

STATE OF FLORIDA
DEPARTMENT OF CONSERVATION
FLORIDA GEOLOGICAL SURVEY

GEOLOGICAL BULLETIN NO. 20

STRATIGRAPHIC AND PALEONTOLOGIC STUDIES
OF WELLS IN FLORIDA—No. 2

Suwannee Petroleum Corporation's Sholtz No. 1
Florida Oil Discovery Company's Cedar Keys No. 2

By
W. Storrs Cole, Ph. D.
Ohio State University

TALLAHASSEE, FLORIDA
1942

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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.

Sir:

I have the honor to transmit a report entitled *Stratigraphic and Paleontologic Studies of Wells in Florida—No. 2*, by Dr. W. Storrs Cole of Ohio State University, Columbus, Ohio, to be published as Geological Bulletin No. 20.

This paper is a continuation of a series of studies of deep wells that have been drilled in Florida. Studies of this type are indispensable in gaining a knowledge of the subsurface conditions in Florida and are particularly timely now when there is a keen interest in petroleum exploration in Florida.

In the Fourth Biennial Report of the Florida Geological Survey it was stated that studies of the white-firing clays of Florida by Frank Westendick had been completed and would be issued as Bulletin 20. The manuscript has been submitted but editing is still in progress. It has seemed advisable therefore to substitute this paper instead.

I want to take this opportunity to express my appreciation for the interest you have shown in the work of the Geological Department and for the support you have so generously given it.

Very respectfully,

HERMAN GUNTER, Director
Geological Survey

Tallahassee, Florida
January 5, 1942

PUBLISHED April 1, 1942

NOTE

In the Fourth Biennial Report of the Florida Geological Survey we stated that Bulletin 20 would be a report on the white-firing clays of Florida by Frank Westendick. Due to unforeseen delays this report has been held up and this paper substituted. This will keep from breaking the continuity of our Bulletin series and avoid confusion.

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STRATIGRAPHIC AND PALEONTOLOGIC STUDIES OF WELLS IN FLORIDA—NO. 2

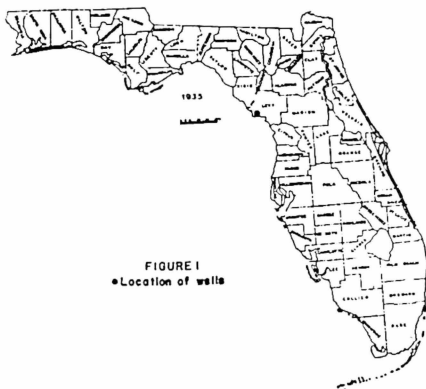
Suwannee Petroleum Corporation's Sholtz No. 1
Florida Oil Discovery Company's Cedar Keys No. 2

W. STORRS COLE, Ph. D.
Ohio State University

INTRODUCTION

This bulletin is a continuation of the project which was initiated by Mr. Gunter in 1936 to make detailed stratigraphic and paleontologic studies of the wells which have been drilled in Florida. Two bulletins¹ have been published so far in which four wells in critical areas have been analyzed.

Two other wells have been studied for this bulletin although they are only 1500 feet apart. This was necessary as there were serious gaps in the samples from each, but by combining the information a satisfactory account of the stratigraphy and faunas of the area can be rendered.



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

ACKNOWLEDGMENTS

The writer is indebted most of all to Herman Gunter, State Geologist of Florida, for many suggestions and a sympathetic attitude during the progress of this study. Mrs. Dorothy K. Palmer of Habana, Cuba, sent certain specimens and commented

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.

on others. Dr. T. Wayland Vaughan compared photomicrographs of *Pseudophragmina zaragosensis* from Florida with the type specimens and with Dr. Alfred Senn granted permission to publish a photomicrograph of *Dictyoconus americanus* which was collected by Dr. Senn in St. Bartholomew. Mrs. Elizabeth Burckmyer of Ithaca, N. Y., made the drawings of the small Foraminifera. The United States Geological Survey took the photomicrographs of the external views. To all these acknowledgment is made and appreciation of their efforts expressed.

SUWANNEE PETROLEUM CORPORATION'S SHOLTZ NO. 1

FLORIDA OIL DISCOVERY COMPANY'S CEDAR KEYS NO. 2

The Suwannee Petroleum Corporation's Sholtz No. 1 (W-166)² was drilled in the SW $\frac{1}{4}$ of Section 9, Township 15 South, Range 13 East, Levy County, Florida. This well was started in August, 1926, and completed at a depth of 4010 feet on June 12, 1929. Small gas flows are reported from a depth of 4010 feet. This gas was inflammable and sufficient in quantity to cause the owners to conduct extensive tests. The well was finally abandoned in May, 1930.

The Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) was drilled in the SW $\frac{1}{4}$ of the NE $\frac{1}{4}$ of Section 9, Township 15 South, Range 13 East, Levy County. Both wells are about 5 miles from the city of Cedar Keys on Florida State Highway No. 13. The Cedar Keys No. 2 is 1500 feet north of the Suwannee Petroleum Corporation's Sholtz No 1 (W-166).

The Cedar Keys No. 1 at the new location was lost at a depth of about 500 feet. The rig was skidded 20 feet and the Cedar Keys No. 2 (W-355) was started on May 10, 1937, and had been drilled to a depth of 5266 feet on August 5, 1939.

E. L. Stoner was Superintendent and Fred Swenson was the driller. The samples were presented to the Florida Geological Survey by Edward A. Hill, Consulting Geologist, of Tampa, Florida. The approximate location of the wells is shown in Fig. I.

The first sample from the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) came from a depth of 115 feet. Samples

² Florida Geological Survey's file number for the samples from this well.

are missing in this well from 1930 to 2090 feet and from 2250 to 2807 feet. Although no cores were taken, the cutting samples are very complete except for the gaps which have been mentioned. Most of the samples were taken at 5-foot intervals.

The first sample from the Florida Oil Discovery Company's Cedar Keys No. 2 came from a depth of 44-55 feet; the second is from 89-92 feet and the third from 93-386 feet. Below this depth a sample was collected about every 30 feet although the intervals represented by the individual samples vary. Some cores were taken from this well. W-166 was drilled with standard tools and W-355 was drilled by the rotary method.

STRATIGRAPHY

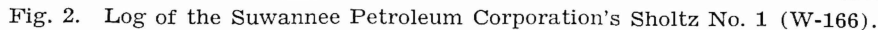
The formations encountered and their lithologic characteristics are shown graphically on Figures 2 and 3. Definite formational names are not given for the middle and lower Eocene as these units are known only from wells and their correlation with known outcropping formations is not fully understood. The faunas of middle Eocene age in peninsular Florida are related to those of equivalent age in Cuba and Mexico.

Formational names are used for the Upper Cretaceous. Except for the uppermost portion of the Upper Cretaceous, the formations encountered agree lithologically and faunally with known formations in the Coastal Plain of the Gulf States. The fauna in the uppermost portion of the Upper Cretaceous is similar to that described from the uppermost Cretaceous of Cuba.

PLEISTOCENE AND RECENT

The first sample received from the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) was collected at a depth of 115 feet, but the first from the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) came from a depth of 44-55 feet. Each of these samples contains typical Ocala limestone fragments and fossils. Inasmuch as section 9 in which these wells were drilled is completely covered by undifferentiated Pleistocene and Recent deposits,³ the wells must have penetrated deposits of these ages before encountering the Ocala limestone.

³ Cooke, C. Wythe and Mossom, Stuart, "Geology of Florida," *Florida Geol. Survey 20th Ann. Rept.*, pl. 2, 1929.



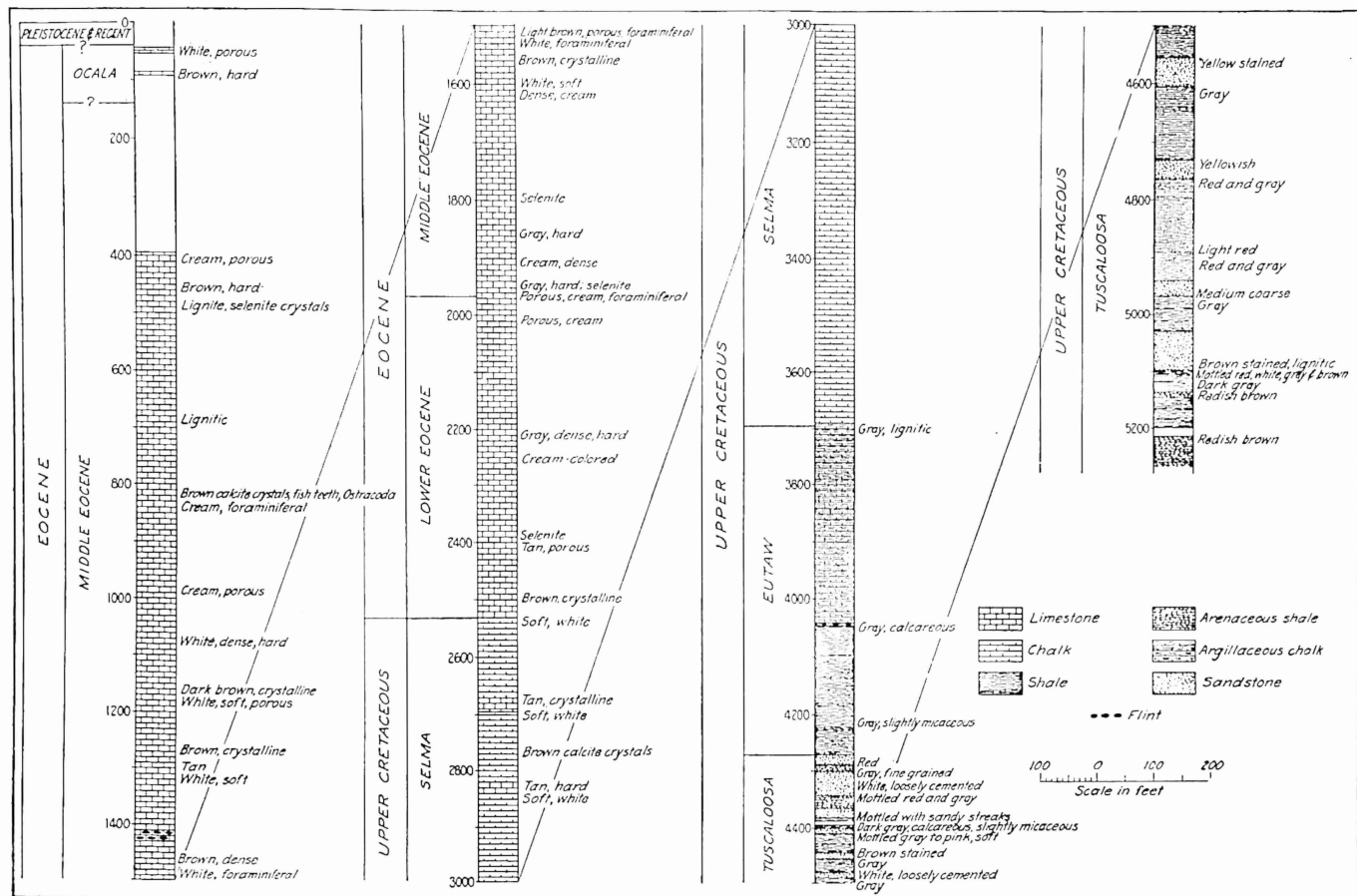


Fig. 3. Log of the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355).

Therefore, the combined Pleistocene and Recent deposits in this vicinity have a thickness of less than 44 feet. The thickness of the Pleistocene in Florida is quite variable as shown by studies of other wells.⁴

EOCENE

OCALA LIMESTONE.—The exact elevation of the top of the Ocala limestone could not be determined because of the lack of samples, but from the information at hand these wells encountered the Ocala limestone above a depth of 44 feet. As the elevation of the well head in each case is about 25 feet above sea-level, it is apparent that the top of the Ocala limestone in this area is approximately at sea-level.

The bottom of the Ocala limestone is found at a depth of 140+ feet in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) inasmuch as the next sample (145 feet) contains abundant specimens of *Dictyoconus cookei* (Moberg) which mark the top of the middle Eocene.⁵ Definite location of the bottom of the Ocala limestone cannot be stated for the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) as the interval from 93 to 386 feet is represented by one sample.

The upper portion of the Ocala limestone in these wells is a soft, white, fossiliferous limestone below which occurs a hard, brown, fossiliferous limestone. The samples representing the Ocala limestone contain considerable amounts of sand which represent cavings from the overlying Pleistocene and Recent.

The fauna of the Ocala limestone is dominated by abundant specimens of the genus *Camerina* of which three species were recognized. The genus *Lepidocyclus* is represented by one species of which four specimens were recovered. The echinoid, *Fibularia vauhani* (Twitchell) (see plate 16, figures 7, 8) occurred in some abundance at 130 feet in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166).

MIDDLE EOCENE.—The top of the middle Eocene is based on the first appearance of *Dictyoconus cookei* (Moberg) as well as a slight lithologic break. The sample taken at 145 feet in the

⁴ Cole, W. Storrs, *Stratigraphy and Micropaleontology of Two Deep Wells in Florida*, Florida Geol. Survey Bull. 16, p. 8, 1938.

⁵ Cole, W. Storrs, *Stratigraphic and Paleontologic Studies of Wells in Florida*, Florida Geol. Survey Bull. 19, pp. 7, 8, 16, 20, 1941.

Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) contained specimens of this species in considerable numbers. The sample is composed of fragments of an arenaceous limestone with a brownish color. This arenaceous bed is thin as abundant fragments of it were found only in this sample.

The middle Eocene in this area is composed largely of limestone, the upper portion of which is prevailingly brown colored. The lower portion of the middle Eocene has lighter colors with cream predominating, although beds of white occur.

Thin beds of lignitic shale occur infrequently in the upper portion of the middle Eocene, but the lower portion is limestone except for the occurrence at certain horizons of flint and selenite. The flint occurs as concretionary masses in the limestone.

Fossils occur in the middle Eocene in rather definite zones. Between these zones, the rocks are either non-fossiliferous or contain few fossils. The lower four hundred feet of the section assigned to middle Eocene is entirely devoid of recognizable fossils. The fossil zones and the depth at which they were encountered in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) are as follows: 1. *Dictyoconus cookei* zone at 145 feet; 2. *Fabularia vauthani* zone at 310 feet; 3. *Dictyoconus americanus* (formerly *D. gunteri*) at 840 feet; 4. *Gunteria floridana* zone at 1100 feet; 5. *Amphistegina lopeztrigoi* zone at 1340 feet; 6. *Pseudophragmina zaragosensis* zone at 1470 feet; 7. *Coskinolina elongata* zone at 1497 feet. The geographic and stratigraphic distribution of these zones must be checked in other wells before too much reliance is placed on them.

In the Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445) two zones were recognized in the middle Eocene, namely the *Dictyoconus cookei* zone and the *Dictyoconus americanus* (*D. gunteri*) zone. In the J. W. Cory No. 1 (W-445) the interval between the top of the *D. cookei* and the top of the *D. americanus* zones was 700 feet. In the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) this interval is 695 feet.

Fabularia vauthani has been found in a number of wells in Florida.⁶ *Dictyoconus americanus* (formerly *D. gunteri*) has

⁶ Cole, W. Storrs and Ponton, Gerald M., "New Species of *Fabularia*, *Asterocyclina* and *Lepidocyclina* from the Florida Eocene," *Amer. Midland Nat.* vol. 15, pp. 140, 141, 1934.

been used extensively as a marker⁷ but it is possible that the identification of the specimens may not always have been correct. Exact determination of this species must depend upon the examination of suitable thin sections. The other species used as zonal markers are either new or recorded from so few wells that definite statements cannot be made at the present time.

The fossil zones recognized in the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) follows: 1. *Dictyoconus americanus* (formerly *D. gunteri*) at 833-855 feet; 2. *Gunteria floridana* at 1102-1132 feet; 3. *Amphistegina lopeztrigoi* at 1301-1308 feet; 4. *Pseudophragmina zaragosensis* at 1416-1438 feet; 5. *Coskinolina elongata* at 1482-1495 feet.

The *Dictyoconus cookei* and *Fabularia vughani* zones could not be ascertained because one sample covered the interval from 93 to 386 feet in this well.

The base of the middle Eocene is determined from samples from the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) as the samples for this interval are missing from the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166). The base of the middle Eocene occurs at about 1965 feet in this well as the sample at 1965-1986 feet contains Foraminifera of the *Borelis gunteri* zone.

From the data obtained from these two wells the middle Eocene has an approximate thickness of 1820 feet.

LOWER EOCENE.—The lower Eocene is characterized by *Borelis gunteri* and its variety *floridana*. Small Foraminifera are associated with these but they are in the form of casts so identification was not attempted.

The lithologic break between the middle and lower Eocene is not great, but the limestone in the upper portion of the lower Eocene is more porous than that in the lower portion of the middle Eocene.

In the lower portion of the lower Eocene some selenite occurs and the rocks are apparently non-fossiliferous.

The interval between the *Dictyoconus americanus* (*D. gunteri*) and the *Borelis gunteri* zones has been determined for a number of wells. These determinations are listed:

⁷ Campbell, Robert B., "Outline of the Geological History of Peninsular Florida," *Florida Acad. Sci. Proc.*, vol. 4, pp. 91-97, 1939.

WELL	Interval in feet between <i>D. americanus</i> and <i>B. gunteri</i> zones
†Florida Oil Discovery Company's Cedar Keys No. 2	1218
†Peninsular Oil and Refining Company's J. W. Cory No. 1.....	1300
*St. Mary's River Oil Corporation's Hilliard Turpentine Co. No. 1.....	1270
*J. S. Cosden's Lawson No. 1.....	1825
*Ocala Oil Corporation's Clark-Ray-Johnson No. 1.....	1220

†After Cole

*After Campbell

UPPER CRETACEOUS

SELMA FORMATION.—The determination of the contact between the lower Eocene and the Upper Cretaceous is based on the samples from the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) as samples are missing in this interval from the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166).

A soft, white chalk was encountered in the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) at 2531-2554 feet. This sample contained one specimen of *Lepidorbitoides*. The next sample (2554-2576 feet) contained numerous specimens of *Lepidorbitoides* (*Lepidorbitoides*) *minima* H. Douvillé, *L. (Lepidorbitoides) planasi* M. G. Rutten and a few specimens of *L. (Asterorbis) aguayoi* D. K. Palmer. At 2716-2736 feet specimens were found which are assigned to *L. (Asterorbis) rooki* Vaughan and Cole.

The section assigned to the Selma formation in the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) is mainly white chalk with some chalky limestone. In the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) samples representing the Selma begin at 2807 feet and are more variable in lithologic character than the samples from the Selma in W-355. Shale and some sandstone members occur interbedded with the chalk and chalky limestone. The discrepancy between the lithologic character of the Selma formation in the wells may be the result of the manner in which the samples were taken.

Small Foraminifera are found in both wells. Some of the more diagnostic are listed with the depth of their first appearance in each well.

Species	Sholtz No. 1 (W-166)	Cedar Keys No. 2 (W-355)
<i>Cibicides constrictus</i>	3112 feet	3045-3089 feet
<i>Stensiöina americana</i>	3175 feet	3165-3180 feet
<i>Gyroidina alabamensis</i>	3267 feet	3239-3268 feet

The base of the Selma formation is marked at a depth of 3680 feet in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) with the appearance of a hard, dark gray shale.

The thickness of the Selma formation is about 1149 feet. This formation had a thickness of 942 feet in the Granberry No. 1 (W-285).^s

EUTAW FORMATION.—The Eutaw formation consists of hard, dark gray shales, some chalk and sands in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166). In the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355), the samples for this portion of the well contain a large amount of chalk. An occasional small fragment of lignite, lignitic shale or hard shale in the sample from 3697 to 3720 feet indicated that the top of the Eutaw had been encountered. Not until a depth of 4044 feet had been reached, did the samples contain an abundance of shale. The top of the Eutaw is, however, recorded in this well on the first appearance of lignitic shale fragments at 3697-3720 feet.

The Eutaw has a thickness of 573 feet in the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355). In the Granberry No. 1 (W-285) the Eutaw had a thickness of 575 feet, and it contained much more sand and sandstone and the shales were micaceous. The lower Eutaw shales are micaceous in the Cedar Keys No. 2 (W-355), but not those in the upper portion of this formation.

TUSCALOOSA FORMATION.—The Tuscaloosa formation is present in the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355), but not in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166). The latter well was completed in the Eutaw at 4010 feet.

The top of the Tuscaloosa formation occurs at 4270 feet in the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) where a sandstone is encountered below the shales assigned to

^s Cole, W. Storrs, Florida Geol. Survey, Bull. 16, p. 28.

the Eutaw. Immediately below this sandstone there is red, sandy shale.

The Tuscaloosa in this area consists dominantly of red, light red, brown or mottled shales with interbedded sandstones. Occasionally, some lignite is found.

The well was completed at a total depth of 5266 feet, ending in a sandstone, the top of which was encountered at 5260 feet. There is 996 feet of Tuscaloosa present in this well. The well was completed in this formation and it is impossible to state the total thickness of the Tuscaloosa.

The Tuscaloosa formation in this well is similar in many respects to that reported from the Granberry No. 1 (W-285),⁹ except that the Tuscaloosa formation in the Granberry No. 1 had more sand and sandstones interbedded with the shales than is found in the Tuscaloosa of the Florida Oil Discovery Company's Cedar Keys No. 2 (W-355). The Tuscaloosa formation in both of these wells represents a continental phase.

ANALYSIS OF THE FAUNAS

OCALA LIMESTONE.—The fauna of the Ocala limestone of this area is similar to that found in many localities in Florida. The Ocala fauna of two deep wells has been studied in detail.¹⁰ Of these two wells the fauna found in the Ocala limestone of the United Brotherhood of Carpenters and Joiners of America Power House No. 2 (W-448) more nearly resembles that of the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) than does that of the Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445).

The chief element of the fauna of the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) is various species belonging to the genus *Camerina*. The fauna of the United Brotherhood of Carpenters and Joiners of America Power House No. 2 (W-448) has a more varied fauna, but several species of *Camerina* formed a considerable element in that fauna. The fauna of the Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445) is composed mainly of various species of *Lepidocyclus*.

⁹ Cole, W. Storrs, Florida Geol. Survey Bull. 16, p. 26, fig. 3.

¹⁰ Cole, W. Storrs, Florida Geol. Survey Bull. 19, pp.6-8, 16, 20.

The following species are common to the Ocala limestone of the United Brotherhood of Carpenters and Joiners of America Power House No. 2 (W-448) and the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166):

Camerina moodybranchensis Gravell and Hanna

Camerina vanderstoki (M. G. Rutten and Vermunt)

Camerina sp. probably *C. vanderstoki* (M. G. Rutten and Vermunt)

Lepidocyclina (Lepidocyclina) ocalana Cushman

MIDDLE EOCENE.—The fauna of the middle Eocene in these wells is entirely different from that reported from the Gulf Coast of the United States, or even that of the Granberry No. 1 (W-285).¹¹

The fauna of the two wells under consideration is similar to the Eocene faunas reported from other wells of peninsular Florida, particularly in the presence of such species as *Dictyoconus americanus*, *D. cookei*, *Borelis gunteri* and others.

One of the principal results of the study of the middle Eocene faunas in these wells was the recognition that the specimens of *Dictyoconus* formerly called *gunteri* should be referred to *americanus*. This suggests that a widespread correlation may eventually be made in the West Indian area with Florida as *D. americanus* is known from the island of St. Bartholomew (type locality of this species), Jamaica (as *D. codon*) and Haiti (as *D. codon*). It is probable that this species occurs in Cuba as a number of authors have referred to the occurrence of *Dictyoconus* in Cuba without giving specific details.

Vaughan¹² has already voiced the suspicion that the horizon of *Dictyoconus americanus* in St. Bartholomew may be middle instead of upper Eocene. This study supports Vaughan's suspicion.

Gunteria floridana has been reported from one middle Eocene locality in Cuba¹³ and *Amphistegina lopeztrigoi* has been re-

¹¹ Cole, W. Storrs, Florida Geol. Survey Bull. 16, pp. 21-25, pp. 31-34.

¹² Vaughan, T. Wayland, "American Species of the genus *Dictyoconus*," *Jour. Pal.*, vol. 6, p. 97, 1932.

¹³ Palmer, Dorothy K., "Some Large Fossil Foraminifera from Cuba," *Soc. Cubana Hist. Nat. Mem.*, vol. 8, p. 259, 1934.

ported from Cuba and Mexico.¹⁴ *Helicostegina gyralis* is associated with *Amphistegina lopeztrigoi* in Mexico, and also in Florida. Barker and Grimsdale give the horizon of these two species as lower middle Eocene which is identical with their stratigraphic position in the Florida wells. *Pseudophragmina zaragosensis*¹⁵ is another species reported from Mexico and found for the first time in Florida. Its stratigraphic position is the same for both areas. *Fabularia vauhani* has been reported from Jamaica by Hanzawa.¹⁶

Thus, it would appear that the faunas of the middle Eocene of peninsular Florida more nearly resemble those of Mexico and the West Indian region than those of the Gulf Coast of the United States. The middle Eocene faunas of Florida should prove an important connecting link in the paleontologic and stratigraphic studies of these areas.

LOWER EOCENE.—The lower Eocene fauna of peninsular Florida is little understood at the present time because of the poor state of preservation of the specimens. So far as the writer knows such species as have been recognized are not reported elsewhere.

UPPER CRETACEOUS.—The Upper Cretaceous fauna of the wells under discussion is rich in various species of *Lepidorbitoides*, most of which are known from Cuba. One species is reported from Mexico and another from the state of Mississippi in addition to the Cuban records.

The uppermost portion of the Upper Cretaceous of this area is different from that reported from the Granberry No. 1 (W-285)¹⁷ in that *Lepidorbitoides* was not found in the Granberry No. 1 (W-285). The similarity of the Upper Cretaceous fauna in these wells with that in the Granberry Well commences with the appearance of the species *Stensiöina americana* Cushman at a depth of 3175 feet.

¹⁴ *Ibid.*, p. 255.

Barker, R. Wright and Grimsdale, Thomas F., "A Contribution to the Phylogeny of the Orbitoidal Foraminifera with Descriptions of New Forms from the Eocene of Mexico," *Jour. Pal.*, vol. 10, p. 233, 247, 1936.

¹⁵ Vaughan, T. Wayland, "Descriptions of New Species of Foraminifera of the Genus *Discocyclina* from the Eocene of Mexico," *U. S. Nat. Museum Proc.*, vol. 76, p. 14, 1929.

¹⁶ Hanzawa, Shoshiro, "Notes on Some Interesting Cretaceous and Tertiary Foraminifera from the West Indies," *Jour. Pal.*, vol. 11, p. 112, 113, 1937.

¹⁷ Cole, W. Storrs, Florida Geol. Survey Bull. 16, p. 25.

PALEONTOLOGICAL RECORD

SUWANNEE PETROLEUM CORPORATION'S SHOLTZ NO. 1 (W-166)

- 115 feet.
Camerina vanderstoki (M. G. Rutten and Vermunt)
- 120 feet.
Camerina jacksonensis Gravell and Hanna
moodybranchensis Gravell and Hanna
Lepidocyclina (*Lepidocyclina*) *ocalana* Cushman
- 130 feet.
Fibularia vauhani (Twitchell)
- 145 feet.
Dictyoconus cookei (Moberg)
- 165 feet.
Coskinolina floridana Cole
- 200 feet.
Amphistegina pinarensis Cushman and Bermudez
Discorinopsis gunteri Cole
Lituonella floridana Cole
- 310 feet.
Fabularia vauhani Cole and Ponton
- 330 feet.
Spirolina coryensis Cole
- 340 feet.
Textularia coryensis Cole
- 840 feet.
Asterigerina cedarkeysensis Cole, n. sp.
Criobulimina floridana Cole, n. sp.
Dictyoconus americanus (Cushman)
Discorbis inornatus Cole, n. sp.
Eponides gunteri Cole, n. sp.
Globulina sp.
Lepidocyclina (*Pliolepidina*) *cedarkeysensis* Cole, n. sp.
Sigmomorphina floridana Cole, n. sp.
- 1050 feet.
Gunteria floridana Cushman and Ponton (rare)
- 1100 feet.
Gunteria floridana Cushman and Ponton (abundant)
- 1340 feet.
Amphistegina lopeztrigoi D. K. Palmer
- 1355-1365 feet.
Helicostegina gyralis Barker and Grimsdale
Linderina floridensis Cole, n. sp.
Pseudorbitolina cubensis Cushman and Bermudez
- 1470 feet.
Pseudophragmina (*Proporocyclina*) *zaragosensis* (Vaughan)
- 1497 feet.
Coskinolina elongata Cole, n. sp.
Lituonella elegans Cole, n. sp.
- 1525 feet.
Clavulina floridana Cole, n. sp.
Discorbis suturalis Cole, n. sp.
Nonion sp.
Siphonina sp.
- Samples missing from 1930 to 2090 feet.

2554-2576 feet.

Lepidorbitoides (*Lepidorbitoides*) *minima* H. Douvillé
planasi M. G. Rutten
 (*Asterorbis*) *aguayoi* D. K. Palmer

2716-2736 feet.

Lepidorbitoides (*Asterorbis*) *rooki* Vaughan and Cole

2737-2760 feet.

Lepidorbitoides (*Lepidorbitoides*) *floridensis* Cole, n. sp.

3045-3089 feet.

Cibicides constrictus (Hagenow)

3165-3180 feet.

Stensioina americana Cushman

3239-3268 feet.

Gyroidina alabamensis Sandidge

DESCRIPTION OF CORES

FLORIDA OIL DISCOVERY COMPANY'S CEDAR KEYS No. 2 (W-355)

Feet

- 1510-15 (Core) Light brown, porous, foraminiferal limestone (largely composed of Foraminifera).
 1518-21 (Core) White, porous, foraminiferal limestone with abundant calcite crystals.
 4045-48 (Core) Light and dark gray, calcareous shale. Light gray fragments are soft, but the dark gray fragment is hard.
 4059-62 (Core) Dark gray, calcareous, hard, shale.
 4213-17 (Core) Hard, dark gray, calcareous shale showing a few minute specks of mica on broken surfaces.
 4311-18 (in cutter head) Fine grained gray sandstone with some light red streaks and mottlings.
 4324-26 Medium coarse, loosely cemented, white sandstone with some flakes of muscovite (one fragment), flat fragments of dark gray shale with their corners rounded, enclosed in yellowish brown shale (several fragments).
 4328-30 Medium coarse, loosely cemented, slightly micaceous sandstone with a slight brownish color.
 4382-86 (Core) Largely fragments of mottled, calcareous shale with some streaks of fine-grained tightly cemented sandstone.
 4392-4400 Dark gray, hard, calcareous, slightly micaceous shale.
 4412-14 Mottled dark gray to light pink, soft shale.
 4446-55 (Core) Medium coarse, very poorly cemented (with ash) sandstone stained a light tan color.
 4447-51 (Core) See 4446-55, except gray in color.
 4879-4903 Light red colored shale.
 4964-66 Medium coarse, gray sandstone with abundant ash cement.
 5170 Yellowish brown shale with some dark gray shale fragments.
 5200 Yellowish brown shale.

DESCRIPTION OF SPECIES

FAMILY VALVULINIDAE

Subfamily VALVULININAE

Genus CLAVULINA d'Orbigny, 1826

CLAVULINA FLORIDANA Cole, n. sp.

Plate 2, Figures 6, 7

Test elongate, stout, earlier portion triserial, later uniserial; the initial triserial portion of the test is triangular in transverse section with flat sides and bluntly rounded edges, the uniserial portion is rounded; sutures are indistinct in the triserial portion, but more distinct in the uniserial part where they are slightly depressed; wall finely arenaceous and smoothly finished; aperture terminal, rounded, with a distinct valvular tooth.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 1525 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1885) measures: Length, 1.74 mm.; diameter, 0.72 mm.

Occurrence: Lower middle Eocene.

Cushman¹⁸ states that "no typical Clavulinas occur in the American Tertiary at this time" (middle Eocene). These specimens, however, seem to belong to this genus.

Clavulina corrugata Deshayes from the upper Eocene of France is described as having the later chambers "in a loose spiral becoming nearly uniserial."¹⁹ This structure may be observed in *C. floridana* just above the triserial portion. *C. corrugata* maintains this spiral structure to the terminal end, but in *C. floridana* the final chambers are uniserial. The sutures of *C. corrugata* are more depressed and the final chambers more inflated.

Genus CRIBROBULIMINA Cushman, 1927

CRIBROBULIMINA FLORIDANA Cole, n. sp.

Plate 1, Figures 7, 8

Test subglobular, periphery broadly rounded, last formed whorl comprising most of the test; chambers increase rapidly in

¹⁸ Cushman, J. A., Cushman Lab. Foram. Res. Sp. Publ. No. 8, p. 15, 1937.

¹⁹ *Ibid.*, p. 18.

size as added; about 6 or 8 chambers in the last formed whorl; sutures between the last two or three chambers very slightly depressed; those between the other chambers not depressed, obscure; wall finely arenaceous, very smoothly finished; aperture with a large valvular plate, fused to the edge of the final chamber, but pierced around the outer edge by small, circular openings and with supplementary openings developed in the central area of the plate.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 860 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1873) measures: Length, 2.12 mm.; breadth, 1.53 mm.; thickness, 1.70 mm.

Occurrence: Middle Eocene.

Although the initial chambers are obscure, the aperture indicates that this form belongs to the genus *Cribratulimina*. *C. polystoma* (Parker and Jones)²⁰ has the test sharply angled, but *C. floridana* is broadly rounded.

Subfamily EGGERELLINAE

Genus PSEUDORBITOLINA Douvillé, 1910

PSEUDORBITOLINA CUBENSIS Cushman and Bermudez

Plate 3, Figure 4; Plate 5, Figure 1

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.

Only three specimens of this species were recovered, two from the Sholtz No. 1 (W-166) and one from the Cedar Keys No. 2 (W-355). The specimens are slightly smaller than those found in the United Brotherhood of Carpenters and Joiners of America Power House Well (W-448)²¹ In that well *P. cubensis* occurred in the *Dictyoconus cookei* zone, but in the wells under consideration they were found lower in the middle Eocene section.

²⁰ *Valvulina polystoma* Parker, W. K. and Jones, T. R., "On some foraminifera from the North Atlantic and Arctic Ocean, including Davis Strait and Baffin's Bay," *Royal Society London Philos. Trans.*, London, vol. 155, pp. 437-438, Table X (1865).

²¹ Cole, W. Storrs, Fla. Geol. Survey Bull. 19, p. 22.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 1355-1365 feet; in the Cedar Keys No. 2 (W-355) at a depth of 1287-1300 feet.

Occurrence: Lower middle Eocene (these specimens may represent cavings).

Genus LITUONELLA Schlumberger, 1905

LITUONELLA ELEGANS Cole, n. sp.

Plate 3, Figure 7; Plate 5, Figures 9, 10; Plate 16, Figures 5, 9

Test short, stout, circular in cross-section, initial end pointed, twisted to one side of the test. The surface of the test is unornamented. The length of an average sized individual is 0.96 mm., the diameter at the base is 0.66 mm.

The marginal trough has a width of about 120 μ ; the thickness of the floor of the marginal trough is about 40 μ . The outer wall of the test has a thickness of 20 to 50 μ . The central shield area is much reduced in size and is composed of a series of irregular pillars.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 1497 feet.

Cotypes (Fla. Geol. Survey Cat. No. S-1883).

Occurrence: Lower middle Eocene.

L. elegans is a much smaller species than *L. floridana* Cole.²² *L. floridana* has surface corrugations which are lacking on *L. elegans*.

LITUONELLA FLORIDANA Cole

Plate 5, Figure 8

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.

Specimens which represent this species were found infrequently in the Sholtz No. 1 (W-166) starting at a depth of 165 feet. The state of preservation was poor.

Occurrence: Upper middle Eocene.

²² Cole, W. Storrs, Florida Geol. Survey Bull. 19, p. 23, pl. 3, figs. 14-17; pl. 4, fig. 10; pl. 6, figs 9-11.

Genus COSKINOLINA Stache, 1875

COSKINOLINA ELONGATA Cole, n. sp.

Plate 3, Figures 15-17; Plate 4, Figures 1-3; Plate 5, Figures 2-7;
Plate 16, Figure 6

The measurements of five typical specimens from the Sholtz No. 1 (W-166) are:

Height	Diameter of base
1.15mm.	1.15mm.
1.40	1.36
1.53	1.0
1.70	1.19
2.08	1.44

The test is in the shape of a cone of which some have the diameter at the base equal to the height and others have the diameter at the base smaller than the height. All gradations occur between the shorter, broader forms and the elongate types. The surface of the cone is unornamented, although commonly the juncture between the cups show as a depressed area encircling the test. The base of the test is slightly convex. The apex of the cone may be pointed or slightly inflated in which case it is to one side of the axis of the test.

The measurements of various internal features are given in the following table. All the specimens are from the Sholtz No. 1 (W-166).

Depth in feet	1497	1500-05	1525
Width of marginal trough.....	140 μ	160 μ	160 μ
Distance between chamber partitions.....	120 μ	200 μ	180 μ
Height of cups	80 μ	80 μ	80 μ
Thickness of floor of marginal trough	30 μ	30 μ	20 μ
Thickness of floor of central shield	40 μ	40 μ	40 μ
Diameter of perforations of central shield	40 μ	50 μ	40 μ
Spacing of perforations (center to center)	100 μ	100 μ	100 μ
Thickness of outer wall	25 μ	20 μ	20 μ

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 1497 feet.

Cotypes (Fla. Geol. Survey Cat. No. S-1882).

Occurrence: Lower middle Eocene.

C. elongata is a larger form with coarser internal structure than *C. floridana* Cole.²³ *C. floridana* consistently has the cham-

²³ Cole, W. Storrs, Florida Geol. Survey, Bull. 19, p. 24, 25, pl. 3, figs. 1-7; pl. 4, figs. 1-9; pl. 5, figs. 1-5, 11; pl. 18, fig. 9, 1941.

bers of the marginal trough divided by a single vertical plate, but this feature occurs only rarely in specimens assigned to *C. elongata*.

COSKINOLINA FLORIDANA Cole

Plate 4, Figures 4, 5

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, fig. 1-9; pl. 5, figs. 1-5, 11; pl. 18, fig. 9.

Typical specimens of this species were found in the Sholtz No. 1 (W-166) at a depth of 165 feet.

Occurrence: Upper middle Eocene.

Genus DICTYOCONUS Blanckenhorn, 1900

DICTYOCONUS AMERICANUS (Cushman)

Plate 3, Figures 12, 13; Plate 6, Figures 1-9; Plate 7, Figures 1-5;
 Plate 16, Figures 14, 15

1919. *Conulites americana* Cushman, Carnegie Inst. Wash. Publ. 291, p. 43, text-fig. 3.
 1924. *Dictyoconus codon* Woodring, Geology Repub. Haiti, p. 608, pl. 9, figs. 1, 2.
 1924. *Dictyoconus puilboreauensis* Woodring, Geology Repub. Haiti, p. 609, pl. 9, figs. 3, 4, 7, 8.
 1925. *Cushmania americana* (Cushman). Silvestri, Acad. Lincei mem., 2d ser., vol. 8, p. 52.
 1928. *Dictyoconus* ? *gunteri* Moberg, Florida Geol. Survey, 19th Ann. Rept., p. 168, pl. 3, figs. 9, 10; pl. 4, figs. 1-3.
 1928. *Dictyoconus codon* Woodring. Vaughan, Jour. Pal., vol. 1, p. 280, pl. 43, figs. 1-5.
 1928. *Dictyoconus puilboreauensis* Woodring. Vaughan, Jour. Pal., vol. 1, p. 281, pl. 43, fig. 6.
 1930. *Dictyoconus puilboreauensis* Woodring. Davies, Roy. Soc. Edinburgh Trans., vol. 56, p. 504, pl. 56, fig. 12.
 1932. *Dictyoconus codon* Woodring. Vaughan, Jour. Pal., vol. 6, p. 97, pl. 14, figs. 1-2.
 1932. *Dictyoconus americanus* (Cushman). Vaughan, Jour. Pal., vol. 6, p. 95, pl. 14, figs. 3-5.
 1937. *Dictyoconus americanus* (Cushman). Cushman, Cushman Lab. Foram. Res., Sp. Publ. No. 8, p. 189, pl. 23, figs. 6-9.
 1937. *Dictyoconus codon* Woodring. Cushman, Cushman Lab. Foram. Res., Sp. Publ. No. 8, p. 190, pl. 23, figs. 10-14.
 1937. *Dictyoconus gunteri* Moberg. Cushman, Cushman Lab. Foram. Res., Sp. Publ. No. 8, p. 191, pl. 24, figs. 1-3.
 1941. *Dictyoconus gunteri* Moberg. Cole, Florida Geo. Survey, Bull. 19, pp. 27, 28, pl. 3, figs. 8-10; pl. 7, figs. 2-6, 8.
 1941. *Dictyoconus codon* Woodring. Cole, Florida Geol. Survey, Bull. 19, p. 28, pl. 7, figs. 1, 7; pl. 18, figs. 10, 11.

In 1928 Mrs. Moberg erected the species *gunteri* for certain specimens questionably assigned to the genus *Dictyoconus*. The type specimens were selected from the Ocala Oil Corporation's Well near York (W-2), Marion County, Florida. Mrs. Moberg²⁴ states "Specimens from a well at Marathon, Florida, previously identified by Doctor Vaughan (1924, p. 803) as *D. codon* Woodring, appear to be *D. ? gunteri*."

Earlier Cushman²⁵ had referred these specimens to the genus *Orbitolina*, although in 1927 he revised his determination²⁶ Vaughan²⁷ definitely proved that the question mark placed by Mrs. Moberg after her generic identification should be removed. Vaughan²⁸ figured a portion of a horizontal section of a specimen from a depth of 2000 feet from the well at Marathon, Florida. This section definitely showed that the marginal trough was divided into chamberlets which were subdivided into cellules. By means of a key, Vaughan attempted to present characters which would serve to separate the species of *Dictyoconus* which had been described from America at the time he wrote. The essential factors of this key are rearranged here in tabular form.

Species	Distance between platforms at center at periphery		Character of cellules
<i>D. gunteri</i>	0.04 mm. or less	0.06-0.08 mm.	Few
<i>D. codon</i>	0.05 mm.	0.10 mm.	More numerous than in <i>D. gunteri</i>
<i>D. americanus</i>	0.38-0.054 mm.		Relatively numerous but cavities may be filled with a compact- ing substance
<i>D. fontabellensis</i>	0.05 mm. at base; 0.175-0.20 mm. 0.175 mm. near summit		Most numerous

Vaughan²⁹ states that the usual number of subdivisions of each chamberlet is three in *D. americanus*. In the type description of *D. fontabellensis* the number of short lamellae that project inward between the peripheral platforms is given as about

²⁴ Moberg, M. Wilcox, *Florida Geol. Survey, 19th Ann. Rept.*, p. 170, 1928.

²⁵ Cushman, J. A., *Florida Geol. Survey, 13th Ann. Rept.*, p. 42, 1921.

²⁶ Cushman, J. A., *Washington Acad. Sci. Jour.*, vol. 17, p. 199, 1927.

²⁷ Vaughan, T. Wayland, *Jour. Pal.*, vol. 6, p. 98, 1932.

²⁸ *Ibid.*, pl. 14, fig. 8.

²⁹ Vaughan, T. Wayland, *Jour. Pal.*, vol. 6, p. 97, 1932.

7.³⁰ Specimens of *D. codon* from Jamaica³¹ have from one to four although the number may be somewhat more.

For comparison with the specimens from the Sholtz No. 1 (W-166) and the Cedar Keys No. 2 (W-355) the writer had available 10 thin sections of *D. codon* from the type locality of that species, 4 thin sections from specimens recovered at a depth of 2000 feet in the Marathon Well (W-2) and numerous sections of specimens from the J. W. Cory No. 1 (W-445).³² In addition one horizontal section was made available by Dr. T. Wayland Vaughan of a specimen from St. Bartholomew which he identified as *D. americanus*.

Previously, in studying the specimens from the J. W. Cory No. 1 (W-445) the conclusion was reached that *D. gunteri* was specifically identifiable and distinct from the other American species of *Dictyoconus*. However, as more specimens and thin sections were examined the inescapable decision was reached that the specimens which were given the name *gunteri* in reality represented *codon*. Vaughan³³ and Cushman³⁴ had arrived at this conclusion before Mrs. Moberg created the species *gunteri*.

In the topotype specimens of *D. codon* it was observed that the usual number of short lamellae that project from the lateral walls into the cavities between the platforms was three (pl. 6, figs. 7, 8). This same condition was observed in specimens from the Marathon Well (W-2) (pl. 16, fig. 14), the J. W. Cory No. 1 (W-445) (pl. 6, figs. 2, 9) and the Sholtz No. 1 (W-166) pl. 7, fig. 1). Unfortunately, the specimens from the Sholtz No. 1 (W-166) are not so well preserved as the other specimens, but detailed analysis shows that the three short lamellae to each chamber are the normal condition.

Mrs. Moberg³⁵ states "*Dictyoconus gunteri* differs from *D. codon* Woodring by its smaller size, broader apex and fewer, more definitely arranged labyrinthic chambers. The layers of labyrinthic chambers are arranged parallel to the concave base

³⁰ Vaughan, T. Wayland, *Jour. Pal.*, vol. 1, p. 282, 1928.

³¹ *Ibid.*, p. 281.

³² Cole W. Storrs, Florida Geol. Survey, Bull. 19, pp. 27, 28, pl. 3, figs. 8-10, pl. 7, figs. 2-6, 8.

³³ Vaughan, T. Wayland, *Geol. Soc. Amer. Bull.*, vol. 35, p. 803, 1924.

³⁴ *Op. cit.*, p. 199, 1927.

³⁵ *Op. cit.*, p. 169.

in this species, while in *D. codon* Woodring they are convex toward the base."

These contentions are best refuted by illustrations. Comparison of figures 1, 5, 7, 8, Plate 6 and figure 15, plate 16 (*D. codon*) with figures 2-4, 6, 9 of this same plate and figure 14, plate 16 (*D. gunteri*) show that there is no essential difference in size, shape or internal arrangement in selected specimens of *D. codon* or *D. gunteri*. Detailed measurements of internal structures are similar for the Haitian and Floridan specimens when specimens of approximately the same size are selected. This is illustrated by figures 7, 8, 9, plate 6 and figures 4, 5, plate 7.

Vaughan³⁶ has refigured the type specimen of *D. americanus*. This specimen has a height of 1.2 mm. and a diameter at the base of 1.8 mm. The number of subdivisions of each chamberlet is 3. There is no observable characteristic which would serve to separate the type specimen of *D. americanus* or the one thin section of a specimen referred to this species (pl. 7, fig. 2) which I have examined from selected specimens of *D. codon* and *D. gunteri*. Thus, the conclusion is reached that the names *codon* and *gunteri* must go into synonymy under *americanus*.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 840 feet; in Cedar Keys No. 2 (W-355) at a depth of 833-855 feet.

Occurrence: Upper middle Eocene.

The identification of specimens previously called *gunteri* and *codon* with *americanus* opens the way for a correlation of middle Eocene deposits between the Plaisance limestone, Republic of Haiti, the "yellow limestone" of middle Eocene age at several localities in Jamaica, the St. Bartholomew formation, St. Bartholomew, Leeward Islands and the middle Eocene of Florida.

DICTYOCONUS COOKEI (Moberg)

Plate 3, Figure 10; Plate 4, Figure 8

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.

³⁶ Vaughan, T. Wayland, *Jour. Pal.*, vol. 6, pl. 14, fig. 4, 1932.

This species has been discussed and a number of illustrations of it have been published in connection with the study of the faunas encountered in the J. W. Cory No. 1 (W-445) and the United Brotherhood of Carpenters and Joiners of America Power House Well No. 2 (W-448). The specimens found in the Sholtz No. 1 (W-166) are entirely typical, although most of them are badly eroded (see fig. 10, pl. 3).

Illustrations of *D. walnutensis*³⁷ are given (figs. 6, 7, pl. 4) for comparison with *D. cookei*.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 145 feet.

Occurrence: Upper middle Eocene.

Family MILIOLIDAE

Genus FABULARIA Defrance, 1820

FABULARIA VAUGHANI Cole and Ponton

Plate 3, Figure 14; Plate 15, Figure 1

1934. *Fabularia vauhani* Cole and Ponton, Amer. Midland Nat. vol. 15, pp. 139-141, pl. 1, figs. 1-9.
 1937. *Fabularia vauhani* Cole and Ponton. Hanzawa, Jour. Pal., vol. 11, pp. 111-113, pl. 20, figs. 1-4.

Typical specimens of this species were found at a depth of 310 feet in the Sholtz No. 1 (W-166). The occurrence of this species in this well was recorded by Cole and Ponton in the original description of the species.

Cole and Ponton (pl. 1, fig. 12) reported the occurrence of *Fabularia* sp. from a limestone core at a depth of 4518-4531 feet from the Miami Oil and Gas Company's Well (W-147).³⁸ These specimens should not be referred to *Fabularia*, but instead to *Borelis*. They probably represent *B. gunteri* and its variety *floridana*.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 310 feet.

Occurrence: Upper middle Eocene about 165 feet below the top.

³⁷ *Orbitolina walnutensis* Carsey, D. O., *Foraminifera of the Cretaceous of Central Texas*, Texas University Bulletin No. 2612, Austin, 1926.

³⁸ Cole, W. Storrs and Ponton, Gerald M., "New Species of *Fabularia*, *Asterocyclina* and *Lepidocyclina* from the Florida Eocene," *Amer. Midland Nat.*, vol. 15, p. 139, 1934.

Fabularia vaughani should be an important stratigraphic marker as it is large, easily recognized and apparently has a short vertical range.

Family POLYMORPHINIDAE

Subfamily POLYMORPHININAE

Genus SIGMOMORPHINA Cushman and Ozawa, 1928

SIGMOMORPHINA FLORIDANA Cole, n. sp.

Plate 1, Figures 11, 12

Test elongated, greatest breadth just above base, tapering toward the apertural end; chambers much elongated and rather slender, slightly embracing, arranged in a contraclockwise sigmoid series, each succeeding chamber removed from the base; sutures of clear shell material, distinct, very slightly depressed; wall smooth, unornamented; aperture radiate.

Holotype (Fla. Geol. Survey Cat. No. S-1866) measures: Length, 1.19 mm.; breadth just above base, 0.54 mm.; thickness just above base, 0.30 mm.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 840 feet.

Occurrence: Upper middle Eocene.

This species is similar to *S. trilocularis* Baggs,³⁹ but *S. trilocularis* has chambers which are roundly triangular in cross-section. *S. floridana* has compressed chambers.

Family CAMERINIDAE

Subfamily CAMERININAE

Genus CAMERINA Brugiére, 1792

CAMERINA JACKSONENSIS Gravell and Hanna

Plate 8, Figures 3-5

1935. *Camerina jacksonensis* Gravell and Hanna, Jour. Pal., vol. 9, p. 331, pl. 29, figs. 1-5, 7, 8, 10-11, 13-14.
1939. *Camerina jacksonensis* Gravell and Hanna. Barker, U. S. Nat. Mus. Proc., vol. 86, p. 324, pl. 13, fig. 6; pl. 20, fig. 8; pl. 22, fig. 9.

³⁹ *Polymorphina trilocularis* Baggs, R. M. Jr., *Pliocene and Pleistocene Foraminifera from Southern California*, U. S. Geol. Survey Bull. 513, p. 75, 1912.

The salient internal features of this species are summarized below:

HORIZONTAL SECTIONS

Diameter	Number of chambers in final volution	Number of coils	Diameter of initial chamber
2.3 mm.	20	4	80 μ
2.2 mm.	21	3 $\frac{1}{8}$	140 μ

VERTICAL SECTION

Diameter	Thickness	Surface diameter of axial plug	Diameter of initial chamber
2.3 mm.	0.96 mm.	0.3 mm.	140 μ

First appearance: In the Sholtz No. 1 (W-166) at a depth of 120 feet.

Occurrence: Ocala limestone.

CAMERINA MOODYBRANCHENSIS Gravell and Hanna

Plate 8, Figures 6-8

1935. *Camerina moodybranchensis* Gravell and Hanna, Jour. Pal., vol. 9, p. 332, pl. 29, figs. 15, 22-24.
 1939. *Camerina moodybranchensis* Gravell and Hanna. Barker, U. S. Nat. Mus. Proc., vol. 86, 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.

The specimens from the Sholtz No. 1 (W-166) are entirely typical. This species was reported previously from Florida from the Carpenters Home Well (W-448).

First appearance: In the Sholtz No. 1 (W-166) at a depth of 120 feet.

Occurrence: Ocala limestone.

CAMERINA VANDERSTOKI (Rutten and Vermunt)

Plate 3, Figure 8; Plate 8, Figures 1, 2, 9, 10

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, U. S. Nat. Mus. Proc., vol. 86, 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.

Specimens assigned to this species are identical to those reported from the United Brotherhood of Carpenters and Joiners Power House Well (W-448) from a depth of 258-265 feet. Meas-

urements made on the specimens from the Sholtz No. 1 (W-166) follow:

Diameter	Thickness	Number of whorls	Chambers in final whorl	Diameter of initial chamber
3.3 mm.	1.4 mm.	5	25	140 μ

First appearance: In the Sholtz No. 1 (W-166) at a depth of 115 feet.

Occurrence: Ocala limestone.

Associated with the typical specimens of *C. vanderstoki* are other specimens (pl. 8, figs. 1, 2) which may represent a new species. However, the differences are mainly in the transverse sections. The spiral lamina is thicker in these specimens than in typical *C. vanderstoki*. Specimens of this type were found in the United Brotherhood of Carpenters and Joiners of America Power House Well No. 2 (W-448) in association with *C. vanderstoki*. (See Florida Geol. Survey Bull. 19, pl. 8, figs. 7-10.)

Family ALVEOLINELLIDAE

Genus BORELIS Montfort, 1808

BORELIS GUNTERI Cole

1941. *Borelis gunteri* Cole, Florida Geol. Survey Bull. 19, p. 34, pl. 2, figs. 1-3; pl. 18, figs. 5, 6.

Illustrations of this species and its variety *floridana* have been presented in Bulletin 19 from the Sholtz No. 1 (W-166). There is no need to refigure either this species or its variety. The state of preservation of the specimens from these wells is not especially good and adequate thin sections are hard to prepare.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 2090-2100 feet. (Samples missing from 1930 to 2090 feet); in the Cedar Keys No. 2 at a depth of 2051-2073 feet.

Occurrence: Lower Eocene.

Family BULIMINIDAE

Genus GUNTERIA Cushman and Ponton, 1933

GUNTERIA FLORIDANA Cushman and Ponton

Plate 16, Figures 1-4

1933. *Gunteria floridana* Cushman and Ponton, Contrib. Cushman Lab. Foram. Res., vol. 9, pp. 25-30, pl. 3, figs. 1-3.
 1934. *Gunteria floridana* Cushman and Ponton. D. K. Palmer, Soc. Cubana Hist. Nat. Mem., vol. 8, pp. 257-259, pl. 15, figs. 5, 7, 9; pl. 16, figs. 1, 2, 4, 5, 8.

1937. *Gunteria floridana* Cushman and Ponton. Cushman, Cushman Lab. Foram. Res., Sp. Publ. No. 8, p. 197, pl. 24, figs. 13-15.
 1939. *Gunteria floridana* Cushman and Ponton. Davies, Roy. Soc. Edinburgh Trans., vol. 59, pp. 779, 780, pl. 1, figs. 2, 5, 8, 10, 11.

The type specimens of this species are from the Sholtz No. 1 (W-166) at a depth of 1100 feet. Mrs. Palmer has found typical specimens of this species at one locality in Cuba.

Cushman and Ponton placed the genus *Gunteria* in the family Valvulinidae, stating "It is apparently a very highly specialized genus and so far as is known represents the most complex member of the Valvulinidae." Cushman⁴⁰ retains *Gunteria* in this family in spite of the contention of Davies⁴¹ "that the wall of the test is, indeed, typically perforate; so the genus *Gunteria* really belongs to the hyaline division of the Foraminifera; its communication with the outer world extended all round its surface, and were not limited to its base as in *Dictyoconus*." Davies suggests that *Gunteria* is more nearly related to the genus *Pavonina* than to the genus *Dictyoconus* and its allies.

Although Mrs. Palmer⁴² states "Unlike *Dictyoconus*, this arenaceous structure appears to be limited to the surface," her description of the embryonic chambers might be interpreted as indicating that in its initial development *Gunteria* is triserial.

The specimens from the Florida well do not appear to be arenaceous. The writer is inclined to agree with Davies, but most of the Floridan specimens are slightly water worn so that the arenaceous character might have been destroyed.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 1100 feet; in Cedar Keys No. 2 (W-355) at a depth of 1102-1132 feet.

Occurrence: Upper middle Eocene about 955 feet below the top.

Cushman and Ponton state that in the examination of the samples from the Sholtz No. 1 (W-166) the first specimens of this species were found at a depth of 1055 feet, but that abundant specimens did not appear until the sample at 1100 feet was examined.

In the main zone specimens are extremely abundant. This species has a very restricted vertical range.

⁴⁰ Cushman, J. A., *Foraminifera*, Harvard Univ. Press, p. 132, 1940.

⁴¹ Davies, L. M., *Roy. Soc. Edinburgh Trans.*, vol. 59, p. 780, 1939.

⁴² Palmer, Dorothy K., *Soc. Cubana Hist. Nat. Mem.*, vol. 8, p. 258, 1934.

Family ROTALIIDAE
Subfamily DISCORBINAE
Genus DISCORBIS Lamarck, 1804

DISCORBIS SUTURALIS Cole, n. sp.

Plate 2, Figures 3, 4

Test plano-convex, dorsal side strongly convex, with a rather sharply pointed spire, ventrally flattened or concave with a marked umbilicus; about 8 chambers in the final whorl which increase very rapidly in size as added; sutures on the dorsal side are wide, limbate and raised, ventrally the sutures are obscure; a series of channels radiate out from the umbilicus, but do not extend to the periphery of the test which is smooth and broadly rounded; aperture ventral, low.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 1525 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1886) measures: Length, 0.90 mm.; breadth, 0.76 mm.; height, 0.60 mm.

Occurrence: Lower middle Eocene.

Discorbis incrustatus Cushman and Bermudez⁴³ has raised sutures on the dorsal side, but the shape of the chambers is different from those of *D. suturalis* which increase very rapidly in size. *D. incrustatus* lacks the ventrally radiating channels from the umbilicus which are so prominent in *D. suturalis*.

DISCORBIS INORNATUS Cole, n. sp.

Plate 1, Figures 1-3

Test plano-convex, dorsal side convex with a moderately high spire, ventrally flattened, periphery subacute, not definitely keeled, but outlined in clear shell material; 5 chambers, distinct dorsally and ventrally, comprise the final volution, dorsally the chambers of the spire are indistinct; sutures on the dorsal side are recurved, composed of clear shell material and flush with the surface of the test; ventrally the sutures are slightly recurved, nearly radiate, depressed particularly near the small umbilicus and toward the apertural end; ventrally, the inner ends of the chambers are thickened and raised into knob-like projections which nearly obscure the umbilicus; wall smooth, unornamented; aperture, ventral, low.

⁴³ Cushman, J. A., and Bermudez, Pedro J., *Contrib. Cushman Lab. Foram. Res.*, vol. 13, p. 21, pl. 2, figs. 17, 18, 1937.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 840 feet.

Appearance elsewhere: In the Cedar Keys No. 2 (W-355) at a depth of 811-833 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1865) measures: Diameter, 0.62 mm.; height, 0.34 mm.

Occurrence: Upper middle Eocene.

D. inornatus differs from *D. alveata* Cushman⁴⁴ in its larger size and by possessing a single knob-like projection at the inner edge of the chambers on the ventral side, whereas *D. alveata* has a series of channels radiating from the umbilicus.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA CRETOSA Cole, n. sp.

Plate 2, Figures 11, 12

Test small, subglobular, trochoid, tightly coiled, dorsal side slightly convex, ventral side strongly convex, with a very small umbilicus, peripheral margin broadly rounded; 8 or 9 chambers form the final coil, increasing gradually in size as added, not inflated; sutures gently curved dorsally, nearly radiate ventrally, limbate, flush with the surface; aperture a low slit at the base of the final chamber between the periphery and the umbilicus.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 3277 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1912) measures: Length, 0.36 mm.; breadth, 0.28 mm.; thickness, 0.22 mm.

Occurrence: Upper Cretaceous, Selma chalk.

Gyroidina nitida (Reuss)⁴⁵ is a closely related species, but has 4 to 6 chambers in the final volution.

Subfamily ROTALIINAE

Genus EPONIDES Montfort, 1808

EPONIDES GUNTERI Cole, n. sp.

Plate 1, Figures 4-6

Test equally biconvex, or with the ventral side strongly convex and the dorsal side much less so, periphery subangular, um-

⁴⁴ Cushman, J. A., *U. S. Geol. Survey Prof. Paper 181*, p. 44, pl. 17, figs. 4a-c, 1935.

⁴⁵ *Rotalina nitida* Reuss, A. E., *Geognostische Skizzen aus Böhmen; II—Die Kreidegebilde des westlichen Böhmens, ein monographischer Versuch*, C. W. Medau, Prag, Österreich, Bd. 2, p. 214, 1844.

bilicus either filled with clear shell material or showing as a slight depression; about 12-14 chambers in the final volution increasing gradually in size as added; sutures on the dorsal side slightly recurved, limbate and flush with the surface of the test, ventrally, radiate, strongly depressed near the periphery, but becoming less depressed as the umbilical region is approached; wall rather coarsely perforate dorsally, finely perforate ventrally; aperture a low, elongate opening at the margin of the ventral side of the last formed chamber.

Type locality: In the Sholtz No. 1 (W-166) at a depth of 840 feet.

Appearance elsewhere: In the Cedar Keys No. 2 (W-355) at a depth of 811-833 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1863) measures: Diameter, 1.4 mm.; height, 0.64 mm. Paratype (Fla. Geol. Survey Cat. No. S-1863a) measures: Diameter, 0.85 mm.; height, 0.42 mm.

Occurrence: Upper middle Eocene.

This species superficially resembles *E. jucundus* Bermudez.⁴⁶ However, *E. jucundus* has about 8 chambers in the final volution, but *E. gunteri* has 12-14 chambers. *E. jucundus* has a distinct keel and the shape of the test is plano-convex with the dorsal side strongly convex. *E. gunteri* lacks the keel and the test is equally biconvex, or with the ventral side more convex than the dorsal. Mrs. D. K. Palmer kindly sent me topotype specimens of *E. jucundus* for comparison with the Florida specimens.

This species is named in honor of Herman Gunter, State Geologist of Florida.

Family AMPHISTEGINIDAE

Genus ASTERIGERINA d'Orbigny, 1839

ASTERIGERINA CEDARKEYSENSIS Cole, n. sp.

Plate 1, Figures 9-10

Test trochoid, biconvex, periphery sharp, angular, outlined in clear shell material, but lacking a distinct keel; dorsally, all the coils are visible; ventrally, the chambers of the last volution show peripherally with well developed secondary chambers and

⁴⁶ Bermudez, Pedro J., *Soc. Cubana Hist. Nat. Mem.*, vol. 11, pp. 145, 146, pl. 18, figs. 4, 5, 1937.

a large umbilical boss occupying the central area; dorsally, about $2\frac{1}{2}$ coils are visible with 7 chambers in the final whorl; sutures are composed of clear shell material and are flush with the surface of the test; wall smooth, finely perforate except for a roughened area near the aperture.

Type locality: In the Sholtz No. 1 (W-166) at a depth of 840 feet.

Appearance elsewhere: In the Cedar Keys No. 2 (W-355) at a depth of 833-855 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1861) measures: Diameter, 0.66 mm.; height, 0.40 mm.; diameter, ventral boss, 0.26 mm.

Occurrence: Upper middle Eocene.

This species differs from *A. texana* (Stadnichenko)⁴⁷ in possessing a much larger central boss and in lacking a wide, distinct keel. The papillate area near the aperture is larger and more pronounced in *A. texana* than in *A. cedarkeysensis*.

Genus AMPHISTEGINA d'Orbigny, 1826

AMPHISTEGINA LOPEZTRIGOI D. K. Palmer

Plate 15, Figures 2, 3; Plate 16, Figure 11

1934. *Amphistegina lopeztrigoi* D. K. Palmer, Soc. Cubana Hist. Nat. Mem., vol. 8, p. 255, pl. 15, figs. 6, 8.
 1936. *Amphistegina lopeztrigoi* D. K. Palmer. Barker and Grimsdale, Jour. Pal. vol. 10, p. 233, pl. 30, figs. 1, 2; pl. 32, figs. 1-3; pl. 34, fig. 1; pl. 38, fig. 3.

This is an easily recognized species because of the distinct ornamentation which is developed. The dorsal and ventral surfaces have a group of centrally placed prominent pustules. Mrs. Palmer states in the type description that this species attains a maximum diameter of 3 mm. with a thickness of 1.2 mm. The largest specimens from Florida have a diameter of 1.8 mm. A specimen in the present collection with a diameter of 1.5 mm. has a thickness of 0.7 mm. Barker and Grimsdale (p. 236) give the diameters of Mexican specimens assigned to this species as 1.0 to 1.5 mm. with a thickness of 0.65-0.8 mm.

⁴⁷ Stadnichenko, Maria M., Jour. Pal., vol. 1, pp. 232, 233, pl. 38, figs. 1-5, 1927.

A specimen with a diameter of 1.8 mm. has $3\frac{1}{8}$ coils in the spiral with 20 chambers in the final volution.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 1340 feet; abundant at a depth of 1355-1365 feet in this well. In the Cedar Keys No. 2 (W-355) at a depth of 1301-1308 feet.

Occurrence: Lower middle Eocene.

Mrs. Palmer kindly examined specimens of this species sent by the writer and stated that she agreed that the Florida specimens should be assigned to this species.

Genus *HELICOSTEGINA* Barker and Grimsdale, 1936

HELICOSTEGINA GYRALIS Barker and Grimsdale

Plate 15, Figures 4-6; Plate 16, Figure 10

1936. *Helicostegina gyralis* Barker and Grimsdale, Jour. Pal., vol. 10, pp. 236, 237, pl. 30, figs 3-5; pl. 32, figs. 4, 5; pl. 34, figs. 2-6; pl. 37, fig. 6.

Small specimens were found in association with *Amphistegina lopeztrigoi* Palmer which superficially resembled that species in that they had an umbonal cluster of bosses both dorsally and ventrally. Detailed examination of these specimens showed that the ventral surface was covered by a continuous layer of subsidiary chamberlets.

Although the horizontal sections are not as perfect as might be desired, they show that the final chambers are subdivided by curved partitions into two or more chamberlets of irregular size and shape.

Average size specimens have a diameter of about 1.4 mm. and a thickness of about 0.6 mm. The final volution is composed of about 24 chambers of which the last 5 are subdivided.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 1340 feet; abundant at a depth of 1355-1365 feet in this well. In the Cedar Keys No. 2 (W-355) at a depth of 1301-1308 feet.

Occurrence: Lower middle Eocene.

Family ANOMALINIDAE

Subfamily ANOMALININAE

Genus *ANOMALINA* d'Orbigny, 1826

ANOMALINA SHOLTZENSIS Cole, n. sp.

Plate 2, Figures 1, 2

Test nearly equally biconvex, the early coils showing on the dorsal side, only the chambers of the last whorl visible on the

ventral side, periphery subacute; usually 12 to 14 chambers in the adult whorl, not inflated, gradually increasing in size as added; sutures distinct, limbate, nearly flush with the surface dorsally, slightly raised ventrally especially near the umbilical area; chamber wall smooth, finely perforate; the umbilical area ventrally with a distinct, rather large boss; the chambers of the final volution separated from the remainder of the test both dorsally and ventrally by a marked depressed area which is especially prominent toward the apertural end of the test; aperture peripheral.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 3401 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1916) measures: Length, 0.54 mm.; breadth, 0.48 mm.; thickness, 0.26 mm.

Occurrence: Upper Cretaceous, Selma formation.

ANOMALINA sp.

Plate 2, Figures 9, 10

A small form, apparently belonging to the genus *Anomalina*, is quite common in the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 3401 feet. It is an undescribed species, but is figured for future reference. Certain of the characters suggest *A. rubiginosa* Cushman,⁴⁸ but it is not that species.

Genus PLANULINA d'Orbigny, 1826

PLANULINA CEDARKEYSENSIS Cole, n. sp.

Plate 2, Figures 13, 14

Test much compressed, nearly planispiral, evolute on the dorsal side, involute on the ventral side; chambers distinct, numerous, about 14 in the final volution, of nearly uniform shape and gradually increasing in size as added; periphery subacute, not distinctly keeled; sutures of the last whorl very distinct, limbate, raised, recurved, on both the dorsal and ventral sides; ventrally, the central area contains an irregular, raised mass of clear shell material; dorsally, the chambers of the initial coils may be seen in the central area through a thin film

⁴⁸ Cushman, J. A. "The Foraminifera of the Velasco Shale of the Tampico Embayment." *Am. Assoc. Petroleum Geologists Bull.*, vol. 10, pl. 1, No. 6, p. 607, 1926.

of clear shell material; chamber walls distinctly perforate, smooth, except for the thickened margins of the chambers which form rounded, raised ridges; aperture a low opening at the inner margin of the last formed chamber.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 3175 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1907) measures: Length, 0.50 mm.; breadth, 0.44 mm.; thickness, 0.18 mm.

Occurrence: Upper Cretaceous, Selma formation.

This species is close to *Planulina schloenbachi* (Reuss) figured by Cushman and Jarvis,⁴⁹ but differs in being more compressed, and lacking the closely pitted umbos of that species. *P. schloenbachi* is a much larger species. *P. spissocostata* Cushman,⁵⁰ another closely related species, has a lobate periphery, a rather distinct peripheral keel and a coarsely perforate umbonal area on the dorsal side.

Family PLANORBULINIDAE

Genus LINDERINA Schlumberger, 1893

LINDERINA FLORIDENSIS Cole, n. sp.

Plate 11, Figure 8; Plate 15, Figures 7-11

Test small, discoidal or umbonate with a narrow rim encircling the central, inflated area. Surface ornamentation of most of the specimens examined obscure because of the poor state of preservation. Certain specimens apparently have small papillae developed on the umbo when it is present. The forms which lack the well developed umbo have a smoother appearing surface. The dimensions of five specimens are given in the following table.

Diameter	Thickness	Cross-section shape
1.04 mm.	0.30 mm.	discoidal
1.40	0.60	umbonate
1.53	0.34	discoidal
1.74	0.60	umbonate
2.12	0.60	discoidal

The embryonic apparatus consists of two, nearly equal, initial chambers more or less surrounded by several accessory cham-

⁴⁹ Cushman, J. A., and Jarvis, P. W., *U. S. Nat. Museum Proc.*, vol. 80, pp. 52, 53, pl. 16, figs. 7a-c, 1932.

⁵⁰ Cushman, J. A., *Contrib. Cushman Lab. Foram. Res.*, vol. 14, p. 69, pl. 12, fig. 4, 1938.

bers. The length of the initial chambers is $140\ \mu$ and the width is about $100\ \mu$. These measurements include the chamber walls which are about $20\ \mu$ in thickness. The partition separating the initial chambers is nearly straight and is thinner than the outer wall of the chamber.

The equatorial chambers have arcuate outer walls and pointed inner ends. The equatorial layer is from 8 to $14\ \mu$ in height at the center of the test and from 12 to $18\ \mu$ in height at the periphery of the test. The chamber walls as viewed in vertical sections are convex toward the periphery of the test and have a pectinate structure.

Above and below the equatorial layer is a series of appressed laminae which may entirely cover the equatorial layer although in some cases the outer margin of the test is formed by the equatorial layer without covering.

The umbonate specimens have small pillars in the central area which extend from the equatorial layer to the surface of the test, expanding regularly as they approach the surface. These pillars have a surface diameter of 40 to $80\ \mu$. There is a slight suggestion of centrally located pillars in the discoidal shaped specimen.

First appearance: In the Cedar Keys No. 2 (W-355) at a depth of 983-1068 feet.

Type locality: Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) at a depth of 1301-1308 feet.

Cotypes (Fla. Geol. Survey Cat. Nos. S-1936 and S-1936a).

Family ORBITOIDIDAE Schubert

Subfamily ORBITOIDINAE Prever

Genus LEPIDORBITOIDES A. Silvestri, 1907

LEPIDORBITOIDES (LEPIDORBITOIDES) FLORIDENSIS Cole, n. sp.

Plate 9, Figures 5, 6

Test evenly biconvex, sloping regularly from the center to the periphery. Surface ornamentation consists of one large, centrally located, papilla on each side of the test. Of these papillae, one is usually more prominent than the other. The remainder of the test is smooth. The diameter is about 1.5 mm.; the thickness about 0.7 mm.

The embryonic apparatus consists of a small initial chamber partially embraced by a larger chamber, these chambers en-

closed by a relatively thick wall. At least 3 accessory chambers partially surround the initial chambers. The initial chamber has an internal diameter of about $70\ \mu$ and the second chamber has internal diameters of 60 by $140\ \mu$. The wall enclosing these chambers has a thickness of about $25\ \mu$. The largest accessory chamber has internal diameters of 45 by $100\ \mu$. The other accessory chambers are much smaller. The internal height of the initial chambers as observed in cross-section is about $100\ \mu$.

The equatorial chambers in plan view have curved outer walls and pointed inner ends. The radial diameter is about $25\ \mu$ and the tangential diameter is about $40\ \mu$. In cross-section, the equatorial layer has an internal height at the center of the test of about $25\ \mu$ and at the periphery of about $60\ \mu$.

The lateral chambers are open and distinct, arranged in regular tiers with 7 to 9 chambers on each side of the equatorial layer at the center of the test. The number of lateral chambers decrease regularly toward the periphery, but the periphery is covered by one or more layers of lateral chambers. Lateral chambers near the surface of the test have an internal height of about $20\ \mu$ and a length of about $80\ \mu$. The floors and roofs have a thickness of about $15\ \mu$.

Two large, distinct pillars are present, one on either side of the equatorial layer at the center. These pillars are broad at the base and expand slowly toward the surface of the test. The surface diameter of these pillars is from 140 to $180\ \mu$. Much smaller pillars are present between the tiers of lateral chambers. These pillars are normally straight. They have diameters from 30 to $50\ \mu$.

Type locality: Florida Oil Discovery Company's Cedar Keys No. 2 (W-355) at a depth of 2737-2760 feet.

Cotypes (Fla. Geol. Survey Cat. No. S-1957 and S-1957a).

Occurrence: Upper Cretaceous, Selma chalk.

L. floridensis differs from *L. nortoni* Vaughan⁵¹ in possessing large central papillae which are lacking in *L. nortoni*. *L. nortoni* has a finely papillate surface and the lateral chambers are slightly overlapping. The equatorial chambers are larger in *L. nortoni* than in *L. floridensis*.

⁵¹ Vaughan, T. Wayland, *Jour. Pal.*, vol. 3, pp. 170-174, pl. 22, figs. 1, 2, 1929.

LEPIDORBITOIDES (LEPIDORBITOIDES) MINIMA H. Douvillé

Plate 3, Figure 9; Plate 9, Figures 2, 3, 12-14; Plate 11, Figure 2

1923. Description without name, H. Douvillé, France Soc. géol. 4 ser., vol. 23, p. 370.
 1927. *Lepidorbitoides minima* H. Douvillé, France Soc. géol. C. R., p. 34, text-figs. 1, 2.
 1928. *Polylepidina cardenasensis* Galloway, Jour. Pal., vol. 1, pp. 302, 303, pl. 51, figs. 1-6; 3 text-figs.
 1929. *Orbitocyclina minima* (H. Douvillé). Vaughan, Jour. Pal., vol. 3, pp. 174, 175, pl. 22, figs. 3-6.
 1935. *Lepidorbitoides (Lepidorbitoides) minima* H. Douvillé. M. G. Rutten, Jour. Pal., vol. 9, p. 536.

Photomicrographs of the external appearance, horizontal and vertical thin sections of the specimens assigned to this species illustrate the characters so well that a detailed description is not considered necessary.

First appearance: In the Cedar Keys No. 2 (W-355) at a depth of 2554-2574 feet.

Occurrence: Upper Cretaceous, Selma chalk.

LEPIDORBITOIDES (LEPIDORBITOIDES) PLANASI M. G. Rutten

Plate 3, Figure 5; Plate 8, Figure 12; Plate 9, Figures 4, 7-11;
 Plate 11, Figures 1, 3

1935. *Lepidorbitoides (Lepidorbitoides) planasi* M. G. Rutten, Jour. Pal., vol. 9, pp. 536, 537, pl. 60, figs. 6, 7; text-fig. 4P.
 1941. *Lepidorbitoides (Lepidorbitoides) planasi* M. G. Rutten. Cole, Florida Geol. Survey Bull. 19, p. 41, pl. 12, figs. 9-14.

Rutten's illustrations of this species are inadequate. Certain specimens from the Cedar Keys No. 2 (W-355) possess many features which are similar to those described by Rutten. For the present, these Florida specimens are assigned to this species.

The following table summarizes the similarities and differences:

	Cuban specimens (After Rutten)	Florida specimens
Diameter	1.2 to 1.5 mm.	0.90 to 1.87 mm.
Thickness	0.6 mm.	0.26 to 0.68 mm.
Diameter of first embryonic chamber	0.05 mm. to 0.06 mm.	0.04 mm.
Diameter of second embryonic chamber	0.09 X 0.05 mm. to 0.10 X 0.04 mm.	0.08 X 0.04 mm.
Equatorial chambers horizontally	0.03 X 0.04 mm.	0.03 X 0.04 mm.
Height of equatorial chambers	0.03 to 0.04 mm.	0.02 to 0.04 mm.

The surface of the Florida specimens is normally smooth, although a single apical papilla is found in some specimens (pl. 9, fig. 10). The lateral chambers are very low, compressed, appearing as slits between thick floors and roofs.

The Florida specimen which most nearly resembles the type vertical section is illustrated on plate 9, figure 7. Considerable variation in the degree of inflation of the test is typical of the Florida specimens (pl. 9, figs. 7-11).

In Cuba *L. planasi* is associated with *L. minima*. This same association is found in Florida.

First appearance: In the Cedar Keys No. 2 (W-355) at a depth of 2554-2576 feet.

Occurrence: Upper Cretaceous, Selma chalk.

Subgenus ASTERORBIS Vaughan and Cole, 1932

LEPIDORBITOIDES (ASTERORBIS) AGUAYOI D. K. Palmer

Plate 3, Figures 3, 6; Plate 10, Figures 2-5

1934. ?*Asterorbis aguayoi* D. K. Palmer, Soc. Cubana Hist. Nat. Mem., vol. 8, pp. 246, 247, pl. 13, fig. 7; text-figs. 6-8.
1935. *Lepidorbitoides (Asterorbis) aguayoi* D. K. Palmer. M. G. Rutten, Jour. Pal., vol. 9, p. 537.

Test small, lenticular, the periphery extended into 4 or 5 projecting arms. There is a faint suggestion of the inward continuation of the peripheral projections over the lenticular, central portion of the test as the surface of this portion is convex along the continuation of the arms and slightly concave in the intervening areas. There are two apical papillae on one specimen with diameters of 60 and 100 μ . The remainder of the surface is covered with a reticulate mesh. The diameter of the lenticular, central portion of the test of one specimen is 0.6 mm, and of the other specimen is 1.0 mm. The best developed arm projects 0.6 mm. beyond the margin of the central, inflated portion of the test. The thickness of a specimen with a diameter of 1.0 mm. is 0.44 mm.

Equatorial sections show the embryonic apparatus consists of two chambers with one or more periembryonic chambers. The initial chamber is circular with an internal diameter of about 20 μ . The second chamber is more or less kidney shaped with internal diameters of 40 by 60 μ . The two initial chambers are

surrounded by a relatively thick wall in proportion to the internal diameters of the chambers. This wall is about $18\ \mu$ thick.

The equatorial chambers have curved outer walls and pointed or truncate inner ends. The stellate character of the test is shown by the arrangement of the equatorial chambers. Normally the equatorial chambers increase in size as they approach the periphery of the test. The equatorial chambers are slightly larger along the rayed portions of the test than in the intervening areas. Well developed equatorial chambers near the margin of the test have radial diameters of about $30\ \mu$ and tangential diameters of about $60\ \mu$.

In vertical sections the equatorial layer has an internal height of about $20\ \mu$ at the center of the test. There is practically no increase in height of the equatorial layer as the margin of the test is approached in the inter-ray areas. However, along an arm the equatorial chambers increase rapidly in height so that they may have an internal height of about $90\ \mu$ at the end of an arm.

There are about 6 layers of lateral chambers on each side of the equatorial layer. These decrease rapidly in number so that the outer edge of the inflated, central portion is covered by only one layer of lateral chambers. The projecting arms are composed entirely of uncovered equatorial chambers. The lateral chambers are not arranged in definite tiers. Lateral chambers over the center and near the periphery have a length of 60 to $80\ \mu$ and an internal height of about $18\ \mu$. The thickness of the roofs and floors is from 5 to $15\ \mu$. The roofs and floors are slightly curved. Scattered pillars are present, the largest one occurring above the embryonic apparatus.

The type specimens of *Asterorbis aguayoi* D. K. Palmer are larger than the Florida specimens assigned to this species. Also the type specimens from Cuba have more lateral chambers to a tier and lack pillars according to the description given of the type specimen. However, the external appearance of the Florida specimens is similar to that of the Cuban specimens.

After studying numerous specimens of *Asterorbis rooki* which exhibit a bewildering degree of individual variation, it appeared logical that the same degree of variation should occur in *A. aguayoi*. As the Florida specimens exhibit many of the characters of the type species, they are assigned to this species.

First appearance: In the Cedar Keys No. 2 (W-355) at a depth of 2554-2576 feet.

Occurrence: Upper Cretaceous, Selma chalk.

LEPIDORBITOIDES (ASTERORBIS) ROOKI Vaughan and Cole

Plate 3, Figure 11; Plate 10, Figures 1, 6-10;

Plate 16, Figures 12, 13

1932. *Asterorbis rooki* Vaughan and Cole, Nat. Acad. Sci. Proc., vol. 18, pp. 611-613, pl. 1, figs. 1-6.
1934. *Asterorbis rooki* Vaughan and Cole. D. K. Palmer, Soc. Cubana Hist. Nat. Mem., vol. 8, pp. 250-251, pl. 13, figs. 1, 3, 5; text-figs. 11, 12.
1935. *Lepidorbitoides (Asterorbis) rooki* Vaughan and Cole. M. G. Rutten, Jour. Pal., vol. 9, pp. 528, 537.

Test small, compressed lenticular, stellate, central area slightly raised, umbonate, from which five rather conspicuous ribs and a sixth faint rib radiate. The ribs increase gradually in width as they approach the periphery. Two ribs project beyond the margin of the test. The entire surface of the test is covered with papillae which are slightly larger on the umbo and along the rays. Diameter of available specimens, 1.4 mm. to 2.8 mm.; thickness, 0.36 to 0.6 mm.

Embryonic apparatus not observed. In horizontal section the equatorial chambers may be diamond shaped or their outer walls may be curved with pointed inner ends. Average-size equatorial chambers have a radial diameter of about 40 μ and a transverse diameter of about 80 μ . Equatorial sections indicate the stellate shape of the test.

Two vertical sections were available for study. Although neither of the sections show the embryonic chambers, they were oriented so that they passed through the center of the test. The section with a thickness at the center of 0.6 mm. has 6 lateral chambers on each side of the equatorial layer. These chambers are arranged in rather definite tiers, especially in the portions where pillars occur. In the portions of the section where pillars are absent the lateral chambers may overlap. Lateral chambers at the periphery and over the center of the test may have a length of as much as 100 μ . The chamber cavities are about 20 μ in height and the roofs and floors have a thickness of about 18 μ . Pillars at the center have a surface diameter of about 60 μ ; pillars near the outer margin of the test have a surface diam-

eter of 30 to 40 μ . The equatorial chambers have an internal height of about 20 μ at the center of the test. There is a gradual increase in height of the equatorial chambers as the periphery of the test is approached, at which point the internal height is about 40 μ .

The vertical section with a thickness through the center of 0.36 mm. is similar to the thicker one described above except that the lateral chambers are not so pronounced. They have thicker roofs and floors and less distinct chamber cavities. This condition may be due to the state of preservation.

Only four specimens of this species were recovered. The external appearance suggested that these specimens should be assigned to *Asterorbis rooki* Vaughan and Cole. Although the one horizontal section available substantiated this identification, certain discrepancies were noted in the vertical sections. In the type specimens of *Asterorbis rooki* the lateral chambers are arranged in very definite tiers and the height of the chamber cavity is greater than the thickness of the roofs and floors.

Comparison of the specimens from the Cedar Keys No. 2 (W-355) with topotype material suggests that the differences shown by the Florida specimens are within the range which might be allowed within a species. Photomicrographs of topotype specimens (pl. 10, figs. 6-8) as well as illustrations (pl. 16, figs. 12, 13) of Cuban specimens assigned to this species by Mrs. Dorothy K. Palmer are presented so that direct comparisons may be made.

First appearance: In the Cedar Keys No. 2 (W-355) at a depth of 2716-2736 feet. This species undoubtedly occurs higher in this well, but because of its rarity it was not encountered in the higher samples.

Occurrence: Upper Cretaceous, Selma chalk.

Genus LEPIDOCYCLINA Gumbel, 1870

Subgenus PLIOLEPIDINA H. Douvillé, 1915

LEPIDOCYCLINA (PLIOLEPIDINA) CEDARKEYSENSIS Cole, n. sp.

Plate 3, Figures 1, 2; Plate 8, Figure 11; Plate 11, Figures 6, 7;
Plate 12, Figures 1-7

Test small, lenticular, usually bordered by a small rim. Surface ornamentation consists of papillae of clear shell material,

normally with an apical group composed of 3 or more papillae which are larger than those on the remainder of the test. If the encircling rim is present, the papillae are not developed on it. The walls of the equatorial chambers appear on the surface of the rim, forming a mesh-like pattern of clear shell material. The apical papillae have a surface diameter of 80 to 100 μ and project noticeably above the surface of the test. The papillae which surround the apical group project but slightly above the surface of the test and have a surface diameter of about 40 μ .

Measurements of 9 thin sections of megalospheric individuals follow:

VERTICAL SECTIONS

Specimen number	1	2	3	4	5
Diameter	2.76 mm.	2.63 mm.	0.84 mm.	0.64 mm.	1.91 mm.
Thickness	0.7 mm.	0.72 mm.	0.4 mm.	0.54 mm.	0.70 mm.
Number of lateral chambers on each side of equatorial layer	6	6	3	4	5
Height of embryonic chambers	80 μ	120 μ	140 μ	80 μ	140 μ
Height of equatorial layer at center	25 μ	30 μ	60 μ	40 μ	40 μ
at periphery	100 μ	80 μ	80 μ	60 μ	80 μ
Length of lateral chambers	60-100 μ	100-180 μ	60-100 μ	60-80 μ	80-120 μ
Height of lateral chambers	20-40 μ	20 μ	20 μ	20 μ	20-30 μ
Thickness of roofs and floors of lateral chambers	20 μ	20 μ	20 μ	30 μ	10-20 μ

HORIZONTAL SECTIONS

Specimen number	1	2	3	4
Diameter	1.49 mm.	2.97 mm.	1.74 mm.	1.39 mm.
Length across both embryonic chambers	160 μ	200 μ	200 μ	160 μ
Diameters of initial chamber	60X100 μ	100X120 μ	120X130 μ	80X100 μ
Diameters of second chamber	80X120 μ	80X120 μ	80X160 μ	80X100 μ
Thickness of bounding wall of embryonic chambers	20 μ	25 μ	30 μ	25 μ
Diameters of equatorial chambers near the periphery:				
radial	40 μ	40 μ	50-60 μ	50 μ
tangential	60 μ	60 μ	60-80 μ	60 μ

The equatorial chambers as observed in horizontal sections have curved outer walls and pointed inner ends. There are normally two periembryonic chambers, one at either end of the straight dividing partition between the two initial chambers.

Vertical sections show that the lateral chambers are arranged in regular tiers between pillars. However, if the section so cuts the specimen that pillars are not present the lateral chambers are not so regularly aligned in tiers. In such sections a certain amount of overlap of the lateral chambers from one layer to the next is shown.

Between the peripheral ends of many successive lateral chamber walls there are small wedge-shaped projections into the chamber cavities from the pillars or vertical walls between adjacent chambers.

Figure 11, plate 8 is a horizontal section to show the form of the initial chambers of a microspheric individual.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 840 feet and 860 feet.

Appearance elsewhere: In the Florida Oil Discovery Company's Cedar Keys No. 2 at a depth of 833-855 feet.

Holotype (Fla. Geol. Survey Cat. No. S-1871).

Occurrence: Upper middle Eocene.

L. cedarkeysensis belongs to the same group of species as *L. pustulosa*⁵² and *L. sherwoodensis*.⁵³ *L. cedarkeysensis* is closely related to *L. sherwoodensis*, but in *L. sherwoodensis* the distance across both embryonic chambers is about 0.40 mm., although one specimen has a length of 0.25 mm. across both chambers. In *L. cedarkeysensis* the length across both chambers is never more than 0.2 mm.

Subgenus LEPIDOCYCLINA Gümbel, 1870

LEPIDOCYCLINA (LEPIDOCYCLINA) OCALANA Cushman

Plate 11, Figures 4, 5

1919. *Lepidocyclina ocalana* Cushman, U. S. Geol. Survey Prof. Paper 125, pp. 71, 72, pl. 28, figs. 3, 4; pl. 29, figs. 1-3.
 1941. *Lepidocyclina (Lepidocyclina) ocalana* Cushman. Cole, Florida Geol. Survey Bull. 19, pp. 41-43, pl. 13, figs. 1-7; pl. 16, figs. 1-4, 6-10, 15 (references and synonymy).

⁵² Vaughan, T. Wayland, and Cole, W. Storrs, Geol. Soc. Amer. Sp. Paper No. 30, pp. 64-67, 1941.

⁵³ Vaughan, T. Wayland, *Jour. Pal.*, vol 1, pp. 287, 288, pl. 48, figs. 4-8, 1928.

This species has been fully described in Bulletin 19. Only 4 specimens were recovered in the present study.

First appearance: In the Sholtz No. 1 (W-166) at a depth of 120 feet.

Occurrence: Ocala limestone.

Family DISCOCYCLINIDAE Vaughan and Cole

Genus PSEUDOPHRAGMINA H. Douvillé, 1923

Subgenus PROPOROCYCLINA Vaughan and Cole, 1940

PSEUDOPHRAGMINA (PROPOROCYCLINA) ZARAGOSSENSIS
(Vaughan)

Plate 13, Figures 1-5; Plate 14, Figures 1-5

1929. *Discocyclina zaragosensis* Vaughan, U. S. Nat. Museum Proc., vol. 76, pp. 13, 14, pl. 4, figs. 1-3.

Some 30 specimens of a small species referred to the genus *Pseudophragmina* were found in the sample at a depth of 1470 feet in the Sholtz No. 1 (W-166). Several additional specimens of this same form were found at a depth of 1416-1438 feet in the Cedar Keys No. 2 (W-355). All of these specimens were more or less incomplete, and in most cases represented only the central portion of the specimen.

Test small, flat lenticular to umbonate with a marginal rim. Diameter of perfect specimens would exceed 3 mm.; thickness, 0.56 to 0.9 mm. The surface of the test is covered with small papillae which are stronger on some specimens than on others. The central umbo has a diameter from 1.3 mm. to 2.1 mm.

VERTICAL SECTIONS

Specimen number	1	2	3	4
Thickness	0.56 mm.	0.9 mm.	0.7 mm.	0.58 mm.
Diameter (incomplete specimen)	1.9 mm.	2.4 mm.	2.9 mm.	2.0 mm.
Number of lateral chambers on each side of the equatorial layer	8±	12±	8	7±
Embryonic chambers				
length	160 μ	160 μ	165 μ	180 μ
height	80 μ	140 μ	90 μ	90 μ
Height of equatorial layer				
at center	15 μ	10 μ	10 μ	8 μ
at periphery	15 μ	15 μ	10 μ	8 μ
Length of lateral chambers	60-100 μ	50-120 μ	60-100 μ	40-80 μ
Height of lateral chambers	10 μ	10 μ	5-15 μ	8-12 μ
Thickness of roofs and floors	20-30 μ	20 μ	10-30 μ	20-40 μ
Surface diameter of pillars	40-80 μ	80-100 μ	60-80 μ	60-80 μ

HORIZONTAL SECTIONS

Specimen number	1	2	3	4
Diameter (incomplete specimen)	2.5 mm.	2.5 mm.	2.5 mm.	2.2 mm.
Diameter initial chamber ...	60 μ	120 μ	80 μ	100 μ
Diameter across both embryonic chambers	160 μ	260 μ	180 μ	220 μ
Equatorial chambers at center				
radial diameter	20 μ	40 μ	30 μ	
tangential diameter	20 μ	40 μ	40 μ	
At periphery				
radial diameter	40 μ	60 μ	40 μ	40-60 μ
tangential diameter	30 μ	40 μ	30 μ	20-30 μ

The lateral chambers are low with thick roofs and floors. Toward the equatorial layer the chamber cavities are virtually obliterated by the thickened roofs; near the periphery the roofs are slightly thinner and the chamber cavity is higher.

The horizontal sections show that the chamber walls in one annulus are more or less in alignment with those of the next adjacent annuli. The annular stolon is distally situated. (pl. 13, fig. 5).

The Florida specimens agree in general with the description and illustrations given by Vaughan for *zaragosensis*, particularly the vertical sections. The following table indicates the similarity:

Measurements of type specimens	Measurements of Florida specimens
Diameter	5-6 mm. 1.9-2.9 mm. (incomplete specimen)
Thickness	0.5-1 mm. 0.56-0.9 mm.
Equatorial chambers	
Height at center	23 μ 8-15 μ
Radial diameter	30-50 μ 20-60 μ
Tangential diameter	23 μ 20-40 μ
Number of lateral chambers on each side	10-11 7-12
Thickness of roofs and floors of lateral chambers	23-30 μ 10-40 μ
Length of lateral chambers ..	40-250 μ 40-120 μ
Surface diameter of pillars ..	160 μ 60-80 μ

The horizon of *P. zaragosensis* in Mexico is given by Vaughan as very low in the Claiborne group or high in the Wilcox group. The horizon in Florida is lower middle Eocene. This is another species that connects the faunas of peninsular Florida with those of Mexico.

Occurrence: Lower middle Eocene.

APPENDIX

During the course of the drilling of the two wells reported on in this bulletin some data were collected that could not be incorporated appropriately in the main body of the text. For the sake of completeness this summarized information is being added at this point, together with the Driller's logs of each well.

SUWANNEE PETROLEUM CORPORATION'S SHOLTZ NO. 1
(W-166)

In the Suwannee Petroleum Corporation's Sholtz No. 1 at a depth of 2822-2870 feet a strong stream of water was encountered. A sample of water was collected April 25, 1930, when the well had reached a depth of 4010 feet, but Edward A. Hill, consulting geologist for the Suwannee Petroleum Corporation, reports that no water was encountered below 2870 feet and that the sample collected must have come from that horizon. Hill's report on this water states that it entered the well after the casing seat at 3674 feet was broken. The sample was submitted to the Quality of Water Division of the United States Geological Survey for analysis, and the analysis run by S. K. Love of the United States Geological Survey is as follows:

Constituents.	Parts per million
Iron (Fe)	3.1
Calcium (Ca)	5,010
Magnesium (Mg)	1,456
Sodium (Na)	36,800
Potassium (K)	518
Carbonate (CO_3)	0
Bicarbonate (HCO_3)	134
Sulphate (SO_4)	1,785
Chloride (Cl)	69,500
Bromide (Br)	18
Iodide (I)	1
Total dissolved solids	118,800
Note: 1 cc. at 29°C. weighs 1.0836 g.	

In July of 1929, it was reported that gas under sufficient pressure to blow the tools up the hole and kink the drill line was encountered in a sand at 4010 feet.

On April 23, 1930, G. M. Ponton, former Assistant State Geologist, visited the well and attempted to obtain a sample of the

gas. The following information is extracted from his memorandum on that visit.

On April 23, the well was being swabbed. The static head of the water in the well was reported to be about 215 feet below the surface. During swabbing about 750 gallons of colorless, highly saline water with a temperature of from 99 to 103° Fahrenheit was pulled from the hole with each swab. Each time the swab was pulled a small amount of gas was obtained but not in sufficient quantity to ignite.

In order to obtain a larger sample of this gas the well was shut in and fitted with a swedge nipple to which a glass cylinder equipped with a pet-cock was attached. After standing from 6:45 P. M. April 29, 1930, to 10:00 A. M. May 1, 1930, a quantity of gas that could be ignited had collected. Ponton reported that the gas had a strong petroleum odor.

DRILLER'S LOG*

SUWANNEE PETROLEUM CORPORATION'S SHOLTZ NO. I (W-166)

DEPTH	FORMATION
0- 24	Surface wastage and quicksand. 20" froze at 24'.
24- 42	Quicksand—derrick undermining.
42- 44	Hard white limestone—derrick O.K.
44- 79	Quicksand, heavy water level. 15½" froze at 79'.
79- 378	Unconsolidated friable clay, marl, brecciated limestone carbonized wood fibre lignitic.
380- 380	Very heavy body of fresh water, apparently inexhaustible. 12" seated at 380'.
380- 419	Extremely hard blue shell, very hard drilling.
419- 431	Shelly lime of clay consistency, marl-like.
431-1392	No water from 380 to 1382 but considerable gas after seat of 10" casing in limestone, perfect shut-off. Broken lime, clay and sand at 961'—10" casing at 1392.
1392-1400	Hard limestone, heavy viscous residuum at 1398.
1400-1445	Broken lime 6' shale, black, clay, lots of gas.
1445-1465	Same as above but shows extreme compression, little gas.
1465-1489	Viscous petroleum residuum ("Liver") inflammable, black.
1480-1490	Dead oil in brecciated limestone and clay, no gas.
1490-1500	Sandy clay lense, slight gas odor.
1500-1507	Fine brownish sugar-like sand, saturated with oil, green. Drillers "jumped pin" off of bit here and worked on fish.
1507-1507	From March to June, finally removing bit with rotary.
1507-1513	Water, slightly salt, 1512-3 rose in hole 900'.
1513-1520	More water, dark color, sulphuretted hydrogen odor, stood at 5 to 50 feet of the top of the hole.
1520-1524	Hard limestone shell, gas shows fairly well in bailer.

*Log received through Edward A. Hill, Consulting Geologist, Tampa, Florida.

DEPTH	FORMATION
1524-1545	Water almost black, stands 10 to 30 feet of top.
1545-1549	Black bituminous shale, considerable gas showing. Carried the test from 1545 to 2536 in gray to brown limestone and shale, reporting an occasional showing of gas, traces of oil.
1570-1570	Black water flows from top of casing.
1570-2536	Water salt, black, odorous, sulphuretted hydrogen smell.
2536-2754	Additional water at 2435' still flowing from top.
2754-2754	Hole was straight reamed from 1392 to 2754 for 8" pipe.
2754-2763	3' bluish-green slate under which was 1½ feet of excellent brown sand carrying green oil good showing (probably base of Ripley—Epi-Mesozoic horizon).
2763-2776	Chalky glauconitic material argillites occasional.
2776-2791	Fine gray sand, chalky mixture, rock salt level.
2791-2800	Aug. 7-8-9, 1928. Winds almost hurricane force storm.
2791-2800	Blue shale (8" casing holding at 2802').
2800-2810	Blue shale, fine chalk partings, highly compressed.
2810-2826	Water sand at 2822-25, extreme saltiness, oilified brine.
2826-2826	Rose in hole to 60 feet of top.
2826-2831	Blue shale, indurated, occasional argillaceous spots.
2831-2856	Hematite fragments and nodular iron, some fine sand grains.
2856-2872	Addition small amount water at 2871-72, much iron.
2872-2898	Glauconite in fine partings, chalk horizon, has all of the characteristics of the Selma Chalk.
2898-2898	
2895-3005	8" casing swinging in hole on slips, shoe at 2956 in the chalk, chalk from 2898 to 3005.
3005-3014	At 2969 driller says "hardest formations has drilled in the well"—probably argillites in the chalk. At 2963-2964 Smith, Emery Co., of San Francisco, report "Volcanic material", Analytical chemists.
3014-3022	Limestone, soft, chalky, traces of oil past 20'.
3022-3052	Chalk, pyritic definitely, blue shale inter-stratification.
3052-3105	Chalk and blue shale series of beds, many Brachipoda.
3105-3136	Blue shale, lime lenses and thin chalky members.
3136-3141	Limestone, soft, permeable, under-reamed to this level.
3141-3141	Then carried 6½" casing on slips and lowered.
3141-3164	Characteristic Selma chalk, many traces of oil.
3164-3182	Strong gas odor, effervescing in bailer, traces of oil.
3182-3224	Coralline limes (coral red frequent—algae) gas strong.
3224-3229	Few small quartz sand grains, volcanic ash level 2'.
3229-3257	Chalk, casing settled as fast as water is bailed out.
3257-3259	Distinctive volcanic ash, bluish grit (abrasive dust).
3259-3268	Chalk, more lime content, irregular small argillites.
3268-3284	Pyrites abundant, water black as tar, sulphuretted.
3284	Probably the base of the Selma Chalk.
3284-3417	Gray soft lime, crinoids, coralline, some pyrites.
3417-3483	Excellent gas flow in thin seal seam, traces of oil.
3483-3548	Blue shale, carbonized fossils (ostrea) moulders clay.
3548-3548	In very fine bedding planes or thin seams.
3548-3634	Blue shale, fossils uncommon in quantity, crinoids.
3634-3674	Better limestone horizon than for hundreds of feet will make effort to seat 6½" casing, cemented.
3674-3680	Some woody fiber, carbonized, full of oil good grade. Water shut-off almost perfect at 3674, leak only about 3 bailers in 24 hours.
3680-3712	Blue shale, very strong gas, only carrying water for drill.
3712-3745	Blue shale, occasional thick slaty horizon, gas strong.
3745-3832	Blue shale, carrying load of pyrites and marcasite.

DEPTH	FORMATION
3832-3919	3876-3888 best showing of oil ever seen in hole, the material was brecciated lime, blue shale and excessive quantity of finely comminuted shells.
3919-3960	Bluish black sticky shale in thin levels, mass of material a brownish mottled limestone, fine grained.
3960-4000	Blue shale, gumbo like, sticky, compact, true shale.
4000-4010	Blue shale showing slaty metamorphism, and the bottom 2 feet a hard resistant blue slate.
4010	Sand, comparatively fine, well rounded marine type of grains, exhibiting every physical characteristic of the Woodbine. Apparently a sand occupying the level which belongs in the water stage and time scale and formational complex of the Woodbine.

FLORIDA OIL DISCOVERY COMPANY'S CEDAR KEYS No. 2

Two water samples were taken from the Florida Oil Discovery Company's Cedar Keys No. 2. These were taken at shallower depths than the one from the Suwannee Petroleum Corporation's Sholtz No. I, and by comparison show the change in character of the water with depth in this area. Sample No. 1 represents water from a depth of 350 to 479 feet and sample No. 2 represents a mixture of water from a depth of 1790 to 1792 feet and from 1960 to 1964 feet. These analyses were made by Margaret D. Foster of the United States Geological Survey.

Constituents	Parts per Million.	
	1	2
Silica (SiO_2)	15	18
Iron (Fe)	.17	.32
Calcium (Ca)	603	961
Strontium (Sr)	6.9	42
Magnesium (Mg)	244	549
Sodium (Na)	1,551	4,280
Potassium (K)	67	184
Carbonate (CO_3)	0	0
Bicarbonate (HCO_3)	212	91
Sulphate (SO_4)	1,694	3,664
Chloride (Cl)	2,809	7,378
Bromine (Br)	40	59
Iodine (I)	0	0
Total dissolved solids	7,188	17,208
1. 1 ml at 24°C. weighs 1.0034 grams.		
2. 1 ml at 24°C. weighs 1.0100 grams.		

DRILLER'S LOG*

FLORIDA OIL DISCOVERY COMPANY'S CEDAR KEYS No. 2 (W-355)

PIPE AND CASING IN HOLE:

18" Steel-Surface	38'
10" Conductor	94'
8" Casing	382'
6" Casing	3986'

There was sunk first a cribbing 15' then material filled around it and the 18" was run to 38' and set on lime. The 10" and 8" are set in limestone.

DEPTH	FORMATION	DEPTH	FORMATION
18- 48	Surface sand.	912- 920	Soft lime, streaks lignite.
48- 85	Soft lime.	920- 932	Soft lime, water.
85- 97	Hard lime.	932- 940	Hard brown lime.
97- 100	Flint rock.	940- 970	Lime, sand and lignite.
100- 104	Soft with cavity.	970- 980	Hard lime.
104- 130	Hard rock.	980-1040	Sand, lime and lignite.
130- 133	Hard lime, soft streaks.	1040-1046	Sand and lime.
133- 146	Hard lime.	1046-1060	Lime.
146- 149	Broken lime.	1060-1070	Sand and lime.
149- 165	Hard lime.	1070-1107	Soft lime.
165- 211	Soft lime.	1107-1112	Lime.
211- 214	Hard lime.	1112-1145	Hard lime.
214- 265	Hard rock.	1145-1153	Soft lime.
265- 330	Hard lime, soft streaks.	1153-1177	Hard dolomite rock.
330- 333	Soft lime.	1177-1200	Soft sand.
333- 355	Hard streaks.	1200-1240	Soft brown lime.
355- 382	Lime.	1240-1260	Broken formation.
382- 388	Soft sulphur water.	1260-1265	Hard limestone.
388- 400	Hard lime.	1265-1277	Brown lime and shale.
400- 402	Soft lime.	1277-1285	Hard lime and dolomite.
402- 442	Hard rock.	1285-1288	Soft lime.
442- 446	Hard lime, and streaks	1288-1309	Hard limestone.
446- 495	of shale.	1309-1328	Secondary chalk.
495- 524	Solid hard lime.	1328-1333	Hard limestone.
524- 529	Soft brown, lime and	1333-1340	Secondary chalk.
529- 540	shale.	1340-1360	Hard limestone, water.
540- 620	Hard lime, and shale.	1360-1395	Secondary chalk, hard limestone.
620- 677	Hard brown lime in	1395-1408	Gray limestone.
677- 683	streaks.	1408-1450	Chalk, soft broken.
683- 692	Brown lime and some	1450-1465	Hard gray limestone.
692- 710	gypsum.	1465-1490	Chalk and limestone.
710- 809	Soft black lignite.	1490-1506	Hard limestone and dolomite.
809- 813	Gypsum and brown lime	1506-1535	Soft marl lime.
813- 904	streaks.	1535-1545	Hard limestone and dolomite.
904- 912	Hard lime and gypsum.	1545-1548	Soft marl lime.
	Lime, lignite and shale.	1548-1564	Hard gray limestone.
	Soft lignite.		
	Soft lime, and lignite.		
	Hard lime.		

*Log received through Edward A. Hill, Consulting Geologist, Tampa, Florida, November 23, 1939.

DEPTH	FORMATION	DEPTH	FORMATION
1564-1569	Soft marl lime.	3209-3590	Chalky lime.
1569-1596	Hard gray limestone.	3590-3632	Pyrite chalky lime.
1596-1603	Soft marl lime.	3632-3838	Pyrite marcasite chalk.
1603-1608	Hard gray limestone.	3838-3840	Liver.
1608-1614	Soft marl lime.	3840-3950	Shale and lime.
1614-1622	Hard gray limestone.	3950-3960	Liver residuum.
1622-1656	Hard gray limestone, and dolomite.	3960-3986	Shale and lime and slate.
1656-1659	Soft marl lime.	3986-3990	Shale, lime and slate.
1659-1730	Hard gray limestone and dolomite.	3990-3993	Sand salt water.
1730-1772	Chalky limestone, soft.	3993-3998	Hard slate and lime.
1772-1785	Hard lime and clay.	3998-4044	Hard shale and lime broken.
1785-1840	Dark lime, sand and dolomite.	4044-4045	Shale and lime soft.
1840-1911	Hard limestone and sand.	4045-4048	Core slate and shale.
1911-1912	Soft marl lime.	4048-4059	Hard shale and slate.
1912-1960	Dark limestone and dolomite.	4059-4062	Core hard lime and shale.
1960-1968	Crystallized formation.	4062-4076	Hard broken lime and shale flakes.
1968-2035	Sandy lime and shale.	4076-4079	Flaky shale soft.
2034-2055	Secondary chalk.	4079-4092	Shale and lime broken.
2055-2166	Dark shaly limestone.	4092-4101	Shale and lime soft streaks.
2166-2179	Limestone, dolomite and shale.	4101-4119	Hard shale and soft streaks.
2179-2210	Chalk and dark limestone.	4119-4159	Shale and lime and lignite.
2210-2230	Gray limestone, dolomite and blue chalk.	4159-4161	Soft lignite.
2230-2295	Hard gray limestone and dolomite.	4161-4170	Hard lime.
2295-2360	Brown limestone.	4170-4186	Flaky shale and lime.
2360-2397	Gray limestone and dolomite.	4186-4223	Hard flaky dark shale.
2397-2400	Hard limestone.	4223-4226	Soft shale and lignite.
2400-2415	Gray limestone and dolomite.	4226-4242	Dark heaving shale.
2415-2489	Gray limestone.	4242-4244	Hard lime.
2489-2540	Dark shaly lime.	4244-4259	Heaving shale and lime.
2540-2570	Blue shaly, chalky lime.	4259-4272	Sand, shale and lime.
2570-2590	Blue shaly, soft chalky lime.	4272-4290	Hard lime and shale broken.
2590-2660	Chalky lime.	4290-4311	Core hard white sand slate.
2660-2670	Chalky white lime hard.	4311-4324	Core white sand.
2670-2720	Brown lime muddy.	4324-4328	Core white sand salty.
2720-2768	Chalky lime.	4328-4375	Sandy shale.
2768-2780	Brown limestone.	4375-4377	Sand soft.
2780-2815	Chalky lime.	4377-4379	Core sand.
2815-2820	Hard brown limestone.	4379-4382	Sand and shale.
2820-2858	Hard dark lime and slate.	4382-4412	Sand and shale core.
2858-2882	Chalky lime.	4412-4414	Sand and red sticky shale, oil show.
2882-2905	Hard dark lime muddy.	4414-4433	Red sticky shale and lime.
2905-2995	Soft lime.	4433-4442	Hard yellow sand.
2995-3010	Hard lime.	4442-4446	Red clay shale.
3010-3165	Chalk and lime.	4446-4455	Sand brown and white.
3165-3209	Anhydrite and sulphate.	4455-4472	Hard sand shale and lime.
		4472-4480	Sandy clay and lime.

DEPTH	FORMATION	DEPTH	FORMATION
4480-4487	White sand and clay.	4915-4919	Hard shale and lime.
4487-4496	Sandy shale and lime.	4919-4921	Hard lime.
4496-4500	Hard shale and lime.	4921-4942	Hard sandy shale and lime.
4500-4550	Hard sandy shale and lime.	4942-4954	Hard lime— <i>pyrites</i> (?) 12' little gas.
4550-4553	Hard sand.	4954-4985	Hard sand and shale.
4553-4597	Sand.	4985-5002	Hard sandy shale and lime.
4597-4660	Hard sandy shale and lime.	5002-5003	Hard lime.
4660-4670	Hard shale and lime.	5003-5012	Hard black shale and lime.
4670-4710	Sandy shale and lime.	5012-5025	Hard sandy shale and lime.
4710-4744	Hard shale and lime.	5025-5027	Hard lime.
4744-4746	Hard lime.	5027-5053	Hard sandy shale and lime.
4746-4760	Hard sandy shale and lime.	5053-5057	Hard sandy lime.
4760-4770	Hard shale— <i>pyrites</i> (?).	5057-5074	Hard sand, little shale.
4770-4810	Hard sand, shale and lime.	5074-5085	Sandy shale and lime.
4810-4812	Hard sand and <i>pyrites</i> (?).	5085-5112	Hard sticky, red shale and lime.
4812-4828	Hard sand, shale and lime.	5112-5125	Hard sticky shale, little sand.
4828-4830	Hard sand and <i>pyrites</i> (?).	5125-5205	Hard shale sticky, little sand.
4830-4865	Hard shale and lime.	5205-5251	Hard sandy shale and lime.
4865-4866	Hard lime.	5251-5256	Hard sand (<i>pyrites</i> ?) rock bit.
4866-4887	Hard sandy shale and lime.	5256-5266	Hard sandy shale.
4887-4889	Hard lime.		
4889-4900	Hard sandy shale and lime.		
4900-4912	Hard red shale and lime.		
4912-4915	Sandy shale—little gas.		

WELL LOG

Halliburton
Oil Well Cementing Co.

Company: FLORIDA OIL DISCOVERY
Well: CEDAR KEYS NO. 2
Field: CEDAR KEYS, FLA. County: LEVY
Date: MAY 23, 1939 File No. _____
Operator: RW LONG

POTENTIAL-Mv.					DEPTH- FEET	IMPEDANCE-Ohms				
-120	-90	-60	-30	0		0	1.5	3	4.5	6
					23	0	4	8	12	16

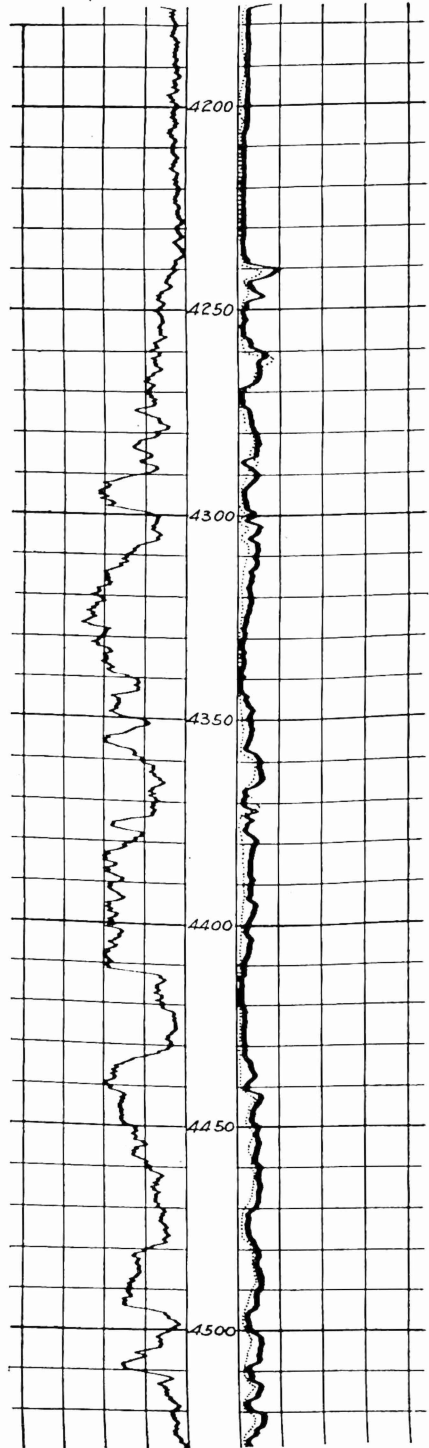
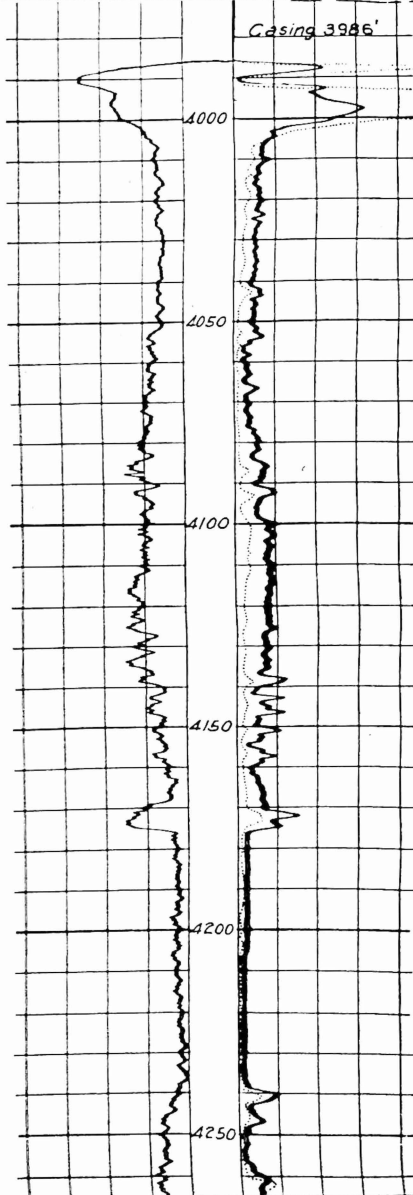
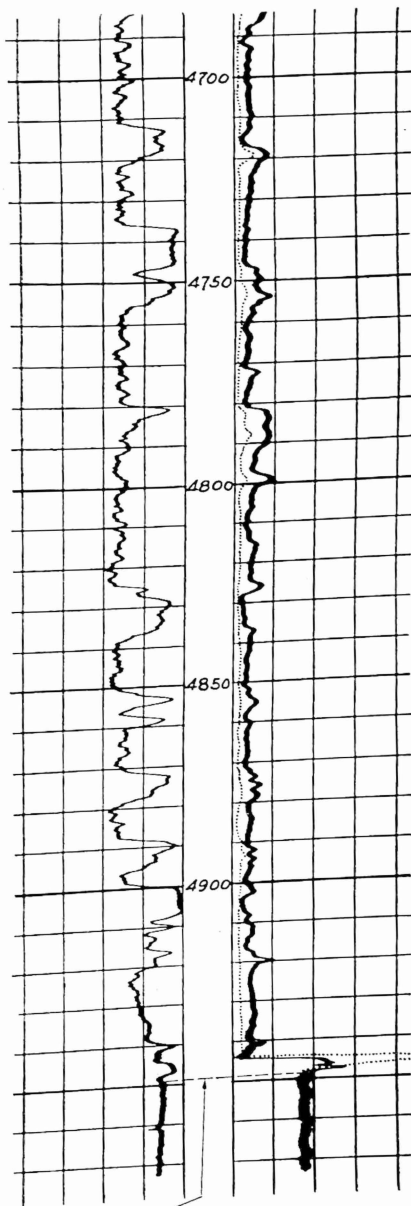
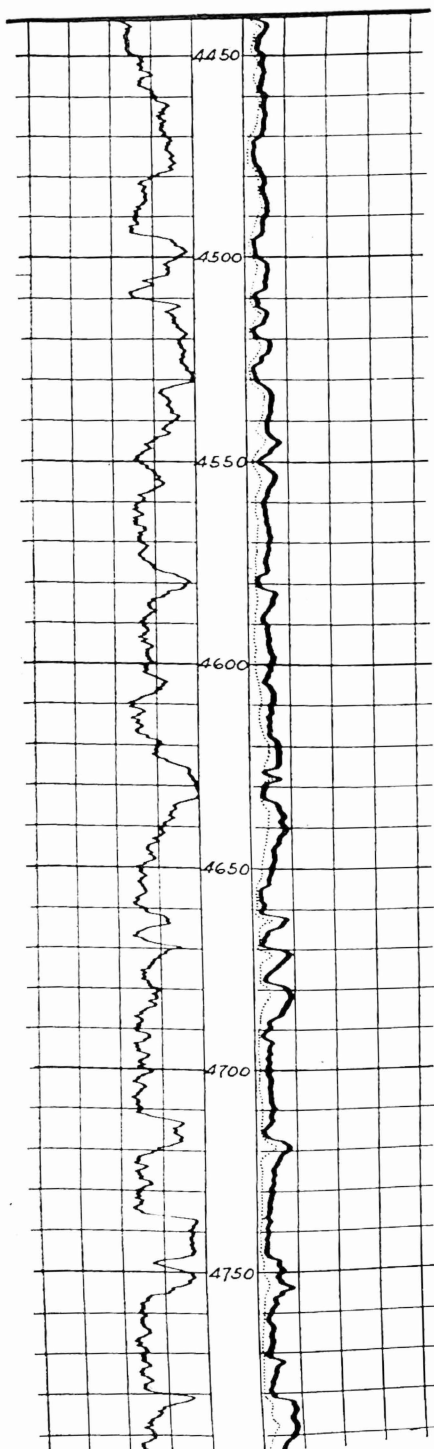


Figure 4. Electric Log of the Florida Oil Discovery Company's Cedar Keys No. 2



Bottom 4948'
Scale: 1" = 20'

PLATES 1-16

PLATE I

Figures 1-3, 5-12, of specimens from the Sholtz No. 1 (W-166); 1-3, 5, 6, 9-12 at a depth of 840 feet; 7, 8, at a depth of 860 feet.

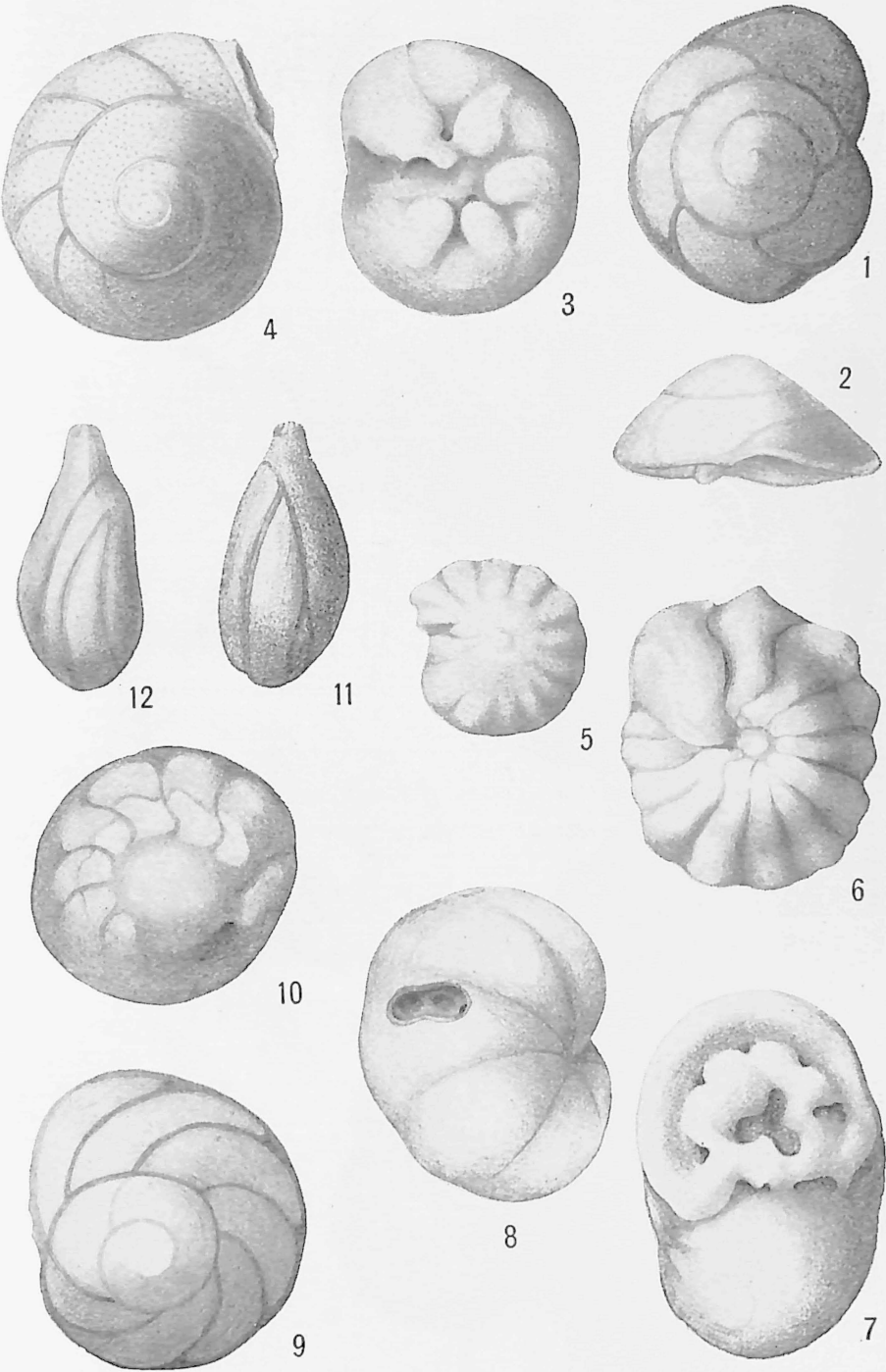
Figure 4, of a specimen from the Cedar Keys No. 2, (W-355) at a depth of 855-877 feet.

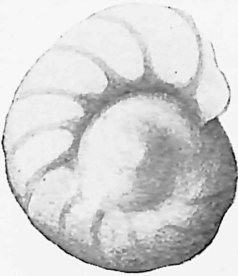
Figures 1-3, 9, 10, X 61

Figures 4-8, 11, 12, X 29

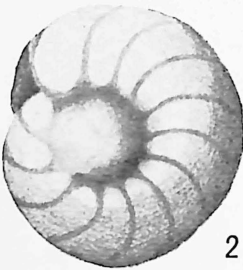
Figure

- 1-3 *Discorbis inornatus* Cole, n. sp.; 1, dorsal view; 2, side view; 3, ventral view; 1-3, holotype (F.S.G.S. No. S-1865).
- 4-6. *Eponides gunteri* Cole, n. sp.; 4, dorsal view; 5, 6, ventral views; 6, holotype (F.S.G.S. No. S-1863); 4, paratype (F.S.G.S. No. S-1930); 5, paratype (F.S.G.S. No. S-1863a).
- 7, 8. *Cribrobulimina floridana* Cole, n. sp. 7, dorsal view; 8, ventral view; 7, 8, holotype (F.S.G.S. No. S-1873).
- 9, 10. *Asterigerina cedarkeysensis* Cole, n. sp.; 9, dorsal view; 10, ventral view; 9, 10, holotype (F.S.G.S. No. S-1861).
- 11, 12. *Sigmomorphina floridana* Cole, n. sp.; side views of holotype (F.S.G.S. No. S-1866),

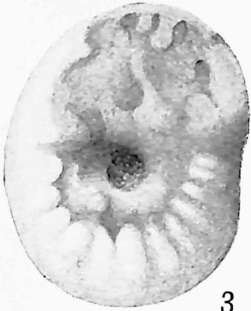




1



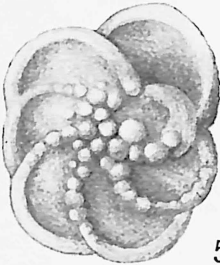
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6



5



4



7



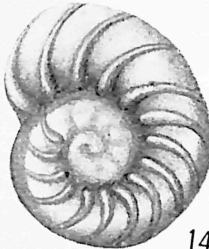
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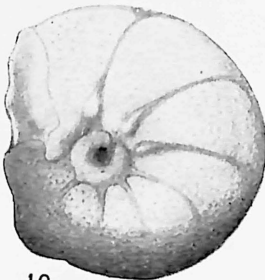
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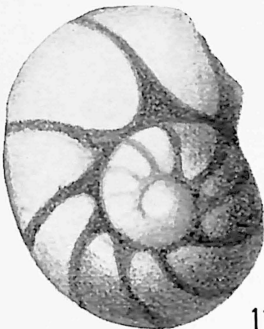
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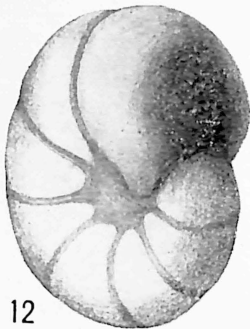
14



10



11



12

PLATE 2

All figures of specimens from the Sholtz No. 1 (W-166); 1, 2, at a depth of 3401 feet; 3, 4, 6, 7, at a depth of 1525 feet; 5, 13, 14, at a depth of 3175 feet; 8, 11, 12, at a depth of 3277 feet; 9, 10, at a depth of 3402 feet.

Figures 1-10, 13, 14 X 61

Figures 11, 12 X 120

Figure

- 1, 2. *Anomalina sholtzensis* Cole, n. sp.; 1, dorsal view; 2, ventral view; 1, 2, holotype (F.S.G.S. No. S-1916).
- 3, 4. *Discorbis suturalis* Cole, n. sp.; 3, ventral view; 4, dorsal view; 3, 4, holotype (F.S.G.S. No. S-1886).
5. *Globotruncana cretacea* Cushman; dorsal view.
- 6, 7. *Clavulina floridana* Cole, n. sp.; 6, side view of holotype (F.S.G.S. No. S-1885); 7, apertural view of paratype (F.S.G.S. No. S-1885a).
8. *Gyroidina alabamensis* Sandidge; side view.
- 9, 10. *Anomalina* sp.; 9, apertural view; 10, ventral view.
- 11, 12. *Gyroidina cretosa* Cole, n. sp.; 11, dorsal view; 12, side view; 11, 12, holotype (F.S.G.S. No. S-1912).
- 13, 14. *Planulina cedarkeysensis* Cole, n. sp.; 13, ventral view; 14, dorsal view; 13, 14, holotype (F.S.G.S. No. 1907).

PLATE 3

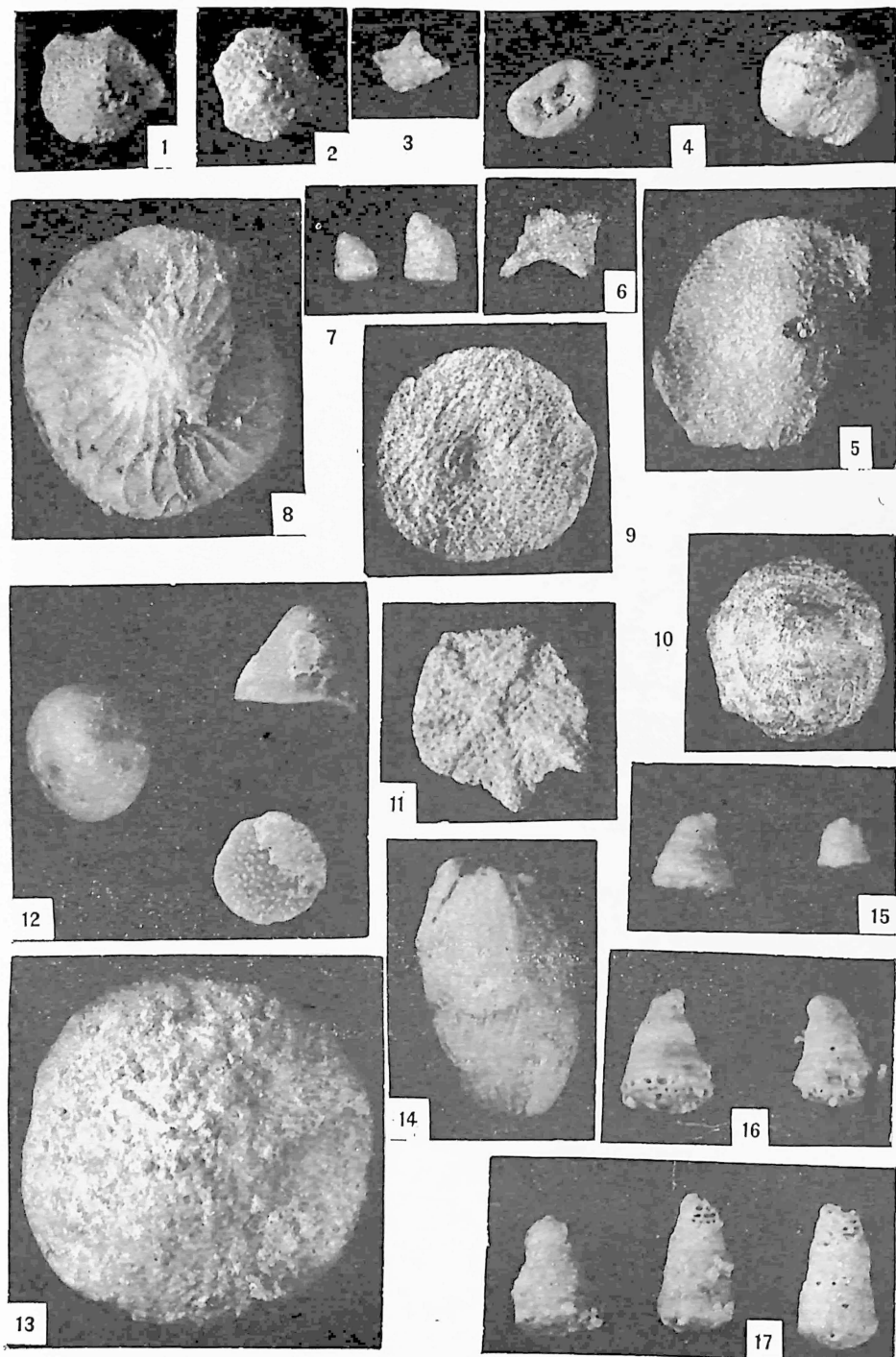
Figures 1, 3, 5, 6, 9, 11, of specimens from Cedar Keys No. 2 (W-355); 1, at a depth of 833-855 feet; 3, at a depth of 2554-2576 feet; 5, at a depth of 2799-2822 feet; 6, at a depth of 2620-2684 feet; 9, at a depth of 2778-2799 feet; 11, at a depth of 2716-2737 feet.

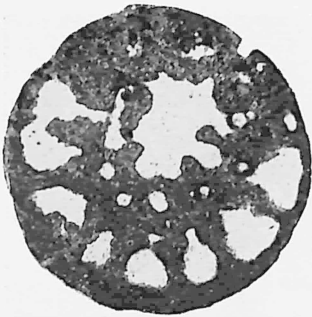
Figures 2, 4, 7, 8, 10, 12-17, of specimens from the Sholtz No. 1 (W-166); 2, 12, at a depth of 860 feet; 4, at a depth of 1355-1365 feet; 7, 16, at a depth of 1497 feet; 8, at a depth of 120 feet; 10, at a depth of 145 feet; 13, at a depth of 840 feet; 14, at depth of 310 feet. 15, at a depth of 1545 feet; 17, at a depth of 1525 feet.

All figures, X 10, except figure 3, X 14

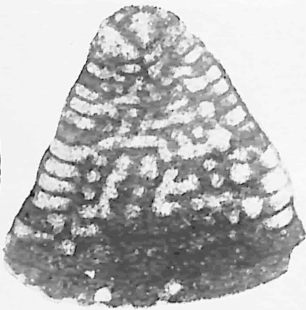
Figure

- 1, 2. *Lepidocyclina* (*Pliolepidina*) *cedarkeysensis* Cole, n. sp.; external views; 2, holotype (F.S.G.S. No. S-1871).
- 3, 6. *Lepidorbitoides* (*Asterorbis*) *aguayoi* D. K. Palmer; external views showing stellate form of the test, both specimens with some of the rays broken.
4. *Pseudorbitolina cubensis* Cushman and Bermudez.; external views; specimen on the left, ventral view, showing large umbilical area; specimen on the right, dorsal view.
5. *Lepidorbitoides* (*Lepidorbitoides*) *planasi* M. G. Rutten; external view.
7. *Lituonella elegans* Cole, n. sp.; external views of cotypes (F.S.G.S. No. S-1883).
8. *Camerina vanderstoki* (M. G. Rutten and Vermunt); external view.
9. *Lepidorbitoides* (*Lepidorbitoides*) *minima* H. Douvillé; external view.
10. *Dictyoconus cookei* (Moberg); external view of a slightly abraded specimen which shows chamberlets.
11. *Lepidorbitoides* (*Asterorbis*) *rooki* Vaughan and Cole; external view to illustrate stellate character of the test and surface ornamentation.
- 12, 13. *Dictyoconus americanus* (Cushman); external view; 13, specimens of this size and shape have been previously called *gunteri*.
14. *Fabularia vaughani* Cole and Ponton; side view of a slightly abraded specimen.
- 15-17. *Coskinolina elongata* Cole, n. sp.; external views to illustrate differences in size and shape; 16, cotypes (F.S.G.S. No. S-1882).





1



4



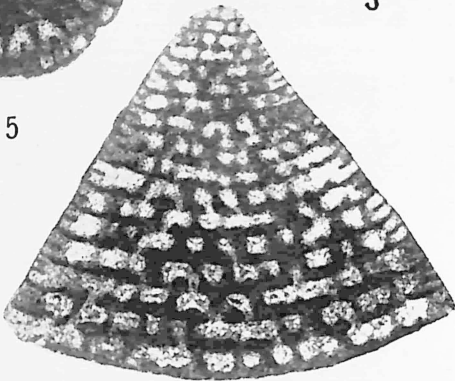
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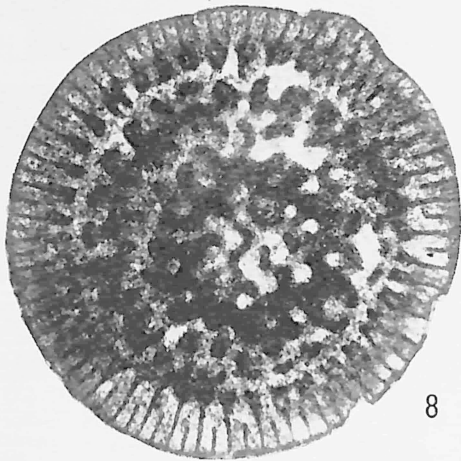
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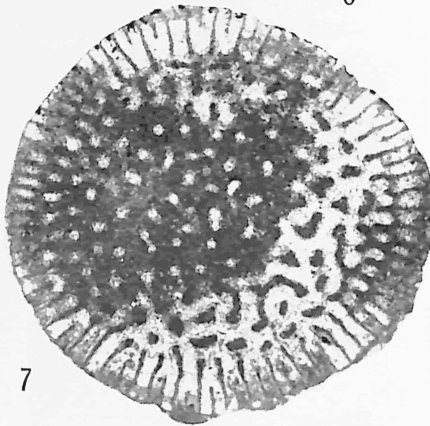
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8



7

PLATE 4

Figures 1-5, 8, of specimens from the Sholtz No. 1 (W-166) 1, 2, at a depth of 1525 feet; 3, at a depth of 1497 feet; 4, 5, at a depth of 860 feet; 8, at a depth of 145 feet.

Figures 6, 7, of specimens from near the top of Mt. Barker on the Colorado River, west of Austin, Texas; presented to the writer by Mrs. Helen Jeanne Plummer; collection of W. S. Cole.

All figures, X 41

Figure

- 1-3 *Coskinolina elongata* Cole, n. sp.; 1, horizontal section; 2, 3, axial sections; 1, paratype (F.S.G.S. No. S-1888d) 2, paratype (F.S.G.S. No. S-1888e).
- 4, 5. *Coskinolina floridana* Cole; 4, axial section; 5 horizontal section.
- 6, 7. *Dictyoconus walnutensis* (Carsey); 6, axial section; 7, horizontal section; introduced for comparison with the Florida specimens of *Dictyoconus*.
8. *Dictyoconus cookei* (Moberg); horizontal section.

PLATE 5

Figures 1, 7, of specimens from Cedar Keys No. 2 (W-355); 1, at a depth of 1287-1300 feet; 7, at a depth of 1510-1515 feet (core).

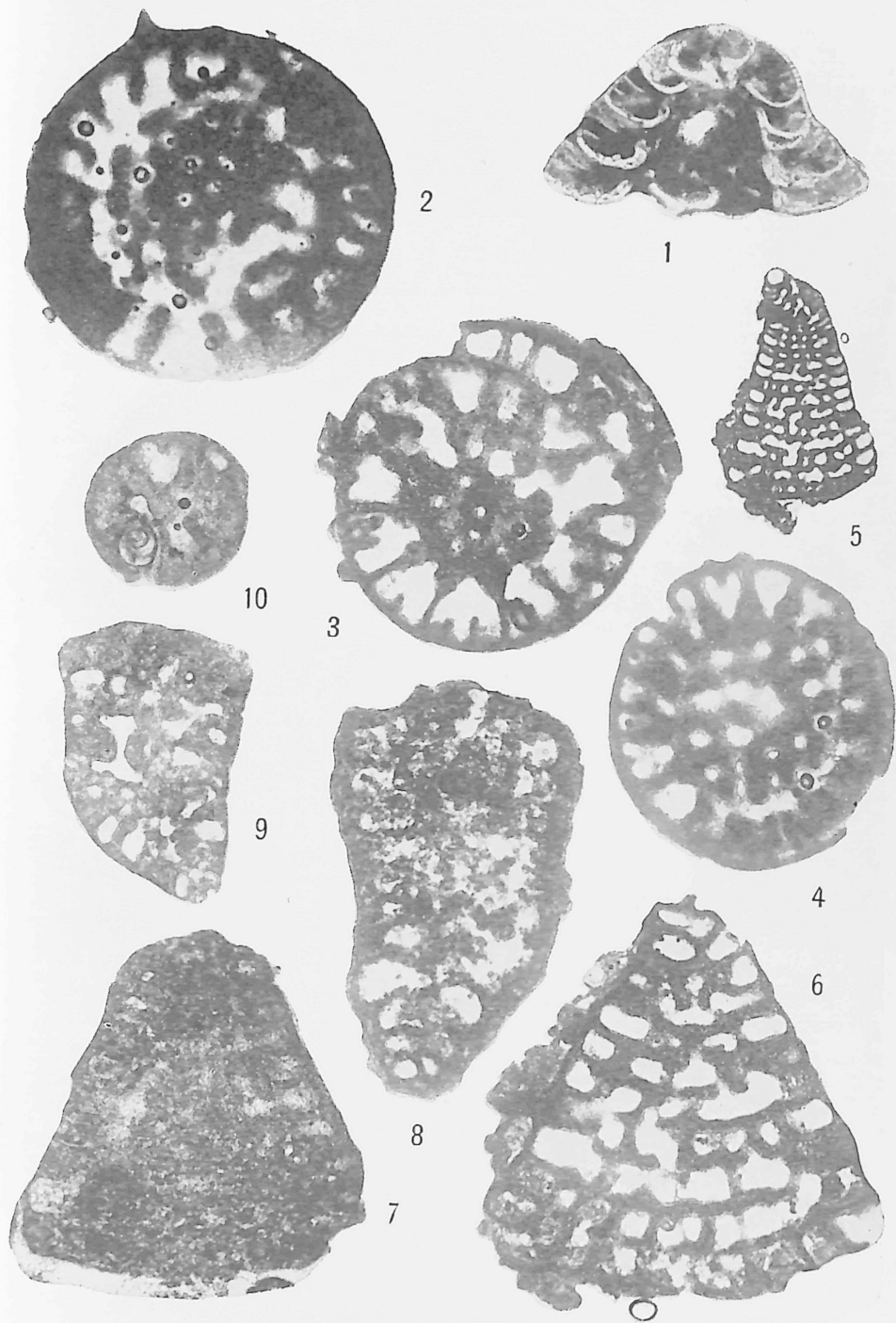
Figures 2-6, 8-10, of specimens from the Sholtz No. 1 (W-166); 2, 5, 9, 10, at a depth of 1525 feet; 3, 6, at a depth of 1500-1505 feet; 8, at a depth of 200 feet; 4, at a depth of 1497 feet.

Figures 1-4, 6-10, X 41

Figure 5, X 15

Figure

1. *Pseudorbitolina cubensis* Cushman and Bermudez; axial section.
- 2-7. *Coskinolina elongata* Cole, n. sp.; 2-4, horizontal sections; 5-7, axial sections.
8. *Lituonella floridana* Cole; axial section.
- 9-10. *Lituonella elegans* Cole, n. sp.; 9, axial section of a paratype (F.S.G.S. No. S-1887a). 10, horizontal section of a paratype (F.S.G.S. No. S-1887).



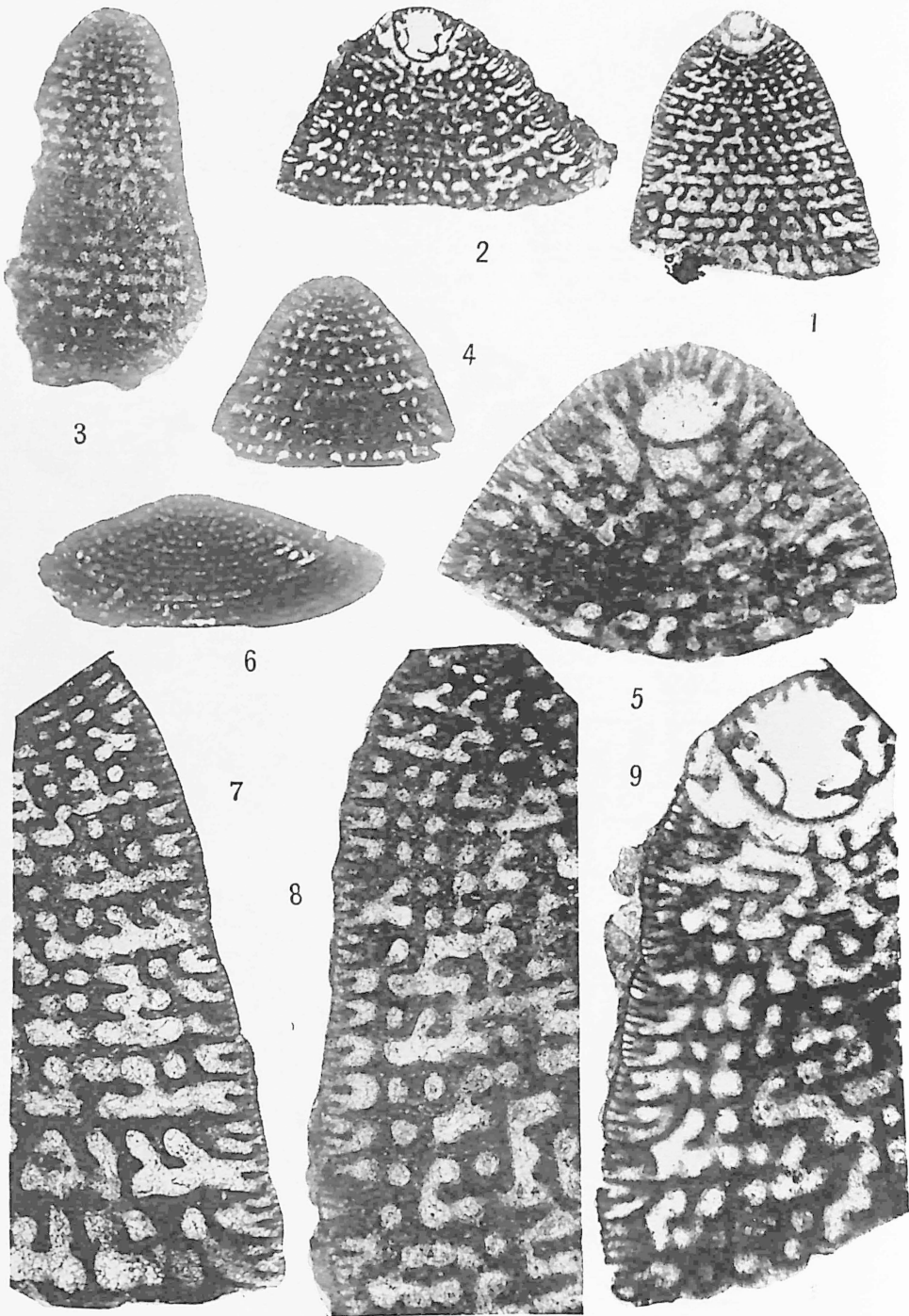


PLATE 6

Figures 1, 5, 7, 8, of specimens from about one kilometer below the pass at the north foot of Mt. Puilboreau, Haiti, presented to the writer by Dr. T. Wayland Vaughan; collection of W. S. Cole.

Figures 2, 9, of a specimen from the Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445) at a depth of 2070-2080 feet.

Figure 3, of a specimen from Cedar Keys No. 2 (W-355) at a depth of 1287-1300 feet.

Figures 4, 6, of specimens from the Sholtz No. 1 (W-166); 4, at a depth of 860 feet; 6, at a depth of 840 feet.

Figures 1-4, 6, X 15

Figures 5, 7-9, X 41

Figure

- 1-9 *Dictyoconus americanus* (Cushman); vertical sections; 9, enlarged portion of figure 2; 7, enlarged portion of figure 1; 2, 9, represent specimens previously identified as *D. gunteri* Moberg (text, p. 23); compare internal structure illustrated in figure 9 with that shown in figures 7 and 8 which represent portions of *D. codon* Woodring. (Note: see also pl. 7, figs. 1-5; pl. 16, figs. 13, 14).

PLATE 7

Figures 1, 3, of specimens from the Sholtz No. 1 (W-166) at a depth of 860 feet.

Figure 2, of a specimen from Pointe Popine, a promontory between Anse des Lezards and Anse des Cayes, on the north coast of St. Bartholomew. The specimen was collected by Dr. Alfred Senn from a brown, marly tuff 1.2 m. thick which contained larger Foraminifera in the upper part (Senn loc. S.B.13)

Figure 4, of a specimen from the Marathon Well (W-2) at a depth of 2000 feet; collection of W. S. Cole.

Figure 5, of a specimen from about 1 km. below the pass on the north foot of Mt. Puilboreau, Haiti, presented to the writer by Dr. T. Wayland Vaughan; collection of W. S. Cole.

Figures 1, 4, 5, X 41

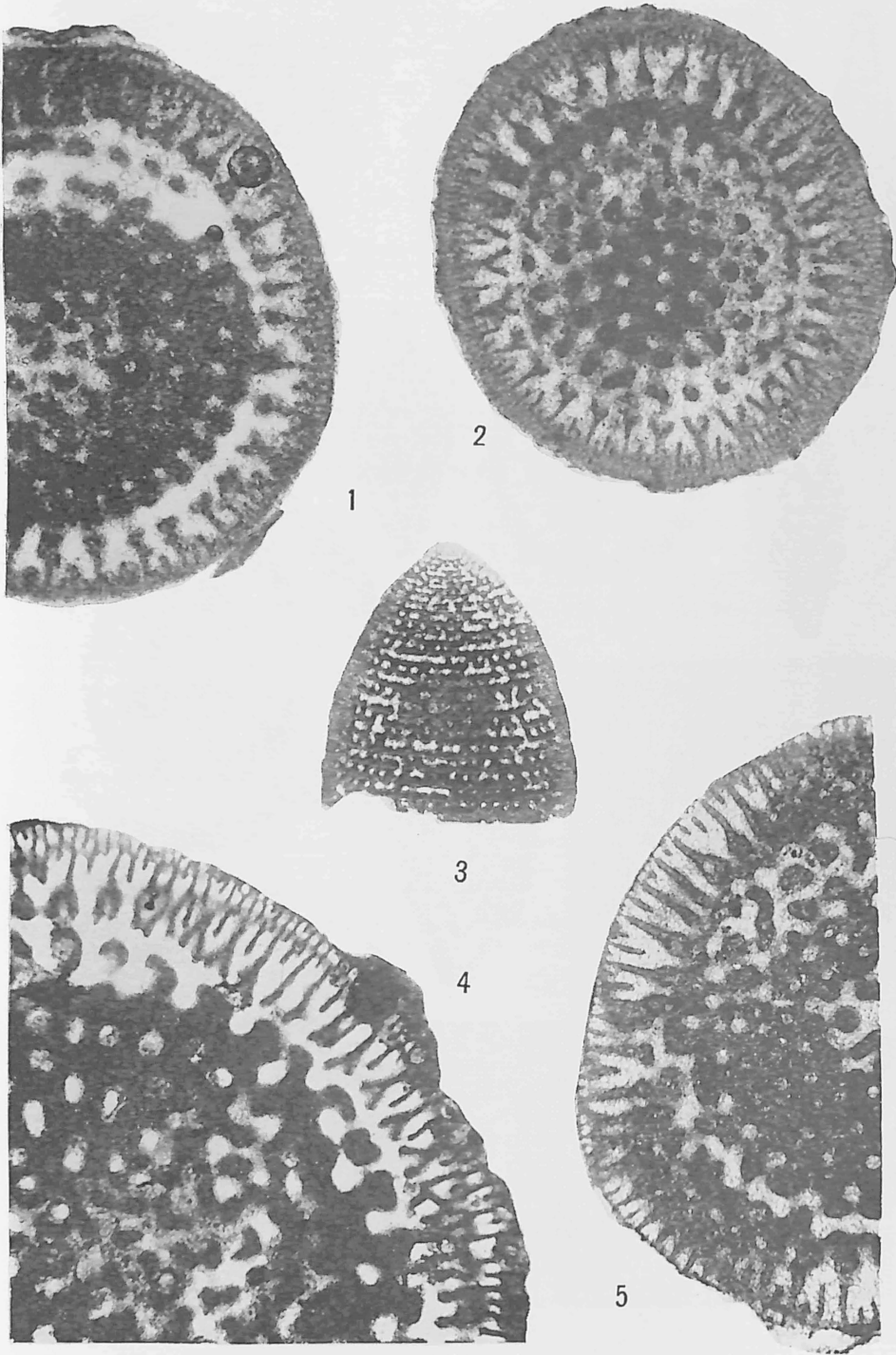
Figure 2, X 40

Figure 3, X 15

Figure

1-5 *Dictyoconus americanus* (Cushman); 1, 2, 4, 5, horizontal sections. 1, portion of a horizontal section of a specimen from the Sholtz No. 1 (W-166). 2, horizontal section of a specimen from the lower limestone of the St. Bartholomew formation which Dr. Vaughan identified as *americanus*. This limestone is probably a slightly lower member of the St. Bartholomew formation than that from which the type specimens of *D. americanus*⁵⁴ came. 4, portion of a horizontal section of a specimen previously named *gunteri*. This thin section was published as figure 6, plate 7 of Florida Geol. Survey Bull. 19. 5, portion of a horizontal section of a specimen previously named *codon*. This thin section was published as figure 11, plate 18 of Florida Geol. Survey Bull. 19. 3, axial section. Compare with figure 1, plate 7 of Florida Geol. Survey Bull. 19. This specimen is identical in size and shape with those called *codon*.

⁵⁴ Personal communication from Dr. Alfred Senn.



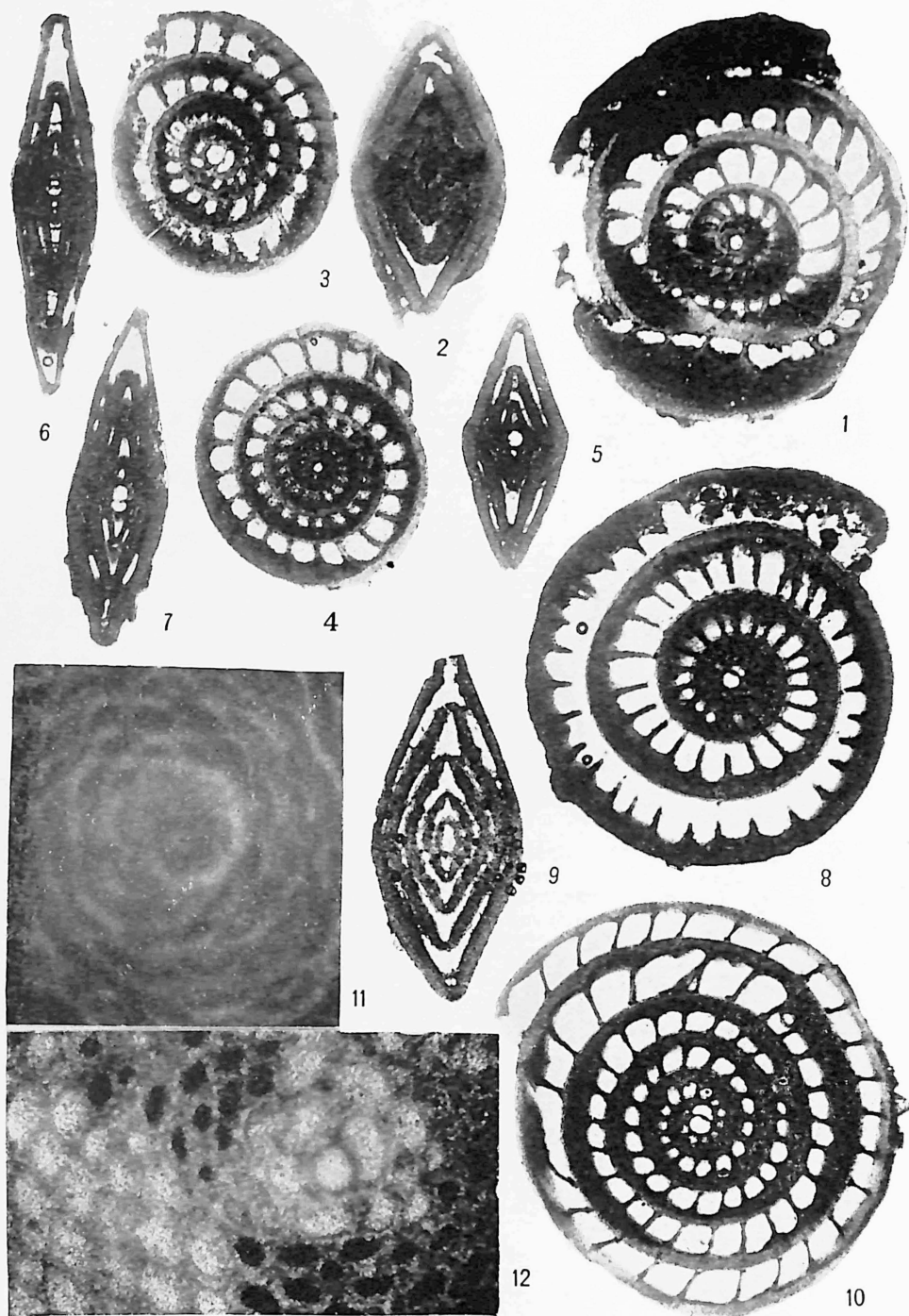


PLATE 8

Figures 1-11, of specimens from the Sholtz No. 1 (W-166); 1-6, 9, 10, at a depth of 120 feet; 7, 8, at a depth of 130 feet; 11, at a depth of 860 feet.

Figure 12, of a specimen from the Cedar Keys No. 2 (W-355) at a depth of 2778-2799 feet.

Figures 1-10, X 15

Figures 11, 12, X 163

Figure

- 1, 2. *Camerina* sp. probably *C. vanderstoki* (M. G. Rutten and Vermunt); 1, median section; 2, transverse section.
- 3-5. *Camerina jacksonensis* Gravell and Hanna; 3, 4, median sections; 5, transverse section.
- 6-8. *Camerina moodybranchensis* Gravell and Hanna; 6, 7, transverse sections; 8 median section.
- 9, 10. *Camerina vanderstoki* (M. G. Rutten and Vermunt); 9, transverse section; 10, median section.
11. *Lepidocyclina* (*Pliolepidina*) *cedarkeysensis* Cole, n. sp.; portion of horizontal section to illustrate the initial chambers and equatorial chambers of a microspheric specimen.
12. *Lepidorbitoides* (*Lepidorbitoides*) *planasi* M. G. Rutten; portion of a horizontal section to illustrate the embryonic apparatus of a megalospheric individual.

PLATE 9

Figure 1, of a specimen from 5.6 kilometers southeast of Coliseo, Matanzas Province, Cuba, presented to the writer by Mrs. Dorothy K. Palmer; collection of W. S. Cole.

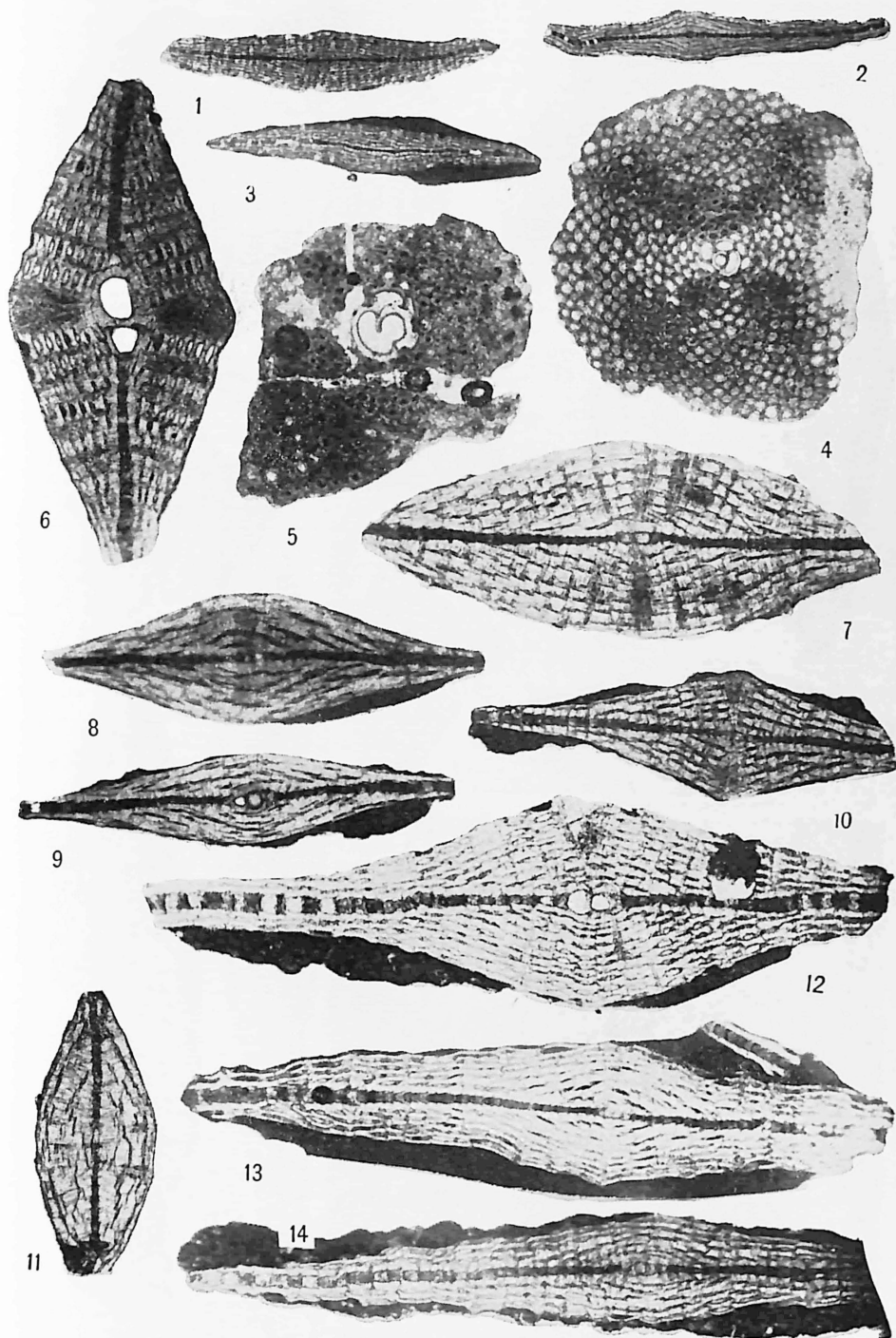
Figures 2-14, of specimens from the Cedar Keys No. 2 (W-355); 2, at a depth of 2716-2737 feet; 3, 5, 6, 9, 13, at a depth of 2737-2760 feet; 4, 7, at a depth of 2648-2671 feet; 8, at a depth of 2866-2888 feet; 10, 11, at a depth of 2620-2648 feet; 12, at a depth of 2760-2788 feet; 14, at a depth of 2554-2574 feet.

Figures 1-3, X 15

Figures 4-14, X 41

Figure

1. *Lepidorbitoides (Lepidorbitoides) rutteni* Thiadens; introduced for comparison with the Florida specimens of *L. minima* H. Douvillé.
- 2, 3, 12-14. *Lepidorbitoides (Lepidorbitoides) minima* H. Douvillé; vertical sections, showing various degrees of inflation of the central portion of the test. (Note: compare with figures given by Vaughan, *Jour. Pal.*, vol. 3, 1929, pl. 22, fig. 6.)
- 4, 7-11. *Lepidorbitoides (Lepidorbitoides) planasi* M. G. Rutten; 4, horizontal section of a megalospheric individual; 7-11, vertical sections to illustrate various degrees of inflation of the central portion of the test. (Note: compare figure 7 with the figure given by Rutten (*Jour. Pal.*, vol. 9, 1935, pl. 60, fig. 6).)
- 5, 6. *Lepidorbitoides (Lepidorbitoides) floridensis* Cole, n. sp.; co-types: 5, horizontal section to show the embryonic apparatus and the shape of the equatorial chambers (F.S.G.S. No. S-1957); 6, vertical section (F.S.G.S. No. S-1957a).



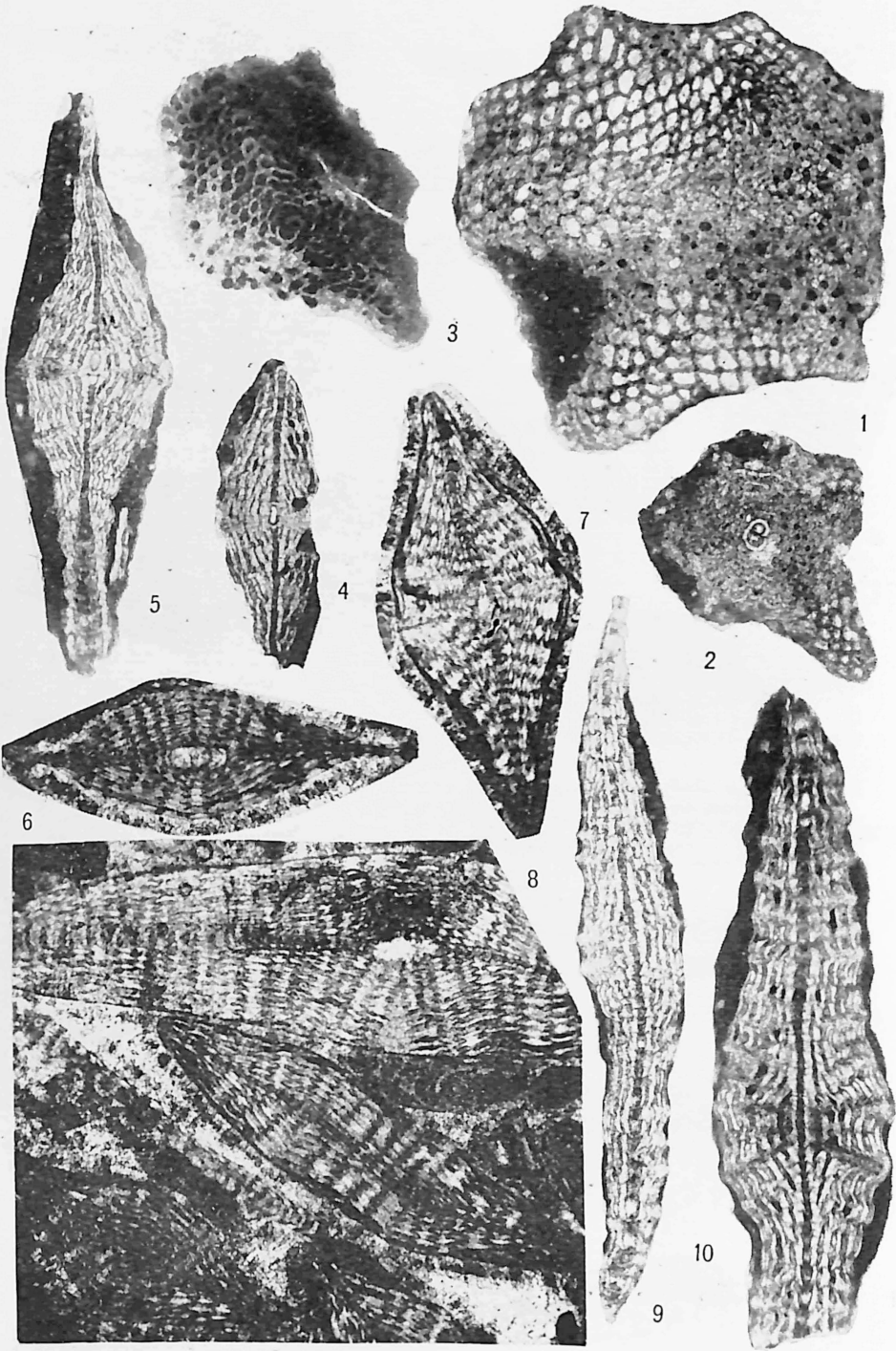


PLATE 10

Figures 1-5, 9, 10, of specimens from the Cedar Keys No. 2 (W-355); 1, at a depth of 2716-2737 feet; 2, at a depth of 2694-2716 feet; 3, 4, 10, at a depth of 2737-2760 feet; 5, at a depth of 2620-2648 feet; 9, at a depth of 2799-2822 feet.

Figures 6-8, of specimens from the Misterfeldt Well 1, at a depth of 3480-3491 feet, Sec. 2, T. 4 N., R. 1 E., Rankin County, Mississippi. Topotypes, presented to the writer by Dr. T. Wayland Vaughan; collection of W. S. Cole.

All figures, X 41

Figure

- 1, 6-10. *Lepidorbitoides (Asterorbis) rooki* Vaughan and Cole; 1, horizontal section, showing stellate form of the test and the shape of the equatorial chambers; 6-10, vertical sections; 6-8, introduced for comparison with the Florida specimens assigned to this species (see also pl. 16, figs. 12, 13).
- 2-5. *Lepidorbitoides (Asterorbis) aguayoi* D. K. Palmer; 2, 3, horizontal sections; 4, 5, vertical sections; 5, lower portion of this figure illustrates the increase in height of the equatorial chambers in one of the rays.

PLATE 11

Figures 1-3, 8, of specimens from the Cedar Keys No. 2 (W-355); 1, a depth of 2866-2888 feet; 2, at a depth of 2737-2760 feet; 3, at a depth of 2694-2716 feet; 8, at a depth of 1312-1331 feet.

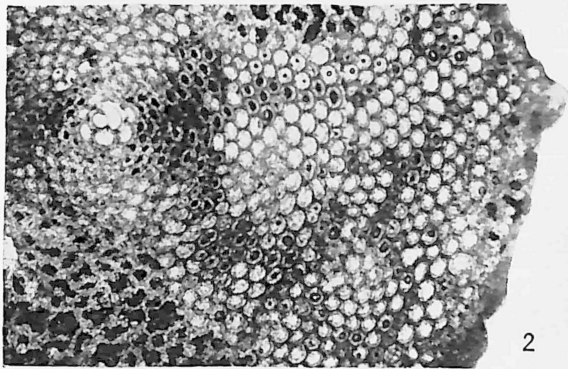
Figures 4-7, of specimens from the Sholtz No. 1 (W-166); 4, 5, at a depth of 120 feet; 6, 7, at a depth of 840 feet.

Figures 1-3, 6-8, X 41

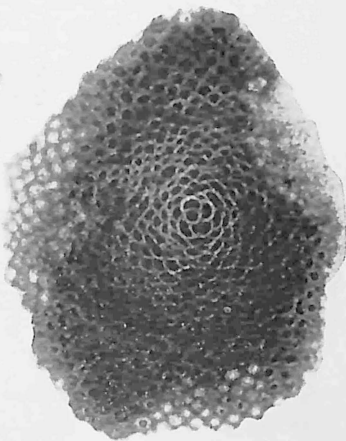
Figures 4, 5, X 15

Figure

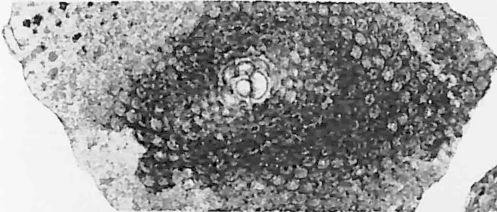
- 1, 3. *Lepidorbitoides (Lepidorbitoides) planasi* M. G. Rutten; horizontal sections of megalospheric individuals to illustrate embryonic chambers and equatorial chambers.
2. *Lepidorbitoides (Lepidorbitoides) minima* H. Douvillé; portion of a horizontal section of a megalospheric individual to illustrate embryonic chambers and equatorial chambers.
- 4, 5. *Lepidocyclina (Lepidocyclina) ocalana* Cushman; 4, horizontal section; 5, vertical section.
- 6, 7. *Lepidocyclina (Pliolepidina) cedarkeysensis* Cole, n. sp.; horizontal sections of megalospheric individuals.
8. *Linderina floridana* Cole, n. sp.; vertical section.



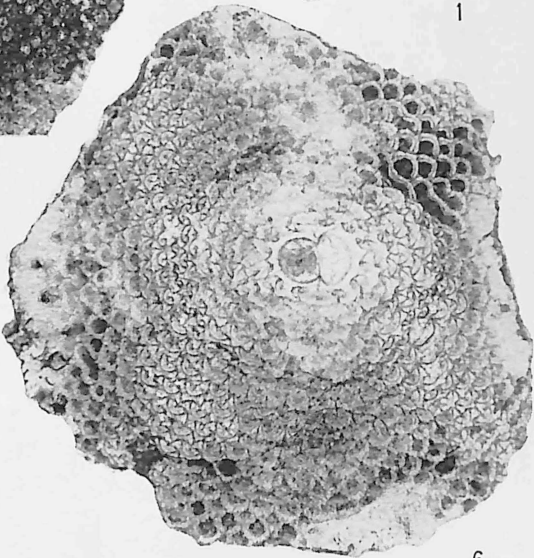
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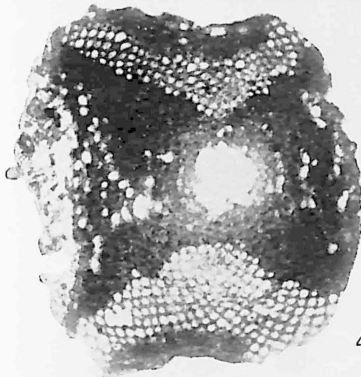
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3



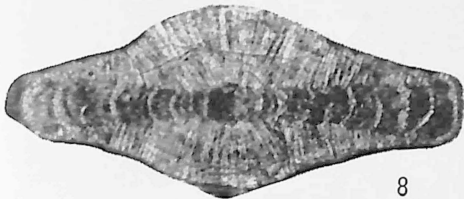
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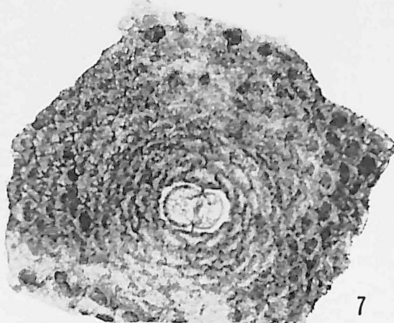
4



5



8



7



PLATE 12

All specimens are from the Sholtz No. 1 (W-166) at a depth of 840 feet except the specimens illustrated by figures 4 and 5 which occurred at a depth of 860 feet.

All figures, X 41

Figure

- 1-7. *Lepidocyclina (Pliolepidina) cedarkeysensis* Cole, n. sp.; 1-6, vertical sections; 6, paratype (F.S.G.S. No. S-1869f); 7, horizontal section; paratype (F.S.G.S. No. S-1869e).

PLATE 13

Figures 1-5, of specimens from the Sholtz No. 1 (W-166) at a depth of 1470 feet.

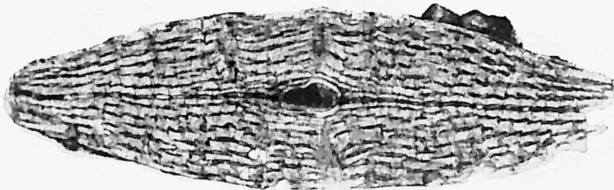
Figures 1, X 10

Figures 2-4, X 41

Figure 5, X 163

Figure

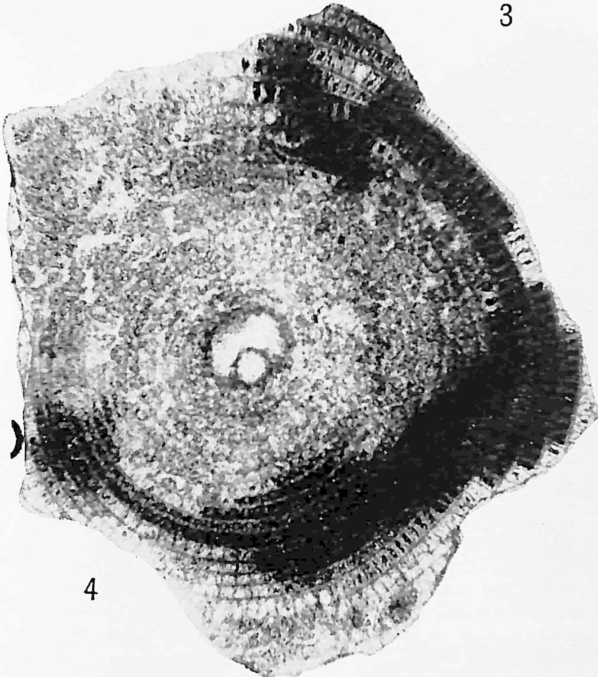
- 1-5. *Pseudophragmina (Proporocyclina) zaragosensis* (Vaughan); 1, external views; 2, 3, vertical sections; 4, horizontal section; 5, portion of the specimen illustrated by figure 4, greatly enlarged, to illustrate that the annular stolon is distally situated, the radial chamber walls are in alignment and tend to be wavy.



3



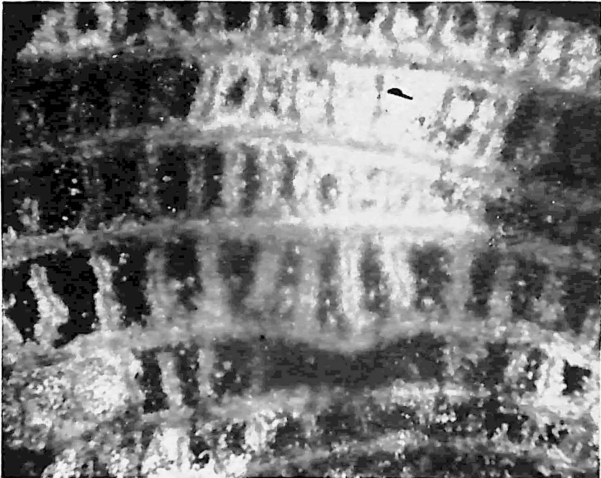
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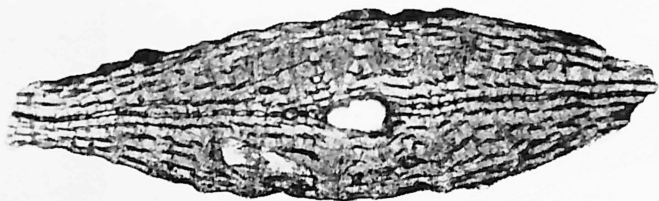
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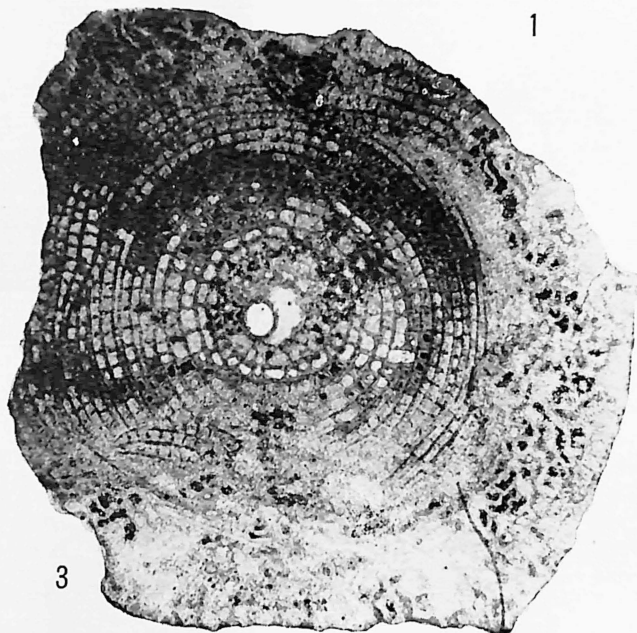
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5



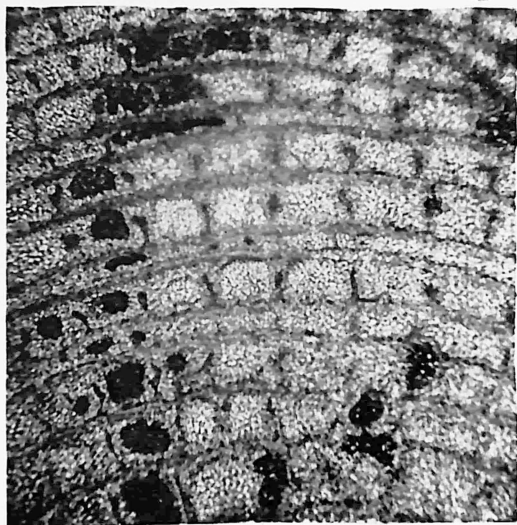
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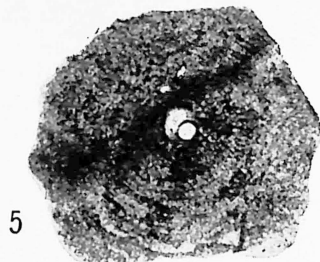
3



2



4



5

PLATE 14

All specimens from the Sholtz No. 1 (W-166) at a depth of 1470 feet.

Figures 1-3, X 41

Figure 4, X 15

Figure 5, X 163

Figure

- 1-5. *Pseudophragmina (Proporocyclina) zaragosensis* (Vaughan); 1-2, vertical sections; 3, 5, horizontal sections; 4, equatorial chambers to show that the radial chamber walls are in alignment and that the annular stolon is distally situated. This figure illustrates a portion of the horizontal section, figure 3.

PLATE 15

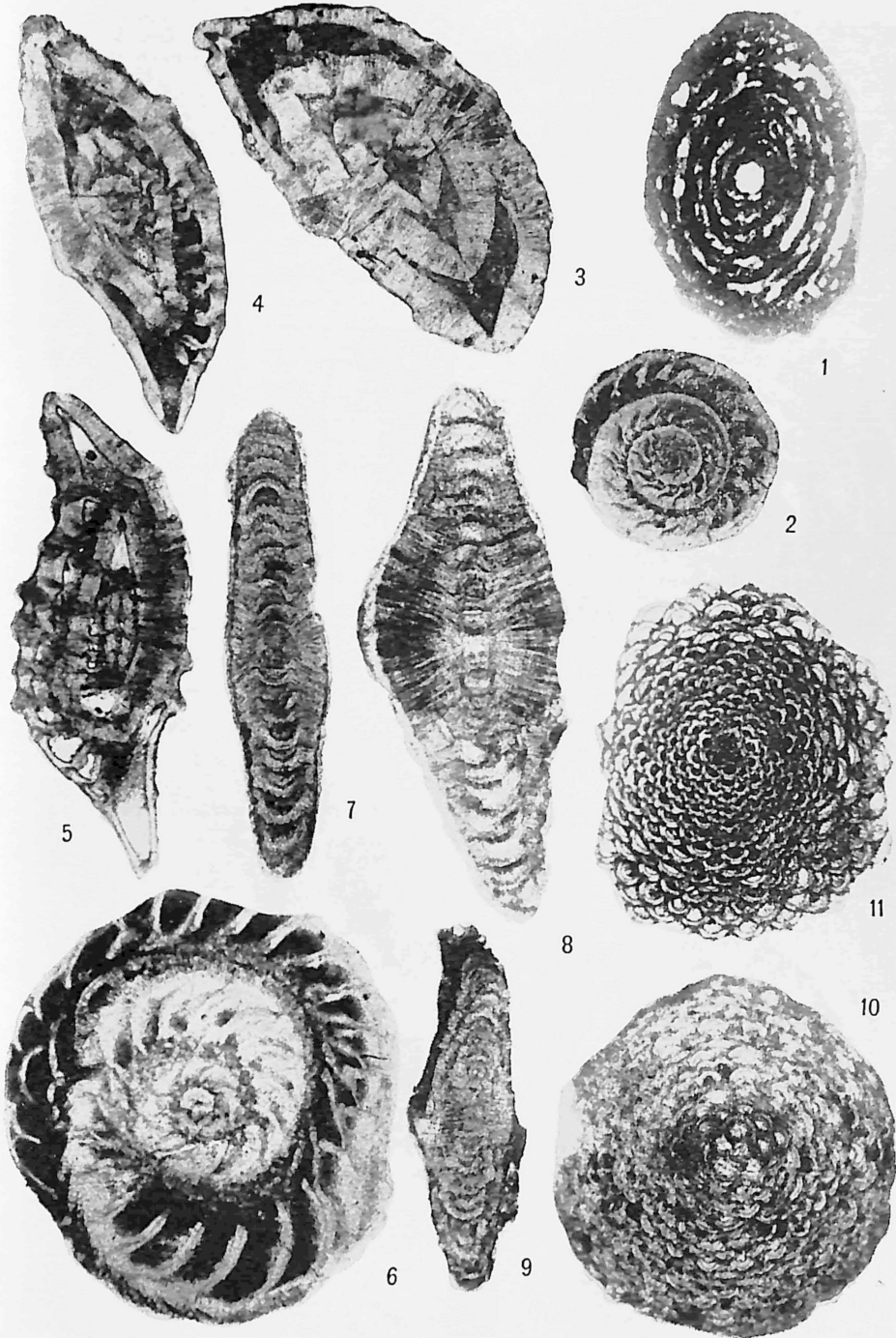
Figures 1-6, 11, of specimens from the Sholtz No. 1 (W-166); 1, at a depth of 310 feet; 2, 3, at a depth of 1340 feet; 4, at a depth of 1365-1370 feet; 5, 6, 11, at a depth of 1355-1365 feet.

Figures 7-10, of specimens from the Cedar Keys No. 2 (W-355); 7, 8, at a depth of 983-1068 feet; 9, 10, at a depth of 1301-1308 feet.

All figures, X 41 except figures 2, X 15

Figure

1. *Fabularia vaughani* Cole and Ponton; axial section.
- 2, 3. *Amphistegina lopeztrigo* D. K. Palmer; 2, horizontal section; 3, vertical section.
- 4-6. *Helicostegina gyralis* Barker and Grimsdale; 4, 5, vertical sections; 6, horizontal section.
- 7-11. *Linderina floridensis* Cole, n. sp.; 7-9, vertical sections; 10-11, horizontal sections; 9, cotype (F.S.G.S. No. S-1936); 10, cotype (F.S.G.S. No. S-1936a).



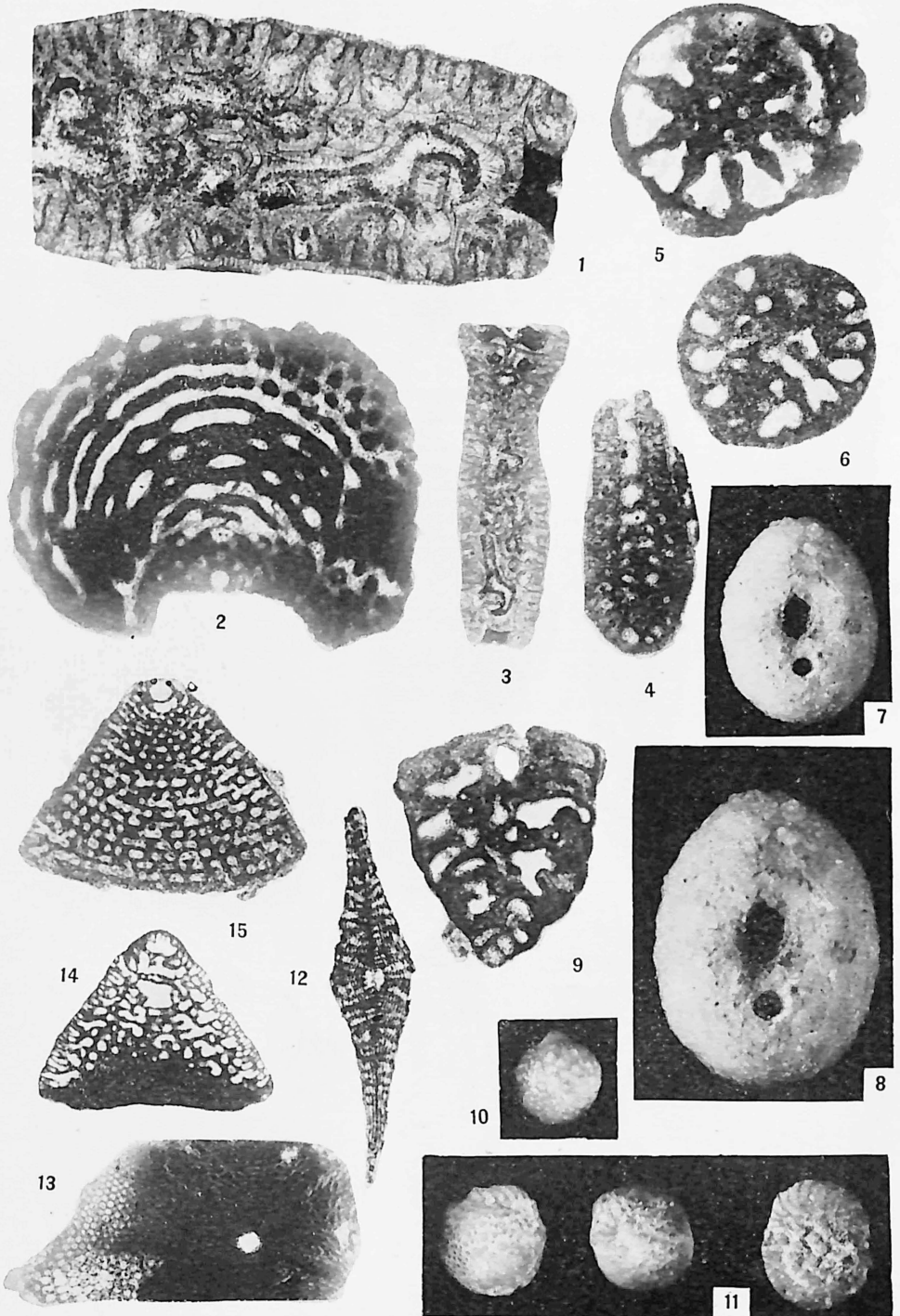


PLATE 16

Figures 1-4, of specimens from the Cedar Keys No. 2 (W-355) at a depth of 1102-1133 feet.

Figures 5-11, of specimens from the Sholtz No. 1 (W-166); 5, 6, 9, at a depth of 1525 feet; 7, 8, at a depth of 130 feet; 10, at a depth of 1365-1370 feet; 11, at a depth of 1355-1365 feet;

Figures 12, 13, of specimens from 1 kilometer west of Central San Antonio (Madruga) on the railroad to Central Hershey, Havana Province, Cuba, presented to the writer by Mrs. Dorothy K. Palmer; collection of W. S. Cole.

Figure 14, of a specimen from the Marathon Well (W-2); collection of W. S. Cole.

Figure 15, of a specimen from about 1 kilometer below the pass, north foot of Mt. Puilboreau, Haiti, presented to the writer by Dr. T. Wayland Vaughan; collection of W. S. Cole.

Figures 1, 5, 6, 9, X 41
Figures 2-4, 12-15, X 15
Figure 7, X 7
Figures 8, 10, 11, X 10

Figure

- 1-4. *Gunteria floridana* Cushman and Ponton; 1, enlarged portion of figure 3 to show details of internal structure; 2, median section; 3, 4, transverse sections.
- 5.9. *Lituonella elegans* Cole, n. sp.; 5, horizontal section; 9, axial section.
6. *Coskinolina elongata* Cole, n. sp.; horizontal section.
- 7, 8. *Fibularia vauhani* (Twitchell).
10. *Helicostegina gyralis* Barker and Grimsdale; external view.
11. *Amphistegina lopeztrigoi* D. K. Palmer; external views.
- 12, 13. *Lepidorbitoides (Asterorbis) rooki* Vaughan and Cole; Cuban specimens introduced for comparison with the Florida specimens (See pl. 10, figs. 1, 9, 10); 12, vertical section; 13, horizontal section.
- 14, 15. *Dictyoconus americanus* (Cushman); axial sections of megalo-spheric individuals; 14, specimen previously called *D. gunteri*; 15, specimen previously called *D. codon* (note: similarity of shape and internal structure).

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