

## Late Middle Eocene

## AVON PARK LIMESTONE

*Introduction:* The term Avon Park limestone was applied by the Applins (1944, pp. 1680, 1686) to the upper part of the late middle Eocene in Florida, and Florida Geological Survey well No. W-668, samples from 600 to 930 feet, was selected as the type well. The limestone in this well, located at Avon Park Bombing Range in Polk County, is a cream-colored, chalky limestone that contains a distinct microfauna.

The lithology and fauna of the Avon Park limestone is known from a detailed study of surface outcrops and samples taken from several hundred wells. The formation is exposed in Citrus and Levy counties and extends into the subsurface throughout all of peninsular Florida, except for an area in Columbia and Suwannee counties where it is absent (Applin, 1944, p. 1687). In the Tallahassee area the formation lies upon the Tallahassee limestone, and these two formations are considered to be the equivalent of the Yegua formation of the western Gulf Coast by the Applins (1944, p. 1687).

In northern peninsular Florida, the Avon Park limestone lies upon the Applins' non-fossiliferous limestone, which may be a dolomitized part of the Lake City limestone in which fossils have been destroyed. Elsewhere in the Peninsula, where the Lake City limestone is not dolomitized, the formation definitely rests, possibly unconformably, upon the Lake City limestone.

*Definition:* During the study of Levy and Citrus counties the writer became familiar with the general lithology of the Avon Park limestone through intensified studies of exposures in the counties and samples of well cuttings and cores taken from adjacent counties. As used in this report the Avon Park limestone is a series of pasty to fragmental, marine carbonate beds, containing a distinct fauna and considerable amounts of peat, lignite and plant remains. The formation lies unconformably between the Lake City limestone and the Moody Branch formation.

*Physiography and Outcrop Pattern:* The Avon Park limestone is the oldest rock cropping out in Florida. The formation is exposed along the crest of the Ocala uplift where the fold has been breached by marine planation and stream excavation. Two large irregular shaped outcrops are present in central and southeastern Levy County, the last extending into Citrus County along the Withlacoochee River Valley, see Plate 1. Because the outcrop is located upon the crest of the Ocala uplift the Avon Park limestone is extended both up and down stream valleys along



opposite flanks of the fold. The outcrop in central Levy County has a dendritic pattern in part, but the southeastern outcrop is more regular and uniform, except where it is drawn out into parallel bands along small normal faults.

Small irregular outcrops are present along the Withlacoochee River Valley at the Florida Power Corporation dam in sections 7, 8, and 17, Township 17 South, Range 17 East, and in the same Township in Section 19.

The Avon Park limestone composes a portion of the limestone shelf of the Pamlico surface, and where it crops out it floors the hammocks of the area. Much of the southeastern Levy County outcrop, and the two most westerly outcrops in Citrus County are thinly veneered by sands of the Pamlico and Wicomico formations and exposures are present in sinks, along river valleys and as pinnacles extending through the sand. The formation in eastern Citrus County is known only from well penetrations and quarry excavations, elsewhere it is covered by a thick section of sand and clay of the Coharie, Okefenokee, and Alachua formations, which form the Coharie-Okefenokee Sand Ridge.

*General Lithology:* The Avon Park limestone is composed of several lithologies having in common a distinct and prolific fauna and a high content of lignitic and other carbonaceous plant residues. Three general lithologic types, all carbonates, are present in Citrus and Levy counties in exposures and well penetrations of the formation. These are:

- (1) Cream to brown, highly fossiliferous, miliolid rich, marine, fragmental to pasty limestone that weathers cream to white and purple-tinted. The bed contains abundant specimens of mollusks, foraminifers and corals. In its porosity and fauna it resembles a reef, and grades laterally and vertically through a tan to brown, dense, brittle, thin lithographic limestone; a four- to six-inch "*fucoid-Cerithium*" fragmental dolomite; an irregular lens of lignite and a Foraminifera-filled dolomite-clay into the other rock types, see locality L-118, pages 108 to 110.
- (2) Cream to brown, pasty and fragmental, peat-flecked and seamed, very fossiliferous, marine limestone, not exposed. This bed is extremely rich in well-preserved bryozoa, foraminifers and ostracods, and the fauna is concentrated and somewhat deformed along thin beds that are interbedded with peat and more barren pasty limestone seams to give the rock a laminated and mottled appearance, to which the term "molasses and butter" has been applied by some geologists.
- (3) Tan to brown, thin-bedded and laminated, very finely crystalline marine dolomite. Molds of characteristic Avon Park foraminifers are common. The dolomite is composed of euhedral, silt-sized, crystals of dolomite interbedded with layers of lignite and carbonaceous plant remains, each



layer being commonly 1/16 to 1/4 inch in thickness. The structure of the rock resembles varves and the poor consolidation and grain size cause the rock to resemble siltstones.

The formation has been dolomitized since deposition and any of the general types may be irregularly or completely dolomitized, although the original structures and composition of the rock have been preserved commonly.

*Thickness:* No exposure of the complete section of the Avon Park limestone is present in the counties, but wells penetrate 200 to 300 feet of sediments that are assigned to the formation. It is thinned from west to east in the counties, but thickens again in Marion County. The thinnest portion is located over the crest of the Ocala uplift which indicates that the area was high post middle Eocene, see page 57.

*Fauna and Age:* The fauna of the Avon Park limestone ranges from a shallow-water marine beach to only slightly deeper marine facies. The environment favorable for such deposits are shallow coastal bays, beaches, and marine shelves where almost no clastic material was being deposited. In some wells and exposures the entire formation is dolomitized and the fauna exists as molds, if it is not absent entirely. Rarely dolomite casts of these molds, particularly of the mollusks, are present, and the foraminifers are commonly preserved in the dolomite as internal skeletal-like dolomite molds.

No detailed paleographic maps of the Avon Park limestone have been prepared but in general a beach area, represented by abundant echinoids, principally specimens of *Peronella dalli*, occurs in Polk County, where the Avon Park limestone appears to be transitional into the overlying Jackson beds. Encircling Polk County, and including most of Citrus and Levy counties, the limestone is a shallow-water marine deposit made of a coquina of specimens of *Dictyoconus*, *Coskinolina*, *Lituanella*, *Spirolina*, other foraminifers, ostracods, corals, bryozoa and mollusks contained in a pasty matrix. Most of the species of these organisms are new and undescribed. The laminated dolomite, page 109, appears to have been formed in a partially land-locked shallow marine basin in which seaweed and other marine plants flourished.

The fauna of the Avon Park limestone has been presented in papers by Applin and Applin (1944), Applin and Jordan (1945), Cole (1942, 1944), Cooke (1945), and in addition to these papers Dr. H. V. Howe, Director, School of Geology, Louisiana State University, has prepared a paper on the ostracods from a carbonaceous dolomite, occurring as a clay in the Avon Park limestone, see locality L-118, page 109. He has



described and figured twenty-nine species, all of which are new, and has erected seven new genera. His paper is published in Florida Geological Survey Bulletin 34.

In some of the exposures in Levy and Citrus counties rare specimens of corals and mollusks are preserved but molds are more common. Casts and specimens of these have been collected and their description and identification will appear in a forthcoming bulletin. Dr. H. V. Stenzel, Bureau of Economic Geology, University of Texas, studied some of these macrofossils and his determinations are given under the detailed discussions of exposures in Citrus and Levy counties. Most of these mollusks are new species, but one of the two identifiable species, *Corbis claibornensis* Dall occurs in the Gosport sand and the other, *Clavillithis columbaris* Aldrich, in the Cook Mountain formation of the Gulf Coast section.

Of the microfauna the formation is characterized by a distinct ostracod fauna, pavement-type bryozoa, abundant undescribed algae and the following common foraminifers: *Coskinolina floridana* Cole, *Dictyoconus cookei* (Moberg), *Fabularia vauhani* Cole and Ponton, *Lituonella floridana* Cole, *Spirolina coryensis* Cole, *Cribratulimina cushmani* Applin and Jordan, *Valvulina avonparkensis* Applin and Jordan, *V. martii* Cushman and Bermudez, *Discorinopsis gunteri* Cole, and an undescribed Peneroplid up to 15 millimeters in diameter, that is apparently a new genus and is called Peneroplid sp. "X" in this report.

**Zone "B":** A very prolific and unusual microfauna was penetrated by wells W-1847, W-1202, W-1194, W-1187-8, and W-1186 of Section E-E', figure 14, and has been named zone "B" of the Avon Park limestone. The species composing this fauna are well-preserved and abundant and occur as concentrations in the mottled and laminated limestone, type 2, page 96. In addition to abundant specimens of the species that characterize the Avon Park limestone this zone contains *Textularia coryensis* Cole, *Pliolepidina cedarkeysensis* Cole, *Rotalia avonparkensis* Applin and Jordan, *Dictyoconus?* *gunteri* Moberg, and Peneroplid sp. "X". Specimens of *Dictyoconus?* *gunteri* were identified tentatively by Cole<sup>18</sup> as *D. americanus*. On the basis of this identification and the presence of *Pliolepidina cedarkeysensis* in the bed, Cole thought that zone "B" of the Avon Park limestone was the Lake City limestone. Thin sections of the *Dictyoconus?* are typical of *gunteri* and the presence of *Pliolepidina cedarkeysensis* in

<sup>18</sup>Letter to Mr. Fred N. Ricks, U. S. Engineer Office, Ocala, Florida, dated August 14, 1944 — Report on forams from core holes along the Ship Canal at Dunnellon and Inglis, Florida.



the overlying Moodys Branch formation discount the possibility of these beds being Lake City limestone. The assignment of this zone to the Avon Park limestone is substantiated in the deeper well W-1847 which passes through zone "B" into typical Avon Park limestone that rests upon a lithology and fauna characteristic of the Lake City limestone, see figure 17.

*Stratigraphic Relations:* The Avon Park limestone is separated from older and younger beds by erosional unconformities. The unconformable contact of the formation with the overlying Inglis member of the Moodys Branch formation is exposed at localities L-73, L-94, L-118, and L-139, at which a rubble and pebble bed representing a soil mantle in the base of the Inglis member has been developed across the eroded beds of the Avon Park limestone. The unconformity is exposed at locality L-139, on the Withlacoochee River at the Florida Power Corporation dam, where it cuts across the thin beds of the Avon Park limestone and the soil mantle contains concretions and pebbles eroded out of the underlying beds, see figure 18 and the detailed section on pages 129 to 130.

This unconformity can be traced into the subsurface of these and adjacent counties by well penetrations. The contact is marked by thin sand stringers; peat and sapropel beds; limonite pebbles; the weathered, case-hardened, limonite stained top of the Avon Park limestone that is covered by poorly consolidated limestones of the Inglis member; and by a sharp change from dolomite to limestone, separated by a carbonaceous clay.

The contact of the Avon Park limestone upon the Lake City limestone is also unconformable, and the evidence has been given on page 92.

*Subsurface Characteristics:* To the north of the outcrop area in Taylor and Lafayette counties the Avon Park limestone is a pasty limestone containing abundant "cones" with the base a light-gray purple tinted very pasty limestone containing an abundance of specimens of *Fabularia*, Peneroplid sp. "X" and "cones" including *Dictyoconus? gunteri* Moberg, a characteristic fossil of zone "B" of the formation.

In the Gainesville-High Springs area, Alachua County, the Avon Park appears to be structurally low and is composed of carbonaceous dolomites containing the "cone" molds and is separated from the overlying Moodys Branch formation by a well-developed bed of sapropel and sand stringers containing *Peronella dalli* and Avon Park foraminifers in great abundance. These fossils are eroded and etched although beautifully preserved and are free of all limestone matrix.



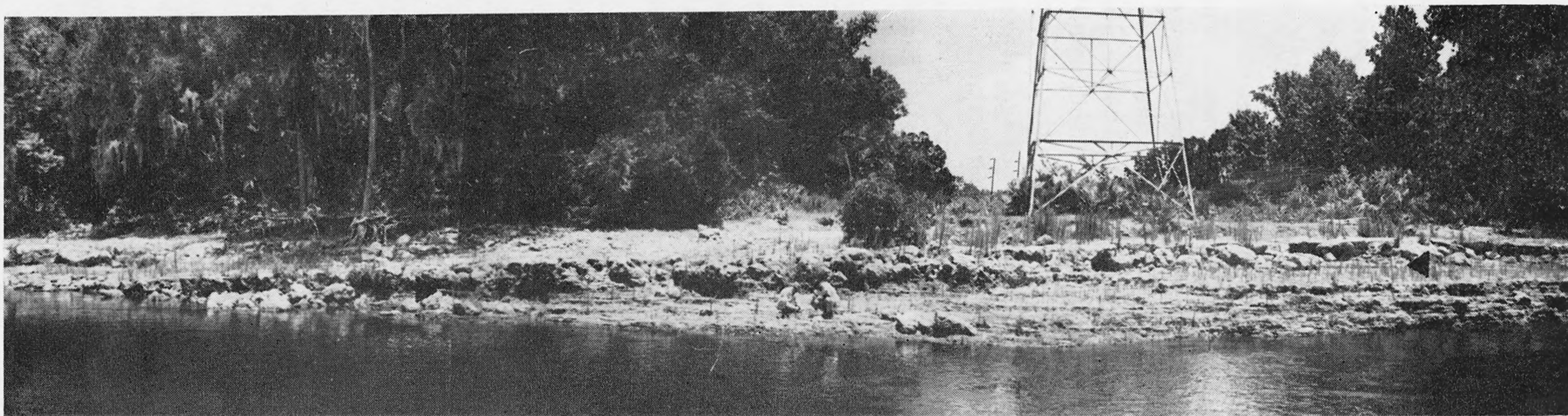


Figure 18. Panorama of the exposure of the unconformable contact of the Moodys Branch formation upon the Avon Park limestone as viewed facing north from an island in the center of the Withlacoochee River at the Florida Power Corporation dam, Levy County. Note the overlap and bisection of the thin beds of the Avon Park limestone by the massive beds of the Inglis member, marked by triangles.



The formation was structurally high in a poorly defined area in Lake and Marion counties when the Inglis member of the Moodys Branch formation was deposited. This is indicated by reworked faunas of zone "B" contained in the sediments of the Inglis member and by the development of sand stringers, peat seams, and limonite nodules at the contact of the Moodys Branch formation with the Avon Park limestone in Lake County. Rolled, filled, and eroded specimens of *Lepidocyclina cedarkeysensis*, *Coskinolina floridana*, and *Dictyoconus? gunteri* are found in the base of the Inglis member in eastern Citrus and central Levy counties.

The Avon Park limestone appears to be absent in parts of Duval County where the Moodys Branch formation has overlapped the Lake City limestone. In Volusia County and in counties along the eastern seaboard the basal Avon Park limestone is marked by abundant specimens of *Fabularia vauhani* contained in cream-colored, pasty limestones that overlie carbonaceous limestone and an occasional peat bed of the Lake City limestone.

The upper one hundred feet of the formation in Osceola County is a coquina of "cones", algae and *Peronella dalli* (Twitchell), the middle is a pasty, cream to gray, porous limestone containing irregular, nodular, limestone masses, specimens of *Peronella dalli* and a sparse fauna otherwise. The base is a brown, crystalline dolomite. Dolomitization has extended upward in some areas into the middle of the formation, but the nodular masses can be recognized in irregular seams of more porous dolomite. Dense dolomite occurs commonly at the base of the formation in Orange, Polk, Hillsborough, Levy, Citrus and Dixie counties.

The upper fifty feet of the Avon Park limestone throughout Polk and adjacent counties is composed of a coquina of *Peronella dalli*, the specimens of this small echinoid composing up to 80 per cent of the sample. An algal and foraminiferal rich pasty limestone underlies the *Peronella* bed and the lithology is similar to that in Citrus and Levy counties. The *Peronella* bed contains in some well samples only those foraminifers that characterize the Avon Park limestone. In others it contains this fauna in association with foraminifers that characterize the Inglis member of the Moodys Branch formation, particularly *Fabiania cubensis* and *Amphistegina pinarensis cosdeni*. In adjacent wells, the *Peronella dalli* bed is present in one well and characteristic Inglis member in another. For these reasons it is believed that the *Peronella* bed may represent a continuation of Avon Park deposition into Inglis time.

*Detailed Geologic Exposures in Levy County:* The northernmost outcrop of Avon Park limestone occurs along the Waccasassa River in the



vicinity of Fishermans Bridge located in the northeast quarter of the northwest quarter of Section 32, Township 13 South, Range 16 East, Levy County. The following section was measured:

| Locality L-61                                                                                                                                                                                                                                                                                 | Feet  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Pleistocene series                                                                                                                                                                                                                                                                            |       |
| Pamlico formation                                                                                                                                                                                                                                                                             |       |
| 2) White to tan, mottled, sandy, argillaceous limestone and shell marl. Numerous <i>Chione cancellata</i> , and species of <i>Cardium</i> , <i>Phacoides</i> , <i>Strombus</i> and <i>Oliva</i> are common. The bed extends into crevices and solution holes of the Avon Park limestone ..... | 2.4   |
| Unconformity                                                                                                                                                                                                                                                                                  |       |
| Middle Eocene series                                                                                                                                                                                                                                                                          |       |
| Avon Park limestone                                                                                                                                                                                                                                                                           |       |
| 1) Tan to brown, very soft and friable, porous dolomite composed of euhedral silt-sized crystals and containing abundant molds of Avon Park foraminifers filled with calcite dust, the remains of the foraminifers .....                                                                      | 6.75  |
|                                                                                                                                                                                                                                                                                               | ----- |
| Total thickness                                                                                                                                                                                                                                                                               | 9.15  |

From Fishermans Bridge on the Waccasassa River to the junction with Wekiva River small exposures of irregular thicknesses are present. These alternate with exposures of the Inglis member of the Moodys Branch formation, the river valley having cut through a very irregular unconformable contact of the two beds. Along the upper portion of this valley the contact is alternately above and below river level, but downstream from State Road 55 the Avon Park limestone is exposed almost continuously along the valley. The Pamlico formation thinly veneers the bedrock throughout the flatwoods along the river banks. Additional exposures of the dolomite of locality L-61 are approximately as follows:

- L-63 Approximately one mile downstream from Fishermans Bridge in the SW $\frac{1}{4}$  SE $\frac{1}{4}$ , Sec. 32, T. 13 S., R. 16 E., 0.7 foot.
- L-67 Ledge at water level, 1 $\frac{1}{4}$  miles downstream from Fishermans Bridge approximately in the NW $\frac{1}{4}$  NE $\frac{1}{4}$ , Sec. 5, T. 14 S., R. 16 E.

David B. Ericson (1945) described beds of dolomite and dolomitic limestone cropping out in the Gulf Hammock region in Citrus and Levy counties and named then the "Gulf Hammock formation", which he thought was equivalent to the Avon Park limestone and suggested the abandonment of the term Avon Park limestone in favor of the name proposed for the outcrop area. His correlations were based on molds of foraminifers and studies of samples from core holes placed along the proposed Florida ship canal. One of his type sections is located on the dredged channel of the Waccasassa River in the southwest quarter of



southwest quarter of Section 8, Township 14 South, Range 16 East, below the bridge on Road 55. This section was incorrectly located in the northwest quarter of the southeast quarter of Section 6, by Vernon (1947a, p. 4). The following section was measured (100 feet downstream on the right bank) August 10, 1947, and was restudied September 15, 1949:

| Locality L-73                                                                                                                                                                                                                                                                                       | Feet       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Pleistocene series                                                                                                                                                                                                                                                                                  |            |
| Pamlico formation                                                                                                                                                                                                                                                                                   |            |
| 5) Gray, fine to medium, argillaceous, quartz sand and carbonaceous soil zone. Interbedded with a white sandy limestone that overlies the section irregularly, and penetrates the Inglis member along solution cracks, being hardened at the surface and somewhat dolomitized                       | 2.5        |
| Unconformity                                                                                                                                                                                                                                                                                        |            |
| Upper Eocene series                                                                                                                                                                                                                                                                                 |            |
| Moodys Branch formation                                                                                                                                                                                                                                                                             |            |
| Inglis member                                                                                                                                                                                                                                                                                       |            |
| 4) Tan to brown, dense, massive, poorly fossiliferous, hard ledge of dolomite containing rare mollusk and <i>Cassidulus ericsoni</i> Fischer, n. sp. molds which are found in the lower part of the Inglis member                                                                                   | 2.6        |
| 3) Tan, very soft, friable, thin-bedded but not laminated dolomite composed of euhedral silt-sized crystals. Pebbles of laminated dolomite and rare concretions are in the basal few inches, and probably are reworked Avon Park limestone. Fossils are rare                                        | 1.25       |
| Unconformity                                                                                                                                                                                                                                                                                        |            |
| Middle Eocene series                                                                                                                                                                                                                                                                                |            |
| Avon Park limestone                                                                                                                                                                                                                                                                                 |            |
| 2) Tan to brown, fairly hard, porous, massive dolomite. The porosity is almost entirely molds of mollusks and and foraminifers. <i>Trigonocardia</i> sp., Peneroplid sp. "X", <i>Velates</i> sp. (juvenile?), Echinoid spines, <i>Coskinolina</i> and <i>Dictyoconus</i> cross-sections are present | 0.2 to 0.8 |
| 1) Extending at least two feet below water level — tan to brown, porous, fairly soft, euhedral silt-sized crystalline, poorly fossiliferous, slightly laminated dolomite. To water level                                                                                                            | 0.65       |
| Total maximum thickness                                                                                                                                                                                                                                                                             | 7.8        |

An additional exposure of the Avon Park limestone located 200 feet downstream from the measured section, L-73, on the left bank of the river contains dolomite casts and skeletal molds of *Coskinolina floridana*,



*Lituonella floridana*, *Spirolina coryensis*, Peneroplid sp. "X", and undescribed mollusks. These fossils appear as white spots in the dolomite and the bed is exposed 4 feet above water level and 6 to 12 inches below the massive pebble bed, No. 3 of locality L-73.

The "Gulf Hammock formation" of Ericson (1945), as defined, included the Inglis member of the Moodys Branch formation and the upper part of the Avon Park limestone as used in this report. Since the Avon Park limestone is very thin in parts of the outcrop area and since a regional unconformity separates it from the Moodys Branch formation, Ericson's correlation of the "Gulf Hammock formation" with the Avon Park limestone is inexact and the use of the term "Gulf Hammock formation" has been abandoned in order to avoid confusion.

The Avon Park limestone is the floor of much of the large hammock located due west of the town of Gulf Hammock. Throughout this wide outcrop, exposures in sinks, streams and as pinnacles are fairly common. Some of the exposures of tan to brown, soft, friable dolomite containing molds of the Avon Park microfauna are located as follows:

- 1) Along State Road 24 in the SE $\frac{1}{4}$  SW $\frac{1}{4}$  Sec. 12, T. 14 S., R. 14 E. in a canal — 0.5 foot thick
- 2) In a solution pipe in the drainage canal crossing State Road 24, 870 feet downstream in the NE corner Sec. 6, T. 14 S., R. 15 E. — 3.6 feet thick
- 3) In a well at a hunter's camp in the SW corner of the NW $\frac{1}{4}$  Sec. 19, T. 14 S., R. 15 E. — 3.6 feet thick covered by weathered limestone of the Inglis member.
- 4) Along a small stream crossing the timber road in the NE $\frac{1}{4}$  Sec. 11, T. 14 S., R. 15 E. — ledges.

Limestone exposures are relatively rare, but almost all of Section 14, Township 14 South, Range 15 East, is paved with limestone, dolomitic limestone and dolomite. Two of the best of these exposures may be studied at the following localities:

- 1) Locality L-77: Exposed as ledges on both sides of a timber road in the center of the NW $\frac{1}{4}$  Sec. 14, T. 14 S., R. 15 E. Tan to cream, soft, very fossiliferous, porous, massive to laminated limestone containing Peneroplid sp. "X" and other Avon Park microfauna.
- 2) Locality L-76: Exposed as ledges in the timber road in the NW corner of the SW $\frac{1}{4}$ , Sec. 14, T. 14 S., R. 15 E. Hard, porous, cream to light gray — purple tinted, massive, miliolid, fragmental, marine limestone. Some of the miliolids are the size of buckshot and numerous undescribed mollusk molds are present. One undescribed Lucinid is nine inches in diameter. Casts of these molds will be described.

A poor but interesting exposure of the Avon Park limestone - Inglis member contact is present at locality L-94 along the stream crossed by



State Road 55 in the southeast quarter southwest quarter, Section 6, Township 14 South, Range 16 East. Along the bottom of the stream and a drainage canal that enters the stream about 100 feet downstream on the right bank, are ledges of Avon Park limestone composed of tan, massive to poorly laminated, porous dolomite containing *Peneroplid* sp. "X", eel grass impressions and miliolid molds. In the banks are approximately 2 feet of dolomite of the Inglis member that is more massive and contains pebbles of the laminated dolomite. The whole section is cut by many solution cavities that are filled by very sandy, dolomitized marl and sand containing abundant Pleistocene mollusk shells of the Pamlico formation. *Chione cancellata*, *Arca scalarina* and *Venus* sp. are abundant.

The Pleistocene marl and sand, locally indurated, grades upward into an irregular thickness of red, leached, argillaceous sand. Progressively downstream the thickness of the Pamlico formation increases and about two-tenths mile below the bridge the spoil banks are composed entirely of Pleistocene deposits, from which good collections of shells can be made. No older deposits are exposed here.

A broad area in the vicinity of the town of Gulf Hammock is underlain by tan to brown, friable dolomite composed of silt-sized euhedral crystals, and filled with molds, casts, and skeletal remains of the Avon Park microfauna. The formation is extensively exposed through a thin veneer of sandy shell marl, sandy limestone and sand of the Pamlico formation. Several good exposures are present in the streams that are crossed by State Road 55 near Gulf Hammock, the best of which can be seen at locality L-82, located in a drainage ditch paralleling the road on the southwest, about one-eighth of a mile southeast of the town.

The thickest and best exposure of the limestone facies of the Avon Park limestone, which can be considered the type locality of the formation in the outcrop area, is reached by driving from the town of Gulf Hammock, leaving State Road 55, four-tenths mile southeast of the town, on the narrow pavement and driving for two and one-quarter miles to the end of the pavement and turning northwest on a dirt road to Sulphur Springs Landing on the left bank of the Wekiva River in the southwest quarter, northwest quarter, Section 32, Township 14 South, Range 16 East, where the following section was measured September, 1946:

Locality L-92

Feet

Middle Eocene series

Avon Park limestone

- 3) Mottled cream to gray, very soft, granular, fragmental, massive, weathered, marine limestone topped by blocky,



|                                                                                                                                                                                                                                                                                                                          |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| red, sandy, clay soils that extend back into a cultivated field .....                                                                                                                                                                                                                                                    | 4.0        |
|                                                                                                                                                                                                                                                                                                                          | (variable) |
| 2) Cream to white, mottled, hard ledge of dense, very fossiliferous, marine limestone containing excellent specimens of Peneroplid sp. "X" and other Avon Park microfauna. Mollusk molds are abundant and several Lucinids, <i>Corbis</i> sp. cf. <i>C. claibornensis</i> and <i>Trigocardia</i> n. sp. are common ..... | 1.5        |
| 1) Lithology above but softer and containing hard nodules ..                                                                                                                                                                                                                                                             | 3.0        |
|                                                                                                                                                                                                                                                                                                                          | ----       |

|                 |     |
|-----------------|-----|
| Water level     |     |
| Total thickness | 8.5 |

The lowlands along the streams south of Gulf Hammock are developed in the soft dolomites of the Avon Park limestone, the stream valleys having breached the more resistant limestones of the Inglis member. The following exposures are significant in the interpretation of the stratigraphy of the area:

- 1) Locality L-144: Dolomite, 1.5 feet thick, in a ditch and along Ten Mile Creek at a hunter's camp, located 2/10-mile west of an abandoned tram bridge in the NE¼, Sec. 24, T. 15 S., R. 15 E. This is the most southerly of the Avon Park limestone exposures in the northern outcrop area.
- 2) Locality L-96: The thickest and most diversified exposure of the dolomitic limestone and dolomite of the Avon Park limestone was uncovered in a quarry and 1,015 feet down a drainage ditch that crosses State Road 55 in the NE¼ of SE¼, Sec. 4, T. 15 S., R. 16 E., where the following section was made at what appears to be the top of a gently dipping fold, although the beds were not continuous enough for this to be definitely determined.

|                                                                                                                                                                                                                       |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Locality L-96                                                                                                                                                                                                         | Feet |
| Middle Eocene series                                                                                                                                                                                                  |      |
| Avon Park limestone                                                                                                                                                                                                   |      |
| 5) Brown, black and gray, laminated, very hard, finely granular, dolomitic limestone .....                                                                                                                            | 0.25 |
| 4) Light cream-colored, weathering almost white, massive, dense, tough, slightly laminated, finely granular dolomitic limestone with white limestone concentrations, seaweed impressions and Peneroplid sp. "X" ..... | 1.1  |
| 3) Cream, dense, very soft, finely granular, thin-bedded dolomitic limestone, containing many white limestone specks .....                                                                                            | 0.4  |
| 2) Brown to gray, blue and white speckled, thin-bedded, somewhat laminated, cross-bedded dolomitic limestone ..                                                                                                       | 1.6  |
| 1) Limestone of bed 3, more massive .....                                                                                                                                                                             | 0.25 |
|                                                                                                                                                                                                                       | ---- |
| Total thickness                                                                                                                                                                                                       | 3.6  |

There is no overburden where the section was made in the drainage ditch but up gradient the formation is covered by the Pamlico formation, composed



of 4 feet of tan to brown, silty, porous dolomitic marl, overlain by calcareous clays, and 2 feet of white loose quartz sand. Down gradient from the described section an additional 26 inches of hard, porous, massive to cross-bedded dolomite with unidentifiable molds is exposed. This bed is placed in the Avon Park limestone. Further down the ditch boulders of the Inglis member and marl of the Pamlico formation cover the Avon Park limestone.

The most southerly outcrop area of the Avon Park limestone in Levy County, see Plate 1, is covered by a thick sand veneer of the Pamlico and Wicomico formations and exposures are fairly rare, except for the most westerly extension. All of this area, west of Big Spring, is dolomite similar to that occurring to the north, and exposures are common on the timber roads and in the streams and sinks of the area. Much of this dolomite is laminated and contains molds of Avon Park microfauna.

Boulders of dolomite and cream to gray purple-tinted, finely granular limestone containing *Peneroplid* sp. "X" and other Avon Park foraminifers are exposed at locality L-111, in a sink on the west side of State Road 55 at a bridge in the northeast corner of the southeast quarter of Section 36, T. 15 S., R. 16 E. A core hole placed here penetrated 10.7 feet of white to gray, fine quartz sand, 4 feet of white to gray, dolomitic, quartz sand of the Pamlico formation, 0.25 foot of blue to gray, sandy clay and 1.1 feet of white to gray, purple-tinted, pasty, dense limestone containng *Lituonella floridana* and *Coskinolina floridana*. The last two beds are placed in the Avon Park limestone.

The Avon Park limestone is exposed at low water, in a newly formed sink located in the southwest quarter of southwest quarter of Section 7, Township 16 South, Range 17 East, about 75 feet west of Old State Road 55 near Lebanon, figure 19. The following section was measured October, 1948.

| Locality L-119                                                                                                                                                                                                      | Feet |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Pleistocene series                                                                                                                                                                                                  |      |
| Pamlico formation                                                                                                                                                                                                   |      |
| 4) Tan to gray, fine quartz sand with a weathered tan clay zone at the base .....                                                                                                                                   | 2.85 |
| Unconformity                                                                                                                                                                                                        |      |
| Middle Eocene series                                                                                                                                                                                                |      |
| Avon Park limestone                                                                                                                                                                                                 |      |
| 3) Tan ledge, very hard, porous but impermeable, finely crystalline dolomite containing Avon Park microfauna molds. Blocks of this bed are slumped down on and are sharply separated by weathering from bed 2 ..... | 1.75 |
| 2) Tan, soft, finely crystalline, case-hardened dolomite with molds of mollusks and a microfauna of the Avon Park limestone .....                                                                                   | 0.35 |





Figure 19. Exposure of the Avon Park limestone at locality L-119, a small sink in SW¼ SW¼ Sec. 7, T. 16 S., R. 17 E., on the west side of Old State Road 55. Photograph taken facing northwest.

|                                                                                                                                                                                                                                                                                                                                                                                      |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1) Tan, soft, finely crystalline, massive, dolomitized limestone composed of silt-sized crystals and containing Peneroplid sp. "X", Avon Park foraminifers, and many mollusks and miliolid molds. Grades downward into brownish-gray, purple-tinted, porous, granular to massive limestone containing "buckshot" miliolids, Peneroplid sp. "X" and well-preserved mollusk molds..... | 5.7   |
| Water level                                                                                                                                                                                                                                                                                                                                                                          | ----- |
| Total thickness                                                                                                                                                                                                                                                                                                                                                                      | 10.65 |

The most accessible exposure of the Avon Park limestone in the area is present in the New Lebanon Dolomite pit located in the southwest quarter, northeast quarter, Section 12, Township 16 South, Range 16 East. The following section was measured in the middle of the pit on the east side of the quarry, December 14, 1946. There is an apparent dip of 6 degrees south so that beds in the south end are younger and beds in the north end are older than those at the top of the section. The section exposed is therefore thicker than given.

|                                                        |            |
|--------------------------------------------------------|------------|
| Locality L-118                                         | Feet       |
| Pleistocene series                                     |            |
| Pamlico formation                                      |            |
| 8) White to gray, fine, argillaceous, quartz sand..... | 1.5 to 4.0 |



## Unconformity

## Upper Eocene series

## Moodys Branch formation

## Inglis member

- 7) Tan, dense, hard, massive dolomite containing scattered molds of foraminifers and broken mollusks.....2.35
- 6) Tan, very soft, friable, finely crystalline, porous to dense, thinly-bedded dolomite composed of silt-sized euhedral crystals. Grades laterally into large, massive, dolomite beds containing platy dolomite pebbles, apparently reworked from beds below. This bed is high and low along the quarry face and apparently has covered an erosional surface of relief up to 10 feet.....9.75

## Unconformity

## Middle Eocene series

## Avon Park limestone

- 5) High areas extending into bed 6 — Tan to brown, extremely platy and laminated by alternate layers of plant remains and silt-sized euhedral crystals of dolomite. The base is dark brown, heavily laminated and contains thin beds of peat and specimens of *Peneroplid* sp. "X", *Coskinolina*, *Dictyoconus* and *Lituonella*. Extensively exposed in the south side of the quarry .....Variable to 3.0
- 4) Tan to brownish-gray, dense, fine-grained, fragmental dolomite cut by numerous long, narrow borings made by worms or boring mollusks. Many molds of "*Cerithium*" n. sp. are present and the bed is absent at places .....0.35 to 0.85
- 3) Brownish - gray, purple - tinted, very dense, fine grained, lithographic dolomite. Beds 3 and 4 grade laterally and vertically into bed 2 or where absent into bed 1.....0.7 to 1.6
- 2) Brown to greenish-gray, very pure, thin-bedded, dense, carbonate having the texture and consistency of clay when wet and analyzing 95 to 98 percent calcium-magnesium carbonate. Upon drying the material cements solidly. The bed is laminated by carbonized plant remains, thin peat beds in places, and a pavement-like bryozoa. It contains an abundant and beautifully preserved microfauna of the Avon Park limestone and includes *Elphidium* sp. "A", *Coskinolina floridana* and *Dictyoconus cookei* in great abundance, and an ostracod fauna that has been described by Dr. H. V. Howe and is published in Florida Geological Survey Bulletin 34 .....0.7 to 1.0
- 1) Brownish-gray to brown, purple-tinted, soft but tough, granular, massive, porous limestone containing an



abundant Avon Park fauna. *Peneroplid* sp. "X", *Elphidium* sp. "A" are prominent. From this bed H. B. Stenzel has identified the following fossils:

*Corbis claibornensis* Dall (a Gosport species), *Trachycardium* or *Trigonocardia* n. sp., "*Cerithium*" n. sp., *Ectinochilus* n. sp., *Clavilithis columbaris* Aldrich (a Cook Mountain species) and a Hexacoral, genus indet. On November 15, 1947, and July 11, 1948, boulders of this limestone, completely dolomitized, were mined in the north side of the pit, and these contained the large Lucinid of L-123, a Manatee rib, and numerous dolomite casts of "*Cerithium*" n. sp.-----3.0

Maximum cumulative thickness

25.55

An abandoned dolomite pit located in the northwest quarter southeast quarter, Section 12, Township 16 South, Range 16 East, exposed 6 feet of the extremely laminated dolomite of bed 5, which has apparently thickened toward the south and southeast.

These laminated dolomites are also exposed along the Withlacoochee River, the best exposure of which is locality L-139, at the Florida Power Corporation dam in the southwest quarter of Section 8, Township 17 South, Range 17 East, along an outcrop developed on the upthrown side of a small fault, see pages 129 to 130.

*Detailed Geologic Exposures in Citrus County:* Exposures of the Avon Park limestone in Citrus County are rare except along the Withlacoochee River near Dunnellon, Marion County. The outcrop is dolomite, and the formation was penetrated by the core holes illustrated in figure 14.

A series of boulders are present on the south side of the Power Dam along the upthrown side of a small fault in the southwest quarter, Section 8, Township 17 South, Range 17 East, and extend southeast into Section 17. These are brown, dense to porous, finely crystalline dolomite and gray chert and contain seams composed of molds of mollusk and foraminifers. Molds of *Coskinolina*, *Dictyoconus*, *Peneroplid* sp. "X", *Lituanella* and eel grass were identified.

An irregular exposure of the dolomite is also present at locality C-97 in the valley of a small stream crossing a dirt road running southeast from a cross roads at Red Level turpentine still, eight-tenths mile from the cross road and about 300 feet downstream, approximately in the northwest quarter southeast quarter, Section 19, Township 17 South, Range 17 East.



The Avon Park limestone is exposed along another fault block in northeastern Citrus County. A series of horst-graben normal faults, figure 14, that combine to extend the formation and younger beds along parallel elongate bands. The plane of a small fault was penetrated by well W-1199, figure 14, and can be traced southeast where it passes through the Section 12 mine of Kibler-Camp Phosphate Enterprise located in the southwest quarter northeast quarter, Section 12, Township 17 South, Range 16 East. On July 16, 1946, a section described on the northeastern side of the pit, locality C-4, pages 203 to 204, recorded up to 17 feet of very fossiliferous Avon Park limestone, boulders of which were thrown out on the quarry waste banks. In late 1949, the pit was expanded to the west and penetrated phosphatized limestone of the Williston member of the Moodys Branch formation, the fault plane being located between the two sides of the quarry.

The wells drilled in Citrus and Levy counties that have penetrated the Avon Park limestone are recorded in Table 11, which gives the locations of the wells, the elevations of the formations, and the covering beds.

### Upper Eocene

## JACKSON GROUP

### HISTORY

The history of the use of the term Jackson has been adequately covered in publications by Vernon (1942, pp. 40-41) and Cooke (1945, p. 53). In Florida the beds of the upper Eocene, Jackson group, and Ocala limestone have always been synonymous. However, the Applins (1944) recognized in the Jackson group and in the Ocala limestone an upper and lower member, and with the completion of the study of Citrus and Levy counties it was possible to separate from the base of the Ocala limestone about 80 feet of section that is composed of two lithologically and faunally distinct beds, approximately 30 and 50 feet thick. This interval is correlated with the Moodys Branch formation and the names Williston and Inglis are proposed for the two members. The Inglis member corresponds to the Applins' lower member of the Ocala limestone.

As used in this report the upper Eocene, Jackson group of peninsular Florida, is composed of two formations, the Ocala limestone (restricted) and the Moodys Branch formation, by which the Jackson group is divided into upper and lower units. The Florida section compares favorably with the section exposed at Claiborne Bluff in Alabama, see Table 9, on the



TABLE 9.—Upper and Late Middle Eocene Deposits—Comparison of Florida and Alabama Sections.

| Alabama<br>(Claiborne Bluff Section) |                          | Jackson-Claiborne<br>Contacts in Alabama                                          | Citrus and Levy Counties, Florida                           |                     | Microfaunas                                                                                                                                                                                          |
|--------------------------------------|--------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| JACKSON GROUP                        | Ocala limestone          |                                                                                   | Ocala limestone<br>(restricted)                             |                     | Numerous large foraminifers<br><i>Lepidocyclina</i> , <i>Asterocyclina</i><br>and camerinids common                                                                                                  |
|                                      | Moody's Branch formation | Upper<br>limestone<br>member                                                      | Williston<br>member                                         |                     | <i>Camerina vanderstoki</i> ,<br><i>Operculinoides floridensis</i> ,<br><i>O. vughani</i> (noded),<br><i>Amphistegina pinarensis cosdeni</i> ,<br><i>Rotalia cushmani</i> ,<br><i>Nonion advenum</i> |
|                                      |                          | Lower<br>sand<br>member<br><i>Scutella</i><br>( <i>Periarchus lyelli</i> )<br>bed | Inglis<br>member<br>( <i>Periarchus lyelli floridanus</i> ) |                     | <i>Fabiania cubensis</i> ,<br><i>Spiroloculina seminolensis</i> ,<br><i>Amphistegina pinarensis cosdeni</i> ,<br><i>Rotalia cushmani</i> ,<br><i>Nonion advenum</i>                                  |
|                                      | Disconformity            |                                                                                   | Disconformity                                               |                     |                                                                                                                                                                                                      |
| Leaf shale<br>and<br>lignite         |                          | MacNeil<br>(1947)                                                                 | CLAIBORNE GROUP                                             | Lignitic            | Algae<br><i>Coskinolina floridana</i> ,<br><i>Dictyoconus cookei</i> ,<br><i>Lituonella floridana</i> ,<br><i>Spirolina floridana</i> ,<br><i>Dictyoconus? gunteri</i>                               |
| Gosport sand                         |                          | Stenzel<br>(1947)*                                                                |                                                             | Avon Park limestone |                                                                                                                                                                                                      |
| Disconformity                        |                          |                                                                                   |                                                             | Disconformity       |                                                                                                                                                                                                      |
| Lisbon formation                     |                          | Cooke<br>(1939)                                                                   |                                                             | Lake City limestone | <i>Archaias columbianaensis</i> ,<br><i>Dictyoconus americanus</i> ,<br><i>Discorbis inornatus</i>                                                                                                   |

\* Personal communication, December 5, 1947.



basis of stratigraphy, lithologic types, and rare species of the fauna that occur in both sections.

Cooke (1939) correlated the interval of the Moodys Branch formation with the Gosport sand in the Alabama section transferring the Gosport to the Jackson group. Toulmin (1940), MacNeil (1947) and H. B. Stenzel<sup>19</sup> prefer placing the Jackson-Claiborne contact in Alabama at the top of the Gosport sand. For numerous reasons presented in the discussion that follows, the contact in Florida is placed at the top of the Avon Park limestone and the stratigraphic sequence of the two sections are sufficiently similar to support the application of the term Moodys Branch formation to the lower Jackson beds of Florida.

### JACKSON-CLAIBORNE CONTACT

The problem of the location of the Jackson-Claiborne boundary is similar to the problem in other States. This is indicated in Table 9, in which comparisons of the Florida section with a generalized section of Alabama are given, and is evident if comparisons of the data in this report are made with those presented by Stenzel (1939) on the Yegua problem of Texas.

The Jackson-Claiborne contact is placed at the top of the Avon Park limestone, which appears to be the most logical place. The division at this horizon places three limestones of similar characteristics, the basal Inglis member, the Williston member (upper and lower members of the Moodys Branch formation), and the Ocala limestone (restricted), into the Jackson group; restricts all highly carbonaceous beds to the Claiborne group and separates the Jackson group from older beds by an unconformity. Faunas of Jackson group affinities begin in the Inglis member and range upward. All known described Eocene echinoids in Florida, with the possible exception of *Peronella dalli*, thus are confined to the Jackson group and many are confined to the Inglis member. Widespread, shallow-water facies are overlain by limestones of deeper-water facies indicating encroachment of seas following the initiation of Inglis time. The widespread occurrence of *Periarchus lyelli* Conrad, even though the fossil is a sub-species in Florida, provides a basis by which comparisons with Jackson-Claiborne sections elsewhere can be made. The species is recognized as a basal Jackson fossil.

In placing the boundary of the Jackson and Claiborne groups in Florida there appears to be only one choice, at least insofar as the outcrop area is concerned. Close correlations with the sections of adjacent

<sup>19</sup>Personal communication, December 5, 1947.



states support placing the upper and middle Eocene contact in Florida where the Moodys Branch formation lies upon older beds, but in selecting this boundary other possible segregations must also be considered.

Since the Inglis member of the Moodys Branch formation has a distinct and bizarre fauna with combined Gosport and Jackson affinities and since there generally is a lithologic break at the top, some argument could be presented that the top of the Inglis member should be the Jackson-Claiborne contact. In favor of placing the contact here it can be cited that some species found in the Avon Park limestone continue through the Inglis member, but against it the Inglis marks the beginning of Jackson fauna. Placing the contact at this horizon has the obvious disadvantage of including within the Claiborne a marked unconformity, in a section where unconformities are rarely recognized. It likewise has the less obvious disadvantage of including dissimilar facies, an alternate deep marine and shallow lagoonal facies overlain by a shallow-water facies, with the lower facies having been eroded. A division on essentially a lithologic grouping is difficult since the entire section is calcareous and since dolomitization has crossed formational boundaries. Considering faunas, lithologic differences and erosion in the section, the upper limit of the Claiborne group can be placed at the top of the Avon Park limestone.

The Avon Park limestone is overlain by the Inglis member of the Moodys Branch formation at the dam of Florida Power Corporation on the Withlacoochee River, locality L-139, page 130. Here, both beds are dolomitized although the Avon Park limestone is laminated, carbonaceous and thin-bedded whereas the Inglis member is massive. Molds of fossils are common in both beds and are easily identified.

This is the best available exposure of the two beds in contact and it has been studied with particular care. The contact is very definite and is exposed along a long section. In some places the laminated dolomite lies at higher elevations than at others, and is clearly truncated by the more massive beds of the Inglis member, see figure 17. The dolomite of the Avon Park contains many crystalline "cannon" ball dolomite concretions. The base of the Inglis member contains pebbles of the laminated dolomite and a concentration of the dolomite concretions, many of which are leached and oxidized. This bed has the appearance of a greatly re-worked sediment and contains numerous elongate rods and pipes which are apparently filled burrows of boring animals (?). These burrows are also present in the upper part of the Avon Park limestone and probably connect to those in the Inglis member.



The outcrop clearly represents an eroded Avon Park limestone, overlain by the Inglis member, the base of which is a soil mantle representing reworked residue from the lower bed. This unconformity can be recognized by sand zones, limonite concentration, peat and sapropel seams and the weathered tops of the Avon Park limestone in many of the water wells and canal borings located in and around the outcrop area.

## MOODYS BRANCH FORMATION

### INTRODUCTION AND DEFINITION

Distinctly fossiliferous beds exposed along Moodys Branch of Pearl River in Jackson, Mississippi, were named "Moodys Branch" by Meyer in a table published in 1885 (Wilmarth, 1938, p. 1415) but the term was not defined. Lowe (1915, p. 80) described the Moodys Branch green marls as a member (formation) of the Jackson group and thought the bed overlay the Yazoo clay. The Mississippi Geological Survey now divides the Jackson formation into a Yazoo clay at the top and Moodys marl at the base. In southern Alabama the Jackson group is divided by most students into the Ocala limestone and the Moodys Branch formation, see MacNeil (1947).

The Moodys Branch formation has been traced from Mississippi into Alabama where it is composed of an upper limestone and a lower sand member, the sand member being the "Scutella" bed, a calcareous sand containing numerous specimens of *Periarchus lyelli*. Both members are present in southern Alabama and an almost continuous line of wells extending from the outcrop area in Florida into western Florida indicates that the name Moodys Branch formation can be used in Florida stratigraphic nomenclature.

The Moodys Branch formation of Florida is a cream to white, fragmental, marine, highly fossiliferous limestone that is composed of a camerinid-rich limestone member, the Williston, at the top and an echinoid-rich limestone member, the Inglis, at the base. It is approximately the basal 80 feet of the Ocala limestone of Cooke (1945) which has been restricted by the separation of this interval.

### INGLIS MEMBER

*Definition:* The Inglis member is the base of the Jackson group in Florida, and is a miliolid- and echinoid-rich, cream-colored, marine limestone that lies unconformably upon the Avon Park limestone. It is separated generally from the Williston member by changes in lithology and



fauna but the contact is apparently conformable. Its distinct fauna and lithology are present in several quarries in the vicinity of Inglis, Levy County, and along an almost continuous exposure on the Withlacoochee River from Inglis to the Gulf Coast. Excellent collections of the fauna can be made along the spoil banks developed in improving the river channel.

*Physiography and Outcrop Pattern:* The bed is thin but very resistant and underlies most of the hammock-swamps of the area at low and consistent elevations, see figure 6. This is apparent when it is realized that the road from Long Pond, Levy County, to Crystal River, Citrus County, a distance of about 39 miles, is underlain by the limestone and dolomite of the thin Inglis member, except for narrow areas where the Avon Park limestone is exposed, see Plate 1. At no point along the route does the elevation rise above 30 feet.

The Inglis member occupies a broad shield-shaped annular area about the Avon Park limestone outcrops, completely surrounding these outcrops except in southeastern Levy County where the Avon Park limestone is apparently faulted against the Williston member. Two small circular outcrops, representing breached small domes or folds are present in western Levy and southeastern Citrus counties. The member has been extended along the eastern portion of Citrus County by the Inverness fault, and makes a rectangular outcrop that is veneered irregularly by sediments of the Alachua formation and by younger clastic beds.

Two elongated outcrop patterns, controlled by structure, are present in north-central Levy County near Long Pond and four miles east of Chiefland. The outcrop at Long Pond has been extended along the up-thrown side of the Long Pond fault, and the area east of Chiefland appears to be a breached, small anticline that has steeply dipping flanks.

*General Lithology:* The Inglis member is a cream to tan, granular and rarely pasty, porous, fairly hard, massive, shallow-water, marine limestone containing an abundant and bizarre fauna, in part being a coquina of foraminifers, mollusks and echinoids. The base of the bed has been dolomitized in some of the outcrop area and rarely the bed is completely dolomitized. The dolomite is tan to brown, very porous but poorly permeable, soft and friable ranging to hard and indurated and massive. Silt-sized, euhedral dolomite crystals, poorly cemented, form much of the dolomite rock.

The base of the member is generally marked by a rubble of pebbles, concretions and soil eroded from the underlying Avon Park limestone, and by a well-developed barnacle bed. Some portions of the Inglis mem-



ber are characterized by abundant fragments of a mud shrimp, *Callianassa* n. sp., claws of which are so common and prominent that this particular facies was called "the shrimp claw limestone" in the process of mapping.

The limestone in southeastern and western Citrus County is essentially a cross-bedded beach sand composed of grains of calcite. It contains an abundant mollusk, echinoid and foraminiferal fauna, and is loosely cemented although on weathered surfaces secondary crystallization has occasionally cemented the rock to relative tightness. The limestone in other parts of the outcrop area is more pasty but otherwise very similar to that in southeastern Citrus County.

In the subsurface the limestone of the Inglis member can be identified by increased drilling time and by a gray mottling of finely divided pyrite that is characteristic. On weathered surfaces the limestone commonly has a pink tint and the hardened pinnacles sometimes resemble bleached bones in shape, color and texture.

The Jackson group contains a peculiar spongiform limestone body. Specimens are generally conical to tubular, ranging in length up to 9 inches and in diameter up to 4 inches. Commonly the diameter at one end is approximately  $1/2$  to  $1/3$  the diameter of the other. A tube extends down the center of the long axis and this is filled with a porous detrital calcite grain that differs in texture from the more crystalline matrix of the body. Thin sections show that the matrix is composed also of detrital grains composed of foraminifers, sponge spicules and shell fragments, but cemented by calcite to a dense mass. Because of their shape these bodies were believed to be sponges or holothurians, and specimens were sent to Dr. K. P. Oakley of the British Museum, London, who believes them to be concretions similar to the large cylindrical flints in the English chalk. Dr. Oakley<sup>20</sup> stated:

"It is difficult to explain how a concretionary process produced sub-cylindrical forms with tubular axes, but that it can do it is a matter of fact . . . The large fragment [*Periarchus lyelli*] imbedded in the wall of the biggest of your specimens is to my mind a clear indication that these bodies are concretions and not replaced-sponge-skeletons."

These bodies are abundant in the Inglis member, common in the Williston member and rare to common in the Ocala limestone (restricted), and are of little value as a stratigraphic guide in Florida.

*Thickness:* The complete thickness of the Inglis member is not exposed at any one place in the counties. The most reliable data on the true

<sup>20</sup>Letter dated February 3, 1950.



thickness of the bed are the core holes placed along the proposed ship canal, section E-E', figure 14, in which a thickness ranging from 37 to 54 feet was penetrated. Rock cuttings from water wells throughout the Peninsula commonly contain about 50 feet of the Inglis member, which appears to be the average. The thickest exposures are at localities C-3, L-118 (page 109) and L-136 where 24, 12.1 and 11.25 feet of carbonates are present.

*Fauna and Age:* The fauna of the Inglis member is prolific and varied, but largely undescribed. Some of the foraminifers have been described by Cushman (1935), the Inglis being considered at that time a part of the Ocala limestone. Applin and Jordan (1945) also described some of the foraminifers from "the lower Ocala", which is equivalent to the Inglis member. A checklist of significant foraminifers from selected localities was prepared by Dr. Louise Jordan and is presented as Table 10. Milionids are very abundant, but are usually so poorly preserved that specific identifications can rarely be made. Only one large Foraminifera, *Camerina vanderstoki* (Rutten and Vermunt) is present and it is limited to the upper few feet. *Amphistegina pinarensis cosdeni* Applin and Jordan, *Nonion advenum* (Cushman), *Rotalia cushmani* Applin and Jordan, *Cameguyia perplexa* Cole and Bermudez, *Fabiania cubensis* (Cushman and Bermudez), *Spiroloculina seminolensis* Applin and Jordan, *Elphidium* sp. "A". Peneroplid Sp. "X" and *Discorinopsis gunteri* Cole characterize the bed. The first four species occur also in the Williston member, and the last three in the Avon Park limestone. Many other species that occur in the Avon Park limestone, particularly *Coskinolina floridana* and *Dictyoconus cookei* occur in the base of the Inglis member and in eastern Citrus County specimens of *Dictyoconus?* *gunteri* and *Lepidocyclina* (*Pliolepidina*) *cedarkeysensis*, that characterize zone "B" of the Avon Park limestone, occur in the bed. These specimens appear rolled, eroded, and are filled by calcite commonly. They are believed to have been eroded from the Avon Park limestone and redeposited in the Inglis member, but may represent poorly preserved specimens that continued to live into Inglis time.

The most characteristic fossils in the Inglis member are the mollusks and echinoids that occur in great abundance, the echinoids composing in some exposures up to 60 per cent of the rock. The echinoids have been described by Alfred Fischer and this study is published as a part of Florida Geological Survey Bulletin 34. Sixteen species are present in the bed and of these, *Periarchus lyelli floridanus* Fischer, n. sub-sp.; *Cassidulus ericsoni* Fischer, n. sp.; *Cassidulus globosus* Fischer, n. sp.; *Cassidulus lyelli* (Conrad), *Eupatagus mooreanus* Pilsbry; *E.* sp., and *E. clevei*



Cotteau are confined to the Inglis member. Both the *Periarchus* and *E. mooreanus* occur in large numbers.

The species of mollusks are largely undescribed and unknown from the Eocene of the Gulf Coast. Specimens and molds of these are being studied by Horace G. Richards, Philadelphia Academy of Natural Sciences, assisted by G. D. Harris and Katherine V. Palmer, Paleontological Research Institute at Ithaca, New York. A preliminary report by Dr. Richards on some well-preserved specimens collected at locality L-93, page 126, limestone boulders in a pit located southwest of State Road 55 in the southeast quarter southwest quarter Section 34, Township 14 South, Range 16 East, is reproduced as follows:

#### GASTROPODA

*Caricella* n. sp.

This is a new species, related to *C. pyruloides* (Conrad), a Claiborne form. This new species is apparently not closely related to any form described from the Jackson.

*Agarinia* sp.

This is probably not well enough preserved to permit specific description. It is related to, but not identical with, the Jackson species *A. media* (Meyer).

*Turritella ghizna* de Gregorio

Several specimens within the range of variations of this Claiborne species are present.

*Turritella perdita* Conrad

A Jackson species. Fairly common.

*Scaphander* n. sp.

A few specimens are closely related to *S. jacksonensis* Harris and Palmer, of Jackson age.

*Melongena* (?) n. sp.

One specimen apparently belongs to this genus, although the preservation does not permit positive identification. This genus is not known from the North American Eocene.

*Campanille* n. sp.

A few specimens can be referred to this genus, which has been recorded from the West Indies, but not from the Eocene of the Mississippi embayment.

*Lyria* sp.

One specimen is apparently unrelated to anything described from the Eocene of the Mississippi embayment, but in general resembles some forms found in the Eocene of the Paris basin (France). Probably not sufficient to form a new species unless other specimens are found.

*Cypraedia* n. sp.

Two specimens of this very rare genus found and while definitely new, it shows a close relationship to the Jackson species *C. fenestralis* (Conrad).

*Ficus* (?) n. sp.

Two specimens so embedded in the matrix that it is impossible to determine their



generic relationship, are tentatively referred to the genus *Ficus*. Superficially they resemble *Cypraedia* n. sp., although the spire is very different.

*Calyptraea aperta* (Solander)

This species is wide ranging throughout the Eocene and is also found in the Miocene.

*Crommium* n. sp.

This genus of large gastropods has not hitherto been reported from the Eocene of eastern North America. Related to *Potamidea*.

*Polinices* sp.

Several very imperfectly preserved individuals are referred to this genus.

"*Pleurotoma*" sp.

One specimen is referred to this genus (in a broad sense).

"*Cerithium*" sp.

A species of "*Cerithium*" is fairly common at this locality and bears no close relationship to any form described from the Jackson or Claiborne of the Mississippi embayment but resembles some forms from the Eocene of France and India. It also superficially resembles the Recent *C. minimum*. The true *Cerithium* is not found in rocks older than the Miocene; in the absence of detailed work on the Eocene relatives of this genus, the various species are referred to "*Cerithium*" in a broad sense.

*Rimella*, n. sp.

Several examples of this fossil are referred to the European genus.

## PELECYPODA

*Venericardia* sp. cf. *V. diversidentata* Meyer

Fairly common; of Jackson age.

*Glycymeris* sp.

Similar to some specimens from the Ocala limestone of Florida which Harris (manuscript) refers to this genus. Too incomplete for specific identification and of no value in correlation.

*Crassatellites eutawacola* Harris

One internal cast is very close to Harris' type which he described from Eutaw Springs, South Carolina, in the Santee formation which is probably Jackson in age.

*Crassatellites* sp.

Several incomplete specimens, not referable to *C. eutawacola*.

*Cardium* n. sp.

Several specimens of *Cardium* are definitely new and unrelated to anything from the Eocene of the Mississippi embayment. They are, however, related to *C. alicula* Dall from the Tampa limestone of lower Miocene age.

*Ostrea* sp.

Fragments.

*Corbula alabamensis* Lea

Common; characteristic of the Claiborne of Alabama and Mississippi.

*Callista annexa* (Conrad)

A Jackson species. Similar to some found by Harris in the Ocala limestone of Florida.



*Corbis* (?) n. sp.

Unrelated to anything described from the Eocene of eastern North America. The generic determination is questioned because of the imperfect preservation of the single shell.

*Velates floridanus* Richards

A genus widespread in the Eocene of Europe, Asia, Africa and this is the first known occurrence in North America.

## SCAPHOPODA

*Dentalium* sp.

Too worn for specific determination.

This locality contains the best preserved mollusks of any in the area and the fauna is of particular interest because of the presence of genera known hitherto only from Europe, Asia, Africa and the West Indies. This indicates a close similarity to the Eocene deposits of the Eastern Hemisphere and a more tropical and possibly deeper water environment than that in which the Eocene of the rest of the Gulf Coast was formed.

The mollusks show a Jackson age affinity although three of the species are found in the Gulf Coast Claiborne beds. The echinoids are predominately of Jackson age and *Periarchus lyelli*, found throughout the Gulf Coast in the basal Jackson is abundant in Florida. The fauna of the Inglis member, insofar as the Florida section is concerned, grades down into that of the Claiborne group and up into that described from the Ocala limestone, which has been proved to be Jackson in age. Since this gradation is abrupt into the Claiborne and gradual into the Jackson, a Jackson age is favored.

*Stratigraphic relations:* The Inglis member lies unconformably upon the Avon Park limestone, see page 130. The contact of the Inglis and Williston members is conformable but at all exposed contacts the boundary is marked by a distinct faunal change and a definite lithological break, see localities L-20, L-31, and C-24 and figures 21, 22 and 24.

*Subsurface Characteristics:* In Taylor, Dixie and other counties to the north dolomitization has extended upward through the Ocala limestone (restricted) and critical contacts cannot be placed exactly. The top of the Inglis in these counties is believed to be marked by the first dolomite that underlies a zone containing numerous molds, specimens, and skeletal images of *Camerina* thought to be *C. vanderstoki* (Rutten and Vermunt).

In northeastern and eastern peninsular Florida, particularly in Columbia, Bradford, Duval and Volusia counties the Moodys Branch forma-



tion has thickened to as much as 150 feet, the thickening, based on the occurrence of abundant fragments of echinoids, appears to be in the Inglis member. The top of the Inglis member is marked by fragments of *Periarchus lyelli floridanus*, by dolomitization rarely and in well penetrations by an increase in hardness. In some wells the Inglis member cannot be differentiated although the interval for the Moodys Branch formation remains the same. In such wells there is a gradual increase in the gray mottling of the cream-colored limestone, in the granularity, and in the percentage of echinoid fragments toward the base of the formation. These characteristics are indicative of the Inglis member but no sharp distinction between the members was evident.

In Marion County the Inglis member has thinned in overlapping erosional hills of the Avon Park limestone but probably the true thickness of about 55 feet is represented in well W-1160. In this well the member is composed of a basal barnacle bed and a fine beach carbonate sand containing rolled, filled and eroded Avon Park foraminifers that are covered by a typical beach facies composed largely of shells of *Periarchus lyelli floridanus* firmly cemented in a fragmental, pasty limestone matrix. Well W-206 has a zone of limestone that has the consistency of clay and which contains eroded Avon Park foraminifers and shells of a fresh-water mollusk. This separates the Inglis member from the Avon Park limestone and represents an erosional period prior to the deposition of the Inglis member. An increased mottling of gray in the Inglis member serves as an excellent top of the member in Pasco, Putnam and other counties where other markers are absent. In Polk County the Inglis member is a cemented granular mass of foraminifers, in part recrystallized. It underlies a thickened Williston member and may in part be represented by the *Peronella* bed of the Avon Park limestone. For instance, in well W-904 a normal section of the Inglis member, fifty feet thick, lies on top of a normal section of the *Peronella* bed, forty feet thick; whereas in well W-437 the *Peronella* bed contains Avon Park foraminifers as well as specimens of *Camerina vanderstoki*, *Amphistegina pinarensis cosdeni*, *Fabiania cubensis*, and apparently represents the Inglis member. In at least one well, W-1754, a thick sand zone separates the Inglis member from the Avon Park limestone. The sand contains *Peronella dalli* and Avon Park foraminifers in great abundance. The foraminifers appear eroded and specimens of the echinoid are cleansed of all adhering matrix and details are beautifully preserved as if etched.

*Detailed Geologic Exposures in Levy County:* The type locality of the Inglis member is in the vicinity of Inglis, where the limestone is exposed in several road metal pits and along the Withlacoochee River, in its



banks and the channel improvement spoils along them. The following section, about 1/8-mile below the Florida Power Corporation plant at Inglis, Florida, on the right bank of the Withlacoochee River in the southeast quarter of northwest quarter, Section 3, Township 17 South, Range 16 East, is typical of exposures along the river, see figure 20.

|                                                                                                                                                                                                                                                                                                                                   |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Locality L-135                                                                                                                                                                                                                                                                                                                    | Feet     |
| Pleistocene series                                                                                                                                                                                                                                                                                                                |          |
| Pamlico formation                                                                                                                                                                                                                                                                                                                 |          |
| 2) Quartz sand .....                                                                                                                                                                                                                                                                                                              | Variable |
| Unconformity                                                                                                                                                                                                                                                                                                                      |          |
| Upper Eocene series                                                                                                                                                                                                                                                                                                               |          |
| Moodys Branch formation                                                                                                                                                                                                                                                                                                           |          |
| Inglis member                                                                                                                                                                                                                                                                                                                     |          |
| 1) Cream to tan, soft, porous, but case-hardened and densely crystalline where weathered, massive, granular, miliolid, marine limestone. Contains numerous echinoids, particularly <i>Eupatagus mooreanus</i> , <i>Periarchus lyelli floridanus</i> , and associated foraminifers. Exposed to water level in the stream bank..... | 5.0      |
|                                                                                                                                                                                                                                                                                                                                   | <hr/>    |
| Total thickness                                                                                                                                                                                                                                                                                                                   | 5.0      |

The channel was improved in 1942 and the contact of the limestone facies with the underlying dolomite facies of the Inglis member was

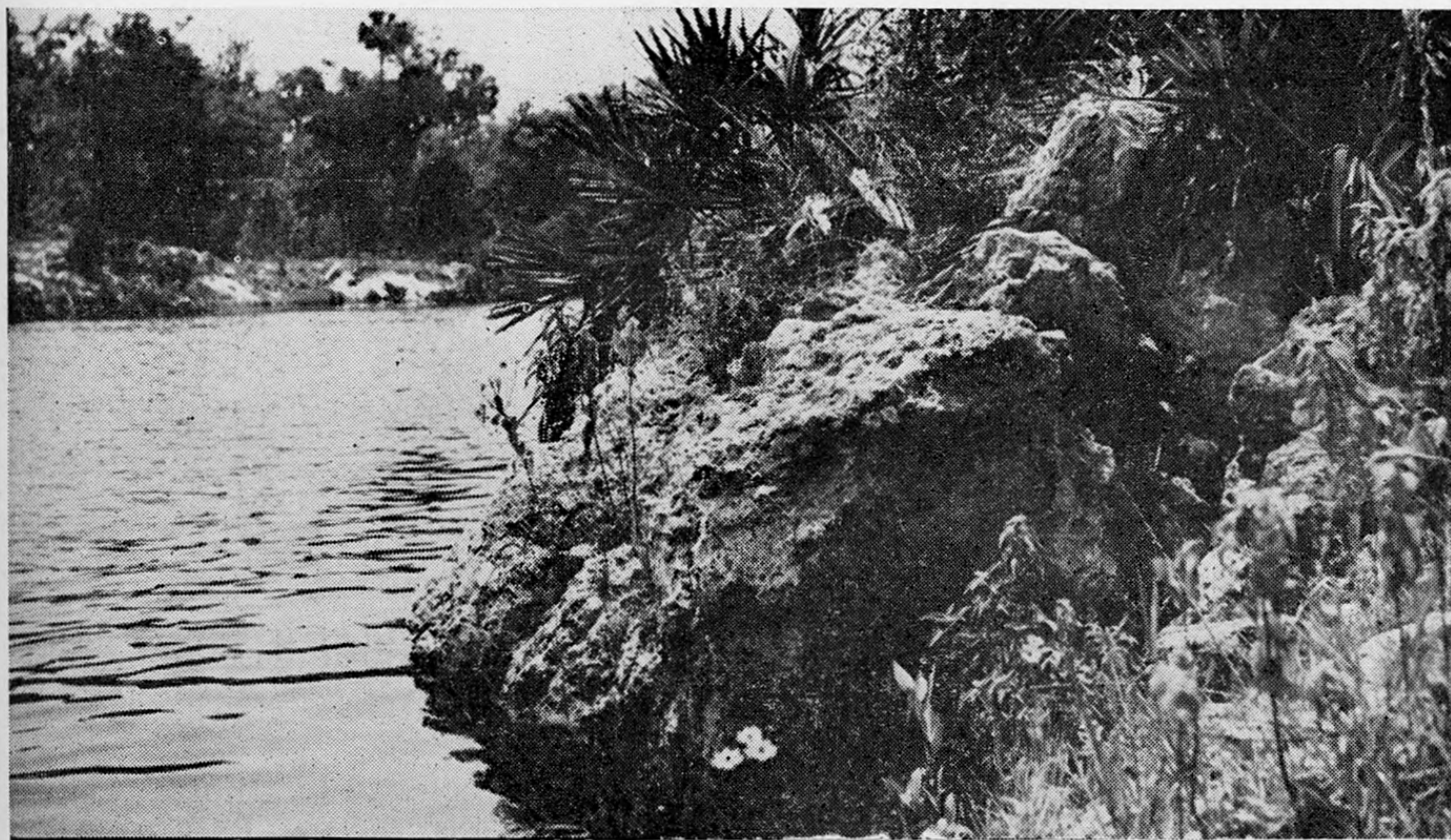


Figure 20. Locality L-135, one of the type exposures of the Inglis member, Moodys Branch formation.



penetrated. Boulders of the following lithologies can be seen along the banks of the river at locality L-135:

- 1) Gray, granular limestone as exposed along the river banks.
- 2) Cream-colored, soft, granular, porous miliolid limestone with specimens of *Velates floridanus*, Lucinid sp. "A", buckshot miliolids and echinoids. In addition to these Dr. H. B. Stenzel identified "*Cerithium*" n. sp., *Xenophora* sp., *Turritella carinata* Lea?, *Crassatella?* *flexura* Conrad, *Trachycardium* or *Trigonocardia* n. sp., and *Corbula* (*Caryocorbula*) *densata* Conrad or *C. alabamensis tecla* de Gregorio. Across the river in channel dredgings of similar rock, one *Aturia* sp. was found.
- 3) Mottled gray and brown, porous, finely crystalline, massive, sugary textured dolomite with rare molds of mollusks and *Periarchus lyelli floridanus*.

Probably the thickest exposure of the Inglis member in these counties is present at locality L-136 along a small stream that crosses State Road 40 in the northeast quarter southwest quarter, Section 1, Township 17 South, Range 16 East, 1-65/100 miles east of State Road 55 at the escarpment of the Pamlico-Wicomico terraces. An aggregate thickness of 11.35 feet of cream, soft, porous, massive limestone composed of foraminifers, broken shells and granular calcite in a pasty matrix lies below a variable thickness of sand of the Wicomico formation.

Numerous exposures of the limestone of the Inglis member are present throughout the broad hammock covering the area around Inglis, Levy County. The following localities are typical:

| Locality L-124:                                                                                                                        | Feet |
|----------------------------------------------------------------------------------------------------------------------------------------|------|
| 1) In a small pit located in the SW <sup>c</sup> SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 34, T. 16 S., R. 16 E. ....                    | 4.0  |
| Locality L-134:                                                                                                                        |      |
| 2) In a small pit east of section road south of Crackertown in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 3, T. 17 S., R. 16 E. ....   | 10.9 |
| Locality L-133:                                                                                                                        |      |
| 3) In a small pit in the NE <sup>c</sup> NW $\frac{1}{4}$ Sec. 5, T. 17 S., R. 16 E. ....                                              | 5.75 |
| Locality L-122:                                                                                                                        |      |
| 4) In SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 13, T. 16 S., R. 16 E., in timber road and fire lane west of road. (Barnacle facies) .... | 0.6  |
| Locality L-121:                                                                                                                        |      |
| 5) Along spring run in the center of NW $\frac{1}{4}$ Sec. 18, T. 16 S., R. 16 E. (Shrimp claw facies) ....                            | 2.25 |
| Locality L-130:                                                                                                                        |      |
| 6) In SW <sup>c</sup> Sec. 27, T. 16 S., R. 16 E., in solution holes and a natural bridge passing under the timber road ....           | 6.0  |
| Locality L-132:                                                                                                                        |      |
| 7) Center SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 31, T. 16 S., R. 16 E., in small pit south                                            |      |



of fork in a woods road. Cut by solution pits filled by sandy shell marl of the Pamlico formation.....6.15

Locality L-126:

- 8) In a small sump well at hunter's camp in SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 23, T. 16 S., R. 16 E., where the following section was made:

Pleistocene series

Pamlico formation

- 3) Hard, brown, porous dolomite containing *Chione cancellata* .....1.5

Unconformity

Upper Eocene series

Moodys Branch formation

Inglis member

- 2) Very soft, tan, finely crystalline dolomite.....0.25  
1) White to cream, pasty, dense, granular limestone with numerous echinoid fragments. Dolomitized at top irregularly and extending at least 5 feet below water level .....1.9

Water level

Exposed thickness 3.65

Locality L-114:

- 9) In sinks along a timber road in the NE  $\frac{1}{4}$  Sec. 2, T. 16 S., R. 15 E.....3.6

Locality L-115:

- 10) In a sink at Kelly Runnell's Camp Crazy (The Old Johnson's Place) in the SE  $\frac{1}{4}$  Sec. 1, T. 16 S., R. 15 E.....3.35

The base of the Inglis member has been dolomitized irregularly. The dolomite was penetrated by the core holes of the "Ship Canal", figure 14, wells W-1204 through W-1219, and was dredged from the Withlacoochee River during channel improvements. It is exposed in central Levy County northward from Inglis, toward the outcrop of the Avon Park limestone. Two exposures, easily reached, can be seen in the pit southeast of State Road 55 in the southeast quarter southeast quarter of Section 26, Township 16 South, Range 16 East; and in a small stream crossing the road at the section line of sections 26 and 35, Township 16 South, Range 16 East. The rock is a tan to brown, finely crystalline, massive bedded dolomite that contains impressions and molds of *Periarchus lyelli floridanus*.

The coast line and submarine shelf from Shell Point, Citrus County, north to the west line of Range 14 East is formed by limestone of the Moodys Branch formation. A series of collections of submarine rock exposures was made in Crystal and Waccasassa bays by shallow diving, and the locations of these are shown in Plate 1. Of the twelve samples



collected, all were limestone of the Inglis member except the two most westerly, which were limestone of the Williston member.

The broad hammock lying about the towns of Gulf Hammock, Wyly and Ellzey is paved with limestone of the Inglis member and limestone and dolomite of the Avon Park limestone. Some of these exposures have been discussed on pages 101 to 107. Along State Road 24 from Otter Creek to Wyly almost continuous exposures of the Inglis member are present and pits located in sections 4, 5 and 6 of Township 14 South, Range 15 East and sections 14 and 15 of Township 14 South, Range 14 East, penetrate a few feet of the limestone of the Inglis member. Excellent exposures also are found along the valley of Ten Mile Creek, south of the town of Gulf Hammock.

The best collections of mollusks of the Inglis member can be obtained from locality L-93, a road metal pit southwest of State Road 55, 2.9 miles south of the north limits of the town of Gulf Hammock in the southwest quarter, Section 34, Township 14 South, Range 16 East. Dolomite is exposed in the northeast corner of the pit and very indurated cream to tan, hard, dense limestone over the remainder. Boulders of this limestone contain numerous specimens of echinoids, particularly *Periarchus lyelli floridanus*, and well-preserved mollusks. A list of the mollusks is given on pages 119 to 121. The dolomite exposed in this pit is believed to be the base of the Inglis member and an excellent exposure of this rock can be seen at locality L-143 in the northwest corner, Section 10, Township 15 South, Range 16 East, where a pit has penetrated more than five feet of thin-bedded, very soft and friable, porous dolomite composed of silt-sized euhedral crystals. *Periarchus* fragments were found in the south end of the quarry. The dolomite is cut by solution pipes and holes that are filled by shell marl of the Pamlico formation.

The broad outcrop area present over most of central Levy County, northeast of State Road 55, is covered to variable depths by Pleistocene deposits and good exposures of the Inglis member are rare. Some are present along the Waccasassa River above and below Fishermans Bridge located in the northeast quarter, Section 32, Township 13 South, Range 16 East, see pages 101 to 104; along the upper course of Wekiva River and at locality L-101 at Wekiva Springs in the southeast corner, Section 12, Township 14 South, Range 16 East. From four feet above the water surface in the main spring to a depth of at least 9 feet, there is an excellent exposure of the shrimp-claw facies of the Inglis member. The rock is a cream-colored, pasty, indurated limestone that is filled with detrital grains of foraminifers, shrimp claws and broken mollusks. The



shrimp claws are very prominent and weather out to make sharp points on all the banks. The largest springhead is 29 feet deep but samples could not be collected below a depth of 9 feet.

The most westerly exposure of the Inglis member in Levy County is present in the central sections of the south half of Township 13 South, Range 13 East where a small dome has been breached by erosion and the limestone paves a hammock that occupies the dome. The limestone is exposed as pinnacles, ledges and in sinks through out the area and the better exposures are found as follows:

- 1) Locality L-55: In the SW  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 27 — pinnacles.
- 2) Locality L-53: On a hunter's road in a small sink in the SW<sup>c</sup> Sec. 22 — 2.25 feet exposed in the sink and 1.5 feet additional in the road.
- 3) Locality L-57: In a collapsed cavern at a hunter's camp south of a timber road in the NE<sup>c</sup> Sec. 28 — 2.6 feet of pasty mollusk facies.

West of Long Pond and about 1-1/2 miles south of Chiefland the Inglis member is extensively exposed in sinks and as pinnacles extending through the hammocks located there. The area is the upthrown block of the Long Pond fault and the Williston and Inglis are in contact in a sink located in a field east of the section road in the southwest quarter northwest quarter, Section 13, Township 12 South, Range 14 East, where the following section was made, see figure 21.

|                                                                                                                                                                           |      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Locality L-31                                                                                                                                                             | Feet |
| Pleistocene series                                                                                                                                                        |      |
| Wicomico formation?                                                                                                                                                       |      |
| 4) Quartz sand soil .....                                                                                                                                                 | 1.0  |
| Unconformity                                                                                                                                                              |      |
| Upper Eocene series                                                                                                                                                       |      |
| Moodys Branch formation                                                                                                                                                   |      |
| Williston member                                                                                                                                                          |      |
| 3) Typical <i>Camerina-coquina</i> in a cream-colored, pasty limestone .....                                                                                              | 5.0  |
| 2) Buff, pasty, hard, tough, porous limestone with numerous <i>Camerina vanderstoki</i> .....                                                                             | 1.0  |
| Inglis member — Elevation 25 feet                                                                                                                                         |      |
| 1) Light tan, weathering pink, massive, hard, porous limestone. Many mollusk molds, Peneroplid "X", <i>Camerina vanderstoki</i> , and rare <i>Fabiania cubensis</i> ..... | 1.25 |
| Total thickness                                                                                                                                                           | 8.25 |

The thickest section of the Inglis member in the Long Pond area is present at locality L-142 in a series of sinks located in the northeast





Figure 21. Contact of the Williston member on the Inglis member, Moodys Branch formation, exposed in a sink in SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 13, T. 12 S., R. 14 E. The hammer marks the contact.

quarter, Section 13, Township 12 South, Range 14 East, where 9 feet is exposed.

Five miles east of Chiefland and two miles south of Double Sink, located on the downthrown block of Long Pond fault, a structure believed to be a narrow steep fold has been breached by erosion and good exposures are present in several sinks. The contact of the Williston and Inglis members, figure 22, is exposed in a small sink west of State Road 49 in the southeast quarter northeast quarter, Section 34, Township 11 South, Range 15 East, where the following section is exposed on the north side:

| Locality L-20                                                                                   | Feet |
|-------------------------------------------------------------------------------------------------|------|
| Upper Eocene series                                                                             |      |
| Moodys Branch formation                                                                         |      |
| Williston member                                                                                |      |
| 2) Cream, red-stained, pasty <i>Camerina</i> -rich limestone                                    | 1.0  |
| Inglis member                                                                                   |      |
| 1) Cream, granular, hard limestone with <i>Periarchus lyelli</i><br><i>floridanus</i> fragments | 1.6  |
| Total thickness                                                                                 | 2.6  |

Two sinks on J. C. Hutchins' farm in the southeast quarter southeast quarter, Section 34, and a series of nine sinks in the south half of



Section 27, Township 11 South, Range 15 East, expose sections of the Inglis member, up to 11 feet thick. One of these sinks on George Coleman's farm in the southwest corner, southeast quarter, Section 27, exposes at locality L-18 more than 10 feet of the echinoid-mollusk limestone facies, the top of the section being at an elevation of 49 feet.



Figure 22. Contact of Williston and Inglis members, Moodys Branch formation, exposed on the northwest rim of a sink in SE ¼ NE ¼ Sec. 34, T. 11 S., R. 15 E. Note the abundance of echinoids at the top of the Inglis member.

The contact of the Inglis member with the Avon Park limestone is exposed along the Withlacoochee River at the dam of the Florida Power Corporation in the southwest quarter, southwest quarter, Section 8, Township 17 South, Range 17 East. The following section was made along the right bank of the river about 200 feet below the dam, see figure 18.

| Locality L-139                                                                                                                                                                                                | Feet |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Upper Eocene series                                                                                                                                                                                           |      |
| Moodys Branch formation                                                                                                                                                                                       |      |
| Inglis member                                                                                                                                                                                                 |      |
| 5) Tan, very soft, finely crystalline, massive dolomite containing abundant foraminifers, barnacle and mollusk molds, <i>Coskinolina</i> sections, shrimp claws and <i>Periarchus lyelli floridanus</i> ..... | 1.0  |
| 4) Similar dolomite containing pebbles of laminated dolomite and abundant nodular concretions of hard, brown                                                                                                  |      |



to gray, crystalline, dolomitic limestone. *Periarchus lyelli floridanus*, *Cassidulus ericsoni*, *C. globosus*, *Eupatagus mooreanus*, all dolomitized and deformed but beautifully preserved, sections of *Coskinolina*, *Dictyoconus* and *Lituonella*, impressions of Peneroplid sp. "X" and buckshot miliolids are present. Of the mollusks, specimens of *Volutospina petrosa* (Conrad), "*Cerithium*" n. sp., *Turritella* sp., *Globularia* sp., *Glycymeris* sp., Lucinid sp. "A", *Trachycardium* or *Trigonocardia* n. sp., *Chaina* sp., *Tellina* sp. near *T. eburnlopsis* Conrad have been identified<sup>21</sup>. Grades into bed 3 ..... 1.9

- 3) Tan, soft, finely crystalline, massive dolomite containing many molds of the mollusks above. The base contains boulders and pebbles of tan, laminated dolomite and many oxidized concretions. A reworked soil mantle developed on bed 2 ..... 2.15

#### Unconformity

##### Middle Eocene series

##### Avon Park limestone

- 2) Soft, tan, finely crystalline, platy dolomite, laminated by differing colors and textures of dolomite and by carbon residues of eel (?) grass and other plant remains. The top has many brown to tan concretions that are more calcareous than the matrix and elongate, meandering tubes that appear to be animal borings. Molds of the Avon Park microfauna are numerous — to water level ..... 1.4
- 1) Bed 2 visible below water ..... 1.5

#### Total thickness

6.95

Downstream an additional section, about 1.25 feet, of the platy dolomite of beds 2 and 1 is exposed, and appears to be a high area covered by sediments of the Inglis member. The whole section is topped and crevices are filled with fresh-water Pleistocene marl. Downstream, 250 yards below the dam at the bend in the river, there is a 1.5 foot exposure of this bed, a bluish-gray, fine-grained, sandy, argillaceous, soft but tough, massive marl containing many ostracods and these mollusks: *Polynices duplicatus* Say, *Planorbis* sp. cf. *P. disstoni* Dall, *Physa meigsii* Dall, *Terebra* sp., and a land snail. Several poorly preserved bones of a mastodon are also present in the marl, which is questionably correlated with the Lake Flirt marl of late glacial Wisconsin age.

Beds 3 and 4 of the section contain pebbles and boulders of laminated dolomite and concentrations of concretions that have been oxidized, limonite-coated and leached. Bed 3 appears to be reworked, containing

<sup>21</sup>H. B. Stenzel, November 12, 1947.



numerous animal(?) borings that extend into the underlying Avon Park limestone.

The section is slightly arched and ends eastward against a small fault, see figure 14. Additional evidence of structure is present at locality L-138, a barrow pit dug for the dam in the northwest quarter southwest quarter, Section 8, Township 17 South, Range 17 East. A ledge at water level on the southwest end of the pit exposes 2.5 feet of tan to cream, soft, finely granular, porous, friable coquina limestone containing many fragments of barnacles, *Fabiania cubensis*, *Coskinolina floridana*, *Elphidium* sp. "A.", *Lituonella floridana* and *Nonion advenum*. The limestone is similar in fauna with bed 5 of locality L-139 and an apparent dip northeast is indicated. The barnacle bed occurs at the base of the Inglis member and is a very satisfactory marker since the barnacle plates are easily recognized in well samples, even in dolomite. Several large silicified Ocala limestone boulders lie on the banks 50 feet to the south of locality L-138 and are well below their original position.



Figure 23. Exposure of the Inglis member, Moody Branch formation, in barrow pit for the Florida Power Corporation dam located in the NE  $\frac{1}{4}$  NW  $\frac{1}{4}$  SW  $\frac{1}{4}$ , Sec. 8, T. 17 S., R. 17 E., Levy County. Photograph taken facing southwest.

*Detailed Geologic Exposures in Citrus County:* The core holes of section E-E', figure 14, show that the Inglis member extends out from shore along the submarine shelf a distance of about 4-1/4 miles. The bed is present throughout the coastal hammock in northwestern Citrus County, west of State Road 55, and exposures are almost continuous, especially along the road south to Crystal River. East of State Road 55, northeast



of Red Level, sand of the Pamlico formation veneers the bed and exposures are less common. Good exposures in these areas are present as follows:

- 1) Locality C-1: Several pits in the SE  $\frac{1}{4}$  Sec. 4, T. 17 S., R. 16 E. — 5 to 8 feet thick.
- 2) Locality C-111: Along the road leading to locality C-1, in the SW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 3, T. 17 S., R. 16 E., a thin veneer of white to tan, porous, crumbly, coquina limestone, usually very friable and cross-bedded. The rock is composed essentially of specimens of *Coskinolina*, *Dictyoconus*, *Lituonella*, rare mollusks and *Periarchus lyelli floridanus*. The bed overlies limestone that is more typical of the Inglis member.
- 3) Several exposures along the bank of the lower part of Crystal River, see Plate 1.
- 4) Locality C-112: Boulders excavated from State Road 488 piled in the NW $\frac{1}{4}$  Sec. 29, T. 17 S., R. 17 E.
- 5) Locality C-114: In a pit between the old and new routes of State Road 55 in the SW $\frac{1}{4}$  Sec. 30, T. 17 S., R. 17 E. — 5 feet thick.

An excellent exposure of the Inglis member, all dolomite, is exposed one-quarter mile west of locality C-114 at the Golden Dolomite Company pit at Red Level, Citrus County, in the northwest quarter, southeast quarter, Section 25, Township 17 South, Range 16 East. Section made on the east end of the south pit, July 19, 1947:

| Locality C-115                                                                                                                                                                                                                                                                                                                                  | Feet       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Pleistocene series                                                                                                                                                                                                                                                                                                                              |            |
| Pamlico formation                                                                                                                                                                                                                                                                                                                               |            |
| 4) Red to tan, fine, argillaceous sand.....                                                                                                                                                                                                                                                                                                     | 3.0 to 5.0 |
| Unconformity                                                                                                                                                                                                                                                                                                                                    |            |
| Upper Eocene series                                                                                                                                                                                                                                                                                                                             |            |
| Moodys Branch formation                                                                                                                                                                                                                                                                                                                         |            |
| Inglis member                                                                                                                                                                                                                                                                                                                                   |            |
| 3) Tan, very soft, friable, finely crystalline, porous dolomite which grades laterally into hard dolomite. Contains spheres, rosettes and irregular masses of hard brown dolomite concretions, which are generally more calcareous than the matrix and the bedding planes continue across some but others are uniform and show no bedding ..... | 4.9        |
| 2) Tan, rather indurated, massive, somewhat porous, finely crystalline dolomite. Molds of <i>Periarchus lyelli floridanus</i> , <i>Eupatagus clevei</i> , <i>Corbula densata</i> , barnacle plates and irregular rounded masses, some of which resemble animal borings, are present.....                                                        | 4.85       |
| 1) Tan to brown, very soft and friable, rather dense, massive, finely crystalline dolomite, with no fossils noted .....                                                                                                                                                                                                                         | 1.35       |
| Maximum thickness                                                                                                                                                                                                                                                                                                                               | 16.1       |



Shot hole drillers report that they have drilled 55 feet in dolomite at locality C-115. Some of the boulders from the pit are filled with molds of barnacle plates, some of which are impressed on broad plant leaves. The Gulf Dolomite Company pit (abandoned) to the east exposes a similar section.

The outcrop of the Inglis member has been extended south and east at Crystal River, Florida, and is broken by an elongate outcrop of the Williston member that is preserved in a small graben. Exposures are fairly common and the better ones all in Township 18 South, Range 17 East, are located as follows:

| Locality C-32:                                                                                                                                                                      | Feet |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1) Small pit west of road in the center of the NE $\frac{1}{4}$ Section 9 .....                                                                                                     | 3.5  |
| Locality C-28:                                                                                                                                                                      |      |
| 2) In shallow sink depression in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ Section 11, covered by 25 ft. of sand .....                                                 | 3.1  |
| Locality C-35:                                                                                                                                                                      |      |
| 3) Across old State Road 55 in road pit in NE $\frac{1}{4}$ SE $\frac{1}{4}$ Section 17. Cut by solution holes that are filled with clay and sand containing pebble phosphate ..... | 3.0  |

The contact of the Williston and Inglis members is exposed in an abandoned road metal pit on the old route of State Road 55 in the center

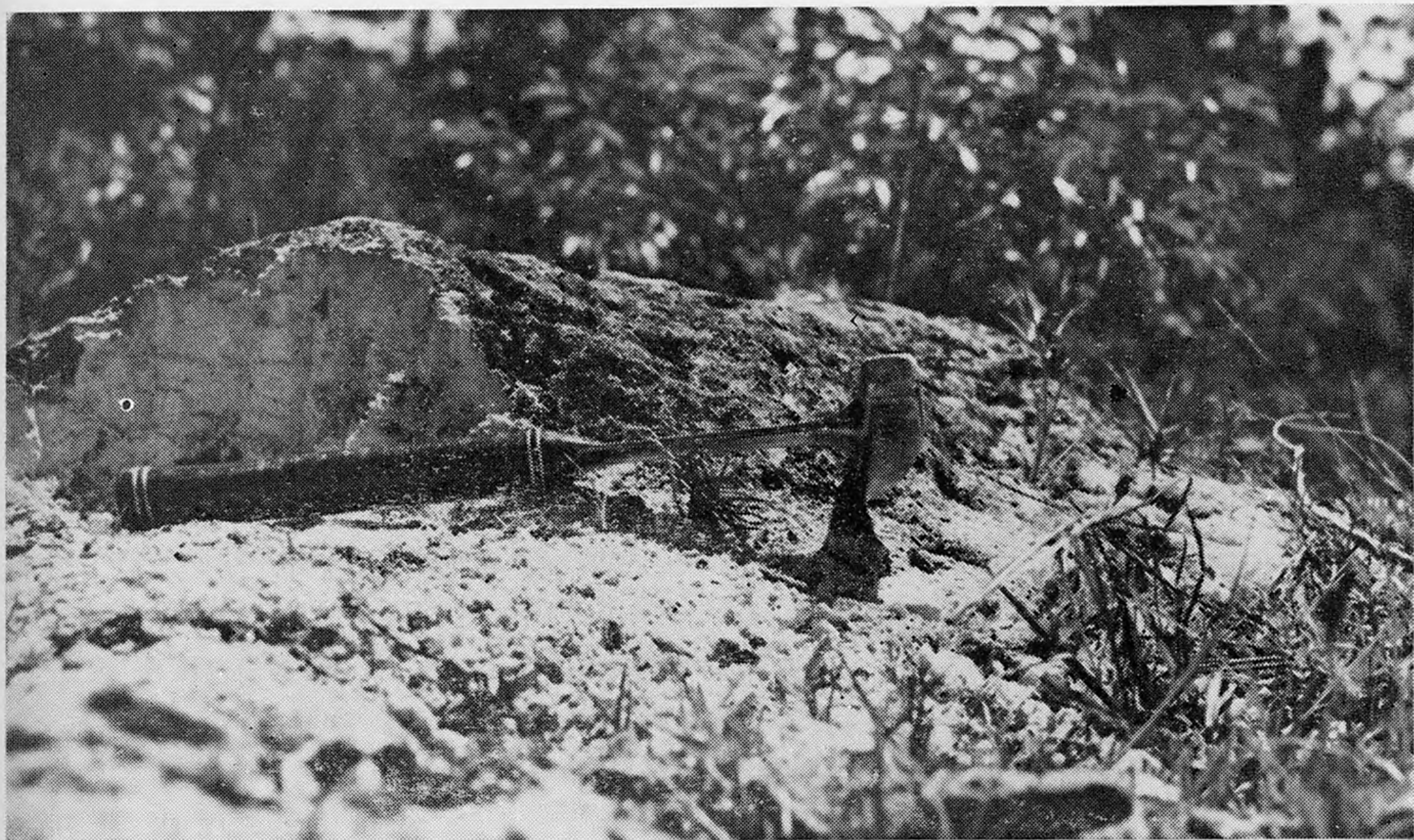


Figure 24. The granular miliolid limestone of the Williston member lying upon the echinoid-rich limestone of the Inglis member at locality C-24, in the center of the SW  $\frac{1}{4}$  Sec. 8, T. 18 S., R. 17 E., two and one-half miles northwest of Crystal River, Citrus County.



of the southwest quarter, Section 8, Township 18 South, Range 17 East, see figure 24. The following section was measured November 18, 1948, in the south end of the pit:

| Locality C-24                                                                                                                                                                                                                                                                                                                                                | Feet  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Upper Eocene series                                                                                                                                                                                                                                                                                                                                          |       |
| Moodys Branch formation                                                                                                                                                                                                                                                                                                                                      |       |
| Williston member                                                                                                                                                                                                                                                                                                                                             |       |
| 2) Tan to cream, soft, massive, granular, miliolid limestone with a pasty matrix, softer and more pasty than bed 1. Shrimp claws, starfish plates, <i>Reussella eocena</i> (Cushman), <i>Amphistegina pinarensis cosdeni</i> , <i>Cama-gueyia perplexa</i> Cole and Bermudez, <i>Nonionella hant-keni spissa</i> Cushman are present.....                    | 0.5   |
| Inglis member                                                                                                                                                                                                                                                                                                                                                |       |
| 1) Cream to tan, soft, porous (hard, dense and crystalline where weathered), granular, miliolid limestone containing many poorly preserved mollusk molds, <i>Eupatagus mooreanus</i> , <i>Periarchus lyelli floridanus</i> , <i>Fabiania cubensis</i> , <i>Camerina vanderstoki</i> and <i>Amphistegina pinarensis cosdeni</i> and associated ostracods..... | 3.0   |
|                                                                                                                                                                                                                                                                                                                                                              | ----- |
| Total thickness                                                                                                                                                                                                                                                                                                                                              | 3.5   |

Throughout the quarry floor there are numerous boulders of laminated, granular, concretionary, silicified, miliolid limestone with numerous molds of *Pecten* sp. and large foraminifers of the Ocala limestone.

The outcrop of northwestern Citrus County is separated from outcrops exposed over a dome-like fold, north of the town of Homosassa Springs, by a small synclinal fold. Exposures are present, in the vicinity, along State Road 55 and along all improved roads that lead to the coast, as pinnacles, pavements in swamps and in road cuts. The whole of the southwest quarter of Section 34, Township 18 South, Range 17 East, owned by Jerry Adair, is covered by the limestone.

Along the northeastern and southeastern edges of Citrus County the limestone of the Inglis member is the bedrock, being drawn out along the upthrown block of the Inverness fault. The entire area is veneered by the Alachua formation and Pleistocene sands. The phosphate occurring in the Alachua formation was formerly extensively mined here. Boulders of limestone mined from these pits are from the Inglis member in association with the silicified residuum of younger limestones. Good examples of these bounders are present at locality C-11 in the southwest quarter southeast quarter, Section 10, Township 18 South, Range 19 East, the last pit operated by the Dunnellon Phosphate Mining Company, where tan to brown limestone boulders containing echinoids and mol-



lusks of the Inglis member are present. The most easterly of four pits located southwest of Felica in the southeast quarter, northwest quarter, Section 15, Township 18 South, Range 19 East, show similar boulders.

An almost continuous exposure of the Moodys Branch formation is present above and below Stokes Ferry Bridge on the Withlacoochee River, and the Inglis member is the ground surface throughout much of the area in the vicinity of the bridge. The Inglis member in this area is a detrital limestone that is cross-bedded, see figure 25, and was apparently a beach deposit. It contains a fauna eroded from zone "B" of the Avon Park limestone and this fauna led to the early identification of these beds by some workers as Lake City limestone.

The following section was measured November 25, 1948, at Gray Eagle Fish Camp on the left bank of Withlacoochee River in the northwest quarter, northwest quarter, Section 30, Township 17 South, Range 20 East:

|                                                                                                                                                                                                                                                   |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Locality C-10                                                                                                                                                                                                                                     | Feet     |
| Pleistocene series                                                                                                                                                                                                                                |          |
| Pamlico formation                                                                                                                                                                                                                                 |          |
| 3) Sandy, tan to brown, shell marl with <i>Chione calcellata</i> ,<br>filling solution cavities.....                                                                                                                                              | Variable |
| Unconformity                                                                                                                                                                                                                                      |          |
| Upper Eocene series                                                                                                                                                                                                                               |          |
| Moodys Branch formation                                                                                                                                                                                                                           |          |
| Inglis member                                                                                                                                                                                                                                     |          |
| 2) Cream to tan, hard, partly silicified, massive limestone.<br>Large fracture blocks show exfoliation plates. <i>Cassidulus</i> sp. and <i>Periarchus</i> sp. fragments are present.<br>Makes rapids ½-mile upstream. Exposed to water level.... | 5.85     |
| 1) Limestone of bed 2, below water.....                                                                                                                                                                                                           | 3.0      |
| Thickness                                                                                                                                                                                                                                         | 8.85     |

Downstream one-quarter mile the Inglis is completely masked along the river by limestone of the Williston member but approximately 2-1/2 miles downstream on the left bank of the river in the southeast quarter, northwest quarter, Section 23, Township 17 South, Range 19 East, at locality C-7, the Inglis member is exposed 3.35 feet above and 3.0 feet below river level. The limestone is cream to light gray, cross-bedded, see figure 25, granular, detrital and contains a mixed fauna of the Avon Park limestone and the Inglis member. Specimens of *Periarchus lyelli floridanus*, *Lepidocyclina* sp. cf. *L. cedarkeysensis*, *Dictyoconus?* *gunteri*, *Coskinolina*, *Dictyoconus*, *Lituonella* are abundant and appear eroded





Figure 25. Cross-bedded limestone of the Inglis member, Moodys Branch formation, exposed on the left bank of the Withlacoochee River about two miles north of Stokes Ferry, Citrus County.

and calcite filled. Otherwise, the bed contains a normal fauna of mollusks, echinoids and foraminifers of the Inglis member and a lower Jackson age is indicated.

This detrital limestone is also found to the south of Stokes Ferry and good exposures are present as follows:

- 1) Locality C-85: Abandoned phosphate pit  $\frac{3}{4}$ -mile south of Inverness, Florida, in the SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 20, T. 19 S., R. 20 E. — Pinnacles up to 14 feet extending into the Alachua formation.
- 2) Locality C-71: In road metal pit on graded road  $\frac{1}{2}$ -mile north of State Road 44 in the NE<sup>c</sup> of Sec. 11, T. 19 S., R. 20 E. — 3 feet.
- 3) Locality C-91: In two abandoned road metal pits in the NW  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 34, T. 19 S., R. 20 E. — pinnacles up to 12 feet extending into the Alachua formation.
- 4) Locality C-82: Along timber road in the SE  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 18, T. 19 S., R. 21 E. — ledges.

A recently opened road metal pit in the southeast quarter, northeast quarter, Section 3, Township 20 South, Range 20 East, exposed the following section, which is typical of the occurrence of the Inglis member in this area.



| Locality C-9                                                                                                                                                                                                                                                                                                                                                                | Feet             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Miocene series?                                                                                                                                                                                                                                                                                                                                                             |                  |
| Alachua formation                                                                                                                                                                                                                                                                                                                                                           |                  |
| 4) Yellow to red, slightly argillaceous sand .....                                                                                                                                                                                                                                                                                                                          | Variable to 10.0 |
| 3) White to light-gray, phosphatic-clayey sand containing boulders and pebbles of phosphorite and laminated plate-rock. Lenses of red, argillaceous sand, boulders of silicified limestone and chert, and lenses of clay-phosphate. The phosphorite increases toward the base and the whole bed is slumped and bedded irregularly .....                                     | Variable to 25.0 |
| Unconformity                                                                                                                                                                                                                                                                                                                                                                |                  |
| Upper Eocene series                                                                                                                                                                                                                                                                                                                                                         |                  |
| Moodys Branch formation                                                                                                                                                                                                                                                                                                                                                     |                  |
| Inglis member                                                                                                                                                                                                                                                                                                                                                               |                  |
| 2) Pinnacles extending into beds 3 and 4. Top of highest pinnacle is a cream-colored, pasty limestone matrix with detrital grains of <i>Lepidocyclina</i> sp. cf. <i>L. cedarkeysensis</i> , <i>Periarchus</i> fragments, Lucinid sp., barnacle plates, numerous specimens of <i>Coskinolina floridana</i> , <i>Lituonella floridana</i> and <i>Elphidium</i> sp. "A" ..... | 0.15             |
| 1) Limestone above with no specimens of <i>Lepidocyclina</i> noted .....                                                                                                                                                                                                                                                                                                    | Variable to 12.0 |
| Thickness of section (all beds variable)                                                                                                                                                                                                                                                                                                                                    | 29.7             |

One of the most interesting exposures in northeastern Citrus County is located upon the Coharie-Okefenokee Sand Ridge in a deep solution pipe northwest of State Road 488 in southwest quarter, northwest quarter, Section 6, Township 17 South, Range 18 East, where the following section was measured February 18, 1948:

| Locality C-3                                                                                                                                                                            | Feet |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Pleistocene series                                                                                                                                                                      |      |
| Coharie-Okefenokee formations                                                                                                                                                           |      |
| 8) Loose quartz sand to top of hill .....                                                                                                                                               | 61.0 |
| Unconformity                                                                                                                                                                            |      |
| Upper Eocene series                                                                                                                                                                     |      |
| Moodys Branch formation                                                                                                                                                                 |      |
| Williston member                                                                                                                                                                        |      |
| 7) Tan to cream, soft, granular, chalky, miliolid limestone. <i>Camerina</i> sp. cf. <i>C. moodybranchensis</i> .....                                                                   | 3.0  |
| 6) Hard, granular, cream, miliolid limestone. <i>Camerina</i> sp. cf. <i>C. moodybranchensis</i> , <i>Lepidocyclina ocalana</i> var., <i>Gypsina</i> sp., <i>Heterostegina</i> sp. .... | 6.0  |
| 5) Cream-colored, soft, chalky, granular, miliolid limestone containing abundant echinoids and starfish os-                                                                             |      |



|                                                                                                                                       |       |
|---------------------------------------------------------------------------------------------------------------------------------------|-------|
| sicles. <i>Camerina</i> sp. cf. <i>C. moodybranchensis</i> (abundant), <i>Lepidocyclina ocalana</i> .....                             | 23.0  |
| Inglis member — Elevation 43.57 feet.                                                                                                 |       |
| 4) Same — somewhat harder and more fossiliferous, coarsely crystalline. <i>Camerina vanderstoki</i> and many echinoid fragments ..... | 4.0   |
| 3) Almost entirely echinoid fragments. <i>Periarchus</i> , <i>Eupatagus</i> (?) and starfish ossicles .....                           | 5.0   |
| 2) Hard, broken, coarsely crystalline, dense, dolomitic limestone .....                                                               | 7.0   |
| 1) Tan, porous, moldy, even-grained dolomite .....                                                                                    | 8.0   |
| Total thickness                                                                                                                       | 117.0 |

**Localities tabulated in Table 10. A checklist of Foraminifera  
of the Moodys Branch formation**

Citrus County

|                |                                                                                                                                                                              |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Locality C-1*: | Pit, NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 4, T. 17 S., R. 16 E. Sample A: top 6 inches, Sample B: composite of basal foot of 7.35-foot section.                            |
| C-5:           | Road cut, NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 4, T. 19 S., R. 17 E. Composite of a ledge.                                                                                 |
| C-6:           | In NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 17, T. 19 S., R. 20 E. Composite of a ledge.                                                                                       |
| C-7*:          | Left bank Withlacoochee River, SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 23, T. 17 S., R. 19 E. Sample A: top 18 inches, Sample B: basal 4 feet of 6.35-foot section.           |
| C-8:           | Left bank Withlacoochee River, one mile downstream from Stokes Ferry in NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 24, T. 17 S., R. 19 E. Composite of ledge 4 feet below water. |
| C-9*:          | Pit, SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 3, T. 20 S., R. 20 E. 12.15-foot pinnacle. Sample A: top 6 inches, Sample B: composite of basal 2 feet.                          |
| C-10*:         | Left bank Withlacoochee River, NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 30, T. 17 S., R. 20 E. Composite of 8.85-foot section.                                                 |
| C-20:          | Creek near Gulf, NE $\frac{1}{4}$ Sec. 5, T. 18 S., R. 16 E. Composite of 12-inch pinnacle.                                                                                  |
| C-31:          | At U. S. E. (d) B.M. CRC8 on Crystal River. Composite of 18-inch ledge.                                                                                                      |
| C-34*:         | Pit, SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 17, T. 18 S., R. 17 E. Composite of 5.8-foot section.                                                                            |
| C-35*:         | Pit on old Road 55, NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 17, T. 18 S., R. 17 E. Composite of 3-foot section.                                                               |
| C-61:          | Road Cut, SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 4, T. 19 S., R. 17 E. Composite of a 1-foot ledge.                                                                          |
| C-68:          | In N $\frac{1}{2}$ SW $\frac{1}{4}$ Sec. 10, T. 19 S., R. 17 E. Composite of 3.2-foot section.                                                                               |
| C-71*:         | Pit, NE <sup>c</sup> Sec. 11, T. 19 S., R. 20 E. Composite of 3-foot section.                                                                                                |
| C-77:          | In NW <sup>c</sup> NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 15, T. 19 S., R. 17 E. Composite of boulders.                                                                      |
| C-81:          | Road cut NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 16, T. 19 S., R. 20 E. Composite 8-foot section.                                                                             |



- C-82\*: Road Cut, SE  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 18, T. 19 S., R. 21 E. Composite of 20-inch ledge.
- C-85\*: Abandoned phosphate pit, SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 20, T. 19 S., R. 20 E. Composite of a pinnacle.
- C-91\*: Abandoned pits, NW  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 34, T. 19 S., R. 20 E. Composite of 12-foot pinnacle.
- C-92\*: Abandoned phosphate pit, SW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 9, T. 20 S., R. 20 E. Composite of 3-foot pinnacle.
- C-111\*: On timber road, SW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 3, T. 17 S., R. 16 E. Composite of 12-inch section.

## Levy County

- Locality L-5: Hickory Ford Camp, Ten Mile Creek, NE<sup>c</sup> SE  $\frac{1}{4}$  Sec. 19, T. 15 S., R. 16 E. Composite of 3.25-foot section.
- L-6: Abandoned phosphate pit, NW  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 9, T. 14 S., R. 19 E. Basal foot of 18.5-foot section.
- L-9\*: Pit east of road, SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 23, T. 11 S., R. 15 E. Composite of 13.0-foot section.
- L-12: Sink, NE<sup>c</sup> Sec. 30, T. 11 S., R. 15 E. Basal foot of 4.0-foot section.
- L-16: Left bank Suwannee River, NE  $\frac{1}{4}$  Sec. 6, T. 11 S., R. 14 E. Composite of 5.75-foot section.
- L-19: On road, C NW  $\frac{1}{4}$  Sec. 22, T. 14 S., R. 13 E. Composite of 17-inch section.
- L-23: Sink, NW<sup>c</sup> Sec. 4, T. 12 S., R. 18 E. Composite of 2-foot ledge.
- L-25: Pit, NE  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 5, T. 14 S., R. 15 E. Composite of 2.4-foot section.
- L-28\*: Road cut and sink, SW of road, SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 34, T. 12 S., R. 18 E. Sample A: composite of section in sink. Sample B: composite of exposure in road.
- L-30: Pit, NE  $\frac{1}{4}$  SE  $\frac{1}{4}$  Sec. 15, T. 14 S., R. 14 E. Composite of 3.0-foot section.
- L-32: In C SW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 31, T. 16 S., R. 16 E. Top foot of 5.8-foot section.
- L-36\*: Pit, NE  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 30, T. 12 S., R. 15 E. Sample A: top 2 feet. Sample B: 6 feet from base. Sample C: bottom 6 inches of a 12.0-foot section.
- L-37\*: Type locality Williston member, pit, SE  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 27, T. 12 S., R. 18 E. Top foot of 17.15-foot section.
- L-40: Road, SE  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 35, T. 16 S., R. 16 E. Composite of 3.0-foot section.
- L-42\*: Sink W of road NE<sup>c</sup> NW  $\frac{1}{4}$  Sec. 10, T. 13 S., R. 18 E. Composite of 9.3-foot section.
- L-45: In NW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 2, T. 17 S., R. 16 E. Composite of 18-inch ledge.
- L-49: In NE  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 6, T. 17 S., R. 16 E. Composite of 5.0-foot section.
- L-50: Dug well, hunters camp, Cummer Grade, SE  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 20, T. 13 S., R. 13 E. Composite of 4.0-foot section.
- L-51\*: SW Timber road, sink, SE  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 21, T. 13 S., R. 13 E. Composite of 3.9-foot section.
- L-54: Sump well, NE<sup>c</sup> Sec. 10, T. 15 S., R. 16 E. Composite of 2.5-foot section.



- L-56: In C NW  $\frac{1}{4}$  Sec. 26, T. 13 S., R. 13 E. Composite of 18-inch ledge.
- L-59: Stream, SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 25, T. 14 S., R. 16 E. Basal foot of 3.8-foot section.
- L-60: In C SE  $\frac{1}{4}$  SE  $\frac{1}{4}$  Sec. 10, T. 14 S., R. 16 E. Composite of 12-inch ledge.
- L-62: Stream, SW  $\frac{1}{4}$  SE  $\frac{1}{4}$  Sec. 3, T. 14 S., R. 16 E. Composite of 2.5-foot section.
- L-64\*: Sink, Lake Stafford, NE  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 35, T. 13 S., R. 18 E. Composite of 4.0-foot section.
- L-65: Right bank Withlacoochee River, SE  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 3, T. 17 S., R. 16 E. Composite of 5.0-foot section.
- L-69: Pit dug for gas tank, NW  $\frac{1}{4}$  NE  $\frac{1}{4}$  Sec. 1, T. 12 S., R. 14 E. Composite of 4.0-foot section.
- L-72\*: Natural well, Cummer Grade, NW  $\frac{1}{4}$  Sec. 9, T. 14 S., R. 13 E. Composite of 2.8-foot section.
- L-84\*: Ditch on road, NW  $\frac{1}{4}$  Sec. 27, T. 14 S., R. 13 E. Composite of 10-inch section.
- L-99: About 2 miles NE Corrigan Reef, about 2 miles offshore on line between Cedar Keys and Tripod Point. Composite of ledge 8 feet below water.
- L-101\*: Wekiva Springs, SE<sup>c</sup> Sec. 12, T. 14 S., R. 16 E. Sample 2 feet at top of 4.0-foot section exposed.
- L-104: Off Dry Creek in Waccasassa Bay. Composite of ledge in 5 feet of water.
- L-114\*: Sink east of timber road, NE  $\frac{1}{4}$  Sec. 2, T. 16 S., R. 15 E. Composite of 3.6-foot section.
- L-116: Tram bridge on stream, NW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 19, T. 15 S., R. 16 E. Composite of 3.3-foot section.
- L-121\*: Spring run, NW  $\frac{1}{4}$  Sec. 18, T. 16 S., R. 16 E. Composite of 2.25-foot section.
- L-122\*: Timber road and fire lane, SE  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 13, T. 16 S., R. 16 E. Composite of 6-inch section.
- L-130\*: Solution holes, SW<sup>c</sup> Sec. 27, T. 16 S., R. 16 E. Composite of 6.0-foot section.
- L-132\*: Pit, C SW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 31, T. 16 S., R. 16 E. Composite of 6-foot section.
- L-135\*: Right bank Withlacoochee River, SE  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 3, T. 17 S., R. 16 E. Composite of 5.0-foot section.
- L-136\*: Along stream, NW  $\frac{1}{4}$  SE  $\frac{1}{4}$  Sec. 1, T. 17 S., R. 16 E. Sample A: top 3 inches. Sample B: lower 2 feet of 11.3-foot section.
- L-138\*: Pit, NW  $\frac{1}{4}$  SW  $\frac{1}{4}$  Sec. 8, T. 17 S., R. 17 E. Composite of 2.5-foot section.
- M-1\*: Right bank Withlacoochee River, SE<sup>c</sup> Sec. 24, T. 17 S., R. 19 E. Sample A: top 10 inches. Sample B: basal 25 inches of 35-inch section. Sample C: composite 4-10 feet below water.
- M-2: Right bank Withlacoochee River, SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  Sec. 24, T. 17 S., R. 19 E. Composite of ledge 2 feet below water.
- M-3: Upstream, Stokes Ferry, right bank Withlacoochee River, C NW  $\frac{1}{4}$  Sec. 30, T. 17 S., R. 20 E. Composite of 2-foot section.

\* Locality described fully in the text.