THE FAMILY VASIDAE IN THE INDO-PACIFIC

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The family Vasidae, a worldwide and warm water group of marine gastropods, belongs to the superfamily Volutacea. Because of radula and columellar plicae differences, the family is divided into two major parts—the subfamily Vasinae which includes the Vase shells and the subfamily Xancinae which contains the large Chank shells.

Subfamily Vasinae

Shells usually large, heavy, usually prominently sculptured, and with 2 to 6 irregularly-sized columellar plicae on the lower half of the inner parietal wall. Periostracum thin to heavy. Operculum horny, brown, unguiculate and curved. Radula rachiglossate, with 3 strong teeth, the central bearing 3 strong cusps, the lateral with two cusps. (In the Xancinae, the columellar plicae are located much higher up on the inner parietal wall, and the lateral radular tooth has only one large cusp).

Here, we are dealing with all the known Recent species of the subfamily Vasinae, except those found in the Western Atlantic (see Abbott 1950, Johnsonia, vol. 2, no. 28). Of the twenty known species, five are Western Atlantic, twelve Indo-Pacific, one South Australian, one Panamic and one South African. Most of these species live in the intertidal zone or in very shallow water, although the South Australian species has been dredged at a depth of 120 fathoms. Some prefer reef flat habitats, while others are found on sandy and/or grassy bottoms. Little is known about their biology, except that they feed on clams (and possibly marine worms). The sexes are separate.

The genera now assigned to the subfamily are *Eovasum* Douvillé 1920 (Eocene of Africa and South America), *Vasum* Röding 1798 (Recent, worldwide), *Tudicla* Röding 1798 (Recent, Indian Ocean) and *Tudicula* H. and A. Adams 1863 (Recent, Indo-Pacific). Wenz (1943, p. 1306) also places the genera *Afer* Conrad 1858, *Metzgeria* Norman 1879, *Ptychatractus* Stimpson 1865 and *Piestochilus* Meek 1864 in this subfamily, but further research is evidently needed before accepting these placements.

Genus Vasum Röding

1798 *Vasum* Röding, Museum Boltenianum (2), p. 56. **Type** by subsequent designation (see Abbott 1950, p. 208): *V. turbinellus* Röding 1798 = *Murex turbinellus* Linné, 1758.

1810 *Volutella* Perry, Arcana or the Museum of Natural History, signature B 1, pl. 2. **Type** by monotypy: *V. divergens* Perry 1810 = *V. muricatum* Born, 1778.

1817 *Cynodonta* Schumacher, Essai Nouveau Système Habit. Vers Test., p. 73. **Type** by monotypy: *Voluta ceramica* Linné. (*Cynodona* on p. 241 is a spelling error.)

1835 *Scolymus* Swainson, Elements of Modern Conchology, p. 21; 1840, Treatise Malacology, p. 304. **Type** by subsequent designation (Abbott 1950, p. 208): *S. cornigerus* Chemnitz = *turbinellus* Linné, 1758.

The subgenera employed in the genus *Vasum* are rather nebulous in character, and it is possible that as other species are discovered, especially among the fossils, the differences will become less recognizable. At first glance, there seems little conchological similarity between *Vasum (Altivasum) flindersi* of South Australia and *Vasum (Globivasum) globulus* of the West Indies, yet a more or less gradual transition of generic shell characters may be seen between them in such species as *horridum* Heilprin (Pliocene of Florida), *ceramicum* Linné (Indo-Pacific) and *capitellum* Linné (West Indies). The subgenera of *Vasum* are:

Subgenus *Vasum* Röding, 1798. Type: *turbinellus* Linné, 1758.

Subgenus *Altivasum* Hedley, 1914. Type: *flindersi* Verco, 1914.

Subgenus *Siphovasum* Rehder and Abbott, 1951. Type: *latiriforme* Rehder and Abbott, 1951 (Caribbean).

Subgenus *Globivasum* Abbott 1950. Type: *globulus nuttingi* Henderson, 1919 (Caribbean).

Subgenus Vasum Röding 1798

(for synonymy see under the genus *Vasum*. The type is *Vasum turbinellus* Linné, 1758.)

The shells in this subgenus are fairly large (2 to 5 inches in length), heavy, with slightly to moderately produced spines, and with 3 to 5 columellar plicae. The spire is moderately high, and the siphonal canal short.

Only two of the Indo-Pacific *Vasum* are widely distributed, these being the coral reef species *turbinellus* and *ceramicum* which extend over most

of the Indian and Western Pacific Oceans. The other five species are rather limited in their range, such as *V. tubiferum* which is only found in the Cuyo-Palawan section of the Philippines and *V. rhinoceros* which is known only from British East Africa.

Key to the Indo-Pacific *Vasum* *sensu stricto*

a	Shell nodulated, without spines	*truncatum*
a	Shell with blunt or sharp spines	b
b	Inside of outer lip with black spots	c
b	Inside of outer lip without black spots	d
c	Lower third of columella without black	*armatum*
c	Lower third of columella and lower part of outer lip with black	e
d	Columellar plicae 3; parietal wall yellow-brown	*rhinoceros*
d	Columellar plicae 5; parietal wall purple-brown	*tubiferum*
e	Spire high; 3 columellar plicae strong	*ceramicum*
e	Spire low; 4 to 5 columellar plicae unequal	*turbinellus*

(*Vasum crosseanum* Souverbie is known from a single specimen which we have not seen nor included in this key.)

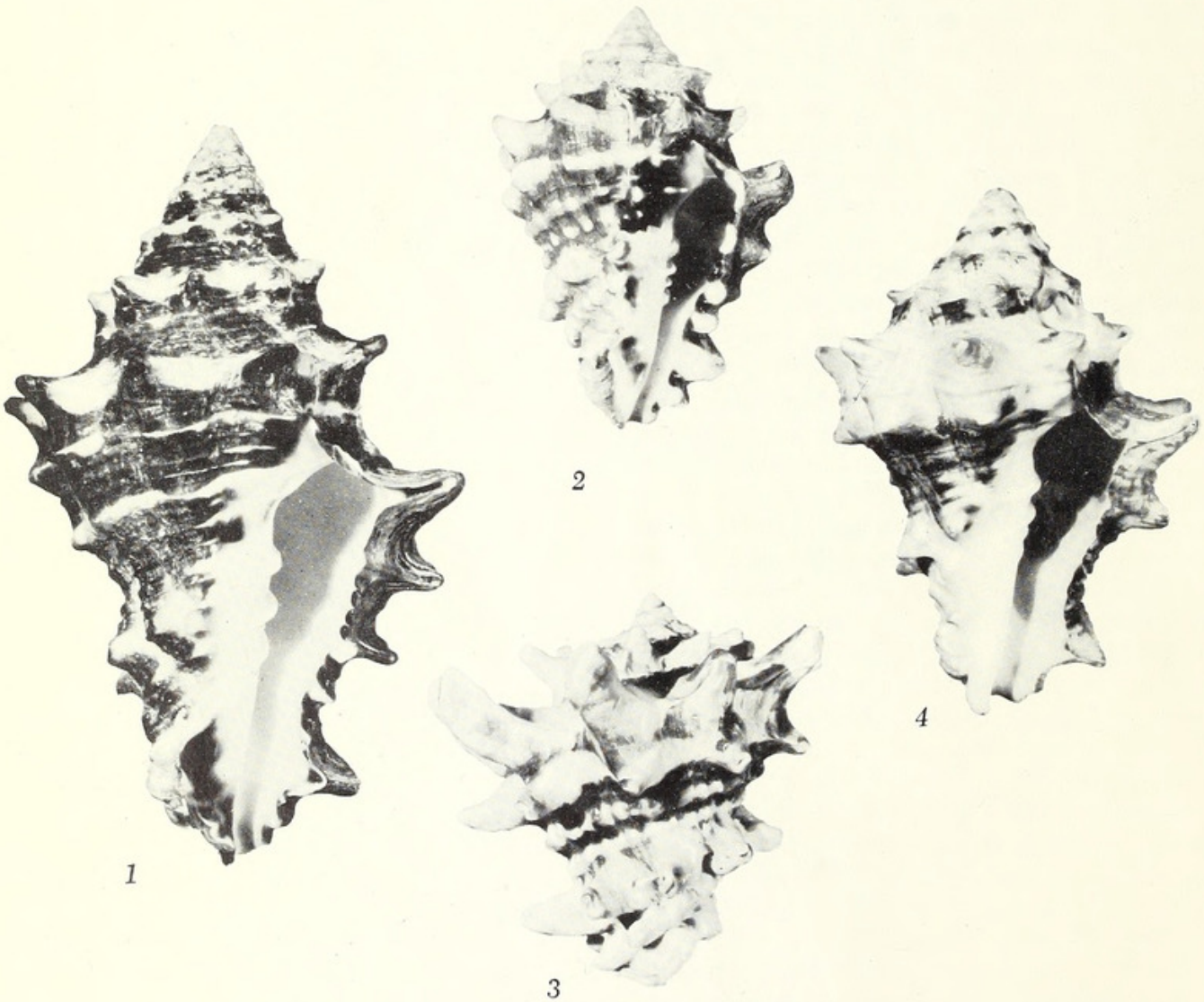


Plate 1, fig. 1, *Vasum ceramicum* (Linné), Philippines; fig. 2, *Vasum turbinellus* (Linné), New Guinea; fig. 3, *Vasum turbinellus* form *cornigerum* (Lamarck), Red Sea; fig. 4, *Vasum armatum* (broderip), Tuamotu Islands. All natural size.

Vasum (Vasum) turbinellus (Linné, 1758)

(Pl. 1, figs. 2, 3; pl. 2, fig. C)

Range—East Africa to western Polynesia.

Remarks—This is the commonest *Vasum* in the Indo-Pacific and is generally abundant wherever it occurs. It is distinguished by its relatively low spire, by the 3 strong columellar plicae between which are two additional smaller ones, and by the black, slightly raised teeth on the inner edge of the outer lip which are not bifid or in pairs as in *Vasum ceramicum*. *V. armatum* which has a pure-white columella and whose two peripheral rows of spines are almost equal in size replaces *turbinellus* in the central and eastern portions of Polynesia. Since *Vasum* is a neuter noun, adjectival names of species have a neuter ending; however, the name "turbinellus" is a substantive noun, meaning a "top" or "little whirlwind", and should not be changed to *turbinellum*.

The length of the spines on the shoulder of the shell of *turbinellus* varies considerably, and throughout the range of the species, particularly in the Red Sea, they may be very long and curled upward. These specimens may be referred to as **form** *cornigerum* Lamarck, 1822 (Pl. 1, fig. 3).

Habitat—*V. turbinellus* lives in shallow water from the low tide mark to a depth of about 30 feet. In some areas, it is fairly common on the reef flats where, during the day, it takes shelter under dead coral rocks. In other areas, it may be found on a bottom of sand, coral rubble and sparse eelgrass.

Description—Adult shell 30 to 80 mm. in length (1 to 3 inches), solid, heavy, turbinate and strongly spined. Spire moderately elevated. Whorls 7 to 9, the body whorl bearing at the shoulder 8 to 9 stout, blunt, upwardly pointing spines which are slightly open at their ends; immediately below is a similar row of much smaller spines. The middle of the whorl bears 2, rarely 3, spiral cords which may each bear 8 to 15 small knobs. At the base of the shell there are three rows of 7 to 8 bluntly conical spines. Suture indistinct and wavy. Parietal wall glazed, yellowish white with black-brown mottlings. Columella with three large plicae between which may be 2 additional, smaller ones. Outer lip slightly thickened, somewhat crenulated, creamy-white with 4 to 6 squarish black spots over the slightly raised, short teeth on the outer lip. Lower third of columella usually with a brownish stain. Umbilicus absent or rarely a small indentation. Color of outer shell grayish with sparse or heavy blackish brown mottlings. Periostracum thin, weakly foliaceous, and grayish yellow or gray-brown in color. Operculum fills most of the inner aperture, corneous, blackish and unguiculate.

Measurements (mm.) (including spines)—

length	width	no. whorls	
85	73	6	(large; Dutch New Guinea)
50	48	6	(average; Palau Islands)
44	35	6	(small; Marshall Islands)

Synonymy—

1758 *Murex turbinellus* Linné, Systema Naturae, ed. 10, p. 750, no. 466 (in O. Asiatico ad Nussaanan); refers to Rumphius Mus., pl. 24, fig. B, and others.

1767 *Voluta turbinellus* Linné, Systema Naturae, ed. 12, p. 1195, no. 430; 1955, Dodge, Bull. Amer. Mus. Nat. Hist., vol. 107, art. 1, pp. 127-129.

1811 *Volutella nigra* Perry, Conchology, London, pl. 26, fig. 1 (African Seas).

1822 *Turbinella cornigera* Lamarck, Anim. sans Vert., vol. 7, p. 105, no. 7 (Moluques); 1840, Kiener, Coquilles Vivantes, vol. 6, Turbinelle, pl. 1

1822 *Turbinella variolaris* Lamarck, Anim. sans Vert., vol. 7, p. 110 (locality not given); 1840, Kiener, Coquilles Vivantes, vol. 6; Turbinelle, pl. 21, fig. 1 (a young, worn specimen).

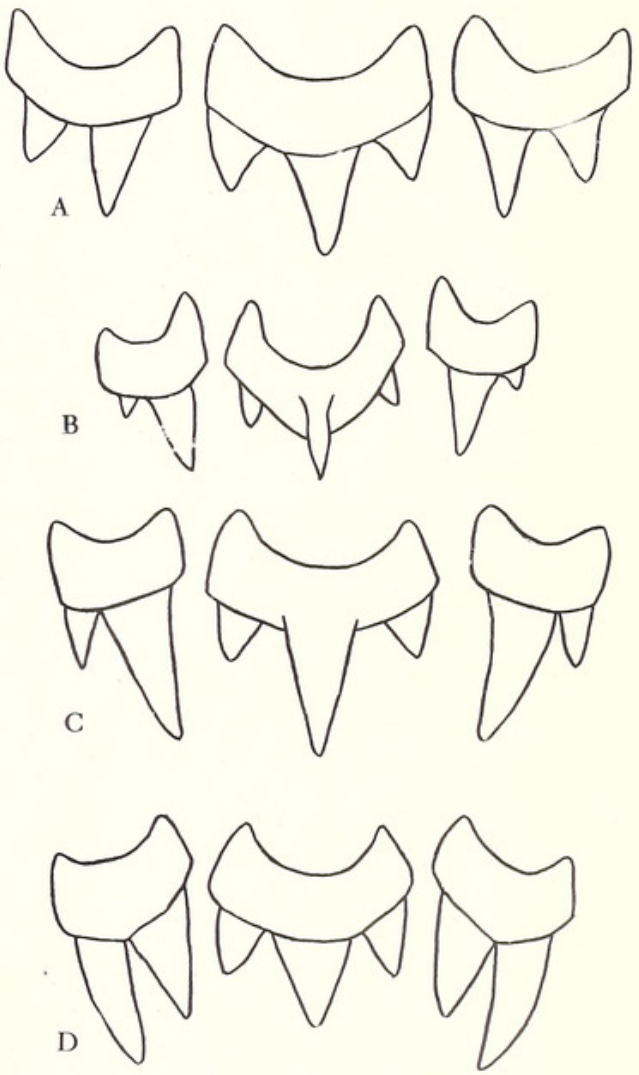


Plate 2. Single rows of radulae from adult *Vasum* (greatly enlarged). Fig. A, *Vasum rhinoceros* (Gmelin), Zanzibar; B, *Vasum armatum* (Broderip), Toau Atoll; C, *Vasum turbinellus* (Linné), Philippines; D, *Vasum ceramicum* (Linné), Philippines.

Types—Linné's type locality is "ad Nussaanan," a place quoted from Rumphius and probably referring to the small islet of Nusa Laut, to the east of Ambon near Saparoea and Haroekoe (formerly Ona) Islands, Indonesia. Possible cotypes of *turbinellus* are in the Linnaean Society collection in London (Dodge, 1955, p. 128).

Locality records—See accompanying map, p. [20-406] solid dots: specimens examined; open circles: from the literature. *Selected records:* SOUTH AFRICA: Natal (Natal Mus.). EGYPT: Berenice, Foul Bay (ANSP) SAUDI ARABIA: Jedda (C. Aslakson, ANSP). KENYA COLONY: Mombasa (B. Verdcourt; ANSP). RYUKYU IDS.: Okinawa (W. A. McCarty, ANSP). POLYNESIA: Vailele Bay, Upolu Id.; Samoan Ids. (N.S.F.); Johnston Id. (D. Thaanum); Howland Id. (Ted Dranga, ANSP).

Vasum (Vasum) armatum (Broderip, 1833)

(Pl. 1, fig. 4; pl. 2, fig. B)

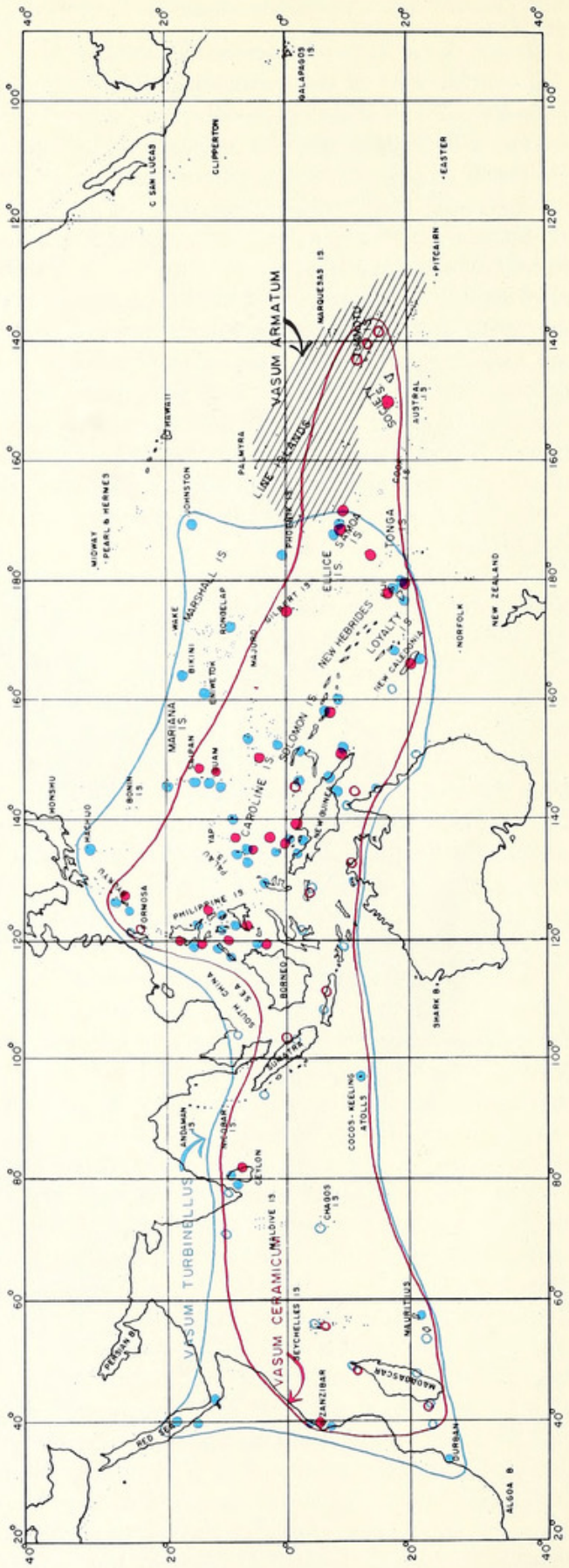
Range—Eastern Polynesia from the Phoenix Islands to the Tuamotu Islands (not Hawaiian Islands).

Remarks—The fusiform shape, white lower columella, and the two rows of equal-sized, conic spines at the shoulder distinguish this Polynesian species from *turbinellus*. Tryon (1882, Manual of Conchology, vol. 4, p. 72) considered this species as a synonym of *ceramicum*. This species appears to be limited to low coral islands and atolls of eastern Polynesia.

"Animal above pale flesh-colour, finely mottled with purplish; siphon and locomotive disk salmon-coloured; eyes on a bulbous expansion near tip of tentacles. Operculum yellowish" (Couthouy's notes in Gould 1852).

Habitat—This appears to be a moderately common to abundant species in pockets of sand on the reef flats facing the open ocean in the intertidal zone.

Description—Adult shell 23 to 70 mm. in length (usually about 52 mm.) (1 to 2¾ inches). Solid, heavy, somewhat fusiform, and moderately heavily spined. Spire elevated. Whorls 6 to 7, the body whorl bearing at the shoulder two rows of 7 to 8 almost equal-sized, conic spines which are slit along their anterior faces. The middle of the whorl bears 3 or 4 small, rough, spiral cords, below which is first a single row of small, well-developed spines, and then, at the base, 1 or 2 rows of weak nodules. Suture indistinct and wavy. The entire outer shell has numerous, coarse, raised, wavy threads. Parietal wall glazed, enamel-white, and rarely with brown markings at the top. Columella white, usually with



4 equal-sized, slanting plicae, rarely with a weak fifth. Inside of body whorl with about 8 small, raised spiral cords. Outer lip thickened and with 4 or 5 pairs of black, rounded teeth. Umbilicus absent. Color of outer shell bluish gray to grayish white with diffused mottlings of bluish brown which are usually more concentrated in a band just below the suture and on the middle of the last whorl. Periostracum thin, translucent, weakly foliaceous. Operculum corneous, claw-shape, light yellowish brown in color, and with its outer surface with very coarse, uneven lines of growth which give it a gnarled appearance.

Measurements (mm.) –

length	width	no. whorls	
74	57	7+	(large; Henderson Atoll)
36	30	7	(average; Henderson Atoll)
26	18	7	(small; Henderson Atoll)

Synonymy –

1833 *Turbinella armata* Broderip, Proc. Zool. Soc. London, vol. 1, p. 7 (ad Insulam Elizabethae); 1847, Reeve, Conch, Icon., vol. 4, Turbinella, pl. 5, fig. 29; 1876, Kobelt, Syst. Conchyl. Cab., vol. 3, no. 3, pl. 16, fig 2 (good).

1852 *Turbinella armata* Broderip, Gould, U.S. Exploring Exped., vol. 12, p. 238, pl. 17, figs. 290, 290a, 291 (animal).

1933 *Vasum ceramicum* var. *armata* Broderip, Dautzenberg and Bouge, Journ. de Conchyl., vol. 77, p. 206. (Anaa Atoll).

Type Locality–On coral reef, Elizabeth Island [Henderson Id., Tuamotu Islands] Hugh Cuming, collector. The types are in the British Museum. Possible cotypes are in ANSP 35230.

Locality records–TUAMOTU ISLANDS: Puka-puka Id. (Honden Id., Gould 1852, p. 238); Toau Atoll (H. A. Pilsbry); Takaroa Atoll (H. A. Pilsbry); Fakarava Id., Makemo Id., Tikahau Atoll, Raroia Atoll (all USNM). Henderson Id., near Pitcairn (Cuming). Flint Island (USNM). Fanning Island (B. P. Bishop Museum). PHOENIX ISLANDS: Hull Id. (USNM). EASTERN SAMOA: Rose Atoll (USNM). See accompanying map, p. [20-406].

Vasum (Vasum) ceramicum (Linné, 1758)

(Pl. 1, fig. 1; pl. 2, fig. D)

Range–British East Africa to eastern Polynesia.

Remarks–The Ceram Vase is the largest member of this genus in the Tropical Indo-Pacific province, being exceeded in size only by *Vasum (Altivasum) flindersi* Verco of South Australia. It is distinguished from the smaller and commoner *V. turbinellus* by its high spire, three strong, slanting columellar plicae (rarely with one or two additional weak plicae), and the small *paired* teeth on the inside of the outer lip. It differs from *armatum* of eastern Polynesia in having a blackish brown patch on the lower end of the columella. Tryon (1882, Manual of Conchology, vol. 4, p. 72) erroneously considered *Latirus vexillulum* (Reeve) a synonym.

Habitat–Moderately common in surging waters off the front edge of coral reefs, usually in depths of 3 to 30 feet.

Description–Adult shell 80 to 140 mm. in length (3 to 5½ in.). Solid, heavy fusiform, and rather strongly spined. Spire elevated. Whorls 9 to 11, the body whorl bearing at the shoulder 7 to 10 strong, somewhat triangular, outwardly projecting spines which are slit open on their anterior faces; immediately below are two similar rows of much smaller spines. Below this are 2 to 4 small, rough spiral cords. The base of the shell bears 1 or 2 rows of small spines. Suture indistinct and wavy; below it on the upper part of the shoulder there are 4 to 6 distinct, raised, spiral threads. Parietal wall glazed, all white or sparsely mottled with black-brown. Columella with 3 very strong, slightly slanting, squarish plicae between which are rarely 1 or 2 more very weak plicae. There are a dozen or so weak, white, spiral cords within the aperture on the inside wall of the body whorl. Outer lip slightly thickened, crenulated and bearing 5 or 6 pairs of small, black, raised teeth. Lower fourth of the columella usually with a brownish black stain. Umbilicus chink-like and shallow. Color of outer shell whitish with heavy mottlings of black or black-brown. Periostracum thin, varnish-like, translucent brown, somewhat foliaceous. Operculum fills most of the inner aperture, is corneous, claw-shaped, blackish, and with a muscle scar of a little more than ⅔ the area of the inner side. Odontophone ¼ the length of the shell, and with 150 rows of radular teeth (see pl. 2, fig. D).

Measurements (mm.) (including spines)–

length	width	no. whorls	
148	94	9+	(large; Guam Id.)
125	81	9+	(average; Zanzibar)
81	56	7+	(small; Guadalcanal Id.)

Synonymy –

1758 *Murex ceramicus* Linné, Systema Naturae, ed. 10, p. 751, no. 470 (O. Asiae ad Ceram). Refers to Rumphius, pl. 24, fig. A, pl. 49, fig. L; Bonanni, pl. 286; and others.

1767 *Voluta ceramica* Linné, Systema Naturae, ed. 12, p. 1195, no. 432; 1955, Dodge, Bull Amer. Mus. Nat. Hist., vol. 107 art. 1, p. 130-132.

1807 *Turbinellus spinosus* G. Fischer (von Waldheim), Museum Demidoff, Moscow, p. 205 (Tranquebar et Nicobar). Refers to Gualtier, pl. 55, fig. D; Lister, pl. 829-51; Chemnitz Conchyl.-Cab., vol. 11, figs. 1725, 1726, the latter being *turbinellus* Linné.

Types–The type locality is Ceram Island, Indonesia. The possible type is in the Zoological Museum of the University of Uppsala, Sweden (Dodge, 1955, p. 131).

Locality records—(see accompanying map). *Selected records*: ZANZIBAR: Chango Id.; Pange Id.; Chumbe Id. CEYLON: Hikkaduwa (G. F. Kline, ANSP). NEW GUINEA: Wombrisau, Biak Id. (NSF). SOLOMON ISLANDS: Lunga, Guadalcanal (ANSP). CAROLINES: Ifaluk Atoll (USNM); Round Rock, Helen Reef (NSF); PALAU ISLANDS: Babelthuap Id. (NSF); Koror Id. (NSF). GILBERTS: Apamama (USNM). RYUKYU ISLANDS: Okinawa Id. (W. A. McCarthy, ANSP). FIJI ISLANDS: Makuluva Id., and Suva, Viti Levu Id. (USNM); Bega Id. (ANSP). NIUAFOU ISLAND (USNM). SAMOA: Fagalii Bay, Upolu Id. (NSF). SOCIETY ISLANDS: Moorea Id. (USNM).

Vasum (Vasum) tubiferum (Anton, 1839)

(Pl. 4, fig. 1; pl. 3)

Range—Cuyo Islands, west central Philippines (also Mindanao Island ?).

Remarks—The Imperial Vase is a very distinctive and highly localized species known, so far, only from one area in the Philippines. It resembles *V. turbinellus*, but differs in having a deep and funnel-shaped umbilicus, purple to lavender splotches on the parietal wall, a "furry" brown periostracum and lacking black spots on the inside of the outer lip. Conchologically, this species most resembles *V. rhinoceros* from East Africa. Melvill and Standen (1895, Jour. Conch., vol. 8, p. 104) report this species from Lifu Island, Loyalty Islands, but I suspect these may be *turbinellus*. I am indebted to Dr. Ramon Lim of Cuyo City, Palawan, for sending preserved specimens for study.

Habitat—A Philippine shell collector told us that this is a moderately common species found in very shallow water in quiet bays where there is a sand and eelgrass bottom.

Description—Adult shell 60 to 116 mm. in length (about 2½ to 4½ inches). Solid, heavy, turbinate and strongly spined. Spire rather well elevated. Whorls about 7, the body whorl bearing at the shoulder 8 long, upwardly curving spines which are flaringly open at their ends. Below are 4 or 5 spiral, coarse cords of decreasing size which may bear raised nodules or very small open-faced spines. Base of the shell with a row of well-developed, open-faced spines, below which are two much weaker rows of low, scale-like spines. Suture indistinct. Parietal wall well-developed, slightly raised, glazed and colored a light tan with large splotches of chestnut- or purple-brown. Columella bears 5 plicae, the upper, lower and middle ones being the largest. Interior of aperture white and smooth. Outer lip thickened, slightly reflected, coarsely crenulated, and tan or whitish in color. Lower third of columella white. Umbilicus funnel-shaped and deep. Color of outer shell orange-brown to yellowish. Periostracum thick, brown, and strongly foliaceous. Operculum corneous, dark-brown, unguiculate, and its exterior with fine, irregular growth lines.

Measurements (mm.) (including spines)—

length	width	no. whorls	
116	90	7	(large; Cuyo Id.)
88	70	7	(average: Cuyo Id.)
74	60	8	(small; Cuyo Id.)

Synonymy—

1839 *Turbinella tubifera* Anton, Verzeichniss der Conchyl., Halle, p. 70 (no locality); 1876, Kobelt, Syst. Conchyl. Cab., vol. 3, no. 3, p. 155, pl. 9, fig. 3.

1842 *Turbinellus imperialis* Reeve, Conch. Systematica, vol. 2, p. 181, pl. 229, fig. 4 (no locality); 1843, Reeve, Proc. Zool. Soc. London, vol. 10, p. 198 (no locality); 1847, Reeve, Conch. Iconica, vol. 4, Turbinella, pl. 5, fig. 28 (Cagayan, Island of Mindanao, Philippines).

Types—Anton gave no locality; nor did Reeve in 1842 and 1843 for his *imperiale*. In 1847, Reeve states that Hugh Cuming collected it at Cagayan, Island of Mindanao, Philippines. I have looked for this species at Cagayan and elsewhere on Mindanao without success, and it is possible that Cuming meant Cauayan Island in the Cuyo—Palawan group where this species is known to exist. Reeve's type in the British Museum is 78 mm. in length, and the purple-brown on the parietal wall has faded to brown.

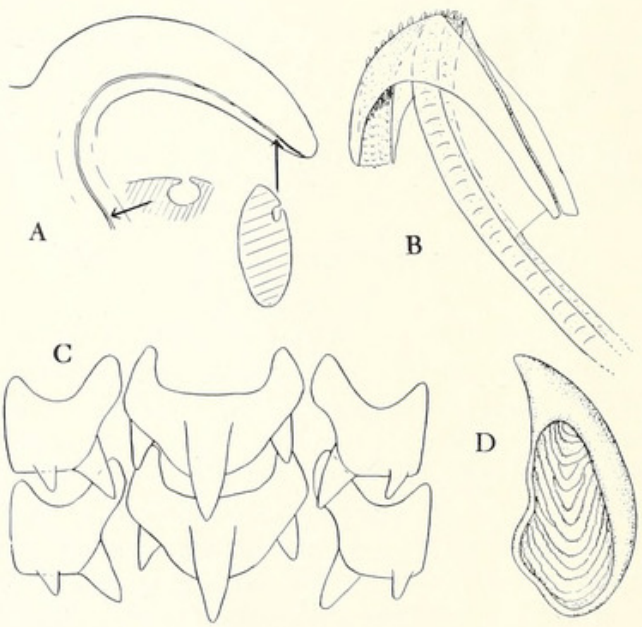


Plate 3. *Vasum tubiferum* (Anton), Cuyo Id., Philippines. Figs. A, external verge, showing cross-section; B, three-quarter view of odontophore; C, two rows of radular teeth; D, attachment side of operculum.

Records—Hugh Cuming is supposed to have collected this species at Cagayan, Misamis Prov., Mindanao Id., Philippines, although there is some doubt about this. A Philippine shell collector brought us two dozen specimens during the 1958 du Pont—Academy Expedition which he had collected on Cuyo Island, Palawan Province, Philippines.

Vasum (Vasum) rhinoceros (Gmelin, 1791)

(Pl. 4, figs. 3, 4)

Range—Kenya Colony and Zanzibar, British East Africa.

Remarks—The Rhinoceros Vase is common, but only found, in Kenya and Zanzibar. It is distinguished by its three single columellar plicae, massive nodules on the shoulder, brown-splotched parietal wall and by the absence of black markings on the outer lip. An unusual color form occurs in some colonies in Zanzibar in which the brown maculations on the outer shell are absent and in which the parietal wall is a pure light-yellow.

Habitat—This species occurs in fairly large colonies in shallow water on a rock, sand and weedy bottom just inside fringing coral reefs. Rarely, it is dredged on a sand and rubble bottom to a depth of 48 feet.

Description—Adult shell 45 to 85 mm. (1¾ to 3½ inches) in length. Solid, heavy, varying in shape from turbinate to sub-fusiform, and with blunt or sharp spines. Whorls 7 to 8, the body whorl bearing at the shoulder one or two rows of 5 to 8 spines which may be large and blunt, open or closed at their ends, or rather pointed and somewhat triangular. The middle of the body whorl bears 6 to

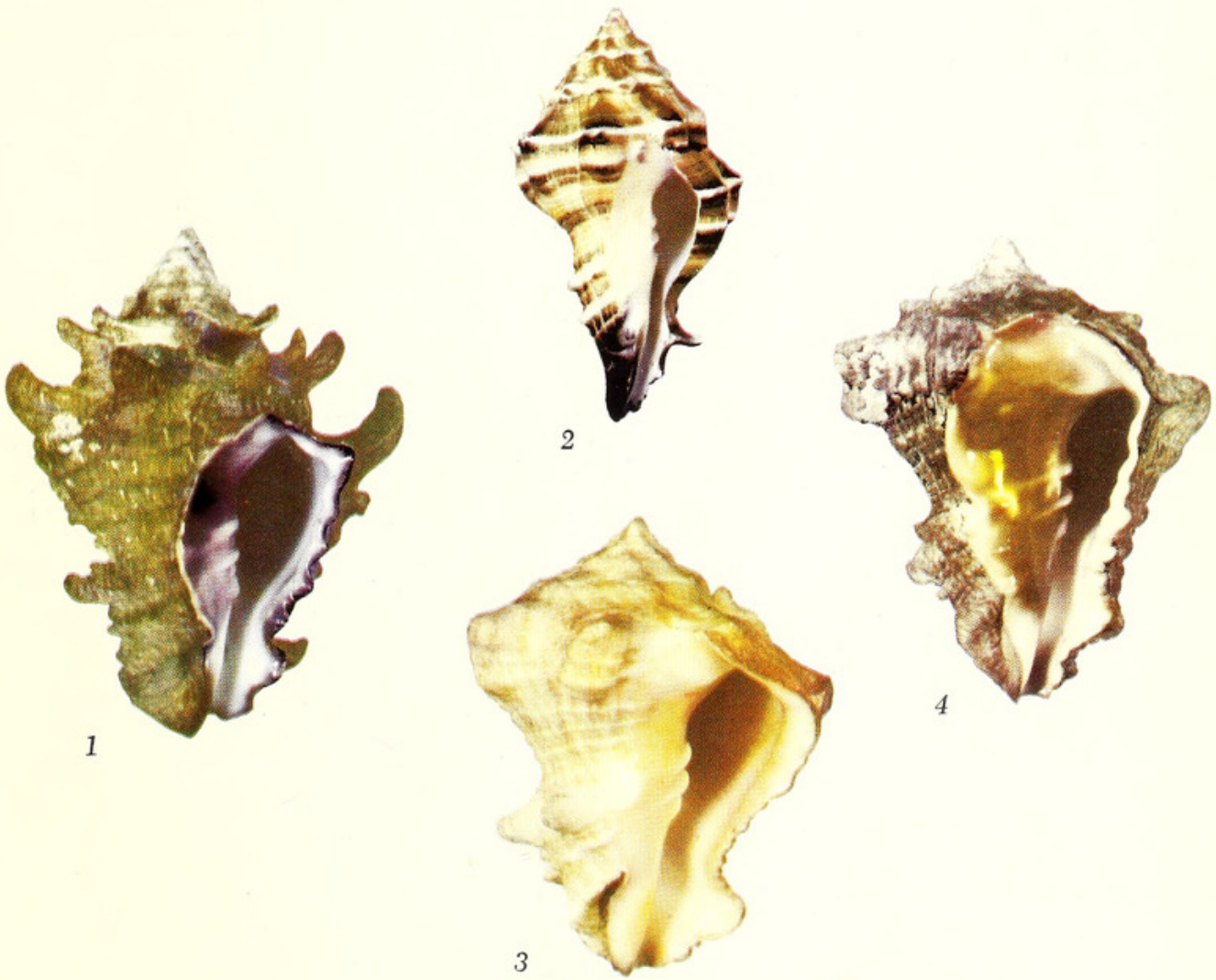


Plate 4, fig. 1, *Vasum tubiferum* (Anton), Cuyo, Philippines; fig. 2, *Tudicula rasilistoma* new species (young shell), Queensland.

Figs. 3 and 4, *Vasum rhinoceros* (Gmelin), Zanzibar; fig. 3 is the yellow form; fig. 4 is normal. All natural size.

10 small, indistinct, unevenly-sized spiral cords. Base of shell with a single row of fairly prominent, open-ended spines, below which are 3 or 4 indistinct, sometimes spined, cords. Nuclear whorl rather large, bulbous, chalky white, followed by numerous, small axial riblets. Axial sculpture of fine foliaceous growth lines which may develop into fine scales. Parietal wall thick, raised, glazed, and colored either chocolate-brown with tan mottling or a pure light-yellow. Columella with 3 distantly-spaced, rather strong, slightly slanting, purplish white plicae, the lowest being the smallest. Aperture elongate, tapering below, and within it is whitish with a large, diffused, mauve-brown splotch and with about 24 fine, spiral ridges. Outer lip thickened, slightly reflected, crudely crenulate, and glossy tan. Umbilicus partially open, narrow, sometimes deep, sometimes sealed. Color of outer shell cream with light-brown mottlings and specks; rarely all yellowish. Periostracum thin, translucent brownish, and slightly foliaceous. Operculum corneous, unguiculate, light-brown, and its outer surface with several weak longitudinal striations. For radula, see pl. 2, fig. A, p. [20-405].

Measurements (mm.) (including spines)—

length	width	no. whorls	
92	76	8+	(large; Zanzibar)
73	58	8	(average; Zanzibar)
57	40	7	(small; Kenya)

Synonymy —

1791 *Voluta rhinoceros* Gmelin, Systema Naturae, ed. 13, p. 3458, no. 128 (ad Novae Guineae); refers to Chemnitz, Conchyl.-Cab., vol. 10, figs. 1407, 1408.

1822 *Turbinella rhinoceros* Gmelin, Lamarck, Anim. sans Vert., vol. 7, p. 105 (Nouvelle-Guinée); 1847, Reeve, Conch. Icon., vol. 4, Turbinelle, sp. 33 (Zanzibar); 1876, Kobelt, Syst. Conchyl. Cab., vol. 3, no. 3, pl. 16, fig. 1 (good), pl. 6, figs. 2, 3 (poor).

Types—Gmelin's type locality of "New Guinea" was evidently erroneous, and it was not until 1847 that the proper locality of Zanzibar was recorded by Reeve. Gmelin did not have a type specimen.

Locality records—KENYA: Malindi; Kilifi; Vipingo; Mombasa (all Coryndon Mem. Mus.); Diani Beach (Abbott, USNM). ZANZIBAR: Chumbe Id. (4-6 fms.); Mangapwani (intertidal); Ras Nungwe (1 fm.); Fumba (intertidal); Mnemba Id. (intertidal); Paje; Mnemba Id. (intertidal); Kiwengwa; Chwaka; Chango Id.; Chukwani; Chumbe Id.; off Kisiki Id. (9 fms.). (all Ostheimer, Orr and Thorington, 1957, ANSP).

Vasum (Vasum) truncatum (Sowerby, 1892)

(Plate 5)

Range—Eastern Cape of Good Hope and southern Natal, South Africa.

Remarks—The South African Vase is evidently a rare species, and, although specimens have been found dead on the beach, Quekett (E. A. Smith, 1903, p. 370) reports it from "deep water". It is readily recognized by its white shell, almost conic shape and its low, weak nodules.

Description—Adult shell 65 to 72 mm. (about 2 to 3 inches) in length, solid whitish, subtriangular and nodulated. Spire flattish, except for the two raised, smooth, papillate nuclear whorls. Whorls 8, the shoulder somewhat carinate and bearing 9 to 11 low but distinct and slightly pointed nodules. Sides of last whorl slightly concave and bearing 5 indistinct rows of very weak, rounded nodules. Suture distinct and very wavy. Aperture white within. Columella and thickened outer lip blotched with brown. Upper end of parietal wall bears a whitish, swollen callus. Columellar plicae 4, the uppermost the largest. In young specimens, umbilicus present and chink-like. Periostracum rather thick, deciduous, matted, and light-brown in color.

Measurements (mm.) –

length	width	no. whorls	
65	50	8	(from Sowerby, 1892)
71	52	–	(from E. A. Smith, 1903)
50	35	7	(immature, Pondoland)

Synonymy –

1892 *Turbinella truncata* Sowerby, Marine Shells of South Africa, London, p. 17, pl. 4, fig. 85 (Port Elizabeth).

1902 *Turbinella triangularis* E. A. Smith, Jour. Conchology, vol. 10, p. 249, pl. 4, fig. 6; 1903, Proc Mal. Soc. London, vol. 5, p. 370, pl. 15, fig. 3 (off Durban and Port Shepstone).

1915 *Xancus truncatus* Sowerby, Bartsch, Bull. 91, U.S. Nat. Mus., p. 42 (Port Alfred).

Types—Port Elizabeth is the type locality. Sowerby states that the type collected by S. D. Bairstow was deposited in the Oxford University Museum, England. The type of *triangularis* is in the British Museum (Natural History), London.

Locality records—SOUTH AFRICA: Port Elizabeth; Port Alfred; Fossil head, Pondoland, (Natal Museum, 3869), all Cape of Good Hope; Port Shepstone; Off Durban, both Natal.

Vasum (Vasum) crosseanum (Souverbie, 1875)

(Plate 6)

Range—Presumably Madagascar.

Remarks—There has been no further information on this evidently rare species since it was first described by Souverbie in 1875. Tryon (Manual of Conchology, vol. 4, p. 71, 1882) erroneously con-

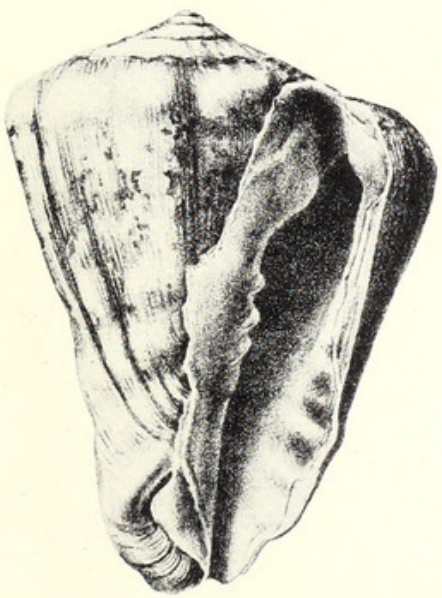


Plate 5. *Vasum truncatum* (Sowerby), Union South Africa (natural size; from the Proc. Mal. Soc. London, vol. 5, pl. 15, fig. 3).

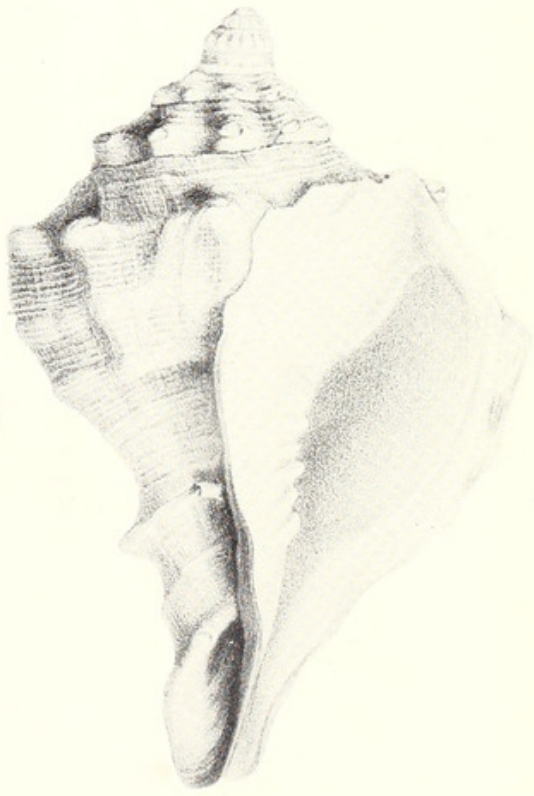


Plate 6. *Vasum crosseanum* (Souverbie). Madagascar? (natural size; from the Journ. de Conchyl., vol. 24, pl. 13, fig. 1).

sidered this a worn and abnormal specimen of *Vasum muricatum* (Linné) from the West Indies, but I feel certain that it is a good species awaiting re-discovery. It appears to be characterized by 5 well-developed columellar plicae, bulbous apex, rounded body whorl, yellowish white mouth, and slight umbilicus. This species is provisionally placed in the subgenus *Vasum*.

Description—Shell 95 mm. (3¾ in.) in length, solid, pyriform, very deeply and narrowly umbilicate and whitish in color with subdued bands of yellowish rose. Whorls 8, the first 4 mammillate and with numerous axial costae. Suture wavy, impressed and with fine fimbriations. Spiral sculpture of numerous uneven, raised, rough threads. Axial sculpture of moderately developed, somewhat pointed nodules on the shoulder of the whorls. Aperture elongate-oval, with a thickened, slightly reflected outer lip and with a strong, raised, yellowish white, glossy parietal shield. Columella bears 6 spiral plicae, the 2nd, 4th and 6th being strong, and the 1st, 3rd and the 5th being weak. Siphonal canal short and open along its entire length. Umbilicus narrow and very deep. Operculum and soft parts unknown.

Measurements (mm.) –

Length 95, width 65, length of aperture 80, width of aperture 32.

Synonymy –

1875 *Turbinella crosseana* Souverbie, Jour. de Conchyl., vol. 23, p. 297; 1876, *ibid*, vol. 24, p. 382, pl. 13, fig. 1 (Mauritius or Madagascar ?)

Types—The type is in the National Museum of Natural History in Paris, France.

Records—Unknown, except for Souverbie's surmise that it comes from Madagascar or Mauritius.

Subgenus Altivasum Hedley 1914

This subgenus includes those *Vasum* species which have evolved in the direction of delicate spinosity, elevated spire, and rather shortened anterior siphonal canal. Evidently the only Indo-Pacific representative is the subgenotype, *flindersi*. In the Western Atlantic region, it is represented by the Recent *V. capitellum* Linné and by two Miocene species *(subcapitellum)* Heilprin and *horridum* Heilprin. *Vasum (Vasum) ceramicum* Linné of the Indo-Pacific bears a superficial resemblance to members of this subgenus by its possession of an elevated spire, but is excluded by its 5 columella plicae, fewer and stouter spines, and lack of an umbilicus.

Description—Shell moderately large, rather heavy and solid, with a well-elevated spire, and bearing several to many spiral rows of long, scale-like spines. Columella with 3 slanting plicae. Umbilicus funnel-shaped and usually deep. Siphonal canal moderately to greatly shortened. Periostracum, thin, coriaceous, brownish yellow in color. Operculum horny, unguiculate, and with a terminal nucleus.

Synonymy —

1914 *Altivasum* Hedley, Biological Results . . . F. I. S. "Endeavour" 1909-1914, vol. 2, pt. 2, p. 68, pl. 9. **Type** by monotypy, *Latirus aurantiacus* Verco 1895, non Montfort 1810 = *Altivasum flindersi* Verco, 1914); 1914, Hedley, Trans. and Proc. Royal Soc. South Australia, vol. 38, p. 484.

1950 *Vasum (Altivasum)* Hedley, Abbott, Johnsonia, vol. 2, no. 28, p. 213.

Vasum (Altivasum) flindersi Verco, 1914

(Pl. 7, figs. 1, 2)

Range—From the Gulf of St. Vincent, South Australia, to Nurina, Western Australia, from 18 to 120 fathoms.

Remarks—This is the largest and most attractive of the Indo-Pacific Vasidae. It is considered a rare shell, at least in collections, probably because of the infrequency at which it is dredged by commercial fishermen off the southern coast of Australia. This species is readily distinguished from *Vasum ceramicum* Linné by its numerous, open spines, wide and deep umbilicus, proportionately high spire and salmon-chalk color. Young specimens lack spines and have a narrower umbilicus, thus giving them the appearance of a *Latirus*.

Habitat—Dredged in 18 to 120 fathoms.

Description—Shell large, 130 to 160 mm. (5 to 6 inches) in length, solid, strongly spinose, and whitish orange to pure white in color. Whorls about 12, the early ones bearing 9 to 11 blunt, axial nodules which in the last 3 or 4 whorls develop into long, slightly recurved, anteriorly open, tubular spines. Nuclear whorls 1½, slightly swollen, round and smoothish. Spiral sculpture on post-nuclear whorls of 5 to 6 raised threads. Suture wavy, indented and bordered below by a raised thread which becomes well fimbriated in the last 3 whorls. Shoulder of the last whorl bears the largest spines, and below this row are 7 to 8 crowded spiral rows of smaller spines. Aperture ovate, white within. Columella bears 3 small, spiral, slightly slanting plicae. Umbilicus rather large, funnel-shaped and very deep. Periostracum thin, translucent-brown and coriaceous.

Measurements (mm.) —

length	width	no. whorls	
160	98	11	(adult, ANSP)
130	65	–	(fide Hedley, 1914)
95	52	8	(immature, ANSP)

Synonymy —

1895 *Latirus aurantiacus Verco*, Trans. Royal Soc. South Australia, vol. 19, p. 89 [79], pl. 2, figs. 1, 1a (Backstairs Passage, South Australia, 18.5 fms.)

1914 *Altivasum flindersi* Verco, Trans. and Proc. Royal Soc. South Australia, vol. 38, p. 484. New name for *L. aurantiacus* Verco 1895, *non* Montfort 1810.

Types—The type locality is Backstairs Passage, South Australia, Australia, in 18.5 fathoms. The holotype, an immature specimen 46 mm. in length, is in the South Australian Museum in Adelaide.

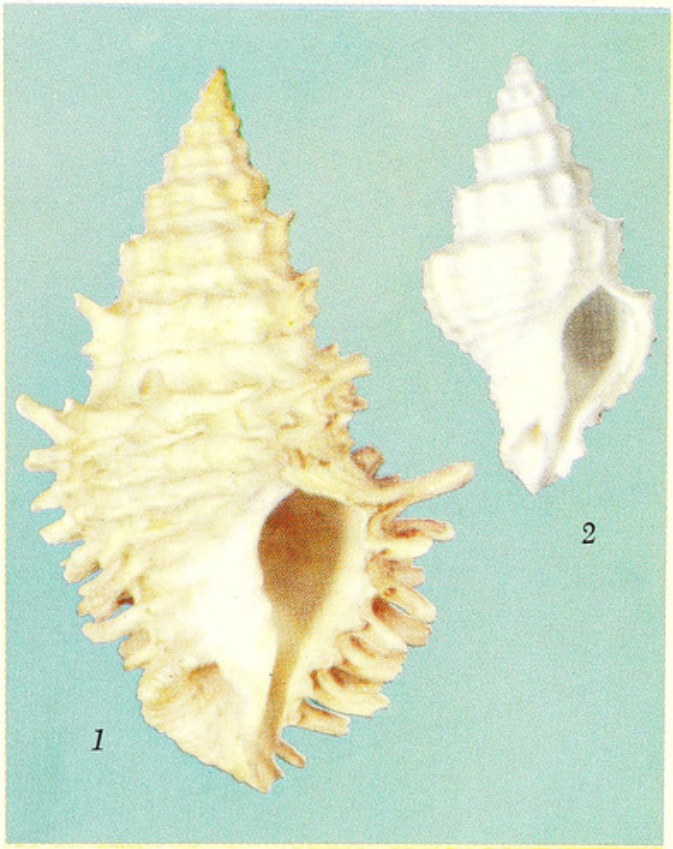


Plate 7. *Vasum (Altivasum) flindersi* Verco, Great Australian Bight. Fig. 1, adult; fig. 2, young. (Both half natural size).

Locality records—SOUTH AUSTRALIA: Backstairs Passage, 18.5 fms. (Verco, 1895); off Newland Head, 20 fms. (Verco, 1914); Gulf of St. Vincent (Hedley, 1914); Great Australian Bight (ANSP). WESTERN AUSTRALIA: Great Australian Bight from 126° to 129° East Long., 120 fms. (Hedley, 1914).

Genus Tudicula H. and A. Adams 1863

Recent species of this genus of Vasidae are known only from the Indian Ocean and the northern half of Australia, although some probably exist in the East Indies. On the whole, they may be considered uncommon or rare, perhaps because of the difficulty in dredging for them at depths ranging from 4 to 20 fathoms. One species, *armigera*, is occasionally found living in the intertidal zone. Members of this genus are undoubtedly carnivorous, and, so far as we know, live on sand and rocky bottom. There are five known Recent species. A number of fossil species have been described under both *Tudicla* and *Tudicula*, but only *sinotecta* Ludbrook, 1941 from the Pliocene of South Australia (Trans. Royal Soc. South Australia, vol. 65, p. 97, pl. 5, fig. 14) seems to belong to true *Tudicula*.

Synonymy –

1863 *Tudicula* H. and A. Adams, Proc. Zool. Soc. London for 1863, p. 429 (as a subgenus of *Tudicla*). Type by subsequent designation (W. Wenz, 1943, p. 1303): *T. armigera* A. Adams.

Description—Shells medium in size, 30 to 70 mm. in length, moderately solid, usually pyriform or fusiform, sometimes spinose, and with a long, narrow, anterior siphonal canal. Whorls 4 to 7, usually spinose, rarely smoothish, but always with fine spiral threads. Nuclear whorls rather large and slightly mammillate. Parietal shield usually well-developed. Lower third of columella with 3 or rarely 4, moderately developed, slanting plicae. Operculum corneous, unguiculate, brown, and with a terminal nucleus. Radula rachiglossate, the central tooth with 3 cusps, the lateral teeth with two cusps. Body and penis similar to those in *Vasum*.

Key to the Indo-Pacific *Tudicula*

a Spire angle less than 85° . . . . . b
a Spire angle greater than 85° c

b With 7 shoulder knobs per whorl . . . *rasilistoma*
b With 10 to 12 shoulder spines per whorl . . . . . *armigera*

c Aperture oval-round; white . . . . . d
c Aperture oval-elongate; orange . . . *zanzibarica*

d Shoulder with 12 to 14 spines . . . . . *spinosa*
d Shoulder without spines . . . . . *inermis*

Tudicula (Tudicula) armigera (A. Adams, 1855)

(Pl. 9, figs. 9, 10)

Range—Queensland, Australia.

Remarks—This handsome *Tudicula* is moderately common in some parts of Queensland. It is characterized by the single row of well-developed shoulder spines, and the two rows of spines on the rather slender siphonal canal, and by its white parietal wall. The length of spines in adult shells is variable, some being 5 mm. in length, others as long as 14 mm. The color of the shell may vary from yellowish white to reddish brown. This is the type of the genus *Tudicula* H. and A. Adams.

Habitat—This species lives on sand and rubble bottom from low tide mark to a depth of 20 fathoms.

Description—Adult shell 55 to 72 mm. (2¼ to 2¾ inches) in length, solid, pyriform with a long, thin anterior siphonal canal, and spinose. Color white to yellowish cream, with or without light-brown to purplish brown flecks or small maculations. Nuclear whorls 1½, proportionately large, rounded, smooth,

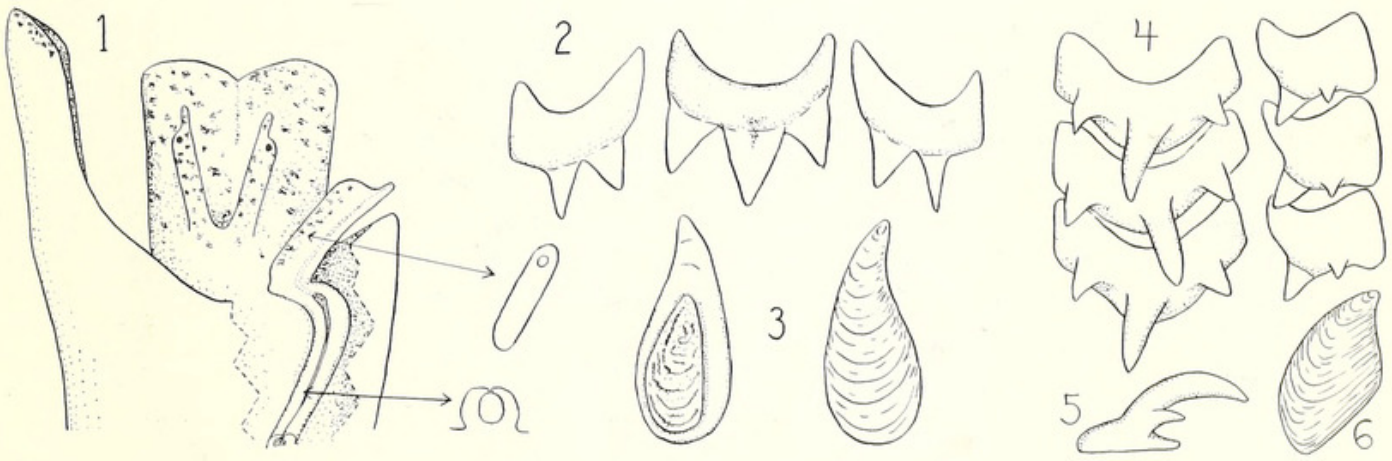


Plate 8. Figs. 1-3, *Tudicula zanzibarica* Abbott, paratype. 1, dorsal view of animal with cross-section of verge; 2, radulae; 3, operculum.

Figs. 4-6, *Tudicula inermis* Angas, off Broome, Western Australia. 4, radulae; 5, side view of central tooth; 6, operculum.

semi-glossy, and white to purple-brown. First postnuclear whorl weakly cancellate; the next 5 whorls bearing 6 to 7 raised, finely fimbriated, spiral threads; the lowest thread, located just above the wavy, well-indented suture, bears increasingly longer, open-faced spines (10 to 12 per whorl). The long siphonal canal bears 2 spiral rows of long, delicate spines. The numerous spiral threads on the body whorl may bear numerous, very small spines. Axial sculpture of 10 to 12 low, rounded folds. Aperture ovate. Outer lip slightly reflected, thickened, glazed and weakly crenulate. Parietal shield well-developed, raised, glossy white to cream. Lower third of columella with 3 (rarely with a weak 4th), slightly slanting plicae, the lowermost being the broadest. Operculum corneous, chestnut-brown, unguiculate, and with a terminal nucleus.

Measurements (mm.) (including spines)—

length	width	no. whorls	
71.4	31.0	6	(large; off Bundaberg)
65.1	30.8	6	(average; Palm Isle)
56.5	28.0	5	(small; Pancake Creek)

Synonymy —

1855 *Tudicla armigera* A. Adams, Proc. Zool. Soc. London for 1854, p. 221 (Moreton Bay).

1884 *Turbinella (Tudicula) armigera* A. Adams, E. A. Smith, Report Zool. Collections H. M. S. "Alert", London, p. 53, pl. 5, fig. G.

Types — The type locality is Moreton Bay, Queensland, Australia. The type is in the British Museum (Natural History), London.

Plate 9. Figs. 1 and 2, *Tudicla spirillus* Linné, east coast of India. Figs. 3 and 4, *Tudicula inermis* Angas; 3, from Exmouth Gulf, West Australia; 4, holotype (Cornell Univ. Paleo. Mus. 19232). Figs. 5 and 6, *Tudicula spinosa* H. and A. Adams; 5, off Darwin, West Australia (A. R. Cahn collection at ANSP); 6, Torres Straits, Queensland (Mrs. W. Barker collection). Figs. 7 and 8, *Tudicula zanzibarica* Abbott, off Zanzibar; 7, paratype (ANSP); 8, holotype (ANSP). Figs. 9 and 10, *Tudicula armigera* A. Adams; 9, Pancake Creek, Queensland (ANSP); 10, off Bundaberg, Queensland (MCZ). All natural size.

Locality records—QUEENSLAND: Palm Isle in 18 fms. (ex J. Brazier, ANSP); Pancake Creek, Bustard Head (ANSP); off Bundaberg in 20 fms. (MCZ); Moreton Bay, Port Curtis, 0 to 11 fms., and Port Molle in 14 fms. (E. A. Smith, 1884, p. 53).

Tudicula (Tudicula) rasilistoma *new species*

(Pl. 4, fig. 2, p. [20-409])
(Pl. 10, figs. A-C)

Range—Known only from northern New South Wales and southern Queensland, Australia.

Remarks—The recently discovered "Polished-mouthed" Tudicula from northeast Australia is evidently related to *T. armigera*, but differs in having two brown spots on the parietal wall, in having a shorter, stouter and brown-tipped siphonal canal, and in having 7 to 8 weakly spined or smooth nodules per whorl (instead of 10 to 12 strong spines per whorl). The apex of most adult shells is eroded away. Young specimens have a delicate pink to rose aperture and lack the parietal shield.

Habitat—Nothing is known about the habitat or habits of this species, except that it occurs in 30 fathoms of water (according to shrimp fishermen).

Description—Adult shell 56 to 72 mm. (2½ to 3 inches) in length, solid, fusiform, weakly spinose, and with a moderately short, stout siphonal canal. Color chalky pinkish cream to whitish and overlaid with irregular bands of various shades of brown. Nuclear whorls 1½, smooth, rounded and opaque-white. Body whorl with two closely set, peripheral rows of 7 (rarely 8) blunt nodules. The midpoint of the stout anterior siphonal canal bears a row of 5 or 6 fairly long, slender, open-faced spines, below which may be a second row of obsolete spines. Lower third of siphonal canal an almost solid, dark chocolate-brown. Umbilicus chink-like, shallow or absent. Parietal wall well-developed, raised, glossy cream to pinkish and with a brown blotch on the left center and at the posterior or upper end. Columellar plicae 3, the middle one being the largest and most distinct. Outer lip slightly reflected, sharp, strong, but finely and unevenly crenulate. Inner wall, behind the outer lip, with weakly developed, raised, spiral lirae. Periostracum grayish brown, translucent, thin, and microscopically fimbriated. Operculum corneous, unguiculate and dark-brown in color.

Measurements (mm.)—

length	width	no. whorls	
72.0	39.0	8	(holotype)
59.0	34.5	7	(Tin Can Bay, Queensland)
58.0	33.0	5?	(paratype, ANSP)

Synonymy—

I am indebted to Miss J. Hope Macpherson of Victoria who suggested the name and asked that I describe this species.

Types—The type locality is off Tweed Heads, northern New South Wales, dredged in 30 fathoms. Holotype (F18189) and paratypes in the Nat. Mus. Victoria. One paratype from Brisbane in ANSP no. 227669.

Locality records—QUEENSLAND: Caloundra (Mrs. L. Brown Coll'n.); off Brisbane (Nat. Mus. Victoria and ANSP); dredged in Tin Can Bay (ANSP). NEW SOUTH WALES: 30 fathoms, off Tweed Heads (Nat. Mus. Victoria).

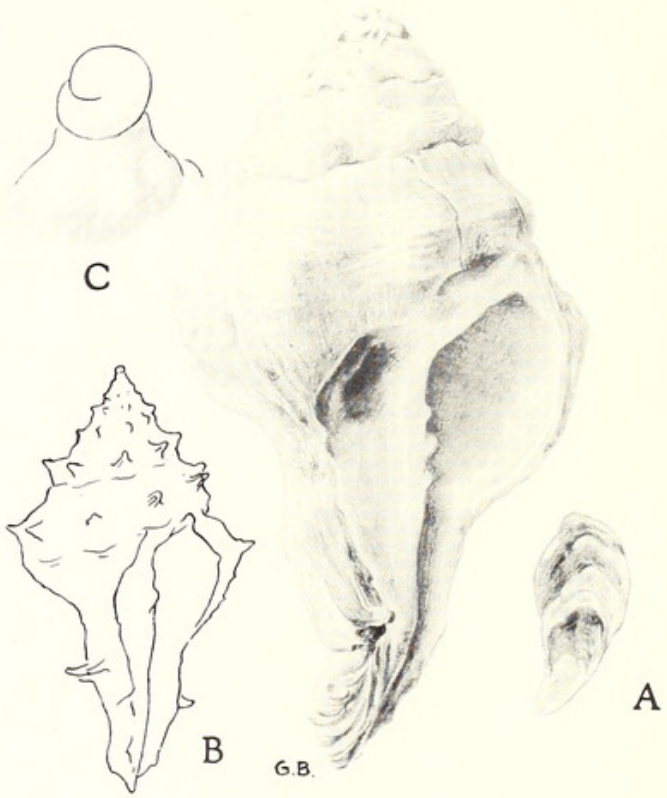


Plate 10. *Tudicula (Tudicula) rasilistoma* new species, holotype from New South Wales. Immature paratype: A, operculum; B, shell; C, nuclear whorls enlarged. (Courtesy of J. Hope Macpherson).

Tudicula (Tudicula) spinosa H. and A. Adams, 1863

(Pl. 9, figs. 5, 6, p. [20-444])

Range—Northern Territory to Queensland, Australia.

Remarks—This small and attractive species is found in a few fathoms of water along the Queensland coast and westward to the Darwin area. It is rather rare in collections, but, to judge from the number of specimens sent to us from the Arafura Sea by Colonel A. R. Cahn, it is not uncommon in its habitat. The species is recognized by the single series of small sharp spines on the periphery of the shoulder. Most specimens are cream in color with small and numerous reddish brown flecks, although some may be pure white or with a wide, broken, subdued band of brownish on the body whorl.

Habitat—Unknown, except for the fact that it has been dredged in 9 fathoms of water.

Description—Adult shell 40 to 50 mm. (2 inches) in length, turnip-shaped, finely spinose, with a long aspinose siphonal canal, and white with yellowish brown flecks. Nuclear whorls 1, glossy, opaque-cream to tan and slightly mammillate. First postnuclear whorl with fine, axial riblets which are soon crossed by 2, then 3, fine spiral threads. Spire flattish, its angle about 100°, and each whorl with 8 to 10 small, irregular, spiral threads. Suture wavy and marked by broken, former shoulder spines. Shoulder of body whorl carinate and with 12 to 15 short, sharp, flattened spines which are open on their anterior faces. Below each spine, a low axial fold runs to the base of the whorl and is crossed by small, distinct, raised, wavy cords. Aperture oval-round, white. Parietal shield raised, white; base of columella bears 3 well-developed plicae which are set at almost right angle to the axis of the shell. Interior of outer wall with 9 to 11 sharp, fine spiral cords running back into the aperture. Siphonal canal about ¾ the length of the entire shell. Periostracum very thin, light-tan, and somewhat deciduous.

Measurements (mm.) (including spines; all from off Darwin)—

length	width	length of siphon	no. whorls
50.0	22.5	31.5	5
42.5	19.5	26.0	5
41.2	19.0	24.3	5

Synonymy—

1863 *Tudicla (Tudicula) spinosa* H. and A Adams, Proc. Zool. Soc. London for 1863, p. 429 (Port Curtis).
1884 *Turbinella (Tudicula) spinosa* H. and A. Adams, E. A. Smith, Report Zool. Collections H. M. S. "Alert", London, p. 54, pl. 5, fig. H.
1932 *Tudicla inermis* Angas, Kuroda, Venus, vol. 3, p. 117, fig. 3 on p. 114 (northern Australia).

Types—The type locality is Port Curtis, Queensland, Australia. The type in the British Museum (Natural History) is 38 mm. in length and entirely white in color.

Locality records—QUEENSLAND: Port Curtis (Hugh Cuming); Prince of Wales Channel, Torres Straits in 9 fms. (E. A. Smith, 1884, p. 54). NORTHERN TERRITORY: off Darwin (ex A. R. Cahn, ANSP).

Tudicula (Tudicula) inermis Angas, 1878

(Pl. 9, figs. 3, 4, p. [20-444])

Range—Western Australia and Northern Territory, Australia.

Remarks—This rare species differs from *spinosa* in lacking the small spines on the shoulder of the body whorl. Most specimens we have seen are rather heavily pigmented with light-brown. We have two specimens from off Darwin which have undulations at the shoulder and weak axial folds on the sides of the body whorl, characters which are approaching those found in *spinosa*. *T. inermis* may subsequently be found to be a western subspecies of *spinosa*. The radula figured is from a specimen loaned by the Australian Museum (no. C. 57363) from Exmouth Gulf. See pl. 8, p. [20-443].

Habitat—Unknown, except for the fact that it occurs at a depth of 5 to 11 fathoms.

Description—Adult shell 40 to 47 mm. (1¾ inches) in length, turnip-shaped, smoothish, with a relatively long siphonal canal; color cream to whitish with light-brown mottlings and flecks. Nuclear whorls 1, glossy, opaque-tan to pinkish brown and slightly mammillate. First two postnuclear whorls with 3 or 4 slightly nodulated spiral threads. Spire flattish, its angle about 100°, and with 8 to 13 irregularly-sized spiral threads. Shoulder of body whorl slightly carinate and with or without weak undulations. In some specimens there may be a very weak axial fold below each of the undulations. Base of last whorl with numerous, fine spiral threads. Aperture oval-round, white. Parietal shield raised, white; the base of the columella bears 3 well-developed plicae which are set almost at right angle to the axis of the shell. Posterior end of the parietal wall with a small, swollen, white callus. Interior of outer wall with 9 to 11 sharp, fine spiral cords running back into the aperture. Siphonal canal about ¾ the length of the entire shell, with brownish flecks, rarely with pink. Periostracum thin, grayish, axially fimbriated and deciduous. Operculum corneous, translucent yellowish brown, unguiculate, with fine growth lines and with a terminal nucleus. The head, foot and tentacles are very similar to those in *Vasum*. In a shell 44 mm. in length, the odontophore is 5.0 mm. in length and bears about 103 rows of teeth.

Measurements (mm.)—

length	width	no. whorls	
41.0	21.0	5.5	(holotype)
44.5	20.0	5.6	(off Broome)
46.5	21.5	6.0	(Exmouth Gulf)

Synonymy—

1878 *Tudicula inermis* Angas, Proc. Zool. Soc. London for 1878, p. 610, 2 figs. (from a dealer at Singapore); 1887, E. A. Smith, Annals and Mag. Nat. Hist., series 5, vol. 19, p. 465 (Exmouth Gulf).

Types—The type locality given by Angas was Singapore. This is evidently erroneous. The holotype is in the Paleontological Museum, Cornell University, Ithaca, New York, no. 19232, from the Newcomb collection.

Locality records — WESTERN AUSTRALIA: Exmouth Gulf, T. H. Hayes (B.M. and ANSP); between Cape Bossut and Broome, 5 fms., A. A. Livingston (Aust. Mus.); Pearl bank, 42 mi. W.S.W. of Cape Jaubert in 42 to 66 ft. (Odhner, 1919). NORTHERN TERRITORY: off Darwin, T. Ino (ANSP).

Tudicula (Tudicula) zanzibarica Abbott, 1958

(Pl. 9, figs. 7, 8, p. [20-444])
(Pl. 8, figs. 1-3, p. [20-443])

Range—Zanzibar, British East Africa.

Remarks—The Zanzibar Tudicula is characterized by its elongate, apricote-colored aperture and the 7 to 8 delicate, somewhat triangular, purple-brown spines on the last whorl. The close relationship between *Tudicula* and *Vasum* is demonstrated in the characters of this species in which the aperture and nucleus are *Vasum*-like, but the general shape of the shell, the spines and the radula are more *Tudicula*-like.

Habitat—Dredged in 8 fathoms on a bottom of sand, broken shell and wiry grass.

Description—Adult shell 28 to 40 mm. (1 to 1½ inches) in length, subtriangular, solid, and spinose. Color chalky-white with a flush of light-orange, and with dark purple-brown on the ends of the shoulder spines and the siphonal canal. Spire moderately elevated, its angle about 90°, its length about ¼ that of the entire shell. Whorls 6, strongly shouldered near the top where there is a peripheral row of 7 to 8 large, flattened, somewhat triangular, purple-brown spines which may be narrowly extended. Sides of whorls flat to slightly concave. Nuclear whorls 1, rather large, bulbous, elevated, smooth and yellowish white. First postnuclear whorl rudely cancellated by 4 coarse, unequal, spiral cords and about 8 axial, poorly-developed ridges. Lower third of the last whorl, in the central region of the siphonal canal, bears 2 spiral rows of about 6 elongate spines which may become obsolete in the last whorl. Microsculpture consists of numerous, small, spiral cords of varying size and of numerous, very fine, axial threads and fimbriations of light-tan periostracum. Aperture long, wide above, gradually becoming constricted below. Outer lip thickened, glossy, weakly crenulate, and pale peach in color. Parietal shield well-developed and raised. Columella bears 3 weak, whitish, spiral plicae. Interior wall of last whorl with about 9 very weak, small, spiral ridges. Operculum corneous, rather thick, unguiculate, brown, and with its muscle scar being about ½ the area of the entire operculum.

Animal's soft parts similar to those of *Vasum*, with a short, squarish foot; head small, bearing two, short stubby tentacles with the eyes near the ends. Gills with about 400 lamellae. Osphradium well-developed, bi-laminate and about half the length of the gills. Color of preserved soft parts cream with maculations of purple-brown. Odontophore long (6 mm. in the 40 mm.-long shell of the holotype), narrow, and with about 145 transverse rows of rachiglossate teeth (see pl. 8, figs. 1-3).

Measurements (mm.) (not including spines)—

length	width	no. whorls	
40.0	25.2	6.0	(holotype)
36.5	20.5	5.5	(paratype)
28.0	15.0	5.0	(paratype)

Synonymy—

1958 *Tudicula zanzibarica* Abbott, Notulae Naturae (Philadelphia), no. 305, pp. 1-4, figs. 1-7 (Zanzibar).

Types—The type locality is 1½ miles W.S.W. of Ras Nungwi, north end of Zanzibar Island, Natural Science Foundation station no. 651, March 4, 1957 (Ostheimer and V. Orr). Holotype in ANSP no. 225261; paratypes in the Coryndon Mem. Mus., B.M., and ANSP.

Locality records—Known only from the type locality.

Genus Tudicla Röding 1798

This genus is apparently limited in Recent times to the Bay of Bengal in the Indian Ocean where it is represented by a single species, *Tudicla spirillus* (Linné). The anatomy is unknown, so that the genus is placed, at present, in the Vasidae solely on conchological grounds. The genus has had several fossil subgenera and six or seven Recent species assigned to it by several authors, but we believe that none of these properly belongs to this genus. Among the possibly related fossil genera are: *Tudiclana* Finlay and Marwick 1937 (Cretaceous, New Zealand), *Pyropsis* Conrad 1860 (probably a Buccinidae from the Upper Cretaceous of southeast United States), and others listed by W. Wenz, 1943, vol. 6, p. 1304.

The genus *Afer* Conrad 1858, represented by two Recent West African species (*afer* Gmelin and *porphyrostoma* Adams and Reeve) has been traditionally placed in the Vasidae next to *Tudicla*, but the shells appear to be more like those of *Latirus* in the family Fasciolariidae. Its anatomy is unknown.

True *Tudicla* appears first in the Cretaceous of East Africa (*krenkeli* Cox, 1925) and Madagascar

(*hourcqi* Collignon, 1951), then the Eocene of Egypt (*rames* and *thebaica* Cuvillier, 1933), the Miocene of Europe (*rusticulus* Bastérot, 1825), the Pliocene of Australia (*angulata, costata* and *turbinata* Angas, 1888), and the Pliocene of Karikal, India (*spirillus* Linné). See also Cossmann, 1901, Essais de Paleoconch. Comp., pt. 4, pp. 68-72.

We have not seen specimens of *"Fusus" couderti* Petit 1853 or *Tudicla fusoides* A. Adams 1854, both from China, but they do not appear to belong to true *Tudicla* as Tryon (1881) and Küster (1876) believed. Other Recent species, such as *armigera* A. Adams and *spinosa* H. and A. Adams, were once assigned to *Tudicla,* but are actually members of the genus *Tudicula* and much more closely related to the genus *Vasum.*

Fischer in 1884 (Manual de Conch., p. 619) included *Spirillus* Sowerby 1842 as a generic synonym of *Tudicla.* However, Sowerby (Conch. Manual, 2nd ed., p. 306) did not propose this as a new generic name, but was merely capitalizing Linné's specific name of *spirillus.*

Description—Shell medium in size, moderately solid, pyriform, with a swollen, slightly bicarinate body whorl, flattish spire, and a long, narrow siphonal canal. Without an umbilicus. Parietal shield raised, with a sharp edge, and glazed. Columella roundly arched and bearing at its base a single, raised spiral cord. Region of the posterior canal with a swollen, button-like callus. Nucleus mammillate, high and with 1½ round, swollen, glossy whorls. Operculum corneous, narrowly oval with an apical nucleus, according to H. Adams, 1874.

Synonymy —

1798 *Tudicla* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 145. **Type** (by subsequent designation, P. Fischer, 1884, p. 619): *T. carinata* Röding = *Murex spirillus* Linné, 1767.

1835 *Pyrella* Swainson, Elements of Conchology, London, p. 21. **Type** (by monotypy): *P. spirilla* L. = *Murex spirillus* Linné, 1767.

1838 *Spirillus* Schlüter, Kurzgefasstes Verzeichniss Conchyl., Halle, p. 21. **Type** (by monotypy): *S. rostratus* Schlüter = *Murex spirillus* Linné, 1767.

1857 *Pyrenella* J. E. Gray, Guide Syst. Distrib. Mollusca Brit. Mus., pt. 1, p. 11. **Type** (by monotypy): *P. spirilla* = *Murex spirillus* Linné, 1767.

Tudicla (Tudicla) spirillus (Linné, 1767)

(Pl. 9, figs. 1, 2, p. [20-444])

Range—Southeast India and northern Ceylon.

Remarks—This is the only known living species in this genus, and it is easily recognized by its turnip shape, bicarinate body whorl, the single fold on the lower part of the columella, and by its mammillate nuclear whorls.

Habitat—Unknown, except that it probably lives on a sandy bottom in several fathoms of water.

Description—Adult shell 66 to 82 mm. (2½ to 3¼ inches) in length, moderately solid but strong, pyriform, and with a long, sinuous, smooth siphonal canal. Color of shell shiny cream to pinkish gray with sparse flecks of light-brown which form small squarish spots on the upper carina of the body whorl. Nuclear whorls mammillate, projecting, and of 1½ round, swollen, pinkish or yellowish, glossy whorls. Spire flattish, its angle about 140°. Postnuclear whorls 3½. Spiral sculpture of numerous, raised threads which are squarish and broad on the base of the whorls. Body whorl with a squarish periphery, bounded above by a sharp, wavy keel and below by a series of 6 to 8 round, low nodules. Aperture ovate-round, glossy, pinkish to purple within, and bounded on the outer side by a sharp lip. Inside of outer wall with numerous, fine, raised, spiral ridges. Parietal shield well-developed, smooth and glossy white. Posterior canal region with a swollen, button-like, white callus. Base of columella with a single, strong, spiral plica. Siphonal canal open along its length, long and slightly sinuous. Operculum corneous, elongate-oval, and with an apical nucleus. Radula unknown.

Measurements —

length	width	
66.0	36.5	(small; Ceylon)
70.5	41.0	(average; Ceylon)
78.0	43.0	(large; Ceylon)

Synonymy —

1767 *Murex spirillus* Linné, Sysyema Naturae, ed. 12, p. 1221, no. 554 (in Tranquebar); 1957, Dodge, Bull. Amer. Mus. Nat. Hist., vol. 113, art. 2, p. 156.

1798 *Tudicla carinata* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 145 (refers to Knoor, vol. 6, pl. 24, fig. 3). No locality.

1811 *Monoplex capitatus* Perry, Conchology, London, pl. 3, fig. 4 (locality unknown).

1838 *Spirillus rostratus* Schlüter, Kurzgefasstes Verzeichniss Conchyl., Halle, p. 21 (refers to *"Pyrula spirillus* Lam.").

Types—The type locality given by Linné was Tranquebar, a section of the southeast coast of India. The type is in the British Museum (Natural History), London.

Locality records—Known only from the Tranquebar coast in southeast India and the northern part of Ceylon. Gravely, F. H. (1942, p. 66) reports that this species is occasionally washed ashore on the beaches near Madras, southeast India.