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GEOLOGY AND GROUND-WATER RESOURCES OF MITCHELL COUNTY, GEORGIA

by

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United States Geological Survey

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Geology And Ground-Water Resources Of Mitchell County, Georgia

Vaux Owen, Jr.

ABSTRACT

Mitchell County is underlain by 5,000 to 7,000 feet of sedimentary rocks ranging in age from Early Cretaceous or older to Recent; some of the lower sedimentary beds are possible Paleozoic or Triassic in age. Water is obtained from wells that tap rocks of the middle Eocene, upper Eocene, Oligocene, and Miocene Series from depths ranging from 80 to 750 feet. The middle Eocene includes the Tallahatta and Lisbon Formations of the Claiborne Group. The upper Eocene includes the Ocala Limestone of the Jackson Group. The Oligocene includes the Suwannee Limestone of the Vicksburg Group, and the Miocene includes the Tampa Limestone and the Hawthorn Formation. No water is obtained from formations below the Tallahatta because of the availability of water at shallower depth. Potable water may be available, however, from rocks as deep as the Upper Cretaceous series.

The Tallahatta Formation consists of massive sand commonly containing a coquina limestone near the top, and the Lisbon Formation consists of dense, sandy limestone. The Ocala Limestone ranges from pure, bioclastic limestone to crystalline, dolomitic limestone. The Suwannee Limestone consists of pure, bioclastic limestone. The Tampa Limestone consists of sandy limestone, sandy marl, sand and fuller's earth, and the Hawthorn Formation consists of clayey sand and sandy clay.

The area may be divided into three geologic and ground-water regions--the Dougherty Plain, the Solution Escarpment, and the Tifton Upland. The main structure in the Dougherty Plain and Solution Escarpment is a regional homocline, which dips southeastward at a rate ranging from about 22 feet per mile on top of the rocks of the Upper Cretaceous Series to about 10 feet per mile on top of the Ocala Limestone. The main structure in the Tifton Upland is a northeast-trending syncline, the northwest flank of which crosses the southeast corner of Mitchell County.

Small supplies of water for domestic purposes may be obtained in the Dougherty Plain from drilled wells 80 to 460 feet deep that tap the Ocala Limestone or the Tallahatta Formation. Large supplies of water for municipal, industrial, and irrigation purposes may be obtained in the Dougherty Plain from drilled wells 200 to 540 feet deep that tap the Ocala Limestone or the Tallahatta Formation. Yields of at least 1,000 gpm (gallons per minute) can be expected from properly constructed wells 200 to 300 feet deep that tap the Ocala Limestone throughout most of the Dougherty Plain. Ground-water conditions in the Solution Escarpment are similar to those in the Dougherty Plain except that wells are generally from 100 to 200 feet deeper.

Small supplies of water in the Tifton Upland are obtained from drilled wells 300 to 500 feet deep that tap the Ocala, Suwannee, or Tampa Limestones. Large supplies of water in the Tifton Upland are obtained, along its northwestern boundary, from drilled wells 500 to 750 feet deep. Some of these wells obtain water only from the Ocala Limestone, but most of them obtain water from the Ocala and Suwannee Limestones and the Tallahatta Formation. Yields of as much as 1,000 gpm may be obtained from properly constructed wells in the Ocala Limestone or Tallahatta Formation near the northwestern border of the Tifton Upland, but such yeilds probably would be difficult to obtain in other parts of the Tifton Upland where the aquifers are more deeply buried and less productive.

Ground water in Mitchell County is of good chemical quality and is suitable for most purposes without treatment. The water ranges from moderately hard to hard and does not contain excessive amounts of undesirable dissolved constituents.

INTRODUCTION

The increased use of deep wells for supplemental irrigation in Mitchell County in recent years has brought attention to the county's abundant and readily available ground-water supplies. As late as 1954 the county had no irrigation wells; but, in 1959, some 30 wells were used to irrigate 1,630 acres of farm land, and more than 3,000 acres could have been irrigated had conditions warranted additional irrigation. Supplemental irrigation results in improved crop yields, fewer crop losses, and improved value of agricultural land. Wells are the most practical source of irrigation supplies of water in most of Mitchell County, although surface streams are practical in certain localities.

The use of ground water in Mitchell County is by no means new as wells have been the principal source of water for domestic, municipal, and industrial purposes for many years. The recent development of wells for irrigation is of interest, however, because it illustrates one way in which ground-water resources may be more fully utilized to bolster the economy of the county. The possibility of increased use of ground water in other fields should not be overlooked. For example, the large supplies of ground water in the county should make the area attractive to certain types of industry. An abundant, low-cost water supply is frequently one of the major factors an industry considers in the location of its plants particularly those industries requiring large quantities of water. Many industries have found ground water to be especially desirable as a source of supply when it is available in sufficient quantity and quality because of favorable constructional, maintenance, and water-treatment costs.

Ground water has been predominant as a source of supply in Mitchell County because wells may be located conveniently at homes, fields, industrial plants, and municipalities; are economical to construct, and generally furnish ample water without expensive treatment. Any expanded use of water in the near future logically will be accomplished mostly by the further development of ground water. Ground water is one of the most important economic assets in the county, and, in terms of the amount available, has been developed to a very limited extent.

Purpose and Scope of Investigation

The present report is one of a series being prepared by the U. S. Geological Survey in cooperation with the Georgia Department of Mines, Mining and Geology. It is similar to other reports on Dougherty, Lee, Sumter, Terrell, Clay, and Calhoun Counties in southwestern Georgia.

The purpose of the present investigation was to appraise the ground-water resources of Mitchell County in terms of the various aquifers, the quantity and quality of water available, and the general construction requirements of wells.

Well cuttings and exposed rocks were studied to determine the geologic features of each formation--thickness, structure, lithology, and depth below land surface--and their variability within the area. Wells were canvassed to obtain data on depth, diameter, type of finish, reported yields, reported water levels and the chemical quality of the water.

Location and Extent of Area

Mitchell County covers an area of 511 square miles near the southwest corner of Georgia and is within 35 miles of both the Alabama and Florida State lines. Camilla, the county seat, is near the center of the county and is 200 miles south of Atlanta, Ga., 26 miles south of Albany, Ga., and 63 miles north of Tallahassee, Fla. The county is readily accessible by state and federal highways and by railroads. The location of Mitchell County and of areas in Georgia described in previous ground-water reports are shown in figure 1.

Previous Investigations

The first widely publicized reference to ground water in Georgia was made by Spencer (1891) in a preliminary report on the geology of the State. McCallie (1898 and 1908) prepared ground-water reports on the State which were concerned mainly with the Coastal Plain and which contained a few data from Mitchell County.

The most comprehensive report to date on the ground-water resources of the Georgia Coastal Plain was that of Stephenson and Veatch (1915). This report related the occurrence of ground water to stratigraphy and also presented a few data from Mitchell County. Warren (1944) included Mitchell County in a piezometric map of the principal artesian aquifer of the Coastal Plain of Georgia.

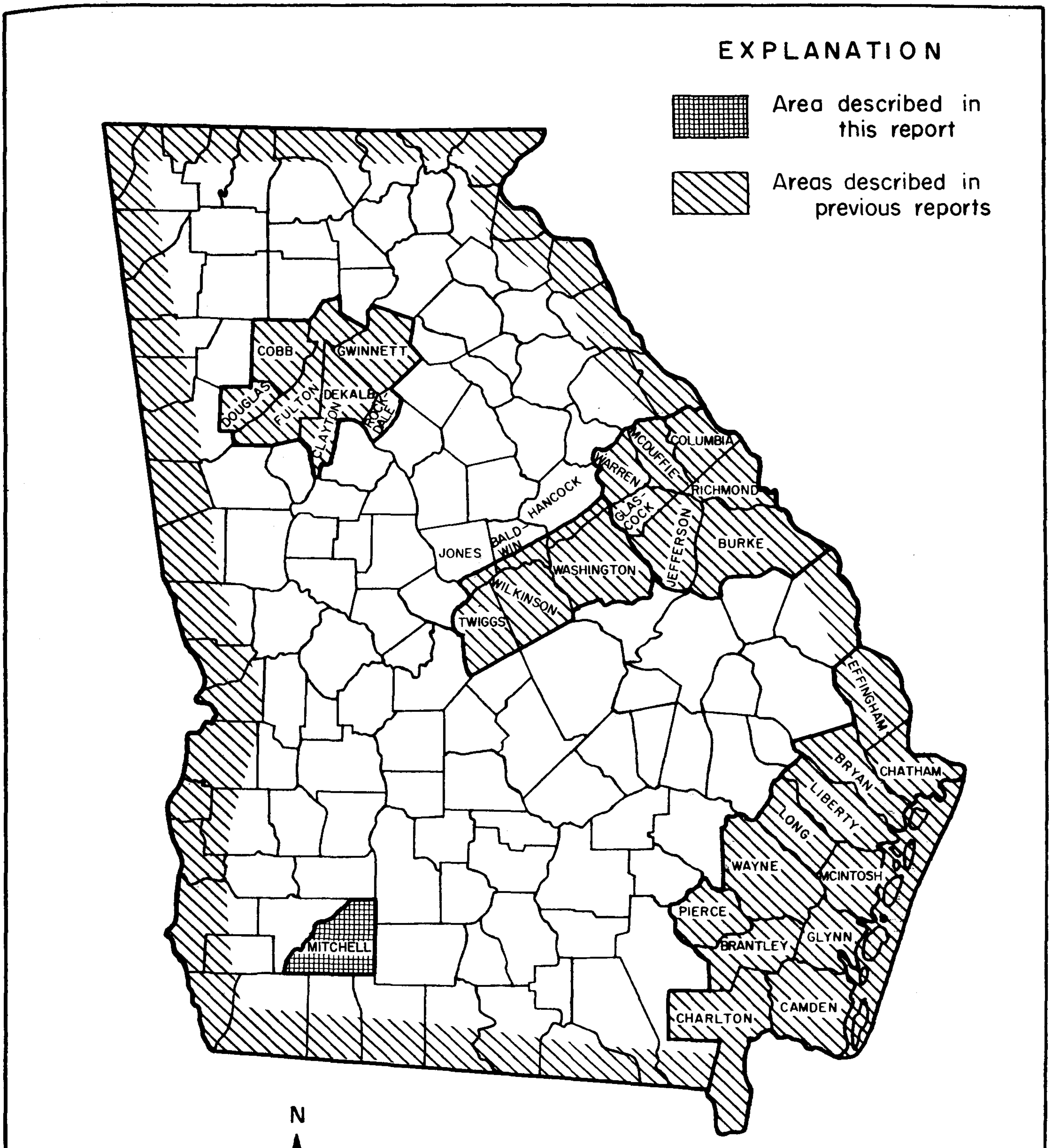

Figure 1.—Map of Georgia showing Mitchell County and areas described in previous reports.

Other reports about the ground-water resources of Georgia include Georgia Geological Survey Bulletins 52 (LaMoreaux, 1946), 55 Herrick and LeGrand, 1949), 64 (LeGrand and Furcron, 1956), and 65 (Thomson, Herrick, and Brown, 1956).

The most comprehensive reports on the geology of the Coastal Plain of Georgia are those by Veatch and Stephenson (1911) and Cooke (1943). Each report discussed the entire Coastal Plain of Georgia. Each referred to a few outcrops in Mitchell County and include the county in geologic maps. Mitchell county also is included in a geologic map of the Tertiary and Quaternary formations of Georgia prepared by MacNeil (1947).

Acknowledgments

The writer thanks the many individuals and concerns who supplied information about wells in Mitchell County. These include the Layne-Atlantic Drilling Co., of Albany, Ga., the South Georgia Drilling Co., and the Georgia-Florida Drilling Co., of Cairo, Ga., the Row Bros. Drilling Co., of Tallahassee, Fla., the Mitchell County Drilling Co., of Pelham, Ga., Mr. Harvey Meinders of the U. S. Department of Agriculture in Camilla, Ga., Mr. W. R. McGrew of Thomasville, Ga., the U. S. Department of Agriculture, Agricultural Stabilization and Conservation office in Camilla, Ga., and numerous private citizens throughout Mitchell County. Thanks also are given Mr. Charles Solbrig, Geologist for the Marquette Cement Co., who generously made available test-drilling core samples.

Well-Numbering System

Wells in Mitchell and adjacent counties that were used in the preparation of this report are shown on figure 2. Each well in Mitchell County is assigned a number consisting of three groups, such as 3105-8405-6. The first two groups denote the location of the well within a certain 5-minute grid of latitude and longitude. In the example above, 3105 is a contraction of lat 31°05′ N., and 8405 is a contraction of long 84°05′ W. These numbers denote the southeast corner of the 5-minute grid of latitude and longitude in which the well is located. The last number is a serial number denoting that the well was the sixth to be located within the particular grid.

Certain wells in Mitchell County have an additional set of numbers such as GGS-564 and Alb-4. These are well-sample library numbers and indicate that drill cuttings from the wells are on file in Atlanta at the Georgia Department of Mines, Mining, and Geology, and are available for inspection. Wells outside Mitchell County are designated only by the well-sample library numbers.

PHYSICAL GEOGRAPHY

Cooke (1925) divided the Coastal Plain of Georgia into six physiographic divisions (fig. 3). Mitchell County lies within two of these divisions--the Dougherty Plain and the Tifton Upland. Cooke indicated that the boundary between the Dougherty Plain and Tifton Upland across Mitchell County was a well-defined westward-facing escarpment.

Those areas in Mitchell County that most closely fit Cooke's description of the Dougherty Plain and Tifton Upland are shown in figure 2 as is an intermediate region that is a northwest to to west-facing escarpment. Cooke appears to have considered the boundary between the Dougherty Plain and Tifton Upland to be near the base of the escarpment, but, as the escarpment occupies a considerable area between base and crest, it is considered in this report to be a separate physiographic division. The name "Solution Escarpment" is applied to it, a term first used by MacNeil (1947). The boundary of the Solution Escarpment with the Dougherty Plain is poorly defined and is shown as a dashed line in figure 2. A small part of the Dougherty Plain is considered separately from the principal part and is termed "Sub-area A." The main part of the Dougherty Plain and Sub-area A are separated by a poorly defined boundary, which also is shown as a dashed line in figure 2.

Mitchell County lies within the drainage basins of two rivers--the Flint and the Ochlockonee. Streams in the Solution Escarpment and Dougherty Plain drain to the west and southwest toward the Flint River, and streams in the Tifton Upland drain to the southeast toward the Ochlockonee River.

Dougherty Plain

The Dougherty Plain, as described in this report, is divided into a large western and a small northeastern part. The large part is referred to as the Dougherty Plain and the small part as Sub-Area A.

The Dougherty Plain is a plain of low altitude and very slight relief in which solution topography is well developed. The surface has been modified by river terracing and probably by Pleistocene marine terracing. In Mitchell County the plain extends from the Flint River on the northwest to the approximate western limit of hilly country in the Solution Escarpment and Sub-area A on the southeast and east. (See fig. 2). The southeastern and eastern boundary would closely correspond to the 200-foot contour on a detailed topographic map.

The altitude of the bed of the Flint River ranges from about 150 feet above sea level at the northern border of Mitchell County to about 115 feet at the southern border. A few isolated hills in the Dougherty Plain are as much as 210 feet above sea level, thus giving a total relief of about 95 feet between the highest hills and the lowest point in the slightly entrenched bed of the Flint River. Over areas of many square miles, however, relief does not exceed 20 feet.

Shallow sinks, most of which do not exceed 10 feet in depth, are numerous in the Dougherty Plain. The sinks are mostly elongate or irregular in shape and range in greatest horizontal dimension from a few feet to more than a mile. Most of the sinks are dry throughout the greatest part of the year but many become filled with water during periods of high ground-water levels chiefly in the spring.

One of the most striking features of the Dougherty Plain is the lack of surface streams. Many streams flow down the slopes of the Solution Escarpment, but practically all of them disappear into the ground after traveling a short distance across the Dougherty Plain. Racoon Creek is the only perennial stream of consequence that flows across the plain into the Flint River. It enters the river near Baconton in the northern part of the county. Big Slough Creek, which flows southwestward from near Camilla, sometimes flows in the spring when ground-water levels are high but, throughout most of the year, it is a shallow solution valley dotted with sinks and isolated ponds of water. Several vigorous perennial streams flow from the Solution Escarpment across 2 or 3 miles of the Dougherty Plain only to disappear near the eastern edge of Big Slough Creek. These streams do not flow into well-defined depressions but fan out into wide, swampy areas and the water apparently seeps gradually downward.

The lack of surface drainage probably is due to two factors--the cavernous nature of the underlying limestone and the porosity of the surficial deposits. Much of the surface of the Dougherty Plain in Mitchell County is covered by loose clayey sand which locally extends to depths of at least 60 feet, although the average thickness probably is much less. The surficial deposits of the Dougherty Plain between Big Slough Creek and the Solution Escarpment, however, are composed on relatively nonporous clay, and across this belt streams are able to maintain their flow.

Much of the sand cover in the Dougherty Plain of Mitchell County probably is due to Pleistocene marine terracing. Cooke (1925, p. 41) states that the Okefenokee Terrace extends up the valley of the Flint River

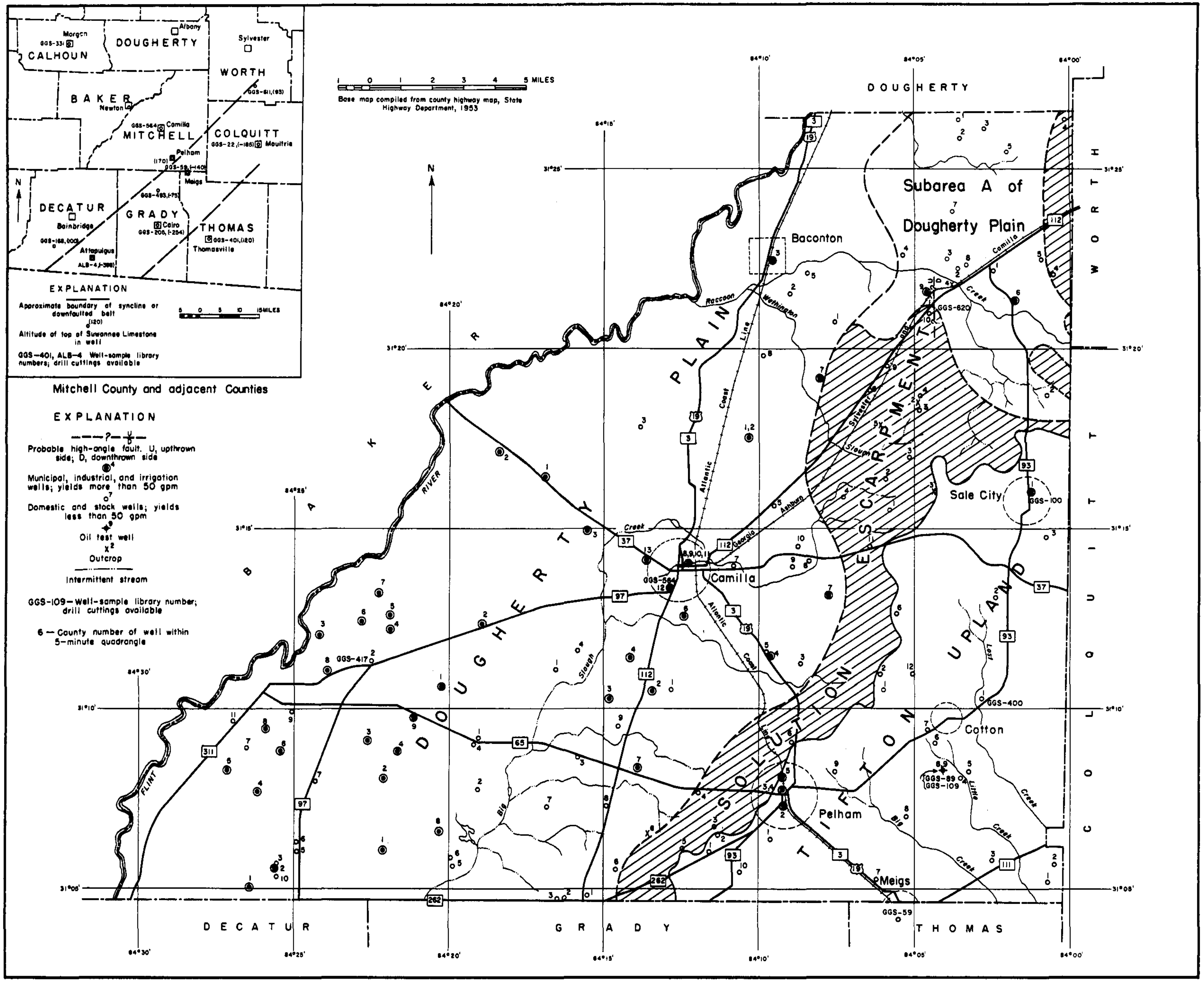

Figure 2.—Map showing well locations and physiographic features, Mitchell County, Ga.

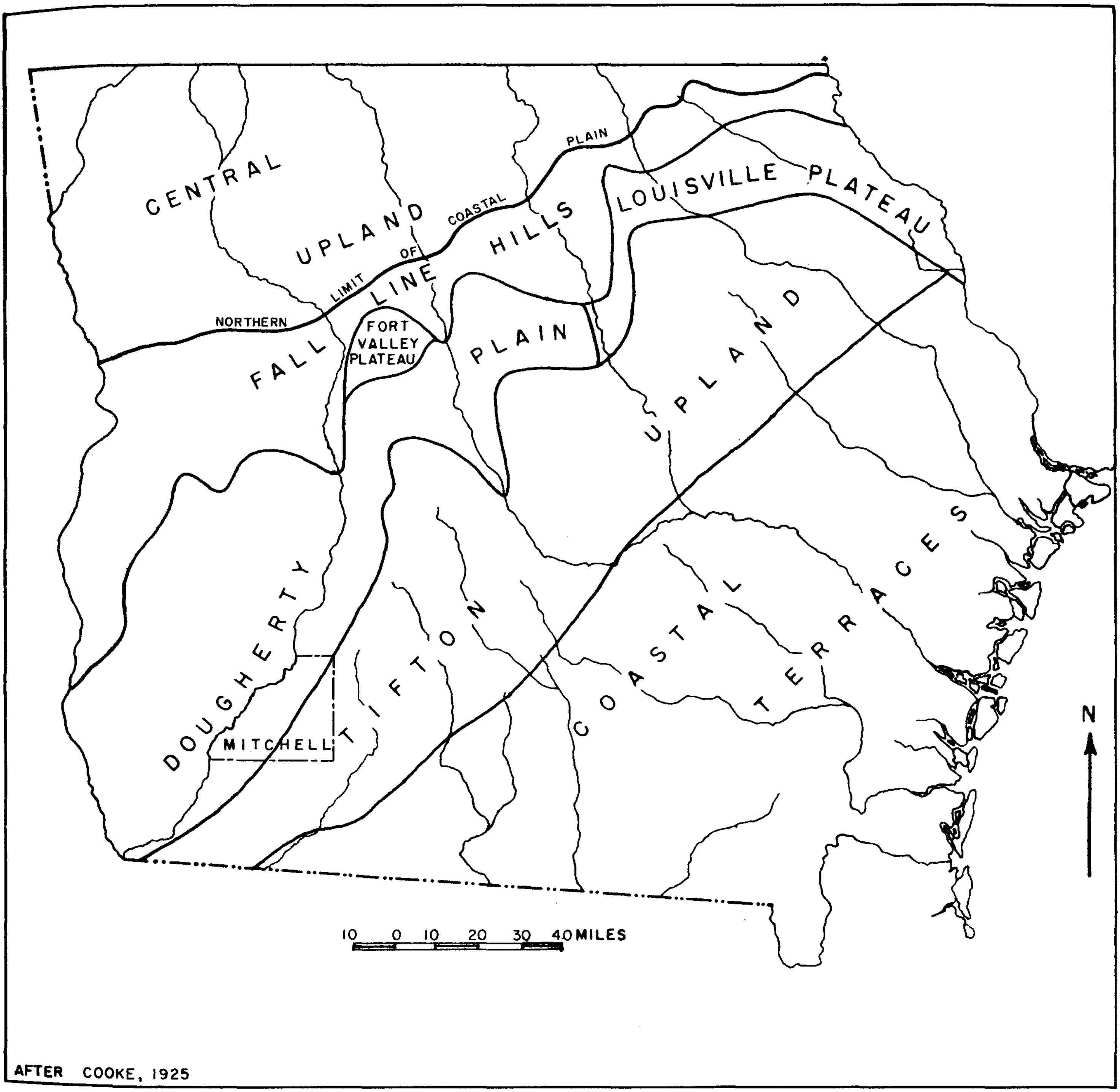

Figure 3.—Physiographic divisions of the Coastal Plain of Georgia.

almost to Baconton in Mitchell County and indicates that remnants of other marine terraces could be found in Mitchell County if detailed topographic maps were available.

Sub-area A is that part of the Dougherty Plain which lies in the northeast corner of figure 2--which, on a detailed topographic map, would correspond roughly to the 200-foot contour of altitude--and east of the Solution Escarpment. Solution features are similar to those in the main part of the Dougherty Plain, although streams are more numerous. Relief is much greater than that in the main part of the Dougherty Plain, with altitudes ranging from 200 feet to 380 feet. The area is predominantly hilly but wide flat areas occur along streams. The valleys of Raccoon Creek and tributaries are more than a mile wide in places and ascend in a very gentle gradient from the level of the Dougherty Plain to altitudes of about 280 feet at the base of the Solution Escarpment.

Solution Escarpment

The Solution Escarpment in Mitchell County is a northwest to west-facing escarpment bounded along its base by the Dougherty Plain and along its crest by the Tifton Upland. It has greater relief and is more finely dissected than either the Dougherty Plain or the Tifton Upland. Sinks are present but differ from those of the Dougherty Plain in that they are less numerous, are deeper and more active, and are generally much smaller in diameter. Some of the sinks are as much as 60 feet in depth but few, if any, exceed 200 feet in width. Surface drainage is much better developed than that in the Dougherty Plain but somewhat less so than that in the Tifton Upland.

The crest of the Solution Escarpment is a well-defined line which follows the watershed between the drainage basins of the Flint and Ochlockonee Rivers and forms a sharp boundary with the Tifton Upland, the topography of the two regions strongly contrasting. As shown in figure 2, the crest runs generally northeastward across Mitchell County from near the center of the south county line to a point on the east county line about 1 mile northeast of Sale City. Maximum altitudes along the crest range from about 400 feet in the northern part of the county to about 300 feet in the southern part.

The base of the Solution Escarpment is approximately as shown in figure 2 but cannot be determined precisely without adequate topographic maps. Altitudes along the base are mostly about 200 feet along the border of the main part of the Dougherty Plain but range from 200 to 290 feet along the border of Sub-area A. From the crest of the Solution Escarpment to the base, the land surface slopes an average of about 125 feet in a distance usually not exceeding 1 1/2 miles. In a small area northwest of Sale City, however, the distance from crest to base is as much as 5 miles.

Tifton Upland

The Tifton Upland in Mitchell County is a rolling upland which gradually descends in altitude southeastward from the crest of the Solution Escarpment. The topography contrasts strikingly with that of the Doughperty Plain and Solution Escarpment. Surface streams are numerous, and a southeastward-flowing dendritic drainage pattern is strongly developed. Sinks or other solution features are absent except along the crest of the Solution Escarpment, where several oval-shaped depressions as much as half a mile in width and less than 5 feet deep occur. They occur at stream heads, have narrow outlets, and are generally swampy areas supporting a growth of cypress trees. It is possible that they are very shallow sinks which are no longer active, or they may be bogs developed at the heads of the streams.

Altitudes in the Tifton Upland range from a maximum of about 400 feet along the northwestern border to somewhat less than 250 feet in the southeastern part. Relief between stream valleys and adjacent ridges is generally no more than 60 feet. Most of the streams flow between low banks in flat, swampy valleys as much as half a mile in width. The interstream ridges are of more or less uniform height and have rounded crests.

Climate

Mitchell County has a warm, humid climate, although it is subject to occasional periods of 1 or 2 days duration of rather cold weather in the winter. Droughts of several weeks duration are not uncommon in the summer. Figure 4 shows the average monthly precipitation and temperature at Camilla. Data are from the U. S. Weather Bureau.

Mitchell County has an average annual temperature of about 68.3°F and an average annual precipitation of about 51.78 inches. January is the coldest month and has an average temperature of 52.2°F. July is the warmest month and has an average temperature of 82.3°F. July is generally the wettest month, having an average precipitation of 5.67 inches, and October is driest, having an average precipitation of 1.93 inches.

Development

The 1960 population of Mitchell County was 19,652 (U. S. Dept. Commerce, 1960). Camilla, the county seat, had a population of 4,753 and Pelham 4,609. All other communities had populations of 500 or less.

Agriculture is the leading occupation in Mitchell County, and about 90 percent of the area is in farms. The principal crops are tobacco, tomatoes, peanuts, and corn. Beef cattle, hogs, poultry, dairy products, and pine trees are other major farm products.

Mitchell County has a few small industries such as textiles, fish, poultry, and peanut-processing plants, fertilizer plants, and various small forest-product industries. Mining operations in the county are restricted to one quarry, which produces lime for agricultural purposes.

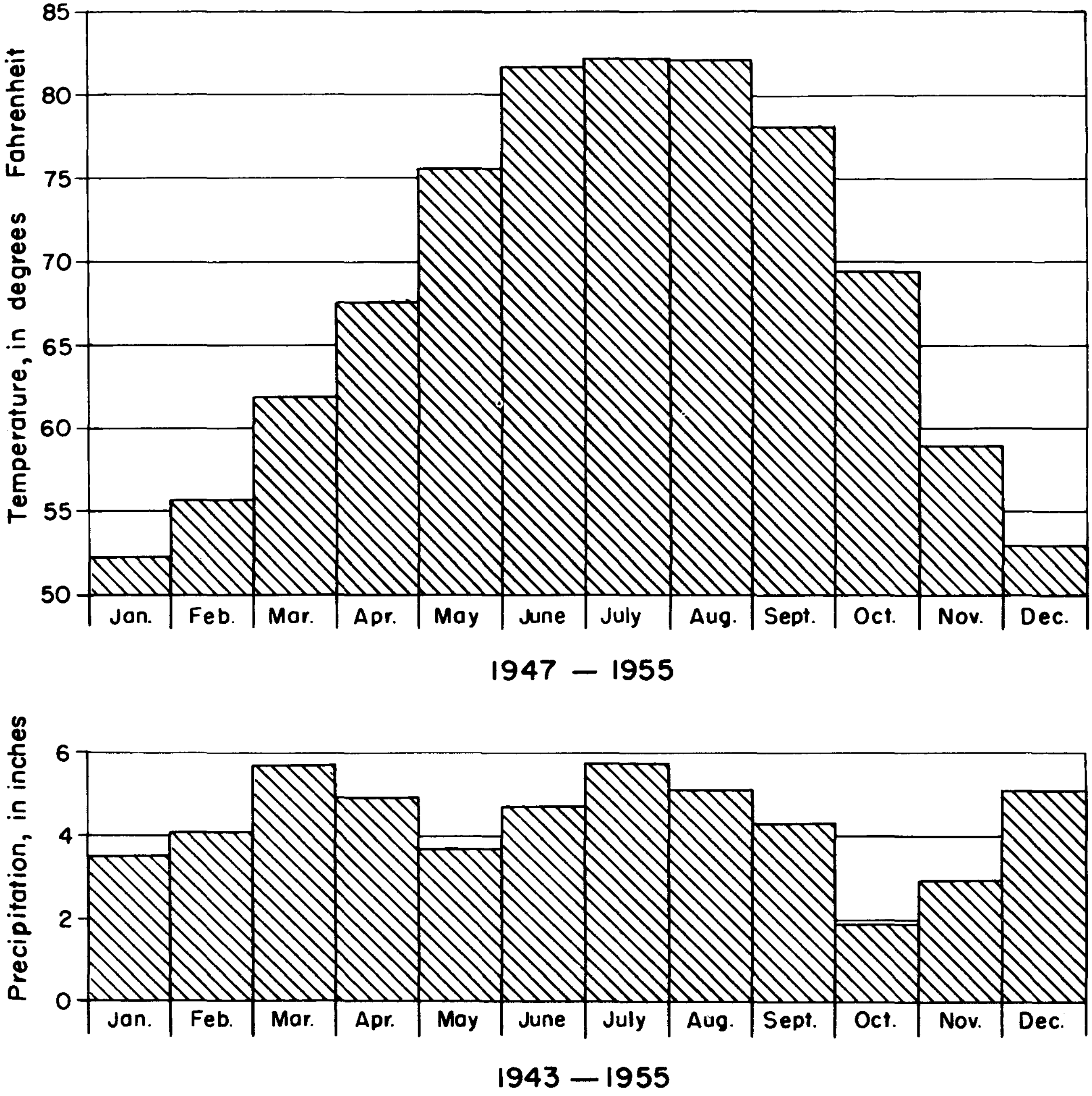

Figure 4.— Average monthly precipitation and temperature at Camilla, Ga.

GEOLOGY

The exposed rocks of Mitchell County include the Ocala Limestone, the Suwannee Limestone, the Tampa Limestone, the Hawthorn Formation, and the undifferentiated residuum. The surface geology of the area is shown on figure 5, which is a part of a geologic map of the Coastal Plain by MacNeil (1947). The writer is in general agreement with MacNeil. The Ocala Limestone crops out as shown at scattered points along the Flint River. The Suwannee Limestone crops out at the points shown in figure 5 in a roadcut and a sink and at a few additional points near the base of the Solution Escarpment. The Tampa Limestone crops out as shown in figure 5 in stream valleys in the southeastern part of the county; it also crops out generally along the Solution Escarpment but is much weathered and difficult to separate from underlying and overlying formations. Outcrops of recognizable Tampa are limited to the Tifton Upland and the Solution Escarpment. The Hawthorn Formation covers most of the Tifton Upland, and the undifferentiated residuum covers most of the Dougherty Plain.

Stratigraphy

Mitchell County is underlain by 5,000 to 7,000 feet of sedimentary rocks, ranging in age from Early Cretaceous or older to Recent. Well 3105-8400-9 (fig. 2) in southeastern Mitchell County is an oil-test well (J. H. Pullen no. 1) drilled in 1944 by the Stanolind Oil and Gas Co. The well was drilled to a depth of 7,490 feet and bottomed in gneiss (Richards, 1948, p. 67). Sandstone and shale beds were penetrated between depths of 6,230 and 7,300 feet and may be either Triassic or Paleozoic in age (op. cit.). Olivine diabase sills were reported to occur at depths between 6,550 and 6,612 feet and at 7,070 feet.

Few data are available concerning the formations below the Ocala Limestone because it is not generally necessary to drill wells any deeper than the Ocala. For this reason the geology of only the Ocala Limestone and overlying formations is discussed in some detail in this report. These formations and the rocks of the Claiborne Group constitute the only aquifers used in Mitchell County. Generalized data concerning the sedimentary formations of the county, including those below the Ocala, are shown in table 1.

EOCENE SERIES

The Eocene series in Georgia consists of the Wilcox Group (early Eocene), the Claiborne Group (middle Eocene), and the Jackson Group (late Eocene).

Jackson Group

The term "Jackson" was first applied to Eocene rocks in the Coastal Plain by Conrad (1856, p. 257-258), when he described a group of rocks as "Older Eocene Jackson." The Jackson is now recognized as a group, and the name comes from the city of Jackson, Miss., near which the type deposits are exposed along the Pearl River and Moodys Branch.

In eastern Georgia the Jackson Group consists of the Ocala Limestone, the Barnwell Formation, which is a nearshore facies of the Ocala, and the Cooper Marl. In western Georgia only the Ocala Limestone is present.

OCALA LIMESTONE

The Ocala Limestone was first described by Dall and Harris (1892, p. 103, 157, and 331) who assigned it to the "Eocene or Oligocene." Cooke (1915, p. 107-117) established the late Eocene age of the Ocala and first applied the name Ocala to rocks in Georgia at a point near Bainbridge, Decatur County, about 12 miles southwest of Mitchell County.

Lithology. -- The Ocala Limestone underlies all of Mitchell County and crops out irregularly in low bluffs along the Flint River. The Ocala in Mitchell County ranges from a very pure limestone to dolomitic limestone. On the basis of a few data it appears that most if not all of the Ocala in the Dougherty Plain area is relatively pure and that dolomitic beds are limited mostly to the Tifton Upland. Locally in the Tifton Upland dolomitic beds are predominant although generally they are interbedded with pure limestone.

A typical section of the Ocala in the Dougherty Plain, described from cuttings from well 3110-8410-12, a city well at Camilla, is listed below:

LOG OF WELL 3110-8410-12, CITY WELL AT CAMILLA

	Thickness (feet)	Depth (feet)
UNDIFFERENTIATED RESIDUUM		
Mudstone: pinkish gray (5YR 8/1),* mostly silt and clay; quartz abundant, medium-grained sand to granule gravel	25	25
Mudstone: dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), mostly silt and clay; iron oxide and medium to coarse-grained quartz sand common	3	28
Mudstone: moderate yellowish brown (10YR 5/4) to dark yellowish orange (10HR 6/6), mostly silt and clay; iron oxide abundant; quartz common, fine-grained sand to granule gravel	18	46
Ironstone: dark yellowish brown (10YR 4/2), mostly iron oxide; limestone and fine to coarse-grained quartz sand rare	4	50
Total undifferentiated residuum	50	
UPPER EOCENE SERIES		
JACKSON GROUP		
OCALA LIMESTONE		
Limestone: very pale orange (10YR 8/2) to grayish orange (10YR 7/4), bioclastic; iron oxide common; bryozoa abundant; Foraminifera and shell fragments common	11	61
Bryozoan limestone: very pale orange (10YR 8/2), bioclastic, impurities rare; secondary quartz cryatals rare; bryozoa and Foraminifera abundant; shell fragments rare	20	81
Limestone: very pale orange (10YR 8/2), bioclastic, impurities rare; bryozoa and Foraminifera abundant	34	115
Limestone: very pale orange (10YR 8/2), bioclastic, impurities rare; Foraminifera and bryozoa common; shell fragments rare	20	135
Limestone: very pale orange (10YR 8/2), bioclastic and oolitic, impurities rare; secondary calcite rare; Foraminifera and bryozoa common; shell fragments rare	50	185

* Numbers refer to rock color chart, Goddard and others, 1948.

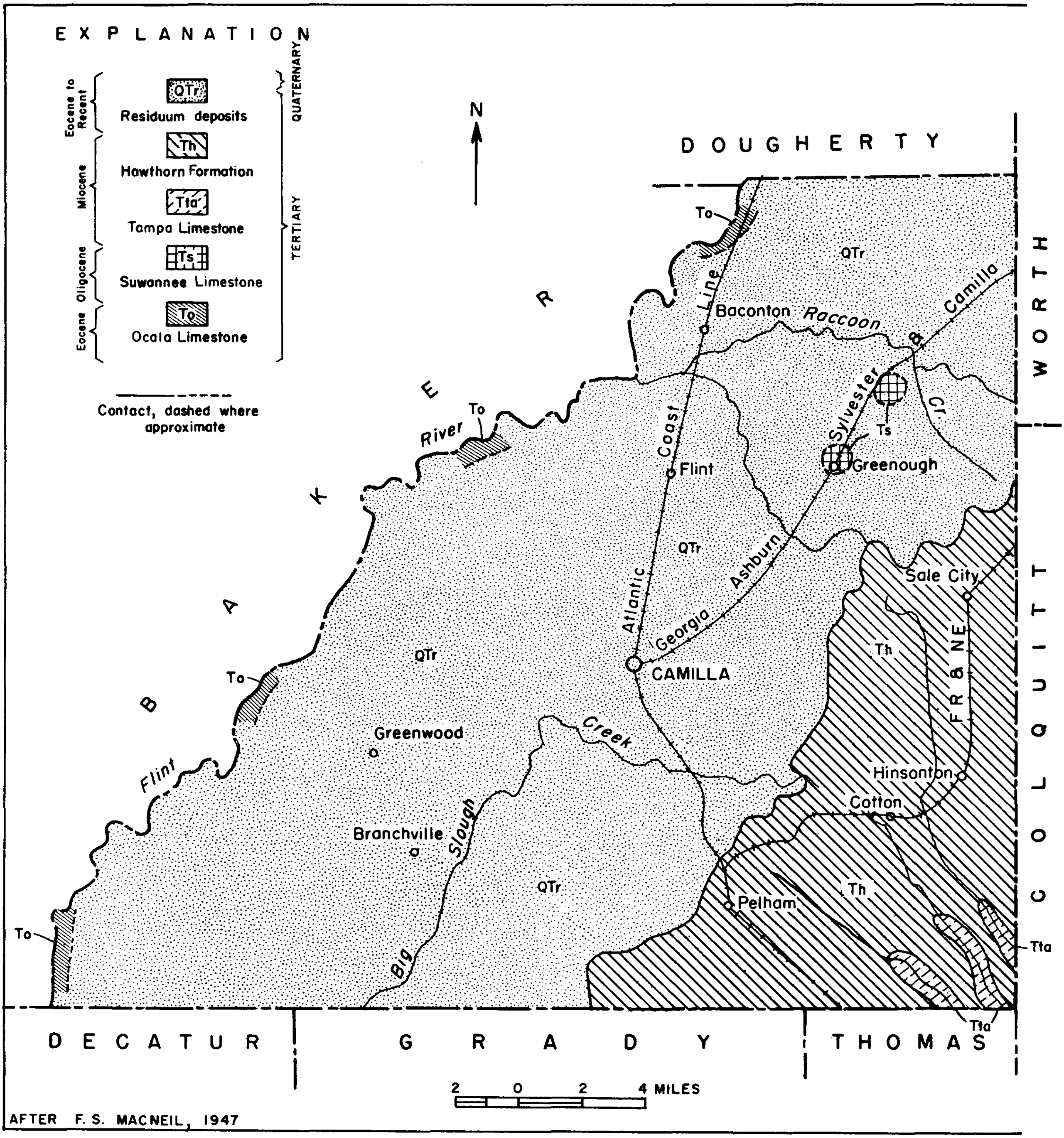

Figure 5.—Geologic map of Mitchell County, Ga.

Table 1.--Geologic formations in Mitchell County, Ga.

System	Series	Group	Geologic unit	Lithology and water-bearing properties	Thickness (feet)
Ouaternary and Tertiary	Upper Eocene to Recent		Residuum	Varicolored clayey sand and sandy clay containing chert nodules and boulders. Includes weathered and disarranged beds of Jackson, Oligocene, and Miocene age and probably Pleistocene terrace sand. Confined mostly to Dougherty Plain. Poor aquifer; yields 1 to 5 gpm to dug wells.	0-70
Tertiary	Miocene		Hawthorn Formation	Varicolored current-bedded ferruginous sand and sandy clay, nonfossiliferous. Confined mostly to Tifton Upland. Poor aquifer; yields 1 to 5 gpm to dug wells.	0-100
			Tampa Limestone	Gray massive-bedded sand, sandy marl, sandy limestone, and fuller's earth. Sparsely fossiliferous. Confined mostly to Tifton Upland. Fair to poor aquifer; yields small quantity of water to wells.	0-450
	Oligocene	Vicksburg Group	Suwannee Limestone	Pinkish white pure fossiliferous limestone. Confined mostly to Tifton Upland and Solution Escarpment. Fair aquifer; yields small quantity of water to wells.	0-100
	Upper Eocene	Jackson Group	Ocala Limestone	Pinkish white pure bioclastic limestone to brown crystalline dolomitic limestone. Excellent aquifer in Dougherty Plain; yields 1,000 to 2,500 gpm to wells. Good aquifer in Tifton Upland; yields 500 gpm to wells locally.	200-300
	Middle Eocene	Claiborne Group	Lisbon Formation	Brownish-gray dense glauconitic fossiliferous sandy limestone containing sandstone and marl beds. Fair to poor aquifer.	70-100
			Tallahatta Formation	Mostly gray massive clean phosphatic sand containing shell fragments, fish teeth, and thin marl beds. Upper 50 to 100 feet commonly consists of sandy coquina limestone. Lower 20 to 30 feet consists of dense cherty limestone. Excellent aquifer in Dougherty Plain; yields more than 1,000 gpm to wells. Good to fair aquifer in Tifton Upland; yields 1,000 gpm to wells locally.	275-390
	Lower Eocene	Wilcox Group	Tuscahoma Formation	Mostly gray glauconitic silt. Upper 30 to 40 feet contains thin beds of sandy glauconitic limestone. Lower 30 to 40 feet consists of fine- to coarse-grained glauconitic sand. Not utilized as aquifer, probably would yield only small quantity of water to wells.	125-195
	Paleocene	Midway Group	Undifferentiated Midway deposits	Gray silty calcareous sand and thin beds of foraminiferal limestone. Not utilized as aquifer; probably would yield only small quantity of water to wells.	60-150
			Clayton Formation	White bioclastic limestone. Not utilized as aquifer but yields 200 gpm to wells in counties to north.	140-250
Cretaceous	Upper Cretaceous		Undifferentiated (Includes Providence, Ripley, Cusseta, Blufftown, and Eutaw Formations.	Dark-gray fossiliferous glauconitic sandy marl containing thin beds of sand, clay, and limestone. Water-bearing properties not known. Upper beds probably would yield at least 200 gpm of potable water to wells.	1,400 (approx)
			Tuscaloosa Formation	Coarse arkosic sand and gravel and lenses and stringers of clay. Water-bearing properties not known; water possibly saline.	600 (approx)
	Lower Cretaceous		Undifferentiated	Lithology and water-bearing properties not known; water possibly saline	2,500 (approx)

	Thickness (feet)	Depth (feet)
UPPER EOCENE SERIES		
JACKSON GROUP		
OCALA LIMESTONE (continued)		
Limestone: very pale orange (10YR 8/2, aphanitic and bioclastic, impurities rare; secondary calcite rare; Foraminifera and bryozoa common; shell fragments rare	20	205
Limestone: very pale orange (10YR 8/2), oolitic and bioclastic, impurities rare; secondary calcite common; Foraminifera and bryozoa common, shell fragments rare	34	239
Limestone: very pale orange (10YR 8/2), aphanitic and bioclastic, impurities rare; Foraminifera and bryozoa common; shell fragments rare	16	255
Limestone: very pale orange (10YR 8/2), oolitic and bioclastic, impurities rare; secondary calcite common; Foraminifera and bryozoa common	18	273
Limestone: very pale orange (10YR 8/2), aphanitic, impurities rare; Foraminifera common; bryozoa and shell fragments rare	4	277
Limestone: very pale orange (10YR 8/2), bio-clastic, impurities rare; secondary calcite common; Foraminifera and bryozoa common; shell fragments rare	10	287
Limestone: very pale orange (10YR 8/2), aphanitic and bioclastic, impurities rare; bryozoa and shell fragments rare; Foraminifera common	50	337
Limestone: very pale orange (10YR 8/2), to pale yellowish brown (10YR 6/2), aphanitic, dense, recrystallization common; impurities rare; fossils rare	3	340
Total Ocala Limestone	290	
MIDDLE EOCENE SERIES		
CLAIBORNE GROUP		
LISBON FORMATION		
Limestone: pale yellowish brown (10YR 6/2), fine to coarsely crystalline; glauconite abundant; fossils rare	1	341

	Thickness (feet)	Depth (feet)
MIDDLE EOCENE SERIES CLAIBORNE GROUP LISBON FORMATION (continued)		
Calcareous sand: yellowish gray (5Y 7/2) to very pale orange (10YR 8/2), very fine to fine grained, subrounded, fair sorted, clear quartz, clean; glauconite abundant; limestone fragments abundant; Foraminifera and bryozoa common; shell fragments rare--------------------------------	5	346
Total Libson Formation------------------------	6	

As shown in the above log, the Camilla well penetrated 290 feet of Ocala and bottomed in the Lisbon Formation. The Ocala in the Camilla well is almost uniformly very pale orange (10YR 8/2) but appears almost white. It is porous and predominantly bioclastic in texture with Foraminifera, worn shells, and bryozoa fragments cemented in a matrix of fine-grained material. Oolitic and aphanitic textures occur at irregular intervals. Secondary calcite rhombs are rare to common throughout the formation, but none of the rock could be regarded as having crystalline texture. Iron oxide pellets occur in the upper 10 feet of the beds, but the rocks contain few other, if any visible impurities. The section of Ocala penetrated by the Camilla well is very similar to the Ocala in Dougherty and Lee Counties to the north but apparently was deposited in somewhat deeper water. In Dougherty and Lee Counties the basal 30 or 40 feet of the Ocala contains much quartz sand which is absent in the Camilla well. Cuttings from well 3120-8400-10 in northern Mitchell County, which penetrated 41 feet of Ocala, are closely similar to those in the Camilla well, as are cuttings from well 3110-8420-2 in the Dougherty Plain of southwestern Mitchell County.

Drill cuttings from the Ocala interval underlying the Tifton Upland of Mitchell County are available from only two wells--3115-8400-1 at Sale City and 3105-8400-9 about 2 miles south of Cotton. The upper 185 feet of the Ocala from the Sale City well is principally a relatively pure limestone ranging in texture from bioclastic to oolitic to finely crystalline and in color from white (N9) to grayish orange pink (5YR 7/2). The section contains a 15-foot bed and several very thin beds of saccharoidal dolomitic limestone. The well near Cotton is an oil test and penetrated the entire thickness of the Ocala. Sample recovery from this well was very poor, and each sample interval is intermixed with cuttings from overlying beds. S. M. Herrick, however, determined on the basis of microfauna that the well penetrated 300 feet of Ocala deposits (written communication, 1960). Fragments of brown dolomitic limestone and dolomite are abundant in the cuttings from the Ocala zone in this well. Brown limerock is reported in most drillers' logs of wells penetrating the Ocala throughout the Tifton Upland of Mitchell County, and it appears that dolomitic beds are general throughout the area.

It appears that the dolomite and dolomitic limestone in the Ocala Limestone in southeastern Mitchell County is related to an extensive area of regional dolomitization in southwest Georgia and that the regional dolomitization may be related to a northeast-trending syncline or downfaulted structure parallel to and southeast of the Solution Escarpment. The syncline or downfaulted zone is discussed later in this report. A more dolomitic section of the Ocala in or near Mitchell County is found in cuttings from well GGS 493 in Grady County (fig. 2). The Ocala in this well was penetrated to a depth of 170 feet and consists almost entirely of dolomitic limestone and a few beds of almost pure dolomite. The texture is principally saccharoidal; a few beds are oolitic. The color ranges from pinkish gray (5YR 8/1) to light brownish gray (5YR 6/1) but appears brown at first glance. Foraminifera, bryozoa, and ostracods are common to abundant but shell fragments are rare. No impurities other than dolomite were noted.

Cuttings from the upper 250 feet of the Ocala interval are available from well GGS 59 in Thomas County half a mile south of Mitchell County (fig. 2). On the basis of the cuttings, the Ocala there is principally limestone but contains beds of dolomitic limestone from a few feet to 43 feet thick. A log of this well is shown below:

LOG OF WELL GGS 59, CITY WELL AT MEIGS

	Thickness (feet)	Depth (feet)
MIOCENE SERIES		
HAWTHORN FORMATION		
Mudstone: pale red (5R 6/2) and grayish orange pink (5 YR 7/2), mostly silt and clay; fine to medium-grained quartz sand abundant; iron oxide common	25	25
Argillaceous sand and gravel: light brown (5YR 6/4), coarse-grained sand to pebble gravel, subrounded, poorly sorted, milky and clear quartz; silt and clay abundant	30	55
Total Hawthorn Formation	55	
TAMPA LIMESTONE		
Fuller's earth clay: yellowish gray (5Y 8/1); impurities rare	80	135
Sand: grayish orange (10YR 7/4), fine to medium-grained, subrounded, fair sorted, clear quartz; dark minerals, silt, and clay common	16	151
Marl: yellowish gray (5Y 7/2); iron oxide and fine to medium-grained quartz sand common; fossils rare or absent	34	185
Sandy limestone: very pale orange (10YR 8/2) and moderate brown (5YR 3/4), aphanitic, dense; amber chert, iron oxide, and very fine to fine-grained quartz sand abundant	20	205
Limestone: pale yellowish brown (10YR 6/2), aphanitic, dense; iron oxide and very fine to fine-grained quartz sand abundant; fossils rare or absent	41	246
No samples	24	270
Calcareous sand, yellowish gray (5Y 7/2) fine to medium-grained, subrounded, fair sorted, clear quartz; limestone fragments abundant; gray and green clay common; shell fragments rare	19	289
Sandy limestone: yellowish gray (5Y 7/2), aphanitic, dense; very fine to fine-grained quartz sand abundant; gray and greenish clay common	31	320

	Thickness (feet)	Depth (feet)
MIOCENE SERIES		
TAMPA LIMESTONE (continued)		
Calcareous sand: yellowish gray (5Y 7/2), fine to medium-grained, subrounded, well-sorted clear quartz; sandy limestone fragments abundant; greenish clay common; poorly preserved pelecypods rare	14	334
No samples	12	346
Limestone: Yellowish gray (5Y 7/2), aphanitic, somewhat porous; very fine to fine-grained quartz sand; greenish clay rare; core	19	365
No samples	13	378
Calcareous sand: light olive gray (5Y 6/1), fine to coarse-grained, subrounded, poorly sorted, clear quartz; fine-grained sandy limestone fragments abundant, fish teeth rare	39	417
Limestone: yellowish gray 5Y 8/1), aphanitic, dense; interbedded medium to coarse-grained quartz sand abundant; poorly preserved pelecypods rare	42	459
No samples	3	462
Sandy limestone: light olive gray (5Y 6/1), aphanitic, dense; very fine to fine-grained quartz sand abundant; interbedded marl common	22	484
Total Tampa Limestone	429	
OLIGOCENE SERIES		
SUWANNEE LIMESTONE		
Limestone: pinkish gray (5YR 8/1), oolitic and aphanitic, recrystallization common; iron common; Foraminifera abundant; bryozoa common	27	511
Limestone: yellowish gray (5Y 8/1), aphanitic and fragmental, recrystallization common; Foraminifera abundant	75	586
Total Suwannee Limestone	102	

	Thickness (feet)	Depth (feet)
UPPER EOCENE SERIES		
JACKSON GROUP		
OCALA LIMESTONE		
Limestone: very light gray (N8), aphanitic and fragmental, recrystallization common; saccharoidal dolomite fragments common; bryozoa and Foraminifera abundant	20	606
Limestone: yellowish gray (5Y 8/1), finely crystalline; manganese common; bryozoa rare; core	14	620
Limestone: yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), fragmental and aphanitic, recrystallization common; phosphate rare, bryozoa common; core	21	641
Dolomitic limestone: pale yellowish brown (10YR 6/2), saccharoidal; fossils rare; core	25	666
Limestone: very light gray (N8), oolitic and fragmental, recrystallization rare; Foraminifera common; bryozoa rare; core	22	688
No samples	39	727
Argillaceous limestone; pale yellowish brown (10YR 6/2) and very pale orange (10YR 8/2), aphanitic, oolitic, and fragmental; silt, clay, glauconite rare; Foraminifera and broyozoa common	43	770
Dolomitic limestone: very pale orange (10YR 8/2) and pale yellowish brown (10YR 6/2), saccharoidal; impurities rare; bryozoa rare	26	796
Dolomitic limestone: yellowish gray (57 7/2), saccharoidal, dense, impurities rare; core	19	815
Limestone: white (N9), oolitic; impurities rare; Foraminifera common	20	835
Total Ocala Limestone	249	
No samples	485	1,320

	Thickness	Depth (feet)
LOWER EOCENE SERIES WILCOX GROUP TUSCAHOMA SAND		
Glauconitic sand: dark greenish gray (5GY 4/1), fine to medium-grained, subrounded, fair sorted, clear and green quartz, clean, glauconite abundant, at least 50 percent of sample--	210	1,530
Total Tuscahoma Sand---	210	

Thickness.-- The Ocala ranges in thickness from about 200 feet in extreme northern Mitchell County to about 300 feet in the extreme southeastern part. In the Dougherty Plain area the thickness is rather variable within short distances owing to uneven solution weathering of the top of the limestone.

OLIGOCENE SERIES

The Oligocene Series includes all rocks overlying the Upper Eocene Series and underlying the Miocene Series. As currently recognized by the U. S. Geological Survey, the Oligocene Series in Georgia includes all rocks younger than the Cooper Marl and older than the Tampa Limestone.

Vicksburg Group

The term "Vicksburg Group" was first used by T. A. Conrad (1847, p. 280-299) when he applied the name to "Upper or Newer Eocene" beds exposed near Vicksburg, Miss.

SUWANNEE LIMESTONE

C. W. Cooke and W. C. Mansfield (1935, p. 71-72) proposed the name "Suwannee Limestone" for yellowish limestone exposed along the Suwannee River in Florida between Ellaville and White Springs and tentatively correlated the beds with the Flint River Formation in Georgia, which is typically exposed along the Flint River near Bainbridge.

Lithology.-- The Suwannee Limestone underlies the Tifton Upland in Mitchell County and scattered areas of the Dougherty Plain, where the limestone is thin and discontinuous. It crops out in scattered sinks and roadcuts near the base of the Solution Escarpment. The Suwannee overlies the Ocala Limestone and underlies the Tampa Limestone.

The Suwannee is well exposed in a quarry (outcrop X-1, fig. 2) of the Bridgeboro Lime and Stone Co., about 5.5 miles east of Baconton. There it is composed of about 70 feet of limestone overlain by about 10 feet of green clay. The limestone is light gray to white, bioclastic to aphanitic, and contains rounded nodules of clastic limestone. Chert boulders, elongated horizontally and 5 to 6 feet in diameter are common, as are scattered pockets and seams of green clay. The limestone contains few impurities other than dendritic manganese. Pelecypods, gastropods, and large Foraminifera are common. The limestone occurs in two massive beds, and the upper bed, about 20 feet thick is separated from the lower by a horizontal depositional break. Erosion on top of the lower bed is not evident. A similar depositional break separates the upper bed from the overlying green clay. The green clay is nonsandy, plastic when wet, and contains abundant irregularly spaced nodules and boulders of fossiliferous limestone. The green clay is overlain by 2 to 3 feet of weathered red clay, but the weathered clay is as much as 50 feet thick where the green clay is absent and it fills solution pipes in the underlying limestone.

Well 3120-8400-10, a test hole drilled by the Marquette Cement Co., about half a mile south of the quarry, penetrated 114 feet of Suwannee and bottomed in the Ocala Limestone. The section is lithologically similar to that in the quarry and has been identified as Suwannee by Herrick (1961, p. 306) on the basis of microfauna. Preliminary examination of cores from numerous other test holes drilled by the Marquette

Cement Co. in the vicinity of well 3120-8400-10 also indicate a Suwannee interval which is similar in lithology to that in the quarry at outcrop X-1.

The Suwannee Limestone in Mitchell County is very similar lithologically to the Ocala Limestone of the Dougherty Plain area. However, as the Suwannee is largely restricted to the Tifton Upland where the Ocala contains brown dolomitic beds, the absence of such beds in the Suwannee in Mitchell County may be useful in distinguishing it from the Ocala. Also, the Suwannee generally contains pockets of green clay which are absent in the Ocala and it appears to be less fossiliferous in downdip areas than the Ocala. Such criteria were used in separating the Suwannee from the Ocala in wells located in adjacent counties (Alb-4, Alb-55, GGS-59, GGS-493, and GGS-611, fig. 2).

In the Tifton Upland of Mitchell County, cuttings are available from only one well which went through the Suwannee and into the Ocala, well 3105-8400-8. The sample recovery was too poor to make a lithologic separation of the two formations. However, Herrick (personal communication) logged 105 feet of Suwannee in this well on the basis of microfauna. Cuttings are available from two other wells in the Tifton Upland of Mitchell County which penetrate part of the Suwannee. These are wells 3105-8400-9, 2 miles south of Cotton, and 3110-8400-1, about 1 mile northeast of Cotton. These wells penetrate 16 and 11 feet, respectively, of Suwannee Limestone, which is pinkish white, nondolomitic, aphanitic to crystalline, and sparsely fossiliferous. The cuttings from well 3105-8400-9 have been identified as Suwannee by Herrick (personal communication) from microfauna. No microfossils were found in cuttings from well 3110-8400-1. Drillers logs from different parts of the Tifton Upland in Mitchell County report about 100 feet of white limestone overlying brown limestone or limestone containing brown beds; the white limestone probably is Suwannee and the brown is Ocala.

The Suwannee Limestone is easily distinguishable from the Tampa Limestone throughout Mitchell County and adjacent areas, the Tampa containing abundant quartz sand which is absent in the Suwannee.

Thickness.-- The Suwannee Limestone is approximately 100 feet thick throughout the Tifton Upland and parts of the Solution Escarpment in Mitchell County. It is reduced largely to residuum in the Dougherty Plain area but it may be 25 or 30 feet thick locally.

MIOCENE SERIES

The Miocene Series in Georgia includes all rocks younger than the Suwannee Limestone and older than the Charlton Formation of Pliocene age. The Miocene consists of the Tampa Limestone, the Hawthorn Formation, and the Duplin Marl, all of which are Miocene in age. Only the Tampa Limestone and the Hawthorn Formation are recognized in western Georgia.

The Miocene in Mitchell County occurs in two lithologic units. The lower unit is mostly calcareous, was deposited under marine conditions, and is assigned in this report to the Tampa Limestone. The upper unit is noncalcareous, probably was deposited under near-shore conditions, and is assigned in this report to the Hawthorn Formation. The Tampa Limestone of this report contains fuller's earth beds which some authors, including Cooke (1943, p. 89-98), have placed in the Hawthorn Formation. MacNeil (1947) appears to have considered the fuller's earth beds to be in the Tampa Limestone, however.

TAMPA LIMESTONE

L. C. Johnson (1888, p. 235) suggested the name "Tampa Formation" for rocks in Florida underlying Tampa and Hillsborough Bays and two nearby lakes.

Dall and Harris (1892, p. 112-113) proposed the name "Tampa Limestone" for some of the beds, and this is the name now accepted by the U. S. Geological Survey. The Tampa Limestone underlies the Tifton Upland in Mitchell County and crops out in stream valleys in the southeastern corner of the county as well as in scattered sinks and roadcuts of the Solution Escarpment.

Lithology.-- The Tampa consists of sand, calcareous sand, marl, fuller's earth, and sandy limestone. Limestone beds apparently are thicker and more common toward the base of the formation and in downdip areas. Well GGS-59, at Meigs, half a mile south of Mitchell County (fig. 2), penetrated 429 feet of Tampa, the lithology of which is representative of the formation in extreme southeastern Mitchell County. The Tampa, as determined by cuttings from this well, consists of alternating beds of fuller's earth, calcareous sand, sandy marl, and sandy limestone. Sandy limestone makes up almost half the section and occurs in several beds, including a bed 70 feet thick at the base. A log of this well is shown on page 16. A thick bed of limestone at the base of the formation appears to be characteristic of the Tampa in extreme southeastern Mitchell County and in adjacent areas along the strike.

An updip exposure of the Tampa occurs in a steep-walled sink at outcrop X-2 (Fig. 2) in the Solution Escarpment, where about 60 feet of the formation are exposed. There the Tampa consists of yellowish gray to greenish gray, very fine to fine-grained quartz sand. The sand is massively bedded and grades locally, chiefly near the base, into sandy limestone containing poorly preserved fossils. In places the sand grades laterally into light-green and light-gray waxy clay with lignite or manganese partings. The sink probably was formed by collapse of overlying beds into cavernous Suwannee Limestone, and the exposed Tampa beds probably are near the base of the formation.

Very fine to fine-grained sand is very abundant in the Tampa and generally makes up almost 50 percent of the marl and limestone beds. The limestone beds are poorly fossiliferous, aphanitic and impure; some are dolomitic. Fossils are rare throughout the Tampa, although poorly preserved gastropods and pelecypods have been found.

The abundance of sand in the Tampa serves to distinguish it from the underlying Suwannee Limestone in which sand is rare or absent. The marine character of the Tampa serves to distinguish it from the overlying Hawthorn Formation. At most outcrops the contact of the Tampa and Hawthorn is poorly exposed owing to weathering, but is sharp at outcrop X-3 (fig. 2), where 3 or 4 feet of gray marine very fine-grained massive-bedded sand of the Tampa is overlain by about 10 feet of reddish fine to coarse-grained argillaceous current-bedded sand of the Hawthorn. In downdip areas in and near southeastern Mitchell County, the top of the Tampa, as interpreted during the present investigation, is marked by limestone marl, or fuller's earth beds.

As determined from well cuttings, fuller's earth occurs in the Tampa Limestone in the subsurface of southeastern Mitchell and adjacent counties. Also, it is mined extensively along a northeast-trending belt extending from Quincy, Fla., through Attapulgus, Ga., to northern Thomas County, Ga., within 2 miles of southeastern Mitchell County. Thick sections of fuller's earth may occur at shallow depth in extreme southeastern Mitchell County. None were noted at land surface during the present investigation, but test drilling might discover commercial deposits with relatively shallow overburden.

Thickness.-- The Tampa Limestone in Mitchell County varies greatly in thickness, ranging from about 150 feet along the northwestern margin of the Tifton Upland to about 450 feet near the southeast corner of the county.

HAWTHORN FORMATION

The Hawthorn Formation was first named and described by Dall and Harris (1892, p. 81-82, 107-112, 157, 158, and 326) from exposures in Florida, Georgia, and other southeastern states. In western Georgia the Miocene deposits overlying the Tampa Limestone are referred to the Hawthorn Formation.

Lithology. -- The Hawthorn Formation covers most of the Tifton Upland and parts of the Solution Escarpment in Mitchell County. Most of the outcrops are much weathered but outcrop X-4 (fig. 2) in Subarea A of the Dougherty Plain, and 13 miles northeast of Camilla is fairly well exposed and is described as follows:

OUTCROP X-4 -- HAWTHORN FORMATION EXPOSED IN ROADCUT ON SOUTHEAST SIDE OF GEORGIA HIGHWAY 112, ABOUT 13 MILES NORTHEAST OF CAMILLA.

Lithology	Thickness
Argillaceous sand: reddish brown, fine to coarse-grained, subangular, poorly sorted, clear and milky quartz, massive-bedded; silt, clay, quartz gravel, and iron oxide pebbles abundant; iron oxide pebbles predominant in 1-foot zone along base; weathers smooth, forms steep slope, base undulating and sharp	10
Sand: yellowish brown, fine to coarse-grained, subangular, poorly sorted, clear and milky quartz, current-bedded, tight, crossed by diagonal streaks of gray clay in weathering cracks; granule gravel common; weathers smooth, forms steep slope, base undulating and gradational	8

Sand: multicolored in shades of brown, yellow, lavender, pink, and gray, fine to coarse-grained, subangular, poorly sorted, clear and milky quartz, current-bedded, tight, crossed by diagonal streaks of gray clay in weathering cracks and by curving pink laminations----------------------------	10

The lithology of the Hawthorn Formation at outcrop X-4 is typical of the formation throughout the Tifton Upland where it is at or near land surface except along stream valleys in the extreme southeast where it has been removed by erosion. Soils in the Tifton Upland contain abundant pebbles of iron oxide which have weathered from the Hawthorn.

Cuttings are available from only one well penetrating the Hawthorn Formation in Mitchell County--3105-8400-9, 2 miles south of Cotton. The Hawthorn in this well consists of 86 feet of mudstone and argillaceous sand, and the top of the Tampa is marked by a 10-foot bed of fuller's earth. The Hawthorn in well GGS 59, half a mile south of Mitchell County, consists of 55 feet of mudstone and argillaceous sand.

Thickness. -- The Hawthorn Formation ranges in thickness from about 40 feet along the crest of the Solution Escarpment to about 100 feet in parts of southeastern Mitchell County.

UNDIFFERENTIATED RESIDUUM

Lithology. -- Most of the Dougherty Plain of Mitchell County has been mapped by MacNeil as residuum (fig. 5). The writer agrees with MacNeil that the residuum is a mixture of the residues of the Ocala, Suwannee, and Tampa Limestones, the Hawthorn Formation, and probably Pleistocene terrace material and that the residues are so intermixed that separation is not practicable. Chert boulders containing Suwannee fossils are scattered over the surface of the Plain, and isolated, weathered outcrops resembling the Tampa Limestone and Hawthorn Formation may be found. Much of the sand in the Dougherty Plain may be of Pleistocene terrace origin. The Dougherty Plain probably was once covered by thin beds of the relatively impervious Tampa Limestone and Hawthorn Formation and the underlying Ocala and Suwannee Limestones have been extensively thinned by solution. The Tampa Limestone and Hawthorn Formation thicken rapidly just southeast of the Solution Escarpment and form a thick cover, which retards solution of the underlying limestone. The Solution Escarpment probably is due mainly to the differential weathering between the Dougherty Plain on the one side and the Tifton Upland on the other, although northwestward-flowing streams are eroding headward into the escarpment and are slowly moving the crest southeastward.

Thickness. -- The thickness of the residuum varies considerably but it probably averages about 60 or 70 feet.

Structure

DOUGHERTY PLAIN

The principal structure in the Dougherty Plain of Mitchell County is the regional homocline which dips to the southeast at a rate ranging from about 22 feet per mile on top of the rocks of the Upper Cretaceous Series to about 10 feet per mile on top of the Ocala Limestone. The term "regional homocline" is used because investigations north and northeast of Mitchell County have shown that similar dips occur throughout wide areas of the Dougherty Plain. The dips in the regional homocline are illustrated in the geologic section in figure 6.

Considerable evidence of faulting exists in Sub-area A of the Dougherty Plain and adjacent areas of the Solution Escarpment. A section of a fault is shown in figure 2 between outcrops X-1 and X-4. The area south of U. S. Highway 19 in this vicinity has been extensively core-drilled by the Marquette Cement Co., and it was found that the depth to the top of the Suwannee Limestone increased abruptly east of a north-south line occupying the approximate position of the fault shown in figure 2. A similar dropoff was noted in a line of test holes drilled by the Bridgeboro Lime and Stone Co., which extended southeastward from U. S. Highway 19. The fault also is apparent in outcrops, as is illustrated by a comparison of outcrop X-1

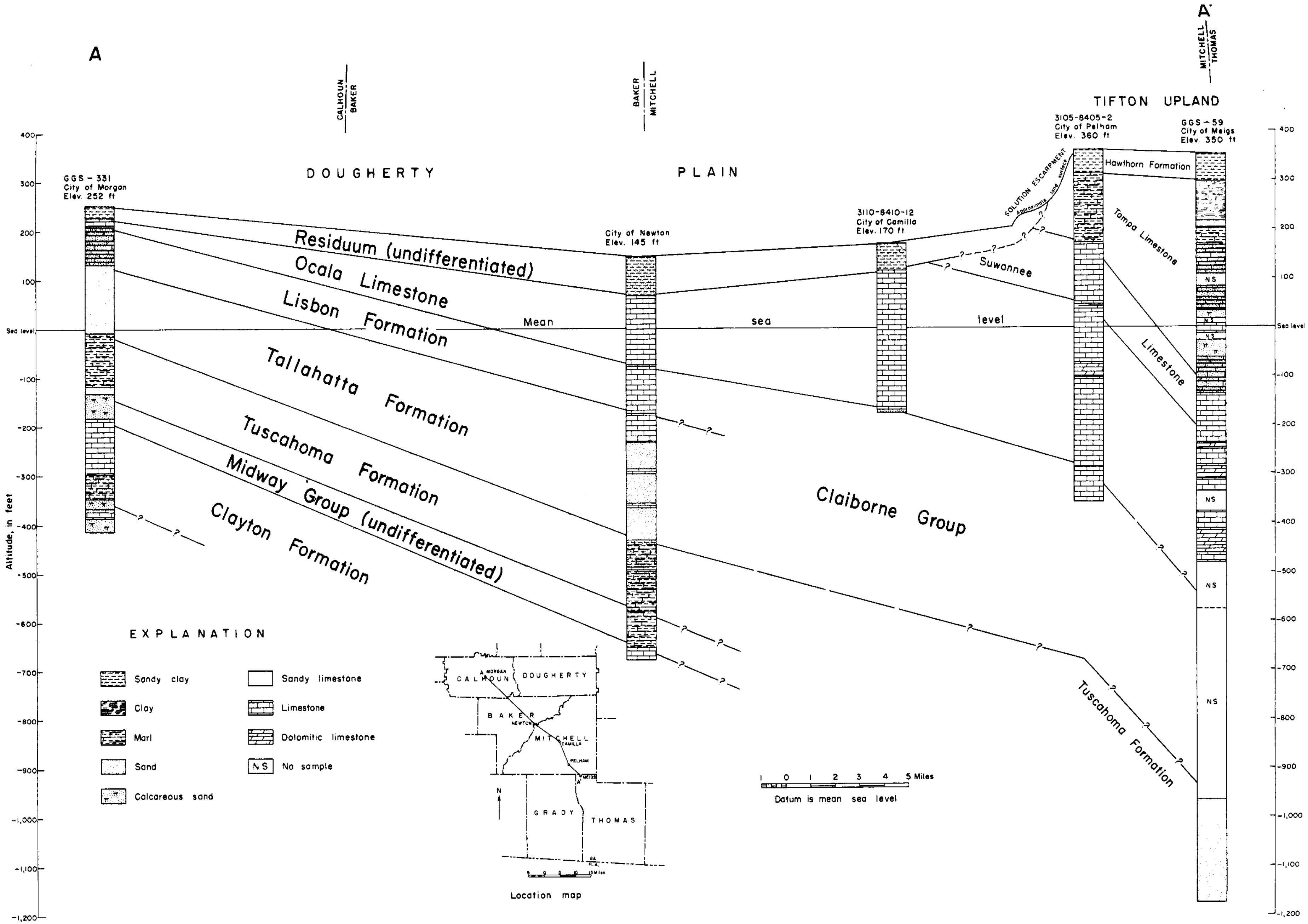

Figure 6.—Geologic section from Morgan to Meigs, Ga.

at the quarry of the Bridgeboro Lime and Stone Co. and outcrop X-4 at a roadcut on U. S. Highway 19 only half a mile northeast of the quarry. The tops of both outcrops are at about the same altitude, but Suwannee Limestone is exposed in the quarry and the Hawthorn Formation is exposed in the roadcut. A small graben-like structure may be seen in the middle of the Hawthorn outcrop. The fault shown in figure 2 has a displacement of 30 to 40 feet and probably is of much greater lineal extent than is shown. Many other faults of similar magnitude probably are present in Sub-area A and the Solution Escarpment, but extensive test drilling would be required to locate them. At several places, Oligocene or Tampa residual material is exposed in a roadcut on one side of a creek and the Hawthorn Formation is exposed in a roadcut on the opposite side.

TIFTON UPLAND

The Tifton Upland in Mitchell County is underlain by the northwest limb of a southwest-northeast-trending syncline or downfaulted area, the approximate location of which is shown in figure 2. The rate of dip on top of the Suwannee Limestone increases from about 10 feet per mile on the northwest side of Pelham and Sale City to more than 50 feet per mile on the southeast side. (figs. 6 and 7).

Preliminary investigation indicates that the axis of the syncline is near Quincy, Fla. and Attapulgus, Cairo, and Moultrie , Ga. In the vicinity of Mitchell county, it is probably between Meigs and Thomasville. The syncline should be located more accurately and defined by investigation now being made in Seminole, Decatur and Grady Counties. The syncline appears to be related to the occurrence of fuller's earth, commercial deposits of which occur along its axis.

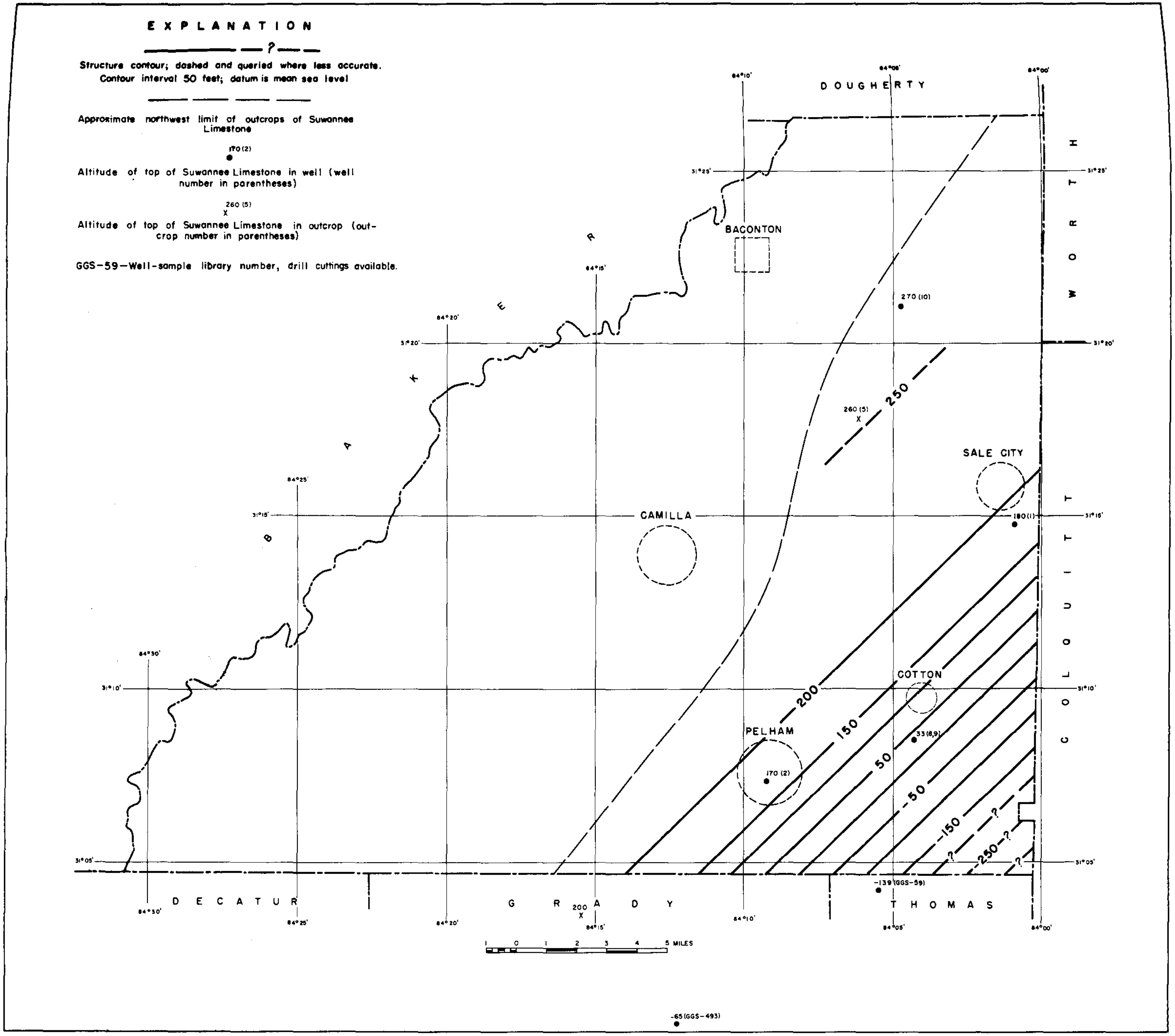

Figure 7.— Structure contours on the top of Suwannee Limestone, southeastern Mitchell County, Ga.

GROUND WATER

The sedimentary rocks of Mitchell County consist of alternating layers of sand, clay, marl, and limestone which differ in hydrologic properties. The porosity, which is determined by the percentage of open spaces, is high in all the rocks. However, the permeability, which is determined by the degree of interconnection and the size and shape of the open spaces, ranges from low in the clay and marl beds to high in most of the sand and limestone beds. Movement of ground water is relatively restricted in the clay and marl beds. They do not yield water readily to wells and are termed ''confining beds''. Movement of ground water is relatively free in most of the sand and limestone beds. They tend to yield water readily to wells and are termed ''aquifers''.

Most ground water enters the rocks of the Coastal Plain from rainfall in outcrop belts and moves southeastward and downdip until it finally becomes confined between relatively impermeable beds and is under artesian pressure. The sedimentary rocks of Mitchell County are saturated from near the land surface to a depth of about 7,000 feet. If a line representing the top of the zone of saturation were superimposed on the structural section in figure 6, the line would average about 50 feet below land surface in Dougherty Plain, as compared with about 200 feet below land surface in the Tifton Upland. The line would be near the top of the Ocala Limestone in the Dougherty Plain, about 30 feet above the top of the Ocala at Pelham, and within the Tampa Limestone a short distance southeast of Pelham.

The water in the saturated zone below the Lisbon Formation is somewhat confined and is under artesian pressure. The water in the saturated zone above the Lisbon is less confined, and the degree of confinement varies from one area to another. Locally the confinement of water is so slight that water-table conditions are approached. In low-altitude areas of the Dougherty Plain, the zone of saturation extends to the top of the Ocala Limestone, and the overlying residuum acts as a confining bed. In some high-altitude areas of the Dougherty Plain, the top of the zone of saturation is a few feet below the top of the Ocala, and the water probably is unconfined. In the northwestern part of the Tifton Upland, the top of the zone of saturation is in the lower part of the Suwannee Limestone, and the water probably is unconfined. In extreme southeastern Mitchell County, where the top of the zone of saturation is in the Tampa Limestone, beds of low permeability within the Tampa serve as confining beds. East and south of Mitchell County, ground water is tightly confined in the Ocala, Suwannee, and Tampa Limestones, and these formations, together with limestones of the Claiborne Group, constitute the ''principal artesian aquifer''. The principal artesian aquifer is tapped by wells in most of southeastern Georgia and much of Florida where it is called the ''Floridian aquifer''.

Above the main zone of saturation, ground water is under water-table conditions in the Hawthorn Formation in the Tifton Upland. Water enters the Hawthorn from local rainfall and seeps downward. Some of the water percolates downward to the main ground-water body, but much of it emerges in springs and seeps at the intersections of relatively impermeable clay beds and the land surface.

Dougherty Plain

The general lithologic and water-bearing properties of the formations underlying the Dougherty Plain of Mitchell County are listed in table 1. The best aquifers in the area are the Ocala Limestone, the Tallahatta and Clayton Formations, and the undifferentiated Upper Cretaceous rocks. Formations that are poor aquifers and serve mainly as confining beds are the undifferentiated residuum, the Lisbon Formation, the Tuscahoma Sand, and the undifferentiated Midway deposits.

Ground-water conditions in the Dougherty Plain of Mitchell County are such that abundant water within 300 feet of the land surface is available to wells of simple construction. The area is fortunate in having abundant ground water available, because, with the exception of the Flint River, there are virtually no surface streams.

No large springs occur in the Dougherty Plain of Mitchell County, although boiling springs are reported to be visible in the bed of the Flint River at low stage, and several limestone springs discharge near the river in adjacent counties. Radium Springs, near the east bank of the Flint River about 5 miles north of Mitchell County, has a measured flow of as much as 135 cfs (cubic feet per second). Two limestone springs of moderate size occur in Baker County about half a mile northwest of Mitchell County. One of the springs is in the valley of Coolewahee Creek at its juncture with the Flint River. The creek apparently has lowered its bed in the relatively recent past, exposing the Ocala Limestone, and thereby creating favorable conditions for the development of a spring. The lack of springs in the Dougherty Plain of Mitchell County is partly due to the lack of tributary streams flowing into the Flint River.

WELLS

Almost all water supplies in the Dougherty Plain of Mitchell County are obtained from drilled wells. Most wells are constructed in the Ocala Limestone, which lies at an average depth of about 70 feet below the land surface and ranges in thickness from 175 to 300 feet. The Ocala generally furnishes ample supplies of water for all purposes, and it is not ordinarily necessary to construct wells in deeper formations. However, at scattered locations, wells have penetrated only nonwaterbearing sand and clay in the Ocala interval and, in such circumstances, it has been necessary to construct wells in the Tallahatta Formation, the next lower aquifer. Ample water may be obtained from the Tallahatta and, so far as is known, no wells have ever been constructed in deeper aquifers in the Dougherty Plain of Mitchell County. However, deep municipal wells in Albany, which is only 9 miles north of Mitchell County, obtain large quantities of water from the Clayton Formation and Upper Cretaceous rocks. Also, a well in Newton, 10 miles northwest of Camilla and only half a mile northwest of Mitchell County, is constructed in limestone of the Clayton Formation and flows at the rate of 1 or 2 gpm. This well is 825 feet deep.

All wells in the Dougherty Plain of Mitchell County are of open-hole finish, and most are in limestone aquifers. The casing is driven or cemented into the top of the limestone, and the lower part of the hole is left open. Although a few wells in the area bottom in sand and sandy limestone of the Tallahatta Formation, these also are of open-hole construction. No screens are required because the beds are too far beneath the water levels in the wells for sand to be agitated and brought up by pumping.

Large-Capacity Wells

Wells of large capacity may be constructed throughout the Dougherty Plain. About 30 irrigation wells are in the area and have reported yields ranging from 500 to 2,500 gpm. In addition, 3 municipal and 1 industrial well have reported yields ranging from 500 to 2,100 gpm.

Representative irrigation wells are shown in table 2, and other irrigation and large-yield municipal and industrial wells are shown in table 3. All wells with reported yields of more than 500 gpm are 6 to 12 inches in diameter and are equipped with 40 to 75 hp turbine pumps. Most of the large yield wells range in depth from 200 to 300 feet and are constructed in the Ocala Limestone, commonly bottoming in the top of the Lisbon Formation.

The newest city well at Camilla is an example. The well was drilled to a depth of 346 feet, penetrating 6 feet into the Lisbon, but was finished at a depth of 335 feet in the Ocala. The few wells which do not obtain large yields from the Ocala must be drilled through the Lisbon Formation and into the Tallahatta Formation. Well 3110-8420-6 (table 2) is an example of this type. Insufficient water was obtained in the Ocala, and it was necessary to drill through the Lisbon and about 200 feet into the Tallahatta, the total depth of the well being 540 feet.

The largest yield in the area is reported from well 3105-8425-1 (table 3) in the southwestern corner of the county. This well was reportedly pumped at 2,500 gpm, and the drawdown was negligible. Well 3110-8410-12 (table 3) at Camilla, was reportedly tested at 2,100 gpm and reported yields of 1,000 gpm, are common in various localities. Most of the irrigation wells in table 2 have reported yields at open discharge of 1,000 gpm, although the pumping rate for irrigating is usually somewhat less. Reported yields are not the maximum yields obtainable; yields of as much as 4,000 gpm could be obtained in the Dougherty Plain from properly constructed wells.

Small- and Moderate-Capacity Wells

Numerous 6- and 8-inch diameter industrial and domestic wells of moderate yields are similar in construction to the large-yield wells, and equipped with sufficiently powerful pumps, would yield at least 500 gpm. Well 3110-8410-13 (table 3) in Camilla, is an example. This is a 6-inch well, 237 feet deep, which yields 120 to 130 gpm continuously from a 7 1/2 hp pump. Several new domestic wells on farms have been constructed with a diameter of 6 inches or more with a view to possible future irrigation use.

Most domestic wells in the Dougherty Plain are 3 to 4 inches in diameter, from 80 to 300 feet deep, and are equipped with low horsepower piston, jet, or submersible pumps. Well 3105-8410-6 (table 3) is a typical domestic well in the Dougherty Plain. Most domestic wells in the Dougherty Plain are constructed in the Ocala Limestone, but, at scattered locations, a few wells have been constructed in the Tallahatta Formation owing to lack of water in the Ocala. Well 3115-8405-8 (table 3) is an example. This well has casing extending into the Lisbon Formation and a 78-foot open-hole interval in the Lisbon and the Tallahatta.

Table 2.--Records of representative irrigation wells in Mitchell County, Ga.

Well no.	Date drilled	Depth (feet)	Diameter (inches)	Cased to (feet)	Aquifer	Pumping rate (gpm)	Number of sprinklers in system	Number acres irrigated by 1 setting of sprinklers	Total number acres irrigated in 1 year: Wet year	Total number acres irrigated in 1 year: Dry year	Number days per year system is used: Wet year	Number days per year system is used: Dry year	Number hours per day system operating	Principal crops irrigated
3120-8400-6	1957	370	6	210	Ocala Limestone	-	12	3	-	30	-	15	16	Tobacco and corn
3115-8405-7	1955	260	10	60	do	950	16	2	30	90	10	20-40	16	Pasture
3110-8410-2	1954	220	10	80	do	700	22	2.5	75	175	10	25	8	Tobacco, peanuts and pasture
3110-8410-3	1955	260	10	147	do	800	2	1.8	30	125	10	40	10	Tobacco, peanuts and corn
3110-8410-4	-	238	8	87	do	600	25	2	0	20	-	6	10	Tobacco, corn and vegetables
3110-8410-6	1958	200	10	120	do	800+	2 guns	1.6	-	30	4	-	11	Tobacco, peanuts, corn and cotton
3110-8415-3	1954	200	10	90	do	1,000	52	3.2	0	150	0	30	12	Peanuts, corn and pasture
3110-8420-1	-	220	8	60	do	600	17	3	10	50	2-3	20	6-8	Tobacco, corn and vegetables
3110-8420-4	1954	198	10	103	do	480	27	2	-	210	-	25	12	Tobacco, peanuts, corn and pasture
3110-8420-6	1954	540	8-10	144-244	Ocala Limestone, Claiborne Group	800	37	3	0	150	0	20	12	Tobacco and peanuts
3110-8420-8	1955	285	10	-	Ocala Limestone	450	22	2	0	50	-	14	4-24	Tobacco, peanuts and pond
3105-8425-2	1955	213	10	70	do	1,000	36	3	40	80	10	10	12	Tobacco and peanuts
3105-8425-4	1953	218	10	56	do	700	36	3	200	495	30	65	24	Tobacco, peanuts, corn and cotton
3105-8425-5	1954	265	10	60	do	750	42	4.5	100	200	10	50	10	Tobacco, peanuts, corn and cotton
3105-8425-6	1954	200	6	90	do	500	33	1	6	56	10	30	12	Tobacco and peanuts

Table 3.--Records of selected wells in Mitchell County, Ga.

Well no.	Remarks	Date drilled	Aquifer	Rock type	Depth of well (ft.)	Casing size (in.)	Casing from (ft.)	Casing to (ft.)	Open hole from (ft.)	Open hole to (ft.)	Reported yield (gpm)	Static water level (ft. below land surface)	Use
3105-8400-1	Tifton Upland, 6 mi. SE of Cotton	1957	Tampa Limestone	Sandy limestone	340	4	0	274	274	340	-	-	Domestic, stock
3110-8400-1	Tifton Upland at Cotton	1954	Suwannee Limestone	Limestone	300	6	0	300	-	-	-	-	School supply
3105-8400-4	Tifton Upland, 1 mi. SE of Sale City	1956	Suwannee Limestone and Ocala Limestone	do	483	4	0	162	162	483	-	178 reported 1956	
3120-8400-6	Dougherty Plain, 1.5 mi. SE of Raiford	1957	Ocala Limestone	do	370	6	0	210	370	370	-	90 reported 1957	Irrigation
3120-8400-9	Solution Escarpment, 2 mi. SW of Raiford	-	do	Limestone (cavity)	350	8	0	?	?	350	500+	-	Industrial
3125-8400-5	Dougherty Plain, NE Mitchell County	1954	do	Limestone	255	4	0	248	248	255	-	-	Domestic
3105-8405-1	Tifton Upland, 1 mi. S of Pelham	1944	Suwannee Limestone and Ocala Limestone	do	340	4½	0	140	140	340	-	200 reported 1944	Domestic, stock
3105-8405-2	Tifton Upland, City of Pelham well	1953	Suwannee Limestone, Ocala Limestone, and Claiborne Group	do	720	12	0	190	190	720	1,000	240 reported 1953	Municipal
3105-8405-5	Tifton Upland, Pelham Phosphate Co.	1947	Ocala Limestone	do	606	10	0	200±	200±	606	375	-	Industrial
3110-8405-7	Dougherty Plain, 4 mi. E of Camilla	1955	do	do	340	12	0	102	102	340	1,000	90 reported 1955	Irrigation
3115-8405-8	Dougherty Plain, 1 mi. N of Flint	1942	Claiborne Group	Limestone and sand	460	4½	0	382	382	460	-	70 reported 1942	Domestic, stock
3105-8410-6	Dougherty Plain, 5 mi. SW of Pelham	1959	Ocala Limestone	Limestone	174	4	0	87	87	174	-	90 reported 1959	Do
3105-8410-7	Dougherty Plain, 5 mi. W of Pelham	1955	Ocala Limestone and Claiborne Group	Limestone and sand	458	12	0	222	222	458	-	82 reported 1955	Irrigation
3110-8410-12	Dougherty Plain, City of Camilla well	1958	Ocala Limestone	Limestone	335	12	0	150	150	335	2,100	-	Municipal
3110-8410-13	Dougherty Plain, in Camilla	1943	do	do	237	6	0	152	152	237	-	32 reported 1943	Industrial
3115-8410-1	Dougherty Plain, 4 mi. N of Camilla	1955	do	do	403	10	0	100	100	403	-	57.12 measured 8-25-60	Not in use
3105-8415-4	Dougherty Plain, at Branchville	1945	do	do	300	3	0	21	21	300	-	24.9 measured 2-19-60	Domestic, stock
3105-8420-5	Dougherty Plain, 1.5 mi. NE of Vada	1924	do	do	74	3	0	70	70	74	-	-	Do
3105-8425-1	Dougherty Plain, 2 mi. W of Vada	1954	do	do	250	12	0	100	100	250	2,500	50.9 measured 12-14-59	Not in use

Water Levels

Reported water levels in wells in most of the Dougherty Plain average about 30 to 60 feet below the land surface but are as much as 100 feet below the land surface at higher altitudes near the base of the Solution Escarpment and in Sub-area A. Water levels in individual wells are subject to fluctuation of at least 20 feet during a given year and are usually highest in April or May and lowest during December or January. A hydrograph of well 3115-8410-1 (table 3), which is constructed in the Ocala Limestone about 5 miles north of Camilla is shown in figure 8. During an 8-month period the water level in this well fluctuated from 58.4 feet below land surface in December 1959 to 40.7 feet below land surface in April 1960.

Flowing wells probably could be constructed in the Clayton Formation of Paleocene age at depths of 800 to 900 feet and in the Upper Cretaceous Series at depths of about 1,000 feet in a strip along the Flint River, but none are known to exist in Mitchell County. A flowing well constructed in the Clayton formation at Newton is near the edge of the Flint River about half a mile northwest of Mitchell County. Stephenson and Veatch (1915, p. 137) reported that the well was 825 feet deep and that it flowed 15 gpm with a head of 35 feet above land surface or about 180 feet above sea level. When visited in 1960, the well was flowing at about 1 or 2 gpm. Flow was reported by local residents to have ceased during 1954-56, but flow had resumed in 1957.

Solution Escarpment

The formations underlying the Solution Escarpment are similar in lithology and water-bearing properties. However, as shown in the geologic section (fig. 6), the crest of the Solution Escarpment is at a much higher altitude than the Dougherty Plain, and, beneath the crest, the Ocala Limestone of late Eocene age is overlain by about 100 feet of Suwannee Limestone of Oligocene age, which is, in turn, overlain by about 190 feet of Miocene deposits. The Suwannee Limestone and the Miocene deposits become comparatively thin near the base of the Solution Escarpment, a short distance beyond which they grade into the undifferentiated residuum of the Dougherty Plain. The undifferentiated residuum has an average thickness of only about 70 feet.

As in the Dougherty Plain, the Ocala Limestone is the major aquifer in the Solution Escarpment. The Suwannee Limestone, although porous and permeable, appears to be almost devoid of water, and the Miocene deposits are composed of relatively impermeable marl, clay, and argillaceous sand. No large springs are found in the Solution Escarpment; only numerous small seepage springs.

WELLS

Comparatively few wells have been drilled in the Solution Escarpment, because of its small area and population. Wells are constructed in the Ocala Limestone and, because of the thickness of the overlying deposits, are generally deeper and have deeper water levels than those of the Dougherty Plain. Casing usually is seated in the Suwannee Limestone, which, being dry and cavernous, causes many of the wells to suck and blow in response to changes in atmospheric pressure.

Large-Capacity Wells

Only one large-capacity well is reported in this area, well 3120-8400-9 (table 3) which is near the end of a ridge extending outward into the Dougherty Plain. This 8-inch well is 350 feet deep and has a reported yield of more than 500 gpm from the Ocala Limestone.

Small-Capacity Wells

Most domestic wells in the Solution Escarpment are 4 to 6 inches in diameter, range in depth from 250 to 500 feet, and are equipped with submersible or turbine pumps. The depth of wells depends mostly on the depth to the Ocala Limestone and, therefore, the land-surface altitude at the well.

Water Levels

The depth to water in wells ranges from about 100 feet below land surface along the base of the escarpment to a maximum of about 250 feet below land surface at higher elevations along the crest.

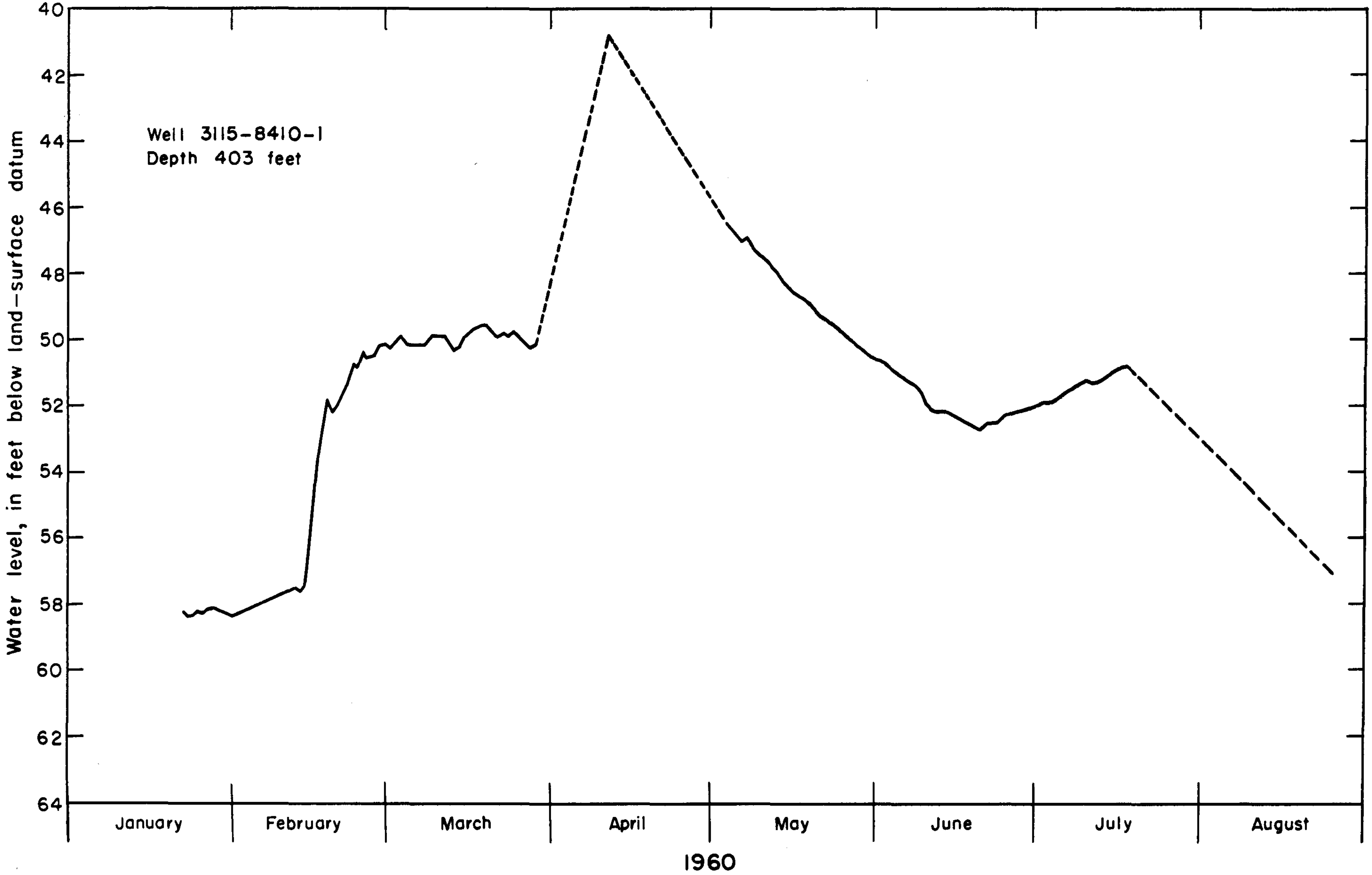

Figure 8.—Hydrograph of well in the Ocala Limestone in the Dougherty Plain of Mitchell County, Ga.

Tifton Upland

The sequence of formations underlying the Dougherty Plain, with the exception of the undifferentiated residuum, also underlies the Tifton Upland. Owing to the higher altitude of the Tifton Upland and the downwarped structure beneath it, the Ocala Limestone in that area is overlain by a considerable thickness of Oligocene and Miocene deposits. Because the formations below the Ocala are deeply buried, few data are available concerning their lithologic and water-bearing properties.

The Ocala Limestone is about 300 feet thick in the Tifton Upland. The altitude of the top is about 80 feet above sea level along the crest of the Solution Escarpment and at least 250 feet below sea level near the southeast corner of the county. Because of the steep rate of dip to the southeast, most wells constructed in the Ocala in the Tifton Upland are limited to a northeast-trending strip 1 or 2 miles wide, just southeast of the crest of the Solution Escarpment.

The Ocala Limestone of the Tifton Upland, in contrast to the Ocala of the Dougherty Plain, has been extensively recrystallized and dolomitized. These processes have destroyed, at least locally, much of the original porosity and permeability of the formation and have reduced its value as an aquifer.

The Suwannee Limestone is about 100 feet thick throughout the Tifton Upland. The altitude of the top ranges from about 180 feet above sea level along the crest of the Solution Escarpment to at least 150 feet below sea level near the southeast corner of the county. Wells constructed in the Suwannee are common throughout the Tifton Upland except for an area of a few square miles near the southeast corner of the county.

The Suwannee Limestone of the Tifton Upland is similar lithologically to the Ocala Limestone of the Dougherty Plain. It ranges in texture from aphanitic to bioclastic and is not extensively recrystallized or dolomitized. It does not, however, yield large quantities of water to wells, and the reason for this is not clear. The Suwannee crops out in scattered deep sinks along the base of the Solution Escarpment, and some water enters the formation through the sinks. The amount of recharge from the sinks probably is small, however, because throughout most of the Solution Escarpment the Suwannee is covered by thick clay, and most rainfall runs off in streams to the Dougherty Plain. Throughout the Tifton Upland, the Suwannee is overlain by thick and relatively impervious Miocene deposits, and probably only a small amount of rainfall seeps downward into the formation. In extreme southeastern Mitchell County, where the zone of saturation extends upward above the top of the Suwannee, some recharge should occur from the underlying Ocala Limestone, but the amount of such recharge does not appear to be great. This may be due to low permeability in the Suwannee, the Ocala, or both in this area.

The Tampa Limestone ranges in thickness from about 150 feet along the crest of the Solution Escarpment to about 450 feet near the southeast corner of the county. Wells constructed in the Tampa are limited to an area probably not exceeding 15 square miles in the extreme southeast corner of the county. The Tampa is a poor aquifer. The marl beds are relatively dense and impervious and the limestone and calcareous sand beds only slightly less so.

The Hawthorn Formation ranges in thickness from about 40 feet along the crest of the Solution Escarpment to about 100 feet at higher altitudes in the southeast corner of the country. No drilled wells are constructed in the Hawthorn. It is a poor aquifer because of its thinness, clayey character, and dissection by streams. A few shallow dug wells obtain small quantities of water from the Hawthorn, but these are being replaced by deeper drilled wells in other formations. No large springs were found in the Tifton Upland of Mitchell County, although small contact gravity springs occur along the tops of impermeable beds in the Hawthorn Formation and along the top of the Tampa Limestone.

WELLS

Most water supplies in the Tifton Upland are obtained from drilled wells. However, some domestic supplies are still obtained from dug wells, and most irrigation supplies are obtained from streams and farm ponds. Drilled wells are constructed in the Tampa, Suwannee, and Ocala Limestones, and the Tallahatta Formation.

Large-Capacity Wells

Very few large-capacity wells are found in the Tifton Upland, a fact due partly to the availability of surface water and partly to relatively poor ground-water conditions, as compared with the Dougherty Plain. Aquifers of the Tifton Upland are deeper than those of the Dougherty Plain and, apparently, are less productive. Also, water levels in the Tifton Upland are as deep as 250 feet below the land surface, which means that wells require pumps of much larger size and power than are needed in the Dougherty Plain.

Well 3105-8405-2 (table 3), the newest city well in Pelham, is an example of a large-capacity well in the Tifton Upland. This 12-inch well is cased to 190 feet and has open hole extending to 720 feet. Driller's log information indicates that the casing extends into the top of the Suwannee Limestone, and open hole extends through most of the Suwannee, all of the Ocala, and about 70 feet into the top of the Claiborne Group. The bottom of the well is probably in the upper part of the Tallahatta Formation. The well has a reported yield of 1,000 gpm and a reported static water level of 240 feet below the land surface. The chemical quality of water from this well indicates that most of the water is produced from the Tallahatta Formation because of the similarity in chemical quality of water from this well to water from well 3115-8405-8, which is constructed in the Tallahatta Formation (fig. 9).

Well 3105-8405-3, another city well at Pelham, is of similar construction. It is 728 feet deep and a 10-inch casing extends to 153 feet. This well was drilled in 1907 and had a reported yield of 500 gpm at that time. The principal water-bearing bed penetrated by the well was reported by Stephenson and Veatch (p. 344) to be a shell formation from 700 to 728 feet; other water-bearing beds were reported at 370 to 371 feet, 450 to 455 feet, and 640 to 650 feet. The shell formation probably is a coquina bed, which is widespread in the upper part of the Tallahatta Formation in southwestern Georgia. Also, the chemical quality of water from this well is similar to that from the new Pelham well and to that from well 3115-8405-8 which is constructed in the Tallahatta Formation (fig. 9).

A third city of Pelham well, 3105-8405-4, drilled in 1931, appears to obtain most of its water from the Ocala Limestone. It is a 12-inch well, 577 feet deep, and has a reported yield of 475 gpm.

The city wells in Pelham are all within half a mile of the crest of the Solution Escarpment, which is the northwestern border of the Tifton Upland and at the highest part of the county. As shown in the structural contour map (fig. 7), the wells are on the edge of the northeast-trending syncline that crosses southeastern Mitchell County. Ground-water conditions similar to those in Pelham probably prevail in a narrow strip of the Tifton Upland all along the northwest edge of the syncline, where geological and structural conditions are similar. Down the flank of the syncline in extreme southeastern Mitchell County, however, it appears that it may be difficult to obtain yields of 500 gpm from wells. No large-capacity wells were found in extreme southeastern Mitchell County, but a city well at Meigs (GGS 59), about 5 miles southeast of Pelham and half a mile south of Mitchell County, had a reported yield of only 400 gpm although it was drilled to a depth of 1,560 feet.

The Meigs well was drilled in 1938 and has eight 5-foot screens and one 100-foot screen, all screens being 6 inches in diameter. On the basis of drill cuttings and the drillers log, four of the 5-foot screens are in the Tampa Limestone and four are in the Suwannee Limestone. The 100-foot screen is in the lower part of the Tallahatta Formation and the upper part of the Tuscahoma Formation. The well was drilled to a depth of 1,560 feet, but it is not known if it is still open to that depth. If so, the open-hole interval is yielding water from the lower part of the Tuscahoma Formation and the upper part of the Midway Group.

The city well at Meigs appears to obtain no water from the Ocala Limestone. Furthermore, yields from the Ocala are variable within short distances in the Pelham area. Recrystallization and dolomitization probably have decreased the porosity and permeability of the Ocala in the Tifton Upland area and these processes may be related to the strongly developed synclinal structure in the area.

Small-Capacity Wells

Small domestic wells throughout the Tifton Upland are generally 3 to 6 inches in diameter, range in depth from 300 to 500 feet, and are equipped with submersible or turbine pumps. Nearly all are constructed in the Suwannee or Ocala Limestones, and casing is seated in the Suwannee. A few wells in the extreme southeast corner of the county are constructed in the Tampa Limestone. Examples of domestic wells are shown in table 3.

Several dug wells constructed in the Hawthorn Formation are still in use in the Tifton Upland, but most are old and are gradually being replaced by drilled wells. The dug wells range in depth from 20 to 50 feet and generally furnish sufficient water for domestic use. They are not as satisfactory as drilled wells, as they are more subject to pollution and sometimes go dry because of their shallow depth.

Water Levels

The depth to water in wells ranges from about 135 to 250 feet below the land surface, depending mostly on land-surface altitude. Average depth to water in wells is about 200 feet. Because of deep water levels, wells in the Tifton Upland must be equipped with more powerful pumps than those in the Dougherty Plain. For example, an electric turbine pump of 45 hp is required to raise water at the rate of 500 gpm for a pumping level of 200 feet, whereas only 13 hp is required to raise water at the same rate from a pumping level of 60 feet.

The water level in dug wells in the Hawthorn Formation is commonly 10 to 20 feet below land surface.

Pumpage

The total annual consumption of ground water in Mitchell County by various consumers is indicated in table 4. The figures in table 4, especially those given for irrigation use, are maximum estimates. Although a total of 475,800,000 gallons of ground water per year would be used for irrigation in a dry year, the total used in a wet year probably would be less than 50,000,000 gallons.

QUALITY OF WATER

The suitability of water for various uses is partly dependent upon its chemical quality. Certain dissolved constituents, if present in large amounts, may render water unsuitable for certain uses. Various methods of treating water to remove undesirable constituents are employed, however.

Table 5 shows chemical analyses of water from eight wells in Mitchell County. Some of the constituents from each of the water samples shown in table 5 are plotted graphically in figure 9 and expressed in equivalents per million. Equivalents per million is the figure obtained when the number of parts per million of a given ion is divided by the combining weight of the ion. One sample is from the Tallahatta Formation, two are from the combined Ocala Limestone and Tallahatta Formation, three are from the Ocala Limestone, and one each is from the Suwannee and Tampa Limestones.

On the basis of graphic patterns, the waters may be divided into three groups. The waters from the Ocala are very similar to one another. The water from the mixed Tallahatta and Ocala are similar to the water from the Tallahatta. The waters from the Suwannee and Tampa are similar to one another to a lesser degree.

Compared with the water from the Ocala, the mixed water from the Tallahatta and Ocala has higher hardness and specific conductance, more dissolved solids, and more silica, magnesium, sodium, potassium, bicarbonate, and sulfate. The water from the Suwannee and Tampa is intermediate, in some respects, between water from the Ocala and mixed Tallahatta and Ocala waters. They are intermediate in specific conductance, dissolved solids, bicarbonate, and sulfate content. The water from the Tampa is higher in sodium and lower in hardness than any of the other waters.

The city wells at Pelham have casing seated near the top of the Suwannee Limestone with open hole extending through the Suwannee and Ocala and into the top of the Claiborne Group. Both wells probably bottom in the Tallahatta Formation of the Claiborne Group. Water from these wells closely resembles the water from the well in the Tallahatta Formation which strongly suggests that most of the water in the Pelham wells is produced from the Tallahatta Formation. It is also in keeping with the apparent fact that the Ocala Limestone and the Suwannee Limestone in at least parts of the Tifton Upland of Mitchell County do not yield large quantities of water to wells. There have been no significant changes in quality of water at Camilla or Pelham in recent years. In Camilla, well 3110-8410-8 was sampled in 1943, and well 3110-8410-12 was sampled in 1960. In Pelham, well 3105-8405-3 was sampled in 1938, and well 3105-8405-2 was sampled in 1960.

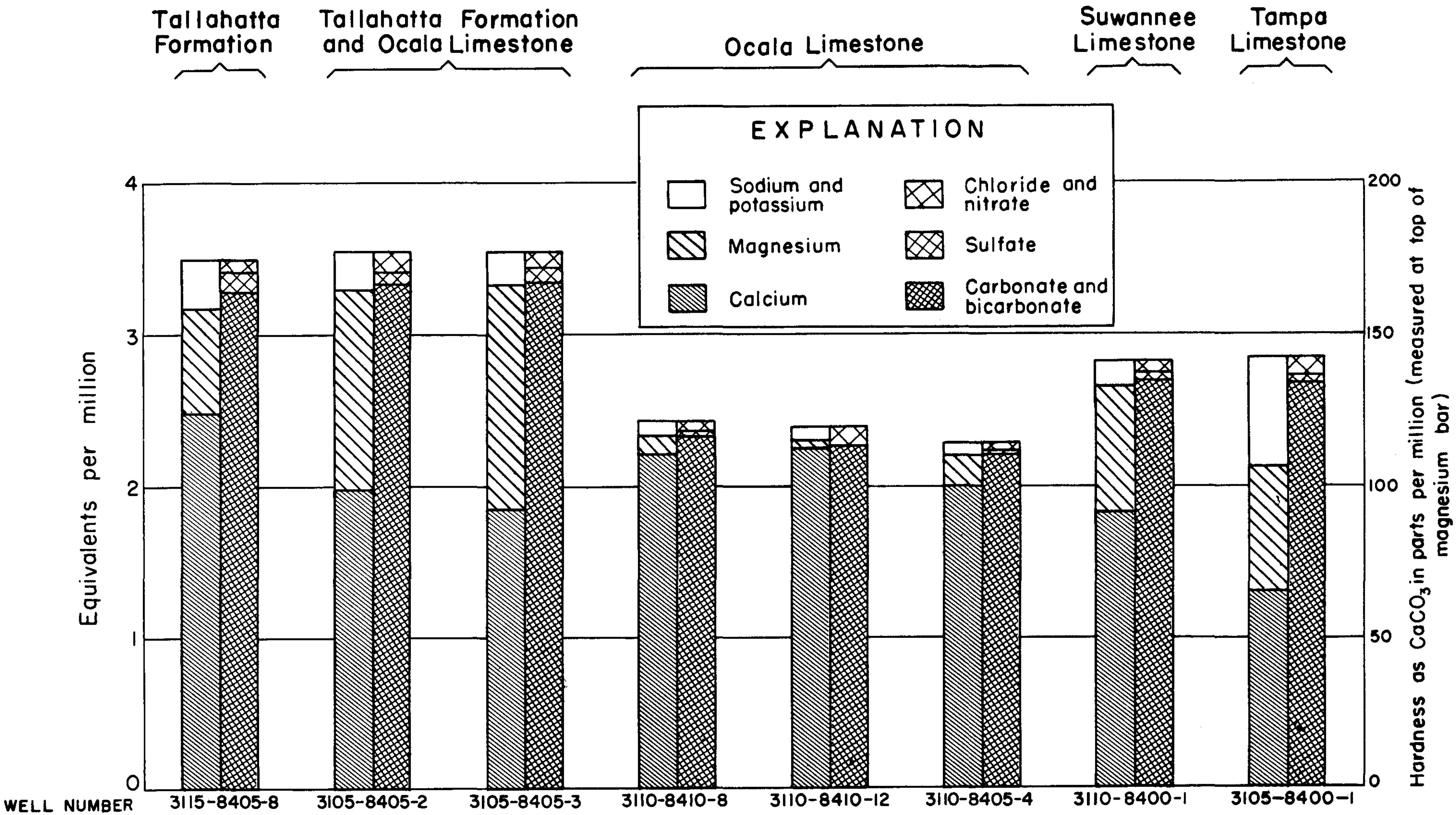

Figure 9.—Quality of water from selected wells in Mitchell County, Ga.

Table 4.--Annual consumption of ground water in Mitchell County, Ga.

Consumer	Quantity (millions of gallons)	Source of data
City of Camilla	564.7	City officials -- based on billing of customers.
City of Pelham	500.0	Estimate.
Irrigation	475.8	Maximum for dry year -- based on figures furnished by owners of half the irrigation wells.
Industry	432.9	Company officials.
Rural domestic	220.0	Allowance of 50 gallons per person per day (ground water considered to be 100 percent of supply).
Cattle	90.0	Allowance of 12 gallons per animal per day (ground water considered to be 75 percent of supply).
Hogs	10.3	Allowance of 4 gallons per animal per day (ground water considered to be 75 percent of supply).
City of Baconton	9.6	City officials -- based on billing of customers.
City of Sale City	3.4	City official.
Chickens	.8	Allowance of 6 gallons per 100 birds per day (ground water considered to be 90 percent of supply).
Sheep	.6	Allowance of $1\frac{1}{2}$ gallons per animal per day (ground water considered to be 75 percent of supply).
TOTAL	2,308.1	

Table 5.--Chemical analyses of water from wells in Mitchell County, Ga.

(Analyses by U.S. Geological Survey)

Well no.	Date of collection	Remarks	Parts per million: Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids Residue at 180°C	Hardness as $CaCO_3$ Calcium Magnesium	Specific conductance (micromhos at 25°C)	pH
							Water from Tallahatta Formation										
3115-8405-8	2-11-60	5 mi. N of Camilla	25	0.04	50	8.1	6.2	1.6	201	6.0	2.5	0.2	0.5	205	158	322	7.9
							Water from Tallahatta Formation and Ocala Limestone										
3105-8405-2	2-10-60	City of Pelham well no. 3	27	.05	39	16	4.4	2.2	206	4.0	4.0	.4	.1	-	164	327	7.9
3105-8405-3	2- 4-38	City of Pelham well	28	.02	37	18	4.1	2.0	204	4.7	3.6	.0	.05	186	166	-	-
							Water from Ocala Limestone										
3110-8410-8	5-27-43	City of Camilla well	7.4	.08	47	1.6	2.2	.3	145	1.6	2.1	.0	1.2	137	124	-	7.5
3110-8410-12	2-10-60	do	6.7	.04	45	.6	2.0	.4	138	.00	3.5	.1	1.4	130	115	225	7.6
3110-8405-4	2-11-60	5 mi. SE of Camilla	11	.02	40	2.4	1.8	.5	135	.8	2.0	.1	0	137	110	220	7.8
							Water from Suwannee Limestone										
3110-8400-1	2-10-60	Near Cotton	27	.05	36	10	3.2	1.2	167	2.4	2.5	.2	.2	166	131	264	7.8
							Water from Tampa Limestone										
3105-8400-1	2-12-60	5 mi. SE of Pelham	17	.08	26	10	15	2.9	164	2.4	3.0	.5	.0	-	106	263	7.7

SUMMARY AND CONCLUSIONS

Mitchell County has important ground-water resources which could be developed to a greater extent, particularly for irrigation and industrial purposes.

The county is divided into three ground-water areas--the Dougherty Plain, the Solution Escarpment, and the Tifton Upland. Considering the shallow depth, maximum yields, and high water levels in wells, the Dougherty Plain is by far the most favorable ground-water area. The Tifton Upland is the least favorable, and the Solution Escarpment is intermediate between the two.

Yields of 1,000 gpm may be obtained throughout most of the Dougherty Plain from wells 200 to 300 feet deep and yields of more than 2,000 gpm are reported from some wells. It might be possible to develop as much as 5,000 gpm. Wells 300 to 500 feet deep are necessary for yields of 1,000 gpm in the Solution Escarpment, and wells 500 to 750 feet deep are necessary for such yields in the northwestern part of the Tifton Upland. In other parts of the Tifton Upland, it may be difficult to obtain yields of 500 gpm from wells as deep as 1,000 feet. The depth required for domestic wells is about 80 to 300 feet in the Dougherty Plain, 250 to 500 feet in the Solution Escarpment, and about 300 to 500 feet in the Tifton Upland. Water levels in wells are commonly 30 to 60 feet below land surface in the Dougherty Plain, 100 to 250 feet in the Solution Escarpment, and 135 to 250 feet in the Tifton Upland.

Ground water from aquifers in use in Mitchell County ranges from moderately hard to hard and industries requiring soft water would need to install water-softening units. However, the water is generally of excellent quality. It is not expected that chemical quality of water will be a serious problem in the Dougherty Plain. However, it is conceivable that it could become a problem in the Tifton Upland where it is difficult to obtain large yields at moderate depths. In an attempt to obtain larger yields, wells eventually may be constructed in aquifers not studied in this investigation. The quality of water in the Tallahatta Formation and Ocala and Suwannee Limestones in the deeper parts of the syncline in that area is not known. It is possible that owing to poor circulation, the quality is not as good as elsewhere.

Only the aquifers now in use were discussed in some detail in this report and, as indicated in table 1, large supplies of water might be obtained at greater depths from the Clayton Formation and Upper Cretaceous Series. This is particularly true of the Dougherty Plain area, where these formations are nearer land surface than elsewhere.

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