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BARNACLES OF THE JACKSONIAN (UPPER EOCENE) GRIFFINS LANDING MEMBER, DRY BRANCH FORMATION IN SOUTH CAROLINA AND GEORGIA

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Abstract

Auger drilling in the southwest quarter of the Seivern 15-minute quadrangle in east-central Aiken County, South Carolina encountered the Griffins Landing Member of the upper Eocene Dry Branch Formation at two localities between 109 and 115 m (360 and 378 ft) above sea level. Except for the absence of the giant oyster *Crassostrea gigantissima* (Finch), the faunal composition of the Griffins Landing Member in Aiken County is identical to that of the type locality in Burke County, Georgia.

Three barnacles were found in the Griffins Landing Member. The scalpelloids are represented by *Aporolepas howei* Cheetham, known from Jacksonian units in Mississippi and Alabama. The archaeobalanids are represented by *Kathpalmeria georgiana* Ross, originally described from the Griffins Landing Member at Shell Bluff upriver from the type locality in Burke County and tentatively identified from the Jacksonian Inglis Limestone of Florida, and a new species, *Hesperibalanus huddlestuni,* known only from the Griffins Landing Member. Differences in preservation and abundances of barnacle species indicate that the sediments of the Griffins Landing Member at the Aiken County sites were deposited closer to shore than those at the type locality and Shell Bluff. The absence of *Lophobalanus bauni* Zullo in the nearshore Griffins Landing sediments of Aiken County supports previous conclusions that the *Lophobalanus*-bearing buhrstones of west-central Aiken County are not part of the Dry Branch Formation.

Introduction

The Griffins Landing Member of the Dry Branch Formation was named by Huddlestun and Hetrick (1979, p. 24-25) for "fairly well-sorted, massive to rudely bedded, calcareous sand" exposed at Griffins Landing on the Savannah River in Burke County, Georgia (Fig. 1). The Griffins Landing Member also crops out upriver in Burke County at Shell Bluff (unit 6 of Herrick, 1960). At both localities the shells of the giant oyster *Crassostrea gigantissima* (Finch) are abundant (pl. 2, fig. M; pl. 3, fig. E). In addition to the oysters, this member is characterized by a rather unique assemblage of barnacles, decapod chelae, bryozoans, pectinid fragments, asterozoan plates, comatulid crinoid centrodorsals and arm ossicles, shark and ray teeth, and fish bones. The sand-size fraction of the sediment is composed predominantly of clear, subrounded, fine- to coarse-grained quartz, with individual sand beds being fairly well-sorted. The matrix is pure white micrite with some concentrations of smectite. In areas where severe leaching has not occurred, the sandy biomicrudite of the Griffins Landing Member is easily identified by its lithologic (including skeletal) components.

A sandy biomicrudite here attributed to the Griffins Landing Member was encountered within the Dry Branch Formation in two auger holes (McK localities 05, 06) drilled in the southwest quarter of the Seivern 15-minute quadrangle east of Aiken in east-central Aiken County, South Carolina (Figs. 1, 2). Huddlestun and Hetrick (1979, fig. 4: correlation chart) alluded to the presence of this unit in southern South Carolina, but did not cite localities. *Crassostrea gigantissima*-bearing beds near Baldock, Allendale County, first reported by Sloan (1908), and subsequently by Canu and Bassler (1920) and Gislén (1934), are here referred to the Griffins Landing Member. Herrick (1972) examined the foraminiferal fauna of the Baldock locality, which he correlated with the lower upper Eocene Clinchfield Sand of central Georgia and the Moodys Branch Formation in Alabama and Mississippi. In Aiken County, the Griffins Landing Member is quite thin (2.4-3.0 m, 8-10 ft thick) and lacks *Crassostrea gigantissima* shells, but is otherwise identical lithologically to the type section. Of particular interest is the excellent preservation of fossils, the majority of which are barnacles.

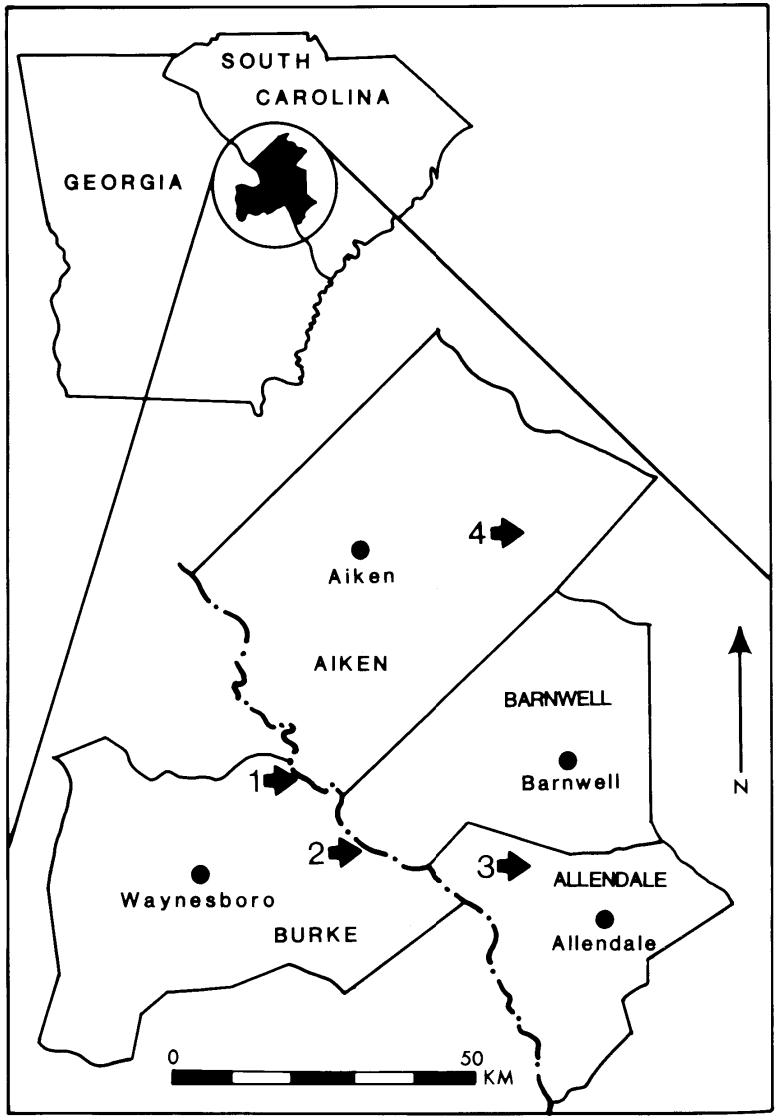

Figure 1. Generalized locality map for Griffins Landing Member collection sites in Georgia and South Carolina. 1) Shell Bluff, 2) Griffins Landing, 3) Baldock, 4) auger holes, Seivern quadrangle.

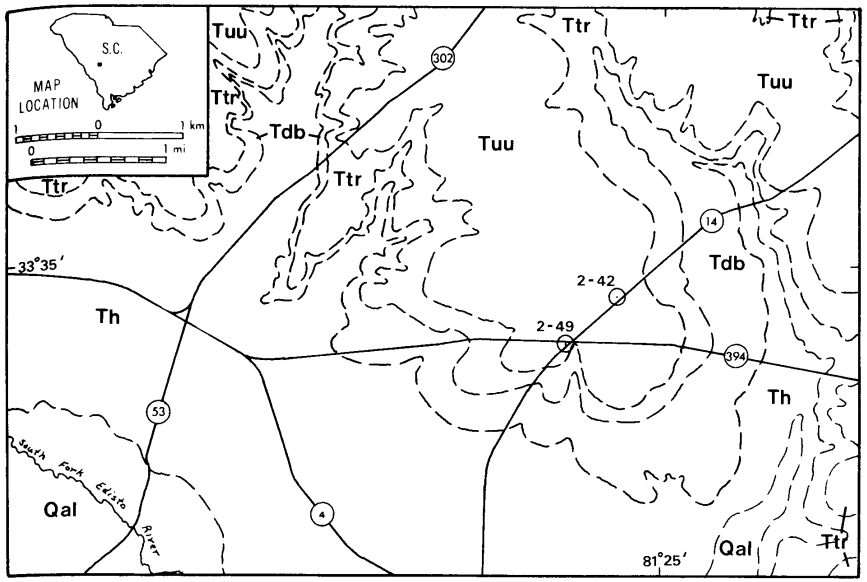

Figure 2. Geologic map of a portion of the southwest quarter of the Seivern 15-minute quadrangle (modified from Kite, 1983) showing location of auger holes; Qal — Quaternary alluvium; Tuu — upland unit; Ttr — Tobacco Road Sand; Tdb — Dry Branch Formation; Th — Huber Formation.

Age of the Griffins Landing Member

Available stratigraphic and paleontologic evidence indicates that the Griffins Landing Member is of late Eocene (Jacksonian) age. Herrick (1960), using foraminiferal evidence, assigned a late Eocene or younger age to the Griffins Landing Member at Shell Bluff. Huddlestun and Hetrick (1979), based on lithostratigraphic criteria and fossil evidence, considered the Dry Branch Formation to be of late Eocene age and correlated it with the lower Jacksonian upper Moodys Branch Formation, North Twistwood Creek Clay, and Cocoa Sand of the eastern Gulf Coast. Alan Cheetham (personal communication, 1983) identified four cheilostome bryozoans from UNCW locality Z-622, *Hippopleurifera incondita* (Canu and Bassler), *Ochetosella jacksonica* Canu and Bassler, *Perigastrella elegans* Canu and Bassler, and *Smittina portentosa* (Canu and Bassler). All four species are known from the Baldock locality, and all except *Perigastrella elegans* have been reported from the Eocene of Florida and the Gulf Coast. *Hippopleurifera incondita* and *Smittina portentosa* are found in Jacksonian strata of the Gulf Coast, whereas *Ochetosella jacksonica* occurs in Claibornian as well as Jacksonian deposits (see Cheetham, 1963b).

The comatulid crinoid *Himerometra bassleri* (pl. 3, figs. F-K) was described by Gislén (1934) on 23,000 ossicles from Baldock, South Carolina. Ossicles of this species were the most abundant fossils other than barnacles in the Aiken County samples, and a centrodorsal, together with a few ossicles, were found at the type locality of the Griffins Landing Member. Howe (1942) figured a centrodorsal and several distal brachials from the lower Jacksonian Moodys Branch Formation near Jackson, Clarke County, Alabama that appear to be referable to this species. Rasmussen (1978) cited the geographic range of *H. bassleri* as South Carolina to Louisiana in Eocene units, but provided no additional locality data. Recently, however,

Strimple and Mapes (1984) described two new species of *Himerometra* from the Moodys Branch in Caldwell Parish, Louisiana. They distinguished their new species from *H. bassleri* on shape and the absence of the rudimentary basals found in *H. bassleri*. Strimple and Mapes concluded that *H. bassleri* should be assigned to a new genus, for no other known extant or fossil *Himerometra* retains basals. Whether Howe's (1942) illustrated specimens or Rasmussen's (1978) Gulf Coast records represent *H. bassleri* or the new Louisiana species will require more detailed study.

Of the three barnacles obtained from the Griffins Landing Member, only *Aporolepas howei* is know definitely from Gulf Coast units where it is found throughout the Jacksonian. *Aporolepas* is represented by *A. americana* in older Claibornian units and is not known to occur in post-Jacksonian units of the Gulf and Atlantic Coastal Plains.

Lophobalanus baumi Zullo, an Oligo-Miocene species of the Carolinas, occurs in buhrstone previously mapped as part of the Dry Branch Formation and overlying Tobacco Road Sand of the Barnwell Group in western Aiken County. Zullo, Willoughby and Nystrom (1982, p. 42) suggested "that the fossiliferous quartz sandstone in the upper Dry Branch Formation and basal Tobacco Road Sand as mapped in Aiken County is not Eocene in age." Willoughby and others (1984) proposed a plausible solution for this apparent age discrepancy. Their re-examination of the stratigraphic occurrence of *Lophobalanus*-bearing buhrstone indicated that the unit uncomformably overlies the middle Eocene Huber Formation and the Dry Branch Formation at different localities. Willoughby and others (1984) concluded that the buhrstone is a separate, locally restricted marine unit that was deposited in tidal or drowned fluvial channels incised in Eocene formations. This conclusion is supported by the absence of *Lophobalanus* in the nearshore Griffins Landing sediments that are unequivocally part of the Dry Branch Formation in Aiken County.

Environment of Deposition

Huddlestun and Hetrick (1978, p. 19) concluded that the Griffins Landing Member represented a regressive phase in the Dry Branch Formation, overlying the transgressive, offshore Twiggs Clay. Updip, in Aiken County and in Burke County, Georgia, the Griffins Landing appears to have been deposited in subtidal to inner shelf environments. During the Eocene, immediate subtidal to inner shelf environments (Zone I) were inhabited by archeobalanids, whereas the scalpelloid genera *Aporolepas* and *Euscalpellum* the outer and mid-shelf regions (Zone II), and *Arcoscalpellum* the outer shelf to upper slope (Zone III) (Zullo, 1983). Fossil barnacle assemblages from Zone I deposits are composed of at least 80 percent archaeobalanid remains and up to 20 percent offshore barnacles that are washed into the deposit. Zone II deposits are characterized by at least 80 percent *Aporolepas* and *Euscalpellum* remains and up to 20 percent inshore and farther offshore forms. Zone III deposits contain at least 80 percent *Arcoscalpellum* remains and up to 20 percent inshore forms. The barnacle assemblages of the Griffins Landing Member at the type locality, Shell Bluff, and in Aiken County are typical Zone I assemblages, but the distribution of archaeobalanid morphotypes within the Griffins Landing suggests that the Aiken County localities were closer to shore than those in Georgia. The new *Hesperibalanus* species dominates the Aiken County samples, but is rare at Griffins Landing and Shell Bluff. *Kathpalmeria georgiana,* which is poorly represented at the Aiken County localities, is abundant at Griffins Landing and Shell Bluff. The shell of the new *Hesperibalanus* has broad radii with denticulated edges that provide an exceptionally rigid articulation for the shell wall. The presence of a scutal adductor ridge indicates that the opercular pyramid was retracted into the shell orifice. Both of these features are adaptations to high energy environments where wave shock and abrasion are important factors (Zullo, 1984a). *Kathpalmeria georgiana,* on the other hand, lacks radii and a scutal adductor ridge. Its shell is poorly articulated, and the opercular pyramid can be extended well above the orifices; these features are best adapted to low energy environments, either protected from wave action or below wave base. As Zone II *Aporolepas* makes up nearly 30 percent of the barnacle assemblage at all localities, and the sediments are equally coarse-grained, *Kathpalmeria*-dominated localities probably represent deeper (below wave base) rather than shallow, protected waters.

Stratigraphic Setting, Aiken County

The Tertiary section exposed in east-central Aiken County (Figs. 2, 3) includes litholigic units that are

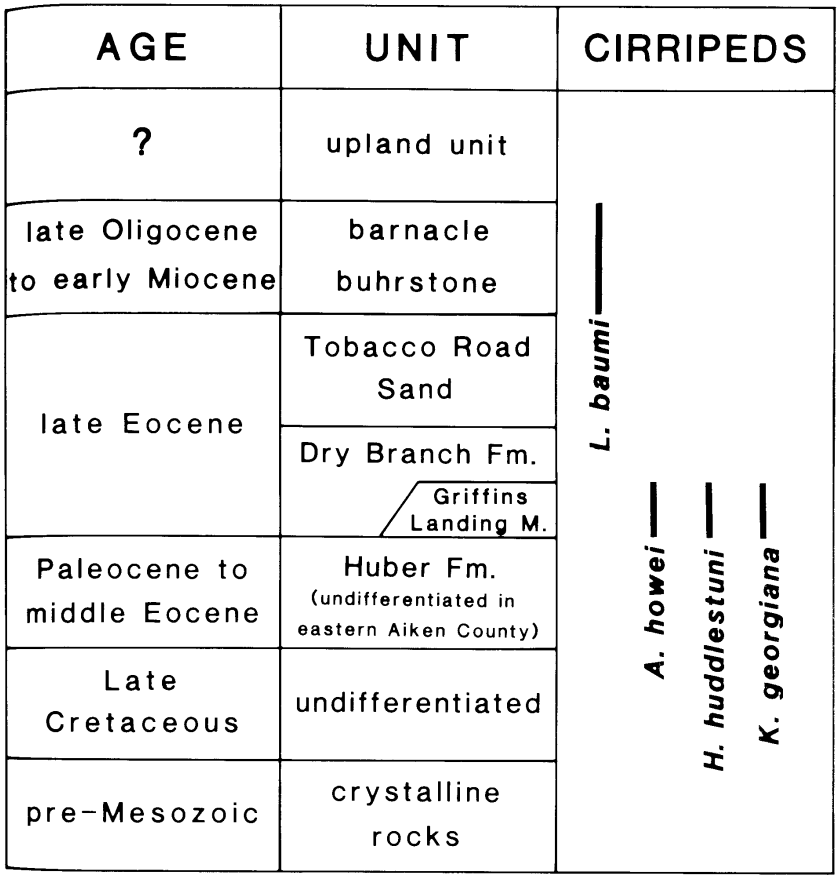

Figure 3. Diagrammatic composite section of units encountered in Aiken County, South Carolina, showing distribution of cirriped species.

physically correlated with the Huber Formation, Dry Branch Formation and Tobacco Road Sand as mapped in western and central Aiken County (Nystrom and Willoughby, 1982; Mittwede, 1982; Kite, 1982) and eastern Georgia (Huddlestun and Hetrick, 1978, 1979).

Huber Formation.—The Huber Formation was defined in east-central Georgia by Buie (1978) as post-Cretaceous, pre-Jacksonian strata and was assigned a Paleocene and medial Eocene (Claibornian) age. In east-central Aiken County exposures of this unit nearest to auger holes 2-42 and 2-49 (McK localities 05 and 06, respectively) consist mostly of poorly sorted, coarse-grained sand, locally crossbedded with discontinuous clay laminae and small, kaolinitic clay clasts. In the northwest part of the study area, at least 4.8 km (3 mi) distant from the auger holes, the uppermost part of the Huber

Formation is marked locally by massive, pure to sandy kaolin. The top of the Huber in auger hole 2-49 is recognized by an abrupt change to fine- to coarse-grained, poorly sorted, clayey sand, brick red to golden yellow in color, just beneath the basal green clay of the Dry Branch Formation.

Dry Branch Formation.—The sandy biomicrudite encountered in the two auger holes is not present in surface exposures of the upper Eocene Dry Branch Formation in eastern Aiken County. The Dry Branch outcrop nearest the auger holes (3.2 km, 2 mi to the northwest) exposes the entire formation, and consists of a fining-upward sequence of sand approximately 4.6 m (15 ft) thick. The coarse, granular, basal part of the section grades upward into a fine- to coarse-grained, poorly sorted sand containing wispy clay laminae that increase in abundance upwards to the top of the formation. Other exposures of parts of the Dry Branch Formation in the area covered by Figure 2 also suggest an overall finding upward sequence and, locally, a clay or sandy clay bed marks the top of the unit. The sandy biomicrudite encountered in the two auger holes is overlain by very sandy clay or clayey sand here interpreted as part of the Dry Branch Formation (Table 1). This overlying sediment is composed primarily of medium-grained, poorly sorted quartz sand with abundant interstitial to matrix-forming, yellow to orange clay.

Tobacco Road Sand.—The overlying upper Eocene Tobacco Road Sand of Huddlestun and Hetrick (1978) consists predominantly of poorly sorted, medium- to very coarse-grained sand with abundant interstitial clay. Bioturbation is quite evident and distinct clay-lined burrows are common in surface exposures. Outcrops nearest to the auger holes on the north and northwest exhibit a basal dark red to purple bed of mostly fine- to medium-grained, moderately sorted sand that coarsens downward to a layer of rounded and discoidal pebbles. This pebble horizon can be recognized in several exposures as marking the base of the Tobacco Road Sand; the underlying Dry Branch Formation being finer-grained and better-sorted overall. This same contact is recognized in the two auger holes by changes in texture and color (Table 1). The pebble horizon was not observed in the subsurface in either hole.

Upland unit.—The Oligo-Miocene *Lophobalanus*-bearing buhrstone of western Aiken County has not been observed in the Seivern quadrangle. The youngest mappable Tertiary unit in the study area is a mostly coarse-grained, very clayey sand which caps the interfluves and is commonly observed in surface exposures throughout Aiken County (Kite and Nystrom, 1983; Kite, 1983; Willoughby, 1983; Nystrom and Willoughby, 1982). Parts of this upland unit have been assigned by various authors to the Lafayette Formation (McGee, 1891; Sloan, 1908), Citronelle Formation (Doering, 1960; Smith and White, 1979; Colquhoun, 1965) and Hawthorn Formation (Siple, 1967). As discussed by Kite and Nystrom (1983), the areal distribution and lithologic variation of the upland unit is much greater than previously recognized, thus preventing assignment to any one of the aforementioned units at this time. A roadcut only a few hundred meters from auger hole 2-42 contains an exposure of the upland unit that consists of very coarse-grained, granular sand, with abundant sand-sized white clay flecks, larger clay clasts, and clay laminae that help delineate bedding. This upland unit was encountered in both auger holes overlying sediments of the Tobacco Road Sand; the contact is defined by coarse-grained, granular, very clayey, stiff sand overlying the looser, finer-grained sand of the upper Tobacco Road (Table 1).

Barnacle Fauna

Barnacles are relatively common in upper Claibornian and Jacksonian shelf sediments of the Gulf and Atlantic Coastal Plains. The Lepadomorpha ("goose barnacles") are represented by four or five genera, most of which disappear from the North American fossil record at the end of the Eocene. The Balanomorpha ("acorn barnacles"), which make their first appearance in the middle Eocene, are represented by the rapidly diversifying, solid-walled archaeobalanids.

All of the barnacles obtained from Aiken County localities are also found at Griffins Landing, Georgia (Fig. 3). Capitular plates of the scalpelloid *Aporolepas howei* Cheetham, and compartmental and opercular plates of a new species of the archaeobalanid genus *Hesperibalanus* make up 90 percent of the Aiken County barnacle fauna. Compartmental and opercular plates of *Kathpalmeria georgiana* Ross account for the remainder. *Aporolepas howei* is found throughout the Jacksonian Stage in Mississippi and Alabama. A few specimens are known from the Moodys Branch For-

Table 1

Generalized lithologic description of auger holes SCGS 2-42 and 2-49.

SCGS 2-42
Location: .8 km N 49 E of intersection of Aiken Co. Road 4 and S. C. Hwy 394, west of intersection of Road 4 and unnumbered dirt road.
Collar elevation: 134.2 m (440 ft, by contours)
Total Depth: 21.35 m (70 ft)

	Drill log	Description
Residuum	0-3.05 m (0-10′)	Soil horizon overlying clayey sand, poorly sorted, stiff.
Upland unit	3.05-8.23 m (10-27′)	Fining upwards sequence of poorly sorted sand, coarse and granular at base; very clayey and somewhat stiff; mostly orange-red color.
Tobacco Road Sand	8.23-13.72 m (27-45′)	Fine- to coarse-grained sand, moderately to poorly sorted; clayey at top, becoming fairly loose downwards; golden yellow darkening downwards to dull reddish orange.
	13.72-16.16 m (45-53′)	Clayey sand, fine- to coarse-grained, poorly sorted grading down to clay with some coarse-grained sand; mostly purple color.
Dry Branch Formation	16.16-18.91 m (53-62′)	Sandy clay, sand well sorted and fine-grained to poorly sorted; very stiff and sticky; golden yellow and cream color darkening downwards.
	18.91-21.35 m (62-70′)	Fossiliferous, calcareous, very sandy clay; sand is fine- to coarse-grained and poorly sorted; cream to white color.

SCGS 2-49
Location: At intersection of S. C. Hwy 394 and Aiken County Road 14; approximately 27.4 m (30 yds) southwest of crossroads in cleared area.
Collar elevation: 125 m (410 ft, by contours)
Total Depth: 18.3 m (60 ft)

	Drill log	Description
Residuum	0-2.13 m (0-7′)	Very clayey sand, poorly sorted, brick red color.
Upland unit	2.13-3.05 m (7-10′)	Clayey sand, fine- to very coarse-grained, poorly sorted; very stiff, pinkish red color.
Tobacco Road	3.05-7.93 m (10-26′)	Sand, fining upwards from coarse-grained, poorly sorted, to mostly medium-grained, moderately sorted; grains are mostly subrounded and clay-coated; light orange-brown color at base.
	7.93-12.20 m (26-40′)	Very sandy clay; sand is fine- to coarse-grained, poorly sorted; sticky and somewhat stiff; yellow-orange and tan color.
Dry Branch Formation	12.20-15.25 m (40-50′)	Fossiliferous, calcareous very sandy clay; sand is moderately well sorted, fine- to medium grained; light green to light creamy gray color.
	15.25-16.77 m (50-55′)	Clay, pure to sandy, sand is fine- to coarse-grained; poorly sorted; green color.
Huber Formation	16.77-18.30 m (55-60′)	Sand, fine- to very coarse-grained, poorly sorted, subangular; micaceous; clayey, with clay content gradually increasing downrod; deep brick red changes to golden yellow.

mation in Mississippi, plates are abundant in the Cocoa Sand of Mississippi and Alabama, and a few plates have been found in the calcareous Shubuta Clay equivalent in Alabama (Cheetham, 1963a; Zullo, 1984b; and unpublished data). This species also occurs in the lower Jacksonian Clinchfield Sand in Georgia and the type section of the Griffins Landing Member (Zullo, 1984b). *Kathpal meria georgiana* was described from the Griffins Landing Member at Shell Bluff (Ross, 1965) and was tentatively identified by Ross and Newman (1967) from the lower Jacksonian Inglis Limestone of northern Florida. It is the most abundant barnacle at Griffins Landing, and is often found attached to *Crassostrea gigantissima* (pl. 2, fig. M, pl. 3, fig. E). The new *Hesperibalanus* species is the oldest representative of this predominantly Pacific basin genus, and is the first true *Hesperibalanus* to be reported from the western Atlantic basin.

The Baldock, Allendale County locality, here ascribed to the Griffins Landing Member, could not be relocated during a recent search by the junior author and Ralph H. Willoughby of the South Carolina Geological Survey. Alan Cheetham provided a fine-fraction sieve sample from the U. S. National Museum's bryozoan collection which was found to contain abundant, well-preserved plates of juvenile *Aporolepas* and an undetermined archaeobalanid. The number of juvenile specimens indicates that the barnacles are as important an element of the Baldock fauna as elsewhere in the Griffins Landing Member, but their identification is dependent on obtaining adults from the site.

The barnacles of the Griffins Landing Member are of interest because: (1) they support a Jacksonian age for the unit; (2) they provide information on depositional environments for the unit in Georgia and South Carolina; and (3) they add to our knowledge of the diversity and geographic distribution of the Eocene barnacle fauna.

Stratigraphic Summary

1. The stratigraphic sequence mapped in east-central Aiken County is similar to that recognized in the upper Coastal Plain of western Aiken County and eastern Georgia.
2. Mappable lithologic units in Aiken County include the middle Eocene Huber Formation and its east-central Aiken County equivalent, the upper Eocene Dry Branch Formation and overlying Tobacco Road Sand of the Barnwell Group, the upper Oligocene or lower Miocene barnacle buhrstone in western Aiken County, and an unnamed upland unit of undetermined age.
3. A sandy biomicrudite encountered in two auger holes in east-central Aiken County is here assigned to the Griffins Landing Member of the Dry Branch Formation; a unit previously known only in eastern Georgia. The Griffins Landing Member in Aiken County occurs above sands of the Huber Formation and beneath clayey sands of the Dry Branch Formation.
4. The fauna of the Griffins Landing Member at its type locality and in Aiken County supports a Jacksonian (late Eocene) age for the unit, and indicates a subtidal to inner shelf depositional environment.
5. The barnacle buhrstone of western Aiken County is not related to Barnwell Group deposition, but occurs in channels cut into these Eocene sediments. Based on the barnacles, the buhrstone is either late Oligocene or early Miocene in age.

Systematics

Subclass CIRRIPEDIA Burmeister, 1834

Order THORACICA Darwin, 1854

Suborder LEPADOMORPHA Pilsbry, 1916

Family SCALPELLIDAE Pilsbry, 1916

Subfamily uncertain

Genus *APOROLEPAS* Withers, 1953

***Aporolepas howei* Cheetham, 1953**
Plate 1

Aporolepas howei Cheetham, 1963a, p. 397, pl. 46, figs. 1-8; Toulmin, 1977, p. 337, pl. 63, figs. 1-3; Weisbord, 1980, p. 128, pl. 11, figs. 7-13; Dockery, 1980, p. 21 (type locality correction).
Euscalpellum (?) isneyensis Weisbord, 1977, p. 150, pl. 19, figs.1-8.
Euscalpellum isneyensis Weisbord, 1980, p. 160, pl. 18, figs. 14-17; Dockery, 1980, p. 21.

Type Lot.—Holotype carina, no. 7184; paratype scuta, mos. 7185, 7186; paratype tergum, no. 7187; paratype upper latus, no. 7188; paratype lower latera, nos. 7189-7191; Louisiana State University Geology Museum, Baton Rouge.

Type Locality.—Cocoa Sand, Yazoo Group, 0.3 mi east of Walker Springs, in railroad cut, Clarke County, Alabama (type locality correction by H. V. Howe as reported by Dockery, 1980, p. 21).

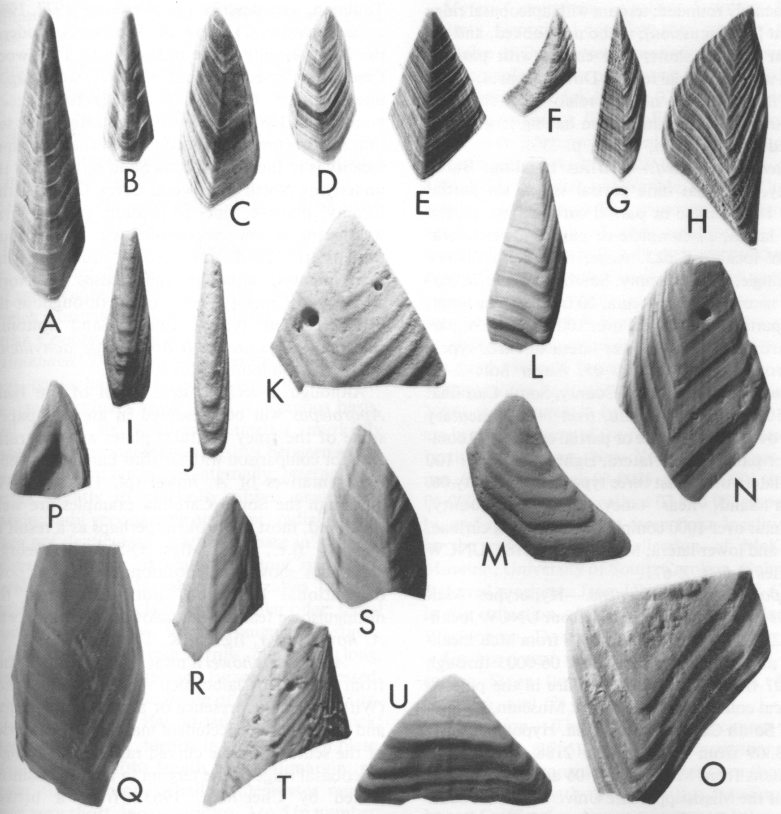

Plate 1

Plate 1. ***Aporolepas howei* Cheetham. Figures *A-H*, basal Cocoa Sand, south side of U.S. Highway 84, 6.4 km east of Isney, Choctaw County, Alabama (MSU locality 2188); *A*, Carina, MSU hypotype 3302; *B*, Carinae, MSU hypotype 3303; *C*, scutum, MSU hypotype 3304; *D*, scutum, MSU hypotype 3305; *E*, lower latus (type 1), MSU hypotype 3305; *E*, lower latus (type 1), MSU hypotype 3306; *F*, lower latus (type 4), MSU hypotype 3307; *G*, upper latus, MSU hypotype 3308; *H*, tergum, MSU hypotype 3309. *I-U*, Griffins Landing Member, Dry Branch Formation; *I*, carina, McK hypotype 06-0003, McK locality 06; *J*, subcarina, McK hypotype 03-0009, UNCW locality Z-622; *K*, lower latus (type 1), McK hypotype 03-0010, UNCW locality Z-622; *L*, upper latus, McK hypotype 06-0004, McK locality 06; *M*, lower latus (type 4), McK hypotype 05-0004, McK locality 05; *N*, tergum, McK hypotype 06-0005, McK locality 06; *O*, tergum, McK hypotype 05-0005, McK locality 05; *P*, interior of apical half of scutum, McK hypotype 05-0006, McK locality 05; *Q*, scutum, McK hypotype 05-0007, McK locality 05; *R*, scutum, McK hypotype 06-0006, McK locality 06; *S*, scutum, McK hypotype 06-0007, McK locality 06; *T*, scutum, McK hypotype 03-0011, UNCW locality Z-622; *U*, lower latus (type 2), McK hypotype 05-0008, McK locality 05. Figures *A-H*, x 2,5; *I-U*, x 4.5.**

Diagnosis. —"*Aporolepas* having elongate scutum with ridge along margin and basolateral angle acutely rounded; tergum with apicobasal ridge straight [see discussion]; umbo not hooked, and occludent margin short; and carina with parietes curled under in apical region. Differs from *A. recurvata* (Bertrand), its nearest relative, in shape of basal margin of scutum and in having tergum not hooked." (Cheetham, 1963a, p. 397).

Material examined.—Griffins Landing, Burke County, Georgia: nine partial scuta, six partial terga, 18 complete or partial carinae, two partial upper latera, 27 complete or partial lower latera; UNCW locality Z-622. Auger hole 2-42, Seivern quadrangle, Aiken County, South Carolina: 25 partial or nearly complete scuta, 20 fragmentary terga, seven partial upper latera, over 100 complete or partial carinae, over 100 lower latera of three types, four rostra; McK locality 05. Auger hole 2-49, Seivern quadrangle, Aiken County, South Carolina: over 50 fragmentary scuta, over 50 fragmentary terga, over 100 compelte or partial carinae, 30 complete or partial upper latera, eight rostra, over 100 lower latera of at least three types; McK locality 06. Cocoa Sand, near Isney, Choctaw County, Alabama: over 1000 complete scuta, terga, carinae, upper and lower latera; MSU locality 2188, UNCW localities Z-660, Z-671.

Disposition of specimens.—Hypotypes McK nos. 03-0009 through 03-0011 from UNCW locality Z-622, 05-0004 through 05-0008 from McK locality 05 and hypotypes McK nos. 06-0003 through 06-0007 from McK locality 06 are in the paleontological collection of McKissick Museum, University of South Carolina, Columbia. Hypotypes MSU 3302-3309 from MSU locality 2188 and referred specimens from McK locality 06 are in the collections of the Mississippi State University Dunn-Seiler Museum. Referred specimens from McK locality 05 are in the U. S. National Museum.

Geologic and geographic range.—Jacksonian Stage (upper Eocene), South Carolina to Mississippi.

Discussion.—*Aporolepas howei* was described from a small assortment of somewhat broken and worn capitular plates from the Cocoa Sand in Clarke County, Alabama. A superb collection of plates from the basal Cocoa Sand east of Isney, Choctaw County, Alabama (MSU locality 2188) provides additional information on capitular plate morphology, variation, and diversity. The Isney barnacles have been reported on previously. Scuta and terga of *A. howei,* collected by Lyman D. Toulman, were described by Weisbord (1977, 1980) as *Euscalpellum* (?) *isneyensis.* Weisbord considered the Isney locality to be in the North Twistwood Creek Clay, based on Toulmin's (1977) stratigraphic interpretation. Ernest E. Russell (personal communication, 1981) in reviewing the stratigraphic section in Choctaw County concluded that the Isney locality is in the basal Cocoa Sand rather than the underlying North Twistwood Creek Clay. At this locality, massive, fine- to medium-grained, gray weathering yellow, unconsolidated, argillaceous, phosphatic and micaceous quartz sand predominates, although thin lenses of North Twistwood Creek-type clay occur throughout the exposure. The typical Cocoa Sand epitoniid gastropod *Cirsotrema (Coroniscala) danvillense* Palmer is common at this locality.

Although a detailed description of the Isney *Aporolepas* will be presented in another paper, some of the Isney capitular plates are illustrated here for comparison with Griffins Landing Member representatives of *A. howei* (pl. 1, figs. A-H). Although the South Carolina examples are well-preserved, most are broken, perhaps as a result of augering (i.e., pl. 1, figs. Q-S). The Georgia specimens show pre-depositional wear and post-depositional corrosion, but still retain the distinguishing features that allow identification with *A. howei* (pl. 1, figs. J, K, T).

Aporolepas howei is most readily distinguished from the upper Claibornian species *A. americana* (Withers) by the presence of a narrow ridge near and parallel to the occludent margin of the exterior of the scutum, by the curved rather than straight apicobasal ridge of the tergum (a feature misinterpreted by Cheetham, 1963a from a broken specimen; see diagnosis), and by the much more triangular shape of the tergum. *Aporolepas americana* and *A. howei* are the only species of *Aporolepas* known from North America. *Aporolepas* is also known from western Europe where it is found in middle Eocene (Lutetian) through upper Eocene/?lower Oligocene (Lattorfian) units.

Suborder BALANOMORPHA Pilsbry, 1916

Superfamily BALANOIDEA (Leach), Newman and Ross, 1976

Family ARCHAEOBALANIDAE Newman and Ross, 1976

Subfamily ARCHAEOBALANINAE Newman and Ross, 1976

Genus KATHPALMERIA Ross, 1965

***Kathpalmeria georgiana* Ross, 1965**
Plates 2, 3

Kathpalmeria georgiana Ross, 1965, p. 63, figs. 1-2f; Newman and Ross, 1976, p. 49; Zullo and Baum, 1979, p. 242.

(?)*Kathpalmeria georgiana* Ross. Ross and Newman, 1967, p. 3.

Holotype.—Scutum, Paleontological Research Institution no. 60756.

Type locality.—Griffins Landing Member, Dry Branch Formation, Barnwell Group, Shell Bluff, Burke County, Georgia.

Emended Diagnosis.—Moderately thick and large, conic, basally spreading shell with flat to irregular, marginally thick, solid, calcareous basis; shell wall of six, solid-monolamellar, markedly costate compartmental plates; sulci between external costae form buttresses internally; internal buttresses slightly to markedly ribbed near basal margin; radii very narrow or absent; radial sutural edges not denticulate except near base in large individuals; interior of scutum without rugosities; scutal adductor ridge absent; no callus between scutal adductor muscle pit and articular ridge; scutal depressor muscle pit large, triangular, distinct, without crests; tergal spur narrow, moderately long, basally rounded; tergal spur furrow not depressed.

Supplementary description of tergum (pl. 2, figs, A-D, G).—Tergum flat, broad, moderately thick; articular ridge erect, highest in apical third of plate, extending four-fifths length of scutal margin; articular furrow broad, shallow; depressor muscle crests very short, inconspicuous, 3 to 5 in number; carinad half of tergal interior radially ridged; tergal spur moderately long, with sloping sides and rounded to subacute base, and placed a distance equal to about one-half its length from the basiscutal angle; apex pointed and horizontally striate internally; tergal margin slightly concave, reflexed at right angle to form shelf; carinal margin gently convex; carinad half of basal margin curving without angulation into spur; scutad half of basal margin slightly concave, not forming angle with spur; exterior of tergum ornamented by closely-spaced growth lines; tergal furrow not depressed, carinal margin bounded by slightly impressed line, scutal margin bounded by narrow, raised ridge in some specimens.

Material examined.—Griffins Landing, Burke County, Georgia: 1 complete shell attached to upper valve of *Crassostrea gigantissima,* and two partially complete shells overgrown by lower valve of *C. gigantissima,* McK locality 03; one complete shell on *C. gigantissima,* CM locality S-228; 17 scuta, 5 terga, over 100 compartmental plates, some with partial basis attached, UNCW locality Z-622. Auger hole 2-42, Seivern quadrangle, Aiken County, South Carolina: over 50 compartmental plates; 40 whole or partial scuta; 8 nearly complete terga; McK locality 05. Auger hole 2-49, Seivern quadrangle, Aiken County, South Carolina: over 50 compartmental plates, 12 whole or partial scuta, 2 nearly complete terga, McK locality 06; several hundred juvenile compartmental and opercular plates, U. S. National Museum bryozoan collection.

Disposition of specimens.—PRI hypotypes 30061 through 30070 from UNCW locality Z-622 are in the collection of the Paleontological Research Institution, Ithaca, New York. Hypotypes McK nos. 03-0002 through 03-0005, and 05-0001 through 05-0003, from McK localities 03 and 05, respectively, and referred material from these localities are in the paleontological collection of McKissick Museum, University of South Carolina, Columbia. Referred specimens from UNCW locality Z-622 are in the collection of the U. S. National Museum, Washington, D. C.

Geologic and geographic distribution.—Jacksonian Stage (upper Eocene), Georgia, South Carolina, and (?) Florida.

Discussion.—The Shell Bluff specimens upon which Ross (1965) based his descripton of *K. georgiana* are considerably smaller than those obtained subsequently from Griffins Landing. The largest Griffins Landing compartmental plates have heights of 18 mm, and most of the adult plates are 15 mm in height, whereas Ross's (1965, fig. 2d) largest figured plate has a height of 14.3 mm, and he cites the mean height of six articulated specimens as 7.6 mm. The holotype scutum is 4.3 mm high, whereas six of the 17 Griffins Landing scuta are at least 7 mm high, and one broken scutum was over 10 mm high. In addition, the tergum was unknown to Ross. Its description herein is based on the five terga from Griffins Landing.

The larger shells of *K. georgiana* differ in some respects from smaller examples described by Ross. In shape, the larger specimens are high-conic in the

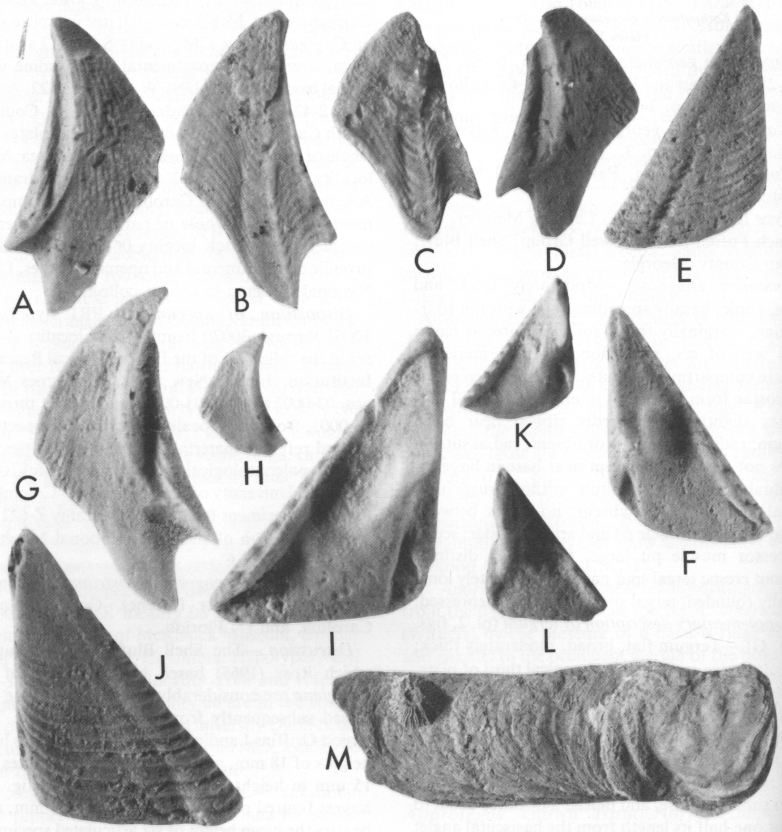

Plate 2. *Kathpalmeria georgiana* Ross. *A-B,* interior and exterior of tergum, PRI hypotype 30061, UNCW locality Z-622; *C-D,* exterior and interior of tergum, PRI hypotype 30062, UNCW locality Z-622; *E-F,* exterior and interior of scutum, PRI hypotype 30063, UNCW locality Z-622; *G,* interior of tergum PRI hypotype 30064, UNCW locality Z-622; *H,* interior of broken tergum, McK hypotype 05-0001, McK locality 05; *I-J,* interior and exterior of scutum PRI hypotype 30065, UNCW locality Z-622; *K,* interior of scutum, McK hypotype 05-0002, McK locality 05; *L,* interior of scutum, McK hypotype 05-0003, McK locality 05; *M,* shell attached to upper valve of *Crassostrea gigantissima,* CM locality S-228. Figures *A-L,* x 6, *M,* x 0.3.

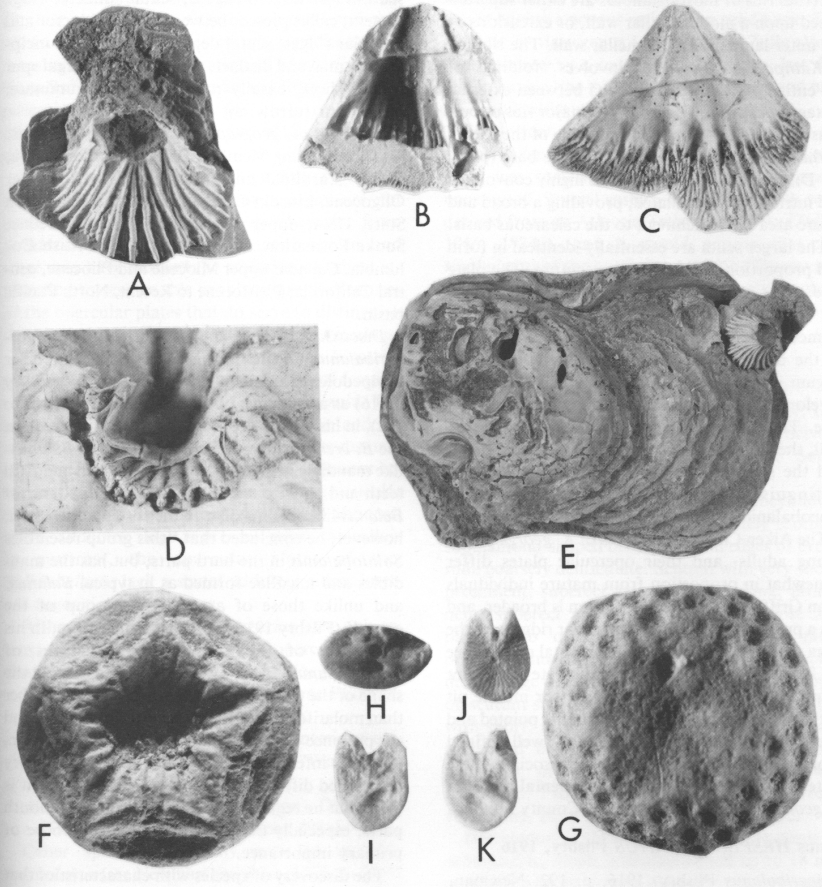

Plate 3. Figures A-E, *Kathpalmeria georgiana* Ross, McK locality 03. *A,* close-up of shell attached to *Crassostrea gigantissima* shown in fig. E, McK hypotype 03-0002; *B,* interior of rostral plate with solid basis attached, McK hypotype 03-0004; *C,* interior of rostral plate showing intricacy of basal denticulations, McK hypotype 03-0005; *D,* basal view of partial shell wall overgrown by *C. gigantissima,* showing buttressed ribbin, McK hypotype 03-0003; *E,* shell (fig. A) attached to *C. gigantissima*, McK hypotype 03-0001. Figures F-K, *Himerometra bassleri* Gislén. *F-G,* ventral and dorsal views of centrobasal, McK hypotype 03-0006, UNCW locality Z-622; *H-I,* arm ossicles, McK hypotypes 03-0007, 03-0008, UNCW locality Z-622; *J-K,* arm ossicles, McK hypotypes 06-0001, 06-0002, McK locality 06. Figure *A,* x 1.6, *B-C,* x 2.5, *D,* x 2.6, *E-K,* x 0.6.

upper (older) half and low-conic and spreading in the lower (younger) half (pl. 3, fig. A). As stressed by Ross (1965, p. 62) the most important feature of *Kathpalmeria* is its pleated or tesselate parietes. External ribs of most balanoids are either superimposed upon a monolamellar wall, or extensions of the outer lamina of a bilamellar wall. The ribbing of *Kathpalmeria,* however, involves "folding" of the entire wall, so that the sulci between external costae are expressed internally as major ribs or buttresses extending from the lower edge of the sheath to the basal margin. Viewed from the base (pl. 3, fig. D), the parietes are seen to be highly convoluted and intricately denticulated, providing a broad and secure area for attachment to the calcareous basis.

The larger scuta are essentially identical in form and proportion to the holotype scutum. The plate tends to be rather thick and is particularly notable for the large, triangular, depressor muscle pit formed in part by a reflexion of the inner border of the articular furrow. The hitherto unknown tergum is relatively thin and narrow, with a well developed tergal spur, but is otherwise unremarkable. The narrow or absent radii, the buttressed wall, the lack of an adductor ridge on the scutum, and the smooth interior of the scutum serve to distinguish *Kathpalmeria* from other archaeobalanid genera.

The Aiken County specimens of *K. georgiana* are young adults, and their opercular plates differ somewhat in proportion from mature individuals from Griffins Landing. The scutum is broader, and has a proportionately longer articular ridge, and the terga tend to have a more arcuate scutal margin (see pl. 2, figs. H, K, L). The denticulate occludent margin and deep, triangular depressor muscle pit of the scutum, and the narrow, apically pointed and internally rugose tergum lacking well-defined depressor muscle crests serve to associate these plates with the numerous compartmental plates of *K. georgiana* found in the Aiken County samples.

Genus *HESPERIBALANUS* Pilsbry, 1916

Hesperibalanus Pilsbry, 1916, p. 192; Newman, Zullo and Withers, 1969, p. R285 (in part); Newman and Ross, 1976, p. 51 (in part).

Solidobalanus Hoek. Henry and McLaughlin, 1967, p. 46 (in part).

Type species. Hesperibalanus hesperius (Pilsbry, 1916), original designation.

Emended diagnosis.—Moderately thick, small, conic to cylindric shell with flat, thin solid-calcareous basis; shell wall of six, solid-monolamellar, smooth to costate compartmental plates; radii broad, solid, articulate; interior of scutum and tergum rugose; scutal adductor ridge present; callus present between scutal adductor and articular ridges; scutal depressor muscle pit incipient to small and distinct, without crests; tergal spur broad, short, basally rounded or subacuminate; tergal spur furrow not depressed.

Geologic and geographic range.—Upper Eocene, Griffins Landing Member, Dry Branch Formation, South Carolina and Georgia, USA; ?upper Oligocene, Lincoln Creek Formation, Washington State, USA; upper Oligocene or lower Miocene, Sooke Formation, Vancouver Island, British Columbia, Canada; upper Miocene and Pliocene, central California; Pleistocene to Recent, North Pacific basin.

Discussion.—The supraspecific taxon *Hesperibalanus* has caused considerable frustration for cirripedologists since it was established by Pilsbry (1916) as a subgenus of *Balanus.* Pilsbry (1916, p. 192), in his diagnosis of *Hesperibalanus,* singled out the *B. crenatus*-like opercular plates, the *Balanus*-like mandible with its short, broad, fourth and fifth teeth and inferior margin with short hairs, and its *Balanus*-like first maxilla. In the ensuing discussion, however, he concluded that "this group resembles *Solidobalanus* in the hard parts, but has the mandibles and maxillae formed as in typical *Balanus,* and unlike those of any poreless group of the genus" (Pilsbry 1916, p. 193). Furthermore, in his discussion of the distinguishing features of *Solidobalanus,* Pilsbry (1916, p. 220) indicated the shape of the tergum, but stressed the spinose, rather than molariform inferior angle of the mandible, and the presence of long spines, rather than short hairs along its inferior margin. Thus, although Pilsbry mentioned differences in the opercular plates, it is clear that he regarded the differences in the mouth parts, especially those of the mandibles, to be of primary importance.

The discovery of species with characteristics that appeared intermediate or peripheral to Pilsbry's conceptions of *Solidobalanus* and *Hesperibalanus* raised questions concerning the assignment of species and the validity of the subgenera (e.g., Nilsson-Cantell, 1932; Millard, 1950; Stubbings, 1961). The controversy seemed to be resolved by Henry and McLaughlin (1967) who synonymized *Hesperibalanus* with *Solidobalanus* and emended the diagnosis of the latter. Their argument was that: (1) Pilsbry had distinguished *Hesperibalanus* on features of the mandible and maxilla, having stated that the hard parts were indistinguishable; and (2) their examination of the mouth parts and cirri of known species indicated no significant differences to warrant separation of *Hesperibalanus* from *Solidobalanus.* Newman and Ross (1976) apparently did not agree for they resurrected *Hesperibalanus* as a subgenus of *Solidobalanus* without comment.

What Henry and McLaughlin did show was that the mouth part and cirral morphologies are not useful in distinguishing *Hesperibalanus* from *Solidobalanus.* What they did not recognize, and what may have escaped the attention of others attempting to resolve this problem, are the features of the opercular plates that do serve to distinguish these taxa, *regardless* of Pilsbry's interpretations.

The opercular plates of *Hesperibalanus hesperius* and its subspecies exhibit a combination of features not found in any other extant archaeobalanid. The interior of the carinal half of the tergum and the interior of the apical part of the scutum are distinctly rugose. A callus, sometimes ridged, is present between the adductor muscle pit and the articular ridge of the scutum. A well developed, although short, adductor ridge is present below the callus. In contrast, the opercular plates of true *Solidobalanus* lack a scutal adductor ridge, internal rugosities and calluses.

Although *Hesperibalanus hesperius* is the only extant species to exhibit these opercular plate characteristics, some fossil species do, including:

H. proinus (Woodring), late Miocene-Pliocene, central California (Zullo, 1979).

H. sookensis (Cornwall), late Oligocene or early Miocene, British Columbia, ?Washington (Cornwall, 1927; Zullo, 1982).

H. stenonotus (Pilsbry and Olsson), Oligocene, Ecuador (Pilsbry and Olsson, 1951).

Other species previously included in *Hesperibalanus* (see Newman and Ross, 1976, p. 51-52 for list) are best reassigned to *Solidobalanus* (strict sense) for the present. The species-group taxa assigned to *Solidobalanus,* and especially the fossil species, appear to represent several genus-group taxa currently under the study by the senior author.

The constancy of these morphological features since the Oligocene in the eastern Pacific supports the view that *Hesperibalanus* is distinct from *Solidobalanus,* and suggests that *Hesperibalanus* is best regarded as a genus at par with *Solidobalanus.* Among archaeobalanid genera, *Hesperibalanus* is most similar to *Actinobalanus* Moroni which differs in having a porous rather than solid basis. The Atlantic Tertiary genus *Lophobalanus* Zullo also is characterized by a scutal adductor ridge, but differs in having non-rugose opercular plates and narrow radii without denticulate sutural edges.

The discovery of a late Eocene species of *Hesperibalanus* in the southeastern Atlantic Coastal Plain was somewhat surprising, but not totally unexpected. Several eastern Pacific balanoids were derived from an Atlantic-Tethyan ancestry (Zullo, 1966, 1984a), and it would appear that *Actinobalanus* of the northeast Atlantic Pliocene and Pleistocene was derived from a tropical American rather than boreal hesperibalanid Pacific ancestor.

Hesperibalanus huddlestuni, new species
Plates 4, 5

Holotype.—Scutum, USNM no. 367869.

Type locality.—Griffins Landing Member, Dry Branch Formation, southwest quarter of Seivern 15-minute quadrangle, Aiken County, South Carolina, McK locality 05.

Diagnosis.—Small, high conic to subcylindric, externally smooth shell with moderately toothed, subdiamond-shaped orifice; sutural edges of broad radii coarsely denticulate. Scutum with very short, prominent, suberect articular ridge, long, prominent, suberect adductor ridge placed close and parallel to occludent margin, and incipient depressor muscle pit; exterior surface of scutal adductor ridge divided by radial furrow; tergal margin of scutum sharply reflected. Tergum broad, flat, with short, prominent, erect to suberect articular ridge and broad, rather deep articular furrow; depressor muscle crests closely spaced, well developed, 5 to 7 in number; tergal spur narrow, very short, placed close to basiscutal angle.

Description.—Shell (pl. 4, figs. A-J) conic to subcylindric; single articulated shell up to 18 mm in height and 16 mm in diameter; parietes solid, triangular, externally smooth to slightly and irregularly plicate; radii moderately broad, with those of rostral plate broadest; summits of radii steeply oblique; radial sutural edges coarsely denticulate; alae broad, relatively thick, with oblique summits and smooth sutural edges; sheath one-third to two-thirds length of compartmental plates; lower edge

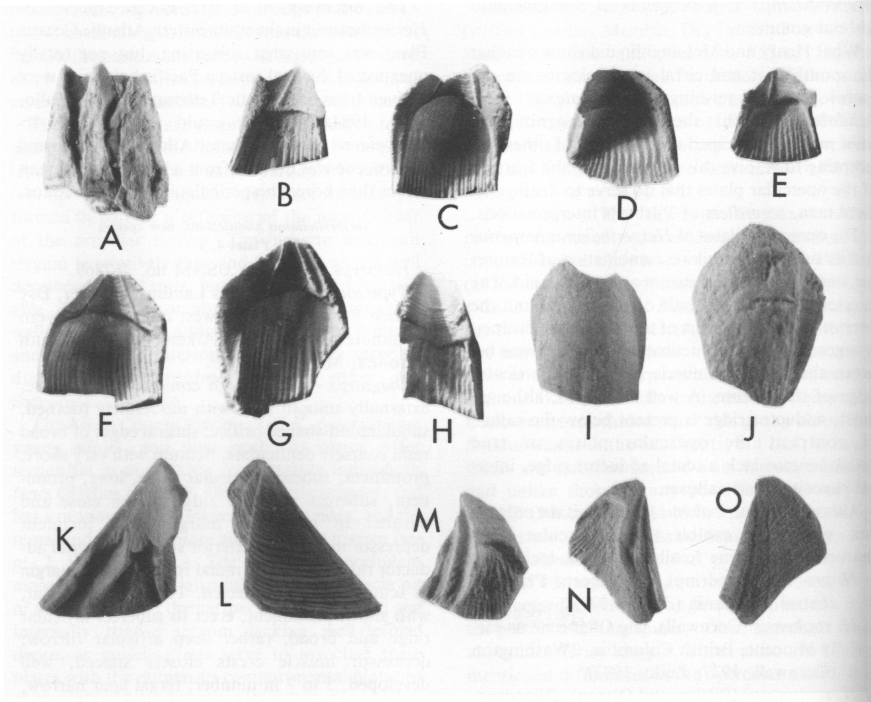

Plate 4. *Hesperibalanus huddlestuni,* new species. *A,* side view of shell, USNM paratype 367878, McK locality 06; *B,* lateral, McK paratype 03-0013, UNCW locality Z-622; *C,* rostral plate, McK paratype 06-0008, McK locality 06; *D,* lateral, McK paratype 03-0014, UNCW locality Z-622; *E,* lateral, McK paratype 03-0012, UNCW locality Z-622; *F,* rostral plate, McK paratype 06-0010, McK locality 06; *G,* rostral plate, USNM paratype 367877, McK locality 06; *H,* carina, McK paratype 06-0009, McK locality 06; *I,* exterior of Fig. C. rostral plate; *J,* exterior of Fig. G rostral plate; *K-L,* scutum, USNM holotype 367869, McK locality 05; *M,* interior of broken tergum showing ridge in articular furrow, USNM paratype 367875, McK locality 05; *N-O,* tergum, USNM paratype 367876, McK locality 05. Figure *A,* x 2; *B-J,* x 5; *K-O,* x 6.

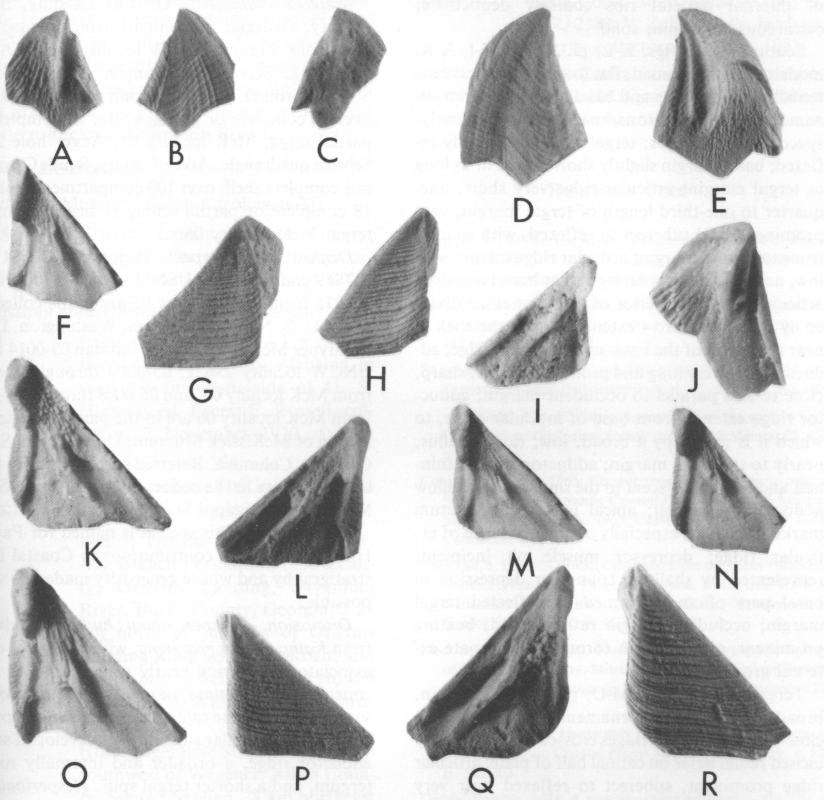

Plate 5. Opercular plates of *Hesperibalanus huddlestuni, new species. A-B,* tergum (spur missing), USNM paratype 367873, McK locality 05; *C,* tergum with intact spur, McK paratype 05-0014, McK locality 05; *D-E,* tergum (basal part missing), USNM paratype 367874, McK locality 05; *F,* scutum, McK paratype 05-0013, McK locality 05; *G,* scutum with exceptionally prominent articular ridge, USNM paratype 367872, McK locality 05; *H,* scutum of Fig. F; *I,* scutum, McK paratype 03-0015, McK UNCW locality Z-622; *J,* tergum, McK paratype 03-0016, UNCW locality Z-622; *K,* scutum, McK paratype 05-0009, McK locality 05; *L,* scutum, USNM paratype 367871, McK locality 05; *M,* scutum, McK paratype 05-0011, McK locality 05; *N,* scutum, McK paratype 05-0010, McK locality 05; *O,* scutum, USNM paratype 367870, McK locality 05; *P,* scutum of Fig. L; *Q-R,* scutum, McK paratype 05-0012, McK locality 05. All figures x 6.

of sheath slightly offset and overhanging interior of parietal wall; internal parietal ribs numerous, narrow, rounded, closely-spaced, and extending from basal margin to base of sheath; lower edges of internal parietal ribs coarsely denticulate; calcareous basis thin, solid.

Scutum (pl. 4, figs, K-L; pl. 5, figs. F-I, K-R) moderately thick, broad, flat to slightly concave externally between apex and basal margin; exterior ornamented by numerous, narrow, low, closely-spaced growth ridges; tergal margin narrowly reflexed; basal margin slightly shorter than or as long as tergal margin; articular ridge very short, one-quarter to one-third length of tergal margin, very prominent, and suberect to reflexed, with sharply truncated basal margin; articular ridge merges with low, narrow ridge bordering rather broad and deep articular furrow; exterior of articular ridge divided by a narrow furrow extending from the apex to near the center of the basal margin of the ridge; adductor ridge very long and prominent, erect, sharp, close to and parallel to occludent margin; adductor ridge extends from base of articular ridge, to which it is joined by a broad, low, ridged callus, nearly to the basal margin; adductor ridge is thinnest and highest adjacent to the small, oval, shallow adductor muscle pit; apical part of the scutum markedly rugose, especially on inner surface of articular ridge; depressor muscle pit incipient, represented by shallow, triangular depression in basal part of angle formed by reflected tergal margin; occludent margin rather broad, bearing prominent, oblique teeth formed by alternate external growth ridges.

Tergum (pl. 4, figs. M-O; pl. 5, A-E, J) thin, broad, flat; exterior ornamented by fine, low, closely-spaced growth ridges crossed by a few deeply incised radial striae on carinal half of plate; articular ridge prominent, suberect to reflexed over very broad, rather deep articular furrow that bears a median longitudinal ridge; articular ridge very high and broad in apical third of plate, tapering abruptly to low, sharp ridge below; internal triangle raised above and slightly overhanging remainder of plate interior and marked by numerous, fine, closely-spaced, horizontal growth ridges; interior of tergum markedly rugose; depressor muscle crests 4 to 7 in number, short, well-developed; tergal spur narrow, one-fourth to nearly one-third width of basal margin, very short, placed about one-half its own width from basiscutal angle, and rounded or subtruncate basally; carinad margin of spur merges with basal margin in smooth curve; scutal junction of spur and basal margin angulate; spur furrow not depressed.

Material examined.—Griffins Landing, Burke County, Georgia: 22 compartmental plates, two scuta, one tergum; UNCW locality Z-622. Auger hole 2-42, Seivern quadrangle, Aiken County, South Carolina: over 100 compartmental plates, over 50 complete or partial scuta, 22 complete or partial terga, McK locality 05; Auger hole 2-49, Seivern quadrangle, Aiken County, South Carolina: one complete shell, over 100 compartmental plates, 18 complete or partial scuta, 11 nearly complete terga, McK locality 06.

Disposition of types.—Holotype USNM no. 367869 and paratypes USNM nos. 367870 through 367878 from McK locality 05 are in the collection of the U. S. National Museum, Washington, D. C. Paratypes McK nos. 03-0012 through 03-0014 from UNCW locality Z-622, 05-0009 through 05-0014 from McK locality 05, and 06-0008 through 06-0010 from McK locality 06 are in the paleontologic collection of McKissick Museum, University of South Carolina, Columbia. Referred specimens from McK locality 05 are in the collection of the Dunn-Seiler Museum, Mississippi State University.

Etymology.—This species is named for Paul F. Huddlestun whose contributions to Coastal Plain stratigraphy and whose generosity made this study possible.

Discussion.—*Hesperibalanus huddlestuni* differs from *Kathpalmeria georgiana,* with which it is often associated, in having nearly smooth, rather than conspicuously costate parietes, well developed, suturally denticulate radii, a shorter but more prominent scutal articular ridge, a well developed scutal adductor ridge, a broader and internally rugose tergum, and a shorter tergal spur. *Hesperibalanus huddlestuni* is most easily distinguished from other species here attributed to *Hesperibalanus* (strict sense) by its scutum, which has its adductor ridge placed much closer to the occludent margin, and a much shorter scutal articular ridge.

Acknowledgments

We thank Ralph Willoughby, South Carolina Geological Survey for the loan of shells of *Kathpalmeria georgiana* on oysters from Griffins Landing and for his advice during this study; Ernest E. Russell for specimens of *Aporolepas howei* from Isney, Alabama and for stratigraphic data on the Isney locality; Paul F. Huddlestun, Georgia Geologic Survey for his generous help in field work in Georgia and Alabama and his review of the manuscript; Alan H. Cheetham, U. S. National Museum for his identification and analysis of bryozoans from the Griffins Landing Member; and Donald J. Colquhoun, William A. Newman, and Norman E. Weisbord for their reviews of the manuscript. Financial support for Zullo's field work in Georgia was provided by a grant from the Southern Regional Education Board.

Locality Descriptions

Charleston Museum, South Carolina (CM)

S-228 Griffins Landing, Burke County, Georgia. Earle Sloan, collector. Probably same locality as McK 03.

Mississippi State University, Seiler Museum (MSU)

2188 Basal Cocoa Sand, 2.4 km east of Isney, Choctaw County, Alabama, in road cut on south side of U. S. Highway 84. Ernest E. Russell, collector, 7 November 1970, 1 May 1971.

University of South Carolina, McKissick Museum (McK)

03 Bed 5, Griffins Landing Member, Dry Branch Formation, type locality, Griffins Landing, Savannah River, Burke County, Georgia, 2.25 km north of junction of Griffins Landing Road and River Road, and 8.4 km north of Girard. Paul Howell and Ralph H. Willoughby, collectors, June, 1981.

05 (from auger hole SCGS 2-42) 9.5 km southwest of Wagener, Aiken County, South Carolina, .8 km northeast of junction of S. C. Hwy 394 and Aiken County Road 14. Lucille E. Kite, collector, February 4, 1983.

06 (from auger hole SCGS 2-49) 10.3 km southwest of Wagener, Aiken County, South Carolina, at junction of S. C. Hwy 394 and Aiken County Road 14. Lucille E. Kite, collector, April 26, 1983.

University of North Carolina at Wilmington (UNCW)

Z-622 Lower Bed 5, Griffins Landing Member, Dry Branch Formation, same locality as McK 03, V. Zullo, collector, 25 January 1980.

Z-660 Basal Cocoa Sand. Same locality as MSU 2188, V. Zullo and W. Burleigh Harris, collectors, 6 March 1981.

Z-671 Basal Cocoa Sand. Same locality as MSU 2188, Ernest E. Russell, collector, October, 1981.

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