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The Recent Crassatellinae of the Eastern Pacific, with Some Notes on *Crassinella*

by

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Abstract. The three eastern Pacific species of the Crassatellinae belong in *Eucrassatella* Iredale, 1924. *Hybolophus* Stewart, 1930, is regarded as a synonym of this genus, as is the recently proposed but unavailable *Eucrassinella* Cruz, 1980. The rare *E. fluctuata* (Carpenter, 1864) occurs off the Channel Islands of southern California at a mean depth of 88 m; a synonym is the Plio-Pleistocene *Crassatellites lomitensis* Oldroyd, 1924. *Crassatella marginata* Keep, 1887, *ex* Carpenter MS, which has been synonymized with *E. fluctuata*, is instead based on specimens of the bernardinid genus *Halodakra,* perhaps *Halodakra salmonea* (Carpenter, 1864). *Eucrassatella gibbosa* (Sowerby[1], 1832) occurs from the Gulf of California to Peru at a mean depth of 32 m. Added to its synonymy are *Eucrassatella* (*Hybolophus*) *gibbosa tucilla* Olsson, 1932, and *Eucrassinella manabiensis* and *E. aequitorialis* Cruz, 1980. *Crassatella corbuloides* Reeve, 1842, which has been synonymized with *E. gibbosa,* is instead an Australian taxon. The Venezuelan *Eucrassatella antillarum* (Reeve, 1842) is synonymized with the eastern Pacific *E. digueti* (Lamy, 1917). In the eastern Pacific this species occurs at a mean depth of 45 m from the Gulf of California to Ecuador. Newly added to its synonymy is *Crassatella laevis* A. Adams, 1854, from the Caribbean. Lectotypes are selected for all of the synonymous taxa of *Eucrassatella.*

There has been an overrecognition of full, cognate species between the Panamic and Caribbean faunal provinces. Increased consideration should be given to the use of subspecies or describing the morphological differences between populations without naming them.

The Caribbean *Crassinella aduncata* Weisbord, 1964, is related to the eastern Pacific *C. adamsi* Olsson, 1961; *C. maldonadoensis* (Pilsbry, 1897) from Uruguay is very similar to the eastern Pacific *C. nuculiformis* Berry, 1940.

I HAVE PREVIOUSLY reviewed the members of the genus *Crassinella* occurring in the eastern Pacific, a genus in the crassatellid subfamily Scambulinae (COAN, 1979). Here I treat the subfamily Crassatellinae, which is represented in the eastern Pacific by the genus *Eucrassatella.* In particular, I have addressed the appropriate generic allocation for eastern Pacific members of this subfamily and the status of the subgenus *Hybolophus*; the validity of two taxa recently described from Ecuador, *Eucrassinella manabiensis* and *E. aequitorialis* Cruz; the proper home for *Crassatella marginata* Keep; the question of whether or not *Crassatella corbuloides* Reeve is a synonym of the eastern Pacific *Eucrassatella gibbosa* (Sowerby); the relationship of the Plio-Pleistocene *Crassatellites lomitensis* Oldroyd to the southern Californian *Eucrassatella fluctuata* (Carpenter); and the relationship of the eastern Pacific *Eucrassatella digueti* (Lamy) to the Caribbean *E. antillarum.* This led to consideration of how, in general, related taxa in the Panamic and Caribbean faunal provinces are handled nomenclaturally, and I have included here a discussion on this topic.

I have also included some information that has recently come to my attention about two western Atlantic species of *Crassinella* that are related to eastern Pacific taxa.

The Crassatellidae is an ancient and conservative family of marine bivalves, first appearing in the Paleozoic (BOYD & NEWELL, 1968; CHAVAN, 1969; MORRIS, 1978). The arrangement of its genera, including the Recent taxa, is in a less-than-satisfactory state. Previous reviews of the Recent crassatellid species of the world are by REEVE (1842, 1843), NYST (1847), TRYON (1872b), LÖBBECKE & KOBELT (1881, 1886), and LAMY (1917). BERNARD (1983:36) has recently listed the three eastern Pacific taxa of *Eucrassatella.*

CONVENTIONS AND ABBREVIATIONS

In the following treatment, the correct name is followed by a synonymy, information on type specimens and localities, notes on distribution and habitat, and an additional discussion.

The synonymies include all major accounts about the species, but not minor mentions in the literature. The entries are arranged in chronological order under each species-name, with changes in generic allocation and other notes provided in brackets at the end of the entry.

The following are the abbreviations of institutions used in the text:

AMNH—American Museum of Natural History
BM(NH)—British Museum (Natural History)
CASIZ—California Academy of Sciences, Department of Invertebrate Zoology
CASGTC—California Academy of Sciences, Geology Type Collection (numbers being replaced with CASIZ numbers)
LACM—Los Angeles County Museum of Natural History
USNM—United States National Museum of Natural History

A "pair" means the two valves of one individual.

Family Crassatellidae Férussac, 1822

Crassatellidae Férussac, 1822:xxxix, xlii; as "Crassatelles"

Subfamily Crassatellinae Férussac, 1822

Crassatella Lamarck, 1799

Crassatella Lamarck, 1799:85–86; type species (monotypy): "*Mactra cygnea* Chemnitz," Lamarck, 1799 (*non Mactra cygnus* Gmelin, 1791:3260, *ex* Chemnitz MS, a *Mactra*), =*Venus ponderosa* Gmelin, 1791:3280, of which both *Crassatella gibba* Lamarck, 1801:119, and *C. tumida* Lamarck, 1805:408–409, are synonyms; middle Eocene, Paris Basin

Crassatellites Krüger, 1823:466 (unavailable; "ICZN Code," Arts. 20, 56b, because is based on *Crassatella* and modified only with an "*ites*" ending to indicate fossil taxa)

There are no known living members of the genus *Crassatella* in the eastern Pacific, but the name has been used for species in that province (as by McLean, 1978:73), as has the unavailable generic unit *Crassatellites* Krüger.

Species of *Crassatella* have an opisthodetic ligament confined to the upper half of a broad hinge plate, and the inner ventral margins of their valves are denticulate. *Crassatella ponderosa* (Gmelin, 1791) is not uncommon in the middle Eocene of the Paris Basin, and the genus has been reported from the Cretaceous to the Recent (Chavan, 1969:N573).

The nomenclatural thicket surrounding the type species of *Crassatella* has been discussed by Stewart (1930:134–136), and by Vokes (1973:48–52), who said that he intended to file a petition with the International Commission on Zoological Nomenclature about it, but none has yet been published. Because it is a classic case of a misidentified type species, a petition would be required to validate the formulation above ("ICZN Code," Art. 70).

Species of *Crassatella* that occur in the Recent fauna are placed into separate subgenera, including *Indocrassatella* Chavan, 1952:119 (type species by original designation: *C. indica* Smith, 1895:265, of the Arabian Sea). Habe (1981:110) now ranks *Indocrassatella* as a full genus, including in it *I. oblonga* (Yokoyama, 1920:142–143: plt. 11, figs. 8, 9) from Japan. A second subgenus, *Riosatella* Vokes, 1973:52, occurs in the western Atlantic. Its type species, by original designation, *C. (R.) riograndensis* Vokes, 1973 (pp. 52–57; plt. 1, figs. 1–5), seems to be a synonym of *C. (R.) brasiliensis* (Dall, 1903a:101–102).[1]

Several fossil taxa from eastern North America are referred to *Crassatella*, and on the Pacific Coast *C. washingtoniana* (Weaver, 1912:32, plt. 4, fig. 42; plt. 5, fig. 51) has been assigned here as well (Stewart, 1930:137). As far as I know, none of these fossil taxa have been assigned to subgenera, and the arrangement and ranking of the named generic units near *Crassatella* awaits careful study.

The anatomy of *Crassatella* (*Indocrassatella*) *indica* has been briefly discussed but not illustrated by Stoliczka (1871:291–292), Ridewood (1903:223), and White (1942:64). Pelseneer (1911:37; plt. 13, fig. 1) discussed and illustrated the external anatomy of another crassatellid, *Bathytormus radiatus* (Sowerby, 1825:7; ii–iii; plt. 1, fig. 2) from Singapore, and that figure is copied here (Figure 1). *Bathytormus* is conspicuously different from *Crassatella indica* and *Eucrassatella* (discussed below) in that the ctenidial axis is oriented almost dorso-ventrally.

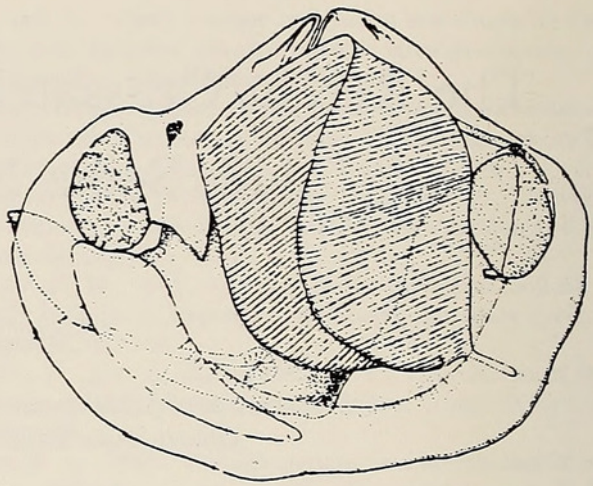

Figure 1

Bathytormus radiata (Sowerby); Singapore; drawing of gross anatomy after Pelseneer (1911). Note vertical orientation of ctenidial axis. Approximately × 2.

Eucrassatella Iredale, 1924

Eucrassatella Iredale, 1924:181, 202; type species (original designation): *Crassatella kingicola* Lamarck, 1805:409, from King Island, northwest of Tasmania

[1] A still older name is possibly *Crassatella uruguayensis* Smith, 1880 (pp. 321–322). Rios (1975:212) synonymizes *C. riograndensis* with *C. uruguayensis*, incorrectly terming Smith's species "invalid."

Hybolophus STEWART, 1930:139; type species (original designation): *Crassatella gibbosa* Sowerby[1], 1832, from the eastern Pacific, discussed below

Eucrassinella CRUZ, 1980:66 (unavailable, no designated type species; "ICZN Code," Art. 13b)

Eucrassatella was erected by IREDALE (1924) for some Australian species that had previously been allocated to *Crassatella*. He argued that neither *Crassatella* nor *Crassatellites* were available for nomenclatural reasons. DARRAGH (1964, 1965a) has discussed the nomenclature and distribution of *E. kingicola* and other Australian members of this genus.

Members of *Eucrassatella* are medium-sized to large (to over 100 mm), with an even outline to produced posteriorly in some. The beaks are inflated in some species and flattened in others, and are prosogyrate to slightly opisthogyrate. The valves have prominent concentric folds, sometimes confined to the beaks but sometimes covering the entire shell surface. There is a dark brown periostracum in most species. Juvenile specimens are extraordinarily flattened laterally in some species.

The attachment of the internal ligament extends from the umbones almost to the ventral margin of the hinge plate. There are two cardinal teeth anterior to the resilium in the left valve and two in the right, although the anterior cardinal may be almost obsolete in the right valve. The cardinal teeth often have serrations on their anterior and posterior surfaces. The right valve has an elongate posterior lateral tooth that fits into a slot in the left valve; the ventral margin of this slot is often raised into a tooth. The left valve has an anterior lateral tooth that fits into a slot in the right valve; the ventral margin of this slot is also often raised into a tooth. DARRAGH (1965b) has discussed the incidence of hinge transposition in *Eucrassatella*. The pallial sinus is entire, and there are no denticulations along the inner ventral valve margins.

The external anatomy of *Eucrassatella* was discussed by WOODWARD (1854:300) and later illustrated by him (WOODWARD, 1866:466; fig. 259). His figure is reproduced here (Figure 2). Woodward's specimen was collected at "Sandy Cape," presumably in Queensland, and was referred by him to *E. pulchra* (REEVE, 1842:43).[2] RIDEWOOD (1903:223) later commented on the flat, homorhabdic ctenidia of the Australian *E. cumingi* (A. ADAMS, 1854a:90–91; plt. 16, fig. 1).

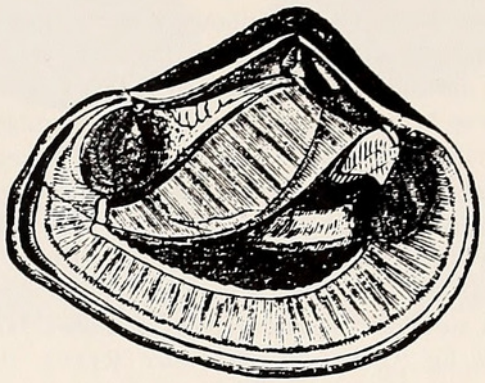

Figure 2

Eucrassatella "pulchra (Reeve)"; Sandy Cape, Queensland, Australia; drawing of gross anatomy copied from WOODWARD (1866). Approximately × 1.

Ridewood also said that he had studied the ctenidia of *Crassatella floridana* DALL, 1881:131, now regarded as a synonym of *Eucrassatella speciosa* (A. ADAMS, 1854b:94), from the western Atlantic. The identity of the material, which had been sent to him by Dall himself, was also confirmed by E. A. Smith. Ridewood found the ctenidia of the specimen to be strongly plicate and the foot to be "relatively huge saltatory." He suggested that these characters were so unique that workers might choose to separate this species from other crassatellids. However, HARRY (1966:86–87) recently examined a specimen of *E. speciosa* and found that the ctenidia are not pleated, leaving doubt about the identity of Ridewood's specimen. Harry also described other features of the anatomy of *E. speciosa.*

STEWART (1930) proposed *Hybolophus* as a subgenus of *Eucrassatella,* with the eastern Pacific *E. gibbosa* as its type species. The chief character he used to separate *Hybolophus* from the Australian nominal subgenus was the supposed opisthogyrate beaks of *E. gibbosa,* of "a large species from Lower California," and of *E. antillarum.* He said that *E. gibbosa* was "distinctly opisthogyrate," the Baja Californian species was "slightly opisthogyrate," and the Caribbean *E. antillarum* was, simply, "opisthogyrate." West American fossil taxa, on the other hand, he said lack backwards-pointing beaks.

Stewart also noted that the two living west American forms he studied differed from Australian material in that they had flattened umbones, but he also pointed out that *Eucrassatella kingicola* has umbones that are not as inflated as other Australian species of the genus. His somewhat ambivalent conclusion was that "Although none of the American species seem particularly closely related to *Eucrassatella,* I have not been able to discover any character by which they may all be separated from the Australian species."

DARRAGH (1965a:5), commenting on this question, said, "Species from the Central American Region (California to Peru and the West Indies) do not belong in *Eucrassatella* but in *Hybolophus.* . . . *Hybolophus* has opisthogyral

[2] Because Sandy Cape is outside the reported distribution of *E. pulchra* (see DARRAGH, 1964:8), the specimen discussed and illustrated by Woodward may have been another species, perhaps also *E. cumingi* (A. Adams). *Eucrassatella corbuloides* (REEVE, 1842:45), an Australian taxon not listed by Darragh, may be a senior synonym of the latter (type: BM(NH) 1953.4.15.9, holotype; length, 44.0 mm; height, 34.4 mm; thickness, 23.9 mm). Darragh (*in litt.,* 2 March 1983) now thinks that *E. cumingi, E. pulchra,* and *E. decipiens* (REEVE, 1842:42–43) may represent a cline from Perth, Western Australia, along the coasts of Northern Australia and Queensland, to northern New South Wales. Presumably, *E. corbuloides* would fit into this cline as well.

or orthogyral umbones, a sinuous ventral margin, and rather elongate anterior laterals."

None of the characters mentioned by Stewart or Darragh seems to be an adequate basis for distinguishing an eastern Pacific subgenus. The Californian *Eucrassatella fluctuata* has inflated, prosogyrate beaks and a more-or-less even ventral margin, and would thus have to be separately placed in *E.* (*Eucrassatella*), as would a number of West Coast fossil taxa. The Australian *E. cumingi* sometimes has a sinuous posterior ventral margin (DARRAGH, 1964: plt. 2, fig. 9), and *E. corbuloides* (REEVE, 1842:45) has a still more sinuous posterior end.

I would not term the beaks of the Recent American species of *Eucrassatella* strongly opisthogyrate. Those of *E. gibbosa* are barely so, if at all. I would term those of what we have called "*E. digueti*" (presumably Stewart's large Baja Californian species) slightly prosogyrate. The beaks of the western Atlantic *E. speciosa* are flattened and orthogyrate.

In contrast to Darragh's claim, the anterior lateral of *E. gibbosa* in the left valve and its corresponding socket in the right valve are not conspicuously elongate. In fact, CHAVAN (1969:N576) characterizes the difference between the two taxa as being quite the opposite—short anterior laterals in *Hybolophus* and long anterior laterals in *Eucrassatella*. The length of the anterior laterals is of some use in separating species, however, as will be shown below.[3]

Thus, the differences between the Australian species of *Eucrassatella* and those of the eastern Pacific and western Atlantic are not sufficiently great or consistent to merit their subgeneric separation, and I regard *Hybolophus* as a synonym of *Eucrassatella*. Perhaps when the living and fossil taxa are studied in greater detail, two distinct lines will be more apparent.

Eucrassinella was proposed by CRUZ (1980) in combination with two new species. Both species are synonyms of *Eucrassatella gibbosa* (see below), and because the genus is proposed without the designation of a type species, it must be regarded as unavailable ("ICZN Code," Art. 13b).

The three eastern Pacific species of *Eucrassatella* may be differentiated as follows:

(1) Anterior lateral in left valve (and socket for it in right valve) elongate; posterior cardinal (just anterior to resilium) bifid, with a thin posterior lamella; beaks flattened; distinctly truncate posteriorly . . *E. antillarum*

(2) Anterior lateral in left valve (and socket in right valve) elongate; posterior cardinal not bifid, but with an indented posterior platform; beaks not flattened; very broadly and indistinctly truncate posteriorly . . . . . *E. fluctuata*

(3) Anterior lateral in left valve (and corresponding socket in right valve) short; posterior cardinal in right valve not bifid, with a flat posterior platform; beaks flattened; narrow posterior ridge present rather than a truncation . . . . . *E. gibbosa*

A word of caution: the most variable feature of species of *Eucrassatella* is the degree of elongation of the posterior end, and unusually elongate specimens may be encountered in both *E. antillarum* and *E. gibbosa*. Other features are more reliable. Fossil taxa should be reexamined in light of the variability in posterior length among Recent material.

Eucrassatella fluctuata (Carpenter, 1864)

(Figures 3, 4, 5)

Astarte fluctuata Carpenter, 1864
- CARPENTER, 1864b:611, 642 [1872:97, 128]
- CARPENTER, 1866:209
- TRYON, 1872b:246
- SMITH, 1881:231
- DALL, 1921:31 [*Crassatellites*]
- OLDROYD, 1925:109 [*Crassatellites*]
- BURCH, 1944:8; BURCH, 1945:11 [*Crassatella*]
- WOODRING, *et al.*, 1946:81–82; 131 (plt. expl.); plt. 13, figs. 1–8 [*Eucrassatella*]
- PALMER, 1958:81; 332 (plt. expl.); plt. 7, figs. 5–7 [*Eucrassatella*]
- MCLEAN, 1969:73–74; fig. 40-3 [repr. 1978] [*Crassatella*]
- MOUNT, 1974:38–40, 42–43; plt. 1, figs. 7–10 [*Crassatella*]
- BERNARD, 1983:36 [*Eucrassatella* (*Hybolophus*)]

[3] BOYD & NEWELL (1968:10; 1969:N908–N911) call into question the routine application of the Bernard and Munier-Chalmas system of numbering bivalve hinge teeth, particularly to the crassatellids, as by LAMY (1917), DARRAGH (1965a), and CHAVAN (1969).

→

Explanation of Figures 3 to 10

Figures 3 to 5: *Eucrassatella fluctuata* (Carpenter). Figure 3. **Lectotype** (herein) of *Astarte fluctuata* Carpenter, length, 8.4 mm. Figure 4. Holotype of *Crassatellites lomitensis* Oldroyd, length, 42.0 mm. Figure 5. Specimens from Catalina Island, Los Angeles Co., Calif.; 10 m; lengths, 43.5 mm and 42.2 mm; LACM 64-26 (illustrated by MCLEAN, 1969, 1978: fig. 40-3).

Figures 6 to 10: *Eucrassatella gibbosa* (Sowerby). Figure 6. **Lectotype** (herein) of *Crassatella gibbosa* Sowerby, length, 59.3 mm. Figure 7. Holotype of *Crassatellites rudis* Li, length, 46.9 mm. Figure 8. Holotype of *Eucrassatella gibbosa tucilla* Olsson, length, 66.6 mm. Figure 9. Holotype of *Eucrassinella manabiensis* Cruz, length, 13 mm; copied from CRUZ (1980). Figure 10. Holotype of *Eucrassinella aequitorialis* Cruz, 18 mm; copied from CRUZ (1980).

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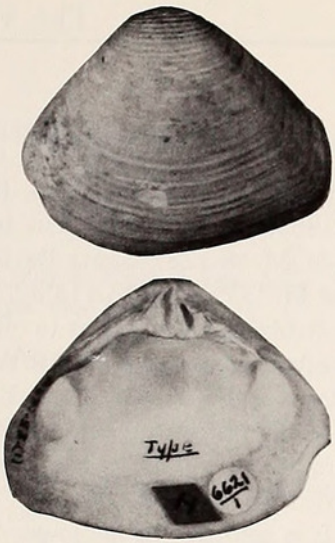

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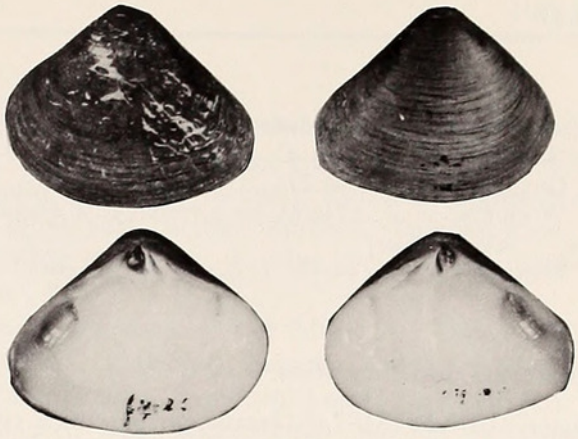

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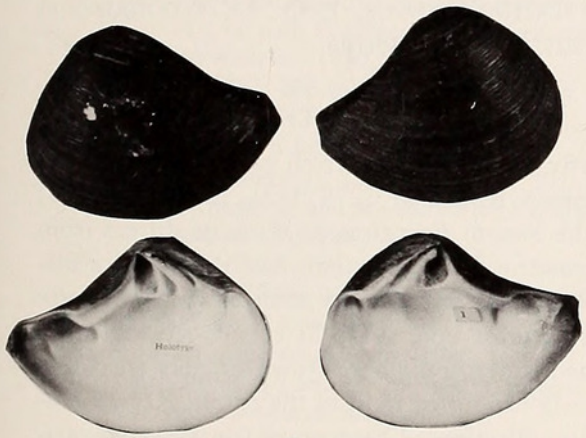

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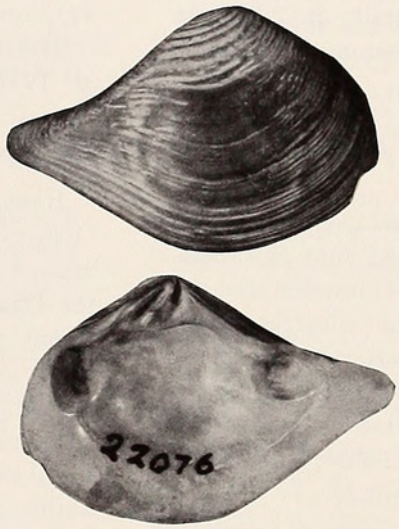

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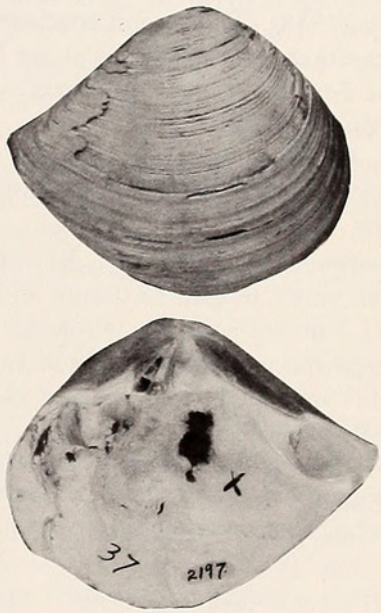

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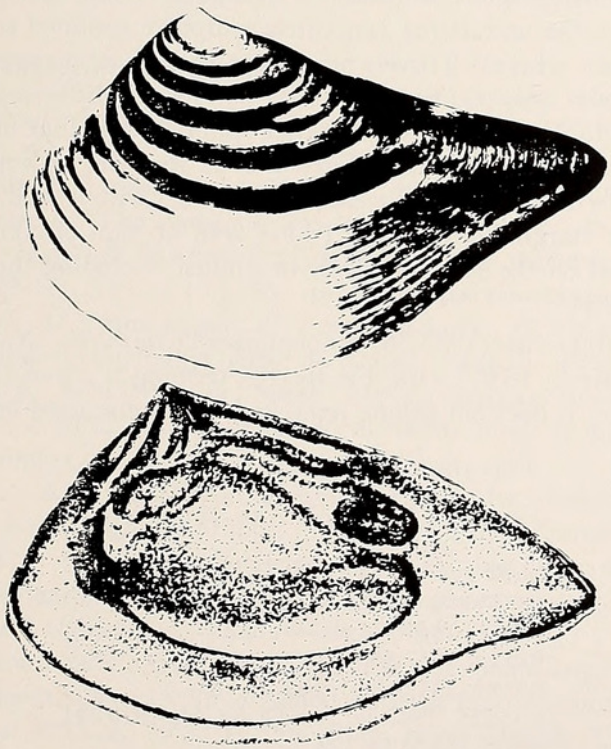

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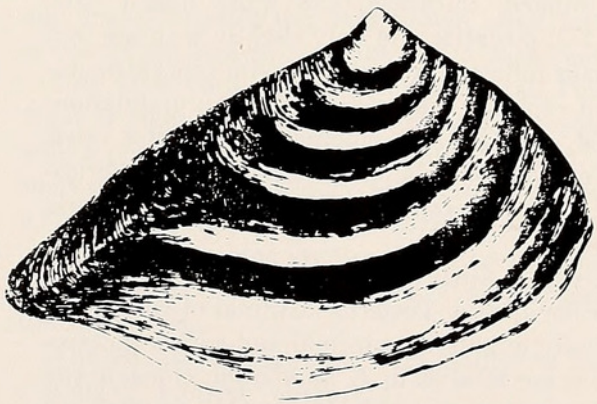

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Crassatellites lomitensis Oldroyd, 1924
OLDROYD, 1924:10; plt. C
GRANT & GALE, 1931:271
WOODRING *et al.*, 1946:81 [as a synonym of *Eucrassatella fluctuata*]
MOUNT, 1974:37–44; plt. 1, figs. 1–6 [*Crassatella*]

Type material and localities:

A. fluctuata—USNM 819749, **lectotype** herein, a right valve, from Calif. State Coll. 1060; length, 8.4 mm; height, 6.5 mm; thickness, 1.6 mm (Figure 3). Carpenter evidently had two right valves, so the specimen in the USNM cannot be a holotype, as indicated by PALMER (1958). The second specimen has not come to light in either the USNM, or at the University of California at Berkeley (David Lindberg, oral communication, 14 March 1983).

Catalina Id., Los Angeles Co., California (about 33°27′N; 118°28′W); 73 m; James G. Cooper; June 20–26, 1863.

C. lomitensis—Univ. Calif. Riverside 6621/1, holotype, a left valve; length, 42.0 mm; width, 33.7 mm; thickness, 11.7 mm (Figure 4). OLDROYD (1924) implied that the type specimen included both valves but illustrated only this left valve, and a right valve was not located by Mount (1974).

Lomita Lime Quarry, southern part of Lomita, Los Angeles Co., California (33°47′N; 118°20′W); Lomita Marl; lower Pleistocene; S. Maus Purple.

Description:

Small for genus, to 53.2 mm in length (LACM 89202; off San Clemente Id., Calif.); shell trigonal to longer posteriorly, length 1.26 times height (SD, ±0.08; N = 11); moderately inflated, thickness 0.58 times height (SD, ±0.04; N = 12); posterior end only slightly truncate, not produced; beaks inflated, prosogyrate, with concentric undulations that continue onto posterior slope; undulations often confined to beaks, but sometimes over entire valve. Lunule and escutcheon relatively short, shallow. Periostracum dark; shell surface under periostracum with dark, radial bands.

Left valve with a fairly thin posterior cardinal and an elongate anterior lateral. Posterior cardinal of right valve attached dorsally to anterior cardinal and with a posteroventral pocket, not bifid as in *E. antillarum*; elongate slot present for anterior lateral of left valve. Hinge teeth not conspicuously serrate, as in *E. gibbosa* and *E. antillarum*.

Pallial line curving more sharply upward at its posterior end than that in *E. gibbosa*. Pit for pedal elevator under beaks not as deep as that in *E. gibbosa*.

The type specimen being a single juvenile valve, I have illustrated here both valves of adult Recent specimens (Figure 5).

Distribution and habitat:

From off Santa Rosa Id. (34°5′N; 120°2′W) (USNM 211883) and off Santa Cruz Id. (34°3′5″N; 119°57′30″W) (LACM 68-128), Santa Barbara Co., to off Santa Catalina Id. (33°25′30″N; 118°30′33″W)(CASIZ 036682) and probably as far south as to off northwest end of San Clemente Id. (about 33°N; 119°W) (LACM 89202), Los Angeles Co., California; 10 to 320 m, with a mean depth of 88 m. No bottom types are recorded, but it probably occurs among rubble. This species is rare, and I have seen only 18 Recent lots.

It is recorded in the lower Pliocene of Los Angeles Co. (WINTERER & DURHAM, 1962:302), the upper Pliocene of Orange Co. (ZINSMEISTER, 1971:122; MOUNT, 1974: 41); and the lower Pleistocene of Los Angeles Co. (OLDROYD, 1924:10; SCHENCK, 1945:513; WOODRING *et al.*, 1946:81–82), all in California.

Discussion:

Based chiefly on a single lot from off Catalina Island (Univ. California Riverside 7279/1-3), MOUNT (1974) argued that the Recent *Eucrassatella fluctuata* differs from the Plio-Pleistocene *E. lomitensis* in that it has (1) a different profile, (2) higher, more pronounced beaks that are closer to the anterior end, and (3) concentric sculpture that is confined to the umbones. However, this species is rare, and having examined most of the extant Recent material in public collections, I have noted considerable variability in these features.

Some specimens have a more elongate posterior end, but many shells are closer to triangular. Some specimens have the undulating concentric sculpture confined to the beaks, whereas it covers most of the shell in other material. Mount also mentions but does not specify differences in the hinge, but his excellent description of the hinge of "*E. lomitensis*" fits Recent material of *E. fluctuata* as well.

In describing *Crassatellites lomitensis,* Oldroyd said, "inner margin crenulated." I have seen no sign of crenulations on the specimens I have studied, including the holotype.

BERNARD (1983:36) synonymizes "*Crassatella marginata* Keep, 1888" with this species, terming it a *nomen nudum*. It does not belong here, and this is discussed below.

Eucrassatella gibbosa (Sowerby, 1832)

(Figures 6 to 11)

Crassatella gibbosa Sowerby[1], 1832
SOWERBY[1], in BRODERIP & SOWERBY[1], 1832:56
REEVE, 1841:63; plt. 44, fig. 2
REEVE, 1842:45
REEVE, 1843:plt. 1, figs. 1a, 1b
HANLEY, 1843:37; plt. 12, fig. 16; 1856:341
NYST, 1847:122–123
C. B. ADAMS, 1852a:516 [1852b:292]
CARPENTER, 1857a:280, 297

Carpenter, 1864a:30 [1872:204]
Carpenter, 1864b:537, 620, 669 [1872:23, 106, 155]
Nelson, 1870:203; ?plt. 7, fig. 9 [in part; see Olsson, 1932:88]
Tryon, 1872b:250
Löbbecke & Kobelt, 1881:8–9; plt. 3, figs. 3, 3a, 4; Kobelt, 1886:41 (plt. expl.)
Lamy, 1917:218–219
Hertlein & Strong, 1946:103 [*Crassatellites* (*Hybolophus*)]
Hertlein & Strong, 1955:181–182 [*Crassatellites* (*H.*)]
Keen, 1958:82, 83; fig. 158 [*Crassatella* (*H.*)]
Olsson, 1961:179–180; 498 (plt. expl.); plt. 25, figs. 1–1b [*Eucrassatella* (*H.*)]
Parker, 1964:117, 159, 168; plt. 4, figs. 18a, 18b [*Crassatella* (*H.*)]
Keen, 1971:104, 105; figs. 230 [*Eucrassatella* (*H.*)]
Bernard, 1983:36 [*E.* (*H.*)]
[not to be confused with *Crassatella gibba* Lamarck, 1801: 119, or with *C. gibbosula* Lamarck, 1805:410–411]

Crassatellites rudis Li, 1930
Li, 1930:257; 286 (plt. expl.); plt. 3, figs. 16
Pilsbry, 1931:429–430; 440 (plt. expl.); plt. 41, figs. 9, 10 [as a form of *C. gibbosus*]
Parker, 1964:120, 159; plt. 5, figs. 20a, 20b [as both *Eucrassatella* and as *Crassatella* (*Hybolophus*), in each case as a form of *gibbosa*]

Eucrassatella (*Hybolophus*) *gibbosa tucilla* Olsson, 1932
Olsson, 1932:88; 228 (plt. expl.); plt. 6, fig. 6
Pilsbry & Olsson, 1941:56

Eucrassinella manabiensis Cruz, 1980
Cruz, 1980:67–68, 72, 73; figs. 5, 6 [figs. 1 and 2 are *Eucrassatella antillarum*]

Eucrassinella aequitorialis Cruz, 1980
Cruz, 1980:68, 72, 73; figs. 3, 4, 7

Crassatella digueti Lamy, *auctt., non* Lamy, 1917
Durham, 1950:70; 161 (plt. expl.); plt. 16, figs. 5, 13

Type material and localities:

C. gibbosa—BM(NH) 1953.4.15.15, **lectotype** herein, pair, the larger specimen figured by Reeve (1843); length, 59.3 mm; height, 44.5 mm; thickness, 31.4 mm (Figure 6). The specimen was labeled "holotype," but it is clear that Sowerby had more than one specimen. BM(NH) 1842.5.10.1586, probable **paralectotype**; length, 41.5 mm; height, 25.9 mm; thickness, 19.3 mm.

Either Jipijapa [Puerto de Cayo], Manabi Prov. (1°20′S; 80°45′W); or Santa Elena, Guayas Prov. (2°11′S; 80°52′W), Ecuador, 20 m; sandy mud; Hugh Cuming.

C. rudis—AMNH 22076, holotype, a right valve; length, 46.9 mm; height, 31.0 mm; thickness, 9.9 mm (Figure 7). The specimen was labeled "syntype," but there is no evidence of there having been any other specimens in the lot (Batten, *in litt.*, 1 March 1983).

Mouth of Río Grande [now the Panama Canal], near La Bocca, about 1.6 km offshore, Panama Bay, Panama (about 8°55′N; 79°33′W); 3–12 m; mud; Donald F. MacDonald, 1907. "lower Miocene," but really Recent.

E. gibbosa tucilla—Paleontological Research Institution 2197, holotype, a broken right valve; length, 66.6 mm; height, 53.3 mm; thickness, 25.6 mm (Figure 8).

Quebrada Tucillal, Zorritos, Tumbez Prov., Peru (3°40′S; 80°40′W); Tumbez Formation; upper Miocene.

E. manabiensis—Mus. Biol. Mar., Inst. Oceanográf. de la Armada, Guayaquil, Ecuador; holotype; pair; length, 13 mm; height, 8 mm; thickness, 2 mm (Figure 9; reproduced from Cruz, 1980: figs. 5, 6). Paratypes, USNM 768218 & 768219. The paratype illustrated in Cruz's figures 1 and 2 appears to be a juvenile of *Eucrassatella antillarum*.

Type locality not made clear in original publication, but according to Cruz (*in litt.*, 23 March 1983) the holotype came from Machalilla, Manabi Prov., Ecuador (1°27′S; 80°46′W); between 11 and 17 m.

E. aequatorialis—Mus. Biol. Mar., Inst. Oceanográf. de la Armada, Guayaquil, Ecuador; holotype, pair; length, 18 mm; height, 11 mm; thickness, 6 mm (Figure 10; reproduced from Cruz, 1980:fig. 7).

Machalilla, Manabi Prov., Ecuador (1°27′S; 80°46′W); on beach.

Description:

Medium-sized for genus, to 87.4 mm in length (CASIZ 036002; Guaymas, Sonora, Mexico); shell elongate, from equilateral to longer posteriorly, length 1.45 times height (SD, ±0.09; N = 19); inflated, especially anteriorly, thickness 0.67 times height (SD, ±0.05; N = 19); posterior end with a very narrow truncation, forming a sharp ridge on many specimens; posterior end very produced in some specimens; beaks flattened, orthogyrate to slightly opisthogyrate, with prominent concentric folds that terminate at posterior ridge; rest of surface with low, irregular growth lines. Lunule and escutcheon relatively short and deep. Periostracum dark brown; shell surface under periostracum brown, sometimes with dark radial rays.

Left valve with a short anterior lateral. Posterior cardinal of right valve rarely attached to anterior cardinal, with a postero-ventral shelf, not bifid, as in *E. antillarum*; short pocket present for anterior lateral of left valve. Hinge teeth serrate, serrations larger than those in *E. antillarum*.

Pallial line curving evenly upward toward posterior adductor muscle scar. Pit for pedal elevator under beaks unusually deep.

The soft parts (Figure 11) are similar to those of *Eucrassatella* "*pulchra*" (Figure 2).

Distribution and habitat:

Bahía San Juánico, outer coast of Baja California Sur, Mexico (26°15′N; 112°27′20″W) (LACM 71-180), throughout the Gulf of California, to Paita, Piura Prov., Peru (5°5′S; 81°7′W) (USNM 48447; Olsson, 1961:180); 5 to 110 m, with a mean depth of 32 m; most records

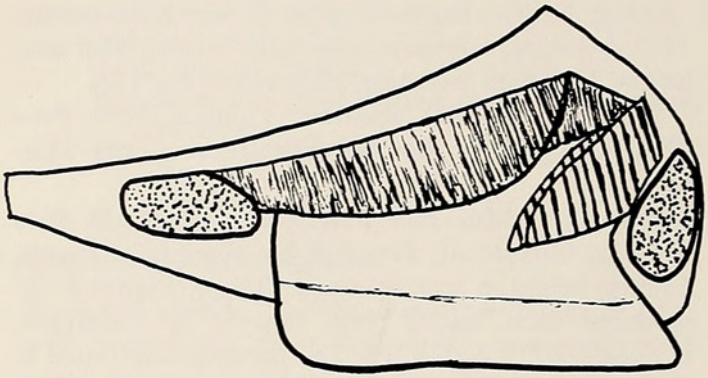

Figure 11

Eucrassatella gibbosa (Sowerby); Puerto de la Concordia, Guatemala; 18 m; ANSP 317727. Sketch of positions of ctenidia, palps, and foot. Approximately × 2.

suggest that the species occurs on sand bottoms, although mud is also recorded at two stations. BERNARD (1983:36) reports this species from the Galápagos Islands, but I have not seen any material from there. This is the most common of the three species, and I have seen 167 Recent lots.

This species has been reported from the upper Miocene of Peru (NELSON, 1870:203; OLSSON, 1932:88) and from the Pliocene of Ecuador (PILSBRY & OLSSON, 1941:56) (the last two references as *E. gibbosa tucilla*); from the Pleistocene of the Burica Peninsula in Panama (OLSSON, 1942:162) and of Bahía de Santa Inez, Baja California Sur (DURHAM, 1950:70, as *C. digueti*). It may also be responsible for the record of "*Crassatella* n. esp. af. *gibbosa*" from the Pliocene of Punta Concepción, Baja California Sur (WILSON, 1948a:35; 1948b:1780).

Discussion:

PILSBRY (1931) was the first to recognize that Li's *Crassatellites rudis* was actually from the Recent fauna, not from the Miocene as Li had thought. It is nothing more than a rostrate specimen of *E. gibbosa*.

Olsson's claims for the uniqueness of *E. g. tucilla* are that this subspecies is (1) larger, (2) less convex, (3) less pointed posteriorly, and (4) has straighter, less contracted postero-dorsal submargins. It is certainly not true that it is larger, the largest Recent specimen being some 17 mm longer than the largest specimens attributed to Olsson's subspecies. Large Recent specimens are generally both less convex and less pointed, making their postero-dorsal slope less convex.

Whereas Cruz's new genus, *Eucrassinella,* is unavailable, his two new species are. However, both holotypes are juvenile specimens of this species.

BERNARD (1983:36) has synonymized *Crassatella corbuloides* Reeve, 1842, with this species, but it is instead from Australia (see footnote 2).

Crassatellites subgibbosus HANNA, 1926 (pp. 463–464; 500; plt. 28, figs. 1–4) from the Imperial Formation of southern California may prove to be a synonym of *Eucrassatella gibbosa*. STANTON (1966:28–29; 24; plt. 5, figs. 9–12) reports *E. subgibbosa* from the upper Miocene Castaic Formation, also in southern California, listing some differentiating characters that I find unconvincing. However, the material available to me from either locality is insufficient for a definitive conclusion to be drawn.

There are several other fossil taxa from the Americas that may be related to this species, but it is beyond the scope of this paper to determine which are closest or to elucidate their nomenclature. Several of these were recently discussed by WOODRING (1982:633–634).

Eucrassatella antillarum (Reeve, 1842)

(Figures 12 to 16)

Crassatella undulata Sowerby[1], 1832; *non* Say, 1824; *non* (Lamarck, 1801)
- SOWERBY[1], IN BRODERIP & SOWERBY[1], 1832:56
- REEVE, 1842:44
- REEVE, 1843:plt. 1, figs. 2a, 2b
- HANLEY, 1843:37; plt. 12, fig. 24; 1856:341
- NYST, 1847:128–129
- CARPENTER, 1857a:297
- TRYON, 1872b:251
- LÖBBECKE & KOBELT, 1881:11–12; plt. 4, figs. 3, 3a; KOBELT, 1886:41 (plt. expl.)
- [*non* Say, 1824:142; plt. 11, figs. 2]
- [*non Crassatella undulata* (LAMARCK, 1801:120)]

Crassatella antillarum Reeve, 1842
- REEVE, 1842:44–45
- REEVE, 1843:plt. 2, fig. 8
- HANLEY, 1843:37
- NYST, 1847:120–121
- CHENU, 1862:131; fig. 623
- TRYON, 1872b:248
- LÖBBECKE & KOBELT, 1881:7–8; plt. 3, figs. 1, 2, 2a; KOBELT, 1886:41 (plt. expl.)
- DALL, 1903b:1475 [*Crassatellites*]
- LAMY, 1917:216–217; 202, figs. [*Crassatella*]
- GRANT & GALE, 1931:271; 906 (plt. expl.); plt. 13, figs. 7a, 7b [*Crassatellites*]
- WEISBORD, 1964:194–197; 514 (plt. expl.); plt. 25, figs. 9, 10 [*Eucrassatella* (*Hybolophus*)]

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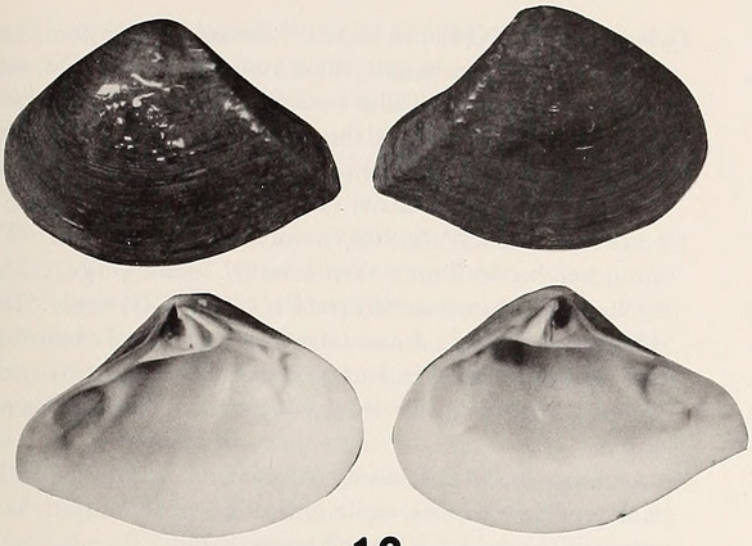
Explanation of Figures 12 to 16

Figures 12 to 16: *Eucrassatella antillarum* (Reeve). Figure 12. **Lectotype** (herein) of *Crassatella antillarum* Reeve, length, 80.0 mm. Figure 13. **Lectotype** (herein) of *Crassatella undulata* Sowerby, length, 66.6 mm. Figure 14. **Lectotype** (herein) of *Crassatella laevis* A. Adams, length, 42.5 mm. Figure 15. Holotype of *Crassatella adelinae* Tryon, length, 75.0 mm. Figure 16. Holotype of *Crassatellites laronus* Jordan, length, 77.5 mm.



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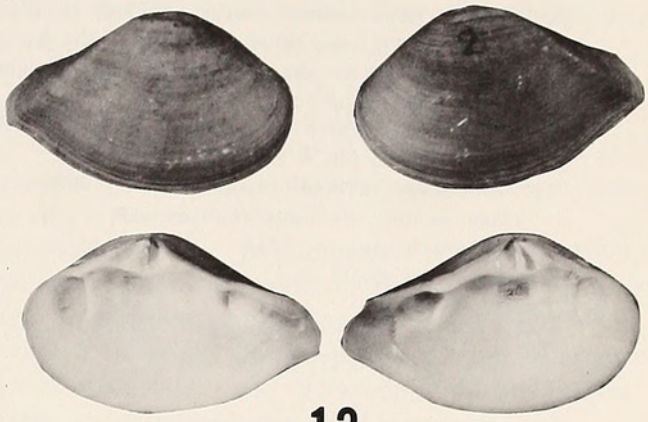

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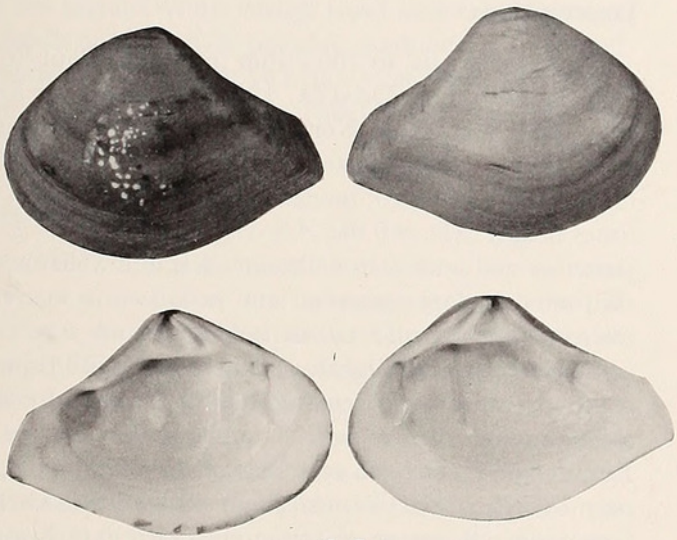

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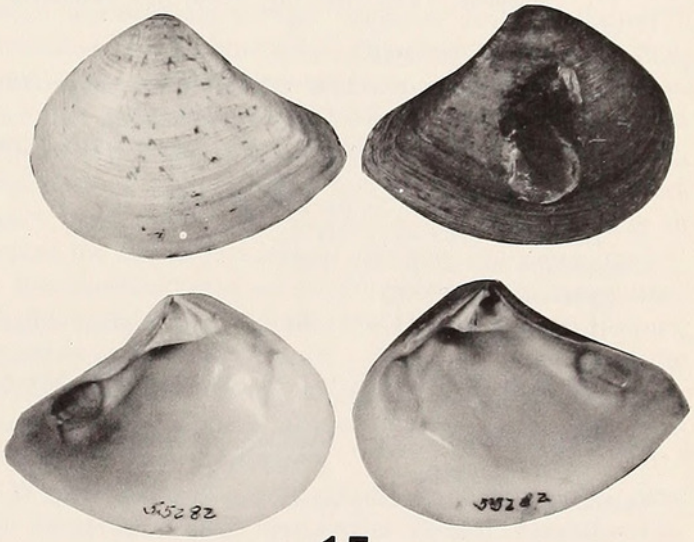

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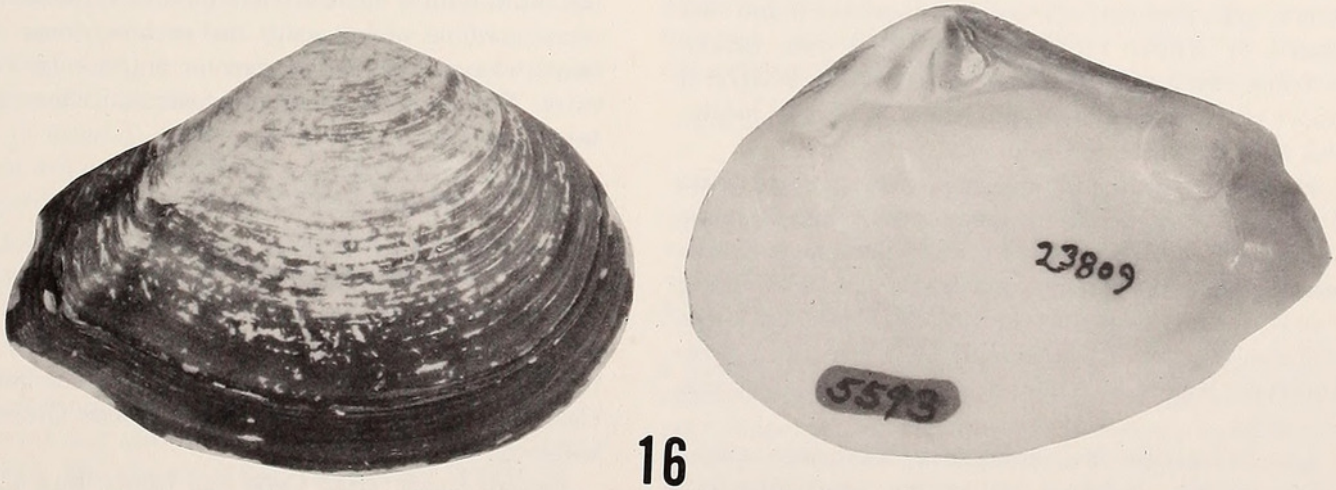

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GIBSON-SMITH & GIBSON-SMITH, 1979:28 [*E. (H.)*]
[note: "*antillarum*" is a noun meaning "of the Antilles" and thus does not change its ending with the gender of the generic name.]
Crassatella rostrata Lamarck, *auctt., non* Lamarck, 1818
DELESSERT, 1841:plt. 4, figs. 2a, 2b, 3a, 3b
[*non* LAMARCK, 1818:482 (LAMARCK, 1805:408, is a *nomen nudum*), an Asian *Bathytormus*]
Crassatella laevis A. Adams, 1854
A. ADAMS, 1854b:94
TRYON, 1872b:250
LÖBBECKE & KOBELT, 1881:9–10; ?plt. 3, figs. 5, 5a; KOBELT, 1886:37; 41 (plt. expl.)
LAMY, 1917:217
[not preoccupied by *C. laevis* HOENINGHAUS, 1831:162, a *nomen nudum*]
Crassatella adelinae Tryon, 1872
TRYON, 1872a:130; plt. 6, figs. 1, 1a
TRYON, 1872b:249
WEISBORD, 1964:195, 197 [as a synonym of *E. (H.) antillarum*]
Crassatella digueti Lamy, 1917; new name for *C. undulata* Sowerby, 1932; *non* Say, 1824; *non* (Lamarck, 1801)
LAMY, 1917:217–218
HERTLEIN & STRONG, 1946:102–103 [*Crassatellites (H.)*]
KEEN, 1958:82, 83; fig. 157 [*Crassatella (H.)*]
OLSSON, 1961:180; 498 (plt. expl.); plt. 25, fig. 2 [as *Eucrassatella (H.) "diqueti"*]
KEEN, 1971:104, 105; fig. 229 [*E. (H.)*]
BERNARD, 1983:36 [*E. (H.)*]
Crassatellites laronus Jordan, 1932
JORDAN, 1932:9–10
JORDAN, 1936:124–125; 164 (plt. expl.); plt. 17, figs. 6, 7
DURHAM, 1950:70–71; 161 (plt. expl.); plt. 16, figs. 8, 14
HERTLEIN & STRONG, 1946:102 [as a synonym of *C. (H.) digueti*]
Crassatella gibbosa Sowerby, *auctt.*; *non* Sowerby, 1832
KOBELT, 1886:34; 41 (plt. expl.); plt. 9, figs. 1
Eucrassinella manabiensis Cruz, 1980 [in part]
CRUZ, 1980:72, figs. 1, 2

Type material and localities:

C. undulata Sowerby—BM(NH) 1953.4.15.12, **lectotype** herein, pair, probably the measured specimen and that figured by REEVE (1843); length, 66.6 mm; height, 41.5 mm; thickness, 25.0 mm (Figure 13). BM(NH) 1953.4.15.12, a **paralectotype**; length, 23.4 mm; height, 14.2 mm; thickness, 7.4 mm.

Puerto Portrero, Guanacaste Prov., Costa Rica (10°27′N; 85°48′W); 20 m; sandy mud; Hugh Cuming.

C. antillarum—BM(NH) 1953.4.15.10, **lectotype** herein, pair, the measured syntype, which was figured by REEVE (1843); length, 80.0 mm; height, 57.0 mm; thickness, 32.6 mm (Figure 12). BM(NH) 1953.4.15.11, a **paralectotype**; length, 82.3 mm; height, 56.4 mm; thickness, 27.3 mm.

Isla Margarita, Nueva Esparta, Venezuela (about 11°N; 64°W); "dredged up in the pearl-fisheries"; Cuming Coll.

C. laevis—BM(NH) 1983.33/1-3, **lectotype** herein, pair; length, 42.5 mm; height, 30.0 mm; thickness, 17.8 mm (Figure 14). The lot also contains two **paralectotypes**, one 31.4 mm in length, the other 27.7 mm in length.

Le Guaira, Federal Dist., Venezuela (10°36′N; 66°56′W); M. Le Marie; Cuming Coll.

C. adelinae—ANSP 55282, holotype, pair; length, 75.0 mm; height, 56.9 mm; thickness, 27.7 mm (Figure 15).

Locality unknown. WEISBORD (1964: 197) says, "The habitat of Tryon's *E. adelinae* was unknown when that species was described in 1872, but it was subsequently determined to be also from Margarita Island in Venezuela."

C. laronus—CASIZ 036680 (formerly CASGTC 5593), holotype, a right valve; length, 77.5 mm; height, 54.6 mm; thickness, 12.8 mm (Figure 16).

West anchorage, near the salt works, Isla San José, Baja California Sur (about 24°53′N; 110°35′W); CAS Loc. 23809; on beach; Fred Baker.

Description:

Large for genus, to 105.2 mm in length (Paul Stillians Coll., according to DRAPER, 1980: 25; Bahía de los Angeles, Baja California Norte, Mexico); shell elongate, almost always longer posteriorly, length 1.49 times height (SD, ±0.09; N = 16); moderately inflated, thickness 0.59 times height (SD, ±0.06; N = 16), less so than *E. gibbosa*; posterior end with a broad truncation and a distinctly set off posterior slope; posterior end produced in many specimens, "pinched off" by an indentation in some; beaks orthogyrate or very slightly opisthogyrate, with prominent concentric folds which end at anterior margin of posterior slope; rest of surface with low, irregular growth lines. Lunule and escutcheon relatively shallow; lunule elongate on most specimens. Periostracum dark brown; shell surface under periostracum sometimes with dark brown radial bands; some specimens with radial bands broken into brown chevrons; young specimens with flecks of brown.

Left valve with an elongate anterior lateral. Posterior cardinal of right valve not attached to anterior cardinal, but bifid, with a narrow ridge next to resilium (the posterior cardinal of left valve fits between these two portions); elongate pocket present for anterior lateral of left valve. Teeth serrate; serrations finer than those in *E. gibbosa*.

Distribution and habitat:

Venezuela: from the west coast of the Peninsula de Paraguaná, Falcon (about 70°W), to Isla de Margarita, Nueva Esparta (about 64°W) (J. Gibson-Smith, *in litt.*, 28 Dec. 1982); from 3 to 8 m, but presumably also occurring somewhat deeper; sand. It is not common in the Caribbean, and I have seen only 15 lots; Gibson-Smith knows of 4 more lots.

Eastern Pacific: from Cabo San Lucas, Baja California Sur, Mexico (20°8′N; 110°W) (LACM 66-12 & 66-14;

CASIZ 036001; USNM 3984 & 12586), throughout the Gulf of California, to Playas, Guayas Prov., Ecuador (2°39′S; 87°52′W) (CASIZ 033528); 5 to 206 m, with a mean depth of 45 m; almost all recorded bottom types indicate sand or gravel. This species is not as common as *E. gibbosa*; I have seen 84 lots from the eastern Pacific.

This species is also known from the Pliocene of Venezuela (Weisbord, 1964:196–197; Gibson-Smith & Gibson-Smith, 1979:28). The Gibson-Smiths suggest that the Mare Formation material might be a recognizable subspecies, differing from Recent specimens in being more elongate, and in having a straighter postero-dorsal margin and a more pointed anterior end.

In the eastern Pacific, this species has been reported as a fossil from Baja California Sur—from the Pliocene or Pleistocene of Santa Rosalía (Grant & Gale, 1931) and from the Pleistocene of Isla Coronado (Durham, 1950, as *Crassatellites laronus*), Punta El Pulpito (Hertlein, 1957:63, as *Crassatella digueti*); and Bahía Magdalena (Jordan, 1936, as *Crassatellites laronus*).

I am not certain which earlier fossil species is closest to *Eucrassatella antillarum*. A possible candidate is *E. nelsoni* (Gryzybowski, 1899:639; 663 (plt. expl.); plt. 19, figs. 2, 2a) from the Miocene of Peru (see Olsson, 1932:87–88; 228; plt. 6, figs. 1, 4).

Discussion:

Reeve (1842, 1843) discussed *Crassatella antillarum,* and noted that it was similar to *C. undulata* Sowerby but did not offer any characters to separate the two. Löbbecke & Kobelt (1881) also stressed the similarity of these species but failed to point to differentiating characteristics. Grant & Gale (1931) used the name *Crassatellites antillarum* for Pacific Coast fossil specimens from Baja California.

After examining the material available to me, I am unable to find features upon which eastern Pacific material can be reliably separated. The average specimen of *Eucrassatella antillarum* from the Venezuelan coast may be more produced posteriorly than the eastern Pacific *E. digueti,* a feature noted by Lamy (1917:217) in the material he studied, but both long and short forms are found in both provinces, and, in fact, the lectotype of *C. undulata* Sowerby (Figure 13) is more produced posteriorly than is the lectotype of *C. antillarum* (Figure 12).

Crassatella laevis A. Adams, 1854b, described from Venezuela, sounded as if it might be a synonym of this species, so I borrowed the type material from the British Museum, and it confirmed my suspicion. Adams gave no measurements of his specimens and reversed the anterior and posterior ends in his description.

With the Caribbean taxon comes the synonym *Crassatella adelinae* Tryon, 1872, described from an unknown locality and synonymized by Weisbord (1964). Caribbean material was also illustrated as "*Crassatella rostrata* Lamarck" by Delessert (1841), but Nyst (1847:126–127), Lamy (1913:104; 1917:221–223; plt. 6, fig. 4), and others have demonstrated that this was an error and that Lamarck's species is really from Asia.

Crassatella undulata Sowerby, 1832, is a primary homonym of *C. undulata* Say, 1824, from the Miocene of Virginia.[4] *Crassatella digueti* Lamy, 1917, was proposed as a replacement name and thus has the same type specimens as Sowerby's species.

Crassatellites laronus Jordan, 1932, is unquestionably another synonym. It was differentiated from *Crassatella undulata* Sowerby as being thinner and less rostrate and as having a straighter postero-dorsal margin, character states well within the range of variability of this species.

Some biogeographic comments:

There is great inconsistency in how various workers nomenclaturally handle related taxa between the Caribbean and Panamic faunal provinces. For the most part, populations in the two provinces that differ in only minor ways morphologically are regarded as separate species, which are properly termed "cognates" or "homologues."[5] Sometimes the morphological differences are so minor that, were the two populations to occur within a single province, the differences would be regarded merely as variation within a single taxon. (In the case of *Eucrassatella antillarum,* I have not been able to find sufficient differences between the populations in the two provinces to regard the names involved as anything but synonyms.)

Intermediate paths are possible between the recognition of full, cognate species and a single species with disjunct, undifferentiated populations—(1) to use the subspecific level, or (2) merely to describe the morphological differences between the populations without recognizing them as separate taxonomic units.

Workers on marine mollusks have not often relied upon the subspecific option across the Panama land barrier, and, in general, few subspecies are recognized among marine mollusks, in part because the pelagic larvae of many forms ensure wide distributions within habitable territory as well as the liberal mixing of genetic material. Whereas the trans-Panama situation meets the criterion of geographic separation required of most subspecies, its absolute and long standing nature—3.1 million years, according to Keigwin (1978)—has made some workers hesitant

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[4] It is also a secondary homonym of *Crassatella undulata* (Lamarck, 1801:120), which was first proposed in the genus *Paphia* and later reassigned to *Crassatella* by Lamarck (1805:408). Lamarck's species is a synonym of *Crassatella contraria* (Gmelin, 1791:3277), from West Africa.

[5] Earlier literature used the term "analogues," which is clearly a misuse of this word since it implies a *lack* of phylogenetic relationship. There remains a tendency to search out and list pairs of so-called cognates between the Panamic and Caribbean faunal provinces without sufficient knowledge of the groups involved, and I harbor doubts about a number of the cognate pairs listed in the useful compilation of Vermeij (1978:269–278).

about invoking subspecies. However, for many groups of marine mollusks, this is not a very long time at all.

In two of the three cases in which I have previously used subspecies among marine bivalves, there were relatively sharp morphological breaks corresponding to geographic constrictions, and I concluded that gene flow was significantly restricted at those points. The third case involved an 1300-km gap between morphologically differing populations. Subspecies have sometimes been used in the eastern Pacific for isolates on offshore islands.

The key decision that a systematist must make is whether or not, in the absence of experimental evidence or other direct measures of genetic divergence, interbreeding and gene flow are occurring or could occur between populations. Judgments about this often have to be made on a case-by-case basis by means of analogies about the systematic importance of morphological differences among other species in the genus or family involved. This is, of course, indirect evidence, and the marine mollusks have many examples both of species within single genera that are scarcely distinguishable morphologically and of single species with astounding ranges of variability.

With regard to the Panama marine barrier, a decision to recognize two species may almost be regarded as a conclusion about the world as it *is,* with workers arguing that reproductive isolation exists between two populations that have significant morphological differences. This is in contrast to a decision to recognize a pair of subspecies, a decision that could be regarded as being a shade closer to a conclusion about the world as it *might be,* with workers arguing that reproductive isolation would not be complete were gene flow once again to be possible between the two differing populations. Thus, the seemingly absolute geographic separation across Panama may unjustifiably force conclusions in favor of separate species; one can know that gene flow is now impossible, whereas it is more difficult to assume that it could take place. With more careful studies on various groups, workers may want to give increased consideration to the use of subspecies for these divergent populations, or merely to describe the morphological differences without providing names.

Crassatella marginata Keep, 1887, *ex* Carpenter MS

A debate has continued for many years as to whether this name was validated by Keep and about what it is. BERNARD (1983:36) has recently termed it a *nomen nudum,* dated it from 1888, and synonymized it with *Eucrassatella fluctuata.*

The name **is** validated in KEEP's **1887** edition (p. 179). Here is the entire entry: "*Crassatella marginata,* Cpr., Crassa-tel'-la mar-gin-a'-ta. Shells minute, about the size of large pinheads; somewhat triangular; yellowish, marked with chevrons of brown." A later version of this work (KEEP, 1904) adds that the species is "southern" (p. 50), and that it was "described in this book" (p. 281).

Although this description is sparse, and although Keep's original specimens have not come to light in the parts of his collection now housed in the California Academy of Sciences and in the University of California at Berkeley (Barry Roth and David Lindberg, verbal communications, Jan. 1983), I think that this taxon is recognizable. There is but one genus with an internal ligament occurring in southern California that fits this description, *Halodakra,* a member of the Bernardinidae. It may be *H. salmonea* (Carpenter, 1864b), which was originally proposed in the homonymous venerid genus *Psephis* with a still more meager description (CARPENTER, 1864b:539, 611, 641; see also BERNARD, 1983:49). I am currently studying the Bernardinidae, and the relationship of *Halodakra salmonea* to the tropical eastern Pacific type species of the genus, *H. subtrigona* (CARPENTER, 1857b:82), is not yet clear. It is possible that there may be two species in southern California.

Keep initially credited his species to Carpenter, but Carpenter never proposed it. What evidently happened is this. When early collectors in southern California found some specimens of *Halodakra,* they were sent to Carpenter for identification. Perhaps forgetting all about his *Psephis salmonea,* he thought that the specimens might be another member of the Bernardinidae that he had already named from Mazatlán, *Circe margarita* CARPENTER, 1857b:81, now assigned to the genus *Bernardina* (KEEN, 1968:394, 395; fig. 4; BERNARD, 1983:49). Evidence for this comes from a label by Carpenter filed with some specimens of *Halodakra* from San Diego that had been in the Stanford University Collection (now CASIZ 036681). The label says, in part, "?*Crassatella margarita,* Cpr., Maz Cat 114. . . . call it ?*Crassatella*; (not *Circe*)." Somewhere along the way to Keep, the "*margarita*" evidently was mistranscribed as "*marginata.*"

Subfamily Scambulinae Chavan, 1952

Scambulinae Chavan, 1952:120

Some comments on *Crassinella*:

In my discussion of *Crassinella adamsi* Olsson, 1961 (COAN, 1979:8), I mentioned Olsson's reference to a similar, undescribed Caribbean species, which he had seen from Panama (OLSSON, 1961:183). I have not encountered any material from the Caribbean coast of Panama, but I think what Olsson may have had is *C. aduncata* WEISBORD, 1964 (pp. 197–199; 514; plt. 25, figs. 11–14), described from the Pliocene Mare Formation of Venezuela. GIBSON-SMITH & GIBSON-SMITH (1979:28) report this species from the Recent fauna of Venezuela,[6] and I have seen specimens I tentatively assign to this species from Jamaica (LACM 74-77). It differs from the eastern Pa-

[6] They also show that *Crassinella triquetra* WEISBORD, 1964 (pp. 199–200; 515; plt. 25, figs. 1, 2) is the same thing.

cific *C. adamsi* in attaining a larger size, having a more abrupt posterior slope, and in possessing more prominent concentric ribs. A Recent Venezuelan lot of *C. aduncata* has been placed in the California Academy of Sciences through the courtesy of Jack Gibson-Smith (CASIZ 033530).

A western Atlantic cognate of another eastern Pacific *Crassinella* has also come to my attention. It is *C. maldonadoensis* (PILSBRY, 1897:295–296) described from Uruguay, which is very similar to the eastern Pacific *C. nuculiformis* Berry, 1940. This Atlantic species has been discussed and illustrated by CASTELLANOS (1970:178–180; figs. 5–10) and by SCARABINO (1977:205, 284–285; plt. 11, fig. 2). The type specimens are in the ANSP (#70522). This species, which has been reported from Uruguay to the Golfo San Matías, Argentina, is more pointed and produced postero-ventrally and has a shorter escutcheon than *C. nuculiformis*. Its umbones are less prominent, with concentric ribs that fade out more quickly toward the ventral margin. Thanks to the courtesy of Dr. James McLean, specimens of this uncommon species have been placed in the California Academy of Sciences (CASIZ 036827).

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LITERATURE CITED

All works cited in the text, including sources of taxonomic units are listed. Volume, bulletin, monograph, memoir, professional paper, and special paper numbers are in bold face; series numbers, in parentheses, precede volume numbers; issue numbers, in parentheses, follow volume numbers; supplementary information, such as second methods of listing volumes, part numbers, and parenthetical statements, are given in brackets. Plates and portraits are listed, but not text figures, maps, charts, and tables. Exact publication dates are given when possible, as well as the sources of this information if not from the publication itself.

ADAMS, A. 1854a. Descriptions of new shells, from the Cumingian Collection. Proc. Zool. Soc. Lond. **for 1852** [pt. 20] (243):90–92; plts. 15, 16 (23 May 1854).

ADAMS, A. 1854b. Descriptions of a new genus, and of several new species, of Mollusca, from the Cumingian Collection. Proc. Zool. Soc. Lond. **for 1852** [pt. 20] (243):92–95 (23 May 1854).

ADAMS, C. B. 1852a. Catalogue of shells collected at Panama, with notes on synonymy, station and habitat, ... Lyc. Natur. Hist. New York, Ann. **5**:229–296 (June); 297–549 (July) [repr.: 1852b]

ADAMS, C. B. 1852b. Catalogue of shells collected at Panama, with notes on their synonymy, station, and geographical distribution. New York (Craighead). viii + 334 pp.

BERNARD, F. R. 1983. Catalogue of the living Bivalvia of the eastern Pacific Ocean: Bering Strait to Cape Horn. Canadian Spec. Publ. Fisheries & Aquatic Sci. **61**:viii + 102 pp. (about 15 April 1983).

BERRY, S. S. 1940. New Mollusca from the Pleistocene of San Pedro, California—I. Bull. Amer. Paleo. **25** (94A):1–18 [=147–164]; 2 plts. [17, 18] (28 Sept. 1940).

BOURGUIGNAT, J.-R. 1925. Dates des livraisons de l'Histoire des Mollusques des Ferussac et Deshayes, vérifiées d'après le registre de l'éditeur Ballière, de Paris. J. Conchyl. **69** [(4) **23**] (1):15–18 (5 July 1925).

BOYD, D. W. & N. D. NEWELL. 1968. Hinge grades in the evolution of crassatellacean bivalves as revealed by Permian genera. Amer. Mus. Novitates **2328**:52 pp. (19 July 1968).

BOYD, D. W. & N. D. NEWELL. 1969. Limitations of Bernard and Munier-Chalmas system for bivalve hinge notation. Pp. N908–N913. *In:* L. R. Cox *et al.* (eds.), Part N, Bivalvia, Vol. **2**:N491–N952. *In:* R. C. Moore, ed., "Treatise on Invertebrate Paleontology." Lawrence, Kansas (Geol. Soc. America & Univ. Kansas).

BRODERIP, W. J. & G. B. SOWERBY[I]. 1832. [. . . the new species of Mollusca and Conchifera collected by Mr. Cuming, ...] [one section only] Proc. Zool. Soc. Lond. **for 1832** [pt. 2] (17):50–61 (5 June 1832).

BURCH, J. Q. (ed.). 1944. Family Crassatellidae, pp. 8–10, *In:* "Distributional list of the west American mollusks from San Diego, California to the Polar Sea. Part I. Pelecypoda." Conch. Club Southern California, Minutes **39**:29 pp. (Sept. 1944).

BURCH, J. Q. 1945. Index, pp. 1–20, *In:* same. Conch. Club Southern California, Minutes **45**:21 pp. (March 1945).

CARPENTER, P. P. 1857a. Report on the present state of our knowledge with regard to the Mollusca of the west coast of North America. British Assn. Adv. Sci., Rept. **26** [for 1856]: 159–368 + 4 pp.; plts. 6–9 (pre-22 April 1857).

CARPENTER, P. P. 1857b. Catalogue of the collection of Mazatlan shells, in the British Museum: collected by Frederick Reigen, ... London (British Museum) i–iv + ix–xvi + 552 pp. (1 Aug. 1857) [private edition published simultaneously] [reprinted by Paleo. Resh. Inst., 1967].

CARPENTER, P. P. 1864a. Review of Prof. C. B. Adams's 'Catalogue of the Shells of Panama,' from the type specimens.

Proc. Zool. Soc. Lond. **for 1863** (3):339–369 (April 1864) [reprinted in CARPENTER, 1872:173–205].

CARPENTER, P. P. 1864b. Supplementary report on the present state of our knowledge with regard to the Mollusca of the west coast of North America. Brit. Assn. Adv. Sci., Rept. **33** [for 1863]:517–686 (post-1 Aug. 1864) [reprinted in CARPENTER, 1872:1–172].

CARPENTER, P. P. 1864–1866. Descriptions of new marine shells from the coast of California. Parts I–III. Calif. Acad. Sci., Proc. **3.** Pt. I:155–159 (July 1864); Pt. II:175–176 (Dec. 1864); 177 (Jan. 1865); Pt. III:207–208 (post-4 Sept. 1865); 209–224 (Feb. 1866).

CARPENTER, P. P. 1866. See 1864–1866.

CARPENTER, P. P. 1872. The mollusks of western North America. Embracing the second report made to the British Association on this subject, with other papers; reprinted by permission, with a general index. Smithsonian Inst. Misc. Coll. **10** (252):xii + 325 + 13–121 pp. (Dec. 1872).

CASTELLANOS, Z. A. DE 1970. Adiciones al genero "Crassinella" Guppy 1874. Soc. Cient. Argentina, Anales **190** (5/6):175–181 (Dec. 1970).

CHAVAN, A. 1952. Mélanges paléontologiques. II.—Distinction et classement des crassatellidés. Cahiers Géologiques de Thoiry **14**:117–120 (23 Oct. 1952).

CHAVAN, A. 1969. Superfamily Crassatellacea Férussac, 1822. pp. N562–N578, *In:* L. R. Cox *et al.*, eds., Part N, Bivalvia, Vol. **2**: N491–N952, illust., *In:* R. C. Moore, ed., "Treatise on Invertebrate Paleontology." Lawrence, Kansas (Geol. Soc. America & Univ. Kansas).

CHENU, J. C. 1859–1862. Manuel de conchyliologie et de paléontologie conchyliologique . . . . Paris (Victor Masson) Vol. **1**:vii + 508 pp. (1859); Vol. **2**:i + 327 pp. (1862).

COAN, E. V. 1979. Recent eastern Pacific species of the crassatellid bivalve genus *Crassinella.* Veliger **22** (1):1–11; 4 plts. (1 July 1979).

CRUZ P., M. 1980. Descripción de un nuevo género y dos especies de moluscos, (Bivalvia), para el Pacífico Ecuatoriano. Acta Oceanográfica del Pacífico, INOCAR, Ecuador **1** (1):65–73 (Oct. 1980).

DALL, W. H. 1881. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico, and in the Caribbean Sea, 1877–79, by the United States Coast Guard Steamer "Blake," . . . . XV. Preliminary report on the Mollusca. Harvard Univ., Mus. Compar. Zool., Bull. **9** (2): 33–144 [pp. 33–48 (12 July); 49–64 (12 Aug.); 65–80 (25 Aug.); 81–96 (26 Sept.); 97–112 (31 Oct.); 113–128 (26 Nov.); 129–144 (5 Dec.)].

DALL, W. H. 1903a. A new *Crassatellites* from Brazil. Nautilus **16** (9):101–102 (5 Jan. 1902).

DALL, W. H. 1903b. Contributions to the Tertiary fauna of Florida with especial reference to the Silex beds of Tampa and the Pliocene beds of the Caloosahatchie River including in many cases a complete revision of the generic groups treated and their American Tertiary species. Pt. 6. Concluding the work. Wagner Free Inst. Sci., Trans. **3** (6):xiv + 1219–1654; plts. 48–60 (Oct. 1903).

DALL, W. H. 1921. Summary of the marine shellbearing mollusks of the northwest coast of America, from San Diego, California, to the Polar Sea, mostly contained in the collection of the United States National Museum, with illustrations of hitherto unfigured species. U.S. Nation. Mus., Bull. **112**:271 pp.; 22 plts. (24 Feb. 1921).

DARRAGH, T. A. 1964. A preliminary revision of the living species of *Eucrassatella* (Pelecypoda: Crassatellidae). J. Malacol. Soc. Australia **8**:3–9; 3 plts. (15 Dec. 1964).

DARRAGH, T. A. 1965a. Revision of the species of *Eucrassatella* and *Spissatella* in the Tertiary of Victoria and Tasmania. Proc. Roy. Soc. Victoria (n.s.) **78** (1):95–114; plts. 12–15 (4 March 1965).

DARRAGH, T. A. 1965b. Hinge transposition in *Eucrassatella* (Pelecypoda: Crassatellidae). Proc. Roy. Soc. Victoria (n.s.) **79** (1):89–90; plt. 7 (10 Dec. 1965).

DELESSERT, B. 1841. Recueil de coquilles décrites par Lamarck dans son Histoire Naturelle des Animaux san Vertèbres et non encore figurées. Paris (Fortin, Masson et Cie.) 40 plts. with explanations and an alphabetical table (post-1 Oct. 1841).

DRAPER, B. C. 1980. Lost operculum club list of champions. Los Angeles, Calif. (Conch. Club Southern Calif.) 32 pp.

DURHAM, J. W. 1950. 1940 E. W. Scripps cruise to the Gulf of California, pt. II: megascopic paleontology and marine stratigraphy. Mem. Geol. Surv. Amer. **43**: viii + 216 pp.; 48 plts. (10 Aug. 1950).

FÉRUSSAC, A. E. J. P. J. F. D'A. 1821–1822. Tableaux systématiques des animaux mollusques classés en familles naturelles, dans lesqueles on a établi la concordance des tous les systèmes; suivis d'un prodrome général pour tous les mollusques terrestres ou fluviatiles, vivants ou fossiles; . . . . Paris (Bertrand) & London (Sowerby) 111 + 27 + xlviii pp. [There are three collations of this work: SHERBORN & WOODWARD (1901), BOURGUIGNAT (1925), and KENNARD (1942). However, some guesswork is necessary.] This is what seems to be the case:
livr. 9—pp. 1–32 (?)—6 April 1821
livr. 10—33–40; 49–56—26 May 1821
livr. 11—57–80—13 July 1821
livr. 12—41–48; 81–96—21 Sept. 1821
livr. 13—97–111—10 Nov. 1821
livr. 14—i–xxiv—16 Feb. 1822
livr. 15—xxv–xlviii—13 April 1822
livr. 16—1–27—16 July 1822

GIBSON-SMITH, J. & W. GIBSON-SMITH. 1979. The genus *Arcinella* (Mollusca: Bivalvia) in Venezuela and some associated forms. Caracas, Escuela de Geol. y Minas, UCV, Geos **24**:11–32; 3 plts. (Jan. 1979).

GMELIN, J. F. 1791. Caroli a Linné . . . . Systema naturae per regna tria naturae . . . edition decima tertia, acuta, reformata **1** (6). Leipzig (Beer) pp. 3021–3910 (pre-14 May 1791).

GRANT, U. S., IV & H. R. GALE. 1931. Catalogue of the marine Pliocene and Pleistocene Mollusca of California and adjacent regions . . . . Mem. San Diego Soc. Natur. Hist. **1**: 1036 pp.; 32 plts. (3 Nov. 1931).

GRYZBOWSKI, J. 1899. Beiträge zur Geologie und Palaeontologie von Südamerika. Unter Mitwirkung von Fachgenossen herausgegeben von G. Steinmann. VIII. Die Tertiärablagerungen des nördlichen Peru und ihre Molluskenfauna. Neues Jahrb. f. Mineral., Geol. und Palaeo. **12** [Beilage-Band]:610–664; plts. 15–20.

HABE, T. 1981. Bivalvia. pp. 25–196; plts. 1–13, *In:* Tadashige Habe *et al.*, "A catalogue of molluscs of Wakayama Prefecture, the Province of Kii. I. Bivalvia, Scaphopoda and Cephalopoda." xx + 303 pp.; 13 plts. Seto Marine Biol. Lab., Special Publ. **7** (1) (31 Aug. 1981).

HANLEY, S. C. T. 1842–1856. An illustrated and descriptive catalogue of Recent bivalve shells. London (Williams & Norgate) xviii + 392 + 24 pp.; plts. 9–24 [dating: pp. v–vi & Reynell (1918)] [pp. 1–32 (late 1842); pp. 1–32 (reissue) + 33–144; plts. 9–13; pp. 1–8 (early 1843); pp. 145–272 (late 1843); plts. 14–16; pp. 9–12 (late 1844); plts. 17–19;

pp. 13–18 (1846); plts. 20–24; pp. 19–24 (26 July 1855?); pp. i–xviii + 273–392 (1856)].

HANNA, G. D. 1926. Paleontology of Coyote Mountain, Imperial County, California, XVIII. Proc. Calif. Acad. Sci. (4) **14** (18):427–503; plts. 20–29 (23 March 1926).

HARRY, H. W. 1966. Studies on bivalve molluscs of the genus *Crassinella* in the northwestern Gulf of Mexico: anatomy, ecology and systematics. Publ. Univ. Texas, Inst. Marine Sci. **11**:65–89 (Nov. 1966).

HERTLEIN, L. G. 1957. Pliocene and Pleistocene fossils from the southern portion of the Gulf of California. Bull. Southern Calif. Acad. Sci. **56** (2):57–75; plt. 13 (31 Aug. 1957).

HERTLEIN, L. G. & A. M. STRONG. 1946. Eastern Pacific expeditions of the New York Zoological Society. XXXV. Mollusks from the west coast of Mexico and Central America. Part IV. Zoologica **31** (3):93–120; 1 plt. (5 Dec. 1946).

HERTLEIN, L. G. & A. M. STRONG. 1955. Marine mollusks collected during the "Askoy" Expedition to Panama, Colombia, and Ecuador in 1941. Bull. Amer. Mus. Natur. Hist. **107** (2):159–318; plts. 1–3 (28 Nov. 1955).

HOENINGHAUS, F. W. 1831. Versuch einer geognostischen Eintheilung seiner Versteinerung-Sammlung . . . . Dritter Thiel. Tertiär-Gebirge. Jahrb. f. Mineral., Geogn., Geol. und Petrefak. **for 1831** [2]:132–170.

IREDALE, T. 1924. Results of Roy Bell's molluscan collections. Proc. Linn. Soc. New South Wales **49** (3):179–278; plts. 33–36 (24 Oct. 1924).

JOHNSON, R. I. 1968. Martini and Chemnitz (Kuester's Edition) "Systematisches Conchylien-Cabinet," 1837–1920, a complete collation. J. Soc. Bibliogr. Natur. Hist. **4** (7):363–367.

JORDAN, E. K. 1932. A new species of *Crassatellites* from the Gulf of California. Nautilus **46** (1):9–10 (23 July 1932).

JORDAN, E. K., introduction by L. G. Hertlein. 1936. The Pleistocene fauna of Magdalena Bay, Lower California. Contrib. Stanford Univ., Dept. Geol., **1** (4):103–173; plts. 17–19 (13 Nov. 1936).

KEEN, A. M. 1958. Sea shells of tropical west America; marine mollusks from Lower California to Colombia, 1st ed. Stanford Univ. Press, Stanford, Calif. xi + 624 pp.; illust. (8 Dec. 1958).

KEEN, A. M. 1968. West American mollusk types at the British Museum (Natural History) IV. Carpenter's Mazatlan collection. Veliger **10** (4):389–439; plts. 55–59 (1 April 1968).

KEEN, A. M. 1971. Sea shells of tropical west America; marine mollusks from Baja California to Peru, 2nd ed. Stanford Univ. Press, Stanford, Calif. xiv + 1064 pp.; illust. (1 Sept. 1971).

KEEP, J. 1887. West coast shells. A familiar description of the marine, fresh water, and land mollusks of the United States, found west of the Rocky Mountains. Bancroft Bros., San Francisco, Calif. 230 pp.; frontis. (post-July 1887).

KEEP, J. 1888. [same title and pagination]. Carson, San Francisco, Calif.

KEEP, J. 1904. West American shells. A description in familiar terms of the principal marine, fresh water and land mollusks of the United States found west of the Rocky Mountains, including those of British Columbia and Alaska. Whitaker & Ray, San Francisco, Calif. 360 pp.; frontis. (post-11 July 1904).

KEIGWIN, L. D., JR. 1978. Pliocene closing of the Isthmus of Panama, based on biostratigraphic evidence from nearby Pacific Ocean and Caribbean Sea cores. Geology **6** (10):630–634 (Oct. 1978).

KENNARD, A. S. 1942. The *Histoire* and *Prodrome* of Férussac. Proc. Malac. Soc. London **25** (1):12–17 (23 Jan. 1942).

KOBELT, W. 1886. See LÖBBECKE & KOBELT (1881–1886)

KOBELT, W. 1904. Museum Loebbeckeanum. Nachrichsbl. Deut. Malakozool. Gesellsch. **36** (2):81–84 (April 1904).

KRÜGER, J. F. 1822–1823. Geschichte der Urwelt. Basse, Quedlinburg & Leipzig **1**: xvi + 428 pp. (1822); **2**: viii + 966 pp. (1823).

LAMARCK, J. B. P. A. M. 1799. Prodrome d'une nouvelle classification des coquilles. Mém. Soc. Hist. Natur. Paris **1**: 63–90.

LAMARCK, J. B. P. A. M. 1801. Système des animaux sans vertèbres, ou tableau général des classes, des ordres et des genres de ces animaux; . . . . Chez l'auteur & Deterville, Paris viii + 432 pp.

LAMARCK, J. B. P. A. M. 1805. Suite de la détermination des espèces de mollusques testacés. Ann. Mus. d'Hist. Natur. Paris **6** (36):407–415 (Dec. 1805).

LAMARCK, J. B. P. A. M. 1818. Histoire naturelle des animaux sans vertèbres, . . . **5**:612 pp. Verdière, Deterville, & chez l'auteur, Paris (25 July 1818).

LAMY, É. 1913. Note sur quelques coquilles du genre *Crassatella* déterminées par Lamarck. Bull. Mus. Nation. d'Hist. Natur. **19** (2):99–105.

LAMY, É. 1917. Revision des Crassatellidae vivants du Muséum d'Histoire Naturelle de Paris. J. Conchyl. **62** (4):197–270; plt. 6 (17 Feb. 1917).

LI, C. C. 1930. The Miocene and Recent Mollusca of Panama Bay. Bull. Geol. Soc. China **9** (3):249–296; 8 plts. (Oct. 1930).

LÖBBECKE, T. & W. KOBELT. 1881–1886. Die Gattung *Crassatella* Lam. *In:* "Systematisches Conchylien-Cabinet von Martini und Chemnitz" **10** (1a):39 + [2] pp.; 9 plts. Bauer & Raspe, Nürnberg [(307):1–16; plts. 1–6 (1881)—Löbbecke & Kobelt; (339):17–41; plts. 7–9 (1886)—Kobelt] [dates: PRASHAD (1932), SMITH & ENGLAND (1937) & JOHNSON (1968)] [note: LAMY (1917) credits this monograph to "Kobelt & Loebbecke" and JOHNSON (1968) to "Löbbecke & Kobelt." Some copies have a title page dated 1886 that says, "bearbeitet von Theod. Löbbecke und W. Kobelt." Other copies, also dated 1886, say "bearbeitet von W. Kobelt" only. Another clue is provided by the text in which "wir" and "unsere" appear up to the end of the part published in 1881 and "ich" afterward. My interpretation is that the two authors began the monograph and are together responsible for the first part, whereas Kobelt alone is the author of the second part. I suspect that the Löbbecke and Kobelt title page was issued in 1886 and later replaced with the Kobelt version. KOBELT (1904) mentions that Löbbecke was married in 1883 and within three years was deeply involved with a museum in Düsseldorf.]

MCLEAN, J. H. 1969. Marine shells of southern California. Los Angeles Co. Mus. Natur. Hist., Sci. Ser. **24** [Zool. 11]: 104 pp.; 54 plts. (Oct. 1969).

MCLEAN, J. H. 1978. Marine shells of southern California, revised ed. Los Angeles Co. Mus. Natur. Hist., Sci. Ser. **24**: 104 pp.; 54 plts. (20 March 1978).

MORRIS, N. J. 1978. The infaunal descendants of the Cycloconchidae: an outline of the evolutionary history and taxonomy of the Heteroconchia, superfamilies Cycloconchacea to Chamacea. pp. 259–275; plts. 1, 2. *In:* C. M. Yonge & T. E. Thompson, eds., "Evolutionary systematics of bivalve mollusks," Philos. Trans. Roy. Soc. Lond. (B) **284** (1001): 199–436; illust. (16 Nov. 1978).

MOUNT, J. D. 1974. Notes on *Crassatella lomitensis* (Oldroyd,

1924) from Plio-Pleistocene of southern California. Echo [Abstracts & Proceedings, 6th Ann. Meeting, Western Soc. Malacol.] **6**:37–44; plt. 1 (3 April 1974).

NELSON, E. T. 1870. On the molluscan fauna of the later Tertiary of Peru. Trans. Connecticut Acad. Arts & Sci., **2** (1):186–206; plts. 6, 7 (July 1870).

NYST, H. J. P. 1847. Sur deux coquilles nouvelles du genre *Crassatella* (*C. astarteïformis, C. Bronnii*), suive d'un tableau des espèces vivantes et fossiles. Bull. Acad. Roy. Sci., Lettres, et Beaux-Arts de Belgique **14** (2):116–130.

OLDROYD, I. S. 1924. Description of a new fossil species of a clam of the genus (*Crassatellites*). Bull. So. Calif. Acad. Sci., **23** (1):10; plt. C (Feb. 1924).

OLDROYD, I. S. 1925. The marine shells of the west coast of North America **1** [Pelecypoda]. Stanford Univ. Publ., Univ. Series, Geol. Sci. **1** (1):247 pp.; 57 plts. (Sept. 1925) [reprinted, Stanford Univ., April 1978].

OLSSON, A. A. 1932. Contributions to the Tertiary paleontology of northern Peru: Part 5, the Peruvian Miocene. Bull. Amer. Paleo. **19** (68):272 pp.; 24 plts. (30 June 1932).

OLSSON, A. A. 1942. Tertiary and Quaternary fossils from the Burica Peninsula of Panama and Costa Rica. Bull. Amer. Paleo. **27** (106):5–106; plts. 1–12 [=157–258; plts. 14–25] (25 Dec. 1942).

OLSSON, A. A. 1961. Mollusks of the tropical eastern Pacific particularly from the southern half of the Panamic-Pacific faunal province (Panama to Peru). Panamic-Pacific Pelecypoda. Paleo. Res. Inst., Ithaca, New York. 574 pp.; 86 plts. (10 March 1961).

PALMER, K. E. H. (VAN WINKLE). 1958. Type specimens of marine Mollusca described by P. P. Carpenter from the West Coast (San Diego to British Columbia). Mem. Geol. Soc. America **76**:viii + 376 pp.; 35 plts. (8 Dec. 1958).

PARKER, R. H. 1964. Zoogeography and ecology of some macro-invertebrates, particularly mollusks, in the Gulf of California and the continental slope off Mexico. Vidensk. Medd. fra Dansk Naturhist., Foren Bd. **126**:178 pp.; 15 plts.

PELSENEER, P. 1911. Les lamellibranches de l'Expédition du Siboga. Partie Anatomique. 125 + [ii] pp.; 26 plts., *In:* Max Weber, ed., "Siboga-Expeditie," Vol. **34**. Leiden (Brill) [is Monogr. 53a [=Livr. 61] of "Uitkomsten op Zoologisch, Botanisch, Oceanographisch en Geologisch Gebied Verzameld in Nederlandsch Oost-Indië 1899–1900 aan boord H. M. *Siboga* onder commando van Luitenand ter zie I^e^ kl. G. F. Tydeman."].

PILSBRY, H. A. 1897. New species of mollusks from Uruguay. Proc. Acad. Natur. Sci. Philadelphia **49**:290–298; plts. 6, 7 (18 June 1897).

PILSBRY, H. A. 1931. The Miocene and Recent Mollusca of Panama Bay. Proc. Acad. Natur. Sci. Philadelphia **83**:427–440; plt. 41 (13 Nov. 1931).

PILSBRY, H. A. & A. A. OLSSON. 1941. A Pliocene fauna from western Ecuador. Proc. Acad. Natur. Sci. Philadelphia **93**: 1–79; plts. 1–19 (9 Sept. 1941).

PRASHAD, B. 1932. The Lamellibranchia of the Siboga Expedition. Systematic Part II: Pelecypoda (exclusive of the Pectinidae). 353 pp.; 9 plts. *In:* Max Weber (ed.) "Siboga-Expeditie," Vol. **34**. Brill, Leiden [is Monogr. 53c, livr. 118; see additional details under Pelseneer (1911)].

REEVE, L. A. 1841. Conchologia systematica, or complete system of conchology: in which the lepades and conchiferous Mollusca are described and classified according to their natural organization and habitats, Vol. **1**:vi + 195 pp.; 129 plts. Longman, Brown, Green & Longmans, London.

REEVE, L. A. 1842. Monograph of *Crassatella,* a genus of acephalous mollusks (Family Mactracea). Proc. Zool. Soc. Lond. **for 1842** [pt. 10] (109):42–46 (Nov. 1842).

REEVE, L. A. 1843. Monograph of the genus *Crassatella. In:* Conchologica Iconica: Or, illustrations of the shells of molluscous animals **1**: 3 plts. + title page Reeve, London (presumably all Jan. 1843, the date on the last plate).

REYNELL, A. 1918. The *Index Testaceologicus* of W. Wood & S. P. Hanley. Proc. Malac. Soc. London **13** (1/2):26–27 (9 Sept. 1918).

RIDEWOOD, W. G. 1903. On the structure of the gills of the Lamellibranchia. Phil. Trans. Roy. Soc. Lond. (B) **195**: 147–284.

RIOS, E. C. 1975. Brazilian marine mollusks iconography. Fundação Univ. Rio Grande, Centro Cienc. Mar., Mus. Oceanográf., Rio Grande, RC. 331 pp.; 91 plts. (Dec. 1975).

SAY, T. 1824. An account of some of the fossil shells of Maryland. J. Acad. Natur. Sci. Philadelphia **4**:124–155; 410; plts. 7–13 (Nov. 1824).

SCARABINO, V. 1977. Moluscos del Golfo San Matías (Provincia de Río Negro, República Argentina). Inventario y claves para su identificación. Soc. Malac. Uruguay, Comun. **4** (31/32):i + 177–285; 11 + [3] plts.

SCHENCK, H. G. 1945. Geologic application of biometrical analysis of molluscan assemblages. J. Paleo. **19** (5):504–521; plts. 66, 67 (4 Oct. 1945).

SHERBORN, C. D. 1922 [1902–1933]. Index animalium. British Museum, London. Sect. 1:lix + 1195 pp.; Sect. 2: cxxxvi + 7056 + cxlvii + 1098 pp.

SHERBORN, C. D. & B. B. WOODWARD. 1901. On the dates of publication of the 'Histoire naturelle générale et particulière des Mollusques terrestres et fluviatiles' and the 'Tableaux systématiques des Animaux mollusques,' by the Barons Férussac and G. P. Deshayes. Ann. Mag. Natur. Hist. (7) **8** (44):74–76 (Aug. 1901).

SMITH, E. A. 1880. Descriptions of five new species of shells from Uruguay. Ann. Mag. Natur. Hist. (5) **6** (34):319–322 (Oct. 1880).

SMITH, E. A. 1881. Observations on the genus *Astarte,* with a list of the known Recent species. J. Conchol. **3** (7):196–224 (July); (8):225–232 (Oct.).

SMITH, E. A. 1895. Natural history notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander C. F. Oldham, R.N.—Series II., No. 20. Report upon some Mollusca dredged in the Arabian Sea during the season 1894–5. Ann. Mag. Natur. Hist. (6) **16** (93):262–265 (Sept. 1895).

SMITH, E. A. & H. W. ENGLAND. 1937. Martini and Chemnitz (Kuester's Edition) "Systematisches Conchylien-Cabinet," 1837–1918. J. Soc. Bibliogr. Natur. Hist., **1** (4):89–99 (8 Dec. 1937).

SOWERBY, G. B.[1] 1825. A catalogue of the shells contained in the collection of the late Earl of Tankerville, arranged according to the Lamarckian conchological system; together with an appendix, containing descriptions of many new species, ... E. J. Stirling, London. vii + 92 pp. Appendix: xxxiv pp.; 8 plts.

SOWERBY, G. B.[1] 1832. See BRODERIP & SOWERBY (1832).

STANTON, R. J. 1966. Megafauna of the upper Miocene Castaic Formation, Los Angeles County, California. J. Paleo. **40** (1):21–40; plt. 7 (12 Jan. 1966).

STEWART, R. B. 1930. Gabb's California Cretaceous and Tertiary type lamellibranchs. Acad. Natur. Sci. Philadelphia, Spec. Publ. **3**:314 pp.; 17 plts. (9 Aug. 1930).

STOLICZKA, F. 1870–1871. Cretaceous fauna of southern India **3**: The Pelecypoda, with a review of all known genera of this class, fossil and Recent, ... Geol. Surv. India, Mem.,

Paleontologia Indica. xxii + 538 pp.; 50 + 4 plts. [pp. 1–222; plts. 1–12 (1 Sept. 1870); pp. 223–408; plts. 13–28 (1 March 1871); pp. 409–538, i–xxii; plts. 29–50 (1 Aug. 1871)].

TRYON, G. W., JR. 1872a. Descriptions of new species of marine bivalve Mollusca. Proc. Acad. Natur. Sci. Philadelphia **24** [for 1872] [II] (6):130; plt. 6 (3 Sept. 1872).

TRYON, G. W., JR. 1872b. Catalogue and synonymy of the family Astartidae. Proc. Acad. Natur. Sci. Philadelphia **24** [for 1872] [III] (9):245–258 (17 Dec. 1872).

VERMEIJ, G. J. 1978. Biogeography and adaptation. Patterns of marine life. Harvard Univ. Press, Cambridge, Massachusetts, & London, England xvi + 332 pp.; illust.

VOKES, H. E. 1973. A new subgenus and species of *Crassatella* (Mollusca, Bivalvia) from southern Brazil. Iheringia (Zoologia) **43**:48–59; 1 plt. (4 Nov. 1973).

WEAVER, C. E. 1912. Preliminary report on the Tertiary paleontology of western Washington. Bull. Washington Geol. Surv. **15**:80 + iii pp.; 15 plts.

WEISBORD, N. E. 1964. Late Cenozoic pelecypods from northern Venezuela. Bull. Amer. Paleo. **45** (204):564 pp.; 59 plts. (18 Feb. 1964).

WHITE, K. M. 1942. The pericardial cavity and the pericardial gland of Lamellibranchiata. Proc. Malacol. Soc. Lond. **25** (2):37–88 (28 Aug. 1942).

WILSON, I. F. 1948a. Topografia supultada, estructuras iniciales y sedimentacion en la region Santa Rosalía, Baja California. Mexico City, Univ. Nac. Auton. Mexico, Inst. Geol., Geofis. y Geod., Bol. **53**:78 pp.; 1 plt. [same as WILSON, 1948b].

WILSON, I. F. 1948b. Buried topography, initial structures, and sedimentation in Santa Rosalía area, Baja California, Mexico. Amer. Assn. Petrol. Geol., Bull. **32** [II] (9):1762–1807 (Sept. 1948) [same as WILSON, 1948a].

WINTERER, E. L. & D. L. DURHAM. 1962. Geology of southeastern Ventura Basin, Los Angeles County, California. U.S. Geol. Surv., Prof. Paper **344-H**:iv + 275–366 pp.; plts. 44–49.

WOODRING, W. P. 1982. Geology and paleontology of Canal Zone and adjoining parts of Panama. Description of Tertiary mollusks (Pelecypods: Propeamussiidae to Cuspidariidae; additions to families covered in P 306-E; additions to gastropods; cephalopods). U.S. Geol. Surv., Prof. Paper **306-F**:iv + 541–759; plts. 83–124 (about Sept. 1982).

WOODRING, W. P., M. N. BRAMLETTE & W. S. W. KEW. 1946. Geology and paleontology of Palos Verdes Hills, California. U.S. Geol. Surv., Prof. Paper **207**:v + 145 pp.; 37 plts.

WOODWARD, S. P. 1851–1856. A manual of the Mollusca; or, rudimentary treatise of Recent and fossil shells. J. Weale, London. xvi + 486 + 24 pp.; 24 plts.; frontis. [viii + 158 + 12 pp.; frontis; plts. 1–12 (1851); ix–xii + 159–330 + 13–24 pp.; plts. 13–24 (1854); iv + xiii–xvi + 332–486 pp.; frontis. (1856)]

WOODWARD, S. P. 1866. A manual of the Mollusca; . . . , 2nd ed., edited by Alexander Ramsay. Virtue & Co., London. xiv + 542 pp.; 23 plts.; frontis. [reprinted in 1868, with Tate appendix].

YOKOYAMA, M. 1920. Fossils from the Miura Peninsula and its immediate north. Tokyo, Imper. Univ., College Sci., Journ. **39** (6):1–193; 20 plts. (22 March 1920).

ZINSMEISTER, W. J. 1971. A late Pliocene macrofossil fauna of Newport Beach, Orange County, California. Bull. So. Calif. Acad. Sci. **69** (3/4):121–125 (29 Jan. 1971).