurface units inasmuch as the type locality and knowledge of the subsurface unit must be fragmentary. It would seem that more confusion would result from the indiscriminate adoption of names for subsurface units than if the policy stated in article 17 were strictly followed.

A preliminary and hasty examination of the entire set of samples from the Southern States Oil Corporation well No. 1 proves that the faunas and lithologies in this well are very similar to the V. G. Philips well No. 1 (W-440).

In the Hilliard Turpentine Company well No. 1 (W-336) the *Discocyclina monticellensis*-*Lepidocyclina ariana* zone occurred between the *Dictyoconus americanus* and the *Lepidocyclina antillea* zones⁵². The correlation and relative position of the *D. monticellensis*-*L. ariana* zone in the V. G. Philips well No. 1 (W-440) with other wells in Florida can be determined because of its known relationship in the Hilliard Turpentine Company well No. 1 (W-336), and in this well this zone was correlated with the Lisbon formation of Alabama and Mississippi. Thus, this section in the V. G. Philips well No. 1 (W-440) is assigned to the Lisbon formation.

Below the section assigned to the Lisbon formation there is an interval without fossils which is considered to represent the lower part of the Claiborne. The top of this section has been placed tentatively at 1860 feet.

LOWER EOCENE

WILCOX GROUP.—There does not seem to be a paleontologic basis on which to separate the middle from the lower Eocene. In fact, in peninsular Florida the division of the interval from the top of the upper Eocene to the top of the Upper Cretaceous appears to fall naturally into a threefold division. This division of this interval into upper, middle and lower Eocene has been used in previous studies.

In order to conform to the usage of the United States Geological Survey, the interval which would have been assigned to the lower Eocene previously is placed in this bulletin in the Paleocene. No attempt is made to delimit the upper boundary of the interval that would represent the lower Eocene except that a tentative boundary is suggested on the graphic log at 2285 feet where a change in lithology occurs.

PALEOCENE

MIDWAY FORMATION.—At 2535 feet the samples contain a dark gray, compact, slightly micaceous, calcareous shale

⁵² *Op. cit.*, (Bull. 26), p. 34.

which has a very small poorly preserved fauna of *Globigerina* and calcite casts of forms which belong to the family Ellipsoidinidae, probably to the genus *Ellipsolagena*. This depth is considered to mark the top of the Midway formation.

Between 2675 and 2715 feet the fauna of small Foraminifera becomes larger with certain critical species appearing for age determination. Certain of these species are known from the Midway, such as *Anomalina acuta* Plummer, *Globorotalia membranacea* (Ehrenberg), *Globorotalia wilcoxensis* Cushman and Ponton, *Globigerina triloculinoides* Plummer, and *Spiroplectammina mexiaensis* Lalicker. Others are recorded from the Aragon formation⁵³ of the Tampico Embayment of which *Nuttalides trümpyi* (Nuttall) may be mentioned.

The Midway formation in this well has a thickness of 180 feet, whereas in the Granberry well (W-285) the thickness of the Midway was 210 feet.⁵⁴ The total thickness of the Eocene and Paleocene in the V. G. Philips well No. 1 (W-440) is 1970 feet.

UPPER CRETACEOUS

SELMA FORMATION.—At 2715 to 2725 feet the first Foraminifera of Upper Cretaceous age were encountered. The faunal break is sharp although there is very little difference in the lithology between the lower portion of the section assigned to the Paleocene and that which is referred to the Upper Cretaceous.

The most abundant specimens at 2715 to 2725 feet are *Globotruncana arca* (Cushman), but other well-known Cretaceous Foraminifera were recovered from this sample of which *Gümbelina punctulata* Cushman, *Lituola taylorensis* Cushman and Waters and *Pseudotextularia varians* Rzehak are the most diagnostic. This sample contained also rather numerous *Inoceramus* prisms.

The next two samples covering the interval between 2725 and 2745 feet have many more species. This faunal assemblage is similar to the one encountered in the Granberry well

⁵³ Nuttall, W. L. F., Eocene Foraminifera from Mexico, Jour. Pal., vol. 4, No. 3, pp. 277-293, 1930.

⁵⁴ *Op. cit.*, (Bull. 16), p. 28.

No. 1 (W-285) between 1940 and 2050 feet although the fauna of the Granberry well No. 1 had a greater number of species.⁵⁵ This zone in the V. G. Philips well No. 1 (W-440) is the equivalent of the zone found in the Suwannee Petroleum Corporation's Sholtz well No. 1 (W-166)⁵⁶ at 3175 to 3267 feet, in that, such species as *Gyroidina alabamensis* Sandidge and *Stensiöina americana* Cushman occur in both wells. These species are found between 3165 and 3295 feet in the Hilliard Turpentine Company well No. 1 (W-336)⁵⁷ in a zone which is the age equivalent of the interval under discussion in the V. G. Philips well No. 1 (W-440).

In the Florida Oil Discovery Company's Cedar Keys well No. 2 (W-355)⁵⁸ above the *Gyroidina alabamensis* Sandidge-*Stensiöina americana* Cushman zone and below the interval assigned to the Paleocene there occurred a section assigned to the Upper Cretaceous which contained *Lepidorbitoides*. This section has an approximate thickness of 634 feet. In the Hilliard Turpentine Company well No. 1 (W-336) there occurs a zone containing such species as *Pseudorbitoides israelskii* Vaughan and Cole and *Vaughanina cubensis* D. K. Palmer above the *Gyroidina alabamensis* Sandidge-*Stensiöina americana* Cushman zone. At the present time this zone in the Hilliard Turpentine Company well No. 1 (W-336) is believed to be the equivalent of the *Lepidorbitoides* zone in the Cedar Keys well No. 2 (W-355). The thickness of this zone in the Hilliard Turpentine Company well No. 1 (W-336) is approximately 180 feet. However, above the horizon of *Vaughanina cubensis* D. K. Palmer there was an interval of 200 feet assigned doubtfully to the Upper Cretaceous. Thus, there is in this well the possibility of a thickness of 380 feet between the base of the Paleocene and the *Gyroidina alabamensis* Sandidge-*Stensiöina americana* zone.

This interval characterized by Cretaceous orbitoidal Foraminifera is missing in the V. G. Philips well No. 1 (W-440). In this well the Paleocene lies upon the *Gyroidina alabamensis* Sandidge-*Stensiöina americana* zone. In general terms this zone of smaller Foraminifera would be the approximate age

⁵⁵ *Op. cit.*, (Bull. 16), pp. 34-36.

⁵⁶ *Op. cit.*, (Bull. 20), p. 15.

⁵⁷ *Op. cit.*, (Bull. 26), p. 34-35.

⁵⁸ *Op. cit.*, (Bull. 20), p. 16.

equivalent of the Taylor marl of Texas. The V. G. Philips well No. 1 (W-440) has virtually the same conditions and fauna at the Paleocene-Cretaceous contact as occurred in the Granberry well No. 1. There is a considerable section of Upper Cretaceous missing in these wells which occurs in certain wells in peninsular Florida.

The upper portion of the section assigned to the Selma formation in the V. G. Philips well No. 1 (W-440) is largely chalk which grades downward into chalk interbedded with gray shale. The lower portion of the Selma formation in this well is composed of dense, light gray, calcareous shale below which occurs some green shales which are included in the Selma, but these green shales might represent the upper portion of the Eutaw.

The Selma formation in the V. G. Philips well No. 1 (W-440) has a thickness of 877 feet. In the Granberry well No. 1 this same formation had a thickness of 942 feet. The Cedar Keys well No. 2 (W-355) had a thickness of about 650 feet from the top of the *Gyroidina alabamensis* Sandidge-*Stensiöina americana* Cushman zone to the top of the Eutaw.

EUTAW FORMATION.—At 3592 feet the sample contains fragments of a micaceous, glauconitic sandstone which resembles material from other wells in which the Selma-Eutaw contact could be ascertained with considerable certainty. The appearance of this sandstone certainly indicates that the drill had penetrated the Eutaw, but the green shale which appeared at a depth of 3432 feet might be included in the Eutaw. In a well of this type it is virtually impossible to be absolutely certain of a contact which must be chosen by a change in lithology for two basic reasons: 1. the samples are all cuttings and contain many "cavings" which obscure the primary characteristics of the material, and 2. the distance between authenticated wells is too great to be sure of the change in conditions which might take place.

The section assigned to the Eutaw is composed dominantly of shale, most of which is dense, waxy and greenish in color in the upper portion and brownish gray to black or speckled in the lower portion. There are some thin sandstone beds, but it is difficult to delimit these exactly.

The section assigned to the Eutaw in the V. G. Philips well

No. 1 (W-440) has a thickness of 578 feet. The thickness of the Eutaw in the other wells studied to date is: Granberry No. 1, 575 feet; Cedar Keys No. 2 (W-355), 573 feet; Hiliard Turpentine Company No. 1 (W-336), 820 feet.

TUSCALOOSA FORMATION.—At 4170 feet fragments of a dark red, micaceous shale appeared. As there is a considerable lithologic change between this sample and the one above it, this depth was chosen as the top of the Tuscaloosa formation.

The Tuscaloosa formation in this area consists largely of shale with numerous rather thin sandstone beds and two or more thick sandstones. The general characteristics are shown on the graphic log. Therefore, a detailed description is superfluous, particularly in view of the fact that the character of the samples would permit only generalization.

Certain reports which have come to my attention consider that many wells of this type have penetrated the Lower Cretaceous. This may be true. In 1938 I wrote regarding the lower portion of the Granberry well No. 1:

"The lithologic character of certain portions of the section encountered in the Granberry well below the Eutaw corresponds rather closely to the Trinity described in the Mississippi well.

"Until more evidence is obtained it is futile to speculate regarding the possibility that the well under discussion actually penetrated the Lower Cretaceous."⁵⁹

The lower portion of the Granberry well No. 1 was rather completely cored so that one had optima conditions for study. The conservative treatment seemed to be that this entire lower section in the Granberry well No. 1 should be assigned to the Tuscaloosa formation until more positive proof of Lower Cretaceous age can be established. Nothing has yet appeared to cause me to believe that these wells did not end in the Tuscaloosa.

PALEONTOLOGICAL RECORD (W-440)

399 feet (first sample)

Dictyoconus cookei (Moberg)

Heterostegina texana Gravell and Hanna

Lepidocyclus (Pliolepidina) ariana Cole and Ponton

⁵⁹ *Op. cit.*, (Bull. 26), pp. 26, 27.

- 516-546 feet
 Dictyoconus americanus (Cushman)
 cookei (Moberg)
 Discorinopsis gunteri Cole
 Eodictyoconus cubensis (Cushman and Bermudez)
- 546-554 feet
 Dictyoconus americanus (Cushman)
 cookei (Moberg)
 Discorinopsis gunteri Cole
 Eodictyoconus cubensis (Cushman and Bermudez)
 Lepidocyclina (*Pliolepidina*) *macdonaldi* Cushman
 Pseudochrysalidina floridana Cole
- 578-584 feet
 Eponides gunteri Cole
 Lituonella floridana Cole
- 615-625 feet
 Lepidocyclina (*Pliolepidina*) *cedarkeysensis* Cole
- 625-635 feet
 Coskinolina floridana Cole
 Textularia coryensis Cole
- 655-665 feet
 Spirolina coryensis Cole
- 675-685 feet
 Lepidocyclina (*Pliolepidina*) *cedarkeysensis* Cole (abundant)
- 745-755 feet
 Camerina vanderstoki (Rutten and Vermunt)
- 945-955 feet
 Camerina moodybranchensis Gravell and Hanna
- 975-985 feet
 Operculinoides willcoxi (Heilprin)
- 985-995 feet
 Operculina barkeri Vaughan and Cole (rare)
- 995-1005 feet
 Lepidocyclina (*Lepidocyclina*) *mortoni* Cushman
- 1015-1016 feet
 Camerina jacksonensis Gravell and Hanna
 Operculina barkeri Vaughan and Cole (abundant)
- 1018-1030 feet
 Operculinoides cookei (Cushman)
 vaughani (Cushman)
- 1757-1768 feet
 Camagueyia perplexa Cole and Bermudez
 Discocyclina (*Asterocyclina*) *monticellensis* Cole and Ponton
 Discorbis inornatus Cole
 Fabularia vaughani Cole and Ponton
 Lepidocyclina (*Pliolepidina*) *ariana* Cole and Ponton

- 1799-1809 feet
Lepidocyclina (*Pliolepidina*) *ariana* Cole and Ponton (very abundant)
2535-2545 feet
Ellipsolagena (?) sp.
Globigerina sp.
2675-2685 feet
Anomalina sp.
Cibicides blaspiedi Toulmin
Eponides sp.
Nonionella insecta (Schwager)
Planulina marialana Hadley
2685-2695 feet
Anomalina acuta Plummer
 dorri Cole
 sp.
Bulimina sp.
Eggerella trochoides (Reuss)
Eponides sp.
Globigerina triloculinoides Plummer
Globorotalia membranacea (Ehrenberg)
Nuttallides trümpyi (Nuttall)
Pseudoglandulina manifesta (Reuss)
Spiroplectammina mexiaensis Lalicker
2695-2705 feet
Anomalina sp.
Cibicides sp. cf. *C. pseudoungerianus* (Cushman)
Gyroldina sp.
Siphonina sp.
Spiroplectammina expansa (Plummer)
2705-2715 feet
Globigerina sp.
Globorotalia membranacea (Ehrenberg)
 willcoxensis Cushman and Ponton
Nuttallides trümpyi (Nuttall)
2715-2725 feet
Bolivina incrassata Reuss
**Globorotalia membranacea* (Ehrenberg)
Globotruncana arca (Cushman)
 cretacea Cushman
Gümbelina punctulata Cushman
Lituola taylorensis Cushman and Waters
**Nonionella welleri* (Plummer)
Pseudotextularia varians Rzehak
Pullenia americana Cushman
2735-2745 feet
Anomalina benbesti Plummer
 nelsoni W. Berry
 sholtzensis Cole
 sp. (same as figures 9, 10, plate 2, Florida Geol. Survey Bull. 20)

Arenobulimina americana Cushman

Bolivina incrassata Reuss

Bolivinoides decorata (Jones)

Buliminella carseyae Plummer

Cibicides stephensoni Cushman

Clavulinoides trilatera (Cushman)

Dorothia stephensoni Cushman

Eggerella trochoides (Reuss)

Globotruncana arca (Cushman)

fornicata Plummer

Gümbelina costulata Cushman

plummerae Loetterle

Gyroidina alabamensis Sandidge

Pseudotextularia varians Rzehak

Pullenia americana Cushman

Stensiöina americana Cushman

2745-2755 feet

Anomalina pinguis Jennings

Gyroidina globosa (v. Hagenow)

nitida (Reuss)

Heterostomella americana Cushman

2755-2765 feet

Anomalina taylorensis Carsey

Buliminella carseyae Plummer

**Globorotalia membranacea* (Ehrenberg)

Gümbelina costulata Cushman

excolata Cushman

Gyroidina depressa (Alth)

globosa (v. Hagenow)

Marssonella oxycona (Reuss)

Planulina cedarkeysensis Cole

Pseudotextularia varians Rzehak

Reussella cushmani Brotzen

Valvulineria allomorphinoides (Reuss)

DESCRIPTIONS OF CORES (W-440)

1966-1983 feet.—Mottled gray and brownish, slightly crystalline limestone with many scattered grains of glauconite and a few small flakes of lignite; some Foraminifera and shell fragments.

2127-2137 feet.—One fragment of light brown silicified limestone; one fragment of light brown, soft, compact limestone with small lignite streaks.

2137-2142 feet.—Brownish gray, compact, soft limestone with few scattered grains of glauconite.

* Specimens so marked may represent species from the Paleocene occurring as "cavings".

2147-2152 feet.—Brownish gray, compact, semi-crystalline, non-fossiliferous limestone with an occasional grain of glauconite.

2152-2157 feet.—Brownish gray, porous, granular limestone with occasionally streaks which contain numerous dark to light green glauconite grains.

2157-2162 feet.—Mottled tan and gray, hard limestone with occasional small grains of glauconite and molds of fossils.

2162-2175 feet.—Fragment of light brownish gray chert with soft, light brownish gray limestone attached to one side.

2198-2205 feet.—Light brownish gray, porous, crystalline, foraminiferal limestone with an occasional small glauconite grain.

2205-2210 feet.—See 2198-2205 feet.

2288-2293 feet (Core?).—Several fragments of light brownish gray, soft, porous, crystalline limestone.

DESCRIPTIONS OF SPECIES

FAMILY VALVULINIDAE

Subfamily EGGERELLINAE

Genus *LITUONELLA* Schlumberger, 1905

Lituonella floridana Cole

Plate 12, Figures 4, 5

1937. *Lituonella* sp. (?) Cushman, Cont. Cushman Lab. Foram. Res. Sp. Publication No. 8, p. 185, pl. 22, fig. 14.

1941. *Lituonella floridana* Cole, Florida Geol. Survey Bull. 19, p. 23, pl. 3, figs. 14-17; pl. 4, fig. 10; pl. 6, figs. 9-11.

The axial thin section (figure 4, plate 12) of a specimen from the Ravlin-Brown well (W-440) is identical with that of a paratype specimen (see figure 9, plate 6, Florida Geol. Survey Bull. 19) from the Carpenter's Home well (W-448).

First appearance: In the V. G. Philips No. 1 well at a depth of 578-584 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

Genus COSKINOLINA Stache, 1875

Coskinolina floridana Cole

Plate 12, Figures 2, 6, 8

1928. *Coskinolina cookei* Moberg (part), Florida Geol. Survey 19th Ann. Rept., pp. 166-168, pl. 3, fig. 6, (not figs. 1-5, 7-8).
1941. *Coskinolina floridana* Cole, Florida Geol. Survey Bull. 19, pp. 24, 25, pl. 3, figs. 1-7; pl. 4, figs. 1-9; pl. 5, figs. 1-5, 11; pl. 18, fig. 9.
1942. *Coskinolina floridana* Cole. Cole, Florida Geol. Survey Bull. 20, p. 21, pl. 4, figs. 4, 5.

Typical specimens occur, but not in great abundance.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 625-635 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

Genus DICTYOCONUS Blanckenhorn, 1900

Dictyoconus americanus (Cushman)

Plate 12, Figure 3

1919. *Conulites americana* Cushman, Carnegie Inst. Washington Publ. 291, p. 43, text fig. 3.
1942. *Dictyoconus americanus* (Cushman). Cole, Florida Geol. Survey Bull. 20, pp. 21-24, pl. 3, figs. 12, 13; pl. 6, figs. 1-9; pl. 7, figs. 1-5; pl. 16, figs. 14, 15 (references and synonymy).
1944. *Dictyoconus americanus* (Cushman). Cole, Florida Geol. Survey Bull. 26, pp. 36, 37, pl. 4, figs. 1-6; pl. 8, figs. 12, 13; pl. 18, fig. 11.

Entirely typical specimens of this species were recovered. This species has been described and discussed in previous bulletins so that additional remarks are not required.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 516-546 feet; abundant in the next sample at 546-554 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

Dictyoconus cookei (Moberg)

Plate 12, Figures 1, 7, 9

1928. *Coskinolina cookei* Moberg, Florida Geol. Survey 19th Ann. Rept., pp. 166-168, pl. 3, figs. 1-5, 7-8 (not fig. 6).
1941. *Dictyoconus cookei* (Moberg). Cole, Florida Geol. Survey Bull. 19, pp. 26, 27, pl. 3, figs. 11-13; pl. 5, figs. 6-10, 12, 13; pl. 6, figs. 1-8; pl. 18, fig. 12.

1942. *Dictyoconus cookei* (Moberg). Cole, Florida Geol. Survey Bull. 20, pp. 24, 25, pl. 3, fig. 10; pl. 4, fig. 8.

The first sample at 399 feet contained four specimens which the thin sections prove should be assigned to this species. The horizontal plate which subdivides the chambers can be seen distinctly on the right hand side of figure 7, plate 12. Abundant specimens were not found until the sample at 516-546 feet was examined.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 399 feet (first sample); abundant at a depth of 516-546 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

Genus EODICTYOCONUS Cole and Bermudez, 1944

Eodictyoconus cubensis (Cushman and Bermudez)

Plate 12, Figures 10, 11

1936. *Pseudorbitolina cubensis* Cushman and Bermudez, Contrib. Cushman Lab. Foram. Res., vol. 12, p. 59, pl. 10, figs. 27-30.
 1941. *Pseudorbitolina cubensis* Cushman and Bermudez. Cole, Florida Geol. Survey Bull. 19, pp. 22, 23, pl. 2, figs. 5-11.
 1942. *Pseudorbitolina cubensis* Cushman and Bermudez. Cole, *idem.*, Bull. 20, pp. 18, 19, pl. 3, fig. 4; pl. 5, fig. 1.
 1944. *Pseudorbitolina cubensis* Cushman and Bermudez. Cole, *idem.*, Bull. 26, pp. 35, 36, pl. 2, fig. 7; pl. 8, figs. 14, 15; pl. 13, figs. 1, 2.
 1944. *Eodictyoconus cubensis* (Cushman and Bermudez). Cole and Bermudez, Bull. Amer. Pal., vol. 28, No. 113, pp. 6-10, pl. 1, fig. 1; pl. 2, figs. 1-12; pl. 3, figs. 1-5.

The specimens from this well have been compared with topotype specimens from the middle Eocene, Jabaco formation of Cuba, as well as with specimens previously assigned to this species from other Florida wells. There are no significant differences.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 516-546 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

Family MILIOLIDAE

Genus FABULARIA Defrance, 1820

Fabularia vaughani Cole and Ponton

Plate 15, Figure 6; Plate 16, Figures 1-10

1934. *Fabularia vaughani* Cole and Ponton, Amer. Midland Nat., vol. 15, No. 2, pp. 139-141, pl. 1, figs. 1-9.

1937. *Fabularia vaughani* Cole and Ponton. Hanzawa, Jour. Pal., vol. 11, No. 2, pp. 111-113, pl. 20, figs. 1-4. •
1942. *Fabularia vaughani* Cole and Ponton. Cole, Florida Geol. Survey Bull. 20, pp. 25, 26, pl. 3, fig. 14; pl. 15, fig. 1.

At 1757-1768 feet in the V. G. Philips No. 1 well (W-440) a few specimens representing the genus *Fabularia* were recovered, and at 1789-1799 feet, numerous individuals were encountered. To date, the only species of *Fabularia* described from North America is *F. vaughani* Cole and Ponton. Cole and Ponton had specimens assigned to this species from the Southern States Oil Corporation well (W-19) located about one and a half miles north of Monticello, Jefferson County, Florida. Cole and Ponton state

"there occur at 1740 feet (in W-19) specimens of *Fabularia* which appear to be identical to those found in the Jacksonville wells. These specimens are not as well preserved as those from the Jacksonville wells, but apparently exhibit the same characters."

These specimens of *Fabularia* in the Southern States Oil Corporation well (W-19) were associated with *Lepidocyclina ariana* Cole and Ponton and *Asterocyclina monticellensis* Cole and Ponton. As these species occur with the specimens of *Fabularia* in the V. G. Philips No. 1 well (W-440), it was desirable to compare the specimens of *Fabularia* from W-440 with those from W-19, and, then, compare the entire group with specimens from the type locality of *F. vaughani*.

Four poorly preserved specimens were available from the Southern States Oil Corporation well (W-19). One axial (figure 10, plate 16) and two transverse (figures 2, 8, plate 16) thin sections were made from these specimens. One transverse section with a maximum diameter of 1.16 mm. has a nearly spherical central chamber with internal diameters of $320 \times 340 \mu$. This section has 5 biloculine chambers following the central chamber. The other transverse section with a maximum diameter of 0.95 mm. has a subspherical central chamber with internal diameters of $260 \times 320 \mu$. There are 4 biloculine chambers disposed around the central chamber. As these specimens were eroded, the diameter and number of biloculine chambers would be increased in uneroded specimens. The axial section was cut from a specimen with a length of 1.56 mm. and a height of 0.95 mm. Unfortunately, the central chamber was lost in the preparation of this thin sec-

tion. The eroded surface of these specimens exhibited costae with a width of about $60\ \mu$ which anastomose.

Five thin sections were prepared from specimens from the V. G. Philips No. 1 well (W-440). All of these specimens were eroded. Therefore, the measurements given of gross diameters are smaller than those which uneroded specimens would have. Of the two transverse sections available, one has a maximum diameter of 0.98 mm. with a subspherical initial chamber with diameters of $400 \times 460\ \mu$ around which there are 3 biloculine chambers; the other has a maximum diameter of 0.74 mm. with a subspherical initial chamber with diameters of $360 \times 320\ \mu$. This specimen also has three biloculine chambers surrounding the initial chamber. The dimensions of the axial sections follow:

Length - - - - -	1.24 mm.	1.3 mm.	1.4 mm.
Height - - - - -	0.74 mm.	0.93 mm.	0.86 mm.
Diameters of initial chamber -	$240 \times 320\ \mu$	$310 \times 320\ \mu$	$360 \times 440\ \mu$
Number of biloculine chambers	5	5	3

Eroded specimens from the V. G. Philips No. 1 well (W-440) have the same appearance as the specimens from W-19, exhibiting rather heavy, anastomosing costae. The conclusion was reached that the specimens from the Southern States Oil Corporation well (W-19) represent the same species as do those found in the V. G. Philips No. 1 well (W-440). There remains, however, the problem of whether these specimens should be assigned to *F. vaughani*.

In the Cole collection there are five specimens from the well (W-72c) drilled by the Gibbs Dry Dock Company, South Jacksonville, Duval County, Florida. A transverse section with a maximum diameter of 0.94 mm. has 5 biloculine chambers surrounding a central chamber with an internal diameter of $140\ \mu$. A note on this thin section states that it was not ground to the center of the specimen. Therefore, it is probable that only the top portion of the central chamber is shown on this thin section. Another transverse thin section with a maximum diameter of 1.32 mm. has 6^+ biloculine chambers, but the central area is destroyed. The third transverse section is broken, but a portion of this broken section has a maximum diameter of 0.96 mm. with 4 biloculine chambers. The only axial section available has a length of 1.2 mm.

and a height of 0.94 mm. The central chamber has diameters of $140 \times 180 \mu$. There are 6 biloculine chambers exhibited in this specimen.

The uncut specimen from W-72c has a length of 2.76 mm., a width of 1.5 mm. and a height of 1.7 mm. Anastomosing costae with widths from 60 to 80μ are present.

The specimens from the Jacksonville wells (type specimens) apparently have a smaller central chamber, at least, in those examined to date. Many specimens from the Jacksonville wells have a greater size than any recovered from W-19 or W-440. But, in no other significant manner do the three lots of specimens differ. Therefore, they are all assigned to the same species.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1757-1768 feet; abundant at a depth of 1789-1799 feet.

Occurrence: Middle Eocene, Lisbon formation.

Family CAMERINIDAE

Subfamily CAMERININAE

Genus CAMERINA Brugière, 1792

Camerina jacksonensis Gravell and Hanna

Plate 13, Figures 3-6

1935. *Camerina jacksonensis* Gravell and Hanna, Jour. Pal., vol. 9, No. 4, p. 331, pl. 29, figs. 1-5, 7, 8, 10, 11, 13, 14.
 1939. *Camerina jacksonensis* Gravell and Hanna. Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, p. 324, pl. 13, fig. 6; pl. 20, fig. 8; pl. 22, fig. 9.
 1942. *Camerina jacksonensis* Gravell and Hanna. Cole, Florida Geol. Survey Bull. 20, pp. 26, 27, pl. 8, figs. 3-5.

Test small, lenticular, some specimens with a very narrow flange, others without this feature, completely involute; surface ornamentation consists of a group of beads of clear shell material. The beads have a diameter of about 100μ and are raised above the surface of the test. These beads are radially arranged from the apex of the test and normally do not occur on the flange.

The septa are oblique and gently recurved at their distal ends. Transverse sections show a strongly developed axial

plug which has a surface diameter of 140 to 200 μ . On certain transverse sections the surface beads may be observed projecting above and penetrating into the shell wall (figure 5, plate 13).

Measurements of two transverse and one median section follow:

Height	- - - -	1.96+ mm.	1.46 mm.	1.84 mm.
Width	- - - -	-----	-----	1.6 mm.
Thickness	- - -	0.72 mm.	0.56 mm.	-----
Number of whorls	-	-----	-----	3 1/2
Number of chambers in the last volution	-----	-----	-----	21
Internal diameter of the initial chamber	30 μ	80 μ	80 μ	

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1015-1016 feet.

Occurrence: Ocala limestone.

Camerina moodybranchensis Gravell and Hanna

Plate 13, Figures 2, 7-9, 12

1935. *Camerina moodybranchensis* Gravell and Hanna, Jour. Pal., vol. 9, No. 4, p. 332, pl. 29, figs. 15, 22-24.
 1939. *Camerina moodybranchensis* Gravell and Hanna. Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 323, 324, pl. 13, fig. 5; pl. 20, fig. 2; pl. 22, fig. 2.
 1941. *Camerina moodybranchensis* Gravell and Hanna. Cole, Florida Geol. Survey Bull. 19, p. 28, pl. 9, fig. 9; pl. 11, figs. 9-15.
 1942. *Camerina moodybranchensis* Gravell and Hanna. Cole, Florida Geol. Survey Bull. 20, p. 27, pl. 8, figs. 6-8.

Test small, completely involute, lenticular in cross section with a rather sharp periphery. Uneroded specimens are without ornamentation except for a mass of clear shell material over the poles. Slightly eroded specimens show raised septa which are straight and radial from the central boss. The dimension of the four uncut specimens illustrated on plate 13, figure 2 follow:

Height	- -	1.7 mm.	1.5 mm.	1.7 mm.	1.7 mm.
Width	- -	1.5 mm.	1.3 mm.	1.5 mm.	1.7 mm.
Thickness	-	1.0 mm.	0.8 mm.	0.8 mm.	1.0 mm.

Median sections show the tight coiling with very gradual expansion of the whorls. The septa are oblique and are very

slightly recurved at their distal ends. Transverse sections show a very prominent wedge-shaped plug of darker material on each side of the initial chambers. The distal end of this mass of shell material forms the polar boss observed on the exterior of the test. The dimensions of four thin sections follow:

TABLE 6
Measurements of *Camerina moodybranchensis*

	TRANSVERSE SECTIONS		MEDIAN SECTIONS	
	1.8+ mm.	1.9+ mm.	1.54 mm.	1.6 mm.
Height	—	—	1.6 mm.	1.56 mm.
Width	—	—	—	—
Thickness	0.84 mm.	0.84 mm.	—	—
Number of whorls	—	—	4	4
Number of chambers in the final volution	—	—	19	20
Internal diameter of the initial chamber	80 μ	60 μ	70 μ	60 μ
Thickness of the outer wall of the test	60-100 μ	40-100 μ	100 μ	60-80 μ
Surface diameter of axial plug	300 μ	300-340 μ	—	—

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 945-955 feet.

Occurrence: Ocala limestone.

Camerina vanderstoki (Rutten and Vermunt)

Plate 13, Figure 1; Plate 15, Figures 11, 12

1932. *Nummulites vanderstoki* Rutten and Vermunt, Kon. Akad. Wetensch. Amsterdam Proc., vol. 35, p. 240, pl. 1, fig. 8; pl. 2, figs. 6, 12.
1939. *Camerina vanderstoki* (Rutten and Vermunt). Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 322, 323, pl. 13, fig. 7; pl. 18, fig. 3; pl. 22, figs. 10-12.
1941. *Camerina vanderstoki* (Rutten and Vermunt). Cole, Florida Geol. Survey Bull. 19, pp. 28, 29, pl. 8, figs. 2-10.

1942. *Camerina vanderstoki* (Rutten and Vermunt). Cole, Florida Geol. Survey Bull. 20, pp. 27, 28, pl. 3, fig. 8; pl. 8, figs. 1, 2, 9, 10.

Numerous thick walled camerinids were found in the sample at 745-755 feet. These specimens represent one species and are identical with specimens which have been assigned to this species from other Florida wells. An accidental median section of a specimen which has a width of 1.6 mm. and a height of 1.8 mm. reveals $3\frac{1}{2}$ whorls with 22 chambers in the final volution. Two transverse sections were made one of which has a height of 2.5^+ mm. and a thickness through the center of 1.4 mm., the other has a height of 1.7^+ mm. and a thickness of 1.0 mm. The initial chamber has a diameter of $80\ \mu$ in one specimen and a diameter of $120\ \mu$ in another.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 745-755 feet.

Occurrence: Ocala limestone.

Genus OPERCULINOIDES Hanzawa, 1935

Operculinoides cookei (Cushman)

Plate 15, Figure 13

1921. *Operculina cookei* Cushman, U. S. Geol. Survey Prof. Paper 128, pp. 127-128, pl. 18, figs. 1, 2.

There was recovered only one specimen which may represent this species. The test of this specimen is more delicate than that of the specimens assigned to *O. vaughani* and the chamber walls have a stronger recurvature as they approach the periphery. The measurements of this specimen follow:

Height	- - - - -	4.6 mm.
Width	- - - - -	2.8 mm.
Coils	- - - - -	$2\frac{1}{2}$
Number of chambers in final volution	-	21
Internal diameter of initial chamber	-	$120\ \mu$

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1018-1030 feet.

Occurrence: Ocala limestone.

Operculinoides vaughani (Cushman)

Plate 16, Figures 11-13

1921. *Operculina vaughani* Cushman, U. S. Geol. Survey Prof. Paper 128-E, p. 128, pl. 19, figs. 6, 7.

1924. *Operculina vaughani* Cushman. Vaughan, Geol. Soc. Amer. Bull. vol. 35, No. 4, p. 788.
1933. *Operculina oliveri* Cushman. Ellisor, Amer. Assoc. Petrol. Geol. Bull., vol. 17, No. 11, pp. 1299, 1301, pl. 2, fig. 15 (*not Operculina oliveri* Cushman, 1925).
1935. *Operculina vaughani* Cushman. Cushman, U. S. Geol. Survey Prof. Paper 181, pp. 32, 33.
1935. *Operculina vaughani* Cushman. Gravell and Hanna, Jour. Pal., vol. 9, No. 4, p. 334, pl. 29, figs. 6, 9, 12, 16-21.

Test medium size, very thin, complanate. The height of the specimen illustrated by figure 12, plate 16, is 4.4 mm. and the width is 3.3 mm. The test consists of a rapidly expanding spire which starts from a low, eccentrically located dome. The sutures are raised and radiate from a large, protuberant mass of shell material which is located at the apex of the low, eccentrically situated, domed portion of the test. The interseptal areas are long, narrow, depressed and without ornamentation. The sutures are beaded at their proximal ends and there is a tendency to bead along their entire length. The sutures indicate that the last whorl would have 21 chambers.

Two additional specimens which are similar to the one described above were available. These specimens were sectioned. The salient measurements from these thin sections follow:

	TRANSVERSE SECTION	HORIZONTAL SECTION
Height - - - - -	4.3+ mm.	3.4+ mm.
Width - - - - -	-----	2.8+ mm.
Thickness - - - - -	0.78 mm.	-----
Number of coils - - - - -	-----	3 $\frac{1}{8}$
Number of chambers in final volution	-----	24
Internal diameter of initial chamber	140 μ	140 μ

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1018-1030 feet.

Occurrence: Ocala limestone.

Gravell and Hanna have made a very complete study of specimens assigned to this species from the Moody's Branch marl of Texas, Louisiana, and Mississippi. The specimens from the V. G. Philips No. 1 well (W-440) are very similar to the specimens described and illustrated by Gravell and Hanna.

Barker⁶⁰ has referred certain Mexican specimens to *O. vaughani*, but his illustrations show that these specimens are the same as those which Cole⁶¹ described as *O. cushmani*. In this same article Barker⁶² places *O. cushmani* in the synonymy of *O. oliveri*. *O. cushmani* is a much smaller species than *O. oliveri*, the spire does not expand as rapidly in *O. cushmani* as it does in *O. oliveri* and the beading of the sutures is more continuous in *O. cushmani*. *O. cushmani* differs from *O. vaughani* in its smaller size, less rapidly expanding spire, and the fact that its sutures are not as strongly raised, but they are more beaded.

Operculinoides willcoxi (Heilprin)

Plate 13, Figures 10, 11, 13, 14; Plate 15, Figure 7

- 1882. *Nummulites willcoxi* Heilprin, Proc. Nat. Acad. Sci. Philadelphia, vol. 34, p. 191, text figs. 1, 2.
- 1884. *Nummulites willcoxi* Heilprin, *idem*, vol. 36, pp. 321-322, text figs. 1, 2.
- 1921. *Operculina willcoxi* (Heilprin). Cushman, U. S. Geol. Survey Prof. Paper 128-E, pp. 129, 130, pl. 20, figs. 9-11.
- 1928. *Operculinella willcoxi* (Heilprin). Vaughan, Florida Geol. Survey 19th Ann. Rept., p. 158.
- 1935. *Operculinoides willcoxi* (Heilprin). Hanzawa, Sci. Rept. Tohoku Imp. Univ., ser. 2 (Geol.), vol. 18, No. 1, p. 18.
- 1939. *Operculinoides willcoxi* (Heilprin). Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 309, 310, pl. 13, fig. 3; pl. 16, fig. 1; pl. 21, fig. 13.
- 1941. *Operculinoides willcoxi* (Heilprin). Cole, Florida Geol. Survey Bull. 19, p. 32, pl. 9, figs. 1-7.

Test of medium size, completely involute, compressed, thickest through the poles, then sloping very gently toward the bluntly rounded periphery. Surface entirely unornamented except for a small knob of clear shell material over the poles. This boss is about 0.2 mm. in diameter and projects very slightly above the surface of the test. Septal sutures can be observed on some specimens by wetting the surface of the test. Such sutures are made of clear shell material. They extend from the central boss to the periphery of the test and

⁶⁰ Barker, R. Wright, Species of the Foraminiferal Family Camerinidae in the Tertiary and Cretaceous of Mexico, Proc. U. S. Nat. Mus., vol. 86, No. 3052, p. 319, pl. 11, figs. 2, 3, 1939.

⁶¹ Cole, W. Storrs, A Foraminiferal Fauna from the Guayabal Formation in Mexico, Bull. Amer. Pal., vol. 14, No. 51, p. 23, pl. 2, fig. 14.

⁶² *Op. cit.*, p. 318.

are gently sigmoid. The dimensions of the specimens (figure 14, plate 13) illustrated to show the external features follow:

Specimen number	1	2	3	4
Height - - - -	2.6 mm.	2.4 mm.	2.5 mm.	2.5 mm.
Width - - - -	2.3 mm.	2.4 mm.	2.3 mm.	2.2 mm.
Thickness - - - -	0.9 mm.	0.7 mm.	0.8 mm.	0.9 mm.

The septa are slightly oblique for about half their length, then recurve gently. The coils expand slowly and regularly. Accurately oriented transverse sections show a small axial plug of darker shell material which represents the inward continuation of the polar boss. This does not extend to the center of the test. Various measurements of two transverse and two median sections follow:

TABLE 7
Measurements of *Operculinoides willcoxi*

	TRANSVERSE SECTIONS		MEDIAN SECTIONS	
Height	2.8+ mm.	2.7 mm.	3.0 mm.	2.6 mm.
Width	—	—	2.7 mm.	2.3 mm.
Thickness	0.8 mm.	0.82 mm.	—	—
Number of whorls	—	—	4¾	4½
Number of chambers in final volution	—	—	25	25
Internal diameter of initial chamber	90 μ	60 μ	60 μ	100 μ
Thickness of outer wall of the test	50-100 μ	40-100 μ	40-80 μ	80-90 μ

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 975-985 feet.

Occurrence: Ocala limestone.

GENUS OPERCULINA d'Orbigny, 1826

Operculina barkeri Vaughan and Cole

Plate 14, Figures 6-13

1936. *Operculina tuberculata* Vaughan and Cole, Proc. U. S. Nat. Mus., vol. 83, No. 2996, pp. 488, 489, pl. 35, figs. 1-4.

1939. *Operculinoides tuberculatus* (Vaughan and Cole). Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 319, 320, pl. 14, figs. 3, 5; pl. 20, figs. 9, 11.
1939. *Operculina barkeri* Vaughan and Cole, Jour. Pal., vol. 13, No. 5, p. 538 (new name for *O. tuberculata* Vaughan and Cole preoccupied by *O. costata* d'Orbigny, var. *tuberculata* Douvillé, 1911).

Test small, compressed, thin, with a slight peripheral keel. The poles of the test are covered normally with a large tubercle which has a diameter of about 0.2 mm. The central tubercle is surrounded by a group of small beads which have diameters of about 0.1 mm. Toward the apertural end of the test there are raised, granulated costae which are the external expression of the septa. The surface of the test is covered almost entirely by the central beaded area or the costal granulations so that very little smooth area remains.

Median sections show that the septa are straight and radial for about three-fourths their length, then they are strongly recurved.

The dimensions, septal sutures, whorls, and initial chambers are given in Table 8.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 985-995 feet.

Occurrence: Ocala limestone.

DISCUSSION.—*O. barkeri* resembles *O. mariannensis* Vaughan⁶³ in that they are both small, thin, compressed forms with well developed surface granules. The external appearance of *O. mariannensis* is illustrated (plate 14, figure 1) and 3 median and a transverse section are presented (plate 14, figures 2-5) for comparison with the illustrations of *O. barkeri*.

⁶³ Vaughan, T. Wayland, New Species of *Operculina* and *Discocyclina* from the Ocala Limestone, Florida Geol. Survey 19th Ann. Rept., p. 158, pl. 1, figs. 1-4, 1928.

TABLE 8
Measurements of *Operculina barkeri*

	MEDIAN SECTIONS				TRANSVERSE SECTIONS	
	2.2 mm.	2.0 mm.	1.6 mm.	1.82 mm.	1.72 mm.	1.26 mm.
Height	2.2 mm.	2.0 mm.	1.6 mm.	1.82 mm.	1.72 mm.	1.26 mm.
Width	1.9 mm.	1.6 mm.	1.26 mm.	—	—	—
Thickness including central tubercles	—	—	—	—	0.6 mm.	0.6 mm.
Thickness without central tubercles	—	—	—	—	0.4 mm.	0.4 mm.
Number of whorls	3 1/2	2 3/4	2 1/2	2 3/4	—	—
Chambers in the final volution	19	15	14	15	—	—
Internal diameter of initial chamber	45 μ	60 μ	40 μ	40 μ	60 μ	55 μ

In external appearance *O. mariannensis* differs from *O. barkeri* in the greater area of the test which is free from granules. In *O. mariannensis* the group of beads over the poles is not as prominent and there is a larger space between the granulated costae.

The measurements of three median and one transverse section of *O. mariannensis* follow:

TABLE 9
Measurements of *Operculina mariannensis*

	MEDIAN SECTIONS			TRANSVERSE SECTION
Height	1.5 mm.	1.6 mm.	1.66 mm.	1.94 mm.
Width	1.22 mm.	1.26 mm.	1.5 mm.	—
Thickness	—	—	—	0.22 mm.
Number of whorls	2½	2½	2¾	—
Chambers in the final volution	12	9	13	—
Internal diameter of initial chamber	40 μ	55 μ	30 μ	35 μ

O. barkeri has been reported from Mexico in the Tanto-yuca formation which is believed to be the equivalent of the Jackson Eocene of the Gulf Coast of the United States. In the well under consideration *O. barkeri* occurs in the upper Eocene well below the top. *O. mariannensis* is known only from the Ocala.

Genus HETEROSTEGINA d'Orbigny, 1826

Heterostegina texana Gravell and Hanna

Plate 15, Figures 9, 10

1937. *Heterostegina texana* Gravell and Hanna, Jour. Pal., vol. 11, No. 6, pp. 525, 526, pl. 63, figs. 1-9.

1944. *Heterostegina texana* Gravell and Hanna. Cole, Florida Geol. Survey Bull. 26, p. 52, pl. 6, figs. 7-9 (references).

Several small specimens were recovered. The surface of these specimens had been smoothed by erosion so that the

surface ornamentation had been destroyed. The measurements of three specimens follow:

Height - - - - -	1.6 mm.	1.48 mm.	1.36 mm.
Width - - - - -	1.4 mm.	1.32 mm.	-----
Thickness - - - - -	-----	-----	0.58 mm.
Number of coils - - - -	3 1/2	2 3/4	-----
Diameter of initial chamber -	70 μ	80 μ	-----
Number of undivided chambers	6	3	-----

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 399 feet (the first sample).

Occurrence: Oligocene.

FAMILY ROTALIIDAE

Subfamily ROTALIINAE

Genus CAMAGUEYIA Cole and Bermudez, 1944

Camagueyia perplexa Cole and Bermudez

Plate 15, Figure 4

1944. *Camagueyia perplexa* Cole and Bermudez, Bull. Amer. Pal., vol. 28, No. 113, pp. 5, 6, pl. 1, figs. 2, 3.

Only one specimen was recovered. This specimen was compared with the type specimens from Cuba. There are certain slight differences, but many of the features are very similar.

In a recent letter,⁶⁴ L. M. Davies expressed the opinion that the genus *Camagueyia* is related to the genus *Sakesaria*. Re-examination of the type specimens has convinced the writer that Davies is correct. The forms have hyaline, finely perforate walls rather than finely arenaceous as stated in the original description.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1757-1768 feet.

Occurrence: Middle Eocene, Lisbon formation.

FAMILY ORBITOIDIDAE Schubert

Subfamily ORBITOIDINAE Prever

Genus LEPIDOCYCLINA Gumbel, 1870

Subgenus PLIOLEPIDINA Douvillé, 1915

Lepidocyclina (Pliolepidina) ariana Cole and Ponton

Plate 15, Figures 1-3; Plate 17, Figures 1-6; Plate 22, Figures 9-14

1934. *Lepidocyclina (Lepidocyclina) ariana* Cole and Ponton, Amer. Midland Nat., vol. 15, pp. 142, 143, pl. 2, figs. 1-5.

⁶⁴ Letter dated July 7, 1944.

1940. *Lepidocyclina* (*Lepidocyclina*) *claibornensis* Gravell and Hanna, Jour. Pal., vol. 14, No. 5, pp. 414-416, pl. 57, figs. 12-18.
1944. *Lepidocyclina* (*Pliolepidina*) *ariana* Cole and Ponton. Cole, Florida Geol. Survey Bull. 26, pp. 61, 62, pl. 1, fig. 14; pl. 13, fig. 3; pl. 14, figs. 1-7; pl. 16, figs. 11-13; pl. 17, fig. 13.

Numerous thin sections were made from beautifully preserved and abundant specimens of *Lepidocyclina* encountered at 1809-1819 feet in the V. G. Philips No. 1 well (W-440). From this depth two horizontal sections (figures 4, 5, plate 17) and three vertical sections (figures 1-3, plate 17) are illustrated. In the Florida Geological Survey Bulletin 26 two vertical sections (figures 1, 2, plate 14) made from topotype specimens were presented to supplement the illustrations of the type description. On plate 17, figure 6 there is given in this bulletin a horizontal section made from a specimen from the type lot.

Specimens which are not so well preserved, but representing this species, were found at 1757-1768 feet.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1757-1768 feet; abundant at a depth of 1809-1819 feet; at 399 feet as reworked specimens.

Occurrence: Middle Eocene, Lisbon formation; and Oligocene, reworked from middle Eocene.

Numerous specimens of *Lepidocyclina* representing a single species occur in the V. G. Philips No. 1 well (W-440) at a depth of 399 feet. These specimens occur in association with *Dictyoconus cookei* (Moberg) and a species of *Heterostegina* which has been identified as *H. texana* Gravell and Hanna. Three vertical sections (figures 9-11, plate 22) and three horizontal sections (figures 12-14, plate 22) made from these specimens of *Lepidocyclina* are illustrated and measurements of four vertical sections and five horizontal sections are given in tables 10 and 11.

The internal features of these specimens are very similar to others which have been assigned to *L. ariana* Cole and Ponton.⁶⁵ Gravell and Hanna⁶⁶ created the specific name *claiborn-*

⁶⁵ Cole, W. Storrs, Stratigraphic and Paleontologic Studies of Wells in Florida—No. 3, Florida Geol. Survey Bull. 26, pp. 61, 62, pl. 1, fig. 14; pl. 13, fig. 3; pl. 14, figs. 1-7; pl. 16, figs. 11-13; pl. 17, fig. 13, 1944.

⁶⁶ Gravell, Donald W. and Hanna, Marcus A., New Larger Foraminifera from the Claiborne of Mississippi, Jour. Pal., vol. 14, No. 5, pp. 414-416, pl. 57, figs. 12-18, 1940.

ensis for certain specimens from the Cook Mountain formation (Claiborne Eocene) of George County, Mississippi. The differences between *L. ariana* and *L. claibornensis* are slight as Gravell and Hanna indicate. Cole in studying a large suite of specimens from the Hilliard Turpentine Company No. 1 well (W-336) concluded that the degree of variation between individuals in a single lot of specimens was sufficiently great to justify combining the two species under a single name.

TABLE 10

Measurements of vertical sections of *Lepidocyclina ariana*

Diameter	2.34 mm.	2.3 mm.	2.2 mm.	2.8 mm.
Thickness	0.88 mm.	1.0 mm.	1.3 mm.	0.92 mm.
Number of lateral chambers on each side of the equatorial layer	3	6	6	4-5
Embryonic chambers:				
Internal length	580 μ	440 μ	700 μ	800 μ
Internal height	500 μ	340 μ	520 μ	400 μ
Thickness surrounding wall	40 μ	40 μ	30-60 μ	40 μ
Height of equatorial layer (including floor and roof):				
At center	200 μ	140 μ	220 μ	160 μ
At periphery	200 μ	160 μ	200 μ	180 μ
* Lateral chambers:				
Internal length	120-160 μ	200 μ	100-160 μ	140-180 μ
Internal height	20 μ	5 μ	10-20 μ	20-30 μ
Thickness of floors and roofs	20 μ	50-60 μ	60-80 μ	40 μ
Surface diameter of pillars	none	140-200 μ	100-120 μ	weakly developed

* At periphery and directly over embryonic chambers.

TABLE 11
Measurements of horizontal sections of *Lepidocyclina ariana*

Diameter	2.34 mm.	1.54 mm.	2.3 mm.	2.3 mm.	1.9 mm.
Embryonic chambers: *Length across both chambers	740 μ	700 μ	580 μ	600 μ	540 μ
Diameters of initial chamber	—	420x600 μ	160x420 μ	280x600 μ	320x540 μ
Diameters of second chamber	—	300x700 μ	360x460 μ	300x540 μ	200x600 μ
Width of bounding wall	40 μ	40-50 μ	60 μ	60 μ	40 μ
Diameters of equatorial chambers near periphery					
Radial	60-80 μ	60-100 μ	60 μ	60 μ	60-80 μ
Tangential	80-100 μ	60-120 μ	80 μ	80 μ	60-80 μ

* Internal measurements.

The specimen illustrated by figure 11, plate 22 of this bulletin is very similar in all its features to the one shown by figure 4, plate 14 in Bulletin 26. The specimen with the thick floors and roofs and appressed lateral chamber cavities (figure 10, plate 22) resembles the specimen illustrated by figure 7, plate 14 in Bulletin 26. The horizontal sections (figures 12-14, plate 22) should be compared with those made from specimens from the Hilliard Turpentine Company No. 1 well (W-336) (figures 11-13, plate 16, Bull. 26*).

Moreover, it should be noted again that *L. (Pliolepidina) ariana* is similar in many of its internal features to *L. (Pliolepidina) macdonaldi* Cushman. Although the writer believes that *ariana* can be separated from *macdonaldi* in our present state of knowledge, the two species are very closely related. Detailed study in the future may demonstrate that such a separation is artificial.

Lepidocyclina (Pliolepidina) cedarkeysensis Cole

Plate 15, Figure 8; Plate 18, Figures 1-6

1942. *Lepidocyclina (Pliolepidina) cedarkeysensis* Cole, Florida Geol. Survey Bull. 20, pp. 43-45, pl. 3, figs. 1, 2; pl. 8, fig. 11; pl. 11, figs. 6, 7; pl. 12, figs. 1-7.
1944. *Lepidocyclina (Pliolepidina) cedarkeysensis* Cole. Cole, Florida Geol. Survey Bull. 26, p. 62, pl. 7, figs. 16, 17, 22.

The specimens from the V. G. Philips No. 1 well (W-440) assigned to this species have slightly thicker tests in proportion to the diameter than the type specimens do. The pillars are better developed and heavier in the specimens under consideration than those from the Suwannee Petroleum Corporation's Sholtz No. 1 well (W-166). Measurements of 8 thin sections of megalospheric individuals are given in table 12 and 13.

One horizontal and two vertical thin sections of specimens assigned to this species from the Hilliard Turpentine Company well No. 1 (W-336) were illustrated in the Florida Geological Survey Bulletin 26. These specimens possess rather heavy pillars and appressed lateral chambers. If the specimens from the three wells are considered, they show complete

* Note: The enlargement given for this plate in Bulletin 26 is given x 40, but it should be x 20.

TABLE 12
Measurements of vertical sections of *Lepidocyclina cedarkeysensis*

SPECIMEN NUMBER	1	2	3	4	5
Diameter	1.98 mm.	1.84 mm.	2.16 mm.	2.1 mm.	1.84 mm.
Thickness	1.2 mm.	0.96 mm.	1.02 mm.	0.9 mm.	1.1 mm.
Number lateral chambers on each side of equatorial layer	8	7	8	7	7
*Height of embryonic chambers	180 μ	160 μ	140 μ	140 μ	180 μ
Height of equatorial layer:					
At center	40 μ	40 μ	40 μ	40 μ	40 μ
At periphery	80 μ	60 μ	60 μ	60 μ	60 μ
Length of lateral chambers	120-160 μ	120-180 μ	140 μ	80-140 μ	100-140 μ
Height of lateral chambers	30-35 μ	20-30 μ	20 μ	30 μ	20 μ
Thickness of roofs and floors of lateral chambers	20-25 μ	20-40 μ	30 μ	30 μ	40 μ
Surface diameter of pillars	100-220 μ	140-200 μ	200-300 μ	40-240 μ	300 μ

* Internal measurements.

intergradation. There are no features which would serve to separate one from the other.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 665-675 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

TABLE 13

Measurements of horizontal sections of *Lepidocyclus cedarkeysensis*

SPECIMEN NUMBER	1	2	3
Diameter	1.78 mm.	1.74 mm.	1.6 mm.
*Length across both embryonic chambers	260 μ	260 μ	200 μ
*Diameters of initial chamber	120x220 μ	130x160 μ	100x140 μ
*Diameters of second chamber	140x200 μ	130x160 μ	100x160 μ
Thickness of bounding wall of embryonic chambers	20 μ	25 μ	20 μ
Diameters of equatorial chambers near the periphery:			
Radial	40 μ	50 μ	60 μ
Tangential	40 μ	40 μ	40 μ

* Internal measurements.

Lepidocyclus (Plielepidina) macdonaldi Cushman

Plate 19, Figures 1-13

1918. *Lepidocyclus macdonaldi* Cushman, U. S. Nat. Mus. Bull. 103, p. 94, pl. 40, figs. 1-6.
1928. *Lepidocyclus (Lepidocyclus) macdonaldi* Cushman. Vaughan, Jour. Pal., vol. 1, No. 4, pp. 288, 289.
1933. *Lepidocyclus (Lepidocyclus) macdonaldi* Cushman. Gravel, Smithsonian Miscell. Coll., vol. 89, No. 11, pp. 25, 26, pl. 5, figs. 1-3.
1941. *Lepidocyclus (Plielepidina) macdonaldi* Cushman. Vaughan and Cole, Geol. Soc. Amer. Sp. Paper No. 30, p. 67, pl. 31, figs. 1, 2.

This species is characterized in vertical section by having slit-like lateral chambers between thick roofs and floors. Pillars are present, but irregularly distributed. The horizontal sections exhibit two subequal embryonic chambers with normally two peribryonic chambers and equatorial chambers with curved outer walls and pointed or truncate inner ends.

The specimens from the V. G. Philips No. 1 well (W-440) were compared with topotype material from U. S. G. S. locality 6523, 2 miles north of David, Panama Canal Zone loaned by Dr. Lloyd Henbest of the U. S. National Museum. One of these specimens (from slide No. 3) is illustrated (figure 1, plate 19) for comparison with the Florida specimens. Measurements of this specimen are given in table 14 as well as the dimension of the Florida specimens assigned to this species.

The specimens from Panama normally have a narrow encircling rim which is composed of equatorial chambers which are not covered by lateral chambers. This feature was not found in the Florida specimens, but as most of these showed definite traces of erosion, it might be expected that such a fragile portion of the test would be lost. In all other aspects the Florida specimens were identical to the topotypes studied. As Vaughan and Cole⁰⁷ have published a satisfactory illustration of a horizontal section of a topotype specimen, no such section is given here, but the horizontal sections of the Florida specimens should be compared with the one given by Vaughan and Cole.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 546-554 feet.

Occurrence: Oligocene, reworked from the middle Eocene.

⁰⁷ Vaughan, T. Wayland and Cole, W. Storrs, Preliminary Report on the Cretaceous and Tertiary Larger Foraminifera of Trinidad, British West Indies, Geol. Soc. Amer. S. Paper No. 30, p. 67, pl. 31, figs. 1, 2, 1941.

TABLE 14
Measurements of vertical sections of *Lepidocyclina macdonaldi*

Locality	U. S. G. S. 6523	W-440 546-554'	W-440 546-554'	W-440 546-554'	W-440 546-554'	W-440 574-584'
Diameter	4.5+ mm.	2.64 mm.	3.0 mm.	3.0+ mm.	3.86 mm.	3.06 mm.
Thickness	0.84 mm.	0.9 mm.	0.7 mm.	0.9 mm.	1.2 mm.	0.96 mm.
Number of lateral chambers on each side of equatorial layer	6	5	5	6	6-7	5
Embryonic chambers:						
Internal length	0.48 mm.	0.46 mm.	0.34 mm.	0.42 mm.	0.46 mm.	0.58 mm.
Internal height	0.3 mm.	0.38 mm.	0.31 mm.	0.3 mm.	0.28 mm.	0.44 mm.
Thickness of surround- ing wall	20-40 μ	20-40 μ	20-35 μ	25-40 μ	25-55 μ	30-40 μ
Height of equatorial layer (including floor and roof):						
At center	140 μ	180 μ	160 μ	140 μ	140 μ	140 μ
At periphery	240 μ	200 μ	180 μ	180 μ	200 μ	180 μ
*Lateral chambers:						
Internal length	120-200 μ	80-120 μ	80-100 μ	80-120 μ	80-160 μ	80-100 μ
Internal height	10 μ	10-20 μ	10-20 μ	20-30 μ	20-30 μ	5-10 μ
Thickness of floors and roofs	25-40 μ	30-60 μ	20-40 μ	20-40 μ	40-60 μ	20-50 μ
Surface diameter of pillars	60-140 μ	120 μ	100 μ	100-140 μ	120-180 μ	90-160 μ

* At periphery and directly over embryonic chambers.

TABLE 15

Measurements of horizontal sections of *Lepidocyclus macdonaldi*

Locality	W-440 546-554'	W-440 546-554'	W-440 574-584'	W-440 546-554'
Diameter	3.2 mm.	3.0 mm.	3.2 mm.	2.5 mm.
Embryonic chambers: *Length across both chambers	0.54 mm.	0.5 mm.	0.5 mm.	0.4 mm.
Diameters of initial chamber	300x520 μ	340x420 μ	480x520 μ	180x540 μ
Diameters of second chamber	220x560 μ	160x360 μ	180x380 μ	200x480 μ
Width of bounding wall	20-30 μ	30 μ	40 μ	20-40 μ
Diameters of equatorial chambers near peri- phery:				
Radial	60-80 μ	60 μ	50-60 μ	60-80 μ
Tangential	80-100 μ	80 μ	80 μ	80 μ

* Internal measurements.

Subgenus LEPIDOCYCLINA Gumbel, 1870
Lepidocyclus (Lepidocyclus) mortoni Cushman

Plate 20, Figures 1-12

1920. *Lepidocyclus mortoni* Cushman, U. S. Geol. Survey Prof. Paper 125, pp. 70, 71, pl. 27, figs. 1-4; pl. 28, figs. 1-3.
1935. *Lepidocyclus (Lepidocyclus) mortoni* Cushman. Gravell and Hanna, Jour. Pal., vol. 9, No. 4, pp. 337-339, pl. 30, figs. 1-9; pl. 31, figs. 1-11; pl. 32, figs. 1-4 (references).
1941. *Lepidocyclus (Lepidocyclus) mortoni* Cushman. Cole, Florida Geol. Survey Bull. 19, p. 41, pl. 15, figs. 9-13; pl. 16, figs. 11, 12, 14; pl. 18, figs. 13, 14.
1944. *Lepidocyclus (Lepidocyclus) mortoni* Cushman. Cole, Florida Geol. Survey Bull. 26, p. 71, pl. 8, fig. 6; pl. 16, figs. 3, 10.

At 995-1005 feet in the V. G. Philips No. 1 well (W-440) numerous fragments of a thin, fragile species of *Lepidocyclus* were observed. At 1016-1017 feet specimens which were sufficiently entire to make thin sections were encountered. Meas-

TABLE 16
Measurements of transverse sections of *Lepidocyclina mortoni*

	MEGALOSPHERIC FORM		MICROSPHERIC FORM
Diameter	3.6+ mm.	2.7+ mm.	4.2+ mm.
Thickness	0.92 mm.	0.76 mm.	0.72 mm.
Number of lateral chambers on each side of equatorial layer	3-4	3	7
Embryonic chambers:			
Internal length	1100 μ	640 μ	—
Internal height	400 μ	300 μ	—
Thickness surrounding wall	20 μ	20-30 μ	—
Height of equatorial layer (including floor and roof):			
At center	240 μ	220 μ	100 μ
At periphery	—	—	180 μ
*Lateral chambers:			
Internal length	60-120 μ	100-120 μ	100-200 μ
Internal height	10-20 μ	20 μ	20 μ
Thickness of floors and roofs	20-25 μ	30 μ	20-40 μ
Surface diameter of pillars	100 μ	80-100 μ	100 μ

* At periphery and directly over embryonic chambers.

urements were made of certain of the thin sections. These are given in tables 16 and 17.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 995-1005 feet as fragments; specimens satisfactory for thin sections at 1016-1017 feet.

Occurrence: Ocala limestone.

TABLE 17

Measurements of horizontal section of *Lepidocyclina mortoni*

Diameter	3.5 mm.
Embryonic chambers:	
*Length across both chambers	480 μ
Diameters of initial chamber	280x460 μ
Diameters of second chamber	180x360 μ
Width of bounding wall	20 μ
Diameters of equatorial chambers:	
Radial	60-100 μ
Tangential	80-100 μ

* Internal measurements.

FAMILY DISCOCYCLINIDAE Tan

Genus DISCOCYCLINA Gümbel, 1870

Subgenus ASTEROCYCLINA Gümbel, 1870

Discocyclina (Asterocyclina) monticellensis Cole and Ponton

Plate 21, Figures 1-13

1934. *Discocyclina (Asterocyclina) monticellensis* Cole and Ponton, Amer. Midland Nat., vol. 15, No. 2, pp. 141, 142, pl. 2, figs. 6-11.
1944. *Discocyclina (Asterocyclina) monticellensis* Cole and Ponton. Cole, Florida Geol. Survey Bull. 26, pp. 76-79, pl. 1, fig. 8; pl. 2, fig. 11; pl. 8, fig. 23; pl. 13, fig. 5; pl. 23, figs. 1-12.

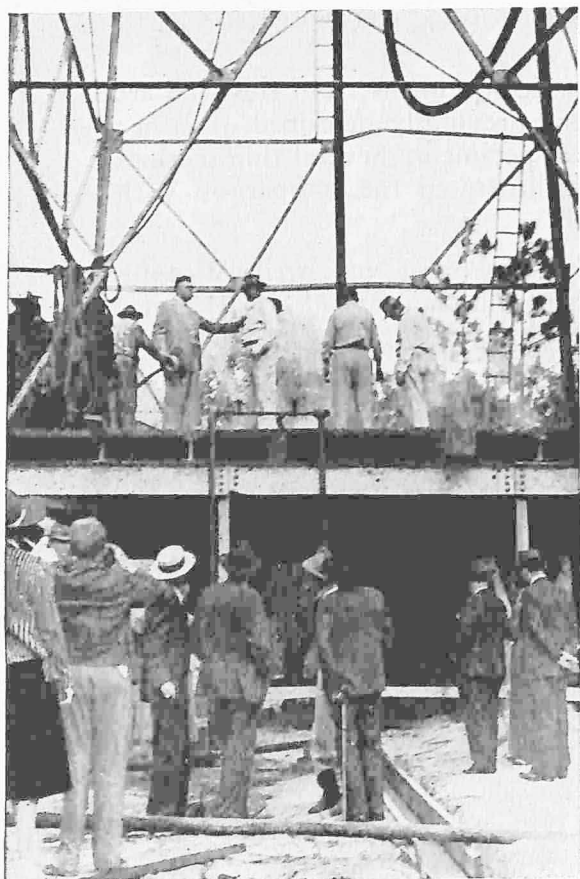
This species was based on numerous megalospheric specimens which were recovered at a depth of 1740 feet from the Southern States Oil Corporation well (W-19) located about one and one-half miles north of Monticello, in Section 17, Township 2 North, Range 5 East, Jefferson County, Florida. Later, Cole found abundant megalospheric and microspheric specimens at a depth of 1198-1200 feet in the St. Mary's River Oil Corporation, Hilliard Turpentine Company No. 1 well (W-336) located about four miles northwest of Hilliard, Nassau County, Florida.

In the well under discussion numerous megalospheric forms were found, but the microspheric generation does not occur.

Inasmuch as the megalospheric specimens from this well are identical with the specimens previously described, it is not necessary to redescribe these specimens. Several thin sections of topospecimens are illustrated for comparison with the specimens from this well.

First appearance: In the V. G. Philips No. 1 well (W-440) at a depth of 1757-1768 feet; abundant at 1881-1891 feet.

Occurrence: Middle Eocene, Lisbon formation.



Justice Rivers Buford
at controls

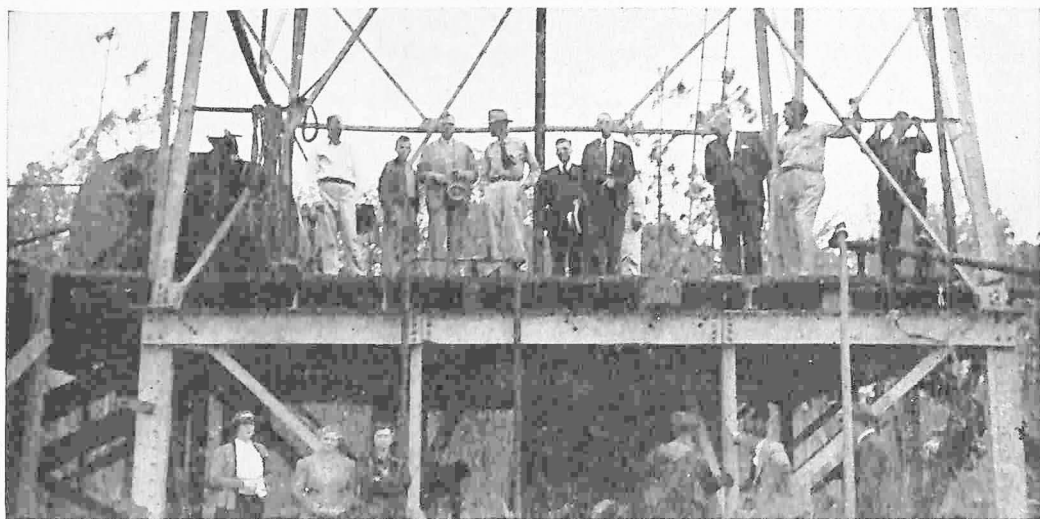
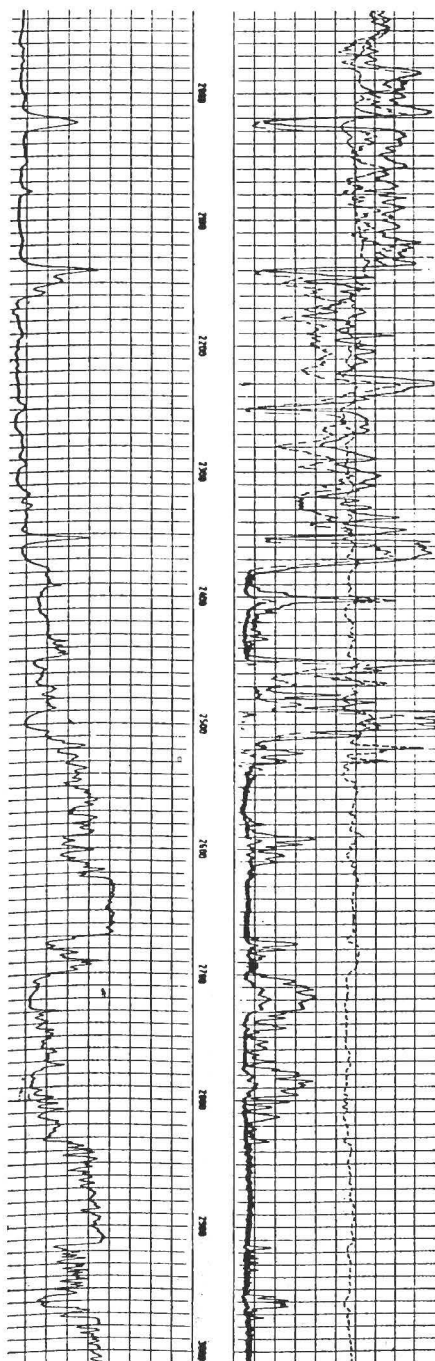


Figure 7. Spudding-in activities at Ravlin-Brown, V. G. Philips No. 1 well

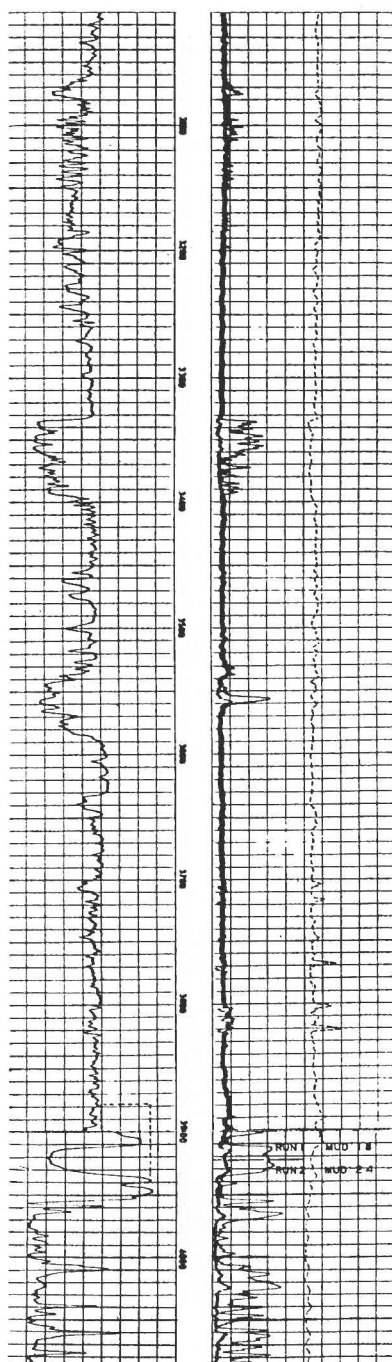
APPENDIX

RAVLIN-BROWN, V. G. PHILIPS NO. 1 WELL (W-440) WAKULLA COUNTY

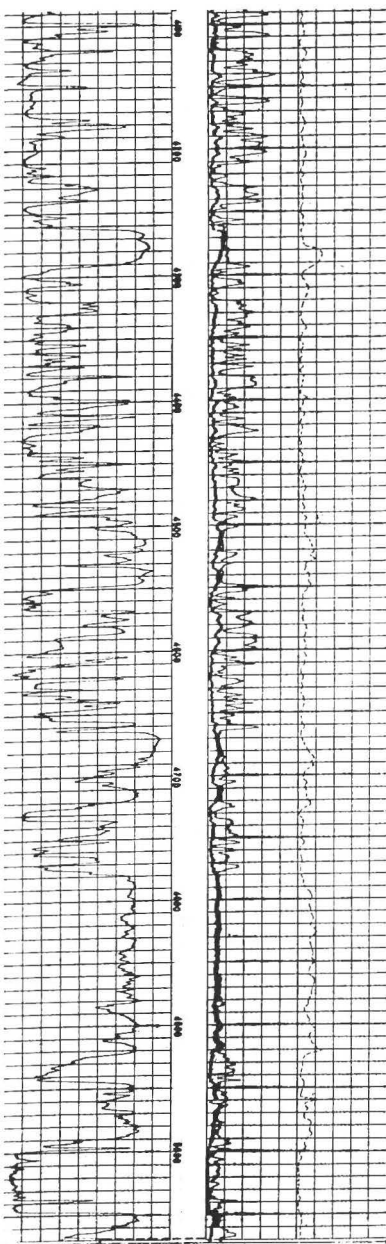
There were two Schlumberger runs of the Ravlin-Brown, V. G. Philips No. 1 well. The first was on December 6, 1942 from the depth of about 400 feet to 3922 feet; the second on January 3, 1943 from 3922 feet to 5069 feet. A copy of this log was obtained through the courtesy of Judge Rivers Buford of the Supreme Court of Florida and is reproduced herewith. It was also through Justice Buford that the illustrations showing the drilling rig (figure 4) and spudding-in activities (figure 5) were procured.



2000-3000



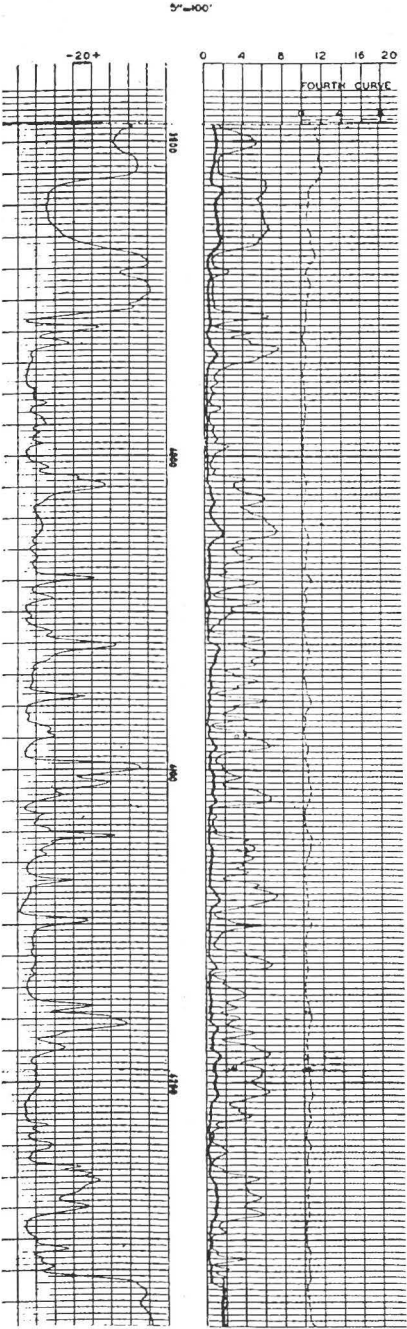
3100-4000



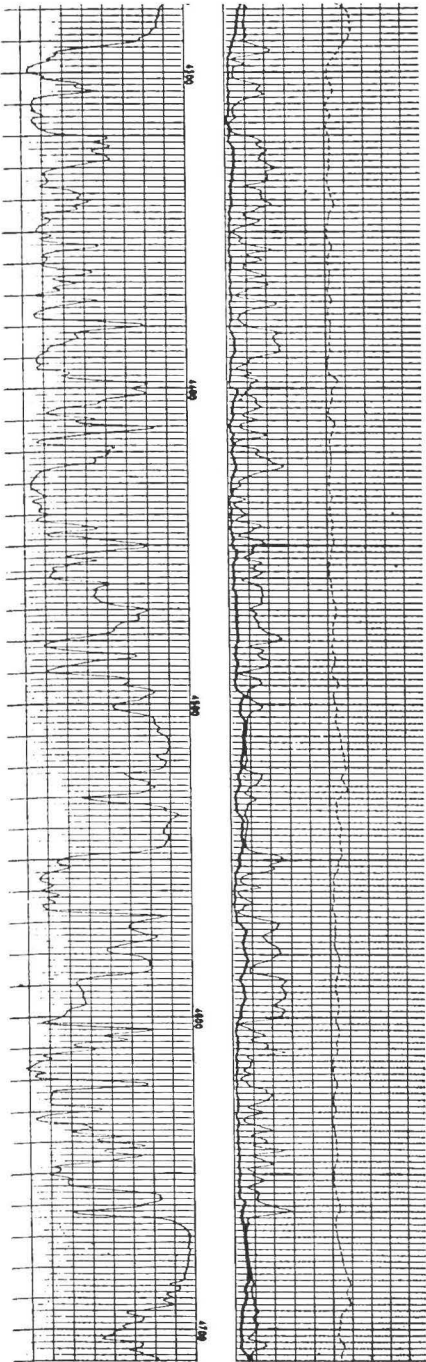
SCHL. F. R. 5085'
DRLR. T. D. 5090'

RAVLIN, BROS.
RAVLIN - BROWN NO. 1 RUN - 2
WC WAKULLA - FLA. ELEV 20 EST

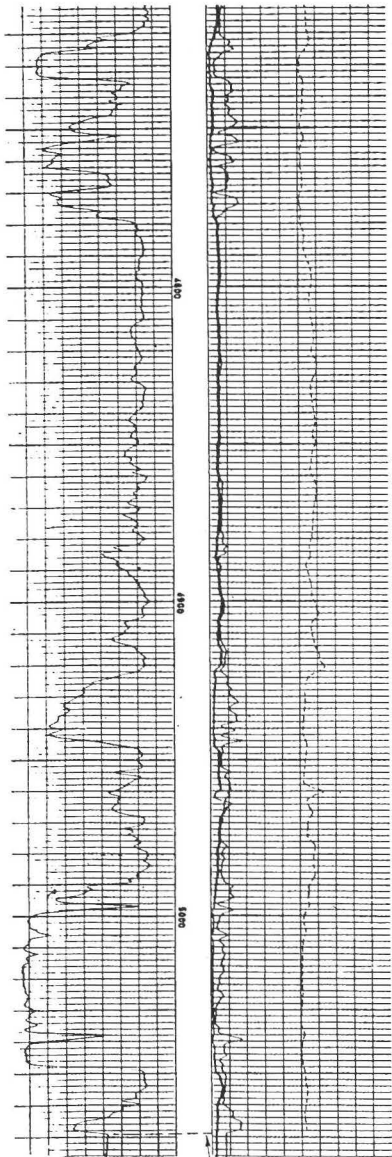
4100-5000



3900-4200



4300-4700



SCHL MAX DEPTH 5063'
DRLR T D 5090'

RAVLIN BROS
RAVLIN - BROWN NO 1
WC WAKULLA - FLA

RUN - 2
ELEV 29.53'

4800-5000

PLATES 12-22

PLATE 12

All specimens from the V. G. Philips No .1 (W-440); 1, 7, at a depth of 546-554 feet; 2, 6, at a depth of 685-695 feet; 3, 9-11, at a depth of 516-546 feet; 4, at a depth of 675-680 feet; 5, at a depth of 606-615 feet; 8, at a depth of 625-635 feet.

Figures 1, 4, 5, 7, 8, X 15
Figures 2, 3, 6, 9-11, X 40

FIGURE

- 1, 7, 9. *Dictyoconus cookei* (Moberg); 1, 7, axial sections; 9, transverse section.
- 2, 6, 8. *Coskinolina floridana* Cole; 2, 8, axial sections; 6, transverse section.
3. *Dictyoconus americanus* (Cushman); portion of an axial section.
- 4, 5. *Lituonella floridana* Cole; 4, axial section; 5, external view.
- 10, 11. *Eodictyoconus cubensis* (Cushman and Bermudez); 10, transverse section; 11, axial section.

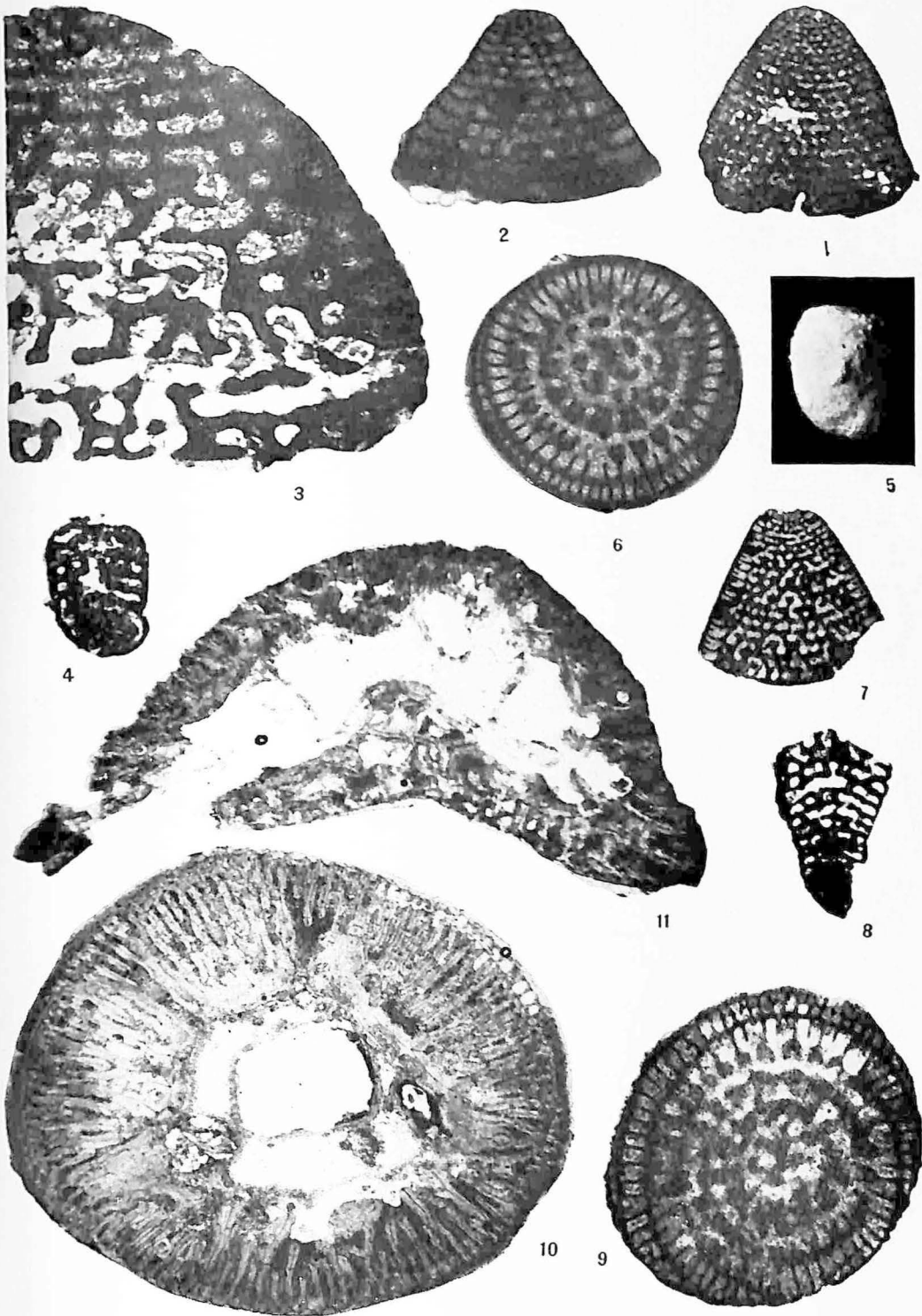


PLATE 13

All specimens from the V. G. Philips No. 1 (W-440); 1, at a depth of 745-755 feet; 2, 7-9, 12, at a depth of 945-955 feet; 3, 5, at a depth of 1081-1091 feet; 4, 6, at a depth of 1015-1016 feet; 10, 11, 13, 14, at a depth of 975-985 feet.

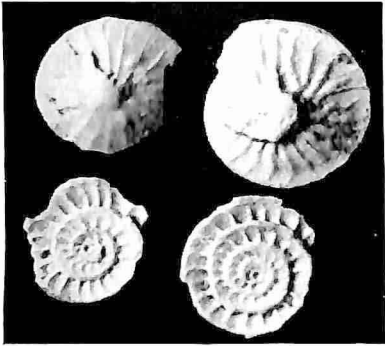
Figures 1, 2, 14, X 10

Figures 3, 4, 7-11, 13, X 15

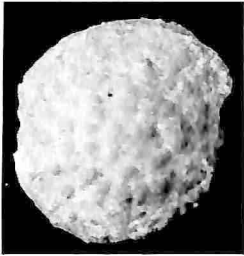
Figures 5, 6, 12, X 40

FIGURE

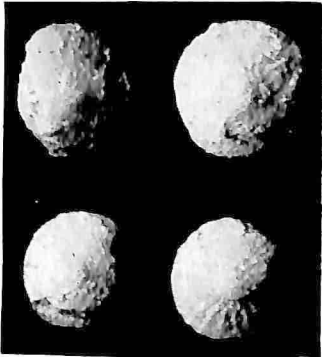
1. *Camerina vanderstoki* (Rutten and Vermunt); external view of two slightly weathered specimens (upper portion), and view of two natural median sections (lower portion).
- 2, 7-9, 12. *Camerina moodybranchensis* Gravell and Hanna; 2, external view of four specimens; 7, 12, transverse sections, each of which has distinct axial plugs; 8, 9, median sections.
- 3-6. *Camerina jacksonensis* Gravell and Hanna; 3, external view to illustrate tuberculate surface; 4, median section; 5, 6, transverse sections; 5, the surface pustules extend inward as wedges of fibrous shell material, illustrated by numerous places on this thin section.
- 10, 11, 13, 14. *Operculinoides willcoxi* (Heilprin); 10, median section; 11, 13, transverse sections; 14, external view of four specimens.



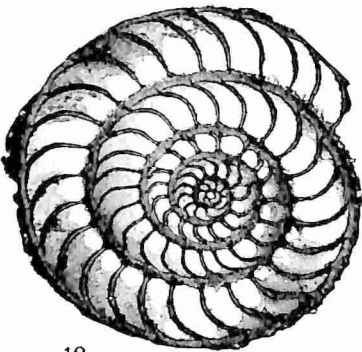
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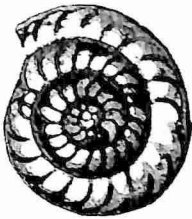
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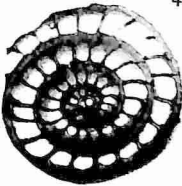
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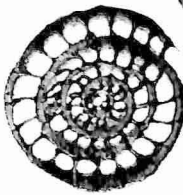
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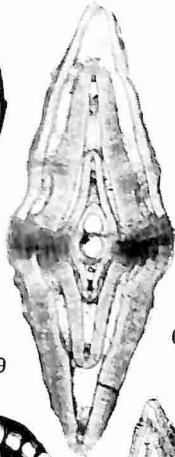
4



9



8



6



7



5



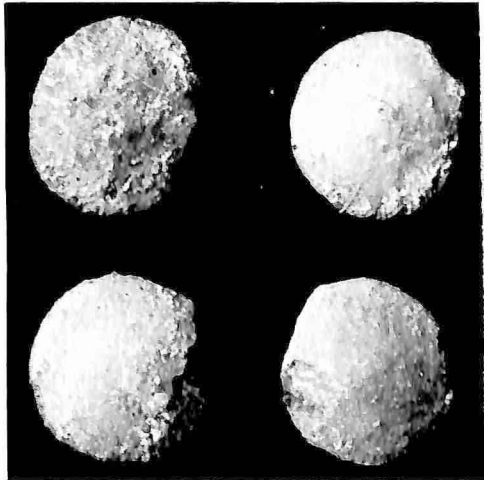
12



11



13



14

PLATE 14

Figures 1-5, of specimens from the Chipola River, below the old wagon bridge, east of Marianna, Florida, collected by Herman Gunter and W. Storrs Cole; collection of W. Storrs Cole.

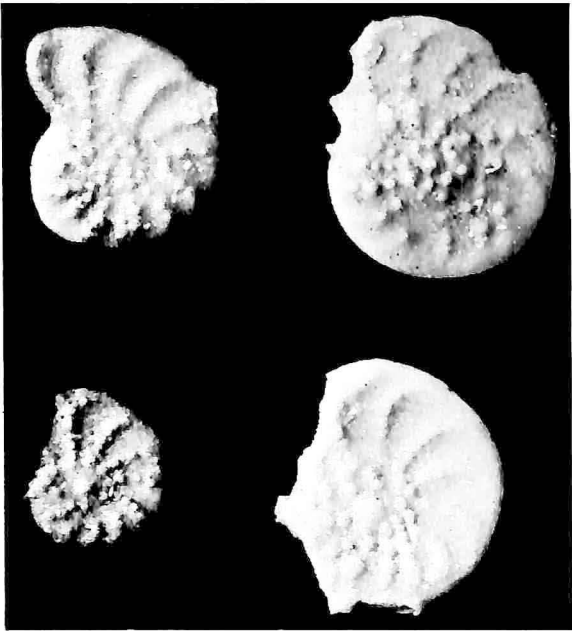
Figures 6-13, of specimens from the V. G. Philips No. 1 (W-440) at a depth of 1015-1016 feet.

Figures 1-4, 6-10, 13, X 15

Figures 5, 11, 12, X 40

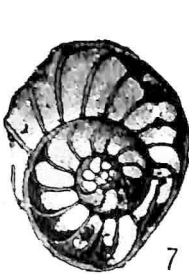
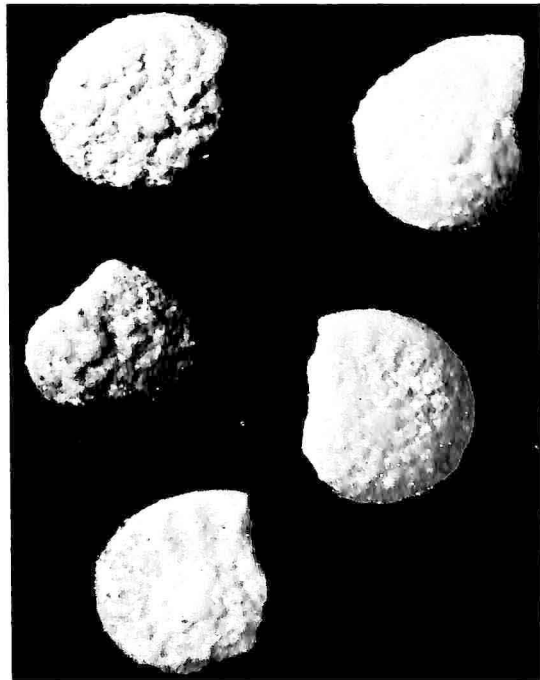
FIGURE

- 1-5. *Operculina mariannensis* Vaughan; 1, external view of four specimens; 2-4, median sections; 5, transverse section. These specimens are figured to illustrate the differences between *O. mariannensis* and *O. barkeri*.
- 6-13. *Operculina barkeri* Vaughan and Cole; 6-10, median sections; 11, 12, transverse sections; 13, external view of five specimens.

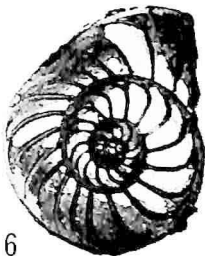


1

13



7



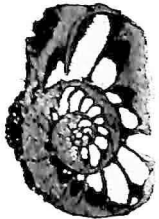
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2



3



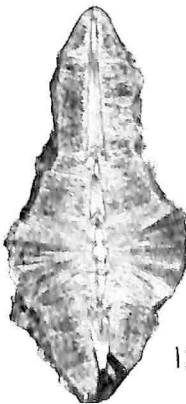
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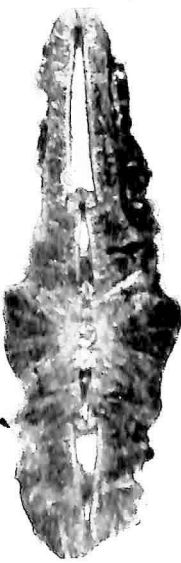
4



12



9



11

PLATE 15

All figures of specimens from the V. G. Philips No. 1 (W-440); 1, at a depth of 1819-1829 feet; 2, at a depth of 1809-1819 feet; 3, 6, at a depth of 1757-1768 feet; 4, at a depth of 1768-1779 feet; 5, at a depth of 2735-2745 feet; 7, at a depth of 975-985 feet; 8, at a depth of 685-695 feet; 9, 10, at a depth of 399 feet; 11, 12, at a depth of 745-755 feet; 13, at a depth of 1018-1030 feet.

Figure 1, X 10

Figures 2, 3, 6, 8-10, X 40

Figures 4, 5, X 20

Figures 7, 11-13, X 15

FIGURE

- 1-3. *Lepidocyclina* (*Pliolepidina*) *ariana* Cole and Ponton; 1, external view of three specimens; 2, 3, vertical sections.
4. *Camagueyia perplexa* Cole and Bermudez; external view.
5. Brachiopod figured for future reference; view of the pedicle valve.
6. *Fabularia vaughani* Cole and Ponton; transverse section.
7. *Operculinoides willcoxi* (Heilprin); median section.
8. *Lepidocyclina* (*Pliolepidina*) *cedarkeysensis* Cole; vertical section.
- 9, 10. *Heterostegina texana* Gravell and Hanna; 9, median section; 10, transverse section.
- 11, 12. *Camerina vanderstoki* (Rutten and Vermunt); 11, transverse section of a large specimen; 12, transverse section of a small specimen.
13. *Operculinoides cookei* (Cushman); median section.

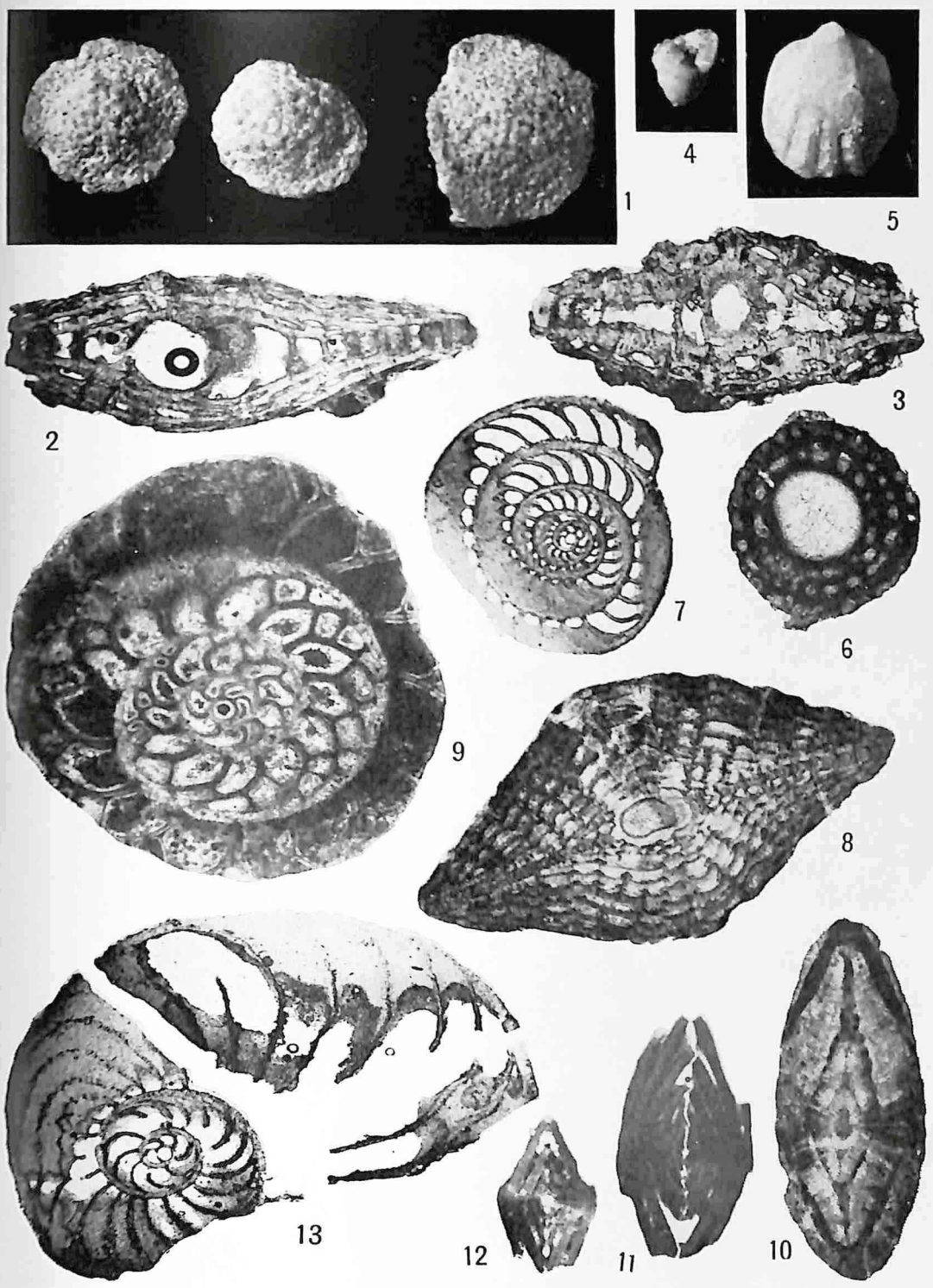


PLATE 16

Figures 1, 4, 5, of specimens from the Gibbs Dry Dock Company's well (W-72c), South Jacksonville Duval County, Florida; 1, 4, at a depth of 890 feet; 5, at a depth of 900 feet; collection of W. Storrs Cole.

Figures 2, 8, 10, of specimens from the Southern States Oil Corporation's well (W-19), located one and a half miles north of Monticello, Jefferson County, Florida, at a depth of 1740 feet; collection of W. Storrs Cole.

Figures 3, 6, 7, 9, 11-13, of specimens from the V. G. Philips No. 1 (W-440); 3, 7, 9, at a depth of 1789-1799 feet; 6, at a depth of 1757-1768 feet; 11-13, at a depth of 1018-1030 feet.

Figures 1-10, X 40

Figures 11, 12, X 15

Figure 13, X 10

FIGURE

- 1-10. *Fabularia vaughani* Cole and Ponton; 1, 2, 5, 7, 8, transverse sections; 1, 5, microspheric specimens; 2, 7, 8, megalospheric specimens; 3, 4, 6, 9, 10, axial sections; 3, 6, 9, megalospheric specimens; 4, microspheric specimen; 1, 2, 4, 5, 8, 10, introduced for comparison with the specimens from the V. G. Philips No. 1 (W-440).
- 11-13. *Operculinoides vaughani* (Cushman); 11, transverse section; 12, external view illustrating raised sutures; 13, median section.

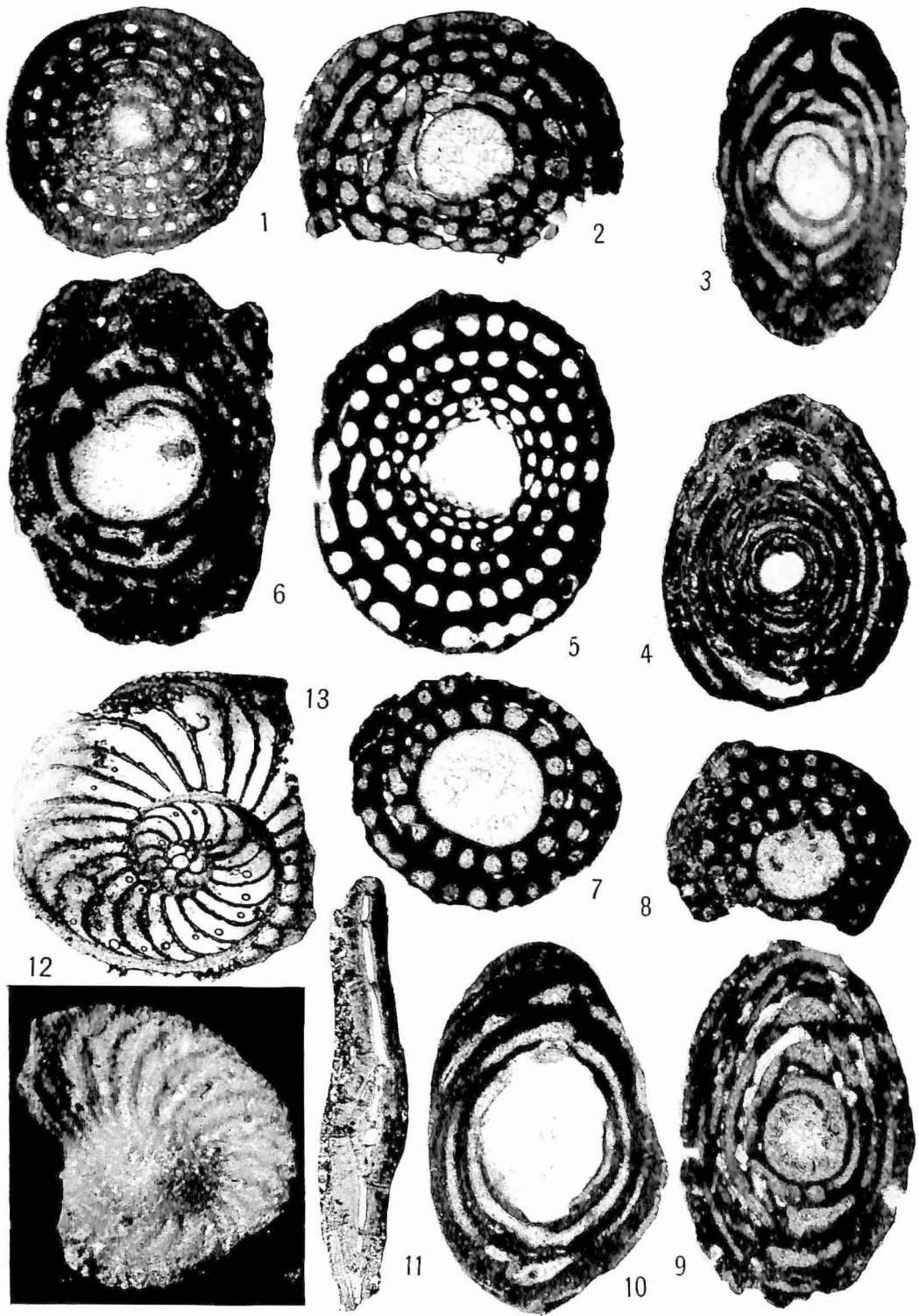


PLATE 17

Figures 1-5, of specimens from the V. G. Philips No. 1 (W-440) at a depth of 1809-1819 feet.

Figure 6, of a specimen from the Southern States Oil Corporation's well (W-19), located one and a half miles north of Monticello, Jefferson County, Florida, at a depth of 1740 feet; collection of W. Storrs Cole.

Figures 1-6, X 40

FIGURE

- 1-6. *Lepidocyclina* (*Pliolepidina*) *ariana* Cole and Ponton; 1-3, vertical sections of megalospheric individuals; 4-6, horizontal sections of megalospheric individuals; 6, topotype specimen introduced for comparison. (Note: compare figure 2 of this plate with figure 2, plate 14, in Bulletin 26 of the Florida Geological Survey.)

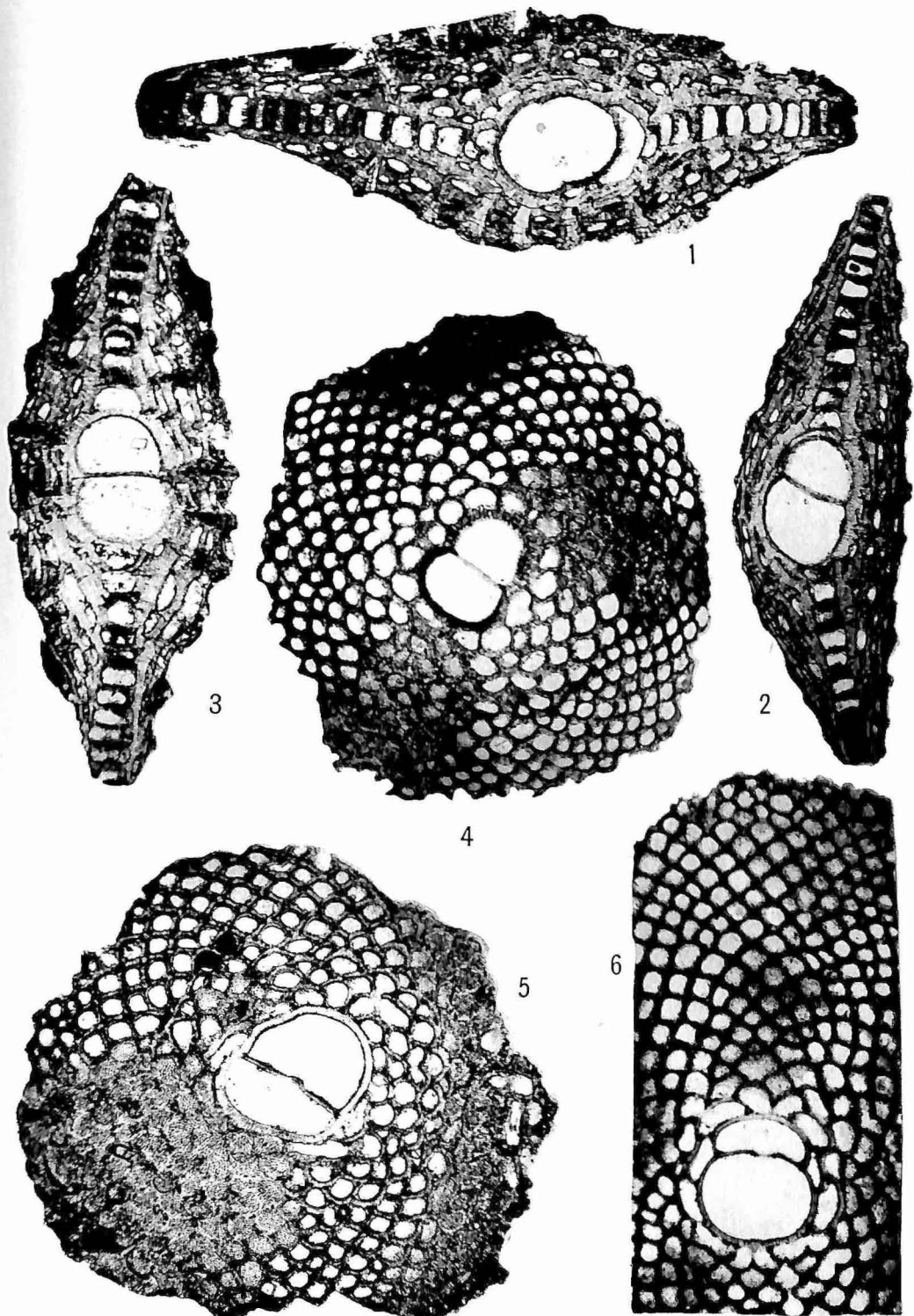


PLATE 18

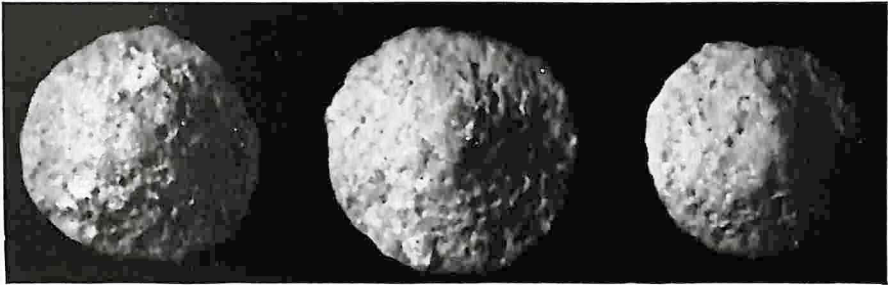
All specimens from the V. G. Philips No. 1 (W-440); 1, 2, 4-6, at a depth of 685-695 feet; 3, at a depth of 675-685 feet.

Figure 1, X 15

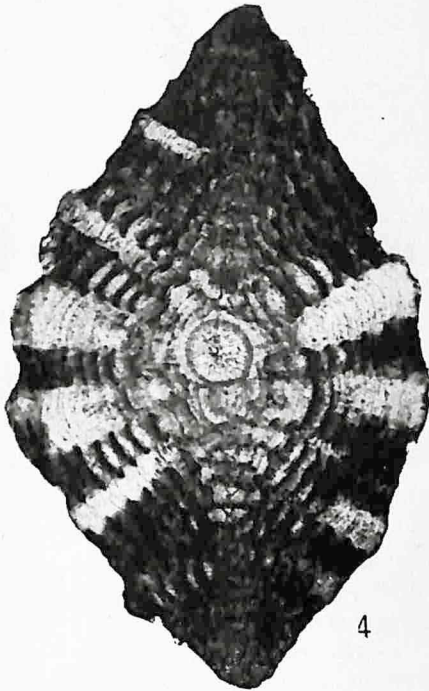
Figures 2-6, X 40

FIGURE

1-6. *Lepidocyclina* (*Pliolepidina*) *cedarkeysensis* Cole; 1, external view of three specimens; 2-4, vertical sections of megalospheric individuals illustrating different degrees of inflation and variable development of the pillars; 5, 6, horizontal sections of megalospheric individuals.



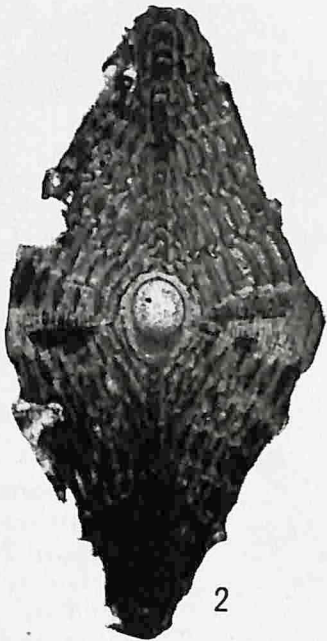
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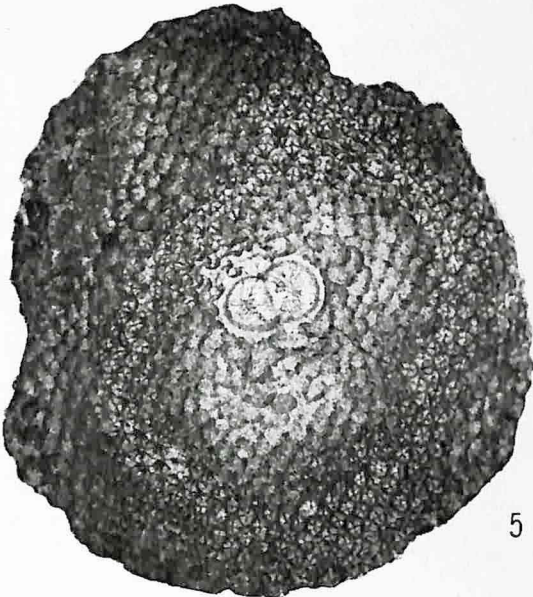
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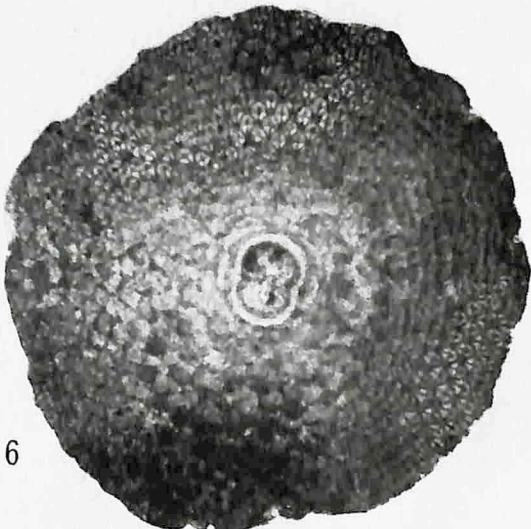
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PLATE 19

Figure 1, of a specimen from U. S. G. S. loc. 6523, David, Panama; collection of the U. S. National Museum, loaned by Dr. Lloyd Henbest.

Figures 2-13, of specimens from the V. G. Philips No. 1 (W-440); 2-4, 7-9, 11, 12, at a depth of 546-554 feet; 5, at a depth of 554-559 feet; 6, 10, 13, at a depth of 574-584 feet.

Figures 1-7, 11, 12, 13, X 15

Figures 8-10, X 40

FIGURE

1-13. *Lepidocyclina* (*Pliolepidina*) *macdonaldi* Cushman; 1, 2, 6-12, vertical sections of megalospheric individuals; 1, topotype specimen introduced for comparison with the specimens from Florida; 3-5, 13, horizontal sections of megalospheric specimens. (Note: Compare figures 3-5, 13, of this plate with figure 2, plate 31 of Geol. Soc. Amer. Sp. Paper No. 30, 1941.)

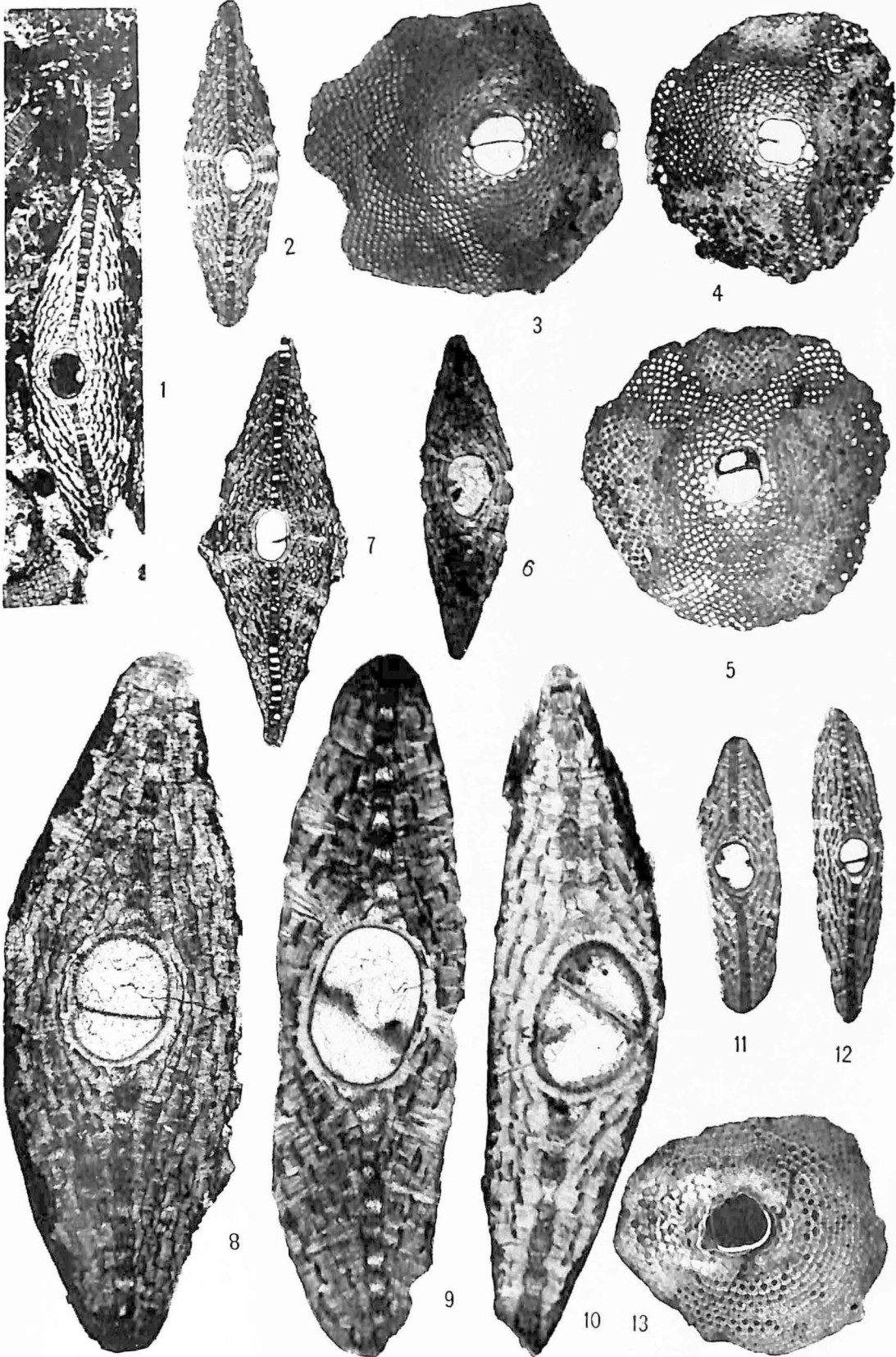


PLATE 20

Figures 1-7, 9-12, of specimens from the V. G. Philips No. 1 (W-440); 1, 2, 6, at a depth of 1018-1030 feet; 3, 7, 9, 11, at a depth of 1081-1091 feet; 4, 5, 10, 12, at a depth of 1016-1017 feet.

Figure 8, of a specimen from Montgomery, Louisiana; collection of W. Storrs Cole.

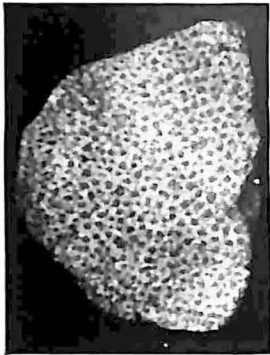
Figures 1, 2, X 5

Figures 3-8, 12, X 15

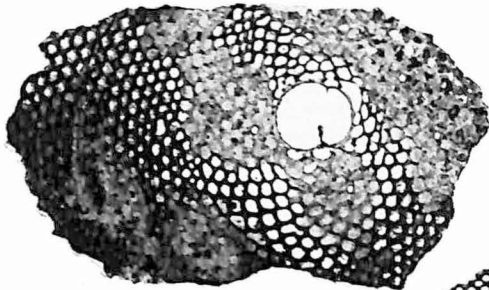
Figures 9-11, X 40

FIGURE

- 1-12. *Lepidocyclina* (*Lepidocyclina*) *mortoni* Cushman; 1, 2, external views of two broken specimens; 1, this specimen is broken across the center, does not possess a marked umbo and has numerous small papillae; 2, this specimen is broken so that the small distinct umbo appears at the bottom of the figure and the wide thin flange extends toward the top of the figure; 3-5, horizontal sections to illustrate the shape of the equatorial chambers and the variable size of the embryonic chambers in megalospheric individuals; 6-10, vertical sections of megalospheric individuals; 8, specimen introduced for comparison (see Gravell, D. W. and Hanna, M. A., Jour. Pal., vol. 9, pp. 337-339, pls. 30, 31, 32, 1935); 11, horizontal section of a microspheric individual (note initial coil); 12, vertical section of a microspheric individual.



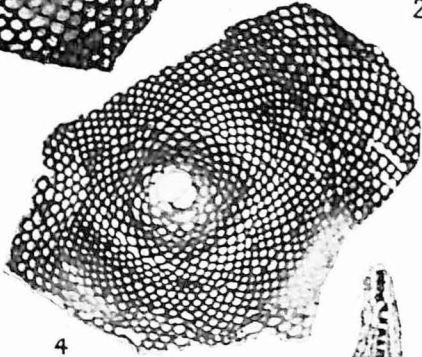
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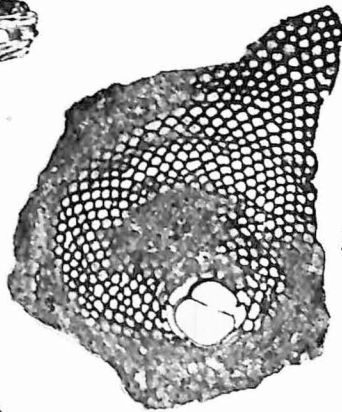
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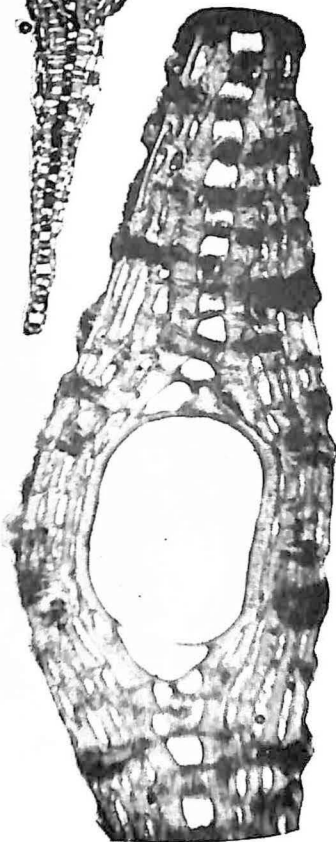
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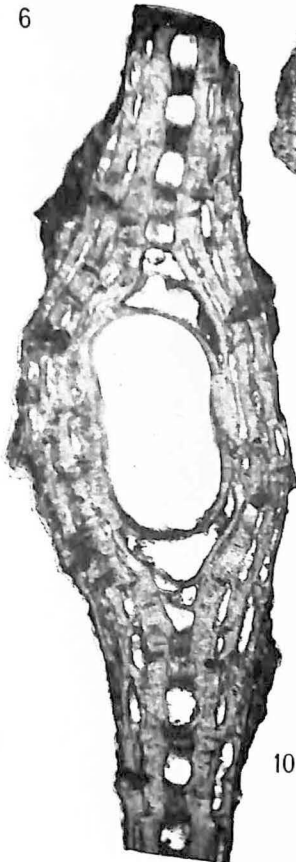
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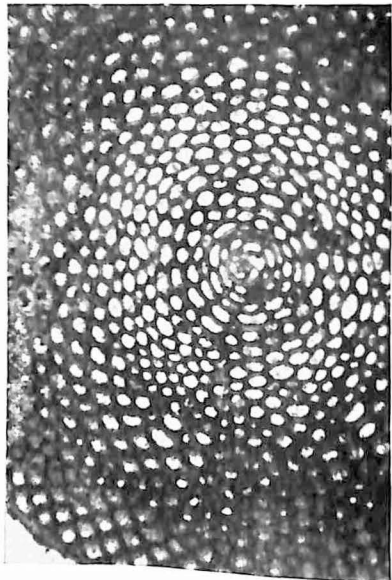
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PLATE 21

Figures 1, 4, 6-8, 11, 12, of specimens from the V. G. Philips No. 1 (W-440); 1, at a depth of 1881-1891 feet; 4, 6, 8, at a depth of 1881-1891 feet; 7, at a depth of 1757-1768 feet; 11, 12, at a depth of 1891-1901 feet.

Figures 2, 3, 5, 9, 10, 13, of specimens from the Southern States Oil Corporation's well (W-19), located one and a half miles north of Monticello, Jefferson County, Florida, at a depth of 1740 feet; collection of W. Storrs Cole.

Figures 1, 11, X 15

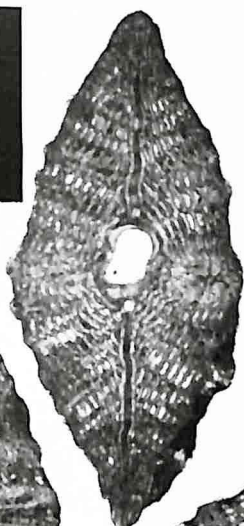
Figures 2-10, 12, 13, X 40

FIGURE

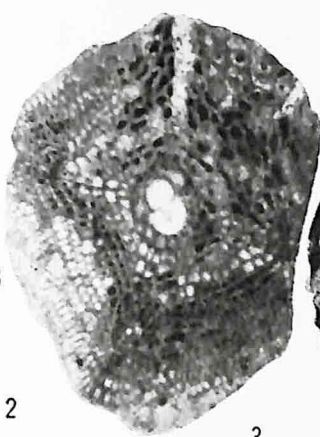
- 1-13. *Discocyclus* (*Asterocyclus*) *monticellensis* Cole and Ponton; 1, external view to illustrate the apical papillae and development of rays on the margin of the test; 3, 10-13, horizontal sections; 4-9, vertical sections; 2, 3, 5, 9, 10, 13, topotype specimens introduced for comparison with the specimens from the V. G. Philips No. 1 (W-440).



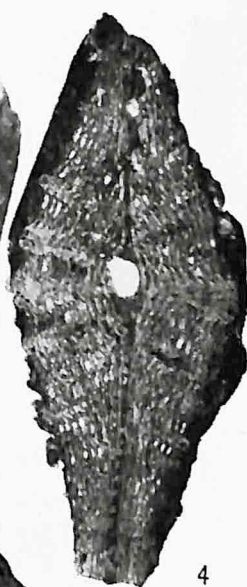
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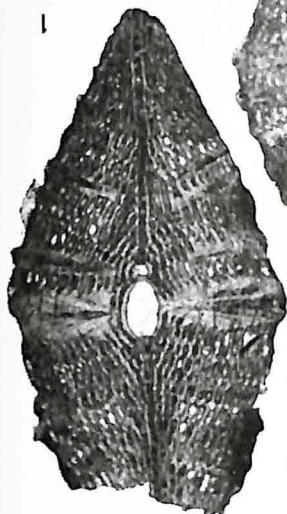
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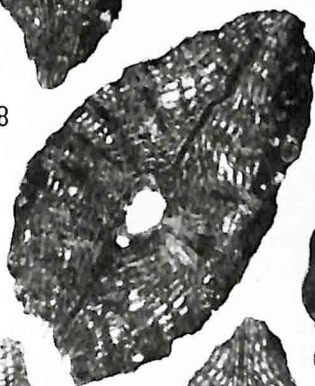
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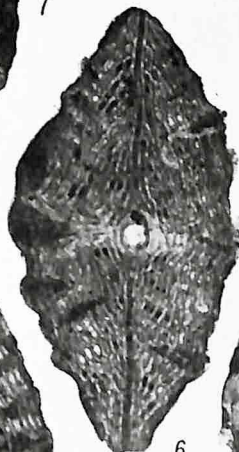
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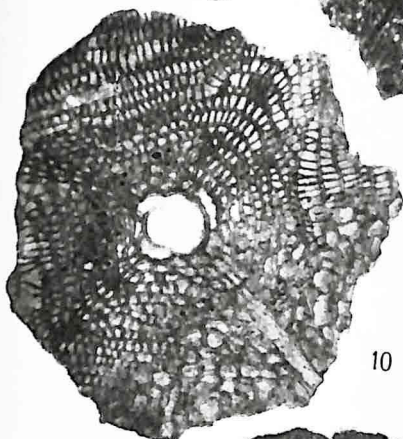
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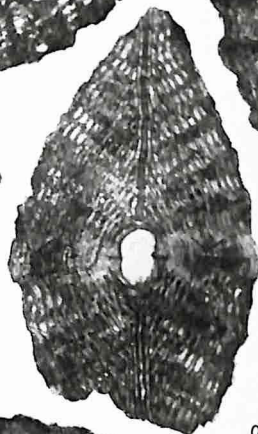
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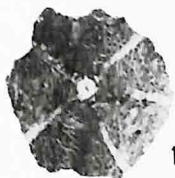
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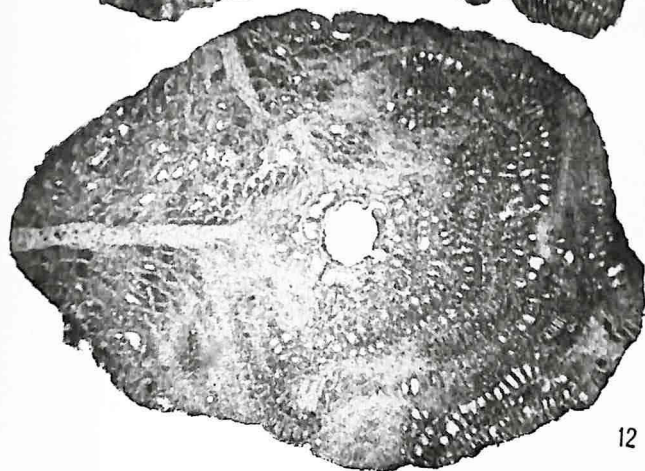
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12 13

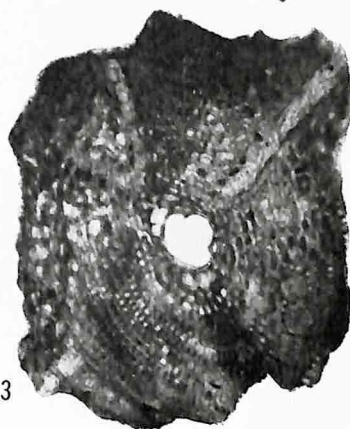


PLATE 22

Figures 1-8, of specimens from the Bonheur Development Company's well No. 1 (W-12), located at Burns, Wakulla County, Florida; 1, 3, 5, at a depth of 180 feet; 2, at a depth of 50 feet; 4, 6-8, at a depth of 150 feet.

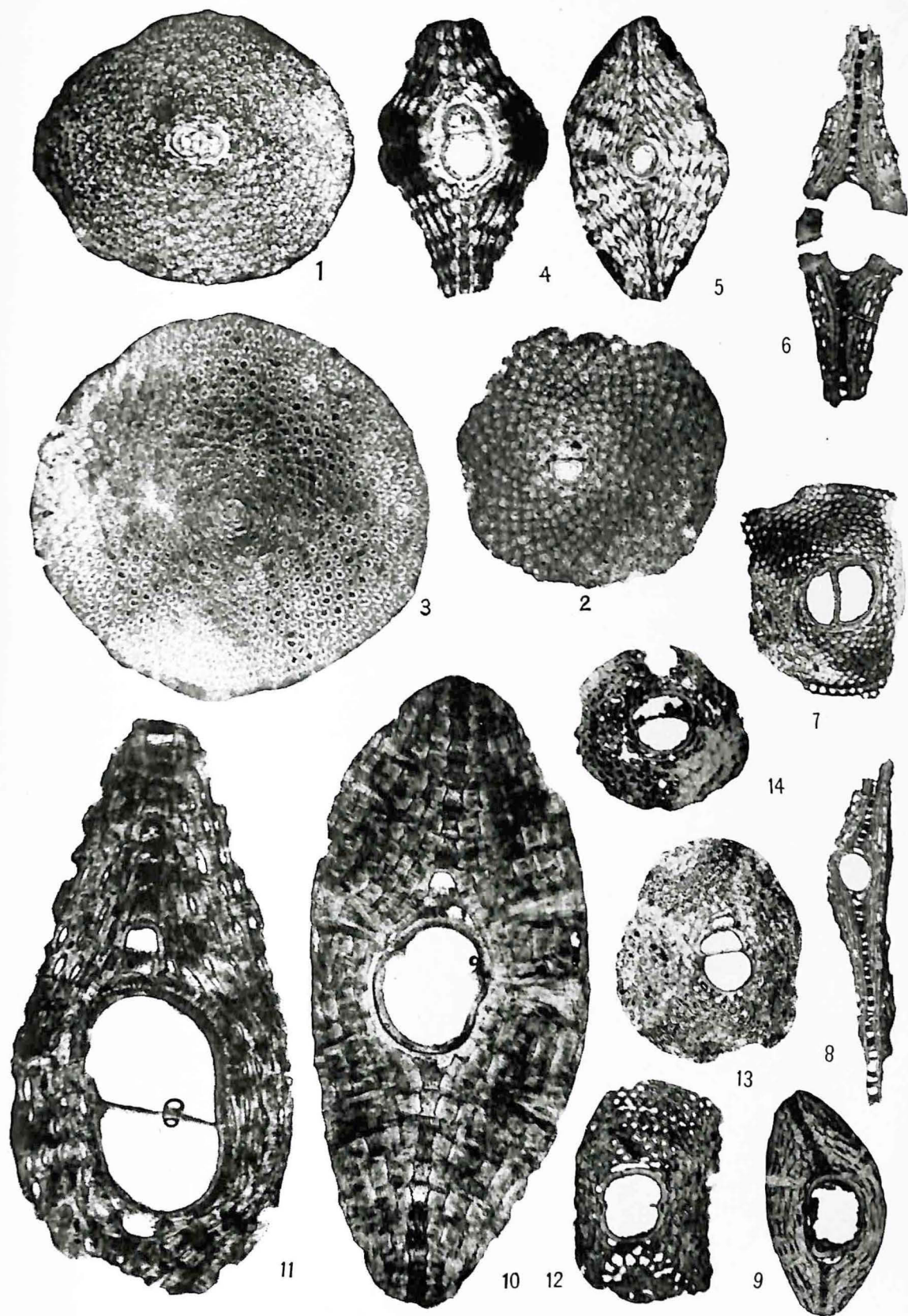
Figures 9-14, of specimens from the V. G. Philips No. 1 (W-440) at a depth of 399 feet.

Figures 1-5, 10, 11, X 40

Figures 7-9, 12-14, X 15

FIGURE

- 1-3, 5. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis* Cushman; 1, 2, horizontal sections of megalospheric individuals to illustrate the embryonic chambers and the diamond-shaped equatorial chambers; 3, horizontal section of a microspheric individual; 5, vertical section of a megalospheric individual.
4. *Lepidocyclina* (*Lepidocyclina*) *yurnagunensis* Cushman, variety *morganopsis* Vaughan; vertical section of a megalospheric individual with well developed pillars.
6. *Lepidocyclina* (*Lepidocyclina*) *parvula* Cushman; vertical section of a megalospheric individual.
- 7, 8. *Lepidocyclina* (*Lepidocyclina*) *supera* (Conrad); 7, horizontal section of a megalospheric individual; 8, vertical section of a megalospheric individual.
- 9-14. *Lepidocyclina* (*Pliolepidina*) *ariana* Cole and Ponton; 9-11, vertical sections; 12-14, horizontal sections.





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Figures in boldface indicate detailed descriptions.

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