ARMATOBALANUS IN THE MIOCENE OF MARYLAND

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Recent armatobalanid barnacles occur predominantly in the Indo-Pacific region. Notable exceptions among the recent fauna are *Balanus circe* Kolosváry (1948, p. 359), from an undetermined locality in the West Indies, and *B. nefrens* Zullo (1963, p. 590), from several localities along the California coast. An undescribed species, mentioned by Zullo (p. 588), found off the southeastern coast of the United States was identified subsequently as a new species of *Conopea* (Zullo, MS.).

Zullo (1963) and Davadie (1963) both assigned the fossil *B. inclusus* Darwin (1854, p. 299) to the subgenus *Armatobalanus*. *Balanus inclusus* was described from the Pliocene (Astian) Coralline Crag of England. This taxon was also reported from several localities in western Germany by Darwin. All the specimens from Germany, referred to by Darwin as *B. inclusus "Var. b"*, probably represent a distinct, but related, species. Although the present writer concurs with Zullo and Davadie in the assignment of *B. inclusus* to the subgenus *Armatobalanus*, Davadie's allocation of *B. bisulcatus* Darwin (1854, p. 293) and *B. dolosus* Darwin (1854, p. 295) to this taxon remains questionable at this time.

In the present study the author describes an armatobalanid, new to science, from the middle Miocene of the United States. This species is significant because it is the oldest form definitely referable to the subgenus *Armatobalanus*.

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Order THORACICA Darwin, 1854

Family **Balanidae** Gray, 1825

Subfamily Balaninae (Gray), 1825

Genus *Balanus* DaCosta, 1778

Subgenus *Armatobalanus* Hoek, 1913

Type Species. *Balanus quadrivittatus* Darwin, 1854, Recent, East Indies, by subsequent designation of Pilsbry, 1916.

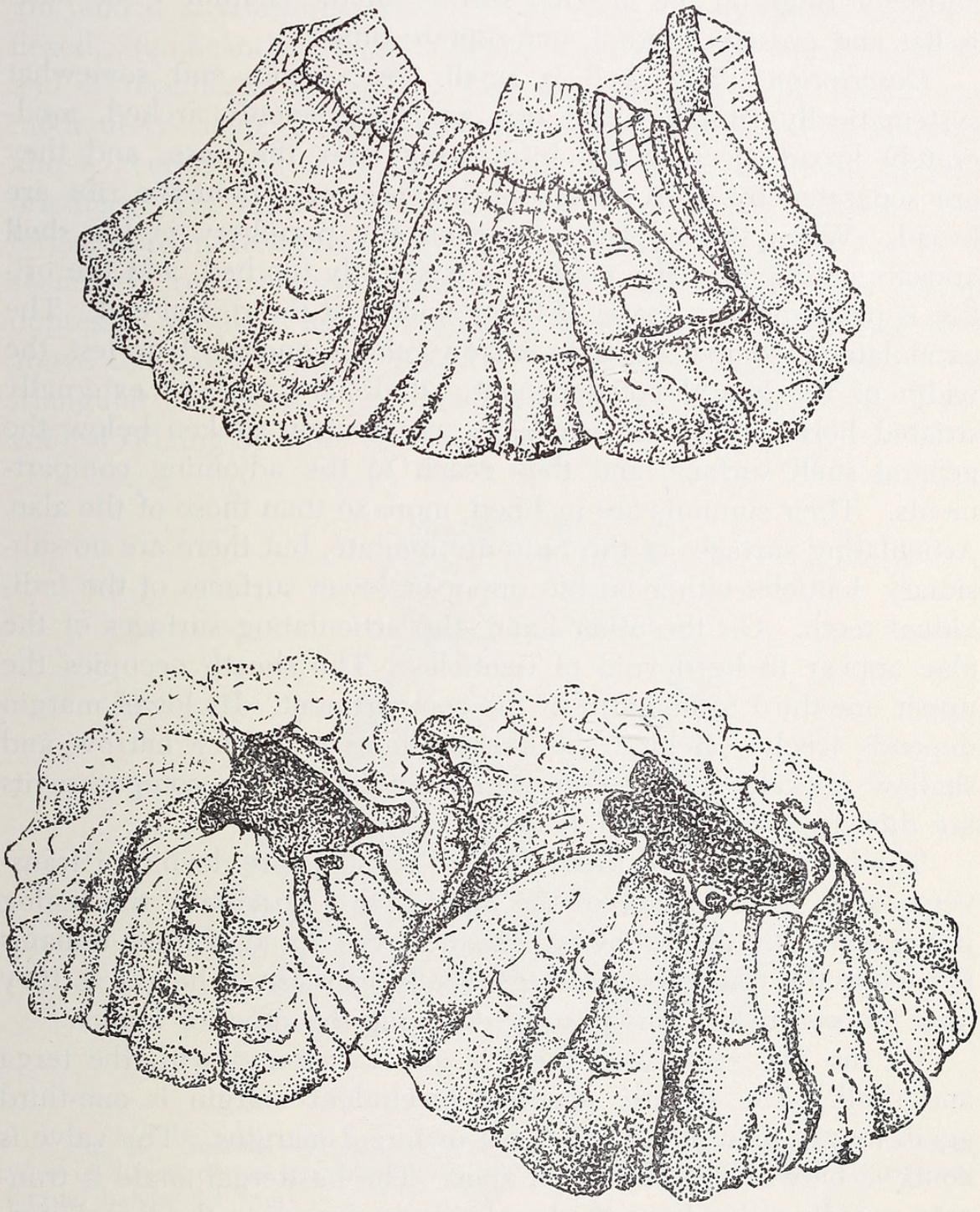

Fig. 1. *Balanus* (*Armatobalanus*) *calvertensis*, new species. Top, lateral view of partially disarticulated shell, carina on right side, holotype, U.S.N.M. No. 649419 (actual height 4.5 mm). Bottom, lateral view of two continguous shells, carina on lower right side, paratype, A.M.N.H. No. 28454/1:1 (actual length of both specimens 10.4 mm).

Balanus (*Armatobalanus*) *calvertensis*, new species

Diagnosis. The shell is small, conic, and well ribbed. Sutural edges of the radii are dentate, and the denticles perfectly smooth. Growth ridges on the scutum are strongly crenate. There is no adductor ridge on the internal surface of the scutum. The basis is flat and possesses radial, non-septate tubes.

Description. The shell is small, low, conic, and somewhat systematically ribbed. The ribs are high, evenly arched, moderately broad, occasionally bifurcating near the base, and they are separated by deep clefts that are narrower than the ribs are broad. When viewed from the apex the periphery of the shell appears scalloped. The peritreme is slightly toothed, and the orifice is pentagonal in shape, it being widest at the rostral end. The carinolateral compartment is narrow, about one-third or less the width of the lateral compartment. Radii are narrow, externally striated horizontally and vertically, moderately sunken below the general shell surface, and they reach to the adjoining compartments. Their summits are inclined, more so than those of the alae. Articulating surfaces of the radii are dentate, but there are no subsidiary denticles either on the upper or lower surfaces of the individual teeth. On the other hand, the articulating surfaces of the alae appear to be devoid of denticles. The sheath occupies the upper one-third to one-fifth of the compartment. Its lower margin depends freely. Behind the sheath there is a very narrow and shallow pocket. Ribs on the inner surface of the compartments are thin, high, and do not reach the sheath.

The basis is flat and tubiferous. The tubes are devoid of transverse septa. The center of the basis is thin, gradually thickening peripherally in the following manner: the basal lamina remains flat while the transverse septa gradually increase in height as they near the perimeter, thus in turn, elevating the superior lamina.

Of the two scuta only the left one was found with the terga and shell. The slightly pectinate occludent margin is one-third again longer than either the basal or tergal margins. The valve is concave between the base and apex. The basitergal angle is truncate, rapidly rising from the basal margin proper to the tergal margin. There is also a slight indentation in the basal margin at the basi-rostral corner. Consequently, when viewed externally the basal margin appears sinuous. Ornamenting the outer surface are

longitudinal striae as well as transverse growth ridges, the latter well developed, the former deeply incised. Thus, the interjunctional areas appear accented, presenting a crenate appearance. There are no longitudinal striae on the inflected tergal segment. The articular ridge occupies about three-fourths of the tergal margin, and it is visible externally. The ridge is prominent, high, reflexed, significantly thinner distally than apically, evenly arched, and it terminates abruptly. The articular furrow is broad and moderately deep. The adductor muscle depression is situated above center, and it is ovate, with the long axis baso-apically oriented. The borders of the depression are clearly defined. The tergal border, however, is greatly thickened and paralleled by a seemingly rudimentary adductor ridge. The pit for the lateral depressor muscle is large, deep, and triangular, and it extends well above the basal margin. The rostral depressor muscle pit is also triangular and deep. The inner apical surface of the valve is devoid of ridging or other markings.

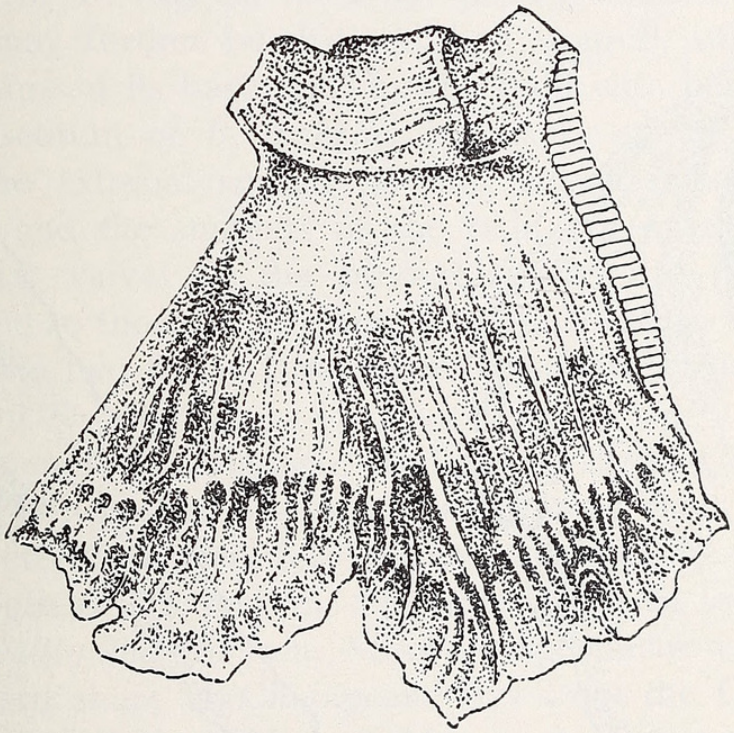

Fig. 2. *Balanus* (*Armatobalanus*) *calvertensis*, new species. Internal view of disarticulated left lateral compartment, paratype, U.S.N.M. No. 649423 (actual height 8.1 mm).

Unfortunately, both of the terga are only partially complete, but the morphological features essential for taxonomic separation are present. The valves are broad, flat, and typically exhibit the

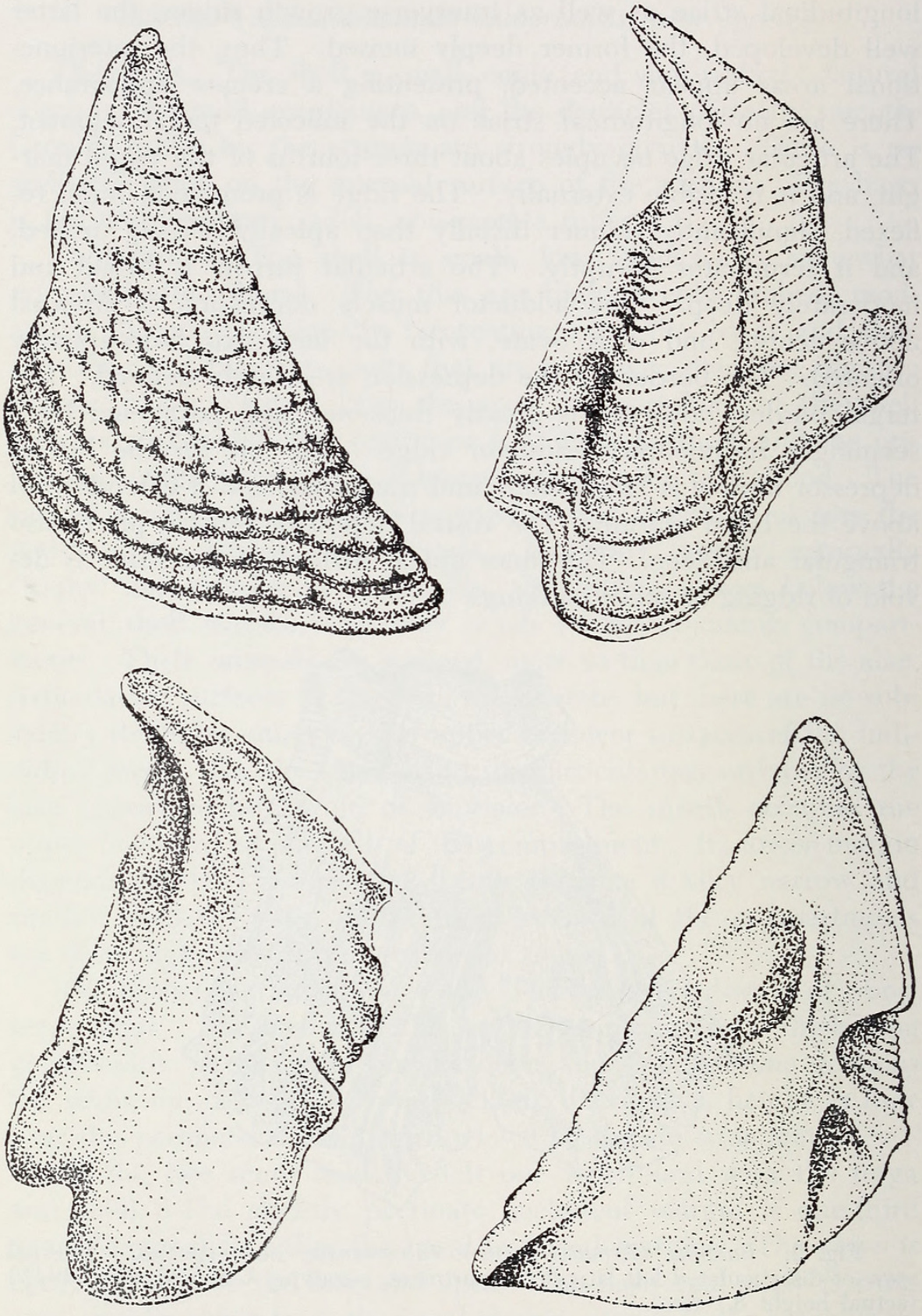

Fig. 3. *Balanus* (*Armatobalanus*) *calvertensis*, new species. Top left, bottom right, external and internal views of left scutum, holotype, U.S.N.M. No. 649420 (actual height 3.5 mm). Top right, bottom left, external and internal views of right and left terga, respectively, holotype, U.S.N.M. Nos. 649421 and 649422 (actual height 3.2 mm).

shallow, external longitudinal furrow, expanding basally. The lateral borders of the furrow are moderately developed. The spur fasciole is shallow and broad. Growth ridges on the valve surface are low and rather wide. The spur is also typically broad, occupying approximately one-half, or more, of the basal margin. It is also about one-fifth of the length of the tergal margin, and it is situated close to the basi-scutal angle. The spur is obliquely truncated parallel to the basal margin. Internally, the articular ridge is prominent, erect, and moderately long. The articular furrow is broad and shallow, and it is not covered by the articular ridge. Crests for the lateral depressor muscles are well developed, reclined, and number about five. The apical half of the valve is marked by a few, irregular, sub-parallel ridges.

Remarks. The external surface of the scutum of *Balanus calvertensis,* new species is ornamented in the same manner as *B. circe,* but it is easily distinguished from this form by the absence of an adductor ridge, which in *B. circe* extends to the basal margin. The scutum of *B. nefrens* does not possess incised longitudinal striae, and may further be distinguished from *B. calvertensis* by the solid nature of its basis, and by the radii with horizontal summits. The scutum of *B. inclusus* also lacks an adductor ridge. However, the external surface of the scutum possesses growth ridges only, and the summits of the radii are nearly horizontal. The opercular valves of the present species are perhaps most closely related to those of *B. allium* Darwin (1854, p. 281), but segregation of the two forms is facilitated by the horizontal summits of the radii of *B. allium.*

Measurements of Holotype. Height of shell, 4.5; lateral diameter of shell, 8.4; carino-rostral diameter of shell, 8.7; carino-rostral diameter of orifice, 3.2; maximum lateral diameter of orifice, 2.6; length of left scutum, 3.5; length of both terga, 3.2 mm.

Type Locality and Horizon. All of the specimens were collected on the western shore of Chesapeake Bay from the Calvert Cliffs at Calvert Beach, Calvert County, Maryland; Choptank Formation (bed 4 of Vokes, 1957, p. 5), Chesapeake Group, Middle Miocene; Arnold Ross collector, June 1961.

Type Depositories. The holotype, catalogue numbers 649419 (shell, fig. 1, top), 649420 (left scutum, fig. 3, top left, bottom right), 649421 (left tergum, fig. 3, bottom left), 649422 (right tergum, fig. 3, top right), and one paratype, 649423 (left lateral compartment,

fig. 2) are deposited with the U. S. National Museum. The remaining paratypes are deposited in the Department of Fossil Invertebrates at the American Museum of Natural History, catalogue numbers 28454/1:1 (fig. 1, bottom), and 28454/1:2 (complete shell, not figured).

Etymology. The specific name, *calvertensis,* denotes the fact that the species was found along the Calvert Cliffs at Calvert Beach, Calvert County, Maryland.

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