

**STATE OF FLORIDA
DEPARTMENT OF CONSERVATION
GEOLOGICAL SURVEY**

GEOLOGICAL BULLETIN No. 19

**STRATIGRAPHIC AND PALEONTOLOGIC
STUDIES OF WELLS IN FLORIDA**

**United Brotherhood of Carpenters and Joiners of America, Power House
Well No. 2.**

Peninsular Oil and Refining Company's J. W. Cory No. 1.

With description of a species of Foraminifera from another well.

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

TALLAHASSEE, FLORIDA

1941

**STATE OF FLORIDA
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FLORIDA GEOLOGICAL SURVEY
S. E. RICE, SUPERVISOR OF CONSERVATION
Herman Gunter, Director, Geological Survey**

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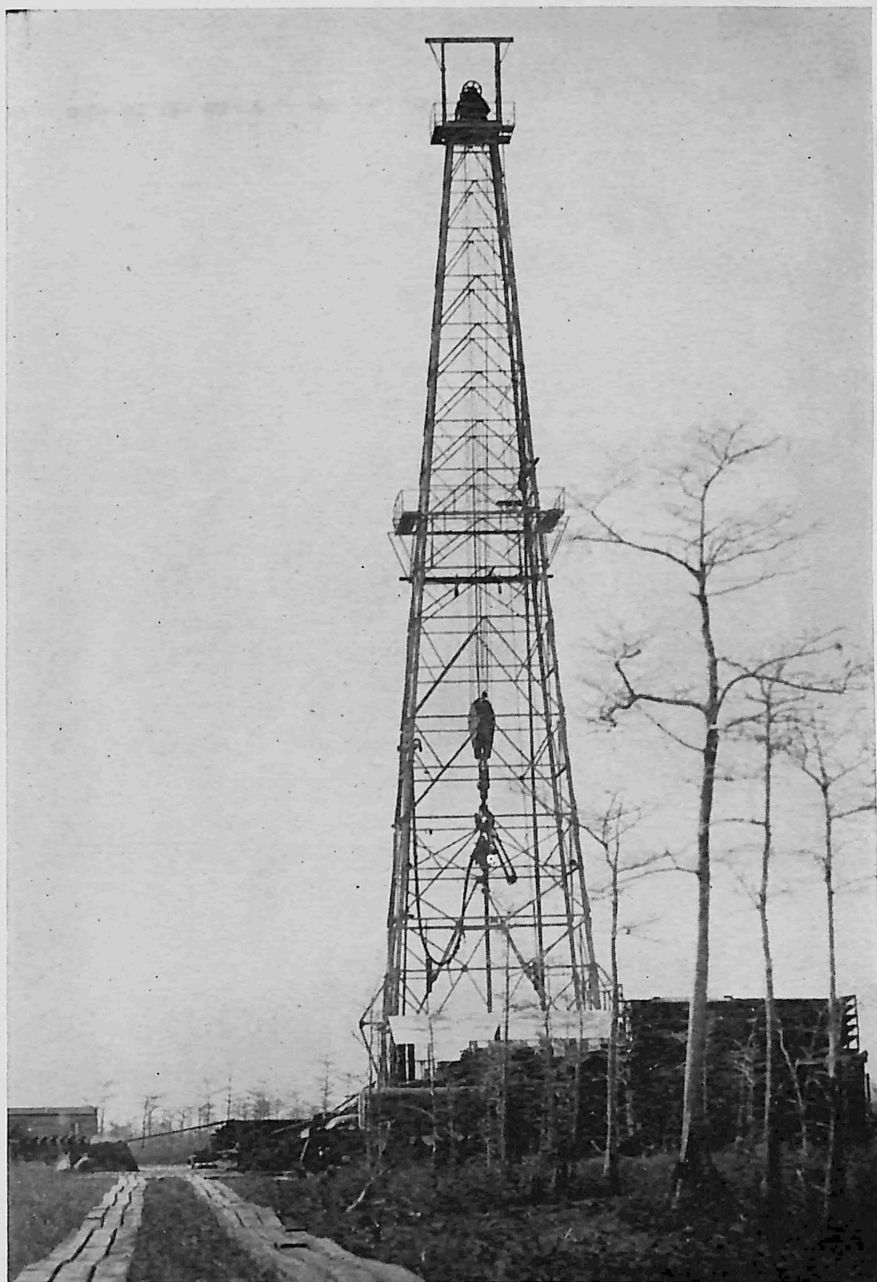
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Drilling rig Peninsular Oil and Refining Company's J. W. Cory No. 1.

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* by Dr. W. Storrs Cole of Ohio State University, Columbus, Ohio, to be published as Geological Bulletin No. 19.

This paper contains studies of two wells in peninsular Florida that are of particular scientific and economic interest, and is a continuation of a series of studies initiated by our Bulletin 16. One of these wells, that of the Peninsular Oil and Refining Company, was drilled as a deep test for oil and is so far the deepest well drilled in Florida. Both because of its depth and geographic position, this well is of great interest to both the pure scientist and the economic geologist. The second well is a water supply well and is included because it furnishes useful data for correlation purposes.

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,
May 6, 1941.

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STRATIGRAPHIC AND PALEONTOLOGIC STUDIES OF WELLS IN FLORIDA

Peninsular Oil and Refining Company's J. W. Cory No. 1
United Brotherhood of Carpenters and Joiners of America,
Power House Well No. 2.

W. STORRS COLE
OHIO STATE UNIVERSITY

INTRODUCTION

In 1938 the Florida Geological Survey published a bulletin entitled "Stratigraphy and Micropaleontology of Two Deep Wells in Florida."¹ The purpose of that bulletin was to make a complete analysis of the stratigraphy and micropaleontology of two wells which Herman Gunter, State Geologist of Florida, selected because of their economic and scientific importance. After the publication of this report, a log and samples of the Peninsular Oil and Refining Company's J. W. Cory No. 1 well, near Pinecrest, Monroe County (W-445), were made available to the Florida Geological Survey by Robert B. Campbell, president of the company, for study and analysis. A set of samples was also submitted by M. R. Vaughan, well contractor, from the second well at the Power House of the United Brotherhood of Carpenters and Joiners of America, 2 miles north of Lakeland, Polk County (W-448). Mr. Gunter wrote the writer requesting that the studies on key wells be continued. The study was begun in the summer of 1939. This bulletin embodies the most significant results of these studies. The approximate locations of the wells are shown in figure 1. Although satisfactory correlations can be made in the younger formations encountered in these wells, definite statements concerning the formations below the middle Eocene must await the analysis of many more wells. One difficulty is the lack of fossils in the older formations. The formations penetrated by the drill in the Granberry well² were recognized and correlated with certainty. At first, it was



FIGURE 1
Location of wells;
1. Carpenter's Union well.
2. Cory no. 1 well.

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

²*Ibid.*, pp. 19-36.

hoped that all the formations penetrated by the drill in the Cory well could be correlated also with other well known units elsewhere. One result of this study has shown that this cannot be done below the middle Eocene. However, studies of wells located in strategic positions between the Granberry and Cory wells may lead eventually to the correlation of the older formations which underlie the middle Eocene in southernmost Florida.

As the United Brotherhood of Carpenters and Joiners Power House well No. 2 ended in the middle Eocene, identification of the stratigraphic units encountered could be made with certainty.

All the specimens discussed in this bulletin are filed in the Florida Geological Survey Museum at Tallahassee.

ACKNOWLEDGEMENTS

Since 1929 it has been the privilege of the writer to cooperate with the Florida Geological Survey on various problems relating to the stratigraphy and microfaunas of that state. During that time Herman Gunter, State Geologist, has assisted those studies in ways too numerous to list. Thus it is a pleasure to acknowledge the encouragement and support which Mr. Gunter has given for the preparation of this bulletin. I am indebted to Dr. T. Wayland Vaughan for examining and commenting on many of the photomicrographs during a brief visit with him this past summer. Mrs. Elizabeth Burekmyer furnished able assistance in making the drawings of the small Foraminifera. The United States Geological Survey undertook the difficult task of supplying suitable photomicrographs illustrating the external appearance of the large Foraminifera.

PREVIOUS STUDIES

The samples from the United Brotherhood of Carpenters and Joiners well (W-448) have not been previously studied by any geologist or paleontologist, but the samples from the Cory well (W-445) have been studied. Campbell³ published two brief accounts of this well in the first of which he discussed some of the drilling problems and stated the important contacts based on work by Mrs. E. R. Applin, Consulting Paleontologist, Ft. Worth, Texas.

³Robert B. Campbell, "Deep Test in Florida Everglades," Amer. Assoc. Petrol. Geol., Bull. vol. 23, pp. 1713-1714, 1939.

"Outline of the Geological History of Peninsular Florida," Fla. Acad. Sci. Proc., vol. 4, pp. 96-97, 1939.

The second note recapitulates the information given in the first, although in the second note Campbell states that *Dictyoconus* (presumably *D. gunteri*) occurs at approximately 1,800 feet, *Borelis* at about 3,300 feet and *Orbitolina walnutensis* (*Dictyoconus walnutensis*) was reported by one worker from the final core.

A summary of the determinations of Mrs. Applin in the first article is given below.

	Depth in feet
Pliocene (Caloosahatchee formation)	0-110
Unassigned	110-390
Top of Miocene	390
Top of Oligocene	900
Top of Eocene (Ocala limestone)	1220
Top of Upper Cretaceous	5730
Top of Lower Cretaceous	8106

The only fossils mentioned in this brief account were *Lepidorbitoides* at 5,730 feet and miliolids in the Lower Cretaceous or Comanchean.

The present study substantiates certain of the contacts given by Campbell in his article, but complete agreement is not possible. This may be due to differences in interpretation.

The top of the Oligocene and the top of the Eocene check with the observations made in this study, but certain points of difference should be indicated. Campbell places the top of the Miocene at 390 feet. This is the top of a calcareous sandstone and does mark a slight lithologic break. The writer, however, places the top of the Miocene (Hawthorn formation) at 90 feet which marks the top of the section of sands and marls in this well.

The top of the Upper Cretaceous is given as 5,730 feet and the top of the Lower Cretaceous is stated definitely to be 8,106 feet, although at both of these depths Cretaceous deposits were encountered, some caution must be exercised. It will be stated clearly in other portions of this bulletin, that paleontological evidence is virtually lacking below 2,000 feet. The fossils that do occur are indicative of the age of the deposits, but are not absolute indicators that the top of a series of rock have been reached.

UNITED BROTHERHOOD OF CARPENTERS AND JOINERS WELL (W-448)⁴

The United Brotherhood of Carpenters and Joiners well was drilled by M. R. Vaughan, Well Contractor of Tampa. This well is located about 2 miles north of Lakeland in Polk County. Samples of cuttings were received July 10, 1939. These were collected at irregular intervals⁵ from 10 feet to 550 feet at which depth the well was completed. The elevation of the well is 157.6 feet above sea level.

Examination of the geological map of Florida⁶ indicates that the area immediately adjacent to the city of Lakeland is underlain by the Hawthorn formation of Miocene age. Although the Hawthorn formation is assumed to underlie all of Polk County, it outcrops only in the western half.

Below the Hawthorn formation, the Tampa limestone is assumed to underlie the entire county.⁷ Some details of the subsurface section of Polk County have already been presented by Mossom.⁸ Unfortunately, only a very generalized picture of the fossil zones encountered in those wells is given. Thus, exact correlation is impossible.

STRATIGRAPHY

The formations penetrated by the United Brotherhood of Carpenters and Joiners well are shown graphically on Figure 2. All of the formations are correlated with known outcropping units except the middle Eocene which has not been recognized at the surface in any area in Florida.

MIOCENE

Hawthorn formation.—The first sample represents the interval from 10 to 25 feet, and is assigned to the Hawthorn formation.

The Hawthorn formation as represented by samples from this well is composed of phosphatic marls, sands, some limestone and beds of greenish to gray, greasy clay resembling fuller's earth. The base of the Hawthorn formation is placed at 110 feet in this well.

⁴Samples from this well were given the Florida Geological Survey number W-448.

⁵A note accompanying the set of samples stated, "Samples taken at every change of formation or as near so as possible."

⁶C. Wythe Cooke and Stuart Mossom, "Geology of Florida," Florida Geol. Survey, 20th Ann. Rept., map in pocket, 1927-28.

⁷*Ibid.*, p. 84.

⁸Stuart Mossom, "A Review of the Structure and Stratigraphy of Florida," Florida Geol. Survey, 17th Ann. Rept., pp. 237-241, 1926.

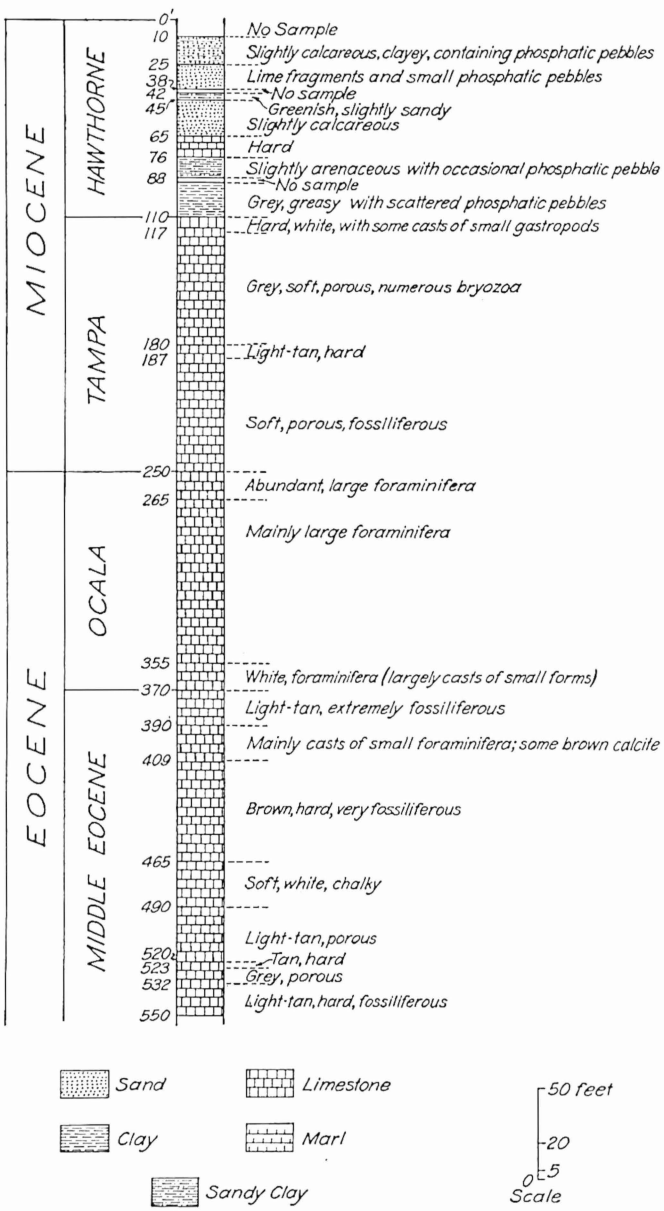


Fig. 2. Log of United Brotherhood of Carpenters and Joiners of America, Power House Well No. 2.

Tampa limestone.—At 110 to 117 feet a hard white limestone containing a few casts of small gastropods was encountered. Although careful search was made, no foraminifera were encountered in this sample. However, because of the lithologic character and the assumption that the Tampa limestone underlies the entire county, it is thought that the well penetrated the Tampa limestone between 110 and 117 feet.

The succeeding sample (117-180 feet) was also found to be devoid of diagnostic Foraminifera, but rather numerous Bryozoa were encountered. These were submitted to Dr. R. S. Bassler of the United States National Museum. The following is a quotation from his letter:⁹ "However, W-448 contains an abundance of the characteristic Jacksonian fossil Reteporidae: *Polyascosoecia jacksonica* Canu and Bassler and with it *Tubucellaria fallax* Canu and Bassler, an equally good species. The other species in this lot are *Nellia oculata* Busk, *Porella* and *Entalophora* which have a wider range."

Canu and Bassler¹⁰ give the following ranges for the various genera and species mentioned in Dr. Bassler's letter:

<i>Polyascosoecia jacksonica</i>	Middle Jacksonian
<i>Tubucellaria fallax</i>	Middle and upper Jacksonian
<i>Nellia oculata</i>	Vicksburgian to Recent
<i>Porella</i>	Lutetian to Recent
<i>Entalophora</i>	Midwayan to Claibornian

Although the prevailing aspect of the Bryozoa suggests an Eocene age, certain discrepancies may be noted. Inasmuch as diagnostic Eocene Foraminifera do not appear until a depth of 250 feet, this portion (117-180 feet) of the well is placed in the Tampa. It may be that the Bryozoa found have a longer range than was believed formerly, or it may be that they represent reworked forms.

EOCENE

Ocala limestone.—The two samples representing the interval from 250 to 265 feet are composed of a soft, porous, gray limestone with abundant large Foraminifera. Certain small Foraminifera were recovered from the sample at 250 to 258 feet. There represented typical upper Eocene species. Large Foraminifera are the dominant constituents of the samples collected between 265 and 355 feet. A white limestone composed mainly of the casts of small Foraminifera is found between 355 and 370 feet.

⁹Letter to the writer, dated June 28, 1940.

¹⁰Ferdinand Canu and Ray S. Bassler, "North American Early Tertiary Bryozoa," U. S. Nat. Mus., Bull. 106; pp. 196, 489, 544, 735, 839; 1920.

Many of the large Foraminifera are diagnostic of the Ocala limestone in other areas of the state. Certain species are associated with these which are reported from the Ocala limestone for the first time, although most of these species have been found elsewhere in deposits of upper Eocene age.

Middle Eocene.—At 370 feet a light tan limestone was encountered. Except for the intervals between 465 and 490 feet and 523 to 532 feet, the predominating color of the limestone encountered is light tan to brown. This section represents the middle Eocene. It is the probable equivalent of the Claiborne section reported from the Granberry Well.¹¹ Much more detailed work must be done before this correlation can be proved. This is undoubtedly the same zone that Stubbs¹² refers to as the Coskinolina zone in Seminole County.

PALEONTOLOGICAL RECORD*

117-180 feet

Bryozoa

Entalophora sp.

Nellia oculata Busk

Polyascosoecia jacksonica Canu and Bassler

Porella sp.

Tubucellaria fallax Canu and Bassler

214-217 feet

Cibicides sp.

Elphidium sp.

Eponides sp.

Globorotalia sp.

Rotalia sp.

Triloculina sp.

250-258 feet

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

Elphidium texanum (Cushman and Applin)

Eponides jacksonensis (Cushman and Applin)

Globulina gibba d'Orbigny

Gypsina globula (Reuss)

Lepidocyclina (*Lepidocyclina*) *mortoni* Cushman

ocalana Cushman

variety *attenuata* Cushman

floridana Cushman

Operculinoides floridensis (Heilprin)

ocalanus (Cushman)

Textularia subhauerii Cushman

Valvulina ocalana Cushman

258-265

Camerina vanderstoki (M. G. Rutten and Vermunt)

Lepidocyclina (*Lepidocyclina*) *ocalana* Cushman, variety *pseudomarginata* Cushman

290-300 feet

Heterostegina ocalana Cushman

¹¹W. Storrs Cole, "Stratigraphy and Micropaleontology of Two Deep Wells in Florida," Florida Geol. Survey, Bull. 16, pp. 21, 22, 1938.

¹²Sidney A. Stubbs, "A Study of the Artesian Water Supply of Seminole County, Florida," Florida Acad. Sci. Proc., vol. 2, p. 27, 1937.

*Only the first appearance of a species is listed. Although a given species may occur in lower samples, it is not so recorded.

- Operculinoides willcoxi* (Heilprin)
300-320 feet
Camerina moodybranchensis Gravell and Hanna
Pseudophragmina (Proporocyclina) citensis (Vaughan)
370-390 feet
Discorinopsis gunteri Cole, n. sp.
Valvulina floridana Cole, n. sp.
390-395 feet
Dictyoconus cookei (Moberg)
409-413 feet
Coskinolina floridana Cole, n. sp.
413-419 feet
Spirolina coryensis Cole, n. sp.
505-520 feet
Lituonella floridana Cole, n. sp.

Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445)

The Peninsular Oil and Refining Company of Tampa, Florida, drilled a wildcat well known as the J. W. Cory No. 1 in the center of NW $\frac{1}{4}$ of Section 6, Township 55 S., Range 34 E., Monroe County. This well was started December 31, 1938 and was abandoned May 27, 1939. It is the deepest so far drilled in Florida. The elevation of the derrick floor was 14 feet. Samples, the driller's log and electric log were presented on June 24, 1939 to the Florida Geological Survey through the courtesy of Robert B. Campbell, Tampa. The drillers were the Loffland Brothers of Tulsa, Oklahoma. (Frontispiece).

Numerous samples of cuttings taken at 10 foot intervals were received. These cuttings represented the intervals from 14 feet to 2,840 feet and from 3,240 feet to 8,310 feet. In addition to the samples of cuttings, 31 cores were sent which were collected at irregular intervals from 3,252 feet to 10,006 feet. The total depth of this well at its completion was 10,006 feet. This set of samples was given the Florida Geological Survey number W-445.

STRATIGRAPHY

The formations encountered in the Cory well (W-445) with their lithologic characteristics are shown on figure 3. The writer has found exact stratigraphic determinations quite impossible below 2,610 feet because of lack of paleontological markers. Below 8,000 feet, only cores are shown as few samples of cuttings were submitted for the final 2,000 feet.

PLIOCENE

Caloosahatchee formation.—Although the first sample was collected from 14 to 19 feet, reference to the geologic map of Florida indicates that this well starts in the Caloosahatchee formation. The samples from 14 to 90 feet are composed of porous, gray, fossiliferous marl, (14-60) followed by an almost white, hard limestone (60-70) which is underlain by an arenaceous marl (70-90).

Foraminifera are present, but are so badly preserved that identification is impossible. The only genus which could be recognized with certainty was *Amphistegina*. The correlation of this portion of the well is based on the fact that the geologic map indicates the well should have penetrated the Caloosahatchee formation.

MIOCENE

Hawthorn formation.—From 90 feet to 510 feet, sand, sandstone and marl were encountered. The sand particles vary in size from

fine to relatively coarse. Some of the largest particles were at least one-half inch in diameter; these were well rounded and polished. The chief constituent of this sand was quartz, but frequently dark, polished, phosphatic pebbles appeared. Between 390 and 480 feet, the sand was cemented by a calcareous cement.

Foraminifera which could be definitely identified appeared in this section of the well. The following depths yielded Foraminifera suitable for identification: 100-110; 110-120; 130-140; 360-370; 480-490; 490-500; 500-510. Although only relatively few species were recovered at each of these depths, the composite fauna represents the Hawthorn formation without question.

At 510 feet soft, porous limestones and dense, fine-grained limestones begin. There is a marked lithologic break at this point. In fragments of a hard, white limestone found in the sample at 510 to 520 feet were fragments of *Sorites* sp. These specimens are similar to those which Cushman and Ponton¹³ report from the Hawthorn formation. Thus, it would appear that the basal Hawthorn in this area is a soft, porous limestone and a dense, fine-grained limestone. Above this is the sandstone section.

The soft, porous limestone and dense, fine-grained limestone of the Hawthorn has a thickness of 80 feet. The sandstone, sands and sandy marl portion has a thickness of 420 feet, therefore the total amount assigned to the Hawthorn formation in this well is 500 feet.

Tampa limestone.—At 590 feet, fragments of a brown limestone appeared in which were embedded a few specimens of *Archaias floridanus* (Conrad), (see plate 8, figure 1). This species characterizes the Tampa limestone at the outcrop of this formation. In fact, it is the only recognizable Foraminifera reported from the Tampa limestone. Although the writer appreciates that the occurrence of one species is a poor basis for the recognition of a formation, it is the best proof that may be offered at present.

OLIGOCENE

The Oligocene was reached at 900 feet. Although there is not a lithologic break at this depth, the sample at 900 to 910 feet contained numerous specimens of *Miogypsina* (*Miogypsina*) *hawkinsi* Hodson. In the Port St. Joe test well (W-288) the first appearance of *M. hawkinsi* was considered to represent the top of the Oligocene.¹⁴

¹³Joseph A. Cushman and Gerald M. Ponton, "The Foraminifera of the Upper, Middle and part of the Lower Miocene of Florida," Florida Geol. Survey, Bull. 9, p. 20, 1932.

¹⁴Op. cit. (Bull. 16), pp. 13-15.

At 1,100 to 1,110 feet, a *Heterostegina* was found which is referred to *H. texana* Gravell and Hanna. In the Port St. Joe test well the first appearance of *H. texana* occurred 159 feet below the appearance of *M. hawkinsi*. In the well under consideration *H. texana* appeared 200 feet below the first occurrence of *M. hawkinsi*.

Below the *Miogypsina hawkinsi* and *Heterostegina texana* zones another *Miogypsina* appeared in the Port St. Joe test well. Although careful search was made for *M. gunteri* in the Cory well, it was not found.

However, associated with *H. texana* was a small brachiopod, *Argyrotheca wegemanni* Cole, (see plate 18, figures 1, 2) which has been described from the Meson formation of Mexico.¹⁵ Previously, this species of brachiopod was known only from its type locality. It is, therefore, interesting to find it in Florida in association with *H. texana* which also occurs at the type locality of *Argyrotheca wegemanni*. It is amazing that more of the Foraminifera associated with these two forms in Mexico did not occur in the samples from this well.

At 1,140 feet, a number of specimens were encountered which were tentatively assigned to *Dictyoconus cookei* (Moberg). The type locality of this species is United State Geological Survey, locality 6828, Newland Spring, near Falmouth, 9 miles west of Live Oak, Suwannee County, Florida. This rock is included in the Suwannee limestone of Oligocene age, named by Cooke and Mansfield¹⁶ in 1935.

The next recognizable Foraminifera were found at 1,220 feet. These were representatives of the genus *Lepidocyclina*. Upon detailed analysis these proved to be species characteristic of the Ocala limestone elsewhere in Florida.

At 1,340 feet specimens were encountered which resembled those discovered at 1,140 feet, namely, forms which were tentatively identified as *Dictyoconus cookei* (Moberg). Specimens were selected at 1,140 feet and 1,350 feet for detailed study. Upon analysis of the specimens, it was found that the same species occurred at both depths although the fauna below 1,340 feet was more diversified because certain genera and species occurred which were not found at 1,140 feet. The species which are common to both depths are *Dictyoconus cookei* (Moberg) and *Coskinolina floridana* Cole, n. sp.

¹⁵W. Storrs Cole, "A new Oligocene Brachiopod from Mexico," Bull. Amer. Pal., vol. 15, no. 57a, pp. 1-7, 1 pl., 13 figs., 1929.

¹⁶C. Wythe Cooke and W. C. Mansfield, "Suwannee Limestone of Florida," Geol. Soc. Amer. Proc. 1935, p. 71, June 1936 (abstract).

Inasmuch as the two zones containing *Dictyoconus* and *Coskinolina* were separated by Ocala limestone, the conclusion was reached that the specimens in the upper zone (1,140 feet) represented reworked middle Eocene forms and that the specimens previously reported from Newland Spring had the same type of origin.

Although Cushman¹⁷ states that the range of *Coskinolina* and *Dictyoconus* is lower and middle Eocene, Davies¹⁸ has proved that a primitive representative of the genus *Dictyoconus* occurs in the Cretaceous. Thus, the range has been extended to older rocks, but records of the occurrence of these forms above the Eocene have not been published except for the Newland Spring locality of Mrs. Moberg.

Inasmuch as the stratigraphic range of *Dictyoconus* has been extended downward, it is only logical to suspect that representatives of this genus might have existed longer in certain areas than in others. Although this possibility was considered to account for the occurrence of both *Dictyoconus* and *Coskinolina* in the Oligocene of the Cory well and at Newland Spring in the Suwannee limestone, it was dismissed in favor of the idea that the specimens in the younger rocks were reworked. The same species occur at both 1,340 feet and 1,140 feet with unquestioned Ocala limestone intervening. Inasmuch as these are specialized forms, it seems doubtful that they would survive for such a period of time without some evolutionary change.

The most abundant species at and below 1,340 feet were found at 1,140 feet, but the rarer species were not. Thus, *Lituonella* was not found at 1,140 feet, but a few individuals were found in many of the samples below 1,350 feet. This may be explained by the fact that in reworking, the more abundant types will occur with greater frequency in the younger deposits. It is possible that careful search will reveal *Lituonella* accompanying *Coskinolina* and *Dictyoconus* in the reworked faunas.

In the future, great care must be taken in dealing with the species of *Coskinolina* and *Dictyoconus* in order to prove that reworked material is not being examined.

On November 29, 1940, Sidney A. Stubbs, Assistant State Geologist of Florida, wrote the writer after reading this report that he interprets the upper *Dictyoconus-Coskinolina* zone in a different manner.

¹⁷Joseph A. Cushman, "Foraminifera, their Classification and Economic Use," Harvard University Press, pp. 131, 132, 1940.

¹⁸L. M. Davies, "An early *Dictyoconus*, and the genus *Orbitolina*: their contemporaneity, structural distinction and respective natural allies," Trans. Roy. Soc. Edinburgh, vol. 59, pp. 773-776, pl. 1, figs. 4,6, 1939.

It seems pertinent to this problem to quote portions of the letter which Mr. Stubbs wrote.

"Your conclusion is that the forms above the Ocala were reworked from the Eocene below the Ocala. To support this you cite the short range of the genera involved and the fact that the same species occur abundantly above and below the Ocala. I still do not feel that these observations constitute proof and that the subject is still open for debate.

"In support of this contention, I cite the following observations. The Ocala limestone was deposited in all parts of peninsular Florida. It was subsequently eroded and in a few places it has been entirely removed, except for small scattered patches. The distribution of the Ocala is based on study of several hundred wells that penetrate the Eocene. The extensive erosion that completely removed a portion of the Ocala seems to have taken place after the deposition of the Hawthorn Miocene. I base this statement on the results of my study of wells in the Seminole-Volusia County area. In that territory, we frequently find the Caloosahatchee marl resting upon Middle Eocene. In much of the territory the Hawthorn occurs as remnants, but where Hawthorn has been present in well cuttings, it has always been immediately underlain by at least a few feet of typical Ocala. Therefore, it is exceedingly difficult to understand how the *Coskinolina* and other forms could have been derived from covered Eocene beds. It further seems that we would necessarily have many Ocala forms present in the reworked material and there is not one Ocala species present.

"There are, so far as we know now, only two areas from which this reworked fauna could have been derived. One is in south Georgia in the Quitman to Thomasville vicinity and the other is in a small part of Volusia, Seminole and Brevard Counties in east central Florida. The south Georgia area is different from that in East Peninsular Florida in one respect. At Thomasville, the Oligocene may rest upon the Middle Eocene. There we find about 100 feet of Oligocene sediments resting upon the *Coskinolina*-bearing Eocene. These Oligocene beds contain *Coskinolina-Dictyoconus*. In both of these areas the Ocala has been removed by erosion after being deposited over the *Coskinolina*-bearing material. The Ocala where present as remnants in these two areas is exceedingly fossiliferous. It seems that this would lend further weight to the argument that if the Oligocene fauna has been derived by reworking, then the reworked material should contain as many or more Ocala species as it does *Coskinolina* Eocene forms.

"On the other hand, in support of the recurrent fauna we find that the lithologic character of the rocks in the Eocene and Oligocene are very similar. This means that ecologic conditions conducive to the life of *Coskinolina* and other members of that group were probably recurrent during Oligocene times. We have no reason to contend that all the forms died during upper Eocene times because our knowledge of the distribution of the fauna is very meager, and because we know that age equivalents do not always mean time equivalents. A fauna migrating from Florida to the West Indies, for example, would cause the geologists examining the West Indian rocks in which this fauna was contained to assign these rocks to the same age as the Florida material. In truth, however, the West Indian rocks would be younger than the Florida deposits. A repetition of the same ecologic conditions in Florida during a later period could cause that same fauna to again appear in Florida sediments. The classic example, William's work on *Tropidoleptus* Zones in the Upper Devonian of New York (U. S. G. S. Prof. Paper 79), may be applicable to the Florida faunas when we have completed studying them."

The writer replied as follows:

"The problem is mainly an academic one rather than practical. I believe you will agree in this. I have now established beyond question that there are two zones in which *Dictyoconus-Coskinolina* occur. Therefore, the use of these forms in establishing stratigraphic units is open to question unless there is supporting evidence. This is all the more true because the same species occur in both zones. In fact, there may be more than two zones.

"The academic problem is not solved so readily. I still hold to my opinion that the upper *Dictyoconus-Coskinolina* zone in the Cory well is due to reworking despite your excellent plea for a recurrent fauna at this horizon. Let me hasten to say, however, that your argument has merits, that the idea cannot be entirely discarded, but I feel that my stand is based on stronger theoretical and practical grounds than yours. Davies (Trans. Roy. Acad. Edinburgh, vol. LIX, pt. 3, 1938-1939, pp. 778-779) has demonstrated that rather rapid evolutionary changes take place, especially in *Dictyoconus*. This is shown in the development of the subdivisions of the marginal trough. That Davies is correct is indicated by the characters found by myself and others in *D. cookei*, *D. gunteri*, *D. codon* and others.

"I am of the opinion, from my rather extensive studies of larger Foraminifera, that these highly specialized forms have very restricted time ranges. I doubt if a species would persist through two epochs, and I am convinced that a genus would show some slight modification.

"I do not see that the *Tropidoleptus* problem is applicable here, inasmuch as there is a definite tonguing of the sediments in which it occurs. In the Cory well the entire section concerned is composed of marls and marly limestones. If the range of *Dictyoconus-Coskinolina* is from middle Eocene to Tampa, why isn't it continuous in this well? Ecological conditions were as favorable for its survival in Ocala time as in either the middle Eocene or Oligocene.

"Let me add a point not covered in my manuscript. In the Cory well at 1130-40 feet there are a few specimens of the form which I am calling *Discorinopsis gunteri*. These show by their physical condition that they have suffered transportation as they are battered and chipped.

"It is true that many of the specimens of *Dictyoconus-Coskinolina* at 1140-1150 feet appear fresh without abrasion of the surface. (Incidentally, this is a point in favor of your argument.) However, most of these specimens are filled with calcite, a condition not found in the specimens below 1340 feet which are perfectly preserved with open chambers. This is not proof, of course, of transportation, but is suggestive.

"The fact that the middle Eocene is covered by the Ocala is well taken and the strongest point for a recurrent fauna. However, the Floridian plateau has only about one-half its surface available for study as the remainder is under the waters of the Atlantic or Gulf. These areas, one or both, may have been high during Oligocene time and have been the source for the reworked middle Eocene forms. (See Cushman, "Eocene foraminifera from the submarine cores off the eastern coast of North America," Contrib., vol. 15, pt. 3, 1939.) This contention is not purely "guess", but is based on the fact that the Marathon well on Key Vaca is structurally higher on the older formations than is the Cory well on the mainland.

"There may be more than one zone of *Dictyoconus-Coskinolina* in the Oligocene. Although it was not practical to subdivide the Oligocene in the Cory well, the *Dictyoconus-Coskinolina* zone occurs below the *Heterostegina* zone and relatively close to the top of the Ocala. On the outcrop near Newland Spring the rocks containing *Coskinolina* are now assigned to uppermost Oligocene. In the Port St. Joe test well 3 *Dictyoconus-Coskinolina* were not found. This suggests to me irregular distri-

bution of these forms and probably two or more reworked zones in the Oligocene.

If we were to hold to your viewpoint, we would not be able to separate any of the section of limestone in the Cory well into formations on the basis of short ranged fossils because we would never know when we were dealing with a recurrent fauna."

EOCENE

Ocala limestone.—The top of the Ocala limestone is based on the first appearance of *Lepidocyclina* in this well. The various species found have been reported from the Ocala limestone elsewhere in Florida or in other deposits of upper Eocene age in the Caribbean region.

Middle Eocene.—At 1,340 to 1,350 feet, a light tan to brown limestone appears. This formation contains abundant *Dictyoconus*. Apparently this formation is widely distributed over peninsular Florida. This limestone may be the deeper water equivalent of the sands described in the paper on the Granberry well¹⁹ (W-285) and assigned to the Claiborne. Many wells must be examined to prove this point.

Two species of *Dictyoconus* are found below 1,340 feet in this well: *D. cookei* (Moberg) first appears at 1,340-1,350 feet and *D. gunteri* is encountered at 2,050-2,060 feet. Some workers divide this portion of the middle Eocene into two zones, i. e., the *Dictyoconus cookei* zone below which occurs the *Dictyoconus gunteri* zone. The *D. cookei* zone in this well has a thickness of 700 feet.

Lituonella floridana is associated with *D. cookei* but is rather rare in most samples examined. It may not extend to the top of the *D. cookei* zone. It may be practical to designate a *Lituonella* sub-zone. More work is needed to establish the validity of these suggestions.

The *Dictyoconus gunteri* zone apparently extends to 2,610 feet at which point the soft, porous limestone ends and a dense brown limestone appears. If this interpretation is correct, the middle Eocene *Dictyoconus* zones have a thickness of 1,260 feet.

Lower Eocene.—Below the *Dictyoconus gunteri* zone, there are no recognizable fossils to a depth of 3,350 feet. At 3,350 feet specimens were recovered which are assigned to the genus *Borelis*. This genus ranges from Eocene to Recent. In this paper the zone containing *Borelis* is assigned to the lower Eocene.

CRETACEOUS

Below the *Borelis* zone, *Lepidorbitoides* occurs at 5,760 feet. In the section between 3,350 feet and 5,760 feet a core at 4,617-4,625 feet

¹⁹*Op. cit.* (Bull. 16), pp. 21, 22.

is composed of a foraminiferal limestone, but thin sections show that the greater percentage of the forms belong to the family Miliolidae. Generic and specific identifications are impossible. Cushman in his textbook²⁰ states "The Miliolidae have reached their greatest development in shallow, warm waters of the Upper Cretaceous and Eocene, and are now particularly characteristic of coral reef conditions in the tropics." Unfortunately, the data derived from the study of this core do not help in determining the age of the section from which it was taken.

The writer has found it impossible to pick the exact point at which the Cory well encountered the top of the Upper Cretaceous. The top of the chalk at 5,750 feet certainly represents the top of an Upper Cretaceous formation. How much of the interval between 3,350 feet and 5,750 feet might be Upper Cretaceous is a question which cannot be decided at this time.

Below the *Lepidorbitoides* zone, macroscopic fossils were found in two cores, from depths of 7,676-7,684 feet and 7,944-7,949 feet. Dr. L. W. Stephenson of the United States Geological Survey examined the macroscopic fossils at the request of Herman Gunter. The following quotation is from Dr. Stephenson's letter²¹ to Mr. Gunter.

"The core from a depth of 7,676-7,684 feet bears the imprint of the posterior part (perhaps about half) of an *Inoceramus*. Although the position of the beak and hinge and the outline of the shell cannot be seen the trend of the concentric marks strongly suggests *Inoceramus labiatus* Schlotheim, a characteristic Eagle Ford species. The matrix also suggests certain hard facies of the Eagle Ford.

The hard limestone from a depth of 7,944-7,949 feet contains many fragments and imperfect young shells of Ostreidae some of which belong to *Gryphaea* (*sensu lato*), but none of them is specifically identifiable. Lithologically the rock might very well be one of the limestones from the Comanche series. . ."

Although there is no doubt that the cores examined by Dr. Stephenson represent the Cretaceous, there is considerable question as to their correlation with standard sections elsewhere.

Campbell places the top of the Lower Cretaceous at 8,106 feet. This determination was based on a change of lithology at this depth. The writer is not able to agree that the evidence is sufficient to state definitely that this well penetrated the Lower Cretaceous.

COMPARISON OF THE CORY WELL WITH THE MARATHON WELL

A well was drilled by the Florida East Coast Railway Company at Marathon on Key Vaca in 1918. This well was begun February,

²⁰Joseph A. Cushman, "Foraminifera, Their Classification and Economic Use," Harvard University Press, p. 162, 1940.

²¹Letter dated August 16, 1939, a copy which Mr. Gunter kindly supplied.

1917 and completed to a total depth of 2,555 feet early in 1918. Mossom²² and Cushman²³ have both studied samples from this well.

In describing the lithologic character of the sediments encountered Mossom logs coralline limestone from 85 to 179 feet; from 180 to 589 feet, sandstone; from 593 to 1,790 feet (the last sample collected), limestone.

Recognizable fossil zones are listed as follows:

	Marathon Well (W-2)	Cory Well (W-445)
	Depth below surface in feet	
* <i>Orbitolites</i> sp.	589	520
<i>Miogypsina cushmani</i>	852	
<i>Miogypsina hawkinsi</i>		900
<i>Lepidocyclina</i> (various sp.)	984	1220
<i>Dictyoconus cookei</i>	1248	1340
<i>Dictyoconus gunteri</i>	1790	2050

*Probably *Sorites* sp.

DESCRIPTION OF CORES FROM THE CORY WELL (W-445)

Depth in feet

- 3252-56.—Dolomitic limestone, mottled, gray to light brown, compact, massive, except for a few pore spaces. One fragment composed almost entirely of a mixture of calcite and dolomite crystals, many of which could be seen with the naked eye.
- 3655-60.—Argillaceous chalk, mottled, salt and pepper appearance with the darker shade predominating, compact, soft. One fragment composed of black dolomitic limestone with masses of selenite.
- 3838-43.—Anhydrite, mottled, white to dark gray.
- 4350-55.—Anhydrite, mottled, white to dark gray.
- 4617-25.—Limestone, cream-colored, compact, massive. Foraminifera and Ostracoda noted on freshly broken surfaces.
- 5256-66.—Limestone, light gray to tan, extremely porous, with casts and molds of fossils.
- 5550-70.—Limestone, cream colored, mainly composed of small calcite crystals.
- 6712-32.—Limestone, light brown, compact, crystalline.
- 7000-10.—Chalk, white, compact.
- 7352-62.—Chalk, white, compact.
- 7676-84.—Limestone, dark gray, compact, with a slight odor of petroleum.
- 7944-49.—Limestone, three light gray fragments which are dense and compact without fossils; three dark gray to nearly black fragments, one of which contains rather abundant fossils.
- 8168-75.—Anhydrite, mottled, white, gray, light brown, compact, massive.
- 8225-50.—Limestone, cream colored, compact (one fragment); Anhydrite (one fragment).
- 8333-52.—Limestone, cream colored, compact.
- 8395-8409.—Anhydrite, massive, mottled gray to brown.
- 8469-75.—Limestone, chalky, gray, compact.
- 8572-8600.—Dolomitic limestone, gray to tan, compact, massive (two fragments); anhydrite (one fragment).
- 8600-10.—Anhydrite (two fragments); limestone, dark gray, compact (one fragment).
- 8700-28.—Limestone, cream colored, compact, massive.
- 8818-32.—Limestone similar to that in 8700-28 (several fragments); anhydrite (two fragments).

²²*Op. cit.* (17th Ann. Rept.), pp. 252-254.

²³Joseph A. Cushman, "Foraminifera from the Deep Wells of Florida," Florida Geol. Survey, 13th Ann. Rept., pp. 33-69, 3 pls., 1921.

- 8937-53.—Anhydrite (several fragments); limestone, dark gray to light tan, massive, few minute pore spaces, slight odor of petroleum (one fragment).
 8964-81.—Anhydrite (several fragments); limestone, dark gray, slightly argillaceous, massive, soft, faint petroleum odor.
 9025-49.—Dolomitic limestone, gray to tan colored, extremely porous (one fragment); dolomitic limestone, dark gray, compact (one fragment).
 9024-49.—Anhydrite (three fragments).
 9185-9208.—Limestone, tan, porous (one fragment); anhydrite (two fragments).
 9341-56.—Anhydrite.
 9611-25.—Limestone, dark gray, massive, compact, faint petroleum odor.
 9750-65.—Limestone, dark tan colored, with rather abundant shell fragments.
 9841-51.—Limestone, dark gray to nearly black, compact and massive, interbedded with some anhydrite.
 9995-10,006.—Anhydrite (several fragments); limestone, dark gray with the appearance of petroleum stain, slight odor of petroleum, massive, slightly crystalline (several fragments).

PALEONTOLOGICAL RECORD

- 100-110 feet
Amphistegina gibbosa d'Orbigny
Sorites sp.
 110-120 feet
Cuneolina angusta Cushman
 130-140 feet
Buliminella elegantissima (d'Orbigny)
Dyocibicides biserialis Cushman and Valentine
Elphidium incertum (Williamson), variety *clavatum* Cushman
 360-370 feet
Robulus americanus (Cushman)
 480-490 feet
Angulogerina occidentalis (Cushman)
Bulimina gracilis Cushman
Buliminella curta Cushman
Cassidulina laevigata d'Orbigny, variety *carinata* Cushman
subglobosa H. B. Brady
Cibicides concentricus (Cushman)
floridanus (Cushman)
Discorbis candeiana (d'Orbigny)
Nonion pizarrensis Berry
Planulina depressa (d'Orbigny)
Textulariella barrettii (Jones and Parker)
Urigerina peregrina Cushman
 490-500 feet
Bolivina marginata Cushman, variety *multicostata* Cushman
 500-510 feet
Cuneolina angusta Cushman, variety *lata* Cushman
 500-520 feet
Gaudryina atlantica (Bailey)
Sorites sp.
 560-570 feet
Amphistegina chipolensis Cushman and Ponton
floridana Cushman and Ponton
Gypsina sp.
 590-600 feet
Archaias floridanus (Conrad)
 750-760 feet
Operculinoides sp.
 900-910 feet
Miogypsina (Miogypsina) hawkinsi Hodson

1100-1110 feet

Argyrotheca wegemanni Cole*Heterostegina texana* Gravell and Hanna

1140-1150 feet

Coskinolina floridana Cole **Dictyoconus cookei* (Moberg) *

1220-1230 feet

Lepidocyclina (Lepidocyclina) ocalana Cushmanvariety *attenuata* Cushman*floridana* Cushman*tschoppi* Thiadens

1230-1240 feet

Lepidocyclina (Lepidocyclina) mortoni Cushman

1250-1260 feet

Operculinoides curasavicus (Rutten and Vermunt)*Lepidocyclina (Nephrolepidina) semmesi* Vaughan and Cole

1340-1350 feet

Dictyoconus cookei (Moberg)

1350-1360 feet

Amphistegina pinarensis Cushman and Bermudez*Discorinopsis gunteri* Cole, n. sp.*Pseudochrysalidina floridana* Cole, n. sp.*Valvulina floridana* Cole, n. sp.

1360-1370 feet

Lituonella floridana Cole, n. sp.*Textularia coryensis* Cole, n. sp.*Valvulina martii* Cushman and Bermudez*Verneulina* sp.

1390-1400 feet

Spirolina coryensis Cole, n. sp.*Fabularia* sp.

1440-1450 feet

Coskinolina floridana Cole, n. sp.

2050-2060 feet

Dictyoconus gunteri (Moberg)

3350-3360 feet

Borelis gunteri Cole, n. sp.variety *floridana* Cole, n. var.

5760-5770 feet

Lepidorbitoides (Lepidorbitoides) nortoni (Vaughan)

*Reworked Eocene specimens, see text p. 13.

DESCRIPTIONS OF SPECIES

Family TEXTULARIIDAE

Subfamily Textulariinae

Genus TEXTULARIA DeFrance, 1824

TEXTULARIA CORYENSIS Cole, n. sp.

Plate 1, figure 13

Test elongate, subrectangular in side, front and top views, widest and thickest near apertural end; chambers numerous, broader than high, each chamber ridged; sutures fairly distinct in marked depressed areas between the ridged chambers; wall rather coarsely arenaceous with calcareous cement; aperture broad, low, indistinct. Length of holotype 1.14 mm.; greatest width 0.85 mm. Certain specimens assigned to this species have a length of 1.7 mm.

First appearance at a depth of 1360-1370 feet in W-445.

Type locality: Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445), at a depth of 1360-1370 feet.

Holotype: Fla. Geol. Survey Cat. No. S-1533; paratype, F.S.G.S. Cat. No. S-1533A.

Occurrence: Middle Eocene:

Family VERNEUILINIDAE

Genus VERNEUILINA d'Orbigny, 1840

VERNEUILINA SP.

Plate 1, figure 14

A few large specimens assigned to this genus were found in the sample at 1360-1370 feet in W-445. These specimens were too poorly preserved to describe specifically. They are figured for future reference.

Family VALVULINIDAE

Subfamily Valvulininae

Genus VALVULINA d'Orbigny, 1826

VALVULINA FLORIDANA Cole, n. sp.

Plate 1, figures 1, 2

Test short, stout, broad, conical with a truncate apertural end, triserial throughout; chambers indistinct except at apertural end, not inflated; sutures indistinct, slightly depressed at apertural end; wall arenaceous, rather finely finished; aperture a rather large opening at

the inner margin of the last formed chamber with a large valvular tooth accompanied by a smaller secondary tooth in many specimens. Diameter 1.5 mm.; height 1.1 mm.

Two species of *Valvulina* have been described from the American Eocene. *V. ocalana* Cushman and *V. martii* Cushman and Bermudez have triangular cross-sections. In both of these species the chambers are fairly distinct.

First appearance at a depth of 370-390 feet in W-448; at a depth of 1350-1360 feet in W-445.

Type locality: United Brotherhood of Carpenters and Joiners Power House Well No. 2 (W-448) at a depth of 390-395 feet.

Holotype: Fla. Geol. Survey Cat. No. S-1582; paratype: F.S.G.S Cat. No. S-1582A.

Occurrence: Middle Eocene:

VALVULINA MARTII Cushman and Bermudez

Plate 1, figure 12

Valvulina martii Cushman and Bermudez, Cont. Cushman Lab. Foram. Res., vol. 13, p. 7, pl. 5, figs. 1a, b, 1937.

Valvulina martii Cushman, Cont. Cushman Lab. Foram. Res., Sp. Publication No. 8, p. 9, pl. 1, fig. 19, 1937.

A few specimens were recovered which are doubtfully assigned to this species.

First appearance at a depth of 1360-1370 feet in W-445.

Occurrence: Middle Eocene.

Subfamily Eggerellinae

Genus PSEUDORBITOLINA Douvillé, 1910

PSEUDORBITOLINA CUBENSIS Cushman and Bermudez

Plate 2, figures 5-11

Pseudorbitolina cubensis Cushman and Bermudez, Cont. Cushman Lab. Foram. Res., vol. 12, p. 59, pl. 10, figs. 27-30, 1936.

This species was described by Cushman and Bermudez from Eocene deposits in Cuba. Associated with the megalospheric specimens, there are large forms which apparently are the microspheric generation.

Although certain specimens have the large open umbilicus shown by the type species, others have a plate which covers the umbilicus. The surface of the umbilical plate is very irregular and is penetrated by several large openings. These may represent the apertures.

First appearance at a depth of 390-395 feet in W-448.

Occurrence: Middle Eocene.

Genus LITUONELLA Schlumberger, 1905

LITUONELLA FLORIDANA Cole, n. sp.

Plate 3, figures 14-17; plate 4, figure 10; plate 6, figures 9-11

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

Test elongate, circular or elliptical in transverse section, initial end bulbous, with the bulb containing the early, spiral chambers. The bulb is twisted to one side of the test. The surface of the test is marked by slight corrugations. The height of megalospheric individuals is from 1.7 to 2.1 mm.; the diameter at the base is 1.0 to 1.2 mm.; the diameter just below the juncture of the initial bulb is about 0.8 mm.

The marginal trough has a width of 120 to 160 μ ; the thickness of the floor of the marginal trough is about 40 μ . The outer wall of the test has a thickness of 80 to 100 μ . The area of the central shield is composed of a series of irregular pillars.

Affinities.—*L. floridana* in longitudinal section slightly resembles *L. liburnica* Schubert. *L. liburnica* is a larger form with a more irregular marginal trough and a greater proportion of the test occupied by the central shield area.

Associated with *L. floridana* are specimens which have a pointed initial end. (see pl. 4 fig. 10). Longitudinal sections indicate that these specimens are microspheric individuals. These specimens may represent a new species, but for the present they are considered to be the microspheric generation of *L. floridana*.

First appearance at a depth of 505-520 feet in W-448; in W-445 at a depth of 1360-1370 feet.

Type locality: United Brotherhood of Carpenters and Joiners
Power House Well No. 2 (W-448) at a depth of
520-530 feet.

Cotypes: Fla. Geol. Survey No. S-1590; paratypes F.S.G.S.
No. S-1590A and S-1590B.

Occurrence: Middle Eocene:

Genus COSKINOLINA Stache, 1875

COSKINOLINA FLORIDANA Cole, n. sp.

Plate 3, figures 1-7; plate 4, figures 1-9; plate 5, figures 1-5, 11;
plate 18, figure 9

Coskinolina cookei Moberg (part), Florida Geol. Survey, 19th Ann. Rept., pp. 166-168, pl. 3, fig 6 (not figs. 1-5, 7-8), 1928.

The measurements of 26 specimens are presented below. The specimens were taken from the sample collected at 419-444 feet in W-448.

Diameter of Base	Height
0.68mm.	0.89mm.
0.68	0.85
0.72	0.89
0.72	0.93
0.72	0.85
0.72	0.98
0.72	0.89
0.76	0.98
0.76	0.85
0.76	1.15
0.76	1.06
0.81	0.93
0.85	0.93
0.89	1.10
0.89	1.02
0.89	0.93
0.89	1.02
0.93	1.23
0.93	1.10
0.97	1.02
0.97	1.10
0.97	1.27
0.97	1.27
1.02	1.15
1.06	1.02
1.06	1.19
22.10	26.60
Average 0.85 mm.	1.02 mm.

In shape the test is a high, steep sided cone, the base of which is normally circular in outline. In the average specimen the height of the cone is greater than the diameter of the base. The surface of the cone is unornamented, although occasionally concentric rings show. The base of the test is either flat or slightly convex.

The measurements of various internal features are given in the following table:

	W-448 419-444'	W-445 1500-10'
Width of marginal trough	100-140 μ	80-130 μ
Distance between chamber partitions	40-60 μ	40-60 μ
Height of cups	about 50 μ	about 45 μ
Thickness of floor of marginal trough	about 20 μ	about 20 μ
Thickness of floor of central shield	35-40 μ	about 35 μ
Diameter of perforations of central shield	about 25 μ	20-25 μ
Spacing of perforations (center to center)	50-60 μ	55-60 μ
Thickness of outer wall	about 20 μ	20-30 μ
Thickness of chamber partitions	about 8 μ	about 8 μ

The horizontal sections show the chambers of the marginal trough to be divided by a single vertical plate. The axial sections indicate that the marginal trough is subdivided into chambers, but that these are not subdivided by any horizontal plate. Thus, the horizontal sections suggest *Dictyoconus*, but the vertical sections suggest *Coskinolina*. This seems to be very constant in all the specimens sectioned.

Affinities.—As Davies recognizes *Coskinolina*, both vertical and horizontal plates subdividing the chambers of the marginal trough are absent. The question arises as to which genus such a form as this should be assigned. The vertical section is definitely *Coskinolina* in type but the horizontal section illustrates the characteristics of primitive *Dictyoconus*. The writer prefers to assign this form to the genus *Coskinolina*, expanding the definition of that genus to include such intermediate forms in which single vertical plates subdivide the chambers of the marginal trough, but horizontal plates have not been developed.

C. floridana is the only representative of this genus reported from this hemisphere inasmuch as *C. cookei* is now considered to represent a primitive *Dictyoconus*. *D. cookei* and *C. floridana* occur in association. *D. cookei* has a larger, broader and lower cone than *C. floridana*. The internal structure is different, particularly the vertical sections.

First appearance at a depth of 409-413 feet in W-448; at a depth of 1440-1450 feet in W-445.

Type locality: Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445) at a depth of 1500-1510 feet.

Cotypes: Fla. Geol. Survey Cat. No. S-1543; paratypes, F.S.G.S. Cat. Nos. S-1543B, S-1543C, and S-1543D.

Occurrence: Middle Eocene.

Genus *DICTYOCONUS* Blanckenhorn, 1900**DICTYOCONUS COOKEI (Moberg)**

Plate 3, figures 11-13; plate 5, figures 6-10, 12, 13;
plate 6, figures 1-8; plate 18, figure 12

Coskinolina cookei Moberg, Florida Geol. Survey, 19th Ann. Rept., pp. 166-168, pl. 3, figs. 1-5, 7-8 (not fig. 6), 1928.

Coskinolina cookei Cushman, Cont. Cushman Lab. Foram. Res., Sp. Publication No. 8, p. 187, pl. 22, figs. 27-29, 31-33 (not fig. 30), 1937.

The measurements of eleven typical specimens from 409-413 feet in W-448 and three specimens from 1440-1450 feet in W-445 are given below:

W-448 409-413 feet		W-445 1440-1450 feet	
Diameter of base	Height	Diameter of base	Height
1.7mm.	1.4mm.	2.3mm.	1.9mm.
1.7	1.3	2.5	1.4
1.8	1.6	2.5	1.8
2.1	1.5	—	—
2.2	1.6	7.3	5.1
2.3	1.8	Average 2.43mm.	1.7mm.
2.4	1.4		
2.4	1.9		
2.5	1.8		
2.6	1.8		
2.7	1.5		
—	—		
24.4	17.6		
Average 2.22mm.	1.6mm.		

A microspheric individual has a height of 1.95 mm. and a diameter at the base of 3.19 mm.

In shape the test is a low cone, the base of which may be perfectly circular in outline, or with one diameter slightly longer than the other. The surface of the test is typically smooth and featureless.

The measurements of various internal features are given in the following table:

Width of marginal trough	140-180 μ
Distance between chamber partitions	60-80 μ
Height of cups	40-60 μ
Thickness of floor of marginal trough	10-12 μ
Thickness of floor of central shield	about 40 μ
Diameter of perforations of central shield	about 60 μ
Spacing of perforations (center to center)	100-160 μ
Thickness of outer wall	about 20 μ
Thickness of chamber partitions	6-8 μ

The vertical (axial) and horizontal sections show this form to be a typical primitive type of *Dictyoconus* related to *D. walnutensis* (Carsey). The marginal trough is subdivided into chambers which are in turn subdivided by a single horizontal plate (observed in axial sections) and a single vertical plate (seen in horizontal sections). *D. walnutensis* has a similar arrangement. Regarding *D. walnutensis*, Davies²¹ has written: "Thus the form is a *Dictyoconus*, and not a *Coskinolina*, and since there is only a single subdividing plate in each plane, the species represents the simplest possible form of *Dictyoconus*. Occasional chambers, both in vertical and horizontal sections, show no subdividing plates at all, and the specimens may be said to be partly *Coskinolina*."

The horizontal section demonstrates the presence of a characteristic central shield with circular perforations more or less evenly distributed over its extent. Semilunar areas within the central shield show the presence of the typical pillar-buttresses. The chambers are usually subdivided by horizontal and vertical plates, but as Davies has reported for *D. walnutensis*, these are occasionally lacking.

Affinities.—*D. cookei* is closely related to *D. walnutensis*. *D. walnutensis* is the smaller form and the inner edge of the floor of the marginal trough rises more abruptly and higher in *D. cookei* than in *D. walnutensis*.

First appearance at a depth of 390-395 feet in W-448; as reworked material at a depth of 1140-50 feet in W-445; as indigenous specimens at a depth of 1340-1350 feet in W-445.

Occurrence: Middle Eocene.

DICTYOCONUS GUNTERI Moberg*

Plate 3, figures 8-10; plate 7, figures 2-6, 8

Dictyoconus (?) *gunteri* Moberg, Florida Geol. Survey, 19th Ann. Rept., p. 168, pl. 3, figs. 9, 10; pl. 4, figs. 1-3, 1928.

Dictyoconus gunteri Vaughan, Jour. Pal., vol. 6, p. 98, pl. 14, fig. 8, 1932.

Dictyoconus gunteri Cushman, Cont. Cushman Lab. Foram. Res., Sp. Publication No. 8, p. 191, pl. 24, figs. 1-3, 1937.

Typical specimens assigned to this species were found only in W-445. Dr. Vaughan kindly presented the writer with specimens of *D. gunteri*

²¹L. M. Davies, "An earlier *Dictyoconus* and the genus *Orbitolina*: their contemporaneity, structural distinction, and respective natural allies," Trans. Roy. Soc. Edinburgh, vol. 59, pp. 775, 776, 1939.

*Studies in progress at the present time suggest that the specimens in Florida which have been called *D. gunteri* are in reality *D. codon*. Proof of this will be presented in a bulletin of the Florida Geological Survey which will be published in the near future.

from the Marathon well at Key Vaca and specimens of *D. codon* Woodring from Haiti. Illustrations are presented (pl. 7, figs. 1, 7; pl. 18, figs. 10, 11) of thin sections made from these specimens for comparison with the thin sections made from specimens of *D. gunteri* from W-445.

First appearance at a depth of 2050-2060 feet in W-445.

Occurrence: Middle Eocene.

Family CAMERINIDAE
Subfamily Camerininae
Genus CAMERINA Brugière, 1792

CAMERINA MOODYBRANCHENSIS Gravell and Hanna

Plate 9, figure 9; plate 11, figures 9-15

Camarina moodybranchensis Gravell and Hanna, Jour. Pal., vol. 9, p. 332, pl. 29, figs. 15, 22-24, 1935.

Camarina moodybranchensis Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 323, 324, pl. 13, fig. 5; pl. 20, fig. 2; pl. 22, fig. 2, 1939.

This species has been adequately described by Gravell and Hanna. Barker has given notes on Mexican specimens assigned to this species. The specimens from W-448 seem to be entirely typical.

First appearance at a depth of 300-320 feet in W-448.

Occurrence: Ocala limestone.

CAMERINA VANDERSTOKI (Rutten and Vermunt)

Plate 8, figures 2-10

Nummulites vanderstoki Rutten and Vermunt, Proc. Konink. Akad. Wet. Amsterdam, vol. 35, p. 240, pl. 1, fig. 8; pl. 2, figs. 6, 12, 1932.

Camarina vanderstoki Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 322, 323; pl. 13, fig. 7; pl. 18, fig. 3; pl. 22, figs. 10-12, 1939.

The horizontal sections of the Florida specimens are identical to the one published by Rutten and Vermunt. The transverse sections exhibit more variation than is indicated by the one section figured by Rutten and Vermunt or their description of transverse sections. Rutten and Vermunt state that the thickness through the center is from 1.125 to 1.2 mm. The thickness through the center of the Florida specimens ranges from 1.3 mm. to 1.8 mm.

The Florida specimens have a distinct axial plug. Although Rutten and Vermunt do not mention the occurrence of an axial plug in the type specimens, their figure (plate 2, figure 12) shows a well de-

veloped axial plug on the right hand side and the suggestion of the corresponding plug on the other side. It is probable that their section is not oriented exactly through the center of the test and it is also slightly oblique.

Barker has assigned certain specimens from the Claiborne of Mexico to this species. The three transverse sections which he figures exhibit as great a range as do the transverse section of the Florida specimens. However, the transverse sections of the Florida individuals agree more closely with the type than do the sections published by Barker since the figures of the Mexican specimens barely indicate the presence of an axial plug. The thickness through the center of the Mexican specimens is nearer that of the type description than the thickness of the Florida specimens which seems to be consistently greater.

A description of the Florida specimens follows: Test medium sized, flattened lenticular to even lenticular, completely involute, sutures of clear shell material normally flush with the surface of the test. Diameters of an average individual 3.0 X 3.6 mm., thickness 1.7 mm.

Sections of average individuals show $4\frac{1}{2}$ to $5\frac{1}{2}$ whorls with 27 to 31 chambers in the final whorl. A small specimen with diameter of 1.9 X 2.1 mm. had $3\frac{1}{2}$ whorls with 18 chambers in the final revolution. The septa are regular, nearly straight for a little more than three-fourths their length, then strongly, but evenly recurved toward the periphery of the test. The chambers are higher than long. The axial plug has diameters ranging from 0.64 to 0.8 mm. at the surface of the test. The internal diameter of the initial chamber ranges from 100 to 120 μ .

First appearance at a depth of 258-265 feet in W-448.

Occurrence: Ocala limestone.

The type specimens came from Curacao from deposits of assumed Jackson age. The specimens referred to this species from Mexico are reported from the Claiborne. It may be that the Mexican specimens represent a variety of this species, or it may be that it has a comparatively long range.

Genus OPERCULINOIDES Hanzawa, 1935

OPERCULINOIDES CURASVICUS (Rutten and Vermunt)

Plate 11, figures 7, 8

Operculina curasvica Rutten and Vermunt. Proc. Konink. Akad. Wet. Amsterdam, vol. 35, pp. 239, 240, pl. 2, figs. 2, 11, 1932.

Three specimens of a small *Operculinooides* were found in W-445 at a depth of 1250-1260 feet. In many of its features these specimens

resemble *O. curasvica*, but there are certain differences. These specimens have a diameter of about 2.9 mm. and a thickness of 0.76 mm. The one horizontal section available has $3\frac{1}{8}$ coils with 23 chambers in the final volution. The internal measurement across both initial chambers is about 140μ .

The size, number of whorls, shape of the septa and thickness of the outer wall are identical with the features shown by Rutten and Vermunt's illustration. But, their transverse section illustrates a specimen with a diameter of about 3.1 mm. and a thickness of 1.2 mm. This specimen is decidedly umbonate with a wide flange. The Florida specimens are thinner and slope rather regularly from the center to the periphery.

O. curasvicus has a much larger embryonic apparatus as Rutten and Vermunt state that the distance across both embryonic chambers is 300 to 450μ . The distance across the embryonic chambers of the Florida specimens is about 140μ . These specimens may be the microspheric form, however.

With more specimens for study it might be decided that the Florida specimens do not represent this species. For the present, it seems best, however, to refer these specimens to *O. curasvicus* in spite of the differences noted above.

Occurrence: Ocala limestone.

OPERCULINOIDES FLORIDENSIS (Heilprin)

Plate 9, figure 8; plate 10, figures 1-3

Nummulites floridensis Heilprin, Proc. Nat. Acad. Sci., Philadelphia, pp. 321-22, text fig., 1885.

Operculina floridensis Cushman, U. S. Geol. Survey Prof. Paper 128, p. 130, pl. 20, fig. 12, 1921.

Assilina floridensis Cushman, U. S. Geol. Survey Prof. Paper 181, p. 32, 1935.

Test medium to large size, very compressed, completely involute, the last whorl somewhat thinner than the earlier coils. The sutures are raised, especially on the surface of the last whorl and they are rather limbate, but without definite beading.

Diameters	Number of whorls	Chambers in final whorl
4.8 X 4.2mm.	$3\frac{1}{8}$	32
4.5 X 3.9mm.	3	29

A specimen with a diameter of 4.6 mm. had a thickness of 0.72 mm. The initial chamber is spherical with an internal diameter of 100 to 120μ .

First appearance at a depth of 250-258 feet in W-448.

Occurrence: Ocala limestone.

OPERCULINOIDES OCALANUS (Cushman)

Plate 10, figures 4-7

Operculina ocalana Cushman, U. S. Geol. Survey Prof. Paper 128-E, p. 129, pl. 19, figs. 4, 5, 1921.

Operculina ocalana Gravell and Hanna, Jour. Pal., vol. 9, p. 333, 1935.

Operculinoides ocalana Hanzawa, Sci. Rept. Tōhoku Imp. Univ., ser. 2 (Geol), vol. 18, No. 1, p. 18, 1935.

Operculina ocalana Vaughan in Sheppard's "The Geology of Southwestern Ecuador," pp. 158, 159, figs. 113 (1-5), 114 (1-3), 1937.

Operculinoides ocalanus Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 316, 317, pl. 12, fig. 5; pl. 15, fig. 5, 1939.

Operculinoides ocalanus Vaughan and Cole, Geol. Soc. Amer.; Sp. Paper No. 30, pp. 38-40, pl. 8, figs. 8, 9; pl. 9, figs. 1-4; pl. 10, fig. 11, 1941.

Several specimens were found in the sample taken at 250-258 feet in W-448 which appear to represent this species. However, certain discrepancies should be noted. Cushman in describing this species states that the last whorl contains "16 to 18 chambers". The figure of the type specimen shows that this specimen has more than 18 chambers in the final volution. Gravell and Hanna have commented on this discrepancy.

The two median sections available of the specimens from this well have more chambers than normally occur in other forms referred to this species. A specimen with diameter of 2.8 X 2.5 mm. has 3 coils with 21 chambers in the final whorl. Another specimen with diameter of 3.2 X 2.7 mm. has 3 coils with approximately 31 chambers in the final volution.

Studies by Vaughan and Cole have proved that small specimens of *O. ocalanus* 3 to 3.3 mm. in greater diameter have 16 or 17 chambers in the final volution; those 4.5 mm. in diameter have 20 to 22 chambers and those 6 mm. in diameter have as many as 26 chambers.

From this, it appears that the specimens under consideration have more chambers in the final volution for their size than Vaughan and Cole found in specimens which they considered typical of this species.

Typical specimens of *O. ocalanus* have the crests of the costae beaded and beading is also present around the raised ends of the axis. The specimens from the well do not exhibit this beading.

Although the foregoing statements tend to cast doubt on the validity of the identification of these specimens, it should be pointed out that in other respects they resemble *O. ocalanus* very closely. The

specimens have the strongly costate surface which is so typical of *O. ocalanus*. The abrupt backward curvature of the costae at the periphery of the test is similar to that shown in the type specimen of *O. ocalanus*. Finally, there is the rapid increase in height of the outer whorl.

First appearance at a depth of 250-258 feet in W-448.

Occurrence: Ocala limestone.

OPERCULINOIDES WILLCOXII (Heilprin)

Plate 9, figures 1-7

Nummulites willcoxii Heilprin, Proc. Nat. Acad. Sci. Philadelphia, vol. 34, p. 191, figs. 1, 2, 1882; *ibid.*, vol. 36, pp. 321-322, figs. 1, 2, 1884.

Operculina willcoxii Cushman, U. S. Geol. Survey Prof. Paper 128-E, p. 129, pl. 20, figs. 9-11, 1921.

Operculinella wilcoxii Vaughan, Florida Geol. Survey, 19th Ann. Rept., p. 158, 1928.

Operculinoides willcoxii Hanzawa, Sci. Rept. Tôhoku Imp. Univ., ser. 2 (Geol.) vol. 18, No. 1, p. 18, 1935.

Operculinoides willcoxii Barker, Proc. U. S. Nat. Mus., vol. 86, No. 3052, pp. 309-310, pl. 13, fig. 3; pl. 16, fig. 1; pl. 21, fig. 13, 1939.

Typical specimens of this species occur in W-448. Cushman states: "The species seem to be characteristic of that portion of the Ocala which is characterized by certain species of *Lepidocyclina* but not of that portion in which *Orthophragmina* is the predominating orbitoid genus. It occurs usually in company with *Heterostegina*." The same association has been found in W-448.

First appearance at a depth of 300-320 feet in W-448.

Occurrence: Ocala limestone.

Genus HETEROSTEGINA d'Orbigny, 1826

HETEROSTEGINA OCALANA Cushman

Plate 11, figures 3-6

Heterostegina ocalana Cushman, U. S. Geol. Survey Prof. Paper 128-E, pp. 130, 131, pl. 21, figs. 15-18, 1921.

Heterostegina ocalana Vaughan, Geol. Soc. Amer. Bull., vol. 35, p. 789, 1924.

Heterostegina ocalana Cushman, U. S. Geol. Survey Prof. Paper 181, p. 33, 1935.

Most of the specimens of this species encountered in this study are slightly smaller than those figured by Cushman. The degree of surface ornamentation is extremely variable. Certain specimens have raised sutures of chambers and chamberlets, but on others the surface of the test is virtually unornamented. All degree of ornamentation occurs between the extremes. Cushman created the variety *glabra* for

the specimens having "the smoother surface of the test." As a complete gradation may be found in specimens from a single sample, the value of the varietal designation may be questioned.

No adequate description of the internal features of this species has been made. The following summary may be given of the specimens studied.

Length.....	3.4-4.0 mm.
Width.....	3.3-3.8 mm.
Thickness through the embryonic apparatus.....	0.74—0.80 mm.
Thickness through flange.....	0.22—0.26 mm.
Portion of test occupied by umbonate area.....	1/3
Surface ornamentation.....	umbonal boss; some specimens with raised costae, others virtually smooth.
Number of whorls.....	3
Diameter of initial chamber.....	80 μ —120 μ
Diameter of second chamber.....	50 μ —61 μ X 100 μ —120 μ
Number of chambers not subdivided.....	3
Number of coils.....	3
Distinct axial plug present.	

First appearance at a depth of 300-320 feet in W-448.

Occurrence: Ocala limestone.

HETEROSTEGINA TEXANA Gravell and Hanna

Plate 10, figures 8, 9; plate 11, figures 1, 2

Heterostegina texana Gravell and Hanna, Jour. Pal., vol. 11, pp. 525, 526, pl. 63, figs. 1-4, 1937.

Heterostegina texana Cole, Florida Geol. Survey, Bull. 16, pp. 40, 41, pl. 5, figs. 18-21; pl. 6, figs. 1, 2, 3-8, 1938.

These specimens are identical to those figured from the Port St. Joe test well.

First appearance at a depth of 1100-1110 feet in W-445.

Occurrence: Oligocene.

Family **PENEROPLIDAE**

Genus **SPIROLINA** Lamarek, 1804

SPIROLINA CORYENSIS Cole, n. sp.

Plate 1, figures 5, 6

Test initially closely coiled, but not completely involute, somewhat compressed, later portion uncoiled, nearly circular in cross-section; sutures indistinct; chambers not inflated; surface ornamentation consisting of fine longitudinal striae; aperture consisting of a series of independent pores in the central portion of the apertural face. Length of adult specimens, about 2.3 mm.

First appearance at a depth of 413-419 feet in W-448; at a depth of 1390-1400 feet in W-445.

Type locality: Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445) at a depth of 1440-1450 feet.

Holotype: Fla. Geol. Surv. Cat. No. S-1541.

Occurrence: Middle Eocene.

Family ALVEOLINELLIDAE
Genus BORELIS Montfort, 1808

BORELIS GUNTERI Cole, n. sp.

Plate 2, figures 1-3; plate 18, figures 5, 6

Alveolina ? sp. Cushman, Florida Geol. Survey, 13th Ann. Rept., p. 64, pl. 3, figs. 6 a, b, 1921.

Test small, involute, circular in outline when viewed from the side, compressed laterally, diameter from 1 to 1.5 mm., thickness 0.7 mm. Surface of uneroded specimens smooth; with slight erosion the surface exhibits a series of low, elongated revolving ridges.

Longitudinal and transverse sections show a globular initial chamber with an internal diameter of 150 to 160 μ . Surrounding the proloculum there are about 5 coils which gradually increase in height toward the periphery. Each chamber is divided into a single row of chamberlets. These chamberlets vary in size and shape.

Type specimens from the Dundee Petroleum Company's well near Bushnell in Section 36, Township 20S., Range 22E., Sumter County, Florida, at a depth of 2270 feet.

These specimens were selected because they are more perfectly preserved than any others in the writer's possession.

Affinities—*B. jamaicensis* Vaughan is the nearest in its features to this species. However, there is a great difference in external shape and number of coils. *B. jamaicensis* is depressed, subglobular in form with a height of 1 mm. and a transverse diameter of 1.4 mm. *B. jamaicensis* typically has 9 coils.

First appearance at a depth of 3360-3370 feet in W-445.

Type locality: Dundee Petroleum Company well near Bushnell, (W-3) Sec. 36, Twp. 20 South, Range 22 East, Sumter County. At a depth of 2270 feet.

Holotype: Florida Geological Survey Cat. No. S-2825; paratypes F.S.G.S Cat. Nos. S-2825A and S-2825B.

Occurrence: Lower Eocene.

BORELIS GUNTERI Cole, variety **FLORIDANA** Cole, n. var.

Plate 18, figures 3, 4, 7, 8

Normally associated with *Borelis gunteri* there are specimens of marked globular shape. A description of these specimens follows:

Test small, slightly compressed, subglobular, height from 0.84 to 1.10 mm., diameter from 0.80 to 0.92 mm.

Specimens from W-166 had a globular initial chamber with an internal diameter of 80 μ . Specimens from W-445 had a globular initial chamber with an internal diameter from 160 to 220 μ .

The specimen with the small initial chamber was composed of about 5 coils. The coils increase in height very slowly and the chamberlets are rectangular in shape. The specimens with the larger initial chambers were so poorly preserved that the number of coils could not be exactly determined. However, the structure which is preserved is similar to that of the smaller specimens.

Except for difference in shape and the fact that the chamberlets appear to be rectangular in shape, these forms are similar to *B. gunteri*. Moreover, they are associated in all the samples which the writer has examined. Therefore, these forms are given a varietal name only.

Type locality: Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) at a depth of 2140-2158 feet.

Cotypes: Florida Geological Survey Cat. No. S-2826 and S-2826A.

Occurrence: Lower Eocene.

Family BULIMINIDAE

Subfamily Reusselinae

Genus PSEUDOCHRYSALIDINA Cole, n. gen.

Genoholotype, PSEUDOCHRYSALIDINA FLORIDANA Cole, n. sp.

Test conical, triserial, chambers inflated; wall calcareous, perforate; labyrinthic axis through the center of the test; aperture consisting of numerous rounded pores on the final chamber.

This genus which is based upon a single species resembles *Chrysalidina* d'Orbigny, 1839, but *Chrysalidina* possesses an arenaceous wall with a thin, outer, epidermal layer. Specimens of *Pseudochrysalidina* placed in dilute hydrochloric acid dissolved completely. Examination of thin sections with a petrographic microscope revealed only calcareous material composing the wall of the test. This material

did not appear to be calcareous grains which the animal had cemented together. *Chrysalidina* is reported to date only from the Cretaceous of France. *Pseudochrysalidina* occurs in the middle Eocene of Florida.

Thin sections show the chambers are large and open, but through the center of the test extends a labyrinthic column. This labyrinthic structure is developed in the terminal chamber and has some relationship to the apertures. As chambers are added, the labyrinthic zone is elongated and surrounded by the open chambers.

PSEUDOCHRYSLIDINA FLORIDANA Cole, n. sp.

Plate 1, figures 10, 11; plate 2, figure 4

Chrysalidina (?) sp. Cushman, Florida Geol. Survey, 13th Ann. Rept., pp. 44, 45, pl. 1, figs. 6 a, b, 1921.

The length of an average sized specimen is 1.3 mm. and the diameter at the terminal end is 0.9 mm. The outer surface of the test is rather coarsely perforate. The chambers are inflated, especially the final ones and the sutures are distinct and depressed.

First appearance at a depth of 1350-1360 feet in W-445.

Type locality: Peninsular Oil and Refining Company's J. W. Cory No. 1 (W-445) at a depth of 1360-1370 feet.

Genoholotype: Fla. Geol. Survey Cat. No. S-1538; paratype: F.S.G.S. Cat. No. S-1538A.

Occurrence: Middle Eocene.

Cushman figures specimens which represent this species from the Marathon Well (W-2) at a depth of 1262 feet.

Family ROTALIIDAE

Genus DISCORINOPSIS Cole, n. gen.

Genoholotype, DISCORINOPSIS GUNTERI Cole, n. sp.

Test typically plano-convex, the ventral side flattened; trochoid, all the whorls visible on the dorsal side, only the chambers of the last whorl visible on the ventral side; umbilical area closed by a spongy mass of shell material; wall calcareous; aperture, a series of openings through the material filling the umbilicus.

DISCORINOPSIS GUNTERI Cole, n. sp.

Plate 1, figures 7-9

Test plano-convex, the dorsal side rather strongly convex, the ventral side flat; periphery not lobate initially, but the final two

chambers may be slightly lobate; 7 chambers typically comprise the last formed coil; sutures recurved, strongly depressed dorsally, slightly depressed ventrally; dorsally a depressed area separates the outer whorl of chambers from the inner whorls; chambers of the outer whorl are long and narrow; umbilical area filled with a spongy mass of shell material through which are a series of irregular openings which are best developed at the outer edge of the umbilical mass.

Height 0.89 mm.; length 2.89 mm.; width 2.12 mm. (type specimen).

Viewed dorsally these specimens would be referred to the genus *Discorbis* but the structure of the umbilical filling is distinct. So far as could be discovered, these specimens could not be referred to any described genus.

First appearance in W-448 at a depth of 370-390 feet; in W-445 at a depth of 1350-1360 feet.

Type locality: United Brotherhood of Carpenters and Joiners
Power House Well No. 2 (W-448) at a depth of
390-395.

Genoholotype: Fla. Geol. Survey Cat. No. S-1581.

Occurrence: Middle Eocene.

Genus EPONIDES Montfort, 1808

EPONIDES JACKSONENSIS (Cushman and Applin)

Plate 1, figures 3, 4

Pulvinulina jacksonensis Cushman and Applin Bull. Amer. Assoc. Petrol. Geol., vol. 10, p. 181, pl. 9, figs. 24, 25, 1926.

First appearance at a depth of 250-258 feet in W-448.

Occurrence: Ocala limestone.

Family ORBITOIDIDAE

Subfamily Orbitoidinae Prever

Genus LEPIDORBITOIDES A. Silvestri, 1907

Table I summarizes the important features described by various authors for American species of *Lepidorbitoides*. This table was prepared during the present study and is published here for the assistance of other workers in order to show the comparison between the various species of this genus which have been described.

It may be noted here that *L. palmeri* and *L. macgillavryi* are undoubtedly two forms of the same species.

Table 1. COMPARISON OF AMERICAN SPECIES OF LEPIDORBITOIDES

SPECIES	<i>mimina</i> H. Douville	<i>nortoni</i> (Vaughan)	<i>planaesi</i> Rutten	<i>rutteni</i> Thiadens	<i>rutteni</i> var. <i>armata</i> Thiadens	<i>palmeri</i> Thiadens	<i>macgillavryi</i> Thiadens	<i>nortoni</i> * (Vaughan)
Diameter.....	1.6-5 mm.	3.5 mm.	1.2-1.5 mm.	3-5 mm.	.....	3-5 mm.	2.4-3.7 mm.	0.5-2.1 mm.
Thickness.....	0.5-1.5 mm.	0.5 mm.	0.6 mm.	0.4-0.7 mm.	.....	1-2 mm.	0.8-1 mm.	0.4 mm.
Surface ornamentation.....	Finely papillate	Finely papillate	Not described	Smooth, reticulate	Fine to coarsely papillate	Smooth to finely papillate	Smooth, reticulate	Smooth, reticulate, occasionally centrally papillate
Diameter of initial chamber.....	90-200 μ †	55 x 65 μ	50-60 μ	.....	.....	140-230 μ	.....	40 μ
Diameter of second chamber.....	70 x 150 μ to 120 x 240 μ	55 x 90 μ	50 x 90 μ to 40 x 100 μ	.....	.....	210-300 μ	.....	20 x 40 μ to 40 x 60 μ
Radial diameter of equatorial chambers..	30-70 μ	70-80 μ	30 μ	74-140 μ	.....	60-110 μ	74 μ	60-80 μ
Tangential diameter of equatorial chambers.....	50-140 μ	70-80 μ	40 μ	74-110 μ	.....	110 μ	.....	30-40 μ
Height of equatorial chambers at center....	20-35 μ	38 μ	30 μ	26 μ	.....	60 μ	25 μ	30 μ
Height of equatorial chambers at peri- phery.....	60-140 μ	75 μ	40 μ	90 μ	.....	110 μ	110 μ	40 μ

†Represents the Greek letter Mu (μ).

SPECIES	<i>mimina</i> H. Douville	<i>nortoni</i> (Vaughan)	<i>planaesi</i> Rutten	<i>rutteni</i> Thiadens	<i>rutteni</i> var. <i>armata</i> Thiadens	<i>palmeri</i> Thiadens	<i>macgillavryi</i> Thiadens	<i>nortoni</i> * (Vaughan)
Shape of equatorial chambers.....	Arcuate	Diamond shaped to arcuate	Arcuate	Hexagonal to arcuate	.....	Hexagonal to spatulate	Ogival to diamond shaped	Arcuate
Number of lateral chambers at center....	3-10	7	10	5-9	.....	13	15	5-6
Shape and arrangement of lateral chambers.....	Overlapping tiers; open	Regular tiers to overlapping; open	Not in tiers; low	Overlapping tiers; open	.....	Tiers; open	Tiers; open	Overlapping tiers; open
Pillars.....	Small	Small	None	None	.....	Small	None	None to few centrally situated

* Specimens from Cory Well (W-445).

LEPIDORBITOIDES (LEPIDORBITOIDES) NORTONI (Vaughan)

Plate 12, figures 1-8

Orbitocyclina nortoni Vaughan, Jour. Pal., vol. 3, pp. 170-174, pl. 22, figs. 1, 2, 1929.

Test small, lenticular, with an encircling rim in perfectly preserved specimens. In most of the specimens, the fragile rim has been destroyed. Surface ornamentation consists of a polygonal mesh of clear shell material surrounding areas of opaque, whitish shell material. In some specimens there is an absence of papillae; in others there is a single, central papillae, and a few specimens have an apical group of very small papillae. The diameter of the smallest specimen is 0.5 mm. and of the largest is 1.2 mm. These specimens lacked the encircling rim. A perfectly preserved specimen has a diameter of 2.1 mm. In this specimen the diameter of the central, inflated area is 1.2 mm. and the width of the encircling rim is about 0.5 mm. The thickness of average individuals is about 0.4 mm.

The embryonic apparatus consists of two initial chambers surrounded by a relatively thick wall and followed by about five accessory chambers which make about three-quarters of a coil around the initial chambers. The longer diameter of the initial chambers is perpendicular to a line joining their centers. This diameter is about 140 μ including the thickness of the surrounding wall. The diameter at right angles to this is about 80 μ . The initial chamber is subspherical with an internal diameter of about 40 μ . In the equatorial sections available, the second chamber is separated from the first by a straight partition. The second chamber is slightly wider than long. The thickness of the wall surrounding these chambers is about 35 μ . The accessory chambers are slightly larger than the equatorial chambers which follow them although some of the equatorial chambers at the periphery of the test are as large as the accessory chambers.

In horizontal sections the equatorial chambers have curved outer walls and truncate inner ends. Certain of the chambers, especially near the periphery have a rude hexagonal shape. Communication between the chambers is by stoloniferous apertures.

In vertical sections the equatorial chambers have an internal height of about 30 μ at the center of the test and about 40 μ at the periphery. There are 5 to 6 lateral chambers to a tier on each side of the equatorial layer at the center of the test. They decrease regularly in number toward the periphery of the test so that in the outermost portion the equatorial chambers are not covered.

The lateral chambers are not arranged in regular tiers, but those of one row overlap those of adjacent rows. The internal height of average lateral chambers is about 15μ and their average length is about 40μ . The thickness of the roofs and floors is about equal to the height of the chamber opening.

Pillars may be present or absent. When present, they are confined to the central portion of the test, usually one on each side of the equatorial layer. Well developed pillars have a surface diameter of about 80μ .

Illustrations (pl. 12, figs. 9-14) of the internal structure of specimens assigned to *L. planasi* Rutten are given for comparison with *L. nortoni*. The detailed description and occurrence of *L. planasi* will be discussed in a bulletin of the Florida Geological Survey which is soon to be published.

First appearance at a depth of 5760-5770 feet in W-445.

Occurrence: Upper Cretaceous.

Genus LEPIDOCYCLINA Gümbel, 1870

Subgenus *Lepidocyclina* Gümbel, 1870

LEPIDOCYCLINA (LEPIDOCYCLINA) MORTONI Cushman

Plate 15, figures 9-13; plate 16, figures 11, 12, 14;
plate 18, figures 13, 14

Lepidocyclina mortoni Cushman, U. S. Geol. Survey, Prof. Paper 125, pp. 70, 71, pl. 27, figs. 1-4; pl. 28, figs. 1-3, 1920.

Lepidocyclina (Lepidocyclina) mortoni Gravell and Hanna, Jour. Pal., vol. 9, pp. 337-339, pl. 30, figs. 1-9; pl. 31, figs. 1-11; pl. 32, figs. 1-4, 1935. (references and synonymy).

Gravell and Hanna have presented a complete description of this species, accompanied by a series of beautiful illustrations. The specimens found in this study are typical representatives of this species.

First appearance at a depth of 1230-1240 feet in W-445; at a depth of 250-258 feet in W-448.

Occurrence: Ocala limestone.

LEPIDOCYCLINA (LEPIDOCYCLINA) OCALANA Cushman

Plate 13, figures 1-7; plate 16, figures 1-4, 6-10, 15

Lepidocyclina ocalana Cushman, U. S. Geol. Survey Prof. Paper 125, pp. 71, 72, pl. 28, figs. 3, 4; pl. 29, figs. 1-3, 1919.

Lepidocyclina ocalana Vaughan, Geol. Soc. Amer. Bull., vol. 35, pp. 796, 797, text fig. 2, 1924.

Lepidocyclus ocalana Douvillé, Mém. Soc. Géol. France, N. S., vol. 1, Mém. No. 2, pp. 38, 39, text figs. 19-21, 1924.

Lepidocyclus ocalana Vaughan, Florida Geol. Survey, 19th Ann. Rept., pp. 155, 156, 1928.

Megalospheric individuals have a diameter from 4 to 6 mm. with an average thickness of 1.2 mm. Microspheric individuals have a diameter from 12 to 16 mm. with a thickness of about 2.5 mm. Cushman has given a very satisfactory description of the external appearance of microspheric individuals. The megalospheric individuals in the present collection have the same external appearance as do the microspheric forms except that they are smaller in size as may be noted by the measurements given above.

Cushman's description of microspheric specimens is as follows: "Test of medium size, flattened, usually slightly sellaeform; usual diameter of specimens from 16 to 18 millimeters, with the range of adult specimens from 15 to 21 millimeters; the two sides of the tests differing; one side typically prominently umbonate in the central portion, thence gradually sloping to the periphery; the opposite side thickened in the center but not umbonate, evenly curved from one side to the other; the umbonate side showing more clearly the sellaeform shape than the more evenly curved side; surface typically smooth or somewhat scrobiculate from unequal erosion of the outer layer of lateral chambers."

To this may be added that in perfectly preserved specimens with smooth surfaces there may be seen small light areas which represent the ends of the pillars. These are irregularly scattered over the surface.

The following table summarizes the internal measurements made on megalospheric specimens from W-448 and W-445.

Horizontal section

Embryonic apparatus

Diameter initial chamber	340 X 440 μ
Diameter second chamber	160 X 480 μ
Thickness of bounding wall	40 μ

Accessory chambers

Size of largest	80 X 280 μ
-----------------	----------------

Equatorial chambers

Shape	short spatulate
Radial diameter	60 μ
Tangential chamber	80 μ

Vertical section

Height embryonic chambers	220 μ
Height equatorial chambers	
at center	80 μ
near periphery	120 μ

Number of lateral chambers	7-8
Thickness of roofs and floors of laterals	30 μ
Height of opening of laterals	40 μ
Average length of laterals	100—260 μ
Surface diameter of papillae	120—200 μ

The lateral chambers are in part arranged in regular tiers, but the longer chambers overlap from one tier to another producing an appearance of irregularity in other portions of the test. Pillars are irregularly distributed.

First appearance at a depth of 250-258 feet in W-448; at a depth of 1220-1230 feet in W-445.

Occurrence: Ocala limestone.

LEPIDOCYCLINA (LEPIDOCYCLINA) OCALANA Cushman
variety **ATTENUATA** Cushman

Plate 15, figures 1-5; plate 16, figure 5

Lepidocyclus attenuata Cushman, U. S. Geol. Survey Prof. Paper 125. p. 67, pl. 24, figs. 7, 8, 1919.

Lepidocyclus ocalana Cushman, variety *attenuata* Vaughan, Florida Geol. Survey, 19th Ann. Rept., pp. 155-157, 1928.

Cushman's original description was based on the microspheric form of this variety. The following description is based on megalo-spheric forms found in W-448 at a depth of 250-258 feet.

Test of medium size, discoid with a small umbo. Surface ornamentation consists of small papillae which cover the central umbo; the outer rim surrounding the umbo is smooth. Average sized specimens have a diameter of about 8 mm. and a thickness at the center of about 1 mm.

The embryonic apparatus consists of two large, subequal chambers with normally two periembryonic chambers. The larger chamber has internal diameters of 360 μ by 520 μ and the smaller chamber measures 220 μ by 420 μ . The bounding wall is about 40 μ thick. The smaller periembryonic chamber has internal diameters of 100 μ by 180 μ and the larger measures 80 μ by 280 μ .

The equatorial chambers seen in horizontal sections are short spatulate. In vertical section, the equatorial chambers have an internal height of about 80 μ at the center of the test, and a thickness of about 130 μ at the periphery of the test.

Vertical sections show about 6 or 7 layers of lateral chambers on each side of the embryonic chambers. These chambers decrease regu-

larly in number toward the periphery. The periphery is normally covered by one layer of lateral chambers, but occasionally the outer most portion of the equatorial layer is not covered. The lateral chambers are low, depressed. The roofs and floors are thicker than the cavity openings. The chambers are not arranged in regular tiers, but overlap in an irregular manner.

Pillars are irregularly present particularly in the central area. They have a surface diameter of as much as 240 μ .

First appearance at a depth of 250-258 feet in W-448; in W-445 at a depth of 1220-1230 feet.

Occurrence: Ocala limestone.

LEPIDOCYCLINA (LEPIDOCYCLINA) OCALANA Cushman
variety **FLORIDANA** Cushman

Plate 14, figures 1-3; plate 16, figure 17

Lepidocyclus floridana Cushman, U. S. Geol. Survey Prof. Paper 125, pp. 67, 68, pl. 25, figs. 1, 2, 1919.

Lepidocyclus floridana Vaughan, Geol. Soc. Amer. Bull., vol. 35, pp. 796, 797, text fig. 3, 1924.

Lepidocyclus ocalana Cushman, variety *floridana* Vaughan, Florida Geol. Survey, 19th Ann. Rept., pp. 155, 156, 1928.

The description of this variety was based on megalospheric individuals. This small species is characterized by possessing a strongly saddle-shaped test. Horizontal sections show the same type of embryonic apparatus and equatorial chambers that characterize *L. ocalana*. The sellaeform character of the test of the variety *floridana* is apparent in horizontal sections because of the pattern made by the arrangement of the equatorial chambers.

First appearance at a depth of 250-258 feet in W-448; in W-445 at a depth of 1220-1230 feet.

Occurrence: Ocala limestone.

LEPIDOCYCLINA (LEPIDOCYCLINA) OCALANA Cushman
variety **PSEUDOMARGINATA** Cushman

Plate 14, figures 4-7

Lepidocyclus pseudomarginata Cushman, U. S. Geol. Survey Prof. Paper 125, p. 69, pl. 26, figs. 2-4, 1919.

Lepidocyclus ocalana Cushman, variety *pseudomarginata* Vaughan, Florida Geol. Survey, 19th Ann. Rept., pp. 155, 156, 1928.

The description of this variety is based on microspheric specimens. Cushman figures two specimens, of which the smaller appears to be

a megalospheric individual. The larger specimen which was selected as the type is apparently a microspheric individual. The smaller specimen has a diameter of 5.6 mm. with the surface strongly papillate, especially on the pronounced umbo.

Several specimens were found in W-448 with a diameter of 5.1 to 6.4 mm. with a prominent umbonate area which is covered with well developed papillae. These specimens were all megalospheric individuals, but represent this variety whose type specimen is a microspheric individual.

Horizontal sections show the same type of embryonic apparatus and equatorial chambers as found in typical *L. ocalana*. The vertical sections of this variety clearly illustrate the differences on which the varietal name was based. Below a description of a typical vertical section is given.

The diameter of the individual from which the vertical section was made is 6.4 mm.; the thickness 1.4 mm.

The lateral chambers are open, low, either short or elongate. Some are arranged in regular tiers, but in most cases certain of the elongate chambers overlap from one tier to the next. There are 7 to 8 layers of lateral chambers on either side of the equatorial layer at the center of the test. The lateral chambers decrease in number toward the periphery of the test. Normally, the outer 0.4 mm. of the test is not covered by lateral chambers. The height of a normal lateral chamber is about 40 μ . The thickness of the roofs and floors varies from 20 to 40 μ .

The internal height of the equatorial chambers at the center of the test is about 80 μ ; at the periphery 140 μ .

Pillars are irregularly present, the larger ones at the center of the test. These may have a surface diameter of as much as 300 μ . Smaller pillars near the periphery of the test have a surface diameter of about 140 μ . Both the large and small pillars taper regularly toward the equatorial layer which they always reach.

First appearance at a depth of 258-265 feet in W-448.

Occurrence: Ocala limestone.

LEPIDOCYCLINA (LEPIDOCYCLINA) TSCHOPPI Thiadens

Plate 14, figure 8; plate 15, figure 14; plate 16, figures 13, 16

Lepidocyclina (Lepidocyclina) tschoppi Thiadens, Jour. Pal., vol. 11, pp. 103, 104, pl. 17, figs. 1, 3; pl. 18, fig. 6; pl. 19, fig. 1; text fig. 3H, 1937.

This species is characterized by possessing unusually large embryonic chambers in proportion to the total bulk of the test. The measurements of four specimens are given below.

Diameter (mm.).....	1.61	1.95	1.99	2.17
Thickness (mm.).....	0.66	0.88	0.85	
Embryonic chambers				
Length (mm.).....	0.54	0.60	0.76	0.90
Height (mm.).....	0.46	0.44	0.56	
Width (mm.).....				0.70
Number of lateral chambers.....	2	3-4	2	

First appearance at a depth of 1220-1230 feet in W-445.

Occurrence: Ocala limestone.

Subgenus *Nephrolepidina* H. Douvillé, 1911

LEPIDOCYCLINA (*NEPHROLEPIDINA*) *SEMMESI* Vaughan and Cole

Plate 15, figures 6-8

Lepidocyclus (*Nephrolepidina*) *semmesi* Vaughan and Cole. Smithsonian Miscell. Coll., vol. 89, No. 10, pp. 29, 30, pl. 15, figs. 3-5; pl. 30, fig. 1; pl. 31, figs. 1, 1 a; pl. 32, figs. 2, 3, 1933.

Lepidocyclus (*Nephrolepidina*) *semmesi* M. G. Rutten, Jour. Pal., vol. 9, p. 540, pl. 61, fig. 6, 1935.

Specimens of a small species of *Lepidocyclus* belonging to the subgenus *Nephrolepidina* were found in the sample taken at a depth of 1250-1260 feet in W-445. Although these specimens are smaller than those studied by Vaughan and Cole, there is little doubt that they represent this species. A characteristic feature of this species is the shape and arrangement of the lateral chambers. Vaughan and Cole state, "The chamber floors are much thickened in the layers adjacent to the equatorial layer, the chamber cavities showing only as narrow slits." This feature may be observed in the vertical sections made from the specimens under discussion.

M. G. Rutten reports this species from certain Cuban stations, giving its stratigraphic range as upper Eocene and Oligocene. The types are from the upper Eocene Tantoyuca formation of Mexico. The Oligocene determination by Rutten may be incorrect.

First appearance at a depth of 1250-1260 feet in W-445.

Occurrence: Ocala limestone.

Family DISCOCYCLINIDAE Vaughan and Cole, 1940

Genus PSEUDOPHRAGMINA H. Douvillé, 1923

Subgenus Proporocyclus Vaughan and Cole, 1940

PSEUDOPHRAGMINA (PROPOROCYCLINA) CITRENSIS (Vaughan)

Plate 17, figures 6, 7

Discocyclus (Discocyclus) citrensis Vaughan, Florida Geol. Survey, 19th Ann. Rept., pp. 159, 160, pl. 2, figs. 1-5, 1928.

A few typical specimens were found. It seems surprising that more representatives of this group were not encountered.

First appearance at a depth of 300-320 feet in W-448.

Occurrence: Ocala limestone.

Family MIOGYPSINIDAE Tan, 1936

Genus MIOGYPSINA Sacco, 1893

MIOGYPSINA (MIOGYPSINA) HAWKINSI Hodson

Plate 17, figures 1, 2

Miogypsina hawkinsi Hodson, Bull. Amer. Pal., vol. 12, No. 47, pp. 28, 29, pl. 7, fig. 9; pl. 8, figs. 1, 2, 1926.

Miogypsina hawkinsi Gravell, Smithsonian Miscell. Coll., vol. 89, No. 11, p. 34, pl. 6, figs. 11-14, 1933.

Miogypsina (Miogypsina) hawkinsi Cole, Florida Geol. Survey Bull. 16, pp. 43, 44, pl. 7, figs. 5-7, 1938.

Specimens were found in W-445 at 900-910 feet which are identical to those reported from the Port St. Joe test well at 700-721 feet. Mr. Gunter sent specimens from the Marathon well (W-2) on Key Vaca²² at 852 feet for identification and comparison with those found in the Cory well. The following table gives a comparison of these specimens.

	Cory Well (W-445)	Marathon Well (W-2)
Diameter.....	1.7 mm.	2.38 mm.
Thickness.....	0.68 mm.	0.90 mm.
Diameter initial chamber.....	120 μ	100 X 190 μ
Diameter second chamber.....	90 μ	110 μ
Distance of initial chambers from periphery.....	40 μ	60 μ
Diameter equatorial chambers.....	80 μ	100 μ
Thickness of equatorial layer.....	80 μ	80 μ
Number of lateral chambers on either side of equatorial layer.....	4	6
Length lateral chambers.....	100 μ	80-100 μ
Height lateral chambers.....	30-40 μ	40 μ
Surface diameter of pillars.....	60-80 μ	80-100 μ

The specimens from the Marathon well (W-2) are figured on plate 17, figures 3-5. These specimens most nearly resemble *Miogypsina (Miogypsina) cushmani* Vaughan.²³

²²J. A. Cushman, "Foraminifera from the Deep Wells of Florida," Florida Geol. Survey, 13th Ann. Rept., pp. 59, 60, 1921.

²³T. W. Vaughan, "American and European Tertiary Larger Foraminifera", Bull. Geol. Soc. Amer., vol. 35, p. 813, pl. 36, figs. 4-6, 1924.

M. cushmani appears to possess characteristics intermediate between *M. hawkinsi* and *M. staufferi* Koch.²⁴ The American species of *Miogypsina* should be restudied.

First appearance at a depth of 900-910 feet in W-445.

Occurrence: Oligocene.

²⁴R. Koch, "*Miogypsina staufferi*, nov. spec., from Northwestern Venezuela," *Ecologiae geol. Helvetiae*, vol. 19, No. 3, pp. 751-753, pl. 28, figs. 1-3, 1926.

Appendix

Peninsular Oil and Refining Company's J. W. Cory No. 1

Inasmuch as this is at present the deepest well that has yet been drilled in Florida it is desirable that all available information be assembled in this Bulletin. For that reason there is being included a copy of the driller's log as prepared from the daily records of the drillers and a reproduction of the electric log made by the Halliburton Oil Well Cementing Company of Houston, Texas.

It has been pointed out that the electric log of this well has very little value, especially at present. In the electric log there is no indication of porosity of any degree throughout the entire section. Drilling conditions indicated, however, that the rocks penetrated were extremely porous throughout the section. Three distinct cavernous sections were encountered during drilling, at 2,846 to 2,864 feet, at 2,958 to 2,963 feet and at 2,986 to 2,997 feet. These cavities were cased off but it was increasingly difficult to maintain circulation down to about 6,000 feet at which depth returns were lost entirely and from that depth down drilling was continued with clear water. At intervals circulation was renewed by excessive use of mud, but below 8,500 feet no mud was used and a record of the formation was obtained by coring.

DRILLER'S LOG*

DEPTH	FORMATION	DEPTH	FORMATION
0- 14	Cellar	1036-1138	Broken lime
14- 19	Sand	1138-1720	Lime
19- 41	Gravel and hard shells	1720-1841	Broken lime
41- 60	Gravel and lime shells	1841-2635	Lime
60- 80	Shells	2635-2682	Hard lime
80- 128	Sand and lime shells	2682-2689	Lime
105- 125	Sand lime	2689-2788	Lime and anhydrite shells
125- 130	Blue shale	2788-2847	Hard lime
130- 218	Sand and lime shells	2846-2864	Cavity
218- 357	Sand	2890-2906	Hard lime and gypsum
357- 480	Lime and sand	2906-2959	Broken lime
480- 505	Sand	2959-2963	Cavity
505- 522	Lime hard	2963-2967	Hard lime
522- 705	Lime	2967-2986	Lime
705- 770	Lime broken	2986-2997	Cavity
770- 785	Hard lime	2997-3023	Hard lime
785- 905	Lime and green shale	3023-3029	Lime
905-1020	Broken lime	3029-3065	Hard lime
1020-1036	Hard lime	3065-3184	Lime

*Log received through Robert B. Campbell, President, Peninsular Oil & Refining Company, Wallace S. Building, Tampa, Florida, June 24, 1939.

DEPTH	FORMATION	DEPTH	FORMATION
3184-3217	Hard lime	4869-4935	Broken lime
3217-3230	Lime	4935-5052	Soft broken lime
3230-3241	Hard lime	5052-5065	Shale and lime
3241-3250	Hard sandy lime	5065-5075	Hard lime
3250-3252	Lime	5075-5130	Soft lime
3276-3298	Hard lime	5130-5140	Hard lime
3298-3302	Lime	5140-5256	Chalk lime with streaks of hard lime
3302-3383	Chalk	5256-5300	Lime and chalk
3383-3417	Chalky lime	5300-5427	Chalk and lime
3417-3431	Hard lime	5427-5550	Broken lime and chalk
3431-3463	Lime and broken chalk	5570-6027	Chalk and lime
3463-3506	Lime, streaks of chalk	6027-6037	Lime
3506-3535	Hard lime	6037-6039	Chalk and lime hard
3535-3555	Gypsum and broken lime	6059-6706	Chalk and lime
3555-3566	Hard lime	6706-6820	Soft lime
3566-3575	Sand—?	6820-6897	Hard broken lime
3575-3593	Gray lime	6897-7000	Broken lime
3593-3608	Lime and gypsum	7000-7010	Lime
3608-3644	Broken lime	7010-7201	Chalk and lime
3644-3655	Chalk	7201-7607	Broken lime, lime and chalk
3655-3660	Lime and gypsum	7607-7615	Chalk
3660-3723	Broken lime	7615-7676	Lime and shale broken
3723-3798	Hard lime	7676-7684	Lime
3798-3823	Broken lime	7684-7707	Shaly lime
3823-3838	Hard lime	7707-7829	Broken lime
3838-3845	Lime	7829-7895	Shale and lime
3845-3850	Broken lime	7895-7918	Lime
3850-3866	Anhydrite	7918-7944	Hard lime
3866-3945	Gypsum and broken lime	7944-7949	Hard gray lime
3945-3963	Chalk, shale and lime	7949-7974	Hard lime
3963-3971	Hard lime and gypsum	7974-7998	Broken lime
3971-3998	Broken lime and chalk	7998-8036	Hard lime
3998-4006	Hard lime	8036-8066	Hard gray lime
4006-4013	Chalky lime	8066-8085	Lime
4013-4027	Lime hard	8085-8095	Sandy shale
4059-4093	Lime and chalk hard	8095-8106	Hard lime
4093-4100	Hard lime and anhydrite	8106-8128	Broken lime
4100-4113	Broken lime and chalk	8128-8131	Gray lime
4113-4123	Lime and anhydrite	8131-8166	Chalky lime with streaks hard lime
4123-4161	Chalk and lime	8166-8168	Hard lime
4161-4206	Lime and anhydrite	8168-8175	Core
4206-4216	Broken lime	8175-8200	Hard lime
4216-4347	Lime and anhydrite	8200-8212	Chalky lime
4347-4383	Gypsum and lime	8212-8220	Hard lime
4382-4446	Lime and anhydrite broken	8220-8225	Chalky lime
4446-4453	Hard lime and anhydrite	8225-8243	Core
4453-5411	Chalky lime with streaks hard lime	8243-8288	Hard lime
4511-4531	Hard lime and anhydrite	8288-8333	Chalk and lime
4531-4541	Lime and anhydrite	8333-8352	Hard lime and anhydrite
4541-4587	Brown lime	8352-8395	Hard lime and anhydrite with streaks chalky lime
4587-4617	Hard lime	8395-8409	Core
4617-4625	Chalky lime	8409-8419	Lime and anhydrite
4625-4713	Hard lime	8419-8429	Hard lime and anhydrite
4713-4726	Broken lime	8429-8495	Broken lime
4726-4738	Hard lime	8495-8572	Hard lime and anhydrite
4738-4774	Chalky lime	8572-8580	Anhydrite
4774-4779	Chalk and lime	8580-8600	Soft lime
4770-4826	Hard lime	8600-8610	Lime
4826-4864	Hard lime and gypsum lime		
4864-4869	Hard lime		

DEPTH	FORMATION	DEPTH	FORMATION
8610-8651	Anhydrite	9370-9413	Lime broken
8651-8700	Hard lime	9413-9434	Hard lime and anhydrite
8700-8721	Core	9434-9464	Broken lime
8721-8828	Hard lime	9464-9472	Core
8828-8854	Lime and anhydrite	9472-9481	Anhydrite and lime
8856-8898	Hard lime		Cored hard black lime
8898-8937	Lime and anhydrite	9481-9482	Hard lime
8937-8945	Anhydrite	9482-9487	Broken lime
8945-8953	Soft lime	9487-9537	Hard lime
8953-8969	Anhydrite and lime	9537-9543	Broken lime
8969-8974	Lime	9543-9555	Hard lime
8974-8983	Lime and anhydrite	9555-9568	Broken lime
8983-8990	Broken lime	9568-9578	Hard lime
8990-9039	Lime and anhydrite	9578-9595	Broken lime
9039-9049	Broken lime	9595-9611	Hard lime
9049-9147	Lime and anhydrite	9611-9625	—
9147-9168	Lime broken	9625-9629	Soft lime
9168-9182	Hard lime and anhydrite	9629-9739	Hard lime
9182-9185	Broken lime	9739-9750	Broken lime
9185-9203	Soft lime	9750-9756	Soft lime
9203-9208	Anhydrite	9756-9758	Hard lime
9208-9251	Hard lime and anhydrite	9758-9765	Broken lime
9251-9332	Broken lime	9765-9994	Hard lime
9332-9356	Hard lime	9994-10006	Broken lime
9356-9370	Hard anhydrite		

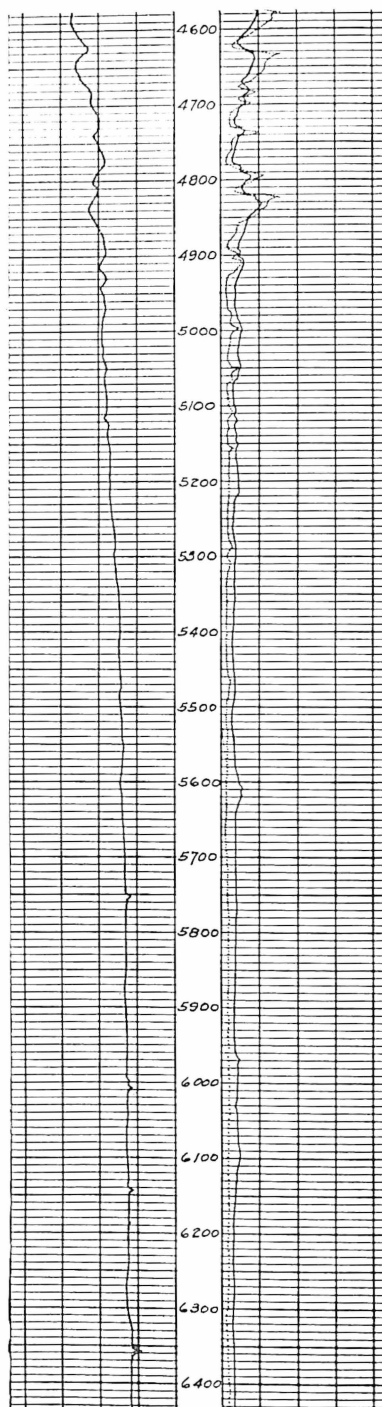
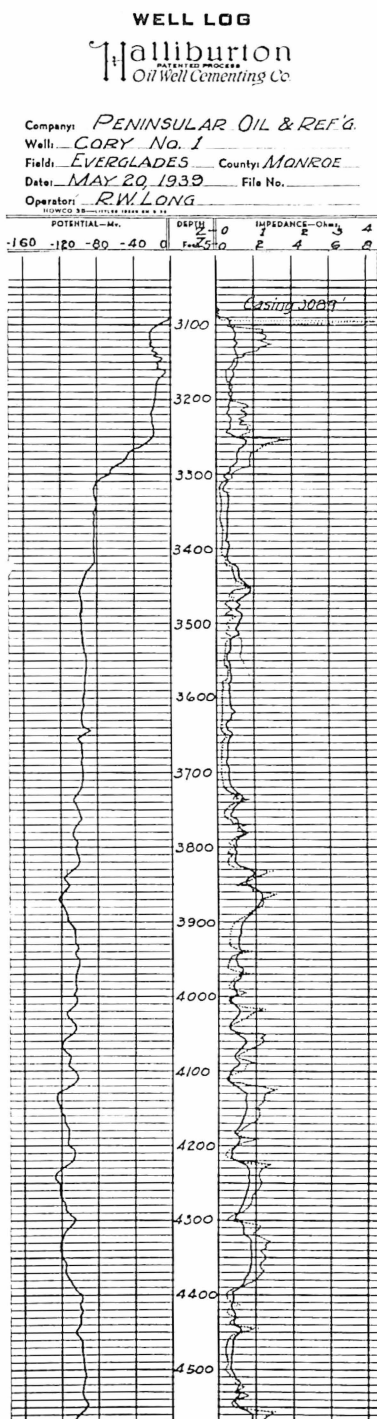
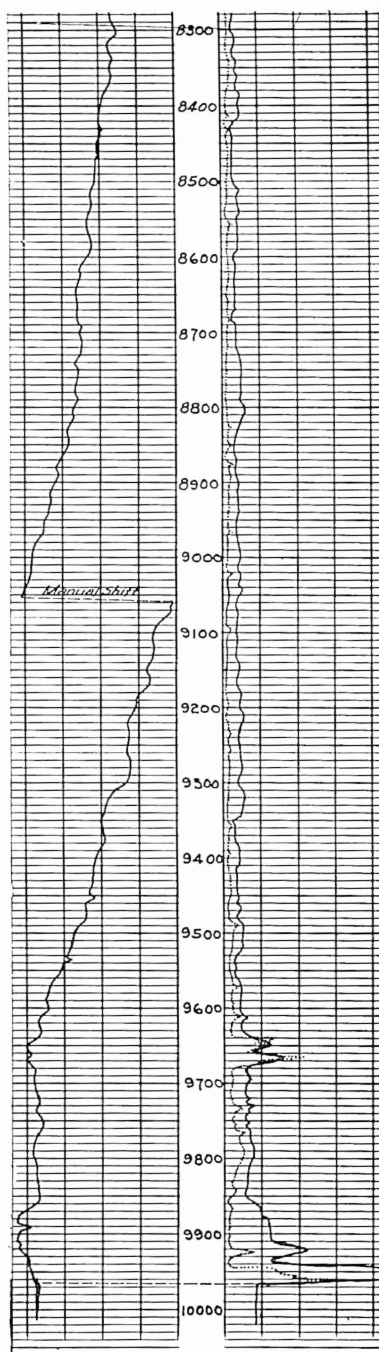
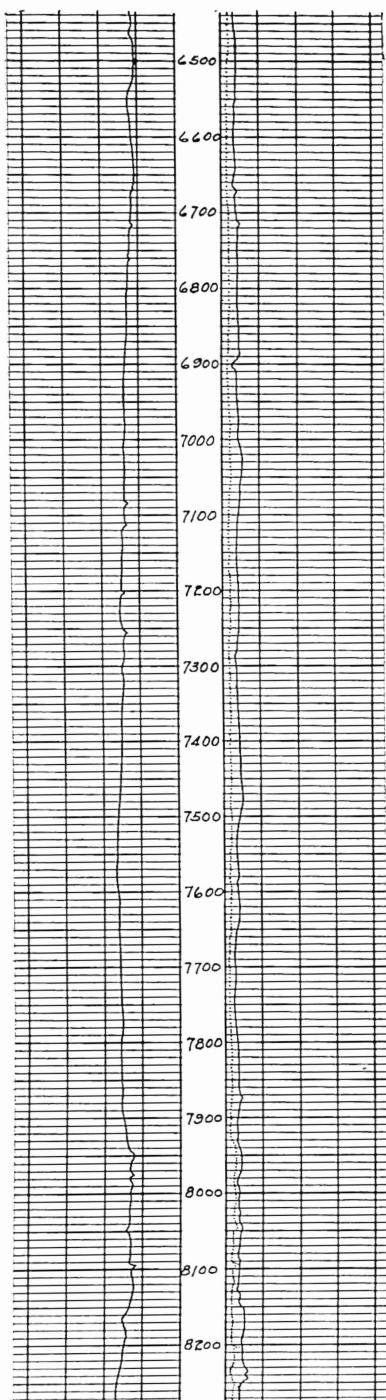


Fig. 4. Electric log of Peninsular Oil and Refining Company's J. W. Cory No. 1.



Total Depth: 9965'
Driller's T.D.: 10006'

[55]

Plate 1

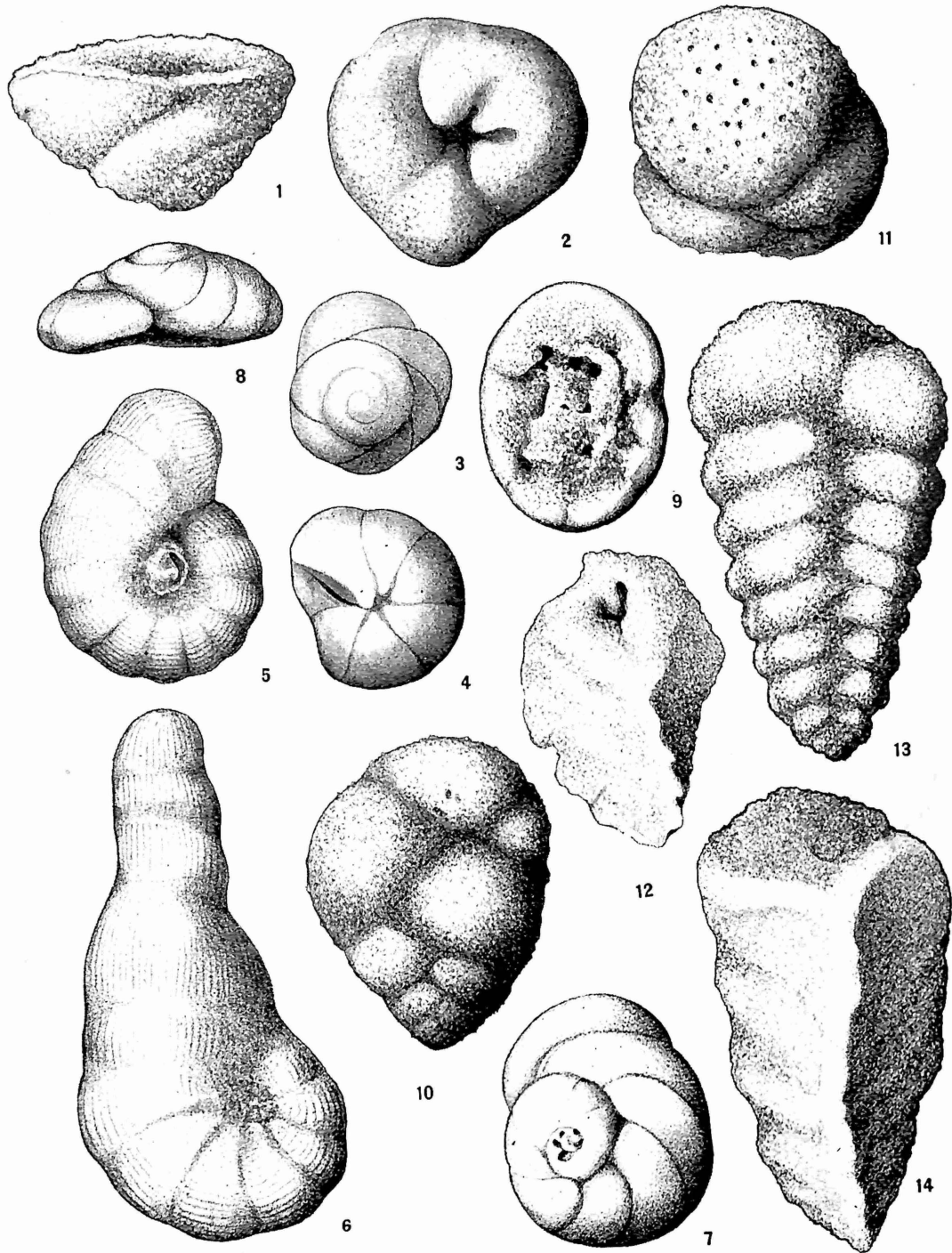
Figures 1-4, 7-9, of specimens from the Carpenters Home well; 1, 2, 7-9, at a depth of 390-395 feet; 3, 4, at a depth of 250-258 feet.

Figures 5, 6, 10-14, of specimens from the Cory well; 5, 6, at a depth of 1440-1450 feet; 10-14, at a depth of 1360-1370 feet.

All figures, X35, except figures 7-9 which are X15.

Figure

- 1, 2. *Valvulina floridana* Cole, n. sp.; 1, front view of a paratype (F.S.G.S. No. S-1582A); 2, apertural view of holotype (F.S.G.S. No. S-1582).
- 3, 4. *Eponides jacksonensis* (Cushman and Applin); 3, dorsal view; 4, ventral view.
- 5, 6. *Spirolina coryensis* Cole, n. sp.; 5, side view of a young specimen; 6, side view of the holotype (F.S.G.S. No. S-1541).
- 7, 8, 9. *Discorinopsis gunteri* Cole, n. gen. and n. sp.; all figures of holotype (F.S.G.S. No. S-1581); 7, dorsal view; 8, side view; 9, ventral view.
- 10, 11. *Pseudochrysalidina floridana* Cole, n. gen. and n. sp.; 10, front view of holotype (F.S.G.S. No. S-1538); 11, apertural view of paratype (F.S.G.S. No. S-1538A).
12. *Valvulina martii* Cushman and Bermudez; front view.
13. *Textularia coryensis* Cole n. sp.; front view of holotype (F.S.G.S. No. S-1533).
14. *Verneuilina* sp.; front view.



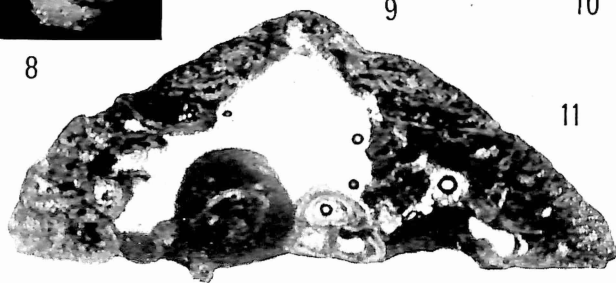
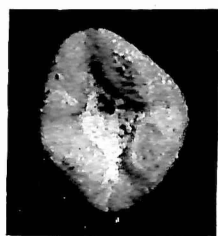
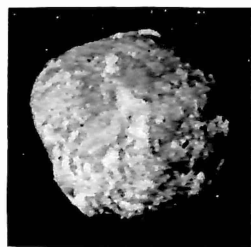
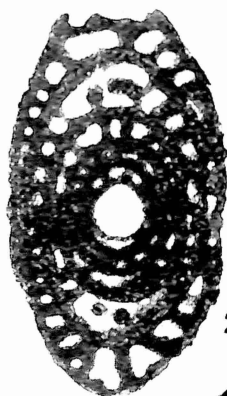
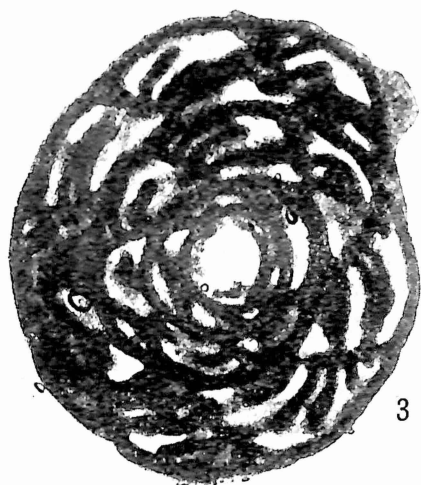


Plate 2

Figures 1-3, of specimens from the Dundee Petroleum Company well (W-3) at a depth of 2270 feet.

Figure 4, of a specimen from the Cory well at a depth of 1360-1370 feet.

Figures 5-11, of specimens from the Carpenters Home well at a depth of 390-395 feet.

Figures 1, 5-10, X15.

Figures 2-4, 11, X40.5.

Figure

- 1-3. *Borelis gunteri* Cole, n. sp.; 1, side view of exterior of holotype (F.S.G.S. No. S-2825); 2, transverse section of paratype (F.S.G.S. No. S-2825A); 3, medium section of paratype (F.S.G.S. No. S-2825B).
4. *Pseudochrysalidina floridana* Cole, n. gen. and n. sp.; section to show internal relationships.
- 5-11. *Pseudorbitolina cubensis* Cushman and Bermudez; 5-10, external views; 5, 6, side view; 7-9, apical view (note: three initial chambers show on specimens figured as 8 and 9); 10, ventral view; 11, vertical section.

Plate 3

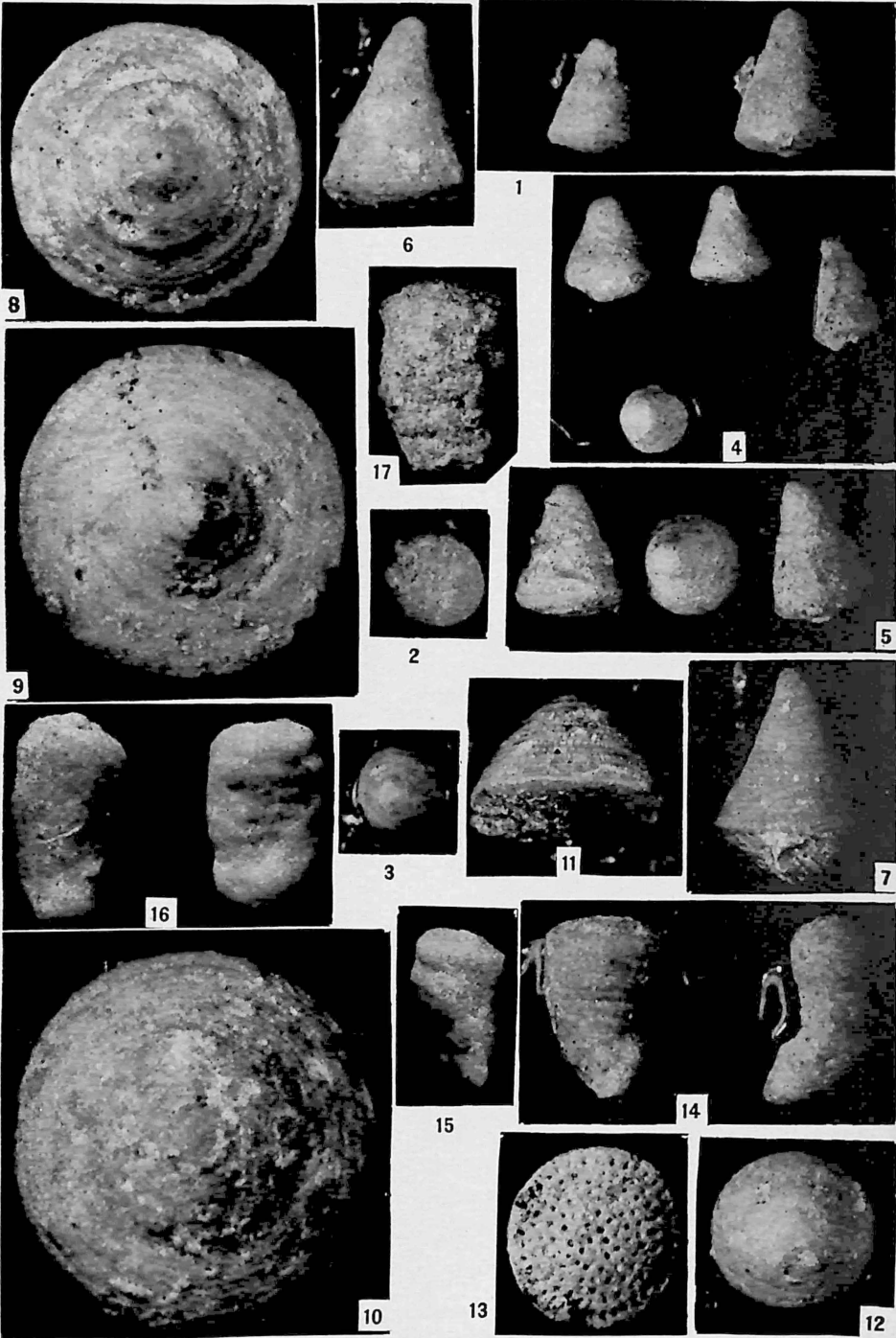
Figures 1-3, 6-15, 17, of specimens from the Cory well; 1-3, at a depth of 1500-1510 feet; 6, 7, 14, 15, at a depth of 1700-1710 feet; 8, 9, at a depth of 2050-2060 feet; 10, at a depth of 2090-2100 feet; 11-13, 17, at a depth of 1360-1370 feet.

Figures 4, 5, 16, of specimens from the Carpenters Home well; 4, 5, at a depth of 419-444 feet; 16, at a depth of 520-530 feet.

All figures, X15.

Figure

- 1-7. *Coskinolina floridana* Cole, n. sp.; external views; 1-3 cotypes (F.S.G.S. No. S-1543).
- 8-10. *Dictyoconus gunteri* Moberg; external views.
- 11-13. *Dictyoconus cookei* (Moberg); external views; 11, side view; 12, apical view; 13, basal view.
- 14-17. *Lituonella floridana* Cole, n. sp.; external views; 16, a cotype (F.S.G.S. No. S-1590).



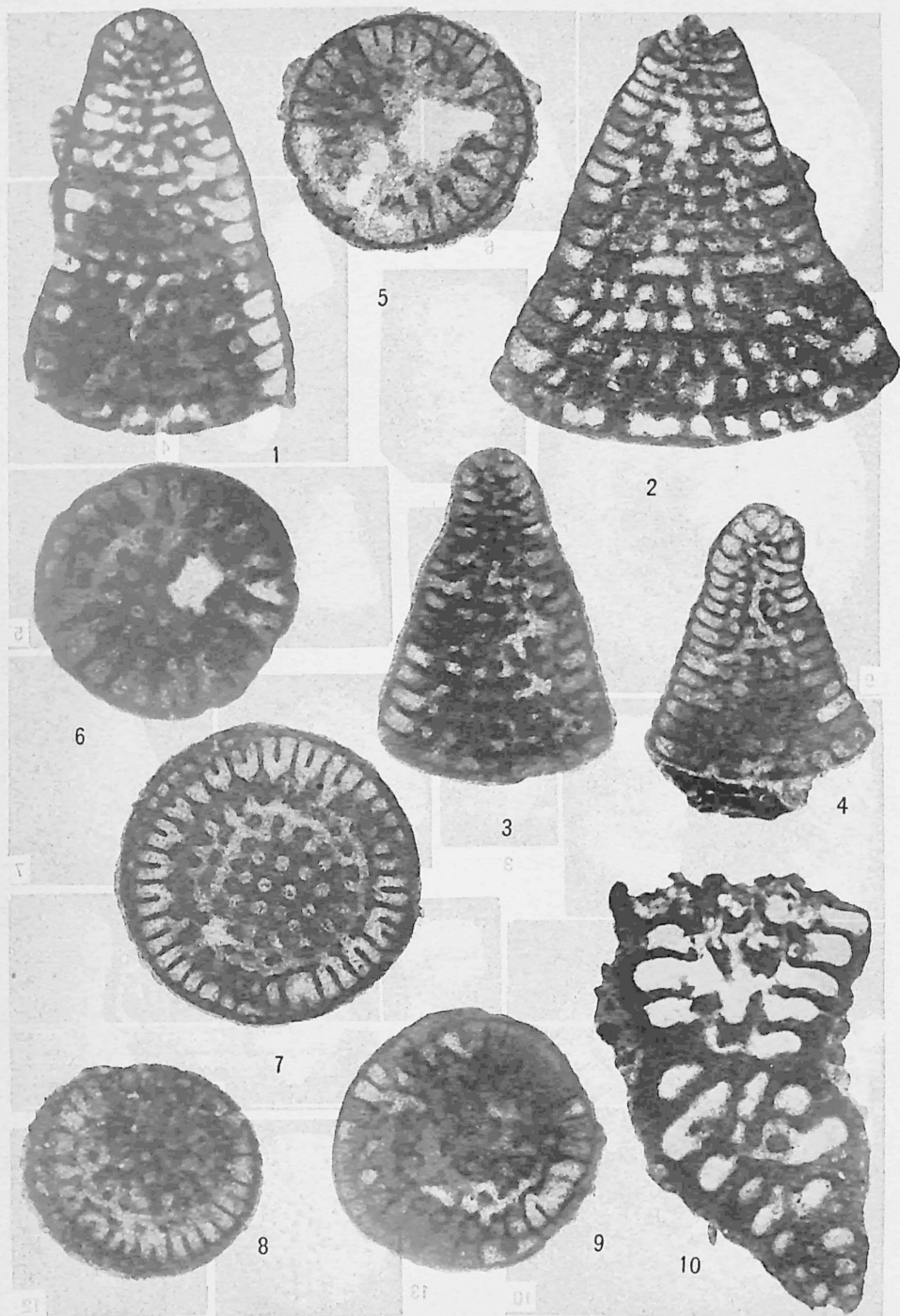


Plate 4

Figures 1, 2, 4-7, 9, 10, of specimens from the Cory well; 1, 6, 7, 10, at a depth of 1700-1710 feet; 2, at a depth of 1140-1150 feet; 4, 5, 9, at a depth of 1500-1510 feet.

Figures 3, 8, of specimens from the Carpenters Home well at a depth of 419-444 feet.

All figures, X40.5.

Figure

- 1-9. *Coskinolina floridana* Cole, n. sp.; 1-4, axial sections; 5-9, horizontal sections; 4 (F.S.G.S. No. S-1543D); 5 (F.S.G.S. No. S-1543C); 9 (F.S.G.S. No. S-1543B).
10. *Lituonella floridana* Cole, n. sp.; axial section of a microspheric individual.

Plate 5

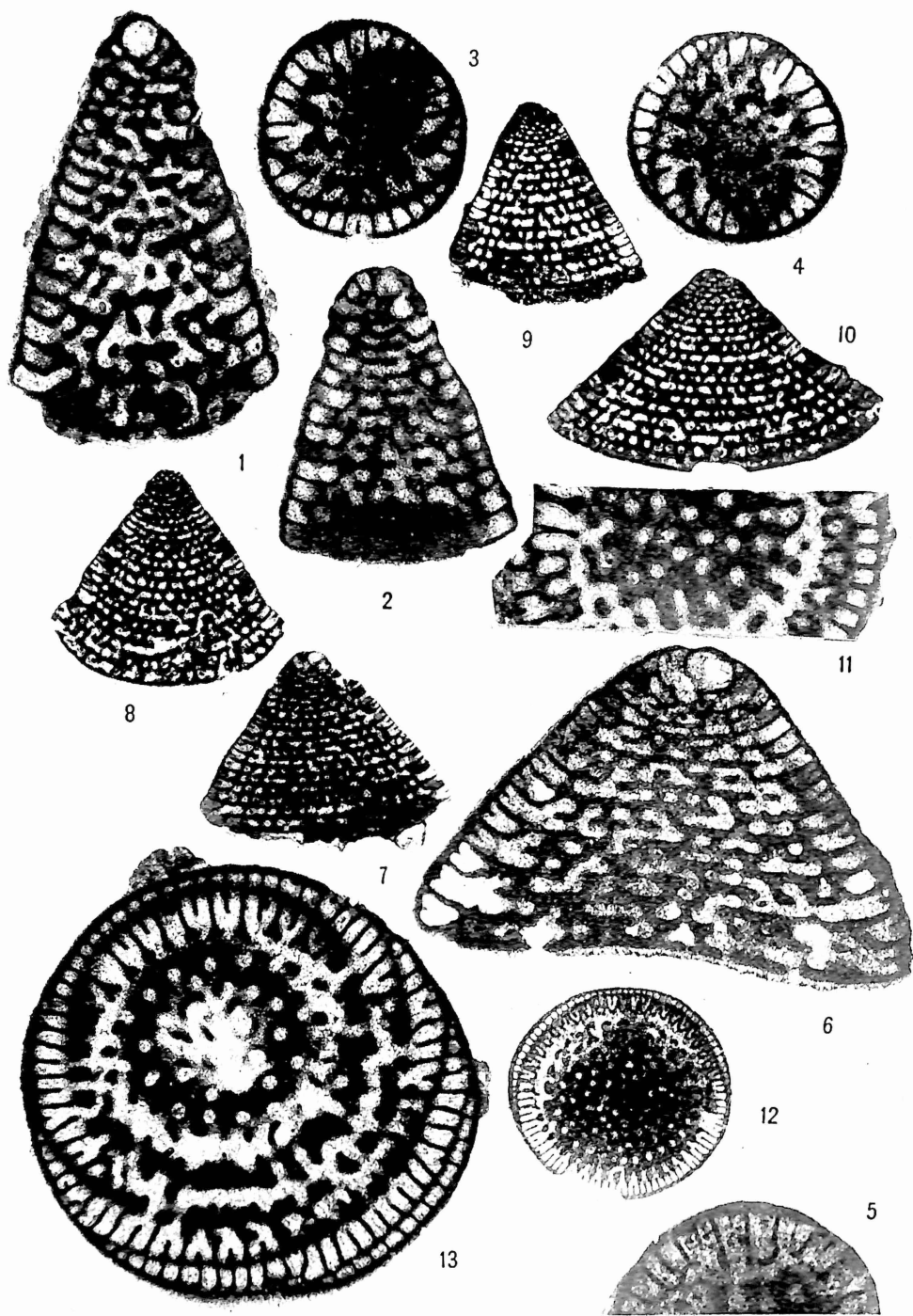
Figures 1-8, 10, 12, 13, of specimens from the Carpenters Home well; 1-4, 8, 13, at a depth of 444-465 feet; 5, 7, 12, at a depth of 409-413 feet; 6, 10, at a depth of 419-444 feet.

Figures 9, 11, of specimens from the Cory well; 9, at a depth of 1350-1360 feet; 11, at a depth of 1140-1150 feet.

Figures 1-6, 8, 11, 13, X40.5.

Figures 7, 9, 10, 12, X15.

- Figure
1-5, 11. *Coskinolina floridana* Cole, n. sp.; 1, 2, axial sections; 3, 4, 11, horizontal sections.
- 6-10, 12, 13. *Dictyoconus cookei* (Moberg); 6-10, axial sections; 10, microspheric form; 12, 13, horizontal sections.



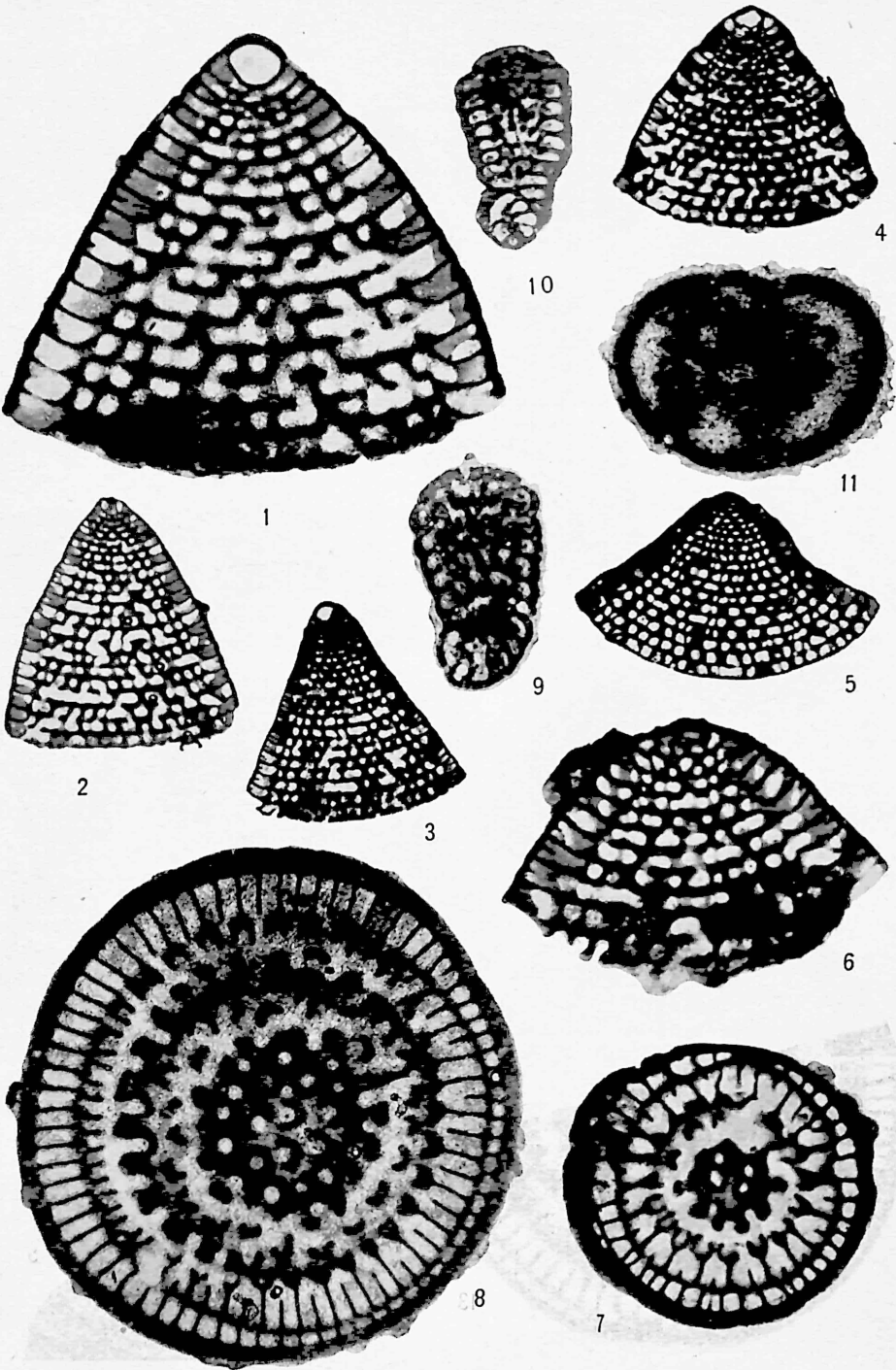


Plate 6

Figures 1-8, 10, of specimens from the Cory well; 1-8, at a depth of 1360-1370 feet; 10, at a depth of 1700-1710 feet.

Figures 9, 11, of specimens from the Carpenters Home well at a depth of 520-530 feet.

Figures 1, 6, 8, 11, X40.5.

Figures 2-5, 7, 9, 10, X15.

Figure

- 1-8. *Dictyoconus cookei* (Moberg); 1-6, axial sections; 5, microspheric individual; 7, 8, horizontal sections.
- 9-11. *Lituonella floridana* Cole, n. sp.; 9, 10, axial sections; 11, horizontal sections; 9, paratype (F.S.G.S. No. S-1590A); 11, paratype (F.S.G.S. No. S-1590B).

Plate 7

Figures 1, 7, of specimens from the north foot of Mt. Puilboreau, Haiti. Topotypes, presented to the writer by Dr. T. Wayland Vaughan; collection of W. S. Cole.

Figures 2, 3, 5, of specimens from the Cory well; 2, at a depth of 2710-2720 feet; 3, 5, at a depth of 2090-2100 feet.

Figures 4, 6, 8, of specimens from the Marathon well (W-2) at a depth of 2000 feet; collection of W. S. Cole.

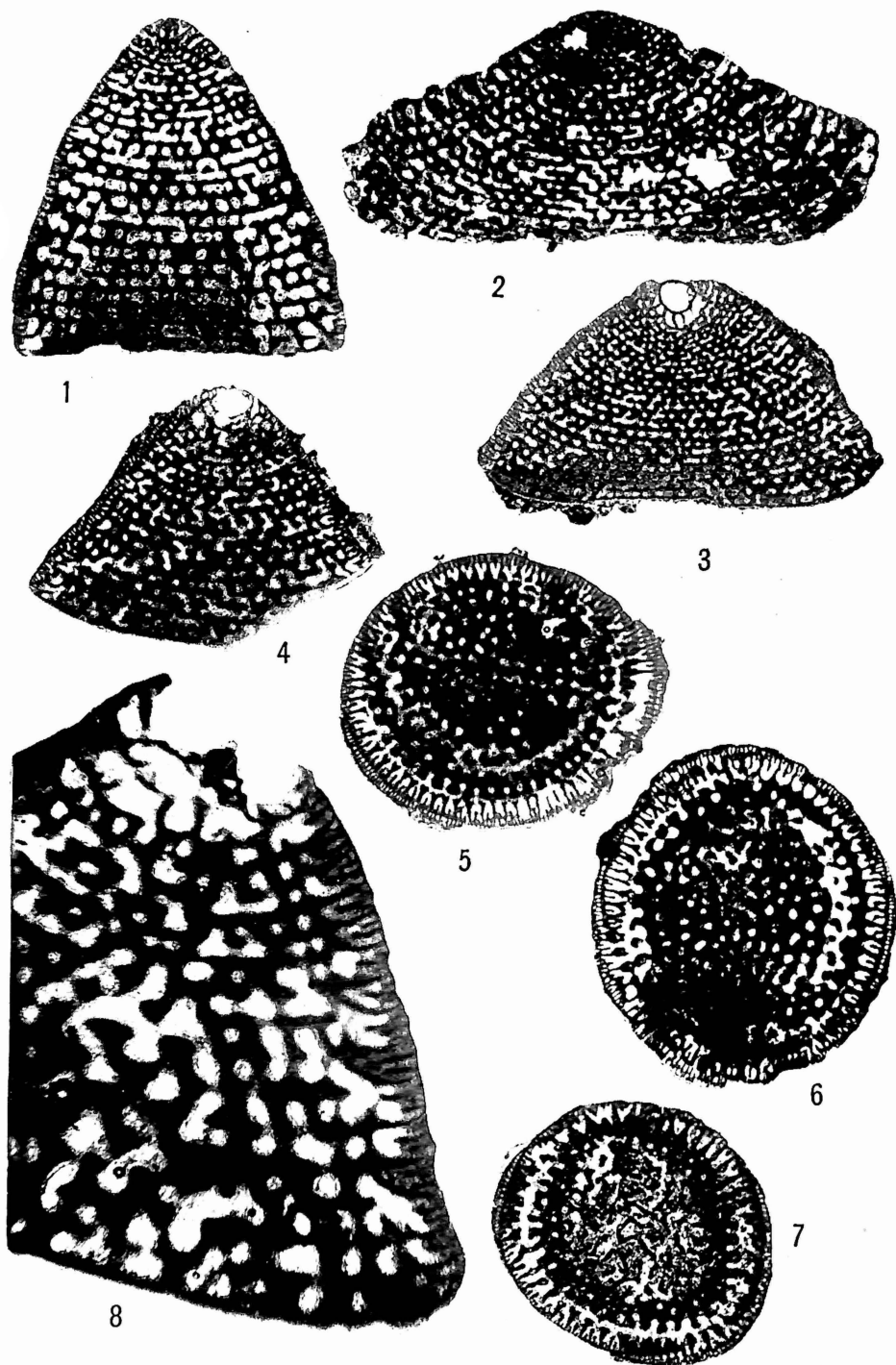
Figures 1-7, X15.

Figure 8, X40.5.

Figure

1, 7. *Dictyoconus codon* Woodring; 1, axial section; 7, horizontal section. These sections are introduced for comparison with *D. gunteri* Moberg.

2-6, 8. *Dictyoconus gunteri* Moberg; 2-4, 8, axial sections; 5, 6, horizontal sections.



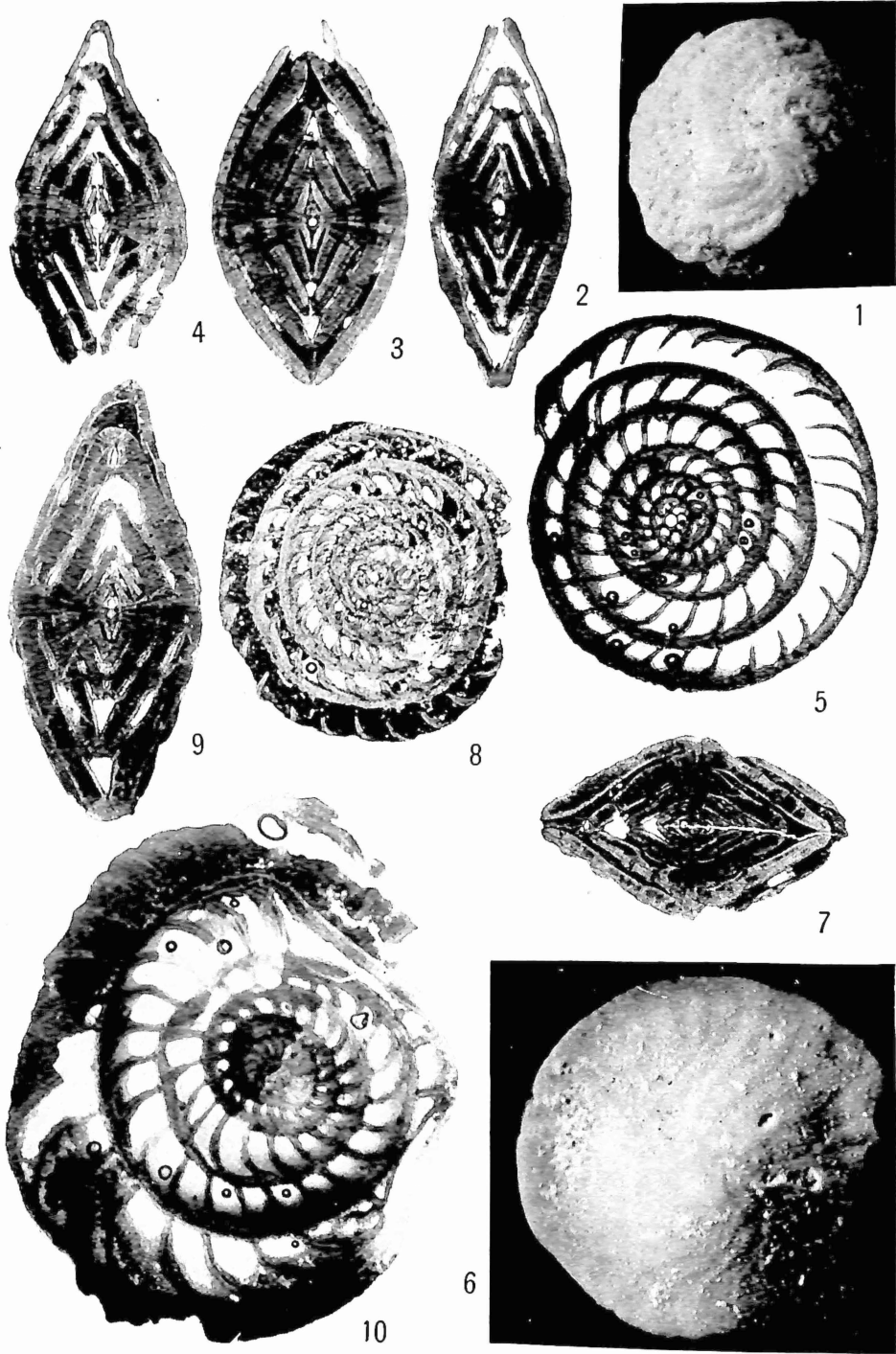


Plate 8

Figure 1, of a specimen from the Cory well at a depth of 790-800 feet.

Figures 2-10, of specimens from the Carpenters Home well; 2-6, at a depth of 258-265 feet; 7-10, at a depth of 250-258 feet.

All figures, X15.

Figure

1. *Archaias floridanus* (Conrad); external view of slightly eroded specimen.
- 2-6. *Camerina vanderstoki* (Rutten and Vermunt); 2-4, transverse sections; 5, median section; 6, external view.
- 7-10. *Camerina* probably *C. vanderstoki* (Rutten and Vermunt); 8, 10, median sections; 7, 9, transverse sections.

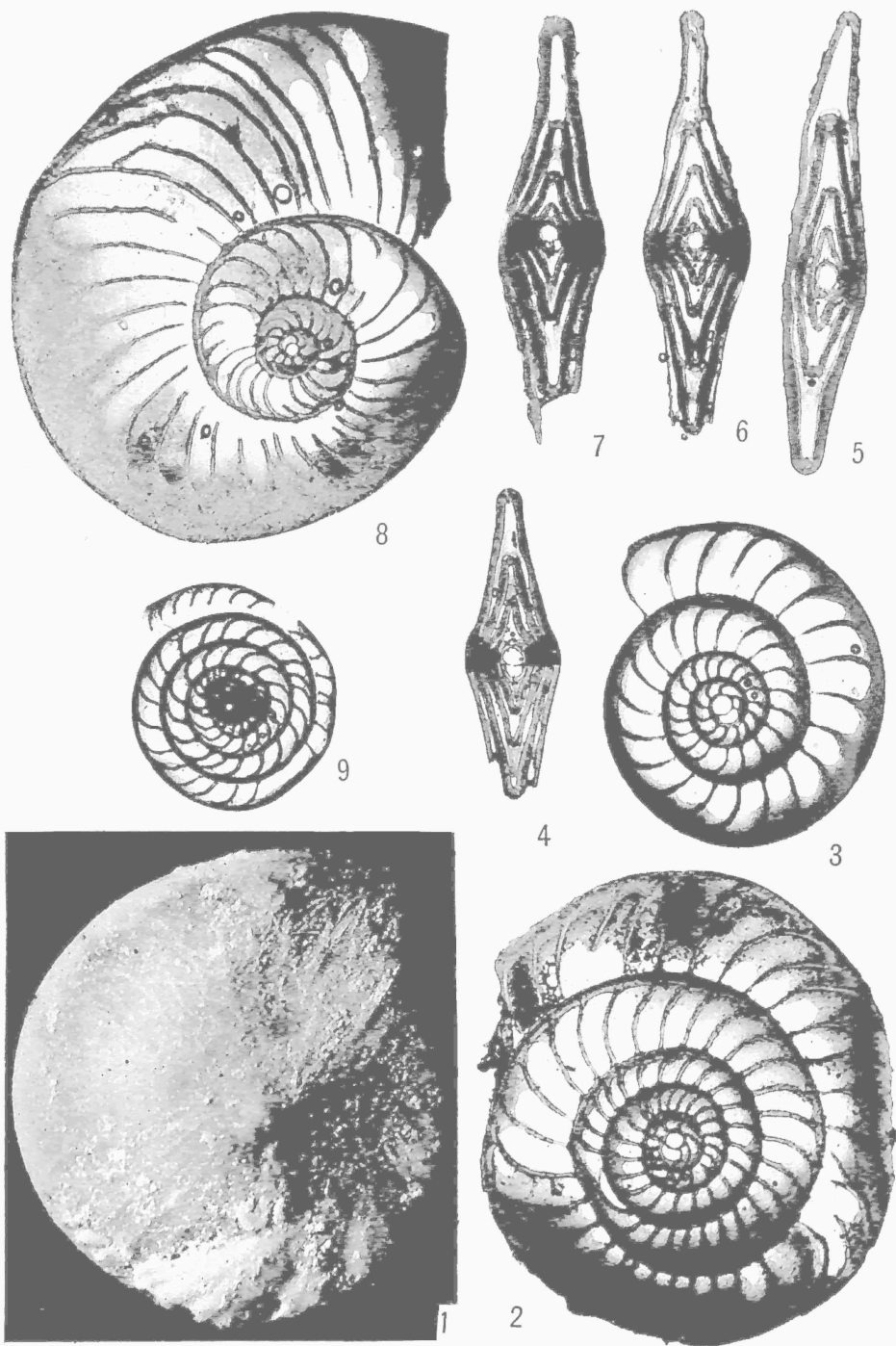
Plate 9

All specimens from the Carpenters Home well; 1-7, 9, at a depth of 300-320 feet; 8, at a depth of 250-258 feet.

All figures, X15.

Figure

- 1-7. *Operculinoides willcoxii* (Heilprin); 1, external view; 2, median section of an adult specimen; 3, median section of a young specimen; 4-7, transverse sections.
8. *Operculinoides floridensis* (Heilprin); median section.
9. *Camerina moodybranchensis* Gravell and Hanna; median section.



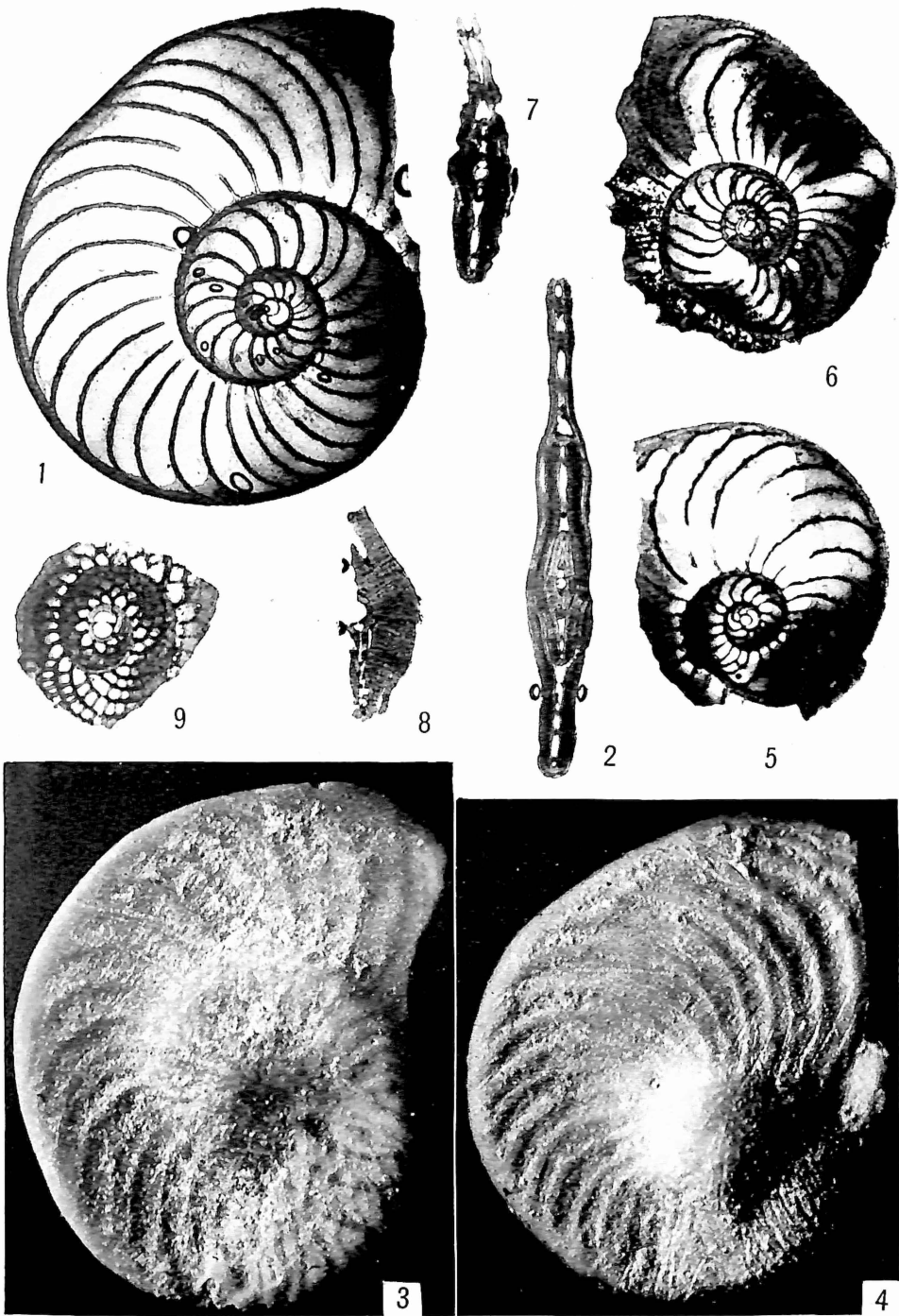


Plate 10

Figures 1-7, specimens from the Carpenters Home well at a depth of 250-258 feet.

Figures 8, 9, specimens from the Cory well at a depth of 1100-1110 feet.

All figures, X15.

Figure

- 1-3. *Operculinoides floridensis* (Heilprin); 1, median section; 2, transverse section; 3, external view.
- 4-7. *Operculinoides ocalanus* (Cushman); 4, external view; 5, 6, median sections; 7, transverse section.
- 8, 9. *Heterostegina texana* Gravell and Hanna; 8, portion of a transverse section; 9, median section, showing embryonic chambers and initial coils.

Plate 11

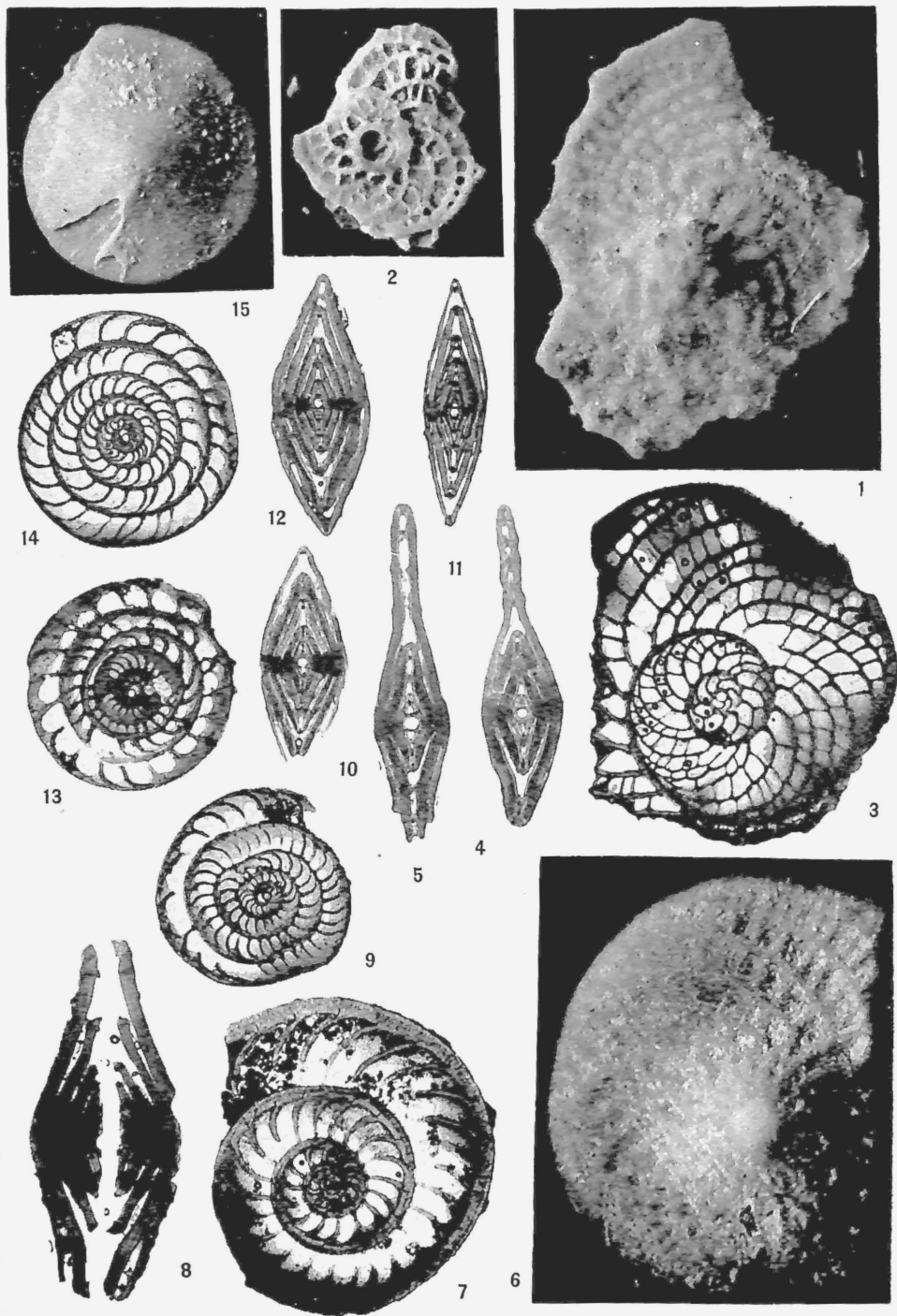
Figures 1, 2, 7, 8, of specimens from the Cory well; 1, 2, at a depth of 1100-1110 feet; 7, 8, at a depth of 1250-1260 feet.

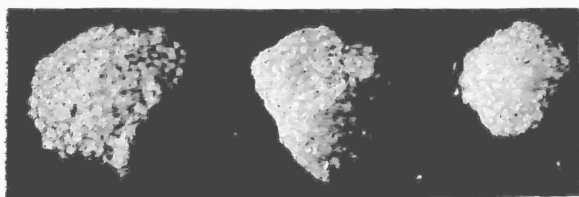
Figures 3-6, 9-15, of specimens from the Carpenters Home well at a depth of 300-320 feet.

Figures 1-15, X15.

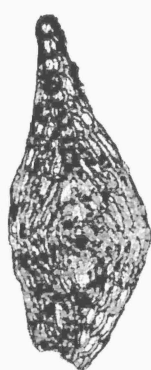
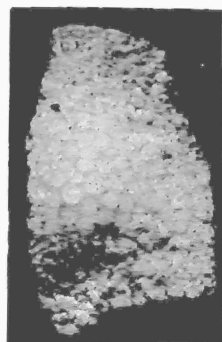
Figure

- 1, 2. *Heterostegina texana* Gravel and Hanna; 1, external view; 2, natural section showing embryonic chambers and the division of the chambers into chamberlets.
- 3-6. *Heterostegina ocalana* Cushman; 3, median section; 4, 5, transverse sections; 6, external view.
- 7, 8. *Operculinoides curasvicus* (Rutten and Vermunt); 7, median section; 8, transverse section.
- 9-15. *Camerina moodybranchensis* Gravel and Hanna; 9, 13, 14, median sections; 10-12, transverse sections; 15, external view.





3



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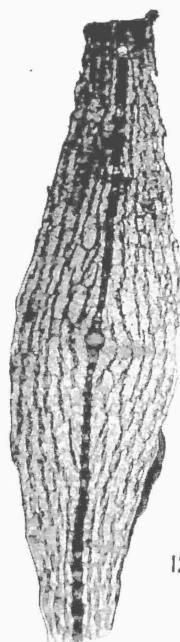
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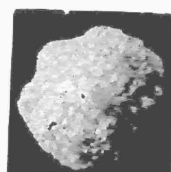
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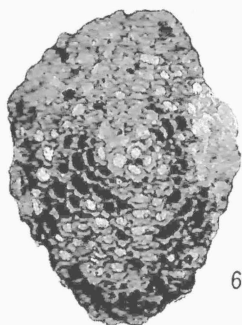
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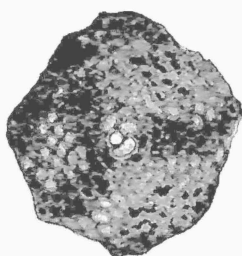
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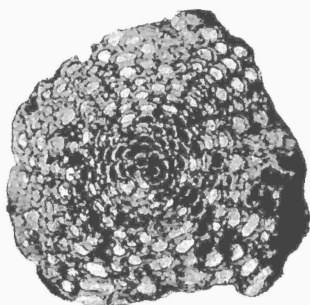
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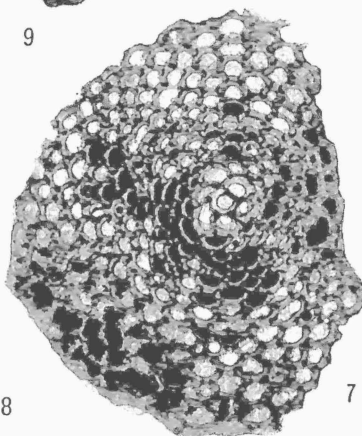
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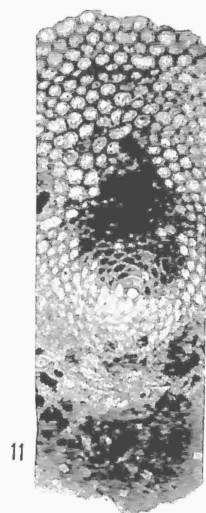
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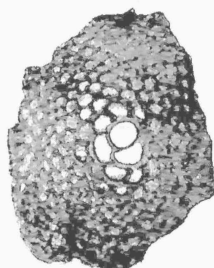
8



7



11



10

Plate 12

Figures 1-8, of specimens from the Cory well at a depth of 5790-5800 feet.

Figures 9-11, 13-14, of specimens from the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) near Cedar Keys at a depth of 2807 feet; figure 12, a specimen at a depth of 2840-50 feet.

Figures 1-3, X15.

Figures 4-14, X40.5.

Figure

1-8. *Lepidorbitoides (Lepidorbitoides) nortoni* (Vaughan); 1-3, external views; 4, 5, vertical sections; 6-8, equatorial sections; 6, 7, megalospheric individuals; 8, microspheric individual.

9-14. *Lepidorbitoides (Lepidorbitoides) planasi* M. G. Rutten; 9-11, equatorial sections; 12-14, vertical sections.

Plate 13

All specimens from the Carpenters Home well; 1, 3, at a depth of 290-300 feet; 2, 4, 6, 7, at a depth of 258-265 feet; 5, at a depth of 250-258 feet.

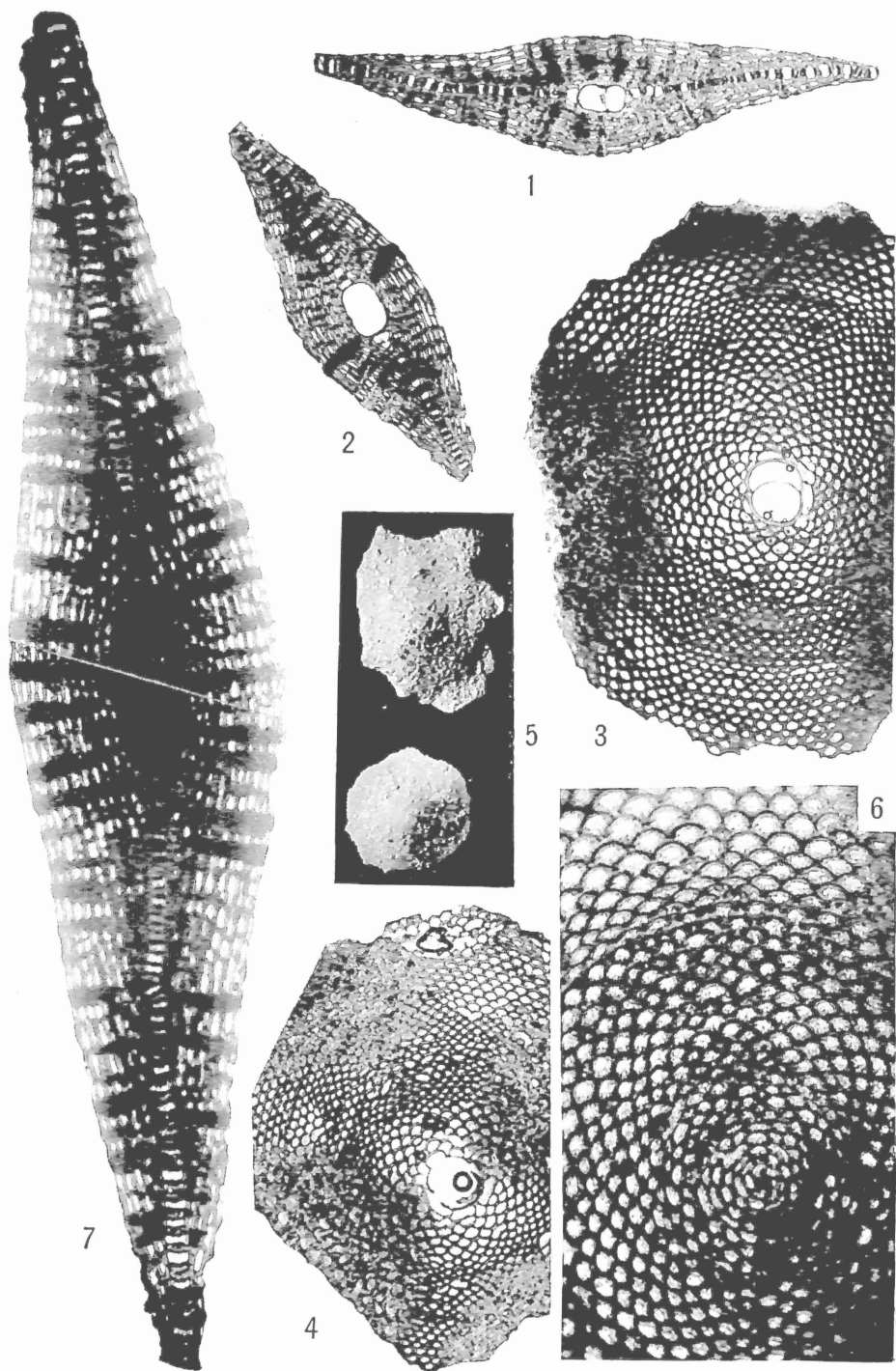
Figures 1-4, 7, X15.

Figure 5, X5.

Figure 6, X40.5.

Figure

- 1-7. *Lepidocyclina (Lepidocyclina) ocalana* Cushman; 1, 2, vertical sections, illustrating different degrees of inflation of the test of megalospheric individuals; 3, 4, equatorial sections of megalospheric individuals; 5, external views; 6, equatorial section of a microspheric individual, illustrating the initial coil and shape of the equatorial chambers; 7, vertical section of a microspheric individual.



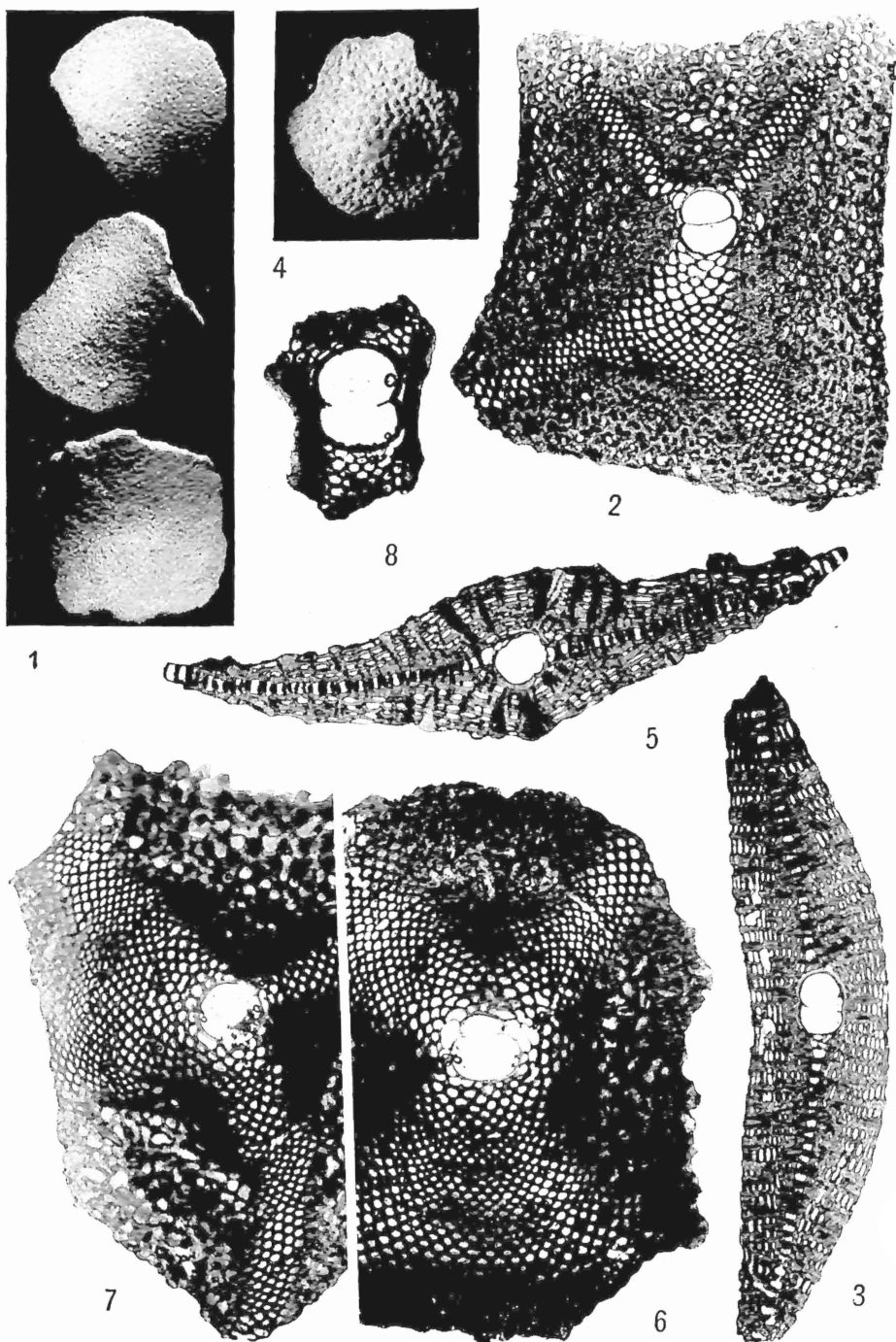


Plate 14

Figures 1-7, specimens from the Carpenters Home well; 1-3, at a depth of 290-300 feet; 4-7 at a depth of 265-290 feet.

Figure 8, a specimen from the Cory well at a depth of 1260-1270 feet.

Figures 1, 4, X5.

Figures 2, 3, 5-8, X15.

Figure

- 1-3. *Lepidocyclina (Lepidocyclina) ocalana* Cushman, variety *floridana* Cushman; 1, external views of three specimens showing sellaeform character of the tests; 2, equatorial section; 3, vertical section.
- 4-7. *Lepidocyclina (Lepidocyclina) ocalana* Cushman, variety *pseudomarginata* Cushman; 4, external view, showing strong papillae which are especially well developed on the umbo; 5, vertical section; 6, 7, equatorial sections.
8. *Lepidocyclina (Lepidocyclina) tschoppi* Thiadens; equatorial section, showing the large embryonic chambers which constitute the greater part of the test and the shape of the equatorial chambers.

Plate 15

Figures 1, 2, 5, 12, of specimens from the Carpenters Home well at a depth of 250-258 feet.

Figures 3, 4, 6-11, 13, 14, of specimens from the Cory well; 3, 4, 14, at a depth of 1220-1230 feet; 6-11, 13, at a depth of 1250-1260 feet.

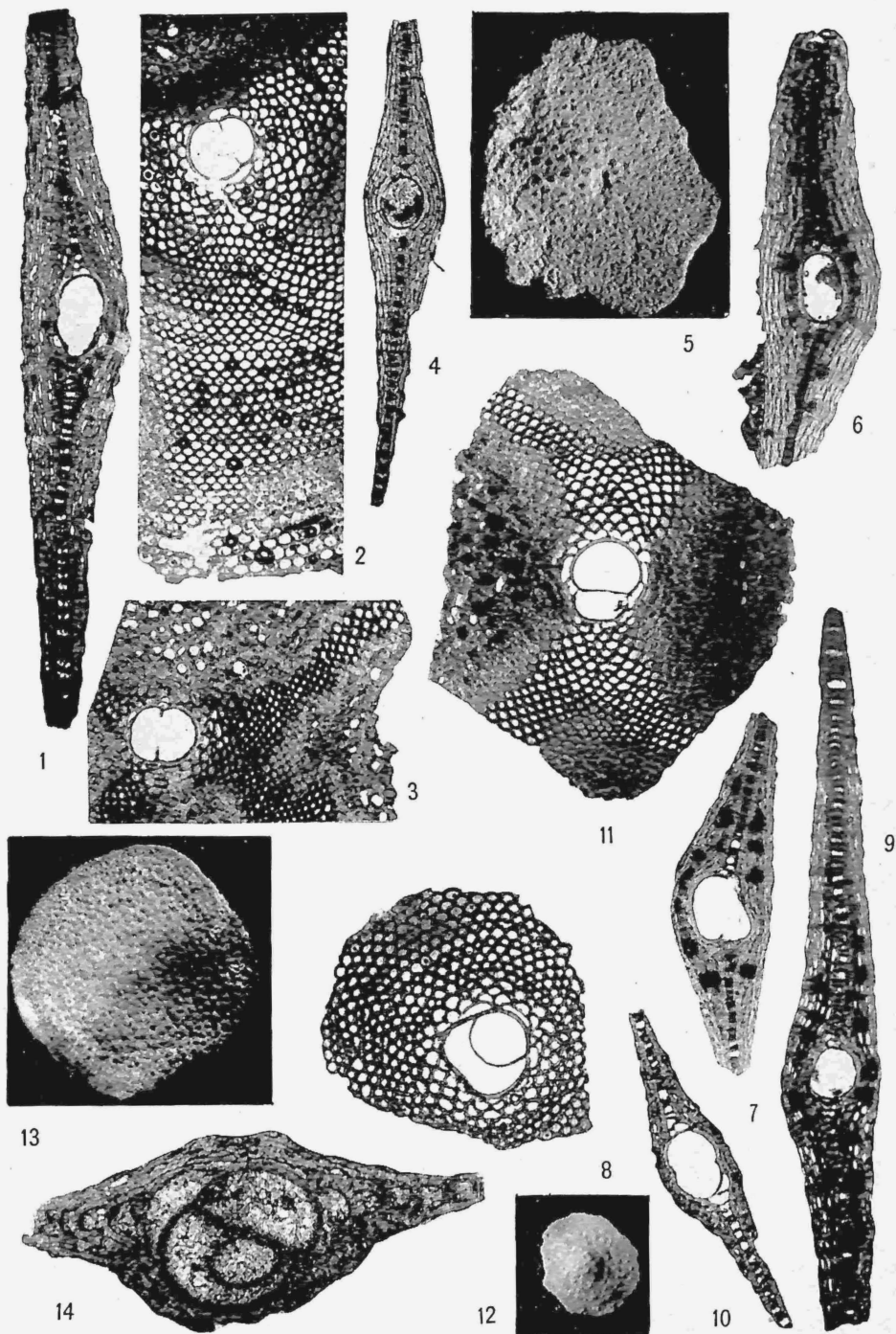
Figures 1-4, 8-11, X15

Figures 5, 12, 13, X5.

Figure 14, X40.5.

Figure

- 1-5. *Lepidocyclina* (*Lepidocyclina*) *ocalana* Cushman, variety *attenuata* Cushman; 1, 4, vertical sections; 2, 3, equatorial sections; 5, external view.
- 6-8. *Lepidocyclina* (*Nephrolepidina*) *semmesi* Vaughan and Cole; 6, 7, vertical sections; 8, equatorial section.
- 9-13. *Lepidocyclina* (*Lepidocyclina*) *mortoni* Cushman; 9, 10, vertical sections; 11, equatorial section; 12, 13, external views.
14. *Lepidocyclina* (*Lepidocyclina*) *tschoppi* Thiadens; vertical section.



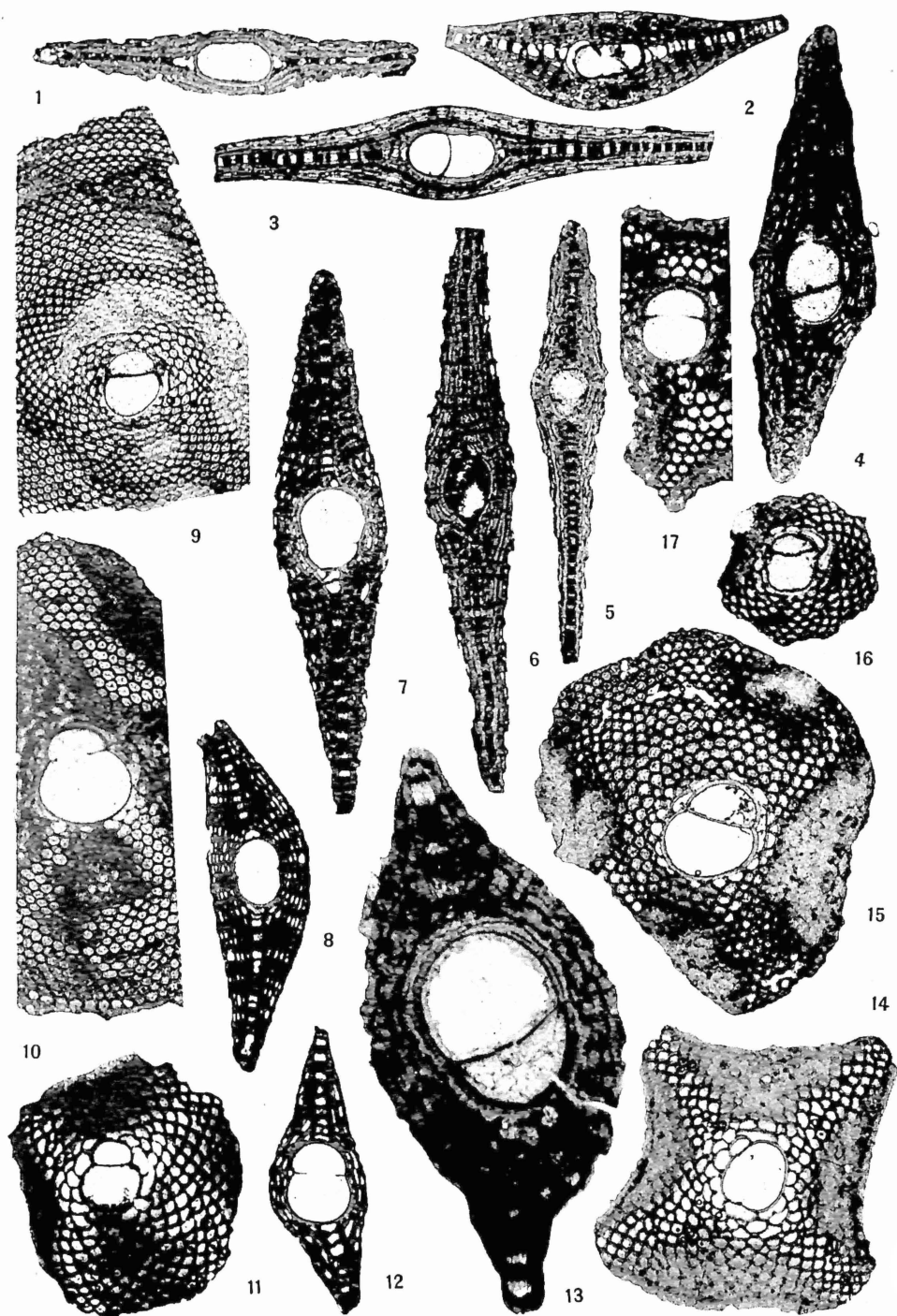


Plate 16

Figures 1-10, 13, 15-17, of specimens from the Cory well; 1, 3-6, 9, 10, 15-17, at a depth of 1220-1230 feet; 2, 8, at a depth of 1270-1280 feet; 7, at a depth of 1250-1260 feet; 13, at a depth of 1260-1270 feet.

Figures 11, 12, 14, of specimens from the Carpenters Home well at a depth of 300-320 feet.

All figures, X15, except figure 13 which is X40.5.

Figure

- 1-4, 6-10, 15. *Lepidocyclina* (*Lepidocyclina*) *ocalana* Cushman; 1-4, 6-8, vertical sections to illustrate variation in the number of lateral chambers which may occur on each side of the equatorial layer; 9, 10, 15, equatorial sections.
5. *Lepidocyclina* (*Lepidocyclina*) *ocalana* Cushman, var. *attenuata* Cushman; vertical section.
- 11, 12, 14. *Lepidocyclina* (*Lepidocyclina*) *mortoni* Cushman; 11, 14, equatorial sections; 12, vertical section.
- 13, 16. *Lepidocyclina* (*Lepidocyclina*) *tschoppi* Thiadens; 13, vertical section; 16, equatorial section.
17. *Lepidocyclina* (*Lepidocyclina*) *ocalana* Cushman, var. *floridana* Cushman; portion of equatorial section to illustrate embryonic apparatus and equatorial chambers.

Plate 17

Figures 1, 2, of specimens from the Cory well; 1, at a depth of 900-910 feet; 2, at a depth of 1000-1010 feet.

Figures 3-5, of specimens from the Marathon well at a depth of 852 feet.

Figures 6, 7, of specimens from the Carpenters Home well; 6, at a depth of 300-320 feet; 7, at a depth of 335-355 feet.

Figures 1, 2, 5-7, X40.5.

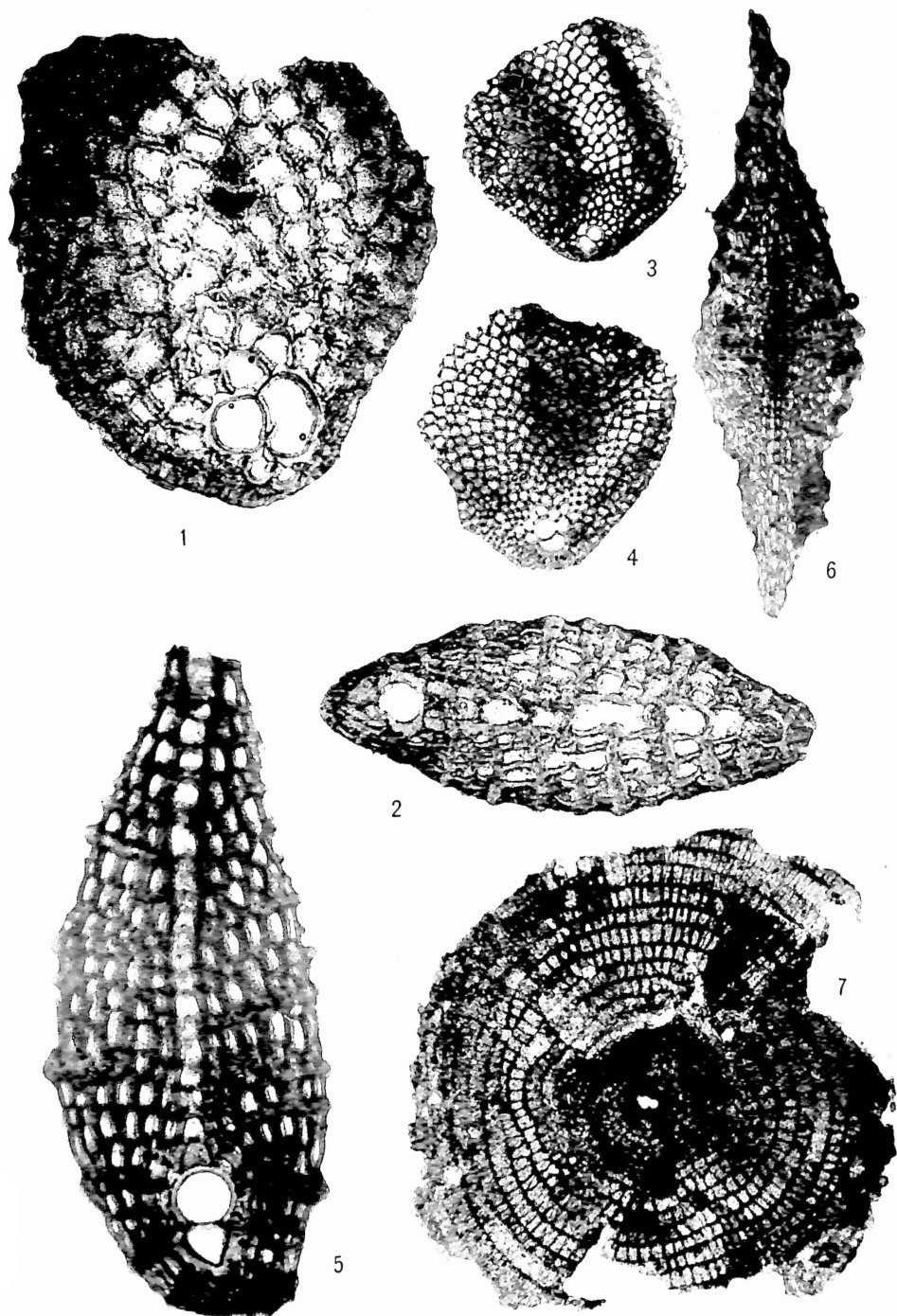
Figures 3, 4, X15.

Figure

1, 2. *Miogypsina (Miogypsina) hawkinsi* Hodson; 1, horizontal section; 2, vertical section.

3-5. *Miogypsina (Miogypsina) cushmani* Vaughan; 3, 4, horizontal sections; 5, vertical section. These are introduced for comparison with *M. hawkinsi* Hodson.

6, 7. *Pseudophragmina (Proporocyclina) citrensis* (Vaughan); 6, vertical section; 7, horizontal section.



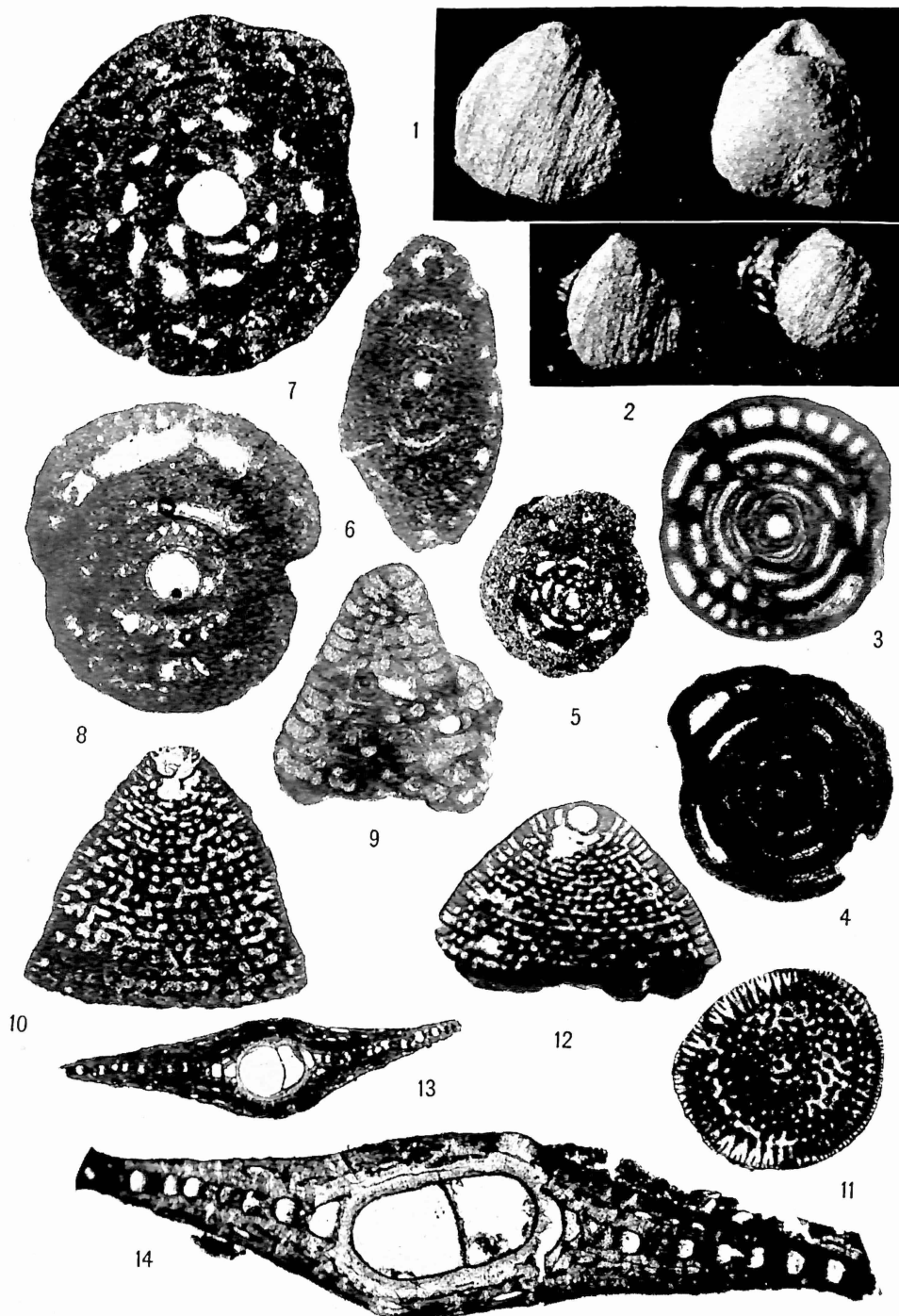


Plate 18

Figures 1, 2, 7-9, 12-14, of specimens from the Cory well; 1, 2, at a depth of 1100-1110 feet; 7, 8, at a depth of 3360-3370 feet; 9, at a depth of 1140-1150 feet; 12, at a depth of 1440-1450 feet; 13, at a depth of 1230-1240 feet; 14, at a depth of 1340-1350 feet.

Figures 3-6, of specimens from the Suwannee Petroleum Corporation's Sholtz No. 1 (W-166) near Cedar Keys at a depth of 2140-2158 feet.

Figures 10, 11, of specimens from about 1 km. below the pass on the north foot of Mt. Puillboreau, presented to the writer by Dr. T. Wayland Vaughan; collection of W. S. Cole.

Figures 1, 2, 5, 10-13, X15.

Figures 3, 4, 6-9, 14, X40.5.

Figure

- 1, 2. *Argyrotheca wegemanni* Cole; external views.
- 3, 4, 7, 8. *Borelis gunteri* Cole, variety *floridana* Cole, n. var.; 4-7 median sections; 3, 8, transverse sections; 3, paratype (F.S.G.S. No. 2826); 4, paratype (F.S.G.S. No. S-2826A).
- 5, 6. *Borelis gunteri* Cole, n. sp.; 5, median section; 6, transverse section.
9. *Coskinolina floridana* Cole, n. sp.; vertical section of a reworked specimen from the Oligocene.
- 10, 11. *Dictyoconus codon* Woodring; 10, vertical section; 11, transverse section. These are introduced for comparison with *D. gunteri* Moberg and *D. cookei* (Moberg).
12. *Dictyoconus cookei* (Moberg); vertical section of a megalospheric individual.
- 13, 14. *Lepidocyclina* (*Lepidocyclina*) *mortoni* Cushman; vertical sections.

