

The Pelecypod Genus *Striarca* from the Indo-Pacific Province¹).

By

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With 11 figures.

Abstract.

The Recent species *Arca aequilateralis* Thiele, from the Dutch East Indies, is renamed because it is a homonym of *Arca aequilateralis* Briart and Cornet, a Cretaceous species from Belgium, here assigned doubtfully to *Trigonarca*. Examination of the type specimens of the Recent species shows that it is to be assigned to the genus *Striarca* Conrad, 1862. The new name proposed is *Striarca thielei*. Although *Striarca* possesses a transversely striated ligamental area and flanges bordering the adductor muscle scars, features suggesting relationship with the Noetiinae, this genus, because of its resemblance to *Barbatia* in other respects, is retained in the subfamily Arcinae.

Introduction.

A study of certain arcid pelecypods has led us to examine specimens of several hundred species described under the name *Arca*. Some of these species are primary homonyms. In this paper, we discuss one of these homonyms (*Arca aequilateralis* Thiele) in order to call attention to the morphology and relationships of the species that it represents, and to illustrate an aspect of taxonomic procedure which is misunderstood by some systematists.

Acknowledgements.

We are indebted to Dr. B. RENSCH, of the University of Berlin, for the loan of the type specimens of "*Arca*" *aequilateralis* Thiele, and to Dr. M. GLIBERT, of the Musée royal d'Histoire naturelle de Belgique,

¹) Read before the Pacific Coast Branch of the Paleontological Society, at Berkeley, California, April 9, 1937.

for the loan of topotypes of "*Arca*" *aequilateralis* Briart and Cornet. Specimens of other species were supplied by A. G. BRIGHTON, Sedgwick Museum; KATHERINE VAN W. PALMER, Paleontological Research Institute; and L. R. COX, British Museum.

Striarca thielei Schenck and Reinhart, new name, figs. 1-4, 7, 12.

1931. *Arca* (*Barbatia*) *aequilateralis* Thiele, in: J. THIELE and SIEGFRIED JAECKEL, Muscheln der Deutschen Tiefsee-Expedition. Wissenschaftl. Ergebn. Tiefsee-Exped. **21**, Heft 1 (1931) 175, pl. 1, fig. 9.

Not *Arca aequilateralis* Briart and Cornet, Mém. Acad. Roy. Belgique **34**, 1867-70 (1870) 57-58, pl. 5, figs. 7-10; Albion, Bracquegnies, Belgium.

Type material: University of Berlin.

Type locality: Padang, southwest coast of Sumatra. Recent.

Description: Shell of medium size, fragile, thin, quadrate, equilateral; beaks central, small, orthogyrate, sharp; numerous generally undivided radial ribs, faintly beaded on holotype and more prominently so on the specimens from Santa Barbara; some ribs present at ventral margin extend only half way to the beaks; ribs slightly rounded, almost flat-topped in section; interspaces wider than ribs, flat at bottom; several distinct concentric lines of growth; weak concentric sculpture visible in interspaces; ligamental area narrow (0.6 mm. wide on holotype); ligament does not occupy entire area and, on the smallest specimen, occupies only a small triangular area directly under the beak, the size of the ligament increasing proportionally with the size of the shell, so that in the holotype, the largest specimen in the suite, the ligament covers about two-thirds of the cardinal area; ligament transversely striated, both on the ligament itself and on the shell underneath the ligament, but no striations are present on that part of the area which lacks the ligament; teeth small, regular, converging ventrally at extremities of hinge, terminated on dorsal margin by the straight hinge-line; inner ventral margin bears numerous faint crenulations; pallial line entire, marked by termination of internal radial striations; adductor muscle scars elongate-oval, bounded on the inner sides by low flanges; byssal gape may be present, but if so it is very narrow.

Dimensions: The measurements of the shells are given in Table I.

Notes on illustrations.

An enlarged view of the ligamental area of a specimen of *Striarca centenaria*, the genotype, is shown in fig. 11; fig. 7 is a similar view of the holotype of *S. thielei*. Transverse ligamental striations are visible

Table 1.
Dimensions of *Striarca thielei* Schenck & Reinhart, n. n.

Specimen	Length in mm.	Height in mm.	Convexity in mm.	Number of teeth	Number of ribs
Holotype (right valve)	20	13,9	4,5	46	84
SB-1 ¹⁾ (right valve) .	15,4	11,6	3,5	38	66
SB-2 (right valve)	10 +	8,2	2,8	30 +	63
SB-3 (left valve)	10,2 +	7,8	2,2	30	63
SB-4 (left valve)	8,2 +	6,3	1,9	25	70

in both figures, although they are stronger on *centenaria*, which has a larger, thicker shell. On *centenaria* the striated part is definitely sunken below the non-striated part of the area, the boundary being marked both anteriorly and posteriorly by a groove. On the holotype of *thielei*, the situation is similar, but less conspicuous.

The holotype of *thielei* is likewise shown in figs. 1, 2, and 3. Comparison of fig. 2 with fig. 9, a specimen of *centenaria*, shows the general similarity in dentition between the two species. The elevated flanges, which border the adductor muscle scars on the inner side, are visible in fig. 9 (*centenaria*) but are indistinct in fig. 2 (*thielei*), although on the actual specimen small flanges are plainly visible. A comparison of figs. 1 and 8 brings out the similarity in general shape and sculpture between the two species. Fig. 3 is an enlargement of the sculpture of *thielei*, and fig. 10, of *centenaria*. Figs. 4 and 12 represent young specimens of *thielei*, enlarged to show the details of the ligament. On the smallest specimen, shown in fig. 4, the ligament occupies only a small triangular area directly under the beak. On the specimen represented by fig. 12, somewhat larger, the ligament occupies about one-half of the area. Finally, on the largest specimen of *thielei* available, shown in fig. 7, the ligament occupies almost the entire area.

Figs. 1 and 2 bring out a large, light-colored, elliptical area between the adductor muscle scars which may represent a muscle attachment,

¹⁾ By the designation "SB-1", etc., we refer to the specimens No. G 1040 from Santa Barbara, off the east coast of Sumatra, latitude 0°; longitude 107°; depth, 28 fathoms.

but this supposition needs to be tested by an examination of additional material.

The genotype of *Galactella*, namely, *Arca lactea* Linné, is shown by fig. 5 and 6 for comparison with *thielei* and *centenaria*. The transverse striations on the ligamental area are faintly shown in fig. 6.

Comparisons.

Certain similarities and differences between *thielei* and *Striarca centenaria* (Say) have been given above. The species are similar in having flanges bounding the adductor muscle scars and in the general arrangement of the hinge and ligamental area. In general shape and ornamentation they resemble each other, although not so closely as to cause confusion. The specimens of *thielei* differ from *centenaria* in the following respects: 1. the shell of *thielei* is thinner and less inflated than that of *centenaria*; 2. the flanges on the muscle scars are less conspicuous on *thielei*; 3. the beaks of *thielei* are centrally located and orthogyrate, instead of slightly anterior to the center and prosogyrate as in *centenaria*; 4. *centenaria*, unlike *thielei*, possesses a median depression extending from the beaks to about the center of the ventral margin, causing a broad indentation in that margin, which suggests the presence of a byssal gape.

The following are the differences between *thielei* and "*Arca*" *lactea* Linné: 1. Although the species resemble each other in having muscle scar flanges and similar hinge and ligamental areas, they differ in profile and degree of inflation; 2. the beaks of *lactea* are slightly anterior to the center of the shell and are slightly prosogyrate; 3. *lactea* has a median depression, as in *centenaria* but not in *thielei*; 4. the shell of *lactea* is thicker than that of *thielei*.

Through the courtesy of Dr. B. RENSCH, we have several specimens of "*Arca (Fossularca)*" *afra* Gmelin, from east Africa, Station 244 of the German Deep-sea Expedition¹). These shells have flanges on the inner side of both adductor muscle scars. The beaks are slightly prosogyrate, strongly incurved. Beneath the beaks on the ligamental area is a slightly depressed, triangular ligamental area bearing transverse striations. This area occupies somewhat less than one-third the total cardinal area²).

¹) Ergebn. Tiefsee-Exped. 1, Heft 1 (1931) 174.

²) The term "ligamental area" is used only for the part actually occupied by the ligament; "cardinal area" refers to the entire area, whether it all was occupied by the ligament or not.

The dentition is as in *Striarca*.

Striarca africana Newton¹), from the Lutetian Eocene of Nigeria, is relatively compressed, thinshelled, elongate-quadrate in profile, with sharp, centrally-located, orthogyrate beaks. The ligamental area is transversely striate. A low, inconspicuous flange borders the posterior adductor muscle scar, but none borders the anterior scar, which would be a reason for removing the species from *Striarca*. The sculpture consists of alternating strong and weak radials crossed by concentric ribs, so as to give a reticulate appearance. The largest specimen examined (No. 5165, Sedgwick Museum) has the following dimensions in millimeters: length, 16; height, 8.8; convexity, 4.

"*Arca*" *pretiosa* Deshayes²), from the Oligocene of western Europe, has some distinctive features in common with *Striarca thielei*. We have had before us a suite of specimens of *pretiosa* (SCHENCK Coll. No. 958), the largest of which is 10 mm. long. These fossils are from the Rupelian (Oligocene) of Waldböckelheim, Rheinhessen, Germany. They show a definite flange bordering each adductor muscle scar. The ligament occupied a small triangular area beneath the beak, covering about one-third of the total cardinal area. This triangle bears transverse striations and is set off from the unstriated part of the area by a slight indentation. The unstriated part of the area bears longitudinal growth lines. Like the genotype of *Striarca*, *pretiosa* has a broad medial depression extending from the beak downward to the center of the ventral margin, but this depression is less pronounced than on *centenaria*. In shape, dentition, and sculpture, the two species are fairly similar.

In view of these observations, it appears that "*Arca*" *pretiosa* belongs to *Striarca* instead of *Arcopsis* (= *Fossularca*), to which it has previously been assigned³). "*Arca*" *pretiosa*, however, is not a characteristic *Striarca*, because of the restriction of its ligament to such a small triangle. A similar restriction has been noted in young specimens of *Striarca thielei* (fig. 4) but not in the adult form of that species. In typical

¹) NEWTON, Geol. Surv. Nigeria Bull. 3 (1922) 69-70, pl. 8, figs. 11-13.

²) We have not seen the original description and figure of this species, apparently described in DESHAYES' Descr. an. sans. Vert., in 1858. The reference given by VON KOENEN (Abh. geol. Spezialkarte von Preuß. und den Thüringischen Staaten 10, Heft 5, Lief. V [1893] 1109) to DESHAYES is incorrectly cited. The German authority discussed and illustrated this species, which he allocated to the subgenus *Fossularca*.

³) VON KOENEN, op. cit., p. 1109; REINHART, Bull. Mus. roy. Hist. nat. Belgique 11, no. 13 (1935) 32.

Arcopsis, the ligament is still further restricted, so as to occupy only a small shallow pit, which is not transversely striated, so far as we have observed. "*Arca*" *pretiosa*, which we assign to *Striarca*, thus has much in common with both *Arcopsis* and *Striarca*, and points to a relationship between these genera.

Generic allocation.

Our reasons for assigning *thielei* to the genus *Striarca* Conrad¹⁾ are the following: 1. The ligamental area of *thielei* bears transverse striations; 2. the arrangement of the teeth is like that of the genotype, *Striarca centenaria* (Say); 3. flanges border the inner sides of the adductor muscle scars; and 4. in general shape and ornamentation, *thielei* is similar to the genotype.

From *Barbatia* (Type: "*Arca*" *barbata* Linné), the species *thielei* differs in having transverse striations on the ligamental area instead of chevron-shaped grooves, in possessing flanges bordering the adductor muscle scars, and in having orthogyrate rather than prosogyrate beaks. THIELE probably allocated his species to *Barbatia* because of profile and external sculpture.

The genus *Striarca*, and hence the species *thielei*, may be separated from *Arcopsis* (= *Fossularca* Cossmann) for the reasons already given by REINHART²⁾. These genera are related, however, as brought out on a preceding page.

Galactella Cossmann and Peyrot, 1912, was described as a subgenus of *Fossularca*, but it was treated as a synonym of *Striarca* by REINHART³⁾. Numerous specimens of "*Arca*" *lactea* Linné, the genotype of *Galactella*, are before us. Direct comparison of these specimens with *Striarca centenaria* and *thielei* leads us to consider them as congeneric. The similarity between *lactea* and *centenaria* is greater than that between *thielei* and either of the other two.

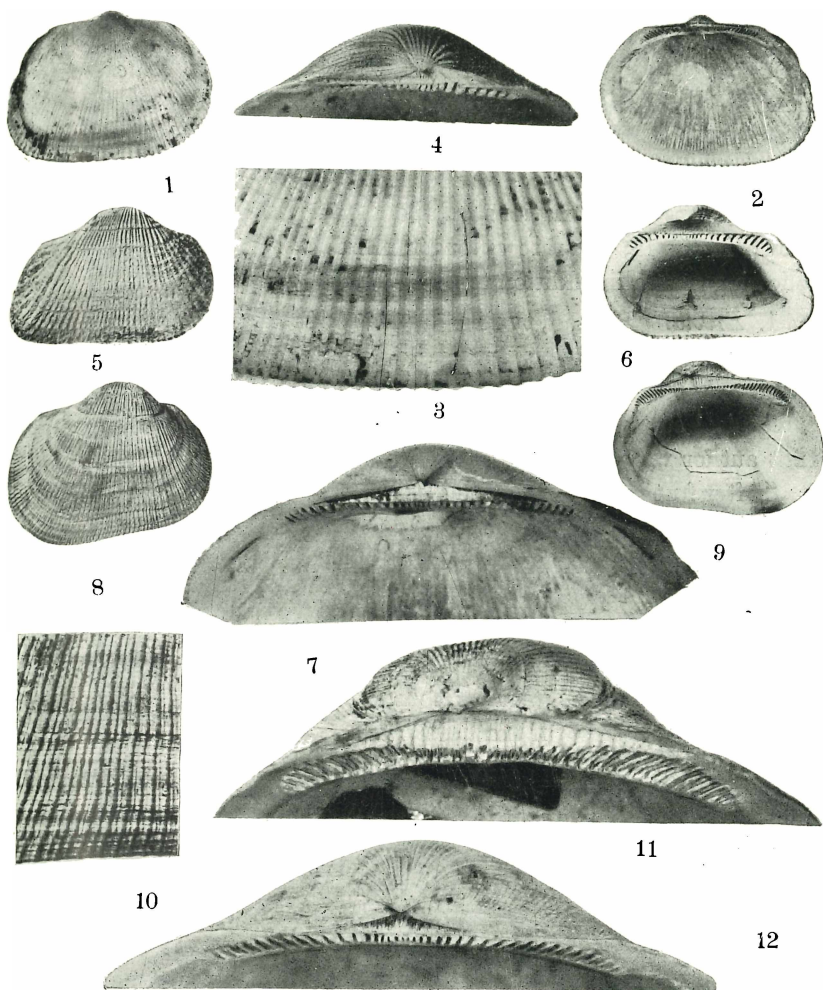
Diagnosis of *Striarca*.

Shell equivalve, nearly or entirely equilateral; surface ornamentation of fine radial ribs; beaks prosogyrate or orthogyrate; ligament transversely striated, extending on both sides of beaks, occupying most, but not all, of cardinal area; hinge of continuous series of obliquely placed teeth, small in central part of hinge; adductor muscle scars

¹⁾ T. A. CONRAD, Proc. Acad. Nat. Sci. Philadelphia 14 (1862) 290.

²⁾ REINHART, *op. cit.*, p. 31.

³⁾ REINHART, *op. cit.*, p. 33-34.



Explanation of Plate.

Figs. 1, 2, 3, 4, 7, 12. *Striarca thielei* Schenck and Reinhart, n. n. Figs. 1, 2, 3, 7, Holotype; Recent, Padang, Dutch East Indies; right valve, length 20 mm. Fig. 1, exterior view (X 1, 4); fig. 2, interior view (X 1, 4); fig. 3, detail of sculpture, length of segment illustrated, 14.5 mm. (X 3, 9); fig. 7, enlarged view showing transverse striations on ligamental area; distance from posterior to anterior tooth, 11.9 mm. (X 3, 4). Fig. 4, Hypotype, Recent, Island of Santa Barbara, Dutch East Indies; left valve, length 8.2 mm., view of hinge showing small triangular area occupied by ligament in a young individual; distance from posterior to anterior tooth, 4.5 mm. (X 6, 0). Fig. 12, Hypotype, Recent, Island of Santa Barbara; right valve, length 15.4 mm., view of hinge of a somewhat larger specimen on which the ligament occupies about one-half of the cardinal area. Distance from posterior to anterior tooth, 8.3 mm. (X 6, 7).

Figs. 5, 6. *Striarca lactea* (Linné), genotype of "*Galactella*". Hypotype No. 6063, Stanford Univ. paleo. type coll., a right valve 13 mm. long (X 2, 2). Recent, Guernsey.

Figs. 8, 9, 10, 11. *Striarca centenaria* (Say), the type species of *Striarca*. Fig. 8-10, Hypotype No. 6060, Stanford University Paleo. Type Coll., a right valve from St. Mary's beds, Miocene of Suffolk, Virginia, 32 mm. in length. Figs. 8 and 9, exterior and interior (X 0, 9); fig. 10, detail of ornamentation (X 3, 0). Fig. 11 (X 3, 7), Hypotype No. 6058, Stanford University Paleo. Type Coll., a right valve 23.5 mm. in length from the Miocene of King's Mill Wharf, 1 1/2 miles southwest of Grove, York Co., Virginia.

bordered on inner side by elevated flange; ventral margin of shell with narrow byssal gape¹). No. II Genotype: *Arca centenaria* Say. Time range: Late Cretaceous or Eocene to Recent.

Other genera with transversely striated ligaments.

The transverse striations on the ligamental area of *Striarca*, best shown in fig. 11, are rare among the arcids, being found only on the following genera in addition to *Striarca*:

1. *Breviarca* Conrad, typified by *Breviarca haddonfieldensis* Stephenson from the Cretaceous, was treated as a synonym of *Striarca* by REINHART²), but as a valid genus by STEPHENSON³). While the latter's categorical statement may be right, the evidence is not convincing, as that author writes:

"After further consideration I am now of the opinion that, although the Miocene and Cretaceous species do possess this feature [striated ligamental area] in common, and are related, there are sufficient differences in form and ornamentation to warrant retaining CONRAD's *Breviarca* for the Cretaceous species."

The present authors hold that there are sufficient similarities in form and ornamentation to warrant considering *Breviarca* as of no higher rank than a subgenus, if that, of *Striarca*.

2. *Noetia* Gray. This genus is typified by *Noetia triangularis* Gray, which is a synonym of *N. reversa*, a well-known species figured by MAURY⁴).

3. *Halonanus* Stewart, 1930; genotype: *Noetia pulchra* Gabb, Eocene. Because of the similarity in form and dentition of this genus to *Trigonodesma* Wood, REINHART⁵) regarded *Halonanus* questionably as a synonym of that genus. Although the similarity is striking, nevertheless *Trigonodesma* lacks the transverse striations of typical *Halonanus*, and has a ligament restricted to a small, triangular area. Therefore, *Halonanus* is here separated from *Trigonodesma*.

¹) A byssal gape is strongly suggested on several unattached valves of *Striarca centenaria* in the SCHENCK Coll., No. 1589, from the Miocene of James River, Virginia. The largest of these shells measures 38 mm. in length. Specimens of *S. lactea*, with valves attached, show definite byssal gapes.

²) REINHART, *op. cit.*, p. 33.

³) L. W. STEPHENSON, Notes on the genus *Breviarca* [J. Washington Acad. Sci., 25, No. 8 (Aug. 15, 1935) 362-363.

⁴) MAURY, Palaeontographica Americana 1, No. 4 (1922), pl. 1, figs. 7, 11.

⁵) REINHART, *op. cit.*, p. 52.

Subfamily Allocation.

The presence of a transversely striated ligamental area on *Striarca* raises the question of its subfamily allocation. Similar striations are present on two genera of Noetiinae (*Noetia* and *Halonanus*), although at least two of the genera which have been assigned to the Noetiinae (*Trigonarca* and *Trigonodesma*) do not have these transverse striations. Whether or not *Paranoetia*, *Sheldonella*, and *Noetiella*, which have also been referred to the Noetiinae, have transversely striated ligaments we do not know, not having seen specimens of representative species. Thus, although these striations are not present on all of the genera now allocated to the Noetiinae, they are found on the typical genus, *Noetia*, and on at least one other group.

The transversely striated area and flanged muscle scars, considered alone, would place *Striarca* in the subfamily Noetiinae. However, several other features distinguish *Noetia* from *Striarca*: *Noetia* possesses opisthogyrate beaks; a trigonal, inflated form; strong, *Anadara*-like radial sculpture; and a flange bordering only the posterior adductor muscle scar. Because these differences in form and sculpture seem to outweigh the similarities between *Striarca* and *Noetia*, we feel that *Striarca* should be assigned, not to the Noetiinae, but to the Arcinae, as that subfamily was defined by REINHART¹).

This decision is influenced by the strong resemblance in form and sculpture of *Striarca* to *Barbatia* which, as previously pointed out, differs only in lacking elevated muscle scar flanges and transverse striations on the ligament. *Striarca*, which thus combines to some degree the most characteristic features of *Barbatia* and *Noetia*, suggests a relationship between these genera, the degree of which is a subject for speculation.

In conclusion, the principle of the summation of characters must be applied to families and subfamilies as well as to smaller taxonomic units. The application of this principle will help in avoiding the mistakes which might be made if the systematist attached taxonomic rank to individual morphological features. To say, for example, that a transversely striated ligament is a subfamily character, flanged muscle scars a generic character, and so on, is bound to lead to unsound arrangements that do not express actual genetic relationship.

Trigonarca (?) *aequilateralis* (Briart and Cornet).

The topotypes supplied to us by Dr. M. GLIBERT show that the protographs are comparatively accurate. An internal mold demon-

¹) REINHART, *op. cit.*, p. 14.

strates the presence of an elevated flange on the anterior side of the posterior adductor muscle scar.

GILLET¹) placed this species in the genus *Trigonarca* Conrad. It is true that the hinge of *aequilateralis* resembles that of *Trigonarca maconensis* (Conrad), the genotype of *Trigonarca*, but the Belgian species has radial ribs and *maconensis* lacks ribs. In shape, *aequilateralis* differs from *Trigonarca*, suggesting, instead, *Cucullaea*. The hinge of typical *Cucullaea*, however, differs from that of *aequilateralis* by possessing a very abrupt change between the horizontal teeth at the extremities of the hinge and the central granular teeth. The species *aequilateralis*, therefore, has some of the characteristics of each genus and hence is only tentatively assigned to *Trigonarca*.

Discussion.

This paper focuses attention on the morphology of certain arcid pelecypods, but its purpose is also to illustrate a case of procedure in taxonomy. We have dealt with this problem: two different species were described under the same specific name in combination with the same genus name. The Recent species is a homonym of the Cretaceous species. Hence, the Recent species is renamed — *thielei*. However, for biological reasons and in accordance with our philosophy, we allocate this species to the genus *Striarca*, the name-combination thus becoming *Striarca thielei*. The fossil *aequilateralis* becomes *Trigonarca* (?) *aequilateralis*, also for biological reasons. Such procedure leaves no taxonomic unit with the name *Arca aequilateralis*.

Many workers have objected to the renaming of homonyms under such circumstances, despite the explicit statements in the International Rules of Zoological Nomenclature. *Arca aequilateralis* Thiele was "still-born" and must be renamed, no matter whether the older-named species is transferred to another genus or not.

To rename the homonym prevents misunderstanding and instability. Specialists fifty years hence may transfer the Cretaceous *aequilateralis* to another genus, or even back to *Arca*, depending upon shifts in biological opinions. Nomenclature can be stable; evaluation of morphologic features of animals and shells, concepts of taxonomic categories, and ideas of variation of species and genera will change continually.

¹) S. GILLET, Etudes sur les lamellibranches néocomiens, Mém. Soc. géol. France, n. s., 1, Mém. No. 3 (1924) 18.

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