EUTREPHOCERAS (NAUTILOIDEA) FROM THE PALEOCENE BEAUFORT FORMATION OF NORTH CAROLINA

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ABSTRACT

Well preserved specimens of *Eutrephoceras sloani* Reeside, collected from a recently exposed outcrop of the Paleocene Beaufort Formation in east-central North Carolina, represent the first reported Paleocene nautiloids from Coastal Plain strata of North Carolina. This species was formerly known only from the Paleocene Black Mingo Formation in eastern South Carolina, about 280 km southwest of the North Carolina Paleocene outcrops. The North Carolina specimens allow clarification and elaboration of Reeside's original description.

INTRODUCTION

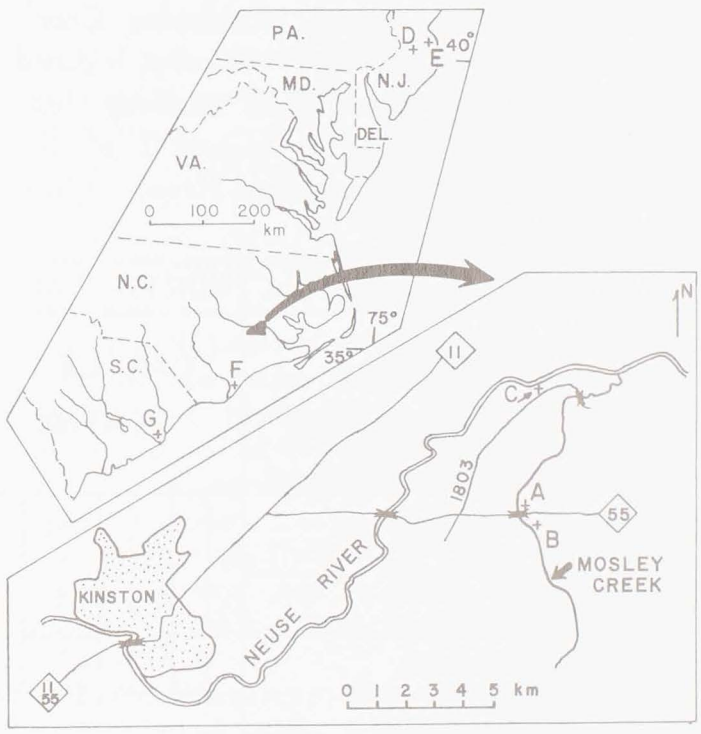
Fossil nautiloids are generally rare in Paleocene strata of the Atlantic Coastal Plain. This scarcity of nautiloid specimens probably results in part from a rather limited area of Paleocene outcrop; however, ecological factors may also be important.

A recently exposed Paleocene outcrop in east-central North Carolina yielded well preserved nautiloid specimens. These nautiloids, identified in this paper as *Eutrephoceras sloani* Reeside, represent the first reported Paleocene cephalopods from North Carolina. The discovery of *E. sloani,* approximately 280 km northeast of the eastern South Carolina outcrop from which it was previously known, allows a significant extension of the geographic range of the species (text fig. 1).

A difficulty encountered in the study of the genus *Eutrephoceras* is that Paleocene and Eocene species from the Atlantic Coastal Plain are represented by few specimens. Little is known of the range of variation of most of the species discussed in this paper. Kummel (1956, p. 379) stated that species in the long ranging *Eutrephoceras* generic group seem to be gradational and generally lack definitive morphological features. The most important diagnostic characteristics for separation of species seem to be conch shape and suture pattern. Specimens of *Eutrephoceras* frequently have been subjected to post-depositional compression, which greatly distorts the conch shape, and complicates the separation of species. Detailed consideration of suture patterns adds objectivity to the rather general comparisons that have been made among species of *Eutrephoceras* in the past. All of the suture patterns (text fig. 5) used for species comparisons were taken from type specimens. Most of these suture patterns have not been illustrated and compared graphically.

STRATIGRAPHY

The new North Carolina outcrop consists of 1.4 m of Paleocene strata which is dis-



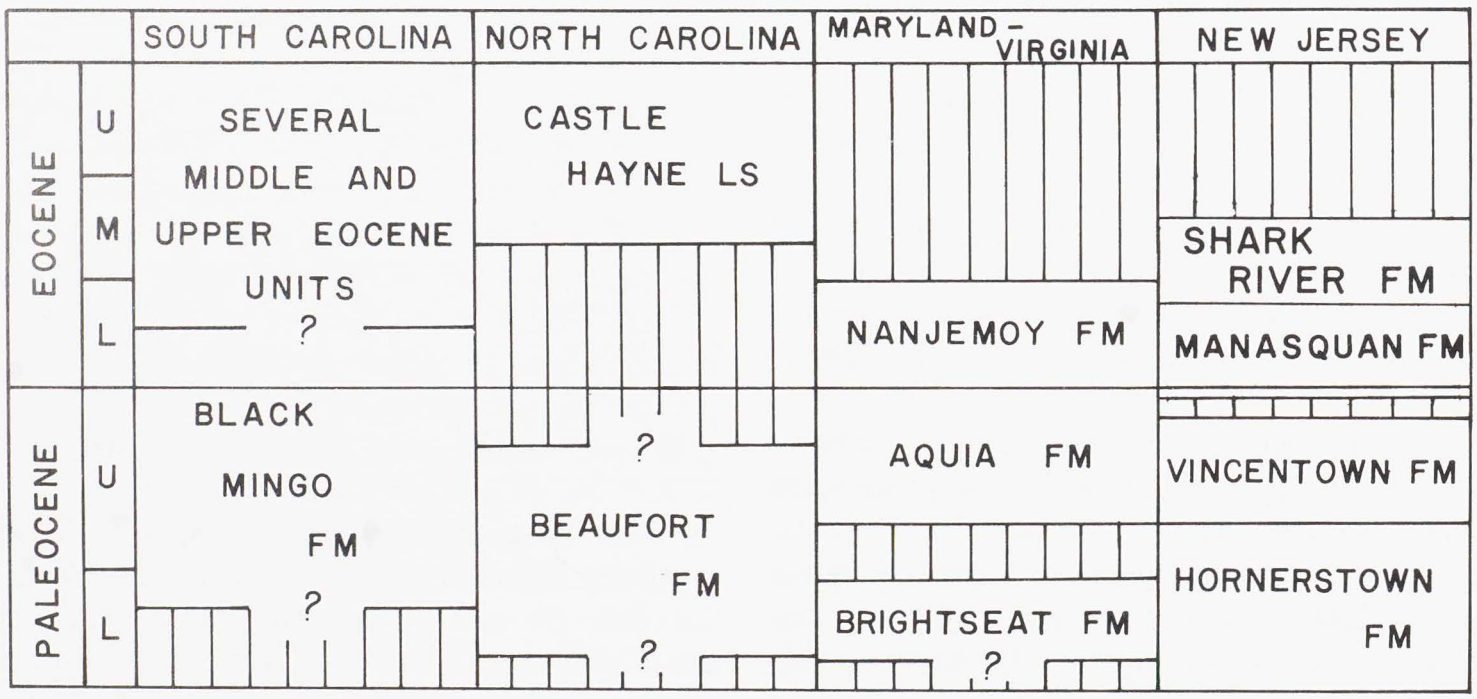
Text fig. 1, Index map showing collection localities for *Eutrephoceras sloani* in North Carolina (A and B, specimens collected *in situ);* locality of the first Paleocene outcrop reported from North Carolina (C); and collection localities of other species discussed in this paper, (D) *E. bryani,* (E) *E. cookanum,* (F) *E. berryi* and *E. carolinensis,* (G) *E. sloani.*

continuously exposed along the banks of Mosley Creek, a northward flowing tributary of the Neuse River. Along portions of the creek, Paleocene rocks are disconformably overlain by about 0.3 m of the Eocene Castle Hayne Limestone (text fig. 3). The Paleocene-Eocene unconformity is marked by a significant lithologic change. Paleocene fossils and clasts of indurated Paleocene sediment have been reworked into the basal Eocene strata, which overlies an undulating erosional surface.

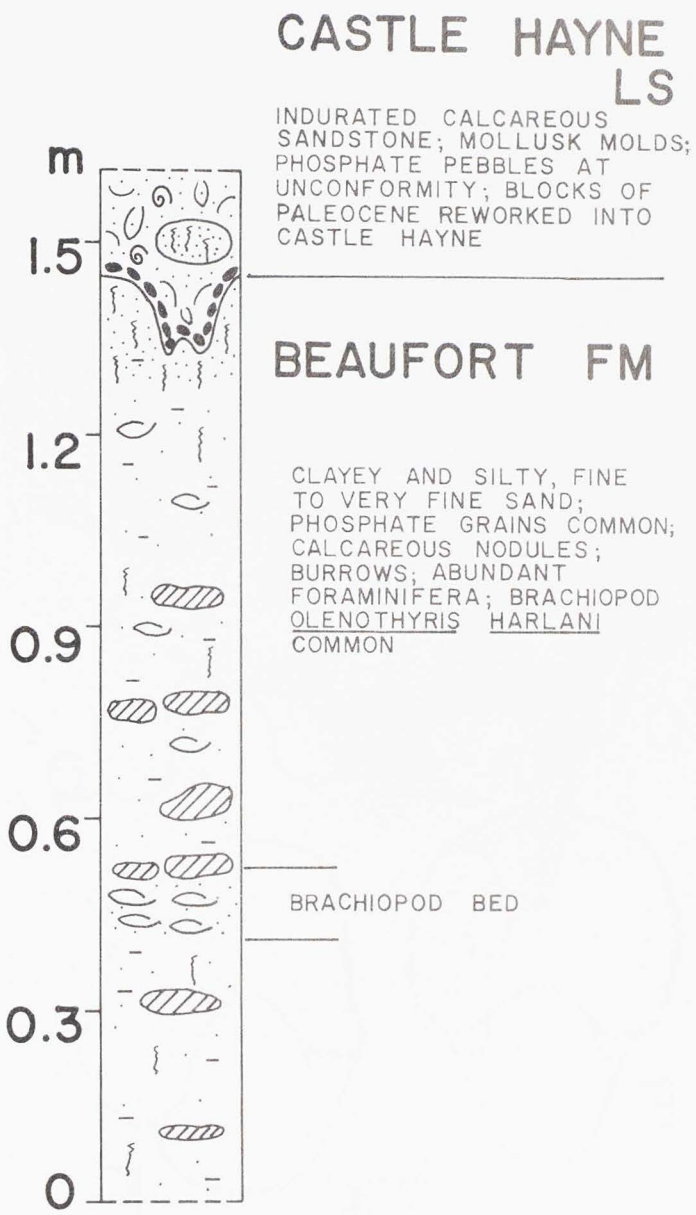
Swift and Heron (1969, p. 229) were the first to record the presence of Paleocene rocks cropping out in North Carolina. Their Danian (lower Paleocene) age was assigned on the basis of planktonic foraminifera collected from an outcrop at West Landing on the Neuse River near the nautiloid locality discussed in this paper (text fig. 1). At the Neuse River outcrop, 1 m of thinly laminated Paleocene shale disconformably overlies 2 m of the Cretaceous Peedee Formation. Extensive exploration along the Neuse River between North Carolina state road 55 and the mouth of Mosley Creek revealed but one significant outcrop, located 3.5 km downriver from West Landing (text fig. 1). This exposure is identical to the section described by Swift and Heron (1969, p. 230) and implies that the Paleocene locality they discussed was inadvertently placed at West Landing. A thorough search of the Neuse River outcrop discussed above yielded no Paleocene macrofossils. Several poorly exposed outcrops of Paleocene shale were found along Mosley Creek, about 0.2 km south of the creek's mouth. No macrofossils were found at these localities.

Brown (1959, p. 8) established a subsurface Paleocene unit, the Beaufort Formation, which has been identified in many wells in east-central North Carolina.

Wilson (1972, p. 129) identified two fossils commonly found in certain Paleocene rocks of New Jersey, the brachiopod *Olenothyris harlani* (Morton) and the bivalve "*Gryphaea vesicularis* (Lamarck)," from the outcrops along Mosley Creek. Wilson suggests that these rocks are probably an extension of the subsurface Beaufort Formation. Swift and Heron (1969, p. 229) assigned the Paleocene shale along the Neuse River to the Black Mingo Formation, a Paleocene-Eocene unit which crops out in South Carolina. Based on the lithologic similarity and the geographic proximity of the subsurface Beaufort Formation to the Paleocene rocks which crop out in east-central North Carolina, it seems logical to apply the name Beaufort Formation to both.



Text fig. 2. Correlations of Paleocene and Eocene units of part of the Atlantic Coastal Plain, modified after Loeblich and Tappan, 1957, p. 177; Hazel, 1968, p. 105; Enright, 1969, p. 17; and Olsson, 1970, p. 591.



Text fig. 3. Composite section of Paleocene strata exposed in the banks of Mosley Creek from 0.2 km north of N.C. Route 55 to 1.8 km south of N.C. 55. Top of section covered by Pleistocene? sands; base of section in creek bed.

Thomas Gibson identified the following species of planktonic foraminifera from the Paleocene rocks along Mosley Creek:

Truncorotataloides (Morozovella) aequa (Cushman and Renz)
T. (Morozovella) apanthesma (Loeblich and Tappan)
T. (Morozovella) angulata (White)
T. (Planorotalites) pusilla (Bolli)
T. (Planorotalites) pseudomenardii (Bolli)
T. (Acarinina) mckennai (White)
Globigerina (Subbotina) triloculinoides Plummer

This assemblage suggests an early late Paleocene age for the exposed Beaufort Formation (Gibson, pers. comm.).

In the Atlantic Coastal Plain, specimens of *Eutrephoceras* have been reported from the Paleocene Vincentown Formation and the middle Eocene Shark River Formation of New Jersey, the Eocene Castle Hayne Limestone of North Carolina, and the Paleocene-Eocene Black Mingo Formation of South Carolina (text fig. 2). Specimens of *Eutrephoceras* have not been reported from the rather well exposed Paleocene strata of Maryland and Virginia.

SYSTEMATIC PALEONTONOGY

Family NAUTILIDAE de Blainville, 1825
Genus EUTREPHOCERAS Hyatt, 1894
Type species: *Eutrephoceras dekayi* Hyatt, 1894

EUTREPHOCERAS SLOANI Reeside

Plate 1, figs. 1-4; Plate 2, figs. 1-4; text figs. 4, 5

Eutrephoceras sloani REESIDE, 1924, p. 1-7, pls. 1-3, text fig. 1.

Material. — Three internal molds; no original shell material; (Pl. 1, figs. 1-3) very slightly deformed conch with 8 camerae; (Pl. 1, fig. 4; Pl. 2, figs. 1-3) adapical portion of conch is severely crushed, adoral portion and living chamber slightly deformed; (Pl. 2, fig. 4) lateral compression has distorted form and suture pattern.

Description. — North Carolina specimens are involute, compressed with a very broadly arched venter and with gently arched, nearly parallel, lateral zones (text fig. 4), leading to an abrupt umbilical shoulder which forms a deeply impressed umbilicus, 12 to 15 mm in diameter. Maximum diameter of largest conch (Pl. 2, fig. 4) is about 150 mm, containing 12 camera to outer volution. Camerae of phragmacone expand rapidly and adoral portion of living chamber is flared. Living chamber, as preserved on two specimens (Pl. 2, figs. 1-4), consists of approximately one-third of the last volution. Siphuncle is holochoanitic, nearly central, perhaps slightly closer to dorsum than venter, and has a maximum diameter of 6 mm (Pl. 1, fig. 1).

External suture consists of a broadly and gently arched ventral saddle, a very gently arched, symmetrical lateral lobe, and a small umbilical saddle (text fig. 5). Internal suture consists of a gently arched dorsal lobe.

Discussion. — The holotype and only known specimen of *E. sloani* is an incomplete internal mold with much of the ventral portion and the adoral half of the last volution missing. The siphuncle, body chamber, and several partial sutures are preserved.

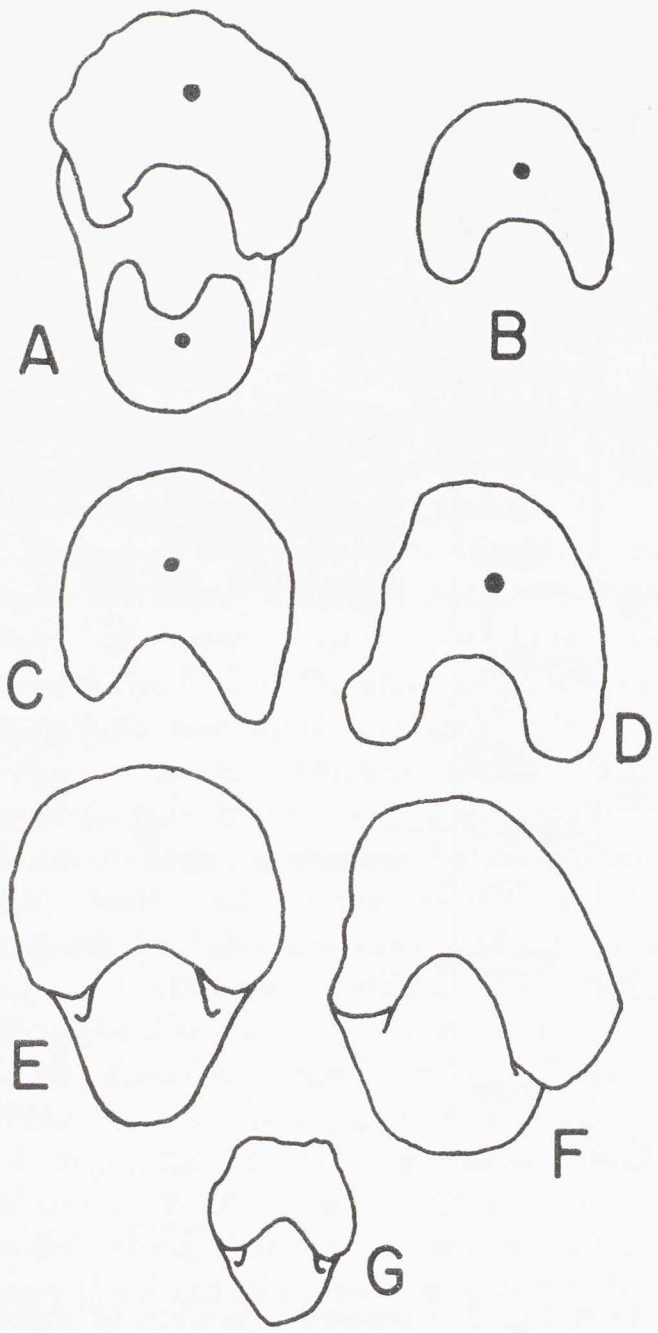
The suture diagrammed by Reeside (1924, p. 3, fig. 1) is atypical of the genus and appears to have been taken from a portion of the holotype that was deformed and eroded. The only intact suture on the holotype is illustrated in text fig. 5. As the holotype is badly deformed, the conch cross-section illustrated by Reeside (1924, p. 3, fig. 1) is difficult to evaluate; however, the cross-section appears to have been roughly equidimensional and very close in shape to the cross-section of the North Carolina specimens (text fig. 4). The external suture of *E. sloani* has a broad ventral saddle and a lateral lobe, similar to the sutures on the North Carolina specimens; however, the suture on the holotype is incomplete. The maximum diameters of *E. sloani* (140 mm) and that of the largest Mosley Creek specimen (150 mm) are similar. It is not known whether either specimen represents a mature individual.

A nearly perfect topotype? of *E. sloani,* listed on an old label in the tray with Reeside's type, unfortunately appears to have been lost. Based on the material I have studied, the similarities of the new specimens to *E. sloani* are great and although the holotype is poor the identification seems justified.

Four other species of *Eutrephoceras* have been found in Paleocene and Eocene formations of the Atlantic Coastal Plain.

The sutures of the North Carolina specimens and those of *E. cookanum* (Whitfield) from the Eocene Shark River Formation of New Jersey are nearly identical (text fig. 5). Reeside (1924, p. 4) stated that *E. cookanum* was broader in cross-section than *E. sloani;* however, the type specimens indicate that just the reverse may be true. (text fig. 4).

E. cookanum attains a large size, nearly 300 mm in diameter, which is much larger than *E. sloani.* Specimens of *E. sloani* (Pl. 2,



Text fig. 4. Whorl cross-sections of *Eutrephoceras* from the Atlantic Coastal Plain (all X 0.28): (A) *E. sloani,* hypotype USNM 219439, Beaufort Fm., (B) *E. sloani,* hypotype USNM 220133, Beaufort Fm., (C) *E. bryani,* holotype ANSP 16117, Vincentown Fm., (D) *E. cookanum,* after (Whitfield, 1892), Shark River Fm., (E) *E. berryi,* holotype USNM 559584, Castle Hayne Ls., (F) *E. sloani,* holotype USNM 352559, Black Mingo Fm., (G) *E. carolinensis,* after Kellum, 1926 , Castle Hayne Ls.

PLATE 1

Figs. 1-3. *Eutrephoceras sloani* Reeside
Beaufort Formation, Craven Co., North Carolina, USNM 219435, X 0.74

Fig. 4. *Eutrephoceras sloani* Reeside
Beaufort Formation, Craven Co., North Carolina, USNM 220133, X 0.97.

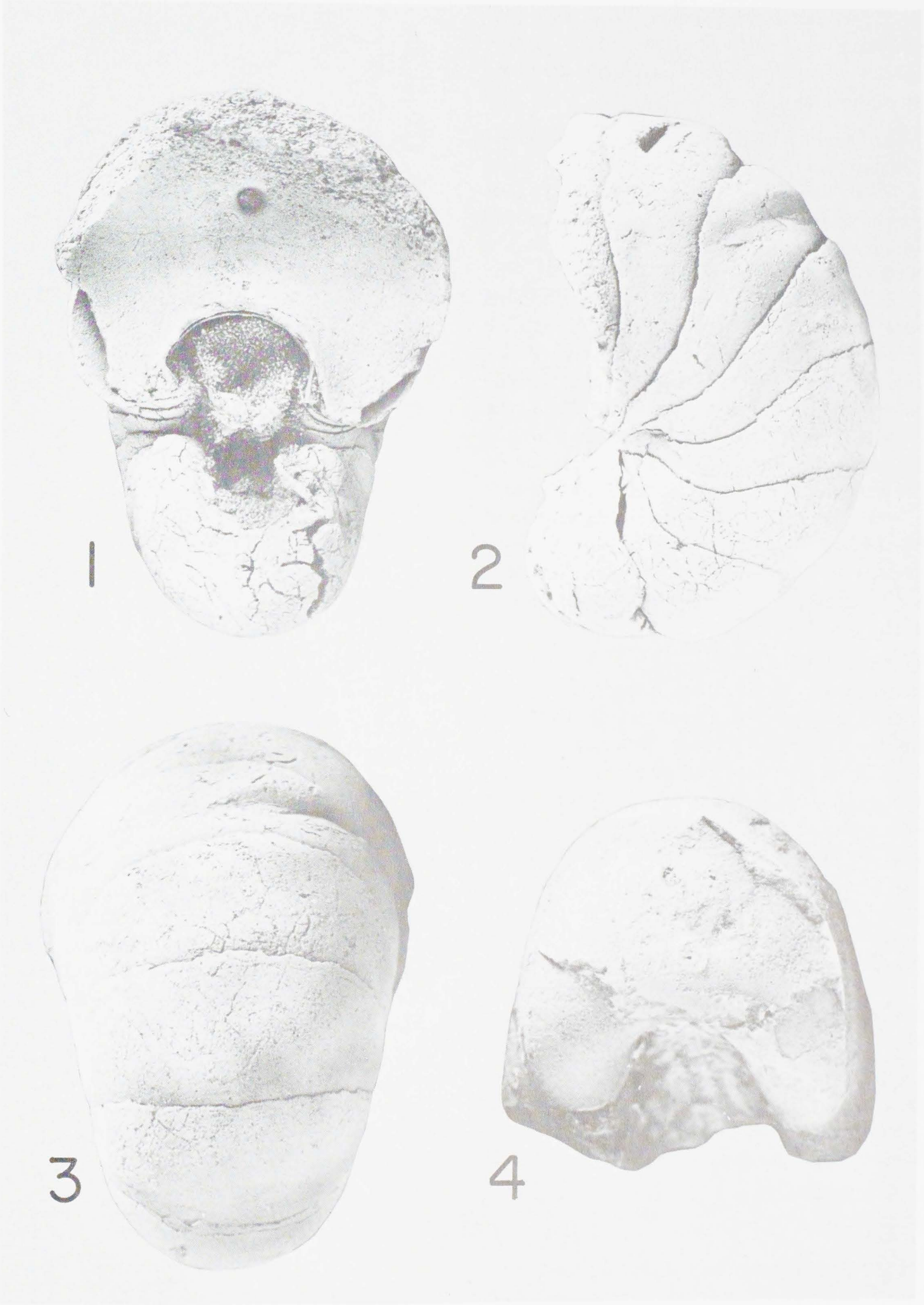


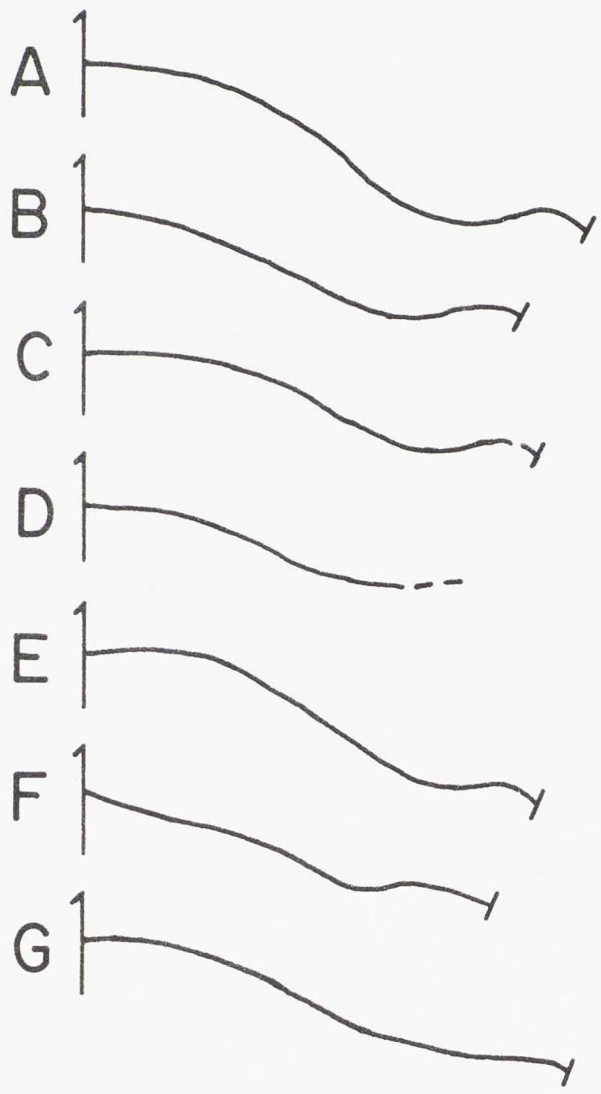
PLATE 1

figs. 1-4) and *E. cookanum* (Pl. 2, figs. 4-6) illustrate the difficulty of separating the species when the conchs have been distorted by compression.

E. bryani (Gabb) occurs in the Paleocene Vincentown Formation of New Jersey (text fig. 2). This species is narrower, expands much less rapidly, and has lateral zones which are more nearly parallel than the North Carolina specimens (text fig. 4). The external suture of *E. bryani* (text fig. 5) is very straight with a small lateral lobe. The internal suture has a small v-shaped annular lobe. Miller (1947, p. 30) stated that *E. cookanum* also has an annular lobe in the center of the dorsal lobe, a feature which is definitely not present on the internal suture of the Mosley Creek specimens. Stenzel (1940, p. 742) questioned the placement of *E. bryani* in the genus *Eutrephoceras* because of the presence of the annular lobe, a characteristic not typical of many species in the genus.

As one specimen (Pl. 2, fig. 4) was collected from the Paleocene-Eocene contact, species of *Eutrephoceras* from the overlying Eocene Castle Hayne Limestone were studied to eliminate the possibility that this specimen was Eocene in age. Two very broad and rounded species, *E. carolinensis* Kellum and *E. berryi* Miller occur in the Castle Hayne Limestone (text fig. 4). *E. berryi* has a broad shallow lateral lobe and a small umbilical saddle and *E. carolinensis,* a much smaller species, has an almost straight suture (text fig. 5). Both species, although of similar shape, possess straighter sutures than the Mosley Creek specimens.

Occurrence. – East bank of Mosley Creek, a northward flowing tributary of the Neuse River, which forms the boundary between Lenoir and Craven Counties; outcrop is



Text fig. 5. Suture patterns of species of *Eutrephoceras* from the Atlantic Coastal Plain (all X 0.63): (A) *E. sloani,* hypotype USNM 220133, Beaufort Fm., at dia. of 100 mm, (B) *E. sloani,* hypotype USNM 220134, Beaufort Fm., at dia. of 90 mm, (C) *E. sloani,* hypotype USNM 219435, Beaufort Fm., at dia. of 80 mm, (D) *E. sloani,* holotype USNM 352559, Black Mingo Fm., partial suture at dia. of about 75 mm, (E) *E. cookanum,* topotype AMNH 9775/2, Shark River Fm., at dia. of 80 mm, (F) *E. bryani,* holotype ANSP 16117, Vincentown Fm., at dia. of 75 mm, (G) *E. berryi,* holotype USNM 559584, Castle Hayne Ls., at dia. of 90 mm.

PLATE 2

Figs. 1-3. *Eutrephoceras sloani* Reeside
Beaufort Formation, Craven Co., North Carolina, USNM 220133, X 0.54.

Fig. 4. *Eutrephoceras sloani* Reeside
Beaufort Formation, Craven Co., North Carolina, USNM 220134, X 0.43.

Figs. 5-6. *Eutrephoceras cookanum* (Whitfield)
Shark River Formation, Monmouth Co., New Jersey, AMNH 9775/2, X 0.57.

PLATE 2

about 11 km northeast of Kinston, North Carolina. Two specimens collected *in situ;* (Pl. 2, figs. 1-3) about 20 m north of bridge where N.C. Route 55 crosses Mosley Creek, 0.3 m below the top of the outcrop or about 0.6 m below the Paleocene-Eocene contact exposed south of the bridge, collected by R.H. Bailey; (Pl. 2, fig. 4) about 370 m south of bridge, at Paleocene-Eocene contact, collected by D. Wilson, W.C. Blow, R.H. Bailey; (Pl. 1, figs. 1-3) collected from spoil banks adjacent to Mosley Creek by E.C. Womble, south of N.C. Route 55 bridge.

Holotype collected from type section of the Paleocene Black Mingo Formation at Perkins Bluff, west bank of Black River 4.9 km above the mouth of Black Mingo Creek, Georgetown County, South Carolina. Specimen found in silicified and laminated shale about 3 m above the contact with the Cretaceous Peedee Formation.

Types. – Holotype of *E. sloani* is deposited in United States National Museum (USNM 352559). Specimens of *E. sloani* from North Carolina are deposited in the United States National Museum (Pl. 1, figs. 1-3, USNM 219435; Pl. 1. fig. 4, Pl. 2. fig. 1-3, USNM 220133; Pl. 2. fig. 4, USNM 220134).

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