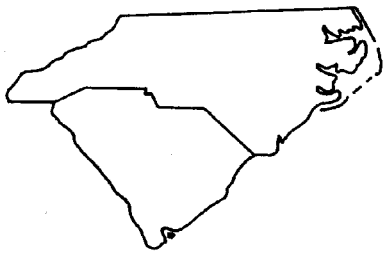
Carolina Geological Society

GUIDEBOOK OF EXCURSION
in
THE COASTAL PLAIN OF NORTH CAROLINA

OCTOBER 8-9, 1955



by
H. E. LeGrand and P. M. Brown
Geologists,
U. S. Geological Survey

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H. E. LeGrand and P. M. Brown
Geologists, U. S. Geological Survey

Field work upon which this trip is based was done for the most part between the fall of 1954 and the spring of 1955. It was a part of ground-water investigations of the North Carolina Coastal Plain by the U. S. Geological Survey, cooperatively with the North Carolina Division of Mineral Resources.

NOTE: This guidebook was retyped and reformatted from the original in May of 1999. Although spell checked, it was not carefully proofed against the original.

CAROLINA GEOLOGICAL SOCIETY
Guidebook for 1955 Annual Meeting
Pages 1-15

GUIDEBOOK OF EXCURSION IN THE NORTH CAROLINA COASTAL PLAIN

OCTOBER 8-9, 1955[1]

H.E. LeGrand and P.M. Brown

Geologists, Ground Water Branch, Water Resources Division,
U.S. Geological Survey, Raleigh, N.C.

1. Publication authorized by the Director, U.S. Geological Survey.

This field trip has been planned to acquaint geologists with features of some of the formations that are exposed I the Coastal Plain of North Carolina. The formations range in age from Late Cretaceous to Recent. As those persons familiar with this part of the State are aware, outcrops are scarce except along the major streams. The localities to be visited, therefore, were selected to present the best picture of the geology within the limits of both accessibility and time available. The order in which we visit them is not the order of their age. Even though outcrops commonly show beds of only one formation, most of which are only a few feet thick, it is believed that the general stratigraphic relations will be apparent after the localities have been visited. All the localities are fossiliferous, most of them abundantly so.

The geology of the Coastal Plain of North Carolina has been under systematic investigation since 1953 by the Ground Water Branch of the U.S. Geological Survey in cooperation with the Division of Mineral Resources, N.C. Dept. of Conservation and Development. Geologic studies of a local nature were made at intervals as early as 1941 as a part of the cooperative ground-water investigation. Knowledge of subsurface geology was found to be inadequate as a basis for ground-water investigations, and since 1953 the geologic work has been intensified by reexamining the surface geology and studying well samples. Microfossils, both Ostracoda and Foraminifera, are abundant and have been useful in studying the stratigraphy. The junior author has prepared a list of Ostracoda to be found at several of the stops. Although many geologists have contributed to the general knowledge of the area, much of the geology is poorly understood and even the better outcrops have been visited only rarely. It is ironical that such a classic locality as Stop 1 (type locality of the Snow Hill marl member of the Black Creek formation, *Exogyra ponderosa* zone) is not known to have been visited by geologists between the time of Condrad's description in 1871 and that of the preparation for this trip.

GENERAL DESCRIPTION OF FORMATIONS TO BE STUDIED

The geologic map (fig. 1) tends to oversimplify the surface distribution of formations of the Coastal Plain. The outcropping beds commonly have a very gentle dip to the southeast, in most places only slightly greater than the slope of the land surface, which also is to the southeast. Topographic relief is not great but is sufficient to cause the outcropping formations to have many thin erosional outliers far west of the main body of the formation. Weathering, which tends to obscure some characteristics of each formation, coupled with mantling by thin sand deposits of Pleistocene age are not separately mapped but are grouped with the underlying Yorktown formation where the aggregate thickness is believed to be at least 25 feet. Even if formational contacts were adequately known it would be impossible to show them accurately in detail. Many outliers, including deposits of late Miocene age in parts of Robeson County and patches of the Castle Hayne limestone in Sampson and Harnett Counties, could not be shown without showing other outliers whose areal limits are unknown. The omission of these outliers unfortunately prevents an accurate appraisal of the geologic history and structure on the basis of the map.

The table on the following page shows a generalized stratigraphic section and a tentative correlation with Gulf Coast equivalents and with equivalents of the Virginia-New Jersey area. Only those formations which crop out are to be seen on this excursion will be discussed in the following pages.

Upper Cretaceous Series

Tuscaloosa formation

The Tuscaloosa is the basal formation in the Coastal Plain, cropping out west of our excursion area along the Fall Line. It has a widespread subsurface distribution.

Black Creek formation

The Black Creek formation crops out in a belt southeast of that of the Tuscaloosa formation. The outcrop area of the Black Creek is about 30 miles wide along the Cape Fear

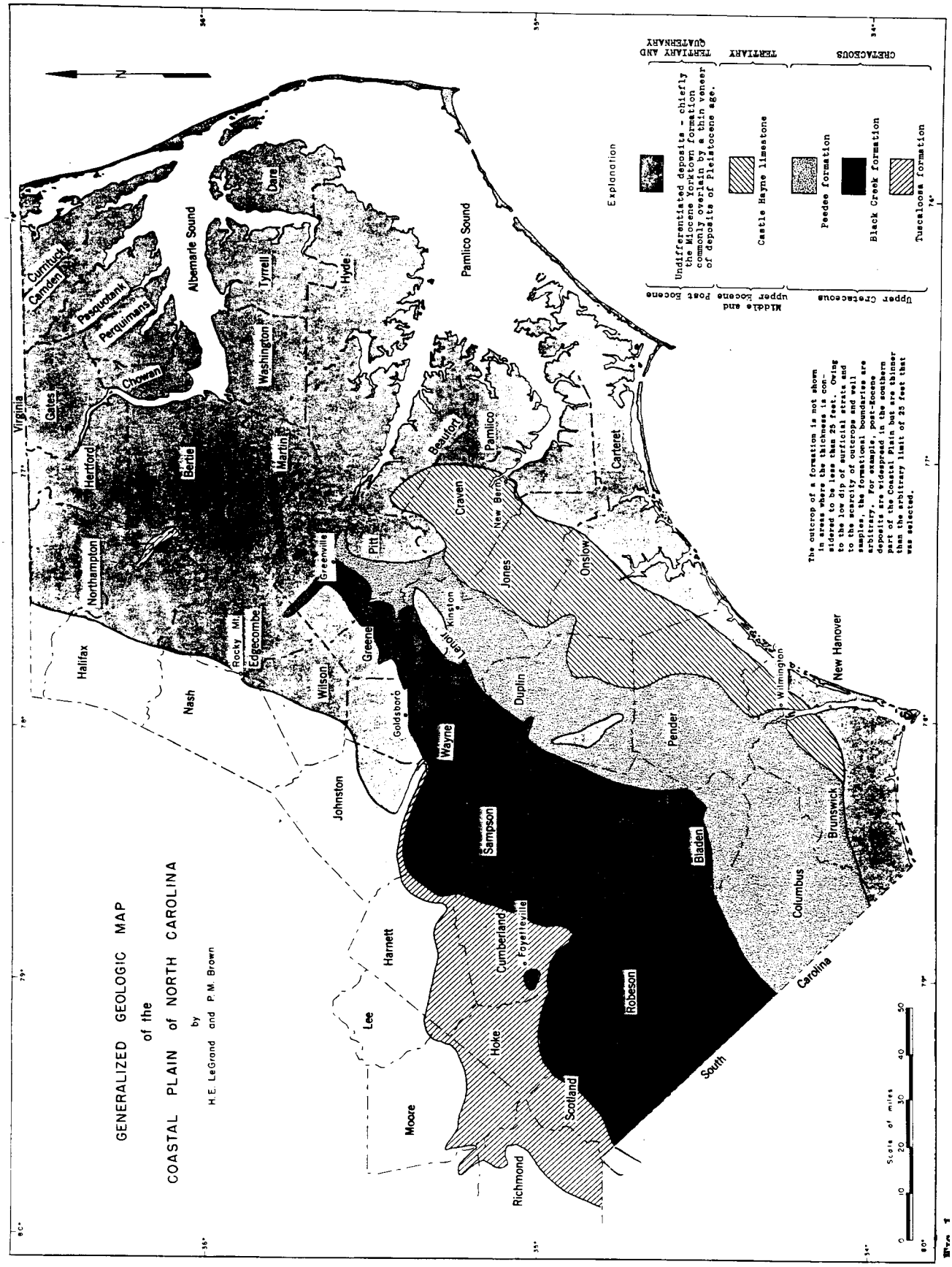

Figure 1. Generalized geologic map of the Coastal Plain of North Carolina.

Table 1. Description of formation snd stratigraphic correlation with the West Gulf Coast and Middle Atlantic Coast equivalents.

Geologic age	West Gulf Coast	Middle Atlantic Coast	North Carolina		Character of deposits in North Carolina
Recent, Pleistocene, and Pliocene	Beaumont clay to Goliad sand	Undifferentiated terrace deposits	Post-Miocene deposits, undifferentiated		Light-colored fine- to coarse-grained sheet and lenticular sands and interbedded clays. Aqueous and eolian, marine and nonmarine deposition, forming a thin blanket over most of the Coastal Plain.
Miocene	Upper	Yorktown formation	Duplin marl Yorktown formation		Sandy shell beds in upper part, massive marine clays and interbedded marls in lower part. Deposited in a transgressive sea and progressively overlaps underlying formation.
	Middle	St. Marys formation Choptank formation Calvert formation	Unnamed, subsurface only		Brown phosphatic sands and silts deposited in a shallow marine basin at depths as great as 200 feet. Largely confined to Beaufort and Washington Counties.
Eocene	Jackson formation	Chickahominy formation, subsurface only	Castle Hayne limestone		Sandy shell limestone and calcareous sand facies predominate. Marine, littoral to neritic reef deposition in open water. Subsurface distribution widespread, thickens rapidly coastward.
	Claiborne group	Nanjemoy formation			
	Wilcox group	Aquia formation	Unnamed, subsurface only		Sand and limestone facies deposited in shallow open water predominate. Material greatly altered by secondary depositional processes.
Paleocene	Midway group	Brightseat formation	Unnamed, subsurface only		Glauconitic greensands deposited in a restricted basin or basins. Glauconite averages about 60 percent. Largely confined to northeastern counties.
Upper Cretaceous	Navarro group	Monmouth formation	Peedee formation		Variable gray to green argillaceous sands and impure limestones; locally, massive marine clays and interbedded sands. Marine, shelf-type deposition.
	Taylor group	Matawan formation	Black Creek formation	Snow Hill marl member	Black to gray interbedded sands, clays, and marls.
	Austin chalk	Magothy formation		Unnamed member	Black micaceous sands and clays and interbedded coarse sands. Marine and nonmarine deposition along a fluctuating strand.
	Eagle Ford shale and Woodbine sand	Raritan formation	Tuscaloosa formation		Tan, red, and gray arkosic sands and interbedded lenticular clays. Chiefly near-shore marine deposition.
Lower Cretaceous	Washita group to Trinity group	Patuxent formation	Unnamed, deep wells only		Drab-gray to tan interbedded shales, limestones, and sandstones. Shell fragments common. Interbedded layers are commonly recrystallized.

River, becoming narrower to the northeast. The formation is not exposed north of the Tar River. It is overlain by the Peedee formation except where younger strata overlap the Peedee.

Except for an upper calcareous member, which Stephenson (1923, p.9) called the Snow Hill calcareous member and which is now known as the Snow Hill marl member, the Black Creek consists typically of thinly laminated sand and clay, the sand predominating in some places and the clay at others. Crossbedded sands are common, and lignitic material, generally associated with marcasite, is widespread. Glauconite occurs sparsely in some of the sands. The clays are characteristically dark gray to black.

Prior to the present study, the beds of the Black Creek below the Snow Hill member were thought to be nonfossiliferous. However, the junior author has found microfossils in well cuttings deeper than 100 feet at Garland, in Sampson County, Fairmont, in Robeson County, and Faison, in Duplin County. All these wells are in the outcrop area of the Black Creek and are west of, and stratigraphically lower than, the Snow Hill member. It is apparent that deposition was both continental and marine, being marked by transgressive and regressive fluctuations of sea level.

The Snow Hill marl member, representing the uppermost beds of the Black Creek, consists of “lenses and layers of invertebrate-bearing sands and clays deposited in deeper marine waters, interstratified with typical laminated strata more or less glauconitic” (Stephenson, 1923, p.10). In places calcareous material has been indurated into an impure limestone. Stephenson made an intensive study of invertebrates from the Snow Hill member at Snow Hill, which is in Greene County, and at other localities, including Blue Banks Landing, on the Tar River, in Pitt County, numerous localities on the Black River in Sampson County, and Hodge’s old mill in Marion County, South Carolina.

In the outcrop area the Snow Hill appears to be less than 30 feet thick. The entire Black Creek formation where exposed is commonly less than 150 feet thick, but it thickens considerably downdip.

Paleontologically, the Snow Hill member belongs to the upper part of the *Exogyra ponderosa* zone of the Atlantic and Gulf Coastal Plain (Stephenson, 1923, p. 10) and is cor-

related with deposits of Taylor age in the Gulf Coast. Spangler (1950, p. 130) accepts this correlation and it is substantiated by Ostracoda determinations of the junior author in the present study. The beds of the Black creek below the Snow Hill member are considered to be pre-Taylor in age, principally Austin.

Peedee formation

The Peedee formation overlies the Snow Hill marl member, to which it is lithologically similar. It is composed chiefly of dark-gray to green glauconitic sand and massive drab-black clay. Many beds contain calcareous material, and thin indurated shell beds are widespread.

The outcrop belt of the Peedee is broad, being about 35 miles wide along the Cape Fear River upstream from Wilmington. Even where covered by younger strata, the surface of the Peedee has a very gentle slope eastward (fig. 2) as far as the –200-foot contour, beyond which the slope steepens. The glauconitic sands furnish artesian water over a larger area of the Coastal Plain than do strata of any other formation.

In its outcrop area the Peedee in North Carolina contains both the *Exogyra costata* and the *Exogyra cancellata* zones. These zones as traced by Stephenson are present in the Monmouth and its equivalents of the Atlantic Coastal Plain and in the Navarro group and its equivalents of the Gulf Coastal Plain. The microfauna is both rich and variable, that near the base of the formation being only slightly different from that of the underlying Black Creek formation and that near the top of the formation showing strong Paleocene affinities. The Ostracoda, in particular, indicate that there was no major hiatus between the Black Creek and the overlying Peedee. Furthermore, the strong affinities of the ostracode faunule near the top of the Peedee formation with that occurring elsewhere in Paleocene sediments indicate that there was no major hiatus between the Peedee and younger sediments of Paleocene age in North Carolina.

Tertiary System

Castle Hayne limestone

The Castle Hayne limestone, named after the town of Castle Hayne in New Hanover County, is extremely variable in composition, ranging from a cream to white marl composed of loose, broken shell fragments to a gray dense silicified limestone. All variations between these two extremes are recognized within the formation, making correlation based upon lithology extremely difficult.

The formation occurs as an extensive sheet deposit over large sections of the Carolina Coastal Plain, where it is overlain and partially concealed by Miocene and post-Miocene sediments. Surface or near-surface expression along its inner margin extends from the vicinity of the Neuse River in Craven County southwestward into New Hanover County near Wilmington. In the subsurface the formation thickens rapidly downdip. That the Castle Hayne limestone extended inland some distance beyond its present position as a main body is clearly indicated by the many outliers some distance west of the main body. The section in the guidebook dealing with structure and structural implications will discuss the outliers in more detail.

Chronologically, the Castle Hayne limestone is not clearly understood. Both upper and middle Eocene biofacies are recognized in the formation by the writers, who are of the opinion that the deposition of the formation commenced during the middle Eocene and continued in a transgressive sea throughout the late Eocene, the bulk of deposition occurring during late Eocene time. This principle of temporal transgression serves to explain why the dominant middle and upper Eocene biofacies occur in similar lithologic units at different localities, as well as accounting for those biofacies that reflect a mixture of forms common to the middle and upper Eocene.

Hydrologically, the Castle Hayne shows a great variation in permeability. However, it is one of the most prolific aquifers in the Carolina Coastal Plain, and large supplies of ground water are available for both industrial and domestic development.

Commercially, the Castle Hayne limestone has been the source of extensive quantities of material used as fertilizers and road metals. At the present time these commercial enterprises are largely centered in Jones and Onslow Counties, where the predominantly silicified facies of the formation occur.

The microfauna of the Castle Hayne has never been systematically described in detail. Therefore, even though most outcrops are abundantly fossiliferous, it has not been possible to provide long lists of microfossils in this guidebook. Many of the Ostracoda and Foraminifera apparently are undescribed, and only those species that have been described elsewhere are listed.

Yorktown formation

The Yorktown formation is extended into North Carolina from the type locality at Yorktown, Virginia and may include elements of the St. Marys formation as mapped elsewhere. Lithologically the formation ranges from gray to blue massive marine clays to lighter colored shell beds and intermediate sands or sandy clays.

The Yorktown formation does not occur as a continuous sheet along its inner margin but occurs as remnants of a former sheet deposit which has been extensively eroded. Along its inner margin and in outliers extending to the west, it occupies slight depressions in the older formations of Eocene and Cretaceous age.

Upper Miocene deposits north of the Neuse River have been mapped as the Yorktown formation, and upper Miocene deposits south of the Neuse River have been mapped as the Duplin marl. The Duplin marl had been considered (Mansfield, *in* Gardner, 1943, p.11) to be of the same age as the

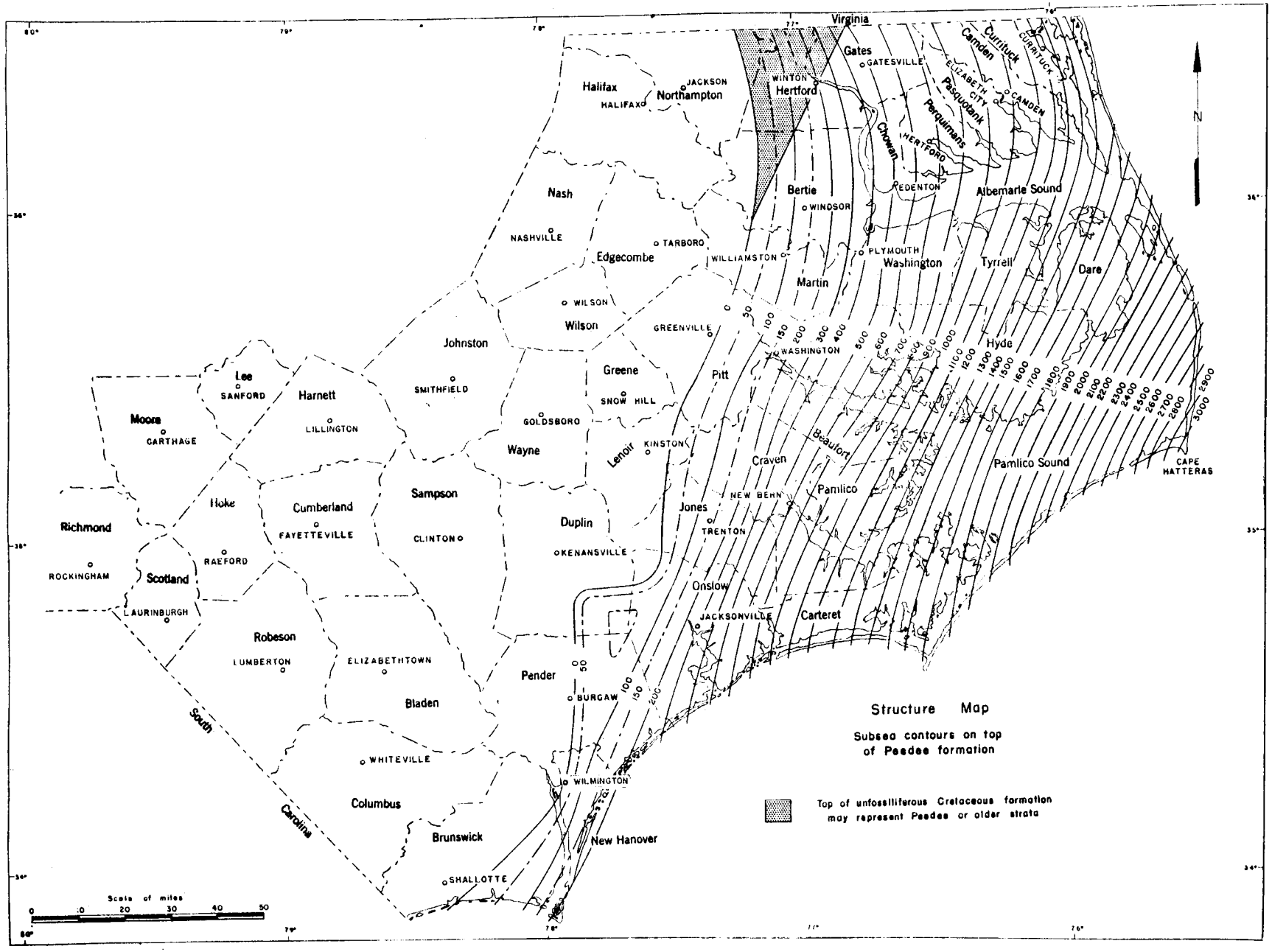

Figure 2. Map showing subsea contours on top of the Peedee formation.

uppermost Yorktown, differences in lithofacies and biofacies reflecting differences in depth and water temperatures in two different basins of deposition. In the present investigation the Duplin and Yorktown are considered as one formation, the Yorktown. There are several reasons for this conjunction of the two formations. Subsurface and surface evidence south of the Neuse River shows the Yorktown formation to be present downdip, whereas the Duplin formation is confined to updip sections and outcrops. In addition, the microfauna of the Duplin marl, although slightly younger than that of the Yorktown formation, carries the same diagnostic species, and they are not considered to form a basis for separation of the two units. Therefore, the Duplin is considered to be a shallow-water facies of the Yorktown and not a separate formation. The Waccamaw formation, considered by Miller (Clark and others, 1912, p.250) and by Mansfield (Gardner, 1943, p.13) to be of Pliocene age, also is considered as contemporaneous with the Duplin marl and therefore is placed in the Yorktown. Evidence for such a step is as follows: 15 species of Ostracoda known to occur in the Duplin marl occur in the Waccamaw formation, and, in addition, no ostracod species have been found in the Waccamaw formation that do not occur in the Duplin marl. Because many of these species have wide distribution in the Western Hemisphere and are not known to occur higher than the upper Miocene, the present writers consider the Duplin and Waccamaw to be contemporaneous. Diagnostic Miocene Ostracoda from Stop 9 at Acme are as follows:

Hemicythere confragosa Edwards
Hemicythere conradi Howe and McQuirt
Loxoconcha subrhomboidea Edwards
Favella? rugipunctata (Ulrich and Bassler)
Trachyleberis martini (Ulrich and Bassler)
Trachyleberis vaughni (Ulrich and Bassler)
Paracytheridea nodosa (Ulrich and Bassler)
Trachyleberis exanthamata (Ulrich and Bassler)
Basslerites giganticus Edwards
Favella? mesacostallis Edwards
Cytherura wardensis Howe and Brown
Loxoconcha reticularis Edwards
Cytheromorpha curta Edwards
Trachyleberis triplistriata Edwards
Cytheretta cf. *C. karlana* Howe and Pyeatt

Post-Tertiary Deposits

A thin veneer of sand lies at the surface at most places on the Coastal Plain. The origin of the sand is not everywhere clear. In some places it is apparent that the sand is the A horizon and the underlying massive clay is the B horizon of soils formed on outcropping formations. In other places the surface materials are sedimentary deposits thought to be younger than Miocene. It is generally difficult to distinguish between the base of the post-Miocene material and the weathered upper part of the underlying formation. The depth to the unweathered or recognizable formation is less than 25 feet almost everywhere, except along a 10- or 20-mile coastal fringe where Pleistocene and Recent sediments tend to thicken.

The Pliocene and Pleistocene history of the Coastal Plain is complex. The extent of marine transgression and terracing in Pleistocene time have frequently been discussed. Intensive research is needed to determine the age and origin of some of the surficial deposits and to ascertain the effects of the Pleistocene epoch in North Carolina.

STRUCTURE

The strata of the Coastal Plain as a whole have a monoclinal eastward dip. Starting as a featheredge at their westernmost extremities, most of the formations thicken as a wedge eastward and coastward. Consequently, the uppermost beds dip only a few feet per mile under the extreme eastern part of North Carolina (Berry, 1948, p. 89). (See fig. 3)

As a result of oil exploration between 1944 and 1947, much was learned about the basement rocks. According to Spangler (1950, p. 132),

> "The rate of dip increases eastward from the Fall line, this increase being moderate to the 2,500-foot subsea contour where it steepens sharply. The average slope of the crystalline floor to the 2,500-foot subsea contour is 35 feet per mile. From the 2,500-foot contour the dip changes to somewhat more than 100 feet per mile."

The most apparent deviation from the monoclinal structure is the Great Carolina Ridge, known also as the Wilmington anticline and as the Cape Fear arch. It appears to be a wide southeast-trending uplift, the axis of which approximately parallels the Cape Fear River. Arched around this axis at Wilmington and extending closer to the Fall Line on both sides of the axis are rocks of Eocene age. This condition cause Cooke (1936, p.2) to conclude that the Carolina Ridge was formed "during late Eocene time by a buckling of the earth's crust that arched up the rocks along the axis of the ridge and bent down the rocks on each side of it." This conclusion is an obvious one, but it does not harmonize with such facts as the occurrence of outliers of Miocene age in parts of Robeson and Sampson Counties and with the oulier of Jackson or Claiborne age at Spout Springs, in Harnett County. The outlier of clay and silicified limestone at Spout Springs is considered to belong to the Castle Hayne limestone because of the presence of *Trachyleberis davidwhitei* (Stephenson), *Cytheretta alexanderi* Howe and Chambers, and *Loxoconcha jacksonensis* Howe and Chambers; its occurrence at the Fall Line, and more than 60 miles of updip from the nearest part of the main body of Eocene rocks, merits primary consideration in an appraisal of structure in the area of the Great Carolina Ridge. The absence of a blanket of

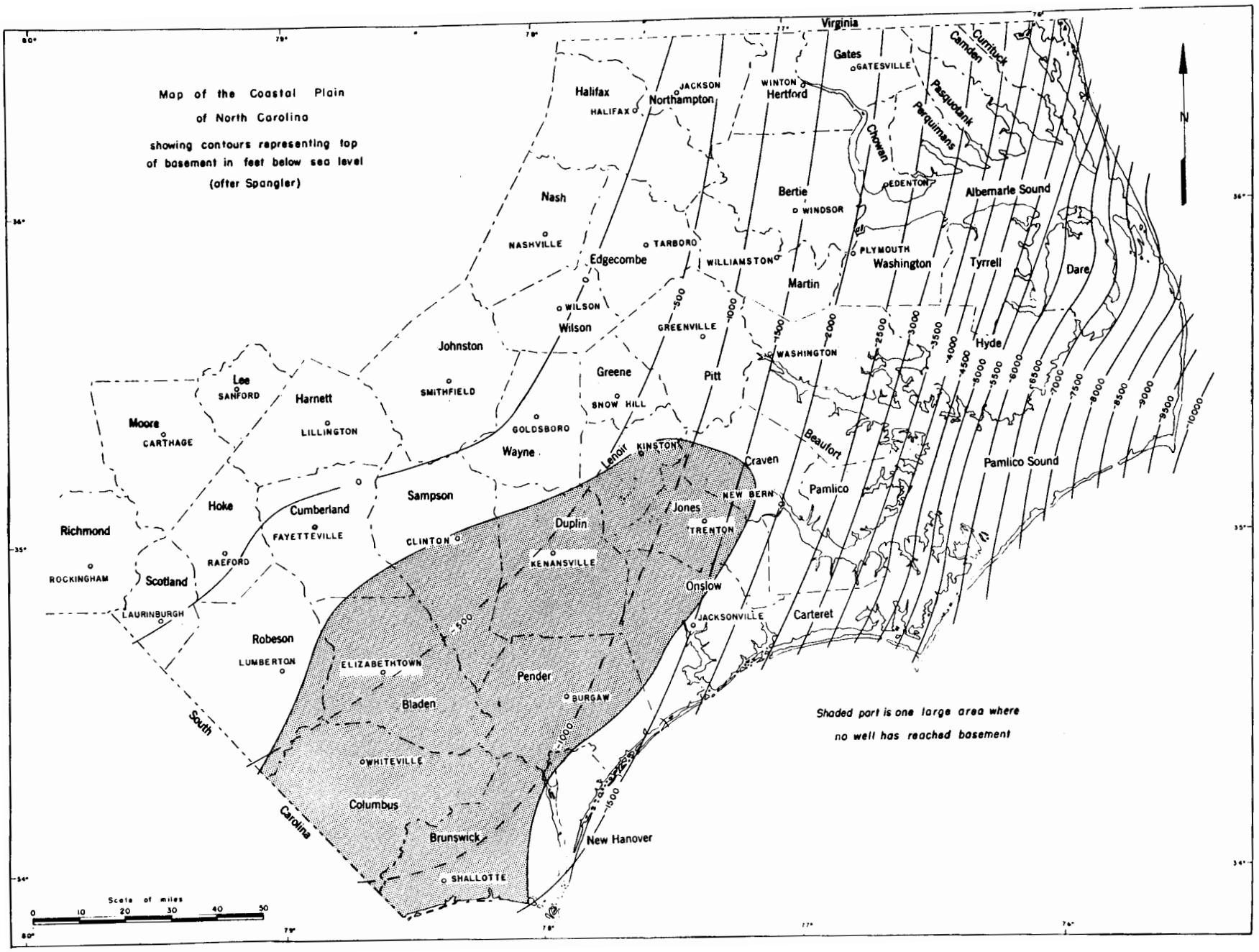

Figure 3. Map showing subsea contours on top of basement rocks.

the Castle Hayne over the Ridge is not easily explained.

The subsurface aspects of the Carolina Ridge are not well known. The penetration of crystalline bedrock at the relatively shallow depth of 1,100 feet below sea level in a well at Wilmington suggests that the arch reflects basement topography. On the other hand, evidence recently gathered (LeGrand, 1955, in press) suggests that complex northeast-trending structures cross the Carolina Ridge in the area northwest of Wilmington. The shallow basement at Wilmington results in an interruption of the downdip, wedgelike thickening of formations elsewhere in the Atlantic Coastal Plain. Stephenson's examination of samples from the deep well at Wilmington revealed that the Black Creek formation rests on basement rocks at about 1,100 feet and that the Tuscaloosa formation, which underlies the Black Creek in the outcrop area, is absent. Samples from three other wells reaching basement, extending on a line from Conway, South Carolina to near Jacksonville, North Carolina, failed to show the presence of the Tuscaloosa, according to Brown (LeGrand, 1955, in press). The absence of pre-Black Creek rocks at Wilmington was considered by Stephenson (Clark and others, 1912, p. 292) as "evidence of a land barrier of some kind in the region about Wilmington." By connecting a line through these four wells, it is assumed that the land barrier in the area during Tuscaloosa time extended northeastward and that a basin of undetermined proportions lies west of Wilmington.

The general irregularity of the basement floor can be demonstrated near the town of Fountain, Pitt County. A buried monadnock of granite protrudes at the surface (Mundorff, 1947, p. 103) on the east side of Fountain, but on the west side as much as 400 feet of sediments overlie the basement rocks.

An undetermined structural feature marks the contact of the Castle Hayne limestone and the Peedee formation along the Northeast Cape Fear River in southeastern Duplin County. On the east side of the Cape Fear River at Chinquapin, more than 100 feet of the Castle Hayne is present, extending to more than 60 feet below seal level; 3 miles due south on the banks of the river, the Peedee crops out 30 feet above sea level. At Chinquapin the Castle Hayne is thicker and lies deeper than is to be expected on the basis of regional structure.

As more subsurface data become available, more structural anomalies doubtless will be revealed, but present knowledge of the Coastal Plain is only a fraction of that necessary to evaluate all types of structural adequately.

GENERAL COMMENTS ABOUT THE EXCURSION

1. Cars should be filled with gasoline each morning before starting; the crowded schedule leaves little time for "gassing up" en route. Motor travel is planned at an average speed of 45 miles per hour.
2. An average of 25 minutes is allowed at excursion stops and 45 minutes for Lunch stop on Saturday. Ample time will be allowed for individual examination and discussion after *brief* talks by excursion leader.
3. On arrival, those at the head of the line should not get impatient and wander off to examine the outcrop before those at the rear of the line can reach the assembly point. Wait for the leader's discussion.
4. A light lunch in the form of sandwiches and coffee will be available on Saturday at the small restaurant in Pollocksville. The excursion will be ended on Sunday before lunchtime, making possible a hot lunch in Elizabethtown, Clinton, or Fayetteville.
5. The road log makes few references to geologic features en route. Unfortunately, post- Miocene sediments mantle older deposits so commonly that good roadside outcrops are rare.

ROAD LOG

Saturday, October 8, 1955

Departure time:

8:00 a.m. for those who plan to see Stop 1. For those who arrive at the assembly point between 8:00 and 8:30, another excursion leader will depart at 8:30 for Stop 2, where you will join the first party. Departures from the assembly points will be sharply at 8:00 and 8:30 a.m.

Assembly point:

Junction of U.S. 70 and N.C. 102, about 2 miles east of Goldsboro. Park on the east side of Route 102 facing north.

Mile	
0.0	Leave assembly point, heading north on N.C. 102.
9.3	Wayne-Greene County line.
11.5	Shine School on right.
16.8	Junction N.C. 58 (on left). Continue on N.C. 102 northward through Snow Hill.
18.2	Bridge over Contentnea Creek.
19.2	Turn right on paved road (Hookerton Road).
22.5	Turn right on dirt farm road.
22.9	**Stop 1** (type locality of the Snow Hill member of the Black Creek formation). For description see pages 11.
23.3	Return to pave road. Turn right.
25.3	Cross N.C. 123. Continue on paved road.
30.3	Turn left on paved road to Scuffleton.
32.5	Junction of N.C. 102. Turn right on N.C. 102 and cross Little Contentnea Creek.
32.7	Turn left on dirt farm road.

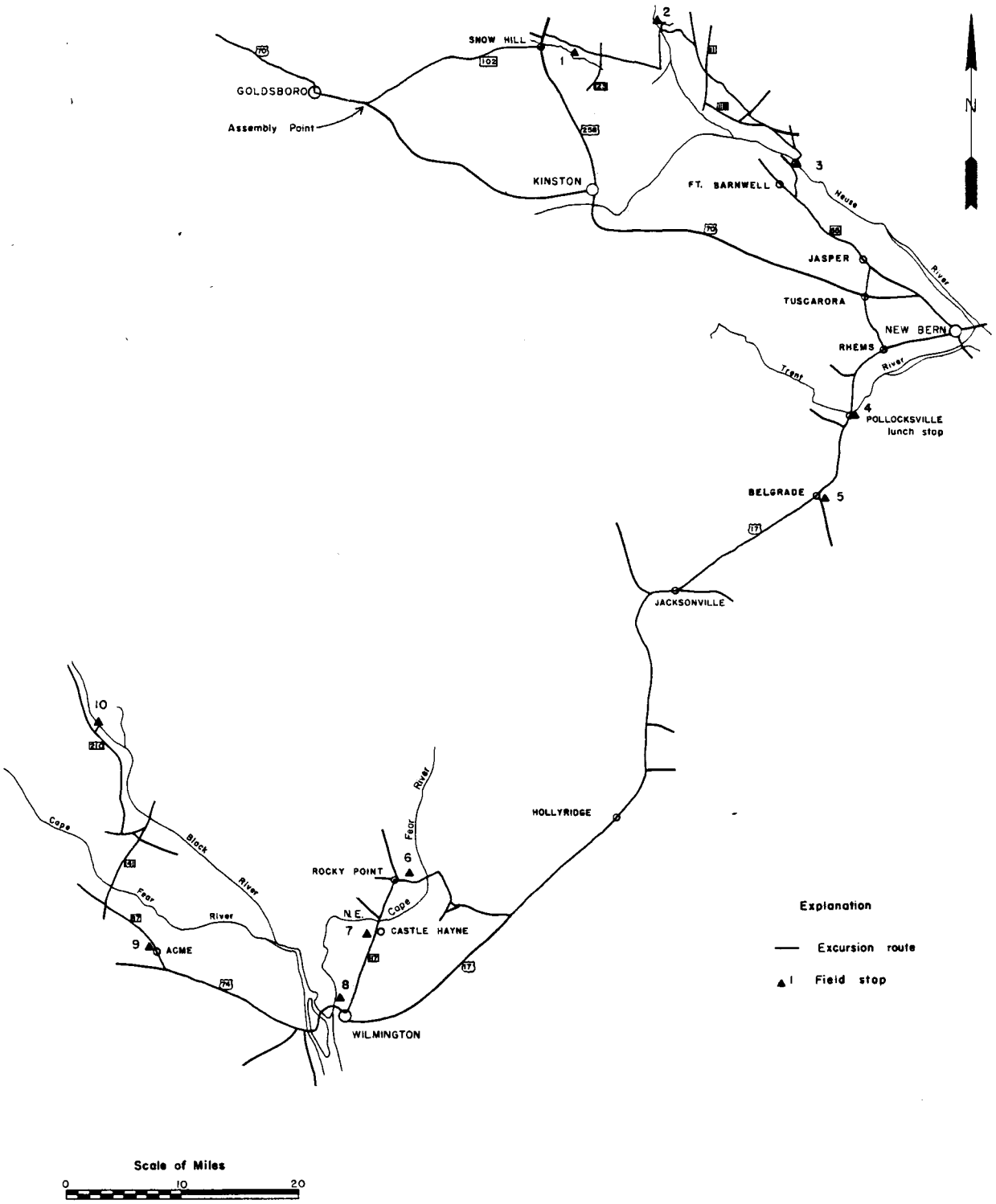

Figure 4. Excursion route and field trip stops.

33.2 **Stop 2** (Peedee formation). Small bluff on Little Contentnea Creek. For description see pages 11-12. Return to N. C. 102.

33.7 Turn right on N.C. 102 and return to paved road east of bridge at Little Contentnea Creek.

34.1 Turn left on paved road.

39.0 Cross N.C. 11.

39.5 Cross Atlantic Coast Line Railroad.

43.9 Road junction. Turn right on paved road.

44.1 Turn left on dirt road.

45.3 Junction of N.C. 118. Go eastward on N.C 118.

46.5 Craven County line.

47.4 Turn right on dirt road.

48.9 Turn right on paved road.

49.5 Turn right on paved road toward Fort Barnwell.

50.4 Crossing of Neuse River

50.8 **Stop 3** (Yorktown formation and Castle Hayne limestone). For description see pages 12. Continue on Fort Barnwell road.

51.0 Turn left on paved road.

53.4 Junction of N.C. 55. Turn left on N.C. 55.

55.1 Pond on left penetrated finely glauconitic sandy clay containing abundant Castle Hayne microfauna.

62.6 Jasper School.

63.1 Turn right on Tuscarora road.

65.6 Cross U.S. 70 and railroad.

72.3 Rhems. Turn right on U.S. 17.

73.1 Jones County line.

77.7 Pollocksville. Turn left at first road south of Trent River bridge. Park at Atlantic Coast Line Station.

Stop 4 (Castle Hayne limestone_. Assemble near railroad trestle. For description see pages 12-13.

Lunch stop. After lunch continue southward on U.S. 17.

86.4 Onslow County line.

87.0 Turn left to quarry.

Stop 5 (Yorktown formation and Castle Hayne limestone). Quarry of Superior Stone Co. For description see pages 13.

88.3 Return to U.S. 17 and continue southward toward Jacksonville.

93.6 Fire tower. Oil test 2 miles southward, drilled in 1953, hit basement at about 1,540 feet.

102.7 Jacksonville. Refreshment stop. Continue southward on U.S. 17.

120.2 Junction N.C. 172. Continue southward on U.S. 17.

124.4 Holly Ridge. Site of Camp David during Second World War. Wells at the camp yielded large amounts of water from the Castle Hayne limestone, the top of which is about 130 feet below the surface. Overlying material is post-Miocene sand and shells, containing no evidence of the Yorktown formation.

137.4 Hampstead. Turn right at Richfield station on Rocky Point road.

141.1 Turn right on Rocky Point road.

141.2 Turn right to Rocky Point.

148.2 Iron bridge over Northeast Cape Fear River.

148.9 Turn right on dirt farm road through open field.

149.5 **Stop 6.** Marl pit (Castle Hayne limestone) on Trask farm. For description see pages 13-14. Return to paved road.

150.1 Turn right and continue to Rocky Point.

152.4 Turn left on U.S. 117. In the vicinity of Rocky Point and Castle Hayne, the Castle Hayne limestone is within 10 or 20 feet of the surface. Shallow sinks are common in this area.

156.0 Junction N.C. 210.

157.8 **Stop 7** (Castle Hayne type locality). For description see pages 14. Return to U.S. 117.

160.1 Turn right, following U.S. 117 into Wilmington.

167.1 Wilmington. End of Saturday's trip.

Sunday, October 9, 1955

Assembly time:

9:00 a.m.

Assembly point:

Hilton Park, at the Wilmington Water Works, on the east side of the Northeast Cape Fear River a short distance north of the bridge. Follow U.S.117 northward from the Cape Fear Hotel, turning left on North Fourth Street at the old Plate Ice Co.

Mile

0.0 **Stop 8** (Peedee formation). This is also the site of the Hilton Park well, which penetrated basement rocks. For description see page 14. Return to U.S. 117 and cross bridge on U.S. 74.

3.6 Crossing of U.S. 74 over Northeast Cape Fear River.

5.2 Mothball fleet of Liberty ships on left.

6.1 Junction of U.S. 17. Continue on U.S. 74.

9.8 Leland School.

20.7 **Stop 9** (Duplin marl (?) and Peedee formation). For

description see page 14. Continue on dirt road to junction of N.C. 87 in Acme.

21.9 Turn left on N.C. 87.

27.4 Junction of N.C. 141. Turn right on N.C. 141.

28.9 Crossing of Cape Fear River. A thin bed of weathered chalky limestone, the Duplin marl, underlain by dark-gray sand and clay of the Peedee formation. Some of Duplin Ostracoda are: *Hemicythere conradi* Howe and McQuirt, *Favella rugipunctata* (Ulrich and Bassler), *Trachyleberis martini* (Ulrich and Bassler), and *Trachyleberis vaughni* (Ulrich and Bassler). Among the Peedee Ostracoda are: *Trachyleberis communis* (Israelsky), *Cytheridea (Haplocytheridea) ulrichi* (Berry), *Bachycythere rhomboidalis* (Berry), and *Eucytherura curta* (Jennings).

33.1 Junction of N.C. 210. Turn left on N.C. 210. Well on left 116 feet deep yielded water with a chloride content of 4,800 parts per million. Two miles southwest is a salt-water spring, the only one known above high tide on the Atlantic coast north of Florida. It is thought that a faulting the Peedee formation allows salty artesian water to rise to the surface in this area

36.2 Junction of N.C. 53.

36.8 Turn right on N.C. 210.

39.2 Colly Creek.

51.9 Turn right on paved road toward Kerr.

52.9 **Stop 10**. South River bridge (Black Creek formation). For description see pages 14-15.

End of excursion

DESCRIPTION OF LOCALITIES

Stop 1. Type Locality: Snow Hill Member of the Black Creek Formation.

On the farm of L.C. Daniels (Stop 1) along Contentnea Creek, about 2 miles below Snow Hill, is an accessible exposure of the Snow Hill member of the Black Creek formation. The Snow Hill is exposed upstream and downstream, a mile or more in either direction. Most exposed sections show megafossils only as ill-preserved casts and molds. At intermittent and discontinuous points along this stretch of the stream are thin sandy glauconitic layers containing finely broken and disseminated shells, and also, a preserved microfauna.

At this point the Snow Hill member consists of a 5- or 6-foot thickness of drab-black arenaceous and micaceous clays containing an abundant but fragile assemblage of megafossils. Thickness of the exposed section is variable with seasonal fluctuations in river level; about 6 feet should be exposed at average October water levels. Diagnostic megafossils include:

Ostrea blackensis Conrad
Exogyra ponderosa Roemer
Lucina glibula Conrad

Foraminifera present include:

Vaginulina taylorana Cushman
Frondicularia frankei Cushman
Robulus pseudo-secans Cushman
Lenticulina sp.
Bullopora sp.

Diagnostic Ostracoda include:

Brachycythere sphenoides (Reuss)
Brachycythere nausiformis Swain
Trachyleberis gapensis (Alexander)
Brachycythere ledaforma (Israelsky)
Orthonotacythere tarensis Brown (in M.S.)

Conrad, in 1871 gave the type locality for the Snow Hill member as being at Snow Hill along the banks of Contentnea Creek. Subsequent investigators, however, have not found the type locality as described by Conrad. L.W. Stephenson (1923, p.15) has described an outcrop along a scarp forming the northern limits of the town of Snow Hill behind what is presently the American Legion Hall; this exposure is now largely covered by slumped material and manmade rubbish. The exposure at the present stop generally conforms with Conrad's description in other respects and is the first and only stretch of the creek downstream from the town of Snow Hill that contains a recognizable macrofauna reasonably well preserved. Therefore, as a matter of record and for the purposes of this excursion the writers consider Stop 1 to be the type locality of the Snow Hill member, as designated by Conrad.

Stop 2. Scuffleton: Peedee Formation

At this stop on the farm of E.H Rogers are several exposures of the Peedee formation along Little Contentnea Creek and its tributaries. A fresh exposure may be noted on the east bank of the creek several tens of feet upstream from the bridge at Scuffleton.

The exposure is unique in North Carolina in that it contains three contrasting lithologic units each of which carries a diagnostic microfauna; these faunas range from one closely allied to the Snow Hill fauna, in the basal unit, to one reflecting marked Paleocene affinities, in the uppermost unit.

The uppermost unit, about 4 feet thick, is a grayish-green glauconitic, argillaceous sand moderately indurated; at its top it contains a hard indurated zone composed mainly of the valves of *Exogyra costate* Say in a hard calcareous matrix. The middle unit, about 8 feet thick, consists of drab-gray arenaceous and micaceous marine clays with minor amounts of glauconite; it contains *Ostrea falcata* Morton, *Belmnitella americana* Morton, and, in its lower fourth, Exogyra costata Say and Exogyra cancellata Say. The lowermost

unit, about 2 feet thick and separated from the middle unit by a hard indurated shell layer containing abundant phosphate nodules, sharks teeth, and well-rounded pebbles, is a black arenaceous and micaceous clay marl with finely disseminated particles of lignitized plant remains. Fossils characteristic of this unit are *Exogyra concellata* Say and *Ostrea subspatulata* Morton.

The lowermost unit, containing a microfauna which resembles closely that of the Snow Hill member, marks the transition zone between the Snow Hill member and the overlying Peedee formation.

The middle unit is characterized faunally by the large increase in number and size of Foraminifera, the dominant families being the Anomalinidae, the Lagenidae, and the Verneulinidae.

Characteristic species are:

Vaginulina wadei Kelly
Nodosaria affinis Reuss
Dentalina gracilis D'Orbigny
Clavulinoides trilatera (Cushman)
Frondicularia clarki Bagg
Planulina taylorensis (Carsey) Cushman

It is estimated that this unit contains about 70 species of Foraminifera which are common to abundant.

The uppermost unit, the greensand, is characterized faunally by the increase in pelagic forms, the decrease in the size of individuals, the absence of the Verneulinidae in a dominant role, and the close affinities of species to those species occurring elsewhere in the Paleocene.

Although zonation of the three units on the basis of Ostracoda is practical, only a few diagnostic species from the exposure as a whole are listed:

Alatacythere alata atlantica Schmidt
Brachycythere rhomboidalis (Berry)
Bairdoppilata pondera Jennings
Velarogythere arachoides (Berry)
Cytheridea (Haplocytheridea) fabaformis (Berry)
Cytherelloidea swaini Brown (in M.S.)

Stop 3. Castle Hayne (Eocene) Overlain by the Yorktown (Miocene)

In the abandoned marl pit on the Cannon property are exposures of the Yorktown formation, about 3 feet thick, which are predominantly large megafossils in a tan sandy matrix. Underlying the Yorktown is the Castle Hayne, several feet thick as exposed, consisting of a thin hard recrystallized limestone in the upper third and grading into a moderately indurated cream-colored marl of variable hardness in the lower two-thirds. Large black phosphate pebbles and nodules from the weathered surface of the Castle Hayne limestone are prominent on the floor of the pit. Where these pebbles have been removed, the surface of the limestone is coarsely pocked.

The Yorktown formation at Fort Barnwell represents an erosional remnant of the main body which lies to the east and north. Richards (1950, p.26) states that 25 species of macrofossils have been identified from the Yorktown at Fort Barnwell.

Characteristic are:

Arca bella Conrad
Cardita arata Conrad
Glycymeris subovata Say

Diagnostic Ostracoda are:

Favella rugipunctata (Ulrich and Bassler)
Trachyleberis vaughni (Ulrich and Bassler)
Loxoconcha subrhomboidea Edwards
Hemicythere conradi Howe and McQuirt

The Castle Hayne limestone at this exposure is part of the main body. Wells in the area penetrate 30 or 40 feet of the formation above the underlying Peedee.

Characteristic Ostracoda are:

Cytheretta alexanderi Howe and Garrett
Brachycythere watervalleyensis Howe and Garrett
Haplocytheridea montgomeryensis Stephenson

At a farm less than one-fourth of a mile west of this locality and at the same elevation, the following Ostracoda were identifies from a pile of marl excavated in the digging for a farm pond:

Trachyleberis rukasi (Gooch)
Trachyleberis hilgardi (Howe and Garrett)
Trachyleberis stenzeli (Stephenson)
Brachycythere martini Murray and Hussey

This suite is indicative of a Claiborne age and in all probability underlies the thin mantle of Castle Hayne limestone which contains a dominant Jackson fauna here at Stop 3.

Stop 4. Pollocksville: *Ostrea georgiana* Facies of the Castle Hayne Limestone

At the north end of the railroad trestle the outcrop to be examined is a massive shell bed composed largely of the valves and fragments of vales of the oyster *Ostrea georgiana* Conrad in a reddish sandy silt matrix. From 10 to 12 feet is exposed, dependent upon the water level in the Trent River. This is the section that caused Miller (Clark and others, 1912) to designate the Trent marl as middle Eocene in age. Since Miller's work *Ostrea georgiana* has been found to be restricted to the upper Eocene, and the present writers include the containing deposit in the Castle Hayne, although recognizing it as a distinctive facies. Kellum (1926), after studying the Trent and Castle Hayne macrofaunas, concluded that the Trent was of early Miocene age, separated from the underlying Castle Hayne limestone of Jackson age by an erosional unconformity. The majority of Kellum's Trent species came from a marl pit in the vicinity of Silverdale, North Carolina, a locality which is not mentioned by

Miller and which is some 17 miles from the type locality along the Trent River. Recent work by the writers has shown that Kellum's as lower Miocene are in part of Castle Hayne age and in part of Yorktown age. Therefore, the original Trent of Miller is moved from the middle Eocene to the upper Eocene and included within the Castle Hayne, and is not a reversal for the section as proposed by Kellum in 1926. The writers have pointed out the need for abandoning the name Trent.

Several outcrops of these distinctive shell beds are prominent in the immediate area. Test holes show that the material becomes considerably harder with depth and grades into the coarser shell rock which is typically exposed along the Trent River at New Bern and intermediate points.

In addition to *Ostrea georgiana* Conrad, *Ostrea trigonalis* Conrad was reported from this vicinity by Kellum (p.17). Swain (1952, p.6) has reported the Ostracoda *Leguminocythereis scarabaeus* Howe and Garrett from this locality. Diagnostic Foraminifera, which indicate a Jackson affinity, are:

Nonion advenum (Cushman)
Nonion inexcavatum Cushman and Applin
Discorbis alveata Cushman
Eponides jacksonensis Cushman and Applin
Siphonia jacksonensis Cushman and Applin
Eponides cocoaensis Cushman
Cibicides lobatulus (Walker and Jacob)

Stop 5. Belgrade: Yorktown Formation Overlying the Castle Hayne Limestone

The following section is exposed in the west face of the west quarry of the Superior Stone Co.:

Feet	
10	Yorktown: Shell limestone, coquinoid, gray to tan; 80-90 percent shell material in a sandy matrix, altered by solution.
15	Yorktown: Shell rock, gray; composed mainly of the casts and molds of pelecypods; hardness variable, softer in the lower 3 feet. Material has been severely altered by solution, resulting in secondary recrystallization and dolomitization.
5	Castle Hayne: Sandy shell limestone or shell marl, gray; broken shell fragments in a sand and clay matrix predominate, loosely to well consolidated, depending on amount of calcareous material present.
Bottom of exposure covered by rubble from the quarry face.	

The apparent disconformity between the two zones within the Yorktown formation is regarded by the writers as a solutional rather than a depositional disconformity. Solution has been so active and has so altered the original material that formational correlation of the units shown in the exposure is discretionary. In such areas it has been necessary to establish stratigraphic sections in wells and to project such sections back to the outcrop, a reversal of the usual procedure. Such methods indicate that the Yorktown occurs as a thin disconnected blanketing deposit throughout the immediate area and that it covers the Castle Hayne limestone. When it is understood that postdepositional solution has materially affected and altered the original strata, it can readily be seen that original bedding contacts as revealed in exposures such as this will be masked and that the placing of formational contacts will necessarily be arbitrary or discretionary. No microfauna is listed from this locality. Recrystallization has made identification of microfossils extremely difficult.

Stop 6. Trask Farm: Castle Hayne Limestone

At this stop the exposure to be examined is a typical artificial excavation or marl pit a few feet deep, where marl has been dug for local use and broadcast over the surrounding fields as a lime fertilizer. The water table is so close to the surface that such pits are often utilized as large dug wells, a source of water for irrigation.

This exposure is atypical because of the large number and variety of megafossils on the spoil banks around the pit. Characteristic fossils include:

Fissuridea penderensis Kellum
Linthia hanoverensis Kellum
(*Endopachys maclurei Terebratula*) *crassa* Kellum
Venericardia nasuta Dall?

The undisturbed material along the banks of the pit, several feet thick, consists of a cream-colored to yellow shell marl. About 85 percent of the material is composed of shell or shell fragments; the remaining 15 percent is a fine white calcareous silt and clay. Foraminifera from this undisturbed layer include the following:

Lagena orbignyana (Seguenza) var. *semiconcentrica* Cushman
Lagena costata Cushman
Marginulina cocoaensis Cushman
Guttulina spicaeformis Roemer
Nodosaria latejugata (Gumbel)
Uvigerina cookei Cushman

Ostracoda include:

Loxoconcha jacksonensis Howe and Chambers
Trachyleberis montgomeryensis (Howe and Chambers)
Cytheropteron montgomeryensis Howe and Chambers
Cytherelloidea danvillensis var. Howe and Chambers

Attention is called to scattered aggregates and small boulders of a hard gray shell rock composed mainly of casts and molds of pelecypods. These boulders are scattered around the edge of the pit. This material is considered to be

identical with the material observed at he Belgrade quarry. Here, the material is associated with, and underlies, the yellow marl.

Stop 7. Castle Hayne: Type Locality of the Castle Hayne Limestone

At the type locality are several contrasting lithologic units, a feature that is characteristic of the Castle Hayne in other localities as well. The pit is now filled with water and observations are limited to the material remaining on and around the banks. According to Miller (Clark and others, 1912, p. 190) about 11 feet of limestone was exposed while the quarry was in operation, and at a shallow depth below the limestone was the Peedee formation of Cretaceous age.

The predominant lithologic unit is a hard gray shell limestone. The shells remain as casts or molds and the material is in varying stages of decomposition while containing large solution cavities. Parts of this limestone are conglomeratic and contain large solution cavities. Parts of this limestone are conglomeratic and contain large pebbles and nodules of phosphate; where these pebbles have been loosened from the enclosing matrix and moved, the surface has a coarsely pocked appearance.

A contrasting lithology is shown by the occurrence of a yellow, rotten shell marl somewhat similar in composition to that observed at the previous stop, but with a larger percentage of calcareous clay occurring as a matrix. Megafossils from this locality identified by Kellum were:

Ostrea trigonalis Conrad
Pecten (Chalmys) membranosus Morton
Nautilus carolinensis Kellum

The microfauna represents a fauna similar to that occurring at the previous stop though not as abundant nor as well preserved. Microfossils conspecific with those listed from the previous stop have been collected at this locality.

An appraisal of the type locality of the Castle Hayne limestone is necessary prior to any evaluation of the Tertiary lithic units observed farther east. Such an appraisal will further show the wide variation in composition, color, and hardness which exists in the Castle Hayne limestone. The type locality then serves as a faunal type locality rather than merely a lithologic type locality. The microfossils obtained from the type locality, which the writers consider to indicate a Jackson age, are present in other Castle Hayne localities previously visited on this excursion as well as in downdip sections. The foregoing is mentioned to point out that the general lithologic criteria useful in correlation have only limited application, mostly local, in the case of the Castle Hayne limestone.

Stop 8. Hilton Park at Wilmington: Peedee Formation

The Peedee formation in this exposure, about 12 feet thick, consists of drab, black to gray, glauconitic, micaceous sands and clays containing freshly broken shells in thin layers. The microfauna at this stop is not comparable to that at Scuffleton (Stop 2). Here Foraminifera consist of abundant but dwarf forms, primarily of the family Anomalinidae. The Ostracoda are fewer in number and species than at most Peedee exposures.
They include:

Eucytherura curta (Jennings)
Brachycythere rhomboidalis (Berry)
Orthonotacythere hannai (Israelsky)
Trachyleberis pidgeoni (Israelsky)

This locality has geologic interest because of a well that was drilled to basement rock. T.W. Stanton, who picked the Peedee-Black Creek contact in this well, recognized 720 feet of Peedee and 389 feet of Black Creek above the granite basement encountered at about 1,100 feet (Clark and others, p. 163). This is the thickest section of the Peedee formation to be reported from the North Carolina Coastal Plain. Recent determinations of the Ostracoda from this well places the Peedee-Black Creek contact at about 720 feet, substantiating Stanton's findings.

Stop 9. Acme: Peedee Overlain by the Duplin Marl (?)

On the farm of J.W. butler is a large artificial excavation formerly worked by the Acme Fertilizer Co. The Peedee formation exposed in the bottom of the pit was used as a filler for commercial fertilizers. About 5 feet of the Peedee is exposed above water level. The exposure consists of glauconitic sands and clays with several moderately hard indurated zones near its base. Megafossils are rare although *Exogyra costata* has been reported. Microfossils are predominantly Foraminifera, small dwarf forms of the family Anomalinidae being most common. No attempt has been made at further identification.

Overlying the Peedee are coarse shell beds; the shells, excellently preserved, occur in a tan sandy matrix. The exposed section is variable because of slumping, but several feet are exposed below the southeast rim of the pit. Overlying the shell beds are several feet of tan sands and clays of post-Miocene age. See page 12 for a list of diagnostic Miocene Ostracoda from this locality.

Stop 10. River Crossing at Kerr: Black Creek Overlain by post-Miocene Material

This last stop was included because of the unusual sedimentary features that are preserved in the exposure. The following section, exposed in the ditch behind the roadcut on the north side, starts at the base of the tree trunks.

Feet

1 Post-Miocene: Light-tan to white sands containing

well-rounded white pebbles and cobbles.

8 Black Creek: Black laminated clays and interbedded lenticular sands. Green sandy glauconitic layers in lower third.

0 Black Creek: Floor of ditch; gray clay, tight and very compact, iron-stained.

On the south side of the roadcut the following section is exposed:

Feet

6 Post-Miocene: Sand, white to tan, medium-grained, and thin interbedded clay lenses.

8 Post-Miocene: Black sands and intermixed peaty material.

2 Black Creek: Interbedded sands, tan to gray, with thin clay partings, passing westward into curved and truncated crossbedded sands separated by thin clay laminae. Curved crossbedded sands contain small white pebbles in elongate layers

Feet

7 Black Creek: Drab-gray to black sands with minor interbedded clay lenses, becoming increasingly argillaceous and heavily glauconitic toward the base.

Crossbedding in fossiliferous sections of the Black Creek is very rare. Indications at this sop point to a minor regression of the sea and almost contemporaneous reworking, followed by a transgressive encroachment of the sea, all during Black Creek time. The material overlying the Black Creek at this stop probably represents lateral accretion deposits in a flood plain.

Casts of several pelecypods have been observed in clays in the ditch on the north side of the roadcut. Foraminifera in the glauconitic materials at the base of the exposure are primarily planktonic *Globigerina* sps. And have not been identified.

REFERNCES

Berry, E. Wilber, 1910, Geologic relations of the Cretaceous floras of Virginia and North Carolina: Geol. Soc. America Bull., v.20, p. 655-659.

Berry, E. Willard, 1947, Marls and limestones of eastern North Carolina: N.C. Dept. Conserv. and Devel. Bull. 54, 16 p.

_____1948, North Carolina Coastal Plain floor: Geol. Soc. America Bull., v. 59, p. 87-89.

Clark, W.B., Miller, B.L., Stephenson, L.W., Johnson, B.L., and Parker, H.N., 1912, The Coastal Plain of North Carolina: N.C. Geol. and Econ. Survey, v.3, 552 p.

Conrad, T.A., 1871, Points connected with the Cretaceous and Tertiary of North Carolina (letter excerpt): Am. Jour. Sci., 3d. ser., v. 1, p. 468-469.

Cooke, C. Wythe, 1936, Geology of the Coastal Plain of South Carolina: U.S. Geol. Survey Bull. 867, 196p.

Dorf, Erling, 1952, Critical analysis of Cretaceous stratigraphy and paleobotany of Atlantic Coastal Plain: Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2161-2184.

Gardner, Julia, 1943, Mollusca from the Miocene and lower Pliocene of Virginia and North Carolina; Part 1, Pelecypoda: U.S. Geol. Survey Prof. Paper 199-A, p. 1-178.

_____ 1948, Mollusca from the Miocene and lower Pliocene of Virginia and North Carolina; Part 2, Scaphopoda and Gastropoda: U.S. Geol. Survey Prof. Paper 199-B, p. 179-310.

Kellum, L.B., 1926, Paleontology and stratigraphy of the Castle Hayne and Trent marls in North Carolina: U.S. Geol. Survey Prof. Paper 143, 56 p.