Pebbles from within the nx

TABLE 15.—Complete Analyses of Phosphate Rock Samples.

Constituents	SAMPLES 1	2	3	4	5
	Hawthorn		Alachua	Bone Valley	Alachua
P_2O_5	25.82	28.83	28.95	34.50	35.33
CaO(*a*)	49.90	45.95	44.30	48.40	49.65
Fe_2O_3(*b*)	1.31	1.70	.66	1.23	.98
Al_2O_3	.61	.82	1.25	.62	.93
SiO_2	8.74	8.42	16.20	8.56	6.15
CO_2	4.98	4.86	3.92	1.82	1.76
Organic	.23	.12	.04	.09	.09
H_2O+	4.24	4.48	1.68	2.40	2.48
H_2O-	.19	.23	.08	.12	.29
Na_2O(*c*)	1.02	1.11	.33	.29	.21
K_2O(*c*)	.32	.34	.03	.04	.02
F	3.50	3.63	3.28	3.67	3.93
MgO	1.07	1.14	0.15	.27	.24
MnO	.03	.03	.03	.04	.14
Cl	.02	.02	.01	.02	.01
V_2O_5	.01	.01	.01	.02	.03
TiO_2	.06	.02	.01	.03	.06
Cr_2O_3	.00	.00	.00	.00	.00
U(*d*)	.02	.02	.01	.02	.00
SO_3(*e*)	.35	.37	.20	.15	.13
Total	102.42	102.10	101.14	102.29	102.43
Less F = O	1.47	1.53	1.38	1.54	1.65
Less Cl = O	.01	.01	.00	.01	.01
Corrected Total	100.94	100.56	99.76	100.74	100.77

Note: (*a*) This represents total of Ca, Sr, Ba present.
(*b*) This represents total iron, some of which may be present as ferrous ion.
(*c*) Determined gravimetrically.
(*d*) The state of occurrence of U is not known. Hence it is not listed in the form of an oxide. Sample 5 had .003% U.
(*e*) This represents total SO_3, some of which may be present as sulfide.

In Florida, if the phosphate has been derived from guano, fluorine could be derived from ground-water enrichment throughout the interval since deposition or from sea water; the Hawthorn phosphate being enriched as it was deposited, and that in the Alachua terrestrial deposits being enriched during the Pleistocene epoch when Florida was covered by marine waters. The uniformity of the fluorine content in the phosphate of several formations in Florida and the lack of a stratified enrichment of fluorine in any formation favors the introduction of fluorine in the phosphate of the Alachua formation at the time of phosphate fixation, during the reaction of phosphoric acid with limestone bedrock. Much work on the thermodynamics of phosphate formation remains to be done, but it is suggested that sufficient fluorine was absorbed in the phosphoric acids and ground water of the hard-rock phosphate area to convert the limestone directly to fluorapatites.

TABLE 15.—(Continued)

Spectroscopic Analysis

Per Cent	SAMPLES				
	1	2	3	4	5
Over 10%.....	Ca P	Ca P	Ca P	Ca P	Ca P
1.0–10.0%.....	Si Mg	Si Mg	Si	Si	Si
0.1–1.0%.....	Na Fe Al K	Na Fe Al K	Na Fe Al	Na Fe Al Mg	Na Fe Al Mg Mn
0.01–0.1%.....	Mn Ti V Zr Cu Zn Pb	Mn Ti V Zr Cu Zn Pb	Mn Ti V Zr Mg ..... Pb K	Mn Ti V Zr Cu Zn Pb K	Co Ti V Zr Cu Zn Pb K
0.001–0.01%.....	Ba B Mo Cr Ni	Ba B Mo Cr Ni	Ba B Mo Cr Ni Cu	Ba B Mo Cr Ni	Ba B Mo Cr Ni .....

Detailed Geologic Exposures: The most available exposure of the Alachua formation is located in the only operating hard-rock phosphate pit; the Section 12 Mine of Kibler-Camp Phosphate Enterprise, in the southwest quarter, northeast quarter, Section 12, Township 17 South, Range 18 East, where the following section was measured July 16, 1946.

Locality C-4 Feet

Pleistocene series

Coharie-Okefenokee formations

10) Tan to red and purple, unconsolidated, poorly sorted, fine to coarse quartz sand with a soil zone at the top. Thin beds are apparent in weathered exposures. Sand is coarser toward the base ..... 30.0 to 40.0

Unconformity

Miocene series (?)

Alachua formation

9) White to gray, unconsolidated, fine to medium quartz sand in a clay-phosphate matrix. Consolidated lenses

and irregular beds grade laterally and up into bed 10 ..... 0 to 10.0

8) Tan to brown, phosphoritic (?), sandy, blocky, fuller's earth-like clay, greatly slumped. Grades laterally into yellow, argillaceous, poorly consolidated and slumped, fine to medium quartz sand ..... 3.0 to 24.0

7) Light gray, friable, argillaceous, very fine to fine quartz sand. Grades into bed 8 ..... 3.0 to 18.0

6) Same as bed 5 but less phosphorite present and an increase in sand. Considerably slumped in north end of pit 4.0

5) ORE BED: Mottled red, gray and pastel colors of sandy clay-phosphate containing irregular lenses of white, argillaceous sand; gray to tan, blocky clay; large irregular purple, tan and brown masses of phosphate; phosphatic limestone; chert; silicified limestone; sand clusters and clay balls. The phosphate is concentrated toward the base and this bed extends into solution cavities of the underlying limestone and phosphate solutions have replaced portions of the bedrock ..... 11.0 to 27.0

4) Black to brown, fibrous peat present irregularly and grading into beds 3 and 5 ..... up to 0.3

3) Black sapropel or reworked organic matter containing no fossils ..... up to 0.3

2) Red, waxy, dense, blocky clay ..... 0.5 to 1.6

Unconformity

Middle Eocene series

Avon Park limestone

1) Gray to tan, hard, dense, massive, miliolid limestone containing fragments and molds of echinoids and mollusks, Peneroplid sp. "X", *Coskinolina floridana*, and *Dictyoconus cookei*. The top is a Karrenfeld, cut by solution pits and caverns, and portions of the limestone are silicified or replaced by laminary phosphate. The bed is largely below water level ..... pinnacles up to 17.0

The total thickness of the section is 96.6 feet as exposed in the north face of the pit, located on the escarpment of the Withlacoochee River. While the lithologies above were identifiable the section varies as if mixed and slumped in a large sink. On March 20, 1950, a new excavation, located 100 feet west of the section above, exposed a 15-foot pinnacle of cream, purple-tinted, soft, friable, mealy limestone with hard, crystalline nodules and leached specimens of *Lepidocyclina ocalana*, *Camerina* sp., a flat, tubular coral, *Pecten* sp. cf. *P. "perplanus"* and *Amusium ocalanum*. The pinnacle was slumped, broken, brecciated, contained slickensides and seams and joints filled with red, waxy, sandy

clay. The pinnacle of limestone is composed of the Williston member of the Moodys Branch formation and the base is at an elevation of 31 feet. The top of the Avon Park limestone, exposed 100 feet to the east, has an elevation of 23 feet and the two exposures indicate a shortened section, with the Inglis member of the Moodys Branch formation being absent. A small normal fault passes through the pit and the Williston member has been faulted against the Avon Park limestone.

In the vicinity of Crystal River, Citrus County, clay and sand of the Alachua formation have been deposited on fault breccia at the Crystal River Rock Company quarry, locality C-64, pages 165 to 167, see figure 36. In addition, almost every pit from which phosphate was mined exposes the upper beds of the Alachua formation but the lower bed, the ore, is generally under water.

Throughout Citrus and Levy counties in the area mapped as Alachua formation on figure 37 exposures can be found in pits, prospect holes, road cuts and in an occasional dug well. A few selected exposures are listed and some sections are given as follows:

1) Prospect pit approximately in the SW^{c} Sec. 22, T. 11 S., R. 17 E.

	Feet
Pleistocene series	
Coharie-Okefenokee formation	
2) Unconsolidated, brown, fine, quartz sand	5.75

Figure 36: The sand and clay of the Alachua formation filling a small graben to the right of the photograph and covering fault breccia on the northeast edge of the Crystal River Rock Company quarry, locality C-64, Citrus County. Photograph facing northwest down a gully.

Unconformity
Miocene series?
Alachua formation

1) Light gray, mottled tan and red, very fine sand in cream-colored clay-phosphate that stands in vertical faces and is locally indurated. Leached at the top of its clay ---------- 12.9

Thickness 18.65

2) In abandoned phosphate pit north of graded road, in the SE ¼ NE ¼ Sec. 18, T. 12 S., R. 18 E.

Pleistocene series — Feet
Coharie-Okefenokee formation

3) Brown, unconsolidated, fine quartz sand ---------- 13.0

Unconformity
Miocene series?
Alachua formation

2) Light gray, mottled cream and red, fine quartz sand in clay-phosphate matrix, containing boulders and pebbles of phosphatic limestone, phosphorite, chert, silicified limestone, limonite and weathered limestone ---------- 29.0

Unconformity
Upper Eocene series
Moodys Branch formation
Williston member

1) Two pinnacles of cream, soft, porous, detrital, massive limestone ---------- up to 5.0

Thickness of section 45.3

3) In a dug well in the NE ¼ NW ¼ Sec. 35, T. 14 S., R. 17 E.

Pleistocene series — Feet
Coharie-Okefenokee formation

2) Brown to gray, unconsolidated, fine quartz sand ---------- 5.75

Unconformity
Miocene series?
Alachua formation

1) Gray, brown to cream mottled, argillaceous, fine quartz sand in a clay-phosphate standing in vertical walls ---------- 12.5

Thickness of section 20.25

4) Abandoned phosphate pit at Hernando in the NW ¼ NE ¼ Sec. 26, T. 18 S., R. 19 E.

Pleistocene series — Feet
Coharie-Okefenokee formation

4) Brown to tan, unconsolidated, slightly argillaceous, very fine to fine quartz sand ---------- 11.4

Unconformity
Miocene series?
Alachua formation

3) Tan to gray, mottled, fine to medium quartz sand in a clay-phosphate, loosely consolidated, stands in steep-sided banks. Base contains phosphorite nodules 28.3
2) Covered 5.7

Unconformity
Upper Eocene series
Moodys Branch formation
Inglis member

1) Pinnacles of soft, very porous, detrital, cream limestone with *Periarchus lyelli floridanus* ..... up to 3.0

Thickness of section 45.4

5) Abandoned phosphate pit in the SE ¼ NW ¼ Sec. 35, T. 18 S., R. 19 E.

	Feet
Pleistocene series	
Coharie-Okefenokee formation	
3) Tan to red, unconsolidated quartz sand	3.0 to 28.0

Unconformity
Miocene series?
Alachua formation

2) Light gray to cream, fine quartz sands in a clay-phosphate matrix that weathers purple tinted and stands in vertical faces ..... 5.0 to 28.0
1) Tan to brown, phosphatic clay containing boulders and pebbles of phosphate rock, silicified limestone and chert, exposed above water 5.0

Thickness of section (beds variable) 38.0

6) On State Road 44, one mile from intersection with U. S. Highway 19 in the NE ¼ SW ¼ Sec. 9, T. 19 S., R. 20 E.

	Feet
Miocene series?	
Alachua formation	
2) Tan, argillaceous, quartz sand containing thin beds of nodular tan and white sandstone	5.75
1) Light gray to tan, mottled, tough, massive, fine-grained, quartz sand in clay-phosphate matrix. Irregular tan, leached sand and fuller's earth clay	8.1
Thickness of section	14.85

7) In abandoned phosphate pit in the SE ¼ Sec. 12, T. 20 S., R. 19 E.

	Feet
Pleistocene series	
Coharie-Okefenokee formation	
3) Loose, cream to tan, fine to coarse, quartz sand	up to 25.0

Unconformity
Miocene series?
Alachua formation

2) Light gray, fine quartz sand in clay-phosphate matrix, vertical faces. May lie on bed 1 or may replace it ... up to 20.0
1) Phosphate ore, composed of boulders, pebbles, colloidal phosphorite in a clay matrix, mixed with rubble of residuum of Ocala limestone ..... up to 25.0

Thickness of section (beds variable) 36.5

QUATERNARY SYSTEM

PLEISTOCENE SERIES

INTRODUCTION

The Pleistocene epoch in the United States has been divided into five glacial and four interglacial stages that are listed from the oldest to the youngest as follows:

Pleistocene series
Nebraskan glacial
Aftonian interglacial
Kansan glacial
Yarmouth interglacial
Illinoian glacial
Sangamon interglacial
Early Wisconsin (Iowan) glacial
Peorian interglacial
Late Wisconsin glacial
Recent series (interglacial)[29]

This classification is based on deposits and erosional surfaces associated with the movements of glacial ice in high latitudes. Fisk (1938, 1939, 1940), Cooke (1939, 1945) and Vernon (1942) have shown that each glacial advance in high latitudes reduced sea level to a degree corresponding to the amount of water required from the ocean to form the ice of the glacier. During each interglacial period the glaciers melted back to high latitudes and ocean basins were refilled. The drop of sea level followed by a rise in sea level, a glacial stage combined with an interglacial stage, constitute a cycle. The fluctuations of sea level in Florida during the Pleistocene epoch caused tremendous changes in marine current distribution, coastal erosion and deposition, stream gradients and these changes have been preserved over the State in the creation of five marine plains bordering the present coastline that are contemporaneous with five sets of alluvial surfaces extending up the valleys of

[29]The Recent was initiated at the beginning of the retreat of the last glacier in the Wisconsin stage.

the major stream systems. The youngest of these is the Recent submarine plain and the flood plain of modern streams. The deposits underlying each marine plain and the related fluviatile surface is a formational unit, separable by lithology, stratigraphic position and physiography, see pages 15 to 42. Four marine terraces and associated fluviatile surfaces have been recognized in this report.

Glacial ages are represented in Florida by unconformities that separate the formations one from another and from older bedrock. Each deposit rests upon an erosional surface that was formed during the preceding glacial period and modified by marine and stream currents as the deposit was formed upon it. Fresh-water marl, present along the Withlacoochee River, see locality L-139, page 130, is probably late Wisconsin in age, formed during a glacial stage. Little is known of its stratigraphic position but in lithology and fauna it resembles the Lake Flirt marl of southern Florida and is tentatively referred to that formation.

Formation Names: The Pleistocene formations recognized in Citrus and Levy counties are as follows:

TABLE 16

Formation	*Elevation of Shore Line*	*Age*
Coharie	220 feet	Aftonian interglacial stage
Okefenokee	150 feet	Yarmouth interglacial stage
Wicomico	100 feet	Sangamon interglacial stage
Pamlico	25 feet	Peorian interglacial stage
Lake Flirt	Fresh water	Late Wisconsin glacial stage

The history of the use of the terms Coharie, Wicomico, Pamlico and Lake Flirt is given in Cooke (1945, pp. 276, 281, 297 and 311), that of the Okefenokee in MacNeil (1950, p. 101). The terms as used in this report refer to the same stratigraphic intervals as those of Cooke and MacNeil but the age assignment differs from that of Cooke (1945, p. 17).

PRE-PLEISTOCENE SURFACE

In Citrus and Levy counties, the land surface upon which the Pleistocene sediments were formed is an erosional surface upon which valleys had been developed in a remnant of Eocene and Oligocene limestones that projected through Miocene deposits. The portion of the remnant that extended through these Miocene deposits was attacked by corrosive acids which formed a pock-marked and craggy limestone surface, referred to as a Karrenfeld in descriptions of guano islands. The continuing attack by acids caused the surface to collapse and a distinct Karst

topography was developed locally. Certain irregularities of structure, inherited by the area, controlled the high and low points of the pre-Pleistocene physiography and shattered rock along folds and faults localized phosphate mineralization and erosion. This erosional surface was flooded during the Pleistocene and leveled by the deposition of sands and clays, the hollows being filled and the hills thinly covered, with an occasional pinnacle extending to the surface.

The data developed from the field study and from well penetrations indicate that this surface has a relief of approximately 160 feet. The surface is highest in eastern Levy and Citrus counties where the immediately underlying bedrock is the Alachua formation. Since there are some high hills composed of Suwannee limestone in southern Citrus County which have no Pleistocene deposits capping them (see Section D-D′, figure 13) it can be inferred that probably most of Levy County and some parts of southern Citrus County were sufficiently high to extend through the Pleistocene seas.

The pre-Pleistocene drainage was partially controlled by structure and is reflected in present drainage. This is true especially along the Withlacoochee River where fresh-water Pleistocene marl deposits have been developed on the Eocene limestone that border the present stream course. These deposits lie three to five feet above present water levels on both sides of the Withlacoochee Valley and indicate that the pre-Pleistocene river occupied a higher course.

Because of the great amount of solution during and since the Pleistocene few details of this surface are visible on the outcrop and scattered well penetrations do not allow an adequate interpretation of its restoration.

Stratigraphy

Physiography and Outcrop Pattern: The distribution of the Pleistocene formation is shown rather generally on figure 2. The Coharie and Okefenokee formations crop out on the surface of the Coharie-Okefenokee Sand Ridge, and make a very irregular sand hill area. The marine sediments of the Wicomico and Pamlico formations crop out in irregular, elongate bands that parallel the modern coast line, and the alluvial sediments, largely sand bars of each formation, extend up the Suwannee River and are present as a small delta and as patches of alluvium along the Waccasassa River, having been formed by a larger stream that once occupied the Waccasassa Valley.

Small irregular patches of the Lake Flirt marl are present on the banks of the Withlacoochee River.

General Lithology: The Coharie and Okefenokee formations are fine to coarse, loosely cemented quartz sand. The two formations were inseparable in Citrus and Levy counties because of slumping and lack of accurate topographic maps. The sand is commonly coarser at the base and has a very poorly developed bedding.

The Wicomico formation is fine to medium, poorly cemented to loose, marine, quartz sand, and sandy clay alluvium. Only the upper part of the formation is exposed in these counties. The Pamlico formation has the most diversified lithology of any of the Pleistocene formations, being composed of irregular patches of sand alluvium; sandy clay alluvium; brackish-water clay; sand and marl; pasty, sandy, non-fossiliferous limestone presumed to have been a bay deposit; sandy, coquina marl and marly sand filled by mollusk shells that is locally dolomitized where it lies upon older dolomites.

Cave and sink deposits of red to cream, argillaceous sand and sandy clay are present over much of the area. These contain vertebrate bones and are referred as a unit to the Pleistocene with no attempt being made to subdivide the sediments.

Thickness: So little is known about the thickness of the Pleistocene formations because of slumping and a lack of well penetrations and exposures that a generalization can be made only by interpolation from geologic sections. Sand of the Coharie-Okefenokee formations reaches a maximum of 40 feet at locality C-4, Section 12 Mine, page 203, but based on outcrops the formations are probably much thicker.

Younger Pleistocene formations occur as thin irregular patches and narrow bands of sediments. The bands of sand of the Wicomico and Pamlico formations probably approach 30 feet in thickness, but the marine shell marl and limestone of the Pamlico formation do not exceed a thickness of 4 feet. Brackish-water deposits and deltaic deposits of the Pamlico formation are known by probings to exceed 15 and 20 feet in thickness respectively. Samples could not be obtained from these probings because of ground water.

The Lake Flirt marl is known from only two exposures where it is 1.5 feet thick.

Fauna: The Coharie, Okefenokee, and Wicomico formations contain no fossils in these counties but the Pamlico formation is very fossiliferous, containing brackish and marine mollusks and ostracods. The Lake Flirt

marl also contains abundant specimens of brackish- and fresh-water mollusks and octracods. These faunas are discussed under descriptions of detailed exposures.

Some of the phosphate pits and an occasional deposit of argillaceous sand and sandy clay that fills sinks and caverns in the Eocene limestones of the area contain vertebrate remains of Pleistocene age. Simpson (1929, p. 264) lists 25 genera and 26 species of plain-dwelling vertebrates of Pleistocene age that were taken from "Saber-tooth Cave" on D. J. Allen's farm, one mile northeast of Lecanto, Citrus County. In the vicinity of Williston, Levy County, Simpson (1929, pp. 270, 291) reported several localities where Pleistocene vertebrates have been found, and specimens of these are in the Florida State Geological Museum. The Survey collection also includes a large number of specimens collected from the Withlacoochee River, mixed with remains believed to be Pliocene and Miocene in age. The exact age of these Pleistocene remains, whether early, middle or late, has not been determined, but since the area was covered during interglacial stages and was a larger land mass during glacial stages, the animals probably lived in Florida at a time that glaciers were advancing in high latitudes, and perhaps were driven south by this ice. The remains of the animals are preserved in sinks and caverns, into which the animals were caught, died and were rapidly covered by sediment.

Detailed Geologic Exposures in Citrus and Levy Counties: The sands of the Coharie-Okefenokee formations lie unconformably upon the Alachua formation and descriptions of these sands are included in the geologic sections of the Alachua formation, pages 203 to 208. The ground surface of the Coharie-Okefenokee Sand Ridge is composed of these sands and road cuts along State roads 24 and 500 expose variable thicknesses.

The marine sand of the Wicomico formation crops out along a narrow band crossing western Citrus and central Levy counties, figure 2, and is exposed in excavations for roads that cross the outcrop. Ten feet of yellow-white, mottled, argillaceous marine sand is exposed at the Wekiva Creek bridge in the center of the southwest quarter, Section 11, Township 14 South, Range 16 East. In the vicinity of Bronson the marine sand apparently merges with alluvial deposits developed along a large stream that once occupied the Waccasassa River Valley. A clay pit southwest of a timber road in the southwest quarter, Section 32, Township 12 South, Range 17 East, exposes 1.7 feet of gray, very fine, quartz sand lying upon four feet of bluish-gray, mottled red and gray, very sandy, massive clay with blocky clay lenses. A clay pit east of a graded

road in the southeast quarter, northeast quarter, Section 20, Township 12 South, Range 17 East, exposes four feet of dark gray to brown, leached, fine quartz, sandy soil overlying 10.7 feet of red and gray mottled, massive, argillaceous, fine sand, with indurated lenses.

The sediments of the Pamlico formation crop out in western Citrus and western Levy counties, as irregular patches that fill depressions in, and pave the top of the Eocene limestone. They are present, also as sand bars along the Suwannee River Valley, as alluvium in a small delta in central Levy County and along the Waccasassa River Valley, and as a narrow band of marine sand along the Pamlico shore line, see figure 2. The formation includes many types of sediments which are described as follows:

Type 1) A white to cream-colored, very soft, porous, very sandy, massive, pasty to granular, somewhat waxy textured limestone that appears decomposed but is fresh, and is believed to have been formed in a brackish- to fresh-water bay. The bed is thin, exposures generally being a thin pavement up to 30 inches thick that covers older limestones. No distribution pattern was determined but exposures are present as follows:

Levy County:

a) Barrow ditches on both sides of State Road 24 in the SW ¼ Sec. 26, T. 13 S., R. 15 E., on Otter Creek.

b) Banks of streams that cross State Road 55 at Gulf Hammock, Florida.

c) In Gulf Hammock (swamp), Sec. 32, T. 14 S., R. 14 E.

d) Along the graded road running south of the town of Otter Creek, numerous exposures of the brackish-water limestone and also the shell marl (type 3).

e) On the banks of Wekiva Creek in the NE ¼, SE ¼, Sec. 16, T. 14 S., R. 16 E.

f) On Ten mile Creek, 150 feet northwest of State Road 55 in the SW^{c} NE ¼, SE ¼, Sec. 24, T. 15 S., R. 16 E.

Citrus County:

a) At road forks in the NE ¼, Sec. 28, T. 19 S., R. 17 E.

Type 2) A brackish-water deposit of which the following exposure is typical. A canal that drains into Long Pond in the SW ¼, NW ¼, Sec. 17, T. 12 S., R. 15 E., on State Road 55. Crops out in Levy County only.

Locality L-26 — Feet

Pleistocene series

Pamlico formation

4) Mottled red and gray sand, sandy clay, clay and blocky, silty clay, somewhat weathered and containing streaks of almost pure, argillaceous, fine quartz sand 4.1

3)	Chocolate-brown, sandy clay containing fragments of turtle shells, bones and oysters – the oysters being questionably in place	0.5
2)	Purple-gray, very sandy, shell marl, containing *Polynices duplicatus, Planorbis* sp. cf. *P. disstoni, Physa meigsii, Terebra* sp. and other fresh- and brackish-water mollusks, and several brackish-water octracod genera including *Cytheridella* sp.[30]	1.9
1)	Gray, argillaceous, well sorted, quartz sand, believed to extend downward to pinnacles of limestone. Grades laterally and upward into bed 2 and is coarser at the base. To water level	1.5
	Thickness of section	8.0

A fault passes through Long Pond, and the Inglis member of the Moodys Branch formation crops out on the high land to the west, but the area to the east is low-lying and is underlain by the deltaic sediments of the Pamlico formation.

Weathered deposits of locality L-26 are exposed in road cuts and pits along State Road 55, approximately one and 3.3 miles south of Chiefland.

Type 3) A shallow-water, marine deposit of tan to gray, shell marl and argillaceous sand containing abundant Pleistocene shells, including *Chione cancellata, Venus* sp., *Arca scalarina* and *Anamalocardia caloosana.* Locally indurated and occasionally dolomitized. The bed varies in thickness up to four feet and commonly grades upward into one to two feet of light-gray, argillaceous, fine to medium, sandy coquina of Pleistocene mollusks, which is leached at the top. No definite distribution of the marl is apparent but exposures were noted as follows:

Levy County:

a) Sections 21 and 23, T. 14 S., R. 16 E.
b) Wekiva Creek, NE ¼, SE ¼, Sec. 16, T. 14 S., R. 16 E.
c) Pits and exposures in hammock in sections 15, 16, 21, 22, 23, 27 and 28, T. 14 S., R. 16 E.
d) Graded road cut in SW^{c}, NE ¼, Sec. 15, T. 14 S., R. 16 E.
e) Mud pit dug for oil test well in SE ¼, SW ¼, Sec. 5, T. 14 S., R. 16 E.
f) Road metal pit south of State Road 55 in the NE ¼, SW ¼, Sec. 14, T. 15 S., R. 16 E.
g) In the NE ¼, SW ¼, Sec. 23, T. 16 S., R. 16 E.

Citrus County:

a) Left bank of Withlacoochee River at locality C-10 in the NW ¼, NW ¼, Sec. 30, T. 17 S., R. 20 E.

Type 4) Yellow to white, unconsolidated, slightly argillaceous, fine to medium, quartz sand deposited as a bar of the Suwannee River, as typified

[30]Identified by Dr. H. V. Howe of Louisiana State University.

by a 16.5-foot exposure in a road cut on "the Cummer Grade", an abandoned tram, in the center of the NW ¼, Sec. 9, T. 14 S., R. 13 E.

Type 5) Alluvium underlying delta and terrace of Waccasassa River Valley, figure 2, as penetrated by a dug well on Lewis Martin's farm in the NE ¼, Sec. 12, T. 11 S., R. 16 E., which exposed 4.8 feet of fine quartz sand overlying 7.3 feet of red, cream and green mottled, very sandy clay, locally indurated.

The Lake Flirt marl (?) of late Wisconsin glacial stage is exposed at locality L-139, pages 129 to 131, about 250 yards below the Florida Power Corporation dam on the right bank of the Withlacoochee River approximately in the northeast quarter, southwest quarter, Section 7, Township 17 South, Range 17 East. The description is not repeated here. The marl is also exposed on the right bank of the river about one mile downstream. These are the only exposures of the marl found in Citrus and Levy counties.

RECENT SERIES

Definition: The Recent alluvium includes all of the deposits associated with the streams of the area along courses occupied by these streams now and excludes the minor deposits associated with these streams but lying at elevations higher than the flood plains. These higher deposits are older and are believed to be Pleistocene in age.

Occurrence: All of the valleys of the larger streams and creeks in Citrus and Levy counties have flat bottoms which are covered annually by high water. These bottoms are alluvial fills of shallow irregular valleys, cut during the late Pleistocene when sea level was lower. These deposits are not mapped since it was impractical to map such narrow deposits at the scale of the map, Plate 1, and since it was believed that a Tertiary map would be more useful in interpreting the geological history of the area.

A well-developed flood plain is present in the valley of the Suwannee River and the valleys of all creeks that empty along the coast. These flood plains are clearly visible on aerial photographs of the two counties and their distribution is well-established. In general, these flood plains are well-developed only along the lower portions of the streams, the deposits being uniformly, although thinly, developed. Upstream, however, these deposits are discontinuous and very thin, and the limestone bedrock is exposed irregularly. In an area underlain by carbonates and well removed from an available and abundant source of clastic sediments the flood-plain deposits are, as expected, thin, irregular and very narrow. They occur as thin veneers over a limestone bedrock, or as bars, and occupy both sides of the stream valley, alternating from one side to the other, crossing at bends in the river course.

Lithology: The flood-plain deposits are gray to black, silty and sandy muds. During low and average water levels almost no load is carried by the spring fed streams of the area, but during high water periods vegetation muds, some silts and sands, and humic acids contribute minor loads. These streams are never heavily charged with sediment. The source of sediment is from swamps, undercut stream banks, and solution, and the resulting muds are colored by decaying vegetation and iron sulphide. Along the embayments of the coast and the mouths of the streams the muds are filled by brackish- and fresh-water mollusk shells, largely oyster and snails, which are abundant along the coast.

Fresh Water Marls: All streams of the two counties with the exception of the Withlacoochee River, have adjusted their courses to the topography of the area, and their deposits are as described above. The Withlacoochee River flows throughout most of its course in solid bedrock, and crosses the crest of the Ocala uplift in the vicinity of Dunnellon, Florida. From this point to the coast the river course is continuous in limestone and dolomite bedrock, the rock making banks standing up to six feet above the river level. Extremely thin veneers of gray to black, silty muds filled by oyster and snail shells are present along the river mouth.

South of Dunnellon, and upstream from the area where the river crosses the crest of the Ocala uplift, the river has been dammed by movement along the structure and the Tsala Apopka lakes have formed. These lakes are sediment traps and all the mechanically and much of the chemically transported load of the river is deposited in them. Gray to black, silty and sandy mud is present along all of the lowlands and swamps near lake margins. The lake basins are filled by an undetermined thickness of cream to gray, carbonaceous, calcareous mud filled with fresh-water mollusk shells, largely snails. The fresh-water marl can be observed most easily in Panasoffkee Lake, Sumter County, which empties into Lake Tsala Apopka. The basin of Panasoffkee Lake has been almost filled, and at low water level much of the lake is too shallow to navigate by flat-bottomed boats, the marl being covered by only inches of water. The marl and shells are well-consolidated at the bottom but a boat paddle can be pushed six to eight feet into the marl, it being held in partial suspension in the water as a pasty mass.

Peat and Muck: Nearly every pond and lake as well as the coastal lowlands in the counties contain beds of brown, fibrous peat; sandy muck and lenses of sapropel muds. These are interbedded with sand and sandy mud reworked from the lake basins, and the peat and muck are too thin to be of value as soil applicators.