The Fishburne Formation (Lower Eocene), a Newly Defined Subsurface Unit in the South Carolina Coastal Plain

GEOLOGICAL SURVEY BULLETIN 1537-C

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CONTRIBUTIONS TO STRATIGRAPHY

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Stratigraphy of the newly defined Fishburne Formation, a thin lower Eocene limestone unit in the South Carolina Coastal Plain

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CONTRIBUTIONS TO STRATIGRAPHY

THE FISHBURNE FORMATION (LOWER EOCENE), A NEWLY DEFINED SUBSURFACE UNIT IN THE SOUTH CAROLINA COASTAL PLAIN

By GREGORY S. GOHN, JOSEPH E. HAZEL,[1] LAUREL M. BYBELL, and LUCY E. EDWARDS

ABSTRACT

The Fishburne Formation is herein defined as the glauconitic, clayey, finely crystalline limestone that occurs below the middle Eocene Santee Limestone and above the Paleocene Black Mingo Formation in the subsurface of the South Carolina Coastal Plain. Calcareous nannofossils, ostracodes, dinoflagellates, foraminifers, and pollen indicate an early Eocene age for the Fishburne Formation in its type section and in other wells in South Carolina. The interval between 416 and 440 ft (depths from kelly bushing) in U.S. Geological Survey Clubhouse Crossroads No. 1, Dorchester County, is designated the type section. The Fishburne Formation is a relatively thin but laterally persistent subsurface unit southwest of the Charleston-Summerville, S.C., area; it does not occur northeast of those cities and is not known in outcrop. Calcareous quartz sand that occurs immediately above typical Fishburne sediments in wells in Beaufort County, S.C., is provisionally assigned to the Fishburne Formation.

INTRODUCTION AND PREVIOUS WORK

A relatively thin but widespread subsurface sequence of impure fine-grained limestone that occurs in parts of Dorchester, Charleston, Colleton, and Beaufort Counties, S.C., is herein described and defined as the Fishburne Formation. The unit is differentiated from vertically adjacent units by differences in glauconite and carbonate content, in grain size, and in signatures on geophysical logs. In several wells, the Fishburne contains ostracodes, calcareous nannofossils, dinoflagellates, foraminifers, and other fossils that indicate an early Eocene age.

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Stratigraphic studies of subsurface Eocene sediments in the coastal counties of southern South Carolina have been limited to short descriptions in ground-water reports, regional syntheses, and reports on individual wells. In the U.S. Government–Parris Island No. 2 well (fig. 1, well 8), beds assigned in this report to the Fishburne Formation have been grouped with underlying beds and assigned an early Eocene (Wilcoxian) age by Siple (1969, fig. 2) and Maher and Applin (1971). In the same well, McLean (1960) recognized the glauconitic limestone of the Fishburne and assigned it to the base of his middle Eocene (Claibornian) section, although he noted the absence of diagnostic fossils in samples from the interval. Counts and Donsky (1963) included these beds in U.S. Government–Parris Island No. 2 in their middle Eocene Lisbon Formation. Zupan and Abbott (1976) in-

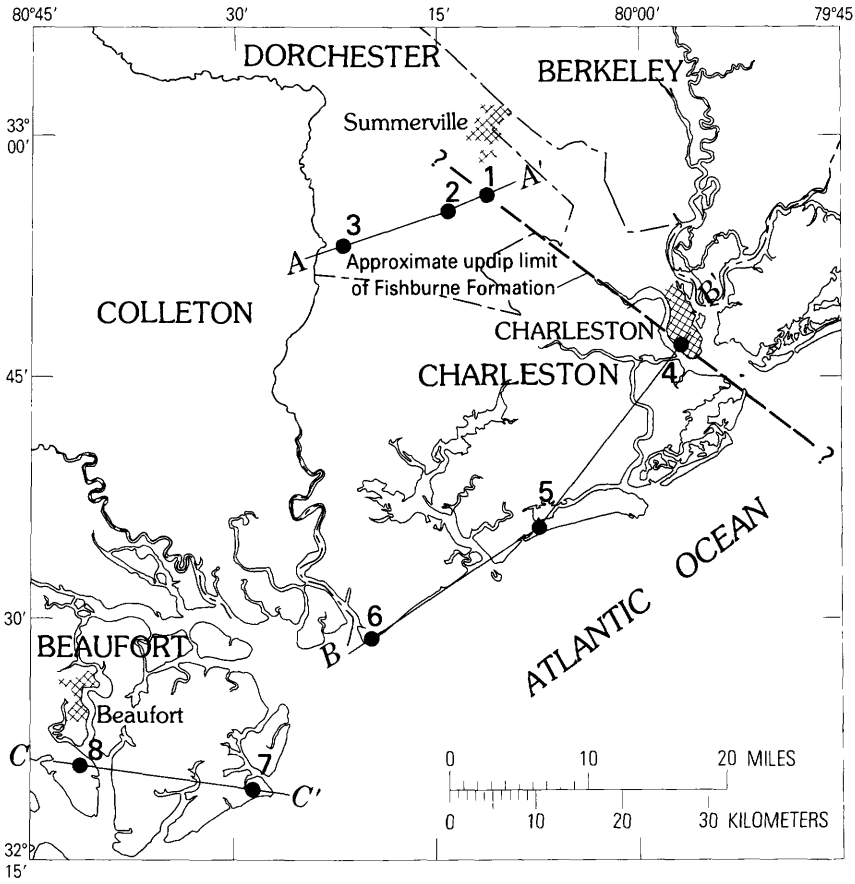

FIGURE 1.—Locations of wells and cross sections that illustrate the distribution of the Fishburne Formation in South Carolina. Table 1 gives names of numbered wells.

cluded this unit in a Paleocene–lower Eocene section in several coastal wells.

Sediments of the Fishburne Formation were first recognized as a distinct lithologic unit by Gohn and others (1977) and Hazel and others (1977) in their studies of the continuously cored section in U.S. Geological Survey (USGS)–Clubhouse Crossroads No. 1 (CC1), Dorchester County (fig. 1, well 3). They provisionally assigned this unit to the top of their Black Mingo Formation, and Hazel and others (1977) suggested an early Eocene (late Sabinian, Ypresian) age on the basis of data from several fossil groups.

Gohn and others (1978) identified this thin limestone unit in the CC1 core as their informal unit Te_1. These authors attempted to trace the distribution of Te_1 and other Tertiary units throughout the subsurface in coastal areas of South Carolina. However, away from Clubhouse Crossroads, because of the lack of detailed biostratigraphic control, they incorrectly correlated Te_1 with a middle Paleocene clay unit, which has similar signatures on geophysical logs, and carried this erroneous correlation through several wells in Charleston County and in southern Georgetown County to the northeast. Their correlations in Beaufort County (their wells 10, 11, and 13), with minor revision, are consistent with the correlations used in the present paper.

Acknowledgments.—Cuttings from the Fripp Island water well and a copy of the driller's log for the Kiawah Island water well were supplied by the South Carolina Geological Survey. Geophysical logs for the Stal 1 and Stal 3 drill holes were run by the South Carolina Water Resources Commission; cuttings from these holes were logged in the field by Earl M. Lemon, Jr. (USGS). We thank the Westvaco Company for the use of their land as drilling sites for Stal 1, Stal 3, and CC1. Drilling operations by the USGS near Charleston, S.C., are supported by the U.S. Nuclear Regulatory Commission, Office of Nuclear Research, under Agreement No. AT(49–25)–1000. We are grateful to R. Z. Poore, USGS, for identifying and interpreting the planktic foraminifers from the Fishburne Formation in CC1.

DISTRIBUTION, THICKNESS, AND ADJACENT UNITS

Data gathered for the present report (table 1) and reexamination of the correlations by Gohn and others (1978) indicate that sediments defined herein as the Fishburne Formation occur only in the subsurface southwest of the Charleston-Summerville area (fig. 1). In southern South Carolina, the Fishburne is a thin but laterally persistent unit that can be traced to wells near the Georgia border. The unit

TABLE 1.—*List of drill holes used in this report*

[* denotes U.S. Geological Survey stratigraphic test holes; remaining drill holes are water wells]

Drill-hole number	Drill hole	County	Total depth (in feet)	Sources of data
1	Stal 1*	Dorchester	526	Cuttings Fossils Gamma log
2	Stal 3*	do	484	Cuttings Fossils Gamma log
3	Clubhouse Crossroads No. 1*.	do	2,599	Core Fossils Gamma and electric logs
4	Charleston Medical Center.	Charleston	2,078	Gamma and electric logs
5	Kiawah Island	do	2,287	Do. Driller's log
6	Edisto Beach	do	970	Fossils Gamma log
7	Fripp Island	Beaufort	3,168	Cuttings Fossils Gamma and electric logs
8	Parris Island No. 2.	do	3,454	Gamma and electric logs Published data

is 24 ft thick in the type section in CC1 and reaches a maximum observed thickness of 74 ft in the Fripp Island water well in Beaufort County.

Gohn and others (1977) and Hazel and others (1977) assigned dominantly quartzose or clayey Paleocene sediments below the Fishburne Formation in CC1 to the Black Mingo and Beaufort(?) Formations, although traditional practice has been to assign all Paleocene sediments in South Carolina to the Black Mingo Formation (see, for example, Van Nieuwenhuise, 1978). Because sediments assigned to the Beaufort(?) Formation are now known to be lithologically and biostratigraphically equivalent to outcropping sediments of the lower part of the Black Mingo Formation in its type area, Williamsburg County, S.C. (Van Nieuwenhuise, 1978), the entire Paleocene section below the Fishburne Formation is herein assigned to the Black Mingo Formation. A laterally continuous marker bed (gamma peak labeled "middle Paleocene marker") within the Paleocene section is shown on figures 2, 4, and 5.

Middle Eocene limestone above the Fishburne is typically assigned to the Santee Limestone (see, for example, Gohn and others, 1977; Hazel and others, 1977; Ward and others, 1979). According to the stratigraphy of Ward and others (1979), the Santee consists of two members: an upper Cross Member consisting of finely crystalline limestone and a lower Moultrie Member consisting of megafossiliferous limestone. The distribution of these members, where known, is shown on the cross sections in this report. On these sections, upper Eocene and upper Oligocene sediments in Dorchester and Charleston Counties are assigned to the Harleyville, Parkers Ferry, and Ashley Members of the Cooper Formation, following Ward and others (1979), and upper Eocene limestone in Beaufort County is assigned to the Ocala Limestone, following Counts and Donsky (1963). [An alternative stratigraphy to that used herein for middle and upper Eocene limestone is given by Baum and others (1980)].

TYPE SECTION IN DORCHESTER COUNTY

The interval between depths[2] of 416 and 440 ft in CC1 is designated the type section for the Fishburne Formation. The formation name is taken from Fishburne Creek, which drains the area in southern Dorchester County between CC1 and Stal 3.

In CC1, there is a sharp contact between coarse-grained, bryozoan-mollusk limestone of the Santee Limestone and underlying finer grained, clayey limestone of the Fishburne. No phosphate-glauconite bed, which is typical of the other major contacts in the core (Gohn and others, 1977, p. 63), occurs at the base of the Santee. The basal contact of the Fishburne is also sharp but irregular between glauconitic, fine-grained limestone above the megafossiliferous, highly porous, quartzose limestone in the top of the underlying Paleocene section. Glauconite from the basal Fishburne bed is piped down about 3 ft into the Paleocene limestone.

In the type section, the Fishburne Formation consists of nodular, glauconitic, clayey limestone, which shows only minor variation in lithology. The limestone typically is greenish gray to pale olive in color (dry) and shows little evidence of stratification. This lack of bedding is probably due to bioturbation, which is represented by subtle mottling produced by minor differences in sediment color and texture. Secondary calcite nodules as large as 4.0 in. in maximum diameter occur throughout the unit.

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[2]Depths used in this report are measured from geophysical logs. For CC1, subtract 5 ft (difference between elevation of ground level and kelly bushing) from stated depths in this report to get depths measured from the top of the core as used by Gohn and others (1977) and Hazel and others (1977).

Petrographically, the limestone is a clayey, microfossil-mollusk biomicrite. It contains common to abundant sand-sized and larger mollusk fragments, particularly in the upper half and the basal 2 ft, and abundant microfossils, principally ostracodes and benthic foraminifers. The carbonate (acid-soluble) fraction of the unit decreases progressively downward from about 75 percent in the top 5 ft of the formation to 40 or 50 percent in the lowest 5 ft. Insoluble residues consist of nearly equal parts of clay and silt-sized to fine-sand-sized glauconite and quartz.

The Fishburne Formation has a distinctive signature on electric logs and natural gamma logs run in the type well and in other wells (fig. 2). On electric logs, the Fishburne has a "necked" pattern produced by low values on the resistivity log and a positive deflection on the spontaneous potential log. This signature reflects the generally low porosity and permeability of the fine-grained Fishburne sediments and contrasts with the signatures of permeable limestones and sands in the overlying and underlying sections. The relatively high glauconite and clay content of the Fishburne Formation produces a high-value signature on gamma logs that contrast with the signatures of the less glauconitic, nonclayey lithologies in the adjacent parts of the bounding formations.

From the 417- to 439-ft interval in CC1, the following microfossils were obtained.

Calcareous nannofossils (partial list)	*Depth below kelly bushing (in ft)*
Discoaster barbadiensis Tan Sin Hok, 1927	426, 436
Transversopontis duocavus (Bramlette and Sullivan, 1961) Locker, 1972	426
T. pulcher (Deflandre, 1954) Hay, Mohler, and Wade, 1966	426, 436
T. pulcheroides (Sullivan, 1964) Perch-Nielsen, 1971	426
Zygodiscus herlyni Sullivan, 1964	426, 436

The presence of *Z. herlyni,* which last occurs at or near the top of the *Discoaster diastypus* Zone of Bukry (1973), and the species *T. pulcheroides* and *D. barbadiensis,* which first occur in the *Discoaster diastypus* Zone, indicate placement of the Fishburne Formation at this locality in the lower Eocene (Ypresian) in the *Discoaster diastypus* Zone [coded CP9 in the system of Bukry (1981) and NP9 or NP10 in the system of Martini (1971)].

Planktic foraminifers (partial list)	*Depth below kelly bushing (in ft)*
Morozovella subbotinae (Morozova, 1939)	439
M. marginodentata (Subbotina, 1953)	439
Planorotalites aff. *P. chapmani* (Parr, 1938) (These specimens are morphologically close to *Pseudohastingerina wilcoxensis.*)	429
Pseudohastigerina wilcoxensis (Cushman and Ponton, 1932)	439
Chiloguembelina crinita (Glaessner, 1937)	439

The occurrences of *Morozovella subbotinae, M. marginodentata,* and *Pseudohastigerina wilcoxensis* without *M. aragonensis* or *M. velascoensis*

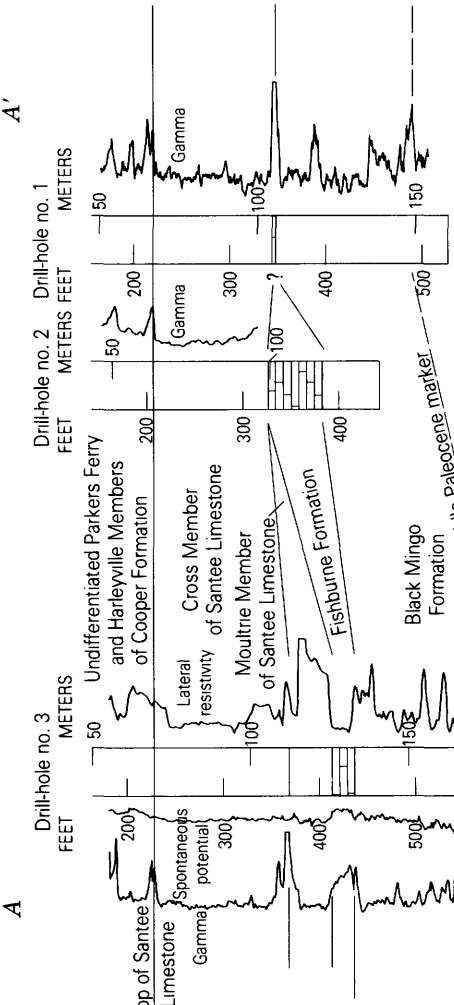

FIGURE 2.—Cross section *A–A'* (fig. 1) showing the type section of the Fishburne Formation (in CC1) and distribution of the unit in southern Dorchester County. Drill hole no. 1, Stal 1; drill hole no. 2, Stal 3; drill hole no. 3, CC1.

indicates that this sample (from 439 ft below kelly bushing) is within the *Morozovella subbotinae* Zone of Stainforth and others (1975). This zone is early Eocene in age.

Ostracodes (partial list)	*Depth below kelly bushing (in ft)*
Ouachitaia broussardi (Howe and Garrett, 1934)	420, 439
Hazelina aff. *H. pauca* (Schmidt, 1948)	439
Buntonia alabamensis (Howe and Garrett, 1934)	439
Acanthocythereis hilgardi (Howe and Garrett, 1934)	417, 420, 439
Cytherelloidea montgomeryensis of Pooser (1965)	417, 439
Haplocytheridea wallacei (Howe and Garrett, 1934)	417, 420
Phractocytheridea cf. *P. veatchi* (Howe and Garrett, 1934)	420
Konarocythere blackmingoensis (Pooser, 1965)	420
Opimocythere aff. *O. martini* (Murray and Hussey, 1942)	417, 420

This assemblage is indicative of the provincial Sabinian Stage (upper Paleocene and lower Eocene). The presence of an *Opimocythere* related to *O. martini*, a common Claibornian form, the abundance of *Haplocytheridea wallacei*, and the absence of early Sabinian indicators common in the Paleocene Black Mingo Formation (Van Nieuwenhuise, 1978) suggest a late Sabinian (early Eocene) Age. The ostracode assemblage also suggests deposition at inner-sublittoral depths in a warm-temperate or warmer climate.

Dinoflagellates and acritarchs	*Depth below kelly bushing (in ft)*
Ascostomocystis hydria Drugg and Loeblich, 1967	439
Cordosphaeridium multispinosum Davey and Williams, 1966	439
Fibrocysta lappacea (Drugg, 1970) Stover and Evitt, 1978	439
Senegalinium dilwynense (Cookson and Eisenack, 1965) Stover and Evitt, 1978	439
Millioudodinium tenuitabulatum (Gerlach, 1961) Stover and Evitt, 1978	439
Wilsonidium cf. *W. tabulatum* (Wilson, 1967) Lentin and Williams, 1975	418, 439

Ascostomocystis hydria and *Fibrocysta lappacea* are known only from upper Paleocene and lower Eocene deposits. *Senegalinium dilwynense* also last occurs in the early Eocene. The genus *Wilsonidium* first appears in lower Eocene deposits (Costa and Downie, 1979). Thus the dinoflagellates indicate an early Eocene age.

Pollen.—Frederiksen (1980) and Frederiksen and Christopher (1978) have reported on the sporomorphs from the type section of the Fishburne Formation. The abundance of *Platycarya platycaryoides* (Roche, 1969) Frederiksen and Christopher, 1978, and *Platycaryapollenites swasticoidus* (Elsik, 1974) Frederiksen and Christopher, 1978, as well as the joint occurrences of *Nuxpollenites* spp., *Thomsonipollis magnifica* (Pflug *in* Thomson and Pflug, 1953) Krutzsch, 1960, and *Pseudoplicapollis limitata* Frederiksen, 1978, in the Fishburne clearly indicates a late Sabinian (early Eocene) Age.

In summary, all the above fossil groups indicate an early Eocene age for the type Fishburne Formation. The Fishburne Formation cor-

relates with the Potapaco Member of the Nanjemoy Formation in Virginia (Gibson and others, 1980) and, on the basis of foraminiferal data presented in Enright (1969), with the lower part of the Manasquan Formation of New Jersey (fig. 3).

The Fishburne Formation also was encountered in another drill hole, Stal 3, in southern Dorchester County (figs. 1, 2). In this hole,

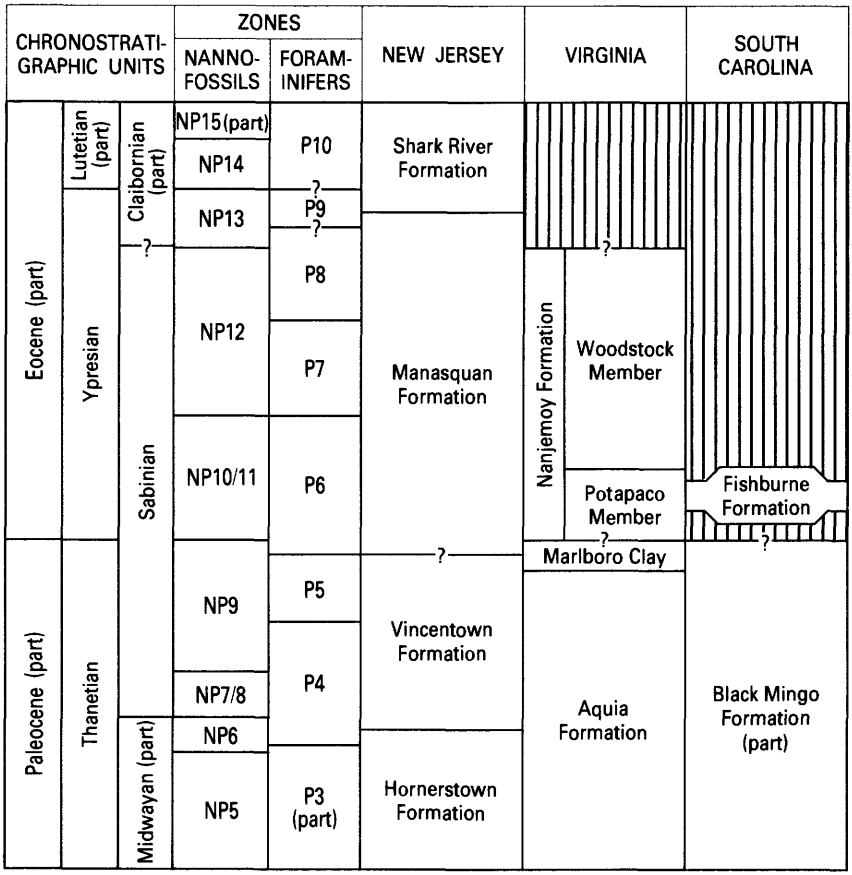

FIGURE 3.—Generalized correlation chart indicating the chronostratigraphic and biostratigraphic position of the Fishburne Formation. New Jersey data from Enright (1969), Loeblich and Tappan (1957a, b), and Olsson (1960). The position of the base of the Vincentown Formation follows Owens and Minard (1964), who included all the *Olenothryris harlani* beds in the Vincentown. The Virginia column is based primarily on data in Gibson and others (1980) and in Hazel (1969); unpublished information on calcareous nannofossils, ostracodes, and dinoflagellates was also used. The South Carolina column is based on data given herein and in Gohn and others (1977), Hazel and others (1977), and studies in progress. The Fishburne and Black Mingo Formations are equivalent to part of the Black Mingo Formation as used in Gohn and others (1977) and Hazel and others (1977). The coded calcareous nannofossil and planktic foraminifer zones are after Martini (1971), Stainforth and others (1975), and Hardenbol and Berggren (1978).

cuttings between depths of 326 ft and about 390 ft consist of microfossiliferous, glauconitic fine-grained limestone. Ostracodes and benthic foraminifers are abundant in these samples (5–15 percent), and some mollusk fragments (5 percent) also are present. Glauconite content averages 5 to 15 percent, but glauconite may constitute as much as one-third of individual samples of cuttings. The limestone cuttings are typically grayish yellow green or yellowish gray when dry. Unfortunately, caving of the hole prevented geophysical logging of this part of the section.

In the Stal 3 hole, cuttings from the interval between 324 and 394 ft contained the same ostracodes as does the Fishburne in its type section, plus several other forms, including *Phractocytheridea moodyi* (Howe and Garrett, 1934), *Haplocytheridea stuckeyi* of Pooser (1965), and an undescribed *Acanthocythereis* that is also known from the Hatchetigbee Formation of Alabama. This is a Sabinian, most probably late Sabinian, assemblage. The dinoflagellate flora from the cuttings between 354 and 364 ft contains many middle Eocene through late Oligocene contaminants, but it also contains *Wilsonidium* sp., *Fibrocysta lappacea* (Drugg, 1970) Stover and Evitt, 1978, and *Kallosphaeridium brevibarbatum* De Coninck, 1975, which together indicate an early Eocene age.

The Fishburne Formation cannot be recognized in logs or cuttings from Stal 1 (fig. 2). In that hole, at a depth of 345 ft, nonglauconitic, fine-grained limestone of the Cross Member of the Santee Limestone (Ward and others, 1979) appears to directly overlie quartz sand that contains an early Sabinian (late Paleocene) ostracode fauna. In particular, that fauna includes (at 357 ft) *Triginglymus dictyolobus* of Pooser (1965), which appears to be a good regional marker for sediments of early Sabinian Age. However, the Sabinian species *Haplocytheridea wallacei* (Howe and Garrett, 1934), a distinctive and dominant element of the Fishburne ostracode assemblage, occurs commonly in cuttings from depths of 364 to 374 ft and 404 to 414 ft. This occurrence suggests that a thin, lithologically unrecognized bed referrable to the Fishburne Formation is present between the upper Paleocene sand and the Cross Member. Stal 1 is probably very near the updip limit of the Fishburne Formation.

SECTION IN SOUTHERN CHARLESTON COUNTY

Water wells drilled at Charleston, Kiawah Island, and Edisto Beach (figs. 1, 4) illustrate the distribution of the Fishburne Formation in southern Charleston County. The gamma log for the Edisto Beach well went to a depth of 653 ft (total depth of hole is 970 ft) and recorded at least the upper part of the Fishburne Formation between depths of 626 ft and the bottom of the log (fig. 4). The high-value signature of

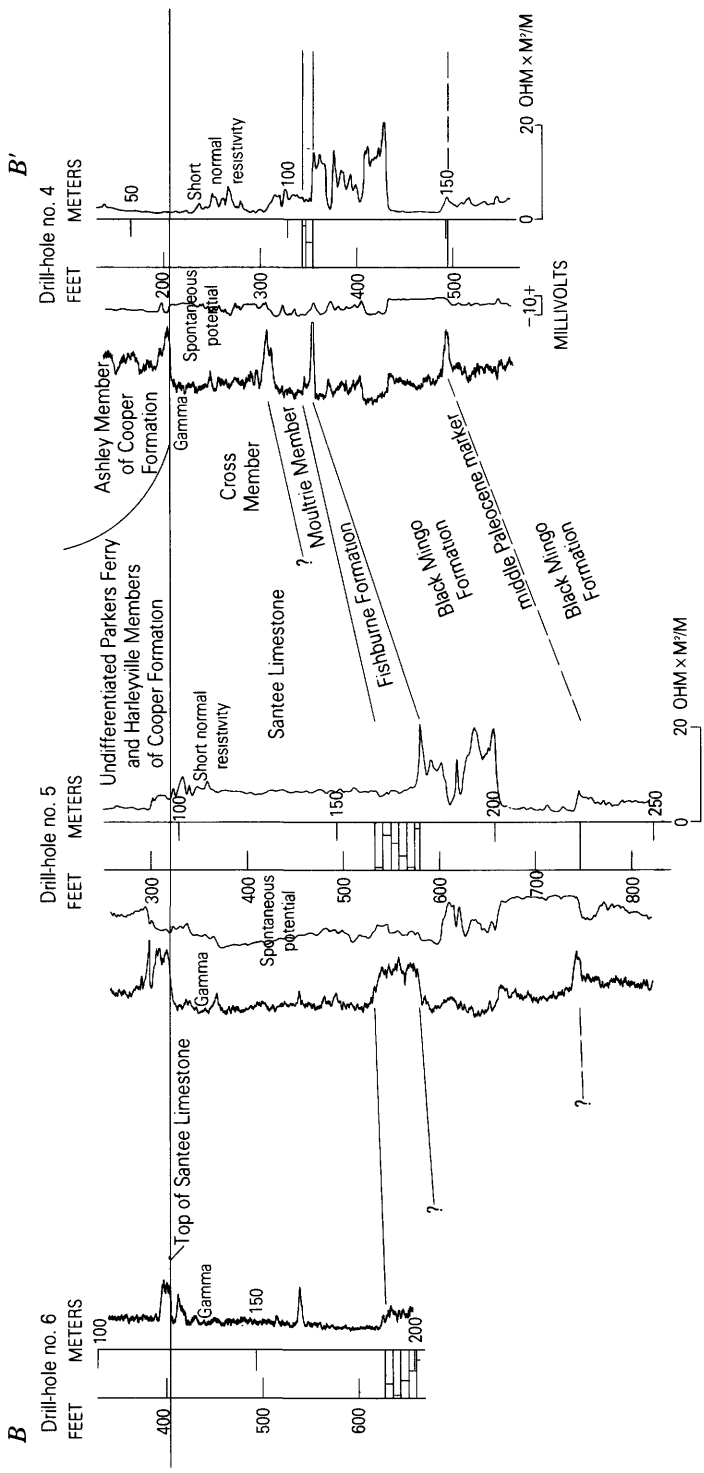

FIGURE 4.—Cross section *B–B'* (fig. 1) showing the distribution of the Fishburne Formation in southern Charleston County. Drill hole no. 4, Charleston Medical Center; drill hole no. 5, Kiawah Island; drill hole no. 6, Edisto Beach.

that unit can be correlated with a similar signature in the Kiawah Island well, as can the gamma peak at the top of the Santee Limestone (fig. 4). Lithologic information from cuttings was not available for the Edisto Beach well; however, ostracodes in a sample collected by G. E. Siple (USGS) in 1962 indicate a late Sabinian Age for the Fishburne in this hole. In the sample interval between 627 and 700 ft, which includes the Fishburne Formation and perhaps some small but unknown thickness of underlying Paleocene sand, cuttings contained the diagnostic Sabinian species *Haplocytheridea wallacei* (Howe and Garrett, 1934).

In the Kiawah Island well, the gamma log has a high-value signature between depths of 530 and 576 ft that contrasts with lower values for overlying and underlying sediments. However, the "necked" electric-log signature of the Fishburne is less obvious in this well than in CC1. On the driller's log, the interval between 532 and 565 ft is described as "fine black sand." These data are interpreted to represent beds of glauconitic fine-grained limestone similar to those of the Fishburne Formation in the type section, and the Kiawah section from 530 to 576 ft is assigned to that formation. The driller's log lists "soft rock" (Santee) above the Fishburne and "light gray or gray sand" (Black Mingo) below. No fossil data are available from the Kiawah well.

In Charleston County, the Fishburne Formation probably does not extend any great distance northeast of the City of Charleston. As shown on figure 4, a thin section of Fishburne sediments (less than 10 ft) is interpreted from the logs for drill hole no. 4 in Charleston City, and the section there is similar, with the addition of the Moultrie Member, to that encountered in Stal 1 near Summerville (fig. 2). Accordingly, the approximate updip limit of Fishburne Formation is drawn as the dashed line on figure 1.

SECTION IN BEAUFORT COUNTY

Approximately 60 to 70 ft of subsurface Eocene sediments in Beaufort County is provisionally assigned to the Fishburne Formation. There, the sediments of the lower half of the formation resemble Fishburne sediments found in the wells to the northeast and contain early Eocene calcareous nannofossils. However, sediments provisionally assigned to the upper half of the unit are not found to the north and northeast.

Glauconitic, fine-grained, clayey limestone occurs in cuttings from the Fripp Island and Parris Island No. 2 water wells (figs. 1, 5). Descriptions of sediments in the Parris Island No. 2 well given by McLean (1960) and listed in unpublished USGS data files indicate

that light-gray or light-yellowish-gray, fossiliferous limestone containing locally common quartz sand and glauconite occurs between depths of 670 and 970 ft. A sample at 946 ft contains abundant glauconite, and a sample at 970 ft is almost exclusively glauconite. However, the electric log for this well shows the characteristic "necked" signature of the Fishburne Formation only between depths of 895 and 955 ft (fig. 5). The gamma log shows a highly radioactive section between depths of 928 and 958 ft but no significant feature at 895 ft. From these data, the Fishburne Formation is interpreted to occur between depths of 895 and 958 ft in the Parris Island No. 2 well.

The lower half of the formation consists of glauconitic fine-grained limestone similar to the typical Fishburne lithology in Charleston and Dorchester Counties. The presence of abundant glauconite in the sample at 970 ft is attributed to caving from a glauconite bed at the base of the Fishburne (950–958 ft). The upper half of the formation consists of less glauconitic (and less clayey) limestone that is not present at the Dorchester and Charleston sections. The upper contact at 895 feet is distinctive on the electric log but lacks a significant gamma peak, as is true of this contact in the sections to the northeast.

In the Fripp Island water well (fig. 5), a 74-ft-thick section (816- to 890-ft interval) that is similar to the Fishburne section in Parris Island No. 2 is also provisionally assigned to the Fishburne Formation. However, in the Fripp Island well, the upper nonglauconitic bed appears as an uncharacteristically permeable unit on the spontaneous potential log, and the upper and lower contacts are marked by distinct gamma peaks (fig. 5). Between depths of 858 and 890 ft, the characteristic "necked" electric log pattern and high gamma values are compatible with cuttings consisting of moderately glauconitic, silty and clayey, microfossiliferous fine-grained limestone. Common phosphate and glauconite in the cuttings from 890 to 900 ft represent the basal gamma peak at 890 ft. The upper half of the formation, between 816 and 858 ft, consists of medium-grained, well-sorted quartz sand containing some macrofossil fragments. Phosphatic and glauconitic limestone in cuttings between 797 and 816 ft (and below as cavings) represents the lithology producing the high gamma values in the basal beds of the overlying Santee Limestone.

Calcareous nannofossils were examined in several Tertiary samples from the Fripp Island well. In the lower half of the Fishburne Formation, cuttings of Fishburne lithology from 867 to 880 ft contain *Transversopontis pulcheroides* and *Toweius craticulus* Hay and Mohler, 1967, which became extinct in the early Eocene. The presence of these two species and the absence of exclusively Paleocene species suggest an early Eocene age for at least the lower half of the Fishburne Formation in this well. A bulk sample of cut-

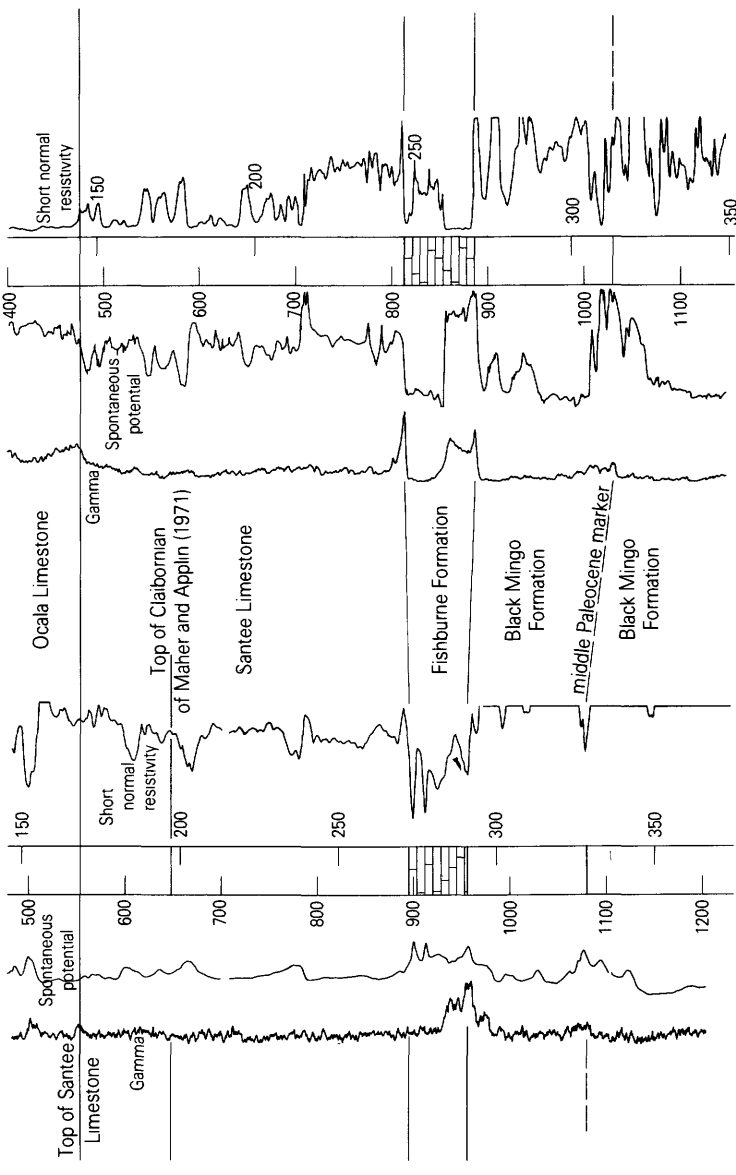

FIGURE 5.—Cross section *C–C'* (fig. 1) showing the distribution of the Fishburne Formation in Beaufort County. Drill hole no. 7, Fripp Island; drill hole no. 8, Parris Island No. 2.

tings from the upper half of the Fishburne at 824 to 837 ft contains only middle and late Eocene species. However, the medium-grained sand in this interval does not have an appreciable fraction of fine-grained sediment, from which nannofossils are normally obtained. In addition, this sand may represent a near-shore environment of deposition that was too shallow for many nannofossil species. Hence, these middle and late Eocene species may represent down-hole contamination from more fossiliferous units into a nannofossil-poor interval. Although a middle Eocene age cannot be discounted for the upper part of the unit, the Fishburne Formation is assigned an early Eocene age in the Fripp Island well.

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