# JOHNSONIA

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

FEBRUARY 13, 1964 | *VOLUTIDAE* | VOL. 4, NO. 43

## THE SUBFAMILIES VOLUTINAE, ZIDONINAE, ODONTOCYMBIOLINAE AND CALLIOTECTINAE IN THE WESTERN ATLANTIC

BY
WILLIAM J. CLENCH AND RUTH D. TURNER

In *Johnsonia*, numbers 22 and 32, the senior author monographed the subfamily Scaphellinae. The present number considers four additional subfamilies which includes most of the remaining genera in the Western Atlantic Volutidae. Such genera as *Lyria*, *Enaeta* and *Volutomitra* will be considered later when more material is available for study.

Few if any families among the marine gastropods show a greater diversification in the structure of the radula, the shell, and the soft anatomy than the Volutidae. Feeding habits most certainly have had an effect upon changes in the basic plan of the radula. So far as is known, all members of the Volutacea are predaceous or are scavengers feeding on dead animal matter.

A striking example of the problems inherent in this family is illustrated by *Adelomelon ancilla* (Solander) and *Odontocymbiola magellanica* (Gmelin). These two species have the same range (Carcelles, 1944) and have very similar shells but very different radulae. It is impossible to state whether they are allopatric or sympatric. The fact that these two species could have been brought up in a single dredge haul does not mean they occupied the same ecological niche.

The shell characters of *Odontocymbiola americana* (Reeve) are close to those of *Aulicina vespertilio* (Linné) of the Western Pacific, yet the radulae are very different, a character which places these two species in different subfamilies: *O. americana* in the Odontocymbiolinae and *A. vespertilio* in the Zidoninae. The radulae of about 55 species are known, which is about 25 percent of the number of species in the Volutidae.

By sectioning the shells it can be seen that the number of columellar plicae varies within the species but remains constant in any one specimen throughout its life, at least among the species we have examined. Specimens sectioned include *Voluta musica* Linné (figured on Plate 80), *Volutocorona imperialis* (Solander) and *Scaphella junonia* (Shaw).

Various systems have been used in the classification of the Volutidae: the adult shell, the characters of the embryonic shell, the extent to which the mantle covers the shell, and the radula. Of all of these systems, the radula appears to be the best single structure upon which a more natural classification can be based; the shell, the protoconch and other structures being secondary in an evaluation of relationships.

Lahille (1895) made a study of the Argentinian species of the Volutidae and figured

most of the variations exhibited by the shells. Unfortunately, he gave names to these variations. It appears, however, that the variations he selected were a mixture from several localities, so that no biological inferences can be made from his study. Subsequent authors have ignored rather than overlooked this work, or at best have given it only casual mention.

Pilsbry and Olsson (1954) summarized the historical aspects of the classification in this family. The earliest classifications were based entirely upon the shell morphology. J. E. Gray (1858) was among the first to base the major classification upon the type of radula. Dall (1890) attempted a new classification based upon the various types of protoconchs, such as trochiform or bulbous, large or small, pupiform or planorboid. The differences in this morphological structure brought together unrelated species and separated those now known to be closely related. Thus, *V. musica* Linné and *V. ebraea* Linné were placed in different species groups, but they are now known to belong to the same genus, based upon the radulae, shell morphology and soft anatomy. Conversely, Dall's classification brought together *Scaphella junonia* (Shaw) and *Adelomelon brasiliana* (Lamarck). These two species are now placed in different subfamilies.

Plate 80. *Voluta musica* Linné (about 2x). "This *Voluta* was used by Professor Peck to illustrate his lectures in Cambridge College, Mass. It was given by Mrs. Peck to Professor Th. Nuttall and by him to the present donor. August 1874. S. S. Haldeman." (From the original label.)

Mr. S. S. Haldeman, Professor of Natural Sciences at the University of Pennsylvania, presented this specimen to John G. Anthony, then in charge of the mollusk collection at the Museum of Comparative Zoology. William Dandridge Peck was Professor of Natural History at Harvard University between 1805 and 1822.

Cossmann (1899) proposed still another classification based upon all of the various shell characters: the columellar plicae, the shape of the siphonal canal, and the degree of development of the fasciole. This was an improvement over the classification of Dall, as relationships were based upon several different characters. It must be remembered, however, that both Dall and Cossmann were attempting to produce a classification by which the fossil forms could be brought into some semblance of order.

The most recent review of the Volutidae is that of Pilsbry and Olsson 1954. In this report they outlined the subfamilies, several of which they described as new. Their classification is based mainly upon the shell and radula.

The fossil history of the Volutidae in the Western Atlantic is extensive. Basic studies by Dall (1889, 1890 and 1907), Cossmann (1899), Ortmann (1902), von Ihering (1907) and Feruglio (1933), as well as others, cover this subject in considerable detail. According to Dall (1900) the Western Atlantic Volutidae first appeared in the Cretaceous and have continued undiminished to Recent times. According to Weaver (1963) there are approximately 200 living species throughout the world. Most of these species occur in tropical waters, mainly below low water line, and a few species have invaded very deep water. Clarke (1962) lists four members of the Volutidae which have been dredged in depths deeper than 1000 fathoms.

## Acknowledgments

We are indebted to many friends who have aided us in this study. R. Tucker Abbott and Robert Robertson of the Academy of Natural Sciences of Philadelphia and H. A. Rehder and Joseph Rosewater of the United States National Museum were generous in the loan of specimens. Clifton S. Weaver of Honolulu was most generous in the gift and loan of specimens from his fine collection of this family. We are grateful to J. J. Parodiz of the Carnegie Museum, Pittsburgh, for the many helpful discussions we had on the volutid species found in Argentina.

Preserved specimens for anatomical work were received from M. A. Klappenbach of the Museo de Historia Natural, Montevideo, and Eliseo Duarte also of Montevideo, from Bernard Kursch of the Instituto de Quimica Agricola, Rio de Janeiro, E. de Carvalho Rios of the Museu Oceanográfico de Rio Grande, Rio Grande do Sul, Brasil and Carl T. Young of the Carroll High School, Corpus Christi, Texas. Without this material it would have been impossible to understand the anatomy of the subfamilies or, in some cases, to allocate species to their proper genera.

We wish to thank D. F. McMichael of the Australian Museum for the use of notes on the types of the Western Atlantic volutids which he had made during his visit at the British Museum and E. H. Ureta of Montevideo, Uruguay for the typewritten copy of his paper on the Volutidae which he presented at the Zoological Congress in São Paulo, Brasil in 1962.

As usual, members of the department have been helpful in reading the manuscript, particularly R. W. Foster to whom we are also grateful for the timely receipt of new material obtained on a recent trip to Brasil.

## Notes on the Anatomy

The external morphology of the animal of a number of volutes has been figured and described chiefly by Quoy and Gaimard (1832), Gould (1856) and d'Orbigny (1847).

The animal, as shown on Plates 90 and 104, is characterized by having a large broad foot which is usually highly colored, at least on the dorsal surface. The operculum, when present, is small, elliptical, and set on a small pad at a right angle to the long axis of the foot. The head is short, broad and flattened, usually having a large central lobe and two lateral lobes which may be produced either in front of or behind the tentacles. The tentacles are short, flattened and somewhat triangular in shape. The eyes, when present, are very small and located near the base of the tentacles. The proboscis, which can be introverted and drawn completely within the body cavity, is protruded from beneath the flattened head lobes. The siphon is a large muscular organ and is characterized by having one (Scaphellinae) or two lobes at the base as shown for several species on Plate 83.

Male specimens are readily distinguished by the presence of the intromittent organ or penis. In the Odontocymbiolinae it is large, carried folded back over the visceral hump completely within the mantle cavity. The vas deferens leading to it is embedded in the body wall as in *Odontocymbiola americana* (Plate 81).

In *Adelomelon ancilla* (according to Woodward, 1900, p. 118), *A. riosi* and *V. vespertilio* (all Zidoninae), the penis is relatively small and usually not folded back over the visceral hump. The opening of the vas deferens is high in the mantle cavity and an open groove leads from it to and along the ventral edge of the penis. In *Voluta ebraea* (Volutinae) the penis is broad, flattened, with a large, tapered, terminal papilla and the vas deferens is embedded in the body wall. Unfortunately in the material we had for study most of the specimens were females, but it would appear that the size and shape of the penis and its means of connection with the testes may prove of importance in the higher classification of this family.

In this study the soft anatomy was examined for nine different species and a total of eighteen specimens. Unfortunately all animals were not well preserved so that detailed comparisons cannot be made in all cases. Because of the limited number of specimens, it was impossible to judge the range of variation exhibited by any one species or to be sure that the specimen examined was normal and typical for the species. Differences, however, were found in the arrangement of the digestive gland which appear to be consistent within species groups, and these agree with the subfamilies created on the basis of shell and radular characters.

The general morphology of *Voluta musica* Linné has been described by Pace (1902) and *Voluta ancilla* Solander by Woodward (1900). *Odontocymbiola americana* has not previously been studied, so it is the anatomy of this species which is illustrated in detail here. Comparisons will be made with this species.

Because of the tremendous size of the foot and the columellar muscle, it was found that the animal could be more readily dissected by cutting through the mantle posteriorly (as close as possible to the columellar muscle) to the posterior end of the mantle cavity and then transversely, but without cutting through the intestine or oviduct, so that all the organs of the pallial or mantle cavity could be turned over and laid out to the left of the animal. This reveals the ventral surface of the large siphon with the lobes at the base and, just posterior to them, the large bipectinate osphradium and the gill. The hypobranchial mucous gland, the intestine, and the renal pore are now at the left. In the female the large swollen oviduct parallels the intestine and its opening is close to the anus. The large intromittent organ of the male is situated on the visceral hump just behind the right head lobe. In all of the characters mentioned above, the Volutidae resemble other rachiglossate species.

In order to examine the organs of the visceral hump a median incision was made through the head and over the hump and then laterally on both sides at the anterior and posterior areas of the animal. The dorsal wall of the body cavity was then folded to the sides and pinned back or cut off. If the proboscis, or introvert as it is often called, was retracted at the time the animal died, it appears as a large, oval, muscular mass at the anterior end of the body cavity. Just posterior to this are the racemose and tubular sali-

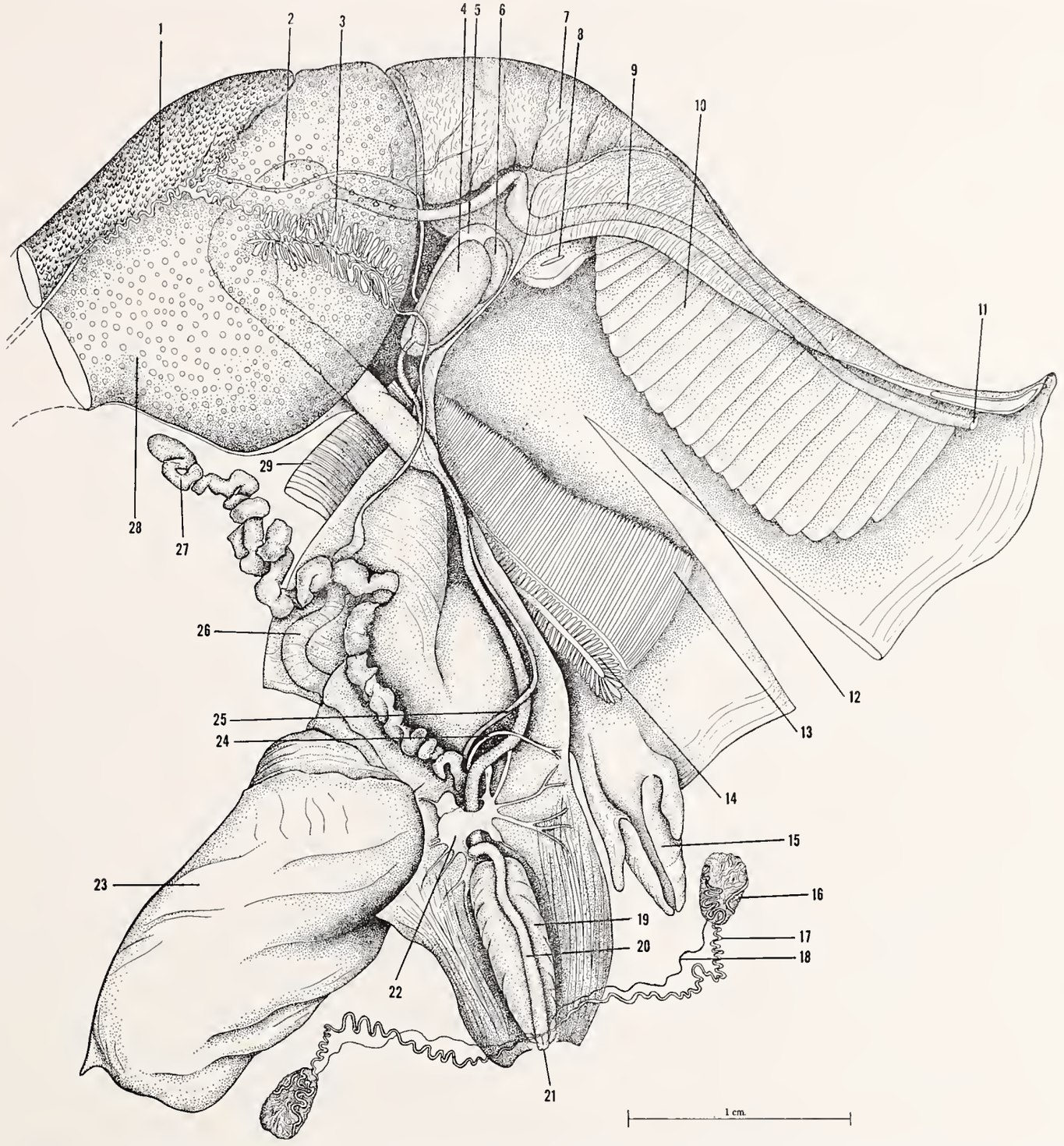


Plate 81. Semi-diagrammatic illustration of the anatomy of *Odontocymbiola americana* Reeve. 1, Testes. 2, Stomach. 3, Vas deferens. 4, Ventricle. 5, Pericardial cavity. 6, Auricle. 7, Kidney. 8, Renal opening. 9, Intestine. 10, Hypobranchial gland. 11, Anus. 12, Mantle cavity. 13, Gill. 14, Osphradium. 15. Siphon with two equal basal lobes. 16, Racemose salivary gland. 17, Tubular salivary gland. 18, Duct of the racemose salivary gland. 19, Buccal mass. 20, Esophagus. 21, Mouth. 22, Nerve ring. 23, Penis. 24, Supra-esophageal nerve. 25, Anterior aorta. 26, Vas deferens embedded in body wall. 27, Gland of Leiblein. 28, Digestive gland. 29, Columellar muscle (cut end).

vary glands and the large, convoluted oesophageal caecum or gland of Leiblein. The convolutions of the gland of Leiblein are tightly bound together by a tough, closely adhering connective tissue, and it has the appearance of an irregular, whitish, glistening ball. In order to study the relationship of the organs it was necessary to separate them. The connective tissue of the gland of Leiblein was removed, the gland uncoiled and pinned to the side. It is much larger than the esophagus into which it opens just posterior to the circumesophageal nerve-ring. Partially covering the nerve-ring and the posterior end of the introvert are the two paired salivary glands. These were not disturbed until the proboscis had been opened. As the proboscis is folded inward upon itself, an incision through the outer wall reveals its anterior end. If the specimen was soft and flexible, the proboscis could be lifted up and stretched forward into its normal feeding position, but with hardened animals it was necessary to make a second incision into the anterior end of the proboscis and to tease away the muscles holding the esophagus and buccal mass, taking care not to injure the ducts of the salivary glands which extend the length of the proboscis. The two pairs of salivary glands were then easily distinguished. The racemose glands in *ebraea* and *musica* (subfamily Volutinae) appear as large white, branching, 'fluffy' organs with short, wide ducts set at right angles to the esophagus just anterior to the nerve-ring (Plate 82). At the point of attachment to the esophagus the ducts diminish in size and extend forward along the sides of the esophagus, becoming extremely fine at the anterior end. Being bound with the esophagus, they are hardly distinguishable from the fine longitudinal muscles. The ducts open into the buccal cavity ventrally near the opening to the esophagus. The tubular salivary glands are long, narrow, convoluted, ribbon-like, and yellowish in color. In *musica* and *ebraea* they are completely free from the racemose glands and when the proboscis is extended they lie completely within it. When it is retracted, the posterior ends of the tubular gland are free in the body cavity. At the posterior end of the introvert, the tubular glands come to lie under the esophagus and extend anteriorly as greatly convoluted tubes which decrease gradually in size. At the posterior end of the buccal mass they unite and then, as a single, very fine duct, continue forward beneath the radular sac and enter the floor of the mouth anterior to the odontophore (Plate 82).

In *riosi*, *brasiliana*, *dufresnei* and *ancilla* (subfamily Zidoninae) the racemose glands are large, irregularly shaped, rather compact organs whose branching structure is not readily evident. They are connected by short, fine ducts to the side of the esophagus in a manner similar to that found in *ebraea*. The tubular glands in this group of species are loosely connected with the racemose gland, the posterior ends of the tubular gland usually extending beyond them posteriorly. The convolutions, however, of the tubular glands can easily be "unwound" and separated from the racemose gland, and they are then found to extend forward in a manner similar to those of *ebraea*, though they are far more convoluted at the anterior end and join to form a single tube anterior to the midpoint of the buccal mass. The proximity of the union to the mouth varies with the species, though none unite as close to the mouth as in *magellanica* and *americana* (Plate 82). In *beckii*, which also belongs to this group, the racemose gland is moderately compact, and the tubular salivary gland in the one poor specimen available did not appear to wind closely around it. The tubular gland in this species is very long and extremely convoluted.

In *americana* and *magellanica* (subfamily Odontocymbiolinae) the racemose glands have become very compact and the tubular glands so closely attached that the two appear

as a single gland. The ducts of the racemose gland are fine throughout their length and terminate in the normal position but, instead of becoming attached to the wall of the esophagus, they parallel the ducts of the tubular glands until the latter unite at the anterior end of the buccal mass and the single duct enters the floor of the mouth anterior to the odontophore (Plate 82).

After the esophagus transverses the nerve-ring and gives off the gland of Leiblein, it continues around the columellar muscle and then becomes slightly enlarged to form the stomach which is imbedded in the digestive gland. The stomach is strongly fluted internally and ducts of the digestive gland open into it. The size and shape of the stomach, the walls of which are thin and non-muscular, appear to vary, depending on the contents. For the specimens dissected it was noted that, if the stomach was empty it was only slightly greater in diameter than the esophagus, but it was conspicuously enlarged in those which were full. Unfortunately, not enough specimens of any one species could be studied to prove this point and the stomach contents were too fragmentary to recognize, except in the case of *A. riosi* which was feeding on *Astropecten*.

In *Odontocymbiola americana* the convoluted portion of the vas deferens lies on the surface of the digestive gland. It emerges from the convolutions at the base of the gland and extends forward around the columellar muscle and enters the pallial cavity where it is imbedded in the muscular body wall and runs forward to the base of the penis. Within the penis the vas deferens winds back and forth until it reaches the penis papilla where it opens. According to Woodward (1900, p. 118) the opening of the vas deferens in *ancilla* is high up in the mantle cavity and a long groove extends from it to the penis which is also grooved. Unfortunately, so few male specimens were available for study the importance of these organs for systematic work could not be determined.

The nervous system for all species studied showed the maximum concentration of the ganglia in the circumesophageal nerve-ring, similar to that figured by Woodward (1900).

The radulae of the Volutidae are characteristically composed of a single row of powerful rachidian teeth. The Western Atlantic species discussed in this report may be arranged in three groups based on the structure of the teeth. The most common is the typical three-pronged tooth as illustrated for *riosi*, *brasiliana*, *dufresnei*, *ancilla* and *beckii* (subfamily Zidoninae). The second type, exemplified by *musica* and *ebraea* (subfamily Volutinae), has a broadened tooth with several denticles all on the same level, the outer ones being the largest. The third group, including *americana* and *magellanica* (subfamily Odontocymbiolinae), has the denticles strongly hooked or fang-like (Plate 82).

Thus it can be seen that the radular characters agree with those of the soft anatomy. It may be noted that *musica* and *ebraea* are further differentiated by having unequal lobes at the base of the siphons, a cleft in the central head lobe, and an operculum which is set on an opercular pad.

A fourth subfamily, the Scaphellinae, was monographed in *Johnsonia* 2: 41–60; 376–380 and, as was shown at that time, the radulae are characteristic. They consist of rachidian teeth only and these may be broadly to narrowly Y-shaped with a large central denticle while the lateral denticles are reduced in size or entirely lacking (see Plate 82). Recent examination of the soft parts of *Scaphella florida* Clench and Aguayo and *Aurinia kieneri* Clench has shown several differences between this subfamily and those considered in this paper. The head is bilobed in front by a deep cleft between the tentacles, which are merely lateral extensions of the lobes. The siphon has only a single basal lobe on

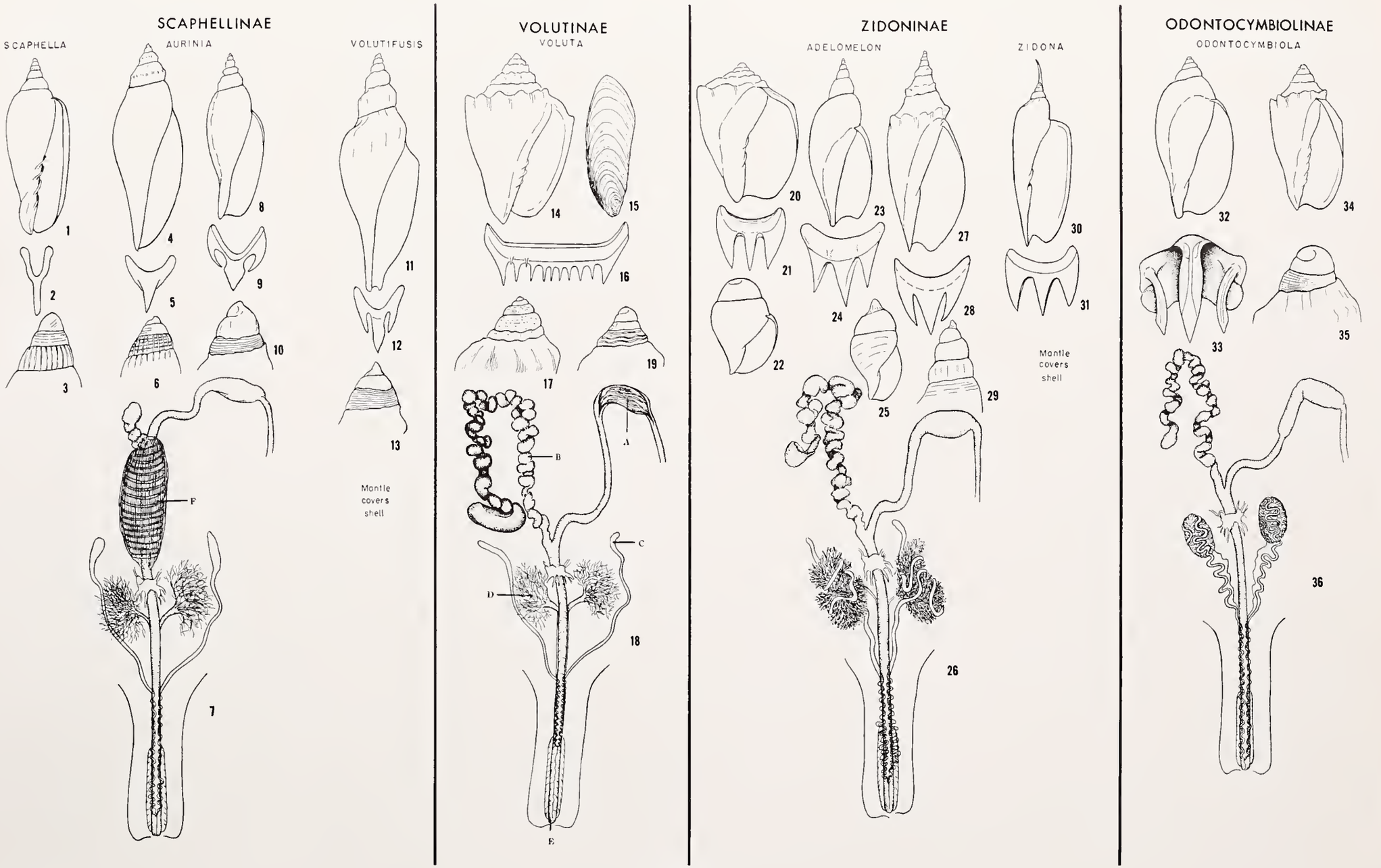
SCAPHELLINAE
SCAPHELLA
AURINIA
VOLUTIFUSIS
1
2
3
4
5
6
7
8
9
10
11
12
13
F
Mantle covers shell
VOLUTINAE
VOLUTA
14
15
16
17
18
19
A
B
C
D
E
ZIDONINAE
ADELOMELON
ZIDONA
20
21
22
23
24
25
26
27
28
29
30
31
Mantle covers shell
ODONTOCYMBIOLINAE
ODONTOCYMBIOLA
32
33
34
35
36

Plate 82

the left side close to the head when the animal is viewed dorsally. The racemose gland is "fluffy" as in *musica;* the tube glands are free, swollen at the distal end and not nearly as convoluted as in other species examined, their union very far towards the anterior. The gland of Leiblein is large and convoluted, but, unlike other volutes, it surrounds the esophagus like a saddle and is so bound by muscles and connective tissue that in preserved specimens it is impossible to separate the regularly arranged loops (see fig. 7, Plate 82).

The present work has shown conclusively that the subfamilies, at least those recognized here, are natural groups established on a variety of characters. However, from an evolutionary point of view little can be said at this time. Though there is a good fossil record, it is now certain that similarity of shell characters does not indicate true relationships. As indicated by Woodward, it is possible that the nervous system may prove useful in this respect. Bouvier (1887) described and figured the nervous system of *Melo* [*Cymbium*] *neptuni* Gmelin showing that the supra-intestinal ganglion was widely separated from the right pleural ganglion. On the basis of this, Woodward, after describing the nervous system of *ancilla*, suggested that there appeared to be an increasing concentration of ganglia in the Volutidae and that *Melo* was probably a more primitive group. A dissection of *Cymbium papillatum* Schumacher shows it to be similar to that of *neptuni*, while in all other species dissected for this study the ganglia were highly concentrated. *Cymbium* also appears to differ from other volutes and perhaps to be less specialized in that the gland of Leiblein is not bound by connective tissues. The placement and appearance of the racemose salivary gland is more like that in *Buccinum*, and the tubular salivary gland is small. The radula of *Cymbium* is of the typically three-pronged type, which may indicate that the Zidoninae arose from a *Cymbium* stock. Undoubtedly when the detailed anatomy of many more species is known, this, in conjunction with the radula, will indicate true relationships and evolutionary trends.

Semi-diagrammatic sketches showing the arrangement of the organs of the anterior portion of the digestive tract of four of the subfamilies are shown on Plate 82.

---

Plate 82. Diagrammatic key to the major subfamilies and genera of the Volutidae in the Western Atlantic. The Odontocymbiolinae and Zidoninae have two equal lobes at the base of the siphons (Plate 83, figs. 1, 4–6); the Volutinae have two unequal lobes (Plate 83, figs. 2, 3) and the Scaphellinae have only the left lobe. The anatomical drawings of the anterior end of the digestive tract are stylized. The gland of Leiblein, except in the Scaphellinae, has been unwound and extended to the side. Normally it is in a tightly wound, irregular ball resting over the esophagus and nerve ring. The anterior end of the esophagus and buccal mass is drawn as if it were transparent in order to show the position of the salivary glands beneath.

Figs. 1–3. *Scaphella junonia* Shaw. Figs. 4–7. *Aurinia florida* Clench and Aguayo. Figs. 8–10. *Aurinia georgiana* Clench. Figs. 11–13. *Volutifusis torrei* Pilsbry. Figs. 14–16. *Voluta ebraea* Linné. Figs. 17–18. *Voluta musica* Linné. Fig. 19. *Voluta virescens* Solander. Figs. 20–22. *Adelomelon* (*Pachycymbiola*) *brasiliana* Lamark. Figs. 23–26. *Adelomelon* (*Adelomelon*) *ancilla* Solander. Figs. 27–29. *Adelomelon* (*Adelomelon*) *beckii* Broderip. Figs. 30–31. *Zidona dufresnei* Donovan. Figs. 32–33. *Odontocymbiola magellanica* Gmelin. Figs. 34–36. *Odontocymbiola americana* Reeve.

Letters on anatomical drawings: A—Stomach opened to show internal ridges. B—Gland of Leiblein. C—Tubular salivary gland. D—Racemose salivary gland. E—Mouth. F—Gland of Leiblein.

The subfamily Calliotectinae is not included, as there is only one species in the Western Atlantic and nothing is known of its soft anatomy.

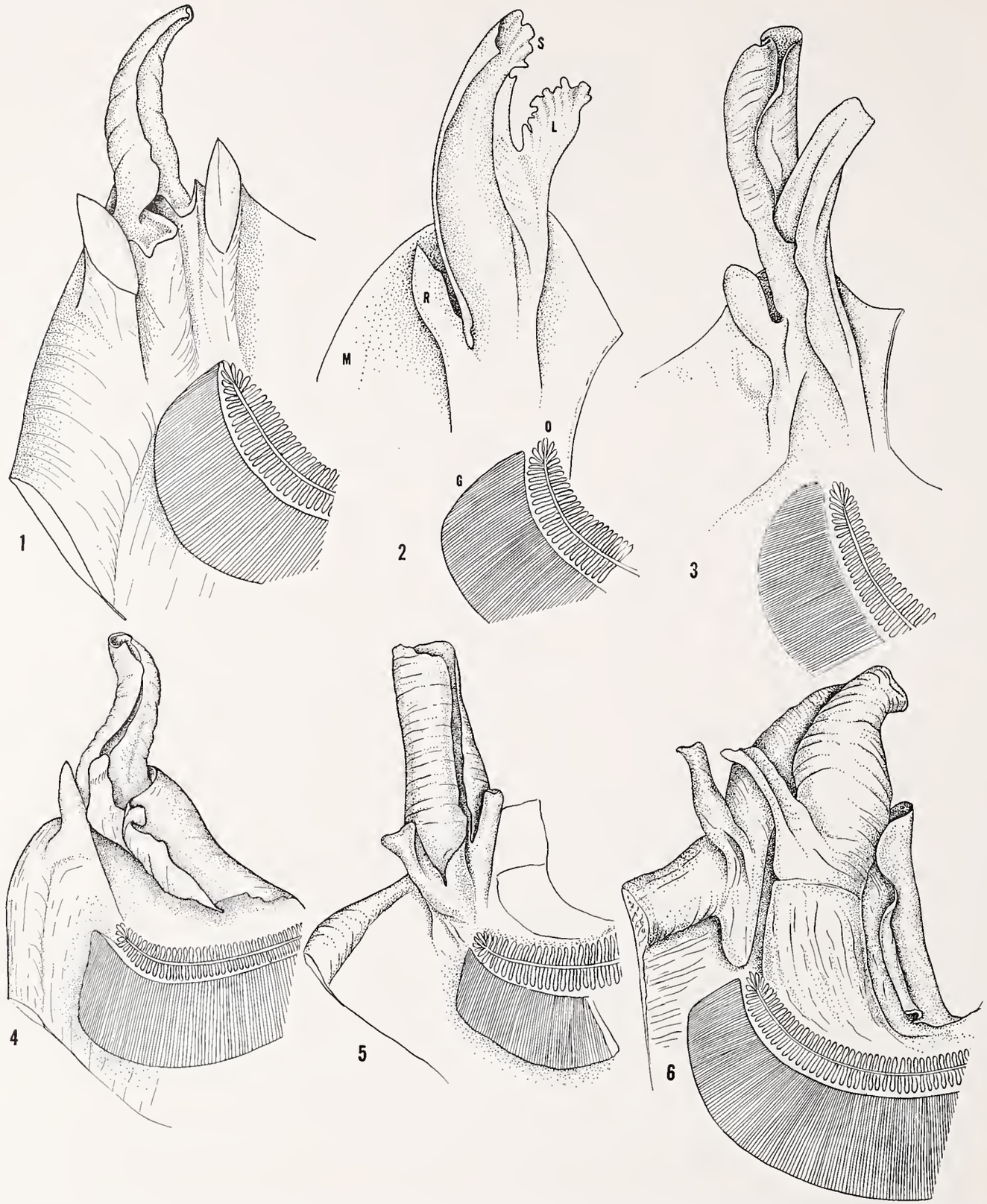


Plate 83. Ventral view of the siphons to show the relationship of the basal lobes, the gill and osphradium. Fig. 1. *Adelomelon riosi* Clench and Turner with short wedge-shaped lobes and thickened mantle margin. Fig. 2. *Voluta ebraea* Linné. Fig. 3. *Voluta musica* Linné. Fig. 4. *Adelomelon ancilla* Solander. Fig. 5. *Zidona dufresnei* Donovan. Fig. 6. *Odontocymbiola magellanica* Gmelin.

S—Siphon. L—Left lobe of siphon. R—Right lobe of siphon. M—Mantle. G—Gill. O—Osphradium.

All drawings made from preserved specimens.

## Family Volutidae *Fleming* 1822

Shells extremely variable in shape and size, the largest species about 45 cm. (18 inches) in length. Most species have columellar plicae. The siphonal canal is well defined, usually forms a notch and succeeding growth stages often form a fasciole. The lip is usually simple and seldom reflected. Operculum, when present, small and unguiculate.

The foot is broad; the head small, flat and wide; the tentacles flat and triangular with eyes when present near their base. The siphonal tube is large with one or two lobes at the base; the mantle is variable: in some forms it may envelop the shell, while in others it extends only slightly beyond the aperture.

The Volutidae are raehiglossate, having the proboscises introvert, paired pre-neural salivary glands, a eoneentrated nervous system and a large gland of Leiblein. The radula is uniserial, except in two small subfamilies which may have small lateral teeth.

## Subfamily Volutinae *Swainson* 1840

The subfamily Volutinae is characterized by having an operculum, unequal lobes on the base of the siphons, broad multicuspid radular teeth, and the tubular salivary gland loosely associated with the racemose salivary gland.

So far as known this subfamily is restricted to the tropieal Western Atlantic.

## Genus **Voluta** *Linné*

*Voluta* Linné 1758, Systema Naturae, ed. 10, p. 729.

*Plejona* Röding 1798, Museum Boltenianum, p. 59 (type species, *V. ebraea* Linné, subsequent designation, Dall 1889).

*Volutarius* Duméril 1806, Zoologie Analytique, p. 166 [no species given].

*Harpula* Swainson 1831, Zool. Illustrations (2) **2**: 77, pl. 77 (type species, *Voluta hebraea* Lam., original designation).

*Musica* Gray 1847, Proc. Zool. Soc. London, p. 141 (type species, *Voluta musica* Linné, monotypic).

*Chlorosina* Gray [in] H. and A. Adams 1858, The Genera of Recent Mollusca **2**: 617 (type species, *Voluta polyzonalis* Gray (=*V. virescens* Solander), monotypic).

*Volutolyria* Crosse 1877, Jour. de Conchy. **25**: 99 (type species, *Voluta musica* Linné, original designation); Fischer 1884, Man. de Conchy. Paris, p. 609.

Type speeies, *Voluta musica* Linné, subsequent designation, D. de Montfort, 1810.

The genus *Voluta*, as now restrieted, consists of three species: *musica*, *ebraea* and *virescens*.

The shells are solid, nodulose and highly ornamented with a complex color pattern. The radula is uniserial, consisting of a series of rachidian teeth which are multicuspid, the two outer cusps being the longest (Plate 85). However, the eentral cusps vary in number in different radulae of any one species, even in a single radular ribbon. Opereulum present. Siphonal lobes unequal.

Dall (1889, p. 146) seleeted *Voluta hebraea* Linné (=*ebraea*) to be the type species of *Plejona*. Much later (1906, p. 143) he attempted to retain *Plejona* and reselected *Conus* (=*Voluta*) *spinosa* Linné as its type. This last seleetion was invalid: first, beeause he had previously seleeted *V. ebraea* to be the type, and seeond, because *Voluta spinosa* Linné was not ineluded in the list of species given by Röding under his genus *Plejona*. *Voluta ebraea* Linné is closely related to *Voluta musica* Linné.

Heilprin (1887) has described a *Voluta musicina* from Tampa Silex beds (Oligocene), Ballast Point, Tampa, Florida, which may well be the ancestral form of the *Voluta musica* complex.

Fischer (1884, p. 609) indicated that *Voluta musicalis* Lamarck (non Müller 1766) of the Eocene of the Paris Basin is a member of *Voluta* s.s. Lamarck's figures (1805, Ann. Mus. d'Hist. Nat. **6:** pl. 43, fig. 7a–b) differ quite sharply from both *V. musica* and *V. ebraea* by being very much smaller and having only three plicae while *musica* and *ebraea* have five or more.

## Voluta musica *Linné*

Plates 80, 82, 83, 84, 85

*Voluta musica* Linné 1758, Systema Naturae, ed. 10, p. 733 (O. Americae ad Jamaecam, Barbados). [We here limit the type figures to those of Gualtieri 1742, Index Test. Conch., pl. 28, fig. Z and here restrict the type locality to Barbados.]

*Voluta thiarella* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 66 (? the Seas of America). [We here limit the type figure to Lamarck 1798, Tab. Encyclopédique et Méthodique **3:** pl. 380, fig. 3.]

*Voluta musica violacea* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 66.

*Voluta thiarella nebulosa* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 66 [nomen nudum].

*Voluta guinaica* Lamarck 1811, Ann. Muséum d'Hist. Nat. Paris **17:** 67 (probably on the coasts of Guinée). [Based upon Chemnitz 1785, Conchylien-Cabinet (1) **11:** pl. 178, figs. 1717–1718.]

*Voluta carneolata* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 67 (locality unknown). [Based upon Lamarck 1798, Tab. Encyclopédique et Méthodique **3:** pl. 379, fig. 4.]

*Voluta laevigata* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 67 (locality unknown). [Based upon Lamarck 1798, Tab. Encyclopédique et Méthodique **3:** pl. 379, figs. 2a–b.]

*Voluta fulva* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 68 (probably the Indian Ocean). [Based upon Lamarck 1798, Tab. Encyclopédique et Méthodique **3:** pl. 382, figs. 3a–b.]

*Voluta sulcata* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17:** 68 (locality unknown). [Based upon Chemnitz 1788, Conchylien-Cabinet (1) **10:** pl. 149, figs. 1403–1404.]

*Voluta musica guineensis* 'Chemnitz' Dillwyn 1817, Descriptive Catalogue of Recent Shells, London, p. 562 (no locality given).

*Voluta plicata* Dillwyn 1817, Descriptive Catalogue of Recent Shells, London, p. 563 (East Indian Seas).

*Voluta polyzonata* 'Lamarck' Kiener 1839, Icon. Coquilles Vivantes **3:** 32, pl. 32, figs. 1–2 (Indian Ocean).

*Voluta musica polypleura* Crosse 1876, Jour. de Conchy. **24:** 163, pl. 5, fig. 6 (locality unknown).

*Voluta musica damula* Dall 1907, Smithsonian Miscellaneous Collections **48:** 347 (Curaçao). [Based upon Sowerby 1847. Thes. Conchyl. **1:** pl. 49, fig. 42.]

*Voluta musica typica* 'Lamarck' Dall 1907. Smithsonian Miscellaneous Collections **48:** 346 (Tobago, West Indies).

*Voluta rugifera* 'Lamarck' Dall 1907. Smithsonian Miscellaneous Collections **48:** 347 [nomen nudum].

*Voluta rugifera* 'Lamarck' Salmon 1952. Jour. de Conchy. **92:** 66, fig. 1 (des Indes). [Type in the Paris Museum.]

*Description.* Shell reaching 88 mm. (about 3½ inches), imperforate, very solid, smooth, axially costate and knobbed. Color ivory to pale pink, overlaid with a complicated pattern of spiral lines and dots with axial threads of color lines between the spiral lines. Irregular lines of spiral dots appear above and below the thin spiral lines. On the inside of the outer lip there are several dark brown spots which are sometimes grouped in couples, in others, these spots occur singly. Spire moderately extended and produced at an angle of about 55° (males) and 70° (females). Aperture relatively wide and oblique. Outer lip thick and recurved. Parietal wall smooth, with a thin glaze and having several plicae, the lower 5 being fairly strong, the upper 2 to 6 being rather weak. Occasionally, small secondary plicae occur between the large lower 5 plicae. These plicae follow back along

the columella to the earliest whorls. Columella short and arched backwardly. Suture slightly impressed and irregular owing to the axial knobs. Sculpture consisting of large rounded knobs at the whorl shoulder. These are the end points of the axial ridges which become narrow and lower below and generally disappear at about the whorl periphery.


Plate 84. Figs. 1–3. *Voluta musica* Linné. Porlomar, Isla Margarita, Venezuela (about natural size). Fig. 4. *Voluta virescens* Solander. Venezuela (2x).

Protoconch smooth, generally a dark brown in color and consisting of two whorls. Operculum unguiculate, about one-fourth the length of the aperture, corneous with concentric lines of growth and a subterminal nucleus.

The radula is uniserial, composed entirely of rachidian teeth, rather wide and having two large marginal denticles and 7 to 12 much smaller central denticles.

Foot divided anteriorly, pale ivory with large, irregularly placed, somewhat diffused purple-brown pigment spots which are interspersed with numerous small red-brown speckles. Head and edge of mantle similarly colored. Eyes small, black and located at the base of the tentacles.

| length | width | |
|---|---|---|
| 88 mm. | 46.5 mm. | Margarita Island, Venezuela |
| 83 | 58 | " " " |
| 77.5 | 42.5 | Grenada, Lesser Antilles |
| 84.5 | 50 | Barbados, Lesser Antilles |
| 42 | 25 | " " " |
| 81 | 53 | Curaçao, Netherlands, West Indies |
| 42.5 | 24 | " " " " |

*Remarks.* A specimen of this species from the collection of Linné is now in the Linnean Society of London. We seriously question whether Linné possessed a specimen in 1758 when the original description was published. The type figure is here selected to be that of Gualtieri 1742, pl. 28, fig. Z. Linné probably obtained his locality data from Martin Lister 1685–1697, Hist. Meth. Conch., where the words "Jamaica, Barbados" were printed on Pl. 805.

On Plate 85, figs. 1–2, the teeth illustrated were from a radula 3 mm. in length, from a specimen 61 mm. in length. In fig. 3 the tooth was from a radula 9 mm. in length, the specimen being 69 mm. in length. Both were females and both were adult specimens. It is quite possible that the small radula was newly regenerated, the animal having lost its original radula through some accident. This theory is supported by unpublished data (briefly summarized in Carriker 1961) regarding the experimental amputation and subse-

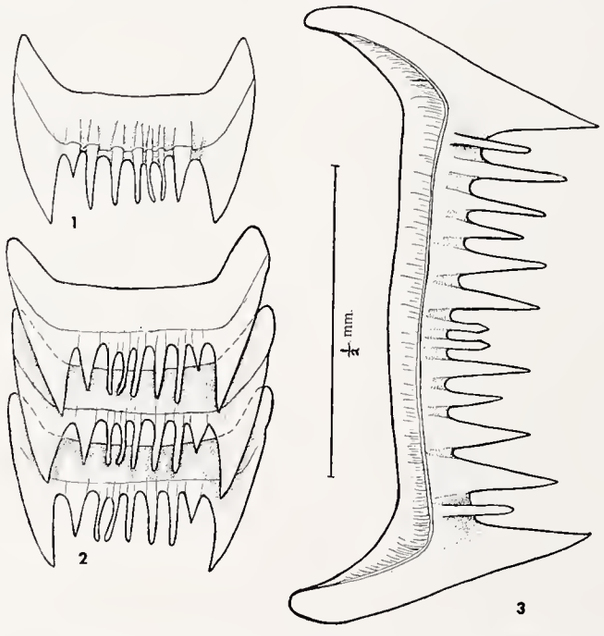


Plate 85. Radula of *Voluta musica* Linné. Bucco Reef, Tobago, Lesser Antilles. Length of radula 3 mm. Fig. 1. Back view of a single tooth. Fig. 2. Front view of three teeth in normal position. Fig. 3. A single tooth from a 9 mm. radula.

quent regeneration of the proboscis in *Urosalpinx* and *Eupleura*. Dr. Melbourne Carriker in a letter stated that the proboscises of numerous specimens were removed with iris scissors, and it took from 11 to 34 days to regenerate the proboscises sufficiently for the animals to begin feeding again.

*Voluta musica* is an exceedingly variable species in all of its shell morphology. The large number of names in the synonymy above are based upon these variations. Even specimens in unit populations exhibit differences in size, coloration, extent of the color pattern and in the size and number of the axial plicae. None of these variations appear to have any geographic significance. *V. musica* Linné differs from *V. ebraea* Linné by being smaller, having the shoulder knobs blunter and having a different color pattern. The largest specimen of *musica* we have seen reached 88 mm. while the largest specimen of *ebraea* measured 206 mm. in length. The operculum differs from that of *V. ebraea* by having the nucleus subterminal, the growth lines concentric and reaching from one margin to the other. In *V. ebraea* the nucleus is subcentral with the growth lines subcircular.

Sexual dimorphism is exhibited in the shells of this species: the heavy and strongly knobbed broad specimens being females; the more numerous and narrower specimens being males.

This appears to be a rather common species in the southern Lesser Antilles, but exceedingly rare in the northern portion of its range.

Dall (1907, p. 346) referred to and described *Voluta musica typica* Lamarck. Very probably Dall meant only the word "typical" in reference to the main species, as no such name was instituted by Lamarck. Nonetheless, this name appears as a validly introduced trinomial and has been used by subsequent students.

No species of *Voluta* s.s. occurs on the west coast of Africa. Even as late as 1907 Dall gave several African localities for *V. ebraea* Linné and *V. virescens* Solander. Early "records" for West Africa have been copied repeatedly from one monograph to another. Nicklès (1950) in his study of West African marine mollusks does not mention the genus.

*Range.* From Hispaniola south through the Lesser Antilles and south to British Guiana.

Warmke and Abbott (1961, p. 126) report this species from near Guanica, Puerto Rico.

*Specimens examined.* Hispaniola: Monte Cristi, Dominican Republic (MCZ). Virgin Islands: St. Thomas (MCZ). Lesser Antilles: Dominica (USNM); Port Castries and Pigeon Island, St. Lucia (both MCZ); St. Vincent (USNM); Maxwell's Coast and off Pelican Id., Barbados (both USNM); St. Georges, Granada; Carriacou Id., Grenadines; Speyside and Buccoo Reef, Tobago (all MCZ); Chaguaramas and Magueripe Bays, Trinidad (both H. G. Kugler); Salybia Bay and Toco, Trinidad (both MCZ). Caribbean Islands: Williamstadt (R. Atmus) and Santa Ana Harbor (ANSP), both Curaçao; Bonaire; Aruba and Isla Orchilla (all USNM); Margarita Id. (MCZ; USNM); Los Testigos (ANSP). Venezuela: Tucacas Bay, Est. Falcon (H. G. Kugler): Porto Cabello (ANSP); La Guaira (USNM). British Guiana: Corentyne River (MCZ).

## Voluta ebraea *Linné*

Plate 82, 83, 86, 87

*Voluta ebraea* Linné 1758, Systema Naturae, ed. 10, p. 733 (O. Asiatico). [We here limit the type figure to F. Buonanni 1684, Recreatio Mentis et Oculi, p. 154, fig. 293.]

*Voluta hebraea* Gmelin 1791, Systema Naturae, ed. 13, p. 3461 (India and Jamaica).

*Voluta chlorosina* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17**: 66 (locality unknown); Salmon 1952, Jour. de Conchy. **92**: 67, fig. 2.

*Voluta turbinata* Kiener 1839, Icon. Coquilles Vivantes **3**: 19, pl. 26, fig. 2 (Indian Ocean).

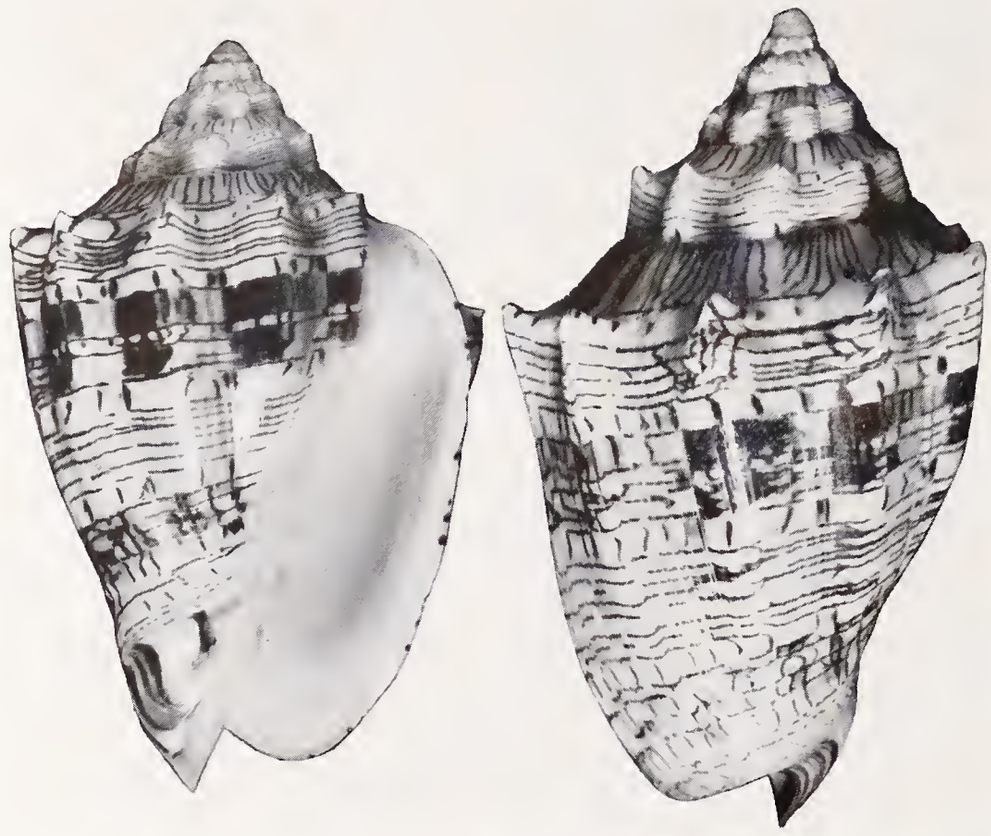

Plate 86. *Voluta ebraea* Linné. (Left) Paripueira, Alagoas, Brasil (1.14x). (Right) Alagoas, Brasil (about natural size).

*Description.* Shell reaching 90 mm. ($3\frac{1}{2}$ inches) in length, imperforate and solid. Color complex and variable, consisting of numerous, spiral lines of reddish brown and usually two broad, irregular, spiral bands of the same color. The ground color ranges from ivory to a dark brown, and occasional specimens lack spiral lines. On the whorl shoulder there are numerous, axial, thread-like lines of brown. Whorls 7 and slightly convex. Spire moderately extended and produced at an angle of about 60° (males) and 75° (females). Aperture long and narrow. Outer lip thick and very slightly reflected. Parietal wall glazed and having 5 to 6 strong plicae below and 4 to 5 weak to very weak plicae above. Columella short and recurved to form a short siphonal canal. Suture irregular and slightly indented. Sculpture consisting of 9 to 11 large, short shoulder spines on each whorl which point upwards and are sharp. The bases of these spines form rounded ridges which flatten out and disappear at the whorl periphery. Protoconch smooth, rather large and having 2 whorls. Operculum unguiculate, only one-fourth as long as the aperture, with a subcentral nucleus and sculptured with numerous, concentric growth lines.

Radula similar, but larger than that of *V. musica* Linné. As in *musica*, the broad and heavily knobbed specimens are females; the more slender ones are males.

The foot and mantle of the animal are pale ivory with numerous, narrow, dark red, thread-like lines which form an irregular, net-like pattern. In addition, there are a few small spots of the same red color which appear along the sides of the foot. The mantle is pale ivory except for a narrow strip of red lines on the inner surface just anterior to the

siphon; this continues over the siphon and around the edge against the columella. Foot very large with a large fleshy lobe anteriorly. No eyes evident.

| length | width | |
|---|---|---|
| 206 mm. | 110 mm. | Barra de Maxaranguapé, north of Natal, Brasil |
| 175 | 111 | 9 miles off Muriú [15 miles north of Natal], Brasil |
| 170 | 112 | off Recife, Brasil |
| 119 | 72 | [Brasil] |
| 98 | 60 | São Luiz do Maranhão, Brasil |
| 83 | 48 | Alagoas, Brasil |

*Remarks.* According to Dodge (1955, p. 126), Linné did not have a specimen of this species, at least at the time the original description was published. As stated in the synonomy above, we select Buonanni, fig. 293, to be the type figure. Linné's reference to the figures in Gualtieri 1742 and Rumphius 1741 are not *ebraea* but *vespertilio* Linné, a species common in Indonesia and the Philippines.

*Voluta ebraea* is probably limited to the coast of Brasil. Many of the early references were to the Indian Ocean, West Africa, and Jamaica, but these were only guesses. It must be remembered, however, that data of this sort had only casual interest during the early days of descriptive zoology.

See *Remarks* under *V. musica* Linné.

*Range.* Probably only the northern coast of Brasil.

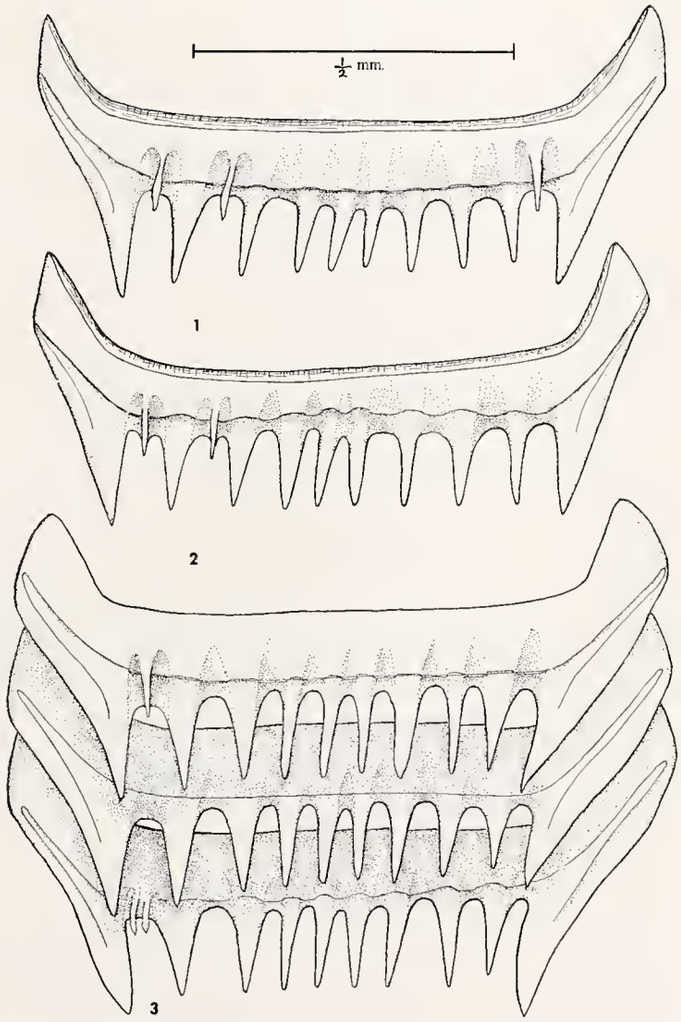


Plate 87. *Voluta ebraea* Linné. São Luiz do Maranhão, Brasil. Figs. 1 and 2. Single teeth showing the variation in the number of small, secondary denticles. Fig. 3. Three teeth in normal position.

*Specimens examined.* Brasil: Barra de Maxaranguapé, north of Natal, Est. Rio Grande do Norte and 9 miles off Muriú (15 miles N of Natal), Est. Rio Grande do Norte, in 15 fathoms, coral, rocks and sand bottom (both B. Tursch); São Luiz do Maranhão, Est. Maranhão (Thayer Exp., MCZ); 7 miles S of and Suape village, 21 miles S of Recife, Est. Pernambuco (both MCZ); Alagoas, Est. Pernambuco (Ruth Craine; P. Cardoso; ANSP); near Todos Santos Bay, Est. Bahia (D. L. Bryant).

## Voluta ? virescens *Solander*

Plates 82, 84

*Voluta virescens* Solander 1786, Catalogue of the Portland Museum, London, p. 26, no. 610 (Guinea). [Based upon Martini 1777, Conchylien-Cabinet (1) **3**: 97, figs. 932–933. [Type locality, here selected, Cartagena, Colombia.]

*Voluta polyzonalis* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17**: 68 (Indian Ocean). [Based upon Lamarck 1798, Tab. Encyclopédique et Méthodique **3**: pl. 379, figs. 1a–b.]

*Voluta fulva* Lamarck 1811, Ann. Muséum d'Hist. Nat., Paris **17**: 68 (probably the Indian Ocean). [Based upon Lamarck 1798, Tab. Encyclopédique et Méthodique **3**: pl. 382, figs. 3a–b.]

*Voluta pusio* Swainson 1823, Philosophical Magazine **61**: 378 (no locality given); Swainson 1823, Zool. Illustrations **3**: pl. 181.

*Description.* Shell relatively small, reaching about 53 mm. ($2\frac{1}{8}$ inches) in length, solid, imperforate and sculptured. Color white to ivory with spiral bands of grayish brown. In addition, there may be a series of brownish dots in spiral arrangement — whitish in zones separating the brownish bands. On the outer lip there may be 6 to 9 short horizontal bars of brown. Whorls 7 and slightly convex. Spire depressed and produced at an angle of about 80°. Aperture long and narrow. Outer lip thickened and reflected. Parietal wall glazed and with 9 to 12 irregular plicae. Columella short and recurved dorsally to form one side of the siphonal canal. Suture slightly indented. Sculpture consisting of 8 to 10 rounded knobs at the whorl shoulder. The bases of the knobs form rounded ridges which extend down the whorl and flatten out at about the whorl periphery. In addition, there are numerous axial threads which are crossed by fine spiral grooves. Protoconch of $1\frac{1}{2}$ whorls and smooth. Operculum and radula unknown.

| length | width | |
|---|---|---|
| 53 mm. | 33 mm. | Cartagena, Colombia |
| 47 | 27 | Cartagena, Colombia |
| 41 | 23 | Puerto Escondito, Colombia |

*Remarks. Voluta virescens* Solander is a rare species judging from the few specimens we have seen. Dall's record (1907, p. 349) of this species from 'Mesquital', Texas, is certainly open to question. West African records are in error.

*Voluta virescens* Solander differs from both *V. musica* and *V. ebraea* by being much smaller and in having a very different color pattern. The soft anatomy of this species has not been examined so that its generic position is still uncertain.

*Range.* Nicaragua and south to Colombia.

*Specimens examined.* Nicaragua: Wounta Haulover (USNM). Panama: Colón (ANSP; USNM). Colombia: SW Bolivar coast, N of Puerto Escondido; S Bolivar coast, near Tolú (both R. W. Barker); Crespo Beach, Cartagena (R. Atmus; USNM); Savanilla; near Santa Marta (both USNM).

## Subfamily ZIDONINAE *H. and A. Adams*

*Zidoninae* H. and A. Adams 1853, The Genera of Recent Mollusca, London **1:** 161.
*Alcithoinae* Pilsbry and Olsson 1954, Bull. American Paleontology **35:** 287.

This subfamily was introduced by H. and A. Adams in 1853 to include the single genus *Zidona*. Pilsbry and Olsson in 1954 created the subfamily Alcithoinae which included *Zidona* along with several other genera.

The subfamily is characterized by having the radula uniserial, composed of rachidian teeth only: each tooth with three, pointed denticles in one plane; having two equal lobes at the base of the siphon; lacking an operculum and having the tubular salivary gland loosely wound around the moderately compact racemose salivary gland (see Plate 82).

## Genus **Zidona** *H. and A. Adams*

*Volutella* d'Orbigny 1841, Voyage dans l'Amérique Méridionale **5:** 422 (type species, *Voluta angulata* Swainson, monotypic); non *Volutella* Perry 1810; Swainson 1830.

*Zidona* H. and A. Adams 1853, The Genera of Recent Mollusca **1:** 161 (type species, *Z. angulata* 'Solander' H. and A. Adams, non Solander 1786, monotypic).

The crediting of *Z. angulata*, the type species of *Zidona*, to Solander rather than Swainson, was a simple case of *lapsus* on the part of H. and A. Adams, for their figures and description are of *angulata* Swainson (=*dufresnei* Don.) and not *angulata* Solander (=*Xancus angulatus* Sol.).

Only a single species is known in this genus; therefore, the specific characters will hold for the genus as well. The radula is uniserial, rachidian teeth only, each tooth with three pointed denticles in one plane. Mantle extended over most of the outer surface of the shell and producing a spur on the apex (Plate 89).

### **Zidona dufresnei** *Donovan*

Plates 82, 83, 88, 89, 90, 91

*Voluta angulata* Swainson 1821, Exotic Conchology, London (1) **1:** [p. 6], pls. 3–4 (Pacific Ocean). [Syntype, British Museum, ex Mawe collection]; ibid. 1841, edited by S. Hanley, p. 17, pls. 3–4 (Southern Pacific Ocean); non *Voluta angulata* Solander 1786, Catalogue of the Portland Museum, p. 76 (=*Xancus angulata* Solander).

*Voluta dufresnei* Donovan 1823. Naturalists' Repository **2:** pl. 61[1] [Argentina.] [Type specimen probably lost.]

*Voluta nasica* Schubert and Wagner 1829, Conchylien-Cabinet (1) **12:** 10, pl. 217, figs. 3031–3032 (locality unknown). [Holotype of this species may be in the Polytechnic Institute in München, Germany.]

*Volutella angulata* Swainson. d'Orbigny 1841, Voyage dans l'Amérique Méridionale, Paris **5:** 423, pl. 60, figs. 1–3 (Río de La Plata to San Blas, Patagonia).

*Zidona angulata* 'Solander' H. and A. Adams 1853, The Genera of Recent Mollusca, London **1:** 161 (South America); non *Voluta angulata* Solander 1786.

*Voluta angulata* Swainson. Lahille 1895, Revista del Museo de La Plata **6:** 307, pl. 2, figs. 69–78; pl. 6 and pl. 7. Lahille has described the following forms: *luteola*, p. 309; *mixta*, p. 309 (non Galeotti 1837); *similis*, p. 310; *distincta*, p. 310; *ventricosa*, p. 310 (non Dillwyn 1817); *affinis*, p. 311 (non Brocchi 1814).

*Description.* Shell rather large, reaching 190 mm. (7½ inches) in length, imperforate, smooth, glazed and with a broad whorl shoulder. Color yellowish to orange, the more intense coloration exhibited on the ventral area. In addition, there are numerous, irregu-

[1] The type "locality" as given by E. Donovan: "Found by Capt. Campbell on the east coast of the Cape of Good Hope, but is better known as a native of California in South America."

lar, axial, zig-zag lines of a reddish brown coloration. Whorls 4 to 5, shouldered and nearly flat sided. Spire extended, acute and produced at an angle of about 50°.[1] Aperture long, nearly equal in length to the body whorl and subquadrate in outline. Outer lip thin. Parietal area heavily glazed. Columellar area with 3 or 4 generally unequal plicae. Suture slightly indented. Sculpture consisting of very fine and irregular growth lines. Protoconch of two small whorls, the first papilliform and covered by a "spur," a narrow prolongation which may be straight or curved and may extend as much as 20 mm. in length beyond the end of and following the shell axis.

The radula is uniserial, with rachidian teeth only, each having three, sharp, subequal, pointed denticles in the same plane.

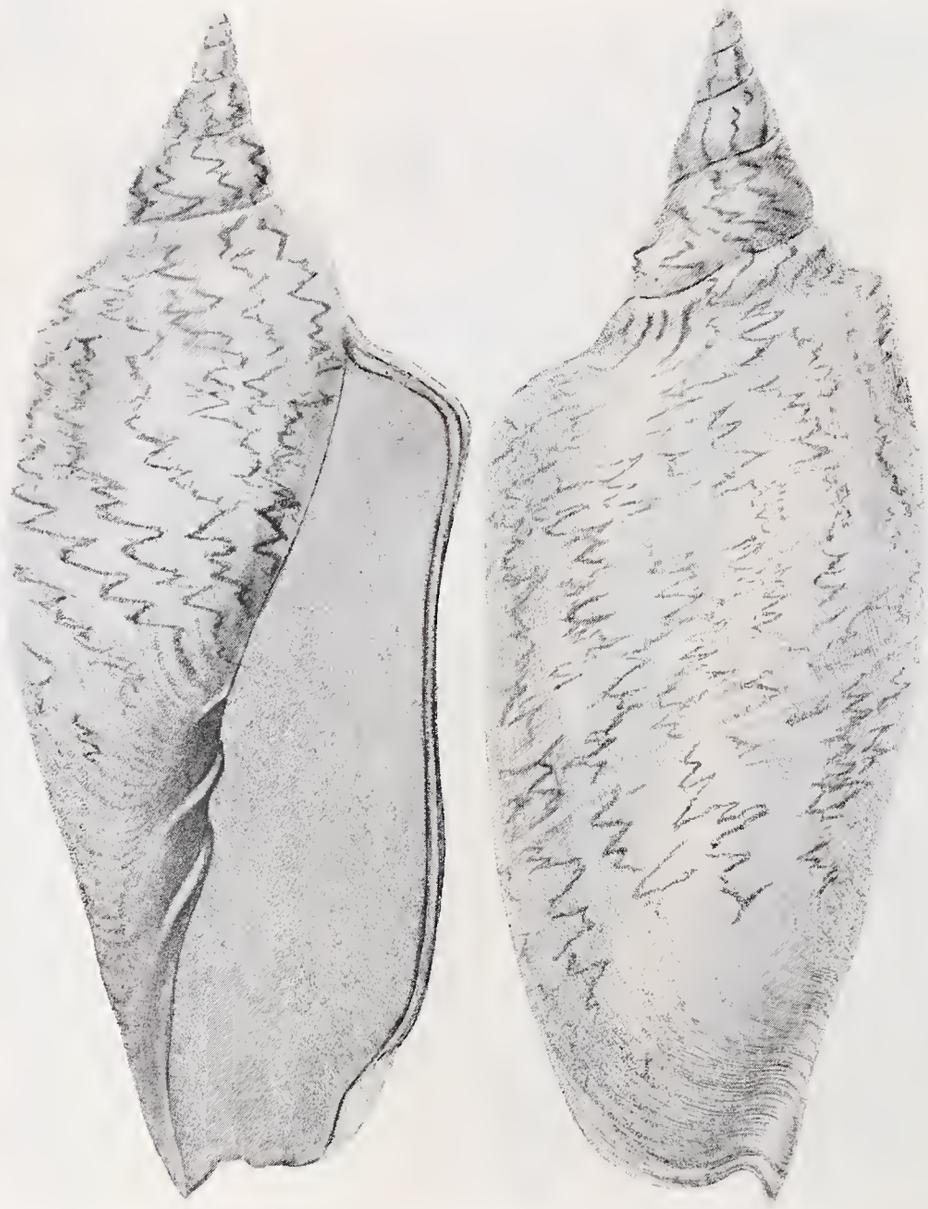

Plate 88. *Zidona dufresnei* Donovan, after Donovan, Naturalists Repository 1823, Vol. 2, pl. 61 (natural size).

[1] Not including the body whorl shoulder.

| length | width | |
|---|---|---|
| 207 mm. | 80 mm. | off Cabo Búzios, Brasil |
| 190 | 73 | Puerto Quequén, Argentina |
| 148 | 71 | Patagonia, Argentina |
| 117 | 60 | off Rio de Janeiro, Brasil |
| 128 | 55 | Punta del Este, Uruguay |
| 130 | 52 | Syntype of *V. angulata* Swainson |

Plate 89. *Zidona dufresnei* Donovan. From Puerto Quequén, Argentina (about natural size).

This species is quite variable in the ratio between the width and length. We give below the measurements of two populations.

17 miles off Ilha Grande, Est. Rio de Janeiro, Brasil

| length | width | ratio of width to length | |
|---|---|---|---|
| 191 mm. | 78 mm. | 2.45 | largest specimen |
| 102 | 45 | 2.26 | smallest specimen |
| 153 | 64 | 2.39 | average of 10 specimens |

Extreme ratios were 2.67 and 2.26

4 miles off Cabo Búzios, Est. Rio de Janeiro, Brasil

| length | width | ratio of width to length | |
|---|---|---|---|
| 207 mm. | 80 mm. | 2.59 | largest specimen |
| 78 | 37 | 2.11 | smallest specimen |
| 134 | 56 | 2.57 | average of 18 specimens |

Extreme ratios were 2.70 and 1.91

*Remarks.* Neither Dall 1907 or Carcelles 1944 have accepted the numerous variants to which Lahille attached names.

This species ranges in shape and size from rather short and broad specimens to those which are a little narrower but proportionately far more attenuated.

The animal possesses a rather broad foot and a mantle which can almost completely

Plate 90. *Zidona dufresnei* Donovan. After A. d'Orbigny 1847, Voyage dans l'Amérique Méridionale, pl. 60 (about $\frac{2}{3}$x).

cover the outer surface of the shell. It is at this time when the mantle is fully extended that the spur is produced. It increases the length of the shell, being sometimes up to one inch long.

According to B. Tursch (in letter) the body of the animal is mottled with dark green on a rich cream colored background.

*Range.* Cabo Frio, Est. Rio de Janeiro, Brasil, and south to the Gulfo San Matías, Argentina.

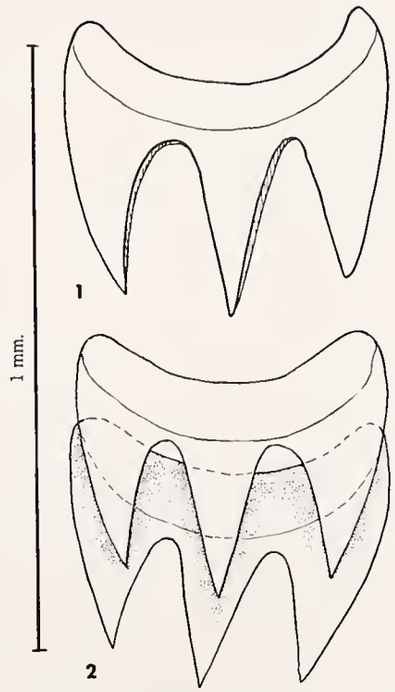


Plate 91. *Zidona dufresnei* Donovan. Off Isla Lobos, Uruguay. Length of radula 6 mm. Fig. 1. Single tooth. Fig. 2. Two teeth in normal position.

*Specimens examined.* Brasil: 15 miles off Macaé, Est. Rio de Janeiro, in 32 fathoms, sand and mud bottom; 4 miles off Cabo Búzios, Est. Rio de Janeiro, in 25 fathoms, sand and mud bottom (both B. Tursch); Cabo Frio, Est. Rio de Janeiro (M. J. de Oliveira); Rio de Janeiro (MCZ); 10 miles off Ilha Rasa, Est. Rio de Janeiro, in 35 fathoms, mud bottom; 17 miles off Ilha Grande, Est. Rio de Janeiro, in 35 fathoms, mud bottom (both B. Tursch); Praía de Imbituba, 30 km. N of Laguna, Est. Santa Catarina (M. J. de Oliveira); Sarita and Albardão, both Est. Rio Grande do Sul (ANSP). Uruguay: Cabo Castillo (=Cabo Polonio) (USNM); Cabo Santa María (MCZ; USNM); Punta del Este, Maldonado (E. Duarte; USNM); Piriapolis (USNM). Argentina: Puerto Quequén, Prov. Buenos Aires (MCZ; ANSP; A. Carcelles); Monte Hermoso, Buenos Aires (USNM); San Antonio, Gulfo San Matias, Prov. Rio Negro (MCZ).

## Genus **Adelomelon** *Dall*

*Scaphella* and *Cymbiola* of authors, not of Swainson 1832.

*Adelomelon* Dall 1906, Nautilus **19:** 143, non Pilsbry and Olsson 1954.

*Janeithoe* Pilsbry and Olsson 1954, Bull. American Paleontology **35:** (152): 25 (type species, *Voluta beckii* Broderip).

Type species, *Voluta ancilla* Solander, original designation.

Shells medium to large in size, elongate and with moderate to strongly convex whorls, which may be smooth or with low ridges or knobs at the whorl shoulder; sculpture consisting of fine growth lines and often with very fine spiral threads.

Radula uniserial, each tooth with three subequal and pointed denticles in one plane. Operculum lacking. Mantle not extending over the shell. Periostracum when present rather thin.

## Subgenus **Adelomelon** *Dall*

Shells smooth or with knobs at the whorl shoulder, usually attenuated and with very moderately convex whorls. Periostracum thin and deciduous.

### **Adelomelon (Adelomelon) ancilla** *Solander*

Plates 82, 83, 92, 93, 94

*Voluta ancilla* Solander 1786, Catalogue of the Portland Museum, p. 137, no. 3061 (Straits of Magellan). [Based upon Davila 1767, Catalogue des Curiosités de la Nature et de l'Art **1:** 140, no. 181, pl. 8, fig. S.] [Type lost.]

*Voluta spectabilis* Gmelin 1791, Systema Naturae, ed. 13, p. 3468 (in freto magellanico). [Based upon Davila 1767, as given above.]

*Voluta magellanica* Lamarck 1811, Annales du Mus. d'Hist. Nat., Paris **17:** 69. [Based on Tab. Encyclopédique et Méthodique 1798, **3:** pl. 385, figs. 1a–b.] (Straits of Magellan); non *V. magellanica* Gmelin 1791.

*Voluta gracilis* Wood 1825, Index Testaceologicus, suppl. p. 59, pl. 3, fig. 2 (no locality given). [Type lost.]

*Voluta magellanica* 'Gmelin' Gould 1852, United States Exploring Expedition **12:** 278, pl. 20, fig. 357 (Burnt Id., Orange Harbour [Straits of Magellan]); non *magellanica* Gmelin.

*Scaphella* (*Voluta*) *arnheimi* Rivers 1891, Proc. California Acad. Sci. (2) **3:** 107 (Monterey Bay, California); Rivers 1892, Nautilus **5:** 111 [Locality in error.]

*Voluta bracata* Mabille and Rochebrune 1891, [in] Mission Scientifique de Cap Horn **6:** H48 (Baie Orange [Orange Bay, Tierra del Fuego, Chile]). [Syntypes, Paris Museum.]

*Voluta ancilla* Solander. Lahille 1895, Revista del Museo de la Plata **6:** 313–316, pl. 1, figs. 9–10; pl. 2, figs. 61, 63, 66; pl. 8; pl. 9 (Argentina). Lahille has introduced the following named forms: *ponderosa*, p. 315; *elongata*, p. 315; *inflata*, p. 315; *expansa* p. 315; *abbreviata*, p. 316.

*Voluta martensi* Strebel 1906, Zoologische Jahrbücher **24:** 124, pl. 9, figs. 34–35; 42–44; pl. 10, figs. 56–56a (Straits of Magellan; Peru).

*Voluta bracteata* 'Mabille and Rochbrune' Strebel 1906, Zoologische Jahrbücher **24:** 92 (error for *bracata* M. and R.).

*Pachycymbiola magellanica* 'Sowerby' Pilsbry and Olsson 1954, Bull. American Paleontology **35:** 306, pl. 28, fig. 3; non *Voluta magellanica* Gmelin 1791.

*Adelomelon ancylla* [sic] (Solander). Barattini and Ureta 1960, La Fauna de las Costas Uruguayas del Este, Montevideo, p. 124, pl. 34.

*Description.* Shell large, reaching 186 mm. ($7\frac{1}{4}$ inches) in length, attenuated, imperforate and smooth. Color dark brown when covered with periostracum. Devoid of periostracum, the shell is dull, a pale, pinkish white, with the interior of the aperture a pale orange. Whorls 7 and convex. Spire extended and forming an angle of about 45°. Aperture semi-circular. Outer lip thin and simple. Parietal wall glazed, sharply margined, and having 2 to 3 well defined plicae. Columella nearly straight. Sutures well indented. Sculpture consisting of exceedingly fine growth lines. Protoconch relatively small. Siphonal canal rather broad and shallow. Periostracum deciduous, but dark brown when present and relatively thick. Radula uniserial, rachidian teeth only with three subequal, pointed denticles in one plane.

| length | width | |
|---|---|---|
| 186 mm. | 66 mm. | off Mar del Plata, Argentina |
| 174 | 86 | off Mar del Plata, Argentina |
| 172 | 68 | Puerto Hambre, Chile |
| 137 | 55 | Isla de Lobos, Uruguay |
| 180 | 67 | Syntype of *V. bracata* M. and R. |
| 160 | 65 | Syntype of *V. bracata* M. and R. |

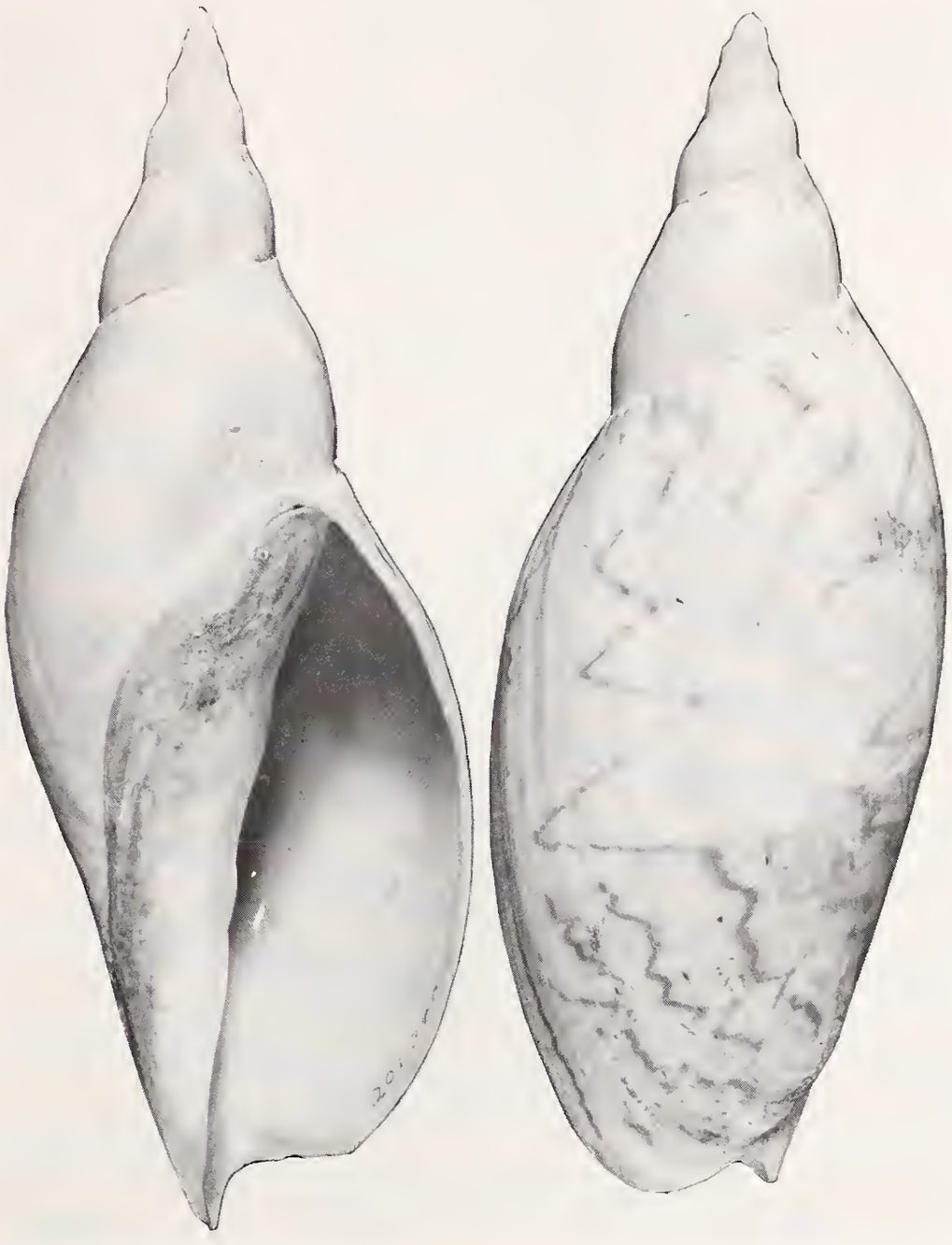

Plate 92. *Adelomelon ancilla* Solander. Isla de Lobos, Maldonado, Uruguay (about natural size).

*Remarks.* There has been considerable confusion regarding *Adelomelon ancilla* (Solander) and *Odontocymbiola magellanica* (Gmelin). The confusion was initiated when Lamarck described his *Voluta magellanica* 1811 (=*ancilla* Solander), non *V. magellanica* Gmelin 1791. This confusion persisted as late as 1954 when Pilsbry and Olsson used the name of *magellanica* "Sowerby" (based upon Lamarck's name, not that of Gmelin). This was most unfortunate as they figured the very remarkable radula of *magellanica* Gmelin, but called it *ancilla* Solander. Very fortunately we had alcoholic material of both species col-

lected by the *Hassler* Voyage in 1872. The shells of these two species are quite similar. *A. ancilla* differs from *O. magellanica* by being narrower, having a more acute spire, and in having fewer zig-zag color markings. The young of *A. ancilla* Solander are extended and have a pointed calcarella.

Plate 93. *Adelomelon ancilla* Solander. Young specimen, about 60 miles east of Punta Rasa, Río Negro, Argentina, *Hassler* Voyage 1872 (3.57x).

*Range.* Southern Brasil and south to the Straits of Magellan. It is reported by Melvill and Standen (1907) from the Falkland Islands.

*Specimens examined.* Brasil: off Chuy, Rio Grande do Sul, in 5 fathoms (ANSP). Uruguay: off Cabo Santa Maria (E. Rios; C. Weaver); Isla de Lobos, Maldonado (E. Duarte); off Punta del Este, Maldonado (USNM). Argentina: off Río de la Plata (37°42′ S; 56°20′ W) in 44 fathoms (*Hassler* Voyage, MCZ); Cabo de San Antonio, in 30 fathoms (ANSP); about 120 miles off Mar del Plata, Prov. Buenos Aires, in 99 fathoms (C. Weaver; E. Rios); *Albatross*, station 2767, about 160 miles SW of Mar del Plata (40°03′ S; 58°56′ W) in 64 fathoms (USNM); off Bahía Blanca, in 55 fathoms (ANSP); about 60 miles E of Punta Rasa, Río Negro (40°22′ S; 60°35′ W) in 30 fathoms (*Hassler* Voyage, MCZ); Cabo Buen Tiempo (ANSP). Chile: Cabeza del Mar (ANSP); *Albatross*, station 2778, Straits of Magellan, about 17 miles NE of Punta Arenas (53°01′ S; 70°42′ W) in 61 fathoms (USNM); Puerto Hambre, Straits of Magellan (53°45′ S; 70°58′ W) (*Hassler* Voyage, MCZ).

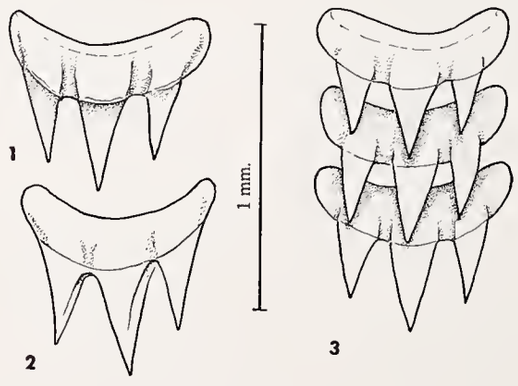


Plate 94. *Adelomelon ancilla* Solander. Off Río Colorado, Argentina. Length of radula 11 mm. Fig. 1. Front view of single tooth. Fig. 2. Back view of single tooth. Fig. 3. Three teeth in normal position.

## Adelomelon (?) subnodosa *Leach*

Plates 95, 96

*Voluta subnodosa* Leach 1814, Zoological Miscellany **1:** 24, pl. 8 (locality unknown). [Lectotype, here selected, in the British Museum, no. 1952.5.10.2.]

*Voluta tuberculata* Swainson 1821, Exotic Conchology, London, p. 19, pl. 29 (locality unknown); ibid. 1841, second edition, edited by S. Hanley, p. 19, pl. 29. [Holotype from the Broderip collection is in the British Museum.]

*Voluta tuberculata* Wood 1828, Index Testaceologicus, London, *Voluta*, pl. 3, fig. 22 (locality unknown).

*Voluta tuberculata* Wood. Lahille 1895, Revista del Museo de la Plata **6:** 322, pl. 1, figs. 12–13; pl. 7, figs. 140–146; pl. 12, figs. 1–10. Lahille has described the following forms: *ferruginea*, p. 323; *decipiens*, p. 323; *fulgurea*, p. 323; *pseudofusiformis*, p. 324.

Plate 95. *Adelomelon subnodosa* Leach. After Leach, Zoological Miscellany 1814, p. 24, pl. 8.

*Description.* Shell medium to large, reaching 160 mm. (about $6\frac{1}{4}$ inches) in length, imperforate, strong in structure and sculptured. Color a dull yellowish orange with zigzag axial lines of brown and with two broad and irregular, spiral bands of the same color. Whorls 6 and moderately convex. Spire moderately extended and formed at an angle of about 60°. Aperture semicircular. Siphonal canal broad and shallow, previous growth lines producing a fasciole. Outer lip thickened a little more above than below. Parietal wall with a heavy glaze which is sharply margined. Plicae 3 or 4. Columella short, straight and inclined to the right. Suture well-defined. Sculpture consisting of a series

of knobs along the edge of the whorl shoulder, usually 10 to 12 on the body whorl. Microscopic sculpture consisting of numerous and very fine, spiral threads. These threads are worn away on adult specimens. Protoconch consisting of 2 smooth whorls. Operculum, periostracum and radula unknown.


Plate 96. *Adelomelon subnodosa* Leach. San Antonio, Río Negro, Argentina. Fig. 1 (about natural size). Fig. 2 (2x).

| length | width | |
|---|---|---|
| 121.5 mm. | 65 mm. | Holotype of *V. subnodosa* Leach |
| 112 | 60 | Holotype of *V. tuberculata* Swainson |
| 160 | 91 | San Antonio, Río Negro, Argentina |

*Remarks.* This is a rare species and very little is known about it. There is no question that the figures of Leach for *subnodosa* and that of Swainson for *tuberculata* refer to the same species.

This species is placed provisionally in the genus *Adelomelon*. The radula is unknown, and until this is available its generic position will remain questionable. Dall (1907, p. 360) confused *subnodosa* with *O. americana* Reeve from off the Brasilian coast. This latter species is small, seldom exceeding two inches in length and is a warm water species.

*Range.* We make no attempt to define the range of this species because the confusion of names renders much of the associated data valueless. It probably extends south from San Antonio, Argentina to the Straits of Magellan.

*Specimens examined.* ARGENTINA: San Antonio, Río Negro, Patagonia (*Hassler* Voyage, MCZ; M. Birabén); off Río Negro (USNM).

## Adelomelon (?) paradoxa *Lahille*

Plate 97

*Voluta paradoxa* Lahille 1895, Revista del Museo de la Plata **6:** 321, pl. 26, fig. 69; pl. 5, fig. 41; pl. 7, figs. 139, 147; pl. 12, figs. 17–21 (Argentina).

*Cymbiola mangeri* Preston 1901, Proc. Malacological Soc. London **4:** 237, text figure (Falkland Islands). [Holotype, British Museum, no. 1901.8.1.35.]

*Description.* Shell medium to large in size, reaching 172 mm. ($6\frac{3}{4}$ inches) in length, imperforate, solid and smooth. Color yellowish orange, inside the aperture a brownish orange. Whorls 6, moderately convex. Spire extended and produced at an angle of about 65°. Aperture semicircular. Siphonal canal broad and shallow, previous growth lines leaving a well-defined fasciole. Outer lip thick with the area below the whorl periphery slightly reflected. Parietal wall heavily glazed and with a well-defined margin. Plicae variable from 3 to 5.[1] Suture indented. Sculpture consisting of fine to rather coarse growth lines. Protoconch missing, as is the periostracum. Probably no operculum. Radula unknown.

| length | width | |
|---|---|---|
| 172 mm. | 89 mm. | Falkland Islands |
| 170 | 85 | Puerto Deseado, Argentina |

*Remarks.* We can add but little concerning this species. Nothing is known about its soft anatomy, so that its generic position will be in question until its radula can be examined.

*Range.* Southern Argentina and the Falkland Islands.

*Specimens examined.* ARGENTINA: Puerto Deseado, Patagonia (M. Birabén). FALKLAND ISLANDS: (MCZ).

## Adelomelon (?) ferussacii *Donovan*

Plate 98

*Voluta ferussacii* Donovan 1824, Naturalists Repository **2:** pl. 67 (Straits of Magellan). [Type specimen lost.]

*Voluta rudis* Gray 1834 [in] Griffith and Pidgeon, Cuvier's Animal Kingdom **12:** 601, pl. 30, fig. 1 (locality not given). [Holotype, British Museum.]

*Voluta oviformis* Lahille 1895, Revista del Museo de la Plata **6:** 312, pl. 2, figs. 53–56; pl. 7, figs. 121–137; pl. 10, figs. 4–9. Lahille has described the following forms: *longiuscula*, p. 312; *fratercula*, p. 313.

*Description.* Shell medium in size, reaching 116 mm. (about $4\frac{1}{2}$ inches) in length, solid, imperforate and smooth. Color brown[2] with the aperture a brownish orange. Whorls 6 and convex. Spire depressed. Aperture semi-circular. Outer lip slightly flaring

[1] Only two specimens of this species available to us.

[2] We have not seen any specimens which have been collected alive.

but not reflected. Parietal area heavily glazed, the margin sharply defined. Plicae 3 to 6. Siphonal canal fairly broad but shallow, previous growth lines leaving a well-defined fasciole. Columella short. Suture indented. Sculpture consisting of both fine and coarse growth lines. Protoconch having $1\frac{1}{2}$ whorls and smooth. Operculum, periostracum and radula unknown.

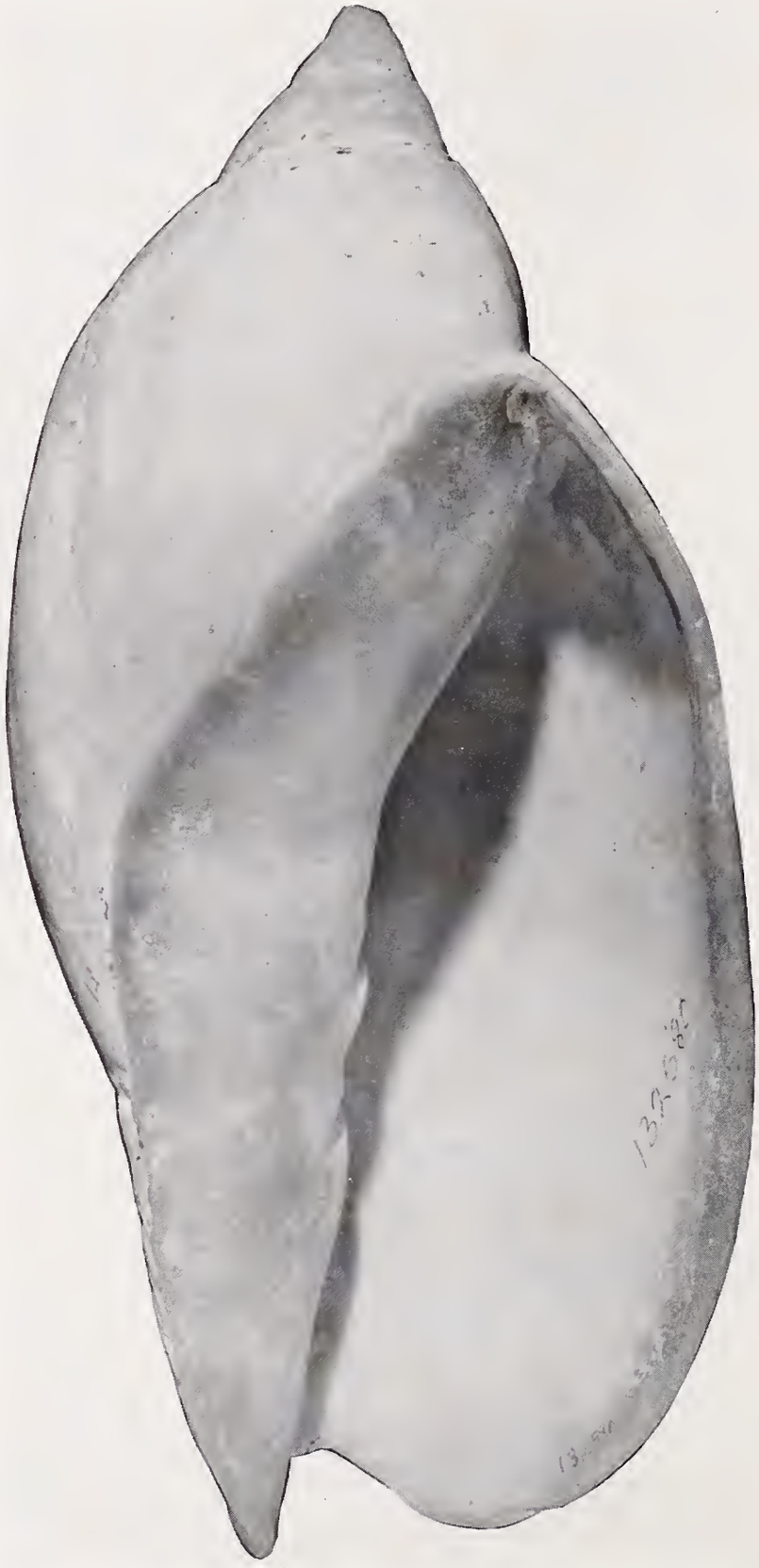

Plate 97. *Adelomelon paradoxa* Lahille. Falkland Islands (about natural size).

| length | width | |
|---|---|---|
| 116 mm. | 76 mm. | Tierra del Fuego, Argentina |
| 96 | 65 | Puerto Deseado, Argentina |
| 91 | 53 | Bahía San Gregorio, Chile |

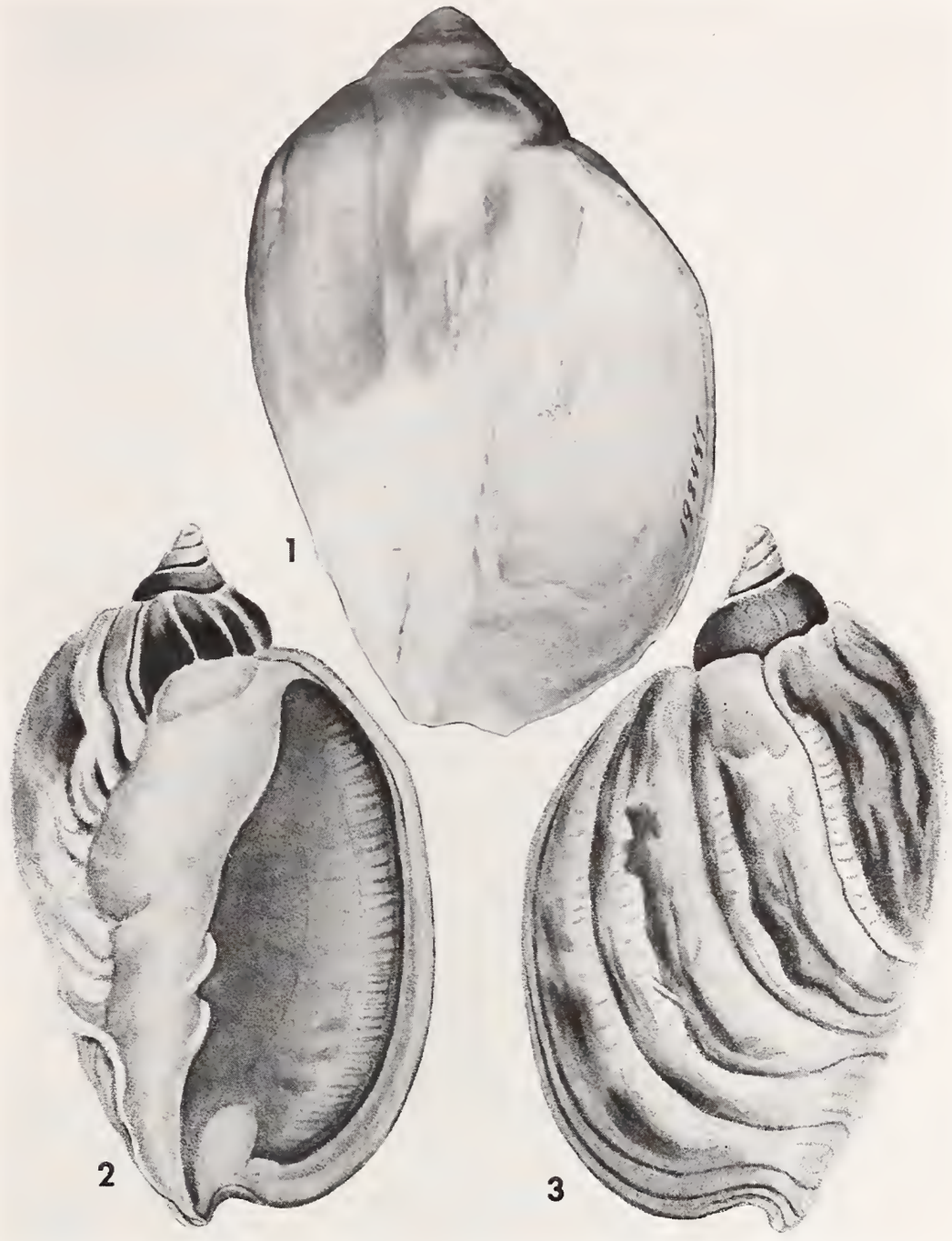


Plate 98. *Adelomelon ferussacii* Donovan. Fig. 1. Bahía San Gregorio, Straits of Magellan, Chile (about 1.1x). Figs. 2–3. Straits of Magellan, after Donovan 1824, Naturalists Repository, Vol. 2, pl. 67 (about natural size).

*Remarks.* Comparatively little is known about this species. All of our specimens were dead when collected, and this appears to be equally true for the specimens figured in most monographs. It very probably lives below the low water line. On the basis of shell characters it is most closely related to *Adelomelon brasiliana* (Lamarck).

*Range.* From latitude 42° S (Gulfo San Matias) south to the Straits of Magellan (Carcelles and Williamson, 1951).

*Specimens examined.* ARGENTINA: Puerto Deseado, Patagonia; Cabo Buen Tiempo, Gallegos Norte, Patagonia (both M. Birabén); Tierra del Fuego (A. Carcelles). CHILE: Bahía de la Posessión, Straits of Magellan (*Hassler* Voyage, MCZ); San Gregorio, Straits of Magellan (M. Birabén; USNM).

## Adelomelon (Adelomelon) beckii *Broderip*

Plates 82, 99, 100

*Voluta beckii* Broderip 1836, Proc. Zool. Soc. London, p. 43 (locality unknown). [Lectotype, here selected, Cambridge Univ., Dept. of Zoology Museum, ex Saul collection. A syntype from the Broderip collection is in the British Museum.]

*Voluta fusiformis* Kiener 1839, Iconographie des Coquilles Vivantes, *Voluta* **3:** 41, pl. 49 (l'Océan Méridional, les Côtes Magellaniques); non Brocchi 1814; Turton 1819; Swainson 1822; Defrance 1829.

*Voluta festiva* d'Orbigny 1841, Voyage dans l'Amérique Méridionale, Paris **5:** 426 (south of the Rio Negro, near Ensenada de Rios); non Lamarck 1822.

*Voluta fusiformis* Kiener. Lahille 1895, Revista Museo de La Plata **6:** 300, pl. 1, figs. 14–15; pl. 3; pl. 4. Lahille has described the following varieties: *ornata*, p. 301 and *connexa*, p. 302.

*Voluta* (*Cymbiola*) *becki* Broderip. Strebel 1906, Zoologische Jahrbucher **24:** 97.

*Adelomelon indigestus* v. Ihering 1908, Anales Museo Nacional Buenos Aires (3) **10:** 433, text fig. 2 (off the Ilha São Sebastião, São Paulo, Brasil; in the stomach of a fish).

*Description.* Shell large, reaching 450 mm. (about $17\frac{3}{4}$ inches) in length, imperforate, moderately solid and sculptured. Color a light orange-white, and with a few dark, brownish red, axial, zig-zag bands of color on the early whorls; the aperture orange. Whorls 7, moderately convex. Spire extended and produced at an angle of about 55°. Aperture semi-circular. Siphonal canal rather broad and shallow. Outer lip simple. Parietal wall with a glazed area which is sharply margined. Columella nearly straight and short. Plicae on the parietal wall two or three. Suture indented and well defined, Sculpture consisting of a series of knobs along the whorl shoulder, but these may be absent on the body whorl. Microscopic sculpture of very fine spiral threads which become nearly indistinct below the whorl periphery. Protoconch of $1\frac{1}{2}$ whorls and smooth. Periostracum probably present. No operculum. The radula is uniserial, rachidian teeth only, each consisting of three denticles, the central denticle being the longest.

| length | width | |
|---|---|---|
| 450 mm. | 177 mm. | off Cabo Frio, Brasil |
| 375 | 151 | 7 miles off Ilha Rasa, Est. Rio de Janeiro, Brasil |
| 368 | 141 | " " " " " " " " " |
| 365 | 149 | " " " " " " " " " |
| 282 | 129 | Puerto Quequén, Argentina |
| 231 | 102 | Ilha Sant'Anna, Macaé, Est. Rio de Janeiro, Brasil |
| 220 | 90 | Lectotype of *Adelomelon beckii* Brod. |

*Remarks.* This is the largest species in the Volutidae known from the Western Atlantic. In relationship it appears to be nearest to *Adelomelon ancilla* Solander, but has a much larger and heavier shell and has shoulder knobs which are not found in *A. ancilla.*

Carcelles states that *A. beckii* occurs on sand in the littoral zone. Dr. Tursch has reported in a letter that this species is an important item of food of the fisherman and is also sold in the markets in Rio de Janeiro.

*Range.* This species extends from southern Brasil, possibly as far south as Tierra del Fuego, and is found in the Falkland Islands according to Carcelles (1951, p. 302).

*Specimens examined.* BRASIL: Ilha de Sant'Anna, off Macaé, Est. Rio de Janeiro (J. W. Donovan); off Cabo Frio (B. Tursch); off Rio de Janeiro (ANSP); 7 miles off Ilha Rasa, Est. Rio de Janeiro, in 32 fathoms, sand and mud bottom (B. Tursch); off southern Albardão, Rio Grande do Sul (E. de C. Rios). ARGENTINA: Puerto Quequén, Prov. Buenos Aires (A. Carcelles; MCZ; ANSP).

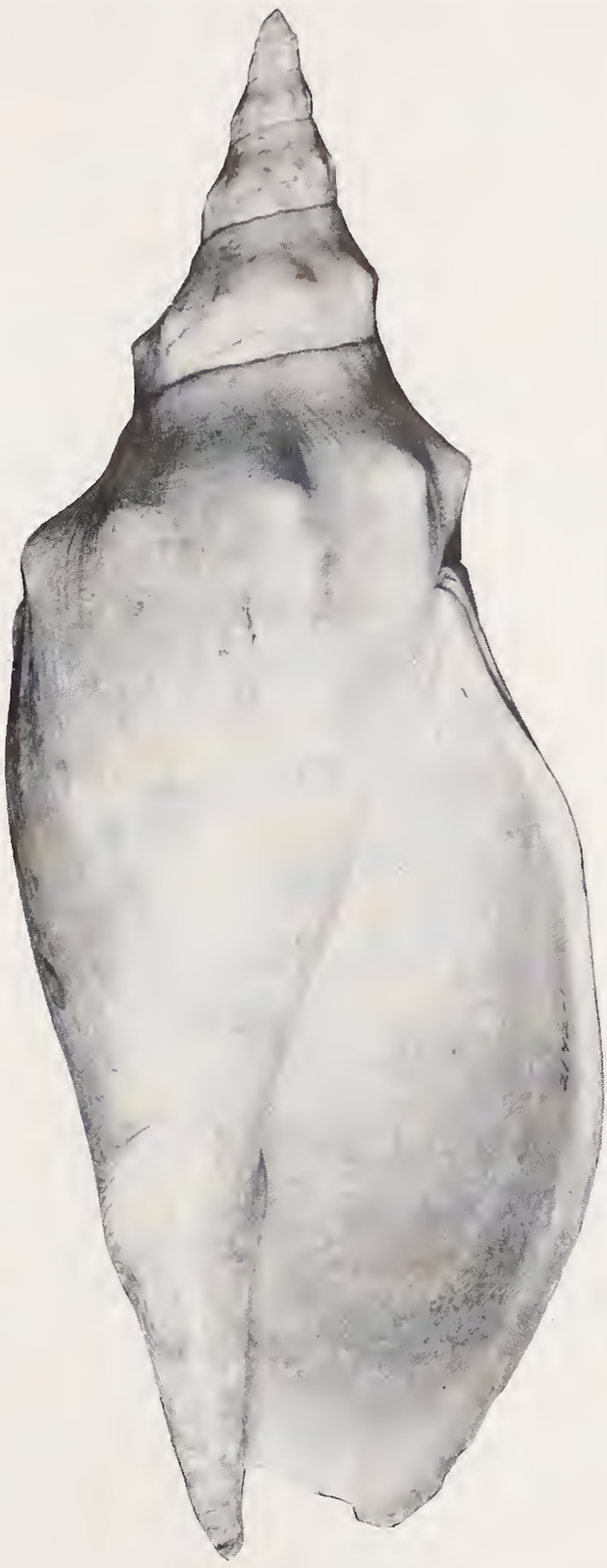

Plate 99. *Adelomelon beckii* Broderip. Ilha de Sant'Anna, Est. de Rio de Janeiro, Brasil (about $\frac{2}{3}$x).

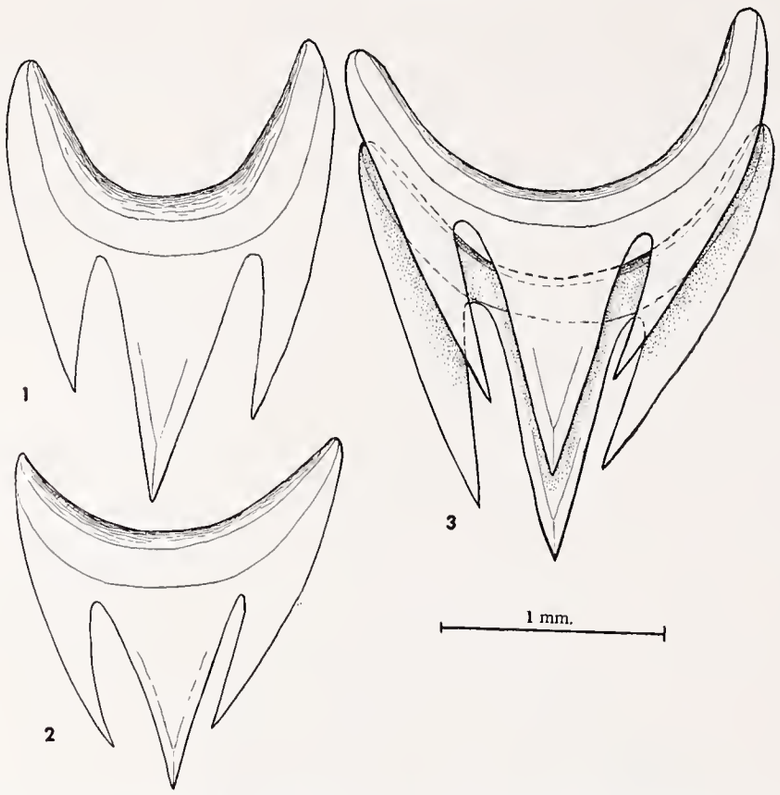


Plate 100. Radula of *Adelomelon beckii* Broderip. Off Rio de Janeiro, Brasil. Length of radula 48 mm. Fig. 1. Single tooth from near the forward end. Fig. 2. Single tooth from near the back end. Fig. 3. Two teeth in normal position.

## **Weaveria,** new subgenus

This subgenus is characterized by having a very small protoconch in proportion to the size of the adult and by having a very thick deciduous periostracum. There is no indication of any zig-zag color markings, and the whorls are far more globose than in other species in the genus *Adelomelon*.

Named for Clifton S. Weaver of Honolulu.

Type species, *Adelomelon* (*Weaveria*) *riosi* Clench and Turner.

## **Adelomelon (Weaveria) riosi,** new species
Plates 83, 101, 102

Shell reaching 245 mm. (about $9\frac{1}{2}$ inches) in length, imperforate and sculptured. Color a dark reddish brown (periostracum); the shell itself, a light, diffused orange. Interior of aperture a bright orange. Whorls 6 and convex. Spire extended, forming an angle of 50° to 60°. Aperture semicircular. Outer lip thin and simple. Parietal wall with a broad aluminum glazed area which is sharply margined. Columella nearly straight. Plicae on the parietal wall variable, from none to two. Suture impressed. Sculpture consisting of numerous, fine, incised, spiral threads on the bulge of the whorl shoulder. Protoconch consisting of two small whorls and having a short calcarella. Periostracum deciduous, but where present is rather thick. No operculum present on either of the two preserved specimens.

The radula is uniserial, rachidian teeth only, each having three, sharp, subequal, pointed denticles in one plane.

Plate 101. *Adelomelon riosi* Clench and Turner. From 130 miles east of Mar del Plata, Argentina, in 99 fathoms. Holotype (about natural size).

| length | width | |
|---|---|---|
| 245 mm. | 107 mm. | Paratype |
| 214 | 106 | Paratype |
| 207 | 102 | Holotype |
| 201 | 104 | Paratype |
| 193 | 101 | Paratype |

*Types.* The holotype is in the Museum of Comparative Zoology, no. 245017, from about 130 miles east of Mar del Plata, Argentina in 99 fathoms. Paratypes from about 150 miles ESE of Cabo San Antonio (36°40′ S; 53°08′ W) [54°08′ W?] in 95 fathoms. Paratypes in the United States National Museum, no. 652353; Museo Oceanográfico de Rio Grande, no. 8.221; and in the collection of Clifton S. Weaver.

The longitude given above as 53°08′ W appears to be in error, as the depth at this point is well over 1000 fathoms. 54°08′ W would agree with the depth given as well as the distance off shore. The material and data were received from the fishing vessel *Pescal II.*

*Remarks.* This is one of the larger species in the Volutidae in the Western Atlantic, being exceeded only by *Adelomelon beckii* Broderip. It is, however, quite variable in size. The five specimens in the type series appear to be about the same age, but the measurements given above show a range in length from 193 to 245 mm.

On the basis of the radula and the soft anatomy this species is an *Adelomelon.* The shell morphology is somewhat different from the other species in this genus, though only in degree. The shape of the shell is somewhat like that of *Guivillea alabastrina* Watson, but *A. riosi* is larger, much heavier, and has a much smaller protoconch. *A. riosi* was dredged in 95 to 99 fathoms from off Argentina, while *Guivillea* was dredged in 1600 fathoms between Marion Island and the Crozets in the South Indian Ocean. The radula and soft anatomy of *Guivillea* are unknown.

Named for E. de Carvalho Rios of the Museu Oceanográfico de Rio Grande.

The stomach contents of *A. riosi* consisted of fragments of an *Astropecten.*[1]

*Range and Specimens examined.* See under *Types.*

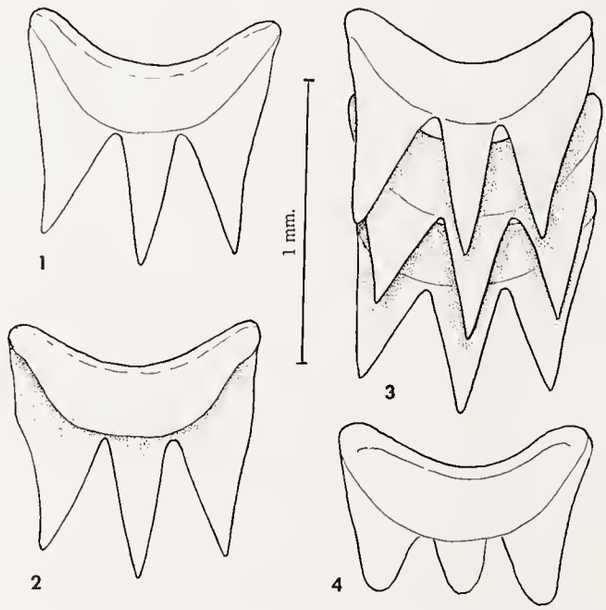


Plate 102. Radula of *Adelomelon riosi* Clench and Turner. About 150 miles ESE of Cabo San Antonio, Argentina. Length of radula 12 mm. Fig. 1. Front view of a single tooth. Fig. 2. Back view of a single tooth. Fig. 3. Three teeth in normal position. Fig. 4. Old tooth showing wear.

[1] Determination by Dr. E. Deichmann.

## Subgenus **Pachycymbiola** *von Ihering*

*Pachycymbiola* von Ihering 1907, Anales Museo Nacional de Buenos Aires (3) **7:** 209.

Type species, *Voluta brasiliana* Lamarck, original designation.

Shells medium to large in size, subglobose, heavy, smooth or tuberculate and with a thick periostracum.

The radula is typical of that for the genus, but the shell and protoconch differ from typical *Adelomelon*, as shown on Plate 82.


Plate 103. *Adelomelon brasiliana* Lamarck. Fig. 1. Punta del Este, Maldonado, Uruguay (about natural size). Fig. 2. Egg case, Punta del Este, Maldonado, Uruguay (1.25x). Fig. 3. About 112 miles east of Punta Piedras, Argentina (natural size).

## **Adelomelon (Pachycymbiola) brasiliana** *Lamarck*

Plates 82, 103, 104, 105

*Voluta brasiliana* Solander 1786, Catalogue of the Portland Museum, p. 186, no. 3958 [nomen nudum].

*Voluta brasiliana* Lamarck 1811, Annales Muséum d'Histoire Naturelle **17:** 62. [Based upon Chemnitz 1795, Conchylien-Cabinet (1) **11:** pl. 176, figs. 1695–1696] (Brasil).[1]

[1] The holotype of *Voluta brasiliana* Lamarck, stated by Kiener to be in the Paris Museum, could not be located by Dr. D. F. McMichael in 1961. The type figure, however, is that of Chemnitz to which Lamarck referred, as given in the synonymy above.

*Voluta colocynthis* Dillwyn 1817, A Descriptive Catalogue of Recent Shells **1:** 574 (inhabits the coast of Brasil).

*Voluta colocynthis* 'Chemnitz' Dillwyn. Lahille 1895, Revista Museo de La Plata **6:** 302, pl. 1, figs. 3–4; pl. 2, figs. 50, 52, 57, 60; pl. 5. Lahille has described the following forms: *lactea*, p. 304; *intermedia*, p. 304; *globosa*, p. 305, non Dillwyn 1817; *depressa*, p. 305, non Lamarck 1802; *pseudomagellanica*, p. 305; *subcarinata*, p. 305; *carinata*, p. 305, non Zekeli 1852; *alternata*, p. 306; *spirabilis*, p. 306.

*Pachycymbiola brasiliana* Lamarck. von Ihering 1907, Anales Museo Nacional de Buenos Aires (3) **7:** 209.

*Cymbiola brasiliana* (Solander). Barattini and Ureta 1960, La Fauna de las Costas Uruguayas del Este, Montevideo, p. 123, pl. 36.

Plate 104. *Adelomelon brasiliana* Lamarck. After A. d'Orbigny 1847, Voyage dans l, Amérique Méridionale, pl. 60. Showing the egg capsule and the young (about $\frac{2}{3}$x).

*Description.* Shell medium to large in size, reaching a length of 183 mm. ($7\frac{1}{4}$ inches) solid, imperforate and nodulose. Color grayish white, overlaid with a thick, blackish brown periostracum. Aperture a light, brownish orange. Whorls 6, and moderately convex. Spire only slightly extended and produced at an angle of about 105°. Aperture semicircular. Siphonal canal broad and shallow, which has produced in its previous growth stages a well-marked fasciole. Outer lip simple. Parietal area with a heavy glaze which is sharply margined. There are two to four plicae, the lower one being the largest. Columella short and arched. Suture slightly indented. Sculpture consisting of numerous, fine to coarse growth lines. On the whorl shoulder there is a single row of well-developed knobs. Protoconch with one and one-half whorls and rather small. Probably without an operculum.

The foot, head and siphonal canal are colored a finely mottled purple, the foot about equal to the length of the shell. The young are subglobose and have a very short rounded calcarella. The young of *A. ancilla* Solander are attenuated and have an extended, pointed calcarella.

The radula is uniserial, consisting only of rachidian teeth, each tooth with three denticles about equal in size.

| length | width | |
|---|---|---|
| 183 mm. | 117 mm. | Banco Ingles, Maldonado, Uruguay |
| 161 | 111 | Puerto Deseado, Patagonia, Argentina |
| 141 | 93 | Praia de Imbituba, Est. Santa Catarina, Brasil |

*Remarks.* This is a large and heavy species. Carcelles (1944, p. 254) reports it to be very abundant on the sandy beaches at Cabo San Antonio and at Mar del Plata, Argentina. It occurs in the intertidal and littoral zones.

This species produces an ovicapsule which may contain five to fifteen embryos.

*Range.* From the southern coast of Brazil and south at least as far as Deseado, Patagonia, Argentina.

*Specimens examined.* Brasil: 20 miles off Punta de Juatinga, Est. Rio de Janeiro, in 35 fathoms, mud bottom; 10 miles off Ilha de São Sebastião, Est. São Paulo, in 30 fathoms, mud bottom (both B. Tursch); Praía de Imbituba, Est. Santa Catarina (M.J. de Oliveira); Rio Grande do Sul (MCZ); Chuí and Sarita, Est. Rio Grande do Sul (both ANSP). Uruguay: Cabo Polonio (=Cabo Castillo); Cabo Santa Maria (both USNM); Maldonado (MCZ); Punta del Este, Maldonado; Banco Ingles, about 50 miles SE of Maldonado (both E. Duarte); La Paloma and Piriapolis (both ANSP). Argentina: about 112 miles E of Punta Piedras (35°12′ S; 55°30′ W) in 7 fathoms (*Hassler* Voyage, MCZ); off Punta Medanos, Prov. Buenos Aires (A. Carcelles); Mar del Plata; Monte Hermosa; off Rio Negro (all USNM); Puerto Deseado, Patagonia (M. Birabén).

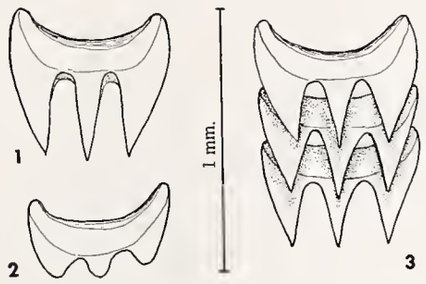


Plate 105. *Adelomelon brasiliana* Lamarck. Off Isla Lobos, Uruguay. Length of radula 7 mm. Fig. 1. Single tooth. Fig. 2. Old tooth showing wear. Fig. 3. Three teeth in normal position.

## Genus **Provocator** *Watson*

*Provocator* Watson 1882, Jour. Linnean Society London **16:** 329; ibid. 1886, Voyage of H.M.S. *Challenger* **15:** 260, pl. 13, fig. 5.

Type species, *Provocator pulcher* Watson, monotypic.

The shells are thin, very finely sculptured with both growth lines and spiral striae. The siphonal canal is broad and shallow, the anal canal narrow and deep. Columellar plicae one or two. On the ventral surface of the shell the glazed area extends over the earlier whorls.

## Provocator corderoi *Carcelles*

Plates 106, 107

*Provocator corderoi* Carcelles 1947, Comunicaciones Zoologicas del Museo de Historia Natural de Montevideo 2 (40): 5, pl. 1, figs. 1–5 (about 100 miles ESE of Necochea, Argentina [39°00′ S; 57°10′ W] in 97 fathoms). [Holotype in the National Museum, Buenos Aires, Argentina.]

*Description.* Shell rather small, reaching 64 mm. ($2\frac{1}{2}$ inches) in length, thin, imperforate and finely sculptured. Color a porcelain white covered with a thin, light brown periostracum. Whorls 5, slightly convex. Spire moderately extended and produced at an angle of 50°. Aperture irregularly semicircular with a broad and shallow siphonal canal below. Outer lip thin, simple and slightly reflected. Parietal wall glazed, the glaze extending to just below the tip of the spire. Columella short and spiral with one or two plicae. Suture broadly impressed and covered by the glaze. Anal canal narrow. Area of the canal forming a narrow, slanting shoulder on the whorl, which is somewhat thickened and china-white in color. Sculpture consisting of very fine growth lines and exceedingly fine and rather indistinct spiral threads. Protoconch glazed over.

Plate 106. *Provocator corderoi* Carcelles. About 135 miles east of Cabo San Antonio, Argentina (about 2x).

Posterior end of the foot an intense bright orange becoming gradually light and diffused anteriorly, the anterior end of the foot being a light salmon color. Mantle light salmon with a bright orange band just inside the edge. Siphon bright orange. Lateral lobes of head and tentacles orange; the broad central lobe a light orange shading to tan at the center. Under surface of foot a uniform ivory. Head very broad and flat; tentacles short and broad. Eyes small, black and located at the base of the tentacles on the lateral lobes. Siphon with two equal basal lobes which in preserved specimens are nearly as long as the siphon. The single animal we had for study was too poorly preserved for detailed anatomical work, but sufficient could be observed to allow us to state definitely that it agrees with the characters of the subfamily Zidoninae. The radular teeth are extremely heavy, though typical of the subfamily.

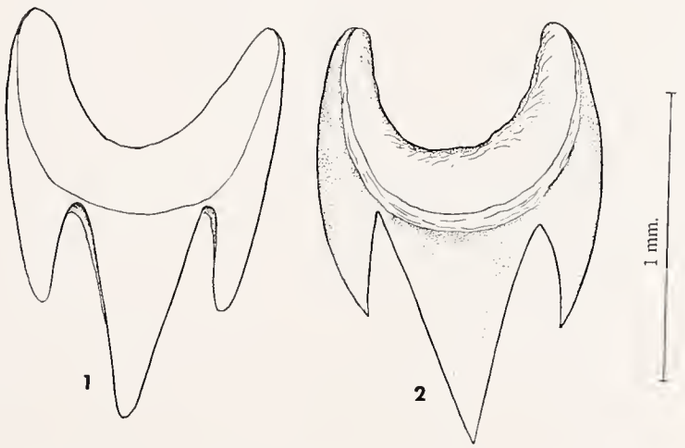


Plate 107. *Provocator corderoi* Carcelles. Fig. 1. Outer view of single worn tooth taken from the anterior end of the ribbon. Fig. 2. Back view of a single tooth taken from the middle of the ribbon and showing thickened ridge which is attached to the ribbon.

| length | width | |
|---|---|---|
| 64 mm. | 30 mm. | 135 miles east of Cabo San Antonio, Argentina |
| 59 | 29 | about 150 miles east of Cabo San Antonio, Argentina |
| 63 | 33 | Holotype |
| 52 | 29 | about 135 miles east of Mar del Plata, Argentina |

*Remarks.* This is the second known species in this genus. *Provocator pulcher* Watson was dredged by the *Challenger* in the southern Indian Ocean between Kerguelen and Heard Islands in 150 fathoms and off Cumberland Bay, Kerguelen Island in 105 fathoms.

*P. corderoi* differs from *P. pulcher* by being smaller and in having fewer whorls and proportionately a more redueed spire. In depth, *P. corderoi* ranges from 30 to 85 fathoms.

We are most grateful to Dr. Rios for the soft parts of *Provocator corderoi* Careelles. Unfortunately, the shell was completely broken, but enough remained for Dr. Rios to determine it. The specimen was dredged by L. R. Pontes of the fishing vessel *Pescal II* off Cabo San Antonio, Argentina in 80 fathoms.

*Range.* The few records available are not sufficient to determine the range of this species. The five stations given by Carcelles all fall within a distanee of 180 nautical miles.

*Specimens examined.* ARGENTINA: about 135 miles E of Cabo San Antonio (36°10′ S; 54°20′ W) in 38 fathoms; about 150 miles E of Cabo San Antonio in 85 fathoms (both C. Weaver).

## **Odontocymbiolinae,** new name

*Adelomeloninae* Pilsbry and Olsson 1954, Bull. American Paleontology **35:** 289.

The type genus of this subfamily is *Adelomelon* Pilsbry and Olsson 1954; non Dall 1906. Unfortunately at the time Pilsbry and Olsson recognized the validity of the subfamily for which they introduced the name Adelomeloninae they misidentified the species

Plate 108. *Odontocymbiola magellanica* Gmelin. Figs. 1–2. Shoal Bay, Straits of Magellan, Chile. *Hassler* Voyage, 1872 (about natural size).

and genus on which the name was based. Thus *Adelomelon* Pilsbry and Olsson 1954 is a homonym of *Adelomelon* Dall 1906, the two genera actually belonging to different subfamilies. Consequently, it is necessary to institute a new name, not only for the genus, but also for the subfamily.

Radula uniserial, rachidian teeth only, with a base plate and three prong or fang-like denticles. This subfamily includes *Odontocymbiola* (new) and possibly *Miomelon* Dall 1907. See also Zidoninae, p. 147.

## **Odontocymbiola,** new name

*Adelomelon* 'Dall' Pilsbry and Olsson 1954, Bull. American Paleontology **35:** 280, 289 and 306; non Dall 1906.

Type species, *Adelomelon ancilla* 'Solander' Pilsbry and Olsson, monotypic (= *Voluta magellanica* Gmelin).

Shells medium to large in size, attenuated and with strongly convex whorls. Surface relatively smooth. Axial zig-zag lines of color rather weak, particularly in old specimens. Radula uniserial, rachidian teeth only, each tooth with three, pointed and fang-like denticles which extend at a right angle from the basal plate and then curve downwards. (See Plate 82.)

*Remarks.* Pilsbry and Olsson were in error by figuring these fang-like rachidian teeth under *Adelomelon ancilla* (Solander). *Adelomelon* has a rake-like, three-pronged tooth, the denticles being more or less in the same plane. See *Remarks* under *A. ancilla*.

## Odontocymbiola magellanica *Gmelin*

Plates 82, 83, 108, 109

*Voluta magellanica* Gmelin 1791, Systema Naturae, ed. 13, **6:** 3465 (Straits of Magellan). [Based upon Chemnitz 1788, Conchylien-Cabinet (1) **10:** 138, pl. 148, figs. 1383–1384.]; non *V. magellanica* Lamarck 1811.

*Voluta magellanica* 'Chemnitz' Lahille 1895, Revista del Museo de la Plata **6:** 317, pl. 1, fig. 1; pl. 2, figs. 64–65; pl. 7, figs. 148–149, 154; pl. 8; pl. 12. Lahille has introduced the following named forms: *curta* and *taeniolata*, p. 318.

*Voluta ambigua* Lahille 1895, Revista del Museo de la Plata **6:** 319, pl. 2, fig. 61; pl. 8, figs. 163–164; pl. 11, figs. 6, 9, 11; pl. 12, figs. 11–16 (Argentina). Lahille has introduced the following named forms: *subnodosa*, p. 319, non Leach 1814; *constricta*, p. 320; *pseudotuberculata*, p. 320.

*Adelomelon ancilla* 'Solander' Pilsbry and Olsson 1954, Bull. American Paleontology **35:** 306, pl. 28, fig. 6; non *Voluta ancilla* Solander 1786.

*Description.* Shell reaching 190 mm. ($7\frac{1}{2}$ inches) in length, imperforate and smooth. Color a light ivory with a few irregular, narrow, zig-zag, axial bands of brown; inside the aperture a light salmon and highly glazed. Whorls 5 and moderately convex. Spire moderately extended and produced at an angle of from 55° to 65°. Aperture semicircular, with a broad, shallow siphonal canal. Outer lip thin and simple. Parietal wall glazed, sharply margined and having 3 or 4 well-defined plicae. Columella straight to slightly arched. Suture indented, occasional specimens showing pointed crenulations on the body whorl. Sculpture consisting of fine, irregular growth lines; occasional speci-

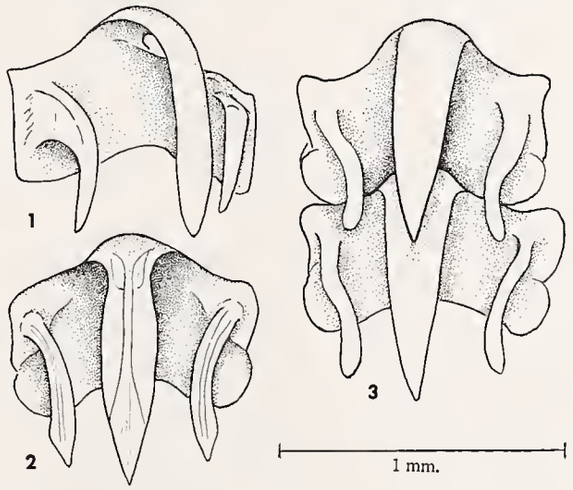


Plate 109. Radula of *Odontocymbiola magellanica* Gmelin. Shoal Bay, Straits of Magellan, Chile. Length of radula 12 mm. Figs. 1–2. Single teeth. Fig. 3. Two teeth in normal position.

mens being tubereulate on the whorl shoulder. Protoconch small and poorly defined. Periostracum deciduous. Opereulum lacking.

Radula uniserial, consisting of raehidian teeth, eaeh tooth with three dentieles which are fang-like.

| length | width | |
|---|---|---|
| 190 mm. | 76 mm. | San Gregorio, Straits of Magellan, Chile |
| 122 | 56 | Shoal Bay, Straits of Magellan, Chile |
| 111 | 50 | Shoal Bay, Straits of Magellan, Chile |

*Remarks.* In shell charaeters this species is nearest to *Adelomelon ancilla* Solander, differing by being proportionately broader, having a wider and more eapaeious aperture and a more solid shell. The radula of *Odontocymbiola magellanica* Gmelin differs remarkably from *Adelomelon aneilla* Solander. In *magellanica* the dentieles or eusps are fang-like and project outward and down, each denticle forming an are. A somewhat similar radula to that of *O. magellanica* is found in *Miomelon philippianus* Dall from the southwest coast of Chile (677 fathoms). The shell, however, is very different.

*Range.* From off Río de La Plata in Argentina south to the Straits of Magellan; north to Chiloe Island, Chile and the Falkland Islands.

*Speeimens examined.* Argentina: about 155 miles E of Cabo San Antonio in 81 fathoms; SE of Punta Médanos (both C. Weaver; E. Rios); off Mar del Plata, Prov. Buenos Aires (A. Carcelles); Puerto Quequén (USNM); *Albatross*, Station 2768, about 275 miles ENE of Cabo Delgada (42°24′ S; 61°38′ W) in 61 fathoms (USNM); Puerto Deseado, Patagonia (M. Birabén). Chile: Shoal Bay, Straits of Magellan (52°55′S; 70°52′ W) (*Hassler* Voyage, MCZ); San Gregorio, Straits of Magellan (52°37′ S; 70°12′ W) (MCZ; USNM); Burnt Id., Bahía Orange (USNM). Falkland Islands: (MCZ); Port Stanley (USNM).

## **Odontocymbiola pescalia,** new species

Plates 110, 111

Shell reaching 103 mm. (about 4 inches) in length, imperforate and finely sculptured. Color a uniform dull, grayish tan with a faint indication of spiral bands of brown. The fasciole is brown; interior of aperture salmon. Whorls 5 and strongly eonvex. Spire moderately extended and produced at an angle of about 50°. Aperture subovate. Outer lip thin and simple. Parietal wall with a broad glazed area whieh is sharply margined. Columella nearly straight and with 3 strong plicae. Suture deeply impressed. Spiral seulpture eonsisting of numerous, fine, incised, spiral threads which are strongest on the early whorls. Axial sculpture consisting of fine growth lines. Protoconch small and poorly defined. Periostracum probably thin and deciduous. Opereulum lacking.

Radula uniserial, eonsisting of rachidian teeth, eaeh tooth with three fang-like denticles.

Upper surfaee of the foot a mottled salmon pink, edged with ivory; the under surfaee a uniform ivory. Head with a eentral and two large lateral lobes; the tentacles loeated at the junction of the lobes. Eyes minute, black and located on the lateral lobes at the base of the tentacles on their outer side. Head a mottled salmon, edged with ivory; the tentacles and mantle ivory. Siphon ivory, with two large equal lobes at the base. Osphra-

dium and gill set well back from the base of the siphon. Anatomy similar to that of *Odontocymbiola magellanica* and *americana*.

| length | width | |
|---|---|---|
| 103 mm. | 45 mm. | 160 miles ENE of Mar del Plata, Argentina |

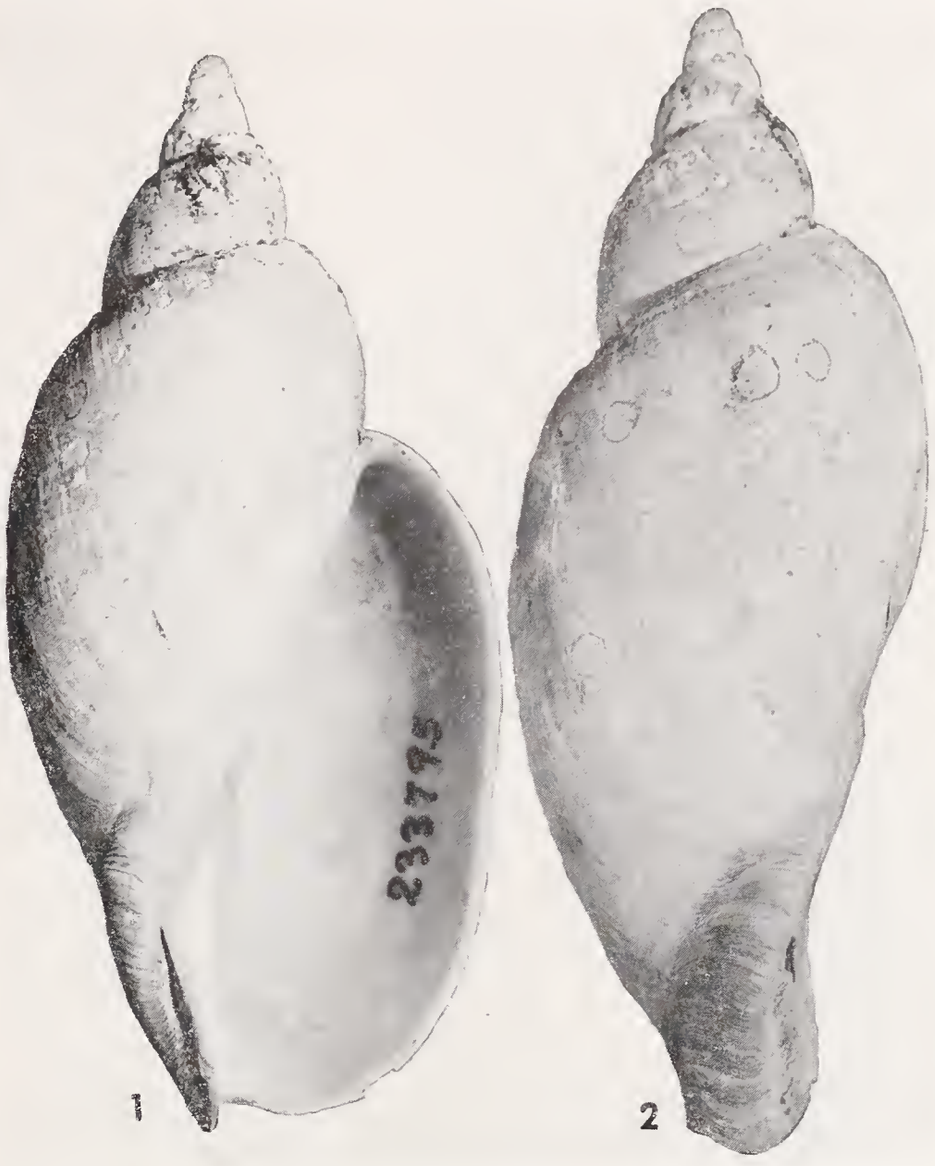


Plate 110. *Odontocymbiola pescalia* Clench and Turner. Fig. 1. Apertural view of Holotype. Fig. 2. Side view to show fasciole (about natural size).

*Types.* The holotype is in the Museum of Comparative Zoology, no. 233795, from about 160 miles ENE of Mar del Plata, Argentina, on a mud bottom. Collected by the fishing vessel *Pescal II* and received from E. de Carvalho Rios of the Museu Oceanográfico de Rio Grande, Brasil.

*Remarks.* This species differs from *O. magellanica* Gmelin in having more convex whorls, having a fine spiral sculpture and a much more highly developed fasciole which extends beyond the base of the columella. In addition, the spire is more attenuated in *O. pescalia*, being seven-tenths the length of the aperture, while in *O. magellanica* the spire is one-half the aperture length.

*O. pescalia* resembles superficially *Adelomelon riosi*, but differs in being much smaller and in having a very different radula.

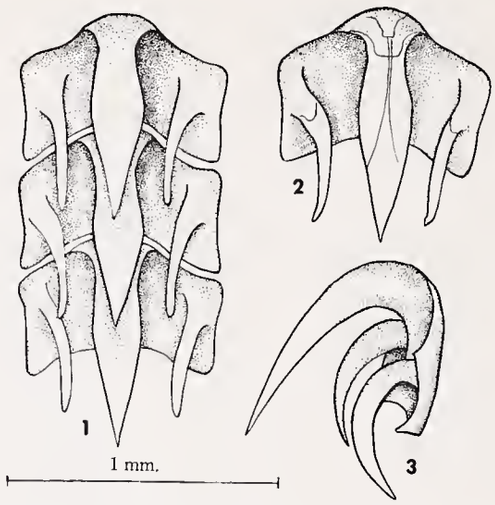


Plate 111. Radula of *Odontocymbiola pescalia* Clench and Turner. Fig. 1. Three teeth in normal position. Fig. 2. Single tooth showing structure. Fig. 3. Side view of single tooth.

## Odontocymbiola americana *Reeve*
### Plates 81, 82, 112, 113

*Voluta americana* Reeve 1856 (June), Proc. Zool. Soc. London, pt. 24, p. 2, pl. 33, figs. 1–2 (Brasil). [Type specimen lost.][1]

*Voluta cleryana* Petit de la Saussaye 1856 (November), Jour. de Conchyl. **5**: 182, pl. 6, figs. 3–4 (Cap Saint Thomé [Cabo de São Tomé] Brasil in 40 fathoms). [Holotype in the collection of the Jour. de Conchyl. in Paris, France.]

*Description.* Shell small, reaching 59 mm. ($2\frac{3}{8}$ inches) in length, rather light in structure, imperforate and sculptured. Color a light, yellowish gray without markings, to a light brownish orange with numerous zig-zag lines of brown in axial arrangement. Occasional specimens with a few dark spots. Whorls 6 and slightly convex. Spire moderately extended and produced at an angle of 45° to 60°. Aperture semicircular. Siphonal canal shallow and narrow with previous growth lines forming a fasciole. Outer lip thin and simple. Parietal area thinly glazed. Plicae 4 or 5 and variable in size. Columella short. Suture slightly indented and well-defined. Sculpture consisting of a series of knobs at the base of the whorl shoulder. Surface of the shell smooth. Probably no periostracum.

Dr. Bernard Tursch in a letter says that "The animal is of a uniform color, a rich yellow-beige, without design. It has no operculum."

| length | width | |
|---|---|---|
| 63.5 mm. | 30.1 mm. | off Macaé, Brasil |
| 59 | 25.5 | Ilha de Sant'Anna, Macaé, Brasil |
| 47 | 27 | Ilha de Sant'Anna, Macaé, Brasil |
| 52 | 31 | Cananéa, São Paulo, Brasil |
| 40 | 20 | Lage dos Santos, São Paulo, Brasil |
| 35 | 17 | Holotype of *cleryana* Petit |
| 46 | 25 | Holotype of *americana* Reeve |
| 34.5 | 18 | Ilha do Pai, Rio de Janeiro, Brasil |
| 32 | 15.5 | Ilha do Pai, Rio de Janeiro, Brasil |

[1] In a letter from D. F. McMichael: "ex. Cathcart collection, sold and now lost."

*Remarks.* This species has been considered a synonym of *Adelomelon subnodosa* (Leach) in most monographs. *O. americana*, however, is a very different species and is as well in a different genus. Confusion existed because young shells of *subnodosa* are somewhat


Plate 112. *Odontocymbiola americana* Reeve. Figs. 1–3. Off Ilha de Sant'Anna, near Macaé, Brasil in 25 fathoms (1.65x). Figs. 4–5. Off Ilha de Pai, Brasil in 6 fathoms. ANSP no. 272512. Photographs of Figs. 4–5 from Clifton Weaver (2.17x).

similar. The adult animal of *subnodosa* produces a shell of at least 160 mm. ($6\frac{1}{4}$ inches) in length, while that of *americana* reaches only 63 mm. ($2\frac{1}{2}$ inches) in length. Dall considered the shells figured in the original descriptions of *americana* and *cleryana* as young specimens, as have others, but most specimens of this species we have examined are adult. Young specimens of *subnodosa* are easily separated from *americana* by having a well-marked shoulder angle, as well as being proportionately broader and in having a different color pattern.

*O. americana* Reeve is exceedingly variable in just about all of its characters. The measurements above indicate how disproportionate individual specimens may be in the

ratio of height to width. *O. americana* is most closely related to *O. magellanica* Gmelin, as both species have fang-like rachidian teeth. The shells, however, are quite different: *americana* is a small species which always has a series of knobs on the whorl shoulder, while *magellanica* is large and only occasional specimens have tubercles on the whorl shoulder.

Dr. Tursch reports in a letter that he dredged this species on hard sand and shell fragments and below 15 fathoms.

*Range.* From Macaé, Est. Rio de Janeiro southwest to Cananéa, Est. São Paulo, Brasil. This is a distance of about 400 miles.

*Specimens examined.* Brasil: Ilha de Sant'Anna, near Macaé, Est. Rio de Janeiro in 15 and 25 fathoms (C. Weaver; B. Tursch); Ponta de Jostinga, Est. Rio de Janeiro (Museo Nacional, Montevideo); (2 miles S of Ilha do Pai, Rio de Janeiro (43°04′ W; 23°01′30″ S) in 19 fathoms (ANSP; B. Tursch); off Ilha Raza, Rio de Janeiro in about 20 fathoms (B. Tursch); Lage dos Santos, 25 miles SE of Santos, Est. São Paulo; Caranéa, Est. São Paulo (both Museo Nacional, Montevideo).

## Subfamily Calliotectinae *Pilsbry and Olsson*

*Calliotectinae* Pilsbry and Olsson 1954, Bull. American Paleontology **35**: 289.

This subfamily is characterized by Pilsbry and Olsson as having fusiform shells sculptured with recurved axial riblets. Columellar plicae weak or lacking. Operculum present. Radula of rachidian teeth each having three denticles in one plane.

The genus *Howellia* is the only member of this subfamily in the Western Atlantic. Nothing is known of the soft anatomy of its single species, *Howellia mirabilis* Clench and Aguayo. It was placed in this subfamily by Pilsbry and Olsson on the basis of its shell morphology.

We retain this subfamily on a provisional basis until we know much more about the soft anatomy. The type genus, *Calliotectum* Dall and its species *vernicosum* Dall, was dredged by the *Albatross* at Station 2793, off the coast of Ecuador in 741 fathoms and

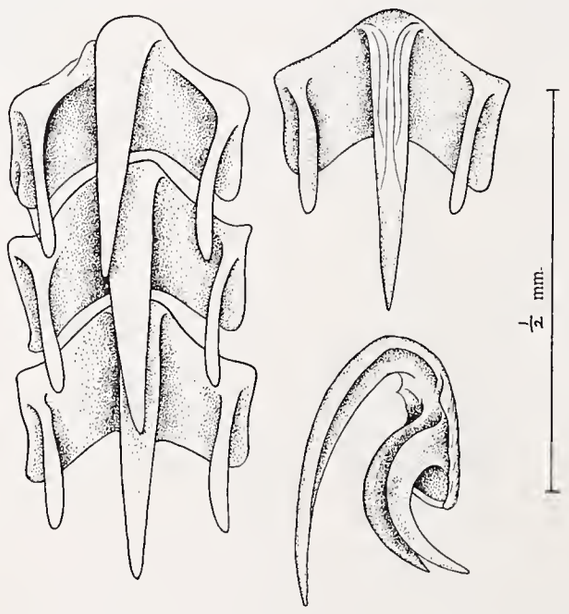


Plate 113. Radula of *Odontocymbiola americana* Reeve.

Station 2807, off the Galapagos Islands in 812 fathoms. Pilsbry and Olsson were able to obtain the radula and they figured a single tooth (1954, pl. 27, fig. 16). This is a simple type with the denticles in one plane and appears to be quite similar to the kind of radulae exhibited by various species in the Zidoninae. If other characters of the soft anatomy are eventually found to agree with those of the Zidoninae, Calliotectinae will become a synonym of the earlier Zidoninae.

## Genus **Howellia** *Clench and Aguayo*

*Howellia* Clench and Aguayo 1941, Memorias de la Sociedad Cubana de Historia Natural **15**: 177.

Type species, *Howellia mirabilis* Clench and Aguayo, original designation.

Plate 114. *Howellia mirabilis* Clench and Aguayo. Off Matanzas, Cuba. Holotype (1.6x).

This is a monotypic genus, its characters are that of the type species.

Based upon shell morphology, this genus is exceedingly close to *Teramachia* Kuroda from Japan (1931, Venus **3:** 45). Relationships of this sort from widely separated areas are unusual, but they do exist.

We are holding *Howellia* and *Teremachia* as different genera until the radulae can be examined.

## Howellia mirabilis *Clench and Aguayo*

Plate 114

*Howellia mirabilis* Clench and Aguayo 1941. Memorias de la Sociedad Cubana de Historia Natural **15:** 177 (off Matanzas, Cuba (23°12′ N; 81°23′ W) in 285 fathoms). [Holotype, Mus. Comp. Zool., no. 135291.]

*Description.* Shell extended, reaching 93 mm. ($3\frac{3}{4}$ inches) in length, fusiform, rather solid, shining, imperforate and strongly sculptured. Color cream and tinged with a very faint brownish red. Whorls 10, convex and regularly increasing in size. Spire extended, acute and produced at an angle of about 27°. Aperture semicircular and colored a light brownish red within. Outer lip simple and slightly thickened. Parietal wall lightly glazed. Columella nearly straight. Suture impressed and crenulated. Sculpture consisting of sinuous, axial costae which disappear below the periphery. In addition, the first 5 whorls have numerous, fine, spiral, incised lines which disappear on the later whorls. Protoconch lost. Operculum unguiculate, corneous and with numerous, fine, parallel growth lines.

| length | width | |
|---|---|---|
| 93 mm. | 28 mm. | Holotype |

*Remarks.* This species is known from but a single specimen. Nothing, so far as now known, even approximates this genus and species in the Western Atlantic. As stated above, the generic relationship appears nearest to the genus *Teramachia* Kuroda from Japan.

* * * *

REFERENCES

Barattini, L. P. and E. H. Ureta 1960. La Fauna de las Costas Uruguayas del Este, Montevideo, pp. 122–126.

Bouvier, E. L. 1887. Système Nerveux des Gastéropodes Prosobranches. Annales des Sciences Naturelles **3:** 1–510, 19 plates.

Carcelles, Alberto 1944. Catalogo de los Moluscos Marinos de Puerto Quequén. Revista Museo de La Plata (n.s.) **3:** 233–309.

Carcelles, A. R. and S. I. Williamson 1951. Catalogo de los Moluscos Marinos de los Provincia Magallanica. Revista del Instituto Nacional de Investigacion de las Ciencias Naturales, Zoology **2:** 225–383.

Carriker, M. R. 1961. Comparative Functional Morphology of Boring Mechanisms in Gastropods. Amer. Zool. **1:** 263–266.

Clarke, A. H. 1962. Annotated List and Bibliography of the Abyssal Marine Molluscs of the World. National Museum of Canada Bull. **181:** 27.

Cooke, A. H. 1922. The Radula of the Volutidae. Proc. Malacological Soc. London **15:** 6–9.

Corsi, A. F. 1900. Moluscos de la Republica Oriental del Uruguay. Anales del Museo Nacional de Montevideo **2:** 291–528.

Cossmann, M. 1899. Essais Paléoconchologie Comparée, Paris **3:** 99–148.

Dall, W. H. 1889. Reports on the Results of Dredging . . . in the Gulf of Mexico and in the Caribbean Sea by the U.S. Coast Survey Steamer "Blake" . . . Bull. Mus. Comp. Zool. **18:** 144–156.

Dall, W. H. 1890. Contributions to the Tertiary Fauna of Florida. Trans. Wagner Free Institute of Science, Philadelphia **3:** 57–90.

Dall, W. H. 1906. Notes on Some Names in the Volutidae. Nautilus **19:** 143.

Dall, W. H. 1907. A Review of the American Volutidae. Smithsonian Misc. Collections **48:** 341–373.

Dodge, Henry 1955. A Historical Review of the Mollusks of Linnaeus. Bull. American Mus. Nat. History **107:** 52–145.

D'Orbigny, A. 1847. Voyage dans l'Amérique Méridionale, Paris **5:** 422–426.

Feruglio, E. 1933. Terrazzi Marini della Patagonia. Annali del R. Museo Geologico di Bologna (2) **8** (bis): 1–288.

Fischer, P. 1879. Note sur l'Animal du *Voluta musica* Linné. Jour. de Conchy. **27:** 97–106.

Fischer, Paul 1884, Man. de Conchy., p. 609.

Fischer-Piette, E. 1950. Liste des Types Décrits dans le Journal de Conchyliologie et Conservés dans la Collection de ce Journal. Jour. de Conchyl. **90:** 8–23; 65–82; 149–180; 310–333.

Fluck, W. H. 1905. Shell Collecting on the Mosquito Coast of Nicaragua—II. Nautilus **19:** 17.

Gray, J. E. 1858. [in] H. and A. Adams, The Genera of Recent Mollusca, London **2:** 615–620.

Heilprin, Angelo 1887. Explorations on the West Coast of Florida. Trans. Wagner Free Institute of Science, Philadelphia **1:** 109.

Krebs, H. 1864. The West-Indian Marine Shells with Some Remarks, Nykôbing, Denmark, pp. 1–137. Republished 1947–1948, Clench, Aguayo and Turner. Revista de la Sociedad Malacologica "Carlos de la Torre" **5:** 23–80, 91–116; **6:** 11–48.

Kuroda, T. and T. Habe 1950. Illustrated Catalogue of Japanese Shells, no. 5, Volutidae, pp. 31–38.

Lahille, F. 1895. Contribucion al Estudio de las Volutas Argentinas. Revista del Museo de La Plata **6:** 295–332.

Melvill, C. and R. Standen 1907. Scottish National Antarctic Expedition, Mollusca **5:** 89–127.

Morretes, F. Lange de 1949. Ensaio de Catálogo dos Moluscos do Brasil. Arquivos do Museu Paranaense **7:** 5–216.

Nicklès, M. 1950. Mollusques Testacés Marins de la Côte Occidentale d'Afrique, Paris, pp. 1–269, text figure 459.

Ortmann, A. E. 1902. Princeton Univ. Expeditions to Patagonia, 1896–1899 **4:** pt. 2, pp. 226–235.

Pace, S. 1902. On the Anatomy and Relationships of *Voluta musica* Linn.; with Notes upon Certain Other Supposed Members of the Volutidae. Proc. Malacological Soc. London **5:** 21–31.

Pilsbry, H. A. and A. A. Olsson 1953. Materials for a Revision of the East Coast and Floridan Volutes. Nautilus **67**: 1–13.

Pilsbry, H. A. and A. A. Olsson 1954. Systems in the Volutidae. Bull. American Paleontology **35**: 277–306.

Sherborn, C. D. 1940. Where is the —— Collection? Cambridge, England, pp. 1–148.

Smith, Maxwell 1942. A review of the Volutidae, Lantana, Florida, pp. 1–127.

Sowerby, G. B. 1845. Thesaurus Conchyliorum, Volutidae **1**: 191–220.

Tryon, G. W. 1882. Man. of Conchology (1) **4**: 73–105.

von Ihering, H. 1907. Mollusques Fossiles du Tertiaire et du Crétacé Supérieur de l'Argentine. Anales Museo Nacional de Buenos Aires (3) **7**: 201–212.

Watson, R. B. 1886. Report on the Scaphopoda and Gasteropoda. Voyage of H.M.S. *Challenger* **15**: 253–264.

Weaver, C. S. 1963. Provisional Species List of Living Volutidae, Honolulu, pp. 1–7.

Wenz, W. 1943. Handbuch der Paläozoologie **6**: 1311–1355.

Woodward, M. F. 1900. Note on the Anatomy of *Voluta ancilla* (Sol.), *Neptuneopsis gilchristi* (Sby.) and *Volutilithes abyssicola* (Ad. and Rve.). Proc. Malacological Soc. London **4**: 117–125.

* * * *

## Book Review

Fauna und Flora der Adria by Rupert Riedl 1963, Verlag Paul Parey, Hamburg and Berlin Publishers, 640 pages, 221 plates of line drawings, 8 colored plates.

This handbook on the flora and fauna of the Adriatic Sea fills a real need, for it is the first general book covering the area to appear in many years. It will be welcomed by all those interested in the marine life of the Mediterranean. The arrangement of the book is systematic, the first part (pp. 19–23 and pls. 3–23) is devoted to the plants, while the major portion (pp. 91–582, pls. 24–221) is devoted to the animals. The Introduction includes two plates which are in reality illustrated keys to the Phyla and Classes of animals. The Class name and page reference are given with each illustration so that the uninitiated can quickly find the proper place in the book. At the beginning of the sections covering each of the higher categories there is a brief discussion of the characters of the group, the methods of collecting and preserving peculiar to the group, and a brief bibliography. The plates are excellent line drawings or superb colored photographs of the species with their scientific names. The plate captions, which are also the text, briefly discuss the species and give the range and habitat of each. In the section on Mollusca (pp. 344–425, pls. 119–148) about 290 species are illustrated and the Opisthobranchia, a group usually neglected, are well covered. — R. D. Turner