

THE GENUS LAMBIS IN THE INDO-PACIFIC

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The nine known species of scorpion or spider conchs of the genus *Lambis* are limited to the tropical Indo-Pacific. Their general anatomy, egg masses and radulae are extremely close to those of *Strombus*, and, from a biological standpoint, some workers might wish to consider them a subgenus of *Strombus*. The main distinguishing characters are the great development of long spines or digitations on the apertural borders of the shell, and the absence or great reduction of the posterior mantle filament. Like members of *Strombus*, the *Lambis* are shallow water, active snails, usually associated with algal-rich coral reefs. C. M. Yonge (1932) gives an excellent account of the herbivorous feeding methods and the nature of the crystalline style. Their diet is evidently largely restricted to the delicate red algae (see under *Lambis lambis* Linné).

The *Strombus* subgenus, *Euprotomus*, has more characters in common with *Lambis* than do any other subgenera. The verge is almost identical and the lateral radular tooth lacks a basal "peg" in both groups. However, the early co-existence of fossil *Lambis crocata* (Link) and *Strombus (Euprotomus) aurisdianae* Linné in the Pliocene of Zanzibar suggests that these two groups had already arisen, perhaps from a common stock, during the early Pliocene or late Miocene. Fossil records are not numerous, except in the Pleistocene where they are not uncommon from the Red Sea to the Hawaiian Islands. Today, they are extinct in Hawaii. H. S. Ladd obtained a *Lambis lambis*-like specimen in the Miocene-Pliocene, tuffaceous limestone of Lakemba, Lau Group, Fiji. Fossil records of *Pterocera* in the nineteenth century European literature refer to members of the family Aporrhaidae. There are no known *Lambis* species restricted to the Tertiary or earlier periods.

Of the nine living species four are polytypic with subspecies of varying degrees of morphological separation, ranging from the distinctly different *chiragra chiragra* and *chiragra arthritica* to the weakly separated *scorpius scorpius* and *scorpius*

indomaris. Most abundant and most ubiquitous is *Lambis lambis* which is the largest and dominant gastropod in many shallow-water areas of the Indo-Pacific. Equally widespread from East Africa to Polynesia are *truncata* (moderately common), *digitata* (rare) and *crocata* (uncommon). Three species have rather limited ranges: *violacea* (rare in Mauritius), *robusta* (rare in southeast Polynesia), and *millepeda* (abundant in the central part of the Western Pacific arc).

Lambis, particularly *lambis* and *truncata*, are



Plate 118. Living animal of male *Lambis lambis* (Linné). Between the eyestalks and tentacles is the darkly colored proboscis. Below is the long muscular foot at the end of which is the corneous, sickle-shaped operculum. Arising from the back of the animal is the long, external verge or penis. (natural size; from Quoy and Gaimard, 1833, pl. 50, fig. 11).

used as food, both cooked and raw, in most areas of the Indo-Pacific. The common *Lambis* is seen on sale alive in most country fish markets in the Philippines. *Lambis millepeda* is generally not eaten because of its bitter taste. In Ceylon, according to Deraniyagala (1933, Ceylon Journal of Sciences, sect. C, Fisheries, vol. 5, p. 63), *Lambis* and *rugosa* [= *chiragra*] are roasted in the shell and eaten by Tamil fishermen. The flesh of the Mullu Shanku or *Lambis* acts as a mild narcotic. Both bitterness and narcoticness may be associated with the algal diet of the animal.

Accounts of the gross anatomy of *Lambis*, which do not differ materially from those of *Strombus*, have been published by M. F. Woodward (1894), R. Bergh (1895), Jean Risbee (1925) and J. H. Princee (1955). The latter treats with the details of the eyestalks of *Lambis lambis*.

Geographical Distribution of Sexual Dimorphism

It has been pointed out by many workers that in *Strombus*, as well as in other dioecious prosobranchs, the shells of the males are smaller than those of the females. Abbott (1949, p. 59) brought attention to the fact that the sexual difference in shell size varied in *Strombus* from colony to colony, and suggested that there might be a geographical distribution of the degree of difference. Our soft anatomy examinations of *Lambis* were limited to thirty specimens, but, together with measurements of over a hundred shells, suggest the existence of sexual dimorphism in the sculpturing and nature of the spines, as well as the expected difference in shell length.

The most striking example occurs in *Lambis lambis* in the central part of its range in the area of the Philippines, the Palaus, Carolines, New Guinea, Indonesia and northeastern Australia. The males are from 30 to 45 percent smaller than the females, and are further characterized by two small knobs on the shoulder of the last whorl (rather than a welding of these two into a longer and higher knob) and by proportionately smaller spines which hook in the plane of the outer lip in the posterior direction of the apex (rather than long, upwardly curling spines). The differences are much less developed both to the west toward East Africa and to the east into New Caledonia, Fiji and Tonga.

When we examine *chiragra* as a species extending from East Africa to Polynesia, we find that the Indian Ocean subspecies, *arthritica*, shows little sexual dimorphism (males slightly smaller), but

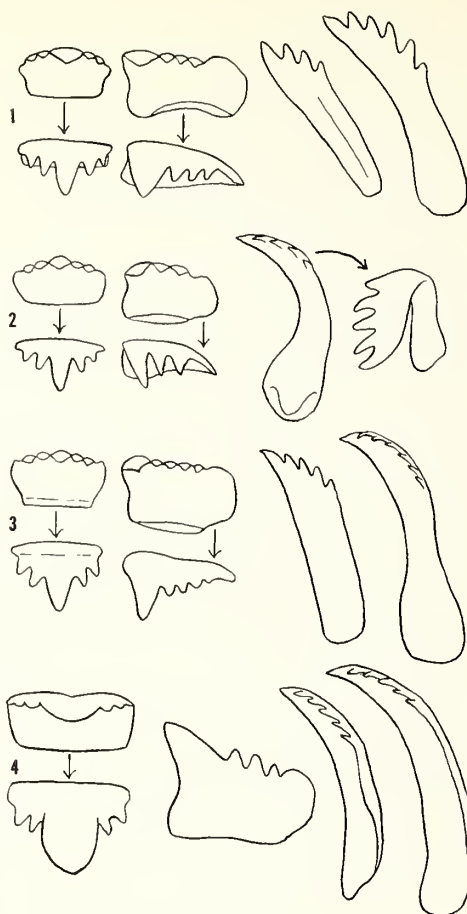


Plate 119. Radulae of *Lambis*; left to right: two views of the central tooth; two views of the lateral; the inner marginal; and the outer marginal. The formula in the text refers to the cusps on each tooth, e.g. for fig. 1: 2-1-2; 1-3; 4; 6. Fig. 1, *Lambis lambis* (Seychelles). 2, *L. crocata* (Zanzibar). 3, *L. chiragra chiragra* (Palau Islands). 4, *L. truncata scabae* (New Caledonia). All $\times 80$.

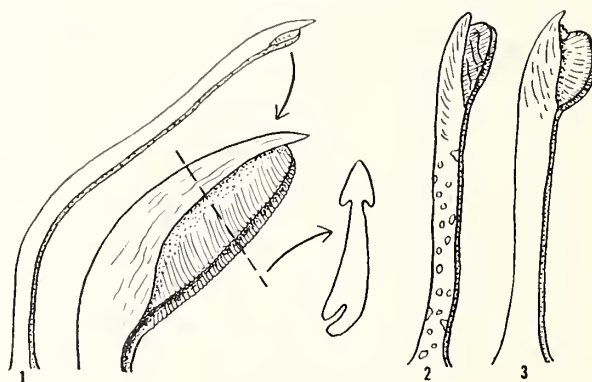


Plate 120. Verges from male *Lambis*. Fig. 1, *Lambis lambis*, showing enlargement of the distal pad and its cross-section (Palau Islands). 2, *L. crocata* (Zanzibar). 3, *L. chiragra arthritica*. All $\times 2$.



Plate 121

- Fig. 1 *Lambis (Millepes) violacea* (Swainson, 1821). Mauritius. Rare.
 2 *Lambis (Millepes) robusta* (Swainson, 1821). Society Islands. Rare.
 3 *Lambis (Millepes) digitata* (Perry, 1811). Upolu Island, Samoa. Uncommon.
 4 *Lambis (Lambis) lambis* (Linné, 1758). A female from Cebu Island, Philippines. Abundant.
 5 *Lambis (Millepes) scorpius scorpius* (Linné, 1758). Okinawa Island, Ryukyu Islands. Moderately common from the East Indies to Samoa. Note small flange on left side of base of topmost digitation which is absent in the Indian Ocean subspecies, *indomaris*.
 6 *Lambis (Millepes) millepeda* (Linné, 1758). Cebu

- Island, Philippines. Common in the S. W. Pacific.
 7 *Lambis (Harpago) chiragra arthritica* Röding, 1798. Mozambique. Uncommon in the Indian Ocean.
 8 *Lambis (Lambis) crocata* (Link, 1807). Zanzibar Island. Moderately common in the Indo-Pacific.
 9 *Lambis (Lambis) truncata scabae* (Kiener, 1843). Saipan Island, Marianas. Moderately common in the Red Sea and Western Pacific.
 10 *Lambis (Harpago) chiragra chiragra* (Linné, 1758). The uncommon *rugosa* form found in certain males.
 11 the same, but a male from the Palau Islands showing very weak columellar sculpturing.
 12 *Lambis (Harpago) chiragra chiragra* (Linné, 1758). A female from Luzon Island, Philippines.

(all 2/5 natural size; center shell, fig. 9, is 12 inches in length)

that the subspecies *chiragra* shows in most cases a great size difference, as well as a columellar difference, in the Western Pacific. The male very commonly takes on the so-called *rugosa*-like columella, while the large females have a smooth, rose columella. Curiously, further to the east in the Line, Tuamotu and Society Islands, only the *rugosa* type has so far been found. I have not seen many specimens from there and have had no opportunity to examine soft parts, but I suspect that both males

and females have a *rugosa*-like columella. I have not been able to find any significant differences, other than size, in the shells of the males and females of the other species of *Lambis*.

List of Recognized Taxa

Genus *Lambis* Röding, 1798

Subgenus *Lambis* s.s. Röding, 1798

lambis (Linné, 1758). Type

truncata (Humphrey, 1786)

subsp. *sebac* (Kicner, 1843)

crocata (Link, 1807)

subsp. *pilsbryi* Abbott, 1961

Subgenus *Millipes* Mörch, 1852

millepda (Linné, 1758). Type

digitata (Perry, 1811)

scorpius (Linné, 1758)

subsp. *indomaris* Abbott, 1961

robusta (Swainson, 1821)

violacea (Swainson, 1821)

Subgenus *Harpago* Mörch, 1852

chiragra (Linné, 1758)

subsp. *arthritica* Röding, 1798

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Plate 122. Young shells of *Lambis*. Fig. 1, *L. truncata sebae* (Tahiti). 2, *L. truncata truncata* (Mauritius). 3, *L. lambis* (Saipan Island). 4, *L. chiragra chiragra* (Sanga Sanga Island, Sulu Sea). All natural size.

Subgenus *Lambis* Röding, 1798

Type: *Lambis lambis* (Linné, 1758)

The typical subgenus of *Lambis* contains three species each of which is characterized by a smooth columella and an inner body wall which lacks spiral lirae. There are 7 digitations, 6 of which arise from the edge of the outer lip, and the seventh being an extended anterior siphonal canal. All three species, *lambis*, *truncata* and *crocata* are moderately common to abundant over a large part of the Indo-Pacific. The latter two are polytypic, one having a subspecies in the Indian Ocean, the other a subspecies in the Marquesas Islands, Polynesia. The earliest fossil records of *Lambis* belong to this subgenus, one of these being *Lambis crocata* (Link) from the Pliocene of Zanzibar.

Synonymy —

- 1798 *Lambis* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 61 (Type by absolute tautonomy: *Lambis lambis* Gmelin = Linné; p. 66).
- 1799 *Pterocera* Lamarck, Mémoires Soc. d'Hist. Naturelle Paris, (Vol. 1), p. 72. Type by monotypy: *Strombus lambis* Linné, (and by Children, 1823, p. 127); 1929, Thiele, Handbuch Syst. Weicht., vol. 1, p. 255; 1940, Wenz, Handbuch der Palaont., vol. 6, pt. 4, p. 946.
- 1807 *Pteroceras* Link, Beschr. Naturalien-Samml., Rostock, part 3, p. 109. (type hereby selected: *Pt. lambis* Linn.).
- 1810 *Pteroceres* Montfort, Conchyliologie Systématique, Paris, vol. 2, p. 607 (substitute name for *Pterocera* Lamarck, 1799). Invalid type by original designation: *P. scorpius* Linné.
- 1823 *Digitata* O. Fabricius, Fortegnelse over Fabriciusses efterladte Naturalien, Copenhagen, p. 86. (nude name).
- 1829 *Pterocerus* Brongniart, Tableau Terrains, p. 410.
- 1852 *Heptadactylus* "Klein", Mörch, Catalogus Conchyl. . . . Yoldi, Hafniae, p. 60 (type hereby designated: *lambis* L.); 1859, Chenu, Manuel de Conchyl. et Paleont. Conchyl., Paris, vol. 1, p. 259 (type by monotypy: *Pterocera lambis* Linné).
- 1878 *Heptadactylus* Kobelt, Illustrirtes Conchylienbuch, vol. 1, p. 106 (type hereby designated: *Pterocera lambis* Linné).

Nomenclature — The genus name *Pteroceres* Montfort, 1810, must evidently be interpreted as a substitute name for *Pterocera* Lamarck. Montfort customarily changed the gender of Lamarck's feminine genera to masculine. He refers to Lamarck's genus. A similar case was similarly interpreted in Opinion 120, I.C.Z.N., Smithsonian Misc. Coll., vol. 73, no. 7, p. 29 (The Status of *Achatinus* Montfort, 1810).

Lamarck's once well known name, *Pterocera*, is a junior synonym of *Lambis* and has not been in general use for over twenty years, despite Thiele's and Wenz's usage in 1929 and 1940, respectively.

Lambis lambis (Linné, 1758)

(Pl. 121, fig. 4; pl. 118; pl. 123, figs. 1-3)

Range — East Africa to Micronesia and eastern Melanesia.

Remarks — This is the commonest and one of the most widely distributed species of *Lambis*. It is one of the few marine gastropods to exhibit pronounced sexual dimorphism, other than size, in its shell



Plate 123. Male and female shells of *Lambis lambis* (Yap Island, Carolines). Fig. 1, male. 2 and 3, dorsal and side

view of females. ½ natural size.

characters. The size of the shell of the male is usually about 60 percent that of the shell of the female. The degree of sexual dimorphism varies geographically. It is most pronounced in the Caroline Islands and in most, but not all, areas of the Philippines, Indonesia, Queensland and the Solomons. The differences are less obvious in the Indian Ocean and at the extreme eastern end of the range in New Caledonia, Fiji and Tonga. In extreme examples in the male, the lowest three labial digitations are short and hooked posteriorly, while in the female, they are two or three times as long and are strongly curved upward. The female usually has a very large, pinched, somewhat-bilobed knob on the dorsal part of the shoulder. In the male this is reduced to two small, equal-sized nodules. The two most posterior digitations are usually more widely separated in females than in males.

It is possible that the upturning of the digitations in the females facilitates mating. When *Lambis* is in the position of coition, the right anterior end, or region of the "stromboid notch," of each shell is approximately in juxtaposition. A closer contact would be possible because of the shortness of the digitations of the male and because the female's digitations are curved upward out of the way.

There is considerable geographical variation in the shape and size of the dorsal knobs in females; within a colony there is a uniformity. At Yap and Ponape Islands in the Carolines, the dorsal knob is very large, axially pinched, and bordered below by a smaller, sharp ridge. In Zanzibar, the dorsal knob is not as high as and is more elongate than those in most East Indian and Western Pacific specimens.

In general, there are three color forms which occur throughout the range of the species in either sex — light-cream with sparse paintings of light-brown; a cream background with heavy mottlings of dark purplish brown; and an over all light-brown with flecks of white. Intergrades are not uncommon within any colony. In the young of some, but not all, shells there is a large burnt-brown splotch on the upper section of the inner parietal wall. Couturier's (1907, p. 154) reference to "*Pterocera lambis*" from Mangareva and Tahiti undoubtedly are specimens of *truncata sebae* Kiener. Although *lambis* has been reported from the Red Sea on several occasions, I have not seen authenticated specimens from there.

C. M. Yonge (1932, p. 260) discussed in detail the herbivorous habits of this species, and included a detailed account of the crystalline style. The animal feeds only on the fine red algae and not on the

gross brown algae or eelgrass. A powerful cellulase digestive enzyme is present in the stomach. Yonge identified his species as "*Pterocera crocata*," but unquestionably he had *Lambis lambis* (Linné), since he figures the latter species in his 1930 book on "A Year on the Great Barrier Reef" (p. 83, pl. XXV, fig. C). He states (in 1932, p. 260) that his species is abundant and the most characteristic member of the fauna of the reef flat and mangrove areas of Low Isles on the Great Barrier Reef. The length of the shell ranged from 180 to 200 mm. and the aperture was red. All of these features are characteristic of *Lambis lambis* in Queensland and do not apply to the uncommon, smaller, outer reef *crocata* (Link).

I have been unable to verify the literature records for this species in the Red Sea. R. Sturany (1903, p. 46) reported the less common *L. truncata* from ten Red Sea localities, but evidently failed to find *L. lambis*.

Miss Virginia Orr made the following observations on the egg mass being laid by a female *lambis* at Poum, New Caledonia, on January 4, 1961: "the tangled clump was laid under an old slab of coral in 2 feet of water. The clear jelly tube was several feet in length and about 1 mm. in diameter. The orange eggs were about 0.3 mm. in diameter and there were about 30 of them per 10 mm. of tube." Risbec also briefly described the egg mass of *lambis* which he says is most commonly laid in February in New Caledonia (Risbec [in Vayssi re], 1927, Ann. Mus. d'Hist. Nat. Marseilles, vol. 21, p. 185).

Habitat — *L. lambis* occurs in colonies on reef flats and on sand or coral-rubble bottom, usually in association with algae, at depths ranging from the zone of low tide to several fathoms. Demond (1957, p. 297) says it "lives in sand on both seaward and lagoon reef flats, and on sandy lagoon floors, ranging from a few feet below low tide line to depths of 10 feet" in the Marshall Island atolls. M. Couturier (1907, p. 154) records it at depths of 3 to 5 fathoms in the Tuamotu Islands, but I believe that he was observing *L. truncata sebae*. Melvill (1909, p. 94) reported a specimen at 30 fathoms at Cargados Carajos, Indian Ocean, but this may have been a dead shell.

Description — Shell, including the digitations, 90 to 200 mm. (about 3½ to 8 inches) in length, with 6 slender, labial digitations which may be either short and bent posteriorly or long and bent upwards towards the dorsum. Siphonal canal moderately long and slightly twisted to the left. Whorls 10 to 11. Nuclear whorls smooth. Postnuclear whorls

slightly concave above the carinate shoulder. The carina may bear numerous small beads or nodules. Spiral sculpture between the indented suture consists of about a dozen, irregular, microscopic threads. Last whorl with strong, blunt nodules on the shoulder. Mid-area of last whorl with a spiral row of 3 or 4 small nodules or rarely a raised, elongate nodule. Aperture and columella smooth, except for 4 to 7 weak lirae at the posterior end of the aperture, just behind the deep, smooth pit. Outer lip crenulated in young specimens, but smooth in old specimens. Color of aperture uniform tan, cream, or rarely orange tan or rose. A black-brown blotch may or may not be present on the upper part of the columellar wall of young specimens. Color of outer shell variable: cream with light- or dark-brown flecks and maculations; or mottled and spotted with purple-tan or blue-black. Periostracum thin, smoothish, translucent-tan. Operculum corneous, brown, elongate, arching, and without serrations. Radula formula: 2-1-2; 1-4 or 1-3; 5 or 6; 5 or 6. Verge as long as the aperture (see pls. 119 and 120).

Measurements (mm.) — (including digitations)

length	width	no. whorls	
200	111	10 +	(large; north Ceylon)
180	100	10 +	(average; Luzon Id.)
92	43	10	(small; Palau Ids.)

Synonymy —

- 1758 *Strombus lambis* Linné, *Systema naturae*, ed. 10, p. 743, no. 425; 1767, ed. 12, p. 1208, no. 493 (O. Asiae); 1956, Dodge, *Bull. Amer. Mus. Nat. Hist.*, vol. 111, art. 3, pp. 250-251.
- 1798 *Lambis lambis* Gmel., Röding, *Museum Boltenianum*, Hamburg, pt. 2, p. 66, no. 844. Refers to *Conchyl.-Cab.*, vol. 3, fig. 855, 888.
- 1798 *Lambis lobata* Röding, loc. cit., p. 68, no. 872. Refers to *Conchyl.-Cab.*, vol. 3, fig. 902. Non *lobata* Röding loc. cit., p. 65, no. 826, which is *Strombus sinuatus* Humphrey.
- 1798 *Lambis lamboides* Röding, loc. cit., p. 66, no. 845. Substitute name for *lambis* Gmelin, 1791.

- 1798 *Lambis cerea* Röding, loc. cit., p. 66, no. 846. Substitute name for *lambis* Gmelin, 1791.
- 1798 *Lambis hermaphrodita* Röding, loc. cit., p. 68, no. 875. Substitute name for *lambis* Gmelin, 1791.
- 1798 *Lambis laciniata* Röding, loc. cit., p. 68, no. 877. Substitute name for *lambis* Gmelin, 1791.
- 1798 *Lambis maculata* Röding, loc. cit., p. 67, no. 854. Refers to *Conchyl.-Cab.*, vol. 3, figs. 858, 859.
- 1817 *Strombus lambis* Linné, Dillwyn, *Descriptive Catalogue Recent Shells*, London, vol. 2, p. 658.
- 1826 *Strombus camelus* "Chemn." Gray in King, *Narrative Survey—Coasts of Australia*, London, vol. 2, appendix, p. 490. (refers to *Conchyl.-Cabinet*, vol. 10, fig. 1478); 1830, Menke, *Synopsis Method. Molluscorum*, ed. 2, Pyramonte, p. 72.
- 1842 *Pteroceras lambis* Lin., Sowerby, *Thesaurus Conchyl.*, vol. 1, *Pteroceras*, p. 41, pl. 11, figs. 5 and 7 not 6.
- 1932 *Pterocera crocata*, Yonge, *Great Barrier Reef Exped., Scientific Reports*, vol. 1, no. 10, pp. 260-267. [feeding and digestion].

Types — Hanley (1855, p. 267) states that a specimen like that figured in Sowerby's *Thesaurus Conch.*, vol. 1, pl. 1, fig. 5 is marked as *lambis* in the Linnaean collection in London. From that figure and from Linné's description it appears that this species was founded upon a male specimen. We restrict the type locality to Amboina, Indonesia.

Nomenclature — Most of the synonyms of *lambis* Linné refer to the male shell. This is true of all of Röding's names listed in our synonymy. Among the early figures of the male are: Schröter, 1782, *Musei Gottwaldiani*, pl. 21, figs. 142, 142; Rumphius, pls. 36A and 35E; Lister, pl. 866, fig. 21; Argenville, pl. 14, fig. E; Regenfuss, pl. 4, fig. 45 [excellent]; Knorr, pt. 1, pl. 28, fig. 1 [excellent]; and the *Conchyl.-Cab.*, vol. 3, figs. 858, 859, 902, 903. It is also figured in Butot, 1955, pl. 2, fig. 2; Blainville, 1827, pl. 25, figs. 4, 4a [excellent].

The female shell, with its long recurved, lower digitations, has received only one other name: *camelus* Chemnitz, 1788 [non-binomial] which was validated in 1826 by Gray. It has been figured in: *Conchyl.-Cab.*, vol. 10, fig. 1478; also vol. 3, fig. 855; Schröter, 1782, pl. 21, fig. 139a; Rumphius, pl. 35F;

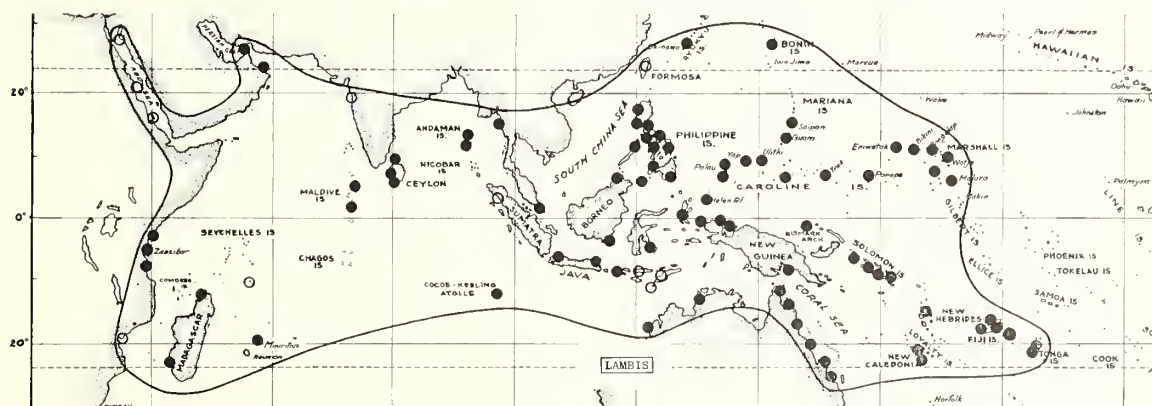


Plate 124. Geographical distribution of *Lambis lambis* (Linné). The Red Sea literature records (open circles) may

be based upon specimens of *L. truncata sebae* (Kiener).

Reeve, 1851, pl. 5, fig. 8; Abbott, 1949, p. 324 (Scientific Monthly, vol. 69).

It may be pointed out that the use of the terms "male" and "female" among native collectors, even today, and among early writers, such as Rumphius, refers not to the sex of the animal but to the immature or light-weight ("female") and the older, heavier ("male") specimens.

Selected records (see accompanying map for others; solid dots: specimens examined; open circles: literature records) — SAUDI ARABIA: Muscat, Gulf of Oman (Melville and Standen, 1901, p. 381). MOZAMBIQUE (von Martens, 1880, p. 279). TANGANYIKA: Inner Sinda Id. (R. T. Abbott, USNM). ZANZIBAR: common around the island; Kiwengwa; Chumbe Id.; Mnazi Mjazi; Paje; (NSF, 1957). RED SEA: Suakin; Aqaba; Massana (all Issel and T. Canefri, 1876, p. 357). Persian Gulf (MCZ). MADA-GASCAR: Nossi-bé (A. Chavane, ANSP). Cargados Carajos (Melville, 1909, p. 94). Mauritius (N. Pike, MCZ). MALDIVES: Gan Id., Addu Atoll; North Malé Atoll (both Yale Peabody Mus.). INDIA: Bombay (Hornell, 1951, p. 87). CEYLON: Fort Frederick, Dutch Bay (Yale Peabody Mus.); Weligama Bay; Hikkaduwa; Eluvativa Id. (all G. and M. Kline, NSF, 1957). ANDAMANS: Port Blair; Long Id. (both Brit. Mus.). THAILAND: Phuket, Bay of Bengal (F. N. Crider, ANSP). SINGAPORE: Raffles Light (R. D. Purchase, ANSP). RYUKYU IDS.: Shioya, Shanawan Bay (USNM). TAIWAN: Hoko (Kuroda, 1941, p. 98). PHILIPPINES: common throughout the islands of Luzon, Samar, Cebu, Catanduanes, Mindoro, Bohol, Masbate, Burias, Panay, Basilan, Lubang, Marinduque, Polillo, Palawan, Mindanao, Jolo, Sanga Sanga (all ANSP, USNM and MCZ). INDONESIA: Pulu Pandjang and Biliton Id., west Sumatra; Madura Id. and Bay of Batavia, Java; Obi Id., Moluccas; Lintido, Celebes (all ex Rijksmus. Nat. Hist., Leiden, ANSP) Banka, Kangeang (east of Madura), Flores, Timor, Amboina, Nusa-Laut, Halmahera, Waigen, Kei Islands (all Oostingh, 1923, p. 78). COCOS KEELING ATOLL (A. R. Whitworth, ANSP). AUSTRALIA: Western Australia: Cape Leveque (A. R. Whitworth). Northern Territory: Darwin (A. R. Whitworth, ANSP). Queensland: Rubber Reef, Port Douglas (Tony Marsh, ANSP); Hayman Id., Brook Id., Orpheus Id., Palm Ids. (all H. A. Pilsbry, ANSP); Mossman (ANSP); Black Reef and Lupton Reef, Whitsunday Group (MCZ); Green Id., near Cairns (MCZ). DUTCH NEW GUINEA: Mios Woendi Atoll, Padaid Ids.; Soweik, Soepiori, Schouten Ids.; Aoeri Id. (all NSF, 1956). Port Moresby, Papua (P. Coleman, ANSP). ADMIRALTY IDS.: Koruniat (ANSP). SOLOMONS: Choiseul, Malita, Bougainville, Shortland Ids. (all W. J. Eyerdam, ANSP). NEW HEBRIDES: Mallicolo Id. (G. Massoulard, ANSP). NEW CALEDONIA: Touho Bay; Yaté; Bourail (all G. and M. Kline, NSF, 1959). BONIN IDS.: Chichi Jima (Y. Kondo, USNM). MARIANAS: Saipan (ANSP); Apra Harbor, Guam Id. (A. J. Ostheimer, NSF, 1953). PALAUS: common throughout the islands of Koror, Babelthup, Kayangel, etc. (NSF, 1955); Yap Id. (C. O. Kile, ANSP); CAROLINES: Ulithi (ANSP); Oneop Id., Lukunor Atoll (MCZ). MARSHALLS: Bikini, Eniwetok, Rongelap and Rongerik Atolls (all USNM). FIJI: Mbau Id. and Suva (H. S. Ladd, USNM); Levuka, Ovalau Id. (R. T. Abbott, MCZ); Ongea Levu, Lau Group (H. S. Ladd, USNM). TONGA: Vliota (BPBM no. 68528); Vava'u (ANSP).

Fossil records — KENYA: Pleistocene; reef limestone, Mom-basa (L. R. Cox, 1930, p. 139). TANGANYIKA: Pleistocene of Dar-es-Salaam (A. Ortmann, 1892, p. 642). SUDAN: Port Sudan, coral reef, Pleistocene (Hall and Standen, 1907, p. 67). INDONESIA: Post-Tertiary Pleistocene, Billiton [Belitong Id.], Borneo. (K. Martin, 1881, vol. 3, p. 17). Young Quaternary at Goenoeng Medong, east Borneo Id. (Beets, 1948, p. 8). FIJI ISLANDS: Lau Id., Futuna limestone, Pliocene (?), Station L 493 (specimen resembling *L. lambis* seen in USNM). NEW HEBRIDES: Espirito Santo Island, Pliocene (?), H. T. Stearns Station ES-14, alt. 240 ft. (specimen of *L. lambis* seen in USNM).

***Lambis truncata* (Humphrey, 1786)**

This is the largest and one of the most widely distributed members of the genus in the Indo-Pacific. Adults reach a length of 10 to 15 inches. It is distinguished from the smaller *L. lambis* by the large knobs on the spire and by the absence of the strong, raised, axially-pinched knob which is present on the dorsum of female *lambis*. The dark purple-brown maculations found in some *lambis* are absent in *truncata*. This species may be readily separated into two subspecies:

truncata truncata (Humphrey, 1786)—with a flat apex, thus giving the spire a truncate appearance. Limited to the Indian Ocean.

truncata sebae (Kiener, 1843)—with a pointed apex, thus giving the spire an acute angle. With a curious, discontinuous distribution in the Red Sea and the Pacific Ocean as far east as the Tuamotu Islands.

We cannot on the basis of the few authentic specimens we have seen distinguish Red Sea and Western Pacific specimens of *sebae*. The dorsal hump or shoulder knob in Red Sea specimens is much more pronounced than that of Pacific specimens. This is a not uncommon feature of some of the *truncata truncata* from Zanzibar. *L. t. sebae* occurs also in Pleistocene deposits in the Red Sea area. It is possible that the subspecies *truncata* has more recently developed in the Indian Ocean and has now isolated the extreme ends of the parent subspecies, *sebae*.

Some, but not all, specimens from eastern Polynesia take on an elongate shape with the spire angle being less than that of East Indian and Melanesian specimens. The interior of the aperture, at the upper end, may have a few axial folds or creases. This is what Mörch named *sowerbyi* which we are synonymizing with *sebae*. The chocolate coloration of the aperture mentioned by Mörch occurs in only a few specimens, and may be only due to environmental conditions. At best, it is a very weak subspecies.

***Lambis truncata* subspecies *truncata* (Humphrey, 1786)**

(Pl. 122, fig. 2)

Range — Indian Ocean from central East Africa to the Bay of Bengal and Cocos Keeling Atoll.

Remarks — This subspecies is characterized by its truncate, flat apex which is brought about by the first 5 whorls revolving in the same plane. The sixth and subsequent whorls descend at a normal

rate, so that the adult shell takes on a normal *Lambis* shape. The young shell is so strikingly different from the adult that Grateloup described it as a new species of "*Pyrula*" in 1840. There is little difference in the adult shells of *sebae* and *truncata*, except that the latter generally has a rather large, indistinct hump on the dorsum, grows to a slightly larger size and usually has one or two fewer knobs per whorl in the spire. This species is moderately common throughout its Indian Ocean range.

Recently matured specimens have six long, slightly arching labial digitations. Rarely, a small, aberrant seventh may occur between the first and second digitations. Old specimens, usually found in shallow water on reefs and in lagoons, are very heavy and encrusted with calcareous algae, vermetid snails and rarely coral. The digitations and siphonal canal are greatly reduced, the aperture constricted and the parietal wall and outer lip covered with a creamy brown, granular glaze.

Habitat — Occurs near reefs in 12 to 15 feet of water (Issel and T.-Canefri, 1876, p. 356). I have seen natives dive for this species in 20 feet of water off the reefs of Kenya. It is rarely seen on the reefs, mainly, I believe, because the natives remove most of the larger shells for food purposes at each low tide.

Description — Shell massive and, including the digitations, 9 to 15 inches in length, with 6 slightly arching labial digitations. Siphonal canal proportionately short and almost straight. Whorls 9 to 10. Apex with about 4 to 5 flat whorls. Shoulder of whorls in spire with rather large, rounded nodules, usually 10 to 12 per whorl, but becoming obsolete in the last whorl. Dorsum of body whorl with 2 or 3 knob-like swellings, one of which may be large and mound-like. Spiral sculpture of numerous, weak, irregularly-sized threads or cords. Aperture

and parietal area with an enamel gloss. The glaze at the upper end of the columella extends over the nodules on the spire and sometimes over the apex. Color of aperture white within and becoming tan or purplish brown near the edges. Outer lip wavy in recently matured specimens, but very thick and smooth in old specimens. Columella straight and smooth. "Stromboid notch" bounded anteriorly by a small, pointed spur. Color of outer shell whitish cream with sparse, light-brown specklings or sometimes with chestnut-brown spiral bands and maculations. Periostracum moderately developed, translucent-tan and flaking off when dry. Operculum chitinous, elongate, very slightly curved, brown, and with smoothish edges. The radulae are proportionately massive and with about 55 transverse rows. The center cusp of the central tooth is broadly rounded. Formula: 2-1-2; 1-3 or 1-4; 5; 6 to 8.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
375	212	10 +	(large; Zanzibar)
387	235	8 +	(large; Seychelles)
250	150	8 +	(small; Zanzibar)

Synonymy —

- 1786 *Strombus truncatus* Humphrey, Portland Catalogue, p. 133, no. 2967 (East Indies); refers to Davila, vol. 1, pl. 12, fig. 14; *ibid.*, p. 150, no. 3307 (young); *ibid.*, p. 169, no. 3655 (China); 1817, Dillwyn, Deser. Cat., vol. 2, p. 659.
- 1791 *Strombus bryonia* Gmelin, Systema Naturae, 13th ed., p. 3520, No. 33 (no locality). Refers to Lister, pl. 882, fig. 4 and others; 1825, Wood, Index Testaceologicus, pl. 24, fig. 8.
- 1798 *Lambis davilae* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 66. Refers to Davila, vol. 1, pl. 14, pl. 13.
- 1798 *Lambis radix* Röding, loc. cit., p. 67, Refers to Conchyl.-Cab., vol. 10, fig. 1514.
- 1840 *Pyrula bengalina* Grateloup, Actes Soc. Linn. Bordeaux, vol. 11, pp. 170 and 448, pl. 4, fig. 5 (Bengal).
- 1852 *Pterocera (Heptadactylus) radix-bryoniae* Ch., Mörch, Catalogus Conchyl. . . . Yoldi, Hafniae, p. 60.

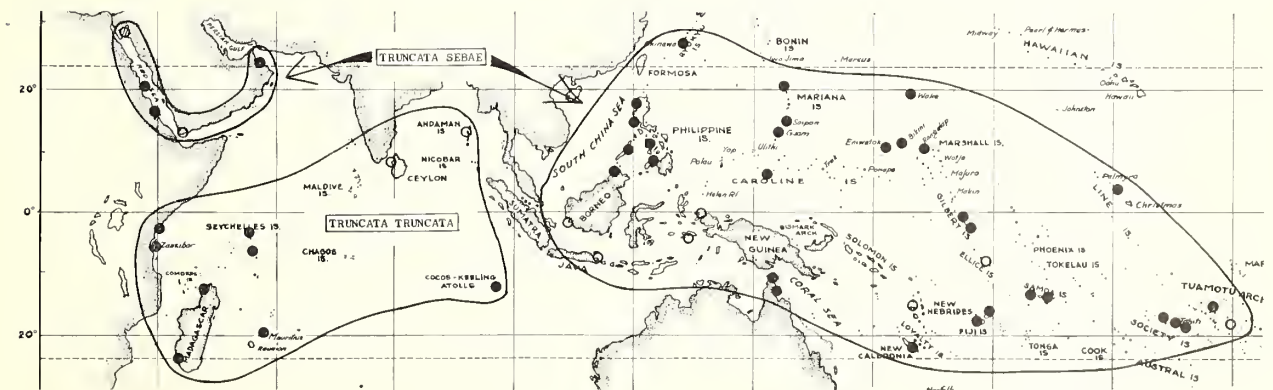


Plate 125. Geographical distribution of *Lambis truncata* (Humphrey) in the Indian Ocean, and of the sub-

species *sebae* (Kiener) which has a discontinuous distribution.

- 1854 *Harpago (Heptadactylus) radix-bryoniae* Cmel., H. and A. Adams, *Genera of Recent Mollusca*, London, vol. 1, p. 261.
- 1822 *Pterocera truncata* Lamarck, *Anim. sans Vert.*, vol. 7, p. 195; 1834, Kiener, *Coquilles Vivantes*, vol. 4, pl. 1, pl. 10, fig. 5.
- 1872 *Pterocera (Heptadactylus) truncata* Humphrey, *Mörsch, Jour. de Conchyl.*, vol. 20, p. 132.
- 1955 *Lambis (Lambis) truncata* (Humphrey), Butot, *Peng-gemar Alam*, vol. 35, p. 76 (in part).

Types — The whereabouts of Humphrey's type is unknown to me. It was probably sold at auction in 1786 in London.

Nomenclature — The eighteenth century figures of *truncata* were a mixture between the flat-topped Indian Ocean and acute-spined Red Sea and Pacific Ocean subspecies. Humphrey's 1786 name of *truncata* refers to Davila, pl. 12, fig. 14, a flat-topped specimen probably from East Africa. The earliest valid name for the acute-spined subspecies appears to be that of *sebae* (Kiener, 1843).

Grateloup's *Pyrula bengalina* is a very young specimen of *truncata truncata*, a fact which was pointed out by Kiener in 1843.

Although Butot (1955, p. 76) seemed to have understood the characters of *L. truncata* which has a truncate spire, he confused the issue by referring his own acute-spined specimen (his plate 2) from Kangean Island, Indonesia, and that of Rumphius ("Cornuta decumana" Rumphius 1705, pl. 35, fig. H) to *truncata*, rather than to *sebae* (Kiener).

Records (also see accompanying map) — KENYA: Diani Beach, south of Mombasa (R. T. Abbott, USNM, MCZ). MADAGASCAR: Nossi Iranja, south side of Nossi-bé (Academy-Madagascar Exped., 1960); Nossi Fanihi; Tulear; Ambodifotatra; Tamatave (all Dautzenberg, 1929, p. 472). SEYCHELLES: Southeast Id., off Mahé Id. (Yale Peabody Mus.). MAURITIUS: Port Louis (MCZ). CEYLON: (Issel and T.-Canefri, 1876, p. 356). ANDAMANS: Port Blair (Issel and T.-Canefri, 1876, p. 356). BENCAL: (Grateloup, 1840, pl. 4). COCOS KEELING ATOLL: shallow water in lagoon (USNM).

Fossil Records — None recorded.

***Lambis truncata* subspecies
sebae (Kiener, 1843)**

(Pl. 121, fig. 9; pl. 122, fig. 1)

Range — Red Sea and the tropical Pacific Ocean from the East Indies to eastern Polynesia.

Remarks — This subspecies differs from the typical *truncata truncata* of the Indian Ocean in having a pointed, rather than a truncate, apex. Adults rarely exceed 13 inches in length (including spines), while *truncata* may reach 16 inches. The curious distribution of this subspecies in two distantly separated areas, one in the Red Sea, one in the Pacific, can be explained by at least two possibilities. Either,

two morphologically similar forms have evolved independently of one another, or the once continuous distribution has recently been broken by the invasion of a geographically intervening race of flat-topped Indian Ocean specimens. The fossil record is too poorly known to settle this matter.

The flesh of this *Lambis* is commonly eaten by natives. Hedley (1899, p. 429) reports that the Ellice Islanders eat the snail raw or roasted.

Habitat — Lives in colonics on sandy, algal and coral rubble bottoms in the vicinity of coral reefs. "Commonly found at depths of 15 to 30 feet off the edge of seaward reefs . . . and on sandy lagoon shelves among seaweed or on minor reef prominences in 2 to 10 feet of water. Invariably occurs below low tide line [Marshall Islands]" (Demond, 1957, p. 297). Old and worn, but living, specimens occur on gravel flats in the lagoon at Funafuti in waist deep water (Hedley, 1897, p. 429, fig. 18). "It is rare in the central Philippine Islands" (E. Zambo, *in litt.*, 1958).

Description — Shell massive, 9 to 13 inches in length, and differing from the Indian Ocean *truncata truncata* in having the apex of the shell with a spire angle of 80 to 100 degrees, and in rarely exceeding a total length of 12 inches. Young specimens show a predominance of fine axial streaks of light-brown. The radulae are illustrated on plate 119, fig. 4.

***Measurements (mm.)* — (including digitations)**

length	width	no. whorls	
300	200	9+	(large; Samoa)
275	170	8+	(average; Saipan Id.)
225	137	8+	(small; Mindanao Id.)

***Synonymy* —**

- 1843 *Pterocera sebae* "Valenciennes" Kiener, *Coquilles Vivantes*, Paris, vol. 4, Ptéroccère, p. 4, pl. 2, pl. 4, fig. 2 (la mer Rouge et l'océan Indien).
- 1872 *Pterocera (Heptadactylus) sebae* Valenciennes, *Mörsch, Jour. de Conchyl.*, vol. 20, p. 131.
- 1872 *Pterocera (Heptadactylus) sowerbyi* Mörsch, *Jour. de Conchyl.*, vol. 20, p. 131 (Ins. Taïti).
- 1935 *Lambis bryonia* Cmelin, Y. Hirase and Pilsbry, 1000 shells in Color (Kai Sen Shu), vol. 4, pl. 73, fig. 368.
- 1938 *Lambis truncata* (Solander), S. Hirase, A Collection of Japanese Shells, 6th ed., pl. 87, fig. 2.
- 1955 *Lambis sebae* Valenciennes (Kiener), Butot, *Peng-gemar Alam*, vol. 35, p. 76, pl. 1, fig. 2.
- 1955 *Lambis truncata* (Humphrey, 1786), Butot, loc. cit., pl. 1, fig. 1, 3, pl. 2, fig. 7.
- 1958 *Lambis (Lambis) truncata* (Humphrey), Oyama, The Molluscan Shells, Tokyo, vol. 2, *Lambis* (I), figs. 7, 8 (Okinawa).

Types — We hereby restrict the type locality of *sebae* Kiener to the Red Sea. The type is presumably in the Musée d'Histoire Naturelle de Genève.

RED SEA records: Case Arm, Israel (ANSP); Aqaba, Israel (Issel and T.-Caettri, 1876, p. 356). Sherm Sheikh; Shadwan Id.; Ras Abu Somer; Hassani Id., and Jidda (all R. Sturany, 1903, p. 28). Port Berenice, Egypt (ANSP). 10 mi. off Port Sudan (R. C. Spencer, coll'n.). Berbera, Gulf of Aden (USNM).

PACIFIC OCEAN records (also see accompanying map) — **RYUKYU ISLANDS:** (USNM). **PHILIPPINES:** Iba, Zambales, Luzon Id. (P. de Mesa, ANSP). Lubang Id., Mindoro Prov. (P. de Mesa, ANSP). Cuyo Id., Palawan Prov.; Zamboanga, Mindanao Id. (both du Pont-Academy Exped., 1958). Sibuyan Id., Romblon Prov. (Alcasis, 1947, p. 180). Sarangani Bay, S. Mindanao Id.; Tara Id. (both USNM). **INDONESIA:** Amboina (Rumphius, 1705, pl. 35, fig. H). Borneo and Ceram Ids.; Kangean Id., N. E. of Java (all Butot, 1955, p. 76). Waigeu Id., west of Dutch New Guinea (Butot, 1955, p. 76). **AUSTRALIA:** Torres Straits (ANSP); Keeper Reef, 40 mi. from Townsville, Queensland (Tony Marsh, *in litt.*). **NEW HEBRIDES:** Erromanga (Hedley, 1899, p. 429). **NEW CALEDONIA:** barrier reef, Touho Bay; Plage de Poe, Bourail (both G. and M. Kline, NSF, 1959). **FIJI ISLANDS:** Namuka Id., Kaloka Levu, Viti Levu Id. (R. T. Abbott, MCZ). Suva, Viti Levu Id. (H. S. Ladd, USNM). **MARIANAS:** barrier reef, Tanapag, Saipan Id. (R. Sutcliffe, ANSP). Tinian Id. (J. L. Chamberlin, MCZ). Guam Id. (USNM). Maug Id. (USNM). **CAROLINES:** 4 fms., Main Pass, Ifaluk Atoll (USNM). **MARSHALL ISLANDS:** Bikini, Eniwetok, Rongelap Atolls (J. P. E. Morrison, USNM). **CILBERT ISLANDS:** Onotoa Atoll (P. E. Cloud, USNM); Apiang (A. Carrett, MCZ). **HAWAIIAN CHAIN:** [Evidently absent. Spicer, 1941, p. 2, reports that Guam specimens were taken to and sold on Midway]. **LINE ISLANDS:** Christmas Id. (Fred Barnett, ANSP). **ELLICE ISLANDS:** Funafuti (Hedley, 1899, p. 429). **SAMOA:** Satalo Id., Upolu Id. (NSF, 1955). Fagaitua Bay, Tutuila Id. (MCZ). **SOCIETY ISLANDS:** District of Anau, Bora Bora; Aua, District of Paea, and Ative, District of Punaauia, Tahiti (all R. Robertson, 1952, ANSP). Nauare, Moorea Id. (H. A. Rehder, USNM). **TUAMOTU ISLANDS:** Ship Pass, Raroia (R. Rufon, ANSP). Hao and Ohura [= possibly Takapoto] (Couturier, 1907, p. 154). Maranganai Id., Toau [Elizabeth Atoll] (H. A. Pilsbry, 1929, ANSP).

Fossil records — Pleistocene of Khor Ambado, French Somalia (Abrard, 1942, p. 62, pl. 6, fig. 34, as *Pterocera* cf. *millepeda* Linné). **HAWAIIAN CHAIN:** "Pleistocene" raised beach, 15 feet altitude, Makua, south coast of Oahu Id. (Children's Museum, Honolulu).

***Lambis crocata* subspecies
crocata (Link, 1807)**

(Pl. 121, fig. 8, pl. 126)

Range — East Africa to Samoa and the Ryukyu Islands to northern Australia.

Remarks — This moderately common species is readily recognized by its solid-orange, smooth aperture. The outer lip bears 6 slender digitations, and the siphonal digitation is long and gracefully curved. We have divided the species into two races—the typical *crocata* of the Indian and western Pacific Oceans which becomes progressively rare towards the east where it appears to have reached its limits in Samoa—and the giant subspecies *pilsbryi* which appears to be limited to the Marquesas Islands in eastern Polynesia.

The exterior of the shell is usually mottled in creamy-white and soft brownish orange, although a pure-orange color form rarely occurs in colonies

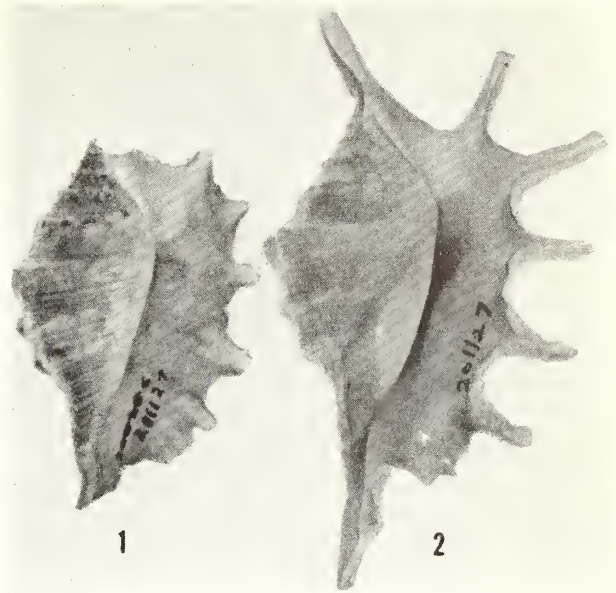


Plate 126. Immature shells of *Lambis crocata* (Kayangel Island, Palau Islands). Fig. 1, with digitations beginning to be formed. 2, with digitations almost completed. Both natural size.

from the Palau Island and the Philippines. A specimen from Chumbe Island, Zanzibar, is malformed and has 9 labial digitations. This species has not been recorded from the Red Sea or the Hawaiian Chain. It was formerly called *aurantia* Lamarck.

Habitat — This species lives on seaward reefs from the low tide mark to a depth of about 10 feet. Melvill (1909, p. 94) reported it at depths of 31 and 34 fathoms in the Seychelles, but did not indicate whether or not these were live specimens. Alan J. Kohn recovered live specimens on the reefs in the Seychelles (Yale Peabody Exped., station 41, 1957).

Description — Shell 100 to 150 mm. (4 to 5½ inches) in length (including the digitations), with 6 labial digitations, and a long, slender, curved siphonal digitation. Aperture a solid, whitish orange and smooth. Nuclear whorls 3, smooth, glossy and light-brown in color. 7 to 8 postnuclear whorls with numerous spiral threads. The shoulder of the whorls in the spire bears a small beaded carina which lies just above the finely indented suture. Last whorl with 3 spiral rows of knobs, the upper row having 2 to 4 widely-separated rather large, rounded knobs and the lower two rows having 4 to 6 smaller knobs. Color of outer shell solid orange-tan or whitish with orange-tan maculations. Lower 3 labial digitations hooked posteriorly at an 80 to 90 degree angle. Aperture elongate, solid orange, smooth, constricted within by a long axial ridge on the inside of the body whorl. Upper end of aperture with

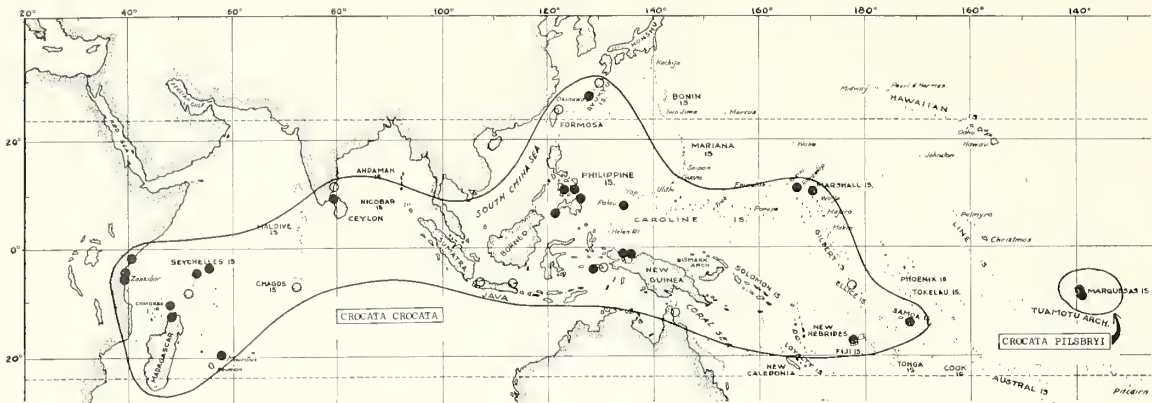


Plate 127. Geographical distribution of *Lambis crocata crocata* (Link) and its Marquesan subspecies *pilsbryi* Abbott.

a deep well which is bounded by a small spiral ridge on the upper end of the columella. Columellar callus enameled, swollen, and with a sinuate line of demarkation on the left side. "Stromboid notch" large and fluted. Periostracum heavy, brown and slightly rough, but usually worn off the body whorl. Operculum slightly curved, brown and its edges smoothish. The verge is slender, with a small distal pad, maculated with cream spots, and about $\frac{1}{2}$ the length of the aperture. The odontophore is about 8 mm. in length with 40 transverse rows of teeth. The radular formula is 2-1-2; 1-2; 5; 5.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
150	73	8+	(large; Tutuila Id., Samoa)
128	55	8+	(average; Cebu Id., Philippines)
103	45	5+	(small; Gulf of Manaar, India)

Synonymy —

- 1798 *Lambis scorpius* Gmelin, Röding, Museum Boltenianum, Hamburg, pt. 2, p. 67, no. 60. Refers to Conchyl.-Cab., vol. 10, figs. 1508-09. Non Gmelin, 1791; non Linné, 1758.
- 1807 *Pteroceras crocatus* Link, Besch. Naturalien-Sammlung, Rostock, pt. 2, pp. 109, 110. Refers to Conchyl.-Cab., vol. 10, figs. 1508-1509.
- 1811 *Strombus aculeatus* Perry, Conchology, London, pl. 13, fig. 2 (no locality). Perhaps a *nomen dubium*.
- 1822 *Pterocera aurantia* Lamarck, Anim. sans Vert., vol. 7, p. 198 (Indes orientales). Refers to Conchyl.-Cab., vol. 10, figs. 1508, 1509 and Knorr, pt. 5, pl. 4, fig. 3.
- 1825 *Strombus lambis* L., Wood, Index Testaceologicus, London, p. 116, pl. 24, fig. 7.
- 1825 *Pteroceras aurantiacum* Sowerby, Catalogue Shells . . . Tankerville, London, p. 67 (substitute name for *aurantia* Lam.).
- 1842 *Pteroceras aurantia* Lam., Sowerby, Thesaurus Conchyl., vol. 1, Pteroceras, p. 42, pl. 11, fig. 11.
- 1941 *Lambis crocata* (Link), Kuroda, Mem. Faculty Sci. Agriculture, Taihoku Imperial Univ., vol. 22, no. 4, p. 98; 1955, Butot, Penggemar Alam, vol. 35, p. 77, pl. 2, fig. 3.

Types — Link's species is based upon figures 1508 and 1509 of the Conchylien-Cabinet, vol. 10. That

specimen is said to come from the East Indies. We hereby restrict the type locality to Amboina, Indonesia. Perry's type of *aculeatus* probably fell into private hands, and may still be in existence, but probably without identifying labels.

Locality records — KENYA: Shimoni, Mombasa (Yale Peabody Mus.); Diani Beach (R. T. Abbott, USNM, MCZ). ZANZIBAR: Chumbe Id., Pange Id.; outer reef, Kiwengwa; Ras Nungwe (NSF, 1957). MADAGASCAR: Nossi-bé (A. Chavane, ANSP). INDIAN OCEAN ISLANDS: Gloriesa Id. (USNM); Providence Id., Mascarenes (E. A. Smith, 1884, "Alert", p. 503); Seychelles: Menai Id., Cosmoledo Atoll, Ile Platte (both A. J. Kohn, Yale Peabody Mus.). Chagos Islands: (Lienard, 1877, p. 95). Mauritius (N. Pike, MCZ). CEYLON: Pearl Bank, Gulf of Manaar (G. and M. Kline, ANSP). INDIA: Pamban and Tuticorn (Thurston, 1895, p. 125). RYUKYU ISLANDS: Okinawa Id. (Mrs. A. A. Scott, ANSP). Amami Islands (Kira, 1959, p. 37). TAIWAN: Ryukyo-syo (Kuroda, 1941, p. 98). PHILIPPINES: Olango Id., east Cebu (du Pont-Academy Exped., 1958); Panglao, Bohol Id. (E. Zambo, ANSP); Surigao, Mindanao Id. (ANSP); Jolo Id., Sulu Arch. (ANSP). INDONESIA: Amboina (MCZ); Java Id.; Madura Id.; Ambon Id.; and Ceram Id. (Butot, 1955, p. 77). AUSTRALIA: Undine Reef, Queensland (Tony Marsh, *in litt.*). DUTCH NEW GUINEA: Mios Woendi Atoll, Padaido Ids. (NSF, 1956). PALAUS: Nguarangel (USNM); Kayangel Id. (NSF, 1955). MARSHALLS: Lomuilal Id., Rongelap Atoll: Taka Atoll (both USNM). FIJI ISLANDS: Namuka Id., off Kaloka Levu, Viti Levu Id. (R. T. Abbott, MCZ). SAMOA: Fagaitua Bay, Tutuila Id. (R. T. Abbott, MCZ).

Fossil records — Pliocene, south end of Mombasa Id., Kenya (J. Weir, 1938, p. 69, pl. 5, fig. 3).

Lambis crocata subspecies
pilsbryi, new subspecies

(Pl. 128, figs. 1, 2)

Range — Known only from the Marquesas Islands, Polynesia.

Remarks and Description — This giant, isolated race is presumed to be limited to the Marquesas Islands. I have seen only six specimens. One of these was given to Dr. H. A. Pilsbry by Père Siméon Delmas of the Marquesas. The shells of this subspecies differ from those of *crocata crocata* in being twice as large (7 to 9 inches in length, including digitations), in having the 3rd, 4th and 5th digita-

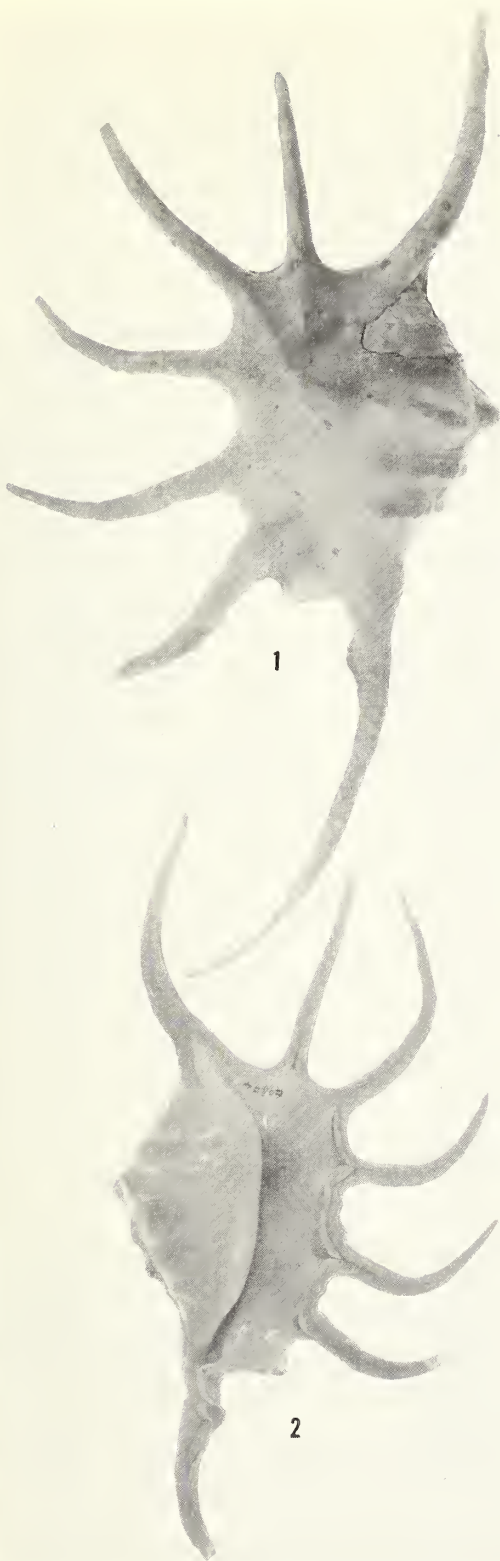


Plate 128. *Lambis crocata* new subspecies *pilsbryi*. Marquesas Islands. Fig. 1, holotype, ANSP no. 156123. 2, paratype, ANSP 255621. $\frac{1}{2}$ natural size.

tions straight or only slightly curved, and in lacking the fairly prominent edge on the left of the parietal callus. In *pilsbryi*, the dorsal shoulder knob is much larger, the apex of the spire is usually buried by the first digitation, and the small, columellar ridge at the posterior end of the aperture is very weak. In other characters, such as the color of the outer shell and aperture and in the sculpturing of the spire, it is similar to *crocata*. Operculum and soft parts unknown.

Two names have been proposed for *crocata* which might possibly refer to this subspecies, although one of them, *Lambis goldii* (Möreh, 1852) is inadequately described, and the other, *Lambis aculeata* (Perry, 1811), is based upon a distorted illustration and too brief a description for certain identification. We consider them *nomen dubia*. We name this new subspecies in honor of Dr. Henry A. Pilsbry, former Curator of the Department of Mollusks at the Academy of Natural Sciences of Philadelphia.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
240	113	7 +	(paratype, MCZ no. 49694)
212 +	95	7 +	(holotype, ANSP no. 156123)
182 +	90	8	(paratype, ANSP no. 255621)

Synonymy —

1842 *Pteroceras lambis* Lin., Sowerby, (in part), Thesaurus Conchyl., vol. 1, Pteroceras, p. 41, pl. 11, fig. 6 only. Not *lambis* (Linné).

Types and Locality Records — The type locality is Nuku Hiva in the Marquesas Islands. The holotype is in ANSP no. 156123 and was collected by Père Siméon Delmas. Most of Delmas' shells were collected on the coral banks in Tai O Hae Bay. One paratype is in MCZ no. 49694. One paratype in B. P. Bishop Mus. no. 68268 from Uahuka, Marquesas (S. Delmas, 1922). Miss Martha E. Hunt of Baltimore kindly loaned me a specimen which T. Gavaldon collected in the Marquesas in 1959.

[These occasional blank areas occur between genera and subgenera to permit the insertion of new material and future sections in their proper systematic sequence.]

Subgenus *Millepes* Mörch, 1852

Type: *Lambis millepeda* Linné

The shells in this group of *Lambis* are characterized by elongate apertures bearing well-developed spiral lirae, by a siphonal canal which is either straight or curved to the right, and by the presence of 6 to 10 labial digitations. There are five species, three of which are quite limited in distribution, the other two being found in both the Indian and Southwest Pacific Oceans. Only one, *Lambis scorpius* Linné, shows any subspeciation.

Below is a synopsis of the differentiating characters of the five living species.

Lambis scorpius scorpius (Linné) — (Southwest Pacific). Six labial digitations nodulose, the lower three strongly hooked. Siphonal canal long, strongly curved to the right. Deep in the throat is a white bar or ridge just below the concavity caused by the dorsal tubercle. An ear-like lobe present at the left side of the base of the first digitation.

Lambis scorpius indomaris Abbott — (Indian Ocean). Differing from the above in lacking a well-developed lobe at the base of the first digitation, and in having stunted, shorter 4th, 5th and 6th digitations.

Lambis robusta (Swainson) — (Southeastern Polynesia). Six axial digitations almost smooth; the 3rd and 4th close together; siphonal canal almost straight. No white ridge deep in throat.

Lambis millepeda (Linné) — (Western Pacific Arc). Nine labial digitations; aperture mauve-brown. Lower parietal callus weakly lirate. Spire low.

Lambis digitata (Perry) — (Indo-Pacific). 8 to 9 labial digitations, the first usually being bifurcate. Spire elongate. Parietal wall callus raised and with prominent, wavy, whitish lirae. Lower 6 digitations very short. Edge of outer lip broad, covered with periostracum.

Lambis violacea (Swainson) — (Indian Ocean). 9 to 11 labial digitations, the first usually being bifurcate, and all being enamel-white and flat-tish on the underside. Spire relatively short. Aperture whitish with yellowish bars on the outer lip, and the throat violet to lavender. Apertural lirae fine and numerous.

There are no species limited to the Tertiary, but *millepeda* and *scorpius* have been recorded from the Quaternary of Indonesia.

Synonymy —

1852 *Millepes* "Klein", Mörch, Cat. Conchyl. . . . Yoldi, Hafniae, p. 60; 1859, Chenu, Manuel de Conchyl. et Paleont. Conchyl., Paris, vol. 1, p. 259; 1940, Wenz, Handbuch der Paläozoöl., vol. 6, pt. 4, p. 948 (type by subsequent designation: *millepeda* Linné).

1854 *Millipes* "Klein", H. and A. Adams, Genera of Recent Mollusca, London, p. 261; 1868, Gabb, American Jour. Conch., vol. 4, no. 3, p. 140; Tryon, Manual of Conch., Philadelphia, vol. 7, p. 125; 1878, Kobelt, Illustriertes Conchlienbuch, vol. 1, p. 106 (type by subsequent designation: *scorpio* Linné).

1870 *Millipes* Mörch, Gill, American Jour. Conch., vol. 5, no. 3, p. 128, 134; 1955, Butot, Penggamar Alam, vol. 35, p. 74.

Lambis millepeda (Linné, 1758)

(Pl. 121, fig. 6; pl. 129, fig. 3)

Range — Southwest Pacific.

Remarks — This species is rather common wherever it occurs, but its distribution is limited to the central portion of the Western Pacific Arc from the Philippines to New Guinea. It is recognized by its 9 labial digitations which arise just behind the edge

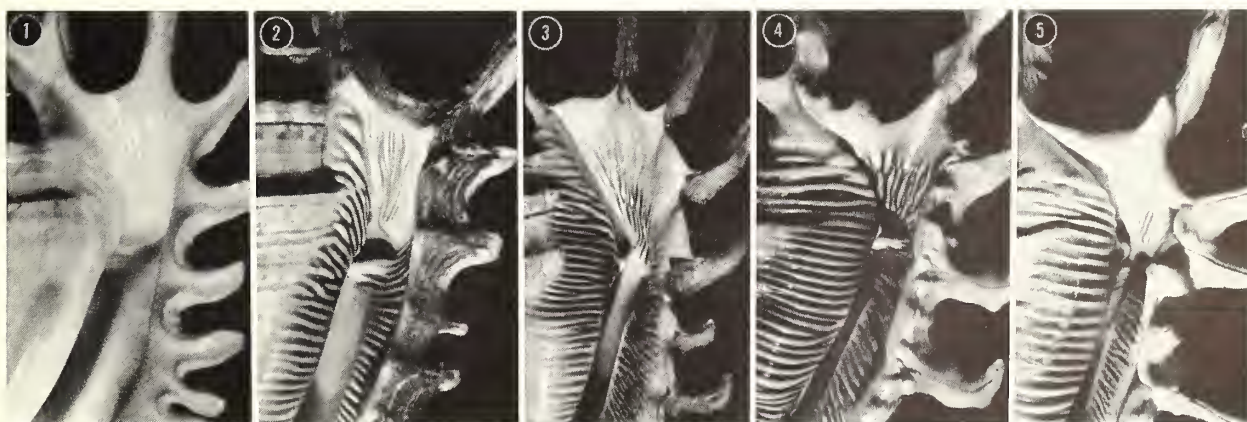


Plate 129. Apertural details of members of the subgenus *Millepes* Mörch. Fig. 1, *Lambis violacea* (Swainson). 2, *L. digitata* (Perry). 3, *L. millepeda* (Linné). 4, *L. scorpius*

(Linné). 5, *L. robusta* (Swainson). All about ½ natural size.

of the outer lip and by the brownish mauve aperture which bears whitish mauve lirae well into the throat of the aperture. The lower 3 or 4 labial digitations are turned or hooked towards the posterior or spire end.

Mr. Evaristo Zambo of Cebu, Philippines, informs me that the flesh of *millepeda* is bitter and generally not eaten by natives. No authentic records of this species are known from the Red Sea or Indian Ocean. An account of the gross anatomy was published by R. Bergh (1895, pp. 364-368, pl. 23).

Habitat — Lives in shallow water down to a depth of 2 fathoms.

Description — Shell 90 to 145 mm. ($3\frac{1}{2}$ to $5\frac{1}{2}$ inches) in length including the digitations. Aperture mauve-brown with numerous white lirae. Outer lip with 9 short labial digitations of which the lower 4 or 5 are hooked towards the apex. Siphonal canal rather short and twisted. Nuclear whorls 3, smooth, translucent-tan. Postnuclear whorls 8. Early whorls with a beaded carina; later whorls with 9 to 11 nodules. Last whorl with 3 spiral rows of nodules, the top row with 4 large, somewhat elongate knobs, the lower two rows with 3 or 4 small, round nodules. Color of outer shell cream with a heavy suffusion or network of dark-brown. Edge of outer lip crenate. Aperture mauve-brown with numerous, wavy, weak lirae of a whitish purple color. Throat yellow within and bounded by an axial whitish ridge on the inside of the body wall. Upper end of aperture has a deep, round, yellow depression or well which is bounded above by two facing, tongue-like whitish ridges. Columella swollen below; bears about 40 to 50 irregular, spiral, mauve-white lirae which cross the blackish to chocolate-brown parietal wall. "Stromboid notch" with 2 or 3 short, flat projections at its edge. Periostracum thin, glossy and translucent-brown. Operculum long, dark-brown and with smoothish edges. Bergh's (1895) figures show a radula similar to that of *scorpius* and with a formula of 2-1-2; 1-4; 6; 6.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
145	62	8+	(large; Luzon Id.)
100	53	11	(average; Cebu Id.)
95	48	9+	(small; Schouten Ids.)

Synonymy —

- 1758 *Strombus millepeda* Linné, *Systema naturae*, ed. 10, p. 743, no. 426 (In O. Asiae); 1764, *Mus. Ludovicae Ulrica*, p. 618; 1767; 12 ed., p. 1208, no. 494; 1956, Dodge, *Bull. Amer. Mus. Nat. Hist.*, vol. 111 pt. 3, pp. 251-252; 1801, Bosc, *Hist. Nat. des Coquilles*, Paris, vol. 4, p. 249.

- 1798 *Lambis millepeda* Gmelin, Röding, *Museum Boltianum*, Hamburg, pt. 2, p. 67, no. 855 (refers to *Conchyl.-Cab.*, vol. 3, figs. 861-862).
 1807 *Pteroceras millepeda* Linné, Link, *Beschr. Natur.-Samml.*, Rostock, pt. 2, p. 110 (refers to *Conchyl.-Cab.*, vol. 3, figs. 861-862); 1842, Sowerby, *The-saurus Conchyl.*, vol. 1, p. 43, pl. 11, fig. 3 (Philippines).
 1807 *Pterocera millepeda* Linné, C. Fischer, *Museum-Demidoff*, Moscow, vol. 3, p. 191 (refers to *Conchyl.-Cab.*, vol. 3, figs. 861-862); 1839, Anton, *Verz. Conchyl.*, Halle, p. 84; 1843, Kiener, *Coquilles Vivantes*, Paris, vol. 4, p. 10, pl. 9, figs. 1, 2 (not pl. 10, fig. 1); 1851, Reeve, *Conch. Icon.*, vol. 6, pl. 6, fig. 10.
 1870 *Pterocera millipeda* Lam. ex Linné, Gill, *American Jour. Conch.*, vol. 5, no. 3, p. 135.
 1955 *Lambis (Millepes) millepeda* (Linné, 1758), Butot, *Penggemar Alam*, vol. 35, p. 77, pl. 2, fig. 4 (Madura, Indonesia).

Types — "The Linnaean collection in London contains a properly marked specimen of *millepeda* which thus may be accepted as the type of the species." (Dodge, 1956.) We hereby designate Olango Island on the east side of Cebu Island, Philippines, as the type locality.

Nomenclature — Linnaeus, Gmelin (1791), Dillwyn (1817) and Lamarck (1822) considered what was later described as *violacea* (Swainson) and *digitata* (Perry) to be synonyms or varieties of *millepeda* (Linné). Swainson in 1821 was the first to accept them as distinct species. Sowerby (1842) and, later, Deshayes (1843) also separated them but gave names which are now considered synonyms. Curiously, Dodge (1956, pp. 251-252) confused the situation by believing that *elongata* (Swainson) and *digitata* (Perry) were different species, and that the latter was the same as *multipes* of Chemnitz and of Deshayes. Actually, *multipes* is a synonym of *violacea* (Swainson, 1821). *Alata polydactylus* Martini 1777 is a non-binomial synonym of *millepeda* Linné.

Records — (See accompanying map, pl. 130) PHILIPPINES: Calapan, Mindoro (P. de Mesa, MCZ). Luzon Id.: Iba, Zambales (P. de Mesa, ANSP); Tabaco, Albay Prov. (du Pont-Academy Exped., 1958, ANSP). Cebu Id.: Olango (ANSP). Bohol Id.: east side of Jagoliao Id. (both du Pont-Academy Exped., 1958). MINDANAO Id.: Davao Bay (MCZ). Masbate Id.; Basilan Id.; Marongas Id.; Jolo Ids. (all USNM). Romblon Prov., Sibuyan (Alcasid, 1947, p. 184). INDONESIA: Amboina (MCZ); Batjan Id. (MCZ); Madura Id.; Java; Ternate; Ceram; Timor (all Butot, 1955, p. 77). DUTCH NEW GUINEA: Soepiori Id., Schouten Ids.; Japen Id. and Biak Id., and Aori Ids. (all NSF, 1956). AUSTRALIA: Cotton (1953, no. 3, second page, fig. 17) reports it from Northern Australia and from Queensland, although J. Allan (1959, p. 102) states this is not so.

Fossil records — INDONESIA: Pleistocene-Pliocene: Koe-pang, Timor Id. (Tesch, 1920, p. 52, pl. 130, fig. 172). [Abrard's 1942, vol. 18, p. 62, pl. 6, fig. 34 of *millepeda* from the Pleistocene of the Red Sea looks like a *Lambis truncata sebæ*.] [R. B. Newton's 1900, p. 509, Pleistocene record for Cemsah, Egypt needs confirmation, and may well be *L. digitata*.]

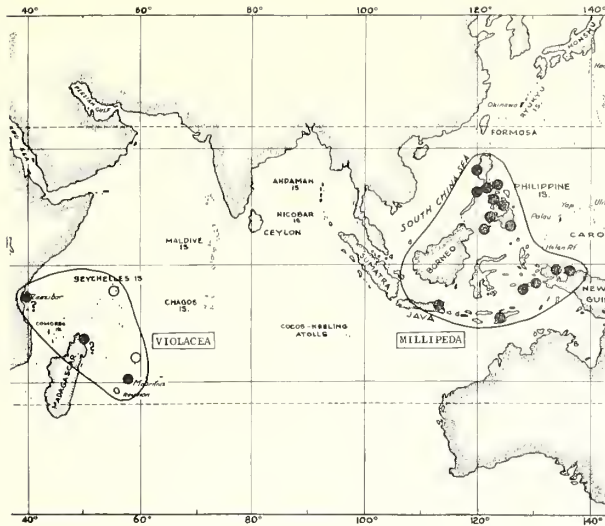


Plate 130. Geographical distribution of *Lambis violacea* (Swainson) and *Lambis millepeda* (Linné).

Lambis digitata (Perry, 1811)

(Pl. 121, fig. 3; pl. 129, fig. 2)

Range — East Africa to Samoa.

Remarks — This is not a common species, but it has a rather wide distribution. It was formerly known as *elongata* (Swainson). It is characterized by a proportionately high spire, by 8 or 9 labial digitations of which the lower 6 or 7 are very small and the first two, at the upper end of the aperture, are longer and widely separated. The first digitation is usually bifurcate. The edge of the outer lip is broad and thickly covered with brown, rough periostracum. The interior of the aperture is similar to that of *millepeda*, but differs in being less constricted and in having a short, spiral, whitish ridge just below the concavity (caused by the last dorsal knob on the outside of the shell). The raised, lirate parietal callus in *digitata* has a sharp, delimiting left edge.

I have seen only two specimens from the Indian Ocean. They have one extra digitation on the outer lip, and other differences, which suggest that there may be an Indian Ocean subspecies, but more specimens are needed to prove this point. Reeve's *crocea* looks like the Indian Ocean form and his name is available for it.

Habitat — Unknown, although it is probably associated with coral reefs at depths from 1 to 3 fathoms.

Description — Shell 98 to 145 mm. (4 to 5½ inches) in length, with 8 (rarely 9) labial digitations of which the anterior or first one is bifurcate and the lower 5 or 6 are very short. Spire very high and with an angle of about 40 degrees. Nuclear whorls unknown. Postnuclear whorls 10. Shoulder of whorls carinate and bearing numerous, small, sharp nodules. Body whorl with 3 rows of nodules, the top row with the 5 largest, and the two rows below bearing 4 to 6 small nodules. Color of outer shell whitish with yellow-brown specklings and mottlings. Outer lip thick. Aperture purplish mauve with numerous whitish spiral lirae. Throat yellowish white within and with a deep depression at the posterior end which is bounded anteriorly by a strong whitish ridge. Columella with a thickened mauve callus which bears about 25 whitish, bifurcating, spiral lirae. This parietal or columellar callus is sharply bordered on its left side. Inside of outer lip purplish with numerous purplish white spiral lirae. "Stromboid notch" well-developed and with the thick outer lip slightly overhanging its upper edge. Siphonal canal rather short and twisted. Periostracum brown and thicker on the edge of the outer lip. Operculum and soft parts unknown.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
140	70	10 +	(large; "Pacific Ocean")
132	53	9 +	(average; "Indian Ocean")
118	53	10 +	(small; "Pacific Ocean")

Synonymy —

- 1811 *Strombus digitatus* Perry, Conchology, London, pl. 13, fig. 1 (Eastern Ocean).
- 1816 *Pterocera millepeda* Lamarck, Le Liste, p. 4; pl. 410, fig. 1a and b of Encyclop. Méthod. (no locality); 1839, Anton, Verzeich. Conchyl., Halle, p. 84, no. 2780. Non Linné, 1758.
- 1821 *Pterocera elongata* Swainson, Exotic Conchology, London, pt. 1, sign. B4, 12th page; 1841, appendix, p. 32 (no locality). Also refers to Conchyl.-Cab., vol. 10, figs. 1479-80.
- 1842 *Pterocera crocea* Reeve, Conchologia Systematica, vol. 2, p. 204, pl. 248, fig. 2 (no locality); 1842, Sowderby, Thes. Conch., vol. 1, pt. 2, pl. 11, fig. 4. [Indian Ocean?]
- 1843 *Pterocera novem-dactylis* Deshayes, in Lamarck's ed. 2, Anim. sans Vert., vol. 9, p. 678, no. 9 (no locality); 1845, Küster, Syst. Conchyl.-Cab., second series, vol. 4, pt. 1, p. 86.
- 1955 *Lambis* (Millipes) *elongata* (Swainson; 1834), Butot, Penggemar Alam, vol. 35, p. 78, pl. 1, fig. 4. [*Lambis*].
- 1955 *Lambis violacea* Swainson, Abbott, Nautilus, vol. 68, no. 4, p. 124.

Types — The type of Perry's *digitata* has probably been lost. I hereby restrict Perry's type locality of "Eastern Ocean" to Upolu Island, Western Samoa. Swainson's type of *elongata* may be at Cam-

bridge University, or possibly lost.

Nomenclature—There can be little doubt from Perry's illustration that his *Strombus digitatus* is the species which Swainson later described and named *elongata*.

Records—MOZAMBIQUE: Mozambique City (ANSP); Port Amelia (MCZ). MADAGASCAR: Sarodrano (Dautzenberg, 1929, p. 473). MAURITIUS: (MCZ). PHILIPPINES: Mindoro Id.; Surigao, Mindanao Id. (both Elera, 1896, p. 255). SAMOA: Upolu Id. (Titian R. Peale, 1839, ANSP).

Fossil records—None reported.

***Lambis scorpius* (Linné, 1758)**

This handsome species is rather widely distributed, and, although well known, it is comparatively uncommon. It is characterized by the gnarled or knobbed digitations and the brightly colored aperture which is purple and white-striped within and brownish to reddish orange at the border. In Eastern Polynesia, this species is replaced by the rare *Lambis robusta* (Swainson). The latter has smoother and heavier digitations and has no small, raised, white spiral ridge deep within the upper part of the aperture, a feature characteristic of *scorpius*.

Indian Ocean specimens of *scorpius* show slight, but fairly constant, differences from the typical Pacific race, and for this reason we are recognizing two geographical races. In Pacific specimens, there is a large, flat ear-like lobe on the left side of the base of the first digitation. In the Indian Ocean subspecies *indomaris*, this lobe is greatly reduced or pushed back over the apex of the spire. Digitations 4, 5 and 6 are considerably more stunted and less protruding in *indomaris* than in the typical *scorpius*.

***Lambis scorpius* subspecies *scorpius* (Linné, 1758)**

(Pl. 121, fig. 5; pl. 129, fig. 4)

Range—Indonesia and the Ryukyu Islands to Samoa.

Remarks—The typical subspecies appears to be limited to the western Pacific. Its distinguishing characters are discussed above.

Habitat—This species is found in shallow water at a depth of 1 to 10 feet, usually on coral reef flats where there is some protection from the ocean waves under or among dead coral slabs and boulders. Mrs. Anita Scott reports (*in litt.*) that they are more often, although uncommonly, found in shallow water during the warm summer months in the Ryukyu Islands.

Description—Shell 100 to 165 mm. (4 to 6½ inches) in length, with 6 knobbed labial digitations and a long slender, knobbed siphonal digitation which is strongly curved to the right. Whorls 9 to 11. Nuclear whorls 3, smoothish, opaque-tan, and elevated. Sometimes with a weak spiral band of brown just below the suture. Postnuclear whorls flattish, and bearing numerous small knobs on a strong carina which is located just above the suture. Body whorl with 3 main spiral rows of low knobs, the top one bearing the 4 largest, the middle row bearing 8 to 9 small knobs and the lowest row bearing 5 or 6 knobs of intermediate size. Outer lip bearing 6 digitations, all having 2 or 3 broad knobs, thus giving them a gnarled or jointed appearance. First digitation usually pointed upward in line with the axis of the shell, and bears a large, flat, ear-like lobe at the base on the left side. Digitations 4, 5 and 6 are bent posteriorly, almost at right angles to the axis of the shell. Siphonal canal long, strongly curved to the right, and bearing 4 or 5 weak knobs. Aperture rather narrow, quadrate, and deep within is solid purple. Inside of outer lip with numerous, crowded, white, slightly raised spiral lirae which end before they reach the broad, smoothish yellow-orange edge of the outer lip. Deep within the upper part of the aperture is a strong, white, bar-like, spiral lira. Columella and parietal wall brownish purple and overlaid with about 30 to 40 white to tan-white, raised, spiral lirae which may or may not run parallel with the spiral cords on the body whorl. Columella bounded by a long, narrow, white, axial swelling deep within the aperture. Periostracum thin, translucent-tan, and heaviest on the under surface of the digitations. Operculum long, slightly curved, light-brown and with 10 small serrations. Verge half the length of the aperture and with a small distal pad. Radula with 46 rows and a formula of 2-1-2; 1-3; 4; 5.

Measurements (mm.)—(including digitations)

length	width	no. whorls	
168.0	66.2	8 +	(large; Okinawa)
135.0	55.1	10	(average; Truk Id.)
97.2	42.0	8 +	(small; Biak Id.)

Synonymy—

- 1758 *Strombus scorpius* Linné, *Systema Naturae*, ed. 10, p. 743 (In O. Asiatico); 1767, 12th ed., p. 1208, no. 492; 1956, Dodge, *Bull. Amer. Mus. Hist.*, vol. 111, art. 3, pp. 249-250.
- 1771 *Strombus scorpio* L., Murray, *Fundamenta Test., Amoenitates Academicæ*, vol. 8, p. 45, pl. 1., fig. 29; 1778, Born, *Index Rerum Natur. Mus. Caesarei Vindobon.*, p. 268.
- 1798 *Lambis chiragra* Gmelin, Röding, *Museum Boltenianum*, pt. 2, p. 67, no. 856, (Non Gmelin 1791, non Linné 1758).

- 1805 *Pterocera scorpius* L., Roissy, Buffon's Hist. Nat. des Moll., vol. 6, p. 91, pl. 58, fig. 5.
 1807 *Pterocera scorpius* Lin., G. Fisher, Museum Demidoff, Moscow, vol. 3, p. 191.
 1810 *Pteroceres scorpius* L., Montfort, Conchyl. Systemat., Paris, vol. 2, p. 607.
 1816 *Pterocera nodosa* Lamarck, in Bruguière's Encyclop. Method., pt. 23, Le Liste, Paris, p. 4, pl. 410, fig. 2; 1821, Swainson, Exotic Conchology, London, appendix, p. 32 (sign, B3, 11th page).
 1822 *Pterocera scorpio* Lin., Lamarck, Anim. sans Vert., vol. 7, p. 197.
 1842 *Pteroceras scorpio* Linn., Sowerby, Thesaurus Conchyl., vol. 1, pl. 11, fig. 1 (Moluccas).
 1843 *Pterocera scorpio* Lam., Kiener, Coquilles Vivantes, vol. 4, pl. 6, (mer des Indes).
 1845 *Pterocera scorpio* Murray, Küster, Syst. Conchyl.-Cab., second series, vol. 4, pt. 1, p. 87, pl. 14, fig. 7.
 1851 *Pterocera scorpius* Linné, Reeve, Conchologica Icon., vol. 6, Pterocera, pl. 3, fig. 3 (Philippines).
 1955 *Lambis* (Millipes) *scorpius* Linné, Butot, Penggemar Alam, vol. 35, p. 77, pl. 2, fig. 5 (Madura, Java).

Types — We restrict the type locality to Mactan Island, opposite Cebu City, Cebu Island, Philippines. Linnaeus' type is in the Linnaean collection in the Linnaean Society of London, according to Dodge, 1956, p. 249.

Nomenclature — Linnaeus originally used the Latin substantive noun "Scorpius" for this species. Later authors (Murray, 1771, Born, 1778, and Lamarck, 1822) used the more common form, "scorpio." We consider the use of the latter name to be an invalid emendation, and are following Butot (1955) who uses *scorpius*. All of Linné's figure references are to the Pacific Ocean form, as are those in Knorr, pt. 2, pl. 3, fig. 1 and Martini, Conchylien-Cabinet, vol. 3, fig. 860.

Records (see map, pl. 131) — RYUKYU IDS.: Okinawa Id. (A. A. Scott and A. R. Cahn Coll'n., ANSP). TAIWAN: Kasyo-to (Kuroda, 1941, p. 98). PHILIPPINES: Calapan and Lubang Id., Mindoro (P. de Mesa, MCZ); Batang Id., Batanes Group (USNM); Borongan, Samar Id.; Gigmoto,

Catanduanes Id.; Marivales, Luzon Id. (all du Pont-Academy Exped., 1958); Jolo Id., Sulu Sea (ANSP); Cebu City, Cebu Id. (A. B. Franco, ANSP). INDONESIA: Sumatra: Atje (Zool. Mus. Amsterdam); Pandjang, Java: Djakarta Bay; Panaitan; Madura; Peutjang, Borneo: Sebuku. Also Roti, Timor, Ambon, Ceram, Ternate, Obi and Waigeu Islands (all Butot, 1955, p. 78). MAURITIE, Flores Id. (Rijksmus. Nat. Hist., ANSP). AUSTRALIA: Queensland (Cotton, 1953, no. 3, second page, fig. 16). DUTCH NEW GUINEA: reef at Biak (NSF, 1956). SOLOMONS: Guadalcanar (AMNH). NEW CALEDONIA: barrier reef, Touho Bay (G. and M. Kline, 1959). MARIANAS: Apra Harbor, Guam Id. (MCZ and ANSP). CAROLINES: Moen Id., Truk (MCZ). FIJI IDS.: Suva, Viti Levu Id. (H. S. Ladd, USNM). SAMOA: Tutuila Id. (ANSP and USNM); Upolu Id. (T. R. Peale, U. S. Explor. Exped., ANSP). [Tahiti records in the literature are probably based upon specimens of *Lambis robusta* (Swainson)].

Fossil records — None reported.

Lambis scorpius subspecies *indomaris* new subspecies

Range — Limited to western and central Indian Ocean.

Remarks and Description — The differences exhibited in the shells of this Indian Ocean race and the typical Pacific Ocean race are slight, but constant, and warrant, we believe, subspecific recognition. In *scorpius indomaris*, the lobe on the left side of the first digitation is either very much reduced or bent back around the apex of the shell. Digitations 4, 5 and 6 are considerably more stunted, their basal portions being not as long as the curved, distal portions. The dorsal sides of the terminal halves of the digitations and the siphonal canal arc usually, although not always, more darkly pigmented with purple-brown. There appears to be no or little difference in the apertural sculpture or coloring. Operculum with about 10 serrations and the radula indistinguishable from that of *scorpius scorpius*.

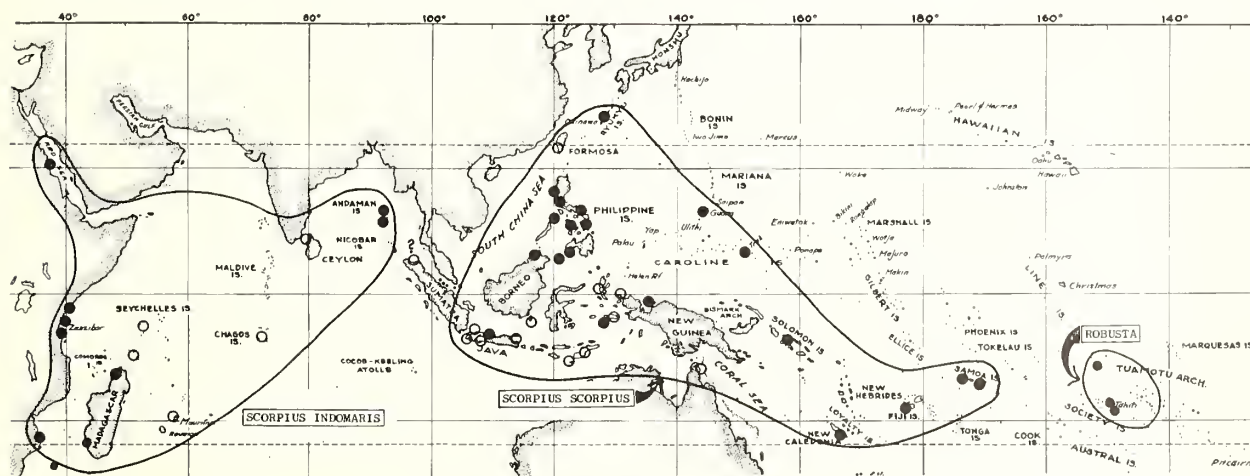


Plate 131. Geographical distribution of *Lambis scorpius scorpius* (Linné) in the central Indo-Pacific, *L. scorpius in-*

domaris Abbott in the Indian Ocean, and *L. robusta* (Swainson) in eastern Polynesia.

This subspecies was named *sinuatus* Perry, 1811 (non Solander, 1786) which is a homonym. I propose the new name, *indomaris*.

Habitat — This is an uncommon subspecies which lives in shallow water on coral and rock-strewn outer reefs. Also found on coral gravel shallows among beds of algae.

Measurements (mm.) — (including digitations)

length	width	no. whorls
135.0	50.0	7+ (holotype, ANSP no. 242210)
130.0	53.0	9+ (paratype, ANSP no. 212384)
111.0	45.0	8+ (paratype, ANSP no. 189165)
170.0	75.0	7+ (Tanikely Id., N.W. Madagascar)

Synonymy —

- 1811 *Strombus sinuatus* Perry, Conchology, London, pl. 13, fig. 3 (American Seas, and at Madeira [both erroneous]). Non Solander (or Humphrey) 1786.
 1829 *Pterocera pseudo-scorpia* Lam., Schubert and Wagner, Conchylien-Cabinet, Numberg, vol. 12, p. 16, pl. 218, figs. 3040-41 (locality unknown).

Types — The type locality is Nossi-bé, northwest Madagascar. The holotype is in ANSP no. 242210. Paratypes in ANSP are listed below.

Records — (see map, pl. 131). MOZAMBIQUE: Mozambique City (K. Grosch, ANSP no. 247564). ZANZIBAR: outer reef, Kiwengwa (ANSP no. 212384); Pange Id. (ANSP no. 214263); Mangapwani (ANSP no. 212968) (all NSF, 1957). KENYA: Kikambala, 15 n. of Mombasa (Coryndon Mus.). EGYPT: Geb Zebara (ANSP no. 189165). MADAGASCAR: Nossi-bé (A. Chavane, ANSP); Tanikely Id. (Academy-Madagascar Exped., 1960). CEYLON: [presumed to be this subspecies] Condatheey, Gulf of Manaar (le Beek, 1799, Philosophical Magazine, vol. 5, p. 339; and Langdon, 1874, p. 74). Andaman Islands: Port Blair; Long Island (both BM). Lienard (1877, p. 38 and 94) reported *scorpis* [this subspecies?] from Mauritius and Chagos Ids., Indian Ocean. Von Martens (1880, p. 279) reported it from the Seychelles and Amirantes.

Fossil records — None reported.

***Lambis robusta* (Swainson, 1821)**

(Pl. 121, fig. 2; pl. 129, fig. 5)

Range — Southeastern Polynesia.

Remarks — Until recently, exact locality data was not known for this rare and poorly understood species. Such erroneous localities as Zanzibar and the Philippines had been listed by Reeve (1851) and others. A specimen was located in the Museum of Comparative Zoölogy which was collected at Tahiti, Society Islands, by W. H. Pease during the latter part of the Nineteenth Century. Dr. Robert Robertson collected five dead specimens on the same island in 1952.

Although this species closely resembles *scorpis*, it is certainly quite distinct and evidently limited to French Oceania. *L. robusta* differs in having stouter, smoothish digitations of which the third and fourth usually have a common base, in having an almost straight siphonal canal, in lacking a lobe at the base of the first digitation, in lacking the short white bar deep within the upper part of the aperture, and in having, instead, a strong lobe deep inside on the upper portion of the columella. This last feature is difficult to see because it is set so deeply within the aperture. *L. robusta* (Swainson, 1821), was formerly known as *pseudoscorpia* (Lamarck, 1822). This species was characterized by Deshayes (1843) as being larger than *scorpis*, but many adults of *robusta* are smaller than some *scorpis*.

Habitat — Unknown, but suspected to be in fairly deep water off the ocean edge of coral reefs.

Description — Shell 110 to 150 mm. (4½ to 6 inches) in length, with 6 moderately stout, smoothish labial digitations and a moderately long, slightly curved, siphonal digitation. Whorls about 9. Nuclear whorls not observed. Postnuclear whorls flat-tish, and bearing numerous small knobs on a strong carina which is located just above the finely impressed suture. Top of apical whorls with numerous, microscopic, spiral threads. Body whorl with 3 main spiral rows of low knobs, the top one at the shoulder bearing 5 or 6 large, irregularly-sized knobs, the middle row bearing 7 or 8 and the lowest row 6 or 7 smaller equal-sized, rounded knobs. Outer lip bearing 6 smoothish digitations, the first and uppermost being the stoutest and longest. Digitations 3 and 4 have a common base. Digitations 4, 5 and 6 have the terminal third bent posteriorly (or upwards). Siphonal canal slightly curved to the right, and about the same length as the first digitation. Aperture rather narrow and quadrate, and deep within is yellowish cream, and, at the upper end has a small sunken depression which is not bounded below by spiral bar. Inside of outer lip tan with an irregular flush of brownish violet which is overlaid by numerous, irregular, raised spiral lirae sometimes extending to the outer edge of the lip. Parietal wall brownish to brownish purple with about 30 irregular, raised, spiral lirae. Columella bounded by a long, weak, narrow, cream-colored, axial swelling deep within the aperture. Periostracum moderately thin and light-brown. Operculum and soft parts unknown.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
190.0	(large, fide Tryon, 1885, p. 125)
153.0	72.0	7 +	(U.S.N.M. specimen)
125.0	80.0	7 +	(average, Tahiti)
111.0	58.0	7 +	(small, Tahiti)

Synonymy —

- 1821 *Pterocera robusta* Swainson, Exotic Conchology, sign. B 3, 11th page; 1841, appendix, p. 32 (no locality).
 1822 *Pterocera pseudo-scorpio* Lamarck, Anim. sans Vert., vol. 7, p. 197 (no locality). Refers to Bonanni, pl. 3, fig. 312 and Lister, pl. 867, fig. 22; 1823, Dillwyn, An Index to Hist. Conchyl. Lister, London, p. 39; 1843, Deshayes, Anim. sans Vert., ed. 2, vol. 9, p. 674; 1870, Gill, Amer. Jour. Conch., Philadelphia, vol. 5, p. 134.
 1842 *Pteroceras pseudoscorpio* Lam., Sowerby, Thesaurus Conchyl., vol. 1, p. 43, pl. 11, fig. 2 (no locality); 1851, Reeve, Conch. Icon., vol. 6, Pterocera, pl. 3, fig. 4 (Zanzibar).
 1852 *Pterocera (Harpago) pseudoscorpio* Lam., Mörch, Cat. Conchyl. Yoldi, p. 60.
 1854 *Harpago (Millipes) pseudoscorpio* Lam., H. and A. Adams, Genera Recent Mollusca, vol. 1, p. 261.
 1955 *Lambis (Millipes) pseudoscorpio* Lamarck, Butot, Peng-gemar Alam, vol. 35, p. 78.

Types — We hereby designate Tahiti Island, Society Islands, as the type locality. The whereabouts of Swainson's type of *robusta* is unknown to me. The type of *pseudoscorpio* Lamarck is presumably in the Muséum d'Histoire Naturelle de Genève. The earliest figure is plate 867 in Lister, 1685.

Records — (see accompanying map, pl. 131). SOCIETY ISLANDS: Tahiti (W. H. Pease, MCZ); Atiue, near Maruapo River; near Punaauia Point (all District of Punaauia, Tahiti, R. Robertson, 1952, ANSP). LINE ISLANDS: Flint Island (C. D. Voy, ANSP). [Records for Zanzibar, Philippines, Australia are probably erroneous].

Fossil records — None reported.

Lambis violacea (Swainson, 1821)

(Pl. 121, fig. 1; pl. 129, fig. 1)

Range — Indian Ocean.

Remarks — This is one of the rarest and most attractive of all the *Lambis*. I would judge that there are no more than a hundred known specimens, and most of these have come from Mauritius. The other localities mentioned in the literature may not be accurate. I am puzzled by Butot's (1955, p. 79) record from Indonesia.

Lambis violacea is readily recognized by its yellowish-white shell, and by its whitish aperture which is tinted with violet or lavender deep within the throat. The spiral lirae on the inside of the outer lip are fine, rather even, numerous and white. The labial digitations may vary in number from 9 to 11.

Habitat — Unknown, although it probably lives on sand and algae bottoms at a depth of 20 to 60 feet.

Description — Shell 73 to 114 mm. (about 3 to 4½ inches) in length, with 10 to 11 thin, blade-like, short labial digitations and a moderately long, slightly twisted, siphonal digitation. Whorls about 9. Nuclear whorls not observed. Post-nuclear whorls slightly concave, and sharply carinate just above the suture. This shoulder earination bears numerous, evenly-sized, nodules which are crossed by 4 to 5 small, but distinct, spiral cords. Above the earination, the whorls are crossed by about a dozen fine spiral threads and by numerous axial threads, thus giving a somewhat reticulated effect. Shoulder of body whorl with a row of 5 or 6 paired knobs, the last one being low and elongate and the next to last one being the highest. Below these, and on the center of the body whorl, are 3 strong beaded cords. Remainder of whorl with numerous, smoothish, smaller, spiral cords. Outer lip with 9 to 11 digitations whose undersurfaces are smoothish, enamel-white and somewhat concave. First digitation obscures the apex of the shell and is bifurcate, the prong to the left being shorter and broader. The other 8 or 9 digitations become progressively smaller towards the anterior end. "Stromboid notch" deep and U-shaped. Below it, the base of the outer lip bears 3 or 4 very small digitations. Siphonal canal is twisted but descends almost straight down. Aperture somewhat quadrate and violet or lavender deep inside, except for a white depression near the top. Outer wall of aperture with about 80 fine, strongly raised, spiral, white lirae. Outer edge of aperture with large, weak, yellowish spots. Parietal wall weakly and unevenly lirate, its lower section strongly swollen, smooth and tan or purplish cream. Outer shell whitish with a few isolated, small, squarish, light-brown spots. Periostracum unknown. Opereulum chitinous, elongate, light-brown and with smoothish edges. Radula unknown.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
113.5	55.1	74	(Mauritius, ANSP)
73.0	42.0	8	(Mauritius, MCZ)

Synonymy —

- 1817 *Strombus millepeda* L., variety C, Dillwyn, Descript. Cat. Recent Shells, London, vol. 2, p. 660 (refers to Conchyl.-Cab., vol. 10, figs. 1494-95).
- 1821 *Pterocera violacea* Swainson, Exotic Conchology, sign. B4, 12th page; 1834, *ibid.*, appendix, p. 33 (Red Sea); 1841, *ibid.*, ed. 2, p. 33.
- 1823 *Strombus purpureus* Mawe, Linné's Syst. Conch., London, p. 127 (nude name).
- 1825 *Pterocera purpurea* Swainson, Dubois, An Epitome of Lamarck's Arrangement of Testacea, London, p. 248; 1837, Swainson [?], Catalogue of the Foreign Shells Manchester Nat. Hist. Soc., p. 74 (both nude names).
- 1842 *Pteroceras multipes* "Chemn." Sowerby, Thesaurus Conchyl., vol. 1, p. 43, pl. 11, fig. 8; 1842, Reeve, Conchologica Systematica, vol. 2, p. 204, pl. 248, fig. 1.
- 1842 *Pteroceras purpurascens* "Swainson" Sowerby, loc. cit., p. 43 (in synonymy).
- 1843 *Pterocera multipes* Deshayes, in Lamarck's ed. 2, Anim. sans Vert., vol. 9, p. 677, no. 8 (mers de l'Inde). Also refers to Conchyl.-Cab., vol. 10, figs. 1494-95; 1850, Traité Element. Conchyl., pl. 115, fig. 7.
- 1843 *Pterocera millepeda* var., Kiener, Coquilles Vivantes,

Paris, vol. 4, Pterocera, p. 11, pl. 10, fig. 1.

- 1955 *Lambis (Millepes) violacea* (Swainson, 1834), Butot, Penggemar Alam, vol. 35, pp. 78-79, pl. 2, fig. 6 (Madura, Indonesia).

Types — The location of Swainson's type is unknown to me, although it may be at Cambridge University. The type locality is the "Red Sea."

Nomenclature — The earliest valid name appears to be *violacea* Swainson, 1821. Dillwyn in 1817 used the name *multipes* Chemnitz only in synonymy under his *millepeda* L. variety C, and is, therefore, not validly used. The name *purpurea* used by Swainson and Mawe is nude.

Records — (see pl. 130) Mauritius (N. Pike, MCZ; ANSP). Cargados Island (J. Robillard, Nat. Mus. Vict.; Lienard, 1877, p. 109). Zanzibar (MCZ). Seychelles (H. Cuming, Nat. Mus. Vict.). Madagascar (McGill Redpath Mus.). Red Sea (Swainson, 1841, p. 33). INDONESIA: Ambat, east Madura (Butot, 1955, p. 79). [Philippine records have never been confirmed].

Fossil records — None recorded.

Subgenus *Harpago* Mörch, 1852

Type: *Strombus chiragra* Linné, 1758.

The speciation problem in this group is very intriguing and not entirely solved to our satisfaction. Collecting of live material in Indonesia and Polynesia will doubtlessly settle the matter. There are three shell forms which have been variously treated by earlier authors as forms, subspecies or even separate species.

One of these, *arthritica* Röding (see our pl. 121, fig. 7), is a shell of quite constant characters and limited to the Indian Ocean. There are no significant differences between the shells of the males and females, other than the slightly smaller size of males. We have been unable to ascertain the eastern limits of this form. Two of Butot's specimens from Indonesia (his pl. 3, figs. 5 and 6) look like *arthritica*. I have also seen specimens labelled "Philippines" but this locality may be in error.

The second kind of shell is the typical and traditionally accepted *chiragra* (Linné). This is the large, rose-mouthed form with an almost smooth, lower columella, which is common in the western Pacific (see our distributional map, pl. 134, and our pl. 121, fig. 12). This is the female shell which is further characterized by the welding together of the last two knobs on the shoulder of the body whorl.

The third form we believe is the male shell of *chiragra*. It has two peculiarities which curiously enough resemble characters found in the Indian

Ocean *arthritica*. These are a tendency to develop white spiral lirae on the purplish brown columella, and the presence of equal-sized knobs on the shoulder. The shell as a whole is generally much smaller than the female shell. The columellar lirae and purple taint vary from a strong development (see our pl. 121, fig. 10) to a weak development (pl. 121, fig. 11). Intermediate shell forms between males and females are not uncommon (see pl. 132, figs. 2-4).

Below, we are presenting our classification and a synopsis of the distinguishing characters. For convenience, we have retained the form name *rugosa* (Sowerby) for the male, and have listed its synonymy separately.

Lambis chiragra chiragra (Linné).

Typical or female form: 6 to 10 inches (150 to 250 mm.) in length; aperture whitish rose; lower columella smoothish (aperture of Bay of Bengal specimens with a purplish stain possibly due to environment); upper end of aperture with an elongate, whitish depressed well or shelf; last two knobs of shoulder larger than the others and welded together; the 5th labial digitation produces a rather high ridge on the dorsal part of the base of the last whorl.

Male or *rugosa* (Sowerby) form: 4 to 7 inches (100 to 175 mm.) in length; aperture rose to reddish with slight or strong purplish markings; lower columella slightly to strongly lirate; upper end of aperture with an elongate, purple and white, depressed well or shelf; last two knobs of shoulder small and not welded together; 5th labial digitation produces a very



Plate 132. Fig. 1, *Lambis chiragra* subspecies *arthritica* Röding from East Africa. Figs. 2-4, intergrading variations in the columellar coloration and spiral lirae in the form

rugosa in *L. chiragra chiragra* (Linné). All about ½ natural size.

low ridge on the dorsal side of the base of the last whorl. The columella of some males is the same as that in the females.

Lambis chiragra subspecies *arthritica* Röding

Male and female form: 5 to 6½ inches (127 to 173 mm.) in length; aperture yellowish white; entire columella purplish brown with strong, white, spiral lirae which parallel the spiral cords (in form *rugosa*, the lirae cross the cords at a slight angle); upper end of aperture without an elongate, deep depression; last two knobs the same size as the others on the shoulder; 5th labial digitation produces a very low ridge on the dorsal side of the base of the last whorl.

It is rather curious that the few records we have seen from eastern Polynesia are the *rugosa* form. This suggests either that only males have been so far collected or that the females also take on the *rugosa*-type characters. If the latter be true, we would have an interesting situation in which major sexual dimorphism occurs in the center of distribution while at both ends of the range there is little or no difference in the shells of the two sexes.

Synonymy —

- 1839 *Pterocera* Lam., Anton, Verzeichniss Conchylien, Halle, p. 84 (type by subsequent designation: *chiragra* Linné).
 1852 *Harpago* "Klein", Mörch, Catalogus Conchyliorum . . . Yoldi, Hafniae, p. 60 (type by indirect tautonymy: *Lambis harpago* Bolten = *chiragra* Linné); 1854, H. and A. Adams, Genera of Recent Mollusca, London, vol. 1, p. 261; 1929, Thiele, Handbuch Syst. Weicht., vol. 1, p. 255; 1940, Wenz, Handbuch der Paläont., vol. 6, pt. 4, p. 946 (type by subsequent designation: *chiragra* Linné).
 1870 *Harpago* H. and A. Adams, Gill, American Journ. Conch., vol. 5, no. 3, p. 136.
 1870 *Pterocera* Lamarck, Kobelt, Illustriertes Conchylienbuch, vol. 1, p. 105 (type by subsequent designation: *Pterocera chiragra* Linné).

Lambis chiragra subspecies
chiragra (Linné, 1758)

(Pl. 121, figs. 10-12; pl. 132, figs. 2-4)

Range — Eastern Indian Ocean to eastern Polynesia (but not now living in Hawaii).

Remarks — Comparative notes are given above in the subgeneric discussion. The females have large shells with a whitish rose aperture and a whitish, smooth lower columella. The male shells are usually smaller and sometimes with strong, white, spiral lirae laid over a darkly-stained, purple columella. These lirae cross the spiral cords of the body whorl at a slight angle, whereas in *arthritica* they are parallel to the spiral cords. In the Bay of Ben-

gal and Western Australia, specimens of *chiragra* usually lack the rose coloration in the aperture and, instead, may have a dirty brownish stain which is probably due to environmental conditions. Suites of dwarf specimens sometimes found in museum collections are probably male shells selected out by collectors in the field, and do not represent a dwarf race.

Dautzenberg's (1929, p. 474) records of *chiragra* from Madagascar (which are based upon identifications by Sganzin, von Martens, Thiele and Odhner), undoubtedly are misidentifications of specimens of *Lambis arthritica* Röding. The latter is moderately common in that area, and we have not seen a specimen of typical *chiragra* with reliable locality data from the western part of the Indian Ocean. E. A. Smith (1903, p. 613) reports *chiragra* from the Maldives and Laccadives southwest of India, but these are probably also *arthritica*. Thiele's Handbuch figure (1929, p. 255, fig. 266) of "*chiragra*" is certainly *arthritica*.

We have seen less than a dozen specimens of *chiragra* from eastern Polynesia, and they have all been the male *rugosa* form. Whether or not the female shell exhibits the characters of large size and whitish rose aperture is not known. It is possible that there is less sexual dimorphism in the eastern part of the range. I have seen typical *rugosa* forms from Okinawa, Ryukyu Islands; "Philippines"; Touho Bay and Noumea, New Caledonia (ANSP); Ngarumaoa Id., Raroia Atoll, Tuamotu Ids. (USNM); Hikueru, Tuamotu Ids. (San Diego Soc. Nat. Hist.); Saipan Id., Marianas; the Society Islands; and from the Line Islands (B. P. Bishop Mus.). Dautzenberg and Bouge's (1932, p. 302) records of *Pterocera rugosa* from the Societies and Tuamotus are probably male *chiragra*.

Lambis chiragra has not been found alive in Hawaii, but we have examined several late Pleistocene specimens from Oahu Island (through the kindness of Clifton Weaver, H. M. Baker and Karl Greene).

Habitat — Demond (1957, p. 297) states that this species, in the Marshall Islands, "lives on seaward reef flats, in sand between rocks and coral heads, and in tide pools. Also found among masses of coral (*Heliopora*) in channels between seaward reefs in 8 to 10 feet of water. Invariably found below low tide line." George and Mary Kline collected males and females on the barrier reef in 4 to 10 feet of water at Touho Bay, New Caledonia. In other areas, such as the Philippines and Palau Islands, it is also associated with sand, coral and algal covered reefs where there is surging of oceanic waters.

Description of shell of female — Shell large, 150 to 250 mm. (6 to 10 inches) in length, massive, with 5 large labial digitations and with the siphonal canal turned to the left. Large "stromboid" notch located between the 4th and 5th labial digitations. Whorls 10 to 11. Whorls in spire concave, bordered above and below by two raised, spiral cords, between which runs the finely indented suture. Spiral sculpture of numerous, small threads and, on the body whorl, of 4 or 5 large spiral cords. The upper cord at the shoulder bears 6 to 7 large knobs of which the last two are the largest and are welded together. The lowest fourth cord is the weakest, but it extends on to the dorsal side of the 5th labial digitation and there forms a raised ridge. Color of outer shell whitish to cream with crowded, zigzag streaks of light- or purple-brown. Color of deep interior of aperture is white. Throat of aperture somewhat constricted, flushed with rose and bearing short, white, raised, spiral lirae. Parietal wall slightly glazed, cream with brown, axial streaks. Lower columella area made into a raised shield which is smoothish, cream and tinted with rose. At the upper or posterior end of the throat of the aperture there is an elongate, concave, greatly depressed, whitish lobe attached to the inner parietal wall. Ceylon specimens usually have a brown or purple-brown stain over all of the apertural area. Periostracum moderately thin, brown, axially striate, but usually worn off on the dorsal sides of the digitations and body whorl. Operculum chitinous, dark-brown, fusiform, with about 16 fine serrations on one side (commonly worn away), usually filling the constricted throat of the aperture and with the muscle attachment scar being half the area of the entire operculum.

Description of shell of male (form rugosa) — Shell similar to that of the female, but about $\frac{1}{2}$ to $\frac{2}{3}$ the size; 100 to 175 mm. (4 to 7 inches) in length. Shoulder with 4 to 6 rather evenly-sized small knobs. Throat and columella pinkish or strongly stained with purple-brown over which run weak to strong, white, raised spiral lirae which cross the spiral cords of the parietal wall at an oblique angle. The inside of the outer lip may be reddish in some specimens. Operculum and periostracum like those in the female.

Radula ribbon with about 46 transverse rows of teeth. Formula: 2-1-2; 1-3 (sometimes 1-4); 5; 7. Verge moderately long, simple and with a laminated pad near the distal end.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
260.0	190.0	9+	(large, female; Ceylon)
246.0	170.0	8+	(large, female; Philippines)
150.0	85.0	9+	(large, male; New Caledonia)
95.0	65.0	8+	(small, male; Palau Ids.)

Synonymy — The names listed below are of *chiragra* (Linné). For convenience and for a clearer understanding of the history of the names applied to the female and male forms, we are listing the synonyms of both forms separately.

Synonymy of female —

- 1555 *Strombus* ———, Belon, La Nature et Diversite des Poissons, Paris, p. 423, fig. (non-binomial).
 1758 *Strombus chiragra* Linné, Systema naturae, ed. 10, p. 742, no. 423 (Ad Bandam Asiae); 1767, ed. 12, p. 1207, no. 491; 1956, Dodge, Bull. Amer. Mus. Nat. Hist., vol. 111, art. 3, pp. 247-249.
 1798 *Lambis harpago* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 67, no. 860, Substitute name for *chiragra* Gmelin, 1791.
 1798 *Lambis undulata* Röding, loc. cit., p. 68, no. 873 (refers to Conchyl.-Cab., vol. 3, fig. 898, a young of *chiragra*?).
 1842 *Pteroceras chiragra* L., Sowerby, Thesaurus Conch., vol. 1, p. 42, pl. 11, fig. 12.



Plate 133. A Pleistocene specimen of *L. chiragra chiragra* (Linné) from a raised beach near Sunset Beach, Oahu Island, Hawaii. (from the Children's Museum of Honolulu). Slightly reduced.

- 1855 *Pterocera kochii* Freyer, Sitzungb. Math.-Natur. der Kaiser. Akad. der Wissenschaften Vienna, vol. 15, p. 22 (no locality). Refers to Kiener, 1843, pl. 5.
- 1938 *Lambis (Harpago) chiragra* (Linné), Hirase, A Collection of Japanese Shells, Tokyo, 6th ed., pl. 88, fig. 2; 1949, Abbott, Scientific Monthly, vol. 69, p. 325, left fig.
- 1940 *Pterocera (Harpago) chiragra* (Linné), Wenz, Handbuch der Paläozoologie, Berlin, Lief. 6, band 6, p. 948, fig. 2764.
- 1950 *Lambis chiragra* Linné, Abbott, Bull. Raffles Mus., Singapore, no. 22, p. 74 (Cocos Keeling Ids.).

Synonymy of male or form *rugosa* —

- 1823 *Strombus chiragra* L., Mawe, Linnæan Syst. Conch., London, p. 125, pl. 25, fig. 4. Not Linné, 1758.
- 1842 *Pteroceras rugosum* Sowerby, Thesaurus Conchyliorum, vol. 1, p. 42, pl. 11, fig. 9 (not 10).
- 1851 *Pterocera rugosa* Sowerby, Reeve, Conchologia Iconica, vol. 6, Pterocera, pl. 4, sp. and fig. 6 (Society Islands). Non Sowerby, 1842; 1936, Robert, Kunstgebilde des Meeres, Bern, p. 15, pl. 14 (Neukalcedonien).
- 1911 *Pterocera (Harpago) rugosa* Sowerby, Dautzenberg, Bull. l'Institut Oceanograph., Monaco, no. 161, p. 3.
- 1938 *Lambis (Harpago) chiragra rugosa* (Sowerby), S. Hirase, A Collection of Japanese Shells, Tokyo, pl. 88, figs. 3.
- 1949 *Lambis rugosus*, Platt, National Geographic Magazine, vol. 96, no. 1, p. 68, fig. 1 (in color).
- 1949 *Lambis arthritica* Röding, Abbott, Scientific Monthly, vol. 69, no. 5, p. 324, fig. upper center.
- 1953 *Harpago chiragra* Linné, Cotton, Malacol. Section, Royal Soc. South Australia, no. 3, Family Strombidae, fig. 18.
- 1959 *Lambis chiragra rugosa* (Sowerby), Sakurai in Oyama, The Molluscan Shells, Resources Exploitation Institute, Tokyo, vol. 2, Lambis pl. 3, figs. 2, 3.

Types — Dodge (1956, p. 247) states that "the specimen marked for *chiragra* in the Linnaean collection in London is a typical and perfect specimen of the *chiragra* of all authors." Hanley (1855, p. 366) likened the type to the shell illustrated by Sowerby (Thesaurus Conchyl., vol. 1, pl. 11, fig. 12). That shell is probably a large female and the color form from Ceylon.

Mr. Peter Dance (1960) was unable to locate

for us the type of Sowerby's *Pteroceras rugosum*. Sowerby illustrated both *arthritica* Röding (his fig. 10) and the male form of *chiragra* (his fig. 9). He speaks of the two varieties. His reference to the "rose aperture" suggests the Pacific male form. I hereby designate his pl. 11, fig. 9 as representing the holotype.

Records (see accompanying map, pl. 134) — [We believe literature records for Madagascar and East Africa are erroneous]. CEYLON: Hikkaduwa (G. and M. Kline, NSF); reef, Foul Point (W. D. Hartman, Yale Peabody Mus.). ANDAMAN IDS.: Port Blair (W. N. Carpenter, USNM). THAILAND: Phuket, Bay of Bengal (F. N. Crider, ANSP). Siantan Id., Anambas Ids., east of Malaya (ANSP). SOUTH CHINA SEA: Paracel Islands (Saurin, 1960, p. 204). COCOS KEELING: (USNM). RYUKYU ISLANDS: Okinawa Id. (W. A. McCarty, ANSP); Shiyo, Shanawan Bay, Okinawa Id. (USNM). TAIWAN: Kasyo-to; Hukukaku (Kuroda, 1941, p. 98). PHILIPPINES: Tabaco, Albany Prov., Luzon Id.; Cuyo Id. (both du Pont-Academy Exped., 1958); Iba, Zambales Prov., Luzon Id. (P. de Mesa, ANSP); San Pedro Bay, Samar Id.; Mindoro Id.; Surigao, Mindanao Id.; Tataan Id., Tawi Tawi Ids.; Camiguin Id.; Dumaguete, Negros Id.; Batan Id., Batanes Group; Leyte Id.; Busuanga Id. (all USNM); Sanga Sanga Id., Sulu Arch. (ANSP); Jolo Id., Sulu Arch. (E. Gutianjo, ANSP). INDONESIA: Sumatra: Sinabang Bay, Simalur Id. (west coast); Biliton Id. (east coast). Java: Leiden Id., Bay of Batavia; Bali Id.; Timor Id.; Great Obi Id., Moluccas; Gulf of Madjene, Celebes (all ex Rykmus. Nat. Hist., Leiden, ANSP). Moluccas: Bouru Id.; Saparua Id.; Batjan Id. (all MCZ). AUSTRALIA: 14 mi. north of Warroora Sheep Station, 150 mi. north of Carnarvon, West Australia (Arch Whitworth, ANSP). Green Id., Queensland (Tony Marsh, in litt.). DUTCH NEW GUINEA: Mios Wocndi Atoll, Padaido Ids.; Maransabadi Id., Aorei Ids. (both A. J. Osheimer, NSF). SOLOMON ISLANDS: Tai Lagoon, Malaita Id. (Calif. Acad. Sci.); Roriana Lagoon, South New Georgia Id. (MCZ); Lutee, Choiseul Id. (W. J. Eyerdam, ANSP). NEW HEBRIDES: Lamap, Mallicola Id. (G. Massoulard, ANSP). NEW CALEDONIA: barrier reef, Touho Bay (G. and M. Kline, NSF). MARIANAS: Saipan Id. (MCZ; USNM); Guam Id. (USNM). PALAUS: Kayangel; Babelthuap; Koror; Eil Malk; Gorokottan (all A. J. Osheimer, NSF). Helen Id., Helen Reef (V. Orr, NSF). CAROLINES: Ulithi; Ponape; Elato; Ifaluk (all USNM). MARSHALLS: Bikini; Rongelap; Eniwetok; Wotho; Ujelang (all USNM); Ebon and Jaluit (MCZ). GILBERTS: Onotoa (USNM). SAMOA: Tutuila Id. (ANSP). SOCIETY IDS.: (San Diego Soc. Nat. Hist. form *rugosa*). WAKE ID.: (A. E. Tara, AMNH). PHOENIX GROUP: Baker's Id.

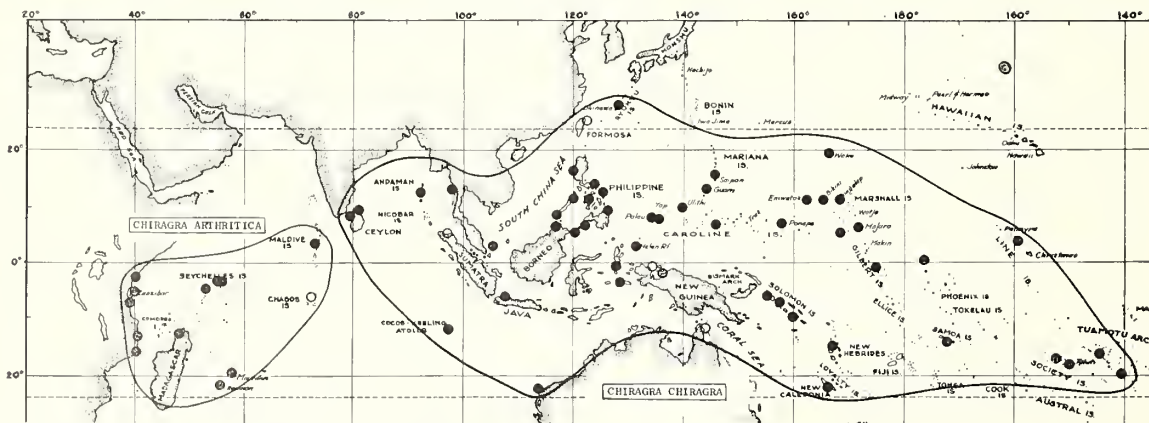


Plate 134. Geographical distribution of *Lambis chiragra* subspecies *arthritica* Röding and *L. chiragra chiragra* (Linné).

(B. P. Bishop Mus.). LINE IDS.: Fanning and Christmas Id. (B. P. Bishop Mus.). TUAMOTU IDS.: Hikueru (San Diego Soc. Nat. Hist.); Ngarumaoa Id., Raroia Atoll (J. P. E. Morrison, USNM); both form *rugosa*; Hao and Otepa (M. Couturier, 1907, p. 153), form *rugosa*. MARQUESAS: (Tony Cavaldon, coll., 1959), form *rugosa*.

Fossil records — HAWAIIAN CHAIN: all Late Pleistocene; Midway (USNM); Sunset Beach, Oahu (Children's Museum); Kapaloma Basin, Oahu (H. M. Baker, coll'n.); side of hill, 15 feet above high tide, Makua, Oahu (Clifton Weaver, coll'n.); lava-coral formation, Waimea Bay, Oahu (H. M. Baker, coll'n.); Kauai Stream, 250-290 ft. alt., Lanai Id. (H. Stearns, USNM 496365); Honolulu Harbor and Kupikipikio, Oahu Id. (J. M. Ostergaard, 1928, p. 26).

Lambis chiragra subspecies *arthritica* Röding, 1798

(Pl. 121, fig. 7; pl. 132, fig. 1)

Range — East Africa to the Central Indian Ocean.

Remarks — This distinct subspecies appears to be limited to the western half of the Indian Ocean. Literature reports of it in the East Indies are probably based upon the similar-looking male phase or *rugosa* form of *L. chiragra*. *L. chiragra arthritica* differs from male *chiragra chiragra* in lacking the deep-set, elongate well or depression at the upper end of the aperture, in having the white spiral lirae on the parietal wall running parallel with the spiral cords (instead of slightly oblique), and in generally having a yellowish rose (rather than a pinkish rose) background color to the aperture.

Both Abbott (1950, p. 74) and Butot (1955, p. 79) seem not to have recognized the problem of subspecific and sexual differences in the *chiragra*-*arthritica* complex. Although Abbott saw intergrades in columella characters in the Pacific shells and rightfully suspected a close connection between the two forms in *chiragra*, he did not realize that he was working with a sexually dimorphic species. He also failed to recognize the morphological and geographical uniqueness of the western Indian Ocean subspecies *arthritica*. Butot recognized the distinctiveness of *arthritica*, but erroneously considered the Pacific males of *chiragra* (the form *rugosa*) as part of *arthritica*. Thus his records of *arthritica* from the Ryukyu Islands, Funafuti, New Caledonia (Ceylon and Indonesia?) are doubtlessly based upon male *chiragra*.

In the shells of male and female *arthritica* I can find no startling differences, other than the slightly smaller size of males and a very slight indication of larger or more elongate shoulder knobs on the shells of females.

Habitat — The Natural Science Foundation expedition to Zanzibar in 1957 found this subspecies reasonably common just below the low tide mark on flat, offshore reefs which were largely covered with algae and marine grass. They found them in company with *Lambis crocata* (Link), *Vasum rhinoceros* (Gmelin), *Conus*, *Haliotis* and some live coral. A label written by Mr. Kurt Grottsch (ANSP 192618) reports that in Mozambique they are found rarely at all seasons "just above the low water level on weed-covered, stony reefs where a swift current moves. In 2 to 3 fathoms of water they live among corals and gravel and their shells are eroded."

Description — Shell (including digitations) 120 to 190 mm. (5 to 7 inches) in length with 5 labial digitations and with its siphonal canal turned to the left. Large "stromboid notch" located between the 4th and 5th labial digitations. Similar to *chiragra chiragra*, but instead of having a deep depression at the upper end of the aperture, there is an arching broadly rounded, slightly depressed shelf projecting from the upper part of the parietal wall. The color of the inside of the outer lip is usually yellowish or pinkish yellow with splotches of purplish underlying the white spiral lirae. The columella is brownish purple with strong whitish spiral lirae which tend to parallel the 4 spiral cords on the parietal wall. On the dorsum of the body whorl, the top spiral cord bears 7 to 9 evenly-sized, rounded nodules. Periostracum thin, varnish-like and translucent-yellowish.

Measurements (mm.) — (including digitations)

length	width	no. whorls	
190	93	7+	(large; Mozambique)
140	75	8+	(average; Zanzibar)
125	70	7+	(small; Zanzibar)
120	70	9+	(small, male, Seychelles)

Synonymy —

- 1798 *Lambis arthritica* Röding, Museum Boltenianum, Hamburg, pt. 2, p. 67, no. 858 (no locality). Refers to Conchyl.-Cab., vol. 3, fig. 857 (which is from Mauritius).
- 1811 *Strombus divergens* Perry, Arcana, London, vol. 2, pl. 74 (no locality).
- 1811 *Strombus nigricans* Perry, Arcana, London, vol. 2, pl. 74 (no locality). Additional name for *divergens*.
- 1842 *Pterocera rugosum* Sowerby, Thesaurus Conchyliorum, vol. 1, p. 42 (South Sea), pl. 11, figs. 10 (not 9). In part.
- 1842 *Pterocera rugosa* Sowerby, Reeve, Conchologia Systematica, vol. 2, p. 204, pl. 247, fig. 1.
- 1855 *Pterocera chiragra* Linné, Freyer, Sitzungsber. der Kaiser Akad. des Wissenschaften, Vienna, vol. 15, p. 22. Refers to Lister, pl. 870.
- 1859 *Pterocera chiragra* Linné, Chenu, Manuel de Conchyl., Paris, vol. 1, p. 258, fig. 1612. Non Linné 1758.
- 1929 *Pterocera (Harpago) chiragra* (Linné), Thiele, Handbuch der System. Weich., Jena, vol. 1, p. 255, fig. 266.

Types — Röding's *arthritica* is based upon a figure of a specimen from Mauritius which we hereby designate as the type locality.

Records — (see map on pl. 134) MOZAMBIQUE: Mozambique City (K. Grotzsch, ANSP); Port Amelia (MCZ; USNM); KENYA: Diani Beach, 20 miles south of Mombasa (R. T. Abbott, MCZ; USNM); Wasin Id., off Shimoni (J. K. Howard, MCZ); Malindi (USNM). ZANZIBAR: rock reef, 5 mi. south of Paje; reef off Ras Nungwe; outer

reef at Kiwengwa (all NSF, 1957). MADAGASCAR: Nossibé (A. Chavane, ANSP). SEYCHELLES: Bird Id., Frigate Id.; Beau Vallon, Mahé Id. (all Yale-Peabody Mus., 1957); Anse Boileau, Mahé Id. (Wickworth, Brit. Mus.). MAURITIUS: (N. Pike, MCZ). REUNION ID.: (MCZ). MALDIVES: Kureduls, Fadifolu Atoll (Yale-Peabody Mus., 1957). CHAGOS IDS.: (Melvill, 1909, p. 94, "Investigator". [the MCZ has records for "Fiji, Singapore and Amboina", but I suspect manufactured data, since they came from old private collections].

Fossil records — None recorded.

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