GEORGIA

STATE DIVISION OF CONSERVATION

DEPARTMENT OF MINES, MINING AND GEOLOGY
A. S. FURCRON, Acting Director

THE GEOLOGICAL SURVEY
Information Circular 31

A SUBSURFACE STUDY OF PLEISTOCENE DEPOSITS IN COASTAL GEORGIA

By

Stephen M. Herrick
U.S. Geological Survey

Prepared in cooperation with the U.S. Geological Survey

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Stephen M. Herrick[2]

ABSTRACT

Coastal Georgia is underlain by Pleistocene deposits consisting of interbedded sands and gravels containing local inclusions of kaolin in updip areas. In downdip areas the sands and gravels interfinger with marine sands and clays. A subsurface study of well cuttings from approximately 200 wells in 28 counties indicates that these deposits dip coastward at about 2 feet per mile. The sediments form a wedge which is thickest at the coast but progressively thins in a west-northwesterly direction, finally pinching out inland. The area of greatest thickening apparently is in southeastern Charlton and Camden Counties, and a similar area but of somewhat less pronounced thickening underlies eastern Chatham, Bryan, and Liberty Counties. Fossils from these deposits include chiefly vertebrate remains and molluscan shells. These sediments appear to belong, stratigraphically, to one mappable unit of Pleistocene (undifferentiated) age. This formation is of potential economic importance, as it contains valuable sand and gravel deposits as well as local concentrations of potentially valuable but commercially unproved heavy mineral and phosphate deposits. Water-bearing sands belonging to this formation constitute a valuable but hitherto untested source of ground water in this part of Georgia.

INTRODUCTION

Previous investigators of the Pleistocene in southeastern Georgia have divided these deposits into formations on the basis of physiographic form rather than on lithologic character. It is the purpose of this report to show that these sediments form a simple, wedge-shaped, stratified mass which constitutes a single lithologic unit upon which physiographic forms have been superimposed. Although similar deposits are known to underlie other parts of the Coastal Plain of Georgia, as for example in the coastal-plain part of the Flint River Valley, this report is arbitrarily limited to southeastern Georgia because most of the available wells penetrating identifiable Pleistocene deposits are limited to that area. Cuttings and cores from approximately 200 wells penetrating deposits of Pleistocene age in Georgia and from 50 wells penetrating similar deposits in 4 counties in northeastern Florida were studied and logged; it is on these logs that this report is based.

This report is one outgrowth of a previous publication (Herrick, 1961) listing well logs of the Coastal Plain of Georgia and was prepared in cooperation with the Georgia Department of Mines, Mining, and Geology. Thanks are due Dr. Robert O. Vernon, State Geologist, Florida Geological Survey, for permission to examine well cuttings from wells in Baker, Duval, Hamilton, and Nassau Counties, Florida. All other well samples utilized in the preparation of this report are contained in the well-sample library maintained by the Georgia Geological Survey.

Literature dealing with the Pleistocene of the Atlantic and Gulf Coasts is voluminous. However, by limiting this survey to articles that are primarily concerned with the Pleistocene deposits of Georgia the number of pertinent publications is significantly reduced. Lyell (1846) was apparently the first to notice the coastal terraces in Georgia. Veatch and Stephenson (1911) differentiated the Pleistocene deposits on physiographic grounds, regarding them as fluviomarine terraces composed in part of fluvial and marine deposits and assigning them formational names. Following the work of Veatch and Stephenson, most of the later investigators—Brantley (1916), Prettyman and Cave (1923), Cooke (1925, 1936, 1943, and 1945), Flint (1940), MacNeil (1950), Toulmin (1952), Richards (1954), and Doering (1960)—tended to treat the Pleistocene deposits in Georgia as physiographic forms, classifying them as marine terraces consisting of a combination of marine and fluvial sediments. Moreover, each marine terrace, or former marine shoreline, was regarded as representative of a single geologic formation and was given a formational name. Although essentially agreeing as to their physiographic form, most of these workers disagreed as to the total number of marine terraces, or formations occurring in coastal Georgia. Flint (1940) thought there were only two but possibly three higher marine terraces, or fossil shorelines in Georgia, whereas Cooke (1945) recognized eight such marine terraces, or Pleistocene formations, in coastal Georgia. In contrast to this, a map of Toulmin (1952) shows the combined thicknesses of the Pleistocene and Pliocene deposits in Georgia and adjacent states. Though not exclusively concerned with the Pleistocene, as far as the writer is aware, this is the first paper in

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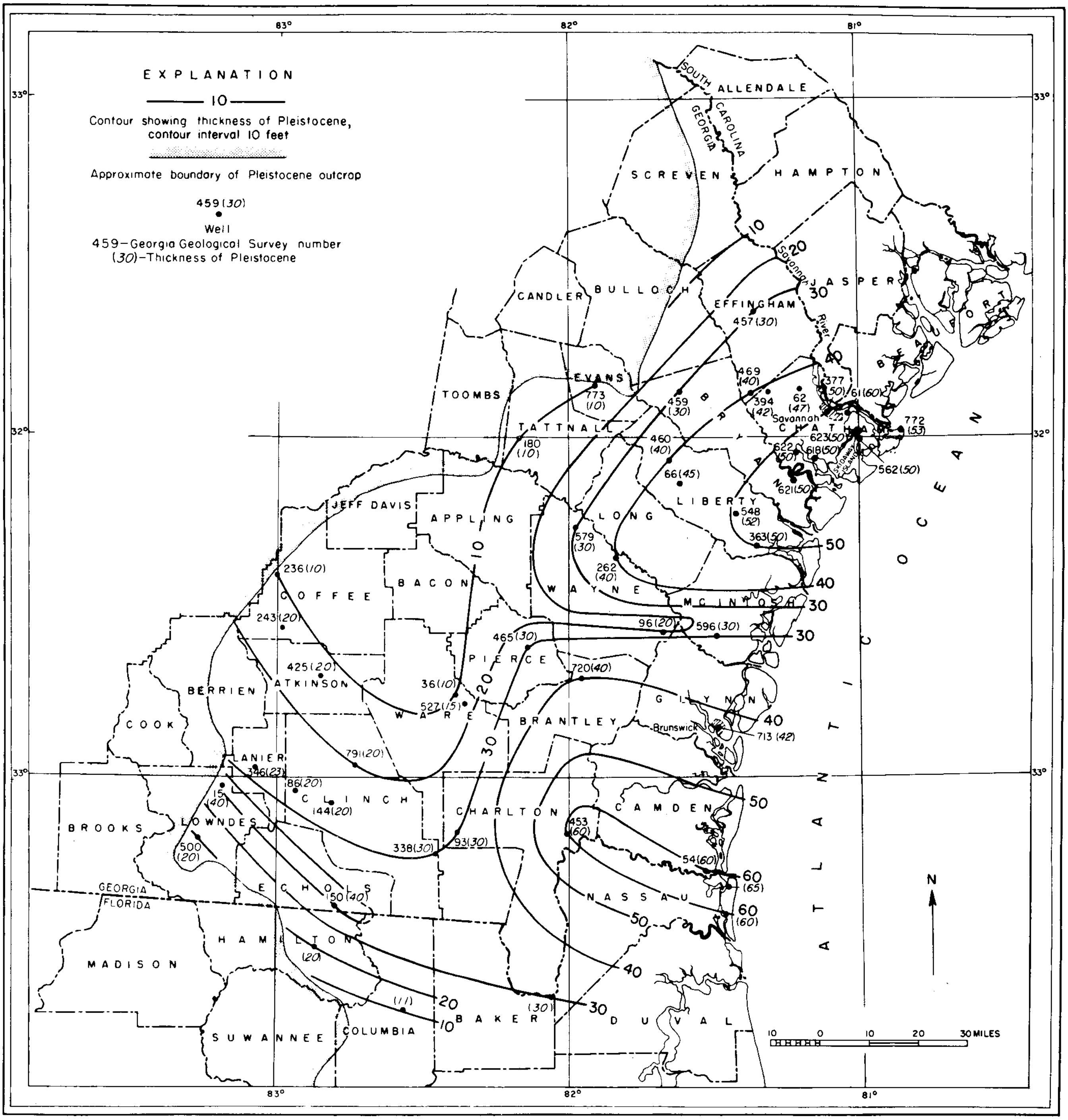

Figure 1.—Map showing thickness and areal extent of Pleistocene deposits in coastal Georgia.

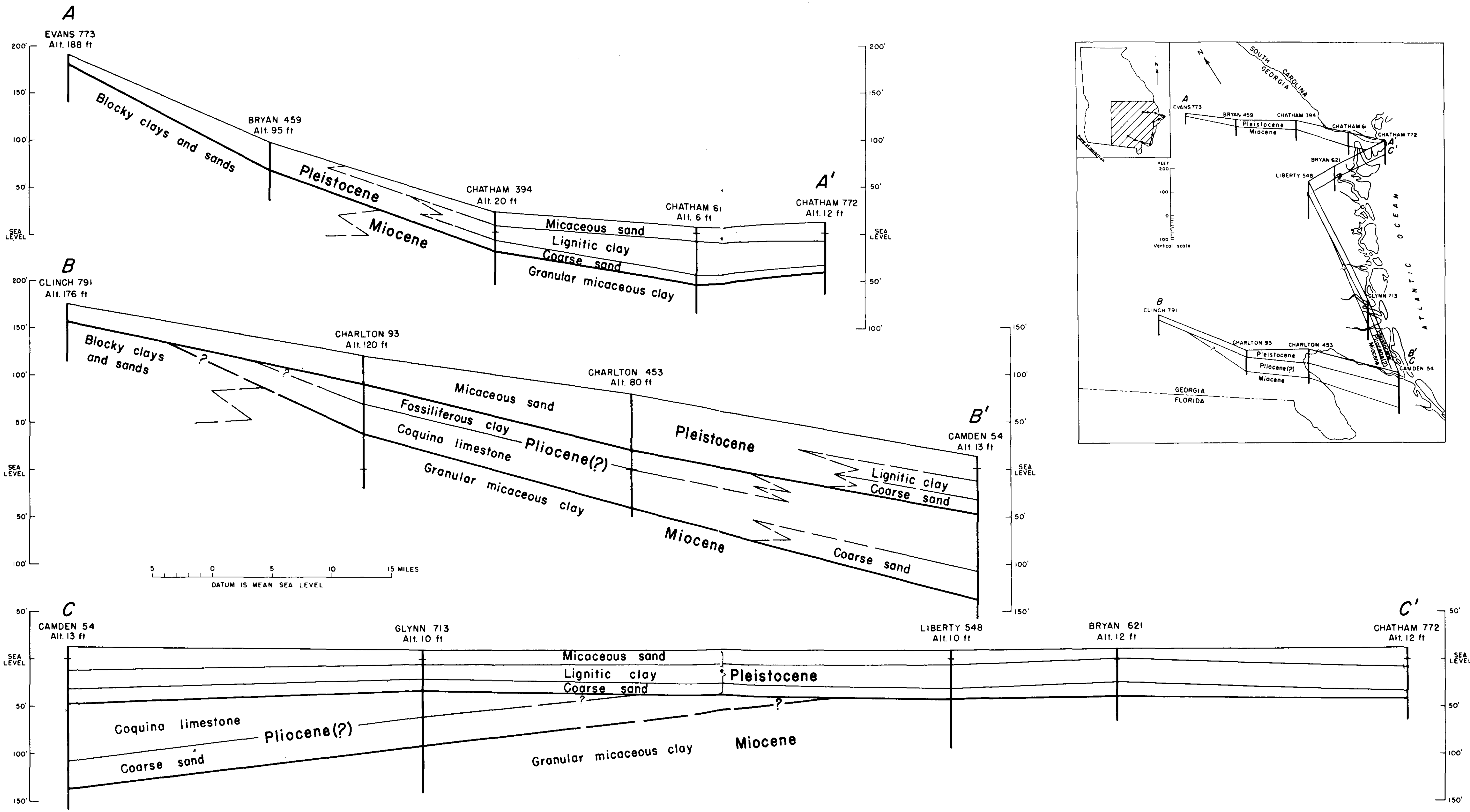

Figure 2.—Geologic sections showing subsurface stratigraphy of Pleistocene deposits in coastal Georgia.

which these deposits were viewed as a 3-dimensional geologic structure and treated as a single subsurface stratigraphic unit. In this report the Pleistocene deposits of Georgia are considered to be a stratigraphic unit rather than a physiographic form.

GENERAL FEATURES

The part of the Coastal Plain of Georgia covered by Recent to Pleistocene deposits lies between the **Tifton Upland** on the west and the Atlantic Ocean on the east and is called the **Coastal Terraces** by Cooke (1925, fig. 2). These sediments have the physiographic form of marine terraces, having flat-topped areas with rather steep seaward slopes, or scarps, representing according to Cooke (1943, p. 3) * * * . . . "former Pleistocene sea bottoms laid bare by the retreat of the sea to successively lower levels."

The Recent to Pleistocene represents the youngest deposits in the Coastal Plain of Georgia and overlies deposits of Miocene and Pliocene(?) age. These sediments consist of interbedded sands and some clays, the clays becoming progressively more prominent in downdip coastal areas. The major source of these deposits was doubtless the crystalline rocks underlying the Piedmont province of central and northeastern Georgia and adjoining parts of South Carolina, though a part was apparently derived from the erosion and reworking of preexisting, geologically older formations of the Coastal Plain. The presence of weathered crystals of feldspar and heavy minerals points to the crystalline rocks of Georgia and South Carolina as the main source of these sediments. The presence of phosphatic pebbles, particularly in the basal part of this stratigraphic unit, suggests reworking of the underlying, geologically older sediments. So far as can be deduced from well cuttings, these deposits are not disturbed by faulting or folding but have a gentle easterly regional dip from their area of outcrop toward the coast.

Although Recent deposits overlie those of Pleistocene age, particularly along the major river valleys (alluvium) and in extreme coastal areas, for purposes of this report all Recent to Pleistocene sediments are considered as one stratigraphic unit, that is, Pleistocene, and are treated as such.

GEOLOGY

Lithology

The Pleistocene deposits in updip areas consist predominantly of fine- to medium-grained, subangular, arkosic, cherty, sparsely phosphatic sand interbedded with minor amounts of very thin-bedded white micaceous, sandy kaolin. In downdip areas much of the sand is apparently replaced by tongues of dark-brownish-gray to black, blocky, rather tough, sandy, coarsely micaceous, lignitic, locally fossiliferous clay. Beneath the lignitic clay is a basal unit consisting of subangular to subrounded, sparsely phosphatic sand and gravel, which is pea size in updip areas (figure 2).

Structure and Thickness

The Pleistocene deposits of Georgia form a wedge-shaped block of sediments that is thickest at the coast but progressively thins inland. These sediments have a coastward dip of approximately 2 feet per mile. The area of greatest thickness is in southeastern Charlton and Camden Counties while a similar area but of less pronounced thickening underlies eastern Chatham, Bryan, and Liberty Counties (figure 1). Both areas of greatest thickening occupy what LeGrand (1961, p. 1559) calls the "southeast Georgia Embayment." He indicates that this embayment area is the result of regional downwarping between two strong positive areas—the Cape Fear Arch on the north and the Ocala uplift to the south. In Georgia the area of greatest thickness underlies Charlton and Camden Counties, where approximately 60 feet of sediments of Pleistocene age were noted in well cuttings. Similarly, the area of thickening underlying Chatham, Bryan, and Liberty Counties has an approximate thickness of 50 to 55 feet. However, it is likely that the base of the Pleistocene is locally irregular. Several of the major streams are known to have cut deep channels when sea level was lower during part of the Pleistocene and pre-Pleistocene time. These channels have been subsequently filled with Pleistocene deposits. At such places the overall thickness of the Pleistocene may be greater than indicated in figure 2.

Paleontology

Except for the extreme coastal area, the Pleistocene deposits of Georgia are uniformly nonfossiliferous. In sediments occurring in downdip coastal areas both vertebrate and invertebrate fossils have been found in abundance. The more important contributions to the Pleistocene paleontology of Georgia include articles by Veatch and Stephenson (1911), Richards (1936, 1943, 1954), Cooke (1943, 1945), and Hurst (1957).

Vertebrate remains that have been found in Georgia include chiefly mammals with some reptiles all of which lived in Georgia during Pleistocene time but are now extinct. Some of these extinct species include fossil remains of a giant beaver, ground sloth, armadillo, elephant, mastodon, bear, cougar, lynx, saber-tooth tiger, deer, buffalo, and horse. In addition to the mammalian remains, sharks teeth and a crocodile have been found in these deposits along the coast of Georgia. Most of these vertebrate fossils have been found in the so-called "bone bed" whose type locality, according to Cooke (1943, p. 115), is near tide level on Skidaway Island in coastal Chatham County. Other localities in Georgia where these vertebrate remains have been found include shallow dredgings from a canal near Brunswick in Glynn County, and similar dredgings along the Savannah River from Savannah coastward. For an interesting account of these vertebrate fossils, some of which are illustrated, the reader is referred to an article by Hurst (1957).

Invertebrate molluscan shells consisting chiefly of various species of pelecypods and gastropods, all of which are living today off the coast of Georgia, South Carolina, and Florida, have been reported from a few surface outcrops and shallow dredgings in Chatham and Glynn Counties. Abundant molluscan shells have been observed by the writer in some wells situated in coastal Georgia, particularly in wells in Chatham and Glynn Counties. Richards (1936, 1954) and Cooke (1943) give good lists of these molluscan fossils, some of which are illustrated by Richards (1954).

As far as the writer is aware, no bona fide microfossils such as Foraminifera have been reported from the Pleistocene of Georgia. Regarding other microfossils, it is quite probable that diatoms and pollen grains occur in these deposits. Therefore, a search should be made for fossils of this type in some of these Pleistocene sediments, particularly in the lignites and clays belonging to this stratigraphic unit.

Stratigraphic Relations

In the part of coastal Georgia north of Glynn County the Pleistocene deposits are underlain by a relatively thin wedge of sediments of late Miocene age. These deposits are considered by Veatch and Stephenson, Cooke, and others as belonging to the Charlton Formation of Pliocene age. However, recent foraminiferal studies by the writer indicate that these deposits are equivalent to the Duplin Marl of late Miocene age. Moreover, clays belonging to these deposits are abundantly phosphatic locally, another indication of their probable Miocene age. In southeastern Brantley and Charlton Counties and all of Glynn and Camden Counties Pleistocene deposits rest upon interbedded, locally fossiliferous clays and coquina-like limestone of Pliocene(?) age (see figure 2). The probable Pliocene(?) age of these sediments is evidenced through the occurrence of the varieties of **Ammonia beccarii** in the clays directly underlying the Pleistocene deposits penetrated by several wells in southeastern Brantley and Charlton Counties. In this regard Cole (1944, p. 23) noted a similar occurrence in stratigraphically equivalent clays penetrated by the Hilliard No. 1 well, Nassau County, Fla. Beneath the inner margin of the area covered by Pleistocene sediments the underlying deposits belong to the Hawthorn Formation of middle Miocene age. In all observed instances the clays of the Miocene deposits are readily distinguishable from the less argillaceous sediments of the Pleistocene.

As noted by Cooke (1943, p. 104), the surface expression of the Pleistocene deposits of Georgia consists of a series of marine terraces that were formed, in part, on the sea bottom and in estuaries when the sea stood at various levels, ranging from its present level up to 270 feet above present sea level. Cooke has shown that these terraces, or formations, were originally established on the basis of their topographic form, each terrace being defined "* * * as the sum of the deposits that accumulated while the sea stood at a definite level" (Cooke, 1943, p. 104). All were correlated by Cooke with their counterparts in South Carolina and Florida. These eight formations, or marine terraces, and their corresponding altitudes above present sea level, are summarized as follows:

Formation	Altitude	Formation	Altitude
Brandywine	270 feet	Penholoway	70 feet
Coharie	215 feet	Talbot	42 feet
Sunderland	170 feet	Horry	Present sea level
Wicomico	100 feet	Pamlico	25 feet

All these Pleistocene formations are based on topographic form, no consideration being given to their occurrence in the subsurface as a three-dimensional geologic structure. On the basis of the evidence presented here it seems clear that the Pleistocene deposits of Georgia represent one formation, lithologically, paleontologically, and structurally, rather than eight formations as originally conceived. The sediments composing this unit change from nonmarine sands containing lenses of kaolin in updip areas to marine clays and sands in downdip areas. Both types of lithology interfinger in middip areas in accordance with normal deltaic sedimentation (figure 2). Viewed as a whole, these deposits constitute a mappable subsurface unit throughout their areal extent in the Coastal Plain of Georgia, a characteristic not strictly true of the eight formations noted above. Moreover, they contain fossils that effectively define these sediments as a legitimate stratigraphic unit, or formation. On the basis of the evidence here presented it is suggested that these deposits be considered as one formation of Pleistocene (undifferentiated) age.

GEOLOGIC HISTORY

After Pliocene(?) time, coastal Georgia was covered by an overlap of the sea at some time during the Pleistocene Epoch. The level of this sea fluctuated and the shoreline advanced and retreated in accordance with the advances and recessions of the continental ice sheet, which was centered at that time in northeastern North America. During fluctuations of the sea the Pliocene(?), the uppermost Miocene, and some of the early Pleistocene sediments were doubtless reworked along the coast of Georgia. At the base of these deposits, for example, is a coarse-grained sand and gravel containing some black subrounded phosphatic pebbles, the latter probably reworked from the underlying sediments of Pliocene(?) and late Miocene age. Cutting and redeposition during successive retreats and lower stands of the sea during Pleistocene time caused the surficial flat-topped terraces and their corresponding scarps to develop in coastal Georgia. In the subsurface, however, these sediments remained, in spite of surficial changes in sea level, as one lithologic and stratigraphic unit, or geologic formation, resting upon geologically older sediments.

ECONOMIC IMPORTANCE

The Pleistocene deposits of coastal Georgia have economic potential as rock products such as sand and gravel, phosphate, and heavy minerals. The prevalent sands, particularly in updip areas, have value in various types of concrete construction. The gravels are often utilized in the construction of artifically gravel-walled water wells. Although phosphate occurs locally in these deposits, there has been to date no effort to develop it as a source of agricultural fertilizer in Georgia. It is well known that certain Pleistocene sands contain important heavy minerals such as monazite, ilmenite, zircon, staurolite, and rutile. So far such deposits have not been commercially exploited. Herrick and Wait (1956, p. 83) suggested the importance of the Pleistocene sands in coastal Georgia as potential sources of ground water. Such sands, particularly the basal sands of downdip areas, might represent a valuable and relatively cheap source of domestic water supply. Along some of the major rivers, sands and gravel deposits may offer a potentially large source of ground water. In some areas these deposits might be recharged with river water.

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