

REVIEW OF *ACTINOBALANUS* MORONI (CIRRIPEDIA, ARCHAEOBALANIDAE),
WITH THE DESCRIPTION OF NEW MIOCENE SPECIES
FROM FLORIDA AND BELGIUM

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I. ABSTRACT

The geologic range of *Actinobalanus* Moroni is extended back to the lower Miocene with the discovery of two new species: *A. collinsi* from the Berchem Formation of Belgium, and *A. floridanus* from the Chipola Formation of Florida. The Chipola species is the first record for the genus outside of western Europe. Of the seven species previously included in *Actinobalanus*, only three, the type species *A. actinomorphus* (Moroni) from the Pliocene and lower Pleistocene of Italy and Sicily, *A. bisulcatus* (Darwin) from the Pliocene of western Europe and *A. dolosus* (Darwin) from the Pleistocene of England are retained in the genus. *Balanus pantanelli* Alessandri and *B. stellaris* (Brocchi) are returned to the genus *Balanus* Da Costa. *Balanus inclusus* Darwin and *Actinobalanus darraghi* Buckneridge are tentatively assigned to *Conopea* Say.

II. INTRODUCTION

Actinobalanus was established as a subgenus of *Balanus* Da Costa by Moroni

(1967) for solid-walled barnacles from the Pliocene and Pleistocene of western Europe that possessed a tubiferous basis and simple, non-denticulate, parietal septa. Moroni included *Balanus actinomorphus* Moroni, *B. bisulcatus* Darwin, *B. dolosus* Darwin, and *B. inclusus* Darwin in *Actinobalanus*. Newman and Ross (1976), in their monograph on the Balanomorpha, raised *Actinobalanus* to generic rank, assigned it to the family Archaeobalanidae, and added *B. pantanelli* Alessandri and *B. stellaris* (Brocchi), together with *B. corrugatus* Darwin as a subjective synonym of *B. stellaris* (following Alessandri, 1906). No reasons were given by Newman and Ross for the addition of these species, but as all three have tubiferous, bilamellar parietes, they are excluded from *Actinobalanus*. Therefore, the retention of *B. pantanelli*, *B. stellaris* and *B. corrugatus* in the genus *Balanus* of the family Balanidae is appropriate.

Balanus inclusus, although possessing solid, monolamellar parietes and a tubiferous basis, differs from the three other species originally assigned to *Actinobalanus* in two significant features. The radii of *B. inclusus* are clearly transparietal (i.e., a radius that extends across the ala to the adjacent paries throughout

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most of its length, and having the sutural edge denticulate) rather than disparietal (i.e., a radius not extending across the ala to the adjacent paries except at the base of the shell wall, and lacking septate sutural edges), and the scutum lacks an adductor ridge. The total combination of characters seen in *B. inclusus*, including the convexity of the scutal articular ridge, the presence of a small, deep, scutal depressor muscle pit, and the basal truncation of the parallel-sided tergal spur, suggests assignment to the genus *Conopea* Say.

Most recently, Buckering (1983) attributed a new species with solid parietes and a tubiferous basis from the upper Miocene and lower Pliocene of Victoria, Australia to *Actinobalanus*. If *A. darraghi* Buckering were indeed representative of the genus, it would signal a significant extension in geographic range for *Actinobalanus*. However, like *Conopea inclusa*, *A. darraghi* has transparietal radii and lacks a scutal adductor ridge, thus removing it from the genus *Actinobalanus*. Generic reassignment of "*A. darraghi*" cannot be determined from the published description and illustrations, but the globulo-conic shell and the form of the scutum of "*A. darraghi*" are suggestive of *Conopea*.

Previous reports of *Actinobalanus bisulcatus* and *A. dolosus* by Alessandri (1907, 1922), Lecointre (1910), Withers (1953) and Davadie (1963) from Miocene or Paleogene deposits cannot be verified. These records are either in lists unsubstantiated by descriptions and illustrations, or are based on shells lacking distinguishing features. The new lower Miocene species described herein, one from the Burdigalian Edegem sands of the Berchem Formation in Belgium, the other from the Burdigalian Chipola Formation in northern Florida, are the first undoubted pre-Pliocene records for the genus. The North American species provides the first undoubted evidence of the presence of *Actinobalanus* outside of western Europe.

III. SYSTEMATIC PALEONTOLOGY

Suborder BALANOMORPHA Pilsbry,
1916

Superfamily BALANOIDEA Leach, 1817,
sensu Newman and Ross, 1976

Family ARCHAEOBALANIDAE

Newman and Ross, 1976

Subfamily ARCHAEOBALANINAE

Newman and Ross, 1976

Genus ACTINOBALANUS Moroni 1967

Actinobalanus MORONI, 1967, p. 919, 926;
NEWMAN, ZULLO and WITHERS, 1969, p.
R628; NEWMAN and ROSS, 1976, p. 49.

Type species: *Balanus* (*Hesperibalanus*?) *actinomorphus* Moroni; original designation.

Emended diagnosis: Parietes monolamellar, solid, smooth or costate; parietal ribs not denticulate; radii solid, narrow to broad, disparietal or paraparietal (fine striations present on sutural edges of *A. dolosus*); basis calcareous, tubiferous; interior of scutum and tergum usually rugose; scutal adductor ridge present; no callus between scutal adductor and articular ridges; scutal depressor muscle pit absent or small and deep, without crests; tergal spur narrow to broad, short, usually acuminate, basally rounded or subtruncate, with spur fasciole.

Geologic and geographic distribution: Miocene - middle Pleistocene, western Europe; lower Miocene, Florida.

Discussion: *Actinobalanus* can be distinguished from most solidobalanid genera by its possession of a well-defined scutal adductor ridge. Among those genera possessing an adductor ridge, *Actinobalanus* is most similar to *Lophobalanus* Zullo, 1984, differing in possessing a tubiferous basis and internally rugose opercular plates. It differs from *Hesperibalanus* in having a tubiferous basis, and in lacking transparietal radii and a ridged callus between the scutal adductor and articular ridges. *Actinobalanus* is distinguished from *Notobalanus* Ross, 1976 by the absence of crests in the scutal depressor muscle pit and of irregular ribs at the base of the shell wall.

ACTINOBALANUS ACTINOMORPHUS (Moroni, 1952)

Balanus (*Hesperibalanus*?) *actinomorphus* MORONI, 1952, p. 73, pl. 1, figs. 1-4, 7-8, pl. 2, figs. 4-7.

?*Balanus bisulcatus* Darwin. WITHERS, 1953, p. 62 (Zanclean White Limestone, Sicily).

Balanus (*Actinobalanus*) *actinomorphus* Moroni. MORONI, 1967, p. 923, text figs. 3-4, pl. 70, figs. 1-2a.

Actinobalanus actinomorphus (Moroni). NEWMAN and ROSS, 1976, p. 49.

Holotype: No. 115, Cirriped Collection, University of Bologna.

Type locality: Sabbie gialle, near Fauglia, Colline pisane, Tuscany, Italy.

Emended diagnosis: Parietes markedly costate or occasionally smooth; radii narrow, disparietal; scutum without external radial ornament and low, indistinct, broadly spaced growth ridges; basal margin of scutum nearly three-fourths length of occludent margin; scutal adductor ridge very short, less than one-fifth length of occludent margin, centrally located; scutal articular ridge reflexed, extending well beyond tergal margin; tergum triangular, with straight scutal margin; carinal margin without upturned growth ridges; tergal spur short, subacuminate, narrow, occupying about one-third width of basal margin; juncture of basal spur and carinal side of basal margin gently arcuate.

Geologic and geographic distribution: Pliocene - lower Pleistocene, Italy and Sicily. Lower Pliocene: Contrada Cicio, near Partana (Trapani), Sicily. Lower Pleistocene (lower Calabrian): Sabbie gialle, Colline pisane, vicinity of Marti, Montecastello, Lorenzana, and Fauglia (type locality), Tuscany, central Italy; sabbie calcarifere a *Flabellipecten alessii*, western shore of the Lago di Pergusa, near Piazza Armerina, Sicily.

Discussion: *Actinobalanus actinomorphus* is most readily distinguished from *A. bisulcatus* and *A. dolosus* by its scutum, which has a much shorter adductor ridge and a highly reflexed articular ridge extending well beyond the tergal margin. Its scutum differs additionally from that of *B. bisulcatus* in lacking external radial furrows. *Actinobalanus actinomorphus* differs from the new Belgian Miocene species in having much thinner opercular plates, and in lacking a broad shelf developed on the scutal margin of the tergum. The new Florida Miocene species is most similar to *A. actinomorphus*, but can be distinguished by its usually smooth rather than usually costate shell, its narrower scutum with a longer adductor ridge, and the carinal margin of the tergum which bears upturned growth ridges. The record of *A. bisulcatus* published by Withers (1953) in a list of species from the Zanclean (lower Pliocene) White Limestone of Sicily probably can be referred to *A. actinomorphus*.

ACTINOBALANUS BISULCATUS (Darwin, 1854)
Plate 1, figs. 1-4

Balanus bisulcatus DARWIN, 1854a, p. 293, pl. 8, figs. 6a-c; 1854b, p. 26, tab. 2, figs. 2a-b, e-h.

Balanus bisulcatus var. *plicatus* DARWIN, 1854a, p. 293; 1854b, p. 26, tab. 2, figs. 2c, 2d.

Balanus (Armatobalanus) bisulcatus Darwin. DAVADIE, 1963, p. 74, pl. 41, fig. 6; pl. 42, figs. 1-2; pl. 47, figs. la-2b.

Balanus (Armatobalanus) bisulcatus plicatus Darwin. DAVADIE, 1963, p. 74, pl. 41, fig. 3.

Balanus (Actinobalanus) bisulcatus Darwin. MORONI, 1967, p. 925.

Actinobalanus bisulcatus (Darwin). NEWMAN and ROSS, 1976, p. 49.

Actinobalanus bisulcatus plicatus (Darwin). NEWMAN and ROSS, 1976, p. 49.

non *Balanus bisulcatus* Darwin. ALESSANDRI, 1907, p. 286, pl. 9, fig. 30; 1922, p. 221; WITHERS, 1953, p. 58, 62; DAVADIE, 1963, p. 75 (in part).

Lectotype: Shell figured by Darwin (1854b, tab. 2, fig. 2a); British Museum (Natural History).

Type locality: Coralline Crag, Ramsholt, Gedrave, Sutton, England.

Emended diagnosis: Parietes smooth or markedly costate; radii narrow or broad, disparietal; scutum with two to four external longitudinal furrows; scutal adductor ridge prominent, length greater than one-half length of occludent margin; scutal articular ridge not extending beyond tergal margin; tergum broad, with convex scutal margin; tergal spur very short, less than one-tenth length of plate, broad, occupying one-half width of basal margin, subtruncate basally, nearly confluent with basiscutal angle; juncture of spur and carinal side of basal margin arcuate.

Geologic and geographic distribution: Pliocene, western Europe: Coralline Crag, Sutton, England; Rauville, Cotentin, France; Bolderberg, near Hasselt, Belgium; Karrendijke Formation, Vrasenedok, Kallo, Antwerp, Belgium (new locality, collected by J. S. H. Collins, 1985).

Disposition of specimens: Hypotypes USNM 423878 through 423881, and paratype lot USNM 423882 from the Pliocene Karrendijke Formation, Belgium are deposited in the collection of the Department of Paleobiology, National Museum of Natural History, Washington, D. C. Reference specimens are deposited in the British Museum (Natural History), London.

Discussion: This species is distinguished from others in the genus *Actinobalanus* by the radial ornament and long, prominent adductor ridge of the scutum, and the broad, short, basally subtruncate tergal spur. There does not appear to be any justification for maintaining a taxonomic distinction between individuals with smooth and costate shells, even in the absence of

opercular plates of the latter. As indicated by Darwin (1854b, p. 27-28), the only other observed differences are the narrower and more steeply sloping radii, and the crenate rather than smooth sutural edges of the alae of costate forms. As both costate and smooth shells are found in all other species of *Actinobalanus*, and as the costate shells occur with the non-costate or partially costate shells of typical *A. bisulcatus*, we are placing *A. bisulcatus plicatus* in synonymy with *A. bisulcatus*. There is the possibility that the unusually costate juvenile shell figured by Darwin (1854b, tab. 2, fig. 2d) represents a different species and, perhaps, genus. Darwin's illustration suggests that the radii of this specimen are transparietal and that the orifice is considerably smaller and untoothed. In the absence of opercular plates and a detailed description of the shell, however, no definite conclusions can be drawn on the affinities of this specimen. *Actinobalanus bisulcatus* (including the variety *plicatus* Darwin) was reported by Alessandri (1907, 1922) and Davadie (1963) from the Eocene (Marinesian), Oligocene and Miocene of France, and from the Miocene of England, Belgium and Germany. To our knowledge, all of these extralimital records are based on shells or parts of shells without opercular plates, and should not be considered further until corroborated. It is particularly unlikely that any of the Paleogene specimens ascribed to *A. bisulcatus* can be attributed to *Actinobalanus*.

ACTINOBALANUS DOLOSUS (Darwin, 1854)

- Balanus dolosus* DARWIN, 1854a, p. 295, pl. 8, fig. 7; 1854b, p. 28, tab. 2, figs. 3a-3d.
Balanus (Armatobalanus) dolosus Darwin. DAVADIE, 1963, p. 76, pl. 41, figs. 4, 4a, 5; pl. 42, fig. 3; pl. 46, figs. 1a-b, 2a-b.
Balanus (Actinobalanus) dolosus (Darwin). MORONI, 1967, p. 925.

- Actinobalanus dolosus* (Darwin). NEWMAN and ROSS, 1976, p. 49.
 non *Balanus dolosus* Darwin. LECOINTRE, 1910, p. 2, pl. 10, figs. 1-6 [Miocene, Faluns de Touraine, France].
 non *Balanus (Armatobalanus) dolosus* Darwin. DAVADIE, 1963, p. 77 [records from Miocene of France, Pliocene of Norway].

Lectotype: Scutum and tergum illustrated by Darwin (1854b, tab. 2, figs. 3c-d).

Type locality: Unknown.

Emended diagnosis: Parietes smooth or costate; radii narrow to broad, paraparietal; scutum without external radial ornament; scutal adductor ridge prominent, length greater than one-half length of occludent margin; scutal articular ridge not extending beyond tergal margin; tergum broad, with convex scutal margin; tergal spur long, over one-fifth length of plate, occupying about one-third width of basal margin, basally rounded, slightly removed from basiscutal angle; sides of spur parallel; juncture of tergal spur and carinal side of basal margin angulate.

Geologic and geographic distribution: Lower-Middle Pleistocene, England: Red Crag, Sutton; Mammaliferous Crag; Norwich Crag, Postwick, near Norwich.

Discussion: This species most closely resembles *A. bisulcatus*, differing in lacking external radial ornament on the scutum, and in having a much longer and narrower tergal spur and paraparietal rather than disparietal radii. *Actinobalanus dolosus* was reported from the Miocene of France and the Pliocene of Norway by Davadie (1963), but as neither of these records are supported by description or illustration and are considerably older than Darwin's English records, we do not consider them valid at this time. The three shells without opercular plates illustrated by Lecointre (1910) from the Miocene of France are similarly unidentifiable.

PLATE 1

Figures

- 1-4. *Actinobalanus bisulcatus*, Karrendijke Formation, Antwerp, Belgium. 1, USNM 423878 (hypotype), interior of scutum, 31X; 2, USNM 423879 (hypotype), interior of tergum, 28X; 3, USNM 423880 (hypotype), exterior of tergum, 31X; 4, USNM 423881 (hypotype), exterior of scutum, 27X.
 5-7. *Actinobalanus collinsi* n. sp., Berchem Formation, Edegem sands, Antwerp, Belgium. 5, USNM 423884 (paratype), exterior of tergum, 28X; 6, USNM 423885 (paratype), interior of scutum, 26X; 7, USNM 423886 (paratype), exterior of scutum, 22X.



PLATE 1

ACTINOBALANUS COLLINSI new species

Plate 1, figs. 5-7; Plate 2;

Plate 3, figs. 1-4

Diagnosis: Parietes usually coarsely costate; radii narrow, disparietal; scutum thick, without external radial ornament; scutal adductor ridge short, prominent, centrally located; scutal articular ridge extends well beyond tergal margin; tergum thick, narrow, with straight scutal margin produced into broad shelf; tergal spur short, acuminate, occupying less than one-third width of basal margin; juncture of tergal spur with carinal side of basal margin arcuate.

Description: Shell known only from disarticulated compartmental plates, moderately small, the larger rostra about one cm in height; parietes thick, solid, coarsely plicate; radii solid, narrow, with steeply-sloping summits and smooth sutural margins; alae broad, thin, with convex, welded summits separated from rest of ala by deep groove and marked by sharply upturned growth lines; sutural edges of alae thin, smooth; sheath occupying upper half to two-thirds of interior of compartmental plate; basal margin of sheath removed from interior of plate, leaving broad, shallow space under sheath; interior of parietes with numerous, prominent, flat-topped to acute longitudinal ribs that extend from basal margin to base of sheath; basal edges of internal ribs acuminate, not denticulate; interior of compartments framed on either side by thickened borders of radii and alae; calcareous basis thickening toward margin, tubiferous.

Scutum thick, markedly bowed outwardly between basal margin and apex, broad, with basal margin as long or longer than tergal margin; exterior ornamented solely by prominent, closely-spaced, cord-like growth ridges; occludent margin thickened to form broad, beveled shelf in upper two-thirds of plate; lower third of occludent margin usually denticulate; articular ridge thick, prominent, occupying upper two-thirds of tergal margin partially reflexed over deep, narrow articular furrow, and extending well beyond tergal margin; adductor ridge short, straight, prominent, acute, parallel to occludent margin, centrally located on plate, and partially overhanging shallow, elongate pit below ridge; adductor muscle pit elongate, parallel to adductor ridge, moderately deep; lateral depressor

muscle pit small, very deep, round to elliptical, situated at basitergal angle on basal margin; apical part of scutum markedly rugose.

Tergum thick, flat, usually narrow; exterior marked by prominent, closely-spaced growth ridges crossed by radial striae on carinal side; scutal margin straight; carinal margin convex without well-developed zone of upturned growth lines; articular ridge prominent, triangular, highest in apical third of plate and extending to basal margin, partially reflexed over broad, deep articular furrow; depressor muscle crests short, prominent, seven in number, located on protuberant corner of basal margin; interior of plate markedly rugose; spur fasciole flat or slightly depressed, bordered on scutal side by narrow groove; tergal spur short, occupying less than one-fourth of basal margin, acuminate, removed by a distance nearly equal to its own length from basiscutal angle; juncture of spur with carinal side of basal margin deeply arcuate to subangular.

Holotype: Tergum, USNM 423883.

Type locality: Berchem Formation, Edegem sands, Metro works spoil heaps, Borgerhout, Antwerp, Belgium; J. S. H. Collins, collector, 1985.

Material: Over 100 disarticulated compartmental plates, 23 scuta and 7 terga from the type locality.

Disposition of types: Holotype USNM 423883, paratypes USNM 423884 through 423896, and paratype lot USNM 423897 are in the collection of the Department of Paleobiology, National Museum of Natural History, Washington, D. C.; reference specimens are in the collection of the British Museum (Natural History), London.

Geologic and geographic distribution: Lower Miocene, Belgium. Known only from the type locality.

Etymology: This species is named for J. S. H. Collins, collector and donator of the only known specimens, in recognition of his numerous contributions to our understanding of fossil Cirripedia.

Discussion: *Actinobalanus collinsi* is most readily distinguished from other species of *Actinobalanus* by its coarsely plicate shell, unusually thick opercular plates and the broadly reflexed shelf developed

PLATE 2

Figures

- 1-7. *Actinobalanus collinsi* n. sp., Berchem Formation, Edegem sands, Antwerp, Belgium. 1, USNM 423887 (paratype), exterior of scutum, 20X; 2, USNM 423888 (paratype), exterior of tergum, 34X; 3, USNM 423889 (paratype), interior of tergum, 28X; 4, USNM 423883 (holotype), interior of tergum, 34X; 5, USNM 423890 (paratype), interior of tergum, 31X; 6, USNM 423891 (paratype), interior of scutum, 24X; 7, USNM 423892 (paratype), interior of scutum, 19X.



PLATE 2

on the scutal margin of the tergum. The Miocene reports of *Actinobalanus bisulcatus* by Alessandri (1907, 1922), Withers (1953, p. 58) and Davadie (1963), and of *A. dolosus* by Davadie (1963) from Belgium and France may represent *A. collinsi*.

ACTINOBALANUS FLORIDANUS new species
Plate 3, figs. 5-9; Plate 4

Diagnosis: Parietes smooth or rarely plicate; radii narrow, dispartiate; Scutum without external radial ornament; basal margin about two-thirds length of occludent margin; scutal adductor ridge prominent, short, about one-quarter length of occludent margin; scutal articular ridge extending beyond tergal margin; tergum broad, with straight scutal margin; carinal margin with upturned growth ridges; tergal spur short, occupying about one-third of basal margin; basally rounded; juncture between spur and carinal side of basal margin deeply arcuate.

Description: Shell small, up to 5 mm in carinorostral diameter, conic, with moderately-toothed orifice; parietes thin, solid, smooth, rarely plicate; radii solid, moderately narrow, with steeply-sloping summits and thin, non-septate sutural margins; alae broad, thin, with convex, welted summits and thin, non-septate sutural margins; sheath occupying upper half to upper two-thirds of compartmental plate; basal margin of sheath either confluent with, or only slightly removed from plate interior; interior of parietes with numerous, prominent, flat-topped longitudinal ribs that fade toward, but extend to base of sheath; basal edges of internal longitudinal ribs thin, not denticulate; interior of compartments framed on either side by thickened borders of alae and radii; calcareous basis thin near center, thickening toward margin, tubiferous; basal tubes dividing near margin in some specimens.

Scutum thin, outwardly bowed between basal margin and apex; relatively narrow, with basal margin about two-thirds length of occludent margin; exterior ornamented solely by widely spaced, sometimes prominent growth ridges; occludent margin often thickened into flat, broad shelf in apical half, with prominent denti-

cles lining basal half; articular ridge prominent, thickened, occupying upper half to two-thirds of tergal margin, reflexed over broad, deep articular furrow, and extending well beyond tergal margin; adductor ridge short, about one-fourth length of occludent margin, straight, prominent, acute, parallel to occludent margin, centrally located on plate; adductor muscle pit elongate, parallel to adductor ridge, deep; an elongate pit also borders the adductor ridge on its tergal side; lateral depressor muscle pit small, round, moderately deep, on basal margin slightly removed from basitergal angle; apical part of interior of scutum rugose.

Tergum thin, broad, triangular, flat; exterior marked by indistinct or occasionally prominent, widely-spaced, growth ridges; scutal margin straight; carinal margin convex, marked externally by narrow band of upturned growth ridges; articular ridge prominent, triangular, best developed in apical third of plate and fading toward, but extending to basal margin, partially reflexed over broad, deep articular furrow; depressor muscle crests short, prominent, closely-spaced, six in number; interior of plate markedly rugose; spur fasciole flat to slightly depressed, usually bordered by impressed line on scutal side; tergal spur short, basally rounded, occupying about one-fourth of basal margin, removed by a distance slightly less than its length from the basiscutal angle; juncture of spur with carinal side of basal margin deeply arcuate.

Holotype: Shell with opercular plates, USNM 423898.

Type locality: Limy facies of the basal Chipola Formation, Alum Bluff Group, at power line on north bank of Ten Mile Creek, 1.3 mi north-northwest of the mouth of the creek at Bailey's Ferry on the Chipola River, Calhoun County, northwestern Florida (= TU 830); Earl Manning, collector, March 27, 1986.

Material: Twenty complete shells, several with opercular plates in growth position; and over 100 compartmental plates.

Disposition of types: Holotype USNM 423898, paratypes USNM 423899 through 423908, and paratype lot 423909 are in the collection of the Department of Paleobiology, National Museum of Natural History, Washington, D. C.

PLATE 3

Figures

- 1-4. *Actinobalanus collinsi* n. sp., Berchem Formation, Edegem sands, Antwerp, Belgium, all 12X. 1, USNM 423893 (paratype), exterior of lateral plate; 2, USNM 423894 (paratype), exterior of lateral plate; 3, USNM 423895 (paratype), interior of rostral plate; 4, USNM 423896 (paratype), exterior of lateral plate.
- 5-9. *Actinobalanus floridanus* n. sp., Chipola Formation, Calhoun County, Florida, all 33X. 5, USNM 423899 (paratype), exterior of scutum; 6, USNM 423898 (holotype), interior of tergum; 7, USNM 423898 (holotype), interior of scutum; 8, USNM 423900 (paratype), exterior of scutum; 9, USNM 423901 (paratype), interior of tergum.



PLATE 3

Geologic and geographic distribution: Lower Miocene (Burdigalian), Florida. Known only from the type locality.

Etymology: This species is named for the State of Florida.

Discussion: *Actinobalanus floridanus* is the only species of the genus known to occur outside of the western European region, and is approximately the same age as the oldest known European species, *A. collinsi* from the Miocene of Belgium. *Actinobalanus floridanus* closely resembles the type species, *A. actinomorphus*, especially in the morphology of the opercular plates. However, the scutum of the new species is narrower and has a longer, more prominent adductor ridge, the external growth ridges of the tergum are upturned along the carinal margin, and the juncture between the tergal spur and the carinal side of the basal margin is deeply, rather than gently arcuate, imparting greater definition to the tergal spur. In addition the shell of *A. floridanus* is typically smooth, with only the rare example being plicate, whereas that of *A. actinomorphus* is usually markedly costate, although examples with smooth shells are known. Most individuals have a relatively flat basis such as a group found on a naticid shell, but others replicate the ornament of the ribbed molluscs to which they were attached. A smaller number are elongate in the carinorostral direction, with their lateral margins curled under to form a clasping basis, indicating attachment to cylindrical objects, possibly echinoid spines.

IV. KEY TO THE SPECIES OF *ACTINOBALANUS*

1. Exterior of scutum with 2-3 distinct radial furrows *Actinobalanus bisulcatus*
1. Exterior of scutum with growth ridges only 2
2. Scutal margin of tergum convex, tergal spur broad, about one-third width of basal margin with nearly parallel sides; length of scutal adductor ridge over one-half length of occludent margin *Actinobalanus dolosus*
2. Scutal margin of tergum straight, tergal spur narrow, no more than one-third width of basal margin, with diverging sides; length of scutal adductor ridge no more than one-quarter length of occludent margin 3
3. Opercular plates thick; scutal margin of tergum produced into broad shelf; shell coarsely plicate *Actinobalanus collinsi*
3. Opercular plates thin; scutal margin of tergum not developed into broad shelf; shell smooth or costate 4
4. Shell usually costate; length of scutal adductor ridge less than one-fifth length of occludent margin; basal margin of scutum nearly three-fourths length of occludent margin; tergum without upturned growth ridges along carinal margin *Actinobalanus actinomorphus*
4. Shell usually smooth; length of scutal adductor ridge one-quarter length of occludent margin; basal margin of scutum less than two-thirds length of occludent margin; tergum with upturned growth ridges along carinal margin *Actinobalanus floridanus*

V. ACKNOWLEDGMENTS

We thank J. S. H. Collins, London, England for the specimens of *A. bisulcatus* and *A. collinsi*, and Earl Manning, Louisiana

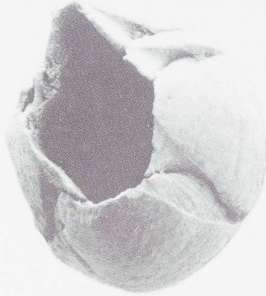
PLATE 4

Figures

- 1-8. *Actinobalanus floridanus* n. sp., Chipola Formation, Calhoun County, Florida. 1, USNM 423902 (paratype), interior of lateral plate, 13X; 2, USNM 423898 (holotype), oblique view of shell, 12X; 3, USNM 423903 (paratype), interior of rostral plate with attached tubiferous basis, 34X; 4, USNM 423904 (paratype), exterior of articulated rostral and lateral plates, 12X; 5, USNM 423905 (paratype), interior of carinolateral plate, 13X; 6, USNM 423906 (paratype), interior of articulated carinolateral and lateral plates with attached tubiferous basis, 20X; 7, USNM 423907 (paratype), exterior of partial articulated cylindrical shell, 14X; 8, USNM 423908 (paratype), interior of carinolateral and lateral plates with attached tubiferous basis, 33X.



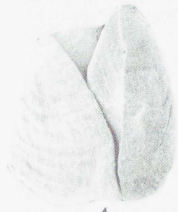
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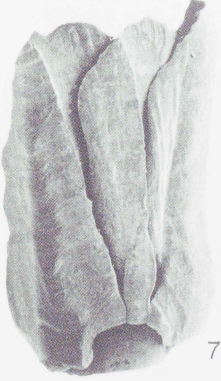
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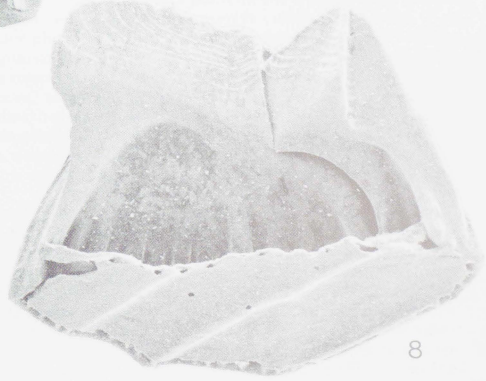
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7



8

PLATE 4

State University for the specimens of *A. floridanus* described herein. Acknowledgment is made to the donors of The Petroleum Research Fund, administered by the American Chemical Society, for support of this research.

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