

**STATE OF FLORIDA
STATE BOARD OF CONSERVATION
DIVISION OF GEOLOGY**

FLORIDA GEOLOGICAL SURVEY

Robert O. Vernon, Director

GEOLOGICAL BULLETIN NO. 48

GEOLOGY OF JEFFERSON COUNTY, FLORIDA

by
J. William Yon, Jr.

**TALLAHASSEE
1966**

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LETTER OF TRANSMITTAL



Florida Geological Survey

Tallahassee

October 1, 1966

Honorable Haydon Burns, *Chairman*
Florida State Board of Conservation
Tallahassee, Florida

Dear Governor Burns:

The Division of Geology, of the State Board of Conservation, is pleased to publish, as Florida Geological Survey Bulletin 48, a study of the geology and hydrology of Jefferson County, Florida. This report continues the series of coverage by county of the geologic and economic resources of the State.

It is hoped that a complete coverage of the State will lead to more comprehensive development of our mineral resources, particularly where these resources require large volumes and realize a low sales price. Only if a large reserve can be shown to be present in an area can such minerals be developed economically.

Respectfully yours,

Robert O. Vernon
Director and State Geologist

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Mr. and Mrs. Paul Appin gave freely of their information concerning the two deep oil tests in Jefferson County, and the writer is grateful to them.

Sincere appreciation is expressed to William Clark and Nevin Hoy of the United States Geological Survey for reading the manuscript and making very useful comments.

GEOLOGY OF JEFFERSON COUNTY, FLORIDA

By
J. William Yon, Jr.

INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this report was to make a detailed study of the geology of Jefferson County and to provide information needed for development of the mineral resources of the area.

The field work was begun in the summer of 1961 and was completed in the latter part of 1962. Where accessible, most of the surface geology was mapped and cuttings from numerous wells were examined for data on the subsurface geology. In conjunction with the geological studies, a survey was made of the mineral resources.

LOCATION OF AREA

Jefferson County is located in what is referred to as the Panhandle of Florida, as shown in figure 1. It bounds the State of Georgia on the north; Leon and Wakulla counties on the west; Taylor and Madison counties on the east; and the Gulf of Mexico on the south. Jefferson County is wedge-shaped being approximately 25 miles wide along its northern boundary and 6 miles wide along the southern boundary. The length of the county is 39 miles and it comprises an area of 598 square miles.

PREVIOUS INVESTIGATIONS

In many of the reports on the geology of Florida, reference is made to Jefferson County. However, only those reports which are countywide in aspect are mentioned below. Reports involving specifics of the county geology are indexed in the text where they have direct bearing on some specific phase of the geology.

A report by Sellards (1917, p. 85-139) is a reconnaissance study of the geology, mineral resources and springs of Jefferson County. The general geology of Jefferson County is discussed by Mossom (1926), Cooke and Mossom (1929), and Cooke (1945). The regional

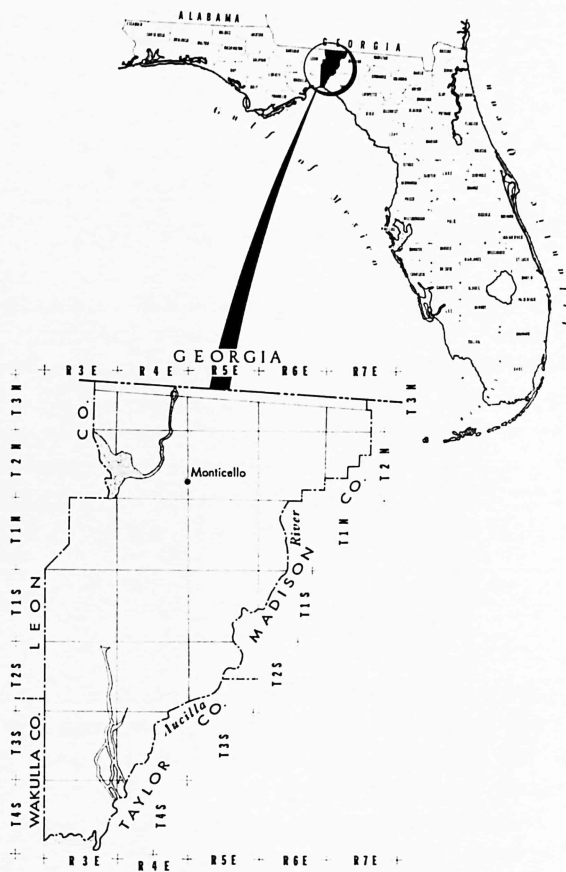


Figure 1. Map showing location of Jefferson County, Florida.

work of Applin and Applin (1944, 1947, 1951, 1955) is a major contribution to the understanding of the subsurface geology of not only Jefferson County but all of Florida.

MAPS

The maps used for plotting the field data were United States Geological Survey topographic maps, figure 2, and the Florida State Road Department general highway map for Jefferson County. The base map used in this report was compiled from the topographic maps.

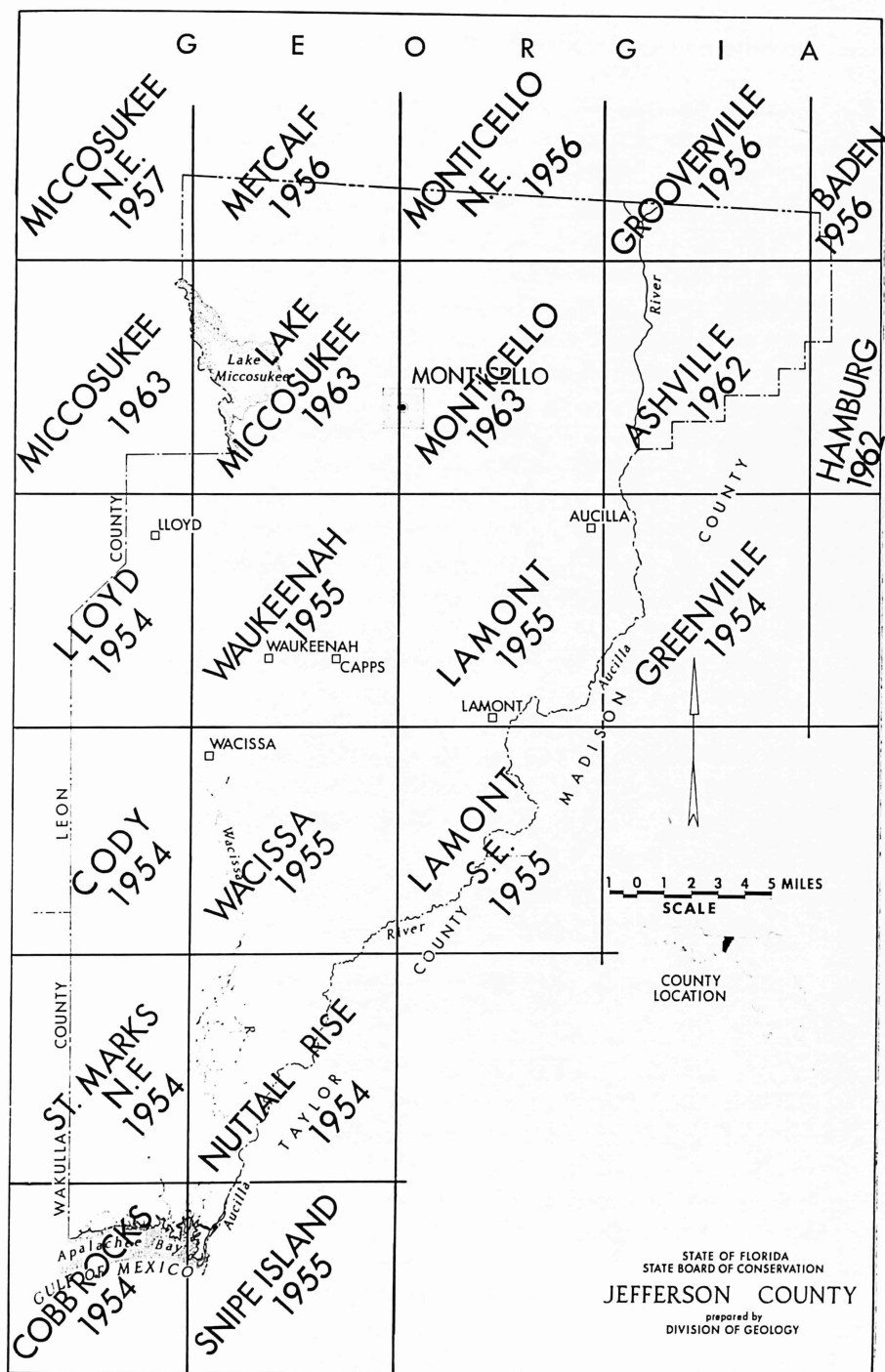


Figure 2. Index to Topographic maps of Jefferson County, Florida.

TRANSPORTATION

Jefferson County is served by two railroads, the Seaboard Air Line, and a branch line of the Atlantic Coast Line.

Three major highways traverse the county from west to east, U. S. 27, 90, and 98. The two major north-south highways are U. S. 19 and 221. Except for the southernmost part of the county there are many secondary paved roads that make the county accessible by car.

CLIMATE

Jefferson County is in an area of southeast wet continental and north Florida transitional climate. It has an average January temperature of about 57°F, an average July temperature of about 82°F and 9 to 10 months frost free. The average annual precipitation is 55 inches. Most of the rainfall occurs during the months of June through September.

POPULATION AND INDUSTRY

The population in Jefferson County for 1950, 1956, and 1960 is shown on table 1. The population figures in 1950 and 1960 are from the records of the U. S. Census Bureau, and the 1956 figure is from estimates by the Bureau of Economics and Business Research, University of Florida.

TABLE 1. Population of Jefferson County,
 1950, 1956, and 1960

1950	1956	1960	Percent change 1950-60
10,413	9,200	9,543	-8.4

Agriculture is the principal industry of Jefferson County; it has 190,000 acres in farms, and the farms average 342 acres. The county is a large producer of pecans and watermelons. Cattle raising, tung oil, and the dairy industry play an important role in the economy of the county. The percent of total land in forest is 73 percent or 248,000 acres.

WELL AND OUTCROP NUMBERING SYSTEM

The well and outcrop numbering system used in this report is based on the location of the well or outcrop and uses the rectangular system of section, township and range for identification. The well or outcrop number consists of six parts: W for well or L for outcrop, county abbreviation, the quarter/quarter location within the section, the section, township, and range.

The basic rectangle is the township which is 6 miles square. It is consecutively numbered by tiers both north and south of the Florida base line and is also consecutively numbered east and west of the principal meridian. In the present numbering system the T will be left off the township number and the R off the range number. Each township is divided equally into 36 square miles called sections, and are numbered 1 through 36 as shown on figure 3. The sections are divided into quarters with the quarters being labeled "a" through "d" as shown on figure 3. In turn, each of these quarters are divided into quarters with these quarter/quarter squares labeled "a" through "d."

An exception to the above system will be used for locations occurring above the Watson Line near the Georgia-Florida State line where irregular consecutively numbered sections are used and will be listed only by the irregular section number.

When there is more than one well or outcrop in a quarter/quarter section they are identified by a sixth number at the end of the fifth unit. The abbreviation used for counties in this report are Jf for Jefferson, Ln for Leon, Md for Madison, Ty for Taylor and Wk for Wakulla.

GEOLOGY

PHYSIOGRAPHY

INTRODUCTION

Cooke (1939, p. 14) divided Florida into the following five natural topographic regions: Coastal Lowlands, for all that area up to 100 feet in elevation; Western Highlands; Marianna Lowlands; Tallahassee Hills; and Central Highlands, for the generally higher, hilly, interior regions.

Vernon (1951, p. 16) proposed a genetic classification in which he recognized four of the following major physiographic divisions:

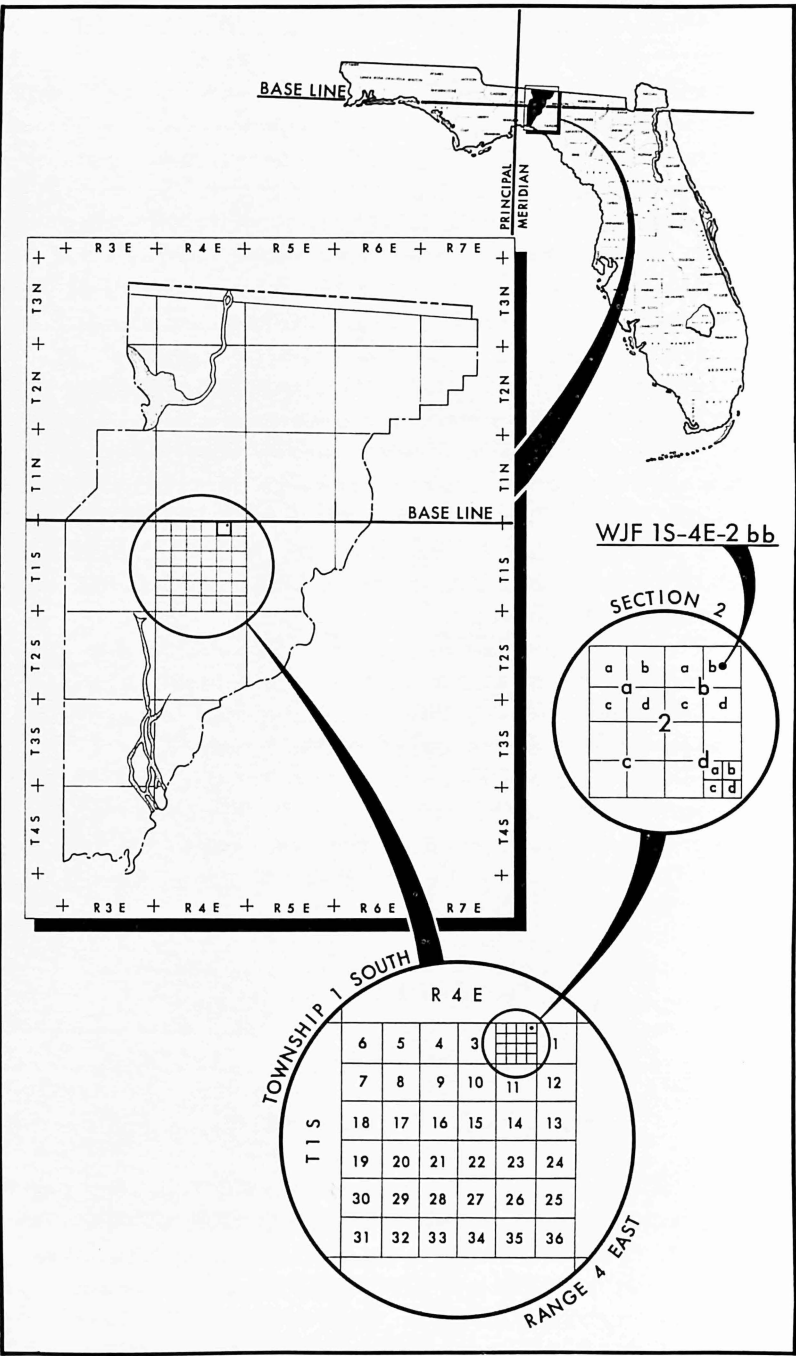


Figure 3. Well and Outcrop numbering system.

Delta Plain Highlands, Tertiary Highlands, Terraced Coastal Lowlands, and River Valley Lowlands. He (Vernon, 1951, p. 16) also stated that these major subdivisions could be further subdivided into smaller units and local names applied to them.

Based on his idea of origin for the physiographic units of Florida, Vernon (1951, p. 14, 16) made the following changes in Cooke's (1939, p. 14) terminology: Vernon replaced Cooke's Tallahassee Hills with Tertiary Highlands; included the Western Highlands and Central Highlands in the Delta Plain Highlands; substituted Terraced Coastal Lowlands for Coastal Lowlands; and River Valley Lowlands for Marianna Lowlands.

The Tertiary Highlands of Vernon (1951, p. 14, 16) include sediments formed either as a part of a high-level, widespread, aggradational delta plain, or of Tertiary sediments rising above this plain. The lowlands were formed by marine erosion and deposition along coastlines, stream erosion, and alluviation along stream valleys.

In the latest work on the physiography of Florida, White, Vernon and Puri (Puri and Vernon, 1964, p. 7-15) divide Florida into the following major groups: Coastal Lowlands, Intermediate Coastal Lowlands, Gulf Coastal Lowlands, Central Highlands, Northern Highlands, and the Marianna Lowlands. These primary divisions are subdivided into secondary and tertiary physiographic units.

The Northern Highlands extend across the northern part of Florida from Trail Ridge on the east side of the State and then westward to the Alabama state line (Puri and Vernon, 1964, p. 10). They are continuous except where interrupted by the Marianna Lowlands. The Northern Highlands are subdivided into the following secondary units: Trail Ridge, Florahome Valley, Tallahassee Hills, Grand Ridge, New Hope Ridge, Washington County Outliers, and the Western Highlands.

White, Puri and Vernon (Vernon and Puri, 1964, p. 13, 14) proposed three primary divisions to replace Vernon's Terraced Coastal Lowlands, and they are: Coastal Lowlands, the Intermediate Coastal Lowlands, and the Gulf Coastal Lowlands.

The deposits studied in this investigation lie within the East Gulf Coastal Plain, a subdivision of the Coastal Plain Province (Fenneman, 1938, p. 1-83). In Jefferson County the major physiographic divisions of Vernon (1951, p. 16), White, Vernon, and Puri are recognized, and include the following major divisions, figure 4: (1) Tallahassee Hills, (2) Gulf Coastal Low-

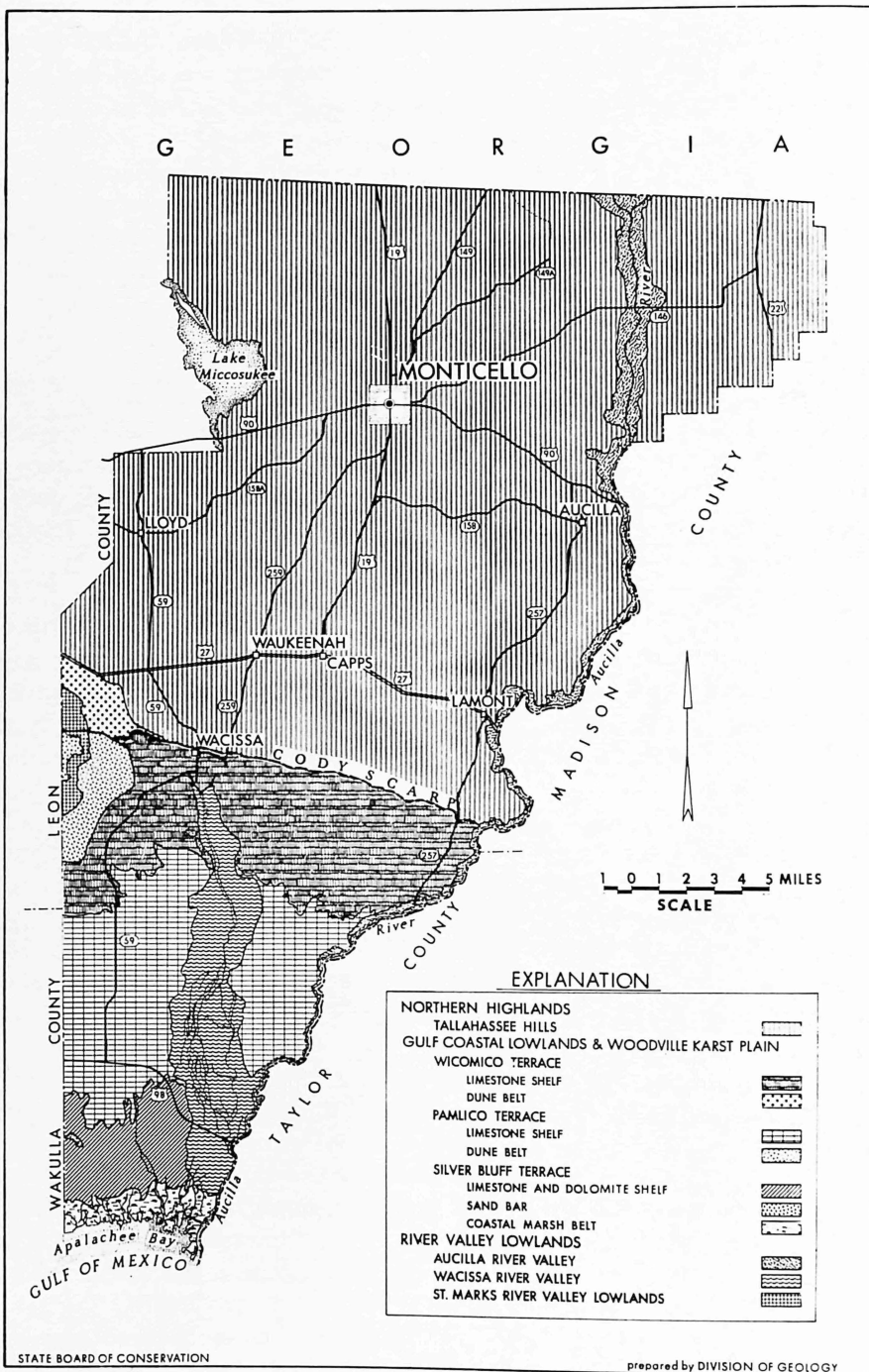


Figure 4. Physiographic map of Jefferson County, Florida.

lands, and (3) St. Marks, Wacissa and Aucilla River Valley Lowlands. A Tertiary unit, the Woodville Karst Plain (Hendry and Sproul, 1966) can be traced through Jefferson County.

NORTHERN HIGHLANDS

TALLAHASSEE HILLS

The term Tallahassee Hills includes the area lying between the Florida-Georgia State line on the north, the Gulf Coastal Lowlands on the south, the Withlacoochee River on the east, and the Apalachicola River on the west. In Jefferson County the Tallahassee Hills includes the area extending southward from the Florida-Georgia State line to the Gulf Coastal Lowlands.

The Tallahassee Hills are erosional-remnant hills and ridges with elevations up to 260 feet. Along the eastern side of the county there is a relatively large topographically low area associated with a number of isolated hills. Although the Tallahassee Hills in this area have been highly dissected by stream erosion and subsurface solution, they probably once represented a nearly flat Miocene delta plain that covered all of northern Jefferson County. The Tallahassee Hills are composed of a heterogeneous mass of clastics that comprise the Upper Miocene Miccosukee Formation and are underlain by the Middle Miocene Hawthorn Formation, and the Lower Miocene St. Marks Formation. Lake Miccosukee occurs within the Tallahassee Hills in western Jefferson County, and in many other places the Hills are interspersed with smaller lakes, streams, and narrow valleys.

The Tallahassee Hills end in the southern part of Jefferson County at a well defined southward-facing escarpment, figure 5, named the Cody Scarp (Puri and Vernon, 1964, p. 11). In the northeastern portion of Jefferson County the Aucilla River cuts through the Tallahassee Hills. Where the Aucilla River forms the county line boundary between Madison and Jefferson counties, the Tallahassee Hills have been separated by erosion from their counterpart to the east.

GULF COASTAL LOWLANDS

INTRODUCTION

The Pleistocene Epoch, or "Great Ice Age," is characterized by worldwide fluctuations in sea level. The periods of time when sea level was lowered are referred to as glacial stages. This was



Figure 5. View looking north towards the Cody Scarp in Jefferson County, Florida.

accomplished by the storing of large quantities of ocean's water as land-glaciers. The interglacial stages were those times when the glaciers receded, thus returning the water to the seas and causing a rise in sea level. During each of the interglacial stages, when sea level rose and remained stationary at one elevation, a terrace and shoreline was formed. According to Vernon (1951, p. 36) the older and higher shorelines and terraces are preserved because each succeeding rise in sea level during the interglacial stages never reached the height of the preceding older stand of the sea. Consequently, the record of the different sea levels during the interglacial stages show a progressive decrease in elevations.

Cooke (1954, p. 248) recognized eight marine terraces and shorelines in Florida. MacNeil (1950, p. 99) recognized only four terraces and shorelines. Vernon (1951, p. 36-41) considered that only four marine surfaces and shorelines exist in Florida. However, in a later report, Puri and Vernon (1959, p. 239-240), recognized another shoreline for a total of five marine terraces and shorelines.

Three marine terraces and shorelines are recognized in Jefferson County, as shown in figure 6. The approximate altitude of the shorelines and tentative age are shown in table 2.

TABLE 2. Pleistocene terraces in Jefferson County, Florida.

Terrace	Approximate altitude of shoreline (feet)	Tentative age assignment
Wicomico	40-45	Sangamon
Pamlico	26-30	Interglacial recession in Wisconsin glacial
Silver Bluff	10	Interglacial recession in Wisconsin glacial or Recent

The Gulf Coastal Lowlands in Jefferson County extend from the Cody Scarp to the coastline and consists of the three Pleistocene terraces and shorelines. The modern coast and submarine plain is included under the Gulf Coastal Lowlands.

Modern Submarine Plain and Coastline

The present coastline of Jefferson County is a low or zero energy shoreline (Price, 1953; Tanner, 1960). It is marshy, very irregular, and is dissected by several streams that originate at the inner edge of the coastal marshes. The absence of sand beaches and barriers along the coastline is attributed to the lack of wave activity and inadequate sand supply (Price, 1953; Tanner, 1960).

The modern submarine plain off the coast of Jefferson County has a gentle seaward slope and the waters covering it are shallow.

In an attempt to determine the nature of the sediments on the sea floor the following methods were used to collect data: sampled pinnacles which protrude above the surface of the water; through the use of self-contained underwater breathing apparatus; and evaluation of data obtained from the Corps of Engineers. The data obtained from the first two methods indicated that the submarine plain is a rock surface of silicified and dolomitized Suwannee Limestone. Two of the features shown on the U.S. Coast and Geodetic hydrograph 1261, the Grey Mare Rock and Cobb Rocks, can readily be seen from a boat. The Grey Mare Rock is a large pinnacle of silicified Suwannee Limestone, and the Cobb Rocks are dolomitized Suwannee. The Corps of Engineers prepared a bottom profile with logs of core borings along a proposed intracoastal waterway from St. Marks to Tampa Bay, Florida. (Survey Report of 1940, 1952, and 1956). Along the coast bordering Jefferson County the logs show that the rock surface is covered by a thin veneer of clastics. Oyster bars are very prevalent along the coast of Jefferson County, especially at the mouths of the creeks and the Aucilla River.

Silver Bluff Surface and Shoreline

The Silver Bluff shoreline is the term applied to a wave-cut notch occurring at an elevation of 5 feet at Silver Bluff near Miami (Parker and Cooke, 1944, p. 24).

The Silver Bluff shoreline was extended by MacNeil (1950, p. 104) to other parts of Florida and northern Georgia, and he considers the toe of the Silver Bluff scarp to occur at an elevation of 10 feet. As shown on the land-surface profiles (fig. 6), the small escarpment whose toe occurs at an elevation of 8 to 10 feet is considered to be the Silver Bluff strandline.

The Silver Bluff marine plain, the youngest and lowest of the coastal terraces, extends from the edge of the present coastline inward, four to six miles, to the 10-foot contour line, which marks the base of a small escarpment.

The coastal marshlands forming the outer part of the Silver Bluff marine plain consist of mud and silts that support grasses. Inland from the coastal marsh belt is a fairly flat, poorly drained sand area, with a prolific stand of cedar, palm, and pine trees. Beneath the clastics is a shelf composed of Suwannee Limestone which in places has been silicified or dolomitized. The formation crops out through the sand cover in many places and in ditches along logging roads.

The absence of barrier islands, the gentle slope of the Silver Bluff marine plain, and the poorly developed escarpment seem to indicate the coastline during Silver Bluff time was generally one of low or zero energy, with a sparse supply of sand. However, the feature shown on the physiographic map (fig. 4) along southwestern Jefferson County may have formed as an offshore bar or shoal.

Pamlico Surface and Shoreline

The Pamlico shoreline and terrace is one of the best developed Pleistocene features in Florida and can be recognized in most areas of the State.

The Pamlico shoreline and escarpment can be seen in western Jefferson County in the vicinity of Fanlew. The escarpment has approximately 8 to 10 feet of relief, and its toe occurs at an elevation of 26-30 feet. The Pamlico terrace covers the county from the shoreline of the Silver Bluff terrace inland for a distance of approximately 8 miles. The Pamlico terrace has formed a limestone plain that is covered by varying thicknesses of sands and clays. The Wacissa River flows across the terrace and gives rise

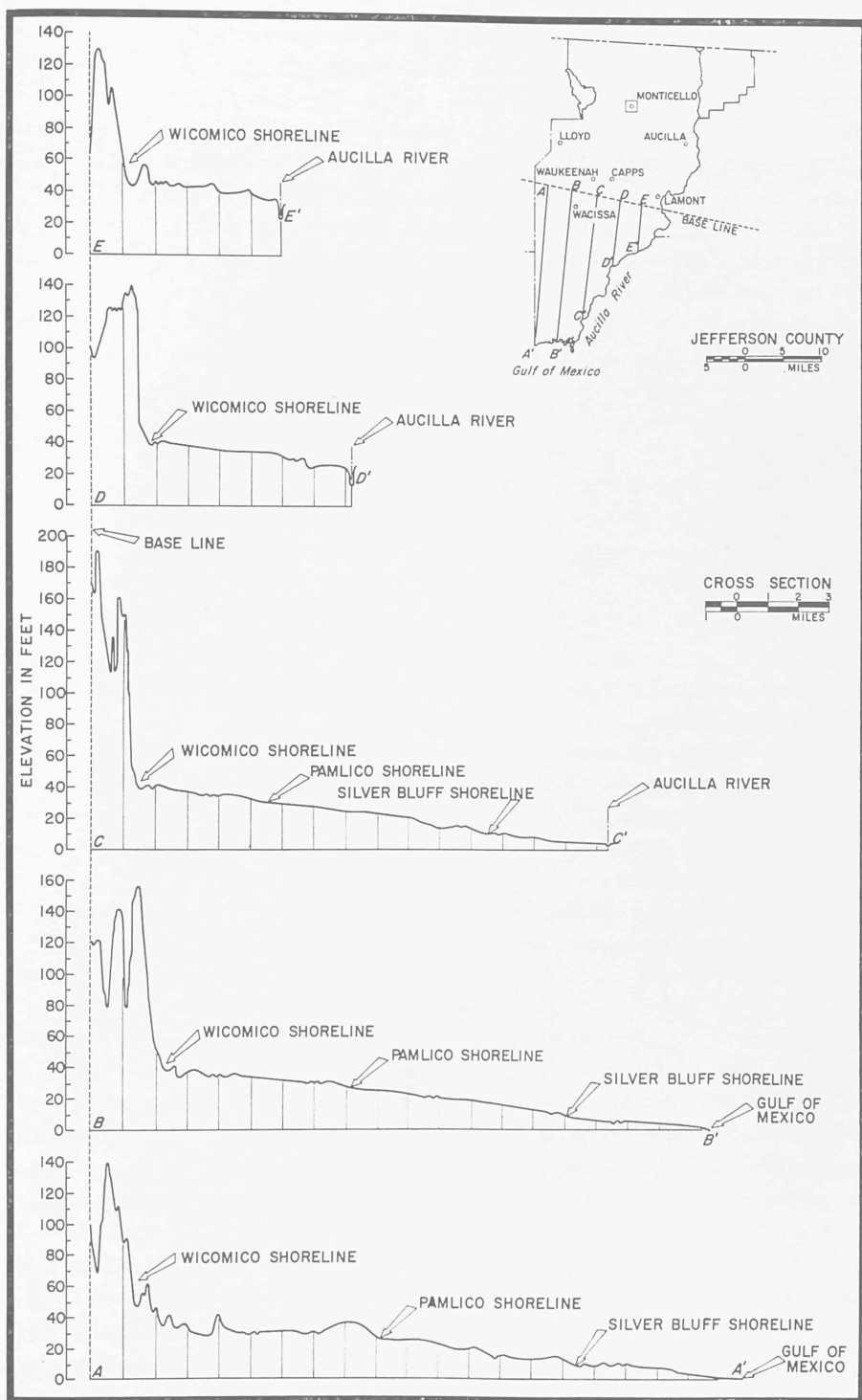


Figure 6. Surface profiles showing Pleistocene shorelines in Jefferson County, Florida.

to a broad swamp area along its course. In eastern Jefferson County the Pamlico terrace is fairly well drained, but to the west the drainage is poor and swamps are more prevalent. Palmetto, scrub oak, hardwood, and pine trees are very common on this surface. Calico Hill, a sand ridge with about 12 feet of relief and lying parallel to the Wacissa River, is probably a Pamlico dune (fig. 4). Inland from the Pamlico shoreline, in eastern Jefferson County, are found a series of crescent-shaped features which are believed to be sand dunes that have relief up to 20 feet. Outcrops of the St. Marks Formation and the Suwannee Limestone occur on the lower part of the terrace near the Silver Bluff shoreline. Montmorillonitic clays, containing weathered mollusk shells, were found at localities LJf-2S-3E-14-ac and LJf-2S-3E-15-center and are believed to have been deposited during Pamlico time.

A portion of the Pamlico shoreline, as shown in figure 6, was drawn by using recognizable escarpments. However, for the most part, the 30-foot contour was used to show the approximate position of the Pamlico shoreline.

Wicomico Surface and Shoreline

Cooke (1945, p. 281-286) places the shoreline for the Wicomico from 100-105 feet.

The Wicomico shoreline is believed to coincide with the Cody Scarp, whose base occurs at 40-45 feet, cutting across the southern part of Jefferson County. However, when the escarpment is traced westward into Leon County it rises to 100 feet and higher (C. W. Hendry, Jr. Personal Communication). This anomaly in elevation of an apparently similarly related feature is not uncommon in Florida where limestone lies near the ground surface and is readily susceptible to solution (White, 1958, p. 9-44). Yon and Puri (1962, p. 679-680) point out that the Wicomico shoreline in Gilchrist County, Florida, occurred at 70 feet because it had been lowered by solution of the underlying limestones. The Wicomico terrace in Jefferson County includes all of the area lying between the Pamlico shoreline and the Cody Scarp. The Wicomico marine plain extends across the width of the county and is approximately 4 to 5 miles wide, except on the western edge of Jefferson County where it becomes about 7 miles wide.

The Wicomico terrace deposits consist essentially of sands and clayey sands that have been deposited on top of a limestone shelf. The surface is generally poorly drained and swampy, especially on the flood plains of the Wacissa and St. Marks rivers. The western

side of the terrace contains a belt of sand dunes formed during the stand of the Pamlico seas.

An area of sandhills, covered with vegetation, with elevations 160 feet and higher, occurs inland from the Wicomico shoreline in Western Jefferson County and are interspersed with sinkhole lakes. It is believed these sand hills are Wicomico age deposits.

WOODVILLE KARST PLAIN

C. W. Hendry, Jr. (Personal Communication) proposes the term Woodville Karst Plain for a low, gently sloping plain beginning in the southern part of Leon County and extending southward through Wakulla County to the Gulf. He describes the plain as being characterized by sand dunes lying upon a limestone surface. The porous nature of the sands has readily permitted ground water to percolate downward, thereby causing dissolution of the limestone. The result of this solution has lead to a continuous and rapid lowering of the original surface. The area is characterized by the formation of shallow sand-bottom sinkholes. The Woodville Karst Plain extends into Jefferson County, and includes all the area mapped as the Gulf Coastal Lowlands (fig. 4).

The Woodville Karst Plain is not generally as well developed in Jefferson County as it is in Leon and Wakulla counties. The dune belt in northwestern Jefferson County best exhibits the characteristics of the Woodville Karst Plain as described by Hendry. The dunes appear to be barchan type with up to 20 feet of relief and are underlain by Miocene and Oligocene limestones that are soluble in percolating acidized water. Because of the collapse of the limestone, shallow sinkhole development is fairly prevalent.

RIVER VALLEY LOWLANDS

INTRODUCTION

The River Valley Lowlands consist of all the valleys in Jefferson County. A number of creeks originate within the Tallahassee Hills and flow into the St. Marks and Aucilla rivers. Most of them are laden with humic acids, are high in color, and carry very little sediment.

The Aucilla River forms part of the eastern boundary of Jefferson County and is the largest stream in the county. The St.

Marks River has its headwaters in Leon County, and only flows a few miles through Jefferson County.

The Wacissa River originates from a group of springs just below the town of Wacissa and flows southward into the Aucilla River.

The Penhook River heads up in the swamps occurring on the Pamlico surface and flows southward across the Coastal Marsh Belt into the Gulf.

A number of creeks originate at the head of the Coastal Marsh Belt in the lower part of Jefferson County and flow southward into the Gulf.

AUCILLA RIVER VALLEY LOWLANDS

The Aucilla River has its headwaters in Brooks County, Georgia, and flows southward along the eastern edge of Jefferson County to the Gulf of Mexico. From the Georgia-Florida State line southward to where U. S. Highway 90 crosses the Aucilla, the river flows in a valley approximately 1-mile wide that has been cut into Miccosukee and Hawthorn clastics. At times the Aucilla is almost dry, as shown in figure 7. However, during periods of high rainfall, the river overflows the small channel and broadens out to cover the entire valley, giving it the appearance of a lake. During periods of high water the main channel is not distinguishable, and swamp conditions are prevalent along the upper course. Why the valley of the Aucilla is considerably wider in the upper reaches than in the lower reaches presents an interesting problem. The configuration of the bedrock, figure 8, the reasonable closeness of the underlying rock to the land surface, and the narrow channel of the present stream occupying the broad valley, may point toward solution of the underlying limestone and subsequent collapse of the overlying sediments as an origin for the valley. However, it is possible that during higher stands of the Pleistocene seas, the valley was formed by progressive downward cutting of the stream as sea level fell.

To ascertain if river terraces occurred along the Aucilla River in the Tallahassee Hills area, a number of land-surface profiles compiled from topographic maps were drawn normal to the river's axis. Two stream-cut terraces above the flood plain of the Aucilla River show up in the profiles at approximately 10 and 40 feet. Higher fluvial surfaces may be present but erosion has altered the land surface to a degree that they are no longer apparent.



Figure 7. Aucilla River at low water stage in Jefferson County, Florida.

From where the Tallahassee Hills join the Gulf Coastal Lowlands the Aucilla River flows in a steep-walled valley cut into the Suwannee Limestone. Rapids flowing over silicified limestone are common. Terraces do not appear to have been formed along this section of the river. The flood plain is narrow, and during flood stage the river flows out over the surrounding area. From the point where State Highway 257 crosses the river to the point where the Aucilla disappears underground, outcrops of dolomitized Suwannee Limestone are almost continuous. From a point in section 21, T3S, R4E to Nutall Rise the river flows underground. The Aucilla River is joined by the Wacissa River in the vicinity of Nutall Rise, and flows on a southerly course to the Gulf. Springs are present along the Aucilla River southward from Nutall Rise to the Gulf of Mexico.

According to the Surface Water Branch, United States Geological Survey, the Aucilla River has an approximate drainage area of 740 square miles in Florida, which would include most of Jefferson County, almost half of Madison County, and a small portion of Taylor County.

Gum Creek, Wolf Creek, Beasleys Creek, and Jones Mill Creek and many others are tributary to the Aucilla River.

WACISSA RIVER VALLEY LOWLANDS

The Wacissa River's origin is a series of springs near the town of Wacissa in Jefferson County. The river is fairly shallow with rapids along its course, and flows across the Gulf Coastal Lowlands in a channel cut into Suwannee Limestone and the St. Marks Formation. The flood plain of the river is 1 to 3 miles wide and although ill-defined in some areas, it is distinguishable as swamps on aerial photographs. Stream terraces are not visible along the river's valley.

Near the confluence of the Wacissa and Aucilla rivers, the Wacissa becomes a multichanneled stream. Observation of aerial photographs shows that the bends in the river seem to indicate that some of these channels are oriented with northwest-southeast, and northeast-southwest linear trends. It is also possible that the bedrock is dolomitized or silicified and offering considerable resistance to erosion; consequently, the stream, in seeking zones of less resistance has formed multichannels. The water is clear in the upper reaches of the Wacissa because the source is springs, but in the lower reaches it becomes charged with humic acid waters from the swamps, and is high in color.

Welaunee and Cow creeks are tributary to the Wacissa River.

ST. MARKS RIVER VALLEY LOWLANDS

The St. Marks River has its headwaters in Leon County and only flows a few miles through Jefferson County. The river is sluggish and flows in a valley approximately a mile wide. Along most of its course swampy conditions prevail, and the river water is charged with humic acids giving it a high color. The course of the river in Jefferson County seems to be somewhat controlled by the dunes. The Cody Quadrangle map shows that the river has a meandering course that is oriented with dune development. In the area where the St. Marks leaves Jefferson County the flood plain of the river is very swampy and difficult to delineate.

Tributary to the St. Marks are Burnt Mill Creek (enters the St. Marks in Leon County), Sweetwater and Moore branches.

Sellards (1910, p. 61) believed that a stream flowed through what is now Lake Miccosukee basin into the St. Marks River. He also stated that Lloyd Creek during periods of excessive runoff emptied into the St. Marks River.

LAKES

Sellards (1910, p. 47-76) published significant information on lakes in Florida. He discussed lakes in the State that were peculiar in character and manner of development. He concluded that most of the shallow lakes in Florida, which included Lake Miccosukee in Jefferson County, were originally stream channels that have been lowered by solution, and greatly enlarged laterally by the formation of sinkholes. He noted that as each new sink formed, the older sinks became clogged and partially filled with sediments washed into them from the lake basins in which they occur.

White (1958, p. 66-73) believes that most of Florida's shallow lakes are the result of solution along the surface of the underlying limestone caused by lateral movement of the ground water over the soluble limestone. The depth that solution takes place is controlled by the depth at which the lateral movement of the ground-water table occurs. White (1958, p. 66-73) further states that basin excavation by sinks might be the reason why the water in the lake basins has disappeared, rather than why the lakes have formed.

Lake Miccosukee, located in the Tallahassee Hills province, is irregular in shape with an area of about 5,000 acres. Located near the north end of the lake is a sinkhole, which has been ringed by an earthen dam to prevent the sinkhole from draining water from the lake. Wards Creek which enters the southeast end of the lake is an intermittent stream that only supplies water to the lake basin during periods of high runoff. The main source of water for the lake is from rainfall in the immediate area. The growth of aquatic vegetation is so prolific in parts of the lake that boat travel is restricted to channels cut through the vegetation.

When the water level of the lake is normal or above its normal stage, surface flow occurs through an outlet in the southern part of the lake. Northeast of Lloyd a series of sinkholes lie along the course of the drain and captures much of the water. According to Sellards (1910, p. 61):

"Lake Miccosukee probably represents a basin developed by solution near the headwaters of streams originally tributary to St. Marks River. Previous to the formation of Miccosukee Basin the drainage of this part of the county doubtless passed through small streams, to the south past the present village of Lloyds, then to the Gulf through the St. Marks River."

The bedrock map, figure 8, indicates that Lake Miccosukee overlies a basin in the limestone. It appears from the available data that the Miocene St. Marks Formation is missing, and the basin is formed in the Oligocene Suwannee Limestone.

The piezometric surface in the area around Lake Miccosukee is 40 to 60 feet above mean sea level, and 20 to 40 feet below the lake surface. Consequently, ground-water recharge is taking place through the sinkholes in the lake region.

SPRINGS

The springs that form the headwaters of the Wacissa River are discussed by Ferguson and others (1947, p. 88-91), and except for the measurements made on Big Spring and Blue Spring on December 7, 1960, they state:

WACISSA SPRINGS AT WACISSA

“Location—The group of springs known as Wacissa Springs are located 1 mile south of the town of Wacissa.

Description—These springs comprise the headwaters of Wacissa River and are located within 0.8 mile of the head of the Wacissa River.

Wacissa Springs are composed of the following springs: Big Spring, Garner Springs, Blue Spring, Buzzard Log Springs, Minnow Spring, Cassidy Spring, two apparently unnamed springs herein designated as No. 1 and No. 2, Thomas Spring, and Log Springs.

BIG SPRING

Big Spring, sometimes known as Big Blue Spring, consists of a circular pool approximately 90 feet in diameter. Having a cavity about 70 feet in diameter whose side walls drop almost vertically to a depth of about 40 feet. The cavity is in limestone which appears to be cavernous on both the east and west sides. Soundings indicate a maximum depth of 45 feet. The bottom of the pool is covered with a layer of silt approximately one foot in depth. The average depth of the pool away from the cavity varies from 2 to 5 feet. The spring flow discharges into two runs, one flowing southwest and the other flowing northwest, both entering the Wacissa River within 0.2 mile of each other. The runs are full of eel grass and measurements of the discharge are made very difficult. The run

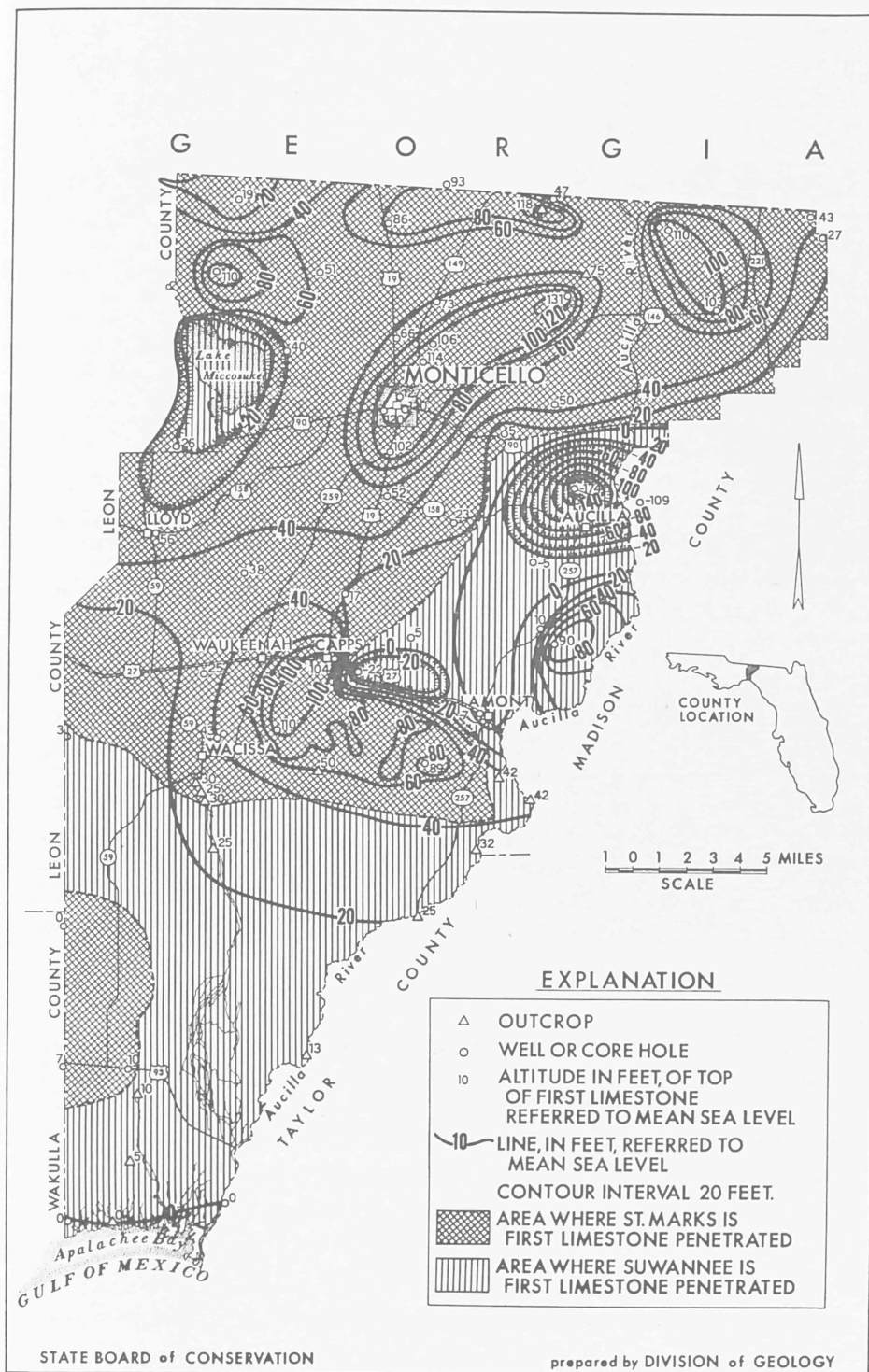


Figure 8. Contours showing approximate altitude of the top of the first limestone in Jefferson County, Florida.

flowing northwest is approximately 0.2 mile in length and 80 feet in width, the dimensions of the other were not determined.

GARNER SPRINGS

Garner Springs consists of two headpools. In the smaller a limestone cavity, 8 feet in diameter, has a maximum depth of 6.3 feet. It was impracticable to get to the larger of the springheads because its outlet channel was obstructed by fallen trees. This spring run is approximately 800 feet long and 50 feet in width and is full of eel grass and other aquatic growth.

BLUE SPRING

Blue Spring consists of a circular pool with a limestone cavity about 40 feet in diameter, which has a maximum depth of 19.0 feet. The spring run is about 900 feet long and approximately 50 feet in width. The run is full of eel grass and aquatic vegetation and the surface has a scum of "duck seed."

BUZZARD LOG SPRINGS

Buzzard Log Springs consists of four springheads, two being at the confluence of the run with the Wacissa River and the other two at the head of the run which is approximately 0.2 mile in length. The maximum depth of the two spring cavities at the mouth of the run was 8.1 feet and the flow emerges from limestone in one and apparently from a sand boil in the other. It was impracticable to get to the head of the run due to the stream being obstructed by logs. The run is covered with "duck seed" and is full of aquatic growth.

MINNOW SPRING

Minnow Spring consists of a circular pool with a limestone cavity about 15 feet in diameter in the bottom at a maximum depth of 8.1 feet. The water in the boil of the spring is filled with sand particles flushed out of the cave. The run is approximately 100 feet in length and flows in an easterly direction.

CASSIDY SPRING

Cassidy Spring consists of a pool with a limestone cavity at the bottom 8 feet in diameter and in a maximum of 28.0 feet of water.

The run is approximately 70 feet long and discharges into the Wacissa River.

SPRING NO. 1

Spring No. 1 consists of a cavity in a limestone outcrop within the Wacissa River. The maximum depth of the pool cavity was 24.7 feet.

SPRING NO. 2

Spring No. 2 discharges from a circular cavity in a limestone outcrop beneath a maximum of 18.9 feet of water in the Wacissa River.

THOMAS SPRING

Thomas Spring discharges from a limestone cavity approximately 8 feet in diameter under the Wacissa River at a maximum depth of 28.2 feet.

LOG SPRINGS

Log Springs discharges from two cavities within a limestone pool 40 feet in length by 15 feet in width. The maximum depths to the floors of the cavities are 28.2 feet and 24.0 feet, respectively.

Sand Spring boils are visible at many points along the stretch of the river from Teate's fish camp to the head of the Wacissa River. There are believed to be additional springs upstream from Thomas Spring, downstream from the mouth of Big Spring Run and also in Little River. These were not investigated.

DISCHARGE

The following measurements of discharges were made on July 16, 1942:

BIG SPRING

Big Spring—The total discharge was found to be 69.4 (64.5 second-feet total, Dec. 7, 1960) second-feet which was comprised of a discharge of 22.7 cfs (15 mgd) in the southwest run, and 46.7 cfs (30 mgd) in the northwest run or a total of 41.7 mgd on December 7, 1960.

GARNER SPRING

Garner Spring—17 cfs (11 mgd) measured 200 feet below the head of the smaller spring.

BLUE SPRING

Blue Spring—9.43 cfs (6 mgd) measured 300 feet below the head of the spring (2.6 cfs, Dec. 7, 1960).

MINNOW SPRING

Minnow Spring—5 cfs (3 mgd), estimated.

Big Spring, Garner Springs, Blue Spring, Buzzard Log Springs, Minnow Spring, Cassidy Spring and Log Springs discharge into the Wacissa River. Thomas Spring, Spring No. 1 and Spring No. 2 are within the Wacissa River channel and therefore their flow would be difficult to measure.

UTILIZATION

The springs are intact in their natural surroundings. A group of men at one time were said to have been interested in developing the springs as an attraction for tourists but the plan never materialized. The river in the vicinity of Springs No. 1 and No. 2 is used for swimming. The runs of the various springs are frequented by fishermen, owing to the abundance of fish.

OTHER SPRINGS

Walker Spring, also in Jefferson County, is 8 miles southeast of Lamont."

LINEAR TRENDS

Vernon (1951, p. 47) recognized faulting and extensive fracture patterns in Florida. The fracture patterns were mapped on the basis of their physiographic expression, as shown on mosaics of aerial photographs.

In Citrus and Levy counties (Vernon, 1951, p. 47) the axis of the Ocala uplift is paralleled by regional fractures trending northwest-southeast, exactly marking the crest of the anticline. A secondary system crosses the primary system at large angles and

trends northeast-southwest. According to Vernon (1951, p. 48) the northwest plunge of the Ocala uplift extends through Madison County into Jefferson County.

Examination of a mosaic of aerial photographs of Jefferson County shows that northeast-southwest and northwest-southeast linear trends exist in the county, as shown in figure 9. The multi-channels of the Wacissa River in its lower reaches may be the result of the stream following fractures in the Suwannee limestone. Certain portions of the Aucilla River also seem to be following linear trends. The lack of subsurface control and surface exposures makes it difficult to determine whether or not all the map lineations represent fractures. However, fractures do exist in the county because the writer observed a large one in the limestone at a spring near the headwaters of the Wacissa River. The trend of the fracture was northeast-southwest. This particular fracture was not seen as a distinct lineation on the aerial mosaic but as figure 9 shows, a northeast-southwest linear zone passes just north of the headwaters of the Wicassa River, to which it may be related. The structure map showing the configuration of the top of the Suwannee Limestone, as shown in figure 10, indicates that a northwest slope of a Suwannee high almost parallels the northeast-southwest linear trend mentioned above. Observation of the bedrock map (fig. 8) shows that the St. Marks does not reflect the slope that occurs within the underlying Suwannee positive area thus, apparently, ruling out a surface fault. It may mean, however, that the lineation is a fracture that extends through the Miocene clastics overlying the limestones of the St. Marks Formation and the Suwannee Limestone.

STRATIGRAPHY

INTRODUCTION

The sediments that occur in Jefferson County range in age from Paleozoic to Recent. The Suwannee Limestone (Oligocene) is the oldest rock exposed in the area, and the deposits laid down during the Recent are the youngest. Table 3 is a list of the geologic formations that occur in Jefferson County.

Most of the subsurface data discussed in this report was obtained from studying well cuttings, and core samples, figure 11. Data on the age of rock older than late Eocene was from two oil exploratory wells. The discussion of the older sediments encoun-

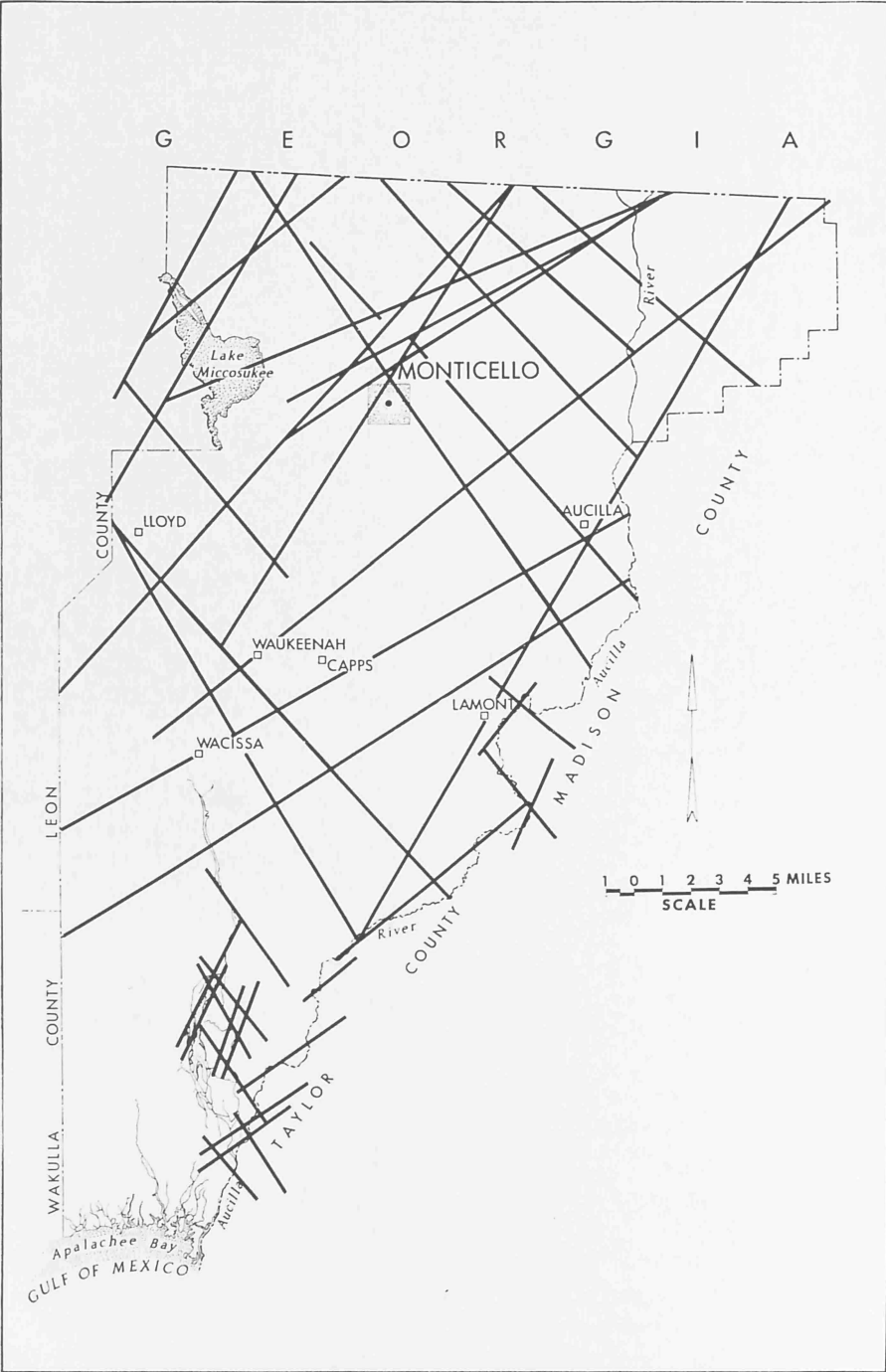


Figure 9. Linear trends in Jefferson County, Florida.

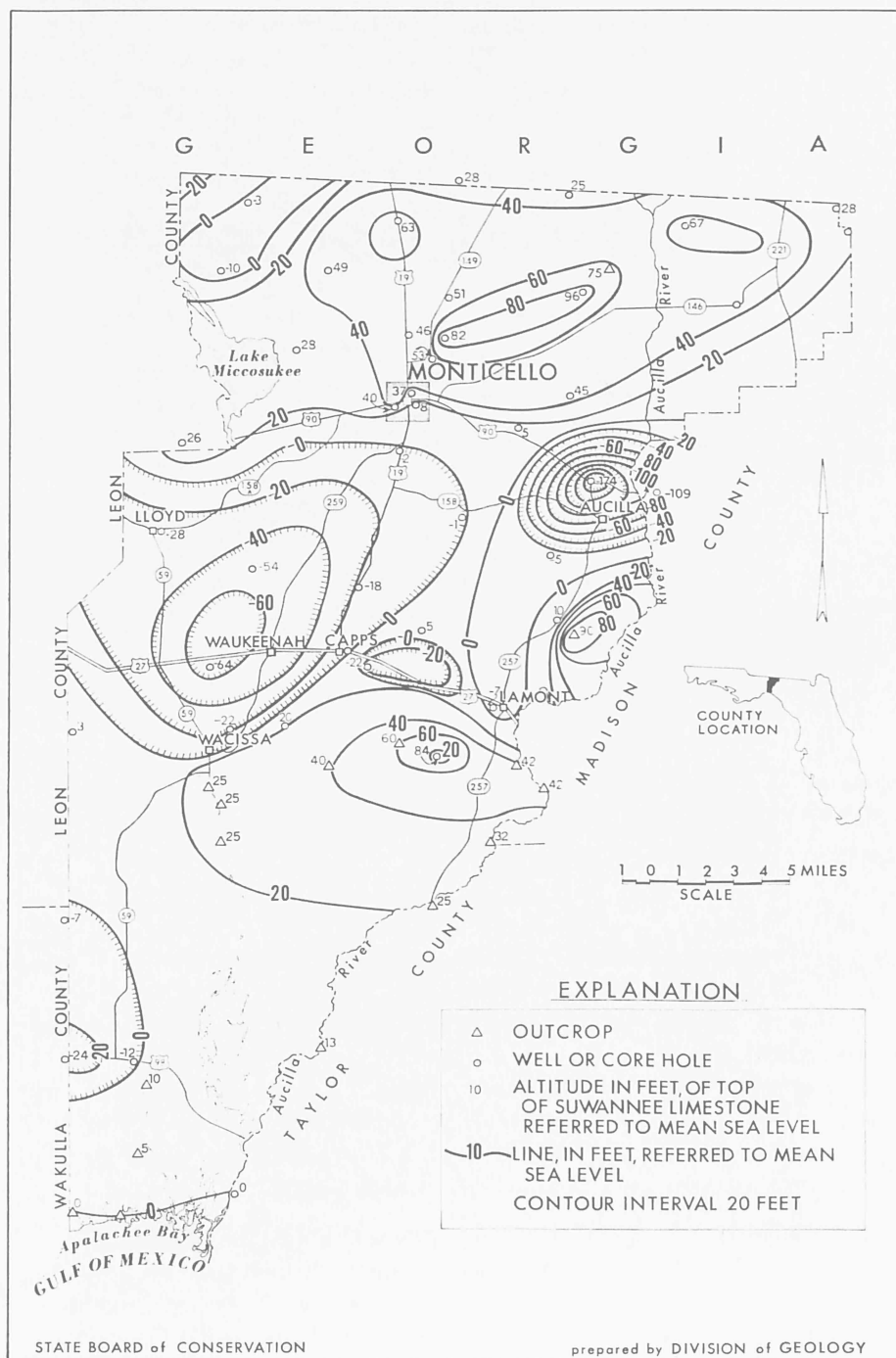


Figure 10. Contours showing approximate altitude of the top of the Suwannee Limestone Jefferson County, Florida.

TABLE 3. Geologic Formations in Jefferson County, Florida.

Era	System	Series	Group	Formation
Cenozoic	Quaternary	Recent		Stream alluvium
		Pleistocene		Terrace sands
	Tertiary	Miocene		Miccosukee Formation Hawthorn Formation St. Marks
		Oligocene		Suwannee Limestone
		Eocene	Ocala	Crystal River Formation Williston Formation Ingles Formation
				Avon Park Limestone Lake City Limestone
Mesozoic	Cretaceous	Paleocene		Beds of Midway Age
		Gulf		Beds of Taylor Age Beds of Austin Age Atkinson Formation
		Comanche		Undifferentiated Shales and sands
	Upper Triassic		Newark (?)	Varicolored shales and sand associated with diabase sills or dikes
Paleozoic	Lower Ordovician (?)			Quartzitic sandstone

tered in these two wells will be generalized, and, for the most part is taken from other sources.

Table 4 lists wells in Jefferson County from which geologic data was obtained.

Jefferson County lies within or near a zone of facies change and, so that a better understanding of how the county fits in with the general stratigraphy of Florida, the following statement of Applin and Applin is cited (1944, p. 1679-80):

“Beds from the top of the Oligocene to the base of the late middle Eocene are a continuous limestone sequence throughout the area, whereas two sedimentary or depositional facies are recognized in Florida and Southern Georgia, in each stratigraphic unit between the top of the early

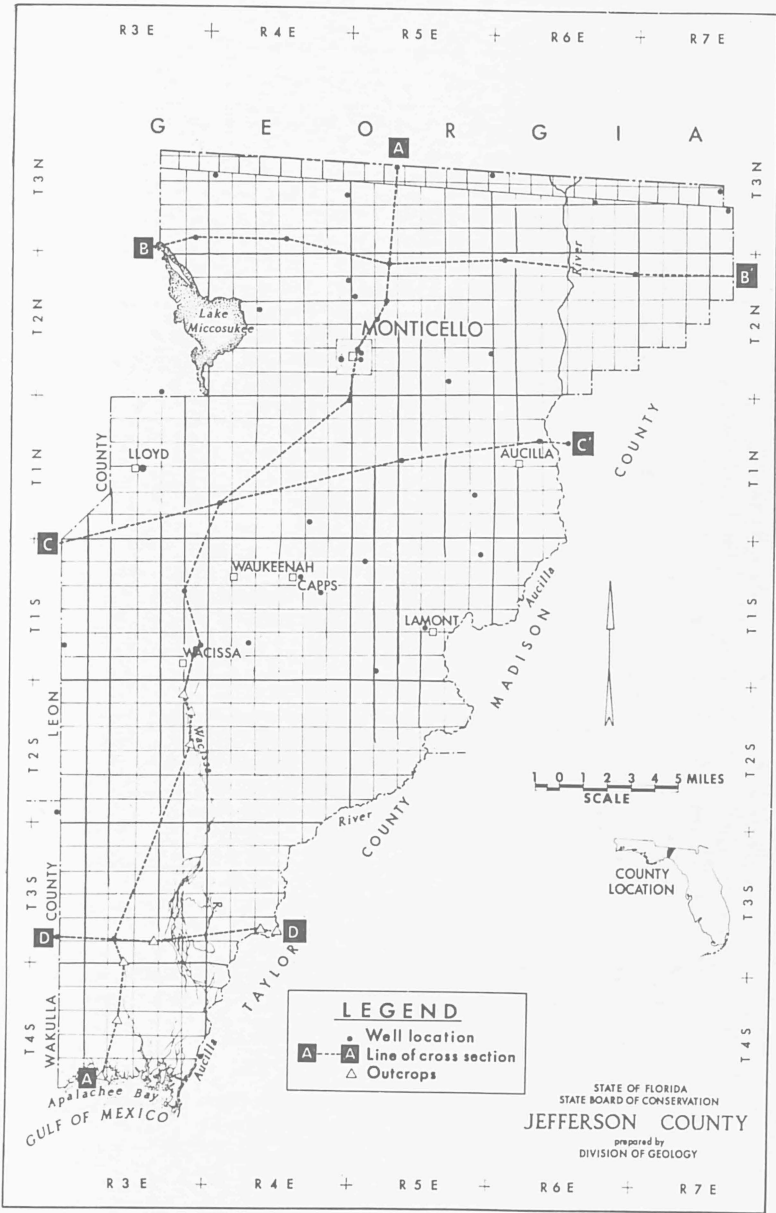


Figure 11. Well locations and lines of sections in Jefferson County, Florida.

TABLE 4. Geologic data from selected wells in the Jefferson County area.
 Source of data: s—samples; d—driller's log; el—electrical log;
 gr—gamma ray log.

Division of Geology W-No.	This report well number	Elevation land surface	Altitude in feet referred to mean sea level					Upper Eocene	Source of data
			Recent and Pleistocene	Upper Miocene	Middle Miocene	Lower Miocene	Oligocene		
W-6933	WJf-3N-3E-36 ca	213.74		213.74	165.0	110.0	-10.0		
W-6186	WJf-3N-4E-18 bc	108.82		108.82	39.0	19.0	6.0		S
W-6029	WJf-3N-4E-34 da	110.30		110.30	61.0		55.0		el., gr.
W-5719	WJf-3N-4E-24 bd	153.21		153.21	133.0	88.0	63.0		el., gr.
W-5703	WJf- 150	193.00		193.00	158.0	93.0	28.0		
W-5702	WJf- 155	124.66		124.66	?	47.0	25.0	-100.0	
W-5701	WJf-3N-5E-25 dd	188.00		188.00	?	?	48.0		
W- 319	WJf-3N-6E-23 cc	154.14		154.14		113.0	67.0		S
W- 97	WJf- 181	117.80		118.00		43.0	28.0		S
	WJf-3N-7E-27 bb	98.32		98.00	54.0	26.0	- 6.0		el., gr.
W-3320	WLn-2N-3-E-35 cc								
W-6185	WJf-2N-4E-16 ca	93.12		93.12	63.0	40.0	26.0		S
W-4733	WJf-2N-4E-12 ab	149.00		149.00	79.0		59.0		S
W-6607	WJf-2N-4E-25 center	190.00		190.00	140.0	120.0	40.0		S, el., gr.
W-6927	WJf-2N-5E-5 center	203.00		203.00	147.0	73.0	51.0		S
W-3871	WJf-2N-5E-7 cc	146.00		146.00	86.0	66.0	46.0		S
W-5302	WJf-2N-5E-17 ba	209.56		209.56	170.00	106.0	82.0		S, el., gr.
W-4813	WJf-2N-5E- 5 ca	74.51		74.51			35.0		S
W- 19	WJf-2N-5E-17 cc	217.94		217.94	146.0	114.0	53.0	-283	S
W-5432	WJf-2N-5E-25 da	156.49		156.49		45.0			S
W-3204	WJf-2N-5E-30 aa	237.01		237.01	187.0	127.0	37.0		S
W-6043	WJf-2N-5E-30 bb	209.84		209.84	2155.0	130.0			S
W- 14	WJf-2N-5E-30 da	210.34		210.34	121.0	91.0	8.0		S
W-6561	WJf-2N-6E- 1 dd	184.09		184.09	148.0	103.0			S
W-6911	WJf-2N-6E- 6 da	189.65		189.65	157.0	131.0	96.0		S
W-5504	WJf-1N-3E-15 cc	95.82		95.82	74.0	56.0	-28.0		S, el., gr.

TABLE 4. CONTINUED.

Division of Geology W-No.	This report well number	Elevation land surface	Altitude in feet referred to mean sea level					Upper Eocene	Source of data
			Recent and Pleistocene	Upper Miocene	Middle Miocene	Lower Miocene	Oligocene		
W-5434	WJf-1N-4E- 1 bb	196.68		196.68	142.0	102.0	— 2.0		S
W-6061	WJf-1N-4E-30 da	121.59		121.59	97.0	38.0	— 54.0		S, el., gr.
W-6932	WJf-1N-4E-35 ca	214.00		214.00	139.0	17.0	— 18.0		S, el., gr.
W-6517	WJf-1N-5E-16 bc	87.89		88.89	43.0	23.0	— 5.0		S
W-6559	WJf-1N-5E-25 ca	80.00		80.00	10.0	00.0	— 5.0		S
W-6560	WJf-1N-6E- 8 dd	82.00		82.00					S
W-6558	WMd-1N-6E- 9 cor. d	115.59		115.59	36.0		—109.0		S
W-6906	WJf-1S-3E-13 aa	165.44		165.44	100.0	25.0	— 64.0		S
	WJf-1S-3E-30 ca	40.00					3.0		S
W- 905	WJf-1S-3E-25 db	187.45		187.45	112.0	43.0			S
W- 906	WJf-1S-3E-25 db	169.36		169.36		— 4.0	— 22.0		S
W-6402	WJf-1S-4E- 1 bc	205.00		205.00	154.0	106.0			S
W-6930	WJf-1S-4E-14 ab	127.98		127.98	— 2.0	00.0	— 22.0		S
W-6931	WJf-1S-4E-29 cb	200.00		200.00	140.0	110.0	23.0		S
	WJf-1S-4E-28 ac	178.83		178.83	151.0	100.0	73.0		el., gr.
W-5455	WJf-1S-5E- 6 cd	73.90		74.90	50.0	?	5.0		S
W-6925	WJf-1S-5E-32 ac	134.00		134.00	99.0	89.0	84.0		S
W-5325	WJf-1S-5E- 1 ad	86.63		86.63			10.0	— 17.0	S
W-6174	WJf-1S-5E-22 bc	68.05		68.05	40.0		— 7.0		S
W-1854	WJf-2S-3E- 1 ad	37.00	37.00			8.0	— 3.0		S, el.
W-6518	WWk-2S-2E-36 db	29.00	29.00			9.0	— 7.0		S
W-6527	WJf-3S-3E-30 ac	14.09	14.09			7.0	— 24.0		S
W-6526	WJf-3S-3E-28 dc	13.00	13.00			10.0	— 12.0		S
W-6525	WTy-4S-3E-24 dd	6.00	6.00				0.0		S

middle Eocene and the base of beds of Austin age (Upper Cretaceous). On the one hand, west Florida and southern Georgia are occupied by a clastic facies which is similar in its broader aspects to the sediments of the western Gulf Coastal Plain and is composed largely of sand and shale with some limestone and chalky marl. On the other hand, over most of the peninsula, the sedimentary section is almost continuous limestone from the top of the Oligocene into the Lower Cretaceous, giving a known thickness for this facies of more than 10,000 feet in southern Florida. Anhydrite and gypsum are present in this facies from late middle Eocene to Paleocene and also in the limestone of the Lower Cretaceous, but little has been noted in the Upper Cretaceous units. Thin streaks of carbonaceous shale and lignite are found in the central part of the peninsula in the limestone facies of the middle Eocene. In northern Florida and in the north quarter or north third of the peninsula, the limestone and clastic facies grade laterally into each other. In general, with the passage of time, the limestone of the peninsula encroaches upon the clastic facies, spreading northward in successive stages, so that by the end of early middle Eocene the limestone facies occupies all of the peninsula, northern Florida, and southern Georgia. In general also, the foraminiferal microfaunas of the clastic facies resemble those present in formations in the western Gulf Coast, whereas the microfaunas of the limestone facies in the peninsula from the top of the early middle Eocene to the top of the beds of Taylor age resemble those of Cuba, the West Indies, Mexico, and Europe, with only a few species present that are known in other places in the United States. Species of ostracods and bryozoans show a like dissimilarity with those found in western faunas. Beginning with the top of the beds of Taylor age in the peninsula, the more familiar Gulf Coast microfaunas again appear. Some mingling of faunas of the two facies has been noted in a few wells in north Florida in the early middle and lower Eocene, but none in Paleocene or late Upper Cretaceous. The fauna of the Lower Cretaceous limestones of southern Florida again resembles that found in certain derived deposits in Cuba and also that of the El Abra limestone of southern Mexico (Cenomanian-Albian) there designated as Middle Cretaceous."

PALEOZOIC ERA

ORDOVICIAN (?) SYSTEM

According to Applin (1951, p. 23), Coastal Petroleum Company, E. P. Larsh No. 1, penetrated Paleozoic quartzitic sandstone at a depth of 7,909 feet. He assigned it to the Lower Ordovician (?) undifferentiated, but stated that only 4 feet of these sediments were penetrated and could be a boulder in the lower part of the Mesozoic (personal communication, August, 1963).

MESOZOIC ERA

TRIASSIC SYSTEM

Newark (?) Group

Varicolored shales and sands of Triassic Age were reported by Applin (1951, p. 10-26) in the Coastal Petroleum Company, E. P. Larsh No. 1 test well at a depth of 6,800 feet. Near the base of the well, from 7,850 to 7,890 feet, volcanic diabase sills or dikes are associated with these clastic rocks of Triassic (?) Age, (Applin, 1957, p. 1489). Applin (personal communication August 1, 1963) now refers the above sediments to the Upper Triassic (?) Newark (?) Group, and also lowered the top of the Triassic beds to 7,030 (?) feet.

CRETACEOUS SYSTEM

Comanche Series

The two deep oil tests drilled in Jefferson County penetrated beds of the Comanche Series. These beds consist of varicolored shales interbedded with quartz sands and limestone.

The Comanche Series was penetrated in the Coastal Petroleum Company, E. P. Larsh No. 1 test well, located in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 1, T2S, R3E, at the depth of 3,875 feet (Applin, personal communication Aug 1, 1963), and the Southern States Oil Corporation test well, located in the SW $\frac{1}{4}$ SW $\frac{1}{4}$, Sec. 17, T2N, R5E, at 3,800 (?) feet. The thickness of the Comanche Series in the Coastal-Larsh well is 3,155 feet.

Gulf Series

Studies made by Applin and Applin (1944, 1947) and the Southeastern Geological Society Mesozoic Committee (1949) placed the Upper Cretaceous sediments occurring in Jefferson County in the Gulf Series. According to these reports, Jefferson County lies within or near the zone where the carbonate facies of peninsular Florida meet the Clastic facies of western Florida. The Gulf Series in Jefferson County, from oldest to youngest beds, consists of the Atkinson Formation, beds of Austin Age, and beds of Taylor Age.

ATKINSON FORMATION

The Applins (1947) introduced the name Atkinson Formation for those subsurface sediments occurring in Alabama, Georgia, and north Florida that lie between the top of the Lower Cretaceous and the base of the beds of Austin Age. On the basis of differences in lithology, they divided the Atkinson into three unnamed members (upper, middle, and lower) and also recognized two microfaunal groups within the Atkinson Formation. The upper member carries a fauna closely related to that of the Eagleford shale in Texas and the middle and lower members contain a fauna similar to that of the Woodbine Sand in Texas. On the basis of this faunal difference The Southeastern Geological Society Mesozoic Committee (September, 1949) divided the Atkinson Formation into an "A" zone, which contains the Eagleford fauna, and a "B" zone, which contains the Woodbine fauna. To facilitate the correlation of the Atkinson Formation of the southeastern gulf region with the Eagleford and Woodbine Formations of Texas, Esther R. Applin (1955, p. 1511) redefined the Atkinson to consist of two members; an upper member, of Eagleford Age, and a lower member of Woodbine Age. The lower member includes the middle and lower members as originally defined by Applin (1947). According to Paul L. Applin (personal communication August 1, 1963) in the Southern States Oil Corporation, Millard and Gossard No. 1, "... the sandy beds in the lower part of the lower Atkinson are absent, and the 'marine shale' (formerly called middle Atkinson) rests unconformably on the Comanche Series." The top of the upper member of the Atkinson occurs from 3,410 (?) to 3,655 (?) feet, and the lower member is encountered from 3,665 (?) to 3,800 (?) feet in the Southern States well, thus giving the formation a total thickness of 390 feet. Lithologically the upper

member is brownish to greenish gray shale, interbedded with some fine grained glauconitic sandstone containing microfossils and molluscan shell fragments. The lower member is primarily a dark gray microfossiliferous shale.

The upper and lower members of the Atkinson Formation are present in the Coastal Petroleum, E. P. Larsh No. 1 oil test well. The upper member occurs from 3,400 to 3,700 feet, and is a greenish gray and gray calcareous sandy shale; and a greenish gray to gray, fine to medium glauconitic quartz sand. The upper member is characterized for the foraminifers *Planulina eaglefordensis*, *Valvulineria infrequens*, *Gumbelina moremai*, *Gumbelina reussi*, *Globigerina cretacea*, and *Trochammina wickendeni*. The lower member of the Atkinson is encountered from 3,700 to 3,875 feet (Applin, personal communication, August 1, 1963) and is a gray to gray-green glauconitic, fine to medium, quartz sand; and a gray to dark gray sandy shale. The foraminifers *Ammobaculites braunsteini*, *Ammobaculites comprimatus*, *Ammobaculites advenus*, *Ammobaculites plummerae*, and *Trochammina rainwateri* characterize the lower member.

BEDS OF AUSTIN AGE

Beds of Austin age occur from the depth of 3,268 to 3,410 (?) feet in the Southern States Oil Corporation oil test well, and the formation consists of gray, chalky, microfossiliferous limestone, gray calcareous shale, brown-speckled shale, and hard gray marl (Applin and Applin, 1944, p.1472-73). The lithology of the Austin beds occurring in the Coastal-Larsh oil test are similar to those described above in the Southern States Oil Corporation well, and range in depth from 2,890 to 3,400 feet.

BEDS OF TAYLOR AGE

The upper beds of Taylor Age are missing in the Southern States Oil Corporation oil test well, and the first penetration is in beds of lower Taylor Age at 3,056 feet, (Applin and Applin, 1944, p. 1711). In the southern part of Jefferson County, in the Coastal-Larsh No. 1 oil test, beds of Taylor Age occur in the interval—2,890 to 3,400 feet. Lithologically the Taylor is composed of gray chalk, and a gray calcareous microfossiliferous shale containing *Inoceramus* fragments.

CENOZOIC ERA

TERTIARY SYSTEM

Paleocene Series

BEDS OF MIDWAY AGE

The Applins (1944, p. 1703) recognized beds in the Tallahassee area containing a microfauna similar to the foraminifers found in the Tamesi (Velasco) of Mexico. They consider this faunal unit a part of the Midway Group. In the Southern States Oil Corporation oil test well, located in Jefferson County, this fauna occurs from 2,490 feet to approximately 3,056 feet (Applin and Applin, 1944, p. 1706). In the southern part of Jefferson County, the writer also found the Tamesi fauna in the Coastal Petroleum Co., Larsh No. 1 oil test well in the intervals—2,510 to 2,560 feet. The lithology of this unit is a dark gray, very calcareous, slightly glauconitic, clay containing abundant microfossils.

Eocene Series

WILCOX UNDIFFERENTIATED

In the Southern States Oil Corporation, oil test well, Applin and Applin (1944, p. 1701) designated a clastic interval of fine to very fine grained, glauconitic and microfossiliferous quartz sand occurring between 2,223 and 2,490? feet as Wilcox Stage. This determination was on the basis of several species of *Globigerina* and *Globorotalia*, and *Globototalia wilcoxensis* Cushman.

CLAIBORNE STAGE

LAKE CITY LIMESTONE

The Lake City Limestone was proposed by Applin and Applin (1944, p. 1693) for a limestone facies of early middle Eocene occurring in north Florida and peninsular Florida.

The Lake City Limestone in Jefferson County consists of cream to light brown, slightly peat flecked, medium hard, limestone (calcarenite). It is gypsiferous, glauconitic, cherty, microfossiliferous and has moderate to good porosity. In the Southern States Oil Corporation oil test well, the Lake City Limestone was encountered from 1,740 to 2,223 feet, a thickness

of 483 feet (Applin and Applin, 1944, p. 1695). In the Coastal-Larsh well the Lake City is from 970 to 1,820 feet, a thickness of 850 feet. The foraminifer *Dictyoconus americanus* is a principal fossil guide to the Lake City Limestone, and occurs in abundance in the Larsh well.

AVON PARK LIMESTONE

The Avon Park Limestone was proposed by Applin and Applin (1944, p. 1686) for the upper part of late middle Eocene deposits found in a well at the Avon Park Bombing Range, Polk County, Florida. Florida Geological Survey well No. W-668 was designated as the type well.

The Avon Park Limestone in Jefferson County is a very pale orange, medium hard, moderately porous, gypsiferous, microfossiliferous, cherty, partially recrystallized to crystalline limestone (calcarenite). Near the bottom of the Avon Park, the sediments became peat flecked and dolomitized. In the Southern States Oil Corporation well the Avon Park Limestone occurs from 880 to 1,740 feet, a thickness of 860 feet. The complete Avon Park Limestone interval in the Coastal-E. P. Larsh No. 1 test well is unknown because of a sample gap from 160 to 925 feet.

OCALA GROUP

For historical review of the term Ocala prior to 1957, Florida Geological Survey Bulletin 38 is cited as a reference. Puri (1957, p. 22-24) redefined the Ocala Limestone and raised it to the rank of group and subdivided it into three formations which are in ascending order: The Inglis Formation, the Williston Formation, and the Crystal River Formation.

INGLIS FORMATION

The Moodys Branch Formation, consisting of two members, the Inglis and Williston, was proposed by Vernon (1951, p. 115-116) for basal sediments of late Eocene age in Florida. Puri (1957, p. 24) later raised the Inglis Member to the rank of formation.

The Inglis Formation in Jefferson County is a tan, soft to medium hard, moderately porous, gypsiferous, microfossiliferous, partially dolomitized, crystalline limestone (calcarenite). In the vicinity of Monticello the top of the formation occurs at 780 feet and the base at 880 feet, a thickness of 100 feet.

WILLISTON FORMATION

The Williston member was proposed by Vernon (1951, p. 141) for about 30 feet of foraminiferal limestone overlying the Inglis member of the Moodys Branch Formation. The Williston member was raised to the rank of formation by Puri (1957, p. 28-29).

The Williston Formation occurs from 705-780 feet, a thickness of 75 feet in a well near Monticello. Lithologically, the Williston Formation is a pale orange, moderately porous, microfossiliferous, crystalline to partially recrystallized limestone (calcarenite).

CRYSTAL RIVER FORMATION

Puri (1953, p. 130) proposed the Crystal River Formation to replace Vernon's Ocala limestone (restricted). The type locality of the Crystal River Formation is in the Crystal River Rock Company quarry, Citrus County, Florida, where 108 feet of limestone is exposed.

The Crystal River Formation primarily consists of a pale orange, soft to medium hard, good to moderately porous, microfossiliferous, partially recrystallized limestone (calcarenite). In some instances it is a calcirudite because of the large number of *Lepidocyclina* specimens. In the vicinity of Monticello the Crystal River Formation is 205 feet thick and occurs from 500 to 705 feet.

Oligocene Series

VICKSBURG GROUP

SUWANNEE LIMESTONE

History.—Cooke and Mansfield (1936) applied the name Suwannee Limestone to the fossiliferous limestones cropping out along the Suwannee River from White Springs to Ellaville. The history of the stratigraphic nomenclature of the Suwannee Limestone has been adequately discussed in Florida Geological Survey Bulletins 21 and 29, and are cited as very good references for historical information.

Distribution.—The Suwannee Limestone is the oldest rock cropping out in Jefferson County and the area of outcrop is shown on the geologic map (Plate 1). It extends from the Wakulla-Jefferson County lines eastward along the edge of secs. 31 and 32, T3S, R3E, for about 2 miles before turning northward and intersecting U. S.

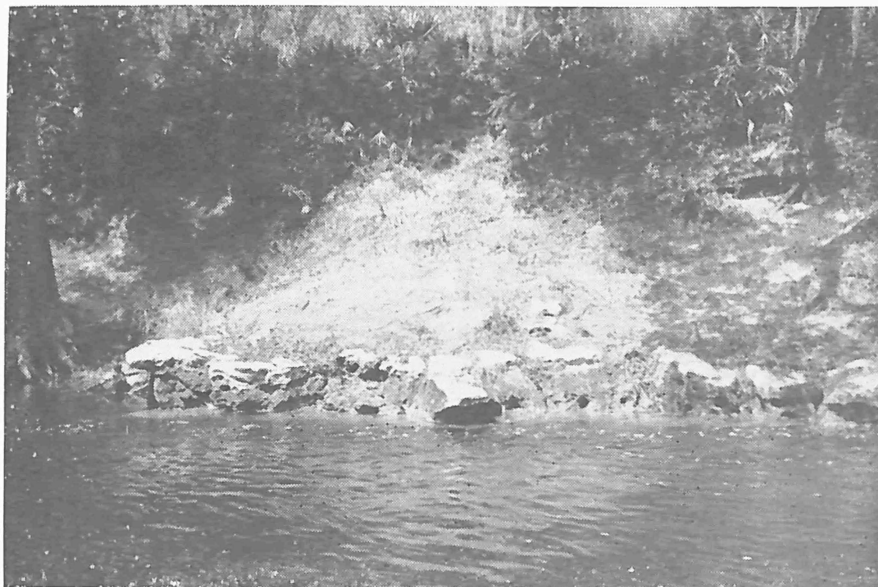


Figure 12. Dolomitized Suwannee Limestone cropping out on the bank of the Aucilla River, Jefferson County, Florida.

Highway 98 on the east side of Gum Creek. From U. S. Highway 98 the outcrop pattern continues northward, almost parallels State Highway 59, and finally merges with the Cody Scarp (fig. 5) north of the town of Wacissa. The Suwannee Limestone, in many areas, is covered by a thin veneer of Pleistocene sand. However, from just below Lamont to just north of Nutall Rise, it is almost continually exposed along the banks of the Aucilla River either as silicified boulders, or as massive dolomite beds, figure 12. Both the dolomite beds and the silicified boulders often form rapids along the river, figure 13.

The Suwannee Limestone is exposed in the bed of the Wacissa River from just below its headwaters near the town of Wacissa to the confluence with the Aucilla River, just above Nutall Rise. North of Cody Scarp the formation is covered by younger deposits. However, a few outcrops have been observed, such as the outcrop of silicified Suwannee Limestone occurring on the rim of a sinkhole lake on sec. 32, T3N, R6E, and at a locality LJf-1S-5E-12-bb located north of Lamont. As shown in the geologic cross sections, figure 14, the Suwannee is continuous over all of Jefferson County and in many places is the first bedrock encountered. Silicified or



Figure 13. Rapids on the Aucilla River caused by dolomitized Suwannee Limestone, Jefferson County, Florida.

dolomitized Suwannee Limestone forms the bottom of the Gulf of Mexico off Jefferson County, shown in figure 15.

General Lithology.—The Suwannee Limestone is a marine limestone consisting of a partially recrystallized limestone (calcarenite). It is very pale orange, finely crystalline, weakly cemented with CaCO_3 , with moderate to good porosity, and very fossiliferous. Chemically, it will approach 97 percent CaCO_3 .

Silicified limestones are very common in the outcrop area in the form of boulders, shown in figure 16. In some cases the top of the formation is silicified in the subsurface. Examination of well cuttings indicates dolomitization of the limestone has also occurred in the subsurface at different depths and in the outcrop area, especially along the Aucilla River.

A lithology different from that at the type locality of the Suwannee Limestone was noted from cuttings and cores for several wells in the county. It is a limestone (calcirudite) characterized by *Lepidocyclus* specimens. Generally, most of the microfauna is so poorly preserved, they are difficult to identify. In core hole WJf-1N-5E-25-ca, near Aucilla, a *Lepidocyclus* horizon was

ERRATA

Correction to Vertical Scale on Section A-A'.
Elevation should be moved down one interval.
Sea Level is at the +40 interval.

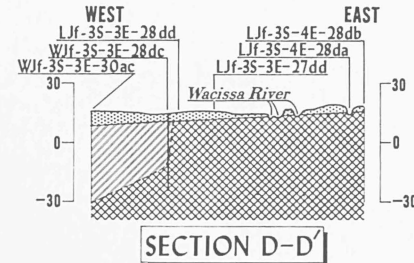
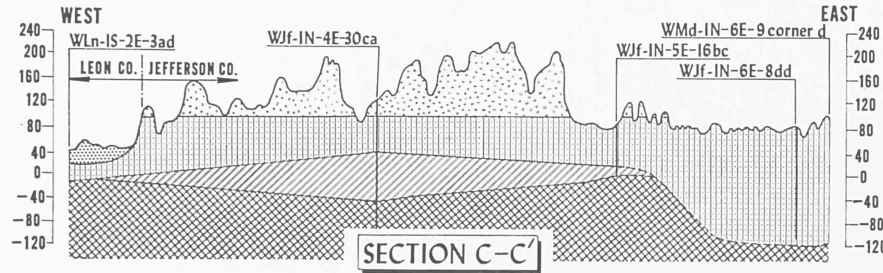
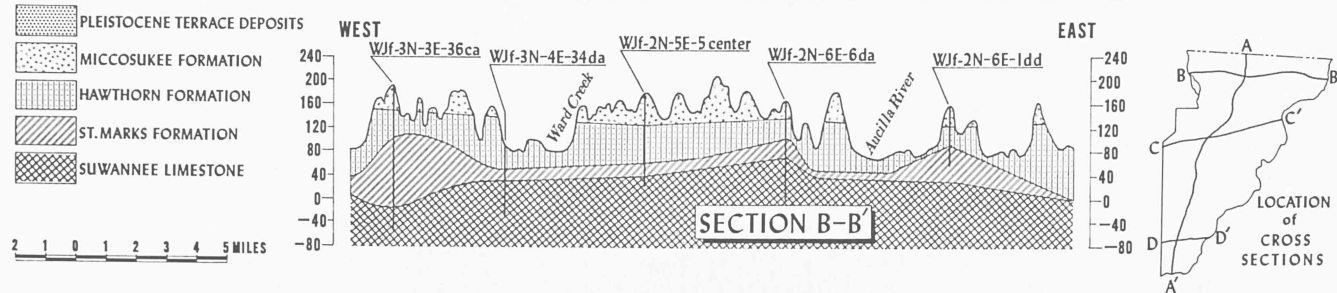
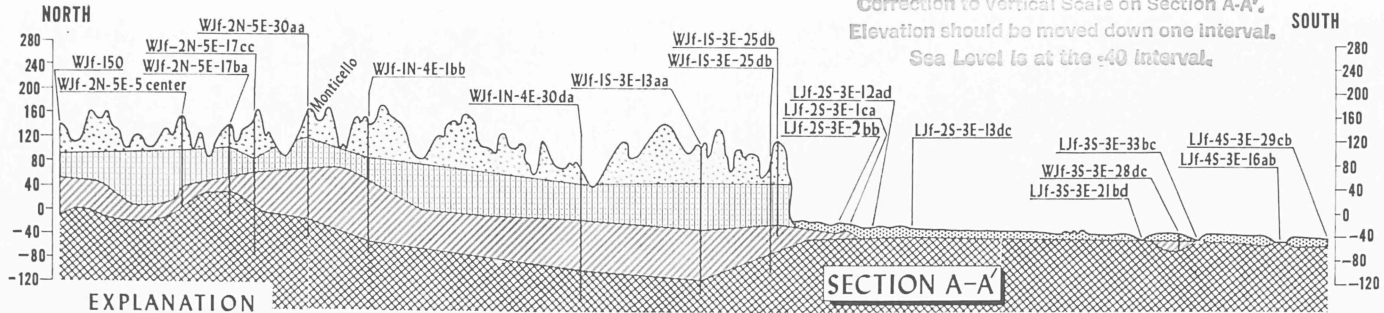


Figure 14. Geologic cross sections in Jefferson County, Florida.



Figure 15. Dolomitized Suwannee Limestone exposed in the Gulf of Mexico off the coast of Jefferson County, Florida.

encountered and according to Cole (personal communication, April, 1964), the *Lepidocyclinas* are *Lepidocyclina* (*Lepidocyclina*) *mantelli* and *Lepidocyclina* (*Eulepidina*) *undosa* and this section could be correlated in time with the Oligocene Marianna Limestone.

Thickness.—The exact thickness of the Suwannee has not been determined in Jefferson County because most of the information available is from wells that terminate in the Suwannee. However, in the previously mentioned Southern States Oil Corporation oil test, 336 feet of the Suwannee Limestone was penetrated and quite likely represents the formation's maximum thickness.

Stratigraphic Relationships.—The Suwannee Limestone lies unconformably upon the Crystal River Formation and unconformably underlies the St. Marks or Hawthorn Formations. Where the St. Marks and Hawthorn Formations are absent, it underlies the younger Miccosukee Formation. Below the Cody Scarp the Suwan-



Figure 16. Silicified boulders of Suwannee Limestone exposed in roadcuts in southern part of Jefferson County, Florida.

nee is covered unconformably by Pleistocene deposits and scattered outliers of the Hawthorn Formation.

Fauna.—The echinoids *Cassidulus gouldii* (Bouvé) and *Clypeaster rogersi* (Morton) were identified from the Suwannee Limestone in the outcrop area. The foraminifers *Coskinolina floridana* Cole, *Discorinopsis gunteri* Cole, and *Rotalia mexicana* Nutall were identified from outcrops as well as well cuttings.

Geologic Exposures.—The Suwannee Limestone is at or near the surface in most of the southern half of Jefferson County.

The best exposure of the Suwannee Limestone in Jefferson County is present at locality LJf-3S-4E-28-da on the south face of an active quarry. The following section was measured at this locality, figure 17:



Figure 17. Quarry of Suwannee Limestone, Jefferson County, Florida.

Bed	Description	Thickness (feet)
Pleistocene Series		
3	Quartz sand, very fine to medium grained	2.0
Unconformity		
Oligocene Series		
Vicksburg Group		
Suwannee Limestone		
2	Partially recrystallized limestone (calcarenite) pale orange, finely crystalline, cemented weakly with CaCO_3 , moderate porosity, weathering irreg- ular, very microfossiliferous, <i>Coskinolina floridana</i> , <i>Discorinopsis gunteri</i>	6.0

1	Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline, cemented weakly to firmly with CaCO_3 , moderate porosity. Cross sections of dissected solution pipes filled with clastic material are present. Some of the pipes appear to have a diameter of 2 feet -----	2.5
	Total thickness -----	10.5

On the north face of the quarry there are hard ledges formed, and in the base of the quarry a hard dark brown dolomite is exposed. Adjacent to the north side of the quarry there are a series of caves, sinks, and natural bridges.

The following are localities where the formation can be seen exposed in the bed of the Wacissa River or in the banks of the Aucilla River:

1. LJf-2S-5E-29 dc: Six-tenths of a mile north of the bridge on State Highway 257 on the east bank of the Aucilla River. Just above rapids formed by silicified Suwannee about 4 feet of partially recrystallized limestone (calcarenite), very pale orange, finely crystalline, becoming deeply weathered with blue-green clay and streaks of chert forming in the rock.
2. LJf-2S-5E-22 aa: On the west bank of the Aucilla River, 2 feet of partially recrystallized limestone (calcarenite), containing molds of microfossils.
3. LJf-2S-3E-2 bd: 10 feet below water level on Wacissa River, is a crystalline limestone (calcarenite), containing molds of microfossils.
4. LJf-2S-3E-13 da: Exposed in the bed of the Wacissa River is a partially recrystallized microfossiliferous limestone (calcarenite).

Approximately 3 miles northeast of Lamont at locality LJf-1S-5E-12 bb, 4 feet of Suwannee Limestone is exposed in an inactive quarry that was dug around the year 1909.

A number of exposures of Suwannee sediments are present in the southern part of the outcrop area just north and to the south of U. S. Highway 98. The following localities are representative:

1. LJf-4S-3E-16 ab: In a ditch beside a timber road.
2. LJf-4S-3E-17 bb: In a ditch beside a timber road.
3. LJf-3S-3E-27 dd: In a ditch beside a timber road.
4. LJf-4S-3E-22 ba: On the bank of the Penhook River.
5. LJf-4S-3E-15 cb: On the bank of the Penhook River.

As shown on the geologic map (Plate 1), numerous localities of silicified Suwannee Limestone are present throughout the county. Perhaps the most impressive evidence of silicification of the limestone is at the Big Blue Spring on the Wacissa River, where about 45 feet of silicified Suwannee Limestone is exposed in a vertical section. Because of the silicification of the Suwannee Limestone many rapids are present on the Aucilla River.

Dolomitization of the Suwannee can be observed at many localities in the outcrop area, and many dolomite boulders, exposed by construction, are present along U. S. Highway 98 beginning in sec. 2, T4S, R3E, and continuing to the Aucilla River. Dolomitization is also very prevalent along the Aucilla River and the following localities are cited:

1. LJf-3S-4E-2 cb: Four feet exposed on east bank of Aucilla River.
2. LJf-3S-4E-10 cc: Eight feet exposed on west bank of Aucilla River.
3. LJf-3S-4E-28 db: Ten feet exposed in one of a series of sinks about three-quarters of a mile from where the Aucilla River goes underground.

Miocene Series

TAMPA STAGE

ST. MARKS FORMATION

History.—The sediments assigned to the Lower Miocene have been sub-divided and redefined many times since the name Tampa was first applied to those deposits by L. C. Johnson (1888, p. 235). The latest revision was made by Puri (1953, p. 17). He places all sediments previously called the Tampa Formation in the Tampa Stage. He divided the Tampa Stage into the St. Marks and Chattahoochee Formations. In the present report, the writer will adhere to the nomenclature presented by Puri.

Distribution.—As shown in Plate 1, the St. Marks sediments do not occur all over Jefferson County, but are confined to two separate areas. The largest area is irregularly shaped and occurs in over half of the northwestern and central parts of the county. A smaller area of St. Marks sediments occur in an oblong shaped region in southwestern Jefferson County. Outcrops of St. Marks are rare as the greater part of the deposits are covered by younger sediments. The exposures of the St. Marks that were observed occur in sinkholes, ditches and stream valleys. As shown by cross sections A-A' and C-C' (fig. 14), the St. Marks Formation is absent in part of the county.

General Lithology.—The St. Marks Formation is a white to very pale orange, finely crystalline, sandy, silty, clayey, limestone (calcilutite). It has poor to moderate porosity, contains molluscan casts, and few species of foraminifers. The calcilutite has been partially dolomitized and silicified in the outcrop area and in the subsurface. In the outcrop area, located in the lower southwestern part of the county, and in core holes WJf-1S-3E-13-aa and WJf-1S-4E-29-db the St. Marks is a partially recrystallized limestone (calcilutite). It is very pale orange, very sandy, finely crystalline, with poor porosity. This lithology is incorporated with a pale yellowish brown, sandy, cryptocrystalline, microfossiliferous, partially dolomitized limestone (calcilutite), with poor to moderate porosity. These two calcilutites are similar to the intraformational conglomerates reported by Hendry and Yon (1958, p. 28) in the Jim Woodruff Dam area.

Thickness.—As shown by the geologic cross sections in figure 14, the thickness of the St. Marks is variable. Geologic cross section A-A' indicates that the accumulation of the St. Marks sediments in the large basin on the western side of Jefferson County approaches a thickness of 90 feet. Section B-B' (fig. 14), in the northern part of the county, shows the thickness is variable. However, in core hole WJf-3N-3E-36-ca the St. Marks is 120 feet thick and this is the greatest noted accumulation of St. Marks sediments in the county. Section C-C' (fig. 14) shows that the St. Marks sediments become very thin or absent on the outer edges of the Suwannee basin in the central portion of the county. Section D-D' shows that 20 to 35 feet of St. Marks accumulated in a Suwannee Limestone basin, but to the east the formation is missing.

Stratigraphic Relationships.—The St. Marks unconformably overlies the Suwannee Limestone and is overlain unconformably by the Hawthorn Formation. In the southwestern part of the county, St. Marks deposits are covered unconformably by the Miccosukee Formation. It appears from the elevation of the St. Marks sediments in the Monticello area that at one time these sediments covered most of Jefferson County. However, during or prior to Hawthorn deposition, the sediments were extensively eroded and removed from a large expanse of the area.

Fauna.—The microfossils in the St. Marks Formation have not been fully described, but *Sorites* sp. and *Archaias floridanus* are two common species that are readily identifiable in St. Marks deposits.

The Mollusca in the Tampa Stage sediments have been described by Dall (1890, 1915) and Mansfield (1937).

Geologic Exposures.—As shown on the geologic map (Plate 1), the St. Marks Formation can be seen cropping out in the ditches along U.S. Highway 98 from the Wakulla County line eastward for 2½ miles to Gum Creek. It is also exposed for about 2 miles in the ditches beside a north-south road that almost parallels the Wakulla-Jefferson County lines in secs. 19 and 30, T3S, R3E.

The thickest exposure of St. Marks beds is at locality LJf-154 located in the southeast corner of Land Lot 154, Monticello NE quadrangle. The following section was measured on the north side of a sinkhole:

Bed	Description	Thickness (feet)
Miocene Series		
Choctawhatchee Stage		
Miccosukee Formation		
4	Badly weathered red clayey quartz sands	18.0
Miocene Series		
Tampa Stage		
St. Marks Formation		
3	Yellowish gray, chalky to finely crystalline, finely sandy, massive, fairly soft, poorly porous limestone	

	(calcilutite), weathered surface is knobby, no fossils observed	1.0
	Covered	5.7
2	Pale yellowish brown, very finely crystalline, massive, finely sandy, hard to fairly soft, dolomitic limestone (calcilutite), weathered surface is knobby due to soft and hard nature of limestone, no fossils observed	5.3
	Covered	9.4
1	Pale yellowish brown, very finely crystalline, massive, finely sandy, hard, dense, dolomitic limestone (calcilutite) weathered surface fairly smooth, no fossils observed; contains inclusions of very pale orange, cryptocrystalline, hard, sandy limestone. This bed is exposed about 1 foot above sinkhole floor	1.0
Total Thickness		40.4

Many exposures of St. Marks Formation were observed on Lloyd Creek north of the town of Lloyd. The following description is of samples taken on the west face of Lake Drain sink (locality LJf-1N-3E-11-dd) located on Lloyd Creek:

Sample no.	Description	Approximate elevation (feet)
4	Very pale orange, very finely sandy, finely crystalline, poor porous dolomitized limestone (calcilutite); no fossils noted	50
3	Silicified sandy limestone (calcilutite); fossil ghosts still apparent	41
2	Very pale orange, finely crystalline and chalky, finely sandy, porous dolomitized limestone (calcilutite); <i>Archaias</i> sp.	37
1	Very pale orange, finely crystalline, finely sandy, poorly porous dolomitized limestone (calcilutite); no fossils noted	33

Approximately 26 feet of St. Marks Formation was observed at Horseshoe Spring, one of the several springs at the headwaters of the Wacissa River.

ALUM BLUFF STAGE

HAWTHORN FORMATION

History.—The term Hawthorn Formation was proposed by Dall and Harris (1892, p. 107) for deposits exposed at Hawthorne, Florida. (For a good historical review of the term Hawthorn, the reader is referred to Florida Geological Survey Bulletin 29). Puri (1953, p. 38, 39) described the formation as a lithofacies of the Middle Miocene Alum Bluff Stage. Puri and Vernon (1959, p. 120) later cited Brooks Sink, Bradford County, as a cotype locality of the Hawthorn Formation. Vernon (1951, p. 187) used the term Hawthorn Formation to include all Middle Miocene marine beds in peninsular Florida.

In the past, the Hawthorn Formation in Jefferson County included all Miocene beds younger than the St. Marks Formation. However, during the course of working well samples and observing the surface outcrops, it became apparent that the sediments contained phosphate and the "mineral" phosphorite. As these phosphatic beds covered most of the county and seemed to correlate with the sediments Vernon defined as Hawthorn in the peninsula, this horizon will be separated from the overlying section of heterogeneous non phosphatic clastics and only the lower section containing phosphate will be considered as the Middle Miocene Hawthorn Formation.

Distribution.—The Hawthorn Formation is present in the subsurface over most of Jefferson County north of the Cody Scarp.

Much of the Hawthorn outcrop pattern shown on the geologic map was not observed in the field. A contour map was drawn on top of the Hawthorn Formation, and where the Hawthorn surface was higher or equal to the ground surface the formation was considered to be at or close to the ground surface. In theory the Hawthorn should be visible in these areas which are generally confined to stream valleys and low areas. However, in most instances the formation is covered by slump and is not visible. Outcrops were observed on Lloyd Creek and the Cascades near the

town of Lloyd. Except for two outcrops observed on the Aucilla River the formation appears to be missing in the southern part of the county.

General Lithology.—The Hawthorn Formation consists of pale olive, light greenish gray, yellowish gray, light gray, and moderate yellow, sandy, waxy, phosphatic clay. The clay contains phosphorite grains and is interbedded with very fine to medium, some coarse, clayey quartz sands that also contain phosphorite. In some instances, the clays and sands are cherty, and are also associated with thin sandy calcilutite stringers.

Thickness.—The geologic section B-B' (fig. 14) indicates that in the northern part of the county the top of the Hawthorn Formation is irregular, and the thickness has been reduced by erosion. Section A-A' (fig. 14) shows that the Hawthorn Formation in central and southern Jefferson County reaches a thickness of 50 to 70 feet. On the eastern side of Jefferson County as shown in cross section C-C' (fig. 14) the Hawthorn appears to have been deposited in a basin and attains a thickness of about 240 feet.

At a sinkhole called the Cascades, 51 feet of Hawthorn sediments are exposed and this is the thickest outcrop of the Hawthorn observed in Jefferson County.

Stratigraphic Relationships.—The Hawthorn Formation lies unconformably upon the St. Marks Formation or the Oligocene Suwannee Limestone.

The type of contact between the Miccosukee Formation and the Hawthorn is not known. However, available data indicates the two units may be conformable. Where the Miccosukee Formation is absent, the Hawthorn deposits are overlain unconformably by Pleistocene sands.

Fauna.—The fauna in the Hawthorn deposits consists of rare sharks teeth and very rare species of the foraminifers *Streblus beccarii*, *Globigerina bulloides* and *Elphidium* species. Oyster shells were observed eroded from the bank of Lloyd Creek just south of the bridge on State Highway 158.

Geologic Exposures.—The thickest exposure of Hawthorn deposits is at the Cascades (locality LJf-1N13E-22-bd). The following section was measured on the northwest wall of the sink:

Bed	Description	Thickness (feet)
Miocene Series		
Alum Bluff Stage		
Hawthorn Formation		
4	Pale olive green to moderate yellow, very fine to fine, some medium grains, angular, very clayey to silty, phosphoritic, quartz sand, more clayey toward the top of bed, contains phosphorite nodules up to 2 mm. firmly cemented by clay and silt, massive on sloped face of sinkhole	11
	Covered	18
3	Predominantly pale olive with light brown, sandy (very fine to fine, some medium grains), clay; seems to contain sand pockets, micaceous, contains nodules of white, sandy calcilutite, massive, verticle side of sinkhole	4
2	Predominantly pale olive with moderate yellow, very fine to fine, some medium grains, angular, micaceous quartz sand; very slightly phosphoritic, contains nodules of white sandy, limestone (calcilutite). The sand is cemented firmly by clay and contains heavies, forms verticle side of sinkhole	5
1	Pale greenish yellow, moderate greenish yellow and moderate yellow, very fine to fine, angular, micaceous, clayey, silty, phosphoritic quartz sand; contains very pale olive clay blebs, cemented firmly by clay, massive, vertical side of sinkhole	5
Total thickness		43.0

Exposures of Hawthorn were observed along the Aucilla River at the following localities:

1. LJf-1S-5E-27 bb: On east bank of Aucilla River, 4 feet of light gray, very sandy, phosphoritic clay.
2. LJf-2S-5E-29 dc: On east bank of Aucilla River, 2 feet of light gray, fine to medium, angular to subangular, clayey, phosphoritic, quartz sand.

Exposures of nonphosphoritic sediments observed along Lloyd Creek are assigned to the Hawthorn Formation because of their stratigraphic position and because lithologically they are similar to the Hawthorn beds exposed at the Cascades.

CHOCTAWHATCHEE STAGE

MICCOSUKEE FORMATION

History.—The Miccosukee Formation is composed of a heterogeneous complex of sediments that was referred to the Lafayette Formation (Pliocene) by Matson and Clapp (1909).

Sellards (1917, p. 96-110) referred the sediments of the Lafayette Formation to the lower Miocene Alum Bluff Formation. Later Gardner (1926, p. 1-2) raised the Alum Bluff Formation to the rank of group. Mossom (1926, p. 184) placed the Alum Bluff Formation as mapped by Sellards in the Chipola Formation of the Alum Bluff Group (Middle Miocene).

Cooke and Mossom (1929, p. 77-125) included these sediments in the Hawthorn Formation (Middle Miocene) and considered the Hawthorn Formation an equivalent of the Alum Bluff Group as mapped by Gardner.

Vernon (1951) recognized the complex of deltaic sediments as a delta of "Hawthorn age."

Doering (1960, p. 182-189) assigned these sediments to the Plio-Pleistocene Citronelle Formation.

Puri and Vernon (1964) reported all pro-deltaic Upper Miocene sediments as the "Miccosukee formation." The name "Miccosukee formation" was taken from preliminary copies of the manuscripts of Yon's Jefferson County and Hendry's Leon County geological reports.

Puri and Vernon (1959) pointed up the need for a detailed survey of the surficial sediments in north Florida that would determine the source of the deposits, the nature of their deposition, and their geologic age.

In the independent investigations of the geology of Jefferson County, Florida, by J. W. Yon, Jr. and of Leon County, Florida, by C. W. Hendry, Jr., cuttings from approximately 200 water wells and 15 core holes and outcrops were examined. The surface deposits in the Tallahassee Hills area of Jefferson and Leon counties represent an upper clastic unit that is deltaic in origin, as pointed out by previous investigators, and unconformably overlies a lower marine clastic unit. The deltaic unit caps the hills

and high level flats, whereas the marine clastics occupy the lower inter-hill areas, though these lower areas are in part rolling topography as well. The gross lithologies of each unit are distinctly different; however, this difference is frequently not readily apparent in single exposures. The upper unit can be mapped across Jefferson and Leon counties, Florida, and in adjacent counties. This unit is herein formally named the Miccosukee Formation by Hendry and Yon (1967, In press).

Definition and Distribution.—In Jefferson County the Miccosukee Formation includes all deposits in the Tallahassee Hills area that lie above the Middle Miocene Hawthorn Formation.

The Miccosukee covers all of Jefferson County from the Cody Scarp (Plate 1) northward to the Georgia State line. The absence of these clastics south of the escarpment, indicates that the Miccosukee was never deposited or was thin and subsequently removed by Pleistocene marine erosion.

The geographic limits of Miccosukee Formation are not yet adequately known. However, in addition to Jefferson County it is present to the west in Leon and Gadsden counties and extends eastward into Madison County. The Miccosukee is a heterogeneous unit with physical features that are characteristic of deltaic deposits, such as channel cut and fill, irregular and variable bedding in the vertical sections, lenticular deposits of sand and clay, crossbedded sands, interbedding of montmorillonitic and kaolinitic clays and alluvial sands, and the presence of land vertebrates. These above features substantiate Vernon's theory (1951) that the deposits from Tallahassee eastward are part of a large deltaic mass. Vernon also postulates that this deltaic mass wedges out to the east.

General Lithology.—The Miccosukee, in outcrops and in subsurface samples is an assemblage of lenticular clayey sands and clay beds which individually can be traced laterally for only short distances. In general, the formation consists of moderately sorted to poorly sorted, coarse to fine grained, varicolored, clayey, quartz sand; and montmorillonitic, kaolinitic, varicolored, sandy clays. Quite frequently the sands are crossbedded, and also contain crossbedded thin laminae of white to light gray clay. The clay laminae are associated with sands of two different grain sizes; that is, very fine to medium size, figure 18, and very fine to very coarse size, figure 19. Vernon Taylor (written communication, 1963) stated the X-ray diffraction patterns indicate that the

laminae associated with both quartz sands is kaolinite. The sands containing the clay laminae are the most widespread and generally the most persistent characteristics of these deposits and always occur at the top of the unit. In general the Miccosukee is heterogeneous in nature and, as already mentioned, no two outcrops exhibit the same pattern of deposition. However, this in itself makes these deposits very distinctive. The sediments in many places are deeply weathered laterites, and the weathered profile is often 10 to 15 feet deep, which gives the outcrops a massive appearance. However, bedding undoubtedly was once present, but has been obliterated by the intense weathering.

Thickness.—As shown on the geologic cross section C-C', (fig. 14) the Miccosukee has a thickness up to 160 feet. The cross sections show the surface of the clastics to be very irregular and probably represents an eroded surface. However, the cross sections indicate that the top of some of the highest hills approach the same elevations and probably nearly represent the original depositional surface.

Stratigraphic Relationships.—In northeastern Jefferson County, the Miccosukee Formation lies unconformably upon the St. Marks Formation. The contact between the Miccosukee Formation and the underlying Hawthorn Formation in Jefferson County may be conformable because of a transition from marine to deltaic sediments with no loss in the record. Regional correlations will be necessary to determine the stratigraphic relationships of this unit with the known upper and middle Miocene beds to the east of Jefferson County.

In southwestern Jefferson County, Pleistocene sands overlie the Miccosukee unconformably.

Fauna.—At locality LJf-2N-6E-1-dd teeth were found that have been described by Olsen (1963, p. 308-314) as molars from the horse *Merychippus* sp. and rhinoceros *Diceratherium* sp. Olsen (1963) compared the Jefferson County horse teeth with a larger series of Tertiary horses from the western United States. They agreed most closely with *Merychippus* from pre-Valentine (Early Pliocene) and post-lower Snake Creek (Upper Miocene) beds. However, the material was too fragmentary for more than a generic determination.

According to Olsen (1963) the single molar of the rhinoceros *Diceratherium* sp. is not the same as those of the genus from the

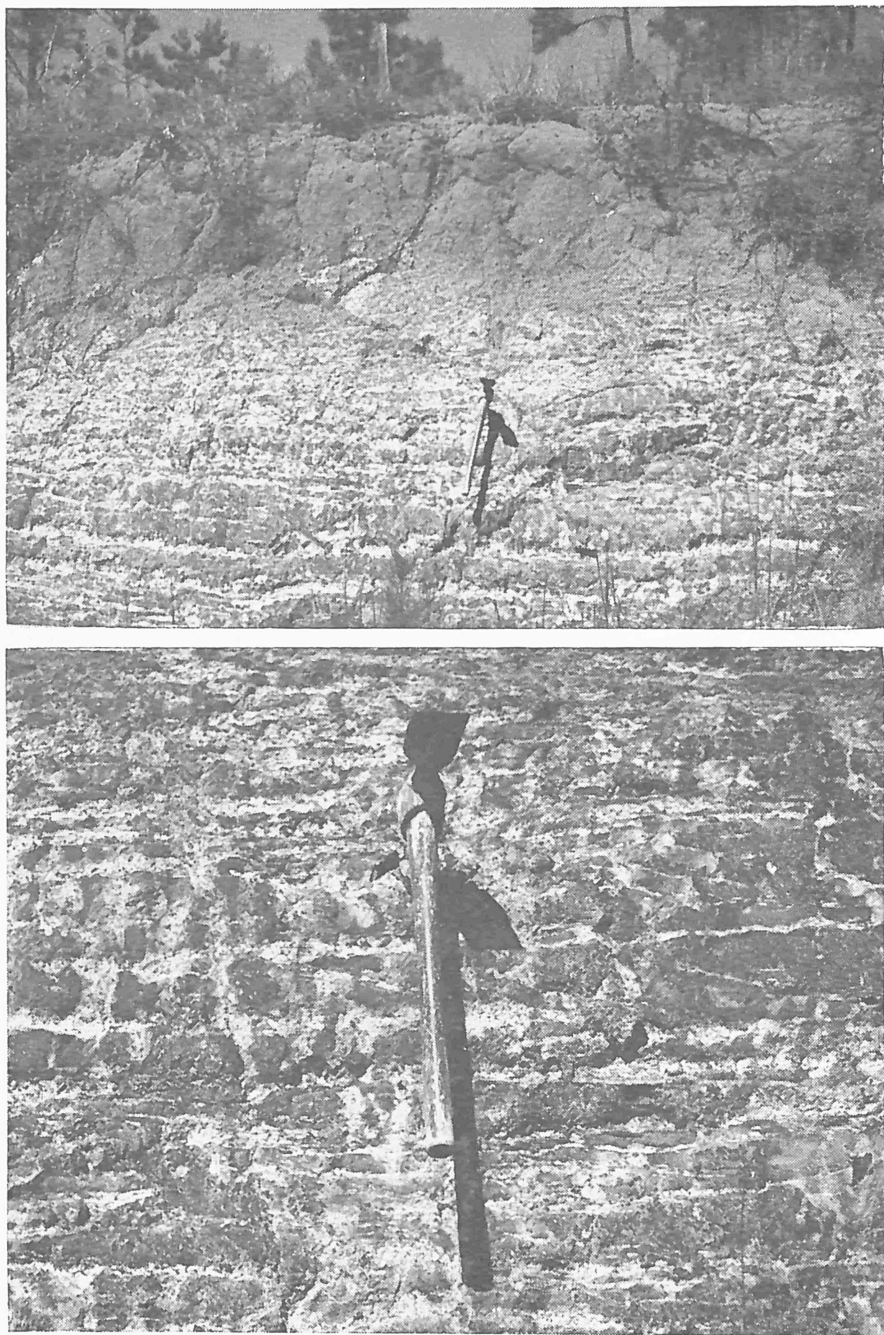


Figure 18. Roadcut showing clay laminae associated with very fine to medium grain size quartz sands.



Figure 19. Roadcut showing clay laminae associated with very fine to coarse sands and also verticle joints filled with sandy clay.

Middle Miocene of western United States. He (Olsen, 1963) concludes this is expected from an animal that occurs in a slightly higher stratigraphic horizon.

Olsen (1963) further states:

"A new species, *Merychippus gunteri* was described by Simpson (1930) from a fullers earth pit of lower Middle Miocene age at Midway, Florida, some 50 miles to the west of the Jefferson County locality: In the same paper, Simpson also recorded another species, *M. westoni* from the Middle Miocene of Newberry, Florida, 85 miles to the south of the locality under discussion. The *Merychippus* teeth from Jefferson County do not belong to either of these two species."

Geologic Exposures.—The Miccosukee Formation can be observed in roadcuts throughout the area. The sediments are so variable

that at any given outcrop you might observe individual features or sequence of beds that are different from any other outcrop. However, as already stated, the fact that the sediments are variable on a local scale makes them mappable on a gross scale. The following outcrops are cited to give some idea of the nature of the sediments:

Locality LJf-3N-5E-31 aa: Roadcut on the east side of U. S. Highway 19, about 3.1 miles south of the Georgia-Florida State line. The sediments in this section illustrate the rapid sedimentation changes and channel cut and fill of a deltaic environment. This section is the type locality of the Miccosukee Formation.

Unit	Description	Variable thickness (feet)
------	-------------	------------------------------

C	Mottled yellow brown, red brown, and greenish gray, very fine to medium, some coarse, angular to subangular, clayey, quartz sand, cemented firmly with clay and iron oxide, contains thin laminae of white clay that apparently dip northward under unit B, these crossbedded laminae are most noticeable near the contact of Unit C with B, top of Unit C becomes a deeply weathered red color (rust).	
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Near the contact of Unit C and B the sand at the base of Unit C becomes fine to coarse and angular to subrounded, predominately coarse grained; there is no sharp contact between Unit C and B except that they weather differently, also near the contact of the units the color in Unit C becomes a mottled purple red and greenish gray, with large gray spots up to 6 inches in diameter. Northward along the roadcut Unit C occurs again. However, here the color is more a light yellow brown, with some mottled red and greenish gray color; this part of the unit contains crossbedded

laminae that apparently dip southward under Unit B. The sand is coarse grained in this part of the unit near the contact of Unit C and A (clay bed), and has 2-inch joints filled with greenish gray clay. These joints have good relief because limonite cemented sands border their outside edges and hold them up. The sediments on the extreme northern end of this roadcut are believed to belong to Unit C, but are a deeply weathered red color and all bedding characteristics are destroyed

Up to 13.0

B Mottled purplish red, red brown, yellow brown, and greenish gray, very fine to medium, some coarse, angular to subangular, quartz sand more clayey than Unit C, firmly cemented by clay and iron oxide, massive; no sharp contact with Unit C. On weathered surface the color is much lighter than fresh cut. Joints filled with greenish gray clay

Up to 14.0

A Yellow brown and greenish gray, slightly sandy, silty, massive clay, that weathers blocky, sharp contact with Unit C that lies above

Up to 5.5

Locality LJf-2N-7E-6 dc: On the east side of Florida State Highway 146.

Unit	Description	Variable thickness (feet)
D	Weathered Zone	
	Fine to very coarse, angular to subrounded quartz sand, most of clay has been leached out, some limonite forming along contact with Unit C	2.0
C	Fine to very coarse, angular to subrounded, quartz sand, some pea-size gravel scattered throughout unit, mottled light and dark red brown, yellow-brown, greenish gray on east end of unit, cemented with iron oxide and clay, contains thin crossbedded laminae, sharp contact with Unit B, resistant to weathering	3.0-9-3

B	Mottled light yellow-brown and greenish gray, slightly sandy, waxy, blocky, massive, clay, sharp contact with Units A and C	1.5
A	Light yellow-brown, fine to very coarse, angular to subrounded, quartz sand, cemented with iron oxide and clay, contains laminae of white clay (0.5-2mm) that are crossbedded, sharp contact with Unit B. Pea gravel scattered throughout unit. At top of unit is a thin bed that is resistant to weathering	3.4

Locality LJf-2N-6E-1 dd: On north side of State Highway 146. Upper Miocene vertebrate remains were found at this locality;

Unit	Description	Variable thickness (feet)
F	Very fine to coarse, predominantly light yellow and red brown, very silty and clayey, quartz sand, massive bedding, gradational contact with Unit E, but more clayey. Roadcut slopes back and near the top of unit the sediments become a highly weathered yellow tan with much of the clay leached away	7.5
E	Very fine to medium, some coarse mottled light brown and grayish green, angular to sub-angular, quartz sand cemented with iron oxide and clay, thin green laminae of clay, ?cross-bedded, gradational contact with Unit F, but fairly sharp contact with Unit D, weathers irregular, forms a slight bluff	2.0
D	Dark yellow-brown, silty, sandy, waxy, massive clay, fairly sharp contact with bed below; most of unit covered but to the east it thickens and becomes a dark gray, pale olive color, similar to Unit B	1.5
C	Mottled yellow-brown, and light gray-green, fine to very coarse, angular to subrounded, quartz sand, contains some pea-size and larger quartz	

	pebbles, clayey, contains blebs of yellow brown clay and light gray clay granules; contact with the underlying clay Unit B fairly sharp. Unit C upon exposure to weathering becomes sufficiently lithified to form a small wall along the side of the roadcut. On the west end of the outcrop, the unit thickens and remains resistant to weathering. This unit contains vertebrate remains	2.0
B	Pale olive, waxy, blocky, sandy, clay, fairly sharp contact with Unit A, unit slopes back along roadcut, a rubble of light gray, very fine grained sandstone on the surface of this unit occurs, which forms a cellular-like structure	4.0
A	Pale olive to white and yellow-brown, very fine to medium, some coarse, angular to sub-angular, quartz sand cemented with silica and clay, very clayey, massive, the outer surface of this unit is case-hardened and forms a thin sandstone layer just on the surface that is very resistant to weathering	3.0

QUATERNARY SYSTEM

Pleistocene and Recent Deposits

Distribution.—Surficial sediments of Jefferson County from the Cody Scarp near Wacissa to the Gulf of Mexico form the Gulf Coastal Lowlands and are Pleistocene in age. The Recent sediments are confined mostly to the present stream valleys. Northwest of Wacissa, Pleistocene deposits make up a series of sand hills.

General Lithology.—The Pleistocene deposits forming the Gulf Coastal Lowlands south of the Cody Scarp are very fine to medium quartz sands with blue-green to light olive montmorillonitic clay lenses. The clay lenses contain occasional very badly weathered macrofossils. In the sandhill area the sediments are yellow-brown, very fine to very coarse, predominantly fine to medium, angular to subrounded, clayey, quartz sands.

The Recent deposits occurring along the stream valleys are reworked Pleistocene quartz sands and quartz sands derived from the Miccosukee Formation.

Thickness.—Geologic cross section A-A' (fig. 14) shows that the Pleistocene deposits range in thickness from 2 to 3 feet at the coastline up to 20 feet at the toe of the Cody Scarp. Cross section D-D' (fig. 14) shows that at the Jefferson-Wakulla County line the Pleistocene is about 7 feet thick. Eastward it thins to only a veneer but at the eastern edge of the county the Pleistocene sands thicken to approximately 10 feet.

In WJf-2S-3E-31-ca and WJf-1S-3E-3-ca located on the western edge of the county, 20 and 37 feet of Pleistocene quartz sand, respectively, overlie the St. Marks Formation.

Stratigraphic Relationships.—The Pleistocene deposits unconformably overlie the St. Marks Formation and the Suwannee Limestone in the southern part of the county. In the sandhill area northwest of Wacissa, Pleistocene sands unconformably overlie the Miccosukee Formation.

Fauna.—Vertebrate remains have been found in the Aucilla River and S. J. Olsen (personal communication, January 8, 1964), remarked that "the general clear waters of the Aucilla River have been particularly rewarding for the skindiving bone collector. From the eroded holes in the bottom of the river bed, along its entire course, countless bones of late Pleistocene and sub-Recent mammals have been collected. These remains appear to be redeposited, and, in some cases, entombed in a reworked clay."

Some of the forms represent animals still found in the area (deer, bear) however, the bulk of the mammals are of genera that become extinct before the close of the Pleistocene."

"Perhaps the most important find is one of associated *Bison bison* (the modern plains "Buffalo") with the remains of the extinct long-horned bison, *Bison* cf. *latifrons*. Most mammalogists, in past reports, do not map the distribution of the plains bison as extending into Florida, although the Spaniards reported the animals in the vicinity of Lake Jackson in Leon County."

"Credit for collecting representative bones of the animals listed below goes to Mr. Richard Ohmes and his son Donald, of Chaires, Florida. The bones were recovered by scuba diving and are in the Ohmes' collection in Chaires."

Edentata:

Megatheriidae:

Megatherium sp. (Ground sloth).

Carnivora:

Ursidae:

Ursus americanus (Black bear).

Proboscidae:

Mammutidae:

Mammut americanum (American Mastodon).

Elephantidae:

Mammuthus sp. (Mammoth).

Perissodactyla:

Equidae:

Equus sp. (Pleistocene horse).

Tapiridae:

Tapirus veroensis (Florida tapir).

Artiodactyla:

Camelidae:

Camelidae indet, cf. *Tanupolama americana* (Camel).

Cervidae:

Odocoileus virginianus (White-tailed deer).

Bovidae:

Bison bison (American "Buffalo" bison).

Bison cf. *latifrons* (Extinct bison).

Geologic Exposures:

1. Locality LJf-2S-3E-14 ac: About 2 feet of yellow-brown and mottled gray, plastic, montmorillonitic, slightly sandy clay, containing very badly weathered macrofossils.
2. Locality LJf-2S-3E-15 center: About 1 to 2 feet of montmorillonitic macrofossiliferous clay similar to locality LJf-2S-3E-14-ac.

STRUCTURE

The configuration and altitude of the Suwannee Limestone is shown by a contour map (fig. 10). The geologic cross-sections in figure 14 further exemplify the altitude of the beds. The contour map was constructed from information gathered by studying well cuttings and gamma ray logs.

As indicated on the contour map, the top of the Suwannee Limestone is very irregular as a result of erosion. The contour lines are generalized and can not possibly show all the irregularities of the limestone surface. The map shows that two positive and

several negative areas are present. The positive areas may be related to the northwest trend of the Ocala Uplift (Vernon, 1951, p. 48). The two negative areas on the western side of the county could be related to the deep basin known as the Apalachicola Embayment of the north Gulf Coast sedimentary province (Pressler, 1947, p. 1853). The geologic cross sections (fig. 14) indicate the basins were active after Suwannee times. The basin developed on the east side of the county is deeper and appears to be smaller than the one mentioned above. The western side of the high located in the central and eastern side of Jefferson County could be interpreted as faulting based on the linear alignment of the contour lines. However, the writer chose not to draw in a fault along this trend, as subsurface data is lacking. Also the contour map may be drawn on an eroded surface and therefore, not a true representative of the structural conditions.

The high area located north of Lamont was drawn on the basis of one outcrop and may represent an area that was once connected to the positive area in the central part of the county, but has been separated by erosion.

Establishing true dip and strike of the Suwannee Limestone would be difficult and would depend largely in what section of the county you were working.

GEOLOGIC HISTORY

The relative age of the deposits in Jefferson County range in age from Recent to Paleozoic. The rocks are either exposed or have been penetrated in the subsurface by wells.

From the beginning of late Cretaceous, until early middle Eocene, Jefferson County was in an area of clastic deposition. At the beginning of early middle Eocene the depositional environment changed and carbonates became the predominant sediment deposited.

During this period of time the middle Eocene, Lake City Limestone, the Eocene Ocala Group, and the Oligocene Suwannee Limestone was deposited. The above formations represent a depositional change from clastics to carbonates that were deposited in a shallow, warm open sea. At the end of the deposition of the Lake City, the early middle Eocene seas regressed and according to Vernon (1951, p. 92), the Avon Park Limestone was deposited by a transgressing sea on the eroded surface of the Lake City Limestone. The end of Avon Park deposition again marked the

regression of the seas and its surface emerged and was eroded. The seas once again returned and the Ocala Group was deposited unconformably upon the Avon Park Limestone. During the time the upper Eocene Ocala Group was deposited the seas did not regress, as there does not appear to be any break in deposition between the formations of the Ocala Group. The Eocene Epoch was brought to a close with the deposition of the Crystal River, the youngest formation in the Ocala Group.

The lithology and fauna of the Oligocene Suwannee Limestone seems to indicate that it was deposited in seas that were warm, shallow and open. At the close of the Oligocene Epoch a period of predominantly clastic sedimentation took place. The two positive areas shown on the contour map (fig. 10) may be related to the Ocala Uplift, a post-Oligocene structural movement, (Vernon 1951(p. 61-62). These areas were not, however, high enough to prevent encroachment by the early Miocene seas that deposited the St. Marks Formation. As the cross-sections in figure 14 show, the St. Marks Formation was deposited on top of the high areas. The basin on the western side of Jefferson County appears to have been formed prior to the encroachment of the early Miocene seas. However, the thick deposits of St. Marks in the basin seems to indicate that subsidence was still taking place up to the close of early Miocene. As shown by the sediments forming the St. Marks Formation, the same influence of carbon deposition was occurring during early Miocene, even though sands and clays were being deposited with the carbonates.

At the end of early Miocene time extensive erosion took place in Jefferson County, especially in the eastern part, where the St. Marks is either missing or very thin and the Hawthorn Formation lies directly upon the Suwannee Limestone.

During Middle Miocene time, the depositional environment changed and a great mass of clastics generally masked out all carbonate deposition. The shallow marine or brackish water deposits composing the Middle Miocene Hawthorn Formation consists of sands and clays that contain phosphorite. As the deposition of the Hawthorn deposits ceased, a predominantly marine depositional environment gave way to a deltaic environment. The deposits forming the delta complex are widespread as they encompass many square miles both to the east and west of Jefferson County. The age of these deposits, at least in part, has been established as late Miocene on the basis of land mammals found in eastern Jefferson County. The sequence of

deposition from Middle Miocene Hawthorn Formation to the overlying Upper Miocene Miccosukee Formation gives the appearance of being only a gradual change in the mode and environment of deposition and the contact is probably a conformable one.

With the inception of the Pleistocene Epoch, the seas once again stood over Jefferson County at various levels and formed the Gulf Coastal Lowlands in the southern part of the county. The Aucilla River and most of the creeks probably had their beginning during the Pleistocene Epoch and the St. Marks Formation was almost entirely removed by erosion in the Gulf Coastal Lowlands.

Since the beginning of the Recent Epoch, sea level has been fairly stationary and the deposition of sediments in Jefferson County is restricted to alluvium along the many streams, peat and muck in the lakes and Coastal Marshes.

THE MYTH OF THE WAKULLA VOLCANO

Articles by Wilfred T. Neill (1963) and Hallie Boyles (1964) have been recently published on a volcano in the southern part of Jefferson County. The following general information was taken from these two articles.

Superstition, folklore and imagination produced strange tales about a thin column of smoke and sometimes fire that rose above the swamps near the Wacissa River, in southern Jefferson County.

According to Indian legend the column of smoke had always been there.

Supposedly, the Spaniards were the next people after the Indians to see the smoke.

Undoubtedly, as they and other people in later years watched the smoke curling up out of the swamp week after week and year after year, they begun to speculate about its origin.

As the story goes the Spaniards thought perhaps the smoke was coming from a pirates den.

When St. Marks began to develop as a seaport, sailors used the smoke column to get their bearings as they approached the coast. They are said to have remarked that the old man of the swamp was smoking his pipe again.

Prior to civil war days the local folks thought perhaps the smoke was coming from a camp of run away slaves.

Finally someone advanced the theory that the smoke was from a volcano. As the story of the volcano began to spread, historians, newspapermen, writers, and just plain folks came from far and

wide to investigate the strange phenomena. In fact, a New York newspaper man lost his life trying to solve the mystery.

The smoke coming from the Wacissa Swamp seemed to be located near the small settlement of Wakulla and was named the "Wakulla Volcano" by Barton Jones in an article published in the Lippincott's magazine in 1882.

Maurice Thompson, in his novel "The Tallahassee Girl," wrote about the great smoke column. He remarked that the smoke column was no hoax and would be a permanent and persistent mystery.

On August 31, 1886, an intense earthquake rocked the city of Charleston, South Carolina. The earthquake was intense enough that shock waves were felt in Tallahassee. The interesting thing about this is that on this day the smoke disappeared, never to be seen again.

Consequently, many of the local residents attribute the disappearance of the volcano to the Charleston earthquake.

In recent years several eye witnesses claim they have seen the crater. According to their reports, huge black boulders charred by fire surround the crater.

However, evidence gathered by the Division of Geology indicates that the surface rocks in Jefferson County are far different from those that come from volcanoes. Volcanic rocks are present in the county, but lie below 7000 feet of sands, clays and limestones. These volcanic rocks form what geologists call volcanic diabase sills or dikes and are believed to be millions of years old. Since the time the sills or dikes were formed the rocks show no evidence of volcanic activity in the area.

The reported smoke coming from the Wacissa Swamp presents a problem, although not an uncommon one. In an article in Florida Wildlife about the volcano Wilfred Neill presents the theory that the smoke was a result of peat fires that varied in intensity. He further states that the earthquake of 1886 caused sinkhole development in the area and subsequently the burning peat slumped into these collapse features and was extinguished. Whether or not Mr. Neill is correct in his assumptions, his explanation is a reasonable one.

The large boulders supposedly of volcanic origin are nothing more than silicified limestone residue of the Suwannee Limestone. They represent the remains of a highly eroded limestone surface where the original composition of the rock has been replaced chemically by quartz. These boulders in no way are related to volcanic activity.

The volcano story makes for interesting popular reading, but cannot be substantiated by any fact, and therefore, is nothing more than a legend or a myth.

ECONOMIC GEOLOGY

LIMESTONE

The term limestone applies to a sedimentary rock composed essentially of calcium carbonate (CaCO_3). It may have varying amounts of impurities such as clay, silica, iron oxide, carbonaceous material and magnesium carbonate.

The quantity of limestone in Jefferson County is sufficient to sustain large quarry operations. The Suwannee Limestone is the most important source of limestone because of its accessibility, softness, and as shown in table 5, it is essentially a pure "high calcium" rock in that it contains more than 95 percent calcium carbonate. The distribution of the Suwannee Limestone is shown

TABLE 5. Chemical analyses of Suwannee Limestone samples from Jefferson County, Florida

F.G.S. sample No.	Calcium carbonate (CaCO_3) (percent)	Magnesium carbonate (MgCO_3) (percent)	Ferrie oxide (Fe_2O_3) (percent)	Aluminum oxide (Al_2O_3) (percent)	Insoluble material (percent)	Total percent ¹
LJf-2S-3E-1 ac	98.2	Trace	0.09	Trace	0.55	98.89
LJf-1S-5E-12 bb	99.1	Trace	.07	Trace	.38	99.55
LJf-1S-5E-12 bb	98.7	Trace	Trace	Trace	.31	99.01
LJf-3S-4E-28 ca	99.5	Trace	.12	Trace	.44	100.06
LJf-3S-4E-28 db	101.2	Trace	.13	Trace	.22	101.55
LJf-4S-3E-16 cb	100.0	Trace	.11	Trace	.88	100.99
LJf-3S-3E-27 dd	99.2	Trace	.16	Trace	.24	99.60

¹The percentage total is the sum of all the percentages of the individual chemical components and do not always add up to 100 percent. To convert the sum of all the components to 100 percent use the following formula:

$$\frac{\text{Chemical component} \times 100}{\text{percent total}}$$

on figure 20. In 1964, the only active mining of limestone was by the Jefferson County Road Department and Buckeye Cellulose Company for use as road metal in the southern part of the county. In adjacent Taylor County, limestone has been quarried for use as a road base. In both cases, the method of mining has been with draglines and front end loaders on tractors.

The abundance of Suwannee Limestone could make it a very valuable commodity for use in road building as a base course material and stabilized base rock. A number of samples were submitted to the State Road Department to see if they would meet their specifications for use as stabilized base rock and base course material and, as noted on table 6, all categories were satisfactory.

The high calcium content of the Suwannee Limestone would make it very suitable for use in any chemical process such as agricultural limestone and the manufacture of cement, and quick and hydrated lime.

Reves (1961) presented a discussion of the various uses and technical data pertaining to uses of limestone.

Some of the main factors involving the future exploitation of the limestone resources in Jefferson County are transportation and fuel. At present no railroads traverse the area where the greatest reserves of limestone occur. However, two major railroads run through the county and spur lines could be extended into this region. Two principal highways, U. S. Highway 90 and U. S. Highway 27, and several Florida secondary highways run sufficiently near the limestone deposits to be useful for transporting the commodity to local consumers or to rail lines for shipping. Upon the completion of Interstate Highway 10, figure 21, across Jefferson County another important transportation route will become available.

Upon the construction and completion of the intercoastal waterway (fig. 21) off the coast of Jefferson County, another means of transportation would become available and open the way to markets all over the State.

A natural gas pipeline traverses the county (fig. 21) and could be an important source of fuel in potential chemical processing of limestone.

DOLOMITE ROCK

Secondary dolomite generally is considered a variety of limestone that theoretically contains 54.6 percent calcium

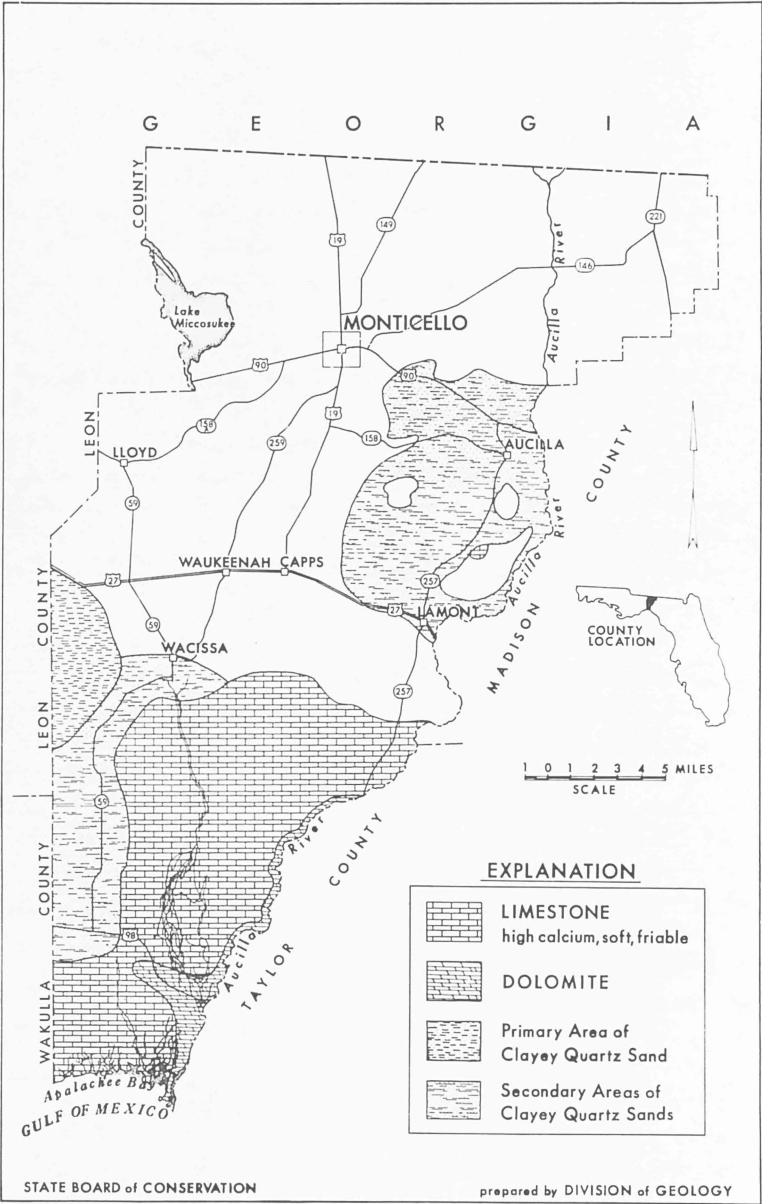


Figure 20. Distribution of the economic deposits of Jefferson County, Florida.

TABLE 6. Soil test results of samples of Suwannee Limestone from Jefferson County, Florida

Sample no.	Liquid limit ¹	Plastic index ¹	Organic matter	Florida State Road Department specifications ²
				Base course materials
LJf-1S-5E-12 bb	NP	NP	0.3	Passes
LJf-4S-3E-16 da	NP	NP	.1	Passes
LJf-3S-3E-34 bb	NP	NP	.1	Passes
LJf-3S-4E-28 ca	NP	NP	.1	Passes
LJf-3S-4E-28 da	NP	NP	.1	Passes
LJf-3S-4E-10 dc	NP	NP	.2	Passes

¹For a technical discussion of these categories see Florida Geological Survey Bulletin 42, p. 99-102.

²See Florida State Road Department Standard Specifications 1959, p. 423.

NP—Nonplastic

carbonate (CaCO_3) and 45.4 percent magnesium carbonate (MgCO_3). This is not to say that all dolomites will approach the theoretical proportions mentioned above for there is generally gradations from dolomitic limestones, (4.4 to 22.7% MgCO_3) calcitic dolomites, (22.7 to 41.0% MgCO_3) to true dolomites (41.0 to 45.4% MgCO_3). Dolomites can, in a general way, be distinguished from limestones by their slower effervescence in

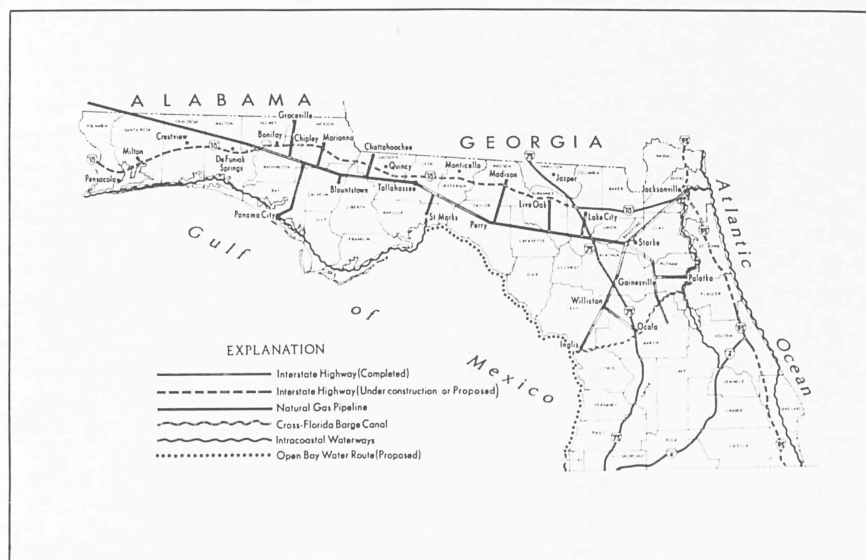


Figure 21. Route of Florida's interstate highway system, waterways, and natural gas pipeline (after Reves)

cold, dilute, hydrochloric acid. This test does not, however, tell you the amount of magnesium carbonate present.

The dolomites of commercial value in Jefferson County are Suwannee Limestones that have been replaced in part by $MgCO_3$. The approximate areal distribution of the dolomites is shown on the mineral resources map (fig. 20). Field observation seems to indicate that the dolomites are confined for the most part along the Aucilla River and the low area east of the Aucilla River and south of U. S. Highway 98. The thickness of the dolomites in this area is not known; however, core test WJf-4S-3E-24-bd bottomed in dolomite at 24 feet. Along the Aucilla River in Taylor County, dolomite prospecting was conducted by the Florida Geological Survey in 1942. For results of these test holes, the location of the wells and the dolomitic areas, the reader is referred to the Florida Geological Survey Report of Investigations No. 3, p. 13-25. Observation of table 7 shows that the dolomites tested are almost pure as they contain 41 to 42 percent magnesium carbonate. One of the samples, LJf-3S-4E-10-dc was subjected to the Los Angeles abrasion test and failed as its abrasion loss was 46 percent and exceeded the 40 percent minimum set by the Florida State Road Department Standard Specifications.

CLAY DEPOSITS

INTRODUCTION

At the present time there is no clay being mined commercially in Jefferson County. The clays are montmorillonites and kaolinites which occur in the Hawthorn, Miccosukee, and the Pleistocene deposits. Some of the clays in the Miccosukee Formation have a very small percentage of sand and may be of commercial value. However, because of their lenticular nature and generally short lateral extent, an extensive drilling program would be necessary to determine if it would be feasible to mine them for commercial use. In the southern part of the county the terrace deposits contain sandy montmorillonitic clays and detailed exploration may find deposits suitable for commercial use.

TESTS

Samples of clays from outcrops were collected and submitted to the Bureau of Mines for determination of the physical and firing characteristics and recommended uses. Table 8 gives the data on

TABLE 7. Chemical analyses of Suwannee Dolomite samples from Jefferson County, Florida

F.G.S. WJf-4S-3E-24 bd (depth in feet)	F.G.S. sample no.	Calcium carbonate (CaCO ₃) (percent)	Magnesium carbonate (MgCO ₃) (percent)	Ferric oxide (Fe ₂ O ₃) (percent)	Aluminum oxide (Al ₂ O ₃) (percent)	Acid insoluble (percent)	Total Percent ¹
8'9" to 14'		55.7	41.8	0.07	Trace	1.64	99.21
14' to 16'		55.7	42.1	.07	Trace	1.44	99.31
16' to 20'		55.3	41.4	.07	Trace	1.96	98.73
20' to 24'		54.9	38.5	.08	Trace	3.26	96.74
	LJf-3S-4E-28 db	57.9	41.1	.07	Trace	.77	99.84
	LJf-3S-4E-28 ac	56.6	41.4	.22	Trace	.70	98.92
	LJf-3S-4E-10 dc	56.2	41.8	.10	Trace	.79	98.89
	LJf-3S-4E- 2 bd	56.6	41.0	.12	Trace	1.67	99.39
	LJf-3S-4E- 2 cb	57.0	41.0	.08	Trace	.48	98.56

¹The percentage total is the Sum of all the percentages of the individual chemical components and do not always add up to 100 percent. To convert the sum of all the components to 100 percent use the following formula:

$$\frac{\text{Chemical component} \times 100}{\text{percent total}}$$

these clays. Also included in the table is an analysis of clay collected from a 11½ foot test hole, located one and one-half miles east of Wacissa near milepost 822 on the abandoned Seaboard Air Line Railway. The data on the clay from the test hole was taken from the Florida Geological Survey Information Circular No. 2, (1949, p. 35, 54).

The location and description of the samples collected and tested as shown in table 8 are as follows:

Sample No.

LJf-2N-5E- 8 ad	Roadcut on Florida Highway 149A. 5 feet of mottled yellow brown and light greenish gray sandy clay.
LJf-152	Roadcut on Florida Highway 149, 2 feet of mottled yellow brown and light greenish gray sandy clay.
LJf-3N-5E-31 ca	Roadcut on U. S. Highway 19, 5 feet of mottled yellow brown and light greenish gray sandy clay.
LJf-2N-6E-1 dd	Roadcut on Florida Highway 146. 5 feet of mottled yellow brown and gray green sandy clay.
LJf-1S-4E-33 ac	Ditch on county road west of Thomas City. 2 feet of mottled yellow brown and light greenish gray sandy clay.
LJf-1S-5E-19 bb	Roadcut on U. S. Highway 27, approximately 15 feet of mottled dark yellowish brown and dusky red sandy, silty clay.

SAND

The most extensive areas of sand occur in the Gulf Coastal Lowlands, along the eastern side of the county, the Dune Belt and in the sandhill area northwest of Wacissa (fig. 20). In the Gulf Coastal Lowlands area the sand deposits are generally thin, slightly clayey, fine to medium grained quartz. The deposits in the Dune Belt sandhill area are very fine to very coarse grained, predominantly fine to medium grained, clayey, iron-stained quartz sand. Coarse sands were encountered in core holes WJf-1S-3E-13-aa from 35 to 60' and in WJf-1N-6E-8-dd located in the eastern part of the county, from 16 to 43 feet. The sands in the core holes, and in the Dune Belt, would require some washing to remove the clay content.

PETROLEUM POSSIBILITY

Two oil test wells, the Southern States Oil Corporation No. 1 Millard and Gossard and the Coastal Petroleum Company No. 1 E. P. Larsh, have been drilled in Jefferson County. The two tests penetrated the Atkinson Formation of Upper Cretaceous age, which is the same age and is similar lithologically to the oil producing zones in the Pollard Field just north of the Florida-Alabama State line in Escambia County, Alabama. Neither of the tests had oil shows and were abandoned as dry holes. Although the absence of oil in these wells has been discouraging, the sands in the lower member of the Atkinson Formation appear to be adequate as a reservoir rock and if oil is present in the county these beds are the best prospect.

PHOSPHATE

Phosphate is common in the Hawthorn Formation in Jefferson County. The phosphate occurs in two forms, as phosphorite and as colloidal phosphate embedded in a clay matrix.

A thick section of colloidal phosphate-clay was found in a core hole located in the center of Sec. 5, T2N, R5E and is the richest phosphate deposit encountered in the county. Nodular beds of phosphate and phosphate pebbles up to 2 inches in diameter also occur within the unit.

The phosphatic unit was analyzed for P_2O_5 and the results of the analyses are listed below:

Core Hole WJf-2N-5E-5 center	
Core Sample (Depth in feet)	% P_2O_5 Dry Basis
70-72½	2.3
72½-75	0.2
75-77½	6.2
77½-80	2.3
80-82½	1.3
82½-85	17.1
85-87½	7.6
87½-90	19.0
90-92½	13.5
92½-95	10.7
95-97½	8.5

TABLE 8. Tests of selected clay samples from Jefferson County, Florida.

Sample Designation	LJf-2N-5E-8 ad	LJf- 152	LJf-3N-5E-31 ca	LJf-2N-6E-1 dd	LJf-1S-4E-33 ac	LJf-1S-5E-19 bb	Sample Designation	0-263 (I.C. #2)
Raw Properties: Working characteristics	Fairly long working, plastic, fine grit	Long working, smooth, plastic	Long working, smooth, plastic	Long working, smooth, plastic sticky	Short working, sticky, plastic	Long working, smooth, plastic	Physical Properties: Plasticity Water of plasticity % Linear air shrinkage % Modulus of rupture Slaking test Color	Good 31.0 8.6 210. Fast Brown
Water of plasticity %	39.0	46.0	38.0	59.0	25.0	26.0		
Drying shrinkage %	10.0	16.0	10.5	4.5	10.0	5.5		
Dry strength	Good	Fair	Good	Fair	Fair, slight scum, rough surface	Fair, warping		
Drying characteristics	Fair, slight scum, slightly rough surface	Fair, slight warping, scumming	Poor, wavey rough surface	Poor, grainy				
Slow Firing Test: % Linear Shrinkage							Firing Behavior: % Linear Shrinkage	
1800° F	15.0	19.5	14.5	5.0	5.5	5.0	950° C	1.0
1900° F	15.0	20.0	14.5	5.0	5.5	5.0	1050° C	2.5
2000° F	15.5	22.0	14.5	5.0	5.5	5.0	1090° C	2.0
2100° F	20.0	25.0	19.5	10.0	5.5	6.0	1150° C	2.5
2200° F	20.0	26.0	19.5	10.0	4.0	9.0	1190° C	2.5
2300° F	20.0	26.0	19.5	10.0	4.0	9.0	1250° C	2.5
2400° F								
% Absorption:							Absorption % by weight	
1800° F	24.4	16.7	16.7	20.8	16.4	18.5	950° C	14.9
1900° F	25.0	15.2	25.0	20.8	18.9	19.6	1050° C	14.8
2000° F	12.7	9.7	20.4	18.5	20.4	17.6	1090° C	14.1
2100° F	11.6	4.1	11.4	18.2	20.4	17.0	1150° C	14.4
2200° F	10.9	3.6	10.8	14.3	20.0	13.9	1190° C	13.6
2300° F		2.1	7.8	14.1	13.3	12.9	1250° C	13.8
2400° F								

Color:							Color:	
1800° F	Light Brown	Light Brown	Light Brown	Flesh	Light Brown	Tan	950° C	Reddish Orange
1900° F	Light Brown	Light Brown	Light Brown	Flesh	Light Brown	Tan	1050° C	Reddish Orange
2000° F	Light Brown	Light Brown	Light Brown	Flesh	Brown	Tan	1090° C	Brick Red
2100° F	Brown	Brown	Brown	Tan	Chocolate	Tan	1150° C	Brick Red
2200° F	Brown	Brown	Chocolate	Buff	Chocolate	Buff Tan	1190° C	Brick Red
2300° F	Brown	Brown	Buff Brown	Buff	Chocolate	Olive Tan	1250° C	Brick Red
2400° F								
Hardness:							Porosity %:	
1800° F	Fair Hard	Fair Hard	Fair Hard	Fair Hard	Fair Hard	Fair Hard	950° C	34.8
1900° F	Fair Hard	Hard	Fair Hard	Fair Hard	Fair Hard	Fair Hard	1050° C	35.0
2000° F	Hard	Very Hard	Hard	Fair Hard	Hard	Hard	1090° C	34.0
2100° F	Very Hard	Steel Hard	Very Hard	Hard	Hard	Hard	1150° C	34.0
2200° F	Steel Hard	Steel Hard	Very Hard	Very Hard	Very Hard	Very Hard	1190° C	32.5
2300° F	Steel Hard	Steel Hard	Steel Hard	Very Hard	Very Hard	Steel Hard	1250° C	33.3
Bloating Test:	Negative	Negative	Negative	Negative	Negative	Negative	Potential Use:	Rather porous, common brick
Potential Use:					Could be used in making brick	Light color, some cracking, shrinkage a little high, addition of alkali might make a pottery or derative tile		

97½-100	8.9
100-102½	9.2
102½-105	13.7
105-107½	11.9
107½-110	12.8
110-112½	6.9
112½-115	6.9
115-117½	3.9
117½-120	11.2
120-122½	7.6
122½-125	6.9
125-127½	11.2
127½-130	8.3

As shown by the analysis, the phosphate content of the core hole interval is low. However, in future years a lower grade phosphate may be economically acceptable and could be utilized as suggested by Vernon (1951, p. 228-30). He (Vernon, 1951, p. 228-30) indicates that this type phosphate is used as a soil conditioner and filler in fertilizer.

The Hawthorn Formation in Jefferson County also contains sand size phosphate particles that are associated with clayey sands or sandy montmorillonitic clays. These particles are referred to in this report as phosphorite. The visual estimate of the phosphorite grains in cuttings from wells, core hole samples and outcrops indicates the phosphorite does not exceed 10 percent of the bulk volume of the sediments. Vernon (1951, p. 224) reports that phosphorite from other areas in Florida is composed of the mineral fluorapatite.

Knowledge of the occurrence of phosphate in Jefferson County is limited to the available data and trends cannot be predicted at this time. However, in the future as more is known of the genesis and occurrence of phosphate, these data may indicate that further investigation is warranted.

GROUND WATER

The term "ground water" refers to the water that fills all the open pores and interstices in the rocks below the surface of the earth in the zone of saturation.

The source of ground water in Jefferson County is the precipitation in the county and nearby areas. Some of the precipitation that falls on Jefferson County leaves the area by

surface runoff in streams, by evaporation and by transpiration. The part that is left soaks into the ground and slowly moves downward to the zone of saturation. After reaching the zone of saturation, the water under the influence of gravity begins to move slowly toward points of discharge such as wells, springs, streams, or the Gulf of Mexico.

Ground water in Jefferson County can be divided into two categories: (1) Unconfined water (water table) which occurs in the shallow formations above the St. Marks Formation and is under atmospheric conditions; that is, the water surface is free to rise and fall. The unconfined water will not be discussed in this report. (2) Water that is confined under pressure between relatively impermeable formations, and is not free to rise and fall. This water is said to be under artesian conditions.

ARTESIAN WATER

The artesian water in Jefferson County occurs in the Floridan aquifer from which most of the water for irrigation, industry, and public supply is derived.

FLORIDAN AQUIFER

The term Floridan aquifer was introduced by Parker and others (1955, p. 188) and it includes all or parts of formations from Middle Eocene to Middle Miocene.

In Jefferson County it is believed that the Floridan aquifer is recharged by Lake Miccosukee through sinkholes, along the Aucilla River, and in the northeastern portion of the county in the swamp areas where leakage occurs through the overlying sediments of the Hawthorn Formation and Miccosukee Formation.

FLUCTUATIONS OF WATER LEVELS

Twenty-one wells were measured periodically from January, 1960, to December, 1962, to determine trends in water-level fluctuations. Water-level recorders were installed on two wells in April, 1960, and were in operation until December, 1962. The graphs obtained from the water-level recorders showed a daily as well as seasonal fluctuation.

To determine the relationship of rainfall to water levels, a cumulative departure curve of average precipitation at Monticello from 1948 to December, 1962, was plotted, figure 22. Except for

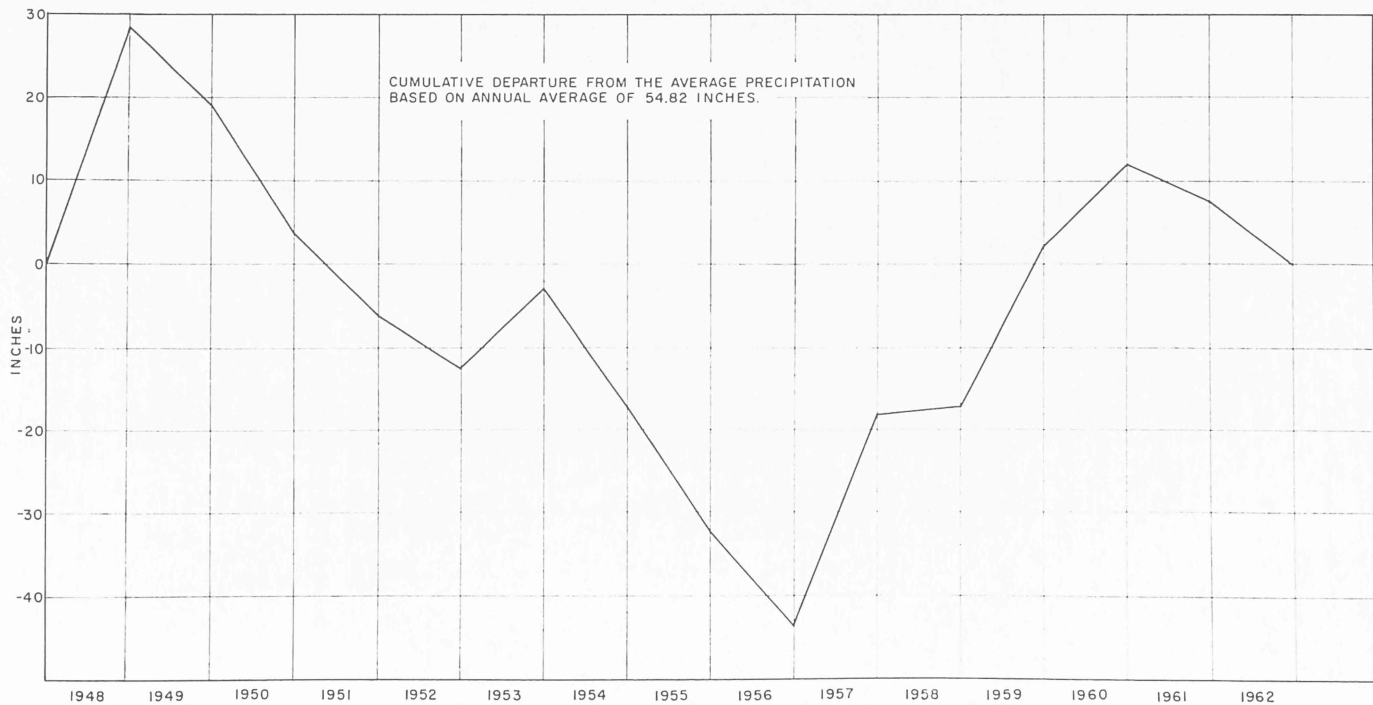


Figure 22. Cumulative departure curve of average precipitation at Monticello, Jefferson County from 1948 to December, 1962.

1952, the rainfall was below average between 1948 and 1956. In 1957 the rainfall was sufficient to start an upward trend which peaked in December, 1960, 12 inches above normal. From December, 1960, through December, 1962, the cumulative departure curve shows a gradual decline.

The hydrograph of wells WJf-3N-4E-22-cb, WJf-3N-7E-27-bb, WJf-1S-3E-15-dc, and WJf-1S-4E-28-ac and the average monthly precipitation graph for the years 1960 through 1962 are shown on figure 23. As shown in the figure, the hydrographs indicate that during the months of high precipitation, the water levels rise and during the months of low precipitation, the water levels fall. The peaks on the hydrograph of well WJf-1S-4E-28-ac indicate rapid response of the water level to heavy rainfall near the well. The overall trend of the water levels from July, 1961, to December, 1962, has been downward.

In well WJf-3N-4E-22-cb, the water levels declined 8.88 feet from May, 1960, to December, 1962, and the water level in well WJf-1S-3E-15-cd declined 3.92 feet during the same period.

The principal cause of fluctuations of water levels in Jefferson County is believed to be rainfall, as very little water is withdrawn from the aquifer.

PIEZOMETRIC SURFACE

The height to which water will rise in tightly cased wells that penetrate an artesian aquifer creates an imaginary surface called the piezometric surface. It should be pointed out, however, that in parts of Jefferson County, the piezometric surface lies below the top of the bedrock forming the Floridan aquifer. This condition indicates that in these areas the ground water is actually under water table conditions rather than artesian.

Two maps, figures 24 and 25, were prepared to show the configuration of the piezometric surface in May, 1960, and in December, 1962. The primary reason for showing the piezometric surface at these two different time intervals was to point out how the artesian pressures had dropped during this period. From May, 1960, to December, 1962, the amount of decline was about 9 feet in the northern half of the county and 3 feet over most of the southern half of the county. This lowering is probably the result of the decline in rainfall after 1960.

The piezometric surface ranges from sea level along the coast to 80 feet above sea level in northeastern Jefferson County. The

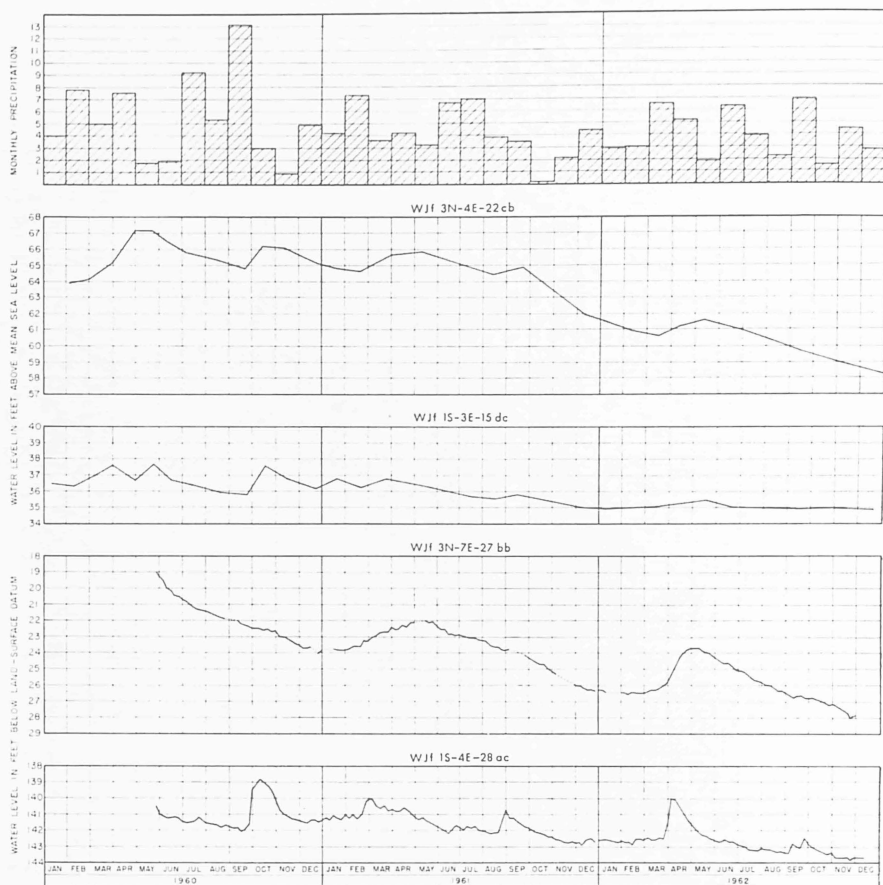


Figure 23. Graph showing hydrographs of selected wells WJf-3N-4E-22 cb, WJf-3N-7E-27 bb, WJf-1S-3E-15 dc, WJf-1S-4E-28 ac and total monthly precipitation in Jefferson County, Florida.

ground water moves in a direction perpendicular to the contours and as is shown in figures 24 and 25 this is generally to the southwest. The shape of the contours in the area just below Lake Miccosukee and southward indicates a recharge area with the flow of water to the southeast. The springs located just below the town of Wacissa, both at the headwaters of the Wacissa River and along the upper part of the river itself doesn't seem to have a great deal of effect on the piezometric surface. Along the lower southeast side of Jefferson County the piezometric map shows an area of recharge and along the lower reaches of the Aucilla River north of Nutall Rise water can be seen entering the aquifer through sinkholes. The Aucilla River goes underground here but

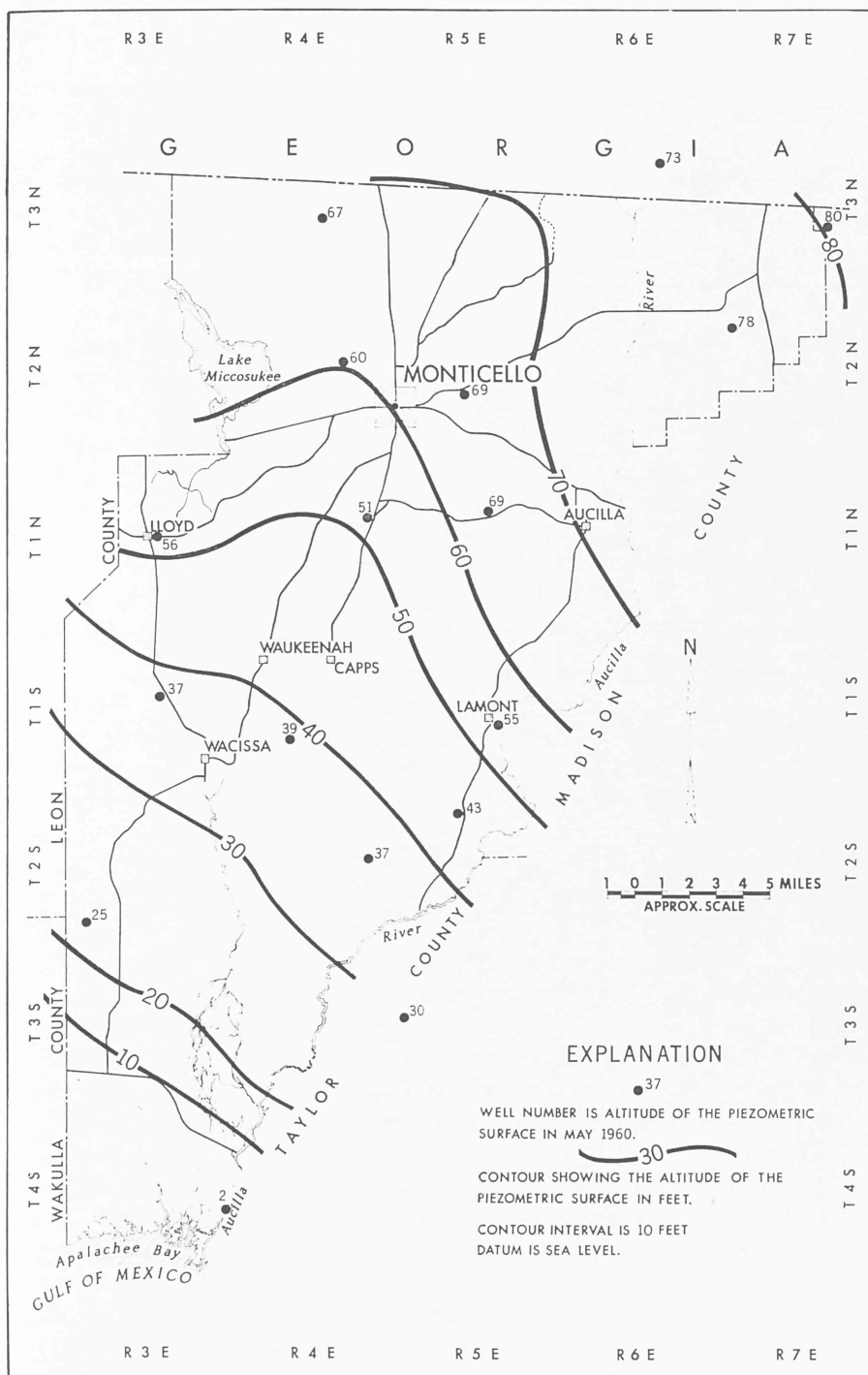


Figure 24. Jefferson County, Florida, showing the piezometric surface of the Floridan aquifer in May, 1960.

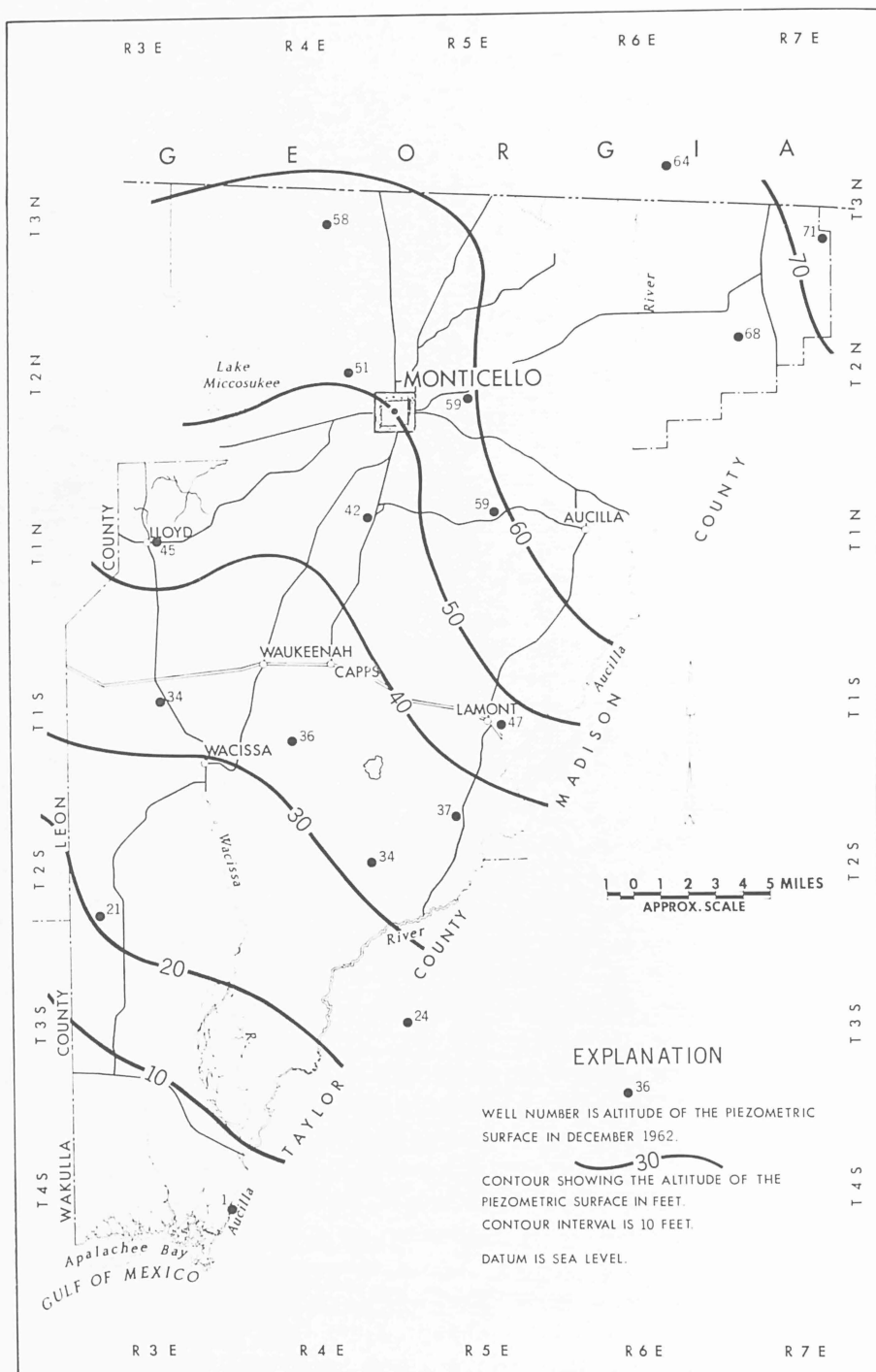


Figure 25. Jefferson County, Florida, showing the piezometric surface of the Floridan aquifer in December, 1962.

comes up again near Nutall Rise. Another area of recharge is believed to exist in the northeast part of the county by leakage through the clastics overlying the Suwannee Limestone.

In well WJf-1N-4E-26-bb the water level is approximately 115 feet higher than the water level in a Floridan aquifer well located two miles to the north. It is on this basis the writer believes that water from WJf-1N-4E-26-bb is coming from a secondary aquifer or that it is a water table well.

The recharge to this aquifer is probably from the overlying Hawthorn Formation and Miccosukee Formation.

By comparing the hydrograph and the average monthly precipitation graph for the years 1960 through 1962, figure 26, the water level seems to respond to rainfall; that is, the water levels rise during wet periods and fall during dry periods.

WJf-1N-4E-26-bb also shows a downward trend of the water levels after 1960. The low water level in September, 1960, was a result of extensive pumping of the well, and at the time the measurement was made the water level in the well had not recovered from the pumping.

A complete water analysis was run on a water sample from well WJf-1N-4E-26-bb and is shown in table 9.

QUALITY OF WATER

The rain falling upon the earth's surface is relatively free of dissolved minerals except for small quantities of atmospheric gases and dust. However, that part of rainfall that is absorbed into the soil and percolates downward through the earth's crust dissolves a part of the rock with which it comes into contact. Consequently, the chemical character of the water is to a large degree dependent upon the composition solubility of the material through which it has passed.

Chemical analyses of water from wells in Jefferson County and from well WTy-4S-3E-24-bd in Taylor County were made by the Quality of Water Branch of the U. S. Geological Survey (table 9). All of the samples were from the Floridan aquifer, except one water sample from a secondary aquifer or water table in Jefferson County. The chemical composition of the seven samples is shown in figure 27 by bar graphs. The mineral constituents analyzed are discussed below. The mineral constituents as shown in table 9 are expressed in parts per million (ppm) by weight. One part per million (ppm) is equivalent to approximately

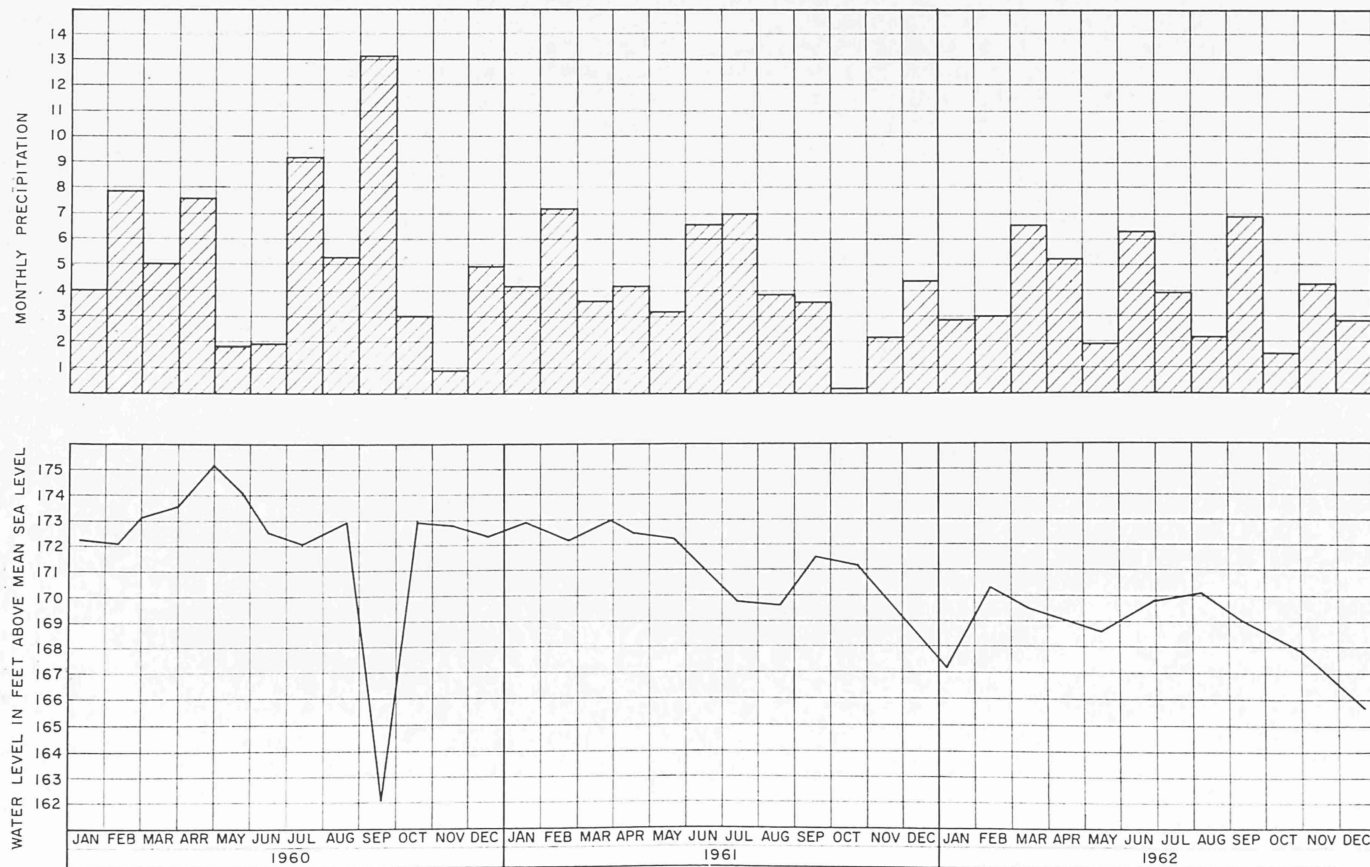


Figure 26. Hydrograph of well WJf-1N-4E-26 bb and a total monthly precipitation graph of rainfall in Jefferson County, Florida.

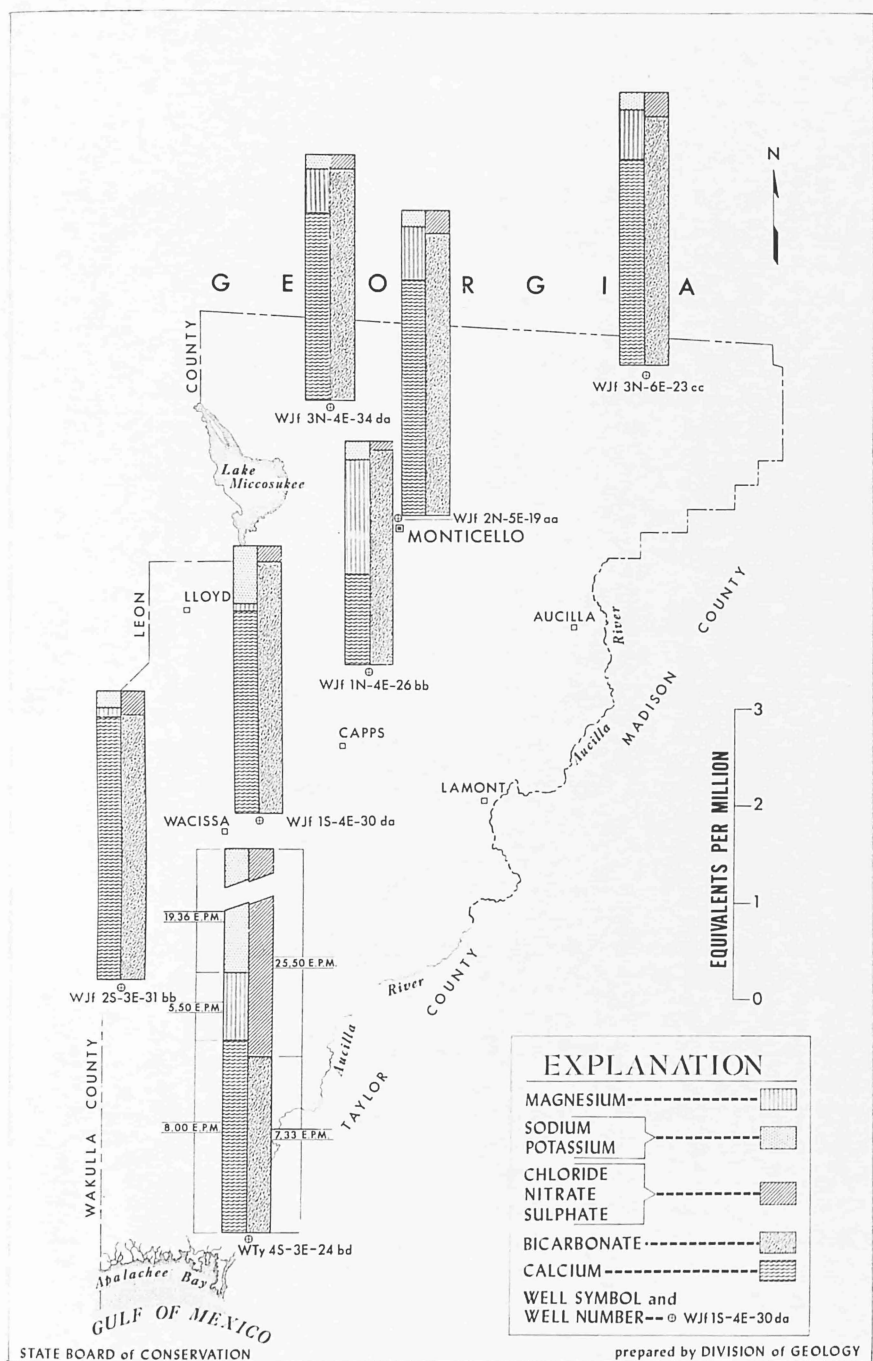


Figure 27. Bar graphs showing chemical composition of artesian water in Jefferson County, Florida.

1 pound of dissolved mineral constituents in 120,000 gallons of water.

DISSOLVED SOLIDS

The concentration of dissolved solids in water is approximately equal to the amount of mineral matter left after a quantity of water is evaporated. The U. S. Public Health Service recommends that for drinking water the maximum amount of dissolved solids should not exceed 500 ppm. However, water containing 1,000 ppm is permissible if water of better quality is not available. The dissolved solid concentrations in the water samples from Jefferson County ranged from 112 to 206 ppm. Well WTy-4S-3E-24-bd, located in Taylor County, had a dissolved solid content of 1,790 ppm.

HARDNESS

In waters that are considered hard, soap does not lather easily and a curd is left on the surface of the water. The cations, calcium and magnesium generally are the cause of hardness of water.

The calcium and magnesium hardness of the water samples analyzed from Jefferson County ranges from 100 to 206 ppm. The water sample from the well in Taylor County had a calcium and magnesium hardness of 670.

TEMPERATURE

The temperature of the water from all of the wells ranged from 68° to 71° F.

SPECIFIC CONDUCTANCE

The specific conductance of water is a measure of its ability to conduct an electrical current. The higher the mineralization the better the water conducts an electrical current.

The relationship between the measured total dissolved solids, hardness and specific conductance of water from six wells located in Jefferson County is shown by the straight line plots in figure 28. Specific conductance of 18 water samples from wells in Jefferson County, one from Madison County, and two from Taylor County, are shown in table 9. An approximate value for the hardness and total dissolved solids was calculated from the specific

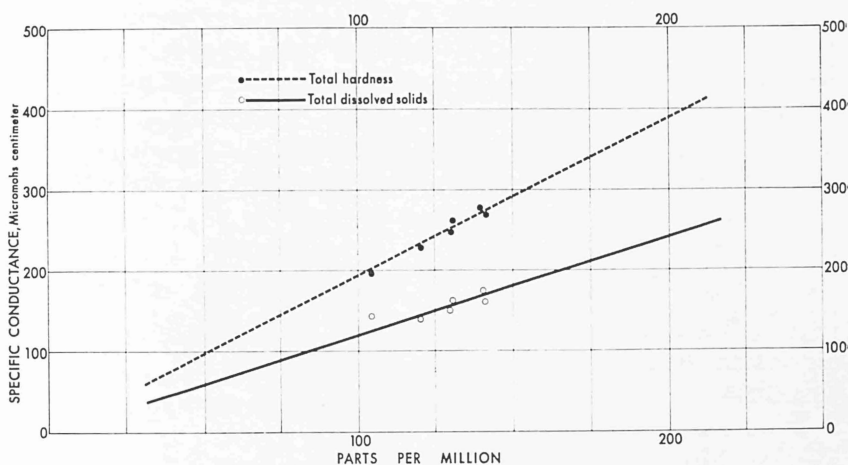


Figure 28. Hardness and total dissolved solids curve of artesian water in Jefferson County, Florida.

conductance of these 18 water samples by using the straight line plots in figure 28.

HYDROGEN-ION CONCENTRATION (pH)

The concentration of hydrogen-ions in water is expressed as pH. A water having a pH of 7.0 is said to be neutral. A higher pH value indicates alkaline water and a lower value is said to be acidic and may be corrosive. All the water samples tested had a pH value greater than 7.0 and ranged from 7.9 to 8.4.

SILICA (SiO_2)

Silica is dissolved from rocks and is present in almost all ground water samples. Silica is of little importance in water use except it can contribute to the formation of scale in steam boilers. Silica in the 6 samples from the Floridan aquifer range from 7.2 to 17 ppm. In the water sample from the secondary artesian aquifer the silica content was 39.0 ppm.

IRON (Fe)

Iron is one of the most objectionable constituents occurring in ground water. The quantity may vary geographically as well as vertically within the same formation. Iron in excessive quantities will stain laundry, plumbing fixtures and cause water

to have a disagreeable taste. Waters containing more than 0.3 ppm of iron in solution may become red upon exposure to the air. In Jefferson County one of the samples of water from the Floridan aquifer was above 0.3 ppm iron and a water sample from the secondary aquifer contained 0.54 ppm iron. In well WTy-4S-3E-24-bd, located in Taylor County, 8.6 ppm of iron was present.

CALCIUM (Ca) AND MAGNESIUM (Mg)

Calcium and magnesium in solution are generally responsible for the hardness of water and are usually present in considerable quantities in waters that are produced from aquifers composed of limestone and dolomite.

The calcium content in the secondary aquifer is 19.0 ppm, while in the Floridan aquifer the range of calcium is 39.0 to 160.0 ppm. The magnesium concentration in the secondary aquifer is 14.0 ppm. The water from the Floridan aquifer has a magnesium content which ranges from 1.3 to 66.0 ppm.

SODIUM (Na) AND POTASSIUM (K)

Fresh ground water contains small amounts of sodium and potassium and does not affect the usability of water. However, if the ground water has been contaminated by salt water the sodium concentration will be higher. Well WTy-4S-3E-24-bd in Taylor County is near the coast and is believed to have been contaminated by salt water from the Gulf of Mexico. Consequently, the sodium content (440 ppm) is high in this well and the potassium content of the water from the above well is 9.0 ppm. The values for sodium range from 2.9 ppm to 3.9 ppm for the other wells producing water from the Floridan aquifer and 3.8 ppm for the water from the secondary aquifer. The potassium concentration in the water from the secondary aquifer is 1.0 ppm.

BICARBONATE (HCO_3)

Bicarbonate (HCO_3) is formed by dissolving limestone and other carbonate rocks with waters containing carbon dioxide. The water from the Floridan aquifer has a bicarbonate content of 140 to 420 ppm. The bicarbonate content of the water from the secondary aquifer contained 123 ppm.

SULFATE (SO_4)

The presence of sulfates in ground water in excess of 500 ppm can result in a laxative effect if used for domestic consumption. The U.S. Public Health Service recommends that water for public consumption have less than 250 ppm sulfate. The sulfate content in water from well WTy-4S-3E-24-bd in Taylor County has a high sulfate content (198 ppm). The water from other wells producing from the Floridan aquifer had 1.6 to 4.4 ppm. There was no sulfate present in water from well WJf-1N-4E-26-bd producing from the secondary aquifer.

CHLORIDE (Cl)

The amount of chloride in ground water has little effect on the usability of water unless it is present in large enough quantities to render the water unpotable or cause a corrosive effect on metal pipes and storage tanks. The U. S. Public Health Service has set a maximum of 250 ppm chloride in water for public consumption. Water containing 500 ppm or more chloride can be tasted by most people. The chloride concentration in the water samples from the Floridan aquifer ranged from 2.0 ppm to 700 ppm. The 700 ppm chloride value is from well WTY-4S-3E-24-bd, located in Taylor County near the coastline and is probably a result of salt water encroachment from the Gulf of Mexico. The chloride content in 20 other water samples from the Floridan aquifer was 2.5 to 7.0. Water from a well WTY-4S-4E-7-dc at Nutall Rise, in southern Jefferson County, had 200 ppm chloride.

FLUORIDE (F)

The fluoride content in the water from the seven wells tested was 0.2 to 0.5 ppm.

NITRATE (NO_3)

The nitrate content of the water from the Floridan aquifer ranged from 0.3 to 6.3 ppm. In the secondary aquifer it was 0.1 ppm which is lower than any of the other water from the wells that are believed to be producing from the Floridan aquifer.

APPENDIX

Lithologic logs of selected wells in Jefferson County, Florida

WJf-3N-3E-36 ca W-6933
J. W. Yon, Jr. February 16, 1966

PERMIT NO. :
OWNER : FGS core hole Sasser No. 1
LOCATION : SW $\frac{1}{4}$ NW $\frac{1}{4}$, Sec. 36, T3N, R3E
COUNTY : Jefferson
ELEVATION : 213.74 feet
DRILLER : Hodges

MICCOSUKEE FORMATION

- 0-7 $\frac{1}{2}$ Top 2" topsoil—SAND, quartz, very fine to coarse, clayey (dark reddish brown becoming mottled yellow orange at 5 $\frac{1}{2}$ feet).
- 7 $\frac{1}{2}$ -10 Mottled same as above from 5 $\frac{1}{2}$ -7 $\frac{1}{2}$ feet.
- 10-12 SAND, mottled red brown, yellow orange and greenish gray, very fine to medium, clayey, about 3" from bottom of core interbedded with yellow orange sandy clay, bottom 3" of core same as above.
- 12-13 As above.
- 13-16 CLAY, sandy, yellow orange, waxy, becoming mottled dark yellow orange gray, either interbedded with sand or contains pockets of sand.
- 16-18 CLAY, mottled yellow orange and greenish gray, slightly sandy, very iron enriched, fall-to-pieces type clay.
- 18-24 As above less ferruginous than above, becoming very sandy at 23 feet.
- 24-27 SAND, quartz, very fine to medium, becoming coarse at 26 $\frac{1}{2}$ feet, clayey (reddish brown and yellow orange), interbedded yellow orange and light gray clay bed some of which are $\frac{1}{2}$ inch thick.
- 27-29 CLAY, yellow orange, silty, sandy, interbedded with reddish brown sand beds of varying thickness, sand beds are ferruginous.
- 29-32 SAND, very fine to coarse, becoming very fine to medium with some coarse at 30 $\frac{1}{2}$ feet, clayey (reddish brown and yellow orange) interbedded with yellow orange clay. Some of the clay beds up to $\frac{1}{2}$ inch thick, some ferruginous enrichment along clay-sand bed contact. Some questionable cross bedding in this interval.

- 32-35 SAND, very fine to medium, clayey, may contain thin clay beds near top of core.
- 35-35½ CLAY, yellow orange grades into pale olive silt bed that is sandy, contains ½" sand bed near center of this interval.
- 35½-37½ SAND, very fine to medium, clayey (yellowish green) more clayey near top of interval at about 37 feet some red brown streaks in sediments and black organic staining.
- 37½-43 SAND, very fine to medium, silty, clayey (mottled greenish gray) yellow orange and red brown, intermixed and interbedded with yellow orange clay beds up to ¼ to 2 inches thick contains fragments of black material (organic ? cross bedded) from 40-42 feet mottled red brown and yellow orange and more clayey.
- 43-43½ CLAY, yellow orange, slightly sandy.
- 43½-47½ SAND, quartz, very fine to medium, silty, very clayey (greenish gray to yellow orange) in part, interbedded with 3 inch yellow orange sandy, clay bed contains organic material, contains lumps of very pale orange clay.
- 47½-48½ SAND, quartz, very fine to fine, clayey (yellow orange to greenish gray) organic stained with fragments of sand organic material becomes greenish gray color at 48½ feet.

HAWTHORN FORMATION

- 48½-55 SAND, quartz, very fine to fine, clayey (greenish gray) organic stained, phosphoritic silty.
- 55-60½ CLAY, greenish gray, fine sandy, waxy, phosphoritic, very silty, maybe a silt rather than a clay, organic streaked near 60½, clay becomes a rubble zone. Large pieces of silicified clay present.
- 60½-61½ Rubble zone of phosphate.
- 61½-63½ CLAY, light olive, waxy, sandy, slightly phosphoritic and phosphatic, interbedded with light gray phosphate and organic material. From 62½-63½ becomes very silty, at base of core interbedded with sandy, very clayey, light gray calcilutite.
- 63½-68 PARTIALLY RECRYSTALLIZED CALCILUTITE, light gray, finely crystalline, very sandy, very clayey, hard.
- 68-68½ SANDSTONE, pale greenish yellow, very fine to fine, some medium, silty, calcareous.
- 68½-70 DOLOMITE, pale yellowish brown, fine to cryptocrystalline, hard, dense.
- 70-70½ SILT, pale greenish yellow, sandy, clayey, interbedded with calcilutite and dolomite same as above.

- 70½-73 SILT, yellowish gray, sandy, clayey, contains rare flecks of organic material.
- 73-76 SILT, as above but pale greenish yellow interbedded with calcilutite at base of interval (76').
- 76-85 SILT, pale greenish yellow, sandy, very clayey, interbedded with very pale orange, sandy, dolomitic calcilutite.
- 85-89½ SILT, as above.
- 89½-92 SILT, pale olive, very sandy in part, clayey? phosphatic.
- 92-93 CLAY, pale olive, waxy, interbedded with thin sand beds.
- 93-95 CLAY, pale olive, very sandy, silty, phosphoritic (trace).
- 95-97 SILT, pale olive, sandy, clayey interbedded with sandy, light gray, calcilutite.
- 97-101 SILT, pale olive, very sandy, clayey, phosphorite (1%) contains grayish olive clay blebs.
- 101-104 CLAY, pale olive, waxy, sandy, silty phosphoritic (trace).

ST. MARKS FORMATION

- 104-116 CALCILUTITE, very pale orange to pale yellowish brown, sandy, clayey, hard, porous, very moldic (macrofossil) almost a calcirudite from 110-116.
- 116-124 As above.
- 124-131 CALCILUTITE, very pale orange, finely crystalline, hard, sandy, some cavernous porosity.
- 131-142 As above, more clayey and macrofossiliferous.
- 142-152 CALCILUTITE, very pale orange, to pale yellowish sandy brown, finely crystalline, chalky, hard to moderately hard, porous, macro and micro fossiliferous. *Sorites* sp.
- 152-156 As above, becoming more sandy and is pale greenish yellow in part.
- 156-160 CALCILUTITE, pale greenish yellow, very sandy, almost a calcareous sand, chalk spots in matrix that may have been fossils.
- 160-172 CALCILUTITE, very pale orange, very chalky, very clayey, sandy, fossiliferous.
- 172-191 Cavity, no recovery.
- 191-215 CALCARENITE, very pale orange, finely crystalline, moderate intergranular porosity, a calcilutitic calcarenite in part, hard, in part looks like Suwannee, may be slightly finely sandy in part.

- 215-224 CALCIRUDITIC CALCARENITE, very pale orange, finely crystalline? slightly sandy, good moldic porosity, macro and micro fossiliferous, *Sorites* sp.

SUWANNEE LIMESTONE

- 224-270 CALCARENITE, very pale orange, finely crystalline, moderately hard, intergranular porosity, microfossiliferous, *Coskinolina floridana*.

WJf-3N-4E-24 bd W-5719
J. W. Yon, Jr. February 16, 1966

OWNER	: J. W. Timmons
LOCATION	: NE $\frac{1}{4}$ SE $\frac{1}{4}$, Sec. 24, T3N, R4E
ELEVATION	: 153.21
COUNTY	: Jefferson
DRILLER	: John C. Carr
CASING	: 104' of 4"
HEAD	: 85'
YIELD	: 100 gpm
USE	: Domestic
QUALITY	: Fresh

MICCOSUKEE FORMATION

- 5-10 SAND, very fine to medium, trace of coarse grains, predominately angular to subangular, friable, slightly clayey (dark grayish brown).
- 10-15 As above, more coarse grains, slightly more clayey (moderate reddish brown).
- 15-20 As above, few limonite pebbles present.

HAWTHORN FORMATION

- 20-25 As above, very fine to fine, some medium grains present, less clayey than above, phosphatic, some of clay pale greenish yellow, *Elphidium* and *Globogerina* sp.
- 25-30 SAND, as above, more clayey (mottled dark yellowish orange and pale greenish yellow) this sample is almost a clay *Elphidium* and *Globogerina* sp.
- 30-35 As above, not quite as clayey.
- 35-40 As above, slightly micaceous (muscovite), trace of heavy minerals.
- 40-45 As above.
- 45-50 As above, with a light gray silicate that is manganese streaked.

- 50-55 SAND, as above, no silicate as above, clay present is a light greenish gray.
- 55-60 As above, slightly phosphoritic (light gray).
- 60-65 As above, more phosphorite.

ST. MARKS FORMATION

- 65-70 SAND, as above with a CALCILUTITE, light gray, cherty (milky) very sandy, very clayey sample almost a calcareous clay firmly cemented with clay and CaCO_3 , intergranular porosity, no fossils observed.
- 70-75 As above, cherty (milky).
- 75-80 As above.
- 80-85 As above.
- 85-90 CALCILUTITE, as above, no clayey sand present, CALCILUTITE has been silicified. Also present is a silicified CALCARENITE.

SUWANNEE LIMESTONE

- 90-120 CALCARENITE, light gray, finely crystallized, firmly cemented with CaCO_3 , moderate intergranular porosity, microfossiferous, *Rotalia mexicana*.
- 120-225 As above, very pale orange to light gray.

WJf-3N-6E-23-cc W-319
J. W. Yon, Jr. February 16, 1966

OWNER	: Gerald M. Livingston
LOCATION	: SW $\frac{1}{4}$ SW $\frac{1}{4}$, Sec. 23, T3N, R6E
COUNTY	: Jefferson
ELEVATION	: 154.14
DRILLER	: W. R. McGrew and Company
CASING	: 101' of 10"
YIELD	: 200 gpm

MICCOSUKEE FORMATION

- 1-8 SAND, quartz, very fine to coarse grained, clear to frosted, angular to subrounded, argillaceous (deep red color).
- 8-18 SAND, as above; CLAY, dark reddish brown, some white (kaolin), sandy (fine to medium), contains black grains of ?phosphorite.
- 18-41 SAND and CLAY, as above, fine grained, very fine to medium, with some coarse grains.

ST. MARKS FORMATION

- 41-80 CALCILUTITE, tan to light gray, finely crystalline, hard, sandy; CHERT (gray), sandy, vitreous, smooth, formed from the limestone.
- 80-87 As above; CHERT, tan silicified CALCILUTITE.

SUWANNEE LIMESTONE

- 87-93 CALCARENITE, light cream, poorly indurated, porous, fine grained, composed of microfossils, *Rotalia mexicana*, with chert as above.
- 93-98 CALCARENITE, and CHERT, as above.
- 98-105 CALCARENITE, light cream, poorly indurated, slight porosity, finely crystalline to fine grained, microfossiliferous; CHERT, as above, tan to gray.
- 105-118 CALCARENITE, light cream (calcarenitic), slightly porous, poorly indurated, chalky to finely crystalline, recrystallized in part, fine grained microfossiliferous; in general, fossils have been recrystallized.
- 118-188 CALCARENITE, light cream (calcarenitic), poorly indurated, porous, chalky to crystalline, recrystallized in part, fine grained, microfossiliferous, "cones," *Coskinolina floridana*.
- 188-195 CALCARENITE, as above.
- 195-218 CALCARENITE, light cream (calcilutite), poorly indurated, good porosity, chalky to very finely crystalline, very fine-grained, microfossiliferous.
- 218-221 CALCARENITE, same as 188-195; DOLOMITE, brown, saccharoidal to microcrystalline, indurated, dense, nonfossiliferous.
- 221-226 CALCARENITE, as above; DOLOMITE, light brown, microcrystalline, indurated, dense, nonfossiliferous.
- 226-238 DOLOMITE, light grayish brown, microcrystalline (lithographic), indurated, dense, nonfossiliferous.
- 238-292 CALCARENITE, same as 218-224, very porous.

WJf-2N-5E-5 cen W-6927
J. W. Yon, Jr. February 16, 1966

PERMIT NO. :
OWNER : FGS core hole Wooten No. 2
LOCATION : Center Sec. 5, T2N, R5E
COUNTY : Jefferson
ELEVATION : 203.00
DRILLER : Hodges

MICCOSUKEE FORMATION

- 0-1 Medium gray SAND, topsoil.
- 1-2¹/₂ SAND, medium gray to yellow gray.
- 2¹/₂-7 SAND, clayey, dark yellow orange, lower 2 feet becoming mottled dark yellow orange and moderate reddish brown.
- 7-10¹/₂ SAND, mottled moderate red brown to very pale orange, clayey silty, with stone pebbles up to ½ inch in diameter, that are ferruginous.
- 10¹/₂-12¹/₂ SAND, thinly bedded, laminated, clayey, silty, thin beds and laminae alternating from dark reddish brown to very pale orange (light gray).
- 12¹/₂-13 Mottled as 7-10¹/₂ with more clay.
- 13-14¹/₂ Same as 10¹/₂-12¹/₂.
- 14¹/₂-18 Mottled same as 12¹/₂-13.
- 18-22¹/₂ Laminae and thin bedded same as 10¹/₂-12¹/₂ with color predominantly pale reddish brown with smaller percentages of light gray.
- 22¹/₂-32 Fine SAND, upper 1½ foot mottled reddish brown to light gray, phasing into grayish orange and light gray. Becoming predominantly gray in last 8 feet, medium clayey throughout.
- 32-43 SAND, dark yellow orange, very clayey, with blebs of gray sandy clay in last 4 feet, elongated zones of grayish brown ferruginous enriched sands.
- 43-47¹/₂ Grades downward into sand, pale yellowish orange, very clayey, with lighter clay blebs oriented in a horizontal plane giving the appearance of bedding. 46-47¹/₂ pale reddish brown, coarse sand interbedded and intermixed with dark yellowish orange, sandy clay. Grades downward into one foot of very light gray to very pale orange sand.
- 48-56 SAND, predominantly pale yellow-orange, cross bedded in upper 3 feet contains irregularly spaced thin beds of clay. Lower 2½ feet dark yellowish brown to light brown (ferruginous enriched) banding.

HAWTHORN FORMATION

- 56-70½ Sharp contact with above sand, dark yellow-orange, upper 1 foot grades downward into yellowish gray, phosphatic clay very waxy. One foot above base is a 4" phosphatic rubble. Contains occasional streaks of light gray? phosphatic clay.
- 70½-71 CLAY, sandy, yellowish gray with light brown streaks, phosphatic.
- 71-76½ SAND, dark yellowish orange, clayey, thinly bedded ?cross bedded thin clay seams, middle 1½ feet, very fine to fine sand, with very little or no clay, unconsolidated (fluid when taken from core barrel), phosphatic.
- 76½-77½ Above bed makes sharp contact with this interval of yellowish gray sandy, phosphatic clay, contains ferruginous enriched, sand pockets.
- 77½-80½ At 77½ occurs a ¾" very fine to fine, white sand, separated bed below. CLAY, pale greenish yellow, sandy, phosphatic, bed grades downward into a grayish orange, clayey sand.
- 80½-82½ CLAY, slightly fine sandy, waxy, very pale orange, phosphatic, upper 4" grading from sandy bed above to clay beneath, lower 6" contains grayish orange mottling with ½" moderate greenish yellow to dark yellowish clay bed at base.
- 82½-94 CLAY, pale greenish yellow, sandy (fine to medium) contains sand size phosphorite grains, angular blebs and rubble zones of phosphate, occasionally cut with a dark yellowish orange color zone. This interval is the beginning of the more rich phosphate zone. Abundant phosphate throughout zone.
- 94-96 CLAY, yellowish gray, mottled with organic staining in upper 8" slightly sandy, occasional angular pellets of clay and sandy clay that have no particular orientation, occasional pockets of sand that contain phosphorite, this unit appears to make angular contact with unit below. Slightly phosphatic.
- 96-101 Same as 82½-94: note: Terminates in 2" nodular bed. Abundant phosphate.
- 101-110 CLAY, pale greenish yellow to very pale orange, moderate to abundantly sandy (quartz and phosphorite) abundant pellets and pebbles of phosphate throughout interval, with concentrated zones of nodular phosphate up to 2" thick. 1 foot below the top of bed is 3" ferruginous stained zone (dark yellowish orange), very phosphatic throughout zone.
- 110-118½ SILT, mottled yellowish gray to pale olive, sandy, very clayey, pellets of phosphate (pale orange) contains few small organic fragments. This zone is moderately phosphatic throughout.
- 118½-120½ Same as 101-110.

- 120½-123 Same as 110-118½.
- 123-129½ SILT, mottled yellowish gray to pale olive, abundant phosphate very rubbly at bottom, lower 6" a loose rubble bed.

The following interval highly weathered.

ST. MARKS FORMATION

- 129½-134 Top 3" light gray chert, CLAY, dusky yellow to pale olive sandy, waxy, contains fragments of decalcified calcilutite, and chert fragments. 2½ feet of recovery.
- 134-137 CLAY, pale olive, blebs of very pale orange clay, slightly finely sandy, 3" zone at base, dark yellowish orange color, very sandy.
- 137-141 Upper 6" silty, very clayey, pale yellowish brown, numerous angular fragments of silicified calcilutite remainder of interval is CLAY, pale olive, waxy slightly sandy, zones and blebs of (22 in. of recovery) pale greenish yellow clay.
- 141-142½ Chert and clay as above, 18" of recovery.
- 142½-143 CHERT, dark gray, fragments. 2" of recovery.
- 143-152 CALCILUTITE, very pale orange, finely sandy, 2" of recovery dense, partially recrystallized.

SUWANNEE LIMESTONE

- 152-157 CALCARENITE, very pale orange, very microfossiliferous, very porous and permeable, soft, 15" of recovery. Typical Suwannee Limestone lithology.
- 157-162 As above, more dense, more recrystallized, contains about 2" zone of pale olive waxy clay.

WJf-2N-5E-30 aa W-3204
J. W. Yon, Jr. February 16, 1966

OWNER	: Florida Power Co., Monticello
LOCATION	: NW¼ NW¼, Sec. 30, T2N, R5E
COUNTY	: Jefferson
ELEVATION	: 237.01 feet
DRILLER	: W. R. McGrew & Co., Thomasville
CASING	: 155' of 12"
HEAD	: —195'
YIELD	: 800 gpm
USE	: City use
QUALITY	: Fresh

MICCOSUKEE FORMATION

- 1-10 SAND, quartz, very fine to medium, some coarse, clear to frosted, angular to subrounded, argillaceous (red).

102 FLORIDA GEOLOGICAL SURVEY—BULLETIN FORTY-EIGHT

- | | |
|-------|---|
| 20-30 | SAND, same as 1-10'. |
| 30-40 | SAND, quartz, very fine to medium, clear to frosted, angular to subangular, argillaceous (red). |
| 40-50 | SAND, same as 30-40. |

HAWTHORN FORMATION

- | | |
|---------|--|
| 50-60 | SAND, quartz, very fine to medium, some coarse, clear to frosted, white to tan silicate, argillaceous (white, olive green, rust-brown), phosphorite. |
| 60-70 | SAND and silicate, same as 50-60. |
| 70-80 | SAND and silicate, same as 60-70. |
| 80-90 | CLAY, white manganese-flecked, hard, sandy, and clay, olive-green, waxy, iron stained, sandy, chert, tannish-gray, cryptocrystalline. |
| 90-100 | CLAY, same as 80', chert more abundant. |
| 100-110 | CLAY, and chert same as 90-100. |

ST. MARKS FORMATION

- | | |
|---------|---|
| 110-120 | CALCILUTITE, cream to tan, finely crystalline, hard, dense, sandy; fine sand (probably cavings). |
| 120-130 | No sample. |
| 130-140 | CALCILUTITE, cream to tan, finely crystalline, hard, dense, very sandy, fossiliferous. <i>Sorites</i> sp. CHERT, gray to tan, cryptocrystalline, in part. |
| 140-150 | CALCILUTITE, light cream, finely crystalline to chalky, soft to hard, dense, argillaceous, very sandy, fossiliferous, <i>Sorites</i> sp.; CLAY, green, waxy, sandy. |
| 150-160 | No sample. |
| 160-170 | CALCILUTITE, light tan to cream, finely crystalline, hard, dense, sandy, fossiliferous; DOLOMITE, tan, cryptocrystalline, hard, dense, sandy. |
| 170-180 | DOLOMITE, same as 160-170. |
| 180-190 | DOLOMITE, same as 170-180 |
| 190-200 | DOLOMITE, same as 180-190. |

SUWANNEE LIMESTONE

- | | |
|---------|------------|
| 200-220 | No sample. |
|---------|------------|

220-230	CALCARENITE, white, finely crystalline, soft, granular porosity, very fossiliferous; CHERT , milky, cryptocrystalline, abundant miliolids. <i>Discorinopsis gunteri</i> , <i>Rotalia mexicana</i> , <i>Coskinolina floridana</i> .
230-240	CALCARENITE, same as 220-230'.
240-250	CALCARENITE, same as 230-240'.
250-260	CALCARENITE, cream to tan, finely crystalline, granules cemented tightly together by calcite, hard, dense, fossiliferous.
260-280	No sample.
280-290	CALCARENITE, same as 250-260'.
290-300	CALCARENITE, same as 280-290'.
310-350	DOLOMITE, brown, finely crystalline, hard, dense.

WJf-2N-6E-1 dd W-6561
J. W. Yon, Jr. February 15, 1966

PERMIT NO.	:	
OWNER	:	FGS Core hole Ashville No. 1
LOCATION	:	0.2 miles W of SE cor. Sec. 1, T2N, R6E, near Monticello
COUNTY	:	Jefferson
ELEVATION	:	184.09
DRILLER	:	Hodges

MICCOSUKEE FORMATION

1-5	SAND, quartz, very fine to medium, some coarse, angular to subangular, clayey, medium brown, becoming mottled, moderate reddish brown and pale greenish yellow, about 5'.
5-7	As above.
7-8.5	As above, becoming clayey near the base.
8.5-10	CLAY, mottled gray to light brown, sandy, waxy, micaceous becomes pale green near 10'.
10-11	SAND, quartz, very fine to coarse, angular to subangular, containing clay partings.
11-12	CLAY, pale yellowish orange, moderate brown and light gray, very sandy, waxy.
12-13	SAND, quartz, moderate reddish brown and greenish gray, very fine to medium, angular to subangular, clayey.
13-14	CLAY, greenish gray and light gray, contains a light gray material which may be phosphatic, sandy, waxy.

104 FLORIDA GEOLOGICAL SURVEY—BULLETIN FORTY-EIGHT

14-17	CLAY, dark yellowish orange and greenish gray, very sandy, waxy.
17-19	SAND, quartz, very fine to medium, angular to subangular, clayey, silty, dark yellowish orange to greenish gray, trace of heavies.
19-22	CLAY, dark yellowish orange to greenish gray, very sandy, waxy.
22-28	SILT, light brown to greenish gray, very sandy, clayey, trace of heavies.
28-31.5	SAND, quartz, light brown to greenish gray, very fine to fine, angular to subangular, clayey.
31.5-34	SILT, same as 24-28.
34-36	SAND, quartz, dark yellowish orange, very fine to fine, some medium grains, angular to subangular, clayey.

HAWTHORN FORMATION

36-41	SAND, quartz, pale yellowish green, very fine to fine, angular to subangular, only slightly clayey, questionable rare grains of phosphorite becomes very clayey about 41 feet.
41-45	As above.
45-48	SAND, quartz, pale greenish yellow to pale olive, very fine to fine, angular to subangular, contains white specks, clayey, silty, micaceous.
48-52	SAND, quartz, pale greenish yellow, very fine to fine, angular to subangular, micaceous, trace of heavies, interbedded with a sandy, pale olive waxy clay, phosphatic.
52-54	SAND, quartz, very fine to fine, angular to subangular, silty, clayey, pale greenish yellow, phosphate, trace of heavies.
54-56	CLAY, pale, olive, very sandy, interbedded with carbonaceous material, sand partings, contains a very pale orange clay material that is very phosphatic, phosphorite present in the clay matrix.
56-57	SAND, quartz, pale greenish yellow, very fine to fine, angular to subangular, silty, clayey, contains phosphorite.
57-57.5	As above.
57.5-64	CLAY, light gray, very sandy, very calcareous, very phosphatic, rare molds of macrofossils, interbedded with pale greenish yellow sandy clay. Becomes almost a pale greenish yellow sandy clay from 63-64 feet.

- 64-65 SILTSTONE, pale greenish yellow, sandy interbedded in the upper part of the interval with a very pale orange, sandy, partially dolomitized calcilutite.
- 65-65.5 DOLOMITIC CALCILUTITE, yellowish gray, finely crystalline, fine, sandy and silty, cemented hard with carbonate moderate cavernous and vuggy porosity.
- 65.5-71 Same as 57.5-64.
- 71-77 SAND, quartz, pale greenish yellow, very fine to fine, angular to subangular, clayey, silty at about 75 feet and the sand contains pockets of light gray, phosphatic, very calcareous clay, at about 77 feet the sand becomes more clayey and contains nodules of a sandy calcilutite.
- 77-79 SAND, as above.
- 79-80 SAND, as above, contains nodules of a sandy calcilutite and pockets of light gray, phosphatic very calcareous clay, interbedded with a pale olive sandy, waxy clay.
- 80-81 SAND, as above, interbedded with a pale olive slightly sandy, waxy clay also contains pebbles of clay.
- 81-81.5 SAND, quartz, pale greenish yellow, very fine to fine, angular to subangular, contains pebbles of clay and granule to coarse size phosphorite.

ST. MARKS FORMATION

- 81.5-88.5 Top of core. Silicified coral head ?*Sideastrea* sp. CALCILUTITE, very pale orange, finely crystalline, sandy cemented hard with CaCO_3 , some moldic porosity, molds of macrofossils.
- 88.5-91.0 As above.
- 91.0-98 CALCARENITIC CALCILUTITE, very pale orange, slightly very fine sandy, finely crystalline, cemented hard with CaCO_3 , good intergranular porosity, very microfossiliferous, *Sorites* sp., *Archaias floridanus*, molds of macrofossils.
- 98-98.5 As above, but primarily a CALCARENITE.
- 101-103 CALCILUTITE, same as 81.5-91 contains blue-green clay blebs.

WJf-1N-3E-15 cc W-5504
J. W. Yon, Jr. February 16, 1966

OWNER	• Miss Laffette
LOCATION	: SW $\frac{1}{4}$ SW $\frac{1}{4}$, Sec. 15, T1N, R3E
COUNTY	: Jefferson
ELEVATION	: 95.82'
DRILLER	: Gainous Well Drilling Co.

POST HAWTHORN

0-10 SAND, quartz, very fine to coarse, clear to frosted, angular to subrounded, argillaceous (tan).
10-30 No sample.

HAWTHORN FORMATION

30-40 CLAY, yellowish-gray, very sandy, phosphoric.

ST. MARKS FORMATION

40-50 CALCILUTITE, white, very sandy, finely granular, medium soft, intergranular porosity, microfossiliferous: *Sorites* sp. DOLOMITE, very pale orange, cryptocrystalline, hard, dense, sandy, slightly moldic.
50-60 DOLOMITE, as above.
60-70 DOLOMITE, as above, CALCILUTITE, same as 40-50.
70-90 No sample.
90-100 DOLOMITE, as above, very fine sand that may represent cavity fill, many sinkholes in vicinity of well.
100-110 DOLOMITE, as above, white CALCILUTITE, light gray, finely crystalline, hard, slight intergranular porosity, microfossiliferous, *Sorites* sp.
110-120 DOLOMITE and CALCILUTITE, as above.
120-130 DOLOMITE, pale yellowish-brown, cryptocrystalline, hard, dense; and DOLOMITE, as above.

SUWANNEE LIMESTONE

130 CALCARENITE, yellowish-gray, finely crystalline, medium hard, intergranular porosity, microcoquina, *Rotalia mexicana*, *Coskinolina floridana*.

WMd-1N-6E-9 cor d W-6558
J. W. Yon, Jr. February 16, 1966

PERMIT NO. :
OWNER : FGS core hole Greenville No. 1
LOCATION : SE $\frac{1}{4}$, Sec. 9, T1N, R6E
COUNTY : Madison
ELEVATION : 115.59 feet
DRILLER : Hodges

MICCOSUKEE FORMATION

- 5-10 SAND, quartz, very fine to coarse, angular to subangular, clayey (moderate reddish brown to moderate yellowish brown).
10-15 SAND, as above, clay as above with grayish green color.
15-50 SAND, as above.
50-65 SAND, quartz, very fine to medium, angular to subangular.
65-80 SAND, quartz, very fine to very coarse, angular to subrounded, clayey (moderate yellowish brown).

HAWTHORN FORMATION

- 80-90 CLAY, very pale orange, very sandy, phosphatic; some loose particles of phosphate.
90-100 SAND, quartz, very fine to very coarse, angular to subrounded, contains some clay as above.
100-105 SAND, as above, more clayey, trace of heavies.
111-113 SAND, quartz, very fine to fine, angular to subangular, clayey (light gray, ?kaolinitic, ?phosphatic).
113-120 SAND, quartz, very fine to very coarse, angular to subrounded, clayey as above.
120-122 As above, trace of heavies.
122-123 SAND, quartz, very fine to medium, angular to subangular, clayey (very pale orange, ?phosphatic).
123-125 SAND, quartz, very fine to fine, angular to subangular, ?phosphatic.
125-130 Same as 122, but very fine to fine grained, trace of heavies.
130-133 SAND, quartz, very fine to fine, some medium, angular to subangular grains, clayey (moderate reddish brown to light gray).
133-163 Same as 125-130.
163-165 SAND, quartz, very fine to medium, angular to subangular, clayey (dark yellowish orange) trace of heavies.

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- 195-197 SAND, quartz, very fine to fine, angular to subangular, clayey (dark yellowish orange to very pale orange, phosphatic), trace of heavies.
- 197-200 SAND, quartz, very fine to medium, angular to subangular, clayey (pale greenish yellow to dark yellowish orange, phosphatic), trace of phosphorite, trace of heavies.
- 200-225 SAND, as above.

SUWANNEE LIMESTONE

- 225-230 CALCARENITIC DOLOMITE, very pale orange, finely crystalline, hard, dense molds of *Lepidocyclina* sp. and other unidentified foraminifera vugs filled with amorphous quartz and crystalline dolomite.

WJf-1S-4E-29 db W-6931
J. W. Yon, Jr. February 16, 1966

PERMIT NO.	:
OWNER	: FGS core hole Walker No. 1
LOCATION	: SE $\frac{1}{4}$ NE $\frac{1}{4}$, Sec. 29, T1S, R4E
COUNTY	: Jefferson
ELEVATION	: 200' Gr. Topo
DRILLER	: Hodges

MICCOSUKEE FORMATION

- 0-60 Sands varicolored, grain size variable.

HAWTHORN FORMATION

- 60-65 CLAY, pale olive, waxy, sandy, organic stained.
- 65-70 SAND, quartz, very fine to very coarse, angular to subrounded, clayey (pale olive), phosphoritic (1-2%), some organic clay present.
- 70-85 As above.
- 85-90 As above; CLAY, light gray, very phosphatic, earthy, sandy, slightly phosphoritic.

ST. MARKS FORMATION

- 90-110 As above; CALCILUTITE, very pale orange, finely crystalline, hard, sandy, intergranular porosity.
- 110-115 As above; CLAY, pale greenish yellow, sandy, very silty.
- 115-120 CALCILUTITE, as above and clay as above.

- 120-127 As above.
- 127-136 CALCILUTITE, light gray to very pale orange, chalky to finely crystalline, hard, sandy, clayey, fossil molds replaced with secondary silica, vugs filled with silica, micro and macro-fossil, *Sorites* sp.
- 136-138 CALCILUTITE, very pale orange, to very pale yellowish brown, finely crystalline, hard, sandy, fossiliferous in part, core at 136' appears to show bedding, has beach rock appearance.
- 138-146 CALCILUTITE, yellowish gray, sandy, contains blebs of pale olive clay, very clayey and silty from 140-142', almost a calcareous silt with pale olive clay blebs.
- 146-157 CALCILUTITE, light gray, chalky to finely crystalline, vugs filled with calcite, sandy, hard, very clayey in part, manganese stained, intergranular and moldic porosity, macrofossil molds ? microfossil.
- 157-162.5 CALCILUTITE, light gray, sandy, contains seams and blebs of pale olive clay, *Sorites* sp.
- 162.5-166 SILT, pale greenish yellow, very sandy, clayey, intermixed with a light gray calcilutite.
- 166-172 CALCILUTITE, very pale orange, sandy, clayey, (pale olive), finely crystalline, chalky, containing angular fragments of sandy, pale yellowish brown, finely crystalline calcilutite, (beachrock).
- 172-176.5 CALCARENITIC CALCILUTITE, very pale orange, chalky, finely crystalline, intergranular porosity, calarenite grains may be recrystallized fossils.

SUWANNEE LIMESTONE

- 176.5-192 CALCARENITE, very pale yellow, finely crystalline, hard, intergranular porosity, microfossiliferous, cherty, (yellow brown), from 178-179, 183.5, from 184 to 186.5 there apparently is a cavity filled with a sandy light gray chalky pasty calcilutite, from 189-192 very cherty, at 191 *Kuphus* sp. is present.

WJf-1S-5E-1 bc W-5325
J. W. Yon, Jr. February 16, 1966

OWNER : Calvin Williams
LOCATION : NE $\frac{1}{4}$ SW $\frac{1}{4}$, Sec. 1, T1S, R5E
COUNTY : Jefferson
ELEVATION : 86.63 feet
CASING : 102' of 4"
HEAD : 26'

0-72 NO SAMPLE.

SUWANNEE LIMESTONE

- 72-83 SAND, quartz, yellow-brown, quartz, 98%, fine 15%, medium 80%, coarse 5%, subangular to subrounded; chert 2%, milky and CALCARENITE, light gray. *Rotalia mexicana*.
- 86-102 CALCARENITE, light gray to yellow-brown, crystalline, CaCO₃, hard, poor porosity, microfossiliferous (not identifiable).
- 102-104 No sample.

CRYSTAL RIVER FORMATION

- 104-121 CALCARENITE, with slight trace of CALCIRUDITE, yellow-brown, crystalline CaCO₃, moderate intergranular porosity, microfossiliferous: *Gypsina* sp., *Lepidocyclina* sp. (This interval resembles sediments at 175 feet in No. 4813.)
- 121-132 No sample.
- 132-151 CALCARENITE, as above, *Echinocythereis okeechobiensis*, *Reussella cocca*, *Cibicides* cf. *C. mississippiensis*.

WJf-1S-5E-22 bc W-6174
J. W. Yon, Jr. February 16, 1966

PERMIT NO. : Lamont No. 1
OWNER : FGS core hole
LOCATION : NE $\frac{1}{4}$ SW $\frac{1}{4}$, Sec. 22, T1S, R5E
COUNTY : Jefferson
ELEVATION : 68.05'
DRILLER : Withers

HAWTHORN FORMATION

- 0-10 SAND, quartz, yellowish-gray, very fine to coarse, angular, clayey.
- 10-25 SAND, as above.
- 25-30 CLAY, light gray, sandy, very fine to coarse, phosphatic.
- 30-35 As above, contains secondary growths of wavellite.

35-40	As above, becoming cherty (milky color), phosphatic.
40-42	As above.
42-50	As above.
50-60	As above.
60-70	As above, contains clusters of phosphatic material.
70-75	As above, contains clusters of phosphatic material and phosphorite.

SUWANNEE LIMESTONE

75-80	CALCARENITE, light gray cryptocrystalline, moderately hard, good intergranular porosity, microfossiliferous.
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WJf-1S-5E-32 ac W-6925
J. W. Yon, Jr. February 16, 1966

PERMIT NO.	: Holcomb No. 1
OWNER	: FGS core hole
LOCATION	: NW $\frac{1}{4}$ SW $\frac{1}{4}$, Sec. 32, T1S, R5E
COUNTY	: Jefferson
ELEVATION	: 134.00 feet
DRILLER	: Hodges

MICCOSUKEE FORMATION

0-5	SAND, quartz, very fine to medium grained, some coarse grains, clay (moderate reddish brown).
5-10	SAND, as above, very pale orange to pale yellowish orange.
10-15	SAND, as above, predominantly pale yellowish orange.
15-20	Same as 5-10.
20-25	As above; CLAY, dark yellowish orange, sandy, waxy.
25-30	SAND, quartz, very fine to coarse, angular to subrounded; SANDSTONE, light gray to pale yellowish orange, quartz, very fine to medium, angular to subangular, cemented with silica.
30-35	As above, CLAY, pale olive, sandy, waxy, micaceous, contains black material that may be organic.

HAWTHORN FORMATION

35-40	SAND, very fine to medium, angular to subangular, clayey (light gray to pale olive questionable phosphatic). Fragments of pale olive sandy organic stained clay present.
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- 40-45 SAND, very fine to medium, predominantly very fine to fine, angular to subangular, trace of light colored phosphorite, CLAY, pale greenish yellow, sandy, phosphatic, organic stained.
- 45-47.5 CLAY, pale olive, sandy, waxy, phosphatic; CALCILUTITE, very pale orange, very finely sandy, hard, dense, (very finely crystalline.

ST. MARKS FORMATION

- 47.5-50 CALCILUTITE, very pale orange, very finely sandy, hard, dense, very finely crystalline.

SUWANNEE LIMESTONE

- 50-54 As above, CALCARENITE, very pale orange, finely crystalline, firm, moderate porosity, microfossiliferous, *Coskinolina floridana*.
- 54-61 This interval appears to be a mixture of the above samples.
- 61-62 CLAY, pale olive, finely sandy, waxy, contains fragments of sandy calcilutite.
- 62-69 CALCARENITE, very pale orange, finely crystalline, firm to very hard, moderate intergranular porosity, microfossiliferous, *Coskinolina floridana*.

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