OCCASIONAL PAPERS ON MOLLUSKS

Published by
The Department of Mollusks
Museum of Comparative Zoology
Harvard University

VOLUME 4
Numbers 48 to 66

Cambridge, Massachusetts 02138
1974-1984

RUTH DIXON TURNER

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It is with great pleasure that this volume of *Occasional Papers on Mollusks* is dedicated to Professor Ruth Dixon Turner, *Emerita.* During over four decades of association with the Department of Mollusks, she has steadily contributed to the field of malacology, frequently made contributions to this series, and steadfastly supported the efforts of staff and students of the Department in their research and scientific endeavors.

Professor Turner began her professional career in biology as Assistant Curator of Birds at the New England Museum of Natural History of the Boston Society of Natural History (now the Boston Museum of Science). After completing the degrees of Bachelor of Science and Master of Science, she had a chance meeting with Dr. William J. Clench that led to her becoming interested in mollusks. With his encouragement, she received a Ph.D. from Radcliffe College (Harvard University) in 1954. Unlike Ph.D. candidates in biology today, who are often given their tuition and expenses, Professor Turner had to support herself and do her graduate work while serving as an instructor of biology at Vassar College and as biologist at the William F. Clapp Laboratories in Duxbury, Massachusetts, where she began to study the shipworms or bivalve family Teredinidae and other substrate boring bivalves. In 1946 she became Research Assistant in the Department of Mollusks and has served as Lecturer in Biology, Research Associate, Alexander Agassiz Fellow in Zoology and Oceanography, and since 1976 as Professor of Biology and Curator of Mollusks. Her academic kudos include two honorary Doctor of Science degrees. In 1985, she formally entered retirement status as Professor of Biology, *Emerita;* but this has not diminished her research activities and she continues to carry on a vigorous program of scientific investigation, contributing significantly to the intellectual and curatorial activities of the Department of Mollusks.

In pursuit of her researches on the Teredinidae, Professor Turner has had longstanding support from the Office of

Naval Research which has enabled her to study the life cycles of these animals in the laboratory, to perform extensive observations in the field, and to travel extensively to collect samples; she has produced a long series of outstanding contributions on the biology of these bivalves, not the least of which include her critical *A Survey and Illustrated Catalogue of the Teredinidae* (1966) and her revisionary monograph of the generic level taxa in the *Treatise of Invertebrate Paleontology* (1969). Although her studies on these animals have been seminal investigations and central to her work, she has never been limited to these alone because of her broad interest in malacology and in marine biology. Thus, often in co-authorship with Dr. William J. Clench, she contributed several distinguished monographs to the series *Johnsonia,* especially on such prosobranch groups as the Volutidae, Epitoniidae, Tonnidae, Cymatiidae, and Melongenidae. Similarly, she pursued studies of terrestrial pulmonates with her contributions to the Austro-Melanesian camaenoids.

A list of her travels comprises a veritable delineation of the continents and oceans of the world, but especial mention needs to be made of her particularly successful and numerous visits to the Indian subcontinent, Australia, and the Soviet Far East, most often as an invited guest of the foreign government involved. Of great import has been her nearly two dozen expeditions at sea with vessels from the Woods Hole Oceanographic Institution, particularly on board the deep-diving research vessel *Alvin;* she was among the first of women scientists to study the fauna of the deep-sea *in situ,* and she has made many dives to investigate experimentally the unique organisms of the hydrothermal vents; these deep-sea explorations have taken place in the West Indies, eastern North Atlantic, and the Pacific Ocean, particularly off the Galapagos Islands.

A member of numerous professional organizations, she has been particularly active in the American Association for the Advancement of Science where she was elected a Fellow in 1976 and served as Chairman of the Biology Section of the

Council in 1986; president of the Radcliffe Chapter of the Society of Sigma Xi in 1956 for which she has been a travelling guest lecturer; the American Malacological Union for which she was president in 1956-57; and the Society of Systematic Zoology where she served on the Editorial Board and as a member of the Council. In addition to her contributions to the publications of the Department of Mollusks, she has served in an editorial capacity to both *Occasional Papers* and *Johnsonia* and is a Consulting Editor to *The Nautilus* and a member of the Editorial Board of *Malacologia*. She frequently reviews manuscripts for a number of scientific journals, including *Science, The Veliger, The Biological Bulletin,* and *Ophelia.*

Professor Turner's success as a teacher — moreover a communicator of enthusiasm for not only the study of malacology, but marine zoology and biology in general — is reflected both in her long-time commitment to instruction in the curriculum of Harvard College and also by her participation in a great many workshops, symposia, and professional meetings. Numerous students at Harvard and other universities have benefited by her advice and tutelage, and for this, many are forever indebted.

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PREFACE

Almost 45 years have passed since the first issues of Occasional Papers appeared. In his Preface to volume one, William J. Clench (1954) commented on what was then thought to be an extensive current literature in malacology: "more than one thousand titles... in more than two hundred journals, museum bulletins and other publications." In the Preface to volume three, I similarly noted that the literature in malacology was continually increasing (Boss, 1973) and surmised that in 1970 more than 2,500 papers by over a thousand authors were published. In the most recent issues of the Zoological Record for 1987 (volume 123) and for 1988 (volume 124) between 4,500 and 5,000 titles were listed. The information explosion continues although a great many papers published treat subjects other than systematics and faunistics.

Of interest is the increased number of journals which are solely dedicated to the study of the Phylum Mollusca. In the 1980s, these include publications of national organizations as well as local interest groups; new journals on mollusks have appeared in Texas, Italy, Poland, Portugal, Spain, Switzerland, Brazil, Korea, Japan, Taiwan, and China. Desk-top publishing in our age of the personal computer promises an even greater volume of printed information.

Clench (1954) averred that there may be as many as 200,000 species of living mollusks. A more rigorous estimate indicated that there were fewer than 50,000 species (Boss, 1971). Although this figure is subject to revision and some workers have considered it demeaning to the field of malacology, a more critical estimate has yet to appear.

That we have a literature which is simply burgeoning with descriptions of new taxa can be noted by scanning the table of contents of just about any malacological journal. Descriptions of new species keep appearing and sometimes in very unforseen abundance in unlikely places. Can it be that there are over twenty species of sphaeriid clams, sixteen of them new, in a small lake on the island of Kunashir in the Kuril Islands (Starobogatov and Budnikova, 1985)? Or can there be 100 new species of macroscopic mollusks from the shallow waters of an area as well known as the Caribbean (Petuch, 1987)? Also new higher taxa are appearing at an alarming rate, thwarting one purpose of our system of taxonomy: information retrieval. Monotypic taxa are of dubious value in that they tell us nothing of phylogenetic affinities.

The recently published *A Classification of the Living Mollusca* by Kay Cunningham Vaught (1989) has not only provided a valuable work to assist collectors and professionals in placing specimens into their collections but also she has listed more taxa than any other authority. At least 15,000 generic level names are available for living mollusks. Yet the description of generic level taxa continues unabated and one can see new ones being introduced every week. In the last year, according to the *Zoological Record,* nearly 200 such names were proposed for mollusks.

In addition to the superabundance of generic level appelations, there is a similar excess of names available at the family level in the Caenogastropoda and Heterostropha (a part of the old Prosobranchia); Ponder and Warén (1988) list over 1,000 nomina. There are at least as many more in the other molluscan classes.

More serious are the constant elevation of taxa and the creation of new higher level groups, often on uncritical criteria. The Russians have become masters at these approaches. One can cite the paper of Golikov and Starobogatov (1975) where wholesale alterations in the systematics of prosobranchs were introduced. Yet almost year by year they have altered the landscape of the classification of the higher groups in the Mollusca. Thus, in 1979 Minichev and Starobogatov considered the gastropods to be comprised of eight subclasses while more recently Golikov and Starobogatov (1987) divided their Order Cerithiiformes, roughly equivalent to the superfamily Cerithioidea, into several suborders, three of them new, and many subordinate groups with new familial and superfamilial names. This phenomenon has occurred in group after group and we have managed to issue critical translations of papers dealing with the Bivalvia and the Pulmonata (Skarlato and Starobogatov, 1979; Schileyko, 1979).

Only recently has the cladistic method made much of an inroad in malacology despite such superb analyses as those of Waller (1978) but unlike that pioneering work, some recent ones simply radically revise earlier systems and name branch after branch of assumed lineages (Haszprunar, 1988). These analyses, especially if carefully documented and critically performed, such as those of Houbrick (1988) on the Cerithioidea, promise to illuminate the most probable phylogenies of molluscan groups.

Lastly, as if not sufficiently plagued by over-naming and taxonomic inflation, malacology has to face an embarrassing new book (Turgeon *et al.*, 1988), which, one might say in mock imitation of the famous phrase, is one giant step backward. This anachronistic tome brings us atavistically to the days of pre-Linnaean authors. We are presented with a list of largely contrived common names, most of them ponderously polynomial. This abysmal volume is terminally and irrelevantly garnished with a dozen color plates, and the penultimate figure is up-side down: an apt metaphor for this return to the 18th century.

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Pages i-xvi published August 30, 1989 .... K.J. Boss

Occasional Papers On Mollusks

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

VOLUME 4 15 NOVEMBER 1974 NUMBER 48*

MONOGRAPH OF THE GENUS *LUCIDELLA* IN CUBA (PROSOBRANCHIA: HELICINIDAE)

By KENNETH J. BOSS AND MORRIS K. JACOBSON

ABSTRACT. Four species of the genus *Lucidella* occur in Cuba; three in the subgenus *Poeniella,* and one in *Poenia.* The Cuban species have zoogeographic affinities with Jamaican and Hispaniolan relatives. The systematics and biology of the genus and the Cuban species are discussed.

INTRODUCTION

This is the sixth recent monograph on the Helicinidae of Cuba. The genera covered in previous revisions were: *Viana, Priotrochatella, Emoda, Glyptemoda, Calidviana, Ustronia, Troschelviana, Semitrochatella,* (Clench & Jacobson, 1968; 1970; 1971 a & b), *Ceratodiscus,* and *Alcadia* (Boss & Jacobson, 1973a, and 1973b).

In contrast to the genera revised heretofore, which are either endemic in Cuba, or in which the Cuban fauna is well represented, there are only 4 Cuban species of *Lucidella* of some 40 nominal forms reported from the Neotropics, this fact affording little credence to the suggestion of Clench (1937: 69) that the genus *Lucidella* originated in Cuba.

Boss and Jacobson (1973 b) discussed the zoogeography and distribution of *Alcadia* in Cuba and concluded that representatives of the genus probably reached Cuba directly

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*Volume 4 starts with Number 48.

from Jamaica. Occasionally species were derived via Hispaniola. *Lucidella,* which is closely related to *Alcadia,* shows a similar zoogeographic pattern: the Cuban represenatives bear a marked resemblance to both Jamaican and Hispaniolan species. *Lucidella rugosa* from Cuba is hardly distinguishable from the Hispaniolan *L. cibaoensis,* and the Cuban *L. tantilla* and *L. granulum* belong to the subgenus *Poeniella* which probably originated in Hispaniola (Baker, 1923). Finally, *L. granum,* a member of *Poenia,* has its closest affinities with Jamaican species.

ACKNOWLEDGMENTS

We here express our gratitude to Dr. R. Robertson of the Academy of Natural Sciences of Philadelphia and Dr. J. Rosewater of the National Museum of Natural History for use of their collections. Dr. W. K. Emerson of the American Museum of Natural History and Dr. R. D. Turner and Mr. R. I. Johnson of the Museum of Comparative Zoology read the manuscript and offered much useful advice. The manuscript was patiently typed and corrected by our secretary, Mrs. G. Dent.

Family HELICINIDAE Latreille, 1825
Subfamily STOASTOMATINAE C. B. Adams, 1849
Genus *Lucidella* Swainson, 1840

Lucidella Swainson, 1840. Treatise on Malacology, p. 330 (type-species, *Helix aureola* Férussac 1822 [La Martinique] by monotypy).

Prosopsis Weinland, 1862. Malak. Blätt 9: 198 (type-species, *Prosopsis sulcata* Weinland 1862 [Haiti] by monotypy), *non* L. Jurine, 1801, *nec* Fabricius, 1804 (Hymenoptera).

Urichia Guppy, 1895. Proc. Victoria Inst. Trinidad, 2: 24 (type-species, *Helicina adamsiana* Pfeiffer, 1848, subsequent designation H. B. Baker, 1927).

Description. Shell between 2 to 9 mm in diameter, lens-shaped, conic, to depressed globose, usually with strongly developed axial or spiral sculpture; body whorl rounded to depressed carinate, umbilical area depressed or excavated, with a thin, variously sized, basal callus. Aperture without teeth or more or less narrowed by toothlike projections above and below on the peristome often with corresponding external depressions or pits; a shallow notch at the upper insertion of the peristome. Operculum rounded triangular or semilunate, thin, translucent, light buff, somewhat darker at the edges; nucleus subcentral or near the columellar edge, not marginal; calcareous layer thin, glassy, closely pebbled, with a long, rounded, raised sigmoid lamella at the collumellar margin; chitinous layer very thin, extending well beyond the margins of the calcareous layer.

Historical remarks. Swainson (1840) introduced *Lucidella* for *Helicina aureola* (Férussac), a species with a discoidal shaped shell and a dentate aperture. He placed the genus in a heterogeneous assemblage, the subfamily Lucerninae or "land volutes" which included widely disparate generic taxa, *Caracolla* (Helicidae), *Anostoma* (Odontostomidae), *Lucerna* (Camaenidae) and *Polymita* (Helminthoglyptidae). The type-species *aureola* was originally described and figured by Férussac (1822; see Kennard, 1942) as *Helix* or *Helicodonta* but was placed in *Helicina* by Gray (1825), who noted its simple operculum and prosobranch affinities. Wood (1828) did likewise and Gray (1842) recognized the genus *Lucidella* in the Helicinidae as "peculiar among operculated shells for having 3 or 4 teeth on the thickened edge of their mouths." Subsequently, Gray (1857) placed *Lucidella aureola* in his family Oligogyradae [*sic*], presently acknowledged as synonymous with the Helicinidae (Keen, 1960).

Petit de la Saussaye (1851) figured freshly collected specimens. In regard to *Lucidella,* Pfeiffer (1847) suggested a relationship with the vianine *Trochatella* and separated it from *Helicina s. s.* by its lack of a basal callus. He noted that the closest relatives of *aureola* were *leana* Adams and *lineata* Adams from Jamaica (see Jacobson and Boss, 1973 b) and delineated three intermediate to typical *Lucidella*-like forms, *depressa* Gray, *rugosa* Pfeiffer and *lirata* Pfeiffer. In 1848 Pfeiffer cited 98 species in the Helicinidae, allocated to 3 genera, *Helicina, Trochatella* and *Lucidella,* with only the single type-species included. In 1850 he figured *aureola* but doubted the scientific correctness of *Lucidella.* In the 1852 edition of the *Monographia,* Pfeiffer listed *aureola* with *Lucidella* and in the 1858 edition added *L. nana,* which he had described in 1857. Later he (1865; 1876) recognized 5 taxa in *Lucidella.* In a more critical and extensive review, Wagner (1910) redefined the genus very much as it is understood today and extended its geographical confines to include species in the Lesser and Greater Antilles as well as in neighboring Central and South America. He suggested that the tiny notch formed where the outer lip inserts on the body whorl serves as an air-hole when the operculum is in place. In his discussion, he omitted many forms and names since, as he admitted, he did not have sufficient material. Two earlier 19th century monographs treated the species of the family Helicinidae in which several *Lucidella* were listed (Sowerby, 1842; 1866; Reeve, 1873). Although the Cuban *Lucidella* have been cited or delineated by Arango (1879), Crosse (1890) and Aguayo and Jaume (1948), no comprehensive review of the Cuban taxa exists.

General characteristics. Members of the genus *Lucidella* are readily recognized. Many species, especially those of *Lucidella s. s.,* have a peristome which is thickened by one or two tooth-like protuberances, a feature uncommon in most Helicinidae with the exception of some *Alcadia.* The rather strong surface sculpture, whether spiral or axial, serves to mark this group off from other helicinids which tend to be smooth (Boss and Jacobson, 1973 b) with the exception of *Glyptemoda, Glyptalcadia* and *Stoastoma.* The operculum is somewhat similar to that of *Helicina s. s.* but has a subcentral rather than marginal nucleus. The calcareous layer of the operculum in *Lucidella* is thinner and more fragile, and the columellar lamella relatively higher than in *Helicina.* In some smaller forms, like *L. granulum, L. granum* and *L. tantilla,* the labial teeth are obsolete, but the operculum and spiral or axial shell sculpture place them in *Lucidella.*

As in many helicinids, the male of *Lucidella* is frequently smaller than the female (Baker, 1934) and resorption of shelly internal partitions is characteristic (Bland, 1858). In addition, the quality of the microhabitat leads to variation in the size and occasionally, of sculptural details in adult specimens (Brown, 1913).

The Subgenera. Subgenera relegated to *Lucidella* were described as *Perenna* and *Urichia* (Guppy, 1867; 1895), *Poenia* (Adams and Adams, 1856) and *Poeniella* (Baker, 1923) and placed in the Helicininae by Wenz (1838) and the Ceratodiscinae by Keen (1960). Since the Ceratodiscinae is so unusual in shell and opercular characteristics as to be considered monotypic (Boss and Jacobson, 1973a), *Lucidella* is accordingly placed in the Stoastomatinae, a group including small shelled helicinids with variable sculpture and a mushroom-shaped T-lateral tooth in the radula with a reduced accessory plate and many, mostly multicuspid marginal teeth.

On the basis of published data and examination of the type-species, we recognize 3 subgenera in *Lucidella* as follows:

1. *Lucidella s.s.* Swainson, 1840, type-species, by monotypy, *Helix aureola* Férussac, 1822, which includes the larger, more solid forms with strong labial dentition, minute basal callus, dark color, and pronounced spiral sculpture, occasionally strengthened by nodules as in *L. granulosa* Adams (See Plate 84, figs. 1–3 in Jacobson and Boss, 1973 b).

2. *Poenia* H. and A. Adams, 1856, type-species, by subsequent designation (Pilsbry and Brown, 1912), *Helicina depressa* Gray, 1825, which comprises small to moderately large shells with spiral sculpture and weak or absent labial teeth. This is a widely spread group with a single representative in Cuba and possibly Hispaniola.

3. *Poeniella* H. B. Baker, 1923, type-species by original designation, *Helicina plicatula christophori* Pilsbry, 1897, which resembles *Poenia* but differs in having axial instead of spiral sculpture. It is widely distributed with 5 species

in Hispaniola, 3 in Cuba and others in Puerto Rico, Florida, the Bahamas and several islands of the Lesser Antilles.

Anatomical remarks. Baker (1926; 1928) provided some notes on the anatomy of *Lucidella aureola* and *L. lirata*, respectively. He found resemblances in the female sexual apparatus of both, including the V-organ with a prominent ovoid protuberance to the left of its apex, the small bilobed sperm sac imbedded in the provaginal sac with a short, stout stalk, and the provaginal sac flattened and deeply lobed on the left side. In these respects the female anatomy does not differ much from that of *Alcadia* and *Eutrochatella* as shown by Bourne (1911: pl. 35, figs. 25, 26). This emphasizes the conclusions of Bourne (1911: 777) and Baker (1926: 35) that the general uniformity of the genitalia of the Helicinidae makes them useless for diagnostic purposes.

Radula. The radula of *Lucidella* exhibits the essential features of a helicinid (Troschel, 1857): a single central rachidian tooth (R), flanked by A, B, and C centrals and a lateral complex (LC) consisting of a comb-lateral and an accessory plate and a marginal complex (MC) consisting of numerous teeth or uncini. These structures can be abbreviated in the formula: (MC) (LC) C B A R A B C (LC) (MC).

Baker (1922) described and figured parts of the radula of *Lucidella* (*Poenia*) *lirata* and *Lucidella* (*L.*) *aureola*. The radulas are generally similar, but differences do exist. Although in both cases the uncusped R-centrals are "hooded," the shape of this tooth differs, that of *lirata* being subcircular with a rounded base, while in *aureola* it is broadly anvil-shaped, with a straight base. The number of cusps on the A-, B-, and C- centrals are roughly equal, but in *lirata* the comb-lateral of the lateral complex has only 6 cusps, whereas in *aureola* there are 9 to 10. The differences in the marginals are even greater, there being in *aureola* 2 teeth with 2 cusps, 21 with 3 cusps, and 20 with 4 cusps; in *lirata* there are only 5 with 3 cusps, and 12 with 4. *L. lirata* has 135 teeth in each transverse row of the radula, including 62 marginals, whereas *aureola* has 283 teeth including 136 marginals. It appears that, in the course of evolution, as *aureola* increased in the size and strength of its labial protuberances it also increased the number and complexity of its radular teeth.

The comb-lateral section of the lateral tooth complex has a terminal post and a large, roughly quadrate, winged, accessory plate which engages only slightly with the comb-lateral. The radula of *Lucidella* roughly resembles that of the subfamily Helicininae. However, because of resemblances with the radula of *Stoastoma, Fadyenia,* and *Ceratodiscus,* chiefly in the presence of pauci-cusped inner marginals, Keen (1960) united *Lucidella* with these genera in the subfamily Ceratodiscinae. Boss and Jacobson (1973a) expressed doubts regarding this arrangement chiefly on zoogeographical grounds, namely that *Ceratodiscus* is absent from Jamaica where the genus *Lucidella* radiated.

Baker (1922: 54), finding that the radula of *Stoastoma lindsleyanum* C. B. Adams, 1849, the type-species of the genus *Lindsleya* Chitty, 1857 (synonym of *Fadyenia* Chitty, 1857) was very close to that of *Lucidella lirata,* placed *Lindsleya* (= *Fadyenia*) tentatively as a subgenus of *Lucidella.* He regarded his *Lucidella venezuelensis,* from Venezuela as belonging here as well. However, both the shell and operculum of *Fadyenia* (and also of "*Lucidella*" *venezuelensis*) are so different from *Lucidella* that it is more advisable to regard *Fadyenia* as a full genus, separate from *Lucidella,* a procedure followed by Keen (1960) and Boss (1972).

Habitats. The species of *Lucidella* are mostly ground-dwellers, living under leaves or rocks in damp places. In Cuba Arango (1879) reported *rugosa* as living under stones and *granum* in bushes ("en los arbustos"). Ramsden (1914: 50) discovered "*tantilla*" (= *granulum*) "in dirt at the root of trees." Brown (1913) extensively observed the habitat preferences of two Jamaican species which were found mostly along the borders of woods or on stone walls. Baker (1934) noted that some of the Jamaican species are subarboreal ("good climbers") and ground dwellers.

Enemies. Many specimens from Cuba have a tiny, perfectly circular hole in the shell which was probably drilled by an unknown predator. Clench and Jacobson (1971b: 409) noticed the same sign of predation in some small Cuban vianine helicinids. Additionally, Clapp (1921: 108) noticed that *Lucidella tantilla* on Chokoloskee Key, Florida, appeared to be a favorite food with some beast that bites them fairly in half.

Zoogeography. Wagner (1910: 337) and Clench and Jacobson (1971b) noted that the distribution of *Lucidella* coincided remarkably with that of *Alcadia* and *Eutrochatella.* Since the latter probably originated in Central America, the point of origin of *Lucidella* may also be sought there, where the species *Lucidella lirata* (Pfeiffer, 1847) has a wide distribution from Venezuela to southern Mexico (Baker, 1928). The mode of dispersal may then have been as follows: the ancestral form, which was possibly related to *L. costata* Simpson, 1894, a Miocene fossil from the Bowden beds of Jamaica (Woodring, 1928), made its way to Jamaica where it underwent a radiation. Some 16 forms of *Lucidella s. l.* are known there today. All the Jamaican forms of *Lucidella* have predominately spiral sculpture, the sort found in *L. lirata* and in the insular form, *L. midyetti* Richards, 1938, from Roatan Island, Honduras. This sculpture is characteristic of the subgenus *Poenia* H. and A. Adams, 1856. In Jamaica, *Lucidella s.s.* developed larger, heavier, more colorful shells with a very much reduced basal callus and with strong lip teeth, greatly constricting the aperture. These features can be seen in *L. aureola* (Férussac), the type-species of the genus. *L. granulosa* (C. B. Adams) developed strong surface nodes, some arranged in vaguely axial rows. The variations in these species have been detailed by Brown (1913) who related them to environmental factors.

Following the routes discussed by Darlington (1938: 295), *Lucidella* appears in Hispaniola where, in addition to 7 species of the Jamaicas subgenus *Poenia,* a new subgenus, *Poeniella,* possibly derived from some form similar to *granulosa,* radiated into the 5 taxa presently found in Hispaniola. From Hispaniola *Lucidella,* in the form of the subgenus *Poeniella,* probably *L. cibaoensis,* made its way to Cuba. The subgenus *Poenia* came to Cuba from Jamaica where today it is represented by the single species, *L. granum.*

From Jamaica and Hispaniola as centers, the various groups migrated to other areas: *Poenia,* starting from Jamaica where 10 forms are known, migrated to Hispaniola where 7 forms are now recognized and then to Barbados, Swan Island, St. Lucia and other of the Lesser Antilles, Trinidad, Martinique, Cuba and Puerto Rico, with a single species each. *Poeniella,* originating in Hispaniola, expanded to Cuba (3 species), Puerto Rico, the Bahamas, Florida Keys, Grand Cayman and St. Kitts where a single form developed in each locality. The possible routes of invasion in these cases is not known though it is assumed that passive transport, probably modulated by hurricanes, figured in the distribution to Cuba, Florida and the Bahamas. These migrations took place long enough ago for largely endemic forms to have developed in each area.

Plotting these data on Map 1, we note that *Poeniella* is located more to the north, from Florida to St. Kitts, whereas *Poenia* is found from Yucatan to Barbados and Trinidad. That *Poeniella* does not occur on Jamaica at all agrees with the generalizations of Darlington (1938), who concluded that the line of migration was from Jamaica to Hispaniola and Cuba, and not from Hispaniola to Jamaica. There are no species of *Lucidella s. s.* in Cuba and there are no species of either *Poenia* or *Poeniella* on the Isle of Pines. Details of distribution of the species found in Cuba appear in the discussion of each of the Cuban species and are illustrated in Map 2.

The catalogue of *Lucidella* which follows this study (Boss and Jacobson, 1974) includes all the names introduced for this genus and forms the basis for the remarks on the zoogeography of the genus. Lack of material made it impossible to judge the state of all the names independently, and the opinions of various authorities on the subject are included as notes.

Subgenus **Poenia** H. and A. Adams

Poenia H. and A. Adams, 1856. Genera of Recent Mollusca 2: 304 (type-species, *Helicina depressa* Gray, 1825 [Jamaica], subsequent designation, Pilsbry and Brown, 1912).

Perenna Guppy, 1867. Ann. & Mag. Nat. Hist. 19: 260 (type-species, by monotypy, *Helicina lamellosa* Guppy, 1867 [Trinidad] [= *H. lirata* Pfeiffer]).

Description. Shell small, 3 to 4 mm in diameter, depressed, light colored, weakly to strongly sculptured with spiral lines or ridges, occasionally crossed by much weaker axial striations, sculpture covering entire shell or obsolescent on base; occasionally with more or less densely spaced short, deciduous bristles; lip teeth weakly developed, aperture not strongly constricted.

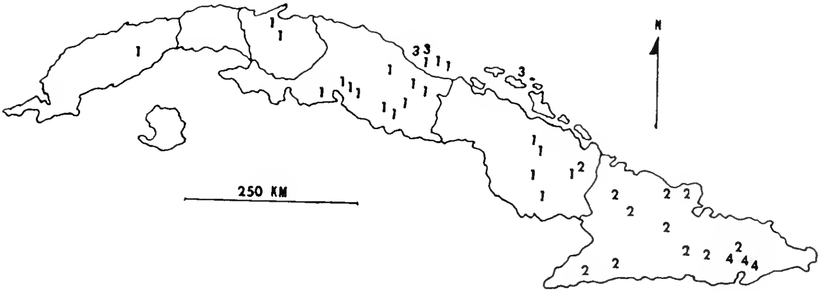
Remarks. Members of this subgenus are recognized by their small size, light color, and predominantly spiral sculpture though species may also have weak axial striations. The single Cuban species, *L.* (*Poenia*) *granum* (Pfeiffer), confined to the easternmost part of the island, must have reached Cuba from Jamaica, possibly via Hispaniola (Map 2). Besides Jamaica, Cuba, Hispaniola, Puerto Rico and Yucatan, the subgenus occurs on the more southerly Lesser Antilles like St. Lucia and Martinique and also on Trinidad, thus in territory lying to the south of the range of *Poeniella*.

Keen (1960: 288) and others recognized *Perenna* Guppy, 1867 with type-species *lamellosa* Guppy (= *lirata* Pfeiffer) as a valid subgenus. It is difficult to justify the separation of this group from *Poenia* because the only difference cited by Keen is the presence of a keel in *Perenna*, an insufficient character for subgeneric distinction.

Baker (1922: 54) cited *H. unidentata* Pfeiffer, 1849 (= *H. lirata* Pfeiffer, 1847) as the type of *Poenia* following Fischer (1885). However, since Fischer did not actually select a type-species, the designation must date from Baker, 1922. This designation, however, was predated by that of Pilsbry and Brown, 1914, who selected *Helicina depressa* Gray, 1825 as the type-species of *Poenia*.

Map 1

The distribution of subgenera of the genus *Lucidella*. *Poeniella* has a more northern distribution from Florida to St. Kitts (No. 1) while *Poenia* is found in the south from Yucatan to Barbadoes and Trinidad (No. 3). Both overlap in No. 2. *Lucidella s.s.* is found principally in Jamaica.



Map 2

The distribution of the Cuban species of *Lucidella*. 1 = *rugosa*. 2 = *granum*. 3 = *tantilla*. 4 = *granulum*.

Lucidella (Poenia) granum (Pfeiffer)

Plate 1, figs. 1–6

Helicina granum Pfeiffer, 1856. Novit. Conch. 1: 86, pl. 23, figs. 20–23; 1857. Malak. Blätt. 3: 49 (type locality, Holguín, Oriente, Cuba; neotype, here selected, MCZ 73863, *ex* Gundlach); 1858. Monographia Pneumonopomorum Viventium, suppl. 1, p. 206; 1865. *Ibid.*, suppl. 2, p. 234; 1876. *Ibid.*, suppl. 3, p. 272; Arango, 1879. Contribución Fauna Malacológica Cubana, p. 53; Crosse, 1890. Jour. Conchyl. 38: 321; Reeve, 1873. Conch. Icon. 19: pl. 25, fig. 225.

Lucidella granum Pfeiffer, Sowerby, 1866. Thes. Conch. 3: 270, pl. 278 (13), fig. 468; Wagner, 1910. [*In*] Martini and Chemnitz, Conch. Cab. (2) 1: sect. 18, pt. 2, p. 343, pl. 68, figs. 14, 15.

Description. Shell attaining 3.5 mm in width and 3.0 mm in height, depressed conic, moderately glossy. Color reddish or coppery brown to pale orange yellow, lip often white. Whorls little more than 5, weakly inflated, slowly increasing in size; body whorl well and evenly rounded, barely descending at aperture. Suture well marked, slightly channeled. Spire convex, about equal in height to the body whorl. Aperture oblique, widely semilunate. Parietal wall thin and glassy. Basal callus thin, depressed, surface with wide, rounded wrinkles. Lip entire, thickened, barely expanded centrally. Columella short, concave. Sculpture of well marked, subregularly spaced spiral ridges, generally narrower than the intervals. Protoconch 1⅛ whorls, well rounded, lightly raised, faintly and closely punctate. Periostracum wanting. Operculum as in genus.

Height mm	Width mm	
3.0	3.2	Botanic Garden, Cienfuegos, Las Villas
2.6	3.5	Vilche's Hill, Soledad, Las Villas
2.5	3.3	Holguín, Oriente (neotype)
2.4	3.3	Cerro Canada de Jagüeyes, Holguín, Oriente
2.1	3.5	Loma Aguada de Puig, Retrete, Banes, Oriente

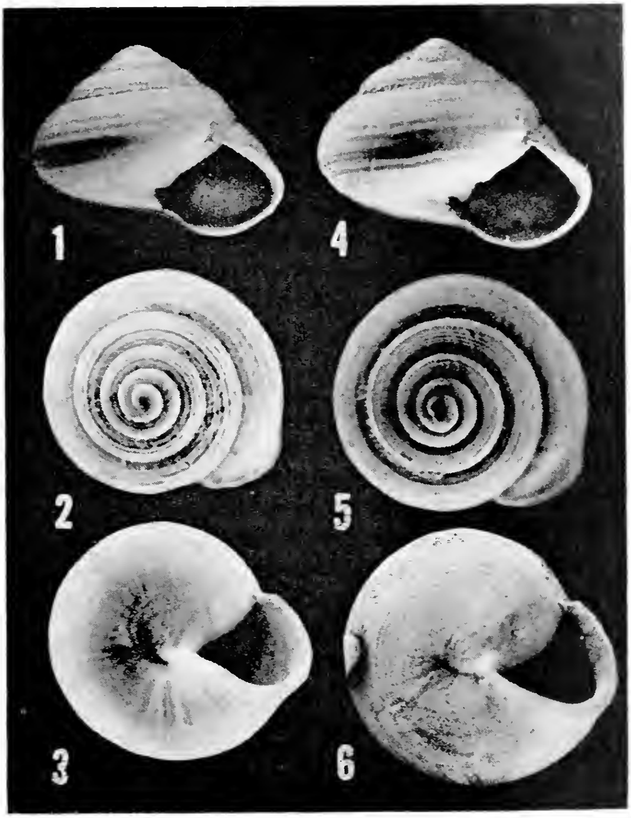


Plate 1

Lucidella (*Poenia*) *granum* (Pfeiffer)

Figs. 1–3. Neotype, here selected, of *Helicina granum* Pfeiffer, 1856, Cuba [Holguín, Oriente], 3.3 mm × 2.5 mm, MCZ 73863.

Figs. 4–6. Botanic Garden, Cienfuegos, Las Villas, 3.5 mm × 2.5 mm, MCZ 277130.

Remarks. This is the only species of the subgenus *Poenia* in Cuba. Its range is limited to the eastern end of the island in Oriente and the easternmost part of the neighboring Camagüey Province. The occurrence in and around the Botanic Garden of Cienfuegos and Soledad in western Las Villas, with no intervening records, is probably due to accidental introductions, possibly with plants.

In Cuba this species is readily identifiable by the presence of spiral sculpture.

Specimens examined. ORIENTE. *Miranda:* Cato del Rey, ca. 20 km from Miranda; Arroyo de Agua, near Miranda; Upper Mercedes Valley; top of hill N of Mercedes Valley; Nipe Hills, Tibisi; mogote, 8 km SE of Miranda (all ANSP). Florída Blanca, Alto Songo (MCZ). *Guantánamo:* Sierra Canasta, Romelia Woods; Monte Verde (both USNM); Guasa River, Mte. Líbano (MCZ). *Holguín:* Cerro Cariblanco, 16 km NE of Holguín; Unas, 12½ km NW of Holguín; Cerro Corralito, 17 km NE of Holguín; 2 km N of Unas; Cerro Canada de Jagüeyes; Buenavista, Bayamo (all MCZ); new road E of Ensenada de Mora; 1 km inland, W of river, Mota (both ANSP); Mogote Santa Ana, San Luis; Camayén, Santa Lucía; La Silla, Santa Lucía; Antilla, Bahía de Nipe (all USNM); Loma de la Aguada de Puig, Retrete, Banes (MCZ). CAMAGÜEY. El Jacinto, Cascorro. LAS VILLAS. Jardin Botánico, Cienfuegos; Vilches Hill, 2½ mi. E of Soledad, Cienfuegos (both MCZ).

Subgenus **Poeniella** H. B. Baker

Poeniella H. B. Baker, 1923. Occ. Papers Mus. Zool. Univ. Michigan no. 137, p. 23 (type-species, *Helicina plicatula christophori* Pilsbry, 1897, St. Kitts, West Indies, original designation).

Poniella "H. B. Baker" Clench, 1961. Occ. Papers Moll., Harvard Univ. 2 (26): 238 [error for *Poeniella*].

Description. Shell small, 2–4 mm in diameter, depressed to moderately raised or subconic; sculpture of regular, variously strong, occasionally sigmoid, slanting axial riblets, spiral striae weak or absent; labial denticles weak or obsolescent.

Remarks. The members of this subgenus are small, with generally pale shells differing from those in *Poenia* by having predominantly axial instead of spiral sculpture. This group is absent from Jamaica and probably originated in Hispaniola which has at least 7 species. In addition to Cuba and Hispaniola, this subgenus occurs in Puerto Rico, St. Kitts, Grand Cayman Island, the Bahamas, and the Florida Keys. It occupies a more northerly area than the subgenus *Poenia,* the area of overlap occurring in the Greater Antilles (see Map 1).

The 3 Cuban species are all small. Of the three, only *rugosa* seems to have an island-wide distribution (Map 2), thinning out considerably in the two outer provinces, Oriente and Pinar del Río. *L. granulum* is limited to the environs of Guantánamo, and *tantilla,* which also occurs in the Bahamas and Florida Keys, is found principally on a few islands off the north central coast of Cuba (Map 2).

Baker (1923: 23) cited the type-species of *Poeniella* as *Helicina* (*plicatula*) [*sic*] *christophori* Pilsbry. The misplaced parentheses caused some confusion in the literature. Pilsbry (1948) repeated the illogical original citation, while Aguayo and Jaume (1948) wrote *H.* (*Plicatula*) *christophori,* and Thiele (1929: 88) and Wenz (1938: 466) cited the type-species as *L.* (*P.*) *christophori.* The correct name is as given above and can be found on p. 22 in Baker (1923).

Lucidella (Poeniella) rugosa (Pfeiffer)

Plate 2, figs. 1–6

Helicina rugosa Pfeiffer, 1839. Wiegmann's Arch. Naturg. 1 (5): 355 (type-locality, Palenque and Pan de Matanzas, Matanzas; type, destroyed); 1852. Monographia Pneumonopomorum Viventium, p. 341; 1858. *Ibid.,* suppl. 1, p. 180; 1865. *Ibid.,* suppl. 2, p. 217; Sowerby, 1842. Thes. Conch. 1: 14, pl. 3, fig. 132; Arango. 1879, Contribución Fauna Malacológica Cubana, p. 45; Reeve, 1873. Conch. Icon. 19: pl. 14, fig. 120.

Lucidella rugosa Pfeiffer, Sowerby, 1866. Thes. Conch. 3: 281, pl. 268 (Helicina 3) figs. 81, 82; Wagner, 1910. [*In*] Martini & Chemnitz, Conch. Cab. (2) 1: sect. 18, p. 347, pl. 69, figs. 8, 9.

Description. Shell small, 3–4 mm in width and 2–3 mm in height, depressed conic, moderately glossy. Color lemon-yellow, lip white. Whorls about 5, weakly rounded, slowly increasing in size. Suture well impressed. Spire low, convex. Aperture semilunate, constricted near both terminations, acutely angled above. Parietal wall strongly sigmoid. Basal callus depressed, thin, glossy, minutely punctate. Peristome thickened, reflected, widened and slightly bent downward, with a tiny notch at insertion in body whorl and a long, low, toothlike tubercle on basal portion. Columella short, concave, smoothly curved at insertion to basal lip. Early teleoconch punctate, later whorls marked by strong, slanting, regularly spaced axial ridges, wider than their interspaces. Protoconch 1½ whorls, rounded, moderately raised, minutely punctate. Periostracum wanting. Operculum as in genus.

Height mm	Width mm	
2.3	3.7	Casa Blanca, Pinar del Río
2.3	3.6	Paso Paredones, Cubitas, Camagüey
2.3	3.6	Harvard House, Soledad, Las Villas
2.2	3.6	El Mamey, Sagua La Grande, Las Villas
2.2	3.5	Cayo Lucas, Caibarién, Las Villas

Remarks. This species is separated from other Cuban *Poeniella* by its larger size and stronger sculpture. *L. granulum* which also has a weakly flaring peristome, reaches only about one-half the size of *rugosa* and the axial sculpture is much weaker. Moreover in *granulum* the labial swelling is barely perceptible and the notch at the upper labial insertion is minute. *L. rugosa* is closely related to several *Poeniella* from Hispaniola (see Hjalmarson and Pfeiffer, 1858: 145). The basal labial swelling and the tiny notch at the upper insertion of the lip are characteristic of *rugosa*.

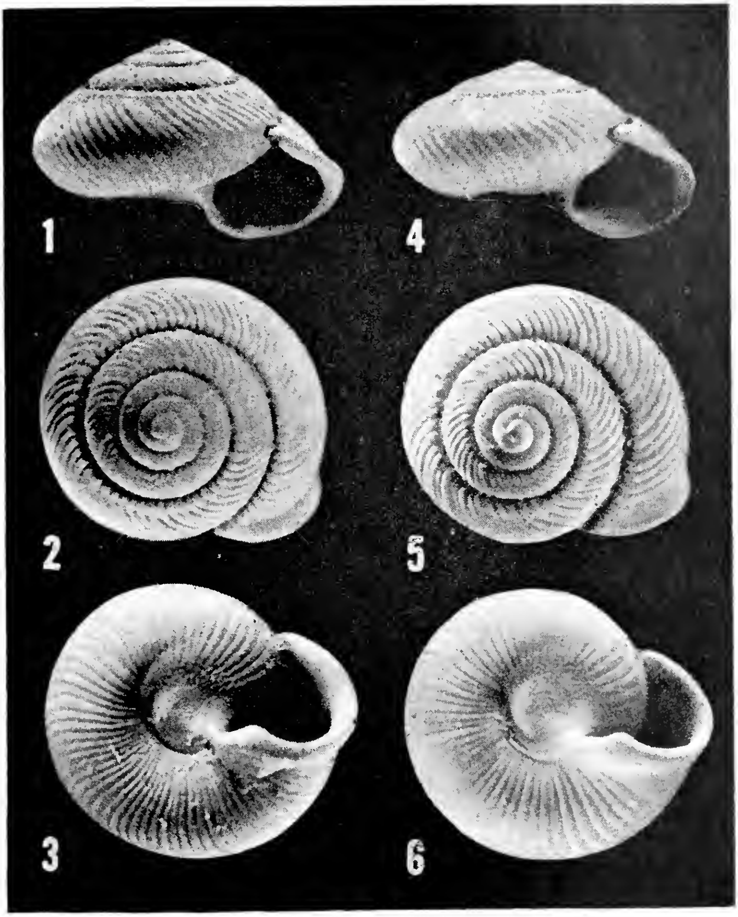


Plate 2

Lucidella (*Poeniella*) *rugosa* (Pfeiffer)

Figs. 1–3. San Martín de Biaya, Camagüey, 3.5 mm × 2.2 mm, MCZ 128780.

Figs. 4–6. Arroyo Hondo, Camagüey, 3.8 mm × 1.8 mm, MCZ 277240.

The distribution of *rugosa* centers around the middle of Cuba in Las Villas, Camagüey, and Matanzas Provinces. Records from Habana are few, and those from Oriente and Pinar del Río are scattered. Arango (1879) cited it from the Yunque de Baracoa in Oriente and Almendares in Havana; Aguayo and Jaume (1948) add Camoa and Sierra del Grillo in Havana. But Jaume (1945) did not find it on the Pan de Guajaibón in Pinar del Río, and the specimens from Sierra Canasta and Florida Blanca, Guantánamo, in Oriente in the Ramsden Collection in the USNM labelled *rugosa* proved to be *granulum.* Farfante (1942: 50) reported it from Camoa and Somorrostro, Havana, and stated that "se encuentra en toda la Isla bajo las piedras y hojarasca." Aguayo and Jaume (1953: 27) found it in small numbers in Baracoa, Havana and the Bosque de la Habana (1939: 238). They stated that the species is very restricted in the western area of Cuba and that it does not occur alive around the city of Habana. It is obvious that documentation of the presence of *rugosa* at the two ends of the island is still desirable.

Specimens examined. PINAR DEL RÍO. Casa Blanca [2 km SE of Palacios]. MATANZAS. 1 km W of Río Canímar; Coliseo, near Matanzas. LAS VILLAS. *Soledad:* Harvard House; Limones Seburoco, 1 mi SE of Soledad; Monte de la Vequita; Vilches Hill, 2½ mi E of Soledad; Guabairo; ½ mi E of Guabairo; Seboruco Portuguesa, 2 mi NE of Soledad; Seboruco, 2 mi NE of Soledad; Seboruco, 2 mi NW of Soledad; Los Portugueses; limestone hills on Caranao River. *Sagua La Grande:* San Miguel; Chinchila; El Mamey. *Vega Alta:* Murciélagos; El Hoyon; La Sinaloa; Piedras. Monte del Pico, El Roble, Cienfuegos; Loma el Ternero, San Juan de las Yeras; mogote near El Palenque de Remedios; loma near San Augustín, Zulueta; La Vigía, Mayajigua; La Veterana, San Diego de Valle; Canon del Yigre, Yaguajay; El Zanjon; Cueva de la Virgen, Corazón de Jesús; El Capiro [5 km S of Cabo Iguare]. *Off Caibarien:* Cayo Aguado; Cayo Conuco, 1 mi off Caibarien; Cayo Lucas. CAMAGÜEY. Paso Paredones, Cubitas Mts.; Corrales de Canilgones, Cubitas Mts.; El Cacaotal, Najaza

Mts.; Arroyo Hondo; San Martín de Biaya; Sibanicu, San Martin.

Lucidella (Poeniella) granulum (Pfeiffer)

Plate 3, figs. 1–3

Helicina granulum "Gundlach" Pfeiffer, 1864. Malak. Blätt. 11: 161 (type-locality, Monte Toro, Guantánamo [Oriente], Cuba; holotype, destroyed (Clench and Jacobson, 1971: 101); neotype ANSP 110769, selected by Jacobson, 1973: 108, fig. 1; between Nimfitas and La Victoria, Monte Toro, Guantánamo, Oriente, Cuba); 1865. Monographia Pneumonopomorum Viventium, suppl. 2, p. 233; 1876. *Ibid.*, suppl. 3, p. 271; Arango, 1879. Contribución Fauna Malacológica Cubana, p. 53; Crosse, 1890. Jour. Conchyl. 38: 321.

Lucidella tantilla 'Pilsbry' Ramsden, 1914. Nautilus 28: 50, pl. 2, fig. 5, *non* Pilsbry, 1902.

Lucidella (*Poenia*) *granulum* (Pfeiffer). Aguayo and Jaume, 1948. Catálogo Moluscos de Cuba, no. 495.

Troschelviana (*Microviana*) *granulum* (Pfeiffer). Clench and Jacobson, 1971. Bull. Mus. Comp. Zool. 141 (7): 441.

Lucidella (*Poeniella*) *granulum* (Pfeiffer). Jacobson, 1973, Nautilus 87: 107–9, fig. 1.

Description. Shell very small, reaching only about 2.7 mm in width and 1.5 mm in height, glossy, translucent; whorls 4+, moderately swollen, increasing slowly in width, the last whorl only slightly wider than the penultimate, slightly descending at aperture; color light greenish-yellow. Spire slightly raised. Aperture oblique, widely semilunate; umbilical area covered; peristome rounded and reflected, narrower near the basal insertion where it terminates in a wide, very shallow notch. Columella short, evenly concave; suture well impressed especially at later whorls. Early teleoconch marked only with closely set punctations, last two whorls with regular, diagonal axial ribs gradually widening but becoming obsolete near the aperture where the only sculpture consists of even, irregularly spaced axial striae. Protoconch one whorl, slightly raised, distinct, dulled by closely set irregular punctations. Periostracum thin, persistent. Operculum unknown.

Height mm	Width mm	
1.4	2.6	Florida Blanca, Alto Songo, Oriente
1.3	2.4	km 54, Sierra Canasta, Santiago de Cuba, Oriente
1.0	2.2	neotype, Monte Toro, Guantánamo, Oriente

Remarks. The rarity of this obscure species, overlooked until recently, has been detailed by Jacobson (1973). Pfeiffer (1865: 233) reprinted his original description verbatim and later (1876: 271) merely listed the name. Sowerby (1866: 296) listed it as an unidentified species, and Reeve (1874) and Wagner (1910) omitted it. Fulton (1915) did not mention it among the names omitted by Wagner. Arango (1879), Crosse (1890), and Aguayo and Jaume (1948) repeated only the locality given originally by Pfeiffer. Clench and Jacobson (1971 b) tentatively referred it to the genus *Troschelviana,* subgenus *Microviana,* although Pfeiffer had made no reference to a mucronate protoconch, a feature characteristic of the helicinine tribe Vianini in which the genus *Troschelviana* belongs. Aguayo and Jaume (1948)) placed *granulum* in *Lucidella.*

Lucidella granulum is easily confused with *L. tantilla* to which it must be very closely related. Chiefly, *granulum* has the lips of the peristome clearly expanded and it does not have a noticeable basal notch. Further, the axial riblets are stronger or heavier in *granulum* and its shell is lighter in color, with a more glossy appearance. The outline of the peristome in *granulum* tends to be rounded rather than ovately expanded as it is in *tantilla* and the insertion of the peristome basally is incurved rather more sharply than in *tantilla.*

Specimens of this tiny species were found by Ramsden (1914) "in dirt at the root of a large tree." Its small size and secretive habitat make this a difficult species to collect, possibly explaining the disjunctive distribution and the paucity of records.

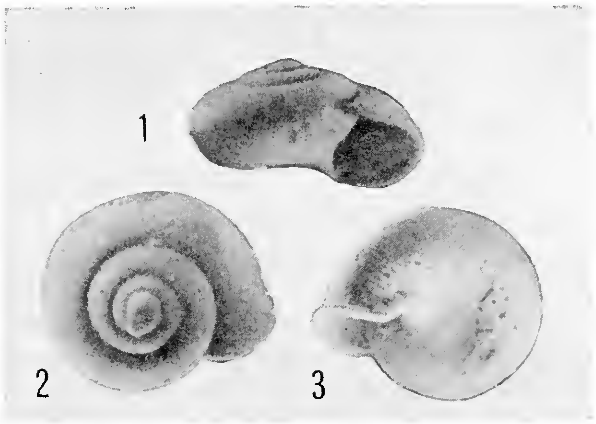


Plate 3

Lucidella (*Poeniella*) *granulum* (Pfeiffer)

Figs. 1–3. Neotype of *Helicina granulum* Pfeiffer, designated by Jacobson, 1973, p. 108, between Nimfitas and La Victoria Monte Toro, Guantánamo, Oriente, Cuba, 2.2 mm × 1.0 mm, ANSP 110769.

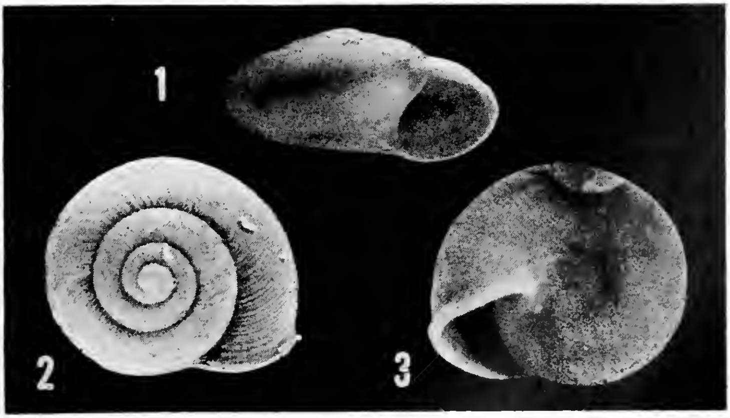


Plate 4

Lucidella (*Poeniella*) *tantilla* (Pilsbry)

Figs. 1–3. Farallón de Don Pepe, Cayo de las Brujas, Caibarién, 2.2 mm × 1.1 mm, MCZ 188613.

Specimens examined. Oriente: Florída Blanca, Alto Songo; km 54, Sierra Canasta, Santiago de Cuba; La Cueva, Diego Cobas, Majaguabo (all Ramsden Collection in USNM); Guaso River, Monte Líbano, Guantánamo (USNM); Monte Toro, Guantánamo (USNM and ANSP).

Lucidella (Poeniella) tantilla (Pilsbry)

Plate 4, figs. 1–3

Helicina tantilla Pilsbry, 1902. Nautilus 16: 53. (type-locality, Palm Beach, Florida; holotype ANSP 77349).

Lucidella (*Poeniella*) *tantilla* (Pilsbry), 1948. Land Mollusca of North America north of Mexico, Monograph 3, Acad. Nat. Sci. Philadelphia 2: 1085, fig. 580.

Lucidella tantila "Pilsbry" Vanatta, 1923. Nautilus 37: 69, error for *tantilla*.

Description. Shell very small, reaching nearly 3.0 mm in width and 1.5 mm in height, depressed, moderately glossy. Color faintly yellowish. Whorls 4¼, barely inflated, slowly increasing except body whorl which is twice as wide as the penultimate; body whorl depressed, subcarinate, not descending at aperture, base excavated. Suture well impressed, spire low, domelike. Aperture oblique, rounded triangular, almost straight above, well rounded below. Basal callus rather strong, minutely pebbled. Peristome thickened, barely expanded, with a slight dip above, labial teeth obsolescent. Columella short, concave, inserting into basal lip with a moderately acute rounded angle. Sculpture of fine, regular, slanting, slightly curved axial ribs, about as wide as their intervals. Protoconch 1½ whorls, rounded, barely raised, minutely pitted. Periostracum thin. Operculum as in genus.

Height mm	Width mm	
1.4	2.9	Caicos Id., Bahamas
1.4	2.5	Farallón Don Pepe, Cayo Las Brujas, Caibarién, Las Villas, Cuba
1.3	2.6	Pumpkin Key, Florida
1.2	2.5	Cayo Cobas, Caibarién, Las Villas, Cuba

Remarks. As mentioned previously, *Lucidella tantilla* is most closely related to *granulum;* these species, because of their extremely small size, are easily confused. However, *tantilla* does not have the lips of the peristome expanded and it does have a noticeable basal notch. Further, Pilsbry (1902) based his description on a single specimen taken in an undisturbed woodland on the beach near the city of Palm Beach, Florida, a type-locality since destroyed. Pilsbry (1948) called his specimen, "a hurricane-borne waif from Cuba." The species is known from Cuba, the Florida Keys (Pilsbry, 1905; Vanatta, 1912; Walker, 1917) and the Bahamas (Clapp, 1913; 1921; Clench, 1937; 1942). In Cuba it is found on only a few keys off the north central coast. Aguayo and Jaume (1948) cited the species from Cayo Guillermo of the northern Coast of Camagüey and the MCZ has one lot each from Cayo Cobas near Cayo Francés, and Cayo de las Brujas, both of which are small keys lying off the northern coast of Las Villas near Caibarién. A single, broken specimen of *tantilla* (MCZ 237756) is from Cafetal Virginea, Guantánamo, but we have no other records from the mainland of Cuba and consider this doubtful.

It is difficult to speculate on the place of origin of *L. tantilla,* since both the Florida Keys and the Bahamas are geologically quite recent and since *tantilla* was apparently transported there by hurricane. We assume that *tantilla* originated in Cuba, and presently occupies refugia along the north central coast of the island.

Specimens examined. FLORIDA: Eliot Key; Pumpkin Key (both MCZ). BAHAMA IDS.: California and NW Point, S. Bimini; Sand Bank, Crossing Bay, Great Abaco; More's Id., 32 mi NW of SW Point, Great Abaco; NW Point, Little Inagua; Cornucopia, Acklins Id.; Cape Comete, E. Caicos, Caicos Ids. (all MCZ). CUBA: *Las Villas:* Farallón de Don Pepe, Cayo de las Brujas, Caibarién; Cayo Cobas, near Cayo Francés, Caibarién (both MCZ). *Oriente:* Guantánamo: Cafetal Virginea (MCZ) ?.

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BOOK REVIEW

GÖTTING, KLAUS-JÜRGEN. 1974. *Malakozoologie. Grundriss der Weichtierkunde.* Gustav Fischer, Stuttgart, X + 320 pp., 160 figs.

Götting presents a modern summary of the biology of mollusks for the use of students and shell collectors with an interest in zoology. After introducing the archetypal structure of mollusks, he reviews each Class by providing a definition of it and then discussing its general organization. A series of rather detailed sections on the various biological systems — integumentary, muscular, alimentary, circulatory, respiratory, excretory, reproductive and nervous complements a brief discussion of the group's ecology. Finally a taxonomic section, following Thiele and Zilch, lists each family with a concise diagnosis and with the citation of representative genera and their geographic ranges. The illustrations are usually taken from recent publications and include original and composite anatomical figures which are considerably diagrammatic.

Götting incorporates the expanded classificatory hierarchy proposed by Salvini-Plawen so that the Phylum is divided into the Aculifera and Conchifera which comprise 8 Classes, including the unfamiliar Caudofoveata. Götting over-estimates the diversity of the Phylum by stating that there are 128,000 molluscan species when it is known that there are fewer than 50,000 species (see *Occasional Papers* No. 40). Relying on Salvini-Plawen again, he lists an unrealistic number of genera of Solenogastres.

The bibliography of nearly 600 titles is useful and includes, as might be expected, numerous European papers with which American workers may not be acquainted. To those who are familiar with the old classical German malacological texts such as von Martens or Hescheler, Götting's volume constitutes an up-dating and extension of a scholarly tradition.

— K. J. BOSS

Occasional Papers On Mollusks

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

VOLUME 4 15 NOVEMBER 1974 NUMBER 49

CATALOGUE OF THE TAXA OF *LUCIDELLA* (PROSOBRANCHIA: HELICINIDAE)

By KENNETH J. BOSS AND MORRIS K. JACOBSON

This catalogue was initiated during the preparation of our taxonomic revision of the species of the genus *Lucidella* which inhabit the island of Cuba (see preceding paper, Boss and Jacobson, 1974, Occ. Papers Moll., no. 48). So much information was collected on nominal species of *Lucidella* that we thought it was worthwhile to make it available. The catalogue includes: 1) generic, subgeneric, specific and subspecific nomina as originally introduced; 2) the original citation with date; 3) the type-locality; 4) and the whereabouts of type-specimens, if found. In some cases we have also provided references of later date if they present a figure of the taxon.

ACKNOWLEDGMENTS

We are indebted to the following persons for providing information about type-specimens: Drs. R. Robertson and G. Davis, Academy of Natural Sciences of Philadephia; Dr. J. Rosewater, United States National Museum of Natural History, Washington; Dr. J. J. Oberling, Naturhistorisches Museum, Bern, Switzerland; Dr. A. Riedel, Instytut Zoologiczny, Warszawa, Poland; Dr. A. Zilch, Senckenbergische Gesellschaft, Frankfort, West Germany;

Miss S. M. Wells, British Museum (Natural History), London. Dr. R. D. Turner and Mr. R. I. Johnson reviewed the manuscript.

ABBREVIATIONS

ANSP — Academy of Natural Sciences, Philadelphia
BMNH — British Museum (Natural History), London
IZW — Instytut Zoologiczny Warszawa, Poland
MCZ — Museum of Comparative Zoology, Cambridge, Massachusetts
NMB — Naturhistorisches Museum, Bern, Switzerland
USNM — United States National Museum of Natural History, Washington
SMF — Senckenbergische Naturforschende Gesellschaft, Frankfort, West Germany.

abbotti Vanatta, **Helicina,** 1920. Proc. Acad. Nat. Sci. Phila. 72: 205, pl. 6, fig. 12, 14 (1 mi NW of Sanchez, Santo Domingo, Hayti Id. [*sic*], [Hispaniola]; type, ANSP 44370a).

adamsiana Pfeiffer, **Helicina,** 1848. Proc. Zool. Soc. London, p. 119 (Jamaica; type, destroyed; Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 344, pl. 68, figs. 18–20). NOTE: type-species of *Urichia* Guppy 1895.

areola (Férussac) Petit de la Saussaye, **Helix,** 1851. Jour. de Conch. 2: 86, pl. 1, fig. 10, error for **aureola** Férussac.

aureola Férussac, **Helix,** 1822. Histoire naturelle général et particulière des mollusques terrestres et fluviatiles, cover of livraison 17 (see: Kennard, 1942), pl. 48, fig. 1; assigned to the subgenus **Helicodonta** in Tableaux systématiques des animaux mollusques . . . Prodrome Général . . . Tableau systématique de la famille des Limaçons, no. 90, p. 33 (La Martinique).

barbadensis Pfeiffer, **Helicina,** 1853. Proc. Zool. Soc. London, p. 60 (Barbadoes; type, destroyed).

beatensis Bartsch, **Lucidella,** 1932. Proc. U.S. Nat. Mus.

81 (2929): 3, pl. 2, figs. 4–6 (Beata Is., Island of Haiti [Dominican Republic, Hispaniola]; type, USNM 403920).

caymanensis Pilsbry, **Lucidella,** 1930. Proc. Acad. Nat. Sci. Phila. 82: 230, pl. 15, figs. 1, 1a, 1b (½ mi S of North Side Area, Grand Cayman Id.; type, ANSP 150867).

christophori Pilsbry, **Helicina plicatula,** 1897. Nautilus 10: 118 (St. Kitts; type, ANSP 62062a). NOTE: type-species of *Poeniella* H. B. Baker 1923.

cibaoensis Crosse, **Helicina rugosa** var., 1891. Jour. de Conch. 39: 185 (Cibao, Santo Domingo, Hispaniola; type, lost); Pilsbry 1928. Proc. Acad. Nat. Sci. Phila. 80: 480 (neotype designated, ANSP 14796a, pl. 27, fig. 1 and 2; Puerto Plata, Santo Domingo, Hispaniola). NOTE: Crosse merely gave a name to var. B of Hjalmarson and Pfeiffer 1858, Malak. Blätt. 5: 145, var. of **rugosa.**

conoidea Pilsbry, **Lucidella (Poeniella),** 1933. Proc. Acad. Nat. Sci. Phila. 85: 133, pl. 7, figs. 7, 7a (Del Monte Plantation, near Salvation, Santo Domingo, 3000 ft.; type, ANSP 160982).

coronula (Shuttleworth) Pfeiffer, **Helicina,** 1862. Malak. Blätt. 9: 155 (Jamaica; type, destroyed); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 345, pl. 68, fig. 21.

costata Simpson, **Lucidella,** 1894. Proc. U.S. Nat. Mus. 17: 449, pl. 16, fig. 6 (marl stratum of Miocene beds, Bowden, St. Thomas, Jamaica; type, USNM 115766).

cruciata Weinland, **Helicina,** 1880. Jahrb. Malak. Gesell. 7: 351, pl. 12, fig. 7 (Port au Prince, Haiti, Hispaniola; type, not located). NOTE: synonym of *paivana* Pfeiffer 1866.

decussata Boettger, **Helicina,** 1887. Jahrb. Malak. Gesell. 14: 102, pl. 4, fig. 8 (Miragoane, Haiti, [Hispaniola]; type, SMF 181169 a). NOTE: subspecies of *paivana* Pfeiffer 1866.

denseplicata Wagner, **Lucidella,** 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 348, pl. 69, figs. 14–15 (St. Lucia, Lesser Antilles; syntypes, IZW 9100).

depressa Gray **Helicina,** 1825. Zoological Jour. 1: 69, pl. 6, fig. 14 (West Indies; holotype, BMNH 1874.99.8). NOTE: Type-species of *Poenia* H. and A. Adams 1856.

euglypta Crosse, **Helicina,** 1874. Jour. de Conch. 22: 119, 204, pl. 4, fig. 4 (near Fort-de-France, Martinique; type, not located). NOTE: Wagner (1910) cited this as a synonym of *plicatula* Pfeiffer 1848.

foxi Pilsbry, **Lucidella,** 1899. Nautilus 13: 56 (Cave at Port Antonio, Jamaica; type, ANSP 61848a); Wagner, 1910, [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 343, pl. 68, figs. 10–11.

gonavensis Pilsbry, **Lucidella (Poeniella),** 1928. Proc. Acad. Nat. Sci. Phila. 80: 481, pl. 27, figs. 8–9 (Gonave Id., Haiti, Hispaniola; type, ANSP 146698).

granulosa C. B. Adams, **Lucidella aureola,** 1850. Contrib. Conch. no. 6: 89 (Jamaica; lectotype, MCZ 156170, Jacobson and Boss, 1973, p. 358, pl. 84, figs. 1–3).

granulum (Gundlach) Pfeiffer, **Helicina,** 1864. Malak. Blätt. 11: 161 (Monte Toro, district of Guantánamo, Oriente, [Cuba]; type, destroyed; neotype, ANSP 110769, designated and figured by Jacobson, 1973, p. 108, fig. 1).

granum Pfeiffer, **Helicina,** 1856. Novit. Conch. 1: 86, pl. 23, figs. 20–23; 1857. Malak. Blätt. 3: 49 (Holguín, Oriente, Cuba; type, destroyed; neotype, MCZ 73863, designated and figured, Boss and Jacobson, 1974, p. 11, pl. 1, figs. 1–3).

holoserica Wagner, **Lucidella,** 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 350, pl. 69, figs. 16–19 (Barbadoes; syntypes, IZW 9101).

ignicoma Guppy, **Helicina,** 1868. Ann. Mag. Nat. Hist. (4) 1: 441 (Trinidad; type, not in the BMNH, probably lost in the fire of the Victoria Institute, Trinidad, in 1920).

inaequalis Pfeiffer, **Helicina (Lucidella),** 1859. Proc. Zool. Soc. London, p. 28 (Jamaica; holotype, BMNH 1974.1).

indecora Pilsbry, **Lucidella pilsbryi,** 1930. Proc. Acad. Nat. Sci. Phila. 82: 243, pl. 17, fig. 5 (Little Swan Id.; [Caribbean Sea]; type, ANSP 150881).

interrupta Simpson, **Lucidella aureola** var., 1894. Proc. U.S. Nat. Mus. 17: 449 (Duncan's, Trelawney, Jamaica; type, USNM). NOTE: Probable synonym of *montegoensis* Brown, *fide*, H. B. Baker (1934).

jeremiensis Pilsbry, **Lucidella,** 1929. Proc. Acad. Nat. Sci Phila. 28: 479, pl. 27, figs. 3–5 (near General's Cave, 1 mi W of Jérémie, Haiti, [Hispaniola]; holotype ANSP 118250a).

kobelti Wagner, **Lucidella,** 1910. [*in*] Martini and Chemnitz Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 350, pl. 69, figs. 12 and 13 (Jamaica; holotype, IZW 9097).

lamellosa Guppy, **Helicina (Perenna),** 1867. Ann. Mag. Nat. Hist. (3) 19: 260, pl. 10, fig. 4 (Trinidad; syntype, BMNH 1874.10.30.12). NOTE: synonym of H. *lirata* Pfeiffer 1847; monotype of *Perenna* Guppy 1859.

lasellensis Clench and Aguayo, **Lucidella (Poeniella),** 1937. Mem. Soc. Cubana Hist. Nat. 11 (2): 63, pl. 7, fig. 6 (La Visite, La Selle Range, Haiti, [Hispaniola]; holotype, MCZ 110626).

leana C. B. Adams, **Helicina,** 1845. Proc. Boston Soc. Nat. Hist. 2: 11 (Jamaica; type, lost, see Jacobson and Boss, 1973, p. 375). NOTE: C. B. Adams (1851) called this a synonym of *depressa* Gray.

Lindsleya Chitty, 1857. Proc. Zool. Soc. London, pp. 167 and 169 (type-species, *Stoastoma lindsleyanum* C. B. Adams, 1849, by virtual tautonymy). NOTE: H. B. Baker (1922: 54) found that the radula of the type-species was very close to *Lucidella lirata* Pfeiffer 1847. Hence, in spite of the *Stoastoma*-like shell, he placed the taxon tentatively as a subgenus of *Lucidella*. He also placed *Lucidella venezuelensis* H. B. Baker 1922, in this subgenus. However, Keen (1960) associated this genus, a synonym of *Fadyenia* Chitty 1857, with *Stoastoma* as did Boss (1972).

lineata C. B. Adams, **Helicina,** 1845. Proc. Boston Soc. Nat. Hist. 2: 12 (Jamaica; lectotype, MCZ 177223, designated and figured by Jacobson and Boss, 1973, p. 378, pl. 86, figs. 9–11).

lirata Pfeiffer, **Helicina,** 1847. Zeits. Malak. 4: 150 (Yucatan, México; type, destroyed); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2,

p. 341, pl. 68, figs. 5–7. NOTE: *lamellosa* Guppy 1867, *rusticella* Morelet 1849, *semistriata* Sowerby 1866, and *unidentata* Pfeiffer 1849 are synonyms.

Lucidella Swainson, 1840. Treatise on Malacology, p. 330 (type-species, *Helix* (*Helicodonta*) *aureola* Férussac 1822, by monotypy).

manni Clench and Aguayo, **Lucidella**, 1932. Proc. New England Zool. Club 13: 35 (Furcy, Haiti, [Hispaniola]; holotype, MCZ 23414); 1937, Mem. Soc. Cubana Nat. His. 11 (2): 63, pl. 7, fig. 8.

midyetti Richards, **Lucidella**, 1938. Proc. American Philos. Soc. 79: 175, pl. 3, figs. 3–4 (between Coxen Hole and French Harbor, Roatan Id., Honduras; holotype ANSP 170021).

minor "Pfeiffer" Brown, **Lucidella aureola**, 1913. Proc. Acad. Nat. Sci. Phila., p. 16, *nomen nudum*. NOTE: we were unable to find this reference in Pfeiffer.

montegoensis Brown, **Lucidella aureola**, 1913. Proc. Acad. Nat. Sci. Phila. 65: 21, pl. 1, figs. 22–26 (Orange Hill, Montego Bay, Jamaica; type, ANSP 104482a). NOTE: probable synonym of *interrupta* Simpson, 1894, *teste* H. B. Baker (1934).

nana Pfeiffer, **Lucidella**, 1857. Proc. Zool. Soc. London, p. 111 (Jamaica; syntypes, BMNH 1974.4); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 342, pl. 68, figs. 12 and 13. NOTE: *tridens* (Shuttleworth) Sowerby 1866 is a synoym; *trochiformis* Pilsbry 1899 is probably a synonym (Pilsbry and Brown 1911).

paivana Pfeiffer, **Helicina**, 1866. Malak. Blätt. 13: 89 (Platon, Haiti, Hispaniola; type, lost); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 346, pl. 69, figs. 1–2. NOTE: *cruciata* Weinland 1880 is a synonym, *teste* Wagner 1910.

peasei Pilsbry, **Lucidella (Poeniella)**, 1933. Proc. Acad. Nat. Sci. Phila. 85: 133, pl. 7, figs 8–8 a (Del Monte) Plantation, 5 or 6 mi W of Barahono, near Salvation, Santa Domingo, 3000 ft., [Hispaniola]; type, ANSP 160986).

Perenna Guppy, 1867. Ann. Mag. Nat. Hist. (3) 19: 260 (type-species, *Helicina lamellosa* Guppy 1867 [= H. lirata Pfeiffer 1847], by monotypy). NOTE: synonym of *Poenia* H. and A. Adams 1856.

persculpta Pilsbry and Brown, **Lucidella,** 1912. Proc. Acad. Nat. Sci. Phila. 63: 584, fig. 1 (Orange Hill and Rosemont Bay, Jamiaca; type, ANSP 104402). NOTE: Baker (1964) gives the type-number as 104415a.

pilsbryi Clapp, **Lucidella,** 1914. Nautilus 27: 97, pl. 6, figs. 5 and 6 (Swan Island; [Caribbean Sea]; type, MCZ 22890).

plicatula Pfeiffer, **Helicina,** 1849. Proc. Zool. Soc. London, p. 123 (Island of Martinique; syntypes, BMNH 1974.2); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 349, pl. 69, figs. 4–7.

Poenia H. and A. Adams, 1856. Genera of Recent Mollusca 2: 304 (type-species, *Helicina depressa* Gray 1825, subsequent designation, Pilsbry and Brown 1912). NOTE: H. B. Baker (1922) stated that the type-species was *Helicina unidentata* Pfeiffer 1849 [= *H. lirata* Pfeiffer 1847], following the designation by Fischer (1885). However, this designation is invalid because Fisher did not use the word "type." A correct designation was given by Pilsbry and Brown (1912).

Poeniella H. B. Baker, 1923. Occ. Pap. Mus. Zool., Univ. Michigan, no. 137, p. 23 (type-species, *H. plicatula christophori* Pilsbry 1897, original designation).

Prosopis Weinland, 1862. Malak. Blätt. 9: 198 (type-species, *Prosopis sulcata* Weinland, 1862, by monotypy), *non* Jurine 1801, *nec* Fabricius 1804 (Hymenoptera). NOTE: synonym of *Lucidella* Swainson 1840.

rugosa Pfeiffer, **Helicina,** 1839. Wiegmanns Arch. Naturgesch. 1 (5): 355 (Palenque and Pan de Matanzas, Cuba; type, destroyed); 1848 [*in*] Martini and Chemnitz, Conch.-Cab. (1) 1: sect. 18, pt. 1, p. 13, pl. 4, figs. 28–30).

rusticella Morelet, **Helicina,** 1849. Testacea novissima 1: 21 (Carmen Id., Yucatan [Mexico]; syntypes, BMNH 1893.2.4). NOTE: synonym of *lirata* Pfeiffer 1847.

samana Pilsbry, **Lucidella (Poeniella)**, 1928. Proc. Acad. Nat. Sci. Phila. 80: 481, pl. 27, figs. 6–7 (1 mi NW of Sanchez, Samana Bay, Santo Domingo, [Hispaniola]; type, ANSP 146696).

semistriata Sowerby, **Helicina**, 1866. Thes. Conch. 3: 281, pl. 268 (3), fig. 86 (no locality given; type, destroyed, not in BMNH). NOTE: synonym of *lirata* Pfeiffer 1847.

striatula Potiez and Michaud, **Helicina**, 1838. Galérie des Mollusques, Museum de Douai 1: 231, pl. 23, figs. 13–14 (no locality given; type, not located), *non* Sowerby 1866.

striatula Sowerby, **Helicina**, 1842. Proc. Zool. Soc. London, p. 6 (no locality given); Thes. Conch., vol. 1, *Helicina*, p. 3, sp. 6, pl. 1, fig. 43 (Martinique; type BMNH 1974. 3), *non* Potiez and Michaud 1838.

striatula (Rang) Pfeiffer, **Helicina**, 1852. Monographia Pneumonopomorum Viventium, p. 340 (Martinique); "in sched. Cuming," *nomen nudum*. NOTE: is *plicatula* Pfeiffer 1849, *fide* Pfeiffer.

sublaevis H. B. Baker, **Lucidella adamsiana**, 1934. Nautilus 48: 9, pl. 2, fig. 4 (nr. Newleigh Hotel, E of Mandeville, S of Williamsfield-Mandeville Road, Jamaica; type, ANSP 162731).

sulcata Weinland, **Prosopis**, 1862. Malak. Blätt. 9: 198 (surroundings of Jérémie, Haiti, [Hispaniola]; type, not located).

tantila (Pilsbry) Vanatta, **Lucidella**, 1923. Nautilus 37: 69, error for *tantilla*.

tantilla Pilsbry, **Helicina**, 1902. Nautilus 16: 53 (Palm Beach, Florida) holotype, ANSP 77349; 1948. Land Mollusca of North America north of Mexico, Monograph 3, Acad. Nat. Sci. Phila. 2: 1085, fig. 580.

tridens (Shuttleworth) Sowerby, **Lucidella**, 1866. Thes. Conch., vol. 3, *Helicina*, p. 282, pl. 268 (3), figs. 90–91 (Jamaica; syntypes, BMNH). NOTE: synonym of *nana* Pfeiffer 1857, *teste* Wagner 1910.

trochiformis Pilsbry, **Lucidella**, 1899. Nautilus 13: 56 (Jamaica; type, ANSP 76441a). NOTE: probable synonym of *nana* Pfeiffer 1857, *teste* Pilsbry and Brown (1911).

umbonata Shuttleworth, **Helicina**, 1854. Mittheil. Naturforsch. Gesell. Bern, nos. 321, 322, p. 93 (Puerto Rico; syntypes, NMB 997); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 340, pl. 67, figs. 21–24.

undulata Pfeiffer, **Lucidella**, 1862. Malak. Blätt. 8: 171 (Jamaica; type, destroyed); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 338, pl. 67, figs. 16–18.

unidentata Pfeiffer, **Helicina**, 1849. Proc. Zool. Soc. London, p. 125 (Honduras; type, probably lost, not in BMNH). NOTE: synonym of *lirata* Pfeiffer 1847.

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valida C. B. Adams, **Helicina depressa**, 1850. Ann. Lyc. Nat. Hist. New York 5: 52 (Jamaica; lectotype, MCZ 275687, Jacobson and Boss, 1973, Occ. Papers Moll. 3: 437, pl. 86, figs. 5 and 6).

venezuelensis H. B. Baker, **Lucidella (Lindsleya ?)**, 1922. Proc. Acad. Nat. Sci. Phila. 74: 54, *nomen nudum*; 1923, Occ. Pap. Mus. Zool., Univ. Michigan, no. 134, p. 21, pl. 4, fig. 17 (radula) (near Caño Minapam, Palma Sola, Venezuela; type, ANSP). NOTE: This species and the subgenus *Lindsleya*, with a shell very much like *Stoastoma*, were placed by Baker in *Lucidella* because of striking similarities in the radula with *Lucidella lirata* Pfeiffer.

vinosa Shuttleworth, **Helicina**, 1854. Mittheil. Naturforsch. Gesell. Bern, nos. 321, 322, p. 92 (near San Juan, Humacao, and Rio Blanco, Puerto Rico; type, not found in NMB); Wagner, 1910. [*in*] Martini and Chemnitz, Conch.-Cab. (2) 1: sect. 18, pt. 2, p. 348, pl. 69, figs. 10 and 11).

wolffi Boettger, **Helicina**, 1887. Jahrb. Malak. Gesell. 14: 102, pl. 4, fig. 9 (Miragoane, Haiti, Hispaniola; holotype, SMF 228074).

yallahsensis Pilsbry and Brown, **Lucidella** 1911. Proc. Acad. Nat. Sci. Phila. 63: 585, fig. 2 (Yallahs, Parish of St. Thomas, Jamaica; type, ANSP 10211).

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Occasional Papers On Mollusks

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

VOLUME 4 15 NOVEMBER 1974 NUMBER 50

APICAL SHELL SCULPTURE OF SOME NORTH AMERICAN FRESHWATER LIMPETS (GASTROPODA: BASOMMATOPHORA)

By J. B. BURCH AND P. T. LOVERDE

ABSTRACT. The present paper describes the apical sculpture of some North American ancylid mollusks in a more detailed way than has been possible previously. The microsculpture of representative groups was studied by the use of the Scanning Electron Microscope (SEM). The clearer observations of the shell apical microsculpture have not shown the need of any generic revisions in the present system of classification in which the generic groups are already based on apical sculpture.

Apical shell sculpture traditionally has been important in the delineation of generic groups in the freshwater limpet family Ancylidae. Because of the greater resolution afforded by the Scanning Electron Microscope (SEM) in studying surface details of minute objects, we employed the SEM for a closer, more detailed look at ancylid shell apex microsculpture than has been possible in the past. The present paper describes the apical sculpture of some North American ancylid mollusks with the use of the SEM.

METHODS AND MATERIALS

The shells of ancylid mollusks were cleaned by immersing them in sodium hypochlorite (commercial "Clorox"), removing the periostracum and rinsing the shells in distilled water. They were then air-dried and glued with Duco cement or aluminum paint to the holder to be used in the SEM. The shells were coated with gold and viewed and photographed with a JEOL (Ltd.) JSM–U3 Scanning Electron Microscope. Photographs were taken variously at magnifications of 100×, 200×, 300×, 600× and 1000× with Polaroid P–51 P–N film.

The specimens used in this study were as follows:

Ferrissia rivularis (Say 1817) (Pl. 5, Fig. 1; Pl. 6, Figs. 1, 2) UMMZ 69189. Muscle Shoals, Tennessee River, Lauderdale County, Alabama. H. H. Smith.

Ferrissia shimeki (Pilsbry 1890). Pl. 5, Fig. 2; Pl. 6, Figs. 3, 4) UMMZ 69610. Deadman's Run, Lincoln, Lancaster County, Nebraska. Bryant Walker Collection.

Ferrissia walkeri (Pilsbry and Ferriss 1906). (Pl. 5, Fig. 3; Pl. 7, Fig. 1). UMMZ 101984. Camp Colfax, La Porte, La Porte County, Indiana. Daniels Collection.

"Gundlachia" californica Rowell 1863. (Pl. 5, Fig. 4; Pl. 7, Fig. 2). UMMZ 143954. Near Oakland, Alameda County, California. Kent Science Institute Collection.

Laevapex diaphanus (Haldeman 1841). (Pl. 5, Fig. 5; Pl. 7, Figs. 3, 4; Pl. 8, Figs. 1, 2). UMMZ 68922. Tennessee River, Knoxville, Knox County, Tennessee. W. B. Barber.

Laevapex fuscus (Adams 1841). (Pl. 5, Fig. 6). UMMZ 100445. Headwater of the Miami River, Ohio. J. B. Henderson Collection.

Hebetancylus excentricus (Morelet 1851). (Pl. 5, Fig. 7; Pl. 8, Figs. 3, 4). UMMZ 100404. Gargitas Creek, Victoria County, Texas. J. D. Mitchell.

Rhodacmea filosus (Conrad 1834). (Pl. 5, Fig. 8; Pl. 9, Figs. 3, 4). UMMZ 69215. Tallaseehatchee Creek, 4 miles above Childersburg, Talladega County, Alabama. H. H. Smith.

Rhodacmea (*Rhodocephala*) *rhodacme* Walker 1917. (Pl. 5, Fig. 9; Pl. 9, Figs. 1, 2). UMMZ 68928. Coosa River, Leoto Shoals, St. Clair County, Alabama. H. H. Smith.

OBSERVATIONS

Ferrissia rivularis. At the exact center of the apex is a very regular pit (the "apical scar" of Pilsbry, 1896 and Bourguignat, 1853) surrounded by a relatively smooth circular area with a radius of about 0.1 mm. From this central smooth area radiate narrow grooves, uniform in width and more or less equally spaced. As the grooves radiate outward from the apex toward the shell apertural margin, the spaces between them widen, and new grooves are formed. In the grooves are concentric, irregularly spaced concentric ridges (?"growth lines"), rather regularly spaced down the length of the groove. The radial grooves terminate rather abruptly about 0.4–0.5 mm distally from the apical scar.

Ferrissia shimeki. The apical sculpturing of the two specimens studied was nearly identical, and basically quite similar to that described for *F. rivularis.* The concentric ridges in and running transversely to the direction of the grooves are a little more prominent in *F. shimeki.*

Ferrissia walkeri. The apical sculpture of this species seems to be practically identical to that of the two species described above.

"Gundlachia" californica. The apical sculpture is nearly identical to that observed in the three species of *Ferrissia* above. The radiating grooves extend out a bit farther from the apical pit, to 0.7–0.8 mm before they terminate. Basch (1963) places *"G." californica* in the synonomy of *F. fragilis* (Tryon).

Laevapex diaphanus. At the exact center of the apex is a small pit like that observed in each of the three *Ferrissia* species described above, and in the two genera which follow. Also, as in *Ferrissia,* there is a relatively smooth area surrounding the central pit. Beginning at about 0.1 mm from the pit is an area of faint, very shallow, radiating ridges and grooves, which extend distally for 0.4 to 0.6 mm. This sculpturing is very weak, hardly visible, and would seem to be perhaps the degeneration of a sculpture that was once similar to that of *Ferrissia*. The radiating ridges and grooves are about equal in width, and at some places are more prominent than at others. Crossing this obsolescent radial sculpture are concentric, irregularly spaced "growth" wrinkles.

Laevapex fuscus. The sculpturing of this species is nearly identical to that of *L. diaphanus*, except being a little less noticeable, and originating a little farther distally from the central pit. As with *L. diaphanus*, one has the impression that this is the obsolescent pattern of a once much more prominent sculpturing.

Hebetancylus excentricus. At the center of the apex is a pit surrounded by a nearly smooth area. Beginning about 0.1–0.2 mm from the apex are radiating grooves, very shallow and crooked. Although somewhat different from those of *Laevapex*, once again these lines seem to be the remnants of what was once a stronger sculpture in some ancestor. We are tentatively following Basch (1963) in assigning Morelet's "*Ancylus*" *excentricus* to *Hebetancylus*. It has previously been assigned to both *Ferrissia* and *Laevapex* by other authors.

Rhodacmea filosus. The apical tip of the shell is "pushed in" or "dimpled," and lacks strong sculpturing, although the surface is irregular and appears somewhat malleated. A more distinct and patterned sculpture begins about 0.1–0.2 mm radially from the exact center of the apex. This sculpture, weak at first, rapidly becomes prominent. Radiating ridges account for the strongest part of the pattern. Most of them are more or less equally spaced at first. As they radiate distally they diverge, and new, weak radial ridges emerge. The radial ridges continue distally to the apertural edge of the shell, although they are more or less obliterated at major growth rest areas. Lower, thinner concentric transverse ridges run perpendicular to the radiating ridges.

Rhodacmea rhodacme. The apical sculpture is in nearly all details identical to that of *R. filosus* described above. However, the ridges stop about 12–13 mm from the apical scar, rather than continuing to the shell margin.

DISCUSSION

The importance of apical shell sculpture for delineating species groups within the Ancylidae was first clearly recognized by Walker (1902). A year later (1903) he formally named two new sections, one for North American species with smooth apices (*Laevapex*) and the other for species with radially striate apices (*Ferrissia*). In 1912, Walker gave the name *Burnupia* to those southern African freshwater limpets having radially punctate apices. Pilsbry (1913) described the apices of his new genera *Hebetancylus* and *Uncancylus* as being smooth and pitted respectively. He described (1924) the apex of his new genus *Anisancylus* as being smooth.

We have not studied the South African or South American genera mentioned above, but we have studied all of the currently recognized North American ancylid genera. In regard to apical microsculpture, the North American species clearly fall into three rather sharply contrasting groups. (1) In *Ferrissia* (including *"Gundlachia" californica*) the apex is finely radially striate, the striae consisting of narrow grooves. In these species, the striate top of the apex is bluntly rounded. (2) In *Rhodacmea* the apex is also striate, but the sculptured pattern is quite different. Instead of the grooves being the most prominent part of the sculpture as in *Ferrissia*, it is the spaced radiating cords or ridges that form the basic apical structure. The apex is more acute in *Rhodacmea*, and especially characteristic of the two *Rhodacmea* species studied here, is an indentation or "dimple" (in addition to the apical scar). (3) In *Laevapex* and *Hebetancylus excentricus* the apices are nearly smooth, showing only a slight radial sculpturing which suggests the degenerative remnants of a once stronger radial sculpture.

The present investigation has not shown the need for any taxonomic revisions from the clearer observations of the shell apical microsculpture as afforded by the SEM. However, our study has shown the apical sculpture of *Ferrissia* in much clearer detail; it has shown that the apices of *Laevapex* and *Hebetancylus excentrica* are not totally smooth as previously thought, but have faint obsolete radiating sculpture, and it has shown the apical sculpture of *Rhodacmea* clearly for the first time. Similar SEM studies on ancylid taxa from other geographic areas may show further apical sculptural differences or similarities, and may help in making phylogenetic assessments in this systematically difficult group.

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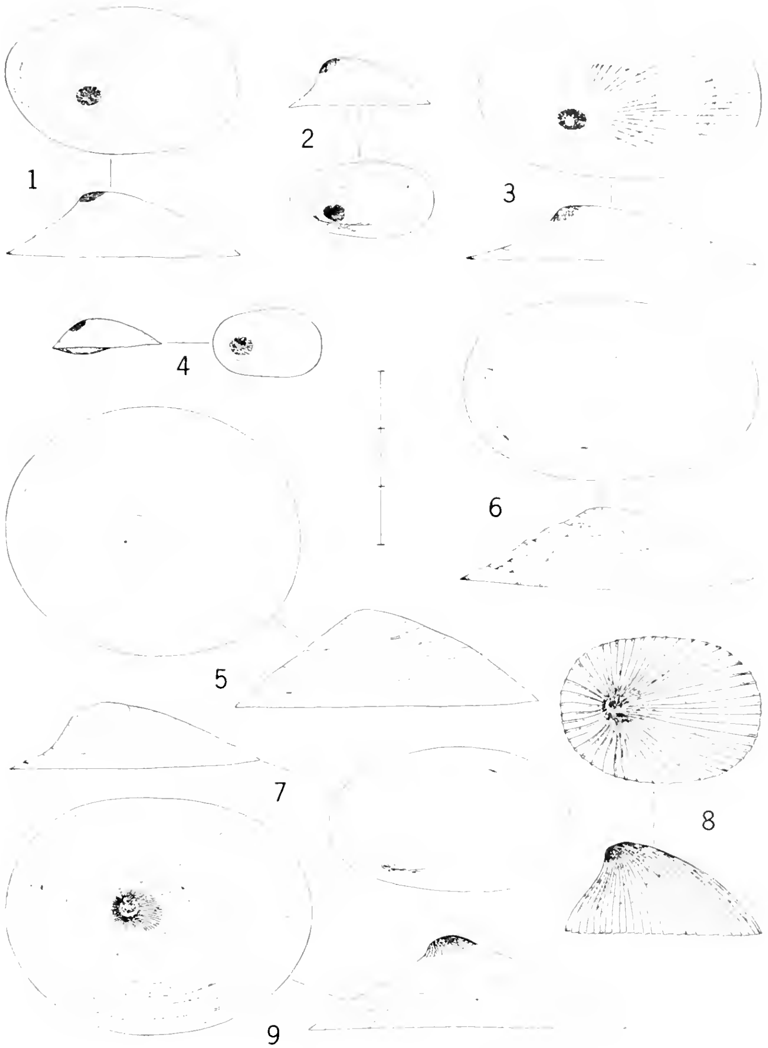

Plate 5. Ancylidae: Top and right side views.
Scale line = 3 mm

Fig. 1. *Ferrissia rivularis* (Say). UMMZ 69189. Fig. 2. *F. shimeki* (Pilsbry). UMMZ 69610. Fig. 3. *F. walkeri* (Pilsbry and Ferriss). UMMZ 101984. Fig. 4. "*Gundlachia*" *californica* Rowell. UMMZ 143954. Fig. 5. *Laevapex diaphanus* (Haldeman). UMMZ 68922. Fig. 6. *L. fuscus* (Adams). UMMZ 100445. Fig. 7. *Hebetancylus excentricus* (Morelet). UMMZ 100404. Fig. 8. *Rhodacmea filosus* (Conrad). UMMZ 69215. Fig. 9. *R.* (*Rhodocephala*) *rhodacme* Walker. UMMZ 68928.

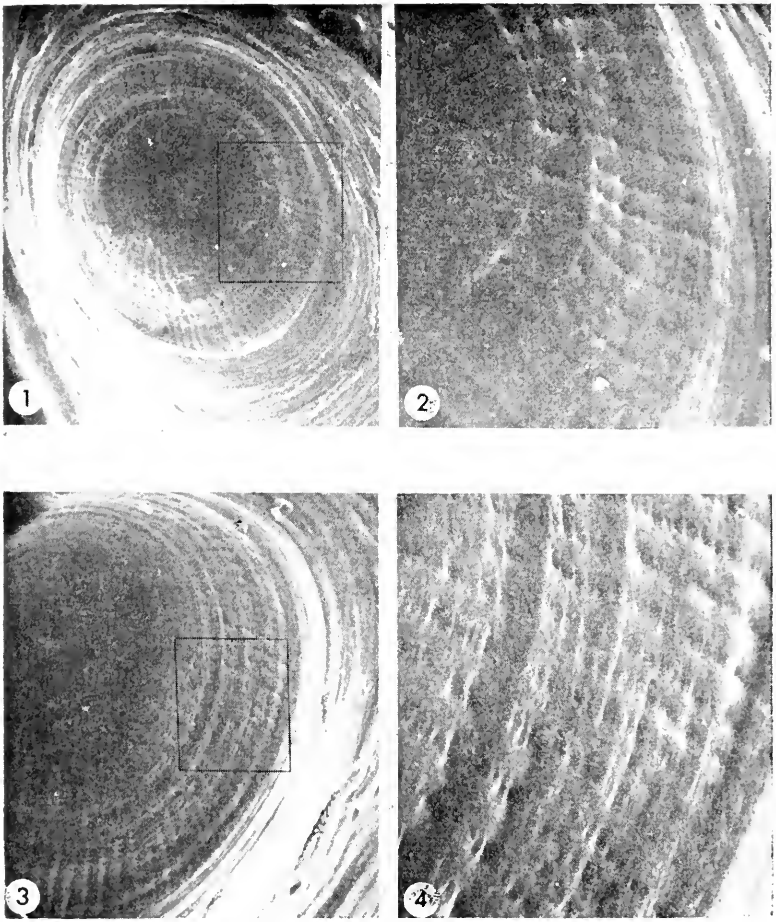

Plate 6.

Fig. 1. *Ferrissia rivularis* (Say). UMMZ 69189 (ca. 110×). Fig. 2. *F. rivularis.* UMMZ 69189 (ca. 340×). Enlargement of area marked in Fig. 1. Fig. 3. *F. shimeki* (Pilsbry). UMMZ 69610 (ca. 170×). Fig. 4. *F. shimeki.* UMMZ 69610 (ca. 560×). Enlargement of area marked in Fig. 3.

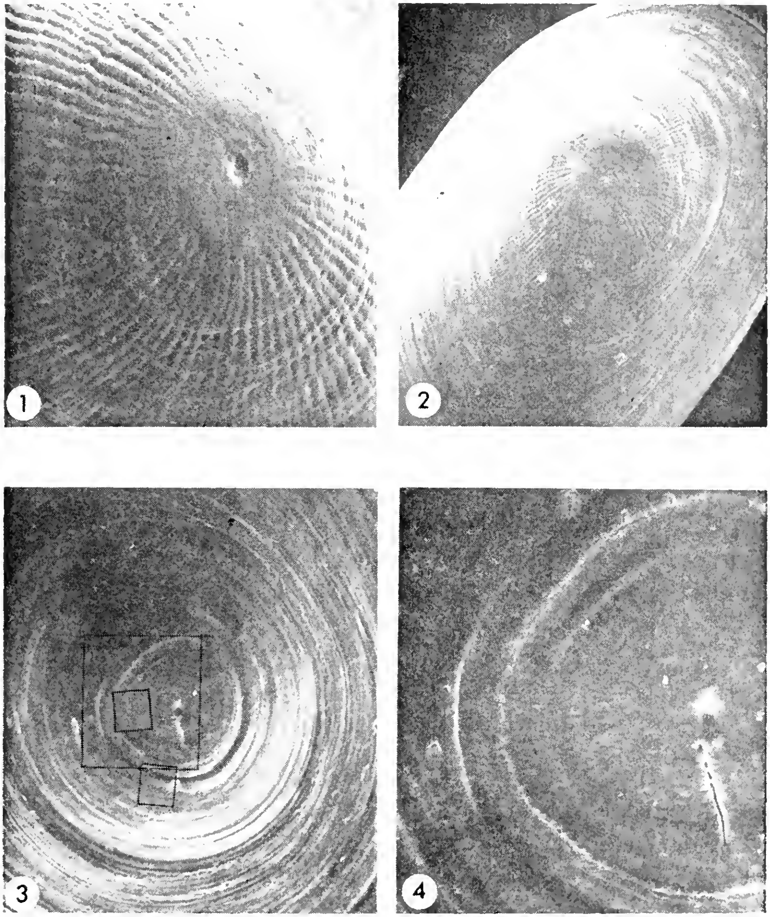

Plate 7.

Fig. 1. *Ferrissia walkeri* (Pilsbry and Ferriss). UMMZ 101984 (ca. 170×). Fig. 2. "*Gundlachia*" *californica* Rowell. UMMZ 143954 (ca. 56×). Fig. 3. *Laevapex diaphanus* (Haldeman). UMMZ 68922 (ca. 56×). The three squares mark the areas enlarged in Fig. 4 and Pl. 8, Figs. 1 and 2. Fig. 4. *L. diaphanus*. UMMZ 68922 (ca. 170×).

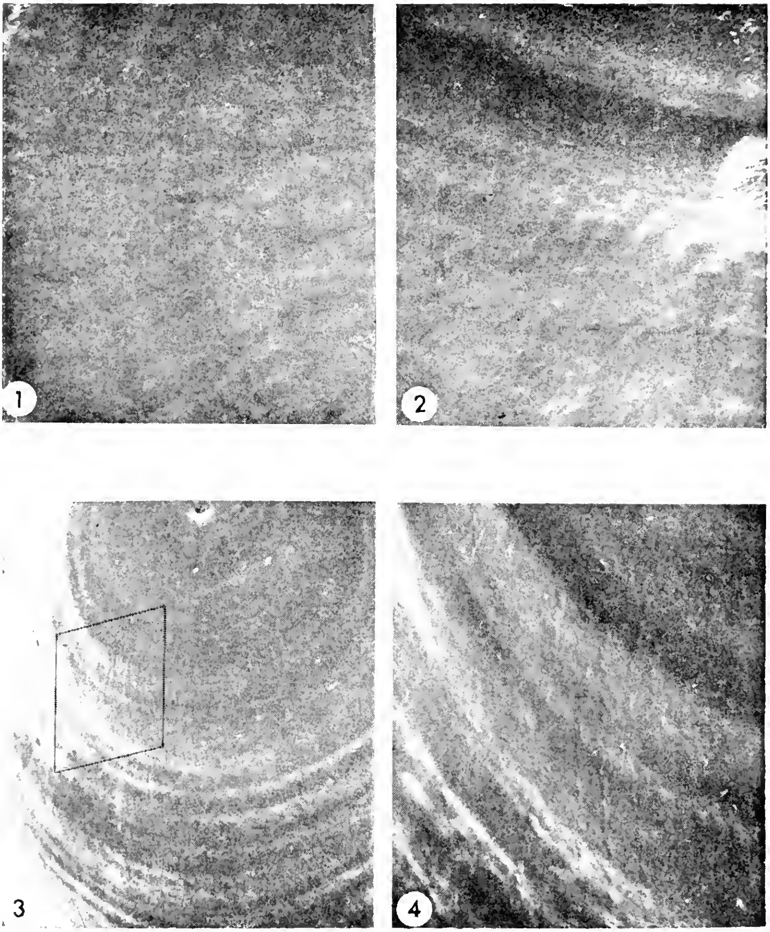

Plate 8.

Fig. 1. *Laevapex diaphanus* (Haldeman). UMMZ 68922 (ca. 560×). Enlargement of area marked in Pl. 7, Fig. 3. Fig. 2. *L. diaphanus*. UMMZ 68922 (ca. 560×). Enlargement of area marked in Pl. 7, Fig. 3. Fig. 3. *Hebetancylus excentricus* (Morelet) UMMZ 100404 (ca. 170×). The square marks the area enlarged in Fig. 4. Fig. 4. *H. excentricus*. UMMZ 100404 (ca. 560×).

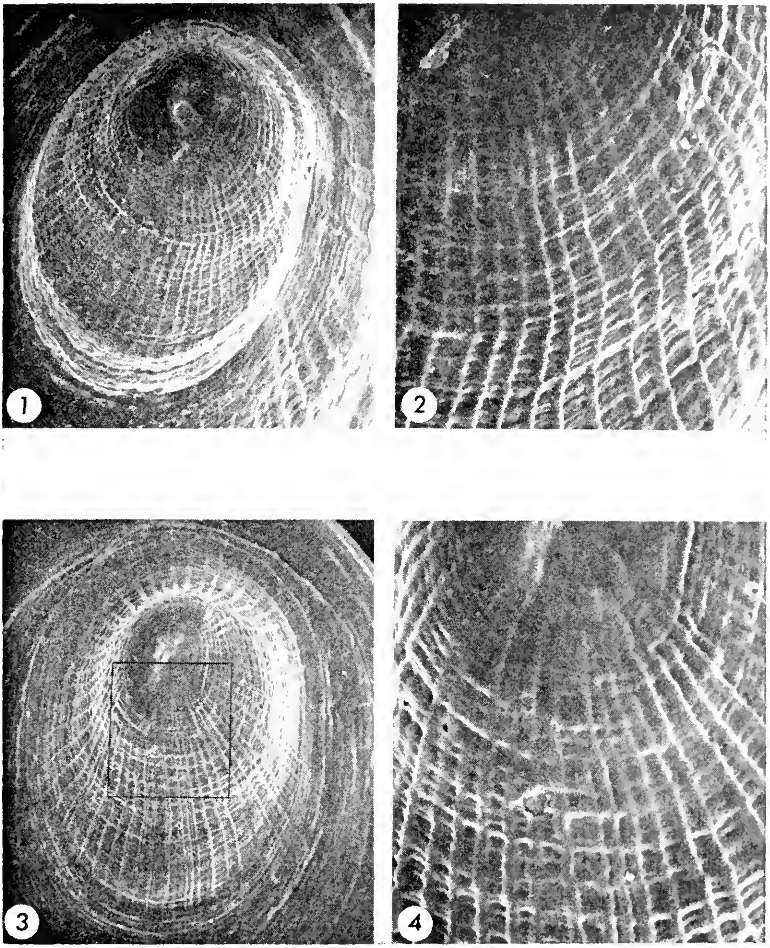

Plate 9.

Fig. 1. *Rhodacmea* (*Rhodocephala*) *rhodacme* Walker. UMMZ 68928 (ca. 56×). Fig. 2. *R.* (*Rhodocephala*) *rhodacme.* UMMZ 68928 (ca. 170×). Fig. 3. *R. filosus* (Conrad). UMMZ 69215 (ca. 56×). The square marks the area enlarged in Fig. 4. Fig. 4. *R. filosus.* UMMZ 69215 (ca. 170×).

THOMAS WYATT AND EDGAR ALLAN POE, A PAIR OF CONCHOLOGICAL PLAGIARISTS

By RICHARD I. JOHNSON

In the introduction to his *Manual of Conchology,* Wyatt (1838) wrote that, "We have endeavored to give a free translation of Lamarck's system, as simplified by De Blainville." The text is, indeed, a simple translation of the descriptions of some of the shells and genera found in Blainville (1825). The "Glossary" was lifted from Brown (1833). According to Wyatt, "The plates were drawn and colored with great care and accuracy from the natural shells in our own cabinet, under the superintendence of Mr. James Ackerman, artist." This is a bold lie; most of the figures are copied from Blainville, and plate 18 is a copy of Blainville's plate 40, without an attempt at disguise.

According to Allen (1926: 442–443) Wyatt's book had proved so expensive to publish that Harpers would not reprint it. It appears that Wyatt paid Poe $50.00 for the use of his name on a new cheaper edition, designed for elementary school use, hoping by the use of Poe's name to further sales and to avoid trouble over the copyright with Harpers, the effect of which was to alienate the 'affections' of that firm from Poe.

According to Robertson (1934) Poe was directly responsible only for the preface and the introduction which was a paraphrase of Brown, with the printing arranged by Isaac Lea, who, it should be remembered, was not only a conchologist but a partner of Carey, Lea, and Blanchard, publishers.

The text was paraphrased from Wyatt, with additional descriptions of the animals which, while credited to Cuvier, appear to be translated from Blainville. Plates 1–5 were lifted directly from Brown as are most of the figures on the other plates. It is said that when Poe was accused of plagiarism, he explained his method by saying, "All school books are necessarily made that way."

Poe's book must have enjoyed some success since it went through three editions (1839, 1840, 1845) issued with plain or colored plates.

Keen (1936: 43) pointed out that as a systematic treatise Poe's work can be safely ignored. Its interest is as a literary curiosity to the bibliographer and collector of Poe's works and has been exhaustively studied by Heartman and Canny (1943: 41–44).

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Occasional Papers On Mollusks

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

VOLUME 4 1 OCTOBER 1975 NUMBER 51

PROSERPINE SNAILS OF THE GREATER ANTILLES (PROSOBRANCHIA; HELICINIDAE)

By KENNETH J. BOSS AND MORRIS K. JACOBSON

ABSTRACT. The zoogeography and phylogeny of the species and genera of the subfamily Proserpininae are discussed in detail and the endemic subgenera *Proserpina* s. s. and *Despoenella* are treated. The subfamily Proserpininae has 7 Antillean species and constitutes a peculiar group of helicinid prosobranchs which has lost the operculum and which envelops the shell with the mantle. A mainland propagule of the Central American proserpine stock gave rise to both *Proserpina* s. s. and *Despoenella*. *Proserpina* s. s. evolved autochthonously in Jamaica while *Despoenella*, which is more primitive, dispersed to Cuba, where disjunct populations of two species occupy sometime Pleistocene refugia.

INTRODUCTION

Proserpina and its allies constitute a unique group of prosobranch land snails in that they have lost the characteristic operculum, have developed apertural lamellae, and have a mantle which may extend and envelop the shell, much in the manner of the marine cowries or cypraeids. Indicative of true affinities, their rhipidoglossate radula allies them with the family Helicinidae, especially in a rather close phylogenetic relationship to such taxa as *Viana* and *Eutrochatella*. Geographically the group is developed in the New World tropics, including Mexico, South America and Cuba, Jamaica, and Hispaniola in the West Indies.

As in the previous series of papers on the Helicinidae, especially of Cuba (*e.g. Viana, Priotrochatella, Emoda, Glyptemoda, Calidviana, Ustronia, Troschelviana, Semitrochatella* (Clench and Jacobson, 1968; 1970; 1971 a & b) and *Ceratodiscus, Alcadia,* and *Lucidella* (Boss and Jacobson, 1973 a; 1973 b; 1974 a), we herein treat the species of the Greater Antilles and add remarks on the mainland forms. As in the case of our study of *Lucidella* (Boss and Jacobson 1974 b) we append a list of all the nominal taxa of the Proserpininae.

ACKNOWLEDGMENTS

We here express our gratitude to Drs. R. Robertson and G. Davis of the Academy of Natural Sciences of Philadelphia, Dr. J. Rosewater of the National Museum of Natural History, Dr. W. K. Emerson of the American Museum of Natural History, Dr. A. Solem of the Field Museum of Natural History, and Mr. G. Goodfriend of the University of Chicago for the loan of specimens. Dr. R. D. Turner and Mr. R. I. Johnson of the Museum of Comparative Zoology read the manuscript and offered much useful advice. The manuscript was patiently typed and corrected by our secretary, Mrs. G. Dent.

ABBREVIATIONS

ANSP — Academy of Natural Sciences, Philadelphia
MCZ — Museum of Comparative Zoology, Cambridge
USNM — National Museum of Natural History, Washington
FM — Field Museum, Chicago

HISTORICAL REMARKS

Proserpina has a complicated nomenclatorial history. The correct authorship of the genus, the valid designation of a type-species, the introduction of unnecessary substitute nomina and the exact familial placement of the genus contribute to this complexity.

The name *Proserpina* was first introduced by G. B. Sowerby II (1839: 124, fig. 274) when he published the binomen *Proserpina nitida* and a recognizable figure. Under the International Code of Zoological Nomenclature (1964), this constitutes sufficient indication both for the genus and its type-species. In 1842, Sowerby repeated the name (p. 237) and the figure (fig. 274) and stated that this was "a small shell belonging to the Helix tribe, to which, it is believed, Mr. Gray has applied the name *Prosperpina nitida*. We do not know how the genus is defined." Earlier, listing the species in *Helicodonta*, he (1839: 124) had also thought the species had affinities with the pulmonate helicids. Gray had indeed used the name *Proserpina* in 1840 (pp. 129, 153, or 125 and 149), also placed in the Helicidae, and subsequently misspelled as *Procerpena* (Gray, 1847: 182), but Sowerby's published figure and binomen has priority, notwithstanding that several authorities have credited it to Gray or even Guilding.

Odontostoma was introduced by Orbigny in 1842 for the two Cuban species of *Proserpina* but since that name is preoccupied by Turton 1830, H. B. Baker (1923) substituted the name *Despoenella,* with *O. depressa* Orbigny as type-species. The misspellings, *Odostoma* and *Despaenella* are errors in Gray (1856) and Neave (1939), respectively.

Newton (1891), supposing that *Prosperpina* Sowerby 1839 was preoccupied by *Proserpinus* Hübner 1816, introduced the substitute name *Despoena*. But since *Proserpina* is not really preoccupied, *Despoena* falls into synonymy.

Proserpina nitida is the type-species of *Proserpina* by monotypy (Sowerby 1839, p. 124). Gray (1847: 182) incorrectly selected *Helicina linguifera* Jonas as the type-species, a procedure in which he was followed by several authors including Wenz (1938: 448). It is clear that the designation is incorrect and subsequent to that of Sowerby, but, fortunately, the generic characteristics of both *P. linguifera* (= *pulchra* C. B. Adams) and *P. nitida* are the same, so that no serious problem was created.

SYSTEMATIC POSITION

The true placement of *Proserpina* with the Helicinidae was suggested by Orbigny (1842: 237) when he wrote that *Odontostoma* (=*Proserpina*) was closer to *Helicina* because of the "encroûtment columellaire" and probably formed "le passage entre les deux familles, Helicidae et Helicinidae." He doubtfully referred the genus to the family Cyclostomidae. In 1847, Gray recognized the phylogenetic affinities of *Proserpina* by establishing the distinct unit, the family Proserpinidae, and placing it in association with the Oligyridae [= Helicinidae], a procedure which he followed subsequently (Gray, 1857) as did Poey (1854) and H. and A. Adams (1856). Such an arrangement was arrived at by a further knowledge of the anatomy of the animal and the structure of the shell. In a personal communication from Shuttleworth in Basel, Gray was informed that *Prosperpina* had two subulate tentacles with subsessile eyes at their outer bases, a prosobranch feature. Further, as in *Helicina* and other genera, notably the Auriculidae [= Ellobiidae = Melampidae], *Proserpina* absorbs the walls of the whorls internally (Bland, 1858). Pfeiffer (1848; 1850; 1853; 1859) placed the group in the Helicidae or in juxtaposition with the Ellobiidae or Auriculacea (1856; 1857). Later (1876) he grouped the genera *Ceres*, *Proserpina*, *Proserpinella* and *Cyane* as the Proserpinacea in the prosobranchs, relating them to the Helicinidae.

Newton (1891) erected the family Despoenidae with prosobranchiate placement on his new name *Despoena*, an unnecessary replacement name for *Proserpina*.

Wagner (1905-1911) did not treat *Proserpina* as a member of the Helicinidae but Thiele (1929) and Wenz (1938) both recognized a helicinid subfamily, the Proserpininae, for *Proserpina*, *Ceres*, *Cyane* and *Proserpinella*. Earlier for *Proserpina* and *Ceres*, Thiele (1925) had introduced the subfamilial nomen, Cererinae, which is synonymous with the Proserpininae.

Keen (1960) utilized two subfamilies, Proserpininae for *Proserpina* and *Despoenella*, and the Proserpinellinae for *Proserpinella, Ceres* and *Linidiella*.

Unfortunately, as has been shown, there has been little consensus of opinion concerning the suprageneric taxa of the Helicinidae. Many different subfamilial and even tribal nomina have been used. For example, in 1922 Baker listed 2 subfamilies, but in 1926 he employed 3 and later he (1956) reverted to two subfamilies with 5 tribes in one and 3 in another. The original subfamilial units introduced by Wagner (1907-1911) have seldom, if ever, been employed subsequently. Recently, Thompson (1967) recognized the group as the family Proserpinidae but shortly thereafter considered it as a tribe, the Proserpinini (Thompson, 1968). A thorough review of the various subfamilies of the Helicinidae and their usages being improper to the scope of this paper, we have utilized the taxon Proserpininae as a distinct subfamily, much as the early application of this nomen as a familial unit (Gray, 1847; Pfeiffer, 1857).

The Proserpininae may be defined as follows: Helicinid prosobranch terrestrial gastropods having a depressed to subconic shell which is usually exceptionally glossy and smooth, being covered with an enamel-like polished coating or wash, and over which the mantle may completely or partially extend. Peristome simple and acute; aperture lunate with one or more lamellae, be they either columellar, parietal or palatal. Umbilicus covered with a callous deposit; septa of inner whorls resorbed. Operculum none. Radula rhipidoglossate, very similar to other helicinids (e.g. *Viana*) but with central teeth somewhat reduced.

According to this definition, the following generic and subgeneric nomina are included in the Proserpininae: *Ceres, Chersodespoena, Cyane, Despoena, Despoenella, Linidiella, Odontostoma, Proserpina, Proserpinella,* and *Staffola*. If the radular structure of the European Paleocene *Dimorphoptychia* were known, it might well be referable to this subfamily; however, at present it remains in its own monotypic subfamily, the Dimorphoptychinae (Wenz, 1938; Keen, 1960).

These taxa and the inclusive species are appended in the following paper (Boss and Jacobson, 1975).

MORPHOLOGY

General anatomy. No thorough anatomical study of any member of the Proserpininae has been published and only two reports on radulae have appeared. The general prosobranch and helicinid affinities were indicated by Gray (1856) and followed by Pfeiffer (1859). The animal possesses a mantle capable of some extension about the shell but without lateral membraneous fringes or "beards" typical of neritids. Only two subulate tentacles are present on the head, and the sessile eyes, not set on separate peduncles, are on the outer bases of these tentacles. The proboscis is short, broad and annulated. The foot is short, anteriorly truncated, dorsally keeled, and pointed posteriorly. Respiration is facilitated by an open vascularized cavity and the sexes are separate (gonochoristic).

The shell. Members of the Proserpininae have spirally coiled shells which are depressed to subconic in shape and which have a lunate aperture provided with one or more lamellae; the peristome is simple and acute. The whorls are totally contiguous and tightly pressed while internally the septa are resorbed. Externally a highly polished or glossy enamel coating or wash is typical except in the genus *Ceres*. The umbilicus is covered by a heavy callosity. An operculum is absent.

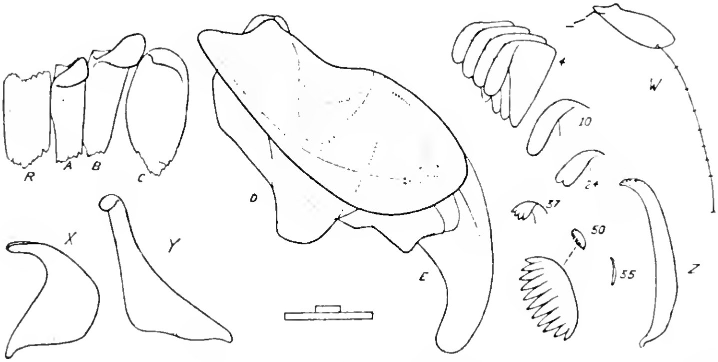
The mantle. The mantle in the Proserpininae is unique in its extension and covering of the shell. Jacobson (1956: 3) observed that the mantle of *P. nitida* of Jamaica, when the animal is active, completely covers the shell, an observation made previously by Baker (1934b: 151) who also noticed the same characteristic in other Jamaican proserpinines: *linguifera* Jonas, *bidentata* C. B. Adams and *pisum* C. B. Adams. Jacobson explained that in the case of *P. depressa* of Cuba, however, the mantle at any one time seemed to cover the shell only partially, leaving the central portion and the apex frequently uncovered. Baker (1934b) added the following remarks on the animals: "In *P. nitida* Swby., *P. linguifera* Pfr. (*sic*) and *P. bidentata* C. B. A. [the mantles] are yellowish green with black maculations, but in *P. pisum* C. B. A. are bright green. The foot, which is similarly colored, is very long, slender and carinate; progression is relatively rapid and is mainly accomplished by lateral, snake-like undulations, although some vague movement appears to take place in the very narrow middle zone of the sole. The animals are very active; when disturbed, they quickly draw in the mantle-flaps and lash their tails back and forth with remarkable strength for small snails."

The radula. The radula of *Proserpina* exhibits the essential rhipidoglossate features of a helicinid (Troschel, 1857): a single central rachidian tooth (R), flanked by A-, B-, and C-centrals and a lateral complex (LC) consisting of a comb-lateral and an accessory plate, sometimes known as the capituliform complex, and a marginal complex (MC) consisting of numerous teeth or uncini. These structures can be abbreviated in the formula: (MC) (LC) C B A R A B C (LC) (MC).

Baker (1926b) examined the radula of *Proserpina depressa* (Text-fig. 1). The strong anvil- or T-shaped lateral complex with its minutely serrated cutting edge and rather large, roughly rhomboidal accessory plate shows that *Proserpina* is allied to the vianine helicinids, including such genera as *Viana*. The radula differs in having an almost vestigial R-central tooth consisting of a thin plate with parallel sides and a weakly notched anterior edge without a reflection. The A-central is more elongate and smaller and the accessory plate is relatively larger than in vianine helicinids. Additionally, the A-central is smaller than the B-central which is just the reverse in the vianine taxa.

The first 22 uncini are unicuspid, the innermost tooth being broadly triangular, basally thickened, twisted posteriorly and reflected at the upper angle. The teeth increase in length from the inside outwardly and the blades become longer to about the 12th tooth. The outer marginals are narrow and elongate (ligulate), the outermost with broad, reflected tips and numerous cusplets. The A-, B-, and C-central teeth are otherwise similar to those of the vianine helicinids with simple, heavy, cutting edges.

Baker (1926b: 451) noted a remarkable resemblance of the radula of *Proserpina depressa* from Cuba to *Calybium mouhoti* Pfeiffer from Indo-China which he had studied earlier (Baker, 1922: 59, 64, pl. 6, fig. 29). *Calybium*, by its radular structure, also shows affinities with such West Indian genera as *Viana* and *Eutrochatella*. Further, *C. massiei* Morlet, which is related to *C. mohouti*, has parietal lamellae and a degenerate, linear, horny operculum, for which reason Morlet (1892: 326) took it to be an intermediate form between *Eutrochatella* and the Proserpininae. The Paleocene *Dimorphoptychia arnoudii* (Michaud) from outcrops near Rheims, France may by its shape and aper-



Text-figure 1. The radula of *Proserpina depressa*. Diagram (W) in upper right hand corner represents positions of highly refractive backs of teeth in right half of a transverse row. Both scales represent lengths of 50 microns (.05 mm); upper one is for diagram (W), lower one for remainder of drawings. In detailed figures, intervals between R and A, between B and C, and between C and D are increased so as to free edges of teeth. Block of first 4 marginals (foreshortened), and tips of 10th, 24th, 37th, 50th (also shown enlarged), and 55th (cusps omitted) are oriented simply with respect to long axis of ribbon. X is an isolated second marginal; Y probably about the 25th; Z probably about the 40th (after Baker 1926b).

tural lamellae have a place in such an arrangement, being referable to the subfamily Proserpininae.

Gray (1856) figured the radula of *Ceres salleana* from Cordera, Vera Cruz, Mexico, showed it to be typically rhipidoglossate, and was followed by Troschel (1857: 84, pl. 6, fig. 2). Although Gray stated that the teeth were unlike *Helicina*, further investigations have shown that the radula of *Ceres* is indeed very similar to *Helicina* (Baker, 1922). Baker (1926b) went so far as to suggest that the radula which Gray figured was a *Helicina* rather than a *Ceres*. That the original shell specimen of *Ceres salleana* was not a *Helicina* is indicated by Gray's statement that his specimen lacked an operculum. Evidently, as Baker suspected, there was some sort of mixup at the time of Gray's description since the figure provided by Gray is more like *Helicina* and rather unlike *Proserpina* in that the A- and B- centrals are cusped, the lateral complex (which is mounted in reverse position in Gray's figure) multiply cusped, the innermost uncinus tricuspid and the next 10-11 bicuspid. The cusped nature of these teeth is similar to what is found in several species of *Helicina* while, with the exception of some outer marginals, *Proserpina* does not have multiply cusped cardinals, laterals or inner marginals. As Baker (1926b: 461) suggested: "if Gray's figure be even approximately correct, *Ceres* would belong in a different family [i.e. subfamily, according to the present system], from *Proserpina*, as it would evidently be derived from a quite different helicinid stock."

ZOOGEOGRAPHY

The Proserpininae (Table 1) are solely New World in distribution with four groups occurring on the mainland in Mexico and South America and two other groups in the Greater Antilles, with the exception of Puerto Rico, in the West Indies. The groups are mainly distinguished by the development of apertural teeth. Most of the mainland forms have a single apertural denticle, on the columella in *Linidiella* and *Staffola* and on the parietal surface in *Pro-*

TABLE I

The species and generic units of the Proserpininae (for more specific data on the nomina, see Boss and Jacobson 1975).

1. Ceres Gray (Spire sculptured, not glossy; 6 denticles).

eolina Duclos	Mexico
salleana Gray	Mexico
nelsoni Dall	Mexico

2. Proserpina s. s. Sowerby (Parietal, columellar, and palatal lamellae present).

nitida Sowerby	Jamaica
linguifera Jonas	Jamaica

3. Despoenella Baker (Parietal and columellar lamellae only).

bidentata C. B. Adams	Jamaica
pisum C. B. Adams	Jamaica
depressa Orbigny	Cuba
globulosa Orbigny	Cuba
marcanoi Clench	Hispaniola

4. Staffoia Dall (Heavy columellar lamella only).

blandiana H. Adams	Peru
cousini Jousseaume	Ecuador
orbignyi Ancey	Bolivia
derbyi Dall	Bahia, Brazil

5. Linidiella Jousseaume (Thin columellar lamella only).

swifti Bland	Venezuela
cinnamomea Sykes	Ecuador
sulfureus Thompson	Chiapas, Mexico

6. Proserpinella Bland (Shell fragile, parietal denticle only).

berendti Bland	Mexico
hannae Dall	Tres Marías Ids., Mexico

serpinella. The Mexican *Ceres* has a total complement of 6 denticles: 1 columellar, 2 parietal, and 3 palatal. The West Indian groups are divisible into *Proserpina s.s.* limited to Jamaica, with 5 lamellae: 1 columellar, 2 parietal and 2 palatal; and *Despoenella* in Jamaica, Hispaniola and Cuba, all with 2 lamellae: 1 columellar and 1 parietal.

Without any substantive fossil evidence, the zoogeographic and phyletic relationships of the Proserpininae must be based on inferential evidence and assumption. Zoogeographically, the West Indies are essentially receivers of immigrants from the mainland areas of North-Central America and South America. As Darlington with his own emphases surmises (1938: 288): "I think it is safe to conclude . . . that the Greater Antillean fauna is an *accumulation* of immigrants, not a *residue* of a larger fauna." Occasionally West Indian propagules have invaded Florida or the Bahamas (*e.g.*, *Lucidella tantilla,* Boss and Jacobson 1974 a: 23) or have radiated within the Antilles themselves.

Phylogenetically, it may be assumed that the loss of the operculum in the Proserpininae was a specialization diverging from the fundamental prosobranchiate structure of the Helicinidae, specifically, and the Neritacea, in general. The elaboration of apertural lamellae may be considered a further specialization so that the ultimate in their development is the elaboration of numerous lamellae, a condition reached in *Proserpina s.s.* with 5 lamellae and *Ceres* with 6. The stem, or most primitive, proserpinine stock, on inferences both geographic and phyletic, must be the lineage comprising *Linidiella, Staffola* and *Proserpinella* of Mexico and South America, each with only a single lamella, be it columellar or parietal.

One line of this primitive stock gave rise to *Ceres* with its full complement of lamellae and another to the Antillean representatives including both *Proserpina s. s.* and *Despoenella.* Of the Antillean representatives, *Despoenella* is the more primitive and older, having two apertural lamellae and a wider geographic range, including Jamaica, Hispaniola and Cuba while *Proserpina s. s.* appears to have evolved autochthonously in Jamaica to a more specialized condition with a fuller complement of 5 apertural lamellae.

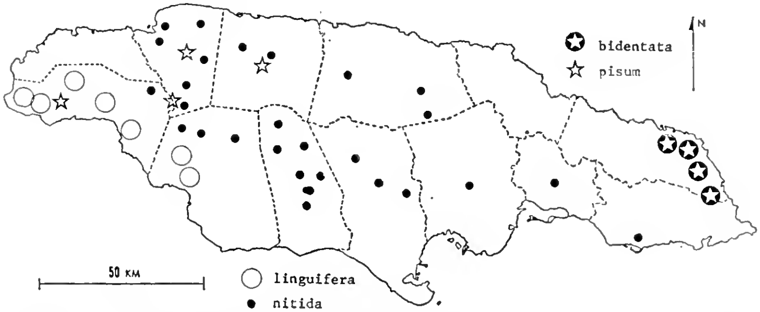
Thus, the similarity of apertural configurations in *Ceres* and *Proserpina s. s.* appears to be convergent and represents advancement and specialization over the primitive, weakly protected apertures of *Linidiella-Staffola* and *Proserpinella*. Further, *Ceres* is surely dissimilar in size being larger than *Proserpina s. s.* and both keeled along its body whorl and radially sculptured on the upper whorl surface unlike *Proserpina s. s.*

It is probable that, like the mammalian invasions of South America which have taken place principally since the closure of the Isthmus of Panama in the Pliocene just a few million years ago, the South American proserpinine snails are relatively new arrivals. All of them are referable to the primitive *Linidiella-Staffola* lineage having just a single apertural lamellae on the columella. There has probably not been time for a multiply lamellate form to have arisen in South America.

The distribution of the Proserpininae in the West Indies is more restricted than most other groups of the Helicinidae, especially such genera as *Alcadia, Lucidella* and *Helicina s. s.* Only two subgenera, *Proserpina s. s.* and *Despoenella* represent the proserpinine lineage in the Greater Antilles, including 2 species on Cuba, 4 on Jamaica and 1 on Hispaniola. The fact that the subfamily is restricted to 3 of the 4 Greater Antilles and does not occur on Puerto Rico or any of the Lesser Antilles seems to suggest a relatively late arrival of the group from the mainland. Unfortunately, no definite time-scale can be postulated for either the arrival of a proserpinine propagule on Jamaica, which was the center of the Antillean radiation in proserpinines, or the subsequent invasions of the group in Cuba and Hispaniola.

Proserpina s. s. is represented by two species, *P. nitida* and *P. linguifera,* both of which arose on the island of Jamaica (Map 1), probably from a *Despoenella*-like precursor which already had at least 2 apertural lamellae.

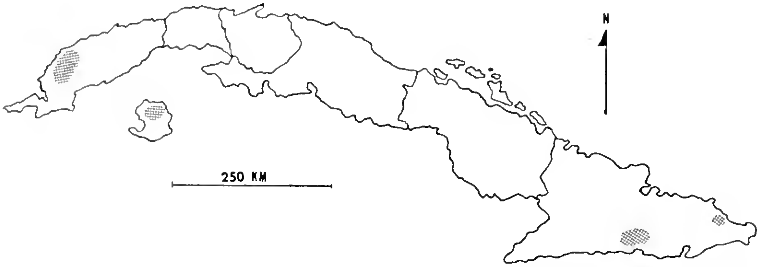
The species are allopatric and have distinct ecological niches in Jamaica. *P. nitida* has a wider distribution extending from the vicinity of Montego Bay in the northwest to St. Thomas' Parish in the southeast and it lives in more montane habitats at elevations from 1000 to 2600 feet. *P. linguifera* is restricted to a smaller geographic range in southwestern Jamaica in Westmoreland and St. Elizabeth Parishes at altitudes from sea level to 600 feet. Indicative of the more Recent evolution and selective superiority of *Proserpina s. s.* is that both *nitida* and *linguifera* have greater geographic and ecological ranges than either species of Jamaican *Despoenella.*



Map 1. The distribution of the 4 Jamaican species of *Proserpina. P. linguifera* and *P. nitida* belong to the nominate subgenus *Proserpina* while *P. bidentata* and *P. pisum* belong to *Despoenella.* The species of each subgenus are allopatrically distributed.

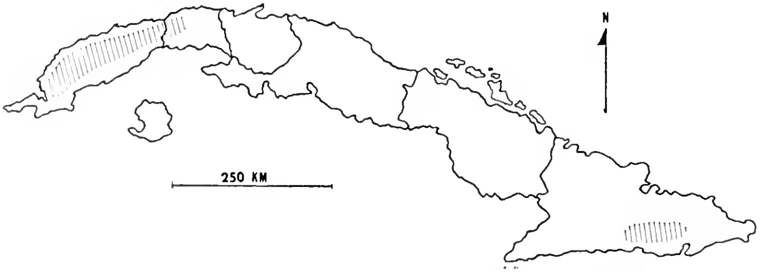
Both Jamaica and Cuba have two representative species of the subgenus, *Despoenella.* On Jamaica (Map 1), the globose species, *P. pisum* is geographically restricted to the western end of the island occurring in, as far as is known, the Parish of Westmoreland, St. James and Trelawney. While the eastern portion of the island, especially in the John Crow Mountains of Portland Parish, harbors *P. bidentata.*

In Cuba, the two species of *Despoenella* have disjunctive distributions which are very similar. The globose species, *P. globulosa* occurs in Pinar del Río and Isle of Pines in the west and Oriente in the East (Map 2) ; the depressed species, *P. depressa* occupies a similar range, including Oriente, Pinar del Río and Habana Provinces but excluding the Isle of Pines (Map 3).



Map 2. The disjunctive distribution of *Proserpina* (*Despoenella*) *globulosa* in Cuba.

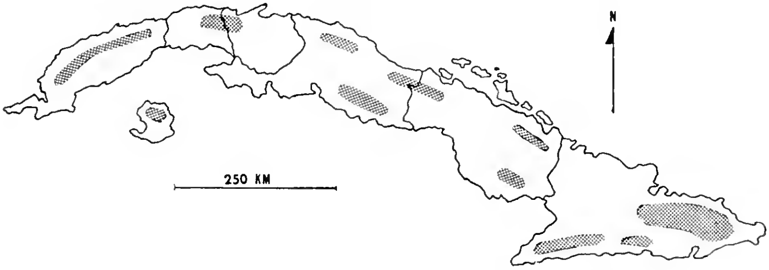
The distinctions which separate the Cuban from the Jamaican forms are greater for the *pisum-globulosa* lineage than they are for the *bidentata-depressa* line, indicating that *globulosa* probably arrived and evolved earlier than did *depressa*. In the features of the shell, the Cuban *globulosa* is more distinct from the Jamaican *pisum* than the Cuban *depressa* is from Jamaican *bidentata*. Further, zoogeographic fact supports the supposition of *globulosa's* earlier arrival and evolution. Having had longer to expand geographically, an older invading stock should have a greater range, even after the exigencies of the Pleistocene. This assumption is apparently true in this case since *P.*



Map 3. The disjunctive distribution of *Proserpina* (*Despoenella*) *depressa* in Cuba.

globulosa has reached the Isle of Pines while *depressa* has not.

The distinctive ranges of both species of Cuban *Despoenella* lend credence to the following hypothesis: the Cuban species of *Despoenella* were derived from Jamaica by hurricane borne propagules, which in becoming separated from the mother stocks in Jamaica, speciated and spread widely in Cuba. During the Pleistocene, they became locally extinct or contracted their ranges to emergent refugia (Map 4) as did some reptiles (Schwartz, 1970) and possibly such other helicinids as *Alcadia, Idesa* and *Hjalmarsona* (Boss and Jacobson, 1973b: 315-318), leaving disjunctive populations in Pinar del Río, Oriente, and the Isle of Pines. Apparently *globulosa* was derived from *pisum* of southwestern Jamaica earlier than Cuban *depressa* was from *bidentata* of the montane regions of northeastern Jamaica. Considering the distances involved, it is most probable that the invasion took place from Jamaica to Oriente.



Map 4. Pleistocene refugia in Cuba (modified from Schwartz 1970).

Family HELICINIDAE Latreille, 1825

Subfamily PROSERPININAE Gray, 1847

Genus **Proserpina** Sowerby

Proserpina Sowerby, 1839. Conchological Manual, 1st Ed., p. 124, fig. 274 (type-species, *Proserpina nitida* Sowerby 1839, by monotypy); Gray, 1840. Synopsis Contents British Museum, ed. 42, p. 129, 153, *non Proserpinus* Hübner 1816 (Lepidoptera).

Procerpena Gray, 1847. Proc. Zool. Soc. London, pt. 15, p. 182, cited as misprint for *Proserpina*.

Despoena Newton, 1891. Systematic List British Oligocene and Eocene Mollusca in the British Museum, p. 255, new name for *Proserpina* Sowerby 1839, *non* Hübner 1816.

Description. Shell ranging from 3 to 10 mm in diameter, imperforate, globose to depressed, smooth and polished; suture perceptible but barely impressed, umbilical region moderately sunken; aperture with one to 3 parietal denticles or lamellae and with zero to 2 palatals; outer lip thin, entire, usually retreating centrally.

Remarks. Details on the zoogeography, nomenclature and subgenera of *Proserpina* appear in the *Introduction*.

KEY TO PROSERPINA S.S. AND DESPOENELLA

1. Columellar, parietal, and palatal lamellae present (*Proserpina s.s.*) 2
   Columellar and parietal lamellae only (*Despoenella*) 3
2. Shell larger, diameter to 10 mm, somewhat depressed, apertural lamellae less strongly developed .... *nitida*
   Shell smaller, diameter to 6 mm, somewhat globose, apertural lamellae more strongly developed .. *linguifera*
3. Shell depressed 4
   Shell globose 6
4. Shell larger, diameter to 8 mm; Cuba ...... *depressa*
   Shell smaller, diameter to 5 mm; Jamaica and Hispaniola 5
5. Proportionately less postembryonic growth; Jamaica .... *bidentata*
   Proportionately greater postembryonic growth; Hispaniola .... *marcanoi*
6. Slightly smaller size, diameter to 5 mm; profile lower; Cuba .... *globulosa*
   Slightly larger size, diameter to 6 mm; profile higher; Jamaica .... *pisum*

Subgenus *Proserpina s.s.*

Description. Shell depressed or subglobose, with 2 or 3 parietal and 2 palatal lamellae.

Remarks. As noted in the *Introduction*, the nominate subgenus is confined geographically to Jamaica where it is represented by 2 allopatric species.

Proserpina (Proserpina) nitida Sowerby

Plate 10, figs. 1–5; Map 1

Proserpina nitida Sowerby 1839. Conchological Manual, 1 Ed., p. 124, fig. 274; 1842, 2 Ed., p. 237, fig. 274 Pfeiffer 1848, Monographia Heliceorum Viventium 1: 12 (Habitat in insula Jamaica; type, ? BMNH).

Helix Proserpina (*sic*) Pfeiffer 1845. Zeitschrift für Malakozoologie 2: 84 (Jamaica; type, destroyed, Clench and Jacobson 1971a: 101).

Odontostoma nitidum (Sowerby). Pfeiffer 1848. Monographia Heliceorum Viventium 1: 12.

Proserpina nitida planulata C. B. Adams 1850. Contributions to Conchology, No. 9: 174 (Jamaica; lectotype, MCZ 276092, selected by Jacobson and Boss 1973: 405, pl. 85, figs. 3–4.

Description. Shell reaching 10.4 mm in diameter, 5.4 mm in height, imperforate, depressed, polished; color very pale lemon yellow or white, apex and earlier teleoconch frequently darker; whorls 5–6, almost flat, the last one twice the width of the penultimate; body whorl narrowly rounded, almost obtusely keeled, periphery somewhat above the center; suture barely impressed, bordered by an opaque white line; umbilical area weakly sunken, translucent; spire very low to almost flat, gently and weakly rounded; aperture oblique, widely subtriangular, with 5 lamellae: a thin thick upward directed one on the columella, a thick horizontal one just above, both projecting somewhat beyond the apertural margin, and a third, still higher in the aperture and more deeply set in the body whorl, and a thin basal and palatal lamella beginning somewhat within the aperture; outer lip entire, slightly thickened, somewhat retreating centrally; sculpture of barely impressed growth lines under surface glaze; protoconch 1½ whorls, glassy, minute punctations (50 ×); periostracum and operculum lacking.

Height	Width	
4.4 mm	10.4 mm	lectotype of *planulata*
5.4	9.4	Mandeville, St. James
5.2	9.1	Windsor Caves, Trelawny
5.2	8.9	Spring Mount, St. James
4.5	7.8	Mocho, St. James

Remarks. P. nitida, the type-species of the genus *Proserpina*, is most closely related to *P. linguifera*. Both species inhabit the island of Jamaica and are characterized conchologically by the development of numerous apertural lamellae: one columellar, 2 parietal and 2 palatal. In *nitida*, these lamellae tend to be less strongly developed or thickened, especially in smaller individuals. Additionally, the uppermost of the parietal lamellae is usually set further back in the aperture. *P. nitida* is larger in overall size, has a less conic, more sublenticular shape and has a proportionately lower outline than *linguifera*. Further, the species have distinct ecological niches and geographic ranges on the island. *P. nitida* is widely distributed from around Montego Bay in St. James' Parish east to the vicinity of Yallahs in St. Thomas'. Data concerning altitudinal preferences show that the species is found principally in elevations above 1000 ft. and extending to 2600 ft. In contrast, *P. linguifera* is restricted to the southwestern portion of the island and usually lives at elevations below 600 ft. (Map 1). Baker (1934a: 63) pointed out that the species aestivates under rocks but rapidly climbs rockfaces during rains. Gloyne (1872: 45) cited the common widespread occurrence of this species and noted the existence of variations in size and color.

Specimens examined (selected). JAMAICA: *Westmoreland* (MCZ). *St. James:* Orange Hill and Spring Mt., Montego Bay (ANSP; MCZ); SE of Catadupa Station (ANSP); Mocho (MCZ); Retreat and Phoenix (FM).

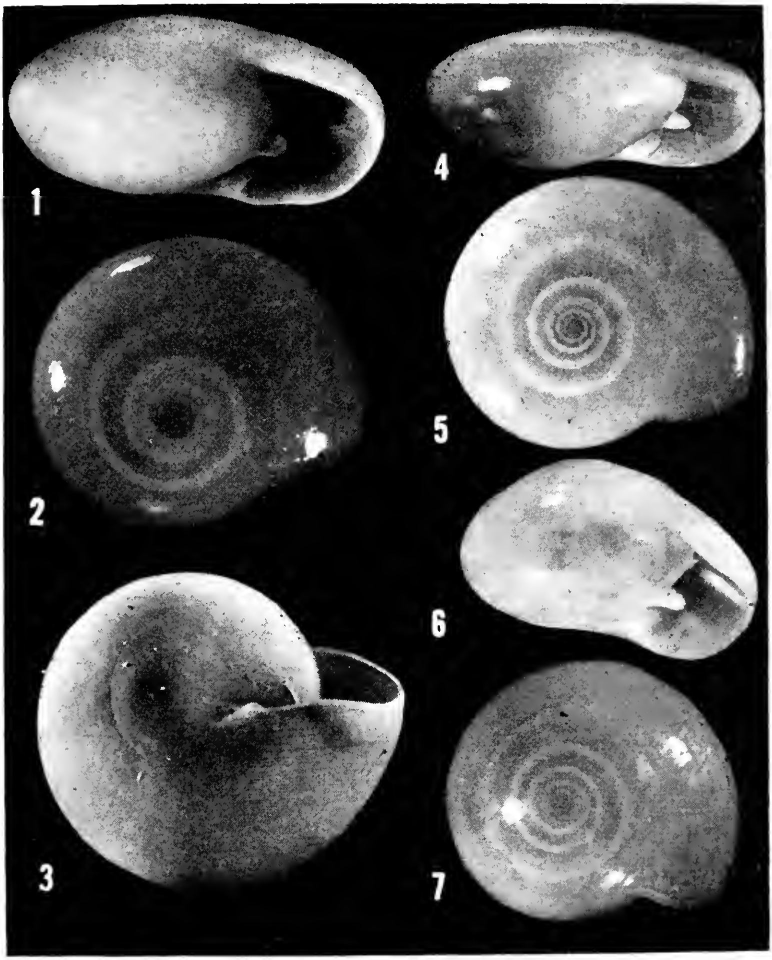


Plate 10

Figs. 1–3. *Proserpina* (*Proserpina*) *nitida* Sowerby. Windsor Cave, Trelawny, Jamaica, 8.1 mm × 3.9 mm, MCZ 94053.

Figs. 4 and 5. Lectotype of *Proserpina nitida planulata* C. B. Adams selected by Jacobson and Boss 1973: 405, pl. 85, figs. 3–4, Jamaica, 10.4 mm × 4.4 mm, MCZ 276092.

Figs. 6 and 7. *Proserpina* (*Proserpina*) *linguifera* (Jonas). Lectotype of *Proserpina pulchra* C. B. Adams, selected by Jacobson and Boss 1973: 409, pl. 85, figs. 5–6, [Westmoreland], Jamaica, 5.5 mm × 3.5 mm, MCZ 275999.

Trelawny: Mahogany Hall, W of Hastings, Burnthill Road (all FM); Windsor Cave (MCZ). *St. Ann:* White Cliff and Pedro River, Lillyfield; Schwallensburgh (all FM); Mt. Diablo, 1500-2600 ft. (MCZ). *St. Elizabeth:* Ipswich; Aberdeen; Redgate; Quick Step (all Goodfriend); Mt. Alta; near Bullett Hall; Balaclava Station (ANSP). *Manchester:* Bloomfield; Bloomsville Cave; Cabbage Hall; Crawl Hill, Bellfield (all FM); Cedar Hill; Comfort Hall (both ANSP); Endeavor; Calway; Heartsease; Knockpatric; Martin Hill (all FM); vicinity of Mandeville (ANSP); Spitzbergen; Topshan; Upper Lincoln (all FM). *Clarendon:* Cumberland; Spaldings, Kyle Hill (both FM). *St. Catherine:* Camperdown and Holly Mountain (both (FM). *St. Andrew:* Long Mountain (FM). *St. Thomas:* Yallahs (MCZ).

Proserpina (Proserpina) linguifera (Jonas)

Plate 10, figs. 6–7; Map 1

Helicina linguifera Jonas 1839. Wiegmann's Archiv Naturgesch. 1: 341 (Patriam ignoro).

Proserpina allognota Jonas 1846. Zeitschrift für Malakozoologie 3: 12, new name for *H. linguifera* Jonas 1839.

Proserpina pulchra Adams 1850, Contribution to Conchology No. 5: 81 (Jamaica; lectotype, MCZ 275999, selected by Jacobson and Boss 1973: 409, pl. 85, figs. 5–6).

Proserpina linguifera Jonas. Pfeiffer 1850. [in] Martini and Chemnitz, Conch. Cab. (2) 1: pt. 12, sect. 2, p. 12, pl. 103, figs. 12–15 (wahrscheinlich Jamaika).

Description. Shell reaching 5.7 mm in diameter, 3.8 mm in height, imperforate, raised discoidal, smooth, glossy; color white, spire frequently pale lemon yellow; whorls about 4-5, barely inflated, the last more than twice the width of penultimate; body whorl wellrounded, the periphery central; suture visible but barely impressed, bordered with opaque white line; umbilical area sunken; spire weakly raised, domelike, the last whorl in adult individuals shelved so that the outline of the spire does not form a straight line; aperture oblique, narrowly semilunate with

5 subequal lamellae: one columellar and 2 parietal, evenly spaced, reaching to or slightly projecting beyond the apertural margin; and 2 palatal, narrower than the parietal and more widely spaced and originating somewhat inside the aperture; shells smooth; the surface weakly punctate at 50 ×, marked by fine, regularly spaced internal lineations and irregular growth lines under the surface glaze; protoconch 1½ whorls, minutely punctate, slightly raised; periostracum and operculum lacking.

Height	Width	
3.8 mm	5.7 mm	Westmoreland
3.5	5.5	lectotype of *pulchra*
3.4	4.6	Luana Spring, St. Elizabeth

Remarks. Proserpina linguifera with its complement of apertural lamellae clearly belongs to the nominate subgenus and is closely related to *P. nitida*, the type-species of *Proserpina*. In his original description of *linguifera* (as the synonym *pulchra*), C. B. Adams (1850: 81) expressed doubt about the distinctness of the species though indicating that a series of 30 specimens which he had at hand showed consistent differences in shell shape. In the samples available to us, *linguifera* and *nitida* may be distinguished by features which were pointed out by Pfeiffer (1850: 12). *P. linguifera* is principally smaller in size than *nitida*. Its shape is more conical and the outline of the shell higher than in *P. nitida*. Further, even in individuals only 3–4 mm in diamter, its lamellae are more strongly developed and more stout. Incidentally, the color of the spire which was mentioned by Adams (1850: 81) is no longer detectable in his specimens, a fact which lends credence to his suggestion that such coloration would bleach out upon exposure.

P. linguifera is also ecologically and geographically separated from its close relative, *P. nitida* (Map 1). Occupying a range in the extreme southwest of the island of Jamaica, *P. linguifera* is found in the hilly and less montane areas of Westmoreland and St. Elizabeth's Parish.

According to Baker (1934a: 63), *linguifera* aestivates under rocks but rapidly climbs rockfaces during rains; the localities he lists for the species, all presently preserved as samples in the Academy of Natural Sciences of Philadelphia, show that the species lives mainly at altitudes between sea level and 600 ft. In contrast *P. nitida* lives at higher elevations in more eastern sections of the island.

Specimens examined: JAMAICA: *Westmoreland:* Bluefield (USNM); Grange Hill (Goodfriend); Mt. Pleasant; Orange Hill (both USNM); Retreat; Sweetwater; Waterwheel (all ANSP). *St. Elizabeth:* Luana Spring (MCZ); near Black River (USNM).

Subgenus **Despoenella** H. B. Baker

Odontostoma Orbigny, 1848. Mollusques [in] Sagra, Histoire Physique, Politique et Naturelle de l'Ile de Cuba 1:237 (type-species, *Odontostoma depressa* Orbigny, 1842, by subsequent designation H. B. Baker, 1923: 84) *non* Turton 1830 (Moll.), *nec* Agassiz 1846 (Moll.), *nec* Mörch 1852 (Moll.).

Odostoma Orbigny. Gray, 1856. Proc. Zool. Soc. London, pt. 24, p. 99, error for *Odontostoma*.

Despoenella H. B. Baker, 1923. Nautilus 36: 85 (type-species. *Odontostoma depressa* Orbigny, 1842, new name for *Odontostoma* Orbigny, 1842, *non* Turton 1830 *etc.*

Despaenella H. B. Baker. Neave, 1939. Nomenclator Zoologicus 2: 51, error for *Despoenella*.

Description. Aperture with one columellar and one parietal lamella; no palatal lamellae.

Remarks. As discussed under *Zoogeography* in the *Introduction* (*q.v.*), *Despoenella* is found in Jamaica, Cuba, and Hispaniola. Like *Proserpina s.s.*, the subgenus does not occur on the mainland. *Despoenella* probably originated in Jamaica from an ancient continental parental stock and subsequently dispersed to Cuba, and, perhaps, later to Hispaniola. In Cuba and Hispaniola, it is the only subgenus of *Proserpina s. l.* present.

Proserpina (Despoenella) depressa (Orbigny)
Plate 11, figs.1–3; Map 3; text fig. 1

Odontostoma depressa Orbigny, 1842. Mollusques [in] Sagra, Histoire Physique, Politique, et Naturelle de l'Ile de Cuba, 1: 238, pl. 18, figs. 4–7 (type-locality, intérieur de l'île; restricted by Aguayo and Jaume, 1947: No. 88, Pan de Guajaibón, Pinar del Río; holotype, BMNH).

Odontostoma depressum Orbigny. Pfeiffer, 1848, Monographia Heliceorum Viventium 1: 11.

Helicina ptychostoma Pfeiffer, 1848. Monographia Heliceorum Viventium 1: 12, footnote (type-locality, Callajabas (*sic*) [= Cayajabos, Pinar del Río]; holotype, destroyed, Clench and Jacobson 1971a: 101).

Proserpina depressa (Orbigny). Pfeiffer 1853. Monographia Heliceorum Viventium 3: 291.

Proserpina depressa rubrocincta (Torre MS) Aguayo and Jaume, 1947, Catálogo Moluscos de Cuba, No. 88 (*nomen nudum*): Aguayo and Jaume, 1957, Mem. Soc. Cubana Hist. Nat. 23: 124, pl. 1, fig. 10 (type-locality, Los Acostas, Luiz Lazo, Provincia Pinar del Río; holotype, MP 5520).

Description. Shell reaching 8.2 mm in diameter, imperforate, depressed and polished; color pale lemon yellow or white; whorls 4–5, barely inflated, rapidly increasing in size, the last whorl twice the width of the penultimate; body whorl narrowly but evenly rounded at the periphery and somewhat shelved in mature specimens; suture indicated but barely impressed; umbilical area shallowly excavated, somewhat more translucent than rest of shell; spire low, dome-shaped, apex barely raised above succeeding whorl; aperture oblique, with two entering lamellae: the upper (parietal) lamella strong, well raised, the lower (columellar) weaker, rising directly from the evenly rounded, concave columella; palatal lamellae wanting; outer lip thin, entire, somewhat retreating centrally; surface smooth, polished with fine regular pebbling, (at 50 ×), sculptured with irregular barely perceptible growth lines; protoconch 1½ whorls, scarcely elevated, smooth except for microscopic pebbling; periostracum and operculum wanting.

Height	Width	
3.7 mm	8.2 mm	Sierra Anafe, Havana
4.2	7.4	Sierra Paso Real, Guane
3.8	6.2	Sierra Anafe, Havana

Remarks. *P. depressa* is closely related to *P. bidentata* from Jamaica and *P. marcanoi* from Hispaniola (see Remarks under *bidentata* and *marcanoi*). *P. bidentata* is considerably smaller in size and is less depressed in outline, having a somewhat more subglobose body whorl. As discussed elsewhere, *P. depressa* was probably derived from *P. bidentata* and presently occupies disjunct, mainly montane refugia in Cuba (see Map 3 and *Zoogeography* in the *Introduction*).

Of the two species of *Despoenella* found in Cuba, *P. depressa* is larger, more depressed in outline and has its columellar lamella rising directly from the columella and not from a small elevation as in *P. globulosa*. Geographically *P. depressa* is isolated in two disjunct areas (see Map 3). It has a wide distribution in western Cuba reaching from Mendoza near Guane to the central part of Havana Province. In the region of Viñales it is an exceedingly abundant species and is found in large numbers in every suitable location. However, unlike *globulosa*, it does not occur on the Isle of Pines. In eastern Cuba, it has been reported only from the southeastern section of Oriente Province in an area extending from around Miranda to Guantánamo.

The name, *P. depressa rubrocincta*, was given to an isolated population around Luis Lazo, Pinar del Río, in which the shells have a wide orange band around the peri-

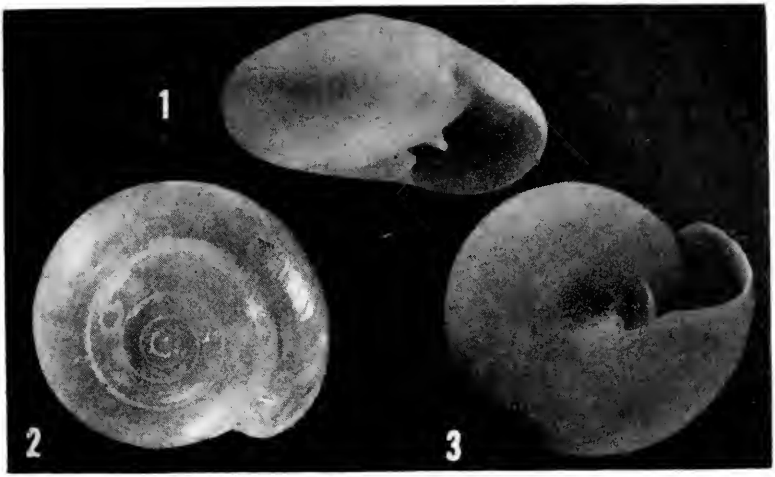


Plate 11

Proserpina (*Despoenella*) *depressa* (Orbigny).

Figs. 1–3. Hoyo Jutia, 1 km E of San Vicente, Viñales, Pinar del Río, Cuba, 6.2 mm × 3.4 mm, MCZ 105397.

phery. However, in the 3 lots from the type-locality in the collection of the MCZ, specimens are found in which the band has been only partially developed near the aperture and others in which the band is missing entirely. There is little reason to view this variable feature in a localized population as worthy of taxonomic distinction, particularly since red or reddish coloring in the shell, whatever its adaptive significance, occurs in other proserpine snails. Pfeiffer (1857: 149) reported a variety of *linguifera* Jonas from Jamaica with a red apex, the South American *P. cousini* Jousseaume from Ecuador has a narrow deep red spiral band, and *P. nitida* has reddish variations in its populations (Gloyne, 1872).

Several authors have noted the abundance and provided documentation for local occurrences of *P. depressa* (Richards, 1933; Farfante, 1942; Jaume, 1945; Jacobson, 1970).

Specimens examined. PINAR DEL RIO: Canalete; Rangel; Mogote de la Villa María, Consolación del Norte; El Mamey, Cayajabos; Sierra la Güira; La Furnia, La Güira; Mogotes de Cerro de Cabras; Ensenada de los Burros, Cabezas; Echevarría, San Diego de los Baños; Finca Balastena, Bahía Hondo; Farallón de Juan Alonso, Sierra Quemado, Isabel María; Sierra la Chorrera, San Vicente; Hoyo Jutía (Hutía), 1 km E of San Vicente. *Guane:* Mendoza; Sierra Paso Real; Sierra de Guane. *Viñales:* Hoyo del Niajagual, Cierra del Ancón; Mogote de la Dinamita; El Queque; Mogote Largo; Laguna de Piedras; Km 14 between Pinar del Río City and Viñales; Mogote Capón; Potrero Manuel Sánchez; Mogotico de Torres; mogote between Cayos de San Felipe and Loma de Isabel. HAVANA: Finca la Alianza, Cotorro; Somorrostro, near Jamaica; Loma de Camao; Peña Blanca, Sierra Anafe; Esperón, Sierra Anafe; Managua; Guayabel, Sierra Anafe (all MCZ). ORIENTE: Monte Toro, Guantánamo (MCZ); San Felipe, Monte Toro (USNM). *Miranda:* Nipi Hills, Tibisí; La Cueva, near Júcaro, Tibisí; Birán; Upper Mercedes Valley; top of hill, N of Mercedes Valley; Arroyo del Agua; Cuyo del Rey, near Miranda (all ANSP).

Proserpina (Despoenella) bidentata C. B. Adams
Plate 12, figs. 4–6; Map 1

Proserpina bidentata C. B. Adams 1850. Contributions to Conchology No. 5: 81 (Jamaica; holotype, MCZ 186126, figured by Jacobson and Boss 1973: 328, pl. 85, figs. 1–2).

Description. Shell reaching 4.0 mm in diameter, 22 mm in height, imperforate, thin, smooth, polished and translucent; color pale yellowish or greenish white; whorls 3-4, weakly inflated, rapidly increasing, the last more than three times the width of the penultimate; body whorl narrowly and unevenly rounded, the periphery distinctly above the center; suture weakly impressed, bordered by an opaque white line; umbilical area weakly sunken; spire depressed; aperture oblique, semilunate with 2 lamellae, one, the smaller one, on the columella, the other, twice the width, set closely above; no palatal lamella; outer lip thin, entire, somewhat retreating centrally; sculpture of weak, irregular growth lines, surface appears weakly punctate and with fine, regular internal lineations, obsolete basally (50 ×); protoconch 1½ whorls, glassy, microscopically punctate, barely raised: periostracum and operculum lacking.

Height	Width	
2.2 mm	4.0 mm	holotype

Remarks. P. bidentata is very closely related to, and probably gave rise to, *P. marcanoi* of Hispaniola, from which it is virtually indistinguishable. Although *bidentata* and *marcanoi* may prove to be conspecific, the widely separated populations represented by extremely small sample sizes are herein treated as separate species (see *Remarks* under *marcanoi*).

The Cuban *P. depressa*, was also probably derived from *P. bidentata*. The latter is considerably smaller in size and differs in being noticeably less depressed with its body whorl somewhat more subglobose than *depressa*.

Nothing is known about the biology of *P. bidentata*. Specific locality records thus far indicate that the species occurs in eastern Jamaica, notably the John Crow Mountains in the Parish of Portland (Map 1).

Specimens examined. JAMAICA: holotype (MCZ); *Portland:* 6.5 mi from Port Antonio, near Nonsuch (ANSP); 3.2 and 4.2 mi S of junction with Route A4, E side of road to Ecclesdown (both Goodfriend); W of Haining (ANSP).

Proserpina (Despoenella) marcanoi Clench
Plate 12, figs. 1–3

Proserpina marcanoi Clench 1962. Breviora, No. 173, p. 2, pl. 1, fig. 3 (Colonia Ramfis, 20 km W of San Cristobal, Santo Domingo [Hispaniola]; holotype, MCZ 188911).

Description. Shell reaching 4.7 mm in diameter, 2.4 mm in height, imperforate, depressed, smooth, polished, thin, fragile, translucent; color light whitish green; whorls 4, barely inflated, rapidly expanding, the last 3 times the width of the penultimate whorl; body whorl well rounded, periphery slightly above the center; suture weakly impressed, somewhat stronger at the body whorl; umbilical area slightly sunken; spire depressed: aperture narrowly semilunate, with a low columellar lamella and a higher parietal one; palatal lamellae lacking; outer lip thin, entire, slightly retreating centrally; sculpture of irregular, very fine growth lines; protoconch 1½ whorls, glassy, transparent, smooth; periostracum and operculum lacking.

Height	Width	
2.4 mm	4.7 mm	holotype
2.2	4.4	paratype
2.1	4.3	paratype

Remarks. Although Clench (1962: 3) remarked on the possible relationship of *marcanoi* with *depressa* of Cuba and differentiated these species thusly:

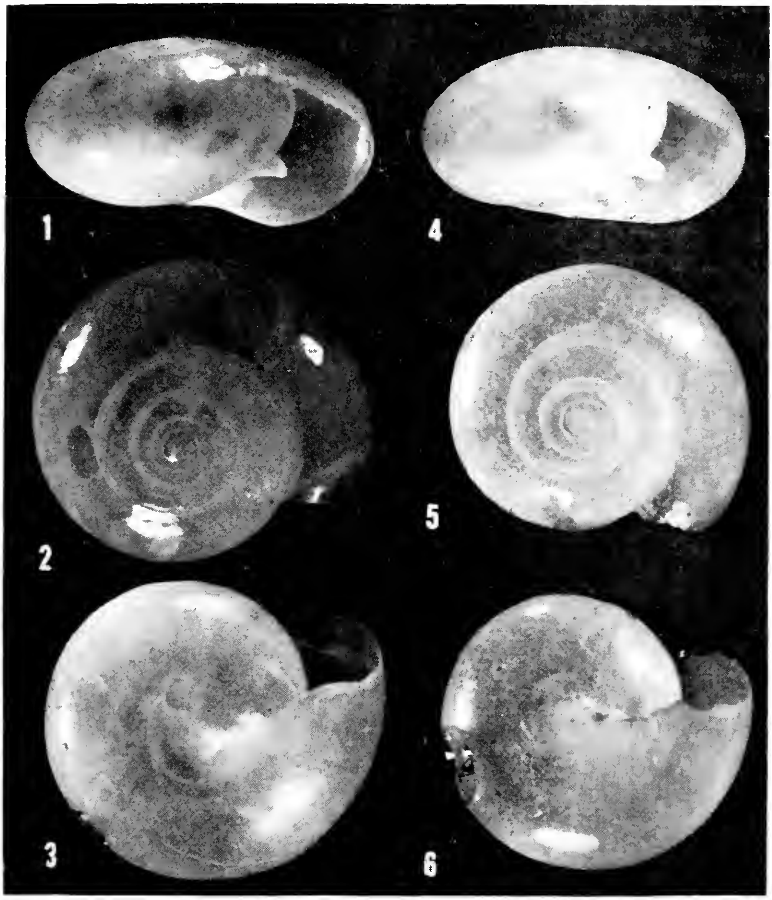


Plate 12

Figs. 1–3. The holotype of *Proserpina marcanoi* Clench, Colonia Ramfis, 20 km W of San Cristobal, Santo Domingo, Hispaniola, 4.7 mm × 2.4 mm, MCZ 188911.

Figs. 4–6. The holotype of *Proserpina bidentata* C. B. Adams, Jamaica, 4.0 mm × 2.2 mm, MCZ 186126.

'It [*marcanoi*] differs from *depressa* by being smaller in size, proportionally higher, and in having a columellar lamella nearly twice as high as the Cuban species.', *P. marcanoi* is virtually indistinguishable from *P. bidentata* from Jamaica. Unfortunately the series of specimens available for either of these species are limited, and in most every feature the shells of the two species appear to be identical. However, considering the great geographic distance separating these populations and taking into account the extremely small sample size, under close scrutiny we were able to detect some minute differences, which though appearing to be minor in importance may prove to be of a specific diagnostic value once larger samples become available. *P. marcanoi* exhibits a proportionately greater post-embryonic growth than *P. bidentata.* That is to say, that the whorl number of *marcanoi* is greater than that of *bidentata* in specimens of the same size. For example the holotype of *marcanoi* which measures 4.7 mm in diameter has 4 postembryonic whorls while a similarly sized specimen of *bidentata* (ANSP 139451), measuring 4.8 mm in diameter, has only 3½ to 3¾ whorls. The same relationship obtained in other measured comparisons. Lastly, there may be some color differences between the Jamaican and Hispaniolan forms where *bidentata* may be more strongly infused with a greenish tint. We have decided on the basis, especially of biogeographic considerations in combination with the whorl number difference noted above, to maintain *marcanoi* and *bidentata* as separate, but very closely related species, the former probably having been derived from the latter.

Specimens examined. Known only from the type-locality.

Proserpina (Despoenella) pisum C. B. Adams
Plate 13, figs. 1–3; Map 1

Proserpina pisum C. B. Adams 1850. Contribution to Conchology No. 7: 108 (Jamaica; lectotype, MCZ 177263, selected by Jacobson and Boss, 1973: 404, pl. 71, figs. 10–11).

Description. Shell reaching 6.1 mm in width, 5.6 mm in height, imperforate, globose, smooth, polished; color white or pale lemon yellow; whorls 4–5+, slightly inflated, slowly increasing, the last whorl little wider than the penultimate; body whorl high, well rounded, shelved in adult individuals, the periphery central; suture well impressed, especially at the body whorl, umbilical area weakly sunken; spire well raised, domelike; aperture slightly oblique, narrowly semilunate, with a columellar lamella closely set to and slightly smaller than a parietal lamella; outer lip thin, simple, somewhat retreating centrally; sculpture of weak, barely perceptible growth lines; the surface weakly punctate and with fine, regularly spaced obsolete internal lineations, obsolete basally (50 ×); protoconch 1½ whorls, microscopically punctate, slightly raised; periostracum and operculum wanting.

Height	Width	
5.6 mm	6.1 mm	lectotype
4.6	5.9	New Hope, Westmoreland
4.2	5.1	paralectotype

Remarks. Proserpina pisum is one of two species of *Despoenella* which live on the island of Jamaica (Map 1). It is easily distinguished from *P. bidentata* by its rounded, globose shape: further, the species are distinctly separated geographically, with *pisum* living in the western regions of the island, from the Parishes of Westmoreland, St. James and Trelawney, and *bidentata* occurring only in the east in the John Crow Mountains. According to Baker (1934a) both species aestivate under rocks during hot and dry periods but emerge to climb rock faces during rain. Gloyne (1872) remarked on the great rarity of the occurrence of *P. pisum.*

P. pisum is most closely related to the Cuban *P. globulosa* with which it shares a similar globular shape and to which it probably gave rise (see *Zoogeography* in the *Introduction*).

Specimens examined. JAMAICA: *Westmoreland:* New Hope (MCZ); *St. James:* 2 to 4 mi SE of Catadupa Station (ANSP); Spring Mount (MCZ); *Trelawney:* 200 ft. W of streambed and entrance to Windsor Cave (Goodfriend).

Proserpina (Despoenella) globulosa (Orbigny)

Plate 13, figs. 4–6; Map 2

Odontostoma globulosa Orbigny 1842. Mollusques [in] Sagra, Histoire Physique, Politique, et Naturelle de l'Ile de Cuba, 1: 239, pl. 18, figs. 8–11 (type-locality, intérieur de l'île; holotype, BMNH).

Odontostoma globulosum Orbigny. Pfeiffer 1848. Monographia Heliceorum Viventium 1: 11.

Proserpina globulosa (Orbigny). Pfeiffer 1850. [in] Martini and Chemnitz, Conch. Cab. (2) 1: pt. 12, sect. 2, p. 12, figs. 19–21.

Description. Shell reaching 5.2 mm in diameter, 4.2 mm in height, imperforate, subglobose, smooth, polished; color pale lemon yellow or white; whorls almost 4–5, quite flat, slowly increasing in width, the last whorl only slightly wider than the penultimate; body whorl well rounded at the periphery; suture very weakly impressed; spire little raised, domelike, apex barely elevated; aperture oblique, narrowly semilunate, with 2 lamellae; parietal lamella stronger; columellar lamella rising from a low elevation in columellar curve; palatal lamellae absent; umbilical area weakly excavated; outer lip entire, somewhat retreating centrally; surface finely punctate and with regularly, closely spaced axial striae becoming obsolete basally (50 ×); punctate; protoconch 1½ whorls, microscopically pebbled, barely elevated; periostracum and operculum lacking.

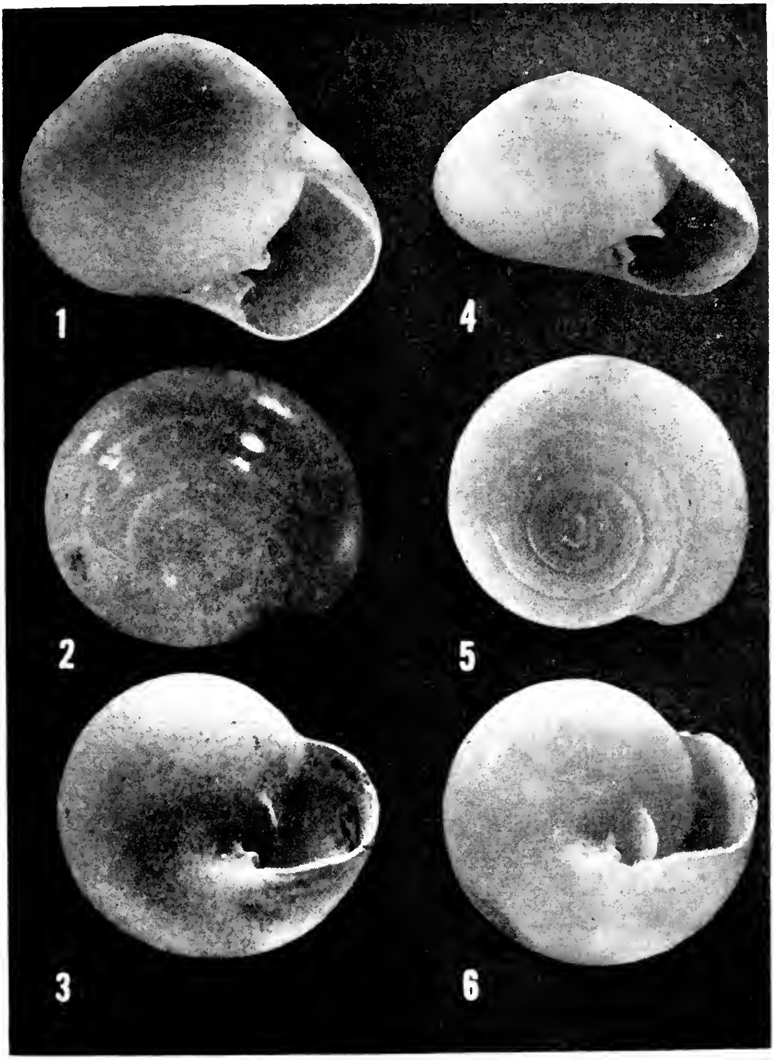


Plate 13

Figs. 1–3. Lectotype of *Proserpina pisum* C. B. Adams, selected by Jacobson and Boss 1973: 404, pl. 71, figs. 10 + 11, Jamaica, 6.1 mm × 5.6 mm, MCZ 177263.

Figs. 4–6. *Proserpina* (*Despoenella*) *globulosa* (Orbigny), Santa Tomas, Viñales, Pinar del Río, Cuba, 5.3 mm × 3.7 mm, MCZ 235260.

Height	Width	
4.2 mm	5.2 mm	La Chorrera, San Vicente, Pinar del Río
3.5	5.2	Mogote de Justo, Viñales, Pinar del Río
3.4	4.2	Cayos de San Felipe, Viñales, Pinar del Río
3.2	5.2	Sierra de Casas, Isle of Pines

Remarks. *P. globulosa* is most closely related to, and probably a derivative of *P. pisum* of western Jamaica. It is distinguished by its slightly smaller size, less globose body whorl, larger aperture and lower profile. From the other Cuban *Despoenella, P. depressa,* with which it is sympatric in Viñales, Pinar del Río, *P. globulosa* can be readily recognized by its smaller size, its higher, subglobular outline, and its columellar lamella which rises from an elevation on the columella rather than directly from the columella itself.

As discussed earlier (see *Zoogeography* in the *Introduction*), *P. globulosa* arose on Cuba having been derived from a Jamaican stock like *P. pisum.* Although Arango wrote (1879: 58) that *globulosa* is found "en casi toda la isla" we have found no records, either published or in museum collections, to support this statement. Presently the species occurs (Map 2) in 4 disjunctive localities: 1) in the west from northwestern Pinar del Río around Luiz Lazo and Viñales; 2) on the Isle of Pines; 3) in the east in south central Oriente around Jarahueca and Florída Blanca; and 4) near the extreme eastern portion of Oriente at Baracoa. It is the only species of *Proserpina* in the Isle of Pines (Henderson, 1916) and unlike *P. depressa,* its range does not extend to Havana Province. Probably at one time *P. globulosa* was widely distributed on the island but now it only lives in several isolated, disjunctive, mainly montane refugia.

Specimens examained. PINAR DEL RÍO: *Viñales:* Mogote Cabrera; Sumidero, Luis Lazo; Hoyo Jaruco; Mogote Marmol; Mogote Cayo de San Felipe; Mogote La Mina;

km 14 between Pinar del Río City and Viñales; Mogote Rinconada; Mogote Zacarías; Mogote Coco Sola; Ensenada Hutía; Mogote Dos Hermanos; Pan de Azucar; El Abra; Paredones de la Puerta del Ancón; Guajaní; Laguna de Piedras; Mogote Palmarito (all USNM); Mogote de la Dinamita; Mogote de Justo; El Cuajaní, Sierra de Viñales; Cayos de San Felipe; Santo Tomás (all MCZ). *San Vicente:* La Chorrera; Costanera de San Vicente (both USNM); Cuevas del Río; Cove of Delight; mogotes in middle of west side, Ensenada de San Vicente; Mogote Justo, Baños de San Vicente (all ANSP). ISLE OF PINES: Sierra Caballos; Sierra Columbo; Sierra de Casas; Sierra Bibijagua (all USNM). ORIENTE: Florída Blanca; Subida de la Hembrita; Los Alemanes, La Leonora, Jarahueca (all USNM); El Yunque de Baracoa (MCZ).

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WORLD'S LARGEST SHELL OF THE PAPER NAUTILUS (*ARGONAUTA ARGO* LINNAEUS)

By Richard I. Johnson

Sometime during the middle of the last century, Col. Thomas H. Perkins, then one of the richest merchants of Boston, purchased the world's largest female Paper Nautilus shell. Perkins paid the astonishing sum of $500.00 for it. Upon his demise it was presented, by his family, with the rest of his shell collection, to the Boston Society of Natural History.

Perkins was not a man who knowingly made foolish investments. How did he know he was purchasing the world's largest known specimen? Dr. Cabot (1856: 370), speaking before the members of the Society, affords a clue: "Orbigny ([in] Férussac and Orbigny, 1840: 168) gives the measurements of the largest *Argonauta* he had examined: greatest length of the shell, 9.5 inches." Férussac and Orbigny's sumptuously illustrated monograph of the Cephalopoda was then the last word on the subject.

Since Perkins, like many of his contemporaries, only kept a cabinet of curios, he must have consulted with learned members of the Society before making the purchase. Most likely, he was advised by Dr. Augustus A. Gould, then one of the leading conchologists in the United States. In a report to the members of the Society, acknowledging the receipt of the collection, Gould (1854: 35) gave the measurements of the shell as 11.75 by 7.5 inches, noting that, "the next largest specimen, in the College of Surgeons, London, measures .75 inches less than this."

Tryon (1885: 136), in his admirable monograph on the Cephalopoda, called attention to the world's largest *Argonauta*, but, alas, by then the specimen had *shrunk* to a diameter of 10 inches. Johnson (1917: 1, 5) figured the specimen, at which time it had a diameter of 10$\frac{3}{8}$ inches.

Although the Society began transferring its non New England specimens to the Museum of Comparative Zoology in 1914, it was not until just a few years ago that the now Museum of Science relinquished the world's largest Paper Nautilus (now MCZ 293001). Surprisingly, it still has the same diameter it had in Johnson's time.

Is Gould's measurement of 11.75 inches a misprint, in which case the London specimen would still measure .75 inches less than the Perkins specimen, or was he peradventure obfuscating the fact that he had subsequently become aware of the existence of a larger shell elsewhere, and did not want to admit it?

It matters not, the mania for having the world's largest Paper Nautilus is past, and we conclude, in this bit of pedantry, with the observation that Perkins paid too much for the world's largest Paper Nautilus, even if its size is not challenged.

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Occasional Papers On Mollusks

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

VOLUME 4 1 OCTOBER 1975 NUMBER 52

CATALOGUE OF THE TAXA OF THE SUBFAMILY PROSERPININAE (HELICINIDAE: PROSOBRANCHIA)

By KENNETH J. BOSS AND MORRIS K. JACOBSON

This catalogue was compiled during the preparation of our systematic monograph of the proserpinine snails in the Greater Antilles (see preceding paper, Boss and Jacobson, 1975, Occ. Papers Moll., no. 51). We brought together so much information on the nominal species and genera in the Proserpininae as well as spurious species at one time referable to the group that we deemed it worthwhile to publish these data which include: 1) generic, subgeneric and specific nomina as originally introduced; 2) the original citation; 3) the type-locality; 4) and the location of the type-specimens, if known. Notes on present systematic placements and synonymies are provided.

ABBREVIATIONS

ANSP — Academy of Natural Sciences of Philadelphia
MCZ — Museum of Comparative Zoology
BMNH — British Museum of Natural History
USNM — United States National Museum
CAS — California Academy of Sciences, San Francisco
UF — University of Florida
MP — Museo Poey, Havana, Cuba

Of the nomina introduced by the various authors for the Proserpininae we conclude on the basis of personal observations and the consultation of the literature, that there are two generic level taxa, *Ceres* and *Proserpina s. l.*, the latter having 5 subgeneric units: *Proserpina s.s.*, *Despoenella*, *Staffola*, *Linidiella* and *Proserpinella*, and 19 valid species. A further examination of some of the nominal species, specimens of which we have difficulty in procuring, especially those from South America, may lead to still further reductions.

Ceres was described by Gray (1856: 100) for its uniquely keeled, rather large helicoid shell, the spire of which is sculptured and the aperture of which is provided with 6 lamellae or denticles. Kobelt (1879: 203) subsequently designated *Caracolla eolina* as the type-species which was originally thought to have helicid affinities. Presently recognized as a distinctive genus, *Ceres* includes three species.

eolina Duclos	Mexico
salleana Gray	Mexico
nelsoni Dall	Mexico

Proserpina s.s. was introduced by Sowerby (1839: 124) with *Proserpina nitida* Sowerby as type-species by monotypy. *Procerpena* Gray and *Despoena* Newton are synonyms of *Proserpina s.s.*

With the exception of *Ceres*, all other superspecific taxa are considered as subgenera of *Proserpina s. l.*, namely *Proserpina s.s.*, *Despoenella*, *Staffola*, *Linidiella*, and *Proserpinella*.

Proserpina s.s. is geographically restricted to Jamaica and consists of two species, both of which have parietal, columellar and palatal lamellae.

nitida Sowerby	Jamaica
linguifera Jonas	Jamaica

Baker (1923: 85) established *Despoenella*, herein considered as a subgenus of *Proserpina s. l.*, with *Odontostoma depressa* Orbigny as type-species. *Odontostoma* Orbigny, *Odostoma* Orbigny, and *Despaenella* 'Baker' Neave are synonymous.

The species of *Despoenella* have parietal and columellar but not palatal lamellae and are all found in the Greater Antilles.

bidentata C. B. Adams	Jamaica
pisum C. B. Adams	Jamaica
depressa Orbigny	Cuba
globulosa Orbigny	Cuba
marcanoi Clench	Hispaniola

Cyane H. Adams 1870 from eastern Peru was introduced for a species with "the base of the columella is truncate instead of being furnished with a spiral plate . . . and both palatal and parietal lamellae are wanting." In establishing *Staffola,* Dall (1905) felt that "this appearance of truncation is due to the fact that there is only a narrow notch between the columellar lamella and the basal margin." Since *Cyane* is preoccupied by Felder 1861 (Lepidoptera) the name *Staffola* with 4 South American species takes its place. Although Keen (1960) considered *Staffola* to be a subgenus of *Linidiella* and it may well be that *Staffola* could be completely synonymized, it is herein treated as a subgenus of *Proserpina s. l.* with 4 South American species.

blandiana H. Adams	Peru
cousini Jousseaume	Ecuador
orbignyi Ancey	Bolivia
derbyi Dall	Bahia, Brazil

Linidiella was introduced by Jousseaume (1889:256) for a species of *Proserpina* in which only a single fine columellar tooth is present. *P. swifti* Bland was designated as type-species for this group by Baker (1923: 84). We accord it subgeneric rank and include three species. *Chersodespoena* Sykes 1900 is synonymous.

swifti Bland	Venezuela
cinnamomea Sykes	Ecuador
sulfureus Thompson	Mexico

Proserpinella was introduced by Bland (1865:157) with *P. berendti* as type-species by monotypy for small, fragile shells with only a single parietal apertural tooth from

Mexico. Two species are currently referable to this taxon which is herein assigned subgeneric rank.

berendti Bland	Mexico
hannae Dall	Tres Marías Ids., Mexico

SPURIOUS TAXA

The species *Helix arnoudii* Michaud from the Paleocene near Reims, France, once thought to be referable to *Ceres,* was rejected as such by Sandberger (1871: 149) and placed in the monotypic *Dimorphoptychia* in the Endodontidae near *Sesara infrendens* Gould. Wenz (1938: 435), considering *arnoudii* close to the Vianinae erected for it the subfamily Dimorphoptychiinae within the Helicinidae, where, under the corrected name Dimorphoptychinae it was retained by Keen (1960: 286). If the species is indeed a fossil helicinid, it seems wisest, for the reasons given by Sandberger, to separate it from the neotropical taxa although its shape and apertural lamellae suggest a relationship with the subfamily Proserpininae.

The following taxa, noted with an asterisk (*) in the subsequent list, are referable to groups other than the Proserpininae: *arnoudii, arnouldi, Dimorphoptychia, discoidea, hyalina, lyelli, margarita, opalina,* and *woodwardi.*

allognota Jonas, **Proserpina.** 1846. Zeitschrift für Malakozoologie 3: 12, new name for *H. linguifera* Jonas 1839.

***arnoudii** Michaud, **Helix.** 1837. Guerin's Magazine de Zoologie 6: Cl. 5, p. 3, pl. 81, figs. 7-9 (fossile du calcaire siliceux du gypse de la montagne de Reims [Paleozän, Thanet, Calcaire de Rilly, Rilly-la-Montagne bei Reims, Dép. Marne, *teste* Wenz 1938: 435]; holotype, ? Lyon Mus., *teste* Dance 1966: 294).

***arnouldi** 'Michaud' Boissy, **Helix.** 1848. Mem. Soc. Geol. de France, ser. 2, 3 (1): 272, pl. 5, fig. 12 a-c, error for *arnoudii.*

berendti Bland, **Proserpinella.** 1865. Ann. Lyc. Nat. Hist. New York 8: 157, fig. 2 (Mirador, Atlantic slope, 3000 to 4000 ft. elevation, Mexico; holotype, ?)

bidentata C. B. Adams, **Proserpina.** 1850. Contributions to Conchology No. 5: 81 (Jamaica; holotype, MCZ 186126, figured by Jacobson and Boss 1973: 328, pl. 85, figs. 1-2).

blandiana H. Adams, **Cyane.** 1870. Proc. Zool. Soc. London, pt. 2, p. 376, pl. 27, figs. 2-2a (Eastern Peru; holotype, BMNH).

Ceres Gray. 1856. Proc. Zool. Soc. London, pt. 24, p. 100 (type-species, *Caracolla eolina* Duclos 1834, by subsequent designation, Kobelt 1879: 203).

Chersodespoena Sykes. 1900. Proc. Mal. Soc. London 4: 136 (type-species, *Despoena* (*Chersodespoena*) *cinnamomea* Sykes, 1900, by original designation). NOTE: Synonym of *Linidiella* Jousseaume, 1889.

cinnamomea Sykes, **Despoena (Chersodespoena).** 1900. Proc. Mal. Soc. London 4: 136, 3 figs. (between Ayabamba and Santa Rosa, Ecuador; holotype, BMNH).

cousini Jousseaume, **Proserpinella.** 1887. Bull. Soc. Zool. France 12: 181, pl. 3, figs. 15-16 (République de l'Equateur; holotype, ?).

Cyane H. Adams. 1870. Proc. Zool. Soc. London, pt. 2, p. 376 (type-species, *Cyane blandiana* H. Adams 1870, by monotypy), *non* Felder 1861 (Lepidoptera), *nec* Chambers 1873 (Lepidoptera).

depressa Orbigny, **Odontostoma.** 1842. Mollusques [in] Sagra, Histoire Physique, Politique et Naturelle de l'île de Cuba 1: 238, pl. 18, figs. 4-7 (intérieur de l'île de Cuba; restricted to Pan de Guajaibón, Pinar del Río, by Aguayo and Jaume 1947: No. 88; type, BMNH). NOTE: *ptychostoma* Pfeiffer and *rubrocincta* Aguayo and Jaume are synonyms.

derbyi Dall, **Proserpina (Staffola).** 1905. Proc. Biol. Soc. Washington 18: 202 (arroyo of Rio Chico, Paraguassú, Bahia, Brazil; type, USNM).

Despaenella H. B. Baker. Neave, 1939. Nomenclator Zoologicus 2: 51, error for *Despoenella*.

Despoena Newton. 1891. Systematic List British Oligocene and Eocene Mollusca in the British Museum, p. 255, new name for *Proserpina* Sowerby 1839, *non* Hübner 1816.

Despoenella H. B. Baker. 1923. Nautilus 36: 85 (type-species, *Odontostoma depressa* Orbigny, 1842, new name for *Odontostoma* Orbigny, 1842, *non* Turton 1830 etc.).

***Dimorphoptychia** Sandberger. 1871. Land.-und Susswasser-Conchylien der Vorwelt, p. 149, pl. 7, figs. 1 a-d (type-species, *Helix arnoudii* Michaud 1837, by monotypy). NOTE: A monotypic helicinid genus in the subfamily Dimorphoptychinae.

***discoidea** C. B. Adams, **Proserpina.** 1850. Contributions to Conchology No. 5: 81 (Jamaica; lectotype, MCZ 247-211, selected by Jacobson and Boss 1973: 345, pl. 86, figs. 12-14). NOTE: Not a *Proserpina* but a member of *Proserpinula* Albers, 1860, in the family Sagdidae. See also *opalina* Adams.

eolina Duclos, **Caracolla.** 1834. Guerin's Magazine de Zoologie, 3, Cl. 5, pl. 30 (no locality given [Mexico, Kobelt 1879: 203]; holotype, ?).

globulosa Orbigny, **Odontostoma.** 1842. Mollusques [in] Sagra, Histoire Physique, Politique et Naturelle de l'Ile de Cuba 1: 239, pl. 18, figs. 8-11 (intérieur de l'île de Cuba; holotype, BMNH).

hannae Dall, **Proserpinella.** 1926. Proc. California Acad. Sci. ser. 4, 15 (15): 486, pl. 36, figs. 6-8 (type-locality, Maria Madre, Tres Marias Islands, Mexico; holotype, CAS 2211).

***hyalina** (C. B. Adams MS) Pfeiffer, **Helix.** 1845. Zeitschrift für Malakozoologie 3: 83, *nomen nudum,* as synonym of *margarita* Pfeiffer.

linguifera Jonas, **Helicina.** 1839. Wiegmann's Archiv Naturgesch. 1: 341 (Patriam ignoro; type, ?). NOTE: *allognota* Jonas and *pulchra* C. B. Adams are synonyms.

Linidiella Jousseaume. 1889. Mem. Soc. Zool. France 2: 256 (type-species, *Proserpina swifti* Bland 1863, by subsequent designation, Baker 1923: 84).

***lyelli** Moore, **Proserpina.** 1867. Proc. Geol. Soc. London 27: 549, pl. 15, figs. 3-4 (Lias; holotype ?). NOTE: probably not a *Proserpina;* possibly a helicoid (Sykes, 1900: 138) or a marine snail.

marcanoi Clench, **Proserpina.** 1962. Breviora, No. 173, p. 2, pl. 1, fig. 3 (Colonia Ramfis, 20 km W of San Cristobal, Santo Domingo [Hispaniola]; holotype, MCZ 188911).

***margarita** Pfeiffer, **Helix.** 1845. Zeitschrift für Malakozoologie 3: 83 (Jamaica; holotype, ? Cuming Colln. BMNH). NOTE: not a *Proserpina;* synonym of the sagdid *opalina* C. B. Adams.

nelsoni Dall, **Ceres.** 1898. Nautilus 12 (3): 27; 1902, Proc. U. S. Nat. Mus. 24 (1264): 501, pl. 28, figs. 1, 3, 5, 8 (Pilitla, San Luis Potosi, Mexico; USNM 107823).

nitida Sowerby, **Proserpina.** 1839. Conchological Manual, 1 Ed., p. 124, fig. 274; 1842, 2 Ed., p. 237, fig. 274 (Habitat in insula Jamaica; type, ? BMNH). NOTE: *Proserpina* Pfeiffer and *planulata* C. B. Adams are synonyms.

Odontostoma Orbigny. 1848. Mollusques [in] Sagra, Histoire Physique, Politique et Naturelle de I'Ile de Cuba 1: 237 (type-species, *Odontostoma depressa* Orbigny, 1842, by subsquent designation H. B. Baker, 1923: 84), *non* Turton 1830 (Moll.), *nec* Agassiz 1846 (Moll.), *nec* Morch 1852 (Moll.).

Odostoma Orbigny. Gray, 1856. Proc. Zool. Soc. London, pt. 24, p. 99, error for *Odontostoma.*

***opalina** C. B. Adams, **Helix** 1845. Proc. Boston Soc. Nat. Hist. 2: 16 (W part of St. Mary's, Jamaica; lectotype, MCZ 247210, selected by Jacobson and Boss 1973: 395, pl. 78, figs. 11-12). NOTE: First described in *Helix* but later referred to *Proserpina* (Adams. 1851. Contributions to Conchology No. 9: 186). Not a *Proserpina* but a member of *Proserpinula* Albers, 1860, in the family Sagdidae. See also *discoidea* Adams.

orbignyi Ancey, **Cyane.** 1892. Le Naturaliste, ser. 2, no. 130, p. 178 (Santa Cruz de la Sierra, Bolivie; holotype, Brussels Mus., *teste* Dance 1966: 278).

pisum C. B. Adams, **Proserpina.** 1850. Contributions to Conchology No. 7: 108 (Jamaica; lectotype, MCZ 177263, selected by Jacobson and Boss, 1973: 404, pl. 71, figs. 10-11).

planulata C. B. Adams, **Proserpina nitida.** 1850. Contributions to Conchology, No. 9: 174 (Jamaica; lectotype, MCZ 276092 selected by Jacobson and Boss 1973: 405, pl. 85, figs. 3-4). NOTE: Synonym of *nitida* Sowerby.

Procerpena Gray. 1847. Proc. Zool. Soc. London, pt. 15, p. 182, cited as misprint for *Proserpina* Sowerby 1839.

Proserpina (*sic*) Pfeiffer, **Helix.** 1845. Zeitschrift für Malakozoologie 2: 84 (Jamaica; type, destroyed, *teste* Clench and Jacobson, 1971a: 101). NOTE: synonym of *Proserpina nitida* Sowerby 1839.

Proserpina Sowerby. 1839. Conchological Manual, 1st Ed., p. 124, fig. 274 (type-species, *Proserpina nitida* Sowerby 1839, by monotypy); Gray, 1840. Synopsis Contents British Museum, Ed. 42, p. 129, 153, *non Proserpinus* Hübner 1816 (Lepidoptera). NOTE: In the 2nd edition of the Manual (1842: 237) Sowerby credited Gray for having suggested the genus, but Gray first published the name in 1840 (Synopsis of the Contents of the British Museum, pp. 129, 153).

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Proserpinella Pilsbry 1949. Nautilus 63: 43, *non* Bland 1865, error for **Proserpinula** Albers 1860.

ptychostoma Pfeiffer, **Helicina.** 1848. Monographia Heliceorum Viventium 1: 12, footnote (Callajabas (*sic*), Cuba [Cayajabos, Pinar del Río]); holotype, destroyed, *teste* Clench and Jacobson (1971a: 101). NOTE: Synonym of *Proserpina depressa* (Orbigny, 1842).

pulchra C. B. Adams, **Proserpina.** 1850. Contributions to Conchology No. 5: 81 (Jamaica; lectotype, MCZ 275-999, selected by Jacobson and Boss 1973: 409, pl. 85, figs. 5-6). NOTE: Synonym of *Helicina linguifera* Jonas, 1839.

rubrocincta Aguayo and Jaume, **Proserpina depressa.** 1947. Catálogo Moluscos de Cuba, No. 88 (*nomen nudum*): 1957. Mem. Soc. Cubana Hist. Nat. 23: 124 (type-locality, Los Acostas, Luiz Lazo, Pinar del Río; holotype, MP 5520). NOTE: Synonym of *depressa* Orbigny.

salleana Gray, **Ceres.** 1856. Proc. Zool. Soc. London, pt. 24, p. 100, 102, 1 fig. (radula) (Cordera, State of Vera Cruz, Mexico in dense woods under dead leaves; holotype, ? BMNH).

Staffola Dall. 1905. Proc. Biol. Soc. Washington 18: 202 (type-species, *Proserpina* (*Staffola*) *derbyi* Dall 1905, by original designation).

sulfureus Thompson, **Linidiella.** 1967. Proc. Biol. Soc. Washington 80: 61, figs. 1-3 (Chiapas, Mexico, 8.2 mi. S Solusuchiapa, 1600 ft. altitude; holotype, UF 19025).

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UNIQUE PURPLE SHELL OF THE PAPER NAUTILUS (*ARGONAUTA ARGO* LINNAEUS)

By Richard I. Johnson

On October 7, 1873, Dr. Augustine Shurtleff wrote the Museum of Comparative Zoology, offering for sale the collection of shells made by his late father, Dr. Samuel A. Shurtleff, who, before his death, was an active member of the Boston Society of Natural History.

"My late father left a very large and complete cabinet of shells. In the year 1840 it was one of the most extensive collections in New England."

J. G. Anthony, then in charge of conchology, but in ill health, turned the correspondence over to his young assistant, Charles E. Hamlin, who wrote on November 15:

"Mr. Anthony's long experience makes his opinion of the money value of your collection worth knowing, while mine is not. He has said to me, and would probably not object to my repeating to you, that he regards from $800 to $1000 as a fair valuation of your shells. They doubtless cost your Father more, but as you are aware all such collections are disposed of at a cruel sacrifice, if put to sale. The dispersion of private cabinets and libraries after the death of their gatherers is one of the saddest things in the world."

In a further letter, December 9, 1873, Hamlin wrote: "With regard to the purple Paper Nautilus, Messrs. Anthony, Jenks and myself conversed about it last week. Mr. A., who is familiar with all the tricks of dealers, pronounced the color to be artificial — the result of some dying process adopted to make it a rare specimen. As he is a very *positive* man he will probably adhere to his notion. But from your account of the shell it seems to me its color is probably genuine. The species is doubtless *Argonauta argo,* ordinarily white, as you are aware, but in this case colored by reason of some unusual conditions of its life or habitat."

The collection was not purchased. Anthony died in 1877 and Hamlin, who was more interested in paleontology, did not pursue its acquisition.

In 1922, William F. Clapp, then Curator of Mollusks, was requested by Francis Shurtleff to remove a shell collection from his home in Cambridgeport. To help him pack the collection Clapp enlisted the aid of a young enthusiast, William J. Clench, who recalls that they were told that the purple Paper Nautilus had cost $1000.00 and that the collection had not been made by the donor. (While S. Shurtleff probably paid a high price for the shell, after two generations of non conchologists, Anthony's maximum value of the collection must have remained in their minds as the price of the single specimen.) It contained little else of scientific interest save a paratype of *Unio shurtleffianus* Lea (MCZ 175566). Clapp, unaware of the provenance of the collection, merely accessioned it as the Shurtleff collection. Upon examining the Nautilus (MCZ 293002), now more pink than purple, Clench noticed that it was covered with a number of very small pink barnacles. Without knowing it, he had confirmed what old Anthony had known, though almost blind when he had declared it: the purple Paper Nautilus is a fake.

ACKNOWLEDGEMENTS

Thanks are due to Ms. Ann Blum, Archivist of the Museum of Comparative Zoology, who enthusiastically made available correspondence, and to Dr. William J. Clench, Curator Emeritus, my mentor of old, who kindly recalled his memory.

Occasional Papers On Mollusks

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

VOLUME 4 1 OCTOBER 1975 NUMBER 53

FELIPE POEY
WITH A CATALOGUE OF THE MOLLUSCA DESCRIBED BY HIM

By KENNETH J. BOSS AND MORRIS K. JACOBSON

Felipe Poey y Aloy (1799-1891), a Cuban of outstanding scientific abilities, is very little known in the United States. To specialists in the biological sciences, especially ichthyology, ornithology, entomology and malacology, he is familiar for his contributions to Cuban natural history. An active student of such diverse disciplines as archaeology, philosophy and jurisprudence, Poey was also the author of an estimable body of poetry and linguistic studies (Dihigo, 1915) and modernized the medieval methods of education in 19th century Cuba. In each of these fields, his contributions were solid and praiseworthy. His studies in malacology are fundamental to the study of Cuban mollusks, especially terrestrial prosobranchs and pulmonates, and most of the species he named and described are still recognized today.

Felipe Poey was born in Havana[1] on May 26, 1799. His father was Juan Andrés Poey y Lacasse, a native of Oloron in the Béarn region of southern France, which was formerly a province of Spanish Navarre. His mother was María del Rosario Aloy y Rivera, a member of the local Spanish aristocracy in Havana.

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[1] We have used the spelling "*Havana*" for brevity and in accordance with earlier English practice, although the citation of "*La Habana*" is preferred by some authorities.

When he was scarcely 5 years old, Felipe and his family moved to France and settled in Pau in the lower Pyrenees. Here he received his primary education. When his father died, his mother moved back to Havana, leaving her son in a boarding school in Pau for 3 more years. Here he contracted what seems to have been polio and he was left for the rest of his life with a paralyzed right side. Chardon (1949:239) wrote that he had "una imperfección física en una pierna" but it was apparently much more serious. Charles Wright, the American botanist and collector, met Poey, and on July 24, 1865 wrote in a letter to Asa Gray at Harvard as follows: "Poey [is] a jolly old soul who takes short strolls where the walking is smooth, swinging about his semi-paralytic arm and leg. His right side is partially paralytic. He writes with his left hand and straight down the page like the Chinese, or he turns the paper side-wise to him — the lines running up and down." As a result of this life-long infirmity, Poey spent very little time in the field. Almost all the new species of mollusks he described were brought to him by colleagues whom he mentions in the descriptions. Friends also probably secured for him the insects, birds, and fishes he worked with. Many of his fishes were given him by the fishermen of Cojímar and Boquete de La Habana who provided him with specimens for more than 35 years.[1] In 1884, when the great American ichthyologist David Starr Jordan was in Havana, he found that when he visited the Calle San Nicolás near the embarcadero to look over the catch of the fishermen, the words " 'amigo de Don Felipe' were a passport to friendly help" (Jordan 1884: 547). The slogan of these fishermen was 'Para todo pez nuevo, busca a Don Felipe" (with every new fish, go looking for Don Felipe). With this sort of help

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[1] Although Poey did very little collecting, he did visit fishing ports often to study and draw fresh specimens. According to Carlos de la Torre, Poey made his outlines placing the specimens over a piece of paper to obtain exact reproductions. This is why some of his original drawings, like those of some sharks, are huge (Canet, *pers. com.*)

Plate 14

FELIPE POEY Y ALOY

1799–1891

he turned out the greatest work on Cuban fishes ever written and one of the outstanding ichthyological treatises.

In the lovely region around Pau the crippled little boy, separated by his ailment from his companions, developed his deep love for nature. However, his mother used to insist that this interest was innate and that even as an infant he spent an entire hour on his belly watching the activities of a colony of ants (Sánchez Roig 1955: 50).

Back in Havana, he attended the Royal Seminaries of San Carlos and San Ambrosio, the most prestigious preparatory schools of Havana. He studied philosophy under Félix Varela and the law under Justo Vélez, and both his theses dealing with philosophy and law, as well as a paper on economics, were published before he graduated.

He received his degree as bachelor of laws in 1820 and in the same year became a member of the Sociedad Patriotica (later the Amigos del País), a learned society of Cubans interested in the cultural, economic and social development of the island. At the same time he began to make collections of plants, animals, while also contributing articles to "El Observador Habanero," a periodical devoted to politics, the sciences, and literature.

To please his mother he went to Madrid to complete his studies in law and received his degree with honors as doctor of laws at the Universidad Central de Madrid in 1822. For a while he taught law in the Nacional Academia de Ambas Jurisprudencias in Madrid. His lectures were popular because of his easy flow of language and his passionate devotion to liberty. He had to leave Spain because he opposed the oppressive regime of Fernando VII, and he returned to Cuba in 1823. While in Spain he visited the archives, searching for manuscripts dealing with the discovery, conquest, and colonization of America. His intellectual interests were always varied.

Once again in Cuba he supported himself by teaching in in the colegios of San Cristóbal, Carraguao, and San Francisco de Asís. He never showed any interest in engaging in the actual practice of law.

In 1824 he married María de Jesús Aguirre y Hornillo with whom he had five children, one of whom, Andrés, was the founder of the Academia de Ciencias de La Habana and a subdirector of the observatory of Paris. In 1824 Poey published some poems and began to interest himself intensively in Natural History, especially fishes.

In 1826 Poey moved to France bringing with him over 80 illustrations of Cuban fishes and a barrel of 35 fish specimens preserved in brandy which he gave to the great French naturalist Georges Cuvier. Poey's observations were included in Cuvier and Valenciennes' *Histoire Naturelle des Poissons.* The interest of such eminent scholars in the work of a young Cuban inspired Poey and he devoted himself more deeply to ichthyology. Poey also brought along specimens of plants, insects, and other animals. In Paris he spent his time at the law school, the Natural History Museum, and the Botanical Garden. Although he received licenses in French and Spanish law, he was never a practising lawyer.

In 1829 he showed his interest in improving primary education by publishing *Cartilla Geográfica para las Escuelas Primarias* in Havana, the first book on geography ever published in Cuba (Alvarez Conde 1958: 217). It went through numerous editions. In 1832 Poey was the youngest of a group of naturalists — including Latreille, Serville, and Guérin-Meneville — who established the Entomological Society of France in Paris. He began, at this time, a monograph on the lepidoptera of Cuba of which two parts were published in 1832. The work was interrupted when he returned to Cuba in 1833, but it was later continued in the *Memorias sobre la Historia Natural de la Isla de Cuba.*

On November 3, 1836 he was elected corresponding member of the Royal Zoological Society of London and in the same year he published two more important works on geography. In 1838 he was honored with the title of Socio de Mérito of the Sociedad Económica de Amigos del País. In 1839, under his instigation, the Museum of Natural History of Havana was founded with himself as first director.

In 1840 he published textbooks on minerology and geography and collaborated in the *Repertorio Médico Habanero,* a monthly review founded by Nicolás José Gutiérrez and others. In this year he also met Juan Gundlach, the gentle and devoted cubanized German with whom he formed a lifelong friendship. Some of the few collecting expeditions in which Poey participated were undertaken with his young disciple Carlos de la Torre. They visited Cárdenas in Matanzas, the Isle of Pines, and Rangel and San Diego de los Baños in Pinar del Río. In 1833 he collected butterflies in Banes, in Oriente (Sánchez Roig 1955: 50).

In 1842 Poey began his long association with the University of Havana which lasted until his death in 1891.[1] It is sufficient merely to list his activities there to show how greatly he influenced the transformation of that ancient institution. In 1842 he introduced the studies of Zoology and Comparative Anatomy, writing the text books and contributing many articles on his investigations to various periodicals. Through his long teaching career, he instructed in diverse disciplines in the natural sciences, including zoology, botany, mineralogy, geology and paleontology. In 1873, he became the Dean of the Faculties of Philosophy, Letters, and Sciences, but in 1880, he retained only the post of Dean of Sciences. In his last years in the University, he taught Vertebrate Zoology and the Zoography of the Vertebrates.

While he was occupying his various positions at the University, he compiled, between the years 1851 and 1861, his *Memorias Sobre la Historia Natural de la Isla de Cuba* in two volumes with many illustrations (see Norman, 1938). His chief contributions to our knowledge of Cuban land shells appear in this work. Of the articles which are part of the *Memorias,* 16 dealt exclusively with mollusks, mainly the descriptions of new species. The degree of enthusiasm with which Poey pursued many of his multiple interests, and the literary skill he utilized, can be seen in

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[1] His very appointment as professor of zoology was, as Sánchez Roig (1955: 36) writes, an "excepción única," because his only degree was a Ph.D. in law.

his account of his trip to Rangel [he had arrived at the end of the arid season and the ground was still quite dry]: "Here I was, on the seventh day after my arrival, spending much time vainly trying to conjure the fleeting clouds to give up their moisture, when at 2 in the afternoon — it began to rain. Don't get excited, worthy reader, it was not one of your stupendous downpours. I repeat, it merely began to rain, but enough rain fell to lure the living mollusks out, to refresh them in their hiding places, to let them know of the presence of the malacozoologist Poey who had arrived to do them the honor of letting the whole world know of their existence so that later they could say with pride, 'So we are worth something after all.' "

Another example of Poey's persevering powers of observation and of the lively style in which parts of the *Memorias* are written is seen in his account of the behavior of *Megalomastoma* (=*Farcimen*), an example of the proverbial snail and its pace (Mem. 1: 401): "It is not an easy matter to observe these animals moving about, since they show such a tremendous amount of laziness and torpor when the time comes to be active. After newly collected living specimens are placed in a humid environment [on a table], and when one of them gets ready to take a walk, he begins by extending his foot very very slowly, taking long resting periods in between. When his head is finally free of the shell, as much as an entire hour can go by without any more movement. It sits there, tentacles drooping, as though dead. Finally there is a slow movement, the heavy shell falls to one side and then plunges to the floor, its weight dragging the owner along, 'owner' of course only in a literary sense since shell and animal are one."

Poey's greatest work is his *Ictiología Cubana.* The text, in French, was completed in 1877 and the Atlas in ten large folio volumes plus a supplement, in 1878. The atlas consists of 1040 plates with 1300 figures in color and natural size (except sharks) illustrating 758 species of Cuban fishes, all executed magnificently by Poey himself. (Though Poey showed himself to be a superb artist and draftsman in his illustrations of fishes, insects, and other creatures, the generally simple shape of some land shells offered little challenge to him and they are sometimes less successful than his other drawings.) The manuscript won prizes at the Amsterdam Fair in 1883 and gained the author two coveted foreign titles of honor.[1] Although the British Museum and the Smithsonian Institution both bid high prices for the work, Poey preferred to sell it at a much lower price to the Spanish government, and it remains largely unpublished in the library of the Museum of Natural History in Madrid to this day. In the 1930's, the government of President Machado in Havana set aside $10,000 to arrange for its publication, and although two prominent naturalists, Dr. Carlos de la Torre and Felipe García Cañizares, worked to prepare it for publication, this was prevented, as Alvarez (1958: 232) writes, by "crisis económicas sucesivas." In 1955, under the editorship of Mario Sánchez Roig and Federico Gómez de la Maza, a first volume in Spanish of 372 pages appeared in Havana, containing an introduction and part of the text. Apparently this work was not continued and the superb illustrations have never appeared in print as of this date. Further efforts are planned to print Poey's *Ictiología* (Duarte Bello, 1962).

Another important work connected with Poey was the *Repertorio Físico Natural de la Isla de Cuba* (see Norman, 1938), a compilation of articles on various fields of natural history which he conducted from 1865 to 1868. Here contributions by most of the well-known Cuban scientists appeared, among them Juan Gundlach, F. Sauvalle, Manuel J. Presas, Nicolás José Gutiérrez, Rafael Arango, Fernández de Castro and many others. In the *Repertorio* Poey published his anthropological article on the deliberately deformed cranium of a Caribe Indian. This study displayed his interest in anthropology and on October 7, 1877, Poey helped found the Sociedad Antropología de Cuba.

Poey was instrumental in founding other Cuban societies of learning. On April 8, 1861 he was one of the founders

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[1] King William III conferred on him the decoration of the order of the "Lion Néerlandais" and the King of Spain distinguished him with the title "Encomendador de la Order de Isabel la Católica."

of the Real Academia de Ciencias Médicas, Físicas, y Naturales de La Habana. In one of the sessions of this group Poey described the jaw of an unknown fossil animal and indicated that it showed that Cuba at one time had had closer faunistic connections with the continent.

Poey's portraits show him, at maturity as well as in old age, to have been a handsome, broad-browed man with a serious dignified face. David Starr Jordan (1922, vol. 1: 285), who met him in 1884, seven years before his death, described him as follows: "A man of large stature, with fair hair and gray eyes, by no means typically Spanish in appearance, he contrasted strongly with his fellow Cubans, and he used to say: 'Comme naturaliste je ne suis pas espagnol — je suis cosmopolite'. He had a most happy temperament with a manner peculiarly cheery and genial. Simple, direct, unaffected, he was to me one of the most charming of my scientific colleagues" (1922: vol. 1: 285).

This picture fits in well with Wright's earlier description of Poey as a "jolly old soul". There were other no less endearing qualities in his character. Montané (1918) mentions his absent-mindedness; he was always forgetting his brief-case, his watch, or his money. "He enjoyed himself like any youngster; he was captivated by women but, like the fabulous salamander, he could walk through the fire without being burned."

Poey died in Havana on January 28, 1891 while he was still active in his work at the University (Chardon 1947). On June 5, 1907 his remains were exhumed from the Colón cemetery and reburied in the vestibule of the building of the Faculty of Sciences which was named in his honor. On January 15, 1909, an impressive mausoleum was raised there with a long Latin inscription and a marble bust of the scholar. On May 26, 1913, the Sociedad Cubana de Historia Natural "Felipe Poey" was organized, and in its well printed *Memorias* many of the most significant studies of Cuban natural history appeared. The society was apparently abolished by the Castro Government in 1960 and its place was taken by the Academy of Sciences. One of the series of publications of the Academy is named *Poeyana* in honor of the famous man.

Among the foreign titles which Poey enjoyed were the following: a co-founder of the Entomological Society of France, corresponding member of the Royal Zoological Society of London, The Smithsonian Institution of Washington, the Academy of Natural Sciences and the Entomological Society in Philadelphia, the Lyceum of Natural History of New York, and the Essex Institute in New England. He was an honorary member of other groups like the Natural History Society of Berlin and Natural History Society of Buffalo.

In an effulgent fashion, the Cuban writers (Dihigo, 1915; Jaume, 1955; Mestre, 1891; Montané, 1918; Torre, 1942) shower reams of almost hysterical praise upon Poey. At times the reader has to struggle through many pages of dithyrambic prose before he can garner a single sober fact. Nevertheless, it must be admitted that this talented and industrious man added much to the intellectual life of his country. He contributed significantly to the knowledge of Cuba's bewilderingly rich fauna and he deserves to be better known.

NOTE TO THE CATALOGUE

Poey frequently included taxa ostensibly introduced by other authors into articles authored by himself. In such cases, he adopted one of two different procedures: he either added the abbreviation "mss." plus the author's name to the taxon or he printed the author's name alone. It is easy to assume that when Poey used "mss." he used the manuscript name alone and that the description itself was written by Poey. Such a taxon should be credited to him. On the other hand, when he used the author's name without "mss." it may be assumed that he merely copied the description of that author and that thus the name should be credited to the author. We have no way of knowing whether Poey really had this in mind, or, if he did, whether he consistently followed this practice.

Unfortunately these two assumptions are not always valid. In some cases, e.g. *Cyclostoma deficiens* Gundlach 1858, Poey added "mss." to the taxon in the *Memorias*. But Gundlach actually had introduced the taxon together with a complete description (which Poey later copied) in an article authored by himself in 1857 (Malak. Blätt. 4: 42). In this case we can only assume that Gundlach sent Poey a description in the manuscript which he (Gundlach) later had published without informing Poey of this fact. This shows that Poey's use of "mss." was not always consistent with our two earlier assumptions.

In spite of this we have assigned all names with the rubric "mss." to Poey unless we found that, as in the case immediately above, the name and the description belong to another author, in which case we have made suitable adjustments. In the other instances where "mss." was omitted, we have, for the sake of completeness, included such names, adding the rubric "[in] Poey" unless the name has been previously published. We have checked both subsequent references for all species as well as the extensively documented summary of the Cuban molluscan fauna by Arango (1878-1880).

For the dates of the pages and plates of the *Memorias* and *Repertorio,* in which Poey described nearly all his species of mollusks, we have relied on Norman (1938).

Dr. R. D. Turner, Dr. I. F. Canet and Mr. R. I. Johnson reviewed the manuscript and made many useful suggestions.

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CATALOGUE OF MALACOLOGICAL TAXA INTRODUCED BY POEY AND THEIR LATEST REPLACEMENT

abdita Poey, **Subulina** 1858. Mem. **2**: 29, pl. 2, figs. 15-16 (Almendares, prope Habanam); *Leptinaria striosa* var. *abdita* (Poey), *teste* Pilsbry 1906: 297.

acuminata (Velasquez MS) Poey, **Helicina** 1851 (pl. 5). Mem. **1**: 112, 119, pl. 5, figs. 13-14 (San Diego [de los Baños, Pinar del Río]); *Ustronia acuminata* (Poey), *teste* Clench & Jacobson 1971b: 415, type-locality there restricted, Viñales, Pinar del Río.

adamsiana Poey, **Cylindrella** 1854. Mem. **1**: 448 (Cuba), *non* Pfeiffer 1851. renamed *gundlachiana* (*q.v.*); *Brachypodella* (*Gyraxis*) *gundlachiana* (Poey), *teste* Pilsbry 1904: 60, pl. 62, figs. 24, 25; pl. 64, fig. 8.

albida (Gundlach MS) Poey, **Succinea tenuis** 1858. Mem. 2: 88 (in montis Trinitariis [Las Villas]); ? synonym of *tenuis* Poey.

apertum Poey, **Megalomastoma** 1851 (pl. 7). Mem. 1: 393, 405, pl. 7 (as *Cyclostoma*), figs. 15-16 (en la costa del Sud); synonym of *Farcimen* (*F.*) *tortum* (Wood 1828), *teste* Torre *et al.* 1942: 26.

arangiana Poey, **Helix** 1854. Mem. 1: 410, pl. 25, figs. 1-4 (as *H. sagemon* var. B); figs. 9-11; pl. 11, figs. 17-20 (Manzanillo [Oriente]); synonym of *Helix* (*Caracolus*) *marginella* Gmelin 1789, *teste* Pilsbry 1889: 123, 1894: 93 as *Pleurodonte* (*Caracolus*). Note: Arango (1879: 74) synonymized *arangiana* with *Helix* (*Caracolus*) *sagemon* (Beck).

ascendens Poey, **Stenogyra** 1854. Mem. 1: 422 (no locality); synonym of *Opeas goodalli* (Miller 1822), *teste* Pilsbry 1906: 201, 203.

baracoensis (Gutierrez MS) Poey, **Helix** 1858. Mem. 2: 26 (Baracoa [Oriente]); see Pilsbry 1889: 67, pl. 2, figs. 13-15; 1894: 97 (as *Pleurodonte* (*Zachrysia*); *Zachrysia* (*Chrysias*) *baracoensis* (Poey), *teste* Pilsbry 1929: 586.

bastidana Poey, **Helicina** 1854. Mem. 1: 415, pl. 33, figs. 11-12 (Puerto Príncipe) [Camagüey]; synonym of *Emoda bayamensis* (Poey), *teste* Clench & Jacobson 1971a: 113.

bayamensis Poey, **Helicina** 1854. Mem. 1: 416, pl. 33, figs. 8-11 [7-10] (Bayamo [Oriente]; lectotype MCZ 73855, selected by Clench & Jacobson 1971a: 113, pl. 2, fig. 4); *Emoda bayamensis* (Poey), *teste* Clench & Jacobson 1971a: 113.

beathiana Poey, **Pineria** 1854. Mem. 1: 430, pl. 34, figs. 17-18 (Sierra de Caballos, Isla de Pinos); *Pineria beathiana* Poey, *teste* Arango 1879: 87.

bellula Poey, **Helix** 1858. Mem. 2: 7, *nomen nudum;* synonym of *Hemitrochus lucipeta* (Poey 1854), *teste* Pilsbry 1889: 32.

blainiana Poey, **Achatina** 1852 (pl. 12). Mem. **1**: 206, 212, pl. 12, figs. 4-6 (en la loma de Rangel [Pinar del Río]); *Liguus blainianus* (Poey), *teste* Pilsbry 1899: 174–5.

briarea Poey, **Helicina** 1852 (pl. 11). Mem. **1**: 108, 119, pl. 11, figs. 9-12 (San Diego de los Baños [Pinar del Río] (*sic*); lectotype MCZ 73854, Clench & Jacobson, 1971a: 116; type-locality, Trinidad mountains, Las Villas); *Emoda briarea* (Poey). Note: The original type-locality was in error; the species is found only in Las Villas Province (Clench & Jacobson, 1971a: 116-7).

callosa Poey, **Helicina** 1854. Mem. **1**: 430, pl. 33, figs. 13-14 (en la Isla de Pinos); *Troschelviana* (*Microviana*) *callosa* (Poey), *teste* Clench & Jacobson 1971b: 441.

chrysochasma Poey, **Helicina** 1853 (pl. 25). Mem. **1**: pl. 25, figs. 17-19 [figure only]; 1858. **2**: 26 [description]; (Rangel [Pinar del Río]); *Troschelviana* (*Troschelviana*) *chrysochasma* (Poey), *teste* Clench & Jacobson 1971b: 419.

ciliata Poey, **Helicina** 1852 (pl. 11). Mem. **1**: 109, 119, pl. 11, figs. 5-8 (Trinidad [Las Villas]); *Emoda ciliata* (Poey), *teste* Clench & Jacobson 1971a: 110.

claudicans Poey, **Cyclostoma** 1851 (pl. 7). Mem. **1**: 100, 106, 444-446, pl. 7, figs. 8-11 (in insula Pinorum); *Chondrothyrella* (*Plicathyrella*) *claudicans claudicans* (Poey), *teste* Torre & Bartsch 1938: 311.

coerulans Poey, **Cylindrella** 1858. Mem. **2**: 9, 37, pl. 1, fig. 14 (Guane, de rupibus elevatis pendens [Pinar del Río]); *Gongylostoma* (*Poecilocoptis*) *coerulans* (Poey), *teste* Pilsbry 1903: 253; 1941: 70.

collare (Poey MS) Torre, Bartsch & Morrison, **Farcimen seminudum** 1942: 18, pl. 4, figs. 7-9, La Cantarilla, San Juan de las Yeras, Santa Clara Province [Las Villas]; USNM 535909.

comes Poey, **Helix** 1858. Mem. **2**: 29 (Insula Pinorum); *Cepolis* (*Cysticopsis*) *comes* (Poey), *teste* Pilsbry 1894: 187.

confertum Poey, **Cyclostoma** 1851 (pl. 8). Mem. **1**: 99, 106, pl. 8, figs. 1-3 (no locality); synonym of *Chondropoma*

(*Chondropomorus*) *canescens* (Pfeiffer 1851), *teste* Torre & Bartsch 1938: 367.

contractus Poey, **Bulimus** 1853. Mem. 1: 205, 212, pl. 26, figs. 19-21 (San Diego de los Baños [Pinar del Río]); synonym of *Opeas micra* (Orbigny 1835), *teste* Pilsbry 1906: 193-5.

coronadoi (Arango MS) Poey, **Cyclostoma** 1867. Rep. 2: 174 (Jaruco, en las isla Cuba); *Annularia* (*Annularops*) *coronadoi coronadoi* ([Arango] Poey), *teste* Torre & Bartsch 1941: 296.

coronatum (Poey MS) [*in*] Pfeiffer, **Ctenopoma** 1856. Malak. Blätt. 3: 59 (Cuba); [*in*] Pfeiffer 1856, Nov. Conch. 1: 96, pl. 26, figs. 17-19; 1858 (as *Cyclostoma*), Mem. 2: 24, pl. 1, figs. 11-12 (Managua, in terris Cl. Franc. Calderon; super rupes sylvarum umbrosas [Habana]); *Rhytidopoma coronatum* (Poey [*in*] Pfeiffer), *teste* Torre & Bartsch 1941: 151.

decurrens Poey, **Cyclostoma** 1858. Mem. 2: 23 (no locality, subsequently given as Dubroc, immediately south of Punta Sabanilla, Matanzas, by Torre & Bartsch 1938: 352, pl. 31, fig. 11); *Chondropoma* (*Chondropoma*) *moestum decurrens* (Poey), *teste* Torre & Bartsch 1938: 352 .

denegatum Poey, **Cyclostoma** 1858. Mem. 2: 2, 23 (Matanzas, Cárdenas); synonym of *Rhytidopoma clathratum clathratum* (Gould 1842), *teste* Torre & Bartsch 1941: 161.

dilatata Poey, **Helicina** 1858. Mem. 2: 26 (Trinidad [Las Villas]); synonym of *Troschelviana* (*Microviana*) *petitiana* (Orbigny 1842), *teste* Clench & Jacobson 1971b: 434.

discors Poey, **Cylindrella** 1858. Mem. 2: 9, 38. (Sierra de Guane [Pinar del Río]); *Gongylostoma* (*Poecilocoptis*) *discors* (Poey), *teste* Pilsbry 1903: 250; 1941: 70.

dissimulans Poey, **Helicina** 1858. Mem. 2: 35, pl. 4, figs. 8-9 [8-10] (Guane, in montibus [Pinar del Río]); *Alcadia* (*Penisoltia*) *dissimulans* (Poey), *teste* Boss & Jacobson 1973: 334.

elliotti Poey, **Cylindrella** 1858. Mem. **2:** 9, 37, pl. 5, figs. 1-4 (Guane [Pinar del Río]), *Gongylostoma* (*Callonia*) *elliotti* (Poey), *teste* Pilsbry 1903: 200.

elongata (Poey MS) [*in*] Pfeiffer, **Truncatella** 1856. Monographia Auriculaceorum Viventium **1:** 193 (in provincia orientali insulae Cubae); Poey 1858, Mem. **2:** 25, pl. 2, figs. 23-24 (Holguín [Oriente]); *Geomelania* (*Merrilliana*) *elongata* (Pfeiffer), *teste* Clench & Turner 1948: 182.

exacuta Poey, **Helicina** 1851 (pl. 5). Mem. **1:** 114, 120, pl. 5, figs. 7-9 (en las lomas de Cayajabos [Pinar del Río]); synonym of *Troschelviana* (*Cubaviana*) *pyramidalis* (Sowerby 1842), *teste* Clench & Jacobson 1971b: 424.

fabreana (Poey MS) Pfeiffer, **Cylindrella** 1860. Malak. Blätt. 6 (for 1859): 96, footnote (Seborucal de San Antonio [Havana]); Poey, 1861. Mem. **2:** 405 (name only): *Gongylostoma* (*Esochara*) *fabreana* ('Poey' Pfeiffer), *teste* Pilsbry 1903: 190.

fossulata Poey, **Helicina** 1858. Mem. **2:** 25 (Trinidad [Las Villas]); *Emoda ciliata* (Poey), *teste* Clench & Jacobson 1971a: 110.

francisca Poey, **Limnaea** [*sic*] 1858. Mem. **2:** 9, 32 (Güines [Havana]); synonym of *Lymnaea columella* (Say), *teste* Hubendick 1951: 188.

fuscolabiata Poey, **Helix** 1858. Mem. **2:** 7, 29, new name for *H. subfusca* Poey (1853) (*q.v.*), *non* (Beck MS) Pfeiffer 1848; *Cepolis* (*Hemitrochus*) *fuscolabiata* (Poey), *teste* Pilsbry 1894: 184.

gigas Poey, **Stenogyra** 1854. Mem. **1:** 395 (name only); 1858. **2:** 8 (listed as a synonym of *S. maximus* (Poey), *nomen nudum*.

gonostoma (Gundlach MS) Poey, **Helicina** 1858. Mem. **2:** 87 (San Juan de Letran, prope Trinidad [Las Villas]); *Alcadia* (*Penisoltia*) *gonostoma* (Poey), *teste* Boss & Jacobson 1973: 336, pl. 5, figs. 1-3.

gouldianum Poey, **Cyclostoma** 1854. Mem. **1:** 419 (Matanzas), 1858. **2:** 43-44; *Chondropoma* (*Chondropoma*) *pictum gouldianum* (Poey), Torre & Bartsch 1938: 337.

gracilis Poey, **Helix** 1865. Rep. 1: 69 (San Juan de los Remedios y en el Bayamo); *Hojeda gracilis* (Poey) *teste* Aguayo & Jaume 1947: no. 29.

gracillima Poey, **Cylindrella** 1853. Mem. 1: 202, 211, pl. 12, figs. 1-3 (San José de las Lajas [Las Villas]); *Gongylostoma* (*Tetrentodon*) *gracillima* (Poey), *teste* Pilsbry 1903: 270.

guanensis Poey, **Helix** 1858. Mem. 2: 35, 91, pl. 4, figs. 11-14 (Guane [Pinar del Río]); *Zachrysia* (*Chrysias*) *guanensis* (Poey), *teste* Pilsbry 1929: 586.

guantanamensis Poey, **Helix** 1858. Mem. 2: 27, pl. 3, figs. 8-9 (Guantánamo [Oriente]); *Zachrysia* (*Auritesta*) *guantanamensis* (Poey), *teste* Pilsbry 1929: 586.

gundlachiana Poey, **Cylindrella** 1858. Mem. 2: 9, new name for *C. adamsiana* Poey 1854, *non* Pfeiffer 1851; *Brachypodella* (*Gyraxis*) *gundlachiana* (Poey), *teste* Pilsbry 1904: 60, pl. 62, figs. 24, 25; pl. 64, fig. 8.

gutierrezi Poey, **Helix** 1854. Mem. 1: 411, pl. 25, figs. 5-8, 12 (en Baracoa y en Santiago de Cuba); as var. of *Helix* (*Caracolus*) *marginella* Gmelin 1789, *teste* Pilsbry 1889: 123; 1894: 93 as *Pleurodonte* (*Caracolus*). Note: Arango (1879: 74) synonymized *gutierrezi* with *Helix* (*Caracolus*) *sagemon* (Beck).

helicoides (Gundlach MS) Poey, **Paludinella** 1865. Rep. 1: 70 (en el litoral de Cárdenas [Matanzas]), *Paludinella* (*Nanivitrea*) *helicoides* (Poey), Wenz (1938): 633.

hians Poey, **Helicina** 1851 (pl. 5). Mem. 1: 113, 120, pl. 5, figs. 1-3 (en las altas montañas de Trinidad [Las Villas]) *Troschelviana* (*Microviana*) *hians* (Poey), *teste* Clench & Jacobson 1971b: 431.

honestum Poey, **Cyclostoma** 1851 (pl. 7). Mem. 1: 103, 106, pl. 7, figs. 1-4 (en la loma de Almendares, á tres leguas de la Habana); *Rhytidopoma honestum honestum* (Poey), *teste* Torre & Bartsch 1941: 151.

illustre Poey, **Cyclostoma** 1858. Mem. 2: 33, 89 (in montibus Trinitariis [Las Villas]); synonym of *Troschelvindex candeana candeana* (Orbigny 1842) *teste* Torre & Bartsch 1941: 331.

incrustata Poey, **Helix** 1852 (pl. 12). Mem. **1**: 208, 212, pl. 12, figs. 11-16 (Puentes Grandes y . . . Santa Cruz de los Pinos [Havana]); *Thysanophora incrustata* (Poey), *teste* Pilsbry 1894: 57-58; Aguayo & Jaume 1947: no. 86

incultum Poey, **Cyclostoma** 1851 (pl. 8). Mem. **1**: 98, 106, pl. 8, figs. 4-5 (not 3) (en las montañas de Trinidad [Las Villas]); *Troschelvindex* (*T.*) *inculta* (Poey), *teste* Torre & Bartsch 1941: 331.

infanda (Shuttleworth MS) Poey, **Pupa** 1858. Mem. **2**: 29, 60 (no locality) (Punta Gorda hasta Punta de Guanos, en Matanzas [Arango 1879: 100]); *Cerion infanda* (Poey), *teste* Clench 1957: 149.

johannis Poey, **Polygyra** 1858. Mem. **2**: 6 (name only); **2**: 36 (as *Helix*), pl. 4, figs. 15-17 (Guane . . . la catalina prope Guane [Pinar del Río]); *non* Mortillet 1853, renamed *poeyi* by Aguayo & Jaume 1947: no. 5; *Polygyra* (*Daedalochila*) *poeyi*, *teste* Aguayo & Jaume 1947: no. 5.

jugulata Poey, **Helicina** 1858. Mem. **2**: 34, pl. 4, figs. 3-4 (Guane [Pinar del Río]; lectotype, MCZ 73780, selected by Clench & Jacobson 1971b: 422); *Troschelviana* (*T.*) *jugulata* (Poey), *teste* Clench & Jacobson 1971b: 422.

juliana Poey, **Helix** 1853. Mem. **1**: 208, 212, pl. 25, figs. 13-16 (Cabo Cruz, donde termina la Sierra-Maestra [Oriente]); synonym of *Cepolis* (*Coryda*) *dennisoni* (Pfeiffer, 1853), *teste* Pilsbry 1894: 181.

laetum (Gutierrez MS) Poey, **Cyclostoma** 1858. Mem. **2**: 33, pl. 4, fig. 1 (Jibara (Gibara) [Oriente]); *Chondropoma* (*Ch.*) *laetum* (Poey), *teste* Torre and Bartsch 1938: 359.

lembeyana Poey, **Helicina** 1854. Mem. **1**: 420, pl. 33, figs. 20-24 (no locality); *Helicina lembeyana* Poey, *teste* Arango 1879: 55 who added the locality, Punta de San Juan de los Perros.

lepida Poey, **Helix** 1853. Mem. **1**: 209, 212, pl. 26, figs. 6-10 (en la costa del Sud), *non* Reuss 1849; synonym of

Hemitrochus lucipeta (Poey 1854), *teste* Pilsbry 1889: 32.

lirata Poey, **Truncatella** 1858. Mem. 2: 25, 89 (Jibara [Gibara] prope Holguín [Oriente]; cotypes MCZ 181277 and 158267); *Geomelania* (*Merrilliana*) *lirata* (Poey), *teste* Clench & Turner 1948: 182.

lucida Poey, **Achatina** 1852 (pl. 12). Mem. 1: 207, 212, pl. 12, figs. 30-31 (en Matanzas, cerca del Río Canímar); synonym of *Opeas micra* (Orbigny 1835), *teste* Pilsbry 1906: 195.

lucipeta Poey, **Helix** 1854. Mem. 1: 447; 1858. 2: 51. New name for *picturata* Poey 1853, *non* C. B. Adams 1849; *Hemitrochus lucipeta* (Poey), *teste* Pilsbry 1889: 32.

luteoapicata Poey, **Helicina** 1854. Mem. 1: 394, 446. Invalid emendation of *H. luteopunctata* Poey 1851, synonym of *Troschelviana* (*Cubaviana*) *scopulorum* (Morelet 1849), *teste* Clench & Jacobson 1971b: 428.

luteopunctata Poey, **Helicina** 1851 (pl. 5). Mem. 1: 115, 120, pl. 5, figs. 10-12 (no locality), synonym of *Troschelviana* (*Cubaviana*) *scopulorum* (Morelet 1849), *teste* Clench & Jacobson 1971b: 428.

mactum Poey, **Cyclostoma** 1852. Mem. 1: 97, 393, 444; 1854. 2: 4 (no locality); *Annularia* (*Annularita*) *majuscula macta* (Poey) from Rangel, Pinar del Río, *teste* Torre & Bartsch 1941: 325.

macta Poey, **Succinea** 1858. Mem. 2: 61 (Cuzco, N. de la Paz y Morejón [Pinar del Río]); *Succinea macta* Poey, *teste* Aguayo & Jaume 1947: no. 84.

maculifera (Gutierrez MS) Poey, **Helix** 1858. Mem. 2: 28, pl. 2, figs. 1-5 (Santa Cruz . . . Puerto Príncipe [Camagüey]); *Cepolis* (*Hemitrochus*) *maculifera* (Poey), *teste* Pilsbry 1894: 185.

mani Poey, **Cyclostoma** 1851 (pl. 7). Mem. 1: 393, 404 (as *Megalomastoma*), pl. 7 (as *Cyclostoma*), figs. 19-22; pl. 13, figs. 23-24 (en la loma de Rangel, cerca de Santa Cruz [Pinar del Río]); *Farcimen* (*Farcimen*) *mani* (Poey), *teste* Torre *et al.* 1942: 30.

marielinus Poey, **Bulimus** 1852 (pl. 12). Mem. **1**: 204, pl. 12, figs. 32-33 (Banes [Oriente]); synonym of *Drymaeus dominicus* (Reeve 1850), *teste* Pilsbry 1899: 3.

maxima Poey, **Stenogyra** 1854. Mem. **1**: 422, pl. 34, figs. 9-11 (Cuba); *Obeliscus* (*Stenogyra*) *maximus* (Poey), *teste* Pilsbry 1906: 260.

mayarina Poey, **Helicina** 1854. Mem. **1**: 417, pl. 34, figs. 6-8 (Mayari [Oriente]), *Emoda mayarina mayarina* (Poey), *teste* Clench & Jacobson 1971a: 117.

modesta Poey, **Cylindrella** 1858. Mem. **2**: 9, 93 (Pan de Matanzas [Matanzas]); *Gongylostoma* (*Tetrentodon*) *camoensis* var. *modesta* (Poey), *teste* Pilsbry 1903: 275.

neglecta (Arango MS) Poey, **Vertigo** 1858. Mem. **2**: 30, pl. 2, figs. 17-18 (prope Cárdenas [Matanzas]); synonym of *Vertigo ovata* Say 1822, *teste* Aguayo & Jaume 1950: no. 662.

newcombiana Poey, **Helix** 1858. Mem. **2**: 7 (*nomen nudum*), 28 (in synonymy of *velasqueziana* Poey); synonym of *Hemitrochus lucipeta* (Poey 1854), *teste* Pilsbry 1889: 32.

nigrata Poey, **Melania** 1858. Mem. **2**: 33 (San Juan de los Remedios . . . quoque in montibus Trinitariis [Las Villas]); *Pachychilus nigratus* (Poey), *teste* Aguayo & Jaume 1947: no. 41.

nobilis Poey, **Succinea** 1853. Mem. **1**: 210, 213, pl. 26, figs. 25-26 (no locality); *Succinea nobilis* Poey, *teste* Aguayo & Jaume 1947: no. 85.

nobilitatum (Gundlach MS) Poey, **Cyclostoma** 1858. Mem. **2**: 87, pl. 8, figs. 23-25 (Enramada, Santiago de Cuba), *Tudora* (*Ramsdenia*) *nobilitata nobilitata* (Poey), *teste* Torre and Bartsch 1941: 259.

nodulatum Poey, **Cyclostoma** 1851 (pl. 5). Mem. **1**: 104, 106, pl. 5, figs. 21-23 (en la cueva de Cotilla [Matanzas]); *Rhytidopoma nodulatum nodulatum* (Poey), *teste* Torre & Bartsch 1941: 153.

notata Poey, **Helix** 1858. Mem. **2**: 94, 434 (1861), new name for *H. johannis* Poey 1858, *non* Mortillet 1853; *Poly-*

gyra (*Daedalochila*) *poeyi* Aguayo & Jaume 1947: no. 5.

nubila Poey, **Cylindrella** 1858. Mem. **2**: 38, pl. 1, fig. 25 (Paso Real Guane [Pinar del Río]); *Gongylostoma* (*Badiofaux*) *nubila* (Poey), *teste* Pilsbry 1903: 258; Pilsbry 1941: 70.

ochracea Poey, **Helicina** 1852. Mem. **1**: 112, 119, pl. 11, figs. 1-4 (Baracoa [Oriente]); synonym of *Emoda silacea* (Morelet 1849), *teste* Clench & Jacobson 1971a: 104.

ornata Poey, **Melania** 1854. Mem. **1**: 422, pl. 33, figs. 5-6 (Vuelta Abajo cerca de Santa Cruz [Pinar del Río]); *non* Michaud 1828, renamed *torrei* Aguayo 1935: 115; *Heminsinus cubanianus torrei, teste* Aguayo 1935: 115.

pallidus Poey, **Ancylus** 1858. Mem. **2**: 32, pl. 2, figs. 13-14 (Bejucal [Havana]); synonym of *Hebetancylus havanensis* (Pfeiffer 1839), *teste* Aguayo 1946: 60.

parallela Poey, **Helix** 1858. Mem. **2**: 88 (Guane [Pinar del Río]); *Jeanneretia* (*Jeanneretia*) *parraiana parallela* (Poey), *teste* Clench and Aguayo 1951: 85.

paucispira Poey, **Helix** 1858. Mem. **2**: 7, 13 (Guisa . . . Santiago de Cuba [Oriente]); *Austroselenites* (*Haplomena*) *paucispira* (Poey), *teste* Aguayo & Jaume 1947: no. 14.

pazensis Poey, **Helix** 1854. Mem. **1**: 410, pl. 83 [33], figs 2-3 (Oriente); synonym of *Helix* (*Caracolus*) *marginella* Gmelin 1789, var. *rostrata* Pfeiffer, *teste* Pilsbry 1889: 124; 1894: 93 as *Pleurodonte* (*Caracolus*). Note: Arango (1879: 74) synonymized *pazensis* with *Helix* (*Caracolus*) *sagemon* (Beck).

pelliculata 'Gundlach' Poey, **Helix** 1858. Mem. **2**: 7 (name only). *Cepolis* (*Cysticopsus*) *pemphigodes* (Pfeiffer, 1846), *teste* Pilsbry 1894: 187.

penicillata Poey, **Helix** 1858. Mem. **2**: 27, pl. 1, figs. 6-10 (Trinidad [Las Villas]), *non* Gould 1842; synonym of *Hemitrochus lucipeta* (Poey 1851), *teste* Pilsbry 1889: 32.

pennicillata Poey, **Helix** 1858. Mem. 2: 51, error for *penicillata* Poey.

pfeifferianum Poey, **Cyclostoma** 1854. Mem. 1: 419; 1858. 2: 44 (no locality); Guane, Pinar del Río (Arango 1879); *Chondropoma* (*Chondropoma*) *pfeifferianum pfeifferianum* (Poey), *teste* Torre and Bartsch 1938: 331.

picturata Poey, **Helix** 1853. Mem. 1: 209, 212, pl. 26, figs. 1-5 (de la costa del Sud) *non* C. B. Adams 1849; synonym of *Hemitrochus lucipeta* (Poey 1854), *teste* Pilsbry 1889: 32.

Pineria Poey 1854. Mem. 1: 428 (type-species, *Pineria beathiana* Poey 1854, subsequent designation Albers and von Martens 1861: 293 [Isle of Pines]).

plicata Poey, **Cylindrella** 1858. Mem. 2: 31, pl. 2, figs. 9-10 (no locality); Lomas de Candela, Guines, Habana; *Gongylostoma* (*Tetrentodon*) *plicata* (Poey), *teste* Pilsbry 1903: 277.

politula Poey, **Helicina** 1851 (pl. 5). Mem. 1: 113, 120, pl. 5, figs. 4-6 (la cordillera frente á Santa Cruz, en tiérras de D. Francisco Adolfo Sauville [Pinar del Río]); synonym of *Troschelviana* (*Cubaviana*) *pyramidalis* (Sowerby 1842), *teste* Clench & Jacobson, 1971b: 424.

procax Poey, **Cyclostoma** 1851 (pl. 7). Mem. 1: 104, 106, pl. 7, figs. 12-14 (Cuba), *Adamsiella* (*Cubadamsiella*) *procax* (Poey), *teste* Torre & Bartsch 1942: 243.

procer Poey, **Megalomastoma** 1854. Mem. 1: 393, 404, pl. 13, figs. 12-18 (as *Cyclostoma tortum* var.) *Farcimen* (*Farcimen*) *procer* (Poey), *teste* Torre *et al.* 1942: 38.

rangelinum Poey, **Cyclostoma** 1851 (pl. 8). Mem. 1: 98, 106, pl. 8, figs. 13-19 (Sierra de Rangel [Pinar del Río]); *Tudorina rangelina* (Poey), *teste* Torre & Bartsch 1941: 280.

redfieldiana (Poey MS) [*in*] Arango, **Helix** 1879: 74, *nomen nudum.*

remota Poey, **Helicina** 1858. Mem. 2: 87, pl. 8, fig. 26 (Guane, Montem Cubae occidentalem [Pinar del Río]); synonym of *Ustronia acuminata* (Poey), *teste* Clench & Jacobson 1971b: 415.

retracta Poey, **Helicina** 1852. Mem. 1: 116, 120, pl. 12, figs. 22-26 (Cayajabos [Pinar del Río]); synonym of *Alcadia* (*Idesa*) *rotunda* (Orbigny 1842), *teste* Boss & Jacobson 1973: 323.

revictum Poey, **Cyclostoma** 1854. Mem. 1: 393, error for *revinctum* Poey.

revinctum Poey, **Cyclostoma** 1851 (pl. 5). Mem. 1: 99, 106, pl. 5, figs. 24-27 (en la punta de San Juan de los Perros [Las Villas]); *Chondropoma* (*Chondropomorus*) *revinctum revinctum* (Poey), *teste* Torre & Bartsch 1938: 364.

rotundatum Poey, **Cyclostoma** 1854. Mem. 1: 419, pl. 34, figs. 19-21 (entre Santa Cruz y Bahía Honda [Pinar del Río]); *Tudora* (*Eutudorex*) *rotundata* (Poey), *teste* Torre and Bartsch 1941: 252.

rubrocincta Poey, **Helicina** 1854. Mem. 1: 417, pl. 33, figs. 16-19 (probablemente en el departamento oriental); synonym of *Emoda pulcherrima* (Lea 1834), *teste* Clench & Jacobson 1971a: 107.

rufo-apicata Poey, **Helix** 1858. Mem. 2: 29 (Jibara [Gibara, Oriente]); *Cepolis* (*Hemitrochus*) *rufoapicata* (Poey), *teste* Pilsbry 1894: 185.

sagebieni Poey, **Cyclostoma** 1858. Mem. 2: 33 (Guane [Pinar del Río]); *Chondropometes* (*Chondrothyroma*) *sagebieni sagebieni* (Poey), *teste* Torre & Bartsch 1938: 217.

saxosa Poey, **Cylindrella** 1858. Mem. 2: 31, 61, pl. 3, figs. 10-11 (Mons Rangelinus [Pinar del Río]); *Gongylostoma* (*Liocallonia*) *saxosa* (Poey), *teste* Pilsbry 1903: 206.

scabrosa Poey, **Helix** 1854. Mem.1: 421, pl. 34, figs. 1-5; 1858. Mem. 2: 57, 67, pl. 6, fig. 13 (Trinidad [Las Villas]); *Zachrysia* (*Chrysias*) *scabrosa* (Poey), *teste* Pilsbry 1929: 586.

sculpta Poey, **Pulpa** [*sic*] 1858. Mem. 2: 30, pl. 2, fig. 22 (Cubana); northern coast of Pinar del Río; *Cerion sculpta* (Poey), *teste* Clench 1957: 163.

seminudum Poey, **Megalomastoma** 1854. Mem. 1: 393, 405 (en Trinidad [Las Villas]); *Farcimen* (*Farcimen*) *seminudum* (Poey), *teste* Torre *et al.* 1942: 17 ff. (pl. 4, figs. 22-24 illustrates the nominate subspecies).

sepulcralis Poey, **Bulimus** 1852 (pl. 12). Mem. 1: 203, 211, pl. 12, figs. 27-29 (Habana); *Bulimulus* (*Bulimulus*) *sepulcralis* (Poey), *teste* Aguayo & Jaume 1948: no. 427.

shuttleworthiana Poey, **Cylindrella** 1858. Mem. 2: 31, pl. 1, fig. 24 (Almirante . . . prope Managua [Havana]); *Gongylostoma* (*Pycnoptychia*) *shuttleworthiana* (Poey), *teste* Pilsbry 1903: 196.

solenatum Poey, **Cyclostoma** 1851. Mem. 1: pl. 7, figs. 17-18; 1861. Mem. 2: 435; synonym of *Farcimen* (*Farcimen*) *auriculatum auriculatum* (Orbigny), *teste* Torre *et al.* 1942: 25.

stellata (Velasquez MS) Poey, **Helicina** 1851 (pl. 5). Mem. 1: 117, 120, pl. 5, figs. 18-20 (en la Isla de Pinos, sobre la Sierra de Casas (*sic*), falda del sud); *Priotrochatella stellata* (Poey), *teste* Clench & Jacobson 1970: 70. Note: The actual habitat is the neighboring Sierra de Caballos (Clench & Jacobson, *ibid*).

strangulata Poey, **Cylindrella** 1858. Mem. 2: 31, pl. 1, figs. 20-22 (Güines, Loma de Candela [Havana]); *Gongylostoma* (*Esochara*) *strangulata* (Poey), *teste* Pilsbry 1903: 189.

strictus Poey, **Bulimus** 1853. Mem. 1: 205, 212, pl. 26, figs. 16-18 (no locality) (Manzanilla, Bayamo, Cabo Cruz . . . Isla de Pinos [Arango 1879: 91]); *Obeliscus* (*Stenogyra*) *strictus* (Poey), *teste* Aguayo & Jaume 1950: no. 10.

subdepressa Poey, **Helicina** 1854. Mem. 1: 420, pl. 34, figs. 22-26 (Cojimar [Havana]); *Helicina subglobulosa subdepressa* Poey, *teste* Wagner 1907-1911: 332.

subfusca Poey, **Helix** 1853. Mem. 1: 210, 213, pl. 26, figs. 11-15 (en la costa del Sud), *non* (Beck MS) Pfeiffer 1848, renamed *fuscolabiata* (*q.v.*); *Cepolis* (*Hemitrochus*) *fuscolabiata* (Poey), *teste* Pilsbry 1894: 184.

subglobulosa Poey, **Helicina** 1852. Mem. 1: 115, 120, pl. 12, figs. 17-21 (Trinidad [Las Villas]); *Helicina subglobulosa* Poey, *teste* Freire & Alayo 1946: 66.

subita Poey, **Cylindrella** 1858. Mem. 2: 32, pl. 3, figs. 12-13 (no locality); synonym of *Gongylostoma* (*Gongylostoma*) *planospira* (Pfeiffer 1855), *teste* Pilsbry 1903: 224.

subunguiculata Poey, **Helicina** 1858. Mem. 2: 34 (Sierra de Guane [Pinar del Río]; lectotype, MCZ 73672, selected by Clench & Jacobson 1968: 14, pl. 4, fig. 4); *Viana regina subunguiculata* (Poey), *teste* Clench & Jacobson 1968: 14.

tenuis (Gundlach MS) Poey, **Succinea** 1858. Mem. 2: 88, pl. 8, figs. 21-22 (in montis Trinitariis [Las Villas]); *Succinea tenuis* Poey, *teste* Freire & Alayo 1946: 66.

terebra Poey, **Pineria** 1854. Mem. 1: 429, pl. 34, figs. 12-16 (Sierra de Casas, Isla de Pinos); *Pineria terebra* Poey, *teste* Arango 1879: 86; Aguayo & Jaume 1947: no. 284.

titanica Poey, **Helicina** 1852. Mem. 1: 110, 119, pl. 11, figs. 13-16 (Las Costas de Baracoa [Oriente]); *Emoda pulcherrima titanica* (Poey), *teste* Clench & Jacobson 1971a: 108.

torquatum (Gutierrez MS) Poey, **Cyclostoma** 1858. Mem. 2: 34, pl. 4, fig. 2 (Cienfuegos [Las Villas]); *Tudora* (*Eutudorops*) *torquata* (Poey), *teste* Torre & Bartsch 1941: 249.

tractum (Gundlach MS) Poey, **Cyclostoma** 1858. Mem. 2: 4 *nomen nudum;* 1858. (Gundlach MS) Pfeiffer, Malak. Blätt. 5: 45 (Guisa, Oriente); *Annularia* (*Troschelvindex*) *tracta* ([Gundlach MS] Poey), *teste* Torre & Bartsch 1941: 327. Note: *tractum* must be attributed to Pfeiffer.

trinitaria (Gundlach MS) Poey, **Achatina** 1858. Mem. 2: 36, pl. 2, fig. 11 [pl. 8, fig. 27] (in montibus Trinitariis [Las Villas]); *Varicella trinitaria* (Poey), *teste* Pilsbry 1907-8: 113.

ungula Poey, **Megalomastoma** 1858. Mem. 2: 24, pl. 3, figs. 1-4 (Santiago de Cuba), *Farcimen* (*Farcimen*) *ungula ungula* (Poey), *teste* Torre *et al.* 1942: 9.

velasqueziana Poey, **Helix** 1858. Mem. 2: 28, pl. 1, figs. 1-5 (Santiago de Cuba); *Hemitrochus lucipeta* var. *velasqueziana* (Poey), *teste* Pilsbry 1889: 32.

velutina Poey, **Helicina** 1858. Mem. 2: 35, pl. 4, figs. 6-7 [5-7] (Guane [Pinar del Río]); *Alcadia* (*Penisoltia*) *velutina* (Poey), *teste* Boss & Jacobson 1973: 337.

venusta Poey, **Pupa** 1858. Mem. 2: 30 (Cuba); *Cerion venusta* (Poey), *teste* Clench 1957: 167.

verecundum Poey, **Cyclostoma** 1851 (pl. 7). Mem. 1: 102, 106, pl. 7, figs. 5-7 (San Diego de los Baños [Pinar del Río]); synonym of *Chondrothyretes shuttleworthi* (Pfeiffer 1851), *teste* Torre & Bartsch 1938: 273.

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Occasional Papers On Mollusks

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

VOLUME 4 1 OCTOBER 1975 NUMBER 54

R. ELLSWORTH CALL WITH A BIBLIOGRAPHY OF HIS WORKS ON MOLLUSKS AND A CATALOGUE OF HIS TAXA

By RICHARD I. JOHNSON

Richard Ellsworth Call was a leading student of the fresh water molluscan fauna of the western United States during the last third of the nineteenth century. His collection of land and freshwater shells of North America is especially rich in Unionidae, most of which were collected by himself in the southern and western parts of the United States. As he said in 1898 in a letter to Alexander Agassiz offering the collection to the Museum of Comparative Zoology, "The collection numbers some 20,000 specimens. It is very rich in geographical series and in series selected for variation. The collection has cost me between four and five thousand dollars in cash. I do not place any value on it. The collection is valuable and ought to be in some place where it will be used. It is now well packed and easily cared for by any competent curator. Every shell is numbered and catalogued. The exact localities are invariably present on the labels or in the catalogue accompanying. Some groups, like Viviparidae, are complete. The Corbiculidae are nearly so and the exchange power of the collection is very considerable from the fact that many species are represented by fifteen to thirty specimens. The Unionidae are all numbered in ink on the interior of the shell. It is very fine indeed, larger far than the collection which went to the U. S. National Museum as the Lea collection. It contains many shells named by Lea, who was for many years a correspondent, some of Say's types, and all of the forms which I myself described as new."

Fortunately, Agassiz accepted the collection for which Call wanted only a complete set of the Museum's publications to date. While he would accept any monies that the authorities might care to send him from $50.00 up, this was not required, since his chief interest was that the collection be placed where it would be studied and be of use to others.

Walter Faxon, Assistant in charge of Crustacea and Mollusks, duely acknowledged receipt of the collection as a gift in the Annual Report of the Museum for 1897–98 (p. 31) noting that the collection amounted to some 40,000 [*sic*] specimens.

R. Ellsworth Call, as he preferred to be known, was born in Brooklyn, New York on May 13, 1856. He wrote his first paper on mollusks in 1878, when he was 22, and continued to contribute to the literature until 1902. He received an A.B. from Indiana University, Bloomington in 1890, and an A.M. in 1891, and somehow managed to also earn an M.S. from Iowa State College in 1890 as well. In 1893 he became an M.D. graduating from the Hospital of the College of Medicine, University of Louisville, Kentucky. Finally Call became a Ph.D. from Ohio University, Athens, the oldest university in the Northwest Territory, in 1895.

At the age of 28 Call was an aid with the U. S. Geological survey, and during 1884–85 explored Utah and Nevada for mollusks, as well as carrying out his geological responsibilities. He remained in the West for many years. From 1885–86 he was principal of the high school in Moline, Illinois, then between 1887–88 he was an assistant professor of zoology at the University of Missouri, Columbia. During 1889–92 he taught science at the West Des Moines, [Iowa], high school. In 1892 he moved to Louisville, Kentucky, where he remained until 1895, teaching chemistry and physics at the Manual Training High School. From 1895–98 Call was superintendent of schools at Lawrenceburg, Indiana. It was at the end of this appointment that Call offered his collection to Agassiz. Afterward, he returned to Brooklyn, where he taught at Erasmus Hall, then the city's most prestigious high school, from 1898–99.

R. Ellsworth Call

1856–1917

From an original photograph in the A. F. Gray collection of portraits in the Mollusk Department in the Museum of Comparative Zoology, taken between 1895–1898 while Call was a resident of Lawrenceburg, Indiana. There is also a photograph in the collection of Call at the age of 22, taken in Mohawk, New York, as well as one made in Des Moines, Iowa, presumably between 1888-1892.

Plate 15

During 1899 he became curator of the Children's Museum of the Brooklyn Institute of Arts and Sciences. He left this post to become an instructor in biology and physiology at DeWitt Clinton High School, New York City in 1905. He died in 1917.

In reviewing Call's career, one is bound to speculate as to why he occupied so many positions in so many places; perhaps he was a wanderer by nature, peradventure he had an irascible nature. I prefer to think that he was more interested in pursuing his studies in mollusks than in promoting his academic career.

In 1884, Call was appointed by Francis W. Craigin of Washburn College, Topeka, Kansas, to conduct a survey of the fresh water mollusks of the state. The resulting publication, based largely on his own collecting, was the first one dealing with the geographical distribution of this fauna in Kansas.

During the summer of 1888 Call volunteered his services to the Geological survey of Arkansas. The result was an impressive geological tome (1891), and a study of the Unionidae of the state (1895). Until Call's latter paper appeared, almost nothing was known about the geographic distribution of the Unionidae of Arkansas. While a resident of Louisville, Kentucky, Call wrote an excellent biography of C. S. Rafinesque (1895) which includes the first bibliography of this prolific naturalist. Later (1899) he reprinted Rafinesque's early work on the fishes of the Ohio River. Call also collaborated with H. C. Hovey (1897) to produce an illustrated guide to Mammoth Cave, Kentucky. Call's most important work was his Descriptive Illustrated Catalogue of the Mollusca of Indiana (1901).

Call had a very modern view of the synonymy of the North American Unionidae both as to the number of valid species, and to the problems of priority caused by the adoption of the often earlier, sometimes ill defined descriptions of Lamarck and Rafinesque.

Concerning the number of species, he wrote to A. J. Jukes Browne in 1900: "I do not think that there are more than 250 good species of *Unio in* North America, though as you know, more than 900 have been described." This is much closer to the number now recognized than anyone until recently cared to admit.

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ACKNOWLEDGMENTS

Thanks are due to Dr. Kenneth Jay Boss and Mr. M. K. Jacobson for reading the manuscript and making several helpful suggestions. Dr. Joseph H. Peck, kindly checked the collection in the Department of Paleontology at the University of California, Berkeley, for a type which Call deposited there. Dr. C. H. W. Hirs of the Division of Biological Sciences, Indiana University, Bloomington, informed me that the Call collection which had been at that University was subsequently transferred to the Museum of Zoology, University of Michigan, Ann Arbor, where Drs. John B. Burch, Henry van der Schalie and Charlotte M. Patterson made the collection available to me.

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1890. The *parvus* group of Unionidae (Abstract). Proc. [Des Moines] Iowa Acad. Sci. for 1887–9, **1**: 45–51.

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1894. A contribution to the knowledge of Indiana Mollusca. Proc. [Indianapolis] Indiana Acad. Sci. for 1893, 3: 140–156.

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1897. Some notes on the flora and fauna of Mammoth Cave, Kentucky. American Naturalist 31 [Mollusks]: 387–388, pl. 10, figs. 6–7.

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1902. The European pond-snail. Science, (n.s.) 16: 65.

Complete sets of the above papers are to be found in the Library of the Department of Mollusks as well as in the library of the Museum of Comparative Zoology, and that of the author.

Molluscan taxa introduced by R. Ellsworth Call with their original references, type localities, and the location of the extant types.

For convenience of reference, the following list is arranged alphabetically by species. All locality data in brackets were found in original labels or are additions from recent maps.

ABBREVIATIONS

ANSP — Academy of Natural Sciences of Philadelphia, Pennsylvania.

MCZ — Museum of Comparative Zoology, Cambridge, Massachusetts.

aldrichi Call and Beecher, *Bythinella:* 1886, Bull. Washburn College Lab. Nat. Hist. **1:** 190, pl. 7, figs. 11–14 (small spring and brooklet, tributary to the Black River, in the Ozark Mountains, Reynolds Co., Missouri). Figured syntypes MCZ 2057 [not located].

bollii, Unio: 1881, Amer. Nat. **15:** 390 (Colorado River, [Austin, Travis Co.], Texas). Lectotype MCZ 5017 selected by Johnson, 1956, Bull. Mus. Comp. Zool. **115:** 108, pl. 1, fig. 2.

bonnevillensis, Limnophysa: 1884, Bull. U. S. Geol. Survey, no. **11:** 18 (372), 48 (402), pl. 6, figs. 10–13 (Upper Bonneville Lake beds, Kelton, [Boxelder Co.], Utah; Quaternary). Figured syntypes MCZ 4154 [not located].

breviculus, Unio: 1887, Proc. U. S. Natl. Mus. **10:** 499, pl. 28 (Currant River, Shannon Co., Missouri, and in Jacks Fork and Big Creek, tributaries to it). Lectotype here selected, MCZ 5020, male specimen portrayed in figs. 1, 1a, 1b from Jacks Fork [Shannon Co.]; figured allotype MCZ 5023 portrayed in figs. 2, 2a, 2b, from Big Creek [Fork, Texas Co.].

cragini, Triodopsis: 1886, Bull. Washburn College Lab. Nat. Hist. **1**: 202, fig. 5 (Banks of Chetopa Creek, Neosho Co., Kansas). Figured holotype MCZ 3123; paratypes MCZ 3124.

dalli, Amnicola: 1884, Bull. U. S. Geol. Survey, no. **11**: 21 (375), 45 (399), pl. 6, figs. 4–6 (Foot of Pyramid Lake, Semons stage station [not located, Washoe Co.], Nevada). Figured holotype MCZ 2087; paratypes MCZ 2088.

floridense, Campeloma: 1886, Bull. Washburn College Lab. Nat. Hist. **1**: 159, pl. 6, fig. 7 (Florida). [ms. name in the synonymy of *C. limum* Anthony]. Lectotype MCZ 189529, Wekiva River, Orange Co., Florida, selected by Clench and Turner, 1956, Bull. Florida State Mus. [Gainesville] **1**: 117, pl. 1, fig. 9.

hamatoides, Mytilus: 1891, [in] Ann. Rept. Geol. Survey of Arkansas for 1889, **2**: 202, text fig. (Claiborne beds, Eocene Tertiary; Little Crow Creek, St. Francis County, Arkansas). [Location of the type not known.]

hockingensis 'Moores' Call, *Anodonta:* 1880, Amer. Nat. **14**: 530 [*nomen nudum*].

mississippiensis Call and Pilsbry, *Pyrgulopsis:* 1886, Proc. Davenport Acad. Nat. Sci. **5**: 13, pl. 2, figs. 14–16 (Mississippi River, near the mouth of Rock River, Rock Island Co., Illinois). Lectotype ANSP 61609a selected by Baker, 1964, Proc. Acad. Nat. Sci. Phila. **116**: 174 specimen portrayed in fig. 15; types also mentioned as in the Call colln. but not in the MCZ [lost].

ozarkensis, Goniobasis: 1886, Bull. Washburn College Lab. Nat. Hist. **1**: 189, pl. 7, figs. 1–10 (Blue Springs, Eminence, Shannon Co., Missouri). Lectotype, here selected, MCZ 175785, specimen portrayed in fig. 2; figured paralectotypes MCZ 1601.

ozarkensis, Unio: 1887, Proc. U. S. Natl. Mus. **10**: 498, pl. 27 (Currant River, Shannon Co., Missouri, and in Jacks Fork and Big Creek, tributaries to it). Lectotype, here selected, MCZ 5707, male specimen portrayed in figs. 1–3, original R. E. Call no. 5307; figured allotype MCZ 5705 portrayed in fig. 4 original R. E. Call no. 5306; *both* from Jacks Fork [Shannon Co.].

Pompholopsis, Subgenus. 1888, Amer. Geologist **1**: 148. Type species, *Pomoholyx whitei* Call, by monotypy.

popenoi, Unio: 1885, Bull. Washburn College Lab. Nat. Hist. **1**: 49, pl. 2 (Fall River, Wilson Co., Verdigris River; *both* Kansas). Figured holotype MCZ 4934 from Fall River. Is *Unio aberti* Conrad, *teste* Call, 1887, Amer. Nat. 21: 860.

Pyrgulopsis Call and Pilsbry, Genus: 1886, Proc. Davenport Acad. Nat. Sci. **5**: 9. Type species, *Pyrgula nevadensis* Stearns, original designation.

somersii 'Moores' Call, *Anodonta:* 1880, Amer. Nat. **14**: 529 [*nomen nudum*].

spinosus Call and Pilsbry, *Pyrgulopsis:* 1886, Proc. Davenport Acad. Nat. Sci. **5**: 14, pl. 2, figs. 17–19 (Comal Creek, New Braunfels [Comal Co.], Texas). Types mentioned as in collns. of Call and Pilsbry. [Not found in either the MCZ or ANSP.]

stearnsiana, Goniobasis: 1886, Proc. Davenport Acad. Nat. Sci. **5**: 1, fig. 3 (Dykes Creek, tributary to the Etowah River, Floyd Co., Georgia). Figured holotype MCZ 1660; paratype MCZ 1661.

stygium, Carychium: 1897, Amer. Nat. **31**: 387, pl. 10, figs. 6, 7 (Mammoth Dome, Mammoth Cave [Edmonson Co.], Kentucky). Figured type in Call colln. at Indiana University, Bloomington, *teste* Call. [The collection was transferred to the Museum of Zoology, University of Michigan, Ann Arbor, but the type is lost.] Specimens from Call ANSP 68147 figured by Pilsbry, 1948, Acad. Nat. Sci. Phila. Monographs, no. 3, **1** (2): 1055, fig. 563. a, b.

uintaense, Sphaerium: 1886, Proc. Davenport Acad. Nat. Sci. 5: 8, text fig. 4 (Lake in the Uinta Mountains, Utah; elevation of 10,500 feet). Figured holotype MCZ 4859; paratypes MCZ 4848.

utahensis, Radix *ampla:* 1884, Bull. U. S. Geol. Survey, no. 11: 19 (373), 47 (401), pl. 6, figs. 7–9 (Lake Utah, near Lehi, [Utah Co.], Utah). Figured holotype MCZ 4036; paratypes MCZ 4037.

utahensis, Valvata sincera: 1884, Bull. U. S. Geol. Survey, no. 11: 22 (376); 44 (398), pl. 6, figs. 1–3 (Lake Utah, near Lehi, [Utah Co.], Utah, not far from the head of the River Jordan). Figured holotype MCZ 2522.

whitei, Pompholys (*Pompholopsis*): 1888, Amer. Geologist 1: 148, figs. 1–3 (Tassajara Hills, California; post-Pleiocene). Types in the cabinet of the State University, Berkeley, California, *teste* Call. [Not located in 1975, *teste,* J. H. Peck.]

WILLIAM A. MARSH, HIS INTRODUCED TAXA OF UNIONIDAE OR FRESH WATER MUSSELS

By RICHARD I. JOHNSON

Very little is known about William A. Marsh at this time, only that he was a resident of Aledo, Illinois, and was active in the study of Unionidae from 1880-1902. He died some time before 1927, and his collection was purchased by Bryant Walker and Lorraine S. Frierson. On the death of the latter, Walker purchased his collection, so that the Marsh collection was reunited, and is now part of the Walker collection in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

Of the 10 unionid taxa Marsh introduced, the holotypes or lectotypes of 6 are in the Academy of Natural Sciences of Philadelphia (Johnson, R. I. and H. B. Baker, 1973, *The types of Unionacea (Mollusca: Bivalvia) in the Academy of Natural Sciences of Philadelphia.* Proc. Acad. Nat. Sci. Phila. 125: 145–186, pls. 1–10); 2 are in the Museum of Zoology, University of Michigan, and 2 which should be there are lost, though a syntype of one of them is in the Museum of Comparative Zoology. Other paratypes or paralectotypes in the Museum of Comparative Zoology and National Museum of Natural History are also included in this list.

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1880. See under: *upsoni, Unio.*

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1885. List of shells collected in central Tennessee. (With A. A. Hinkley senior author). Aledo, Illinois. [Not seen. Mentioned by Ortmann (1924, *The naiad fauna of Duck River in Tennessee,* American Midland Nat. 9: 5) who referred to 18 species on the list], pp. 1–10.

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1891. Description of two new species of *Unio* from Arkansas. Nautilus **5:** 1–2.
1891. Description of two new species of *Unio* from Florida. Nautilus **5:** 29–30.
1896. New American Unionidae. Aledo [Mercer Co., Illinois] Republican, Nov. 18, 1896 [newspaper].
1896. New American *Unio.* Nautilus **10:** 91–92, pl. 1, figs. 3, 4.
1897. New American Uuionidae. Nautilus **10:** 103–104, pl. 1, figs. 1, 25.
1901. Description of a new *Unio* from Missouri. Nautilus **15:** 74–75, pl. 5, figs. 1–2.
1902. Description of a new *Unio* from Tennessee. Nautilus **15:** 115–116; **16:** 8, pl. 1, upper two figs.
1902. Description of a new *Unio* from Tennessee. Nautilus **16:** 7–8, pl. 1, lower two figs.

Species of Unionidae described by William A. Marsh.

Locality data in brackets are additions from original labels or modern atlases.

The following abbreviations have been used:

ANSP — Academy of Natural Sciences of Philadelphia, Pennsylvania
MCZ — Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
MZUM — Museum of Zoology, University of Michigan, Ann Arbor, Michigan
USNM — National Museum of Natural History, Washington, D. C.

andrewsii, Quadrula: 1902, Nautilus **15:** 115 (Holston River, Tennessee); 1902, Nautilus **16:** 8, pl. 1, upper two figs. as *andrewsae.* Figured holotype ANSP 83170; paratype MCZ 134060.

askewi, Unio: 1896, Nautilus **10:** 91, pl. 1, figs. 3, 4 (Village Creek, Hardin Co.; Sabine River; *both* Texas). Figured holotype ANSP 70448a; paratype MCZ 30555, *both* from the latter locality.

beauchampii, Quadrula: 1902, Nautilus **16:** 7, pl. 1, lower two figs. (Little Tennessee River; Holston River; *both* Tennessee). Figured holotype ANSP 83169 from the former locality.

ferrissii, Unio: 1891, Nautilus 5: 30 (a small creek near Pilatka [Palatka, Putnam Co.], Florida). Type figured by Simpson, 1892, Proc. U. S. Natl. Mus. 15: 423, pl. 66, figs. 1–2, probably returned to Marsh [lost].

missouriensis, Pleurobema: 1901, Nautilus 15: 74 (Black River, near Poplar Bluff, Butler Co., Missouri). Holotype MZUM 38855 figured by Walker 1915, Nautilus 28: 140, pl. 5, figs. 1–2; also a smaller paratype.

pilsbryi, Unio: 1891, Nautilus 5: 1 (Little Red River, Arkansas). Holotype ANSP 41589a figured by Pilsbry, 1892, Proc. Acad. Nat. Sci. Phila. 44: 131, pl. 8, figs. 7–8 and in 1892, Nautilus 6, pl. 1, figs. 7–8; paratypes MZUM 42931.

pleasii, Unio: 1891, Nautilus 5: (Little Red River, Arkansas). Lectotype ANSP 56480a selected by Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125**: 166, pl. 9, fig. 5; allotype ANSP 56480; paralectotypes MZUM 237354; MCZ 231258 and USNM 124641.

singleyanus, Unio: 1891, Nautilus 5: 29 (small creek near Pilatka [Palatka, Putnam Co.], Florida). Holotype MZUM 17628 figured by Simpson, 1892, Proc. U. S. Natl. Mus. 15: 426, pl. 68, figs. 4, 5, from the Frierson colln.

superiorensis, Unio: 1897, Nautilus **10**: 103, pl. 1, figs. 1, 2, 5 (Michipicoton River, upper shore of Lake Superior [Canada]). Figured holotype ANSP 70449a; paratype ANSP 70449, fig. 5; paratypes MZUM 209139, MCZ 20169 and USNM 133386.

upsoni, Unio: 1880, "Read before the Mercer County, Illinois, Scientific and Historical Society March 2, 1880. Mr. Marsh had copies of the description published and thinks that the species was described on the records. It was not figured," Simpson, 1900, Proc. U. S. Natl. Mus. 22: 539; Marsh 1887, Conch. Exchange [Nautilus] 1: 51 (Kishaeaukee River, Winnebago County, Illinois). Not found in the MZUM; syntype MCZ 5551 in the R. E. Call colln.

CYPRAEA LEUCODON BRODERIP, RAREST SHELL?

By RICHARD I. JOHNSON

For many years, through many editions, Guinness' *Book of World Records,* has listed *Cypraea leucodon* Broderip as the rarest shell. Burgess (1970: 252) pointed out that in addition to the holotype in the British Museum (Nat. Hist.) and the specimen in the Museum of Comparative Zoology (38370) a third specimen was taken in 1965 from the stomach of a fish caught in the Sulu Sea off the Philippine Islands. He further noted that both *Cypraea katsuae* Kuroda and *barclayi* Reeve are each known from single specimens. Thus in the single genus *Cypraea,* there are at least two species more rare than *leucodon.*

The 1974 edition of the Record Book no longer figures the holotype of *leucodon,* and duly notes that there are three specimens of it, but continues to regard it as the rarest shell. Obviously, there is no single rarest shell, but if one is needed to settle heated altercations in pubs, bars, and elsewhere, it might just as well be *Cypraea leucodon* that contributes to tranquility.

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BRODERIP, W. J. 1828. Zoological Journal 4: 163. pl. 5. [Original description].

BURGESS, C. M. 1970. The Living Cowries. A. S. Barnes & Co. Cranbury, New Jersey, pp. 252–253. pl. 28, figs. A, A1, [Holotype refigured].

GUINNESS. 1974. Book of World Records, by N. and R. McWhirter. Bantam Books, Inc. New York, p. 100.

Note: The specimen of *C. leucodon* in the Museum of Comparative Zoology is now portrayed in color on a postcard, and is available at this writing from the Museum Shop, Museum of Comparative Zoology, Harvard University, Cambridge, MA. 02138, at 10¢ each, postage extra.

Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 21, 1977 NUMBER 55

Comments on three Jamaican Melanellid Species Described by C. B. Adams (Gastropoda: Melanellidae)[1]

By WILLIAM G. LYONS

Abstract. Supression of a previously selected lectotype (MCZ 186183) of *Eulima (=Vitreolina) conica* is recommended because that specimen, a rissoinid, is variant from the original description; it should be replaced by a melanellid (USNM 83270) upon which the description was probably based. A lectotype (USNM 83268) of *Eulima fulvocincta* is proposed. The lectotype (MCZ 156416) of *Rissoa eulimoides* is a poor specimen of a *Melanella;* the species is redescribed from better specimens. *Vitreolina conica* is known only from Jamaica. *Melanella eulimoides* is reported from Cayman Brac, the Bahamas, and West Florida. *Eulima fulvocincta* occurs from offshore waters of North Carolina to Florida, Jamaica, Hispaniola, and probably St. Thomas and Puerto Rico. Types and comparative specimens are illustrated.

INTRODUCTION

Clench and Turner (1950) selected and illustrated extant types of C. B. Adams' western Atlantic molluscan species, in many instances noting subsequent familial or generic classifications. A review of shallow water Florida and Caribbean Melanellidae has revealed new information concerning identities of three of Adams' Jamaican species. Dr. Anders Waren, who is also presently studying western Atlantic Melanellidae, suggested appropriate genera and

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[1] Contribution Number 281, Florida Department of Natural Resources Marine Research Laboratory.

provided additional distributional records for two of the species.

Specimens were examined from collections of the Museum of Comparative Zoology (MCZ), Harvard University, Cambridge, Massachusetts, the National Museum of Natural History (USNM), Washington, D.C., the Academy of Natural Sciences of Philadelphia (ANSP), Pennsylvania, the Florida Department of Natural Resources (FDNR) Marine Research Laboratory (catalogue prefix FSBC I), St. Petersburg, Florida, and the Steger collection, now at the Delaware Museum of Natural History (DMNH), Greenville, Delaware.

Eulima conica C. B. Adams, 1850

Adams named *Eulima conica* with the following description: "shell conic turrited: white: smooth and shining: apex acute: spire with the axis moderately curved throughout with the outlines rectilinear in the plane perpendicular to that of the curvature: whorls about eleven, planulate, with an indistinct suture: last whorl subangular, quite oblique anteriorly: aperture small, ovate. Mean divergence [spire angle] about 22°; length .1 inch; breadth .042 inch."

In their introduction, Clench and Turner stated (p. 234) that all Adams' western Atlantic *Eulima (=Melanella)* were missing, but they assigned types for *Eulima conica* and *E. jamaicensis* C. B. Adams, 1845 in the text. Their illustrated lectotype (MCZ 186183; Figure 1) and a conspecific paralectotype (MCZ 186184; Figure 2) of *Eulima conica* are not melanellids. Relatively large, obtusely conical protoconchs of about two whorls, glassy teleoconchs dulled by many microscopic axial striae, and two tooth-like swellings within outer lips indicate the shells to be specimens of *Zebina browniana* (d'Orbigny, 1842), a species somewhat resembling some melanellids but belonging to the family Rissoinidae.

Adams sold duplicate specimens to finance a monograph of his species, a task he never completed. Some National Museum melanellids are of certain Adams origin, and others may be duplicates acquired from other collections. Dall (1889) mentioned that "specimens [of *Eulima jamaicensis*] in the National Museum were received from Prof. Adams and have lately been compared with his original type"; he also mentioned comparing other specimens with the type of *E. arcuata* C. B. Adams, 1850. This suggests that Adams' melanellid types may have been loaned to Dall prior to completion of the *Blake* Gastropoda report, and at least some may have later been catalogued into the National Museum collection. Apparent types of two such species are presently housed there; both conform well with Adams' descriptions and are marked "Jamaica. . .C. B. Ad.," evidently in Dall's handwriting. One lot (USNM 83270) containing a single specimen so marked is labeled "*Eulima conica* C. B. Ad." The shell (Figure 3) is a melanellid agreeing closely with Adams' description and measurements (Table 1). It is not now possible to demonstrate conclusively that this is the specimen upon which Adams based his description, but it seems certain the shell embodies Adams' concept of *E. conica*.

TABLE 1. Measurements of discussed *Eulima conica* specimens and those from Adams' description.

	Original Description	USNM 83270	MCZ 186183	MCZ 186184
Length	.1 in (2.54 mm)	2.6 mm	3.1 mm	3.2* mm
Breadth	.042 in (1.00 mm)	1.0 mm	1.4 mm	1.4 mm
Spire angle	22°	21°	33°	26°
whorls	ca. 11	10	6-3/4	7*

*First embryonic whorl damaged.

The previously selected lectotype and paralectotype do not agree with Adams' measurements and whorl counts (Table 1). Numbers of whorls are especially variant, being considerably fewer on shells larger than that originally described. Although the shells are of Adams origin, they do not satisfy the criteria of his description. I therefore propose that the previous designation of MCZ 186183 as lectotype be set aside, and that USNM 83270 be considered the proper lectotype of *Eulima conica* C. B. Adams, 1850. Accordingly, the slender outline and moderate curvature of the spire indicate that *E. conica* should be assigned to *Vitreolina* Monterosato, 1884.

To date I have seen this species only from Jamaica, but it probably occurs elsewhere in the northern Caribbean.

Eulima fulvocincta C. B. Adams, 1850

Clench and Turner were unable to locate the type of *E. fulvocincta* but, as with *E. conica*, an apparent C. B. Adams syntype from Jamaica is in the National Museum collection (USNM 83268; Figure 4) and may serve as lectotype. Measurements of the worn shell (length 4.9 mm; breadth 1.6 mm) are similar to those reported by Adams (.2 in = 5.1 mm; .065 in = 1.65 mm). Early whorls are missing, leaving about 6 whorls on the teleoconch and perhaps explaining Adams' reference to a "rather obtuse apex". The shell possesses the two distinctive interrupted spiral bands and scattered, thin, brown stained varices described by Adams, markings which separate this species from all other western Atlantic melanellids. A freshly dead shell from off the Florida west coast (*Hourglass* station B, 27° 37′N, 83° 07′W; 18 m; Figure 5) is illustrated for comparison.

Adams' species is assigned to *Eulima* Risso, 1826, *sensu* Winckworth (1934). It is closely related to the eastern Pacific *E. schwengelae* (Bartsch, 1938), formerly known as *Strombiformis hemphilli* Bartsch, 1917. Both Keen (1971) and Abbott (1974) were unaware of Bartsch's subsequent name, changed to avoid homonymy with the western Atlantic *Eulima hemphillii* Dall, 1884.

Mörch (1875) reported *Leiostraca (=Eulima) fulvocincta* from St. Thomas (Virgin Islands) and Porto Plata (Hispaniola). Soon thereafter, Dall (1889) erroneously designated *fulvocincta* a synonym of *Eulima bilineata* Alder, 1848; the latter species occurs off western Europe, not in the Americas, but its name has been applied to the western Atlantic *S. bifasciatus* (d'Orbigny, 1842) and several apparently unnamed species. Dall's synonymy was evidently convincing, for I find no subsequent use of *fulvocincta*. Illustrations of the shell are also scarce. The battered shell, probably from Puerto Rico, of Warmke and Abbott's (1961) figure 26-o appears to be *E. fulvocincta*. Although their figure legend refers the specimen to *Eulima auricincta* Abbott, 1958, their text treatment of *E. auricincta* makes no mention of that figure, referring properly to figure 26-j.

Specimens examined: NORTH CAROLINA: 1, 6.6 mm length; USFC sta. 2595, 115 m, 22 mi east southeast of Cape Hatteras; USNM 97519.—1; USFC sta. 2616, 31 m, 25 mi east southeast of Cape Fear; USNM 97521.—1; USFC sta. 2622, 27 m, 25 mi southeast of Cape Fear; USNM 92808.—16, largest 5.8 mm; USFC sta. 2619, 27 m, 25 mi southeast of Cape Fear; USNM 97523.—1; USFC sta. 2619, 27 m, off Cape Fear; USNM 330408.—3; 22 m, 12 mi east of Frying Pan Shoal; Rush, coll.; USNM 82989.—FLORIDA: 1; USFC sta. 7106, 23 m, west coast of Florida; USNM 194641.—1; 18-22 m, Florida west coast; Benedict, coll.; USNM 194896.—2; airport, St. Petersburg (Tampa Bay); McGinty, coll.; DMNH 110031.—2; Hourglass sta. B, 18 m, off St. Petersburg, December, 1965; FSBC I 11750.—2; Hourglass sta. B, November, 1967; FSBC I 15258.—2; Eolis sta. 30, 13 m, 5 mi off north entrance to Key West; USNM 417546.—1; 29 m, Dry Tortugas; USNM 433291.—JAMAICA: 1, 4.8 mm; Jamaica; C. B. Adams, coll.; USNM 83268 (suggested lectotype).—14; Port Royal; Orcutt, coll.; USNM 442257.—HAITI: 2; Les Trois Pavillons, Dept. du Nord-Ouest; Orcutt, coll.; USNM 440513.

The range of *Eulima fulvocincta* extends from off Cape Hatteras, North Carolina to west Florida and southward to the Greater Antilles, including the Virgin Islands if Mörch's record is correct. Dr. Waren has also seen material from Yucatan. No depth records accompany the Caribbean specimens, but most were probably collected from beach drift. Most Florida samples were taken in 13-29 m, but the Tampa Bay specimens were obtained from spoil during fill operations for the St. Petersburg Airport (Mrs. Barbara Steger, pers. comm.), and probably lived at shallower depth. Five of six North Carolina lots are from 22-31 m; the sixth, from 115 m off Cape Hatteras, is the northernmost record and contains the largest specimen examined (6.6 mm). These records may indicate temperate submergence of a tropical shallow water species.

Rissoa eulimoides C. B. Adams, 1850

Dr. D. R. Moore first called to my attention that the type of *R. eulimoides* is a melanellid. Subsequent inspection revealed the holotype (MCZ 156416; Figure 6) to be a worn, juvenile specimen with rather dull surface and lacking embryonic whorls. It is, however, identical with an excellent specimen of similar size from Goat Cay, Andros, Bahamas (FSBC I 11749; Figure 7); and others from Cayman Brac (ANSP 296068; Figures 8, 9); and Gulfport, Tampa Bay, Florida (MCZ 104323). The species is redescribed from these specimens.

Shell small, to about 16.0 mm total length, glossy, white, nearly straight. Protoconch of 4 small, slender whorls; postembryonic whorls about 15, considerably broader than long posteriorly, less so anteriorly, slightly rounded, forming shallow, narrow sutures; penultimate whorl merging smoothly with base. Sculpture lacking except for one deep axial incision at completion of each whorl, creating a single, nearly straight, incised line from posterior terminus of outer lip to base of final embryonic whorl. Umbilicus absent. Aperture small, broadly ovate, constricted posteriorly, rounded anteriorly; columella short, simple, slightly elevated, merging with base on juveniles, separated on adults. Outer lip thick, broadly rounded, resembling that of various Rissoinidae.

Poor condition of the type probably misled Adams to place the species in *Rissoa;* the embryonic whorls are missing and early postembryonic whorls are worn to resemble early whorls of some Rissoinidae. The comparatively dull surface and shape of the outer lip further suggest that family. Fresh shells, however, are clearly melanellid as indicated by the shape of embryonic whorls and by the highly glossy, oily texture of the shell surface. The strong labial scars and solid shell dictate that the species be placed in *Melanella* Bowdich, 1822. Linear arrangement of deeply incised varices also occurs on *Melanella dufresnei* Bowdich, 1822, from Japan.

Dr. Waren allowed examination of the MCZ and ANSP specimens on loan to him. He also (pers. comm.) reported examining specimens from the Caribbean coast of Panama

(USNM 620567). The Gulfport specimen is especially curious; I have not otherwise seen the species among many Tampa Bay melanellids. Except for that record, the species seems restricted to shallow areas of the Caribbean, where it is evidently uncommon.

The shell of *M. eulimoides* somewhat resembles that of Abbott's (1974) figure 1344, which he ascribes to *Melanella gibba* (De Folin, 1867). However, that species was described from Margarita Island, Panama (Bartsch, 1917), and the original illustration is of a shell quite different from that illustrated by Abbott, seeming more closely related to the group containing *M. arcuata* (C. B. Adams, 1850).

ACKNOWLEDGMENTS

I thank Dr. Anders Waren, University of Gothenburg, Göteborg, Sweden, for providing information and reviewing the manuscript. Dr. Joseph Rosewater provided study facilities at the U.S. National Museum and loaned USNM specimens. Dr. Ruth Turner (MCZ) graciously provided information concerning the Clench and Turner report and loaned necessary specimens. Dr. D. R. Moore, Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), Miami, Florida, and Mrs. Barbara Steger, Tampa, Florida, are thanked for providing information. The Bahamian specimen of *M. eulimoides* was collected during cruise G-7124 of the M/V Gerda, RSMAS research vessel. Mrs. Sally Kaicher provided photographic assistance.

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Plate 16

Fig. 1. *Eulima conica;* Jamaica; MCZ 186183; lectotype of Clench and Turner (1950) (= Rissoinidae); length 3.1 mm (10 x).

Fig. 2. *Eulima conica;* Jamaica; MCZ 186184; paralectotype; (= Rissoinidae) length 3.2 mm (10 x).

Fig. 3. *Eulima* (= *Vitreolina*) *conica*; Jamaica; USNM 83270; new lectotype; length 2.6 mm (10 x).

Fig. 4. *Eulima fulvocincta;* Jamaica; USNM 83268; lectotype; length 4.9 mm (10 x).

Fig. 5. *Eulima fulvocincta*; *Hourglass* station B, 18 m; FSBC I 11750; length 4.8 mm (10 x).

Fig. 6. *Rissoa* (= *Melanella*) *eulimoides*; Jamaica; MCZ 156416; holotype of Clench and Turner; length 5.2 mm (10 x).

Fig. 7. *Melanella eulimoides*; Goat Cay, Andros, Bahamas; FSBC I 11749; length 5.6 mm (10 x).

Fig. 8. *Melanella eulimoides*; Cayman Brac; ANSP 296068; length 13.0 mm (tip broken) (5 x).

Fig. 9. Same; lateral view (5 x).

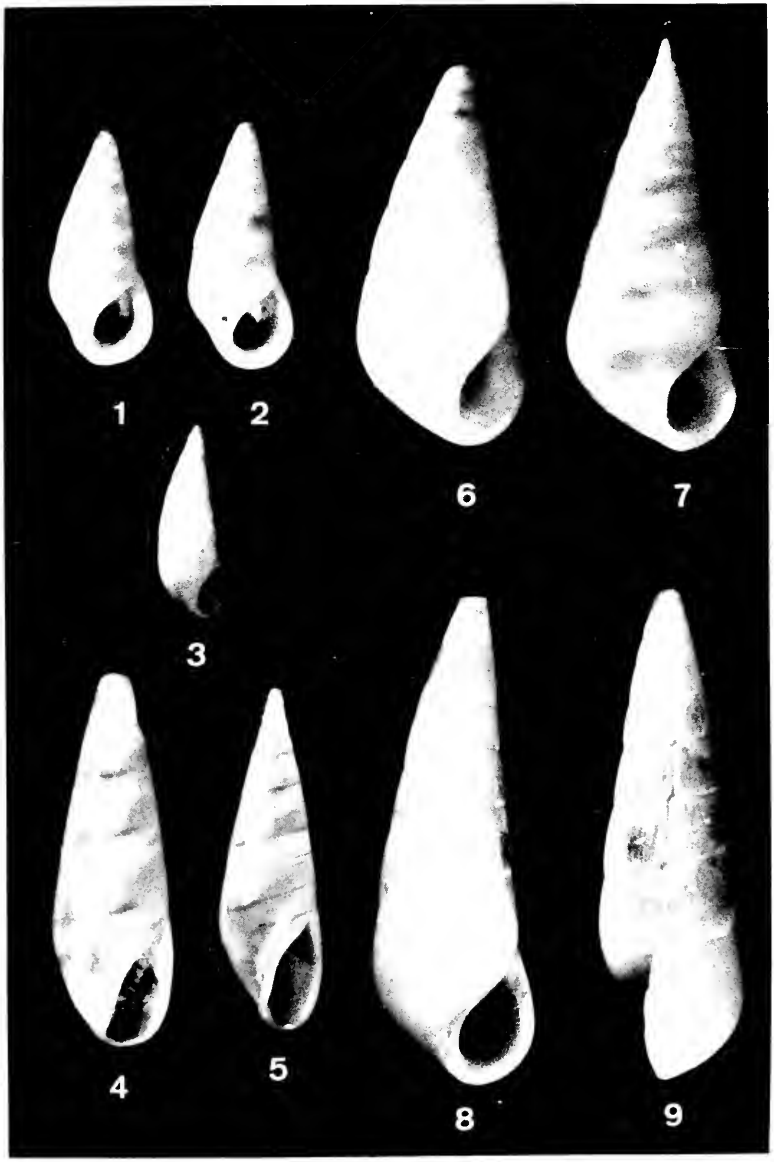

Plate 16

Alcide d'Orbigny's South American Expedition (1826–1833)

By Harriet Hornblower

By 1834, much of the fauna and flora of Brazil and Peru had been collected and described by such eminent naturalists as Alexander von Humboldt and Augustin Saint-Hilaire. The rest of the South American continent to the south remained mostly uninvestigated. The Muséum National d'Histoire Naturelle conceived an ambitious project to fill this lacuna which, at the request of Geoffroy Saint-Hilaire, was undertaken by Alicide Charles Victor Dessalines d'Orbigny (1802–57). Orbigny readily assented, as such an expedition would be an invaluable opportunity for a young and aspiring naturalist.

Saint-Hilaire chose Orbigny because his research had already revealed an ability to clarify and impose new order on hopelessly inadequate systematics. He had separated the Foraminifera from the Cephalopoda which Lamarck had failed to do.

A foundation in zoology had been provided to him by his father, Charles-Marie Dessalines d'Orbigny (1770–1856), a naval surgeon with a passionate interest in natural history. He took his sons, Alcide and Charles, on numerous collecting trips. The Orbignys worked on the marine animals of the coast of Aunis and Vendée, and with Fleuriau de Bellevue, founded the first French regional museum at La Rochelle.

From youth, Alcide had been in contact with other naturalists: Savigny, Cuvier, Audouin, and Milne-Edwards.

On July 26, 1826 Orbigny sailed from Brest, and on September 24 arrived at Rio de Janeiro. Two weeks later he sailed to Montevideo, arriving on October 30 and for several months explored Uruguay. On February 14 he left Buenos Aires, journeying up the Paraná to Rosario and then on to Corrientes. For more than a year, he remained in the Corrientes region making excursions into Chaco and Guaraní territory. In December, he reached the frontiers of Paraguay, which he would have investigated had its dictator, Dr. Francia, not previously taken Bonpland, Humboldt's botanist, captive.

Leaving Corrientes at the end of May, he sailed down the Paraná to Buenos Aires. On January 2, 1829, Orbigny departed for the Río Negro, and for nine months he explored Patagonia.

Warring factions made an overland expedition from Buenos

Aires to Valparaiso impossible; so he went by sea around the Horn to Valparaiso, Chile arriving on February 16, 1830.

After a visit to Santiago, Orbigny learned upon returning to Valparaiso that President Santa Cruz, "a friend of the sciences", had requested his services in evaluating the riches of Bolivia. The offer was providential, for it not only gave Orbigny access to new zoogeographic zones, but afforded him badly needed financial assistance. Orbigny made an ascent of the Cordillera as he journeyed into Bolivia. Once in Bolivia he spent two years investigating the *Yungas*.

In Santa Cruz Province, while exploring the tributaries of the Madeira by *piroque*, he made extensive zoological, geographical and ethnological observations in almost unknown areas.

In Callao, Peru, Orbigny met M. Fontaine, a French physician for *The Griffon*. They collected marine mollusks in the vicinity. Fontaine continued to collect coastal, marine species as far north as Piura and later sent them to Orbigny in Paris.

On returning to Paris, Orbigny published the results of his expedition in nine folio volumes (1835–47). Elie de Beaumont described the work as presenting "in an almost encyclopedic framework, one of the most extensive monographs ever given on any region of the earth." Volume 5, part 3, is devoted to mollusks; many new species are described. [Some had been briefly described previously (Orbigny 1835).]

Orbigny's expedition served as a model for the scientific investigations of other unexplored regions. His contributions to South American geology, paleontology and malacology were monumental and became foundations in these fields.

Orbigny made one of the most extensive collections of the land and freshwater mollusks ever made in South America. The previous collection of shells made by Humboldt and Bonpland, described by Valenciennes, is of nugatory importance. Other naturalists such as Spix and Wagner, and Moricand described only the mollusks of Brazil.

Besides figuring over a hundred new mollusks, Orbigny made general observations on their habitats and a new synthesis of their distribution. Latitudinally he divided the continent into three zones, using gastropods and birds as examples. He noted a sharp diminution in species density from the tropical to the cold zone. He also recognized faunal zones in the distribution of the marine mollusks, concepts which were later augmented by Edward Forbes.

Many of Orbigny's speculations have been since discarded; yet he did much to organize and clarify South America's faunal, geological, and paleontological record, an immense accomplishment for a single man who generally travelled alone under perilous conditions.

Orbigny sold his shells, for pecuniary reasons, to the British Museum (Nat. Hist.), all of them glued to cards, with an x on the figured specimens. The over 800 lots were described by Gray (1854). The freshwater bivalves were critically examined by Johnson (1971).

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Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 21, 1977 NUMBER 56

Monograph of the genus *Medionidus* (Bivalvia: Unionidae) mostly from the Apalachicolan Region, Southeastern United States.

By RICHARD I. JOHNSON

Abstract. This paper attempts to elucidate the synonymy of the six species of *Medionidus* (Bivalvia: Unionidae), to reconstruct what was until recently their known distribution, and to discuss their zoogeography.

INTRODUCTION

Medionidus is a genus of Unionidae, or fresh water mussels, consisting of six species. It appears to have originated on, or at least survived on, the Cumberland Plateau. The restricted distribution of *M. conradicus* (Lea) (Pl. 17, black dots) which is confined to the Tennessee and Cumberland River systems, and its abundance, led Ortmann (1925: 354) to regard this species as most characteristic of the Cumberlandian fauna which consists mostly of species not found beyond these river systems. The few Cumberlandian species which also occur in rivers in the Ozark mountains, suggest that this fauna may be a relect from the Cretaceous. *M. conradicus* spread into the Apalachicolan region by an ancient former connection between the Tennessee and Mobile-Alabama-Coosa River systems, where it evolved into *M. acutissimus* (Lea) (Pl. 17, open circles). It is not clear if *M. mcglameriae* van der Schalie (Pl. 17, black star), found in the Tombigbee River drainage of the same river system, is derived from *conradicus* or *acutissimus,* since it is known only from two small specimens. Unlike *conradi-*

cus or *mcglameriae,* which are not sculptured on the posterior slope, *M. penicillatus* (Lea) (Pl. 17, black squares) found in the Yellow, Econfina and Apalachicola River systems; *M. simpsonianus* Walker (Pl. 17 open squares) endemic to the Ocholockonee River system; and *M. walkeri* (B. H. Wright) (Pl. 17, black triangles) similarly restricted to the Suwannee River system, like *acutissimus,* are all sculptured on the posterior slope. These Apalachicolan species appear to be independently derived from *M. acutissimus.*

HISTORICAL CONSIDERATIONS

The genus *Medionidus* was proposed by Simpson (1900a: 77), who also published a synonymy of the species (1900b: 588-591). He later (1914: 246-253) modified the synonymy and added descriptions of the species. Simpson (1914: 248,251) recognized *M. parvulus* (Lea) and *acutissimus* (Lea), both from the Mobile-Alabama-Coosa River system, as valid, as did Ortmann (1923: 59; 1924: 99). Van der Schalie (1938: 14), with more extensive collections at his disposal, noted that they intergrated. Later, van der Schalie (1940: 199) followed Simpson (1914: 248, 250) and recognized both *M. penicillatus* (Lea) and *kingi* (B. H. Wright) as valid species occurring in the Apalachicola River system. Clench and Turner (1956: 189) correctly synomymized these forms, but also included in their synonymy, *M. simpsonianus* Walker endemic to the Ochlockonee River system, and *walkeri* (B. H. Wright) endemic to the Suwannee River system. Johnson (1970: 270), in a compilation of the Unionacea of the Apalachicolan Region, followed van der Schalie and recognized both *penicillatus* and *kingi.* Actually, Frierson (1927: 92) had previously published the correct synonymy of the then known species of *Medionidus.* Haas (1969: 413-415) in his compilation of the Unionacea, followed Frierson, merely adding *M. mcglameriae* van der Schalie (1939) which had been subsequently described. Burch (1973: 21) in his identification manual of the North American Unionacea recognized only four of the six species of *Medionidus*: *conradicus* (Lea), *acutissimus*, *mcglameriae*, and *penicillatus*. Hurd (1974: 98-99) recognized *conradicus* as occurring in both the Tennessee and the Mobile-Alabama-Coosa River systems, as well as *acutissimus* and *parvulus* in the latter. Burch (1975: 20) in a revised edition of his manual, also recognized *parvulus*. Stansbery (1976: 48) listed *conradicus* as "endangered" in both the "Tennessee and Mobile basins."

ACKNOWLEDGEMENTS

Special thanks are extended to Dr. Joseph Rosewater, National Museum of Natural History, who in addition to permitting me access to the collection, had photographs made of the relevant types. Dr. Juan Parodiz, Carnegie Museum, Pittsburgh, kindly made the collection in his charge available. Drs. Henry van der Schalie and John B. Burch, Museum of Zoology, University of Michigan also afforded me access to the collection in their charge, as well as allowing me to borrow type material. Dr. Fred G. Thompson, Florida State Museum, Gainesville, helped clarify a spurious record. Thanks are also extended to Dr. Kenneth J. Boss for reading the manuscript and making helpful suggestions.

SYSTEMATIC SECTION

The following abbreviations have been used in the text and on the plate captions.

CM — Carnegie Museum, Pittsburgh, Pennsylvania
MCZ — Museum of Comparative Zoology, Cambridge, Massachusetts
MZUM — Museum of Zoology, University of Michigan, Ann Arbor, Michigan
USNM — National Museum of Natural History, Washington, D.C.

Synonymy. For ease of reference, full citations are included for each taxon, including the type locality and the location of the type when known. No plate or figure references are included with Lea's Obs. Unio, since they are always the same as in the preceding entry. Elsewhere in the text references are abbreviated.

Descriptions. The measurements are only intended to convey the general size of specimens from a given station, and to indicate sexual differences.

Anatomy. The available data are cited.

Remarks. These are designed to elucidate the differences between the species, and include comments on distribution and taxonomy.

Range. The distribution is summarized.

Abundance. These data are based on the literature and on the number and size of the lots found in the several collections studied.

Habitat. Included when known.

Specimens examined. The majority of the records are based on the collections in the museums mentioned above. Unless otherwise noted, the records are based on specimens in the Museum of Comparative Zoology. The few records which could not be seen are credited to the responsible author.

Aside from the Tennessee and Cumberland river systems, all the other relevant river systems flow into the Gulf of Mexico and are listed from west to east, the assumed direction of major dispersal. The records from each river system are arranged from headwaters to the mouth.

The cumbersome term, Mobile-Alabama-Coosa River system, is used because it reflects the main channel of the river, which was given a different name at each important confluence.

Figures. When available, the holotype, or lectotype, is used to illustrate each species and nominal taxon. When required several illustrations are included to show ecophenotypic variation. Some of the data on the plate captions, such as the measurements, are sometimes not repeated elsewhere.

It is suggested that anyone not familiar with the genera of North American Unionidae consult the key in one of the editions of Burch (1973, 1975).

Family Unionidae (Fleming 1828) Ortmann 1911
Subfamily Lampsilinae (Ihering 1901) Ortmann 1910
Genus Medionidus Simpson 1900

Medionidus Simpson 1900, Proc. Acad. Nat. Sci. Phila. *52:* 77. Type species, *Unio conradicus* Lea, original designation. Simpson, 1900, Proc. U.S. Natl. Mus. *22:* 588; Ortmann, 1912, Ann. Carnegie Mus. *8:* 334; Simpson, 1914, Cat. Naiades *1:* 245; Ortmann, 1915, Nautilus *28:* 143.

Simpson (1914: 246) noted that *Medionidus* "is closely related to *Lampsilis,* but the embryos are contained in irregular, though distinctly marked, ovisacs near the center of the outer gills instead of in regular ovisacs at the hinder part of the gills. The marsupial swelling of the female shell is less developed than in *Lampsilis* and is placed farther forward than in that genus. The male shell is generally somewhat arcuate and the species generally have a well-developed posterior ridge, characters not often found in *Lampsilis.*" Ortmann (1915: 143) confirmed the validity of the genus.

Medionidus conradicus (Lea)

Plate 18, figs. 1-2

Unio plateolus Rafinesque 1831, Cont. Monog. Bivalve Shells River Ohio, p. 3 (Falls of the Cumberland River [Whitley Co., Kentucky], type lost). Ortmann and Walker (1922, Occ. Papers, Mus. Zool., Univ. Michigan, no. 112, p. 58) convincingly argued that this taxon is unidentifiable.

Unio conradicus Lea 1834, Trans. Amer. Philos. Soc. *5:* 63, pl. 9, fig. 23 (no locality [Caney Fork of the Cumberland River, Tennessee]; figured holotype USNM 84134); Lea, 1834, Obs. Unio, *1:* 175.

Medionidus conradicus (Lea), Wilson and Clark, 1914, U.S. Bur. Fisheries, Doc. no. 781, p. 51. Ortmann, 1923, Nautilus *37:* 58, *Ibid.* 1924, 99; 1924, Amer. Midland Nat. *9:* 30, 1925, 353.

Medionidus plateolus (Rafinesque). Ortmann, 1918, Proc. Amer. Philos. Soc. *57:* 575.

Description. Shell small, seldom exceeding 55 mm in length. Outline long elliptical, usually arcuate, especially when fully adult. Valves inequilateral, subinflated, subsolid. Anterior end regularly rounded, posterior end with a rounded point near the base. Ventral margin straight, or more frequently, incurved. Dorsal margin long and slightly curved, forming an indistinct angle with the obliquely descending posterior margin. Hinge ligament rather long. Posterior ridge broadly rounded. Posterior slope more or less wrinkled. Sometimes somewhat depressed at the center of the disk. Umbos slightly inflated and little elevated, sculptured with fine, irregular corrugations, which tend to be double looped, located at the anterior quarter of the shell. Surface of the shell rather smooth, except for growth ridges. Periostracum scarcely shining, tawny to yellowish green, with feeble, wavy, dark green rays of uneven width which occasionally break into blotches, especially on the posterior slope.

Left valve with two low, stumpy, pseudocardinal teeth and two curved lateral ones. Right valve with one pseudocardinal and one lateral. Anterior adductor muscle scars deep, posterior ones shallow. Pallial line impressed anteriorly, where the shell is thicker. Umbonal cavities slightly excavated, Nacre bluish to dirty white, sometimes iridescent posteriorly.

The male shell is generally arcuate and wider behind. The female shell is generally a little produced along the middle of the base, and this area is sometimes faintly radially groved.

Length mm	Height mm	Width mm	
55	25	14	Clinch River, 5. 5 mi. below Fort Blackmore. Scott Co., Virginia. Male.
48	25	15	Stones River, Murfreesboro, Rutherford Co., Tennessee. Female.
47	23	18	Caney Fork of the Cumberland River, Tennessee. Holotype. Female.

Anatomy. The anatomy was discussed and figured by Ortmann (1912, 335, fig. 22; 1915: 142; 1921:90). Lea (1863: 410 [46]), under *conradicus,* previously discussed the anatomy, but his specimen was from the Etowah River, a tributary of the Mobile-Alabama-Coosa River system, where this species does not occur. Glochidia rather large, subovate, or almost subspatulate. Length 0.22; height 0.28 mm (Ortmann, 1912, pl. 20, fig. 3).

Remarks. Medionidus conradicus (Lea) may be distinguished from the other members of the genus by its lack of a posterior ridge, the fineness or virtual absence of corrugations on the posterior slope, the generally arcuate ventral margin, and by the fine rays, which are not reticulated or spotted, but are generally continuous and straight, though the finer ones are sometimes wavy.

The restricted distribution of this species and its abundance led Ortmann (1925:354) to regard it as most characteristic of the Cumberlandian fauna which consists mostly of those species not found beyond the Tennessee and Cumberland River systems.

Hurd (1974: 98) included *conradicus* in the unionid fauna of the Coosa River drainage, based on his identification of lots 605.2-5, and on the former identification of alcoholic lots nos. 14, 24, 66 [the latter were not located] in the Alabama Museum of Natural History; as well as lots 51034, 51055, 69044, 98410, and 98457 in the Museum of Zoology, University of Michigan. Only two of these lots are *conradicus,* one is actually from the Tennessee River system, and the other, merely labeled, "Coosa River, Alabama, Showalter coll'n" is regarded as spurious. It was impossible to personally examine the several lots of specimens in the Alabama Museum where the Showalter collection is located, but it is assumed they are not authentic records from the Mobile-Alabama-Coosa River system.

Range: Restricted to the Tennessee River system in Virginia, Tennessee and Alabama, and the Cumberland River system in Kentucky and Tennessee, including the intervening Duck River drainage of the former.

Abundance. M. conradicus was a common species in the upper and lower Tennessee and Cumberland River systems before impoundments. It distinctly preferred small streams and headwaters, where it is still found (Stansbery and Clench, 1974). Known in the Tennessee River proper from a single specimen in the Carnegie Museum from Muscle Shoals, Alabama, collected by H. H. Smith.

Neel and Allen (1964: 444) reported that *conradicus* was abundant just below the Falls of the Cumberland River in September 1948. They did not find it elsewhere in the main river, but it was abundant in Beaver Creek and the Rockcastle River, where it extended far up into Laurel Fork.

Habitat: Lives mostly in small streams.

SPECIMENS EXAMINED

TENNESSEE RIVER SYSTEM

Powell River Drainage. *Virginia*: South Fork Powell River, 2 mi. above Big Stone Gap, Wise Co. Powell River above Dryden; 2.5 mi. S. Jonesville; Flannery Ford, 7 mi. SW Jonesville; Walden Creek; Indian Creek, 4 mi. SW Ewing; *all* Lee Co.

Clinch River Drainage. *Virginia*: Clinch River, Cedar Bluff, Tazewell Co. Clinch River, Honaker; Cleveland; Boody; *all* Russell Co. Clinch River, St. Paul, Wise Co. Clinch River, Dungannon; Fort Blackmore; Clinchport; Wayland; Speers Ferry bridge; Moccasin Creek, Weber City; *all* Scott Co. Clinch River, 1.5 mi. S Dona; West Black Water Creek, Black Water; *both* Lee Co. *Tennessee*: Clinch River, Kyles Ford; Sneedsville; "The Rounds"; *all* Hancock Co. Clinch River, 4 mi. NW Thorn Hill, Grainger Co.

Holston River Drainage. *Virginia:* North Fork Holston River, 1.7 mi. SW Ceres, Bland Co. (Stansbery and Clench). Lick Creek, 3 mi. E Chatham Hill; North Fork Holston River, 9 mi. ENE Saltville; 8.5 mi. N Marion; *all* Smyth Co. Wolf Creek, 2 mi NW Lindell; North Fork Holston River, [town of] Holston; Mendota (MZUM); *all* Washington Co. North Fork Holston River, nr. Gate City (MZUM); Big Moccasin Creek, 2.75 mi. SE Gate City; *both* Scott Co. Middle Fork, Holston River, 3. 75 mi. S Glade Spring; South Fork Holston River, 1.25 mi. SE Lodi; *both* Washington Co. *Tennessee:* South Fork Holston River, Bluff City; Kingsport; (*both* MZUM) *both* Sullivan Co. Big Creek, Rogersville, Hawkins Co.

French Broad River Drainage. *North Carolina*: French Broad River, Ashville, Buncombe Co. (CM). Little Pigeon River, Sevierville, Sevier Co.

Little River Drainage. *Tennessee:* Little River, 1.5 mi. below Walland, Blount Co. (MZUM).

Little Tennessee River Drainage. *Tennessee:* Tellico Creek, 1.5 mi. above Little Tennessee River, Monroe Co.

Hiwassee River Drainage. *Tennessee:* Conasauga Creek, Monroe Co. (MZUM 98457).

Chickamauga Creek Drainage. *Georgia:* South Chickamauga Creek (CM).

Paint Rock River Drainage. *Alabama*: Estill Fork Paint Rock River, Estillfork; Paint Rock River, [town of] Paint Rock (CM); *both* Jackson Co.

Flint River Drainage. *Alabama:* Flint River, Gurley, Madison Co. (MZUM).

Elk River Drainage. *Tennessee:* Elk River, Estill Springs; Rock Creek, 2 mi. W Estill Springs (MZUM); Boiling Fork Creek, 1 mi. E Winchester; *all* Franklin Co.

Blue Water Creek Drainage. *Alabama:* Blue Water Creek, Lauderdale Co. (CM).

Shoals Creek Drainage. *Alabama:* Shoals Creek, Bailey Springs, Lauderdale Co.

Tennessee River Drainage. Alabama: Tennessee River, Muscle Shoals, Colbert and Lauderdale Cos. (CM).

Duck River Drainage. *Tennessee:* Duck River, Normandy (CM); Garison Creek, Wartrace (CM); Duck River, Shelbyville; *all* Bedford Co. Duck River, Wilhoite (MZUM); Hardinsons Mill, 12 mi. NW Lewisburg; Clay Hill; *all* Marshall Co. Duck River, Columbia, Maury Co.

CUMBERLAND RIVER SYSTEM

Rockcastle River Drainage. *Kentucky:* Laurel Fork, McGee, Jackson Co. (MZUM). Rockcastle River, Livingston; Cedarville; *both* Rockcastle Co.

Cumberland River Drainage. *Kentucky:* Cumberland River, just below Cumberland Falls, Whitley Co. Cumberland River, Smith Shoals, 3 mi. E Burnside, Pulaski Co.

South Fork Drainage. *Kentucky:* Little South Fork River, 3. 8 mi. E Coopersville, Wayne Co. South Fork, 2 mi. above Burnside, Pulaski Co. (MZUM).

Beaver Creek Drainage. *Kentucky:* Beaver Creek [Wayne Co.] (Neel and Allen).

Obey River Drainage. *Tennessee:* [Obey River] Pickett Co.

Roaring River Drainage. *Tennessee:* Roaring River [Jackson and Overton Cos.] (Wilson and Clark).

Caney Fork Drainage. *Tennessee:* Collins River, Shells Ford, Warren Co. Caney Fork.

Stones River Drainage. *Tennessee:* West Fork Stones River, 8.3 mi NW Murfreesboro; Stones River, Murfreesboro; *both* Rutherford Co. Stones River 1.25 mi. W Couchville, Davidson Co.

Red River Drainage. *Kentucky:* Red River [town of] Red River, Logan Co. (MZUM).

Medionidus acutissimus (Lea)

Plate 18, figs. 3-8

Unio acutissimus Lea 1831, Trans. Amer. Philos. Soc. *4*: 89, pl. 10, fig. 18 (Alabama River, type lost, 3 specimens subsequently identified by Lea, MCZ 178887); Lea, 1834, Obs. Unio *1*: 99

Unio rubellinus Lea 1857, Proc. Acad. Nat. Sci. Phila. *9*: 32 (Othcalooga [Oothkalooga] Creek, Gordon Co., Georgia). Lea, 1858, Jour. Acad. Nat. Sci. Phila. (2) *4*: 70, pl. 13, fig. 51; figured holotype USNM 84136. Lea, 1858, Obs. Unio *6*:70.

Unio parvulus Lea 1860, Proc. Acad. Nat. Sci. Phila. 12: 307 (Coosa River, Alabama; Chattanooga [Chattooga River] Georgia). Lea, 1866, Jour. Acad. Nat. Sci. Phila. (2) *6*: 45, pl. 16, fig. 43, figured holotype USNM 84139 from the latter locality. Lea, 1867, Obs. Unio *11*: 49.

Unio semiplicatus Küster 1862, Conchylien-Cabinet (2) 9, pt. 2 *Unio*, p. 279, pl. 94, fig. 4 (Neu-Holland [Australia, error], location of type not known).

Description: Shell small, seldom exceeding 55 mm in length. Outline elongated rhomboidal. Valves inequilateral, inflated, subsolid. Anterior end regularly rounded, posterior end somewhat to acutely pointed. Ventral margin slightly curved or incurved, dorsal margin rather long and slightly curved, forming an indistinct angle with the obliquely descending posterior margin. Hinge ligament rather long. Posterior ridge low and rounded to rather high and sharp, sometimes slightly double. Posterior slope, and sometimes the greater part of the shell, corrugatedly plicate. Umbos slightly inflated and little elevated, their sculpture not observed, located at the anterior quarter of the shell. Surface of the shell quite smooth except where plicated. Periostracum generally shining, yellowish or greenish, marked with fine green rays which are generally broken or zigzag.

Left valve with two low, stumpy, pseudocardinal teeth and two curved lateral ones. Right valve with one pseudocardinal and one lateral. Anterior adductor muscle scars deep, posterior ones shallow. Pallial line impressed anteriorly, where the shell is thicker. Umbonal cavities slightly excavated. Nacre bluish-green, salmon, flesh color or white.

The male shell is generally arcuate, with the posterior end drawn to a rather sharp point at the posterior base. The female shell is somewhat swollen in the middle of the base, and the posterior point is a little above the base.

Length mm	Height mm	Width mm	
34	18	11	Chattooga River, Chattooga Co., Georgia. Male.
47	20	16	As above. Female.

Anatomy. The anatomy was discussed by Lea (see under the synonymy of: *rubellinus* 1858; *acutissimus* 1863: 411 [47]; and *parvulus* 1866). Ortmann (under *parvulus,* 1923: 59) said that the anatomy of the females he studied was practically identical with that of *M. conradicus* (Lea). He further noted that the glochidia were subspatulate like those of *conradicus* and that they corresponded to the minimum measurements known in the latter. Length 0.19; height 0.25.

Remarks. Medionidus acutissimus (Lea) is closest to *conradicus* (Lea), but differs from the latter in that it usually has a much more pointed posterior end, a sharper posterior ridge, and a posterior slope with coarse corrugations. The color rays are reticulated, interrupted or spotted, whereas those of *conradicus* are continuous.

M. acutissimus (Lea) of the Mobile-Alabama-Coosa River system is obviously derived from *conradicus* (Lea) of the Tennessee and Cumberland river systems. The presence of *Medionidus* in the Mobile-Alabama-Coosa river system affords evidence of a former connection between it and the Tennessee River system (van der Schalie, 1938: 27).

Ortmann (1923: 59, 60) distinguished between *acutissimus* and *parvulus* primarily on the basis that the former had a pointed posterior end and a sharp posterior ridge, whereas the latter was not pointed, and had a rounded posterior ridge, with a less plicate posterior slope. Van der

Schalie (1938: 14), with superior collections of the forms at his disposal, noted that they integrated. The most sharply pointed and plicated specimens are usually immature, which strongly suggests that these adaptations are useful in preventing dislocation from the substrate.

Three of the lots listed by Hurd (1974:98) under *conradicus* from the Mobile-Alabama-Coosa River system are actually *acutissimus* and are included here, under: Specimens Examined, with their catalogue numbers, the only data given by Hurd.

Range. Restricted to the Mobile-Alabama-Coosa River system in Tennessee, Georgia, Alabama, and Mississippi.

Abundance. M. acutissimus is a common species in the headwater streams in Tennessee and Georgia, where it is sometimes locally abundant; elsewhere it appears scarce. Formerly it was abundant in the Cahaba River, Lily Shoals, Bibb County, Alabama. Hurd (1974: 170–180), during an extensive survey of the Coosa River for Unionidae, collected at 194 stations, but he (1974: 42, 99) found a total of only 22 specimens of *acutissimus* from 4 localities.

Habitat. Lives mostly in small streams.

Specimens Examined

MOBILE-ALABAMA-COOSA RIVER SYSTEM

Conasauga River Drainage. *Tennessee:* Conasauga River. [town of] Conasauga, Polk Co. (MCZ and MZUM 51055). Coahulla Creek, 7.2 mi. SSE Cleveland, Bradley Co. *Georgia:* Conasauga River, Beaverdale; Swamp Creek; *both* Whitfield Co. Conasauga River, Gregorys Mill, 10 mi. N Eton; Upper Kings Bridge; Lower Kings Bridge; Campbells Mill; *all* Murray Co. Conasauga River, Fikes Ford, 1.4 mi. N Resaca, Gordon Co.

Oothkalooga Creek Drainage. *Georgia:* Oothkalooga Creek, 3.7 mi. SE Calhoun, Gordon Co.

Etowah River Drainage. *Georgia:* Etowah River [Bartow Co.] (Lea).

Chattooga River Drainage. *Georgia:* Duck Creek; Chattooga River, Martindale, (MZUM); *both* Walker Co. Arumchee Creek, Floyd Co. Chattooga River, Trion (CM); Summerville (MCZ and MZUM 51034, 69044); Lyerly (MZUM); Telloga Creek; *all* Chattooga Co.

Coosa River Drainage. *Alabama:* Mill Creek; Coosa River, Cedar Bluff (MZUM); *both* Cherokee Co. Big Canoe Creek, 9.5 mi. NE Ashville; Coosa River, Minnesota Bend (MZUM); *both* St. Clair Co. Choccolocco Creek, nr. Jackson Shoals (CM); Coosa River, Jackson Shoals (MZUM); Talladega Creek; *all* Talladega Co. Coosa River, Weduska Shoals, Shelby Co. (MZUM). Coosa River, Jumbo, Chilton Co. (MZUM).

Cahaba River Drainage. *Alabama:* Cahaba River, Henryellen, Jefferson Co. (MZUM). Shoal Creek, Montevallo; Cahaba River, Gurnee (MZUM); *both* Shelby Co. Cahaba River. Lily Shoals, Bibb Co. Cahaba River, 5 mi. NE Marion, Perry Co. (MZUM); Cahaba River, 10 mi. W Selma, Dallas Co.

Black Warrior River Drainage. *Alabama:* Locust Fork, 3.75 mi. WNW Selfville, Blount Co. Village Creek [nr. Burmingham]; Black Warrior River; *both* Jefferson Co. Black Warrior River, Lock 15, Rose Shoals, Tuscaloosa Co. (MZUM). Black Warrior River, Erie, Greene Co. (Conrad, 1838: 87).

Tombigbee River Drainage. *Alabama:* Sipsey River, Texas, Marion Co. (CM). Sipsey River, Elrod; Tynes; (*both* MZUM) *both* Tuscaloosa Co. *Mississippi:* Tombigbee River, Columbus (MCZ and MZUM); Floating Creek, Columbus (Hinkley); *both* Lowndes Co.

Medionidus penicillatus **(Lea)**

Plate 18, figs. 9, 10; Plate 19, figs. 1, 2

Unio penicillatus Lea 1857, Proc. Acad. Nat. Sci. Phila. *9:* 171 (Chattahoochee River, near Columbus [Muscogee Co.]; [Chattahoochee River] near Atlanta [De Kalb Co]; Flint River, near Albany [Dougherty Co.]; *all* Georgia). Lea, 1859, Jour. Acad. Nat. Sci. Phila. (2) *4:* 203, pl. 23, fig. 85, figured holotype USNM 84142 from the third locality. Lea, 1859, Obs. Unio *7:* 21. Clench and Turner (1956: 190), not have seen the type, mistakenly restricted the type locality to the first one mentioned.

Unio kingii B. H. Wright 1900, Nautilus *13;* 138 (a branch of the Flint River, Baker Co., Georgia; measured holotype USNM 159965, figured by Johnson 1967, Occ. Pap. on Moll., *3:* 7, pl. 5. fig. 6)

Description. Shell small, seldom exceeding 55 mm in length. Outline elongated rhomboidal to long elliptical. Valves inequilateral, subinflated, subsolid. Anterior end regularly rounded, posterior end with a rounded point near the base. Ventral margin straight or gently curved, sometimes slightly arcuate near the posterior end, dorsal margin slightly curved, merging imperceptably with the obliquely descending posterior margin. Hinge ligament rather long. Posterior ridge rounded to bluntly angled. Posterior slope usually strongly corrugated. Umbos slightly inflated and little elevated, their sculpture consisting of double looped ridges, located at the anterior quarter of the shell. Surface of the shell quite smooth except where plicated. Periostracum generally shining, yellowish or greenish, marked with fine green rays which are often broken, giving a mottled appearance.

Left valve with two low, stumpy pseudocardinal teeth and two curved lateral ones. Right value with one pseudocardinal and one lateral. Anterior adductor muscle scars deep, posterior ones very shallow. Pallial line impressed anteriorly. Umbonal cavities slightly elevated. Nacre purplish or greenish, often lurid and spotted, posteriorly iridescent.

The male shell generally has a straight ventral margin which may be slightly arcuate posteriorly. The female shell is generally smaller than that of the male, is more fully developed ventrally, and the posterior point is more elevated above the base than is that of the male.

Length mm	Height mm	Width mm	
52	27	20	Flint River, Bainbridge, Decatur Co., Georgia. Male.
44	23	17	As above. Female.

Anatomy. The anatomy was discussed by Lea (see under the synonymy of: *penicillatus* 1859) and the glochidum figured (1858: 47, pl. 5, fig. 5). The glochidia are subspatulate.

Remarks. Medionidus penicillatus (Lea) most closely resembles *acutissimus* (Lea) of the Mobile-Alabama-Coosa River system, from which it is undoubtedly derived. It differs from the latter, in that the shell is higher, less arcuate, and has a lower posterior ridge with a posterior slope that is generally more finely and strongly corrugated.

Van der Schalie (1940: 199, pl. 3, figs. 5, 6) figured a female shell as *penicillatus* and a male as *kingi*, recognizing both taxa as valid, however there is much integration of the forms, the acuteness of the posterior ridge and the amount of sculpture on the posterior ridge being variable.

Range. Yellow River System in Alabama; Econfina Creek system in Florida; and the Apalachicola River system in Florida, Georgia, and Alabama.

Abundance. The number of specimens in the collections studied indicate that this species is relatively abundant in the Apalachicola River system, especially the Flint River drainage, and is scarce elsewhere.

Habitat: Lives in sand and gravel in streams where there is moderate current. (Clench and Turner 1956: 191).

Specimens Examined

YELLOW RIVER SYSTEM

Yellow River Drainage. *Alabama:* Yellow River, 7 mi. NW Lockhart, Covington Co. (MZUM, collected by W. H. Heard, Oct. 1963).

ECONFINA CREEK SYSTEM

Econfina Creek Drainage. *Florida:* Econfina Creek 7 mi. W Youngstown, Bay Co.

APALACHICOLA RIVER SYSTEM

Chipola River Drainage. *Alabama:* Big Creek, nr. Taylor, Houston Co. (MZUM). *Florida:* Big Creek, 8 mi. W Malone; Spring Creek, nr. Alabama state line (MZUM); *both* Jackson Co. *Alabama:* Cowarts Creek, nr. Cowarts; Reedy Creek, nr. Madrid (MZUM); *both* Houston Co. *Florida:* Reedy Creek, 6 mi. W Malone; Chipola River, 1 mi. N Mariana; Spring Creek, 2.5 mi. SE Mariana (MZUM); Rocky Creek, 2.4 mi. NNW Sink Creek; *all* Jackson Co. Chipola River, 2.5 mi. SE Chason; 2 mi. E Clarksville; Dead Lake of Chipola River, 20 mi. S. Blountstown; *all* Cahoun Co.

Chattahoochee River Drainage. *Georgia* [Chattahoochee River], near Atlanta, [De Kalb Co.] (Lea). Mulberry Creek, 3 mi. SSE Mountain Hill, Harris Co. (Clench and Turner). Chattahoochee River, Columbus, Muscogee Co. Sawhatchee Creek, 14 mi NW Donalsonville, Seminole Co.

Apalachicola River Drainage. *Florida:* Apalachicola River, Chattahoochee, Gadsden Co.

Flint River Drainage. *Georgia:* Sandy Mount Creek, 6 mi, N Vienna, Dooly Co. Gum Creek, 2 mi. N Cordele; Cedar Creek, 6 mi. SW Cordele; *both* Crisp Co. Jones Creek, 2 mi. S Oakfield; Abrams Creek, 5 mi. S Oakfield (MZUM); Mill Creek, 8 mi. S Oakfield; *all* Worth Co. Branch of Flint River; Flint River; *both* Baker Co. Flint River, Albany, Dougherty Co. Ichawaynochaway Creek, Calhoun Co. (MZUM). Flint River, Bainbridge; Recovery; *both* Decatur Co.

***Medionidus walkeri* (B. H. Wright)**

Plate 19, figs. 3, 4

Unio walkeri B. H. Wright 1897, Nautilus *11*: 91 (Suwannee River, [Ellaville], Madison Co., Florida. Lectotype USNM 150506 selected by Johnson, 1969, Occ. Pap. on Moll. *3*: 9, pl. 8, fig. 1).

Description. Shell rather small, seldom exceeding 50 mm in length. Outline subrhomboid to ovate, but short. Valves inequilateral, rather inflated and solid. Anterior end regularly rounded, posterior end with a rounded point near the base. Ventral margin straight, dorsal margin forming a perceptable angle with the obliquely descending posterior margin. Hinge ligament short. Posterior ridge high and angled. Posterior slope with strong, curved, radiating corrugations. Occasional corrugations on the disk. Umbos full and high, their sculpture not observed, located at the anterior third of the shell. Surface of the shell often with strong irregular growth lines. Periostracum usually black or yellowish green; usually without rays, though sometimes with broad, very faint, greenish ones.

Left valve with two somewhat compressed pseudocardinal teeth, and two short lateral ones. Right valve with one pseudocardinal and one lateral. Anterior adductor muscle scars deep, posterior ones shallow. Pallial line distinct anteriorly. Umbonal cavities slightly excavated, with dorsal muscle scars under the hinge plate behind the pseudocardinal teeth. Nacre bluish white or pinkish.

The male shell is decidedly rhomboid, straight on the base, bluntly pointed at the posterior base, and obliquely subtruncate on the posterior slope. The female shell is smaller and longer than that of the male, is swollen just behind the central base, and the posterior point is raised above the base line.

Length mm	Height mm	Width mm	
44	26	16	Suwannee River, Ellaville, Madison Co. Florida. Male
40	22	14	As above. Female

Anatomy. Not known.

Remarks. Medionidus walkeri (B. H. Wright) is quite distinct from the other members of *Medionidus.* Male shells are more rhomboidal with a sharper posterior ridge with coarser plications than any other species. Although females tend to resemble *penicillatus,* the dark, generally rayless, periostracum distinguishes both sexes from any other *Medionidus.*

Range. Endemic to the Suwannee River system in Florida.

Abundance. Appears to be abundant at the type locality, but elsewhere known from small numbers of specimens.

Habitat. Found in sand and mud in slow, clear water.

Specimens Examined

SUWANNEE RIVER SYSTEM

Withlacoochee River Drainage. *Florida*: Withlacoochee River, Blue Spring, Madison Co.

Suwannee River Drainage. *Florida*: Suwannee River, Ellaville, Madison Co. Suwannee River, Bradford, Suwannee Co. Suwannee River, Oldtown, Dixie Co. (Clench and Turner). Suwannee River, Fannin Springs, Gilchrist Co.

Santa Fe River Drainage. *Florida*: Santa Fe River, Worthington Springs, Union Co.

Medionidus simpsonianus Walker

Plate 19, figs. 5-8

Medionidus simpsonianus Walker 1905, Nautilus *18:* 136, pl. 9, figs. 4, 5 ([Ochlockonee River], Calvary [Grady Co.], Georgia; holotype MZUM 98501).

Description. Shell small, seldom exceeding 55 mm in length. Outline elliptical. Valves inequilateral, rather inflated, subsolid. Anterior end regularly rounded and compressed, posterior end obtusely rounded, the tip being nearly on the medial line of the shell. Ventral margin distinctly and regularly curved. Dorsal margin slightly curved, merging imperceptibly with the posterior margin. Hinge ligament short. Posterior ridge somewhat angled. Posterior slope covered with strong, sub-concentric, somewhat irregular ridges, extending from the posterior ridge to the posterior margin. Sometimes with faint sculpture below the posterior ridge. Umbos rather low, their sculpture not observed, located at the anterior third of the shell. Surface of the shell smooth and usually polished. Periostracum dark yellow, yellowish green, or brownish, covered with dark green pencilled rays which tend to break into a distinctive network of angular lines covering the entire surface.

Left valve with two crenulate, compressed, pseudocardinal teeth, which are nearly in line and two delicate, straight, lateral ones. Right valve with one pseudocardinal and one lateral. Anterior adductor muscle scars deep, posterior ones very shallow. Pallial line usually visible. Umbonal cavities but slightly excavated with dorsal muscle scars under the hinge plate behind the pseudocardial teeth. Nacre bluish-white.

Sexual differences slight, the female shell is less elongate than that of the male.

Length mm	Height mm	Width mm	
44	21	15	Ochlockonee River, 7 mi. S Cairo, Grady Co. Georgia. Male.
42	24	15	As above. Female.

Remarks. Medionidus simpsonianus Walker differs from all other *Medionidus* in that the anterior end tends to be more compressed, the anterior margin more elevated, and the ventral margin is consistently and regularly rounded. The shell is equally curved above and below, the point being nearly on the medial line and not near the basal margin, as it is in all other *Medionidus,* giving *simpsonianus* a unique outline. When the rays are broken they break into angles which form patterns unlike those of any other of the species.

Range. Endemic to the Ochlockonee River system in Georgia and Florida.

Abundance. Long known only from the holotype and two paratypes, it was collected in some numbers from a single locality in 1934 and again from several localities in 1954.

Habitat. Lives in sand and gravel in streams where there is moderate current.

SPECIMENS EXAMINED

OCHLOCKONEE RIVER SYSTEM

Ochlockonee River Drainage. *Georgia*: Ochlockonee River, 7 mi. S Cairo; between Reno and Beachton; Calvary (MZUM): *all* Grady Co. *Florida*: Ochlockonee River, 11 mi. NW Tallahassee; 8 mi. W Talahassee; *both* Leon Co. Ochlockonee River, Wakulla Co. Little River, 3.5 mi. E Quincy, Gadsen Co.

***Medionidus mcglameriae* van der Schalie**

Plate 19, fig. 9

Medionidus mcglameriae van der Schalie 1939, Occ. Pap., Mus. Zool., Univ. Michigan, no. 407: 1-2, pl. 1, figs. 1-3 (Tombigbee River, Epes, Sumter Co., Alabama; holotype MZUM 130460).

Description. Shell very small not known to exceed 2.35 mm in length, "thin, oval in outline, somewhat swollen posteriorly. Posterior ridge low and well rounded, with a more or less prominent wing above the ridge. Beaks placed within anterior third of shell, but slightly raised above the hinge line. Beak sculpture not apparent because of erosion of the umbonal region. Anterior end of shell well rounded and somewhat cut away basally, giving the alate shell a wedge-shaped appearance laterally; posterior end broadly biangulate. Viewed from above the shell has a characteristic wedge shape with the greatest diameter at about the center of the posterior ridge. The outline of the shell when viewed thus tends to be somewhat twisted. The epidermis has a yellow-green background crossed by numerous fine, undulating often blotched, green rays, which are somewhat concentrated along the posterior half of the shell. Outer surface uneven, slightly reticulate, and crossed by prominent growth rests. Left valve with two inconspicuous, stumpy pseudocardinal teeth (the one just anterior to the umbone most prominent), and two rather remote, lamellar, curved laterals. Right valve with one blunt, prominent pseudocardinal and one prominent lateral, occasionally with a small spurious one above it. Nacre bluish white, thin, with relatively deep anterior muscle scars and the posterior scars evident but shallow." (van der Schalie)

Length mm	Height mm	Width mm	
2.35	1.2	0.75	Tombigbee River, Epes, Sumter Co., Alabama. Holotype.
2.10	1.0	0.50	As above. Paratype.

Remarks. Medionidus mcglameriae van der Schalie differs from all other *Medionidus* in that the shell is distinctly alate, and is wedge shaped both laterally and dorsally. It is also distinguishable by its small size, the the thinness of the shell, and the delicacy of the teeth.

It is assumed that this species evolved from *M. conradicus* or *acutissimus,* though it resembles neither very much.

Range. Endemic to the Tombigbee River drainage of the Mobile-Alabama-Coosa River system in Alabama.

Abundance. Known only from the holotype and a paratype in the Alabama Museum of Natural History.

Habitat. Found on a small sand bar in shallow water.

Specimen Examined

MOBILE-ALABAMA-COOSA RIVER SYSTEM

Tombigbee River Drainage. Alabama: Tombigbee River, Epes, Sumter Co. (MZUM).

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Plate 17
Distribution of the Genus *Medionidus*

Black dots. Distribution of *Medionidus conradicus* (Lea). Tennessee and Cumberland River systems, including the intervening Duck River drainage of the former.

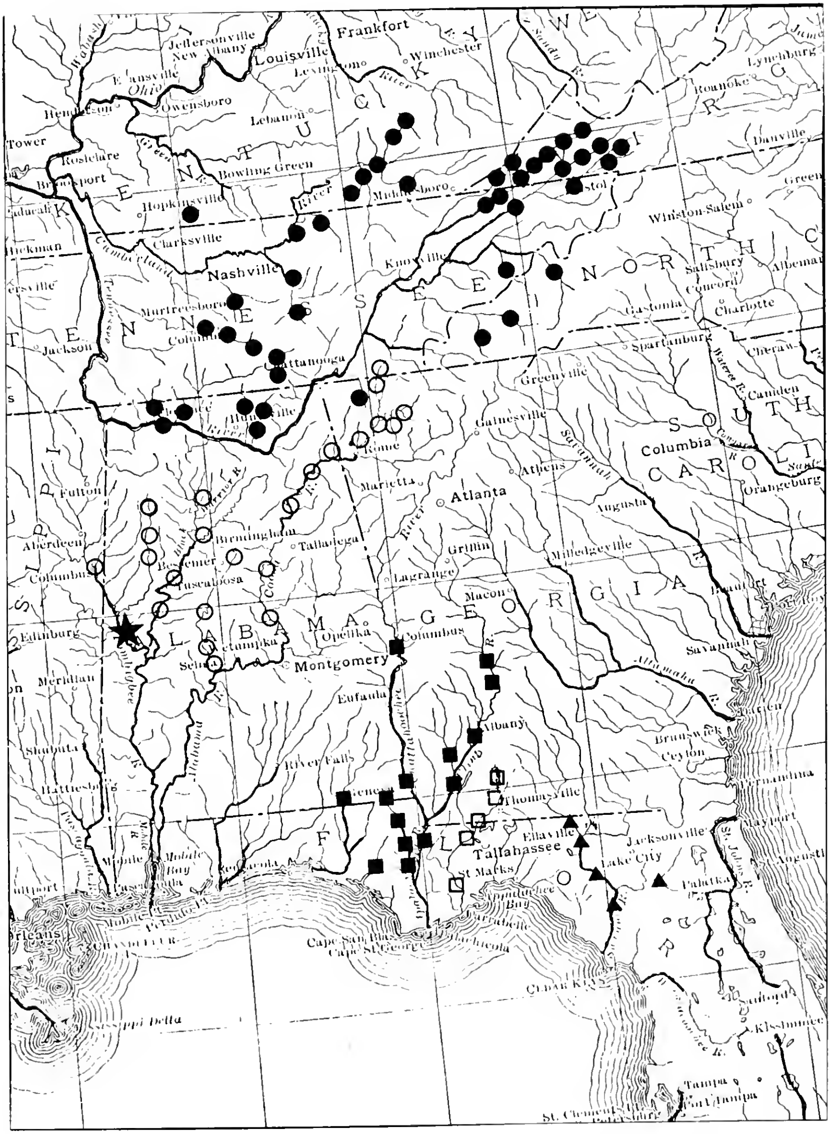
Open circles. Distribution of *Medionidus acutissimus* (Lea) Mobile-Alabama-Coosa River system.

Black star. Distribution of *Medionidus mcglameriae* van der Schalie. Known only from the Tombigbee River drainage of the Mobile-Alabama-Coosa River system at Epes, Sumter Co. Alabama.

Black squares. Distribution of *Medionidus penicillatus* (Lea). Yellow River system, Econfina Creek system, and the Apalachicola River system.

Open squares. Distribution of *Medionidus simpsonianus* Walker. Ochlockonee River system.

Black Triangles. Distribution of *Medionidus walkeri* (B. H. Wright). Suwannee River system.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Orangeburg
Augusta
Milledgeville
Griffin
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Thomasville
Tallahassee
St. Marks
Ellaville
Jacksonville
Lake City
Palatka
Savannah
Darien
Brunswick
Fernandina
Birmingham
Talladega
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Tuscaloosa
Wetumpka
Selma
Columbus
Aberdeen
Fulton
Meridian
Shubuta
Hattiesburg
Mobile
Mobile Bay
Pensacola
River Falls
Geneva
Cape San Blas
Cape St. George
Apalachicola
Tampa
Kissimmee
Charlotte
Gastonia
Salisbury
Concord
Winston-Salem
Danville
Roanoke
Lynchburg
Camden
Cheraw
Henderson
Tower
Hickman
Paducah
Orleans
Mississippi Delta
KENTUCKY
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
FLORIDA
MISSISSIPPI
VIRGINIA

Plate 17

Plate 18

Medionidus conradicus (Lea)

Fig. 1. Virginia. Specimen identified by Lea, MCZ 178931. Length 45 mm, height 20 mm, width 12 mm. Male.

Fig. 2. *Unio conradicus* Lea. [Caney Fork of the Cumberland River, Tennessee]. Holotype USNM 84134. Length 47 mm, height 23 mm, width 18 mm. Female.

Medionidus acutissimus (Lea)

Fig. 3. *Unio acutissimus* Lea. Alabama River. Type lost. Figure from Lea. Length 28 mm, height 12 mm, width 9 mm. Male.

Fig. 4. Alabama. Specimen identified by Lea, MCZ 178887. Length 22 mm, height 10 mm, width 7 mm. Female.

Fig. 5. *Unio rubellinus* Lea. Oothkalooga Creek, Gordon Co. Georgia. Holotype USNM 84136. Length 38 mm, height 19 mm, width 15 mm. Male.

Fig. 6. Conasauga River, Campbells Mill, Murray Co. Georgia. MCZ 64057. Length 47 mm, height 21 mm, width 14 mm. Female.

Fig. 7. *Unio parvulus* Lea. Chattooga River, Gordon Co. Georgia. Holotype USNM 84139. Length 41.5 mm, height 18 mm, width 11 mm. Male.

Fig. 8. *Unio semiplicatus* Küster. [Alabama River system]. Location of type know known. Figure from Küster. Length 24 mm, height 11 mm, width 9 mm. Female.

Medionidus penicillatus (Lea)

Fig. 9. *Unio penicillatus* Lea. Flint River, near Albany, Dougherty Co., Georgia. Holotype USNM 84142. Length 33.5 mm, height 18, width 12.5 mm. Male.

Fig. 10. *Unio kingii* B. H. Wright. A branch of the Flint River, Baker Co., Georgia. Holotype USNM 159965. Length 37, height 20, width 15 mm. Female.

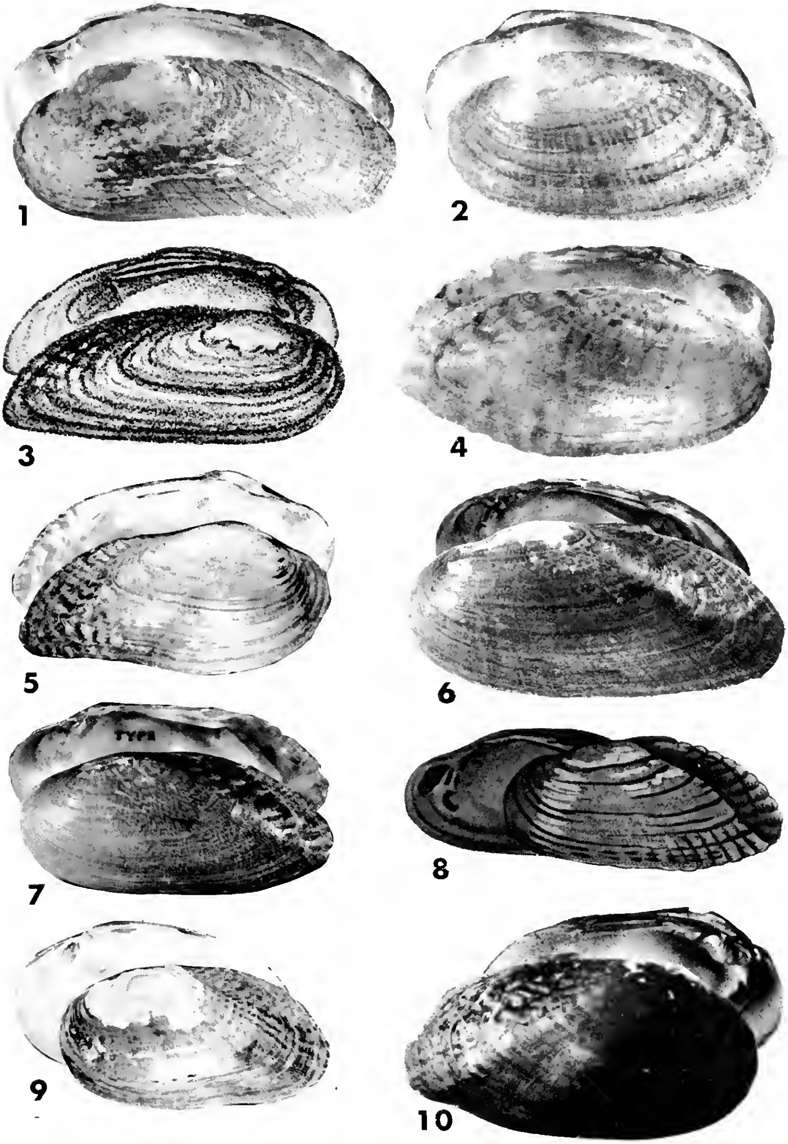


Plate 18

Plate 19

Medionidus penicillatus (Lea)

Fig. 1. *Unio kingii* B. H. Wright. A branch of the Flint River, Baker Co., Georgia. Paratype MCZ 30045. Length 41, height 21, width 15 mm. Male.

Fig. 2. *Unio kingii* B. H. Wright. A branch of the Flint River, Baker Co., Georgia. Paratype MCZ 20156. Length 34 mm, height 20 mm, width 14 mm. Female.

Medionidus walkeri (B. H. Wright)

Fig. 3. *Unio walkeri* B. H. Wright. Suwannee River [Ellaville], Madison Co., Florida. Lectotype USNM 150506. Length 47, height 25 mm, width 17 mm. Male.

Fig. 4. Suwannee River, Ellaville, Madison Co., Florida. MCZ 30049. Length 45 mm, height 22 mm, width 16 mm. Female.

Medionidus simpsonianus Walker

Fig. 5. *Medionidus simpsonianus* Walker. [Ochlockonee River], Calvary, [Grady Co.], Georgia. Holotype MZUM 98501. Length 36 mm, height 19 mm, width 13 mm. Male.

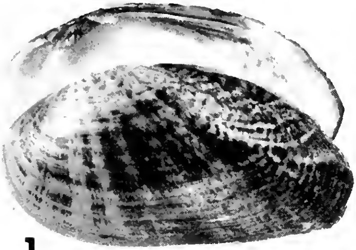
Fig. 6. Ochlockonee River, 7 mi. S Cairo, Grady Co., Georgia. MCZ 190298. Length 42 mm, height 24 mm, width 16. Female.

Fig. 7. Ochlockonee River, 7 mi. S Cairo, Grady Co., Georgia. MCZ 190298. Length 45 mm, height 23 mm, width 17 mm. Male.

Fig. 8. Little River, 3.5 mi. E Quincy, Gadsden Co., Florida. MCZ 190301. Length 33.5 mm, height 19 mm, width 13 mm. Female.

Medionidus mcglameriae van der Schalie

Fig. 9. *Medionidus mcglameriae* van der Schalie. Tombigbee River, Epes, Sumter Co., Alabama. Holotype MZUM 130460. Length 2.35 mm, height 1.2 mm, width 0.75 mm.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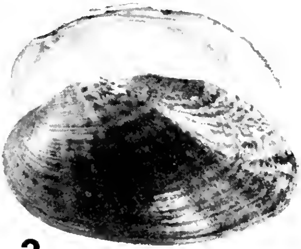
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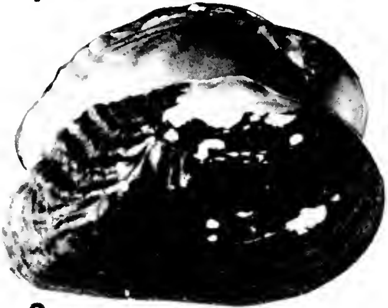
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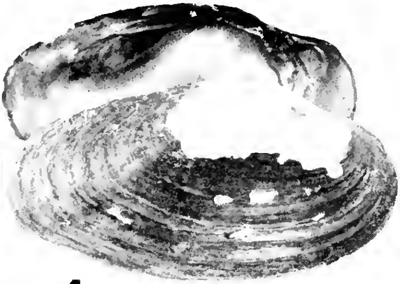
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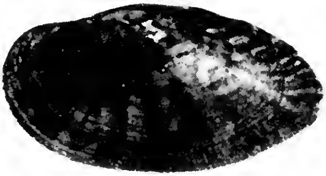
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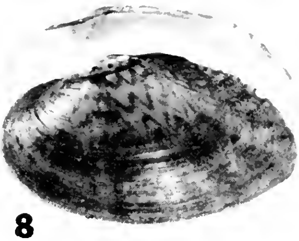
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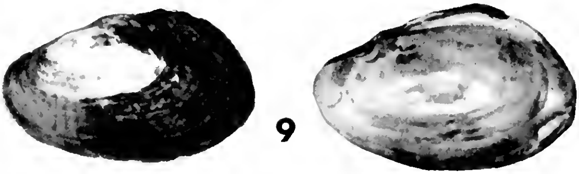
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Plate 19

Book Review

Hurlburt, Sarah. 1977. *The Mussel Cookbook*. Harvard University Press, Cambridge, 169 pp., text illustrations. 8 vo. $8.95.

Years ago, after our first feast of steamed mussels, with white wine and butter, my family swore an oath to dine forevermore on *Mytilus edulis* in lieu of our old favorite, the Cape Cod steamer, *Mya arenaria*. Some of the family may have made this choice because of Yankee frugality. Blue mussels were, and still are, abundant, accessible, and only costly in the labor of harvesting.

Now, Sarah Hurlburt gives the blue mussel its culinary due. Whether it be a traditional Éclade from Provence or a novel variation on the Hawaiian Pupus, she runs the gamut of international mussel cuisine. *Mytilus* readily adapts to soy sauce, wine, beer, or cream bases; to cloves, capers, basil, horseradish, saffron, or dijon spices; to potato, eggplant, tomato, or even to the piquant cranberry complements.

The author offers more than a mere cookbook. She provides a reasoned argument for our cultivation of mussels. This shellfish grows plump on phytoplankton; cattle grow fat on grain. Beef cattle consume 21 pounds of protein to produce one pound of meat protein. Granted our Western palate can afford steak, but as prices rise, Hurlburt suggests that we acquire a preference for this protein of the sea.

She suggests we seriously consider the mariculture of *Mytilus*. This has been successful in Europe, where yields are impressive. Spain, the world's largest producer, cultivates mussels on rafts and produces upwards of 220,000 tons a year. France's pole culture and Holland's bottom culture also have high yields. Hurlburt proposes that a site such as Cape Cod Bay, an area of less than 300 square miles, could be a blue mussel fishery. Ideally, she envisions the Bay as yielding 43 billion pounds of meat a year!

The mussel is a filter feeder, reaping a mixed harvest of nutrients and whatever contaminants, natural or otherwise, flow with the tide. The problem is to keep the mariculture free from pollution and invasions of such dinoflagellates as *Gonyaulax*, which cause paralysis.

Purchase this succulent shellfish in the market, or have fun and gather *Mytilus* from our rocky shores. Then prepare this delicacy, following one of the author's recipes that accords with your mood.

—HARRIET HORNBLOWER

Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 21, 1977 NUMBER 57

Monograph of *Iacra* (Bivalvia: Semelidae)

By KENNETH J. BOSS

Abstract. The alpha-taxonomy of the semelid subgenus *Iacra* reveals that there are three living species of this taxon of bivalves: *seychellarum*, *petiti*, and *trotteriana*, all with principal centers of distribution in the Western Indian Ocean. Primary type-material for all species-level nomina was reviewed; lectotypes were chosen for *Scrobicularia seychellarum* and *Iacra petiti* Dautzenberg; and a neotype for *Strigillina lactea* Dunker was designated. *Iacra* is of interest because of its acentric, scissulate sculpture which converges with that of the tellinid *Strigilla*.

INTRODUCTION

Iacra constitutes a little known group of bivalves which belong to the tellinacean family Semelidae and which, though one species ranges into the tropical western Pacific, is principally distributed in the Western Indian Ocean. Conventionally, the taxon which was introduced by H. and A. Adams (1856), is considered a subgenus of the cosmopolitan, highly eurytopic genus *Abra* (Dall, 1900; Thiele, 1935; Keen, 1969).

Phenomenally interesting is the convergent resemblance which *Iacra* bears to the tellinid *Strigilla*. Both *Iacra* and *Strigilla* are similarly shaped, being more or less roundly ovate or circular in outline, and both exhibit the so-called acentric scissulate sculpture (Boss, 1966). Superficially the shells of the two genera are so similar externally that only the morphology of the hingement can differentiate them. *Iacra* has the typical semelid hinge which bears an internal ligament or resilium in a subtending supportive chondrophore; tellinids lack this structure. The two genera are more or less allopatric: *Strigilla* is represented by a couple of poorly known species in the Australian and West African regions and has its central radiation in Western Tethys, embracing the Caribbean and Eastern Pacific regions. *Iacra* is found mainly along the coast of East Africa, around Madagascar and in the Red Sea.

Sculpture in the bivalves is usually formed concentrically as the shell grows periodically around its entire mantle edge or radially as structural differentiations in the shell form at discrete positions along the edge of the mantle. In the case of acentric sculpture, the peripheral mantle secretory areas shift positions during growth and form the sculpture discordantly. Such unusual sculpture has arisen several times among lineages in the superfamily Tellinacea (Boss, 1966) and occurs in several other families of bivalves as well (Seilacher, 1972). Among tellinids, the suborbicular shape and bilaterally acentric sculpture is typical of *Strigilla* (Boss, 1969) while within the confines of the family Semelidae, it is limited to *Iacra*. As illustrated in Plate 20, figs. 1-3, the acentric incised scissulations cover the surface of the disc of the shell and descend ventrally at an angle of about 45°. Along the posterior dorsal slope the sculpture is angled upward and the lirations are compressed closer together while along the anterior dorsal slope, simple concentric sculpture is evident as is the marked zone where discordance commences (Plate 20, fig. 4). In *Iacra* as well as in *Strigilla,* the exact nature of these differential sculptures combine with features of the pallial sinus, dentition and size of the shell to form taxobases which distinguish species.

The functional and adaptive significance of discordant sculpture in *Strigilla* has been discussed by Stanley (1969: 1970). By inference, this unusual sculpture probably serves the same functional role in *Iacra*. *Strigilla carnaria* and *S. mirabilis* from Puerto Rico are very rapid burrowers. They position themselves vertically with an active and extensible foot and commence penetration of the substrate with a rocking movement during which the scissulations dig into and displace the sand. The acentric sculpture, thus, acts as an important mechanical aid in the penetration of, and slipping through, the substrate. *Strigilla* normally lives in clear sandy substrates where current or wave action frequently necessitates reburial or at least downward movement for maintenance of normal burrow depths (Stanley, 1969). The animals are rather deep burrowers and live in depths of the sediment several times their own shell lengths. The position taken up in the sediment is various but always with the posterior end uppermost and at least the incurrent siphon extending toward the substrate interface. Presumably *Strigilla* is a suspension or interstitial feeder since deposit feeding was not observed in either *S. carnaria* or *S. mirabilis* (Stanley, 1970). It is also probable that the grain of the acentric sculpture serves to maintain position in the substrate as well as to anchor the shell when the siphons are retracted (Boss, 1966). Although little information is available on the ecological preferences of the three species of *Iacra*, most of the data point to their preferring sandy substrates in subtidal depths, and utilizing their sculptural peculiarities in much the same way as *Strigilla*.

ACKNOWLEDGMENTS

The following are acknowledged for the loan of specimens and exchange of correspondence: R. T. Abbott (DMNH), P. H. Boshoff, Port Alfred, and B. C. Fabian, University of Witwatersrand, Johannesburg, Republic of South Africa, J. van Goethem (IRSNB), T. Habe (NSMT), B. F. Kensley (SAM), R. Kilias (ZMB), R. Oleröd (NR), O. Paget (NMW), J. P. Pointier (MNHNP), R. Robertson (ANSP), J. Rosewater (USNM) and K. M. Way (BMNH). Critical readings of the MS were made by R. I. Johnson and R. D. Turner.

ABBREVIATIONS

ANSP — Academy of Natural Science, Philadelphia
BMNH — British Museum (Natural History), London
DMNH — Delaware Museum of Natural History, Greenville
IRSNB — Institut Royal des Sciences Naturelle de Belgique
MCZ — Museum of Comparative Zoology
MNHNP — Muséum National d'Histoire Naturelle, Paris

NMW — Naturhistorisches Museum, Wien
NR — Naturhistoriska Riksmuseet, Stockholm
NSMT — National Science Museum, Tokyo
SAM — South African Museum, Cape Town
USNM — National Museum of Natural History, Washington
ZMB — Zoologisches Museum der Humboldt-Universität, Berlin

SYSTEMATIC SECTION

SUBGENERIC SYNONYMY

Iacra H. and A. Adams 1856, Gen. Rec. Moll. 2: 409 (type-species, by monotypy, *Scrobicularia seychellarum* A. Adams, 1856).

Strigillina Dunker 1861, Malak. Blätt. 8: 43 (type-species, by monotypy, *Strigillina lactea* Dunker, 1861).

Jacra Dunker 1882, Nov. Conch. Suppl. 7: 194, error *pro* *Iacra* H. and A. Adams 1856.

Remarks. Iacra is differentiated from all other semelids by its elaboration of acentric scissulate sculpture very similar to that found in the tellinid *Strigilla.* The presence of an internal ligamental element which is supported by a variously shaped chondrophore allocates *Iacra* to the Semelidae (Boss, 1972). As Keen (1969) has pointed out, *Iacra* is placed in the genus *Abra* which consists of species whose shells tend to be thinner and smaller than *Semele.* More importantly, the pallial sinus of *Abra* and its constituent *Iacra* are confluent with the pallial line while in *Semele* the pallial sinus ascends obliquely from the pallial line at its most posteriad.

Iacra consists of three species: *seychellarum* with strongly developed internal chondrophore, narrowly set, incised scissulations, whitish coloration and wide tropical western Pacific and Indian Ocean distribution; *petiti* also with strongly developed internal chondrophore, rather widely set, incised scissulations, mostly yellowish-purplish coloration and a distribution restricted to Madagascar and the adjacent coasts of southern Africa; and, *trotteriana* with a weakly developed, obscure internal chondrophore, variously set and developed sculpture, whitish coloration and poorly known distribution in the Western Indian Ocean including the Red Sea, South Africa and Madagascar.

Abra (Iacra) seychellarum (A. Adams)

Plate 20, figs. 1-4; Plate 21, figs. 1-3
Plate 22, figs. 1-4; Plate 23, figs. 1-2
Map 1

Scrobicularia seychellarum A. Adams 1856, Proc. Zool. Soc. London *24:* 53 (lectotype, here selected, BMNH 78.1.28.197; type-locality, Seychelles [Seychelle Islands]).

Scrobicularia (Iacra) seychellarum (A. Adams). H. and A. Adams 1856 (Nov.) Gen. Rec. Moll. *2:* 409.

Strigillina lactea Dunker 1861, Malak. Blätt. *8:* 43-4 (neotype, here selected, MCZ 288004; type-locality, aus dem Rothen Meere).

Iacra japonica A. Adams 1864, Ann. Mag. Nat. Hist., (3), *13:* 307-315 (holotype, lost, not located in the BMNH, *pers. comm.* Ms. K. Way; type-locality, Kino-O-Sima [Japan]).

Syndosmya strigilloides Vaillant 1865, Jour. de Conch. *13:* 125, pl. 6, fig. 1 (holotype, MNHNP; type-locality, sur la plage du désert de l'Attaka, Baie de Suez).

Iacra vaillanti 'Jousseaume' Sowerby and Fulton, 1903, Recent Mollusca. A catalogue of Pelecypoda and Brachiopoda, p. 22, *nomen nudum*.

Description. Shell extending to 20 mm in length, 18 mm in height, and 9.0 mm in width, rounded-subtrigonal in outline, slightly inequilateral with posterior portion somewhat greater in length than anterior, moderately inflated with right valve slightly more convex and with slight flexure to left posteriorly. Umbos subcentral, slightly anteriad, a little elevated above the hinge line, pointed and weakly opisthogyrous. Anterior margin broadly rounded, distinctly separated from anterior dorsal margin in right valve; ventral margin weakly convex to almost straight; posterior margin broadly subtrigonal, forming weakly pointed posterior outline; anterior dorsal slope short, slightly convex; posterior dorsal margin longer, more or less straight and rather steeply inclined.

Sculpture consisting of three moieties: anteriorly concentric, finely incised lirations (2-6/mm) and more closely crowded along anterior dorsal slope; scissulate lirations over the postero-central portions of disc (2-6/mm) and extremely closely-spaced, finely incised lirations along posterior dorsal slope (8-16/mm). Posterior ridge weakly developed, especially in left valve. Putative growth annulae from 1 to 7, indicated by differential translucence of shell substance.

Ligament opisthodetic, consisting of very short, external, mostly periostracal element in elongate-lanceolate, weakly distinct escutcheon, an internal variously developed, but usually rather strong, elastic, calcareous portion, resting in spatulate chondrophore.

Hinge line consisting of both cardinal and lateral dentition. Dentition stronger in right valve, cardinal complex consisting of short, protuberant, narrowly subdeltoid anterior and posterior teeth; right anterior lateral tooth subproximal to cardinal complex, shelf-like, bluntly pointed and socketed above; right posterior lateral tooth distal, posterior to external ligament and chondrophore, elongate, narrowly shelf-like, bluntly pointed and socketed above. In left valve, cardinal complex consisting of narrowly to strongly subtrigonal anterior cardinal tooth and thin, obsolete, frequently absent posterior cardinal tooth, often consisting of nothing more than a wrinkle along the ventral edge of the internal ligament. Anterior lateral tooth subproximal to cardinal complex, very weak, consisting of irregularly pointed or knob-like protuberance; posterior lateral tooth even weaker, distal, behind the posterior to ligamental plate, and consisting of pointed, shelf-like protuberance.

Muscle scars not strongly impressed. Anterior adductor muscle narrowed and more elongate than rather rounded posterior adductor. Pallial sinus unequal in opposite valves. In right valve, pallial sinus not contiguous with anterior adductor muscle, gently descending anteriorly from posterior adductor muscle to form confluence with pallial line along ventral margin. In left valve, pallial sinus arising slightly from posterior anterior muscle to form gentle arch and subsinuately descending anteriorly to confluence with pallial line at or very near anterior adductor muscle.

Shell white, opalescent, very rarely with whitish-gray, vague, mostly central suffusions; internally frequently highly polished.

Measurements:

Length	Height	Width	H/L	W/L	Remarks
21.5 mm	17.2 mm	mm	.80		lectotype of *seychellarum* left valve
16.0	13.0	6.0	.81	.37	holotype of *strigilloides*
14.2	12.0	6.3	.84	.44	neotype of *lactea*
18.4	15.7	8.4	.85	.46	Red Sea
17.6	14.3	5.9	.81	.34	Mahé, Seychelle Is.
17.0	14.1	7.8	.83	.45	Ceylon
16.9	14.9	8.3	.88	.49	Red Sea
15.3	12.4	5.2	.81	.34	Aden
13.5	10.8	5.7	.80	.42	Mahé, Seychelle Is.
12.3	11.3		.91		Thursday Is.
10.5	9.2	4.9	.88	.46	Mahé, Seychelle Is.
9.4	8.4	5.0	.90	.53	Ugui, Shingu City, Japan
8.9	6.5	3.5	.73	.39	Luzon
8.8	6.2	3.4	.70	.38	Ceylon
6.8	5.4	3.1	.79	.45	Madras, India
6.5	4.8	2.5	.74	.38	NW Bay, Mahé, Seychelle Is.
5.5	4.8		.87		Bien Son, Vietnam

Types. Adams (1856) described *Scrobicularia seychellarum* on specimens obtained by a Mr. Ricketts and, at that time, belonging to the Cuming Museum. I have chosen a lectotype from a placque in the BMNH which is marked "M.C." but which does not bear the name of Ricketts. The lectotype (Plate 20, fig. 3; Plate 22, fig. 3) consists of one broken right valve and one complete left valve measuring 21.5 mm in length and 17.2 mm in height and bears the catalog number 78.1.28.197. This is the first illustration of the type-specimen, the only previous figure of a specimen referred to as '*seychellarum*' being that of Boshoff (1965, p. 183, pl. 9, fig. 2) from Punta Torres, Inhaca, Mozambique. The back of the placque in the BMNH bears the contradictory notation: "smallest from the Colln of H. Adams 78.1.28.197". The other two remaining specimens on the placque are also *seychellarum,* one consisting of one complete pair, probably that of Preston from Ceylon, the other of an imperfect set comprized, like the type, of a broken right valve and a complete left valve; this latter specimen is probably the one cited by McAndrew (1870) from Suez in the Red Sea.

Since Dunker (1861: 44) specifically states that the specimens upon which he based his description were in the collection of H. Dohrn in Stettin and since that collection was destroyed in World War II (Dance, 1966: 285), I have selected a neotype (MCZ 288004) (Plate 21, figs. 1 and 2) which was originally in the Dohrn collection and which bears an old hand-written label stating "*Strigillina* [Dkr.] n. genus near *Semele* [*lactea* Dkr.] Red Sea". The neotype measures 14.2 mm in length and 12.0 mm in height; the original holotype was 16 mm long. Type-material of this specific nomen has never been illustrated and the first and only illustration of specimens referred to *lactea* was by Odhner (1919, p. 28, pl. 2, figs. 20 and 21), a sample dredged from Tamatave, Madagascar and preserved in the Kaudern Collection of the Rijksmuseum in Stockholm.

Type-material of *Iacra japonica* A. Adams could not be located in the BMNH (Ms. K. Way, *pers. comm.*); an illustration bearing this specific epithet has only been published once (Habe, 1952: 209, figs. 503-4). The original type-locality, Kino-O-Sima is surely problematic and can not be pin-pointed. Consultation with a gazetteer of Japan (U.S. Board on Geographic Names) shows that there are at least 12 islands of the name Okino-Shima, including one in the Oki Guntō (Oki Archipelago) on the west coast of Japan in the Japan Sea at 36°N; 133°E. The original specimens of *I. japonica* probably came from somewhere along the Pacific Coast of Japan as the known Oriental population of *seychellarum* (= *japonica*) extends along that coast and the southern islands from 23° to 34°N (Kuroda and Habe, 1952: 12).

The holotype of *strigilloides* (Plate 20, figs. 1 and 2; Plate 22, figs. 1 and 4) in the MNHNP measures 16 x 13 x 6 mm and was figured in the original description (Vaillant 1865: pl. 6, fig. 1; the type locality was given as 'sur la plage du désert de l'Attaka'; the label with the holotype specimen does not bear this specific locality but reads 'Baie de Suez'. After a thorough search of several gazetteers, including the French Colonial Atlas, I was unable to locate any place called Attaka in the Suez area.

Shortly following Vaillant's description, Semper (1866: 166) pointed out that *strigilloides* was a synonym of *Strigillina lactea* Dunker 1861. In his original description of *strigilloides*, Vaillant noted that the species, here referred to the semelid genus *Abra*, resembled the genus *Strigilla* of the Tellinidae in the unusual superficial sculpture on the surface of the shell.

Anthony (1905) cited '*Syndesmya strigilloides*' from the Gulf of Tajura, near Djubiti, in the Gulf of Aden though the specimen bearing this locality in MNHNP is *trotteriana*. Lamy (1913: 296-7) placed *strigilloides* in the synonymy of *Syndesmya (Iacra) lactea* Dunker and noted that the type was in the Collection of the Museum in Paris.

Iacra vaillanti is a *nomen nudum*, having never been described by either Jousseaume, Sowerby or Fulton; specimens labelled *vaillanti* were sent by Sowerby to Lamy (1913: 297) who recognized that they were *lactea* [=*seychellarum*].

Remarks. Of the three species which constitute *Iacra, seychellarum* is surely the best known and most widely distributed. From *trotteriana,* it may be distinguished by its large conspicuous chondrophore while from *petiti,* to which it is more closely allied, it can be differentiated by its finer sculpture (2-6 scissulations per mm), more subtrigonal shape, more fragile, thinner valves, generally white coloration, and pallial sinus, which in the left valve is contiguous with the anterior adductor muscle. Additionally, *seychellarum* is almost always more laterally compressed than *petiti* (W/L mean = .42).

The range of *seychellarum* overlaps that of *trotteriana* along the coast of East Africa, in the Red Sea and possibly in Madagascar. *Iacra petiti* probably does not co-exist with *seychellarum* although there are some geographic records from Madagascar which might so indicate, but there are too few samples known to have been obtained from living populations.

Iacra seychellarum is less variable than *trotteriana* in shell features. Usually it is relatively thinly shelled and its sculpture tends to consist of rather evenly spaced, finely incised scissulations which number about 2-6 per mm. The species is apparently rather rare in the eastern portion of its range and smaller in size than in the western Indian Ocean (see measurements and compare Plate 23, figs. 1 and 2). The few samples from Japan, Vietnam, the Philippines, the East Indies, the Torres Straits and the subcontinent of India indicate its rarity and consist of smallish individuals with noticeable subtrigonal and rather pointed posterior outlines. Very occasionally specimens will lack the union of the pallial sinus and the anterior adductor muscle scar in the left valve; in these few individuals the sinus becomes confluent with the pallial line just ventral to the anterior adductor.

Evidently the species prefers relatively shallow water and a sandy substrate (Taylor, 1968), and though there are no real data to substantiate the generalization, it appears that *seychellarum* lives in large populations where the ecological conditions are optimal—namely the warm tropical waters of the outlying islands of east Africa.

In immature specimens, at size ranges below 5 mm in length, the outline of the valves is distinctly tellinoid being more subquadrate-elongate than in adults. Shells at 2-3 mm in length are extremely fragile, have a distinct and strong internal resilium resting in a pendant chondrophore. Acentric scissulate sculpture is already apparent, especially in the right valve, in very young individuals even only 3 mm long, it consists at this stage of 4 or 5 angled, incised lines along the posterior portion of the disc. Such sculpture begins just after the smooth tiny prodissoconch, at shell lengths of 1.5–2 mm.

In a very few individuals, especially smaller ones, the pallial sinus of the left valve is not wholly contiguous with the anterior adductor muscle but is confluent with the pallial line just ventral to the adductor scar. The shells, however, are recognizable as *seychellarum* by their lateral compression, fine sculpture, and subtrigonally pointed posterior outline.

From collection data it is apparent that the species prefers clean, white sand as its substrate; living animals have been procured in from 1–8 fathoms of water although McAndrew

(1870) and Cooke (1886) cited a range from 10–20 fathoms.

The record of *Strigilla carnaria* Linnaeus from Mauritius provided by Viader (1937) may well refer to *I. seychellarum*.

Published records for the distribution and occurrence of *I. seychellarum* (and its synonyms) include: entrance to Suez Canal, Egypt ("sur la plage de Moya Soukhn", Moazzo, 1939); Hammam Faraoun, Egypt (Lamy, 1938); Bay of Suez (Vaillant, 1865; Semper, 1866; Issel, 1869; McAndrew, 1870; Cooke, 1886); Red Sea (Dunker, 1861; Paetel, 1892; Sturany, 1901); Aden (Smith, 1891; Anthony, 1905); Seychelle Islands (Adams, 1856; Adams and Adams, 1856); Madagascar (Odhner, 1919; Dautzenberg, 1929; 1932); South East Asia [Annam=Vietnam] (Dautzenberg and Fischer, 1906); Taiwan (Kuroda, 1941; Skarlato, 1965); Japan from 23°–34°N (Adams, 1864; Dunker, 1882; Habe, 1952; Kuroda and Habe, 1952).

Specimens examined (Map 1). MOZAMBIQUE: Delagoa Bay (SAM). MADAGASCAR: plage de Tuléar; baie de Ranofotsy, SW of Fort Dauphin; baie de Galions, W of Fort Dauphin; plage de Vatomandry; plage d'Andevoranto, N of Vatomandry (all IRSNB); Tamatave (NR); Nosy Bé (SAM); 2 mi SE of Nosy Iranja, 32 mi SW of Nosy Bé, 8 fms sand (DMNH; ANSP); Nosy Iranja, 10–12 m (MCZ); 6–20 ft, clear white sand, between Ambatoloaka and Madirokely, SW of Nosy Bé (ANSP); 0–8 ft, sand, grass, coral, rock between Ambatoloaka and Madirokely, SW Nosy Bé (ANSP). TANZANIA: Mbos Mogi, 9 mi S of Dar-es Salaam (USNM). SEYCHELLE ISLANDS: Seychelles (USNM; IRSNB); Mahé (BMNH); NW Bay, Mahé (BMNH); Port Ternay, NW Mahé (MCZ); 15-40 ft, sand and grass, Port Ternay, NW Mahé (ANSP). ADEN: (BMNH; IRSNB; MNHNP; NMW; USNM; ZMB); Khor Maksar Beach, Aden (BMNH). EGYPT: *Pola* Station 5, Rás Mallap, 29°12′N; 32°55′E, off Sinai Peninsula, Gulf of Suez (NMW); Suez; Baie de Suez (both MNHNP); Red Sea (IRSNB; MCZ; MNHNP; ZMB). INDIA: Sindi, presidency of Bombay, between Cutch and Beloochistan; Madras (both BMNH). CEYLON: Ceylon (BMNH). INDONESIA: Pelaboen Ratoe, [=Palabuhan Ratu], 7°05′S; 106°27′E, Java (USNM). VIETNAM: Bien Son, N of Vinh, Gulf of Tonkin (IRSNB).

PHILIPPINE ISLANDS: Luzon (IRSNB). AUSTRALIA: Thursday Island, 10°35′S; 142°13′E, 30 mi N of Cape York, Torres Strait, N. Queensland (BMNH). JAPAN: Ugui, Shingu-City (33°39′N; 135°58′E), Wakayama Pref., Honshu (NSMT).

***Abra* (*Iacra*) *petiti* (Dautzenberg)**

Plate 24, figs. 1–4; Map 2

Iacra petiti Dautzenberg 1923, Jour. de Conch. *68*: 72–74, 3 figs. (lectotype, here selected, IRSNB; type-locality, here selected, plage d'Ankilibé (23°25′S; 43°45′E), Madagascar).

Description. Shell extending to 14 mm in length and to 13 mm in height, subovoid, slightly inequilateral, subequivalve with left valve slightly larger, more inflated and convex, solid, rather plump and inflated with barely detectable posterior flexure to right. Umbos slightly anterior to the middle, pointed, nearly orthogyrous, flattened, and left umbo a little lower than right. Anterior margin broadly rounded and gently convex; ventral margin broadly convex; anterior dorsal margin short, gently inclined, more or less straight and tending to abrupt confluence with anterior margin; posterior dorsal margin longer, steeply inclined and more or less straight; posterior margin short and weakly convex.

Sculpture consisting of three moieties: anterior slightly acentric, incised, rather widely spaced lirations (2–4/mm) more crowded along dorsal slope; acentric, posteriorly descending scissulations on central disc (2–4/mm); and, very closely spaced, finely incised lirations along the posterior dorsal slope (7–10/mm). Posterior ridge not strongly developed especially reduced in left valve. Possible growth annulae (up to 7) noted by differential intensity of coloration in shell substance.

Ligament opisthodetic, consisting of extremely short, external yellowish periostracal element in indistinct lanceolate escutcheon; internal ligamental element or resilium, rather strong and placed in moderately elongate chondrophore.

Hinge teeth consisting of both cardinal and lateral elements. In right valve, dentition stronger, cardinal complex consisting of small, subdeltoid anterior and posterior teeth; right anterior lateral tooth subproximal to cardinal complex, rather well developed, bluntly pointed, upcurled, and socketed above; right posterior lateral tooth distal, behind external ligament and resilium, bluntly pointed and socketed above. In left valve, cardinal complex consisting of narrow, protuberant, anterior tooth and tiny, thin, obsolete or absent posterior tooth closely juxtaposed to ventral surface of internal resilium. Anterior lateral tooth subproximal to cardinal complex, weak, irregular, blunt protuberance along anterior dorsal margin. Posterior lateral tooth stronger, distal to cardinal complex and behind chondrophore, shelf-like, narrow and bluntly pointed.

Muscle scars not strongly impressed. Anterior adductor muscle scar irregularly elongate-subquadrate; posterior adductor muscle scar rounded. Pallial sinus dissimilar in opposite valves; in right valve, arched, gently arcuate, confluent with pallial line some distance from anterior adductor muscle scar; in left valve, more or less extending straightly anterior from posterior adductor muscle scar, very gently descending to confluence with pallial line some distance from anterior adductor muscle scar.

Shell whitish, usually suffused internally and centrally with yellow, purple or peach coloration; internally usually not highly polished.

Measurements:

Length	Height	Width	H/L	W/L	Remarks
13.5 mm	12.5 mm	7.2 mm	.92	.53	lectotype of *petiti*
12.8	11.8	7.4	.92	.57	Ankilibé (23°25°S; 43°45′ E) Madagascar
10.5	9.2	4.9	.88	.46	Plage de Tuléar Madagascar
10.5	9.1	5.0	.86	.48	Ankilibé (23°25′S; 43°45′ E) Madagascar
8.9	7.8	4.1	.87	.46	Ankilibé (23°25′S; 43°45′ E) Madagascar
6.1	5.4		.88		Pointe à Larrée, Madagascar

Types. Dautzenberg (1923) in his description of *Iacra petiti* gave a measurement of a specimen (height, 14 mm; length, 15 mm; diameter, 8 mm) and provided a figure.

In the original material at the Brussels Museum, no type-specimen was designated. Nor, for that matter, was a type-locality assigned since the original description listed Tamatave, Foulpointe, Tuléar, and plage d'Ankilibé, Madagascar. In 1929 Dautzenberg provided several further localities from the island. I herein select a lecototype measuring 13.5 × 12.5 × 7.2 mm, from the beach at Ankilibé, which is therefore restricted and designated as the type-locality.

Remarks. Dautzenberg (1923) described this species based on a series of specimens from Madagascar; most of the material listed in the section of *Specimens examined* is in the Brussels Museum, was available to him, and consists mostly of beach worn specimens. However, one lot from Ankilibé, near Tuléar on the southwestern portion of Madagascar included specimens which were obviously living when collected. From them, as noted previously, a lectotype has been selected.

In contrast to *trotteriana, petiti* can be recognized by its relatively strongly developed resilium while in comparison to *seychellarum* to which *petiti* is more closely allied, it may be distinguished by its plump, rounded shape (the mean W/L ratio is 50), rather heavier shell and thicker dental elements, tendency to yellowish-purplish central suffusions, and left pallial sinus which is well separated from the anterior adductor muscle scar. Additionally, the acentric scissulate sculpture on the central disc as well as the concentric, incised lirations along the anterior slope are more widely spaced in *petiti* (about 2–4/mm).

The shells of *petiti* show certain ontogenetic changes. Small individuals from Ranofotsy (4.5 × 3.7 mm) were thin and translucent, especially centrally; umbos were, as might be expected, more easily discernable, slightly opisthogyrous and sharply pointed. The internal surface of younger specimens also had more noticeable shining, highly polished internal surfaces. Many individuals had fallen prey to muricids which had bored holes through the shells, especially in the umbonal region.

In establishing *petiti,* Dautzenberg (1923) discussed the status of *Iacra,* according it generic rank, and noting that

Strigillina Dunker was synonymous; he pointed out its similarity to the tellinid *Strigilla* but noted that its familial affinities were, because of the internal ligamental resilium, with the Scrobiculariidae (= Semelidae). According to his locality data, several of the samples were taken as living specimens (examplaires vivants) - namely at Tamatave, Foulpointe and Ankilibé. The preferred bottom type was muddy sand. He subsequently added (1929; 1932) several localities where specimens were obtained by his correspondents on the island; these data are incorporated herein. The species has not been cited subsequently, at least by its own name! The material listed by Barnard (1964: 535) as *Iacra trotteriana* from the Tongaat River and from Durban, Natal proved upon examination to be *petiti* while the sample from Ilha dos Portuguesos, Inhaca [island], Mozambique listed as *trotteriana* and figured by Boshoff (1965: 157, pl. IX, fig. 1) is also *petiti*—though the original material could not be obtained from Mozambique for study.

Zoogeographically, *petiti* has a rather limited distribution along the eastern and southwestern shores of Madagascar and the relatively adjacent peripherally subtropical areas of Natal, South Africa and Mozambique (Map 2). Although a few dead, beach worn specimens of *seychellarum* have been taken in samples with *petiti,* it is more probable that the species are allopatric; the ranges may overlap in Mozambique along that portion of the African coast but the known sample from that area, Inhaca by Boshoff (1965), is based on a dead specimen. With their stronger right lateral dentition, the rather robust shells of *petiti* contrast markedly with the more fragile, probably sympatric *trotteriana.*

Specimens examined (Map 2). REPUBLIC OF SOUTH AFRICA: Tongaat River (29°34′S; 31°11′E); Durban, Natal (both SAM). MADAGASCAR: plage de Tuléar; plage de Ankilibé (23°25′S; 43°45′E); Andrahomana, S of Fort Dauphin; baie du Ranofotsy, SW of Fort Dauphin; baie du Galions, W of Fort Dauphin; Anse Dauphine, Fort Dauphin; plage de Vatomandry (19°20′S; 48°59′E); plage d'Andevoranto, N of Vatomandry (18°40′S; 48°35′E); Ambila, S of Tamatave; plage de Soanierana, N of Tamatave

(18°56′S; 47°31′S; 47°31′E; Pointe à Larrée, opposite Ile. Ste. Marie (16°50′S; 49°50′E) (all IRSNB).

Abra (*Iacra*) *trotteriana* (Sowerby)

Plate 22, figs. 5–8; Plate 25, figs. 1–3; Map 2

Strigillia (*sic*) *trotteriana* Sowerby 1894. Jour. of Conch. 7: 376 (holotype, BMNH; type-locality, Durban, South Africa); 1897. Appendix to Marine Shells of South Africa, p. 23, pl. 6, fig. 32 (incorrectly refers to Jour. of Conch., vol. vii, p. 12, April, 1896).

Iacra trotteriana (Sowerby). Barnard. 1964, Ann. South African Mus. *47* (3): 535.

Description. Shell extending to about 20 mm in length and to about 18 mm in height, ovate-subtrigonal, inequilateral subequivalve, with left valve slightly more inflated and convex, subfragile to solid, not too strongly compressed with very weak posterior flexure to right. Umbos somewhat anterior to middle, pointed, almost orthogyrous, not greatly inflated, rather flattened, with left umbo a little lower than the right. Anterior margin convex (more broadly rounded in larger specimens); ventral margin gently convex; anterior dorsal margin short, rather gently inclined, making rather abrupt confluence with anterior (especially in younger individuals); posterior dorsal margin longer, rather steeply inclined, and more or less straight; posterior margin short, irregularly convex and rounded, forming a rather blunt weakly subtrigonal outline posteriorly.

Ligament opisthodetic, short, consisting of yellowish-brown periostracal element set in indistinct escutcheon and of a rather strong elongate subtrigonal calcareous portion subtended by flattened nymphs. Internal ligamental element or resilium markedly reduced, very small, and set in a tiny, very shallow, slit-like obsolete chondrophore.

Hinge teeth consisting of both cardinal and lateral elements. In right valve, dentition stronger with cardinal complex consisting of angular, narrow shelf-like anterior tooth and perpendicular, narrowly subdeltoid posterior tooth; anterior lateral tooth subproximal to cardinal complex, rather well developed, weakly upcurled, blunt, shelf-like and socketed above; posterior lateral tooth distal to cardinal complex and behind ligamental apparatus, pointed, shelf-like, and socketed above. In left valve, cardinal complex consisting of narrow, slightly thickened, nearly perpendicular, anterior tooth and very thin, fragile, obsolete and frequently broken posterior tooth which lies along the base of the tiny chondrophore; anterior lateral tooth consisting of subproximal irregular shelf-like tuberosity; posterior lateral tooth distal, very small, poorly developed and pointed.

Sculpture variable, consisting of several moieties: along anterior slope, finely incised concentric lirations (6–12/mm) and more crowded along the periphery and dorsal slope; acentric, posteriorly and steeply descending scissulations on central disc, generally 4–6/mm; and, very closely spaced, more or less concentric, finely incised lirations along the dorsal slope (7–12 mm). Strongly raised, sharply differentiated, coarse (1/mm) concentric ridges or riblets may develop over the disc, especially peripherally and in the right valve (Plate 25, fig. 2). Further, fine concentric lirations may be formed especially on the central disc, and more noticeably in the left valve, presenting an irregularly reticulate pattern with the acentric scissulations (Plate 25, fig. 1). Posterior radial ridge not strongly developed but more noticeable in larger (19 mm) individuals. Irregular growth annulae, up to 8, sometimes discernable by differential coloration or translucence of shell substance.

Muscle scars rather poorly impressed. Anterior adductor muscle scar irregularly subquadrate (evidently dorsal portion actually being anterior pedal retractor muscle scar). Posterior adductor muscle scar rounded to irregularly subtrigonal. Pallial sinus dissimilar in opposite valves; in right valve, extending for short distance straight anteriorly and then dropping sharply to become confluent with posterior half of pallial line; in left valve, pallial sinus extending somewhat upward anteriorly at first and then very gently becoming confluent with anterior adductor muscle scar (occasionally in younger individuals, pallial sinus not connected to anterior adductor muscle scar but confluent with pallial line just below the anterior adductor muscle).

Shell predominately white, rarely suffused centrally with yellowish or purplish coloration. Internally not highly polished.

Measurements:

Length	Height	Width	Remarks
12.0 mm	10.0 mm	mm	holotype of *trotteriana*
19.9	18.1	9.6	Koseir, Red Sea
18.5	16.2	9.2	El Tor, Bay of Suez
16.9	14.6	7.8	Djibouti, Gulf of Tadjura, Gulf of Aden
14.6	13.2		Natal, South Africa, right valve
13.2	11.7	6.5	Massawa, Eritrea, Ethiopia
12.3	11.2		Ambila, Madagascar, left valve
11.7	10.5	6.2	Massawa, Eritrea, Ethiopia
8.5	7.5		Ambila, Madagascar, right valve

Remarks. The most variable of the species of *Iacra*, *trotteriana* is especially characterized by its very reduced chondrophore. The internal resilial element of the ligament is very much atrophied and consists of an extremely small, slit-like element sandwiched between the posterior cardinal tooth and the rather flattened nymphal plate supporting the external opisthodetic ligament (Plate 22, figs. 5–8). Such a reduced internal ligament is parallelled in the Indo-Pacific-Australian semelid *Semelangulus* and, in the case of *trotteriana*, brings the species even closer in appearance to the true tellinid genus *Strigilla*, which totally lacks even a very small chondrophore and its concomitant resilium. The reduction in the size of the resilium and chondrophore serves to distinguish *trotteriana* from both *seychellarum* and *petiti*.

Morphologically, *trotteriana* has a variable sculpture which in its most simple form is dominated by the acentric scissulations across the central disc. However, in several samples from the Red Sea and Gulf of Suez, including some which were identified as *seychellarum* by Sturany (1901) in his report on the results of the *Pola* expedition, the shells attain their maximum size and have a much stronger sculpture. The left valve (Plate 25, fig. 1) may appear somewhat reticulate on the disc where the concentric sculpture intersects with the acentric scissulations. The right valve may have strongly raised, coarse concentric ridges (Plate 25, fig. 2) similar in their form to those found in *Semele modesta* (Reeve) of the South Atlantic (Boss, 1972),

Subsequent to the original description and remarks of Sowerby (1894: 376; 1897; 23), this species was not cited again until Barnard (1964: 535) listed it in *Iacra*, a citation which I think might well have been for another species (see *Remarks* under *petiti*) though *trotteriana* does occur, at least as partial specimens, in South Africa. Boshoff (1965: 183, pl. IX, fig. 2), following Barnard, also confused these species, figuring a specimen, which is no longer available for study since the revolution in Portuguese East Africa, of *trotteriana* as "*seychellarum*" from Punta Torres, Inhaca Island, Mozambique.

In shape, *trotteriana* tends to be somewhat subquadrate in smaller individuals and more ovate-subtrigonal in adults. In the right valve, the posterior dorsal slope and its conjoining with the umbonal region evince a "hunched" or arched contour, which is sometimes helpful in recognizing beach worn valves.

The distribution of living *trotteriana* is really poorly known since most of the samples listed in the section on *Specimens examined* are based on miscellaneous beach worn valves. The species occurs in the Red Sea, probably along the coast of east Africa to Natal, South Africa, and possibly in such offshore islands as Madagascar. The marked concentric sculpture in the right valve and noticeable reticulations in the left valve seem to occur in populations in the Gulf of Suez and Red Sea areas, and since only poorly preserved material has been obtained from South Africa, Mozambique and Madagascar and no samples whatsoever along the intervening African coast, it is possible that the northern population may be subspecifically or even specifically distinct. However, since so few data are available, it is deemed unwise to establish yet another poorly known "new species" of bivalve.

Specimens examined (Map 2). REPUBLIC OF SOUTH AFRICA: Natal; Tongaat River, Natal; Durban, Natal (all SAM). MADAGASCAR: baie de Ranofotsy, SW of Fort Dauphin; baie de Galions, W of Fort Dauphin; Anse Dauphine, Fort Dauphin; Ambila, S of Tamatave; Tamatave

Veno (all IRSNB); Tamatave (NR); plage de Soanierana, 18°56′S; 47°31′E, N of Tamatave (IRSNB). FRENCH SOMALILAND: Djibouti, Gulf of Tadjura, Gulf of Aden (MNHNP). ETHIOPIA: Massawa, Eritrea, Red Sea (NMW; ZMB). EGYPT: *Pola* Station 21, Koseir, 26°06′N; 34°17′E; *Pola* Station 8, El Tor, 28°14′N; 33°37′E, Sinai Peninsula, Gulf of Suez (both NMW).

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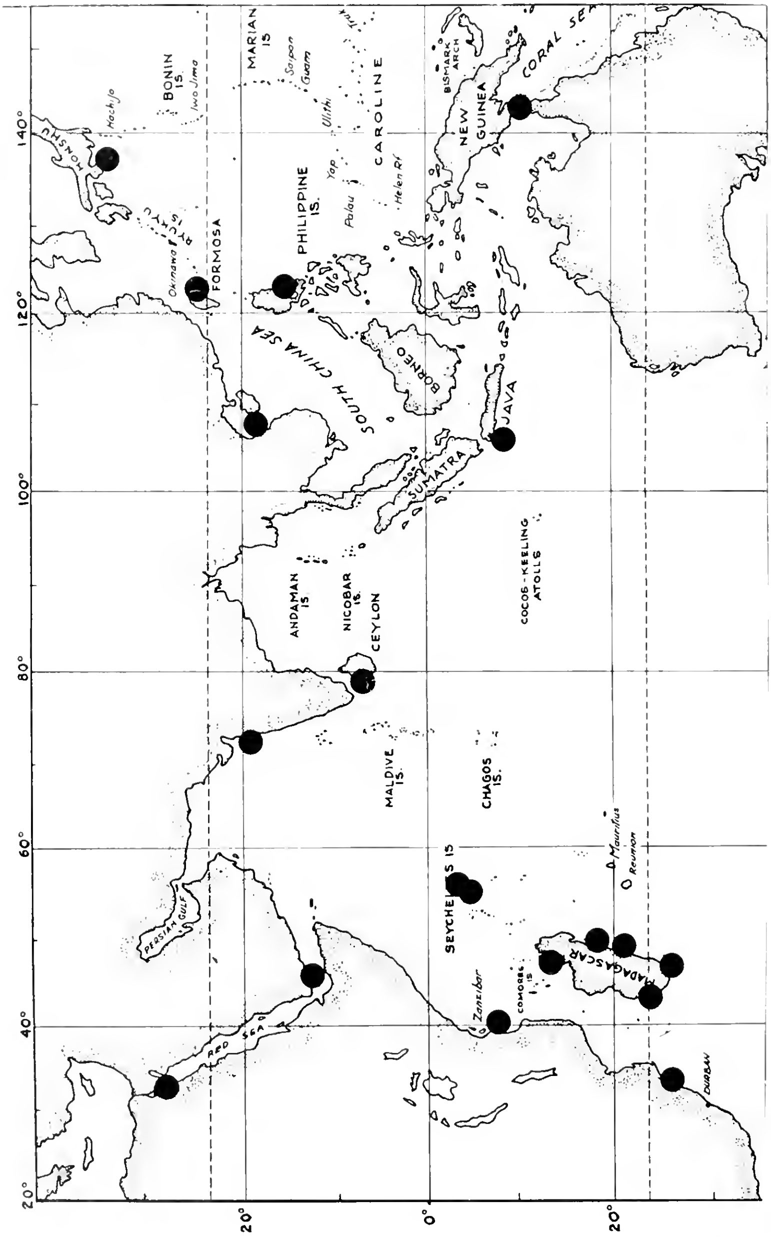
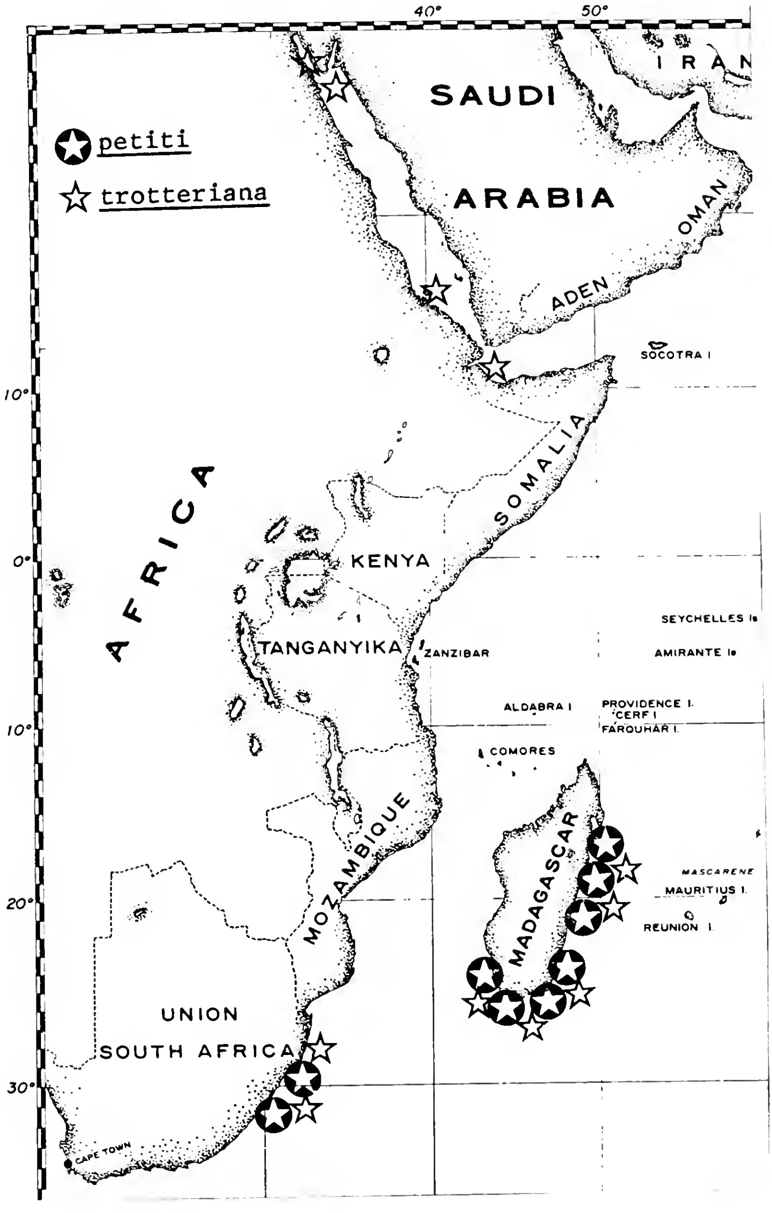
Maps 1 and 2

Plates 20–25



Map 1

The distribution of *Abra* (*Iacra*) *Seychellarum* (A. Adams).



Map 2

The distribution of *Abra (Iacra) petiti* (Dautzenberg) and *A. (I.) trotteriana* (Sowerby).

Plate 20

Abra (Iacra) seychellarum (A. Adams)

Fig. 1. Holotype of *Syndosmya strigilloides* Vaillant 1865. External view of the left valve (sur la plage du désert de l'Attaka, Baie de Suez, 16.0 × 13.0 × 6.0 mm, MNHNP).

Fig. 2. External view of the right valve of same.

Fig. 3. Lectotype of *Scrobicularia seychellarum* A. Adams 1856. External view of the left valve (Seychelles, 21.5 × 17.2 mm, BMNH 78.1.28.197).

Fig. 4. Enlargement of an external view of the right valve of the neotype of *Strigillina lactea* Dunker 1861, (aus dem Rothen Meere, 14.2 × 12.0 × 6.3 mm, MCZ 288004).

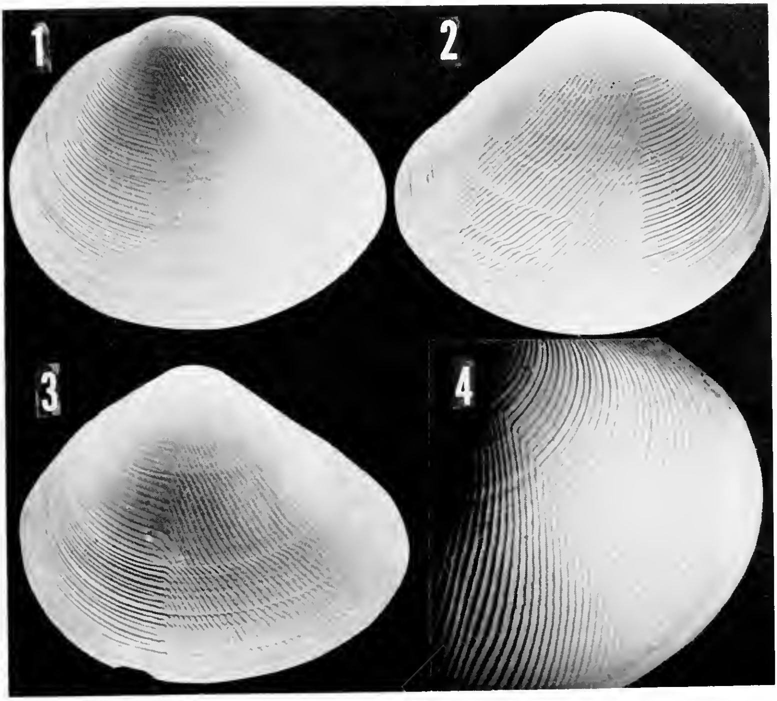


Plate 20

Plate 21

Abra (Iacra) seychellarum (A. Adams)

Fig. 1. Neotype of *Strigillina lactea* Dunker 1861. External view of the left valve (aus dem Rothen Meere, 14.2 × 12.0 × 6.3 mm, MCZ 288004).

Fig. 2. External view of the right valve of same.

Fig. 3. External view of the right valve of *A. seychellarum* (from Nosy Iranja, about 30 miles SW of Nosy Bé, Madagascar, 12.1 × 9.2 × 4.9 mm, MCZ 288378).

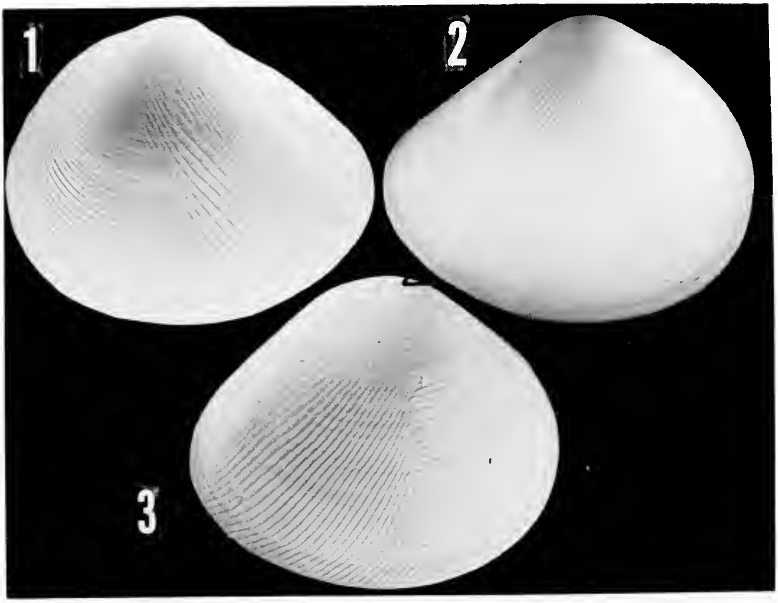


Plate 21

Plate 22

Hinge lines, dentition, and position of the resilium in *Iacra*

Figs. 1–4. *Abra* (*Iacra*) *seychellarum* (A. Adams)

Fig. 1. View of the right valve of holotype of *Syndosmya strigilloides* Vaillant 1865 (sur la plage du désert de l'Attaka, Baie de Suez, 16.0 × 13.0 × 6.0 mm, MNHNP).

Fig. 2. View of a right valve from Nosy Iranja, about 30 miles SW of Nosy Bé, Madagascar, 12.1 × 9.2 × 4.9 mm, MCZ 288378.

Fig. 3. View of the left valve of the lectotype of *Scrobicularia seychellarum* A. Adams 1856. (Seychelles, 21.5 × 17.2 mm, BMNH 78.1.28.197).

Fig. 4. View of the left valve of the holotype of *Syndosmya strigilloides* Vaillant 1865 (sur la plage du désert de l'Attaka, Baie de Suez, 16.0 × 13.0 × 6.0 mm, MNHNP).

Figs. 5–8. *A.* (*I.*) *trotteriana* (Sowerby)

Figs. 5 and 6. View of a right valve from Massawa, Eritrea, Ethiopia [Red Sea], 11.7 × 10.5 × 6.2 mm, ZMB 27365.

Fig. 6. View of a right valve from Koseir, Red Sea, 19.9 × 18.1 × 9.6 mm, NMW.

Fig. 7. View of a left valve from Massawa, Etitrea, Ethiopia [Red Sea], 11.7 × 10.5 × 6.2 mm, ZMB 27365.

Fig. 8. View of a left valve from Durban, South Africa, BMNH.

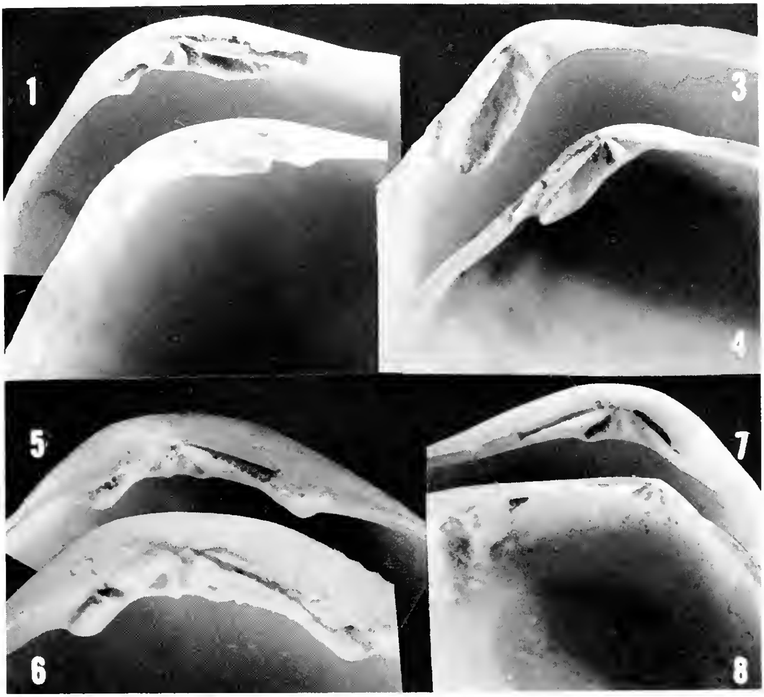


Plate 22

Plate 23

Abra (Iacra) seychellarum (A. Adams). External views of the left valves of specimens from two widely separated localities to show the variation in sculpture, outline of the valves, and comparative strength and configuration of the chondrophore as well as cardinal and lateral dentitions.

Fig. 1. Specimen from Nosy Iranja, about 30 miles SW of Nosy Bé, Madagascar, measuring 12.1 × 9.2 × 4.9 mm, MCZ 288378.

Fig. 2. Specimen from Pelaboean Ratoe (7°05′S; 106°27′E), Java, Indonesia, measuring 6.2 × 5.2 mm, USNM 261458.

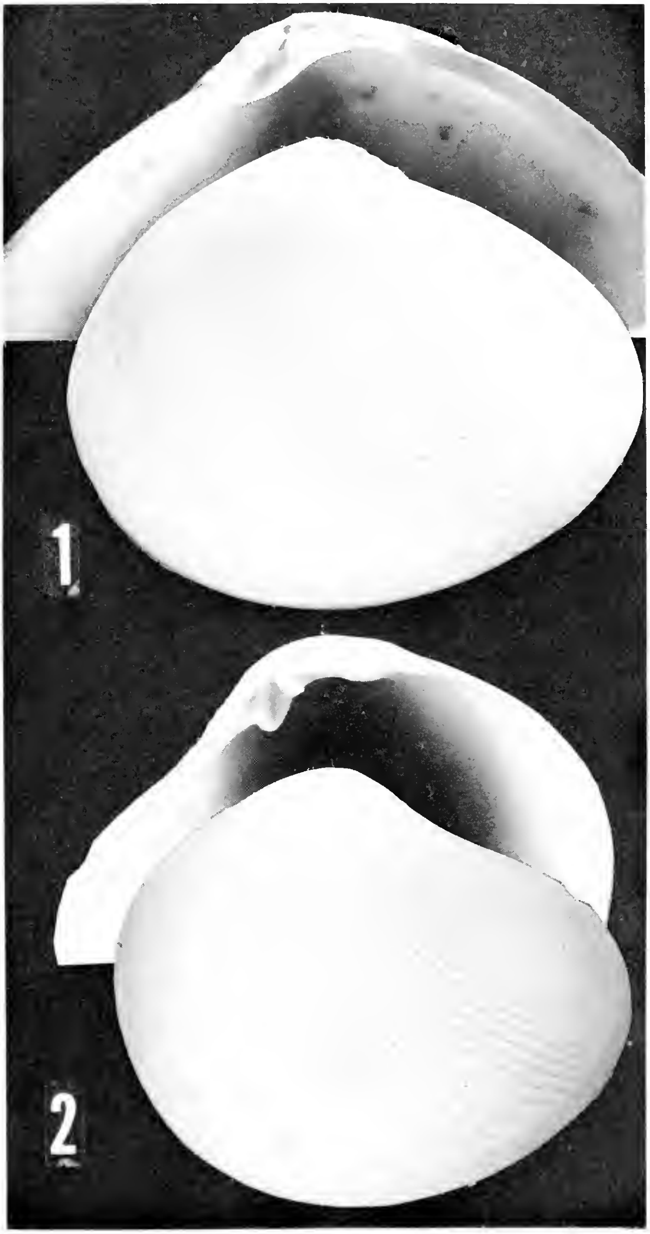


Plate 23

Plate 24
Abra (Iacra) petiti (Dautzenberg)

The lectotype of *Iacra petiti* Dautzenberg 1923, 13.5 × 12.5 × 7.2 mm from plage d'Ankilibé (23°25′S; 43°45′E), Madagascar, IRSNB.

Fig. 1. External view of the left valve.
Fig. 2. External view of the right valve.
Fig. 3. Hinge of the right valve.
Fig. 4. Hinge of the left valve.

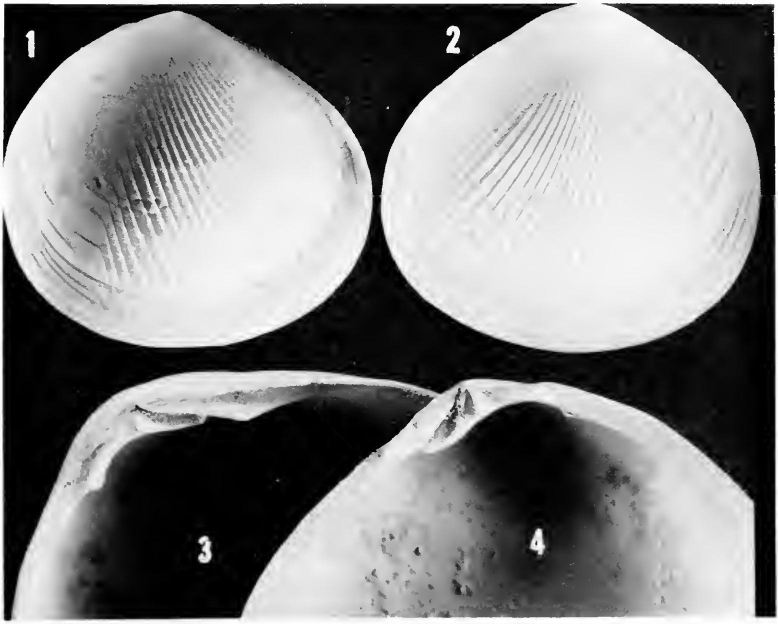


Plate 24

Plate 25

Abra (Iacra) trotteriana (Sowerby)

Specimen measuring 11.7 × 10.5 × 6.2 mm from Massawa, Eritrea, Ethiopia on the Red Sea (in ZMB 27365, collected by Jickeli).

Fig. 1. External view of the left valve indicating the finely reticulate sculpture occurring in some populations.

Fig. 2. External view of the right valve illustrating the heavy concentric sculpture of some populations.

Fig. 3. The holotype of *Strigillia* [*sic*] *trotteriana* Sowerby 1894 (12.0 × 10 mm, right valve only, from Durban, South Africa [BMNH]).

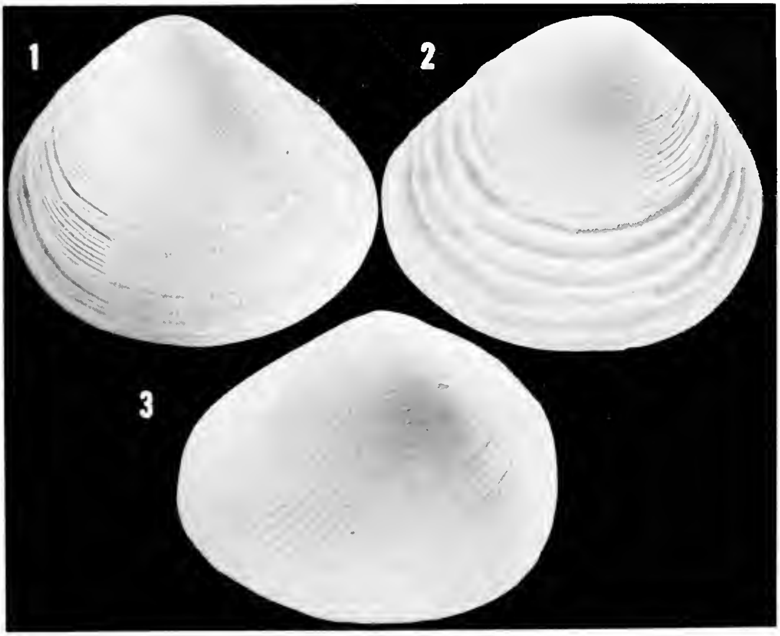


Plate 25

Norman Macdowell Grier, A Bibliography of His Work on Mollusks, with a Catalogue of His Unionid Taxa

By RICHARD I. JOHNSON

Grier was born on June 13, 1890 in Pittsburgh, Pennsylvania. He attended the University of Pittsburgh where he received a B. S. in 1911, an A. M. in 1912, and a Ph.D. in 1919. During 1914–1916, he was an assistant at the Carnegie Museum where he was Arnold E. Ortmann's most prolific student. He contributed numerous papers on the biometrics of the Unionidae. After Ortmann's death in 1927, Grier made no more contributions to the literature of mollusks, though he continued to write on education. From 1937 he was employed by the State Social Security Board. He died on December 26, 1951.

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THE UNIONID VARIETIES INTRODUCED BY N. M. GRIER

ereganensis, Lasmigona costata

1918, Nautilus *32*: 10 (Lake Erie, Presque Isle Bay, Big Bend [W of waterworks, Erie Co., Pennsylvania]). Syntypes CM 61.4720. Syntype figured by Ortmann, 1919, Mem. Carnegie Mus. *8*: 131, pl. 9, fig. 6 (emend. *eriganensis*). Lectotype, Grier's first measured specimen (presumed the one figured by Ortmann, selected by Parodiz, 1967, Sterkiana no. 28, p. 26).

parvula, Fusconaia flava

1918, Nautilus *32*: 11 (Lake Erie, Presque Isle Bay, Big Bend [Erie Co., Pennsylvania]). Syntypes CM 61.4513. The type figured by Ortmann, 1919, Mem. Carnegie Mus. *8*: 21, pl. 2, fig. 2 was selected as lectotype by Parodiz, 1967, Sterkiana no. 28, p. 23 [not renumbered].

sterkii, Elliptio dilatatus

1918, Nautilus *32*: 8 (Lake Erie, Presque Isle Bay, Big Bend [W of waterworks, Erie Co., Pennsylvania]). Holotype CM 61.4268 no. 4 figured by Ortmann, 1919, Mem. Carnegie Mus. *8*: 101, pl. 8, fig. 3, CM 61.4628 [sic], selected as lectotype by Parodiz, 1967, Sterkiana no. 28, p. 25 CM 61.4648, no. 4 [sic].

Book Review

Habe, Tadashige. 1977. *Systematics of Mollusca in Japan. Bivalvia and Scaphopoda.* Tokyo, 372 pp., 72 pls. No price listed. In Japanese.

Dr. Tadashige Habe, long time curator at the National Science Museum in Tokyo and acknowledged authority on the taxonomy of the mollusca of Japan, presents here in bound form, an updating of his several papers on the genera of Japanese bivalves and scaphopods (*Genera of Japanese Shells. Pelecypoda,* nos. 1–4 [1951–1953], and, with S. Kosuge, *A List of the Indo-Pacific Molluscs, Concerning to the Japanese Molluscan Fauna. Class Scaphopoda.* Nat. Sci. Mus., Tokyo [1964]). The compilation is listed according to the outlines provided in the *Treatise on Invertebrate Paleontology.* Thus, for the Bivalvia, which constitutes the bulk of the text, 6 subclasses and 89 families within 42 superfamilies are delineated. Even taxa which are not part of the Japanese fauna are listed for convenience and designated by an asterisk.

Within each family, the general treatment includes the citation of each genus along with a notation of the type-species and currently accepted synonyms. After a short generic diagnosis, there follows a listing of Japanese species with a citation of the original author and date and the common Japanese name accompanied by the Japanese authority for such, mainly Hirase, Kuroda, and Habe, himself. Geographic localities are listed to indicate the range of each species. Depth records are provided as well as an indication of the preferred bottom type or substrate. The line-drawings in the plates illustrate several hundred of the most common Japanese species.

The Scaphopod portion of the volume occupies fewer than twenty pages.

Glossaries of the specialized descriptive terms utilized in the taxonomy of these organisms, as well as a short dictionary of nomenclatorial definitions, are provided. Indicies to Latin and Japanese generic nomina complete the volume.

The work is, of course, indispensible for anyone working on the taxonomy and distribution of bivalves or scaphopods; it will certainly be useful for the student of sea shells of the Western Pacific, and it will have to be consulted by various other specialists since new taxa are introduced. Although comprehensive, the treatment is regional and parochial; critical revisions of most oriental taxa continue to go begging.

—K. J. Boss

Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 21, 1977 NUMBER 58

Arnold Edward Ortmann, A Bibliography of his Work on Mollusks, with a Catalogue of his Recent Molluscan Taxa

By RICHARD I. JOHNSON

Arnold Edward Ortmann was the foremost student of the Unionacea, or freshwater mussels, of the United States during the first quarter of this century. Simpson completed his important world-wide revision of the Unionacea, "Synopsis of the Naiades," in 1900 which was expanded, with little change, into "A Descriptive Catalogue of the Naiades" (1914). Ortmann augmented Simpson's system, with his careful work on the morphology and classification of the Unionacea based on anatomy, expecially the structure of the gills (1912). He also studied the zoogeography of the unionid species in, "The Alleghenian Divide, and its Influence upon the Freshwater Fauna" (1913). These works quickly established Ortmann as America's leading unionid expert.

Ortmann was born in Magdeburg, Saxony, April 8, 1863. He studied at the universities of Kiel, Strasbourg and Jena. At Jena he received his Ph.D. in 1885. He was one of Ernst Haeckel's favorite pupils. When Haeckel went on an expedition to Zanzibar, he took Ortmann with him as an assistant. For a time Ortmann was an instructor in the University of Strassburg. His first two works on mollusks concerned collections of Cephalopods at the Strasbourg Museum made by Döderlein in Japan (1888) and the Sarasins in Ceylon (1891).

Ortmann came to the United States in 1894 and became

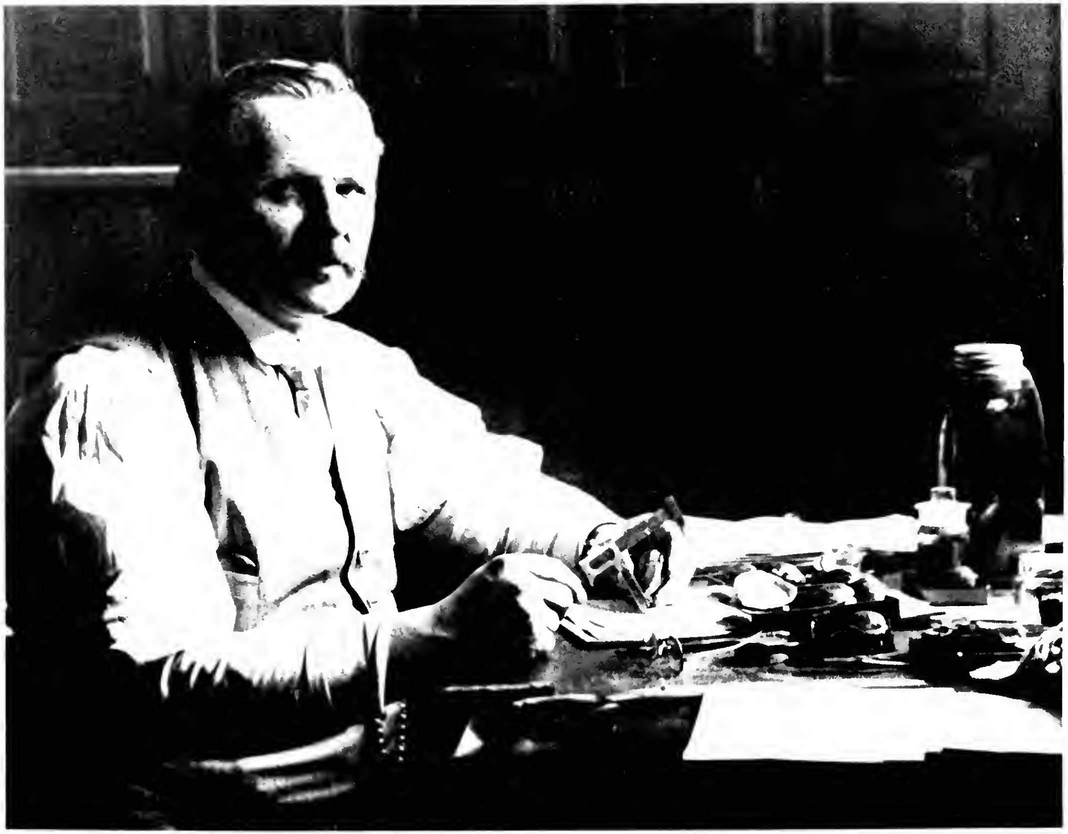

Plate 26

Arnold E. Ortmann (1863-1927), a previously unpublished portrait. Courtesy, J. J. Parodiz, Carnegie Museum.

curator of invertebrate paleontology at Princeton University where he remained until 1903 when he then became curator of invertebrate zoology in the Carnegie Museum where he remained until his death on January 3, 1927.

His extensive report on the Tertiary Invertebrates of the Princeton-Patagonia Expeditions (1896–1899) appeared in 1902 and contained the descriptions of numerous fossil marine mollusks.

Ortmann did not cònfine his zoogeographical studies just to the Unionacea. He was also interested in Crustacea and published, "The Geographical Distribution of Freshwater Decapods, and its Bearing on Ancient Geography" (1902). His work on the crayfishes of Pennsylvania (1906) also contains an important discussion on their zoogeography.

Ortmann's two most elegant works on the Unionacea are on those of Pennsylvania (1911, 1919) and of South America (1921). These volumes were grandly printed in quarto with excellent illustrations, as Memoirs of the Carnegie Museum. Among Ortmann's other faunal studies of the naiades were those of the Tennessee River (1918, 1925), the Duck River (1924) and the Green River (1926).

Pilsbry (1927: 111) says of Ortmann that he was,

> "cordial and prepossessing in manner. His enthusiasm for natural history was contagious, and contributed to his success as a teacher. (He held various teaching positions at the University of Pittsburgh, which in 1911 conferred on him the degree of Sc.D.). In the field he was indefatigable never sparing himself, deterred by neither exposure nor fatigue, in the quest of specimens for his researches."

One can best understand Ortmann's attitude toward his work by quoting from a letter of his to Calvin Goodrich (December 15, 1910) quoted by van der Schalie (1951: 135):

> Do not feel alarmed about having used any information received from me in any way you see fit. I am not jealous, and anybody is welcome to use and to *criticise* whatever I may say in private correspondence. I also do not object if anybody *publishes* anything for I am not working for my personal benefit but for the good of science, and I know myself best that I cannot work out everything myself. I wish I could induce many more conchologists to work along the same lines I am working.

Ortmann was survived by his wife, one son and two married daughters.

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ACKNOWLEDGEMENTS

Special thanks are extended to Dr. J. José Parodiz, Carnegie Museum, Pittsburgh, who, at my request, chose many of the lectotypes selected in this paper. He also kindly gave me access to Ortmann's types, afforded me his synonymies of some of the taxa, and made available the hitherto unpublished photograph of Ortmann used here. Thanks are also extended to Dr. Kenneth J. Boss for reading the manuscript.

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1924. Mussel Shoals. Science *60:* 565–566.

1925. Mussel Shoals. Bull. New York Zool. Soc. *35:* 10–11.

1925. The naiad-fauna of the Tennessee River system below Walden Gorge. American Midland Naturalist *9:* 321–372.

1926. *Helix nemoralis* L. in Lynchburg, Virginia. Nautilus *39:* 73–74.

1926. Unionidae from the Reelfoot Lake region in West Tennessee. Nautilus *39:* 87–94.

1926. The naiades of the Green River Drainage in Kentucky. Ann. Carnegie Mus., Pittsburgh, Pa. *17* (1): 167–188, pl.8.

RECENT GENERIC AND SPECIFIC MOLLUSCAN TAXA INTRODUCED BY ARNOLD EDWARD ORTMANN.

For convenience of reference, the following list is arranged alphabetically by species, with the original references, type localities (locality data in brackets were found on original labels or are additions from recent maps), and the location of the extant types.

Higher categories, and the fossil marine mollusks described in the report on the Princeton-Patagonia Expedition (1902), are *not* included.

ABBREVIATIONS

CM—Carnegie Museum, Pittsburgh, Pennsylvania
MCZ—Museum of Comparative Zoology, Cambridge, Massachusetts

Alasminota, Subgenus: 1914, Nautilus *28:* 41. Type species, *Margaritana holstonia* Lea, original designation.

analoga, Fusconaia cor Plate 27, fig. 1
1918, Proc. Amer. Philos. Soc. *57:* 533. Ortmann refers to Reeve, Conch. Iconica *16, Unio,* pl. 15, species 65 (Tennessee River). This indicated specimen is the holotype, British Museum (Nat. Hist.) 1964117. The type locality is restricted to the Clinch River, Speers Ferry, Scott Co., Virginia from whence came Ortmann's specimens, CM 61.6326. Discussed by Parodiz, 1967, Sterkiana, no. 28: 23.

Arkansia Ortmann and Walker, Genus: 1912, Nautilus *25:* 97. Type species, *Arkansia wheeleri* Ortmann and Walker, original designation.

aspersa, Loligo: 1888, Zool. Jahr. *3:* 661, pl. 25, fig. 3 (Kochi [Japan]). Type in Strasbourg Museum.

berthae, Diplodon: 1921, Mem. Carnegie Mus. *8:* 528, pl. 38, figs. 1–4 (Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil). Lectotype, here selected, CM 61.5865 specimen no. 24, pl. 38, fig. 1 a–d; paralectotype MCZ 100974. Is *Diplodon picens* (Lea) *teste* Parodiz.

brocki, Octopus: 1888, Zool. Jahr. *3:* 645, pl. 21, fig. 4, pl. 22, fig. 1 (Tokiobai and Kagoshima [Japan]). Types in Strasbourg Museum.

cohongoronta, Lampsilis ventricosa: 1912, Nautilus *26:* 53 (Potomac River, Hancock, Washington Co., Maryland). Lectotype selected by Parodiz, 1967, Sterkiana, no. 28: 28, CM 61.3999. Figured by Johnson, 1970, Bull. Mus. Comp. Zool. *140:* 386, pl. 21, fig. 1; allotype CM 61.4000, pl. 21, fig. 2; 2 paralectotypes MCZ 273128.

Cumberlandia, Genus: 1912, Nautilus *26:* 13. Type species, *Unio monodonta* Say, original designation.

decipiens, Diplodon: 1921, Mem. Carnegie Mus. *8:* 499, pl. 36, figs. 3–6 (Creek, tributary to the Rio Iguassú. Serrinha, Paraná, Brazil). Lectotype, here selected, CM 61.9253, specimen no. 4, pl. 36, fig. 3 a–d. Is *Diplodon martensi* Ihering *teste* Parodiz.

döderleini, Tremoctopus: 1888, Zool. Jahr. *3:* 642, pl. 20 (Tokiobai [Japan]). Type in Strasbourg Museum.

enno, Diplodon: 1921, Mem. Carnegie Mus. *8:* 531, pl. 38, figs. 5–8 (Rio Grande, Boqueirão, Bahia, Brazil, S. Francisco drainage). Lectotype, here selected, CM61.9264 specimen no. 1, pl. 38, fig. 7. Is *Diplodon rotundus enno teste* Parodiz.

framea, Sepia: 1891, Zool. Jahr. *5:* 675, pl. 46, fig. 2 (Ceylon). Type in Strasbourg Museum.

Friersonia, Genus: 1912, Ann. Carnegie Mus. *8:* 318. Type species, *Lampsilis iridella* Pilsbry and Frierson, original designation.

hasemani, Anodontites: 1921, Mem. Carnegie Mus. *8:* 609, pl. 42, figs. 6,7 (headwaters of the Rio Paraguay, Santa Rita, Matto Grosso, Brazil). Lectotype, here selected, CM 61.5823, specimen no. 3, pl. 42, fig. 7 a–b.

hasemani, Diplodon: 1921, Mem. Carnegie Mus. *8:* 478, pl. 34, figs. 1–4 (Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil). Lectotype, here selected, CM 61.5857 specimen no. 10. pl. 34, fig. 1 a–b. Is *Diplodon guaranianus* (Orbigny) *teste* Parodiz.

hildae, Diplodon: 1921, Mem. Carnegie Mus. *8:* 514, pl. 36, fig. 7, pl. 37, figs. 1–3 (Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil). Lectotype, here selected, CM 61.5864, specimen no. 16, pl. 36, fig. 7 a–b. Is *Diplodon picens* (Lea) *teste* Parodiz.

hollandi, Monocondylaea: 1921, Mem. Carnegie Mus. *8:* 585, pl. 41, fig. 1 (Sand bar of Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil). Holotype CM 61.5856.

hoylei, Sepia: 1888, Zool. Jahr. *3:* 650, pl. 22, fig. 5 pl. 23, fig. 1 (Maizura, Tokiobai, Kadsiyama. Enoshima, Kochi, Kagoshima [Japan]). Types in Strasbourg Museum.

hyrioides, Anodontites: 1921, Mem. Carnegie Mus. *8:* 604, pl. 42, figs. 3–5 (Rio Tapajos, Santarem, Para, Brazil). Lectotype, here selected, CM 61.5829, specimen no. 6, pl. 42, fig. 3 a–b.

imitator, Diplodon: 1921, Mem. Carnegie Mus. *8:* 491, pl. 34, figs. 5–7, pl. 35, figs. 1, 2 (Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil). Lectotype, here selected, CM 61.9248, specimen no. 29, pl. 34, fig. 5 a–d. Is *Diplodon martensi* Ihering *teste* Parodiz.

kagoshimensis, Octopus: 1888, Zool. Jahr. *3:* 644, pl. 21, fig. 2 (Kagoshima [Japan]). Type in Strasbourg Museum.

leucogona, Fusconaja [*sic*] *subrotunda* Plate 27, fig. 2 1913, Nautilus *27:* 89 (Elk River, Gassaway Braxton Co., West Virginia). Lectotype, here selected, CM 61.5239 specimen A (not 61.5399 as indicated in the description. *teste:* Parodiz, 1967, Sterkiana, no. 28: 23). Paralectotype MCZ 293011; paralectotype Ohio State Museum 18117.

Lexingtonia, Genus: 1914, Nautilus *28:* 28. Type species, *Unio subplanus* Conrad, original designation.

microcotyledon, Sepia: 1891, Zool. Jahr. *5:* 673, pl. 46, fig. 1 (Ceylon). Type in Strasbourg Museum.

Microteuthis, Genus: 1888, Zool. Jahr. *3:* 648. Type species, *Microteuthis paradoxa* Ortmann, monotypic.

mogymirim, Diplodon: 1921, Mem. Carnegie Mus. *8:* 520, pl. 37, figs. 4–7 (Creek near Mogy Mirim, São Paulo, Brazil, tributary to Rio Mogy Guassú and Rio Grande, upper Paraná drainage). Lectotype, here selected, CM 61.9260 specimen no. 22, pl. 37, fig. 4 a–c. Is *Diplodon expansus* (Küster) *teste* Parodiz.

obesa, Monocondylaea: 1921, Mem. Carnegie Mus. *8:* 583, pl. 40, figs. 4–6 (Rio Tapajos, Santarem, Pará, Brazil). Lectotype, here selected, CM 61.5850 specimen no. 10, pl. 40, fig. 4 a–c.

paradoxa, Microteuthis: 1888, Zool. Jahr. *3:* 649, pl. 22, fig. 4 (Kadsiyama [Japan]). Type in Strasbourg Museum.

Prolasmidonta, Subgenus: 1914, Nautilus *28:* 44. Type species, *Unio heterodon* Lea, original designation.

Quincuncina, Genus: 1922, Nautilus *36:* 1. Type species, *Quincuncina burkei* Walker, original designation.

Scalenilla Ortmann and Walker, Subgenus: 1922, Occ. Papers Mus. Zool. Univ. Michigan, no. 112, p. 68. Type species, *Unio sulcatus* Lea, original designation.

simillimus, Diplodon: 1921, Mem. Carnegie Mus. *8:* 495, pl. 35, figs. 3–6 (Rio Nhundiaquara, Morretes, Paraná, Brazil). Lectotype, here selected, CM 61.9250 specimen no. 22, pl. 35, fig. 5 a–d; 2 paralectotypes MCZ 47050. Is *Diplodon martensi* Ihering *teste* Parodiz.

singhalensis, Loligo: 1891, Zool. Jahr. *5:* 676, pl. 46, fig. 3 (Ceylon). Type in Strasbourg Museum.

susquehannae, Alasmidonta (Decurambis) marginata: 1919, Mem. Carnegie Mus. *8:* 187, pl. 12, fig. 4 (Susquehanna River, Selinsgrove, Snyder Co., Pennsylvania). Figured holotype CM 61.4679, selected as lectotype by Parodiz 1967, Sterkiana, no. 28: 26; paratype Ohio State Museum 18118.

tetradynamia, Loligo: 1888, Zool. Jahr. *3:* 659, pl. 23, fig. 4, pl. 25, fig. 1 (Tokiobai [Japan]). Types in Strasbourg Museum.

tokioensis, Sepia: 1888, Zool. Jahr. *3:* 653, pl. 23, fig. 3 (Tokiobai [Japan]). Types in Strasbourg Museum.

torosa, Sepia: 1888, Zool. Jahr. *3:* 652, pl. 23, fig. 2 (Tokiobai [Japan]). Type in Strasbourg Museum.

tritogonia, Quadrula: 1909, Nautilus *22:* 101. New name for *Unio tuberculatus* Barnes 1823 when *Obliquaria tuberculata* Rafinesque 1820 and it were both considered as in the genus *Quadrula*.

Truncillopsis Ortmann and Walker, Subgenus: 1922, Occ. Papers Mus. Zool. Univ. Michigan, no. 112, p. 65. Type species, *Truncilla triqueter* Rafinesque, original designation.

vicarius Diplodon: 1921, Mem. Carnegie Mus. *8:* 497, pl. 35, figs. 7, 8, pl. 36, figs. 1, 2 (in creeks, Aqua Quente, 8 miles from Iporanga, São Paulo, Brazil). Lectotype, here selected, CM 61.9251 specimen no. 15, pl. 35, fig. 8. Is *Diplodon martensi* Ihering *teste* Parodiz.

wheeleri Ortmann and Walker, *Arkansia:* 1912, Nautilus *25:* 98, pl. 8 (Old River, a bayou of the Ouachita River) Arkadelphia, Clark Co., Arkansas. Figured holotype Museum of Zoology, University of Michigan 105514; paratypes MCZ 135712, 23319, and 45759; 2 paratypes CM 61.6162. Discussed by Parodiz, 1967, Sterkiana, no. 28:25.

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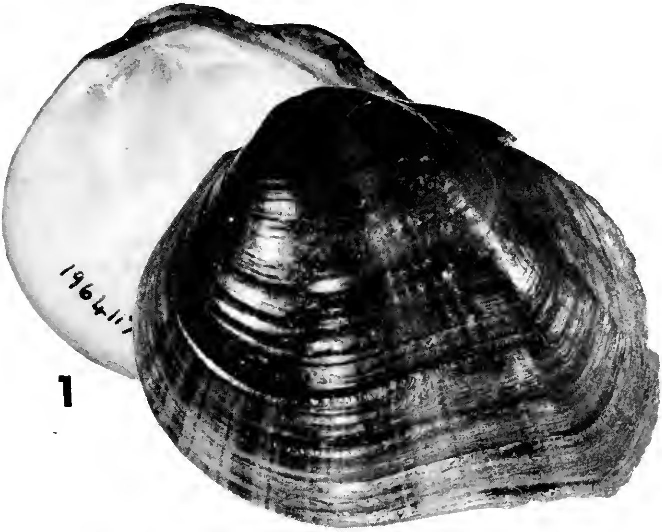
——— 1977. [Present synonymys of certain South American species], in letter.

Plate 27

Fig. 1. *Fusconaia cor analoga* Ortmann. [Clinch River, Speers Ferry, Scott Co., Virginia]. Holotype British Museum (Nat. Hist.) 1964117. Length 47 mm, height 36 mm, width 20 mm.

Fig. 2. *Fusconaja* [*sic*] *subrotunda leucogona* Ortmann. Elk River, Gassaway, Braxton Co., West Virginia. Lectotype Carnegie Museum 61.5239, specimen A. Length 91 mm, height 68 mm, width 35 mm. Male.



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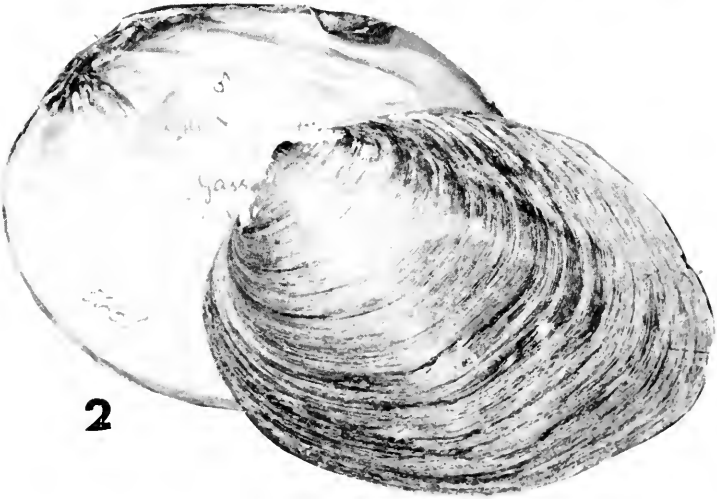

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Plate 27

The Carnegie Museum, its Collections and Curators of Mollusks

By RICHARD I. JOHNSON

The Carnegie Museum opened in November of 1895 with Herbert Huntington Smith in charge of Invertebrate Zoology. At first the mollusk collection consisted only of Smith's, a general one, representing some 3,000 species. To this was soon added the collection of F. R. Holland, containing some 6,000, which included specimens identified by C. B. Adams, T. Bland, J. G. Anthony, and Isaac Lea. In 1899 Smith left to collect specimens in South America. During 1890 George Hubbard Clapp (1859–1949) was appointed Honorary Curator of the Department. He was a wealthy man, a trustee of the museum, with a special interest in the land and freshwater mollusks of North America. Between 1893 and 1927 he contributed 64 articles on mollusks to the *Nautilus*. In 1902, the important collection of *Partula* made by William Dell Hartmann (1817–1899) was purchased, along with his general collection of 9,000 species. His collection of the Hawaiian terrestrial family Achatinellidae had been previously sold to the Natural History Museum in Bremen, Germany. Smith, having returned to the museum, prepared an annotated catalogue of the Hartman *Partula* (1902). In 1903 Smith retired to become Curator of the Alabama State Museum of Natural History. There, through exchange and by extensive collecting, he built an important collection of freshwater mollusks.

In July 1903, Arnold E. Ortmann was appointed Curator of Invertebrate Zoology (exclusive of Insects), and the Carnegie Museum soon became a major center for the study of Unionidae. Not only did Ortmann enrich the collection with the specimens he gathered himself, but his reputation was such that he received unionids from almost all of his interested contemporaries. In 1904, the museum purchased marine shells collected by the *Porcupine* and *Valorous* expeditions from the London shell dealer, of dubious reputation, H. B. Preston.

In 1909 Victor Sterki (1846–1933) was appointed an Honorary Assistant in the department of Invertebrate

Zoology. His extensive collection of Pupillidae and Sphaeriidae, consisting of some 12,000 identified and catalogued lots had been purchased in 1906. Sterki worked mainly, in absentia, from his home in New Philadelphia, Ohio, though he and Ortmann were in the field collecting together during 1911.

Ortmann worked with graduate students from the University of Pittsburgh (which is just across the street from the Museum). During 1913 the collection of shells was moved to its present location and here Ortmann supervised the Doctoral thesis of Miss M. A. Moldenhauer on the Glochidea of Najades. Ortmann's most prolific student was Norman MacDowell Grier (1890–1951) who arrived in 1915 and "was assigned a table in the laboratory of invertebrate zoology, where he took up biometric work on the Najades of Lake Erie." Also present at other tables were Miss Moldenhauer and Miss. E. C. Carter, who were also working for advanced degrees. Grier received his Ph.D. from the University of Pittsburgh in 1919 and went on to make a significant contribution to the study of Unionidae. In 1922, G. H. Ball, another Doctoral candidate from the University, published his thesis on variation in freshwater mussels. This paper was done under Ortmann's direction. The latter suggested the project and the species used.

Ortmann died suddenly in 1927. Interestingly, after Ortmann's death neither Clapp, who was then 76, nor Grier, who went into other work, published anything significant on mollusks. In 1927, Stanley Truman Brooks (1902–ca. 1960), Ortmann's last student, was appointed assistant in charge of the department, and upon the receipt of his Ph.D. in 1929 was made Acting Curator. He and his wife (1931) made studies of the types in the collection. On January 25, 1933, Sterki died and his collection and library were removed to Pittsburgh. Ortmann's extensive library had been purchased by the Museum several years previously.

In 1933, Gordon M. Kutchke (subsequently changed to G. K. MacMillan) (1906–   ) became associate Curator. He held this post, with a few months off in 1944 for military service, until 1951, when he went into wastewater chemistry. He made contributions to the knowledge of land mollusks. In 1936 he revamped the type collection and found

67 overlooked by the Brooks'. Brooks left the Museum in 1946 on a year's leave of absence to work for the U.S. Military Government as a scientific specialist, and subsequently went into private business.

A new era in molluscan studies began at the Museum in 1951 when Dr. Juan José Parodiz (1911–) became Assistant Curator of Recent Invertebrates. He was not long in becoming full curator. Parodiz had spent 20 years with the Museo Argentino de Ciencias Naturales, and was *the* expert on the land mollusca of South America. Parodiz began his tenure with a 10 year survey of the freshwater gastropods of Pennsylvania. He has followed Ortmann in his interest in the naiades of South America. He has published a list of the North American unionid types (1967), and has made numerous contributions to our knowledge of the land and freshwater mollusks of the Americas, the area which has always been the museum's greatest strength.

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The above notes are mostly gleanings from a perusal of the complete Annual Reports of the Carnegie Museum (1897–1975) and from: Abbott, R. T. 1973. American Malacologists. First edit. Falls Church, Va.

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Occasional Papers on Mollusks

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

VOLUME 4 27 MARCH 1981 NUMBER 59

OXYCHILUS (DROUETIA) AGOSTINHOI NEW SPECIES (STYLOMMATOPHORA: ZONITIDAE) FROM THE AZORES ISLANDS, ITS ANATOMY AND PHYLOGENETIC RELATIONSHIPS

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ABSTRACT. *Oxychilus (Drouetia) agostinhoi* n. sp. (Stylommatophora, Zonitidae) from Santa Maria, Azores, shares some characteristics with the subgenus *Ortizius* Forcart, but is placed in the subgenus *Drouetia* Gude on the basis of conchological and penial characters. The phylogeny of those species of *Oxychilus* Fitzinger endemic to the Azores supports the hypothesis of Riedel (1964) that the subgenera *Ortizius* and *Drouetia* evolved in the Azores from a pre-*Ortizius* type of mollusk which arrived from Europe, probably during the Tertiary. Based only upon its resemblances to Azorean species of the subgenera *Drouetia* and *Ortizius*, for which there is no fossil record, this new species is seen as having separated from the branch leading to *Oxychilus (Drouetia) atlanticus* s. l. before the origin of the subgenus *Atlantoxychilus* Riedel.

INTRODUCTION

The first significant publication on the land Mollusca of the Azores was by Morelet and Drouet (1857) which was revised and expanded by Morelet in 1860. Nobre visited the islands in 1919 and published two papers on the fauna in 1924 and 1930. Zonitid material was collected during the 1957 Swedish Zoological Expedition under the direction of P. Brink and E. Dahl and was described by Riedel in 1964. Backhuys (1975) gave a thorough analysis of the land mollusks collected in 1969 by the team integrated in the International Project for the Investigation of the Macaronesian Area, relying on Riedel (1964) when dealing with the Zonitidae.

Collections are still not sufficient for a complete understanding of the distribution and relationships of Azorean mollusks either within or outside the archipelago. The purposes of this paper are to describe a new species of *Oxychilus* and to discuss the relationships and evolution of the endemic subgenus *Drouetia* Gude, particularly its affinities with the subgenus *Ortizius* Forcart. The results support the hypothesis of Riedel (1964) that both groups arose in the Azores from a pre-*Ortizius* type snail which had arrived from Europe, probably during the Tertiary.

The nine islands comprising the Azorean archipelago (Plate 28, fig. 1) lie on the mid-Atlantic ridge, 1450 km west of Portugal and 1776 km east-south-east of Newfoundland. Santa Maria Island (Plate 28, fig. 2) has an area of 97 km^2 and its highest point is only 580 m above sea level. It has ten endemic species and subspecies of land snails, the largest number of any of the islands. São Miguel Island, 80 km north and eight times larger, has only five endemic

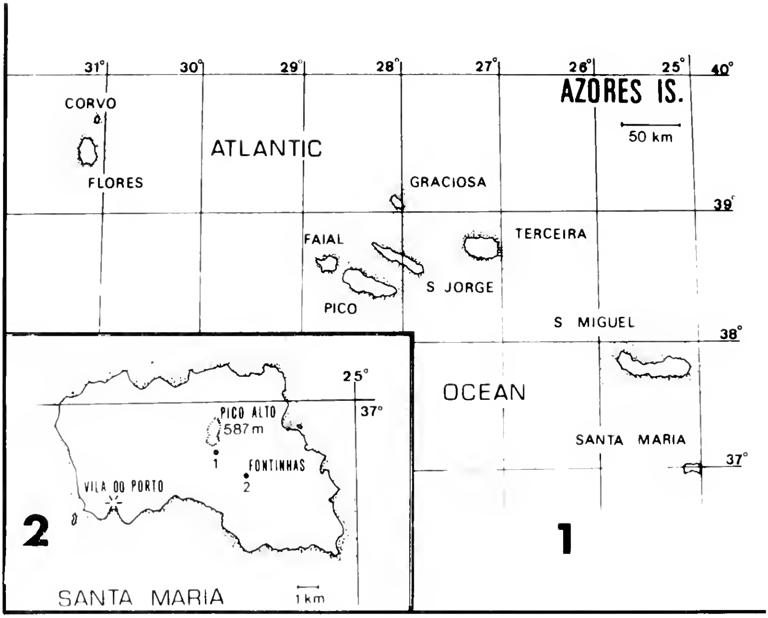

Plate 28

Fig. 1. Map of the Azores Islands.

Fig. 2. Map of Santa Maria Island, showing the collecting stations.

species. It is possible that, after a thorough study of the geological and biological history of the Azores, Santa Maria Island will prove to occupy a key position in the colonization of the archipelago.

ACKNOWLEDGMENTS

I wish to express my gratitude to Drs. Ruth D. Turner and Kenneth J. Boss of Harvard University and Dr. Robert C. Bullock of the University of Rhode Island for their continued assistance and comments on the manuscript.

MATERIALS AND METHODS

Specimens for anatomical work were killed by drowning in freshwater overnight and then preserved in 70% ethanol. No histological preparations or studies were made.

Specimens for examination with the Scanning Electron Microscope (SEM) were first cleaned in distilled water and then in 70% and 90% ethanol, using an ultrasonic cleaner for 10 seconds at each step. They were then mounted on a stub using double coated tape. Radulae were first cleaned in KOH, washed in distilled water and then carried to absolute ethanol to harden the teeth. To avoid destruction of the teeth, ultrasonic cleaning was reduced to two seconds per step. The radula ribbon was mounted on a circular cover glass to which it adhered when dry and the cover slip was attached to the stub with double coated tape. All specimens were covered with carbon and gold-palladium in a Denton DV-502 vacuum evaporator and examined using a ISI Mini-SEM, located in the Department of Zoology, University of Rhode Island.

Systematic work was based on the studies of Wollaston (1878), Gude (1911), Forcart (1957), Zilch (1959) and Riedel (1957, 1964, 1966). Terminology generally follows that of Fretter and Graham (1962) for the description of the soft parts, Rigby (1963) for the digestive and reproductive systems and Simroth (1908), Bargmann (1930) and Franc (1968) for the nervous system.

STATION DATA

Santa Maria Island, Azores Islands: *Station 1*, Pico Alto, south slope, at 500 m. In primitive forest of *Pittosporum undulatum* Vent, *Erica azorica* Hochst, *Laurus azoricus* (Seub) and the introduced *Hedychium gardnerianum* Roscoe. The animals had a special preference for fallen leaves of *Hedychium*. a. 1–XI–1974, 1 dead specimen; b. 9–X–1975, 1 dead and 7 live specimens.

Station 2. Fontinhas, Perímetro Florestal, at 300–400 m of altitude in forest of *Cryptomeria japonica* Don and *Myrica faya* Ait with an undergrowth of *Hedychium.* a. 1-XI-1974, 1 live and 1 dead specimen; b. 10-X-1975, 10 live and 8 dead specimens.

SYSTEMATICS

Family ZONITIDAE Mörch 1864

Subfamily ZONITINAE Mörch 1864

Genus *Oxychilus* Fitzinger 1833

Oxychilus Fitzinger 1833, Beträge Landesk. Oesterreich's unter der Enns [in] Verein fuer Vaterlaendische Geschichte . . ., [Vienna] 3 (3): 100. Type species, *Helix cellaria* Müller, subsequent designation Herrmannsen 1847.

Shell thin, translucent, smooth, somewhat glossy, disc-shaped, moderately umbilicate to non-umbilicate; whorls about 6; sutures not impressed; axial striae indistinct; last whorl elliptical in profile; aperture oblique, lip simple, sharp.

Subgenus *Drouetia* Gude 1911

Drouetia Gude 1911, Proc. Malacological Soc. London 9:272. Type species, *Helix atlantica* Morelet and Drouet, original designation.

Foot tripartite, right posterior tentacle retractor crossing the reproductive organs. Shell imperforate, hyaline, shiny, smooth, sculpture (at 400×) of extremely fine spiral lines crossed by axial threads.

Oxychilus (Drouetia) agostinhoi, new species[1]

Plates 29–35

Type Locality. Fontinhas, Perímetro Florestal, 300–400 m, Santa Maria Island, Azores Islands.

Type Repositories. Holotype and two paratypes, Museum of Comparative Zoology, nos. 288926, 288927, 288928. Additional paratypes at the American Museum of Natural History (1 sp.) Academy of Natural Sciences, Philadelphia (1 sp.), National Museum of Natural History, Washington, D.C. (1 sp.), British Museum (Natural History), London (2 sp.), Musée d'Histoire

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[1] By naming this species after the late Ten.-Cor. José Agostinho, I express my deepest homage to an eminent Azorean scientist and a very dear friend.

Naturelle, Paris (1 sp.), Musée d'Histoire Naturelle "Gr. Antipa", Bucharest (1 sp.), and collection of the author.

Description. Shell (Plate 30, Plate 31, figs. 5–6). Shell dextral, small, reaching 5.1 mm in maximum diameter, disc-shaped, non-umbilicate, whorls 4–4¼, horn-colored or somewhat greenish, with a greasy shine, transparent to translucent, apparently smooth, thin, fragile; first whorls whitish; position of old peristomes persisting as irregularly spaced light and dark axial bands; last whorl elliptic in profile; aperture oblique, depressed; peristome simple, sharp, not continuous; parietal callus whitish, covering the umbilical region where it forms a cup-like depression (Plate 31, fig. 5); suture very shallow; growth lines irregular and very weak; high magnification reveals the presence of very fine regular spirals (Plate 31, fig. 6). Measurements of the holotype and adult or nearly adult paratypes (with 4 whorls or more) are given in Table 1.

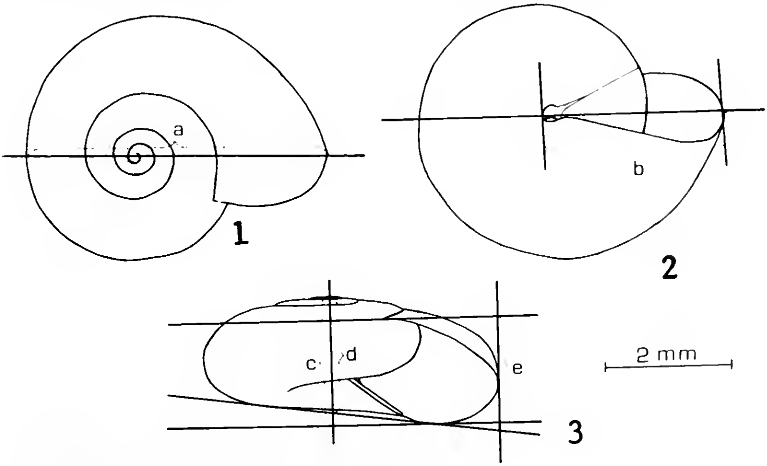


Plate 29

Figs. 1–3. Outline of the holotype, *Oxychilus (Drouetia) agostinhoi*, showing how the different measurements were taken. a, maximum diameter; b, aperture width; c. vertical height; d. oblique height; e, aperture height.

Animal. Neck dark-blue or brownish, becoming gradually lighter toward the foot and with a ring of more intense hue just above sole of foot; anterior tentacles small, grayish; posterior tentacles moderately long, black, their retractor muscles visible through skin; foot tripartite, a uniform light-gray to white; mantle with small, unevenly distributed patches of dark pigment mainly over dorsal region, visible only through the ventral surface of the shell; mantle border black; genital opening marked by a whitish hue behind posterior right tentacle, about midway on neck.

Table 1. Measurements of the shells of the holotype (#315) and adult or nearly adult paratypes of *Oxychilus (Drouetia) agostinhoi*. Measurements in mm. The specimen number refers to my own collection. The mean is given as $\overline{X}$ ± one standard deviation. For locality see text. For measurements see Plate 29, figs. 1–3.

Specimen number	Locality	Maximum diameter	Oblique height	Vertical height	Aperture height	Aperture width	Number of whorls
315	2b	5.1	2.0	2.2	1.8	3.0	4¼
506	2b	5.0	2.0	2.2	1.8	3.0	4
504	2b	5.0	1.9	2.2	1.8	3.0	4
505	2b	4.9	1.9	2.1	1.7	2.9	4¼
174	2a	4.9	2.1	2.4	1.9	3.0	4
377	1b	4.9	2.1	2.3	1.9	2.9	4
514	2b	4.9	2.0	2.4	1.8	2.6	4
507	2b	4.8	2.0	2.2	1.7	2.8	4¼
503	1b	4.8	1.9	2.1	1.7	2.8	4¼
508	2b	4.7	1.9	2.0	1.6	2.9	4
511	1b	4.6	1.9	2.3	1.8	2.9	4
313	2b	4.6	1.9	2.1	1.8	2.7	4
509	1b	4.6	1.9	2.1	1.8	2.6	4
515	2b	4.6	2.0	2.2	1.7	2.5	4
314	1b	4.5	1.7	1.9	1.5	2.7	4
510	1b	4.3	1.8	2.0	1.7	2.6	4
312	2b	4.2	1.9	2.1	1.8	2.4	4
Mean		4.7±.2	1.8±.1	2.2±.1	1.8±.1	2.6±.5	

Radula. (Plate 31, figs. 1–3. Plate 32). Radula formula:

$$\left[\frac{(12-13)}{1-(2)}+\frac{2}{3}+\frac{1}{3}+\frac{2}{3}+\frac{(12-13)}{(2)-1}\right]\times 42-55$$

Central tooth shorter and narrower than laterals, tricuspid; cusps about same size, small; central cusp always thinner than laterals. First lateral higher than central, tricuspid; inner cusp small, broad; median cusp long; outer cusp smaller than inner cusp, somewhat narrower. Second lateral similar to the first lateral, larger. Marginals falciform; first marginal bicuspid, with inner cusp rudimentary and outer cusp strong, curved; other marginals unicuspid, similar to the first marginal, becoming smaller.

Anatomy (Plate 33): *Organs of the neck region*. Anterior tentacles with grayish to dark gray internal wall; a thin contractor

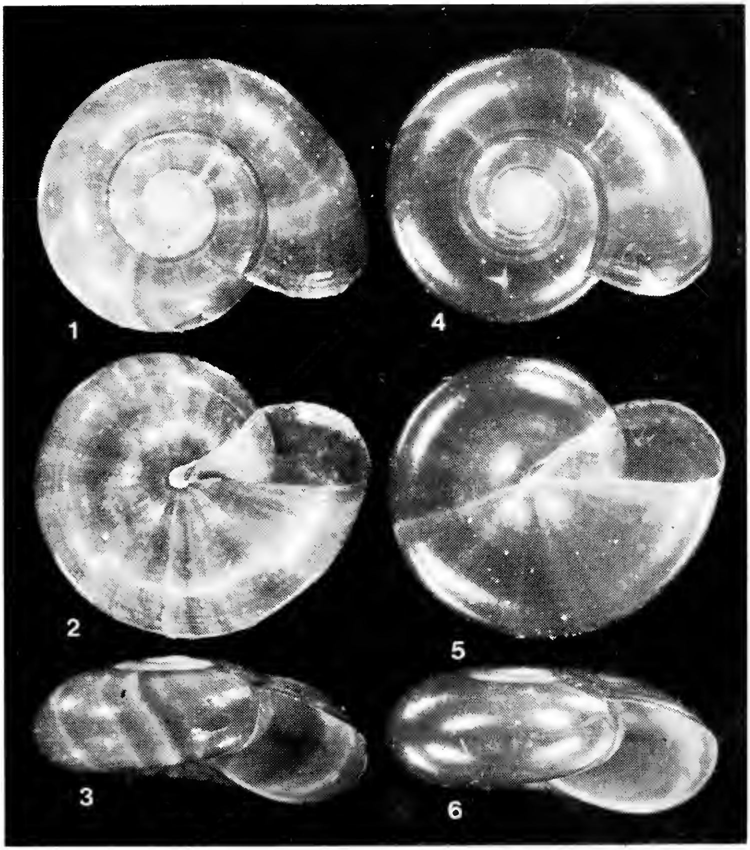


Plate 30

Figs. 1–6. *Oxychilus (Drouetia) agostinhoi.* Shell. Figs. 1–3, holotype (MCZ 288926) (5.1 mm max. diameter); Figs. 4–6, paratype (MCZ 288928) (4.5 max. diameter).

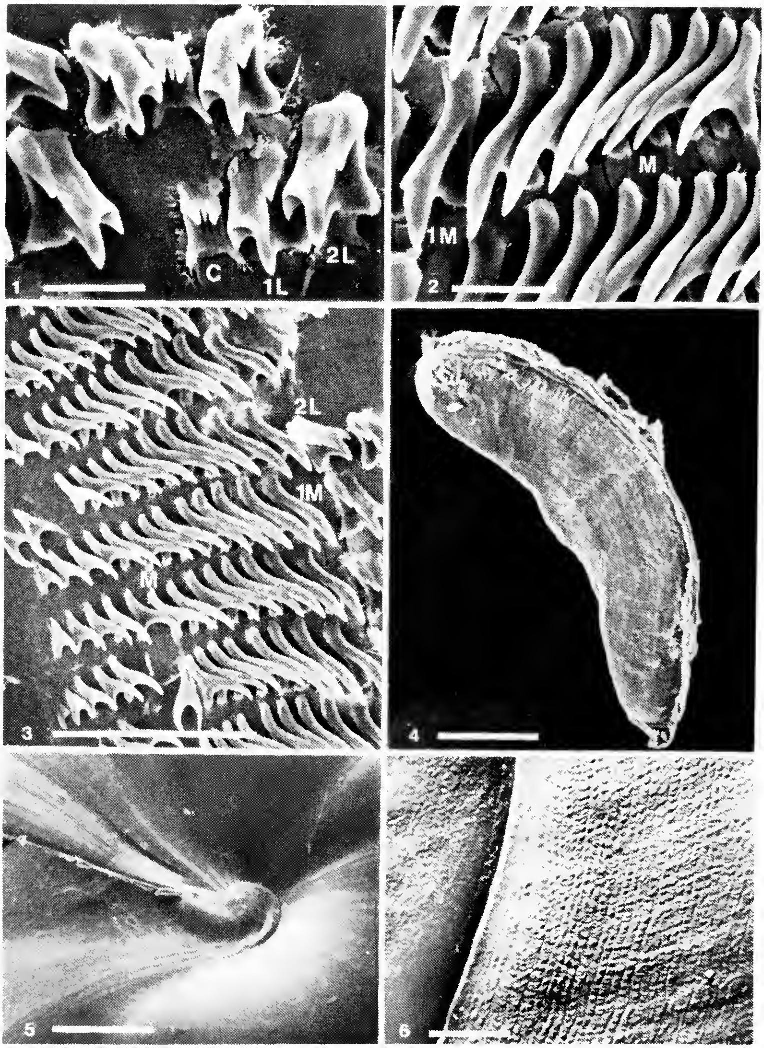


Plate 31

muscle arises near the attachment of the tentacle retractor muscle and inserts on the side of the foot; the retractor muscle adheres laterally to the cerebral ganglion and to most of the length of median lip nerve; the retractor muscle unites with the posterior tentacle retractor after receiving a nerve coming from the base of the pleural-pedal connective. Posterior tentacles bluish-black; two thin contractor muscles originate a little anterior to the insertion of the ocular nerve and attach at the base of each tentacle; right posterior tentacle retractor longer than the left, crossing the genital organs between penis and vagina. Two pairs of mucous glands dorsal to the foot open into the space between the lower lip and foot; the lower glands adhere posteriorly to the pedal ganglia, and are bordered laterally by the inner anterior pedal nerves, from which they receive one branch; the upper glands are round, half the length of the lower ones and free posteriorly and laterally.

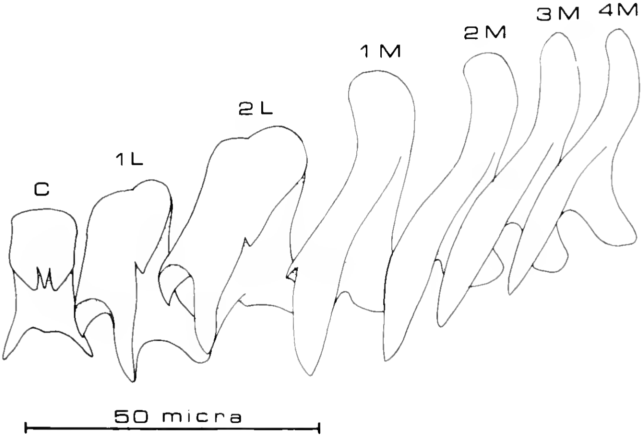


Plate 32

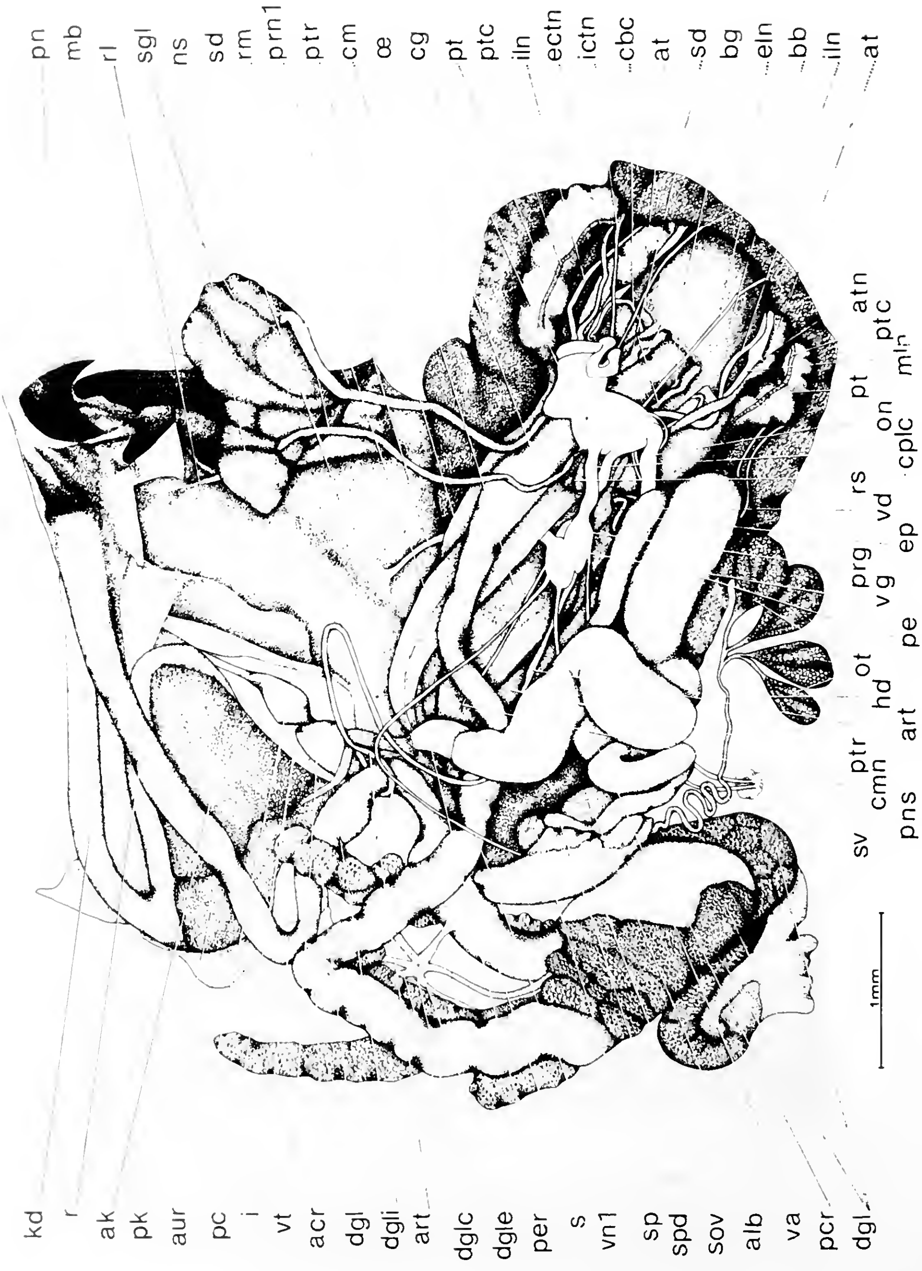
Radula of *Oxychilus agostinhoi*. C, central; 1L - 2L, first and second laterals; 1M - 4M, first to fourth marginals.

Reproductive system (Plate 34, figs. 1-4): Typical of the family. Combined penis and flagellum varying from 3.3 to 5.6 mm in

---

Plate 31

Figs. 1-6. Radula and jaws of *Oxychilus agostinhoi*. Figs. 1-3, radula of paratype MCZ 288927 (scales=25 μm); Fig. 4, mandible of paratype 502 (scale=100 μm); Fig. 5, umbilical region of shell of paratype 508 (scale=17 μm); Fig. 6, microsculpture of the third whorl of shell of paratype 501 (scale=100 μm). C, central tooth; 1L - 2L, first and second laterals; 1M - M, first and remaining marginals.


pn
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cbc
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sd
bg
eln
bb
iln
at
atn
ptc
mln
pt
on
cplc
rs
vd
ep
prg
vg
pe
ot
hd
art
ptr
cmn
pns
sv
1mm
kd
r
ak
pk
aur
pc
i
vt
acr
dgl
dgli
art
dglc
dgle
per
s
vn1
sp
spd
sov
alb
va
pcr
dgl

length; penis thick, twisted posteriorly and with a medial constriction; proximal portion wrapped in a membranous sheath, the external reflection of a strong muscular sheath (fig. 2) which does not cover the constriction; flagellum thick, short; epiphallus thinner than flagellum, shorter than total length of penis and expanding rapidly from the vas deferens; internal wall of penis and epiphallus (fig. 2) with 4 to 5 longitudinal folds, stronger in penis; penis retrac-

Plate 33

Dorsal view of dissected *Oxychilus agostinhoi;* the top of the neck was cut longitudinally and the skin reflected; a lateral cut was made on the body whorl from below the pneumostome to the top of the visceral mass, and the rectum, kidney and all the roof of mantle cavity reflected to the left; the floor of the mantle cavity was removed and most of the organs loosely separated; ovotestis and salivary glands are displaced.

acr, anterior crop
ak, anterior lobe of kidney
alb, albumen gland
art, artery
at, anterior tentacle
atn, anterior tentacle nerve
aur, auricle
bb, buccal bulb
bg, buccal ganglia
cbc, cerebro-buccal connective
cg, cerebral ganglia
cm, columellar muscle
cmn, columellar muscle nerve
dgl, digestive gland
dglc, digestive gland collector ducts
dgle, digestive gland excretor ducts
dgli, digestive gland intestinal duct
ectn, external circumtentacular nerve
eln, external lip nerves
ep, epiphallus
hd, hermaphroditic duct
i, intestine
ictn, internal circumtentacular nerve
iln, internal lip nerve
kd, kidney duct
mb, mantle border
mln, median lip nerve
ns, neck skin
oe, oesophagus
on, ocular nerve
ot, ovotestis
pc, pericardium
pcr, posterior crop
pe, penis
per, penis retractor
pk, posterior lobe of kidney
pn, pneumostome
pns, skin close to the pneumostome where *prn 1* and *vn 1* attach
prg, parietal ganglion
prn 1, first parietal ganglion
pt, posterior tentacle
ptc, posterior tentacle contractor
ptr, posterior tentacle retractor
r, rectum
rl, roof of the lung
rm, radular muscle
rs, radular sac
s, stomach
sd, salivary ducts
sgl, salivary glands
sov, spermoviduct
sp, spermatheca
spd, spermathecal duct
sv, seminal vesicle
va, vagina
vd, vas deferens
vg, visceral ganglion
vn 1, first visceral nerve
vt, ventricle

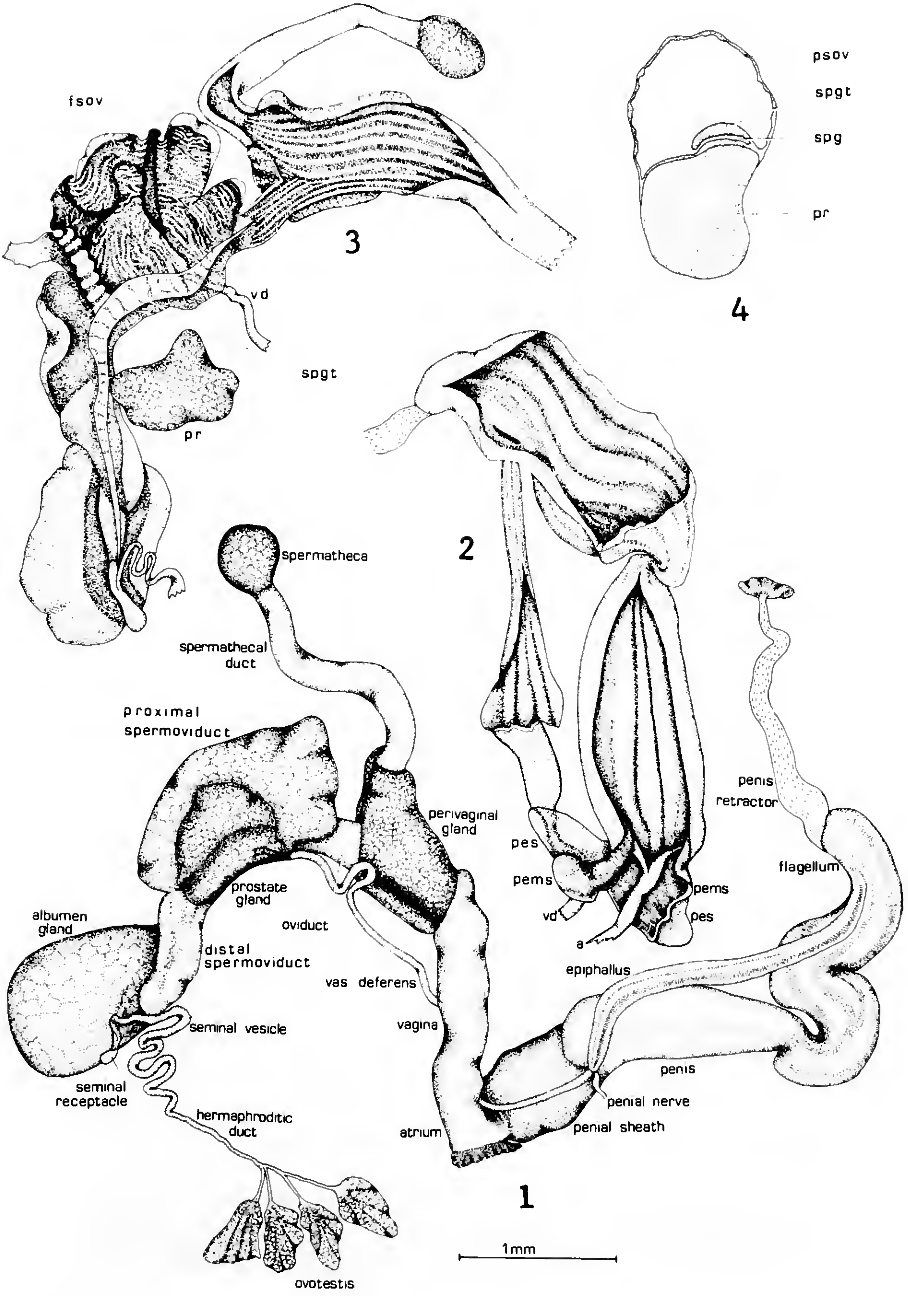
tor thick, usually short, arising from the floor of the lung posteriorly and inserting on the flagellum subapically. Genital atrium very reduced. Vagina almost as thick as penis and, together with oviduct, usually half total length of penis. Perivaginal gland thick, slightly pigmented, enveloping distal portion of vagina and proximal portion of oviduct, as well as proximal end of spermathecal duct. Spermathecal duct as thick as oviduct and as long as vagina; spermatheca pinkish, slightly elongated, twice the diameter of the spermathecal duct. Oviduct short. Internal wall of vagina and oviduct, as well as that portion of spermathecal duct covered by perivaginal gland, and with numerous longitudinal folds (Plate 34, fig. 3). Spermoviduct divided into two parts: 1. distal portion, enveloped by mucous gland, as thick as vagina; 2. proximal portion, thin walled and convoluted; the internal wall of anterior half with numerous folds, posterior half smooth (fig. 3); floor of spermoviduct covered by a thick, whitish sperm groove tract, which tapers and disappears when entering oviduct (Plate 34, figs. 3-4). Prostate gland adhering to floor and right side of proximal spermoviduct, pinkish, large, somewhat quadrangular. Albumen gland about same size as proximal spermoviduct. Ovotestis yellowish, composed of four oval lobes, the narrower ends of the lobes connecting with the hermaphroditic duct through moderately short and thin ducts, fused halfway in the first two lobes.

Digestive system (Plate 33). Buccal bulb well developed, cylindrical. Mandible (Plate 31, fig. 4) oxygnathe, semilunar in shape, strong, smooth, with a slightly curved median prominence on its free edge. Salivary glands white, well developed, fused together, forming a somewhat cylindrical mass, lying on top of the crop fitting up against the penis, spermoviduct and albumen gland. Oesophagus imperceptibly merging with the crop, which ends as a thin

Plate 34

Figs. 1-4. Reproductive system of *Oxychilus agostinhoi.* Fig. 1, external morphology; Fig. 2, internal morphology of male ducts; Fig. 3, internal morphology of female ducts; Fig. 4, diagramatic cross section of proximal spermoviduct, based on dissections and the literature.

a, atrium
fsov, folded portion of spermoviduct
pems, penial muscular sheath
pes, penial sheath
pr, prostrate gland
psov, proximal spermoviduct
spg, sperm groove
spgt, sperm groove tract
vd, vas deferens


3
fsov
vd
spgt
pr
4
psov
spgt
spg
pr
2
pes
pems
vd
a
pems
pes
1
spermatheca
spermathecal duct
proximal spermoviduct
perivaginal gland
prostate gland
oviduct
albumen gland
distal spermoviduct
vas deferens
seminal vesicle
vagina
seminal receptacle
hermaphroditic duct
atrium
ovotestis
penis retractor
flagellum
epiphallus
penis
penial nerve
penial sheath
1mm

walled sac. Stomach small, muscular, tapering abruptly posteriorly. Intestine short, convoluted, imperceptibly merging into the non-convoluted and slightly enlarged rectum. Digestive gland dark, its two main collector ducts merge before reaching the stomach, then subdivide into four excretory ducts, two of which empty into the anterior portion of the crop, one into the posterior portion of the crop and the other one into the stomach; an independent smaller duct empties into the anterior portion of the intestine.

Kidney (Plate 33). Bilobed, yellowish, strongly folded internally; the anterior lobe largest, on the roof of the mantle cavity, posterior to the heart; posterior lobe in visceral mass; nephridial duct S-shaped, large, arising from the tip of the anterior lobe close to the auricle, contouring its right edge and then turning forward to follow the left of the rectum, to open at the pneumostome.

Nervous system (Plate 35). Typical of the family (zonitoid type). Cerebral ganglia well developed, separated by very short cerebral commissure, with 21 nerves emerging from the ganglia, six of them connectives. The single unpaired penial nerve emerges posterior to the right external circumtentacular nerve and enters the penis where the penial sheath adheres to the epiphallus. There are seven sets of paired nerves emerging from the cerebral ganglia:

1. Internal circumtentacular nerves emerge from the front portion of the ganglia, close to the cerebral commissure, and attach to the basal wall of the posterior tentacle.
2. External circumtentacular nerves arise at the latero-posterior side of the ganglia and insert on the external basal wall of the posterior tentacle.
3. Ocular nerves are very thick, arise lateral to the internal circumtentacular nerves, insert on the proximal portion of the posterior tentacle, and continue inside it up to the eye, where they enlarge.
4. External lip nerves arise anterior to the external circumtentacular nerves on the lower surface of the ganglia and insert on the sides of the upper lip.
5. Internal lip nerves originate internal to the median lip nerves and insert internally below the base of the anterior tentacles.
6. Median lip nerves are thick, originate anterior to the previous ones, and extend to the anterior tentacle muscles. At the proximal end of the anterior tentacle muscle the median

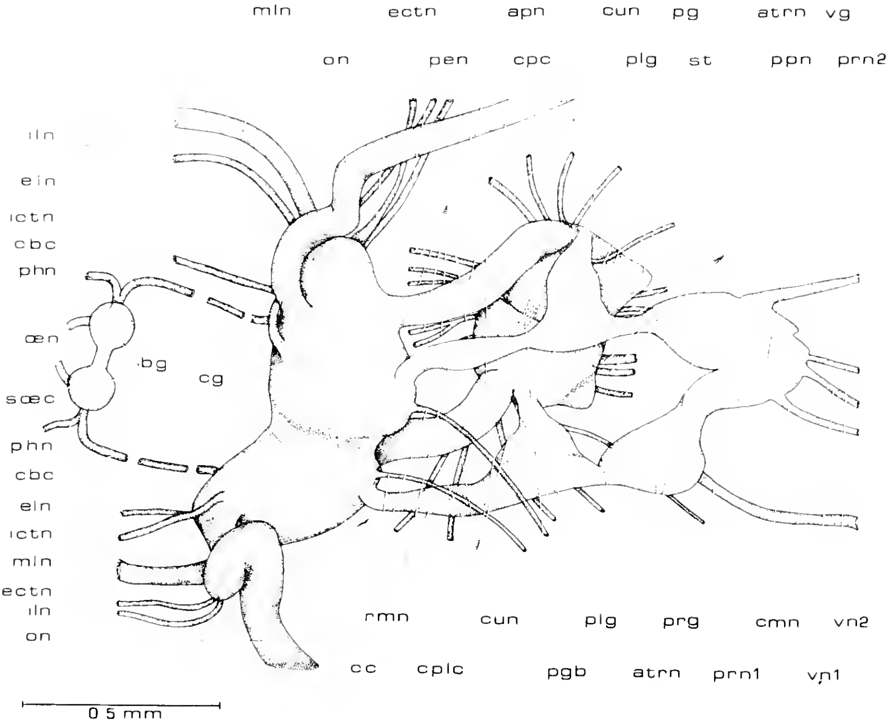


Plate 35
Dorsal view of central nervous system of *Oxychilus agostinhoi*.

apn, anterior pedal nerves
atrn, anterior tentacle retractor nerve
bg, buccal ganglia
cbc, cerebro-buccal connectives
cc, cerebral commissure
cg, cerebral ganglia
cmn, columellar muscle nerve
cpc, cerebro-pedal connectives
cplc, cerebro-pleural connectives
cun, cutaneous nerves
ectn, external circumtentacular nerve
eln, external lip nerve
ictn, internal circumtentacular nerve
iln, internal lip nerve
mln, median lip nerve
oen, oesophagial nerves
on, ocular nerve
pen, penial nerve
pg, pedal ganglia
pgb, pedal ganglia bridge
phn, pharyngeal nerves
plg, pleural ganglia
ppn, posterior pedal nerves
prg, parietal ganglia
prn 1 - *prn 2*, parietal nerves
rmn, radular muscle nerves
soec, suboesophagian commissure
st, statocyst
vg, visceral ganglion
vn 1 - *vn 2*, visceral nerves

lip nerve gives rise to a short anterior tentacle nerve, then divides: one branch has three fusiform thickenings and the other one two; they insert on the base of the anterior tentacles.

7. Radular muscle nerves emerge from the posterior end of the ganglia; the left one loops above and around the left salivary duct; the right nerve curves below the oesophagus.

The right internal circumtentacular, the right ocular and the right external circumtentacular cross the reproductive organs in between the penis and the vagina.

Connectives leaving the cerebral ganglia:

1. Cerebro-buccal connectives, very long, emerge from below the front side of the ganglia and extend to the buccal ganglia, which are located below the proximal end of the oesophagus between the proximal ends of the salivary ducts. The oesophageal nerves emerge from the buccal ganglia, and the pharyngeal nerves from the point of insertion of the cerebro-buccal connectives.
2. Cerebro-pedal connectives, short and thick, emerge from the posterior end of the cerebral ganglia and connect laterally with the pedal ganglia.
3. Cerebro-pleural connectives, short and thick, emerge internal to the previous ones.

Pleural ganglia elongate, twice the diameter of the connectives; bridges to the parietal ganglia very short, tapering downward to the pedal ganglia, and assuming the shape of a triangle; they are about the same size as the other connectives at the point of insertion with the pedal ganglia; at the point of the insertion of the pleuro-pedal connectives emerge the anterior tentacle retractor nerves. The parietal ganglia are asymmetrical; left parietal about the same size as the pleural ganglia, connects to the visceral ganglion through a broad and short connective; from the latero-posterior portion of the left parietal ganglion emerges a parietal nerve, which inserts on the neck, close to the floor of the lung; right parietal larger than the left one, fused with the visceral ganglion, but distinguishable from this one by its outline; it bears also one nerve, which emerges latero-posteriorly and attaches near the pneumostome region. Visceral ganglion about the same size as the right parietal, bears three nerves: the one on the left emerges latero-posteriorly and inserts into the columellar muscle, the one in the middle disappears into the albumen gland after passing close to the tip of the ventricle, and the one on the right inserts on the lung, in the proximity of the pneumostome. Pedal ganglia broad, circular, somewhat flattened, separated by a commissure similar to the one in the cerebral ganglia, connected dorsally by a bridge of fibrous appearance. They give rise to 18 nerves:

1. Three short pairs emerge posteriorly and sink immediately into the foot.
2. Four pairs (cutaneous) emerge laterally and go to the skin of the neck; both middle right cutaneous cross the genital organs.
3. Two pairs emerge anteriorly; the outside pair continues to the side of the anterior portion of the neck, and the inside pair subdivides into two branches: the outer branch goes to the anterior tip of the foot and the inner branch attaches to the outer edge of the lower mucous glands.

REMARKS

According to Riedel (1964) the groups of the genus *Oxychilus* Fitzinger endemic to the Azores are derived from a pre-*Ortizius* type of snail which came to the Azores from Europe sometime during the Tertiary. It gave rise to:

1. The subgenus *Ortizius* Forcart with three species: *O. (O.) miguelinus* (L. Pfeiffer), *O. (O.) juvenostriatus* Riedel and *O. (O.) ornatus* Riedel.
2. The subgenus *Radiolus* Wollaston, with only one species, *O. (R.) volutella* (L. Pfeiffer).
3. The subgenus *Drouetia* Gude, with until now, a single polytypic species, *O. (D.) atlanticus* s.l., which includes at least three subspecies: *O. (D.) atlanticus atlanticus* (Morelet and Drouet), *O. (D.) atlanticus minor* (Morelet) and *O. (D.) atlanticus brincki* Riedel.
4. The subgenus *Atlantoxychilus* Riedel, with one species, *O. (A.) spectabilis* (Morelet), which arose from the subgenus *Drouetia* Gude.

Reported from Santa Maria are: *Oxychilus (O.) miguelinus, O. (R.) volutella, O. (D.) atlanticus brincki* and *O. (A.) spectabilis.*

Table 2. Comparative table of the characteristics of the Azorean species of the subgenera *Ortizius* Forcart, *Drouetia* Gude and *Atlantoxychilus* Riedel, and of *Oxychilus (Drouetia) agnostinhoi* n. sp. Partly based on data from Riedel (1964).

	SHELL							RADULA			REPRODUCTIVE ORGANS		
TAXONOMIC UNIT	MD	W	SP	AP	U	COL	MIC	T/R	R	CC	PE (ext.)	PE (int.)	PVG
ORTIZIUS	5.5 to 15.0	4¼ to 5¾	somewhat raised	depressed and oblique	yes	transparent to translucent; dark-light radial bands moderately compact	fine to marked	31 to 39	34 to 46	longer than laterals	constriction always covered by penial sheath	weak longitudinal folds; sometimes transverse furrows also present	well developed, darkly pigmented
DROUETIA	7.0 to 9.0	5 to 6	raised to somewhat raised	raised and somewhat oblique	no	fairly transparent uniform	very fine	41 to 46	54 to 58	longer than laterals	no constriction	strong longitudinal folds	weakly to well developed; slightly pigmented
ATLANTOXYCHILUS	5.5	5	raised	raised and somewhat oblique	no	fairly transrent; dark-light radial bands somewhatcompact	very fine and very weak; deep spiral furrow	41	46	longer than laterals	no constriction	strong longitudinal folds and papillae	weakly developed slightly pigmented
OXYCHILUS (D.) AGOSTINHOI	5.1	4¼	very flat	depressed and oblique	no	transparent to translucent; unevenly spaced dark-light radial bands	weak and very fine	29 to 31	42 to 55	same size as laterals	constriction always above penial sheath	strong longitudinal folds	well developed, slightly pigmented

AP – aperture
CC – central cusp of central tooth
COL – external appearance and coloration
MD – maximum diameter in mm
MIC – microsculpture
PE (ext) – external morphology of penis
PE (int) – internal morphology of penis
PVG – perivaginal gland
R – number of rows of teeth
SP – spire
T/R – number of teeth per row
U – umbilicus
W – number of whorls

Despite a thorough search of Santa Maria, I failed to collect the first two species. *Oxychilus (D.) atlanticus brincki* is considered endemic to Santa Maria; however, some specimens I collected on Terceira Island are very similar to this subspecies although they possess a much longer epiphallus. Anatomical studies are needed in both groups to determine whether or not they are consubspecific.

Oxychilus (D.) agostinhoi shares characteristics with species of the subgenus *Ortizius* as well as of the subgenera *Drouetia* and *Atlantoxychilus.* This can be easily seen in Table 2. Other characteristics of the new species, not included in Table 2 due to lack of comparative data are:

1. The fine spiral lines on the shell are crossed by finer more compact axial lines, more easily visible in less transparent specimens. This pattern is stronger in *O. (D.) atlanticus brincki,* and weaker in *O. (A.) spectabilis.*
2. The absence of large light-dark patches in the mantle which are visible through the shell of *O. (A.) spectabilis* and all subspecies of *O. (D.) atlanticus.*
3. The grayish to white foot of *O. (D.) agostinhoi* relates it to species of *Ortizius;* the foot of *Drouetia* group is usually deeply colored, yellow to brilliant orange.
4. The mandible is identical to that of *O. (D.) atlanticus brincki,* but very different from the narrow, fragile mandible of *O. (A.) spectabilis.* Lack of material does not permit a comparison with other subspecies of *O. (D.) atlanticus* or with the endemic species of *Ortizius.*

In spite of these differences, I feel that the establishment of a new subgenus is unwarranted and that, based on the shell and internal structure of the penis, this species belongs in the subgenus *Drouetia.* However, its relationship to other species of *Oxychilus* endemic to the Azores elucidates the phylogenetic position of the up-to-now monotypic, endemic subgenus *Drouetia.* Its resemblance to the recent Azorean species of the subgenus *Oritizius* supports the hypothesis of Riedel (1964). Based only on these resemblances, for there is no fossil record, I think that *Oxychilus (Drouetia) agostinhoi* probably arose from the branch leading to the *O. (D.) atlanticus* s. l. before the origin of the subgenus *Atlantoxychilus* (Plate 36).

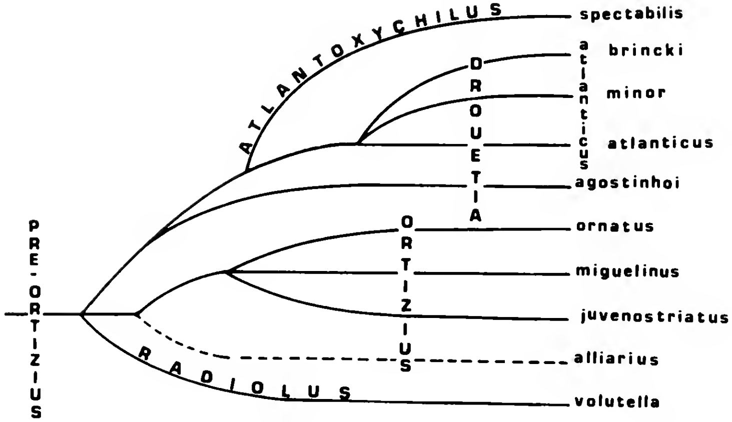


Plate 36

Diagramatic representation of the relationship of the Azorean species of *Oxychilus* Fitzinger, except for *Oxychilus s. s.* (Adapted from Riedel, 1964).

——————— species and groups endemic to the Azores

— — — — — species living also in Europe

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1935. *Aplexa hypnorum pilsbryi.* n. subsp. Nautilus *48:* 100.

1935. New species and races of Lymnaeidae from Newfoundland. By F. C. Baker and S. T. Brooks. Nautilus *49:* 10-13.

1935. Exploration of Southampton Island, Hudson Bay Zoology. I Echinodermata and Mollusca. Mem. Carnegie Mus. *12,* Part II, Sect. 5, pp. 1, 2.

1936. The land and freshwater mollusca of Newfoundland. Ann. Carnegie Mus. *25:* 83-108, pls. 12-13.

1936. *Vertigo clappi,* a new land snail from West Virginia. By S. T. Brooks and G. R. Hunt. Ann. Carnegie Mus. *25:* 121, text fig.

1936. The land snails collected during the 1936 voyage of the "Vagabondia" with descriptions of new species of *Plectostylus.* Ann. Carnegie Mus. *25:* 123-126, 3 text figs.

1936. West Virginian Carychiidae in the Carnegie museum collection. Nautilus *49:* 115.

1936. Some molluscs from Utah. Nautilus *50:* 13-14, text fig.

1937. The West Virginia Pupillidae in the Carnegie Museum. Nautilus *50:* 97-98.

1937. Occurrence of the family Carychiidae in West Virginia. By S. T. Brooks and G. M. Kutchka. Ann. Carnegie Mus. *25:* 155-161, text figs.

1938. Occurrence of the family Pupillidae in West Virginia. By S. T. Brooks and G. M. Kutchka. Ann. Carnegie Mus. *27:* 63-85, text figs.

1939. *Oreohelix eurekensis uinta* [new subspecies]. Nautilus *52:* 105-106.

1940. Geographical distribution of the recent mollusca of Newfoundland. By S. T. Brooks and B. W. Brooks. Ann. Carnegie Mus. *28:* 53-75.

1940. New Gastropoda from West Virginia. By S. T. Brooks and G. K. MacMillan. Nautilus *53:* 95-97, pl. 12, figs. 2, 3.

1944. The Sphaeriidae, a preliminary survey. By S. T. Brooks and H. B. Herrington. Nautilus *57:* 93-97.

MISCELLANY

STANLEY TRUMAN BROOKS, A BIBLIOGRAPHY OF HIS WORK ON MOLLUSKS WITH A CATALOGUE OF HIS MOLLUSCAN TAXA.

Richard I. Johnson

Stanley Truman Brooks was born on October 4, 1902 in Mound City, Kansas. He attended the University of Kansas where he received an A.B. degree in 1926. He did graduate work at the University of Pittsburgh, receiving a M. S. in 1927 and a Ph. D. in 1929. Between 1926 and 1928 he was an assistant in the Department of Invertebrate Zoology, then under the direction of Arnold E. Ortmann (Johnson, 1977). Most of his work was on North American land and fresh water mollusks. After Ortmann's death in 1927, Brooks was appointed curator of the department, a post he held until 1946. He then took a year's leave of absence to act as a scientific specialist for the United States Military Government in Germany. He never returned to the Museum, but for the rest of his life worked for a tobacco company. Brooks died of emphysema in 1960 (pers. comm., J. J. Parodiz).

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Abbott, R. T. 1973. American Malacologists, First edit. Falls Church, Va., p. 74.

Johnson, R. I. 1977. Arnold Edward Ortmann, a bibliography of his work on mollusks, with a catalogue of his recent molluscan taxa. Occasional Papers on Mollusks *4* (58), pp. 229–244.

Molluscan Taxa Introduced By S. T. Brooks

Abbreviations

CM — Carnegie Museum, Pittsburgh, Pennsylvania
MCZ — Museum of Comparative Zoology, Cambridge, Massachusetts

clappi Brooks and Hunt, *Vertigo*
1936, Ann. Carnegie Mus. *26:* 121, fig. 1 (Renick, Greenbrier Co., West Virginia). Holotype CM 62.28186.

mariae Brooks, *Plectostylus*
1936. Ann. Carnegie Mus. *25:* 124 and figure (San Esteban, Chile). Holotype CM 62.28184.

newfoundlandensis Baker and Brooks, *Stagnicola*

1935, Nautilus *49:* 12 (Camp 31, 8 mi. from Lomond, Bonne Bay, Newfoundland). Measured holotype CM 62.26763; paratype MCZ 108814.

papyracea Baker and Brooks, *Stagnicola palustris*

1935, Nautilus *49:* 10 (Rocky Pond near Whitbourne, Newfoundland). Measured holotype CM 62.26761; paratype MCZ 108813.

perpalustris Baker and Brooks, *Stagnicola palustris*

1935, Nautilus *49:* 11 (Pools along Exploits River, Grand Falls, Newfoundland). Measured holotype CM 62.26762; paratype MCZ 108812.

pilsbryi Brooks, *Aplexa hypnorum*

1935, Nautilus *48:* 100 (Pond near White Rocks River, at Paradise Creek, White Rocks Canyon, Uinta Co., Utah, Twp. 2 S, Range 18 E, Salt Lake Meridian). Holotype CM 62.26773. Figured by Brooks, 1936, Nautilus *50:* 14, fig. 1.

platysayoides Brooks, *Polygyra.*

1932, Nautilus *46:* 54–55, 3 text figs. (Cooper's Rock, Monongahela Co., West Virginia). Holotype CM 62.23750.

praelonga Brooks and MacMillan, *Pomatiopsis*

1940, Nautilus *53:* 96, pl. 12, fig. 2 (Hillside along Elk River, 1.5 mi. S Clay Co., West Virginia). Holotype CM 62.32897.

rugosa Brooks and MacMillan, *Triodopsis tridentata*

1940, Nautilus *53:* 96, pl. 12, fig. 3 (Damp Ravine, Blair Mountain, 1 mi. SW Blair, Logan Co., West Virginia). Holotype CM 62.32899.

sanctivincentii Brooks, *Natica*

1933, Ann. Carnegie Mus. *21:* 413, fig. 1 (West Coast of St. Vincent, British West Indies). Syntypes CM 62.3369.

vagabondiae Brooks, *Plectostylus*

1936, Ann. Carnegie Mus. *25:*125 and figure (San Esteban, Chile). Holotype CM 62.28185.

uinta Brooks, *Oreohelix eurekensis*

1939, Nautilus *52:* 105 (Hominy Creek, R. 1 W., T. 3., 3 mi N Uinta Special Meridian, near Whiterocks, Uinta Co., Utah). Measured holotype CM no. [not given, and now apparently lost (pers. comm., J. J. Tripp)]. Paratype Acad. Nat. Sci. Philadelphia, fig. by Pilsbry, 1939, Acad. Nat. Sci. Philadelphia, Monograph 3, 1 (1): 534, fig. 348, lower figs.

Occasional Papers on Mollusks

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

VOLUME 4 27 MARCH 1981 NUMBER 60

RECENT AND FOSSIL UNIONACEA AND MUTELACEA (FRESHWATER BIVALVES) OF THE CARIBBEAN ISLANDS.

RICHARD I. JOHNSON

ABSTRACT. Two species of Recent Unionacea occur in Pinar del Rio, the western-most province of Cuba; one is represented in the fossil record in the province of Habana. They belong to the genera found in North and Central America. One fossil Unionacea and two Recent Mutelacea, found in Trinidad, occur in South America.

INTRODUCTION

In the Caribbean islands, freshwater mussels have been found only in Cuba (and possibly on the nearby Isle of Pines) and in Trinidad. The two Cuban species of Unionacea, *Nephronaias scamnata* (Morelet) and *Villosa gundlachi* (Dunker), are restricted to the streams of the mountainous Province of Pinar del Rio, in the western-most part of the island. The streams in which they occur flow into the Gulf of Mexico or the Caribbean. *Villosa gundlachi* was formerly regarded as a *Nephronaias*, but because it is sexually dimorphic and its shell is similar to that of *V. lienosa* (Conrad) of the Gulf Coastal and Appalachicolan regions of the United States, it is now placed in the same genus. *Nephronaias scamnata* is also found as a fossil in Habana province. The distribution of these genera in Cuba, usually attributed to fortuitous dispersal, may be the result of continental drift (cf. Rosen, 1976).

A single Unionacea, *Triplodon trinitaria* (Maury), an ancestral form of *T. corrugatus* (Lamarck), is found in Pliocene deposits in southwestern Trinidad and eastern Venezuela. The geological relationship of these areas is discussed by Liddle (1928). Two recent species of Mutelacea, *Anodontites leotaudi* (Guppy) and

Mycetopoda siliquosa (Spix) occur both in Trinidad and Venezuela. *Mycetopoda siliquosa*, which is widely distributed from Guatemala to northern Argentina, is reported from Trinidad for the first time.

Classification above genus is that of Parodiz and Bonetto (1963); genera are according to Haas (1969) except the concept of *Villosa*, which is based on Burch (1975).

ACKNOWLEDGMENTS

Special thanks are extended to Dr. Peter R. Bacon of the University of the West Indies, Trinidad, for specimens of *A. leotaudi* and *M. siliquosa*. Dr. Joseph Rosewater, National Museum of Natural History, and Dr. Juan J. Parodiz, Carnegie Museum, Pittsburgh, kindly made the collections in their charge available. Dr. Barry Roth, California Academy of Sciences, San Francisco, lent specimens, and Dr. Rosina Fechter, Zoologische Staatssammlung, Munich, kindly informed me that the types of *M. siliquosa* (Spix) are still extant. Thanks are also extended to Drs. Kenneth J. Boss and Juan J. Parodiz for reading the manuscript and especially to Drs. Ruth D. Turner and Arthur S. Merrill who made critical suggestions and revisions.

ABBREVIATIONS

AMNH—American Museum Natural History, New York
ANSP—Academy of Natural Sciences, Philadelphia, Pennsylvania
BMNH—British Museum (Natural History), London, England
CAS—California Academy of Sciences, San Francisco, California
CM—Carnegie Museum, Pittsburgh, Pennsylvania
MCZ—Museum of Comparative Zoology, Cambridge, Mass.
USNM—National Museum of Natural History, Washington, D.C.

Superfamily UNIONACEA Fleming 1828

Family UNIONIDAE Fleming 1828

Subfamily UNIONINAE Fleming 1828

Genus **Nephronaias** Fischer and Crosse

Nephronaias Fischer and Crosse 1893, Mission Sci. au Mexique, pt. 7, 2: 556 (Type-species, *Unio plicatulus* Charpentier 1856, by monotypy).

Description. "Shell elliptical, biangulate behind, that of the male showing a tendency to become arcuate with age, the female usually having a posterior inflation and never arcuate; surface concentrically sculptured; [umbos] low, with faint, broken ridges, which show a tendency to fall into two rounded loops; pseudocardinals generally rather compressed, ragged; laterals obliquely ridged; [umbonal cavity] rather deep, dorsal muscle scars distinct, running in a line from the [umbonal] cavity downward and forward." (Simpson, 1914: 253).

Remarks. In this paper we are dealing only with the subgenus *Nephronaias* in which Haas (1969: 192–204) included 24 Central American and Cuban species.

Nephronaias (Nephronaias) scamnata (Morelet)
Plate 37, figs. 1–4; Plate 38, fig. 1

Unio scamnatus Morelet 1849. Testacea Novissima *1:* 30 ([Rio Las Pozas] Cacajajícara, [Pinar del Rio] Cuba; lectotype BMNH 1893.2.4.1976 labeled, "Rio Taco Taco [Pinar del Rio], Cuba," selected by Johnson 1971: 92, pl. 2, fig. 3); Martens 1900, Biologia Centrali Americana, Moll., p. 507.

Unio proclinatus Martens 1900. Biologia Centrali Americana, Moll., p. 508 (Rio Taco [Taco]; Gibara [Oriente Prov.], Cuba [erroneous]); and Pinar del Rio; Gundlach, in Museum Berolini [syntypes presumed to be in the Zoological Museum, Humbolt University (Berlin)].

Unio calamitarum Morelet 1849. Testacea Novissima *1:* 30 (rivulum Baluntiè, propre Palenqueanum vicum [Chiapas Prov.], Mexico [presumed erroneous]; lectotype BMNH 1893.2.4.2010 selected by Johnson 1971: 80, pl. 2, fig. 5).

Unio calamitarum prolongata Fischer and Crosse 1894. Mission Sci. au Mexique, pt. 7, *2:* 612, pl. 63, fig. 5, 5a (type locality as preceding entry [presumed erroneous], Morelet colln.; type not located in the BMNH [presumed lost]).

Unio bitumen Cooke. Vaughn 1919 [in] Carnegie Inst. Washington, pub. no. 219, p. 130, pl. 9, fig. 3 a-c, (Angela Elmira asphalt mine, near Bejucal [Habana Prov.], Cuba, Oligocene "?"; holotype USNM 167063).

Nephronaias scamnata (Morelet). Simpson 1900. Proc. U.S. Natl. Mus. *22;* 595; Simpson 1914, Cat. Naiades *1:* 272; Aguayo and Jaume 1947, Catalogo Moluscos de Cuba, no. 134; Haas 1969, Das Tierreich, pt. 88, p. 193.

Elliptio (Nephronaias) scamnatus (Morelet). Frierson 1927, Check List of North American Naiades, p. 34; Haas 1929, Senckenbergiana *11:* 328, figs. 4, 5.

Description. Shell usually of medium size, not often reaching over 80 mm in length. Outline long elliptical, valves rather solid, compressed, and inequilateral. Anterior end broadly and regularly rounded, posterior end less so. Ventral margin almost straight or slightly arcuate. Dorsal margin straight, ending in an indistinct angle with the gradually descending posterior margin. Hinge ligament long. Posterior ridge low, faint, generally double, often ending in a faint biangulation. Umbos low and sharp, located very anteriorly, and sculptured with fine, doubly-looped ridges.

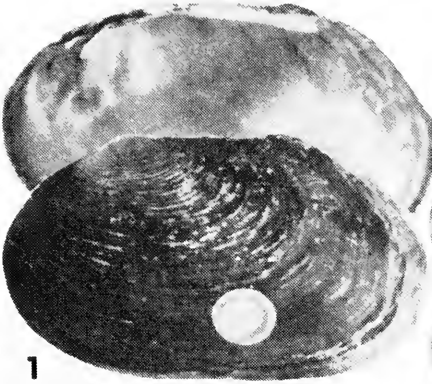
Shell with concentric sculpture covering the entire surface. Periostracum blackish, brownish, or olive, sometimes with a few faint green rays, and occasionally with concentric tawny or light brown bands.

Left valve with two subtriangular, ragged pseudocardinal teeth and two slender, nearly straight, lateral teeth. Right valve having a strong pseudocardinal tooth and a vestigial one anterior to it and a single lateral tooth. Umbonal cavities shallow. Anterior adductor muscle scars deep, posterior ones very faint. Pallial line distinct anteriorly, where the shell is thickened. Nacre usually bluish-white, creamy or yellowish and slightly iridescent posteriorly.

Sexual differences slight, but when apparent, male shells have a straight or slightly arcuate ventral margin, while females may be slightly produced at the posterior ventral margin.

Plate 37

Fig. 1. *Nephronaias (Nephronaias) scamnata* (Morelet). *Unio scamnatus* Morelet. Rio Taco Taco [Pinar del Rio Province] Cuba. Lectotype BMNH 1893.2.4.1976. Length 52, height 34, width 17 mm. Fig. 2. *Unio calamitarum* Morelet. Rio Baluntiè, near Palenque, [Chiapas State], Mexico, erroneous. [Pinar del Rio Province, Cuba]. Lectotype BMNH 1893.2.4.2010. Length 54, height 32, width 20 mm. Fig. 3. *Unio calamitarum prolongata* Fischer and Crosse. No locality given, but presumed to be the same as that of *U. calamitarum.* Figured type in the Morelet collection, according to Fischer and Crosse, but is not in the BMNH and so presumed lost. Figure from Fischer and Crosse. Length 64, height 34, width 22 mm. Fig. 4. Pinar del Rio Province, Cuba. MCZ 6585. Length 63, height 32, width 25 mm. Fig. 5. Rio Caiguanabo, San Diego de los Baños, Pinar del Rio Province, Cuba. MCZ 126800. Length 69, height 36, width 18 mm.



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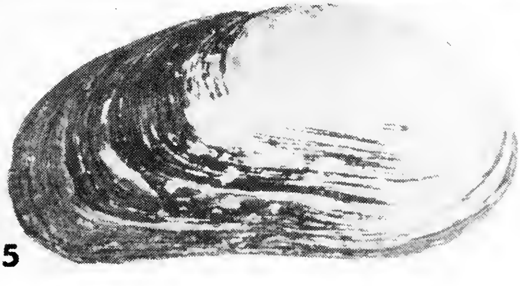

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Length mm	Height mm	Width mm	
85	43	26	Rio Taco Taco, Pinar del Rio Prov. Cuba. Female
78	38	22	Rio Viñales, Pinar del Rio Prov. Cuba. Male

Remarks. Nephronaias scamnata (Morelet), judging by the size and number of lots found in the several collections studied, is not particularly abundant. Only a few lots have consisted of more than a half-dozen specimens. The species has sometimes been confused with male (but not female) *Villosa gundlachi* (Dunker), mostly because their ranges overlap. However, the shells of *N. scamnata* show little sexual dimorphism, are long elliptical, sometimes with a concave ventral margin, have the entire surface of the shell covered with concentric sculpture, and have ragged pseudocardinal teeth. The shells of male *V. gundlachi* are also elliptical but are proportionally much higher and have straight or slightly curved ventral margins, the concentric sculpture either restricted or absent, and the pseudocardinal teeth subcompressed.

This species has not been found in Central America; it bears no close resemblance to *Nephronaias hermanii* (Haas 1929: 30, figs. 12, 13) or *N. tabascoensis* (Charpentier) to which it has been compared. The sculpture of the former is not the same and the latter has a subtruncated posterior end. The lectotype of *Unio calamitarum* and the figure of *U. c. prolongata* are certainly *N. scamnata*, and as no other specimens have been seen from Central America, it is assumed that both taxa are based on Cuban shells from the Morelet collection. Recent *N. scamnata* and Oligocene (?) *U. bitumen* are separated by time, if not by locality but there is no significant morphological difference in their shells.

Aguayo and Jaume (1947) reported *N. scamnata* from Rio Zanjonal [near Viñales], but this river could not be located on the Cuban Military Maps of 1942; also it is impossible to tell which of the two Rio Hondos in Pinar del Rio Province they intended. They further reported this species from the Rio Santa Fé, Isla de Pinos, on the authority of Poey [reference not located], but they were unable to confirm this either by specimens in the Museo Poey or by collecting. Henderson (1916) did not find it when he made a survey of the land and freshwater mollusks of the island. Thus, the range is restricted to Pinar del Rio Province, Cuba as far as can be ascertained.

Specimens examined or recorded. PINAR DEL RIO: *Gulf of Mexico Drainages*—Rio San Vicente, Viñales and Baños de San Vicente; Rio Rosario, Mina Constancia, Viñales; Rio Guacamayos, S of Concolacion del Norte (all MCZ); Rio Las Pozas, Cacarajícara (type locality of *U. scamnatus*); *Caribbean Drainages*—Rio Cuyaguateje, Sumidero and Guane; Rio Los Portales; Rio San Diego, Caiguanabo and San Diego de los Baños; Rio Taco Taco; Rio San Cristóbal, San Cristóbal (all MCZ). HABANA: Angela Elmira asphalt mine, near Bejucal, Oligocene (?) (type locality of *U. bitumen*); ISLA DE PINOS: Rio Santa Fe (Poey, teste Aguayo and Jaume, 1947) [doubtful].

Subfamily LAMPSILINAE Ortmann 1910

Genus **Villosa** Frierson

Villosa Frierson 1927, Check List of North American Naiades, pp. 11, 80. (Type-species, *Unio villosus* Wright 1898, by original designation).

Description. "The shells are small to medium in size and subrhomboidal, subovate or subelliptical in shape, and mostly rather thin. The disc is without sculpture, the periostracum greenish-yellow to nearly black, usually with dark green color rays. The [umbonal] sculpture is double-looped." (Burch, 1975: 124).

Remarks. Burch (1975: 22) included 16 North American species in *Villosa.* Based solely on shell morphology, *Unio gundlachi* from Cuba is herein also placed in this genus.

Villosa gundlachi (Dunker)

Plate 38, figs. 2, 4

Unio gundlachi Dunker 1858, Malakozool. Blätter *5:* 228 ([Rio] Taco Taco [Pinar del Rio], Cuba): measured holotype in the Berlin Museum, *teste* Haas 1929: 328, and figs. 8–11, showing two female paratypes.

Nephronaias gundlachi (Dunker). Simpson 1900, Proc. U. S. Natl. Mus. *22:* 595; Simpson 1914, Cat. Naiades *1:* 274; Aguayo and Jaume 1947, Catalogo Moluscos de Cuba, no. 134, p. [1]; Haas, 1969, Das Tierreich, pt. 88, p. 193.

Lampsilis (Actionaias) gundlachi (Dunker). Frierson 1927, Check List of North American Naiades, p. 84.

Elliptio (Nephronaias) gundlachi (Dunker). Haas 1929, Senckenbergiana *11:* 328, figs. 6–11

Description. Shell usually of medium size, not often reaching over 70 mm in length. Outline elliptical or elliptical rhomboid. Valves rather solid, compressed, inequilateral. Anterior end regularly rounded, posterior end of the male slightly more broadly rounded, that of the female very much more broadly rounded. Ventral margin straight or slightly concave. Dorsal margin straight, ending in an indistinct angle with the posterior slope. Hinge ligament long. Posterior ridge low, faint, generally double, often ending in a faint biangulation. Umbos low, located very anteriorly, their sculpture consisting of doubly looped ridges.

Sculpture of faint, concentric ridges that are most distinct behind the posterior ridge. Periostracum smokey-olive to greenish yellow, occasionally with green rays on the disc.

Left valve with two subcompressed pseudocardinal teeth and two slender, nearly straight lateral teeth. Right valve with one subcompressed pseudocardinal, the vestige of a second one anteriorly, and one lateral tooth. Umbonal cavities shallow, with dorsal muscle scars in the cavities and under the pseudocardinal teeth. Anterior adductor muscle scars deep, posterior ones very faint. Pallial line distinct anteriorly, where the shell is thickened. Nacre whitish, or bluish-white, slightly iridescent posteriorly.

Plate 38

Fig. 1. *Nephronaias (Nephronaias) scamnata* (Morelet). *Unio bitumen* Cooke. Angela Elmira asphalt mine, near Bejucal [Habana Province], Cuba; Oligocene "?" Holotype USNM 167063. Figure from Cooke. Length 68, height 29.5 mm. Fig. 2. *Villosa gundlachi* (Dunker). *Unio gundlachi* Dunker. Rio Taco Taco [Pinar del Rio Province], Cuba. Paratype MCZ 94849, from W. Dunker ex J. G. Anthony collection. Length 53, height 32, width 12 mm. Male. Fig. 3. *Villosa lienosa* (Conrad). Bottom of lock 2, Black Warrior River, Tuscaloosa, Tuscaloosa Co., Alabama. Length 55, height 32, width 20 mm. Male. Fig. 4. *Villosa gundlachi* (Dunker). [Rio Guamá], near Pinar del Rio, Pinar del Rio Province, Cuba. MCZ 20862. Length 54, height 34, width 21 mm. Female. Fig. 5. *Villosa lienosa* (Conrad). Bottom of lock 2, Black Warrior River, Tuscaloosa, Tuscaloosa Co., Alabama, MCZ 28460. Length 48, height 32, width 18 mm. Female.

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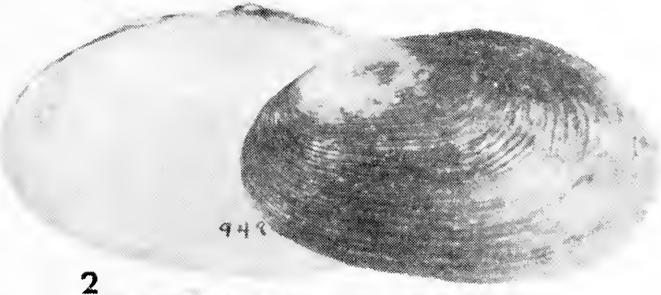

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Male shells quite evenly elliptical, length usually about one and one half times the height, the ventral margin straight, or slightly curved. Female shells much wider posteriorly than anteriorly, with a wide, rounded, marsupial swelling. The posterior point is high on the shell, and sharper than that of the male; below the point the posterior margin is subtruncate.

Length mm	Height mm	Width mm	
68	38	22	Rio Cuyaguateje, Cabezas, Pinar del Rio Prov., Cuba. Male.
62	36	20	Rio Taco Taco, Pinar del Rio Prov. Cuba. Holotype. Male.
62	42	24	Rio Guamá, near Pinar del Rio, Pinar del Rio Prov., Cuba. Female.
54	34	21	As above. Female.

Remarks. The male shell of *Villosa gundlachi* (Dunker) bears some superficial resemblance to *Nephronaias scamnata* (Morelet). However, the female of *V. gundlachi*, on the basis of shell morphology, is close to *V. lienosa* (Conrad), a common species in the Gulf Coastal and Appalachicolan regions of the United States. Simpson (1914: 273) noted the resemblance of the female *V. gundlachi* to *Lampsilis [=Ligumia] subrostrata* (Say). In each of these species, the female shell is much wider posteriorly than anteriorly, has a wide rounded marsupial swelling, a posterior point that is higher than on the male shell, and is subtruncate between the point and the post-basal swelling.

The range of *Villosa gundlachi* is limited to Pinar del Rio Province, Cuba. It is apparently rather rare as only a few of the lots examined have consisted of more than a half-dozen specimens.

Specimens examined or recorded. PINAR DEL RIO: *Gulf of Mexico Drainages*—Rio Las Pozas, near Rancho Lucas (MCZ) and Las Pozas (Aguayo and Jaume). *Caribbean Drainages*—Rio Cuyaguateje, Sumidero and Cabezas; and Rio Guamá, near Pinar del Rio (all MCZ). *Rio San Diego Drainage*—Rio San Diego, Caiguanabo and San Diego de los Baños (both MCZ); *Rio Los Palacios Drainage*—Rio Los Palacios, Pinar del Rio (MCZ). *Rio Taco Taco Drainage*—Rio Taco Taco, Taco Taco (MCZ, type locality of *U. gundlachi*). *Rio San Cristóbal Drainage*—Rio San Cristóbal, San Cristóbal (MCZ).

Family HYRIIDAE Swainson 1840

Subfamily HYRIINAE Ortmann 1911

Genus **Triplodon** Spix

Triplodon Spix 1827, [in] Spix and Wagner, Testacea Fluviatilia ... Brasiliam, Monachii [Munich], p. 53. (Type-species, *Triplodon rugosum* Spix 1827, by monotypy).

Description. Shell subrhomboidal, solid, slightly inflated, narrow and dorsally winged anteriorly, biangulate posteriorly. Umbos low with nearly radial sculpture. Periostracum greenish, to brownish or blackish. Two denticulate pseudocardinals in each valve, one lateral in the right and two in the left valve.

Remarks. The subgenus *Triplodon* s.s. has a well developed posterodorsal wing, while in the subgenus *Triquetrana* Simpson 1900 it is compressed and poorly developed. According to Haas (1969: 545), the former subgenus is represented by four recent species: *T. (T.) corrugatus* (Lamarck, 1819); *T. (T.) latialatus* (Sowerby 1869); *T. (T.) transversus* (Hupé 1857); and *T. (T.) rugosissimus* (Sowerby 1869). These species are found primarily in the Guayanas and Brasil. The fossil forms were discussed by Palmer (1945: 11); one of these, *T. (T.) trinitaria*, occurs in both Trinidad and Venezuela and is included here.

Triplodon (Triplodon) trinitaria (Maury)

Plate 39, fig. 1

Hyria (Hyria) trinitaria Maury 1925, Bull. American Paleontol. *10* (42): 235, pl. 13, figs. 2 (Cedros Point, SW Trinidad, Lower Pliocene, figured holotype Paleontological Research Institution 854); Palmer 1945, Bull. American Paleontol. *31*(118): 12, pl. 1, figs. 1–10.

Description. "Length of shell, without the anterior and posterior points, 65 mm. Shell subrhomboidal, rather solid, only slightly inflated, when perfect with a narrow, conspicuous, pointed, anterior process and a broad, high posterior dorsal wing terminating when entire in a prominent point. Posterior ridge strongly carinate, slightly biangulate. Beaks very low. Hinge line almost perfectly straight. One specimen shows distinctly a pseudocardinal tooth much split up into denticles. Surface marked with close, sharply defined, concentric threads, and on the disc, in front of the umbonal carina, are very beautiful V-shaped markings ..." (Maury, 1925).

Length mm	Height mm	Width mm	
70	40	21	E La Llanera, State of Monagas, Venezuela, Lower Pliocene.
65	50	32	Cedros Point, SW Trinidad, Lower Pliocene. Holotype.

Remarks. Maury (1925: 236) mentioned that *Triplodon trinitaria* Maury is ancestral to *T. corrugatus* (Lamarck 1819), in showing the "dawning" of the V-shaped corrugations which are so striking in *T. corrugatus.* The latter species is found in the rivers of the Guayanas, Brazil, and, based on a specimen so labeled in the Museum of Comparative Zoology, possibly also in the Orinoco River, Venezuela. Palmer (1945: 12) reported *T. trinitaria* from the lower Pliocene of Venezuela proper and noted that the assemblage of species from La Llanera suggests closer affinities with Amazonian and Recent forms than with Colombian species of the same genus.

Triplodon trinitaria is from the lower Pliocene of northeastern Venezuela and Trinidad. It is a rare species, known from about 40 specimens.

Specimens examined or recorded. VENEZUELA: a low hill along the east bank of the Quatatal River, east of La Llanera, and 17.1 kms N of Caicara, State of Monagas; Pliocene (Palmer, 1945: 7). TRINIDAD: Cedros Point, [SW part of island]; lower Pliocene (Maury, 1925: 236).

Superfamily MUTELACEA Parodiz and Bonetto 1963

Family MYCETOPODIDAE Parodiz and Bonetto 1963

Subfamily ANODONTITINAE Parodiz and Bonetto 1963

Genus **Anodontites** Bruguière

Anodontites Bruguière 1792, Jour. Hist. Nat., Paris *1:* 131. (Type-species, *Anodontites crispata* Bruguière, by monotypy). Haas (1969: 557) listed a number of generic synonyms.

Description. "Shell rounded to elongated, inflated, subsolid; [umbos] full, [periostracum] smooth or cloth-like, rarely having faint rays; hinge line straight or slightly curved, edentulous, sometimes a little sinuous, the escutcheon distinct and large; nacre soft tinted, the prismatic border wide and well defined." (Simpson, 1914: 1403).

Remarks. Haas (1969: 572–574) recognized two additional subgenera, *Ruganodontites* Marshall 1931, and *Lamproscapha* Swainson 1840.

Subgenus **Anodontites** s.s.

Description. Shell rounded to elliptical; posterior ridge low or absent.

Remarks. Haas (1969: 558–572) included 19 species in this subgenus and a number of nominal subspecies.

Anodontites (Anodontites) leotaudi (Guppy)

Plate 39, figs. 2–3

Anodon leotaudi Guppy 1866, Annals and the Magazine of Nat. Hist. (3) *17:* 54 (streams flowing into the Caroni River, Trinidad, lectotype ANSP 125443, selected by Johnson and Baker, 1973, *125:* 160, pl. 10, fig. 3; paralectotype BMNH 1861.1.3.1.

Anodontites irisans Marshall 1926, Proc. U. S. Natl. Mus. *69:* 10, pl. 2, figs. 3, 5; pl. 3, fig. 7 (Venezuela; holotype USNM 359920; one lot of five specimens CAS 5825 (originally in the Stanford collection). Marshall saw one of these shells but sent it back to Stanford without measuring it, so a paratype in the lot cannot be determined.

Glabaris leotaudi (Guppy). Simpson, 1900, Proc. U. S. Natl. Mus. *22:* 929.

Anodontites leotaudi (Guppy). Simpson, 1914, Cat. Naiades, *3:* 1413.

Anodontites (Anodontites) patagonicus leotaudi (Guppy). Haas, 1969, Das Tierreich, pt. 88, p. 567.

Description. Shell of medium size, seldom exceeding 80 mm in length. Outline rather obovate. Valves rather thin and compressed. Anterior end regularly rounded, posterior end slightly produced near the base. Ventral margin almost straight. Dorsal margin slightly curved, forming an indistinct angle with the curved, and obliquely descending posterior margin. Hinge ligament short. Posterior ridge rounded and indistinct, though perceptibly double and ending in a slight biangulation in some specimens. Umbos rather full, only slightly elevated above the hinge line, their sculpture unknown. Surface of the shell smooth, sometimes satiny, especially posteriorly. Periostracum yellowish brown, chestnut, or blackish.

Hinge plate and teeth lacking; umbonal cavities shallow; anterior muscle scars distinct, posterior scars and pallial line indistinct, nacre flesh colored, pinkish or whitish.

Length mm	Height mm	Width mm	
84	46	31	[Caroni River], Trinidad. Measured type of *Anodon leotaudi* Guppy.
70	39	22	Venezuela. Holotype of *Anodontites irisans* Marshall.
78	45	25	Trinidad. Lectotype of *Anodon leotaudi* Guppy.

Remarks. Anodontites leotaudi (Guppy) was placed near *A. patagonicus* (Lamarck) by Simpson (1914) and Haas (1969); however, it does not resemble it. The shell of *A. patagonicus* is obovate, more inflated, and heavier than that of *A. leotaudi* and its northern range is southern Brazil. *Anodontites leotaudi* appears close to some specimens of *A. trapesialis glaucus* (Valenciennes) which ranges from Central America south to the Magdalena River system, Colombia. However, the shell of *A. leotaudi* is heavier, the periostracum darker and without traces of green.

Anodontites leotaudi has been found in Venezuela and Trinidad. Guppy (1893: 230) gave an indication of its relative abundance: "I have never been able to procure more than two or three specimens."

Specimens examined or recorded. VENEZUELA: (Marshall; USNM: CAS; AMNH). TRINIDAD: (USNM); *Caroni River system:* "... some of the streams flowing into the Caroni." (Guppy 1866b: 27; ANSP; BMNH). *Nariva Swamp:* Cuche River (MCZ). *Lizard Springs:* 10 mi S E [town of] Rio Claro (MCZ).

Subfamily MYCETOPODINAE Modell 1942

Genus **Mycetopoda** Spix

Mycetopoda Orbigny 1835, Magasin de Zoologie, Paris 5 (5): 41 (type-species, *Anodontis siliquosi [sic]* Spix 1827, subsequent designation, Herrmannsen, 1847: 77).

Description. Shell thin, elongated, truncated posteriorly; posterior ridge low and flat; umbos smooth or slightly concentrically wrinkled; periostracum smooth, shining, pale greenish-yellow or brownish, rayless; hinge line straight and edentulous; nacre bluish white and iridescent; muscle scars shallow.

Remarks. Haas (1969: 574–576) included three species in this genus: *Mycetopoda siliquosa* (Spix), found from Guatemala to the La Plata River, Buenos Aires Province, Argentina; *M. soleniformis* Orbigny found from the headwaters of the Amazon River in Ecuador, Peru, Bolivia and Brazil to the Rio Paragua and Paraná drainages, Argentina (but not found in the Uruguay and La Plata Rivers, J. J. Parodiz, pers. comm.); and *M. legumen* (Martens) found from southern Brazil to the Rio de la Plata system, Uruguay and Argentina. The uniqueness of *M. legumen* is questioned here (see under Remarks for *M. siliquosa).*

Mycetopoda siliquosa (Spix)

Plate 39, fig. 4

Anodon siliquosus Spix 1827, [in] Spix and Wagner, Testacea Fluviatilia ... Brasiliam, Monachii [Munich], p. 30, pl. 23, fig. 2 (flumine Peruaguacú, ad molendinam sacchari Engenho da Ponte, in Provincia Bahiensi [Brazil]; figured type in the Bavarian State Museum, Munich, studied by Ihering (1890: 128), still extant, pers. comm. R. Fechter, 1980 [not seen]).

Mycetopus weddellii Hupé 1855, [in] Castelnau, Expedition ... L'Amerique de Sud ... Pt. 7, p. 93, pl. 20, fig. 2 (Santa-Anna de Chiquitos, Bresil, figured type, Paris Museum [not seen]).

Mycetopoda siliquosa (Spix). Simpson, 1900, Proc. U. S. Natl. Mus. *22:* 934; 1914, Cat. Naiades, *3:* 1459. Ortmann, 1921, Mem. Carnegie Mus. *8:* 633. Haas (1969: 574), with the exception of *M. clessini* Ihering 1893, included the following taxa in the synonymy of *M. siliquosa* (Spix 1827): *Mycetopus ventricosus* Orbigny 1846; *M. subsinuatus* Sowerby 1868; *M. hupeanus* Clessin 1875; *M. occidentalis* Clessin 1879; *M. staudingeri* Ihering 1890; *M. punctatus* Preston 1909; *Mycetopoda krausei* Ihering 1910; *M. staudingeri aequatorialis* Ihering 1910; *M. bahia* Ihering 1910; *M. orbignyi* Ihering 1910; *M. pittieri* Marshall 1927.

Description. Shell usually of medium size, though sometimes exceeding 130 mm in length. Outline elongate subtrapezoid. Valves thin and inflated, gaping at the anterior base. Anterior end regularly rounded, posterior end more broadly and less regularly rounded. Ventral margin long and usually straight. Dorsal margin long, straight and forming a sharp angle with the obliquely truncate posterior margin. Hinge ligament long. Posterior ridge well developed, and narrowly rounded, ending in a blunt point at the base of the shell. Umbos moderately full, but not much elevated above the hinge line, located very anteriorly, their sculpture not known.

Surface usually shining, smooth except for growth lines and inconspicuous radial sculpture; periostracum pale greenish-yellow or brownish, rayless.

Hinge edentulous, or showing faint traces of denticles beneath the nacre; umbonal cavities shallow; muscle scars and pallial line faint. Nacre bluish white and iridescent.

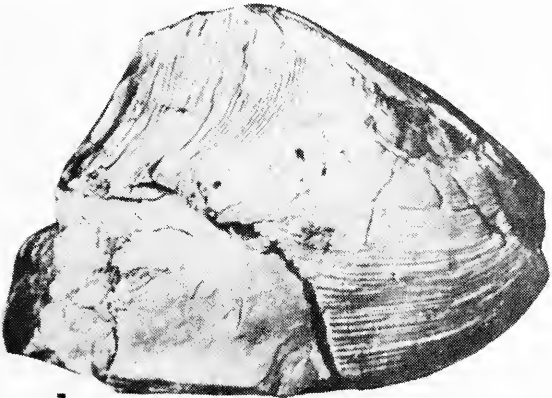
Length mm	Height mm	Width mm	
145	46	31	Peperpot Plantation near Paramaribo, Surinam
99	33	19	Nariva Swamp, Trinidad

Remarks. Mycetopoda siliquosa (Spix) is a variable and widely distributed species. It has been confused with *M. soleniformis* (Orbigny) which has a concave ventral margin and a swollen posterior ridge, but the posterior ridge of *M. siliquosa* is not swollen and its ventral margin is straight.

Bonetto (1962: 180) and Haas (1969: 576) recognized *M. legumen* (Martens) as a mycetopod, though the type had not been figured, and included *M. felipponei* Marshall as a synonym. Mansur and Veitenheimer-Mendes (1979) redescribed *M. legumen,* figured the holotype, and restricted the type locality to: Arroio da Manteiga [city of] São Leopoldo, Rio Grande do Sul [Province], Brazil. They also included *M. felipponei* as a synonym, since it falls within the range of *M. legumen* which is, roughly, the lower Rio de la Plata,

Plate 39

Fig. 1. *Triplodon (Triplodon) trinitaria* (Maury). *Hyria (Hyria) trinitaria* Maury. Cedros Point, SW Trinidad, Holotype Paleo. Res. Inst. 854. Length 65, height 50, width 32 mm. **Fig. 2.** *Anodontites (Anodontites) leotaudi* (Guppy). *Unio leotaudi* Guppy. Streams flowing into the Caroni [River], Trinidad. Lectotype ANSP 125443. Length 78, height 45, width 25 mm. **Fig. 3.** *A. (A.) leotaudi* Cuche River, Nariva Swamp, Trinidad. MCZ 288542. Length 62, height 38, width 22 mm. **Fig. 4.** *Mycetopoda siliquosa* (Spix) Canque River, Nariva Swamp, Trinidad. MCZ 88541. Length 87, height 32, width 18 mm.



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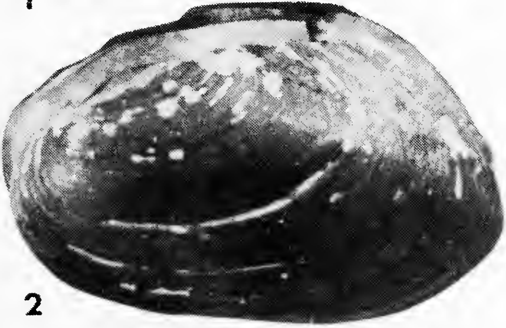

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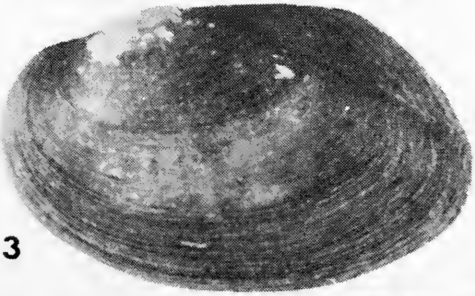

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4

Rio Uruguay, and the rivers flowing into the Atlantic east of the Rio Uruguay. While the validity of *M. legumen* is not of essential concern here, both *M. legumen* and *M. felipponei*, each with a straight ventral margin, appear to be *M. siliquosa*. The morphological shell variation of *M. legumen*, illustrated by Mansur and Veitenheimer-Mendes (1979, fig. 5), is so similar to that of *M. siliquosa* over the rest of its range that I am at a loss to separate them conchologically, although the authors appear able to do so on the basis of the anatomy.

Mycetopoda siliquosa is a well established species ranging from Guatemala to northern Argentina, and Trinidad.

Specimens examined or recorded. GUATEMALA: Rio Conchins, Maya Farm, Quirigua, Izabel Prov. (CM); Paso Antonio [14°03'N; 90°43'W], Santa Rosa Prov. (Martens, 1900: 540). NICARAGUA: Lake Nicaragua (MCZ). COLOMBIA: Rio Chenche, Tulima Prov. (type locality of *M. punctatus*). [Rio Bogota], Bogota, Cundinamarca Prov. (type locality of *M. subsinuatus*). VENEZUELA: *Rio Portuguesa Drainage*—Rio Portuguesa, Mata Verde, near Guanare, Zamora Prov. (type locality of *M. pittieri*). TRINIDAD: Nariva Swamp, Canque River (P. R. Bacon, 1978, MCZ). SURINAM: [Surinam River] Peperpot Plantation, near Paramaribo (MCZ). ECUADOR: *Rio Putumayo Drainage*—[Rio] Putumayo (Martens 1900: 655). *Rio Marañon Drainage*—Rio Napo, near Coca (MCZ); Rio Pastaza (type locality of *M. occidentalis*) (both Napo, Pastaza Prov.). PERU: Rio Huayabamba (trib.of Rio Huallaga), San Martin Prov. (type locality of *M. staudingeri*); Rio Marañon, Loreto Prov. (CM). BOLIVIA: *Rio Madeira Drainage*—Rio Beni [near Rio Orton, Pando Prov.] (MCZ). BRAZIL: Rio Arguaia, Ilha do Bananal, Goiaz Prov. (type locality of *M. krausei*); Rio Gurguéia, Bom Jesus, Piau Prov. (MCZ); Rio São Francisco, Casa Nova, Bahia Prov. (type locality of *M. bahia*); Lagoa Salgado, Rio Salitre Drainage, Bahia Prov. (MCZ); Rio Peruaguacu *[sic]*, Engenho Ponte, Bahia Prov. (type locality of *A. siliquosus*). *Rio Dos Sinos Drainage*: Rio Dos Sinos, 5 km W São Leopoldo (MCZ); Arroio da Mateiga, São Leopoldo (type locality of *M. legumen*) (both Rio Grande do Sul Prov.). URUGUAY: Canada Grande [Jaguarao], Dept. of Cerro Largo (type locality of *M. felipponei*). RIO DE LA PLATA SYSTEM: *Rio Paraguay Drainage—Bolivia:* Rio de Tucabaca, near Mission San Juan (type locality of *M. ventricosus*); [Rio Otuguis] Santa Ana de Chiquitos (type locality of *M. weddellii)* (both Santa Cruz Prov.). *Rio Paraná Drainage—Argentina:* Laguna Guadaloupe, Santa Fe; Rio San Javier, Isla la Dionisia (both MCZ; both Santa Fe Prov.). *Rio Santiago Drainage—Argentina:* Rio Santiago, [a small river, near La Plata], Buenos Aires Prov. (MCZ).

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Occasional Papers On Mollusks

Published by
The Department of Mollusks
Museum of Comparative Zoology, Harvard University
Cambridge, Massachusetts

VOLUME 4 22 July 1983 NUMBER 61

A NEW SPINY MUSSEL, *ELLIPTIO (CANTHYRIA) STEINSTANSANA* (BIVALVIA: UNIONIDAE), FROM THE TAR RIVER, NORTH CAROLINA

Richard I. Johnson and Arthur H. Clark[1]

The existence of an undescribed spiny mussel from the Carolinas was postulated by Morrison (1955) apparently on the basis of a small specimen from the Isaac Lea collection labeled, North Carolina. This specimen USNM 84376 was figured by Boss and Clench (1967: pl. 15, figs. 2, 3) who appear to have correctly recognized it as *Unio collinus* Conrad 1836 (plate 40, fig. 1) which is found only in the James River system, Virginia. They indicated its conchological and anatomical similarity to *Pleurobema masoni* (Conrad 1834) (plate 40, fig. 2) and placed it in that genus. Fuller (1971) placed *masoni* in the genus *Fusconaia* on the basis of its being tetragenous. Later (1972), he suggested that *masoni* should not be confused with the conchologically very similar *Unio subplanus* Conrad 1837, also from the James River system, and the type species of *Lexingtonia* Ortmann 1914, but he did not attempt a corrected synonymy of the two species, if indeed there are two, which were considered as one by Johnson (1970:301). Fuller (1974), in more detail, discussed the close relationship of *Fusconaia masoni* and the genus *Lexingtonia* but did not mention any species of the latter. Davis and Fuller (1981:218) again

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[1] The order of authorship was determined by the flip of a coin.

pointed out that, "*masoni* is tetragenous and thus belongs to *Fusconaia*. Except for the one character-state difference, one finds little difference between *F. masoni* and various species of *Elliptio* and *Pleurobema*." The two species from the James River system appear to be of similar lineage, Boss and Clench (1967) indicated that when *collina* does not have spines it could be confused with *masoni* except that the latter was slightly more rhomboid, often with a brownish clothlike periostracum, generally with at least a trace of green rays on the disk, whereas *collina* has a periostracum that is more yellowish and smooth, with only an occasional hint of brownish rays. Thus, Boss and Clench (1967) and Johnson (1970: 301,303) did not follow Frierson (1927: 46) who placed *U. collinus* and *U. spinosus* Lea 1836 in the genus *Canthyria* Swainson 1840 on the basis of the spines alone, or Morrison (1955) who regarded both as species of *Elliptio* in the subgenus *Canthyria*. Starobogatov (1970: 69) and Fuller (1977: 158) elevated *Canthyria* to generic status without discussion. Ortmann (1912: 269) suggested that the spines on *U. spinosus* were unique, and would possibly justify the erection of a separate genus, *Canthyria* for that species. Simpson (1914: 704) stated that the anatomy of *spinosa* was typical of *Unio* [=Elliptio]. Since *Canthyria* is distinguished from *Elliptio* Rafinesque only by the presence of spines we continue to retain it as a subgenus of *Elliptio*.

Morrison was correct in his assumption that a third spiny mussel existed in the Carolinas. It was discovered by Carol B. Stein, of the Ohio State Museum of Natural History, in 1964. The tiny specimens were misidentified by Johnson (1970:301) who regarded them as a range extension of *Pleurobema (Lexingtonia) collina* which occurs only in the James River system.

Since the discovery of the undescribed Tar River spiny mussel, a number of specimens have been collected by H. D. Athearn, R. G. Biggins, A. H. and J. M. Clarke, W. H. Harmon, D. H. Stansbery, and others. Those specimens subsequently seen by the authors have convinced them as to both their uniqueness and close relationship to *Elliptio (Canthyria) spinosa* (plate 40, fig. 3) of the Altamaha River system. Johnson, as first revisor of the Atlantic Slope unionids (1970), had long planned to describe this species, but was prevented from doing so because few examples of it were at his disposal. Clarke has recently completed an extensive status survey of the Tar River spiny mussel for the U.S. Fish and Wildlife Service, (Contract no. 14–16–0004–82–014) to whom he is grateful for having been chosen for performing such a pleasant task, which added to the number of specimens available for study. The authors are pleased to name this species for Dr. Carol B. Stein who discovered it and her colleague, Dr. David H. Stansbery, one of whose specimens was figured by Shelley (1972). Thanks are extended to Dr. Kenneth J. Boss for suggesting the name and for preparing some of the photographs.

Abbreviations

MCZ—Museum of Comparative Zoology, Cambridge, Massausetts

USNM—National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Elliptio (Canthyria) steinstansana new species

Plate 40, figs. 4, 5

[spiny naiad] Shelley, 1972. Wildlife in North Carolina *36:* 4, fig.

"Canthyria" sp. Fuller, 1977. Endangered and Threatened plants and animals of North Carolina, p. 158.

Holotype: MCZ 282677, from the Tar River, 1.5 mi. N of Tarboro, Edgecombe County, North Carolina.

Paratypes: All of the specimens listed under: Specimens Examined are paratypes.

Measurements

Length	Height	Width	(excluding spines)
mm	mm	mm	
62.0	38.6	27.3	(1) Paratype MCZ 282678
56.1	35.1	19.2	(2) Paratype USNM 758667
54.0	33.0	23.8	(3) Holotype MCZ 282677
32.7	20.8	13.6	(4) Paratype MCZ 282676

(1) no spines
(2) one spine on each valve
(3) one spine on right valve only
(4) one spine on left valve, 3 spines on right valve

Description. Shell medium, reaching about 60 mm. in length. Outline subrhomboidal, valves subinflated, inequilateral; shell solid. Anterior end regularly rounded; posterior end slightly broader, ending in a blunt point just below the medial line. Ventral margin slightly curved. Dorsal margin obliquely descending from the umbos, imperceptibly joining the descending posterior margin. Hinge ligament prominent, but short. Posterior ridge generally slightly angular, sometimes with a faint secondary ridge above it, posterior slope smooth. Umbos slightly elevated above the hinge line, located in the anterior third of the shell, their sculpture consisting of about three short, strong bars. The first one or two bars are oblique and extend diagonally across the growth lines (the posterior ends are closer to the hinge) and the later bars are slightly curved and nearly parallel with the growth lines. Surface of the shell generally smooth and shiny with fine concentric sculpture. Each valve usually ornamented with from one to several short spines. Specimens less than 35 mm. in length usually have two or three erect spines on each valve. They are about 2.6 mm. in length and 1.5 mm. wide at their bases. They project perpendicularly from the shell surface, the tips are slightly bent in a ventral direction, and are generally arranged in a radial row located slightly in front of the posterior ridge.

Periostracum orange-brown and covered with narrow and wide greenish rays when young, becoming darker or blackish-brown, with the rays inconspicuous when adult.

Left valve with two pseudocardial teeth, one in front of the other, both somewhat triangular, the hinder one smaller. Hinge line short and narrow, two straight, elevated, compressed, obliquely descending lateral teeth. Right valve with two roughly parallel pseudocardinals, the posterior one triangular and serrate, the more anterior one low and quite vestigal; one lateral tooth. A thick, low, interdental projection in the right valve articulates with a shallow cavity in the left one. Beak cavities rather shallow with a few dorsal muscle scars. Anterior adductor muscle scars well impressed, posterior ones faint. Pallial line impressed anteriorly where the shell is thicker, faint posteriorly. The nacre is yellowish or pinkish anteriorly, but bluish white and iridescent posteriorly.

Anatomy. "The foot is white. The mantle is also generally white but shading anteriorly to pale orange-brown, translucent, and with a narrow band of brown pigment around the branchial opening. The branchial opening is 9.0 mm. long and bordered at the edge, on each side, by a single row of about 12 simple, flattened papillae, each about 2.5 mm. long. Branchial and anal openings apparently separated only by the diaphragm. Anal opening 6.2 mm. long and bordered within and below the edge, on each side, by a single row of about 7 flattened papillae, each about 1.5 mm. long. Mantle connection between anal and supra-anal opening 2.8 mm. long. Supra-anal opening slit-like, with expanded edges, and 10.0 mm. long. Demibranchs pale orange-brown, the inner demibranchs projecting well beyond the outer demibranchs anteriorly and ventrally. Outer demibranch with about 2.0–2.5 water tubes per mm, and inner demibranch entirely unconnected to the visceral mass posteriorly but attached anteriorly. Labial palps with straight margins above, rounded margins below, and broadly overlapping the inner demibranchs. Based on MCZ 282678 which was frozen in water in a natural position, thawed, fixed in 10% formalin and preserved (and perhaps bleached) in 70% ethyl alcohol. A living, immature paratype USNM 758545 had its branchial opening surrounded by about 30 large and small, gray, white-tipped papillae and its anal opening surrounded by about 12 small, gray, white-tipped papillae. The supra-anal opening was about as long as the branchial and anal openings combined. The foot and mantle edges were pale yellow. In another live specimen, returned to the river, the foot and mantle edges were pale orange (Clarke)."

Breeding season. Not known.

Habitat. "Has been collected on sand and mud bottoms in shallow water, but its presence in muskrat middens (M.J. Imlay, pers. comm.) suggests that it also occurs in deeper water (Fuller, 1977: 158)."

Plate 40

Fig. 1. *Fusconaia collina* (Conrad). James River, Virginia. MCZ 226656. Length 44, height 26, width 13 (less spines) mm. (slightly enlarged).

Fig. 2. *Fusconaia masoni* (Conrad). Tar River, 9 mi. NW of Greenville, Pitt Co., North Carolina. MCZ 250578. Length 38, height 26, width 17 mm. (slightly enlarged).

Fig. 3. *Elliptio (Canthyria) spinosa* (Lea). Altamaha River, 4 mi. NE of Jesup, Wayne Co., Georgia. MCZ 234055. Length 59, height 37, width 22 mm. (approximately 1.2×).

Fig. 4. *Elliptio (Canthyria) steinstansana* new species. Tar River, 1.5 mi. N of Tarboro, Edgecombe Co., North Carolina. Holotype MCZ 282677. Length 54, height 33, width 23.8 mm. (nat. size).

Fig. 5. *Elliptio (Canthyria) steinstansana* new species. Tar River, above River Front Park, Tarboro, Edgecombe Co., North Carolina. Paratype MCZ 282676. Length 32.7, height 20.8, width 13.6. (slightly enlarged).

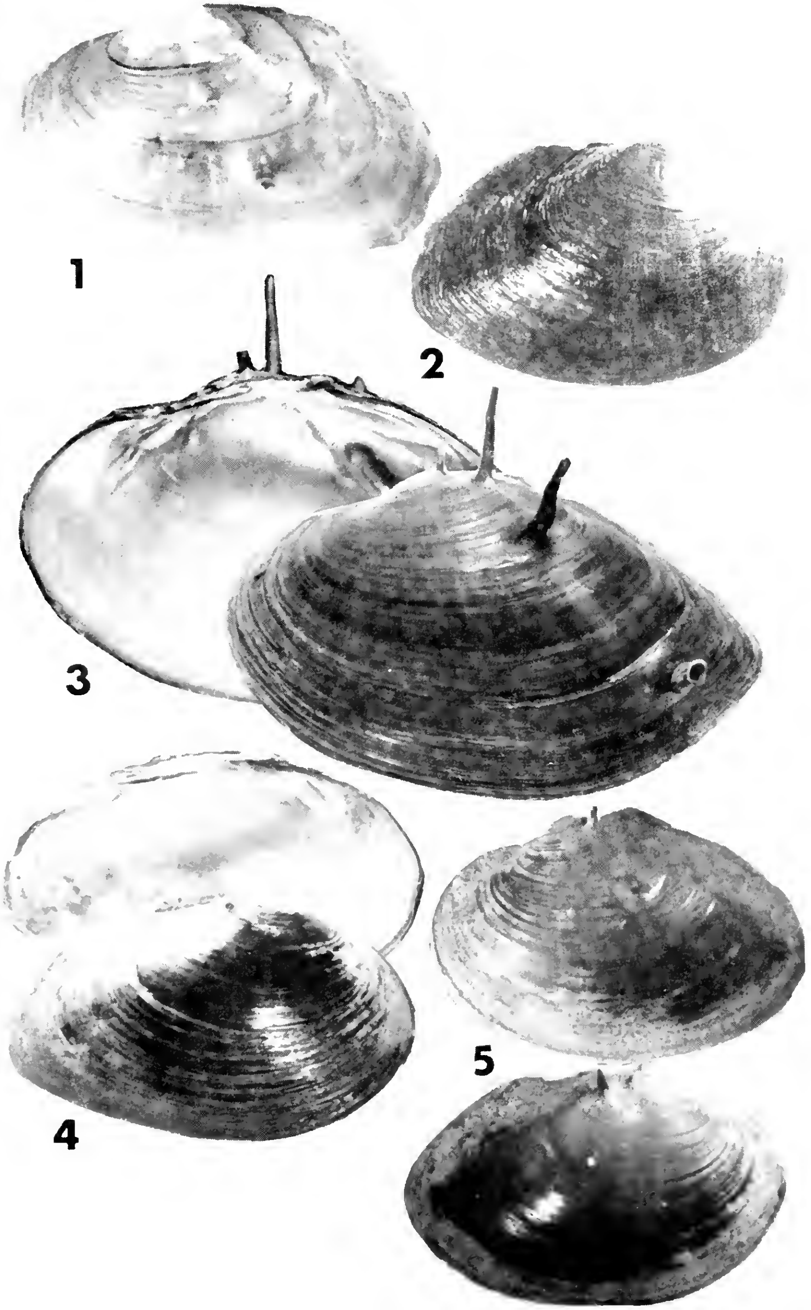

Plate 40

Remarks. Only three species of unionids in the world have spines on their post-larval shells. All of them occur in the Southern Atlantic Slope region. The relationship between *Fusconaia (Lexingtonia) collina* Conrad and *F. (L.) masoni* Conrad of the James River system has been discussed. On the basis of shell morphology, *E. (C.) steinstansana* is more similar to *E. (C.) spinosa* (Lea 1834) (Johnson, 1970: 303, pl. 2, fig. 11) from the Altamaha River system, Georgia than any other species. Specimens of *spinosa* exceed 90 mm. in length whereas those of *steinstansana* are not known to exceed 90 mm. The shall of *spinosa* is proportionately higher, the posterior margin is more pointed, and the posterior ridge is much sharper than in *steinstansana.* The spines in *spinosa* are proportionately much longer and are curved dorsally rather than ventrally, and the umbonal sculpturing in *spinosa* is finer. The periostracum of *spinosa* is greenish yellow or brownish in old shells, usually with faint greenish and yellowish rays, whereas that of *steinstansana* is orange brown and covered with narrow and wide greenish rays when young becoming darker or blackish brown, with the rays inconspicuous when adult. An interdental projection is virtually wanting in *spinosa* but is well developed in *steinstansana.* The nacre in *spinosa* is predominantly purple whereas in *steinstansana* the nacre is yellowish or pinkish anteriorly, where the shell is thickened, but bluish white and iridescent posteriorly.

The anatomy of the two species is similar, but in *steinstansana* the water tubes in the female, not gravid, outer demibranchs extend completely to the ventral margin, but in *spinosa* they do not. The pigmentation of the mantle openings in the latter is more intense.

Range. Southern Atlantic Slope: Tar River, between Nash and Pitt Counties, of the Pamlico River system.

Specimens Examined

PAMLICO RIVER SYSTEM

TAR RIVER DRAINAGE—*North Carolina:* Tar River, 2 mi. W Spring Hope, Nash Co. (W. N. Harman, Sept. 1968, paratype MCZ 267438); Tar River, 1.5 mi. N Tarboro (A. H. Clarke and R. G. Biggins Sept. 1982, Holotype MCZ 282677, paratype MCZ 282678); above River Front Park, Tarboro (A. H. Clarke and R. G. Biggins, August 1982, paratype MCZ 282676); [muskrat midden] Riverside Park, Tarboro (R. G. Biggins, August 1982, paratype MCZ 282784); Old Sparta (C. B. Stein, 1964, 2 paratypes Ohio State Museum; and A. H. and J. M. Clarke, paratypes USNM 758667 and MCZ 282678); *all* Edgecombe Co. Tar River, 1.4 mi. E Falkland, Pitt Co. (H. D. Athearn, ca. 1970, paratype MCZ 293570).

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Occasional Papers On Mollusks

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

VOLUME 4 22 July 1983 NUMBER 62

MARGARITIFERA MARRIANAE, A NEW SPECIES OF UNIONACEA (BIVALVIA: MARGARITIFERIDAE) FROM THE MOBILE-ALABAMA-COOSA AND ESCAMBIA RIVER SYSTEMS, ALABAMA

RICHARD I. JOHNSON

The species from Alabama, described here as distinct, was included with *Margaritifera hembeli* (Conrad, 1838) from Louisiana, by Simpson (1914: 523) and Clench and Turner (1956: 148). *M. hembeli* was figured by Conrad (1838: 93, pl. 51, fig. 1) and the holotype is in the Academy of Natural Sciences of Philadelphia 56639. It has no locality data, but was sent from New Orleans, Louisiana. A specimen was figured by Hanley 1856: 383, pl. 24, fig. 3); by Sowerby (1866, pl. 33, species 172) from a specimen in the H. Cuming collection now in the British Museum (Natural History) 1964174; and here (plate 41, fig. 1). In 1972 Joseph P. E. Morrison collected *hembeli* in Brown and Loring Creeks, Rapides Parish, Louisiana and he realized that the Alabama *Margaritifera* was different from it (pers. comm.). I take pleasure in naming the undescribed species for my wife, Marrian Geer Gleason Johnson.

Davis and Fuller (1981) reduced the Margaritiferidae to the subfamily Margaritiferinae, but their classification is being challenged by Douglas Smith (ms.). Thanks are extended to Dr. George M. Davis of the Academy of Natural Sciences of Philadelphia who kindly lent me the figured type of *Unio hembeli* as well as the extensive series of voucher specimens of it, ANSP 334426, from Rapides Parish, Louisiana which were used in the Davis and Fuller (1981) paper.

Margaritifera marrianae new species

Margaritania hembeli (Conrad, 1838) *partim.* Simpson, 1914. Catalogue of the naiades *1:* 523; Clench and Turner, 1956. Bull. Florida State Mus. *1:* 148, pl. 5, fig. 1. [The figured specimen MCZ 148819 is a paratype of *M. marrianae*].

Margaritana hembeli Ortmann 1912, *non* Conrad. Ann. Carnegie Mus. *8:* 235, fig. 3, 3a. [anatomy of *M. marrianae*].

Margaritana hembeli (Conrad, 1838) ssp. Stansbery, 1976. Bull. Alabama Mus. Nat. Hist., No. 2: 44.

Holotype. MCZ 28491 from Hunters Creek, 8 mi. SW of Evergreen, Conecuh Co., Alabama.

Paratypes: MCZ 62595 from the same locality; and figured paratype (Clench and Turner, 1956: pl. 5, fig. 1) MCZ 148819 from Horse Creek, near Luverne, Crenshaw Co., Alabama.

Measurements

Length mm	Height mm	Width mm	
95	50	29.5	Burnt Corn Creek, Conecuh Co., Alabama
83	41	24.5	Holotype MCZ 28491

Description: Shell, medium, reaching 95 mm. in length. Outline oblong, obovate to subrhomboidal. Valves subinflated, inequilateral; shell solid. Anterior end regularly rounded or subtruncate; posterior end feebly pointed below the medial line, forming a slight angle at the base. Ventral margin usually slightly arcuate though sometimes straight. Dorsal margin obliquely descending from the umbos, joining the descending posterior margin in a slight angle. Hinge ligament prominent. Posterior ridge low, rounded, and somewhat double. Posterior slope strongly corrugately plicate. Umbos slightly elevated above the hinge line, located in the anterior third of the shell, their sculpture not observed. Surface of the shell below the posterior ridge with radial ridges which sweep forward and downward. Periostracum smooth and shiny on the disk somewhat roughened on the posterior slope, olivaceous, or blackish brown, sometimes yellowish brown posteriorly.

Left valve with two pseudocardinal teeth, one in front of the other, both somewhat triangular, low, stumpy, and rough. Hinge line long and narrow, two straight feebly granular lateral teeth. Right valve with one triangular, crenulated pseudocardinal, and the vestige of a second behind it; one lateral tooth. Beak cavities rather shallow, with dorsal muscle scars which often extend into the disk. Anterior adductor muscle scars well impressed, posterior ones faint. Pallial line distinct. Nacre whitish or lurid purplish, moderately iridescent.

Breeding season. Not known.

Habitat. "Lives only in water free from lime...in the waters of pine barrens" (Frierson, 1927: 24).

Remarks. M. marrianae, known only from Alabama, differs from *M. hembeli,* known only from western Louisiana, in that it has an arcuate ventral margin, and is elaborately sculptured on the posterior slope and disk, whereas the ventral margin of *hembeli* is generally straight or slightly curved and, if sculptured at all, it is very faintly so, and limited to the posterior slope and ridge. The surface below the posterior ridge and disk is not sculptured.

Range. Limestone Creek of the Mobile-Alabama-Coosa and Escambia River Systems.

Specimens Examined

MOBILE-ALABAMA-COOSA RIVER SYSTEM

ALABAMA RIVER DRAINAGE–*Alabama:* Limestone Creek, near Monroeville, Monroe Co. (Museum of Zoology, University of Michigan).

ESCAMBIA RIVER SYSTEM

CONECUH RIVER DRAINAGE–*Alabama:* Burnt Corn Creek, near Burnt Corn, Monroe Co. Hunters Creek, 8 mi. SW Evergreen; Otter Creek, branch of Murder Creek, near Evergreen; *both* Conecuh Co. Horse Creek, near Luverne, Crenshaw Co. *(all)* Museum of Comparative Zoology.

Plate 41

Fig. 1. *Margaritana hembeli* (Conrad). [Bayou] Clear, 20 mi. S of Alexandria, Rapides Parish, Louisiana. MCZ 190124. Length 88, height 47, width 27 mm. (about nat. size).

Fig. 2. *Margaritana marrianae* new species. Hunters Creek, 8 mi. SW of Evergreen Conecuh Co., Alabama. Holotype MCZ 28491. Length 83, height 41, width 24.5 mm. (about nat. size).

Fig. 3. *Margaritana marrianae* new species. Horse Creek, near Luverne, Crenshaw Co., Alabama. Paratype MCZ 148819. Length 72, height 39, width 21 mm. (natural size). After Clench and Turner (1956, pl. 5, fig. 1).

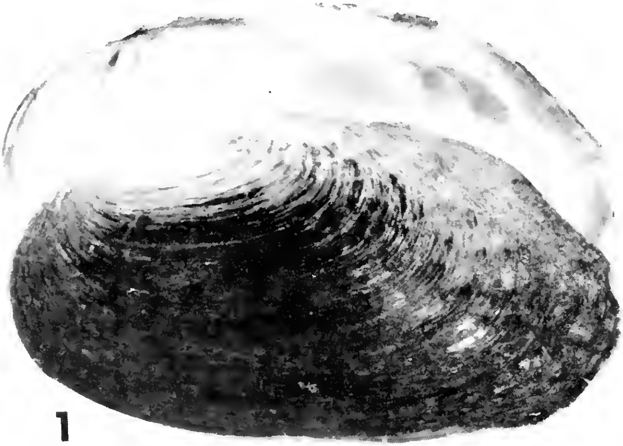

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Plate 41

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Occasional Papers On Mollusks

Published by
The Department of Mollusks
Museum of Comparative Zoology, Harvard University
Cambridge, Massachusetts

VOLUME 4 October 17, 1984 NUMBER 63

A NEW MUSSEL, *LAMPSILIS* (*LAMPSILIS*) *FULLERKATI* (BIVALVIA: UNIONIDAE) FROM LAKE WACCAMAW, COLUMBUS COUNTY, NORTH CAROLINA, WITH A LIST OF THE OTHER UNIONID SPECIES OF THE WACCAMAW RIVER SYSTEM

Richard I. Johnson

Abstract. Twelve species of Unionidae are recognized from the Waccamaw River System, North Carolina—*Elliptio* (*E.*) *waccamawensis, complanata, icterina, angustata, folliculata; Uniomerus obesus; Anodonta* (*Pyganodon*) *cataracta cataracta; Caruncùlina pulla; Villosa delumbus; Lampsilis* (*Lampsilis*) *ochracea; crocata; fullerkati. L.* (*L.*) *fullerkati* is described as new, while *E. angustata, folliculata, U. obesus* and *L. crocata* are removed from the author's previous synonymies.

The Waccamaw River system lies within the Coastal Plain of North and South Carolina and is believed to have been formed during the Late Pleistocene, 32,000 to 75,000 years ago, when an uplifting of the Cape Fear Fault (roughly paralleling the Cape Fear River) resulted in the elevation of land southwest of the Cape Fear River and the subsequent pirating of the upper parts of the then Waccamaw and Little Pee Dee River drainages by the Cape Fear River system, leaving the former two confined largely to the Coastal Plain (Zullo and Harris, 1979). Zoogeographical evidence also suggests that the Waccamaw River system once drained a larger area extending into the inner Coastal Plain and Piedmont. At least five species of fishes are endemic to the

Waccamaw River system or exclusively shared with the Little Pee Dee drainage or Cape Fear River system (Shute, Shute, and Lindquist, 1981: 1). Among the mollusks are two species of endemic mussels, *Elliptio waccamawensis* and a *Lampsilis* described here, which are related to species found in both the Pee Dee (Kool *et al.* 1981; Coney *et al.* 1983a) and Cape Fear River (Coney *et al.* 1983b) systems. Kat (1983c: 143) in an elegant paper on divergence among *Lampsilis,* concluded that this, "is a species distinct from other Atlantic Slope lampsilines; it has recently diverged from *L. radiata,* with which it still exhibits considerable similarity with respect to allele frequencies and anatomical characteristics. Genetic differentiation has occurred mainly at variable-substrate loci such as *Lap*. Divergence time from *L. radiata,* is estimated at 1.3×10^5 years ago, a time consistent with the proposed age of Lake Waccamaw."

The Waccamaw River system originates from Council Mill Pond some nine miles northwest of Lake Waccamaw and it, with a number of small streams, form Friar Swamp which is the principal feeder of the lake. Three smaller streams also drain into the lake: Little, Second, and Third creeks. Acid water from these streams is neutralized by the calcareous Waccamaw limestone formation which underlies the lake and is exposed along the north shore.

Lake Waccamaw is about five miles long and three miles wide. The bottom is mainly sand and fibrous peat. Man-made canals surround much of the lake. It is drained by the Waccamaw River which flows southward for some 145 miles to its confluence with the Pee Dee River at Winyah Bay, South Carolina, an estuarine habitat, which is an effective barrier for faunal exchange between the two systems for most freshwater species. The river has a number of tributaries; the largest is Juniper Creek which is the first to enter the river from the east.

Johnson (1970) failed to recognize the species described here as distinct, since he did not separate his specimens from those of *Elliptio waccamawensis,* another endemic species. Fuller (1977: 164, fig. 3) figured both the male and female shells under "*Lampsilis radiata* (Gmelin) complex, and said that the latter resembles no other species in Lake Waccamaw, while the male is almost indistinguishable from *E. waccamawensis* of either sex." Kat (1983c: 143, fig. 1) on the basis of electrophoretic and anatomical analyses showed that the species described here recently diverged from *Lampsilis radiata radiata* (Gmelin) and is distinct. He further compared and illustrated the other closely related *Lampsilis*.

The author is pleased to name this species for Mr. Samuel L. H. Fuller, who first figured this species, and for Dr. Pieter W. Kat who determined its relationship to other *Lampsilis*.

Lampsilis (*Lampsilis*) *fullerkati* new species

Plate 42, figs. 1–3

"*Lampsilis*" *radiata* (Gmelin) complex. Fuller 1977. Endangered and threatened plants and animals of North Carolina, p. 164, fig. 3.

Lampsilis sp. Porter and Horn 1980. Bulletin of the American Malacological Union for 1980, p. 16; Horn and Porter, 1981, Bulletin of the American Malacological Union for 1981, p. 3; Porter and Horn, 1983, American Malacological Bulletin *1*: 63; Kat, 1983c, Journal of Molluscan Studies *49*: 137, fig. 1B.

Holotype: MCZ 294576 from Lake Waccamaw, [town of] Lake Waccamaw, Columbus Co., North Carolina. Collected by W. J. Clench, K. J. Boss, and S. L. H. Fuller, October 1961.

Allotype: MCZ 294577 As above.

Paratypes: MCZ 294578 As above.

Measurements

Length mm	Height mm	Width mm	
62	32	22	Lake Waccamaw, [town of] Lake Waccamaw, Columbus Co., North Carolina. Male.
51	26	17	As above. Male. Holotype.
41	22	15	As above. Allotype.

Description. Shell small, seldom exceeding 60 mm in length. Outline elongated rhomboidal to long elliptical. Valves subinflated, thin, inequilateral. Anterior end regularly rounded; posterior end slightly biangulate and pointed toward the base in the male; female broadly rounded and somewhat expanded in the postbasal region. Ventral margin straight, slightly curved, or occasionally arcuate roughly parallel to the almost straight dorsal margin which forms an angle with, or merges imperceptably with the obliquely descending margin. Posterior ridge high somewhat angular, usually with a faint second ridge above it ending behind in a broad point in the male. Umbos rather sharp but not full or high, located in the anterior quarter of the shell, their sculpture not observed. Periostracum rather smooth with delicate growth lines, generally yellowish or brownish green, with rather fine dark greenish rays of varying width often visible over the entire surface.

Left valve with two stumpy pseudocardinal teeth, one in front of the other, often of almost equal height. Hinge line short and narrow, two short almost straight lateral teeth. Right valve with one triangular pseudocardinal, and a vestigial one before it; one lateral tooth. Beak cavities very shallow, with a few dorsal muscle scars. Anterior and posterior adductor muscle scars and pallial line distinct. Nacre purplish often lurid and spotted, somewhat iridescent.

Anatomy. Discussed by Kat (1983c).

Breeding season. September, December, March, April and June; bradytidic (Porter and Horn 1983: 65).

Habitat. Lives in sand in sluggish water.

Remarks. *Lampsilis (L.) fullerkati* is a more diminutive species than *L. radiata radiata* with a more delicate shell, a consistently sharp posterior ridge, and purplish nacre. The latter has rounded posterior ridge and the nacre is white, bluish white, or sometimes tinted with pink or salmon. *L.* (*L.*) *fullerkati* exhibits conspicuous sexual dimorphism and the female resembles no other species in Lake Waccamaw. The male shell closely resembles that of *Elliptio waccamawensis* (Lea), but the latter is sculptured on the posterior slope, the periostracum is generally more brownish and less rayed, and the nacre is white rather than purplish.

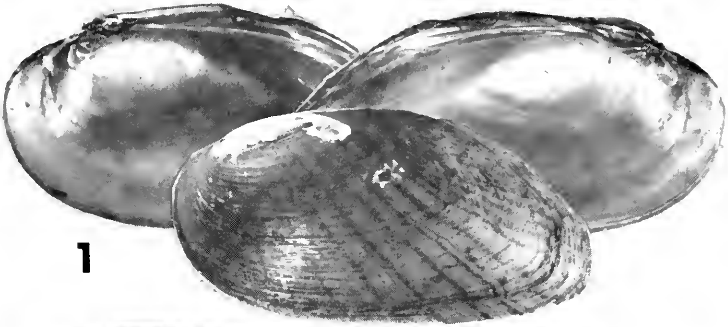

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Plate 42
Lampsilis (*Lampsilis*) *fullerkati* new species

Fig. 1. Lake Waccamaw, [town of] Lake Waccamaw, Columbus Co., North Carolina. Holotype MCZ 294576. Length 51, height 26, width 17 mm. Male. (slightly enlarged).

Fig. 2. Lake Waccamaw, [town of] Lake Waccamaw, Columbus Co., North Carolina. Allotype MCZ 294577. Length 41, height 22, width 15 mm. Female. (slightly enlarged).

Fig. 3. Lake Waccamaw, [town of] Lake Waccamaw, Columbus Co., North Carolina. Paratype MCZ 294578. Length 37, height 21, width 16 [estimated, single valve] mm. Female. (slightly enlarged).

Lampsilis splendida (Lea) (Johnson 1970; 394) which ranges from Georgia to South Carolina does not overlap that of *L. r. radiata* or *fullerkati,* but according to Kat (1983c: 142) "is biochemically and anatomically closely related to both." *Lampsilis splendida* has a sharp posterior ridge like *fullerkati* but the umbos of the former are much higher, fuller and more centrally located.

Range. Southern Atlantic Slope: endemic to the Waccamaw River System; North Carolina.

Specimens Examined

WACCAMAW RIVER SYSTEM

WACCAMAW RIVER DRAINAGE—*North Carolina:* Lake Waccamaw, [town of] Lake Waccamaw, Columbus Co. (Museum of Comparative Zoology). Waccamaw River, below the Lake (Fuller, 1977: 164) [not seen].

The unionids of the Waccamaw River System

Since the publication of Johnson's (1970) work on the Unionacea of the Southern Atlantic Slope a number of papers have appeared which have taken exception to some of the classification, especially, as was predicted, among the members of *Elliptio.* Morrison (1972, 1973) correctly inferred that several valid species were included under Johnson's synonymy of *Elliptio lanceolata,* and though he did not refer to the latter's work, it was obvious that he had it in mind. Davis *et al.* (1981) in a paper on molecular genetics and speciation in *Elliptio* also take a number of names out of Johnson's synonymies, but they did not define, differentiate, or indicate the ranges of their species, nor did Coney *et al.* (1983a, b).

The following list of the unionids attempts to revise the nomenclature of the several species, based on observations and the literature since 1970. Stansbery and Clench (1978) mentioned that ten species of naiades occur in Lake Waccamaw, but did not list them. In a series of papers on the naiades of Lake Waccamaw Porter and Horn (1980; 1983) and Horn and Porter (1981) made interesting contributions to the biological knowledge of the naiad fauna of the lake. The author is especially grateful to Dr. H. J. Porter, Curator of Invertebrate Collections, The University of North Carolina at Chapel Hill for the loan of the samples which formed the basis for these papers and for sharing his views on the nomenclature employed in them.

Several papers have appeared on the genetic relationships among recent genera of Unionacea since Johnson's (1970) revision of the species. The latest of these, by Davis and Fuller (1981) lists the more important previous classifications and presents a new one of their own. In the following list, the classification used in 1970 is retained, not because it is necessarily better, but because a discussion of higher categories is not the purpose of this paper.

All of the species listed here occur in Lake Waccamaw. Little is known about most of them in the rest of the river system, except as mentioned below.

ELLIPTIO (ELLIPTIO) WACCAMAWENSIS (Lea 1863)

Johnson 1970, p. 313, pl. 7, figs. 6, 7; Fuller 1977, p. 162, figs. 1, 2; Porter and Horn 1980, p. 15; Horn and Porter 1981, p. 15; Davis *et al.* 1981, fig 3, H; Porter and Horn 1983.

Johnson's figure 6, cited above, is typical of specimens found in the lake. They achieve greater size and are less eroded in the canals outside of the lake, figure 7.

ELLIPTIO (ELLIPTIO) COMPLANATA (Lightfoot 1786) Plate 43, fig 1

Johnson 1970, p. 322 (records for the Waccamaw River System) pl. 8, fig. 6; Davis *et al.* 1981, fig. 3, J, K, L; Kat 1982, 1983a.

Johnson's figure 6, cited above, is typical of specimens found in the lake. They achieve greater size and are less eroded in the Waccamaw River below the lake.

ELLIPTIO (ELLIPTIO) ICTERINA (Conrad 1834)

Johnson 1970, p. 325, pl. 9, figs. 3–10, pl. 10, figs. 1–3; Davis *et al.* 1981, fig. 3, G, I. Morrison (1972: 38) suggested that *E. icterina* is a synonym of *E. congaraea* (Lea 1831), Johnson 1970, p. 308, pl. 5, figs. 1–8.

Elliptio raveneli (Conrad [May 1834]). Porter and Horn 1980, p. 15.

ELLIPTIO (ELLIPTIO) ANGUSTATA (Lea 1831)

Johnson 1970, p. 333 (*partim*), pl. 11, fig. 3; Morrison 1972; p. 38; Morrison 1973, p. 14; Moore *et al.* 1983, p. 95.

Elliptio producta (Conrad 1836). Johnson 1970, pl. 10, fig. 10; Porter and Horn 1980, p. 14, footnote 1; Porter and Horn 1983, p. 61, footnote 2.

Elliptio fisheriana (Lea 1838). Porter and Horn 1980, p. 14 (*non* Lea).

Elliptio lanceolata (Lea 1828). Fuller 1972; Porter and Horn 1980, p. 16; Davis *et al.* 1981, p. 135, fig. 3B, specimen from Lake Waccamaw; Coney, Moore, and Kool, 1981, 1983 (*non* Lea).

Morrison (1973, p. 14) stated, "The dark species, *E. angustatus* is completely biologically separate from the golden, sand-dwelling *Elliptio lanceolatus* (Lea 1828). The true species *E. lanceolatus* is known only from five river systems in Maryland, Virginia, and North Carolina."

Coney, *et al.* (1983a) suggested that there is an undescribed member of the *Elliptio lanceolata* species group in the Pee Dee River system of which the shell morphology appears to be intermediate between that of *Unio emmonsii* Lea 1857 (Johnson 1970, pl. 11, fig. 4) from the Roanoke River system and *Unio perlatus* Lea 1863 (Johnson 1970, pl. 10, fig. 9) from the Cape Fear River system.

Morrison (1972: 38) stated, "In the Potomac River System, *Elliptio complanatus* Lightfoot, and *Elliptio angustata* Lea, 1831 (+*producta* Conrad, 1836) are living side by side . . . ." He (1973: 14) also stated that *E. angustatus* [sic] occurred in both South and North Carolina, northward as far as the Schuylkill River, near Philadelphia, Pennsylvania.

ELLIPTIO (ELLIPTIO) FOLLICULATA (Lea 1838)

Johnson 1970, p. 333 (*partim*); Morrison 1972, p. 38; Porter and Horn 1981, p. 16; Davis *et al.* 1981, p. 150, fig 3 A.

Elliptio sp. Fuller 1977, p. 175, fig. 7.

Davis *et al.* (1981: 150) stated that, "Two lanceolate species of *Elliptio* live side by side in the sandy-bottom shallows of Lake Waccamaw. One of these resembles *E. lanceolata* (Lea) [*E. angustata* (Lea)] and the other resembles the holotype of *Unio folliculatus* Lea 1838, USNM 86006, from the Savannah River, Georgia". The authors are probably correct in changing *Unio perlatus* Lea 1863 to this synonymy from that of *E. arctata* (Conrad) where it was placed by Johnson (1970: 331).

UNIOMERUS OBESUS (Lea 1831) Plate 43, fig. 2

Uniomerus tetralasmus (Say). Johnson 1970, p. 339 (*partim*), pl. 12, figs. 1–6 (records, p. 343).

Uniomerus carolinianus (Bosc 1801). Morrison 1976, p. 10.

Morrison gave a corrected synonymy of *U. obesus,* but used Bosc's name as earlier. Fuller (1972: 72) had previously shown that Bosc's name should be considered a *nomen dubium.*

Elliptio cistelliformis (Lea 1863). Davis *et al.* 1981, p. 150, fig. 3 F. The type is figured here, Plate 43, fig. 3. The authors claim this to be Fuller's (1977: 189, fig. 13) unidentified *Elliptio.* Johnson (1970: 317) incorrectly included *U. cistelliformis* Lea under the synonymy of *E. complanata* (Lightfoot).

ANODONTA (PYGANODON) CATARACTA CATARACTA Say 1817

Johnson 1970, p. 356, pl. 14, figs. 3, 4; pl. 15, fig. 1; Kat 1983b.

Anodonta teres Conrad 1834. Morrison 1972, p. 39; Porter and Horn 1980, p. 13. Removed from the synonymy of the above without explanation.

CARUNCULINA PULLA (Conrad 1838)

Johnson 1967, p. 127, figs. 1–4; Johnson 1970, p. 370, pl. 17, figs. 4–7; Fuller 1977, p. 159.

Toxolasmus [*sic*] *pullus* (Conrad). Porter and Horn 1980, p. 16.

Johnson (1970: 369) discussed the fact that *Unio lividus* Rafinesque 1831 is a *nomen dubium* and that therefore *Toxolasma* should be disregarded.

VILLOSA DELUMBUS (Conrad 1834)

Johnson 1970, p. 375, pl. 18, figs. 4-8.

Villosa ogeecheensis (Conrad 1838). Porter and Horn 1980, p. 13.

V. delumbus is the male shell while *ogeecheensis*, figure 8 cited above, is that of the female.

Plate 43

Elliptio (*Elliptio*) *complanata* (Lightfoot 1786)

Fig. 1. Waccamaw River, Wachsaw Landing, 2 mi. E. of Murrells Inlet, Georgetown Co., South Carolina. MCZ 185714. Length 86, height 44, width 24 mm. (reduced).

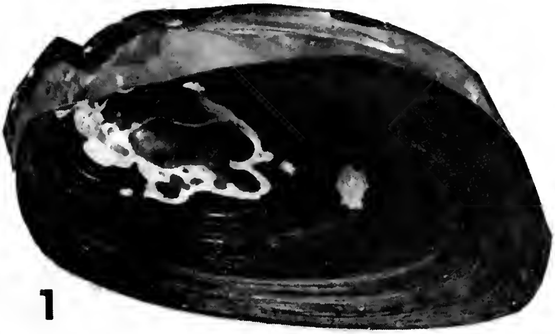
Uniomerus obesus (Lea 1831)

Fig. 2. Waccamaw drainage canal, 1 mi. E Dupree, Columbus Co., North Carolina. MCZ 214258. Length 63, height 35, width 24 mm. (slightly enlarged).

Fig. 3. *Unio cistelliformis* Lea 1863, Proceedings of the Academy of Natural Sciences of Philadelphia *15*: 193 (Neuse River near [6 mi. E] Raleigh [Wake Co.], North Carolina); 1866, Journal of the Academy of Natural Sciences of Philadelphia (2) *6*: 19, pl. 6, fig. 17; 1867, Observations on the Genus Unio *11*: 23, pl. 6, fig. 17. Figured holotype National Museum of Natural History 85533. Length 46; height 26; width 23 mm. (reduced).

Lampsilis (*Lampsilis*) *crocata* (Lea 1841)

Fig. 4. *Unio crocatus* Lea 1841, Proceedings of the American Philosophical Society *2*: 31 (Savannah River, Georgia); 1842, Transactions of the American Philosophical Society *8*: 238, pl. 22, fig. 52; 1842, Observations on the Genus Unio *3*: 76, pl. 22, fig. 52. Allotype National Museum of Natural History 84908.2. Length 42, height 27, width 19 mm. Male. (slightly reduced).



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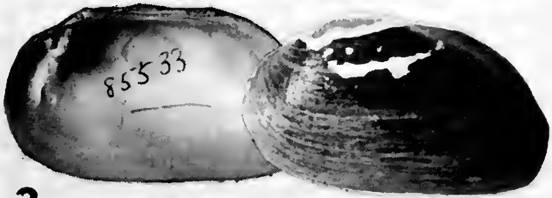

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Plate 43

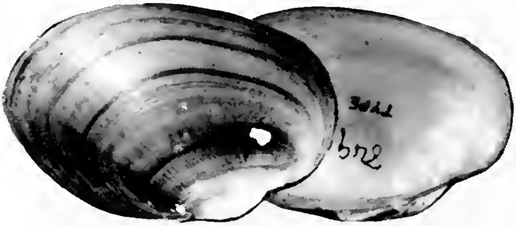
LAMPSILIS (LAMPSILIS) OCHRACEA (Say 1817)
Johnson 1970, p. 388, pl. 21, figs. 4, 5; Bereza and Fuller 1975 p. 42; Fuller 1977, p. 182, figs. 10–12; Johnson 1980, p. 99; Kat 1983c, fig. 1, C, D.

Leptodea fluviatilis (Gmelin 1791). Morrison 1975, p. 38.

Leptodea ochracea (Say 1817). Porter and Horn 1980, p. 15; Horn and Porter 1981; Porter and Horn 1983.

LAMPSILIS (LAMPSILIS) CROCATA (Lea 1841) Plate 43, fig. 4, Text fig. 1. Porter and Horn 1980 and 1983.

Johnson (1970: 382) placed *Unio crocatus* under the synonymy of *Lampsilis cariosa* (Say 1817) thinking that the type specimens were young specimens of the latter on the basis of their having rather heavy valves and pyramidal pseudocardinal teeth, even though they have fine, faint, greenish rays over the entire surface similar to those of *L. ochracea* and have slightly sharper posterior ridges than either *cariosa* or *ochracea*. Morrison (ms. note, 1971) regarded *crocata* as distinct. Porter and Horn (1980) noted differences in the glochidia between populations of *L. crocata* and *ochracea* in Lake Waccamaw where the two species are not easy to separate conchologically except that the latter species has lamelate rather than pyramidal pseudocardinal teeth. Two specimens MCZ 224049 and 294816 from the Waccamaw River, Wachsaw Landing, 2 miles East of Murrells Inlet, Georgetown County, South Carolina closely resemble the types figured here. *L. crocata* is not known to occur in the river systems between the Savannah and the Waccamaw.



Lampsilis (*Lampsilis*) *crocata* (Lea 1841)

Text figure 1. *Unio crocatus* Lea 1841. Savannah River, Georgia. Figured holotype National Museum of Natural History 84901.1. Length 45; height 30, width 20.5 mm. Female (slightly reduced). The author is grateful to Dr. Joseph Rosewater for the loan of the type specimens and to Mr. David Backus for taking some of the photographs.

LAMPSILIS (LAMPSILIS) FULLERKATI new species. Plate 42, figs. 1-3.

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Listed are: Elliptio lanceolata-complex form E. fisheriana (Lea 1838)
Elliptio icterina (Conrad 1834)—species complex
Elliptio raveneli (Conrad 1834)—species complex
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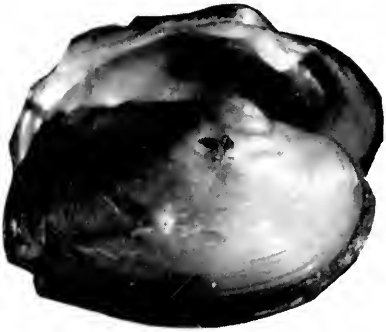
MISCELLANY

Fusconaia collina (Conrad), from the James River, Virginia, an additional note

by

Richard I. Johnson and Kenneth J. Boss

When Johnson and Clarke (1983) described a spiny mussel, *Elliptio* (*Canthyria*) *steinstansana,* from the Tar River, North Carolina, they assumed that the specimens figured by Boss and Clench (1967, pl. 15, figs. 2 and 3) as *Pleurobema* [=*Fusconaia*] *collina* (Conrad) were correctly identified and that the locality, North Carolina, was incorrect. However, the lot, National Museum of Natural History 84376, could not be studied since it was on loan to the Ohio State Museum. It was recently returned and through the kindness of Dr. Joseph Rosewater we have been able to examine it. The specimens numbered 84376.1-4, and 84376.6 (a single valve) are indeed *Fusconaia collina* (Conrad). Specimen 84376 has "N. Car. Emmons" pencilled in one of the valves. E. Emmons collected a number of shells from the Cape Fear, Neuse, and Roanoke River Systems in North Carolina for Isaac Lea, some of which the latter described as new. Unless *F. collina,* now known only from the James River System, Virginia, is eventually found in North Carolina, it is assumed that the locality data with these shells is incorrect. Boss and Clench (1967, pl. 15, fig. 2) gave a dorsal view of specimen 84376.2 which is illustrated here, ventrally, Text fig. 1. Unfortunately the specimen they illustrated ventrally 84376.5 (pl. 15, fig. 3) is a young specimen of *Elliptio* (*Canthyria*) *spinosa* (Lea), known only from the Altamaha River System, Georgia. Of the three known spined species of unionids this is the only one with long spines that are often hollow, that has a faintly greenish periostracum,and is less rhomboidal than the other two.



Text fig. 1. *Fusconaia collina* (Conrad). [James River, Virginia]. National Museum of Natural History 84376.2. Length 19, height 12, width 7 mm. (less spines). (2.25 ×).

The label on this lot from the Isaac Lea collection indicates that the specimens came from J. G. Anthony. In the Museum of Comparative Zoology there are small specimens from the Anthony collection of both *F. collina* and *E. (C.) spinosa* with correct localities, which offer no clues as to which of Lea's specimens came from Anthony or how they all became labeled as from North Carolina. Nevertheless, it appears that this mixed lot, with its incorrect data, led to Morrison's (1955) correct assumption that there was an undescribed spiny mussel in the Carolinas.

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Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 17, 1984 NUMBER 64

THE MARGARITIFERIDAE REINSTATED: A REPLY TO DAVIS AND FULLER (1981), "GENETIC RELATIONSHIPS AMONG RECENT UNIONACEA (BIVALVIA) OF NORTH AMERICA"

DOUGLAS G. SMITH[1] AND WILLIAM P. WALL[2]

ABSTRACT. Davis and Fuller (1981) proposed that the freshwater mussel family Margaritiferidae be reduced to subfamilial status, based on immunogenetic and morphological analyses of several North American unionoid species traditionally divided among the Unionidae and Margaritiferidae. They overlooked published studies contrary to their conclusions, provided little opportunity for alternative interpretations of their data, and failed to show the Margaritiferidae as a derived group within the Unionoida. It is proposed that the lineage which comprises all species exhibiting characters of the freshwater mussel genera *Margaritifera* and *Cumberlandia* may continue to be considered a distinct, derived family within the Unionoida.

Ortmann (1910) revised the freshwater mussel genus "*Margaritiana*" (now divided among *Margaritifera* and *Cumberlandia*) and in 1911 raised the genus to family level. He stressed the importance of certain anatomical characters unique to margaritiferids, including the absence of both a structurally formed diaphragm and vertical gill septa. He further argued that margaritiferids embodied the most

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primitive features among the unionoid mussels. Although challenged at first (Lefevre and Curtis, 1912), Ortmann's views soon found wide acceptance among unionoid systematists (see Heard and Guckert, 1970; Davis and Fuller, 1981; Boss, 1982, for review of classifications). Recently the familial status of the Margaritiferidae has again been challenged (Davis and Fuller, 1981). Although conceding the connotation of primitiveness and morphological distinctiveness of margaritiferids, they concluded that the group represents a subfamily of equal phylogenetic status with other traditional subfamilial groups in the Unionidae.

Davis and Fuller (1981) used information acquired from two sources: an analysis of immunogenetic data gathered from a wide assortment of taxa and a reassessment of the morphological characters of the "Unionacea."

Nonetheless, they neglected to leave open the possibility for alternative interpretation of their results and ignored extant studies relevant, though contradictory, to their own conclusions and further failed to explain why their concept of the Margaritiferinae demonstrates unique derived features distinct from other "unionid" groups. We present another viewpoint supporting the validity of the Margaritiferidae and to show that the Margaritiferidae represents a derived group within the Unionacea.

Davis and Fuller's (1981) immunogenetic analysis clearly showed three distinct clusters of taxa. Two clusters followed traditional systematic interpretations indicating a separation of an "amblemid" group from a margaritiferid group. A third cluster comprising the "anodontids" also was identified. They surmised that the anodontids represented as unique an assemblage as did the margaritiferids or amblemids. Furthermore, they determined that the 47% genetic distance they found between the margaritiferids and amblemids (no analysis was presented for margaritiferids versus anodontids or anodontids and amblemids combined) was insufficient to substantiate recognition of the Margaritiferidae. This conclusion followed a theory in which, among mollusks, genetic distance, expressed as ranges of percent differences between taxa, increased in a similar fashion with morphological (*i.e.* traditional phylogenetic) distance. The criteria for family level status in "most" cases was from 50 to 80% (Davis, 1978). However, in a similar study involving immunogenetic comparisons of five unionid species, a sphaeracean clam, *Sphaerium striatinum,* and a marine veneracean clam, *Saxidomus nuttalli,* Fisher (1969) found that genetic distance did not increase in a similar fashion with "phylogenetic" distance. *Saxidomus nuttalli* and *Sphaerium striatinum* showed equal or less genetic deviation from certain unionids as did *Anodonta grandis*, a unionid species. Davis (1978) remarked that biochemical systematic studies on mollusks were just beginning so it may be premature to categorize higher molluscan groups according to genetic distance.

Nevertheless, in an electrophoretic study on five Palearctic species of Unionidae (genera *Unio* and *Anodonta*) and the margaritiferid *M. margaritifera,* Logvinenko and Kodolova (1979) found that the level of similarity between the traditional unionid species and *M. margaritifera* was very low when compared to levels of similarity observed between each of the five unionid species. They concluded that the low level of similarity between the five unionid species and *M. margaritifera* was indicative of family level differences.

Davis and Fuller (1981) argued that morphological characters in "unionids" had undergone parallel evolution. Since parallel evolution prevented deviation from a basic unionid "groundplan" in margaritiferids, they contended that margaritiferids should not be accorded family rank. Unionoid bivalves (excluding etheriids) are infaunal filter feeders and show a morphological groundplan suited for such a role. In this respect most bivalve groups have undergone convergence or parallel evolution (Stanley, 1970). Davis and Fuller (1981) used certain marine bivalve families as examples to show the degree of difference between groundplans necessary for recognition of families. They consider the Cardiidae and Tridacnidae to have distinct enough groundplans to be considered as separate families within the Cardiacea. Similarly the Pectinidae, Malleidae, and Pteriidae (Pteriacea) are listed as showing family level groundplans. However, these families represent morphological adaptation (groundplans) to vastly divergent niches and demonstrate such great morphological differences that some workers (Abbott, 1974; McCormick and Moore, 1969; Boss, 1982) consider most of them as distinct superfamilies (Tridacnidae in Tridacnacea, Cardiidae in Cardiacea, Pectinidae in Pectinacea, and Pteriidae and Malleidae in Pteriacea). A more accurate comparison among recognized marine families should have included the Lucinidae and Mactromyidae (Lucinacea) in which an infaunal groundplan is present but in which other morphological differences substantiate recognition of separate families. The same is true for the Cardiidae and Hemidonacidae (Cardiacea) and the Astartidae and Crassatellidae (Astartacea). The families above are distinguished by four or five major character states chiefly involving both the shell and anatomy (Boss, 1982).

In comparing margaritiferids with North American unionids Davis and Fuller (1981: Table 10, which see) listed morphological character states assignable to each taxonomic grouping. Characters one through four are of significant systematic importance as they represent substantive morphological differences in the adult morphologies of each group (see Boss, 1982, for accurate descriptions). Among the three subfamilies compared, the Anodontinae and Ambleminae share characters one through four, except that in character two a distinction is made between the Anodontinae and Ambleminae on the basis of the tripartite water tubes in the gills of the Anodontinae. The tripartite condition merely represents a specialization of the gill septa. Modifications of the female septate gill of lampsilines (within the Ambleminae of Davis and Fuller, 1981) occur as well. Modifications of the septate gill in both the Anodontinae and Ambleminae should therefore be included as part of the septate condition (character one). Characters five through nine can be considered of minor systematic importance because they are either highly variable among "unionid" genera or mutually inclusive (character five is inclusive with character two, and six with seven in the Ambleminae and Anodontinae).

Irregular teeth (ventral marginal teeth) on glochidial shells of margaritiferids (character six) are unique among unionacaeans but are thus far known only in *M. margaritifera* (Harms, 1909; Smith, 1976) and possibly *M. laevis* (Okada and Ishikawa, 1959; Awakura, 1968). However, teeth are apparently absent in *C. monodonta* (Surber, 1915; Howard, 1915). "Variable glochidial shape" (character eight, Ambleminae) includes "subtriangular" (Anodontinae) and "subspherical" (Margaritiferidae). Determining the boundaries of "small," "medium," and "large" glochidia (character nine) is arbitrary and overlap exists.

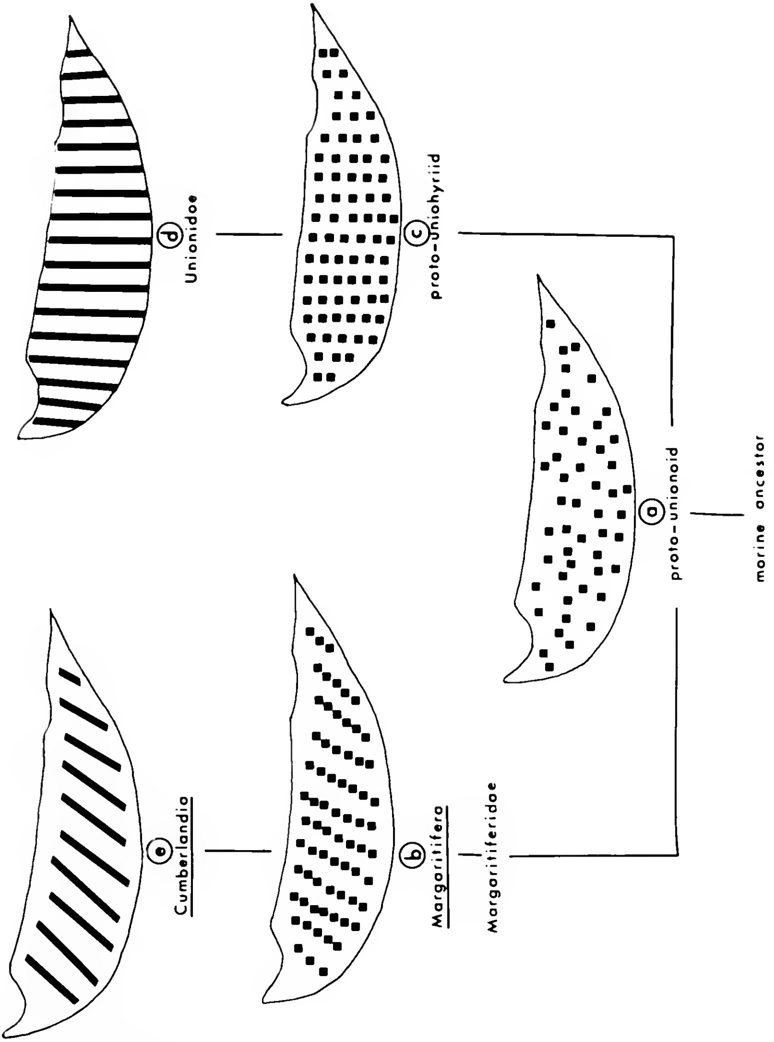
A conchological character separating the margaritiferids from the Nearctic and Palearctic unionaceans not discussed by Davis and Fuller (1981) concerns the presence of mantle-shell attachment scars on the inner surfaces of shell valves of margaritiferids (Pilsbry, 1896; Simpson, 1914). Smith (1983) discussed the histology and distribution of mantle-shell attachment in various species of the Margaritiferidae and mentioned the similarity between mantle-shell attachment scars in margaritiferid shells and scars in Recent trigonioid shells (Trigonioida). Newell and Boyd (1965) have rekindled historical arguments that propose a phylogenetic link between the marine trigoniids and unionoids.

Another overlooked conchological character distinguishing margaritiferids from unionids has been discussed by Tolstikova (1974) and involves the structure of conchiolin layers within the shell valves. She concluded that recognition of the Margaritiferidae and Unionidae as separate families was consistent with the degree of difference in shell structure between each group. Kat (1983) in a similar study has subsequently followed her conclusions.

Thus two conchological characters exist that separate margaritiferids from unionids; however, both characters are indicative of an ancestral condition (and therefore are not derived character states), the former (mantle-shell attachment) representing a carry over from a marine ancestor, and the latter from an unidentified freshwater ancestor which presumably gave rise to unionids as well (Kat, 1983).

The Margaritiferidae therefore differ from the anodontid-amblemid group by six character states (four anatomical, two conchological) which are equivalent to the number used to distinguish marine bivalve families with similar morphological groundplans. Had Davis and Fuller (1981) treated the Hyriidae they would have found that only three anatomical characters and no conchological characters (the morphology of conchiolin is unknown in hyriids) separate the Unionidae from the Hyriidae.

We believe that the margaritiferids diverged early from a stem unionoid group and followed a conservative evolutionary pathway independent of other unionoids. An ancestral eleutherorhabdic (=filibranch) group gave rise to freshwater inhabiting bivalves which acquired a synaptorhabdic (=eulamellibranch) gill condition in which solid interlamellar junctions replaced filamentous junctions to accommodate and brood shelled larvae. From a primitive eleutherorhabdic group a lineage evolved in which the randomly arranged interlamellar junctions (Text fig. 1a, the proto-unionoid stage) were arranged into diagonal rows (Text fig. 1b), a feature maintained in Recent margaritiferids. Another lineage evolved, the proto-uniohyriid, in which perforate (incomplete) vertical gill septa (Text fig. 1c), the alleged primitive state of septate unionoids (Heard, 1974), replaced randomly distributed interlamellar junctions. In later independent steps, perforate vertical septa became complete (Text fig. 1d). Both major branches aspired to accomplish a similar goal: to increase incubative efficiency. To this end the Margaritiferidae were largely unsuccessful as evidenced by the limited number of extant species and the lack of innovative marsupial morphologies otherwise present in unionoids. The culmination of marsupial design in margaritiferids exists in *C. monodonta* in which some of the scattered diagonally directed interlamellar junctions have coalesced to form diagonally elongated septa-like junctions (Text fig. 1e). A precursor to septa-like junctions (but not septa) is suggested by *M. margaritifera* in northeastern North America in which, during the incubative period, connective tissues are produced that line the inner gill lamellae walls and appear as diagonally arranged strands (Smith, 1979).



Text figure 1. Schematic diagram showing extant and assumed morphological states of the interlamellar junctions of gills of the Unionoida: a, the ancestral unionoid gill with randomized junctions (black squares); b, diagonally directed junctions in Recent *Margaritifera;* c, vertically directed junctions in proto-uniohyriids; d, vertical septa (fused junctions) in Recent unionids; e, fused diagonal junctions (non-septate) of Recent *Cumberlandia.*

A hypothetical freshwater ancestor common to both the Margaritiferidae and Unionidae and other unionoid groups, has been described herein containing a character state (randomized interlamellar junctions) not present in any living unionoid group nor found in any suggested hypothetical ancestral marine bivalve. Thus a character (anatomical) becomes available to identify the margaritiferids as a natural derived group within the Unionoida.

In summary, the moderate genetic distance between margaritiferids and unionids may not be fully interpreted at this time. However, the genetic distance exhibited by the margaritiferids represents the most discrete among "unionaceans" (excluding the Hyriidae, for which there are no genetic data). Furthermore, an alternative interpretation of morphological characters suggests that margaritiferids represent a distinct, derived group. Based on these arguments the Margaritiferidae is considered a valid family group.

Acknowledgements

Some of the information presented in this paper is based on material in the Museum of Comparative Zoology, the American Museum of Natural History in New York City, and the Peabody Museum at Yale University. To the respective curators of these collections, Kenneth J. Boss, Richard I. Johnson, William K. Emerson, and Willard D. Hartman, we are deeply grateful. We also thank Ann E. Pratt and William L. Fink for their comments and assistance.

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MISCELLANY

Dates of publication of the Molluscan portion (including the brachiopods) of the "Fauna del Regno di Napoli" (1829-1886) by Oronzio Gabriele Costa and Achille Costa.

by
Richard I. Johnson

This work was issued in signatures of varying amounts of text, at irregular intervals, and never completed. Sherborn (1910) pointed out that most of the signatures are dated and that the dates occur on, or near, the back fold of the signatures; thus they are mostly obliterated in bound copies of the work. Erasmo (1949) published the dates on the signatures based on a copy of the work in the department of zoology at the University of Bari, at the University of Naples, and on other copies elsewhere. He indicated the number of plates that appeared with each section but was unable to give their dates of publication. This is of little importance here, since nomenclature occurs on only one of the plates mentioned.

The unbound portion of the "Fauna" in my possession, and the bound one in the Museum of Comparative Zoology agree with the description given by Erasmo, except that he claimed the section on gastropods should have 19 plates, while both of these copies have only 18. The text for *Tritonium* mentions a plate 12, but it is not known if this was published, or if it is the plate referred to by Erasmo.

The author is very grateful to Dr. Robert Robertson of the Academy of Natural Sciences of Philadelphia for making a copy of Erasmo's work available from what may be the only set of the Journal, in which it appears, in the United States.

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The only title page was issued with the general introduction which appeared with the section on mammals in 1839 and consists of pp. I-XV.

ACEFALI SENZA CONCHIGLI by O. G. Costa

"Following the later name given by Cuvier, Costa designated these as Tunicata".

pls. 1, 2
  sig. 1, pp. 1-8 Catteri generali. gen. *Bifora* .... 1 Jul. 1840

pl. 3* Inscribed *Polychrates scutulatus* [new species].
  sig. 2, pp. 1-3 gen. *Polychrates*........................... 16 Oct. 1838

GASTEROPODI by O. G. Costa

pls. 1-3
  sig. 1, pp. 1-8 Caratt. gen. e classif.—Gasteropodi polmonati.
    gen. *Limax, Helix* .... no date
  sig. 2, pp. 9-16 gen. *Helix* (cont.)............................ no date
  sig. 3, pp. 17-24 gen. *Helix* (cont.) .... no date
  sig. 4, pp. 25-32 gen. *Helix* (cont.) .... 6 May 1839

pl. 4
  sig. 5, pp. 1-8 gen. *Vitrina* .... 18 Mar. 1848
  sig. 6, pp. 9-12 gen. *Vitrina* (cont.) .... 10 Mar. 1848

pl. 1
  sig. 7, pp. 1-8 Gaster. pettinibranchi. gen. *Solarium, Trochus* ....
  .... 12 May 1841

pl. 4
  sig. 8, pp. 1-4 gen. *Janthina* .... 13 May 1841

pls. 1, 2
  sig. 9, pp. 1-8 gen. *Pileopsis, Crepidula* .... 15 Apr. 1841
  sig. 10, pp. 9-16 gen. *Calyptraea, Sigaretus* .... 15 May 1841
  sig. 11, pp. 17-20 gen. *Sigaretus* (cont.) .... 20 Apr. 1844

pl. 11, [pl. 12 not seen]
  sig. 12, pp. 1-8 gen. *Tritonium* .... 1 Mar. 1859

pl. 1
- sig. 13, pp. 1–8 Gastropodi eteropodi. gen. *Atlanta* .... 1 Dec. 1852

pls. 1–4
- sig. 14, pp. 1–8 Gasteropodi tubibranchi. gen. *Dentalium* ... 1 Jul. 1851
- sig. 15, pp. 9–16 gen. *Dentalium* (cont.) .... 3 Jul. 1851
- sig. 16, pp. 17–24 gen. *Dentalium* (cont.) .... 7 Jul. 1851
- sig. 17, pp. 25–32 gen. *Dentalium* (cont.), [e *Ditrupa*] ...... 25 Jul. 1851
- sig. 18, pp. 33–40 gen. *Dentalium* (cont.) .... 27 Jul. 1851
- sig. 19, pp. 41–48 gen. *Dentalium* (cont.) .... 13 Sep. 1851
- sig. 20, pp. 49–56 gen. *Dentalium* (cont.) .... 13 Sep. 1851
- sig. 21, pp. 1–3 gen. *Odontina* .... 30 Jan. 1851

pls. 1–3
- sig. 22, pp. 1–8 Gaster. scudibranchi. gen. *Halyotis, Padollus* ....9 Oct. 1838
- sig. 23, pp. 9–16 gen. *Stomatia, Stomatella, Fissurella* .....15 Oct. 1838
- sig. 24, pp. 17–24 gen. *Fissurella* (cont.), *Emarginula* ......17 Oct. 1838
- sig. 25, pp. 25–32 gen. *Emarginula* (cont.), Gaster. ciclobranchi........ ....27 Oct. 1838

pl. 3
- sig. 26, pp. 1–8 gen. *Chiton* .... 4 May 1841

PTEROPODI by O. G. Costa, pp. 1–10, pls. 1, 2 and
Achille Costa,* pp. 11–28, pls. 3–5.
*page 11 is signed "A. C."

pls. 1–5
- sig. 1, pp. 1–8 Pteropodi gen. *Cymbulia, Hyalea*........... 3 Apr. 1840
- sig. 2, pp. 9–16 gen. *Hyalea* (cont.), *Cleodora* .... 10 Dec. 1873
- sig. 3, pp. 17–24 gen. *Cleodora* (cont.), *Spirialis, Tiedemannia, Pneumodermon, Trichocyclus* .... 27 Dec. 1873
- sig. 4, pp. 25–28 gen. *Clionopsis*—Catal. sistematico—Spiegazione delle Tavole .... 16 Dec. 1873

BRACHIOPODI by O. G. Costa

pls. 1–3
- sig. 1, pp. 1–8 Brachiopodi: Caratt. gen.—gen. *Terebratula* ....1 Oct. 1851
- sig. 2, pp. 9–16 gen. *Terebratula* (cont.) ....8 Oct. 1851
- sig. 3, pp. 17–24 gen. *Terebratula* (cont.) ....15 Nov. 1851
- sig. 4, pp. 25–32 gen. *Terebratula* (cont.) ....17 Nov. 1851
- sig. 5, pp. 33–40 gen. *Terebratula* (cont.) *Orthis* ....24 Nov. 1851
- sig. 6, pp. 41–48 gen. *Orthis* (cont.), *Platydia* .... 5 Jan. 1852
- sig. 7, pp. 49–56 gen. *Thecidea, Crania*—Osservaz.—Indice alfabetico delle specie .... 26 Jan. 1852
- sig. 8, pp.57–60 Spiegazione delle Tavole................ 27 Jan. 1852

Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 17, 1984 NUMBER 65

NOTES ON *ACUTITECTONICA* (ARCHITECTONICIDAE) WITH A DESCRIPTION OF A NEW SPECIES, *A. SINDERMANNI,* FROM BRAZIL

ARTHUR S. MERRILL AND KENNETH J. BOSS

ABSTRACT. *Acutitectonica* is reinstated as the proper generic name for a group of architectonicids characterized by more or less depressed conical shells with a sharply angled body whorl and with weak to moderate sculpture; the radular formula is 2-1-2 with a knob-like central tooth. *Discotectonica,* which has been considered a senior synonym by some authors, is shown by a careful analysis of the figure of the type species not to be congeneric. A new species is also described.

Introduction

Habe (1961: 30) introduced the generic name *Acutitectonica*[1] for the species *Solarium acutissimum* Sowerby 1914 from off the southeastern coasts of Shikoko and Honshu Islands, Japan. Later that year Garrard (1961: 23) established the new genus *Russetia* on his new species *R. dilaniatus,* from off New Castle, New South Wales, Australia. Subsequently, Robertson [*in*] Marche-Marchad (1969: 486) considered *Discotectonica* Marwick 1931 as a senior synonym of *Acutitectonica* and placed the species *Architectonica placentalis* (Hinds 1844) and *Philippia discus* (Philippi 1844) in it; later Roberson [*in*] Keen (1971: 389)

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[1] As best we can determine, Habe's name has priority; the Introduction of Habe (1961) is dated 20 April 1961—there is no specific dating for Garrard (1961); Habe's paper was received at the MCZ Library on 16 February 1962 and Garrard's 14 May 1962; Garrard (1968) indicated the junior synonymic position of *Russetia.*

mentioned *A. placentalis* and added *A. peracuta* (Dall 1899). Garrard (1978: 517) also advocated this procedure and additionally synonymized his own *Russetia* under *Discotectonica.* In this paper we critically evaluate the type species of *Discotectonica* and give our reasons why *Discotectonica* cannot be construed as being synonymous with *Acutitectonica.* We also describe and illustrate a new species of *Acutitectonica.*

Systematics

Family Architectonicidae Gray 1850
Subfamily Philippiinae Boss 1982

Genus Acutitectonica Habe 1961

Acutitectonica Habe 1961. Coloured Illustrations of the Shells of Japan, p. 30, pl. 13, fig. 21 (type species, *Solarium acutissimum* Sowerby 1914, original designation and monotype; Kii, Japan).

Russetia Garrard 1961. Journal of the Malacological Society of Australia, *5:* 23, pl. 1, figs. 11a, b (type species, *Russetia dilaniatus* Garrard 1961 [= *Solarium acutissimum* Sowerby 1914], original designation and monotype; Recent, trawled in 160 fathoms east of New Castle [New South Wales, Australia]).

Description. Shell moderately large, more or less depressed conical; protoconch usually small, with or without anal keel; body whorls sharply angled at the periphery; spiral and basal cords weakly to moderately strong and beaded; lip simple; aperture triangulate with basal outer margin subsinuate; siphonal canal strong; umbilical wall narrow, strongly axially marked; radular teeth five per row with central tooth knob-shaped or pointed and without lateral cusps in species examined. In addition, two species (*Acutitectonica acutissima* and *A. disca*) show a remarkable internal structure found in the esophageal region of the gut (see Boss and Merrill, 1984, for details); this structure has sometimes been mistaken for the radula (Habe, 1952; Melone, 1975). Operculum corneous, paucispiral with an off-center nucleus and internal spiraled process.

Remarks. The genus *Acutitectonica* has living representatives in the tropical and subtropical deeper waters of the world, ranging from 25 to 230 fathoms, including such Indo-Pacific species as the type, *A. acutissima* (Pl. 44, figs. 1–3) from off southern Queensland and New South Wales, Australia through the Philippine Islands and to Japan, and *A. kuroharai* (Kuroda and Habe 1961) from off southern Queensland and Japan (Garrard, 1978). The genus is represented in the eastern Pacific by *A. disca* (Philippi 1844)[1] which is also present on both sides of the Atlantic, in the eastern Atlantic and the Mediterranean by *A. lepida* (Bayer 1942)[2] and *A. bannocki* (Melone and Taviani 1980) [Recent?] only lately discovered in the Mediterranean. A new species described herein is presently known only from the type locality in the western Atlantic.

Acutitectonica, along with the genus *Philippia,* has been placed in the subfamily Philippiinae because of its radular characteristics (Boss and Merrill, 1984).

Marwick (1931) proposed a new subgenus *Discotectonica* with *Architectonica balcombensis* Finlay 1927, a replacement name for *Solarium acutum* Tenison-Woods 1879, *non* Conrad 1854,[3] as the type species; the type locality is "Tertiary beds on the banks of the Muddy Creek, a tributary of the Wannon River, about five miles from Hamilton in Western Victoria", an Eocene Australian outcrop according

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[1] We consider the following nomina to be synonyms of *A. disca:* the variant spellings *discum* and *discoideum, Solarium placentale* Hinds 1844 and its variant spellings *placentula* and *placentulum, S. pseudo-perspectivum* 'Brocchi' Jeffreys 1880, *non* Brocchi 1814, *S. perspectiviforme* Tiberi 1872 and *S. peracutum* Dall 1889.

[2] We include the following as synonyms: *Solarium pseudoperspectivum* 'Brocchi" Hanley 1863, *non* Brocchi 1814, *S. pulchellum* Tiberi 1868, *non* Michelotti 1841, *nec* d'Orbigny 1842 and *S. mediterraneum* Monterosato 1872, *non* Philippi 1853.

[3] Not 1860 as quoted by Finlay (1927) and others. Conrad introduced *Architectonica acuta* in 1854 *in* Walies, p. 289, Pl. 17, figs. 1a, 1b; a lectotype was designated by Palmer *in* Harris and Palmer, 1947, pp. 275–276 as listed in Moore (1962); the *nomen* was not listed in Ruhoff (1980).

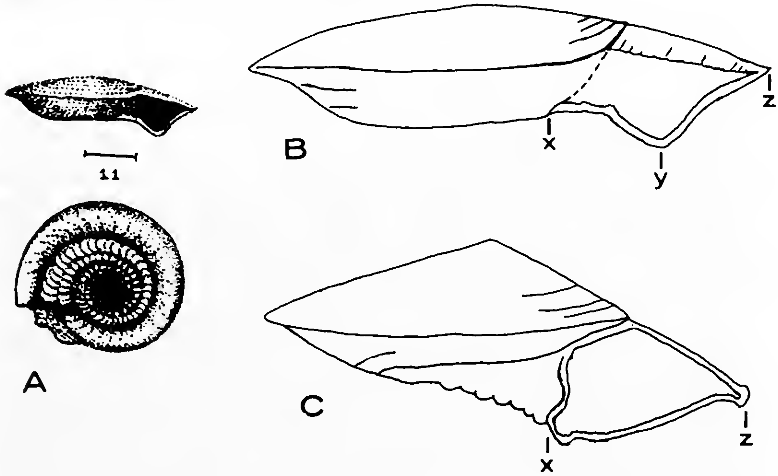
to Harris (1897). Wenz (1939) utilized *Discotectonica* as a subgenus for *Architectonica* for New Zealand and Australian species of Eocene to Oligocene age. Subsequently the age of the type species has been redated to the Tertiary Balcombian Geological Horizon, or more specifically the Middle Miocene (Chapple, 1941; Garrard, 1978).

We herein reproduce Tenison-Woods' (1879) original description, comments, and illustration (Text fig. 1A and B) of the type species for *Discotectonica* as a basis for comparison with *Acutitectonica.*

> SOLARIUM ACUTUM. Pl. 21, fig. 11.
>
> *S. t. parva, depressa, discoidea, tenui, nitente; anfrac, 4, omnino planatis, liratis, ad margines duobus liris majoribus granulosis insignitis; ad peripheriam acutis; basi in medio conspicue convexa, tenuiter lirata; umbilico costulis et liris granulosis in lineis 4 vel 5 marginata. Apertura transversim ovata. Alt. 1½, diam. 6.*
>
> This fossil is not very common. It is easily distinguished by its very small size and depressed form and very acute periphery, where the edge of the shell is produced into a sharp projecting keel. The upper surface is distinctly lirate, and the edges of each whorl margined with rather broad granular lines, two or three in number, the central one where there are three, being much smaller. The under side is abruptly convex in the middle, and faintly lirate. The umbilicus is broadly margined with three to five spiral lines of granules or riblets, varying in size and forming a very elegant pattern. In the figure of this shell on Plate 21, the side view and base with the umbilicus are represented. The species is not like any existing or fossil, its nearest representative is *S. millegranum,* Lamarck. Prof. Tate informs me that this species reaches nine-tenths of an inch in diameter, and that then the ornament is slightly different.

Tenison-Woods (1879) stresses the very small size (6 mm) and a greatly depressed form as easily distinguishing characters. Its aperture clearly portrayed in the type figure (Text plate 1A, B), is distinctly different from true *Acutitectonica* in lacking or possessing a very reduced columellar margin which forms the umbilical wall and the strong siphonal canal of *Acutitectonica.* The "abruptly convex" base of *S. acutum* is reflected in the angulation x-y-z of the apertural view of Text fig. 1B and the basal view of Text fig. 1A which is unlike the more or less flattened to weakly convex base of the typical *Acutitectonica* (Text fig. C, x, z).

Further, the body whorl appears to wrap more completely preceding whorls, a condition reminiscent of the heliacene genera *Awarua,* or *Pseudomalaxis* of the Architectonicidae. The umbilicus, though stated to be margined by 3–5 cords appears to have two exceptionally strong ones inthe basal view of the type figure (Text fig. 1A). These strong umbilical and periumbilical cords are in the area x-y of the apertural view in Text fig. 1B.



Text figure 1

A. *Solarium acutum* Tenison-Woods 1879, *non* Conrad 1854 [Type figure]. Middle Miocene, "... on the banks of the Muddy Creek, a tributary of the Wannon River, about five miles from Hamilton in Western Victoria."; apertural and basal views; maximum diameter 6 mm; height 1.5 mm (after Tenison-Woods 1879: Pl. 21, fig. 11).

B. Line drawing of *S. acutum* Tenison-Woods after the type figure; enlarged about ten times to show structure of the aperture which appears to be more heliacine than philippine.

C. Line drawing of a small specimen of *Acutitectonica lepida* (Bayer 1941) from Ras el Amoush, Mediterranean Sea; actual size 9 mm; enlarged about 7 times to show structure of the aperture of a typical *Acutitectonica.*

The mistaken interpretation of *Discotectonica* as *Acutitectonica* is probably based on the figures of "*S. acutum* Tenison-Woods" provided by Harris (1897: 244, Pl. 7, figs. 6a-c) and reproduced by Wenz (1939: 671, fig. 1913). That specimen is about 19 mm in diameter (3 times larger than the original of Tenison-Woods)—Harris' fig. 6c shows an enlargement of a pie-shaped section of the base, indicating the rather strong numerous (7) periumbilical sulci and granulations. Although Harris does not provide an apertural view there is every indication that it is an *Acutitectonica* as seen in the flattened or weakly convex base, sharp peripheral edge, and the umbilical wall.

Further confounding the issue, Garrard (1978: 520), who noted that the holotype of *S. acutum* Tenison-Woods 1879 was lost, designated a neotype for it. We do not concur with Garrard's selection since the specimen he designated does not agree with the original description, explanatory notes, and figure of Tenison-Woods (1879).[1] Tenison-Woods stressed the small size of his *S. acutum,* namely, 6 mm in diameter and 1.5 mm in height; the specimen designated neotype is 17.5 mm or nearly 3 times larger and its height is 7.0 mm or more than 4 times greater than *S. acutum.* Not only is this neotype larger in size but its proportions differ from that of the holotype; the height/diameter ratio for the holotype (1.5/6) is 0.25 while for the neotype (4/17.5) it is 0.4. Clearly the holotype was, as Tenison-Woods described and illustrated it, depressed, certainly more so than in the neotype. Actually, Tenison-Woods' type figure was even more depressed than his illustration of the apertural view shows since the figure was not aligned to show the exact outline of the aperture as indicated by the exposed dorsal surface of the body whorl above the upper margin of the aperture.

Garrard (1978) also stated: "No other Australian Tertiary fossil species in the genus *Architectonica* possesses the acute

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[1] Therefore, the specimens described and figured by Garrard for what he considered to be "*Solarim acutum* Tenison-Woods" and its replacement name "*Architectonica* (*Discotectonica*) *balcombensis* Finlay" represent an unnamed species of *Acutitectonica.*

peripheral keel and concave basal area adjoining...." which indicates that his specimens were representatives of a species of *Acutitectonica* (Garrard 1978, Pl. 6, figs. 6-8; Pl. 10, figs. 7-9); for the true *S. acutum*, Tenison-Woods (1879) stressed that the base was abruptly convex as clearly shown in Text fig. 1A and B. It is true that *S. acutum* has a depressed form and acute peripheral keel as expressed in Tenison-Woods' type figure (Text fig. 1A and B). However, it must be emphasized that the species is dorsally depressed to the peripheral keel and lacks the even dorsal and basal symmetry of a typical *Acutitectonica* (Text fig. 1C).

Acutitectonica sindermanni new species

Plate 45, figures 1-3
Plate 46, figures 1-2

Description. Shell size medium-small, 8.9 mm in maximum diameter, 4.4 mm in height. Shell strong, color whitish (dead shell); spire depressed-conic; carina sharply keeled; umbilicus moderately open; whorls 3 1/3—defined by a strong dorsal penultimate cord and an even stronger peripheral cord. Protoconch anastrophic, very large (1.33 mm), inflated, emerging and inverting in a single whorl, with an anal keel. Sculpture on dorsum consists of five moderately developed spiral cords and a relatively strong peripheral cord. The first, third, and fourth cords moderately weak, second and fifth comparably stronger; no spiral threads interspersed with cords; sutures well defined. Spiral cords crossed by rather light axial plicae to produce weakly nodulated cords. Basal spiral sculpture consists of a strong nodulated umbilical cord, a moderately strong spiral cord adjoining the peripheral cord, and additional very faint spiral cords and threads on body. Axial plicae radiate above the umbilical cord towards the periphery gradually weakening and disappearing about midway to the periphery; a distinct suture separates the umbilical cord and the axial plicae; a wide, shallow excavation divides the penultimate and peripheral cords. Umbilical wall recessed, rather smooth—marked by very fine axial striae and occasionally by craggy growth plications; aperture subquadrate, sharply keeled at the periphery, lip thin and simple, siphonal canal grooved. Radula and operculum unknown.

Holotype. Museum of Comparative Zoology, No. 294313. Height 4.4 mm; maximum diameter 8.9 mm.

Type locality. About 105 miles north of Cabo Orange, Brazil (06°05′N. Lat.; 51°21′W. Long.), in 96 meters.

Remarks. Acutitectonica sindermanni is known from a single adult specimen. The species is distinct and has characters that easily separate it from *A. disca, A. bannocki,* and *A. lepida,* the other Atlantic forms. The protoconch is almost twice as large as in *A. disca* (1.32 to 0.72 mm) and possesses an anal keel. Other characters separating it from *A. disca* are dorsally the stronger delineated spiral cords in *A. sindermanni* which number six, including the peripheral cord; three are rather uniform with no spiral threads between them. The weakly developed dorsal spiral cords and threads in *A. disca* number about eight. In *A. disca* the basal cords are also generally more weakly developed except for two strong spiral cords adjoining the umbilical cord—the area of strong axial sculpture in *A. sindermanni.* The dorsal surface is more strongly developed in *A. bannocki* with a combination of axial and spiral dominance—the axial sculpture of the inner part of the whorl is actually contoured and separates it clearly from the outer flatter spiral sculpture. Dorsal spiral sculpture is lacking in *A. lepida* except for penultimate and peripheral cords.

Acknowledgments

This species is named for Dr. Carl J. Sindermann, Northeast Fisheries Center, Sandy Hook Laboratory, New Jersey, friend and erstwhile colleague of the senior author. We thank Mr. Richard I. Johnson and Dr. Ruth D. Turner for critical review of the manuscript.

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Plate 44

Fig. 1. *Acutitectonica acutissima* (Sowerby 1914). Japan. MCZ 294338; maximum diameter 37.6 mm, height 14.5 mm; dorsal view.

Fig. 2. The same; apertural view.

Fig. 3. The same; basal view.

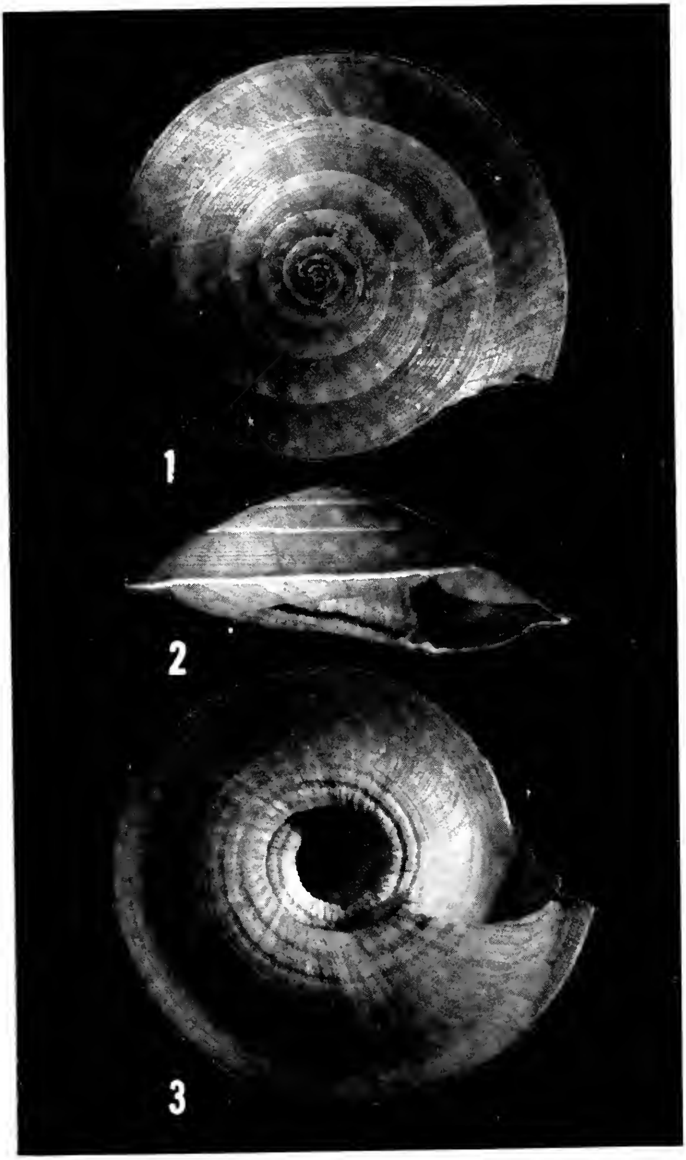

Plate 44

Plate 45

Fig. 1. *Acutitectonica sindermanni,* new species. 105 miles north of Cabo Orange (06°05′N. Lat.; 51°21′W. Long.), Brazil in 96 meters. Holotype MCZ 294313; maximum diameter 8.9 mm, height 4.4 mm; dorsal view.

Fig. 2. The same; apertural view.

Fig. 3. The same; basal view.

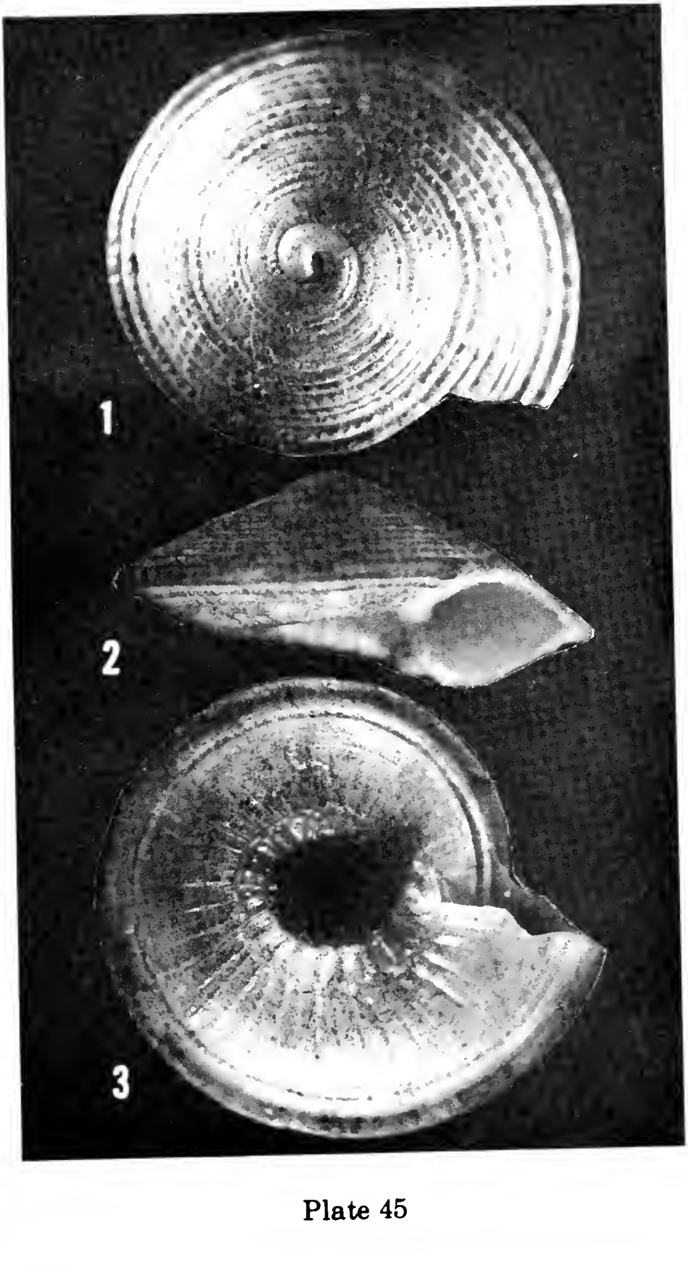

Plate 45

Plate 46

Fig. 1. *Acutitectonica sindermanni,* new species, holotype temporarily coated with magnesium to highlight the configuration of the dorsal spiral sculpture (×8.5).

Fig. 2. Same specimen enlarged to show detail of the very large anastrophic protoconch. Maximum diameter of the protoconch, 1.33 mm (×19).

1

2

Plate 46

MISCELLANY

Ignaz Elder von Born (1742–1791) was a member of the German nobility, though born in Transylvania. At the age of 13 he was sent to Vienna to study with the Jesuits, who convinced him to join their order, which he quit after sixteen months. He then went to Prague where he studied jurisprudence, and later natural history and mining. In 1770 he became associated with the department of mines and the mint, and he soon became counselor of mines. After publishing a work on his mineral collection, he was admitted to a number of learned societies, and his reputation was such that Empress Maria Theresa (reigned, 1740–1780) called him to Vienna in 1766 to arrange and describe the Imperial Collection. Upon the death of the Empress in 1780, the project was discontinued, but not before Baron Born was able, at least, to study the imperial shells. The first work was a modest volume (1788)[1] followed by a large folio volume with elegant plates (1780).[2]

Born used the system of binomial nomenclature introduced by Linnaeus in both his works. He also used this system of nomenclature in a satire on the orders of monks then found in the Empire, *Specimen monachologiae* (1783). It was long after (1852)[3] translated into English.

The shells described by Born, many new to science, now in the Vienna State Museum, were restudied by Brauer (1878)[4] who was then curator of the Imperial Zoological Museum.

Richard I. Johnson

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Occasional Papers On Mollusks

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

VOLUME 4 OCTOBER 17, 1984 NUMBER 66

RADULAR CONFIGURATION AND THE TAXONOMIC HIERARCHY IN THE ARCHITECTONICIDAE (GASTROPODA)

KENNETH J. BOSS AND ARTHUR S. MERRILL

ABSTRACT. The literature dealing with the radula in the Architectonicidae is reviewed and new observations are added both from microscopic and SEM examinations. Three subfamilial units are recognized; a list of species in which the radula is known, all herein described and illustrated, is conjoined: Architectonicinae: *Architectonica c.f. laevigata* (Lamarck 1822), *A. nobilis* Röding 1798, *A. perspectiva* (Linnaeus 1758), and *A. reevei* (Hanley 1862); Philippiinae: *Acutitectonica acutissima* (Sowerby 1914), *A. disca* (Philippi 1844), and *A. lepida* (Bayer 1942), *Philippia hybrida* (Linnaeus 1758), *P. lutea* (Lamarck 1822), *P. krebsii* (Mörch 1875), *P. oxytropis* (A. Adams 1854), and *P. radiata* (Röding 1798); Heliacinae: *Heliacus architae* (Costa 1830), *H. bisulcatus* (d'Orbigny 1842), *H. borealis* (Verrill and Smith 1880), *H. cylindricus* (Gmelin 1791), *H. dorsuosus* (Hinds 1844), *H. fallaciosus* (Tiberi 1872), *H. jeffreysianus* (Tiberi 1867), *H. perrieri* (Rochebrune 1881), and *H. trochoidea* (Deshayes 1830), *Pseudomalaxis nobilis* (Verrill 1885), and *Spirolaxis centrifuga* (Monterosato 1890).

Attempts to ascertain a proper taxonomic position for the Architectonicidae on the basis of its radular morphology were initially thwarted since researchers were unable to find a radula because of its small size and unusual position. The family was, thus, variously placed in aglossate groups, the Aglossa, and the Gymnoglossa (Gray, 1853a and b; Mörch, 1860).

MacDonald (1860: 76–77) was the first to discover and describe the jaws and radula of an architectonicid and he recognized, in the case of *Solarium* [=*Architectonica*] *perspectivum*, a ptenoglossate condition similar to the Epitoniidae and Janthinidae. He described the species as follows:

> The oral teeth [=jaws] form a narrow circular band consisting of a pavement of sharp dental cells, whose points, as in other cases, are directed forwards.
>
> The lingual pavement [=radula] is small, but elongated in form and divided into two lateral areas, supporting several series of long and gracefully curved uncinate teeth, which seem to decrease in length from within towards the lateral borders of the membrane, where they also become bifid in the vertical direction.

Troschel (1861) was the first to figure the radulae and jaws for architectonicids. For *Solarium* [=*Architectonica*] *perspectivum* he counted at least 60 rows of long, narrow teeth (Pl. 47, figs. 1–5) and found that each row has a total of 28 teeth (Pl. 47, fig. 12) and concluded, since he could find no central tooth, that there was none. Therefore, the radula formula is 14-0-14. The lateral teeth are prong-like with the longer ones central or medial in position and the shorter at the margin of the radula (Pl. 47, fig. 1). The longer ones have simple pointed cusps (Pl. 47, fig. 5) while those somewhat more lateral in position, though still prong-like, have a small lateral cusp along shaft of the tooth (Pl. 47, figs. 8 and 11a); the more marginal laterals are not only shorter but the small cusp mentioned above becomes longer (Pl. 47, fig. 2); Troschel likened these teeth to a fork with unequal tines. He also illustrated the lateral teeth in a view so one could not see the small tines clearly (Pl. 47, fig. 3). These teeth measure from 0.06 mm to 0.2 mm in length. He described the jaw of *A. perspectiva* (Pl. 47, fig. 6) as consisting of lancet-like elements arranged like tiles on a roof though not perfectly regular; the free edge is irregular with some of the pointed rod-like elements projecting; these elements measure 0.0075 mm broad by 0.0275 mm long.

Troschel (1861; 1875) could only observe portions of the radula of *Philippia lutea* [=*P. hybrida,* since his specimen was from the Mediterranean Sea]. He noted the presence of numerous teeth, thereby relating it to *Solarium* [=*Architectonica*] but he never gave a radular formula, nor specifically noted the presence or absence of a central tooth though he implied there was no central tooth. He clearly illustrated the lateral teeth as having from two to three prong-like cusps (Pl. 47, fig. 7); however, the dental elements he mentioned as central, or in the middle, in position (Pl. 47, fig. 9) are confusing and probably represent some error in judging the preparation. He observed that the jaw of *P. hybrida* has bluntly rounded, rod-shaped elements which are about four times longer than broad and arranged in 4–6 irregular rows, somewhat like roof tiles (Pl. 47, fig. 10).

Troschel (1875) recounted his earlier work on *Architectonica perspectiva* and studied the radula of another specimen, one from the Philippines which though labelled *Solarium zonatum* he equated to *A. perspectiva.* The angles of the recurved tines of the more marginal lateral teeth (Pl. 47, figs. 11b, c, d) differ somewhat from the specimen he previously figured in 1861 (Pl. 47, figs. 2 and 4). However, the essentials are the same.

Troschel (1875: 157) in an addendum, discussed *Torinia* [=*Heliacus*] *cylindracea.* Although he had difficulty with his preparation because of the minuteness of the radula and was uncertain of the completeness of his observation since the teeth had become disassociated, he could still surmise that the radula of *Torinia* [=*Heliacus*] is a modified taenioglossate one with five teeth per row, giving the formula 2-1-2—two laterals flanking a central tooth. He said the central tooth (Pl. 48, fig. 1) is almost rectangular in shape with the cutting edge consisting of a single central cusp flanked on each side by about 14 rather deeply incised, very narrow cusps. Both lateral teeth are narrow and basally blunt, widened distally and having deeply cleft, finger-like cusps, seven on the inner lateral and eight on the outer (Pl. 48, fig. 2). The central tooth measures 0.08 mm by 0.05 mm. Because of the presence of the central tooth and the limited number of lateral teeth in *Torinia* [=*Heliacus*], he established a new family, the Toriniacea [=Heliacidae] and separated it from the Soliariacea [=Architectonicidae] in which he placed *Solarium* [=*Architectonica*] and *Philippia.*

Marshall *in* Tryon (1885) reproduced Troschel's figures for *Solarium* [=*Architectonica*] and *Philippia* and stated that the teeth "are long, spiniform, pronged and without central tooth." For *Torinia* [=*Heliacus*], he noted "there is a small central tooth, a lateral tooth with pectinated and incised edge united to the central tooth and two marginal teeth which are straight and digitated at their extremities."

Bouvier (1886: 99 and 105) recounted Troschel's (1875) observations on the radula and jaws of *Solarium* [=*Architectonica*], noting that the laterals are numerous, spiniform and terminating in one, two or three cusps. Discussing the radula of *Torinia* [=*Heliacus*], he correctly noted the central tooth with its large central cusp bordered by numerous small cusps and the lateral teeth with their six or seven terminal cusps though he incorrectly stated that there were six lateral teeth per row, the true taenioglossate condition, instead of four.

Thiele (1925) made rather extensive comments on the radular configuration of the Architectonicidae. He rightly pointed out Marshall's (1885) incorrect interpretation of the dental elements of *Torinia* [=*Heliacus*], that his "central tooth" and "lateral tooth" really are, respectively, the central knobby cusp and lateral, finely denticulated cusps of the central tooth. He contrasted the radulae of *Torinia* [=*Heliacus*], *Philippia,* and *Architectonica* referring to Troschel (1875) for *Torinia.* He figured (Pl. 48, fig. 3) the central tooth of *Torinia* [=*Heliacus*] *trochoidea.* This is a side view rather than the usual frontal view but still shows the heliacine configuration of the central tooth—a central cusp flanked by numerous (here 15) fine lateral cusps. The lateral teeth are narrow and distally broadened, terminating in several adjacent finger-like long, narrow, curved cusps of which the outermost are broadest and shortest. He found, after having examined different species, that the form of the lateral teeth in *Torinia* [=*Heliacus*] varies as does the number of cusps, between six and ten. He was the first to figure the jaw of a heliacid—*Torinia* [=*Heliacus*] *trochoidea*; it is narrow and made up of adjacent pointed, slightly curved little rods on which sometimes a second point is found (Pl. 48, fig. 6).

Thiele (1925) also had difficulty in isolating the minute radula of an unnamed species of *Philippia,* but he noted that there were five teeth per row though not explicitly stating but inferring the presence of a single central tooth and two pairs of laterals. The lateral teeth are not greatly differentiated, being narrow and terminating mostly in three but sometimes two thin cusps; however, a closer examination of his illustration indicates a frontal view of a central tooth (Pl. 48, fig. 4) with its single median pointed cusp flanked by the longer pointed, thin lateral cusps and a side view of one lateral tooth (Pl. 48, fig. 5) with its recurved form and three slim, narrow pointed cusps. He found that the jaw rods of *Philippia* gradually taper to points on their free edges (Pl. 48, fig. 7). [This does not conform with Troschel who showed them to be rather bluntly rounded, Pl. 47, fig. 10]. Thiele went on to consider that *Philippia* was an intermediate between the more primitive *Torinia* [=*Heliacus*] and the more derived *Architectonica* with its numerous single and double pronged teeth; he concluded that the family Architectonicidae was not ptenoglossan and therefore, not related to the scalids [=epitoniids] or janthinids, but to the Mathildidae.

Thiele (1926) figured an individual long, narrow, pointed lateral tooth of *A. perspectiva* (Pl. 47, fig. 13), remarking only that the genus had numerous teeth, sometimes with a secondary cusp. He recognized *Heliacus* as having five teeth per row with a strong central tooth and two narrow, distally sharply denticulate lateral teeth and *Philippia* with only a few teeth, without giving a specific number. He formalized the separation of the family from the Ptenoglossa, placing the Architectonicidae next to the Mathildidae in the Cerithiacea.

Thiele (1928) described and figured the central and lateral teeth of what he called *Philippia hybrida*. He characterized the central tooth as strongly formed, long and narrow with a short strong hook or central cusp flanked on either side by two bristle-like appendages or cusps, "borstenartigen Anhangen" (Pl. 48, figs. 8 and 9); the inner lateral tooth has four, the outer five, long, thin, also bristle-like cusps (Pl. 48, figs. 10 and 11, respectively); he then stated that *Philippia,* by its radular structure is closer to *Torinia* [=*Heliacus*] than to *Solarium* [=*Architectonica*], because in the latter the number of teeth is much increased and some of the lateral ones are simply pointed while others are forked (Pl. 48, fig. 12).

Thiele (1929), summarizing the features of the family, stated the radular formula of *Solarium* [=*Architectonica*] as 14–0–14 with the central tooth being absent and the lateral teeth longer and singly pointed more centrally, and shorter and forked more laterally. He characterized *Torinia* [=*Heliacus*] as having five teeth per row, describing the central and lateral teeth as previously known, and then for the first time noted that *Philippia* also has five teeth per row with a central tooth not broader than the lateral teeth and bearing bristle-like projections ("borstenartigen Fortsätzen") on the cutting edge; the lateral teeth are like *Torinia* with several cusps.

Habe (1943), working on *Heliacus dorsuosus,* illustrated the central tooth with its median cusp flanked by numerous lateral serrations (Pl. 49, fig. 3) and both lateral teeth, in this case, each with nine narrow, digitate cusps (Pl. 49, figs. 1 and 2).

Habe (1952) illustrated three odd structures, each having three long spiniform cusps, which he considered with no explanation to be the radula of *Discotectonica* [=*Acutitectonica*] *acutissima* (Pl. 58, fig. 2); we think that this is a separate structure and consider it subsequently.

Robertson (1970) reviewed the literature on the radula of *Philippia,* remarking that Troschel's (1861) *P. lutea* was *P. hybrida* and that Thiele's (1925) *P. hybrida* was really *P.* (*Psilaxis*) *radiata* since the name *P. hybrida* was at that time (Thiele 1925; 1928; 1929) being applied to *P. radiata.* He stated that Troschel (1861; 1875) was wrong in believing that *Philippia hybrida* has about as many teeth as *Architectonica* (*i.e.* about 28). In point of fact, Troschel said he had a difficult time manipulating the tiny radula and that he could only make out single teeth or parts of the radula; he was not able to give an exact number of teeth in *Philippia;* he only remarked that the teeth were numerous and similar to *Architectonica* in their general arrangement. Robertson also found that the radula was difficult to study and stated that, for *Philippia,* there were no subgenerically distinguishing characters. Robertson extracted radulae from six specimens representing four species and gave measurements for the length and height of the radula, the number of rows of teeth and the size of the shell. For four species the radular length varied from 0.33 to 1.4 mm and the number of rows of teeth from 29 to 58. Robertson noted that the "narrow and bilaterally symmetrical teeth are densely packed together... and their bases are positioned in an irregular diagonal pattern across the ribbon." He described the philippiine radula in general using *P. radiata* as an example. We have reproduced his figures 9 B–D as our Pl. 49, figs. 4–6. Robertson said: "I think it more likely that the innermost teeth are the ones that are smallest, narrowest, and singly pointed (fig. 9A). The other two kinds of teeth differ in length, thickness, curvature, and the number of distal spines. The longer ones (fig. 9B) have two or three spines, while the shorter ones are laterally thicker and more curved and have three to six spines (fig. 9C). One of the latter teeth, definitely not from the center of the radula, in frontal view (fig. 9D) resembles Thiele's figure (1928, p. 87) of a *Psilaxis* 'central' ". He also said there appeared to be five teeth per row, but was unable to discern the arrangement of the teeth on the radula—whether there were consistently five in a row or if they were variable or even asymmetrical. It is obvious that Robertson misinterpreted his data as will be clearly shown by Melone's (1974) work with species of *Philippia* (*Philippia*) *hybrida* and Climo's (1975) analysis of *P.* (*Psilaxis*) *oxytropis.* Robertson stated that the jaws differed between the subgenera *Philippia* and *Psilaxis.* The species referable to *P.* (*Philippia*) *hybrida* are subcircular while those in *P.* (*Psilaxis*) (*e. g. krebsii, oxytropis* and *radiata*) have jaw rods that are elongate. This may be the reason he thought Troschel's 1861 *P. lutea* was *P. hybrida* since Troschel figured bluntly rounded, rod-shaped elements about four times longer than broad (Pl. 47, fig. 10) while Thiele (1925) showed them for *P. hybrida (=radiata)* to be rather bluntly rounded and tapering to points on their free edges (Pl. 48, fig. 7).

Melone (1974) described and illustrated with excellent SEM photographs the radulae of two species of philippiines and two species of heliacines. Now for the first time one can see clearly in full three-dimensional aspect the shapes, sizes and positions of various architectonicid radular teeth. Melone kindly sent us a superb set of these photomicrographs which he used in this study, some of which are reproduced in Plates 50 to 53. We take this opportunity to extend our thanks for his cooperation.

Melone (1974) discussed and figured the radula of *Philippia hybrida* (Pl. 50, figs. 1 and 2); it consists of five teeth per row with a formula 1+1+R+1+1 where R equals the rachidian or central tooth, plus a lateral and marginal tooth on each side. The central tooth measures 90.0 u in length and 6.0 u in breadth with a long digitiform spine or cusp on either side of the shorter central cusp; the central cusp measures 15.0 u × 1.5 u and the outer cusps 35 u × 2.5 u; the lateral and marginal teeth are 100 u by 6 u and have three sharp digitiform distal cusps [it appears to us that there are only two cusps on the outer lateral tooth]. He also worked with the radula of *Architectonica mediterranea* [*=Acutitectonica lepida*] (Pl. 53, figs. 1 and 2); it consists of five teeth per row with an elongate, narrow, prong-like smoothly knobbed central tooth measuring 150 u × 12 u flanked by a lateral and marginal tooth on each side which terminate in seven fine, curved, and pointed cusps; the lateral and marginal teeth measure 160 u × 12 u. He remarked that the radula of this species is very similar to that of *Architectonica nobilis* for which he has unpublished data and for this reason a systematic revision of the genus *Architectonica* is required.

Also Melone (1974) described and illustrated the radula of *Heliacus architae* (Pl. 51, figs. 1 and 2). The central tooth is narrow and long (32 u × 15 u) and it terminates in a single simple median cusp (17 u × 3 u) which is flanked by 13–15 smaller short (1 u) dentiform cusps; the inner and outer lateral teeth (65–70 u × 8 u) have several (6) spiniform processes; the lateral teeth tend to arch over the smaller central tooth. He similarly portrayed the radula of *Heliacus fallaciosus* (Pl. 52, figs. 1 and 2); the central tooth is 90 u long and 7 u wide, distally recurved and terminating in a single simple median cusp about 22 u long and 3 u wide which is flanked by 18–20 small spiniform cusps or denticulations (about 1 u in width); the inner and outer lateral teeth (134 u × 10 u) have 9–10 spiniform processes on the inner and only six on the outer tooth; Melone remarked that *H. fallaciosus* is obviously congeneric with *H. architae.*

Melone (1975) described and figured what he considered to be the radula of *Acutitectonica acutissima* (Pl. 54, figs. 1–3); we have reason to believe that this is a specialized structure and discuss it subsequently.

Recently Climo (1975) examined and illustrated the radula of *Architectonica reevei* (Pl. 49, figs. 7–10). He found 27 rows of teeth, each row consisting of seven laterals on each side of a central tooth, thus giving the formula 7–1–7. The central tooth was more "robust" than the laterals and tricuspid with the central cusp flanked by smaller lateral cusps. All lateral teeth were strongly curved and forked with long tapering subequal cusps; the two more medial lateral teeth are the longest. Climo was incorrect in stating that Troschel (1875: 156) did not mention the central tooth in *A. perspectiva* since Troschel explicitly remarked "Die Radula ohne Mittelplatten...". Further, Climo suggested that: "It appears likely that *Architectonica perspectiva,* like *A. reevei,* has a central tooth; it just has not been recognized yet." He related the reduction in the number of lateral teeth in *A. reevei* to its comparatively smaller adult shell size [up to 30 mm in diameter] than *A. perspectiva* [up to 70 mm in diameter]. He noted that the radula of *A. reevei* shows similarity to *Philippia* in the presence of a tricuspid central tooth; however, it does not have the two multicuspid marginal teeth on each side of the central tooth as in *Philippia.* He also said that in contrast to *A. perspectiva,* it differs in having a central tooth and in having all its lateral teeth bicuspid.

Climo (1975) also reported on the radula of *Philippia* (*Psilaxis*) *oxytropis* (Pl. 49, figs. 11–14) describing it thus:

> With formula 2-1-2. Central tooth about as long as outer marginal, curved, with a posteriorly-projecting basal buttress; tricuspid, the central cusp more robust than the two outer, and more curved causing lateral cusps to lie above it when tooth is viewed in profile; cusps much shorter than on marginal teeth. Inner marginal tooth tracing a long, sigmoid curve in profile with three long, curved cusps, the apical one longest and set a little apart from the outer two; basal portion wide with a curved locking buttress. Outer marginal shorter than inner, crown more curved and with four or five cusps, equal in width but in a decreasing length series from apex; about same length as central tooth.

Investigating the radula of 14 species, most of which were previously unknown anatomically, Merrill (1970) confirmed, in his comprehensive but unpublished dissertation on the family Architectonicidae, many previous observations and contributed much new information on the radula. We are herewith incorporating his data into this text and augmenting it by our more recent analyses.

The Indo-Pacific species, *Architectonica perspectiva,* has a radula up to 2 mm in length with the formula 14-0-14. We find that there is no central tooth in this species, confirmed both by light and scanning electron microscopy (Pl. 56, fig. 1a-e; Pl. 63, fig. 2; Pl. 64, figs. 1-3). The lateral teeth are long and prong-like, with the two marginal ones being shorter, forked and bicusped; these teeth measure 0.05 mm to 0.25 mm in length, in very close concordance with Troschel's (1861: 96) measurements. Occasionally there is an anomalous placement of sharply bicuspid lateral teeth (Pl. 64, figs. 2 and 3) placed at some distance inward from the margin of the radula; the difficulty in counting the number of teeth per row is indicated by the jumbled, entanglement of the teeth (Pl. 64, fig. 1). The related *A. nobilis,* a west Tethyean species, has 60-70 rows of teeth with only 14 teeth in a transverse row and is thought to be without a central tooth, thus giving a formula of 7-0-7 (Pl. 56, fig. 2a-c; Pl. 63, fig. 1). The prong-like centrally disposed teeth are long up to 0.2 mm in length and with a single cusp while the single outer marginal tooth is short about 0.05 mm in length, forked and bicusped. In our SEM preparation (Pl. 65, fig. 1) certain elements were present in the central field of the radula (Pl. 65, fig. 2) which might be construed as being a central tooth because they are so placed and appear to be morphologically differentiated from the elongately cusped lateral teeth; that is they have short, pointed cusps. Although we are unable to confirm the presence of these elements by conventional microscopy we cannot be certain if the radular formula of *A. nobilis* is 7-0-7 or 7-1-7. The jaws of both *A. perspectiva* and *A. nobilis* are made up of numerous pointed rods (Pl. 56, figs. 1b and 2b). SEM analysis of the jaws of *A. nobilis* confirms the pointed configuration of the jaw rods (Pl. 67, fig. 1) and shows an unusual hexagonal pattern on the base of the jaw (Pl. 67, fig. 2). The radula of *Architectonica c.f. laevigata* from the Indo-Pacific is less than 1 mm in length (Pl. 66, fig. 1) and has a short pointed central tooth and seven lateral teeth on each side; the lateral teeth are recurved, prong-like and forked with long, tapering subequal cusps (Pl. 66, figs. 2 and 3); thus, the radular formula is 7-1-7.

The genus *Philippia,* on the basis of several well-defined shell characters, has been subdivided taxonomically into *Philippia s.s.* and *Psilaxis*. The radula of *P.* (*Philippia*) *lutea,* type species of the genus, (Pl. 57, fig. 1d) of the Indo-Pacific compares closely to that of *P.* (*Philippia*)*hybrida* of the eastern Atlantic (Pl. 50, figs. 1 and 2; Pl. 65, fig. 3); it has five teeth per row with the formula 2-1-2; the radula is about 0.5 mm in length and 0.1 mm in breadth. Characteristically the central tooth which may attain a length of about 0.07 mm, has a narrow central or median cusp flanked on each side by a long filiform cusp (Pl. 65, fig. 3). The inner lateral tooth has three, the outer lateral two cusps (Pl. 57, fig. 1f). The Atlantic *P.* (*Psilaxis*) *krebsii*, type species of the subgenus, has a radular formula of 2-1-2 with five teeth per row and about 32 rows (Pl. 57, fig. 2a-d). The central tooth, which may attain 0.07 mm in length, has a strong, somewhat knobby central cusp bordered by a slender pointed cusp on each side. The inner lateral tooth has five sharp spiniform cusps while the outer lateral has three cusps. The jaws of *P. lutea* and *P. krebsii* are similar in consisting of rounded, pointed rod-shaped elements (Pl. 57, figs. 1a and 2a). Robertson (1970) noted a subgeneric difference in the shape of the jaw elements, those of *Psilaxis* being elongate and those of *Philippia s.s.* being subcircular. Our observations and illustrations (Pl. 57, figs. 1a and 2a) do not indicate the differences described which seemed clear to Robertson. Our

SEM observation of the jaws of *P. hybrida* confirms the pointedness of the rods and also shows them to have a medial longitudinal furrow (Pl. 68, fig. 1); the basal portion of the jaw exhibits a pattern of papillose knobs (Pl. 68, fig. 2).

Acutitectonica disca has a radula up to 0.75 mm in length with five teeth per row, giving the formula 2–1–2; the central tooth, up to 0.10 mm in length, is long, slender with a simple knobby, somewhat bulbous distal portion (Pl. 58, fig. 1c and d); the inner and outer lateral teeth have up to eight cusps (Pl. 58, fig. 1c–e). The rod-like jaw elements are blunt (Pl. 58, fig. 1b).

Additionally in the esophagus of *A. disca* there is a long, slender and rod-like cuticularized structure about 0.10 mm in diameter along which at regular intervals of about 0.10 mm are found pairs of three spined or pronged recurved appendages, two on each side of the rod or four to the row (Pl. 58, fig. 3; Pl. 55, figs. 1–4). Habe (1952) illustrated similar small recurved hooked portions mistaking them for the radula of *A. acutissima* (Pl. 58, fig. 2). Melone (1975) examined a specimen of *A. acutissima* and also misconstrued this rod-like structure as a radula. Illustrated with fine SEMs (Pl. 54, figs. 1–3) he showed the structure to be between 7–10 mm in length and about 0.20 mm in width with pairs of three pronged recurved elements disposed at about 0.15 mm intervals. He considered each row of these elements as consisting of a pair of lateral and marginal teeth separated by a minute central dental element and, thus, gave a formula of 1–1–R–1–1. The lateral and marginal elements have essentially the same morphology and are indeed reminiscent of lateral teeth, consisting of a subtriangular, anteriorly recurved and posteriorly projecting arcuate lamella with three very long posteriorly pointed cusps. The median element or "central tooth" consists merely of a tiny uncinus. Since we found both a similar structure (Pl. 55, figs. 1–4; Pl. 58, fig. 3) and the true radula (Pl. 58, fig. 1) in the esophagus of *A. disca,* it must be considered as an independently derived and accessory feature in the alimentary canal of *Acutitectonica;* its function remains unknown but presumably it is associated with feeding.

We consider below five species of *Heliacus* and one each of *Pseudomalaxis* and *Spirolaxis*. Although each species has slight differences in detail, the basic radular configuration is a modified taenioglossate pattern with five teeth per row, the formula being 2-1-2; the central tooth has a median cusp or knob flanked on each side by numerous short spines or fine denticulations; the lateral teeth are strong with two to eight more or less spiniform cusps. Details of each species are given in the following descriptions.

In *Heliacus cylindricus* the central tooth is broad, about 0.08 mm long, and has a narrow median knob or cusp flanked by numerous lateral spiniform cusps (13–14) extending on the outer edge of the fold on either side; the lateral teeth have about five spines and are up to 0.13 mm in length (Pl. 59, fig. 1). These observations of *H. cylindricus* compare favorably in most respects with those of Troschel (1875) on the same species (contrast Pl. 48, figs. 1 and 2 with Pl. 59, fig. 1), namely in the length and shape of the central tooth as well as in the number of small lateral cusps on either side of the central knobby cusps. The radula of *H. perrieri* (Pl. 59, fig. 2) is quite similar reaching a length about 1.00 mm with a narrow central tooth about 0.03 mm in width with its median cusp flanked by nine to ten deeply cleft cusps; the lateral teeth about 0.12 mm in length have up to seven finger-like cusps. The jaw elements of *H. cylindricus* and *H. perrieri* are regularly or irregularly pointed though larger and more craggy in the latter (Pl. 59, figs. 1a and 2a).

The radula of the *Heliacus jeffreysianus* (Pl. 60, fig. 1) has a narrow, somewhat cowled central tooth, about 0.03 mm in length and 0.006 mm in width, having a rather triangular spiniform median cusp bordered by numerous (10–12) serrations; the narrow lateral teeth, about 0.03 mm in length and 0.005 mm in width, have up to eight sharply pointed finger-like cusps. In *Heliacus borealis* (Pl. 60, fig. 2) the radular ribbon which is about 0.4 mm in length, has nine rows of regularly spaced teeth; the central tooth, about 0.12 mm in length and 0.02 mm in width, bears a median triangular spine or cusp which is bordered on each side by about 12 narrow spines which are longer nearer the central cusp and become shorter distally; the long narrow (about 0.11 mm by 0.01 mm) inner and outer teeth have several spiniform cusps. The jaw rods are somewhat irregular in shape and distally pointed (Pl. 60, fig. 2a).

The shells of *Heliacus bisulcatus* and *H. architae* were each under 5 mm in greatest diameter making it difficult to manipulate the tiny radulae into suitable positions to see salient features clearly if at all. The radula of *H. bisulcatus* (Pl. 61, fig. 1) is narrow, about 0.01 mm in width and has a cowled central tooth with a short, knobby median cusp flanked by 6–8 short rather blunt or knobby denticulations on its inner fold or cutting edge; the lateral teeth, up to 0.09 mm in length, have 6–8 finger-like cusps while in the related *H. architae* (Pl. 61, fig 2) the central tooth is somewhat broad in comparison to its length, only 0.01 mm in width, with a subtriangular median cusp flanked by about eight blunt cusps; the lateral teeth, up to 0.05 mm in length, bear two or three curved spine-like cusps. The rod-like jaw elements are pointed (Pl. 61, fig. 1b). With the greater resolution of the scanning electron microscope, Melone (1974) had very similar length measurements for the central and lateral teeth of *H. architae* (Pl. 51); the width of the central tooth is 15 u versus ours of 0.01 mm and the width of the lateral teeth is betwen 65–70 u against ours of 0.05 mm; he could more clearly discern the numbers of lateral cusps on each side of the central cusp of the central tooth (13–15) instead of our eight and for the lateral teeth (six) instead of our two to three.

In *Pseudomalaxis nobilis,* the radula (Pl. 62, fig. 1) has a basally broad, about 0.023 mm, central tooth narrowing to a beak, about 0.013 mm, as a distal cusp bearing projection; its median or central cusp, is bordered laterally with numerous (up to 20) sharply pointed serrations; the lateral teeth, which are about 0.08 mm in length and 0.008 mm in width, are rather strongly curved distally and bear four finger-like pointed cusps.

In *Spirolaxis centrifuga* (Pl. 62, fig. 2) the radula has a central tooth which is broad and rectangular, about 0.013 mm in width and 0.02 mm in length, with a median cusp flanked by four denticulate lateral cusps; the lateral teeth are narrow, about 0.07 mm by 0.002 mm, and each have two spiniform, finger-like cusps. A unique feature of this species is the configuration of the jaws which consist of numerous, elongate, multi-cusped strap-like plates (Pl. 62, fig. 2a).

Conclusions

From the preceding review of the literature plus our added work on the radula of the Architectonicidae, we postulate that the family is divisible, by its radular configuration into three principal groups, herein ranked as subfamilies (Architectonicinae, Philippiinae, Heliacinae) and thus confirming, with slight modifications, the earlier opinions of Thiele (1925), Merrill (1970), and Boss (1982).

The Architectonicinae are known by the structure of the radula of four species, *Architectonica perspectiva, A. nobilis, A. reevei,* and *A. c.f. laevigata,* having respectively the radular formulae, 14-0-14, 7-0-7 (or 7-1-7), 7-1-7, and 7-1-7; they are thus characterized by having numerous lateral teeth. Climo's (1975) description of the radula of *A. reevei* is important in at least two respects; its configuration links the purely ptenoglossate condition with the modified taenioglossate one found in both the Philippiinae and Heliacinae, and its central tooth has a shape like the Philippiinae, providing another transition between the Architectonicinae and Philippiinae. Further, both *Architectonica reevei* and *A. c.f. laevigata* (compare Pl. 49, figs. 9 and 10 and Pl. 66, figs. 2 and 3) have seven similarly forked bicuspid lateral teeth on either side of the central tooth, giving both the same radular formula; however, the central tooth of *A. c.f. laevigata* is comparable to that of the philippiine *Acutitectonica* (see Pl. 66, figs. 2 and 3 and Pl. 53, figs. 1 and 2) while the central tooth of *A. reevei* is like that of the philippiine *Psilaxis* (see Pl. 49, figs. 7 and 8 and Pl. 57, fig. 2d). Conchologically the species differ somewhat with *A. reevei* having a shell more similar to that of the Philippiinae and *A. c.f. laevigata* having a shell more closely resembling the Architectonicinae. Melone's (1974) undocumented assertion that *A. nobilis* has a radula very much like *Acutitectonica* which has only five teeth per row is unwarranted since *A. nobilis* clearly has numerous lateral teeth.

For the Philippiinae, the radula has five teeth per row, giving the formula 2–1–2 with the central tooth being a long narrow structure. Climo (1975) pointed out Roberston's (1970) errors in interpreting the radula of *Philippia* and substantiated the presence of a central tooth as noted by Thiele (1925) and Melone (1974). Although Robertson (1970) did not believe that the subgenera of *Philippia* could be distinguished by their radulae; such is not the case since *Philippia s.s.* has a central tooth with a narrow central cusp flanked by long filiform lateral cusps while *Psilaxis* has a central tooth with a knobby central cusp flanked by short cusps. *Acutitectonica* is also distinguished by its radular features, namely the central tooth is a simple naked knob, that is to say, a single cusped structure without lateral cusps. This radular character along with its conchological features serves to separate it at the generic level. The unique cuticularized esophageal structure in *Acutitectonica* further separates it from *Philippia.*

One unresolved problem concerns Thiel's (1927; 1928) illustration of the central tooth of what he called *Philippia hybrida* which Roberston (1970) referred to as *P. radiata.* This is the presence of the two bristle-like cusps on either side of the blunt, knobby central cusp (Pl. 48, figs. 8 and 9). Although Robertson (1970) stated that his lateral tooth of *P. radiata* (Pl. 49, figs. 5 and 6) resembled Thiele's figure of a central tooth, he did not mention that Thiele's figure had two pairs of bristle-like cusps while his only had one pair. His figure of the central tooth of *P. radiata* appears just like the other radularly known species of the subgenus *Psilaxis, e.g. P. oxytropis* and *P. krebsii,* which have only one cusp on each side of the knobby central cusp of the central tooth.

It might be added that the jaws of the Architectonicinae and the Philippiinae may differ in that *A. nobilis* has a hexagonal pattern discernible on the base of the jaw while in *P. hybrida* there are numerous papillose knobs.

Little controversy surrounds the characterization of the radula of the Heliacinae as exemplified by the type species of *Heliacus, H. cylindricus,* with its formula of 2–1–2. The central tooth, which shows a considerable range of variability in shape in the subfamily, is reminiscent of many taenioglossate mesogastropods, in having a median or central cusp or knob flanked by numerous, fine lateral denticulations; the lateral teeth are multicusped with the inner lateral tooth larger and usually with more cusps. Although *Pseudomalaxis* and *Spirolaxis* have been treated previously in their own subfamily, the Pseudomalaxinae (Garrard, 1978), we note that neither the radular structures or conchological features are sufficient to distinguish them from the Heliacinae. We recognize *Spirolaxis* at the generic level because of its unique synapomorphy, the strap-like jaws. Of genera we consider referable to the Heliacinae, only the radula of *Awarua,* which we construe as conchologically intermediate between *Pseudomalaxis* and *Heliacus* remains unknown.

Abbreviations

ANSP—Academy of Natural Sciences, Philadelphia, Pa.
BCF—Bureau of Commercial Fisheries, Pascagoula, La.
MCZ—Museum of Comparative Zoology, Harvard University, Cambridge, Ma.
USNM—National Museum of Natural History, Washington, D.C.
UZM—Universitetets Zoologiske Museum, København

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PLATES 47—68

Plate 47

Figs. 1–6 and 11–13. *Architectonica perspectiva*. Figs. 7–10. *Philippia hybrida*.

Fig. 1. Portion of radular ribbon to show forked lateral teeth in more marginal position (after Troschel 1861, fig. 4).

Fig. 2. Lateral teeth viewed to show cusps or tines (after Troschel 1861, fig. 7).

Fig. 3. Lateral teeth viewed so cusps or tines not easily discerned (after Troschel, 1861, fig. 8).

Fig. 4. Marginally positioned lateral tooth (after Troschel 1861, fig. 6).

Fig. 5. Most medially positioned lateral tooth without cusps (after Troschel 1861, fig. 4).

Fig. 6. The jaw with its pointed rod-shaped elements (after Troschel 1861, fig. 3; 1875, fig. 4a).

Fig. 7. Lateral teeth with two and three pronged cusps (after Troschel 1861, fig. 12; 1875, fig. 5e).

Fig. 8. Lateral teeth along length of row with tiny cusp on shaft (after Troschel 1861, fig. 5).

Fig. 9. Centrally located dental element (not representative) (after Troschel 1861, fig. 11; 1875, fig. 5b).

Fig. 10. The jaw with its roundly pointed, rod-shaped elements (after Troschel 1861, fig. 10; 1875, fig. 5a).

Fig. 11a–d. Individual lateral teeth of the radula (after Troschel 1875, Pl. 15, figs. 4c, d, e, and f) showing *a*, a more centrally disposed tooth larger in size and with a minute cusp on the shank and *b, c,* and *d* progressively more marginally positioned lateral teeth showing proportionate increase in distinctness of the two prong-like cusps.

Fig. 12. A complete half row of the radula (after Troschel 1875, Pl. 15, fig. 4b), the long uncusped lateral teeth being medial in position.

Fig. 13. Individual radular tooth (after Thiele 1926, fig. 52).

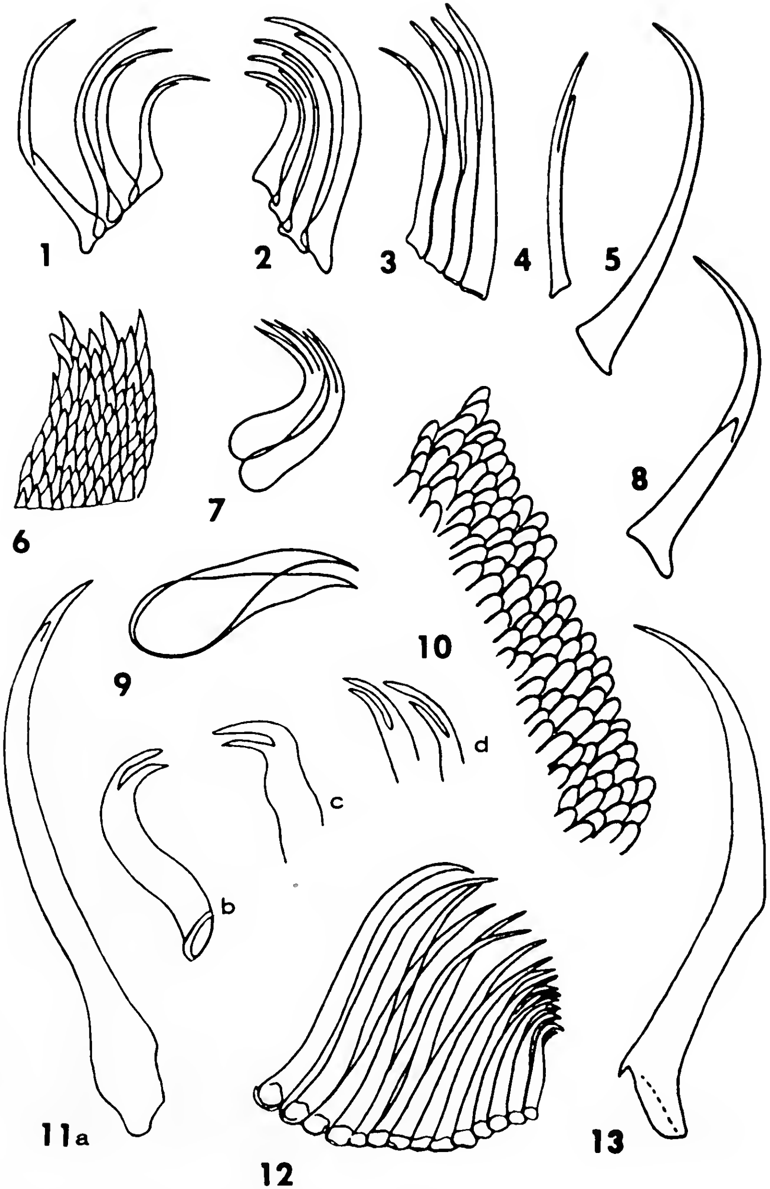


Plate 47

Plate 48

Fig. 1. The central tooth of *Torinia* [=*Heliacus*] *cylindracea* with central or medial knobby cusp and numerous fine lateral denticulations (after Troschel 1875, fig. 7a).

Fig. 2. The two lateral teeth of *Torinia* [=*Heliacus*] *cylindracea* with seven cusps on the inner lateral and eight on the outer lateral (after Troschel 1875, fig. 7b and c).

Fig. 3. Lateral view of the central tooth of *Torinia* [=*Heliacus*] *trochoidea* (after Thiele 1925, Pl. 46 [34], fig. 16).

Fig. 4. Frontal view of the central tooth of *Philippia* (after Thiele 1925, Pl. 46 [34], fig. 18 *pars*).

Fig. 5. Lateral view of the lateral tooth of *Philippia* (after Thiele 1925, Pl. 46 [34], fig. 18 *pars*).

Fig. 6. Jaw rods of *Torinia* [=*Heliacus*] *trochoidea* (after Thiele 1925, Pl. 46 [34], fig. 17).

Fig. 7. Jaw rods of *Philippia* (after Thiele 1925, Pl. 46 [34], fig. 19).

Fig. 8. Lateral view of the central tooth of *Philippia hybrida* (after Thiele 1928, fig. 8).

Fig. 9. Frontal view of the central tooth of *Philippia hybrida* (after Thiele 1928, fig. 8).

Fig. 10. Inner lateral tooth of *Philippia hybrida* (after Thiele 1928, fig. 8).

Fig. 11. Outer lateral tooth of *Philippia hybrida* (after Thiele 1928, fig. 8).

Fig. 12. Two lateral teeth of *Architectonica* (after Thiele 1928, fig. 9).

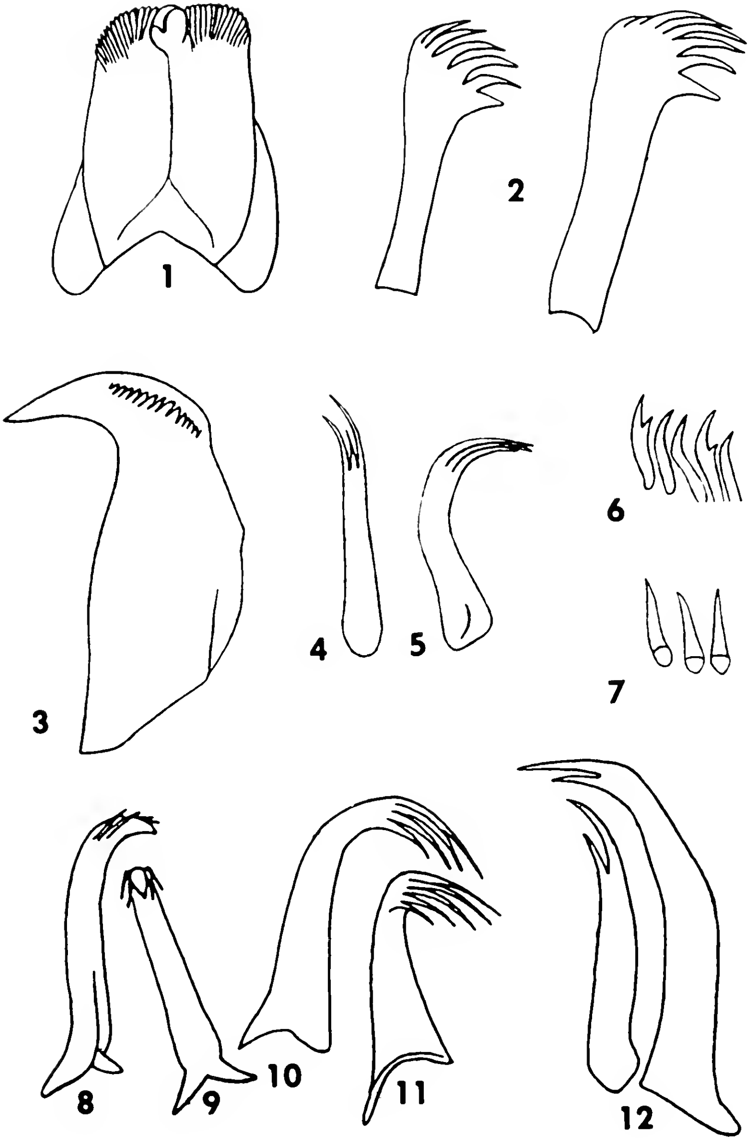


Plate 48

Plate 49

Fig. 1. The outer lateral tooth of *Heliacus dorsuosus* (after Habe 1943, fig. 5 *pars*).

Fig. 2. The inner lateral tooth of *Heliacus dorsuosus* (after Habe 1943, fig. 5 *pars*).

Fig. 3. The central tooth of *Heliacus dorsuosus* (after Habe 1943, fig. 5 *pars*).

Fig. 4. A lateral tooth, in side view of *Philippia radiata* (after Robertson 1970, fig. 9C).

Fig. 5. Central tooth, in frontal view of *Philippia radiata* (after Robertson 1970, fig. 9D).

Fig. 6. Central tooth, in lateral view of *Philippia radiata* (after Robertson 1970, fig. 9B).

Fig. 7-10. Radula of *Architectonica reevei* (after Climo 1975, fig. 4B). Fig. 7. Front view of central tooth. Fig. 8. Lateral view of central tooth. Fig. 9. Lateral view of inner lateral tooth. Fig. 10. Lateral view of outer lateral tooth.

Figs. 11-14. Radula fo *Philippia oxytropis* (after Climo 1975, fig. 4A). Fig. 11. Outer lateral tooth. Fig. 12. Inner lateral tooth. Fig. 13. Frontal view of central tooth. Fig. 14. Lateral view of central tooth.

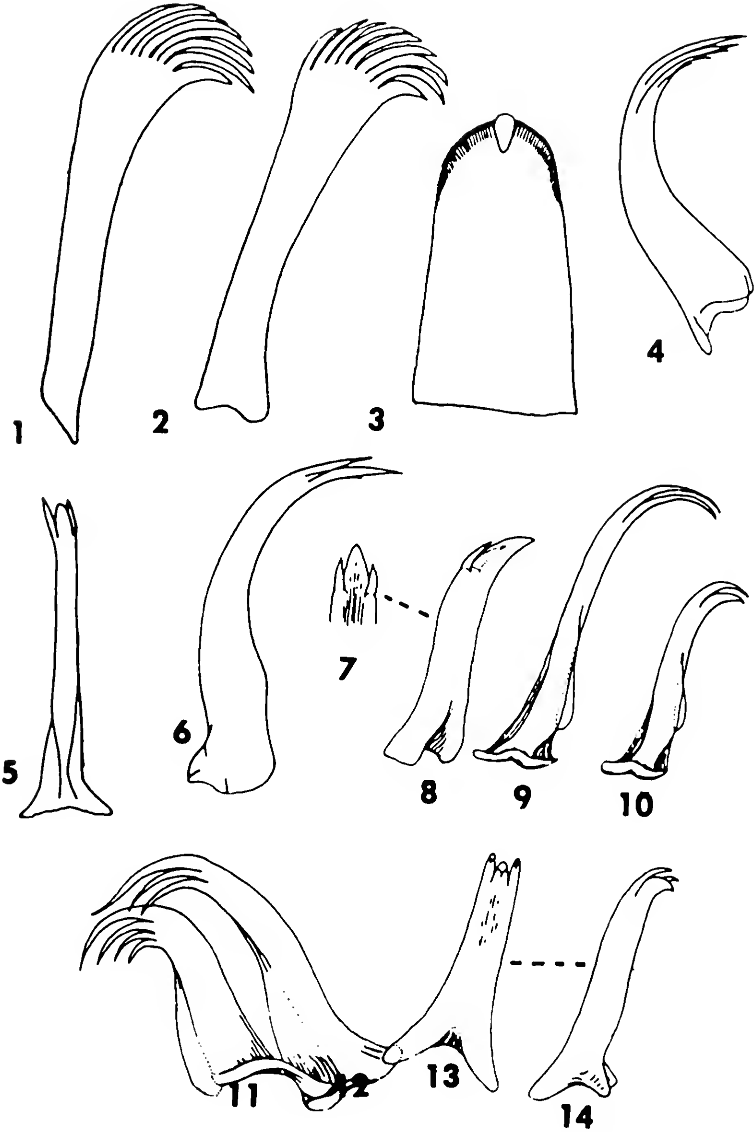


Plate 49

Plate 50. Portion of the radula of *Philippia hybrida*. a = outer lateral tooth. b = inner lateral tooth. c = central tooth. (Courtesy of G. Melone).

Fig. 1. 1000 ×

Fig. 2. 2000 ×

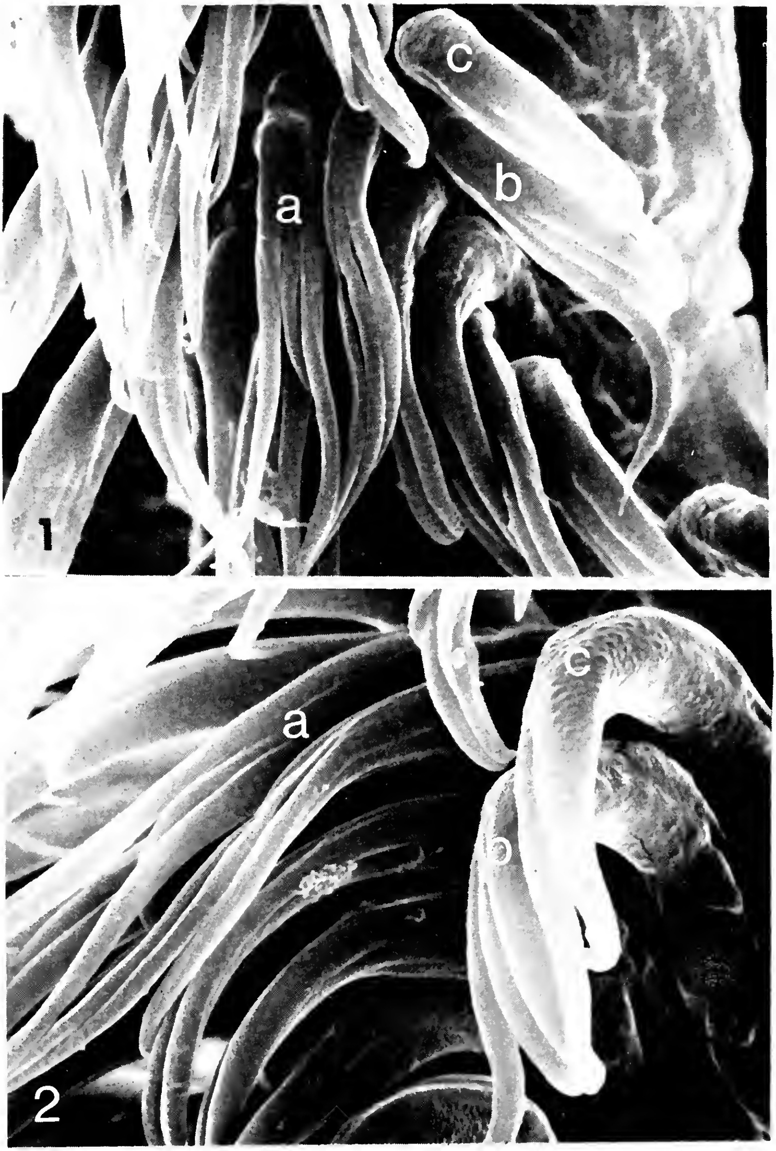


Plate 50

Plate 51. Portion of the radula of *Heliacus architae*. a = outer lateral tooth. b = inner lateral tooth. c = central tooth. (Courtesy of G. Melone).

Fig. 1. 2000 ×

Fig. 2. 5000 ×

Plate 51

Plate 52. Portion of the radula of *Heliacus fallaciosus*. a = outer lateral tooth. b = inner lateral tooth. c = central tooth. (Courtesy of G. Melone).

Fig. 1. 1000 ×

Fig. 2. 2000 ×

Plate 52

Plate 53. Portion of the radula of *Acutitectonica lepida* a = outer lateral tooth. b = inner lateral tooth. c = central tooth. (Courtesy of G. Melone).
Fig. 1. 500 ×
Fig. 2. 1000 ×

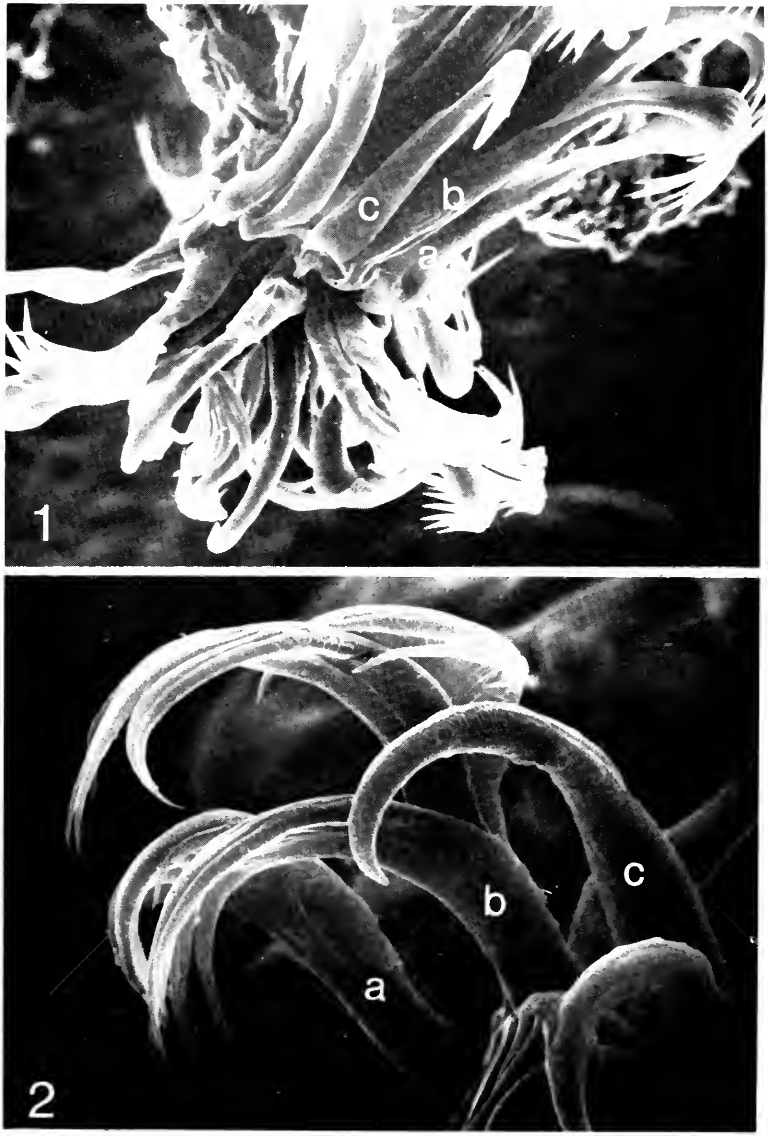


Plate 53

Plate 54. The accessory cuticularized rod-like structure from the esophagus of *Acutitectonica acutissima* (after Melone 1975).

Fig. 1. The structure aligned to show rows of double pairs of recurved elements (200 ×).

Fig. 2. The same enlarged to show recurved elements in greater detail (1000 ×). L = Lateral element. M = Medial element.

Fig. 3. The same viewed from a different angle (1000 ×). L = Lateral element. M = Medial element.

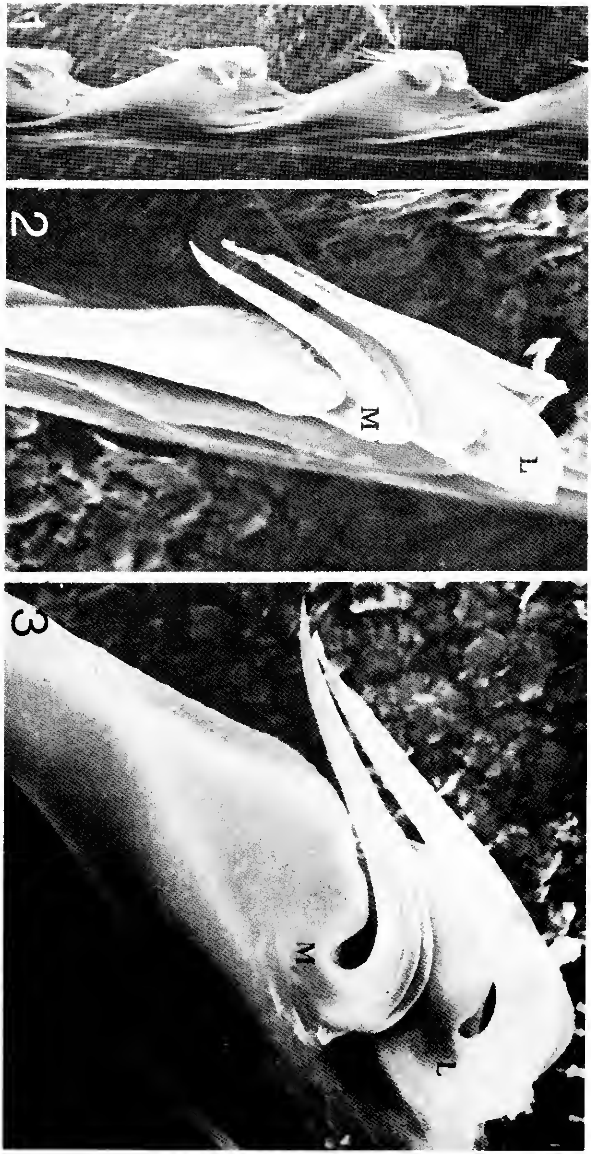


Plate 54

Plate 55

Fig. 1 The accessory cuticularized rod-like structure from the esophagus of *Acutitectonica disca* from El Colorado, Sonora, West Mexico in 80 fathoms. (40 ×). (about 4 mm in length).

Fig. 2. The same enlarged to show rows of double pairs of recurved elements (200 ×).

Fig. 3. The same enlarged to show recurved elements in greater detail (1500 ×).

Fig. 4. The same viewed from a different angle (1500 ×).

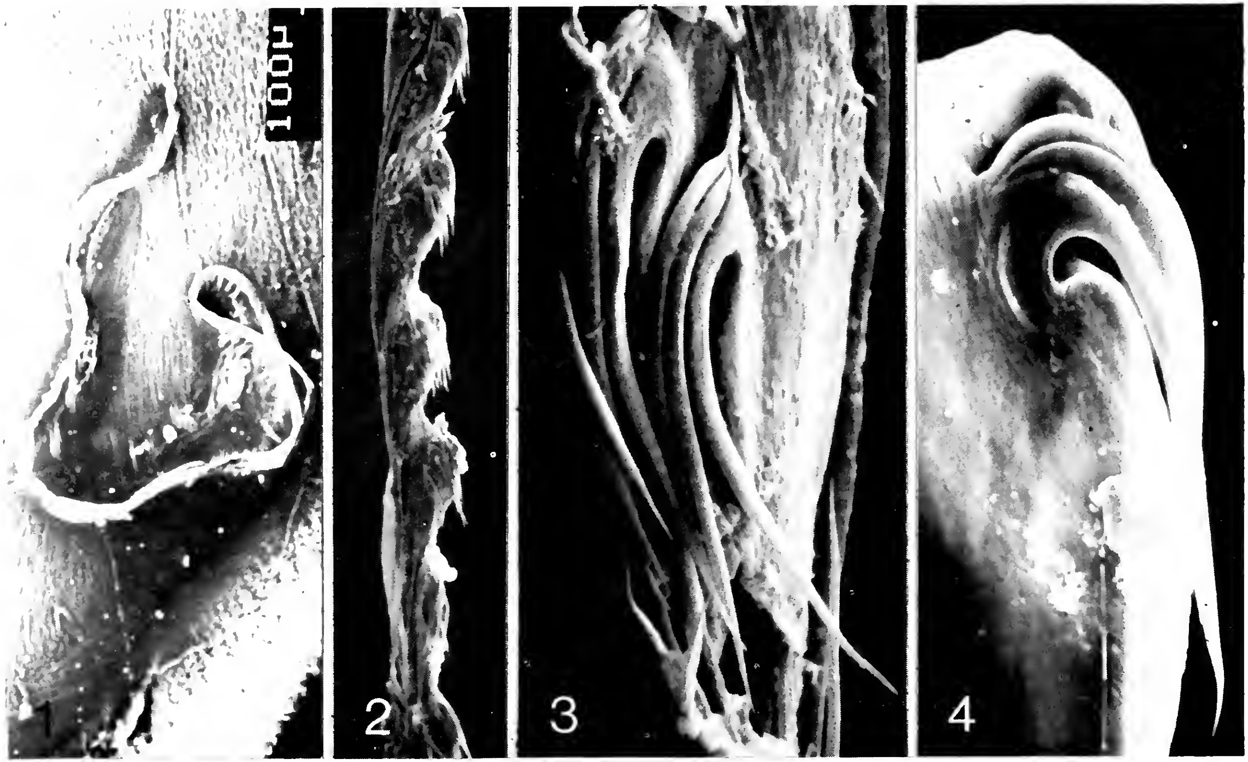


Plate 55

Plate 56

Fig. 1. *Architectonica perspectiva.* Kiwengwa, NE Zanzibar (ANSP); maximum diameter 47.0 mm. a. Portion of cuticularized esophageal tube showing position of radula and jaws within. b. Elements from portion of the jaw. c. Part of a single row of ptenoglossate radular teeth. d. Smallest lateral tooth observed. e. Largest tooth observed near the central part of a row of teeth.

Fig. 2. *Architectonica nobilis.* NE of Cape Kennedy, Florida (USNM); maximum diameter 48.5 mm. a. Portion of cuticularized esophageal tube and the entire buccal cavity showing position of radula and jaws within. b. Elements from portion of the jaw. c. Part of a single row of ptenoglossate radular teeth (figs. 2b, c, same scale).

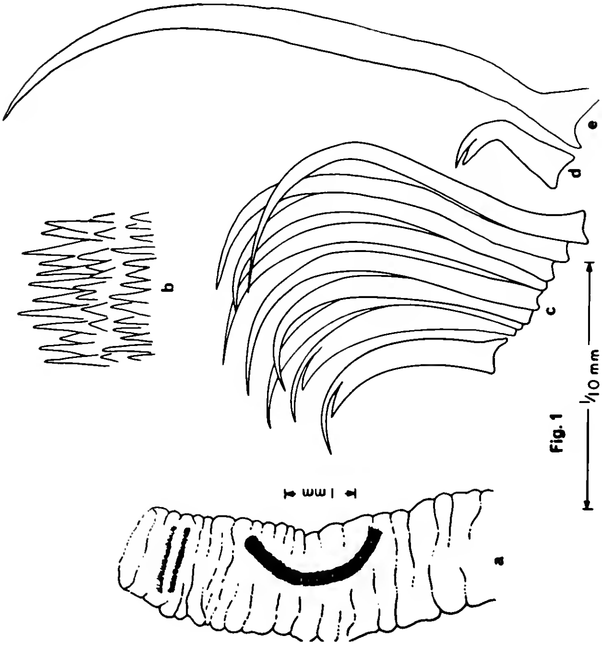


Fig. 1

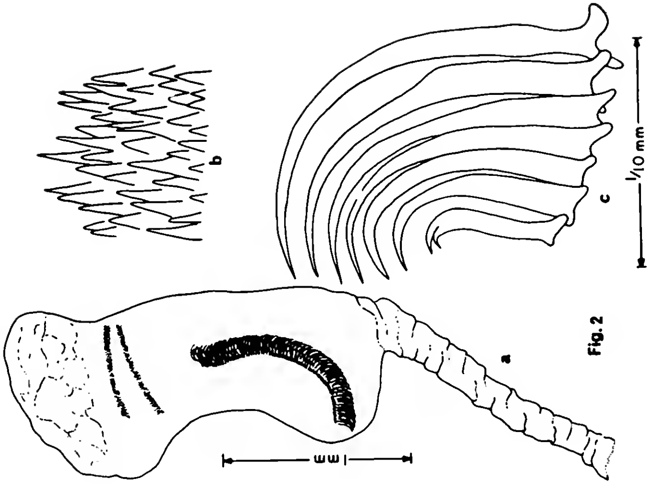


Fig. 2

Plate 56

Plate 57

Fig. 1. *Philippia (Philippia) lutea.* Cape of Good Hope, Africa (USNM); maximum diameter 9.5. mm. a. Elements from portion of the jaw viewed obliquely from under the jaw. b. Entire radula and jaws within portion of cuticularized esophageal tube. c. Outline of the shape of a single row of teeth as viewed from the underside of the radular ribbon. d. Central (left) and two lateral radular teeth. e. Front and oblique views of central radular tooth. f. Side views of lateral teeth.

Fig. 2. *Philippia (Psilaxis) krebsii.* Castle harbor, Bermuda (MCZ); maximum diameter 5.5 mm. a. Elements from portion of the jaw. b. Front view of central radular tooth (left) and side view of two lateral teeth. c. Side view of central radular tooth (left) and two laterals. d. Front view of a complete central radular tooth.

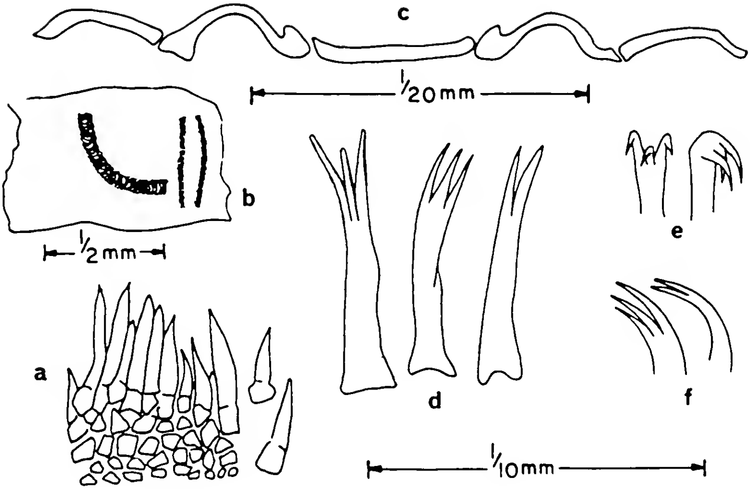


Fig. 1

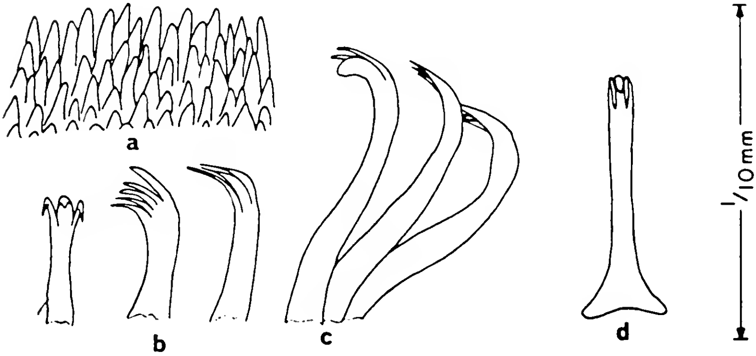


Fig. 2

Plate 57

Plate 58

Fig 1. *Acutitectonica disca.* W of Conakry, Guinea (UZM); maximum diameter 14.0 mm. a. Entire cuticularized buccal cavity including a portion of esophageal tube showing position of radula within the esophageal tube. b. Portion of jaw elements. c. Side views of central (left) and two lateral radular teeth. d. Side views of entire central radular tooth (left) and lateral tooth. e. Side views of lateral teeth to show varying number of cusps (figs. 1b, c, d, e, same scale).

Fig. 2. "Radula" of *Acutitectonica acutissima* (redrawn from Habe, 1952).

Fig. 3. Portion of peculiar cuticularized rod-like structure removed from the esophageal tube of *A. disca* with rows of recurved elements, two on each side of the rod or four to a row.

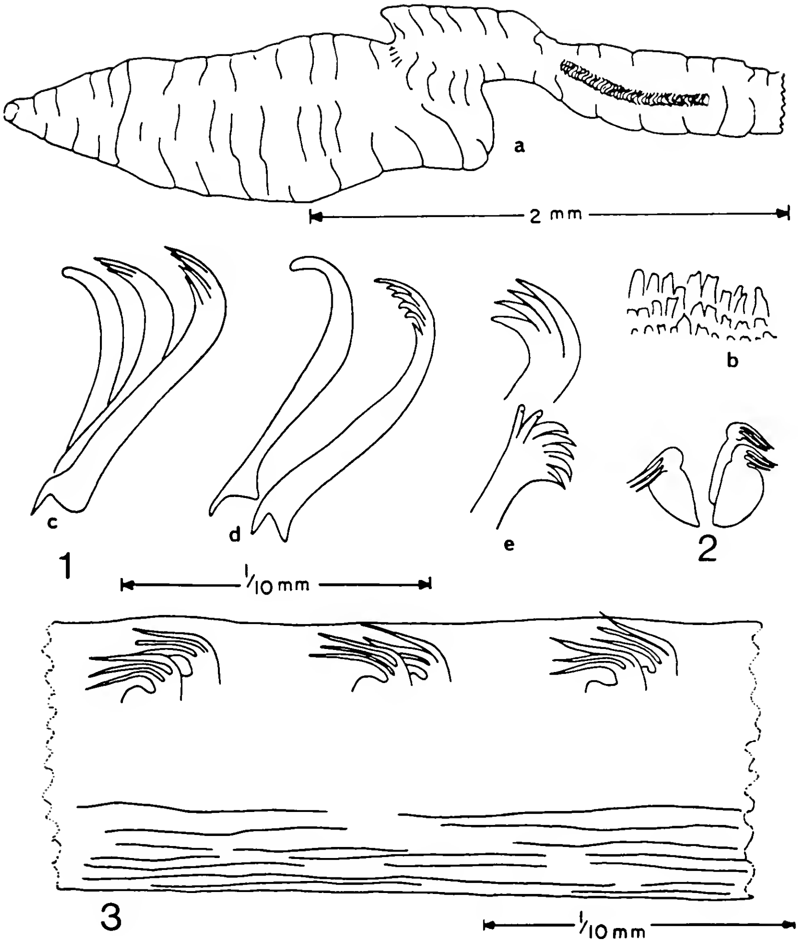


Plate 58

Plate 59

Fig. 1. *Heliacus* (*Heliacus*) *cylindricus*. Buccoo Reef and Bay, Tobago (ANSP); maximum diameter 10.6 mm. a. Portion of jaw elements. b. Front view of central radular tooth (left) and side view of two lateral teeth. c. Oblique view of central radular tooth.

Fig. 2. *Heliacus* (*Heliacus*) *perrieri*. Ragged Keys, Florida (MCZ); maximum diameter 16.1 mm. a. Portion of jaw elements. b. Position of jaws and radula in cuticularized esophageal tube. c. Front view of central radular tooth (right) and side view of two lateral teeth (note: cusps on either side of central knob are pressed out from the normal overlapping position—caused by pressure of cover slide). d. Side view of two lateral teeth. e. Front (left) and side views of two lateral teeth (cusps in lateral tooth, front view, pressed out similar to central tooth in fig. 2c).

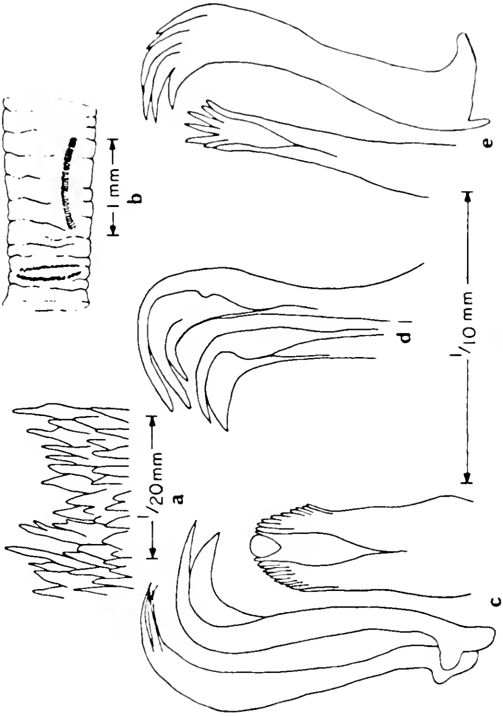


Fig. 2

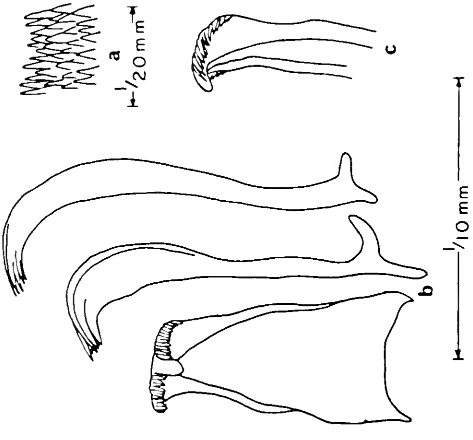


Fig. 1

Plate 59

Plate 60

Fig. 1. *Heliacus* (*Gyriscus*) *jeffreysianus*. Sardinia, Italy (USNM); maximum diameter 8.7 mm. a. Front view of central radula tooth (left) and oblique view of two lateral teeth. b. Front (top) and side views of central radular tooth (note: cusps in lower central tooth pressed out by pressure of cover slide). c. Front (left) and side views of lateral teeth.

Fig. 2. *Heliacus* (*Solatisonax*) *borealis*. N of Iraconbo, French Guiana (BCF); maximum diameter 13.5 mm. a. Portion of jaw elements. b. Side view of complete radular (note regular spacing of the individual rows on the odontophore). c. Front view of portion of central radular tooth (left) and side view of portion of lateral tooth. d. Side view of central radular tooth (left) and two lateral teeth.

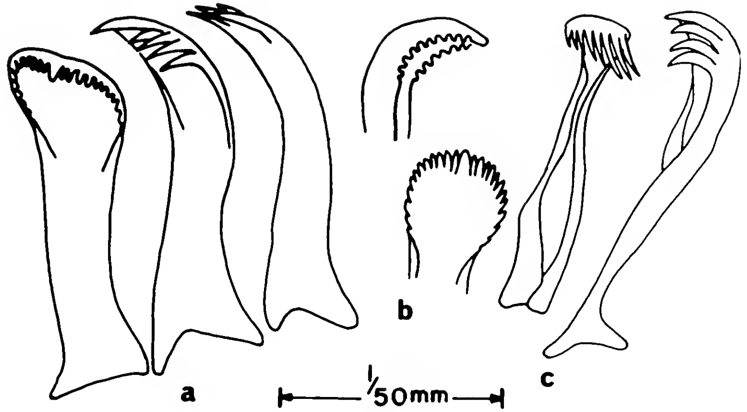


Fig.1

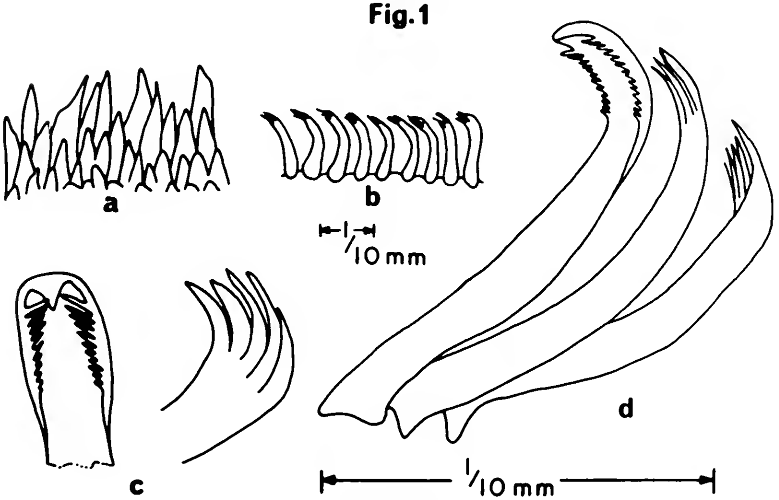


Fig.2

Plate 60

Plate 61

Fig. 1. *Heliacus* (*Pseudotorinia*) *bisulcatus.* Off Government Cut, Miami, Florida (USNM); maximum diameter 4.8 mm. a. Oblique front view of central (left) and two lateral radular teeth. b. Portion of jaw elements. c. Front view of central radular tooth (left), side (right top) and front view of lateral teeth.

Fig. 2. *Heliacus* (*Pseudotorinia*) *architae.* Gulf of Naples, Italy (USNM); maximum diameter 3.8 mm. a. Front view of central radular tooth. b. Oblique view (left) and side view of lateral teeth. c. Side view of central radular tooth.

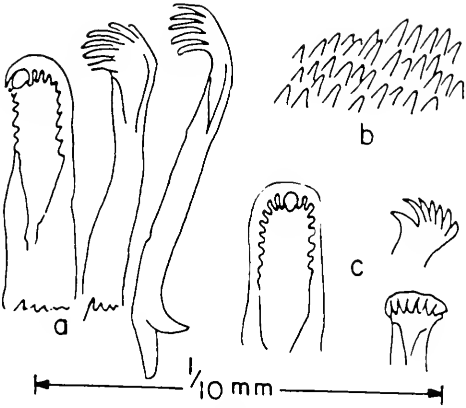


Fig. 1

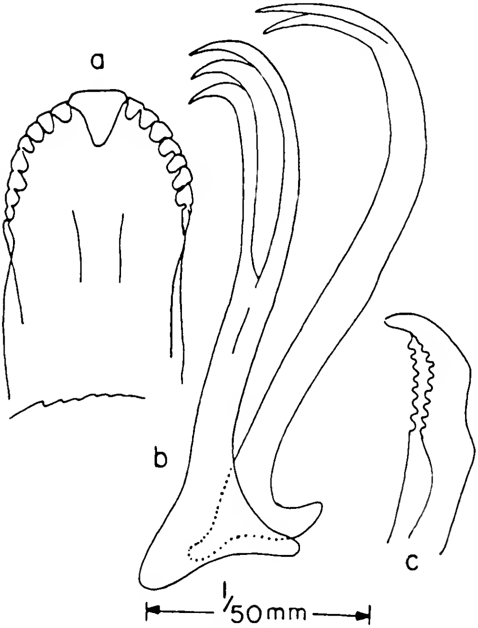


Fig. 2

Plate 61

Plate 62

Fig. 1. *Pseudomalaxis nobilis.* SE of Egmont Key, Florida (USNM): maximum diameter 11.2 mm. a. Side view of central radula tooth (left) and two lateral teeth. b. Front (bottom) and side (top) views of central radular tooth. c. Side view of lateral teeth.

Fig. 2. *Spirolaxis centrifuga.* Madeira (USNM); maximum diameter 3.2 mm. a. Portion of jaw elements. b. Front view of central and two lateral radular teeth. c. Side view of two lateral teeth.

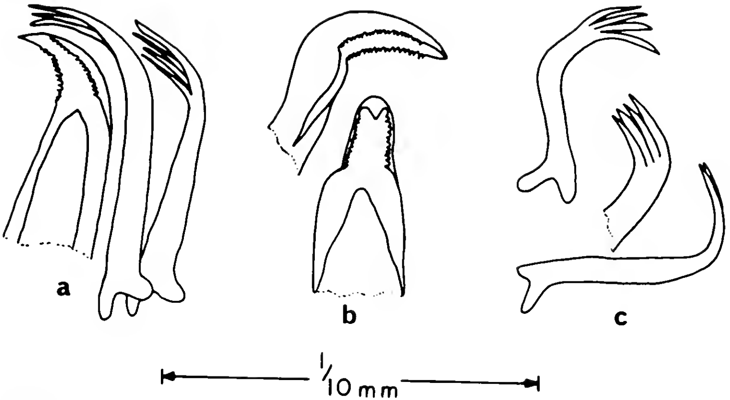


Fig. 1

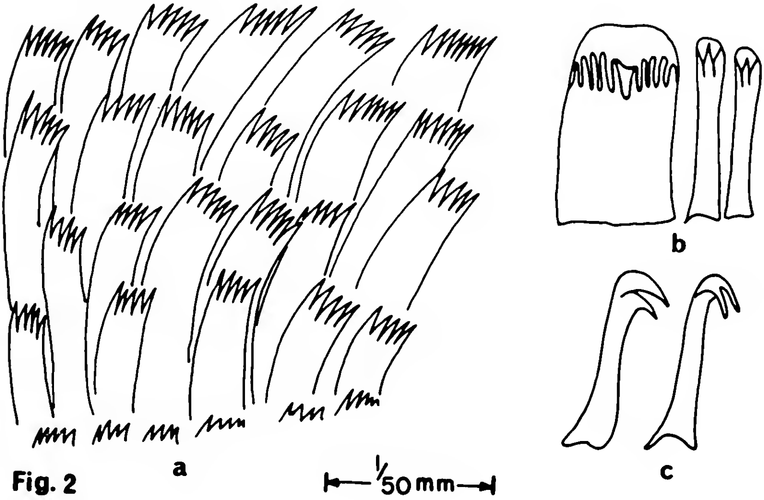


Fig. 2

Plate 62

Plate 63

Fig. 1. Portion of the radula of *Architectonica nobilis* from Brazil showing some rows of teeth with the more marginal lateral teeth being bicuspid, the more medial lateral teeth single pronged and the absence of a discernable central tooth (650 ×).

Fig. 2. Portion of a row of radular teeth of *Architectonica perspectiva* from between Du Rowa and Kai Dulah Is., Kai Islands, Moluccas, Indonesia (USNM 747000) showing bicuspid marginal lateral teeth at far right (660 ×).

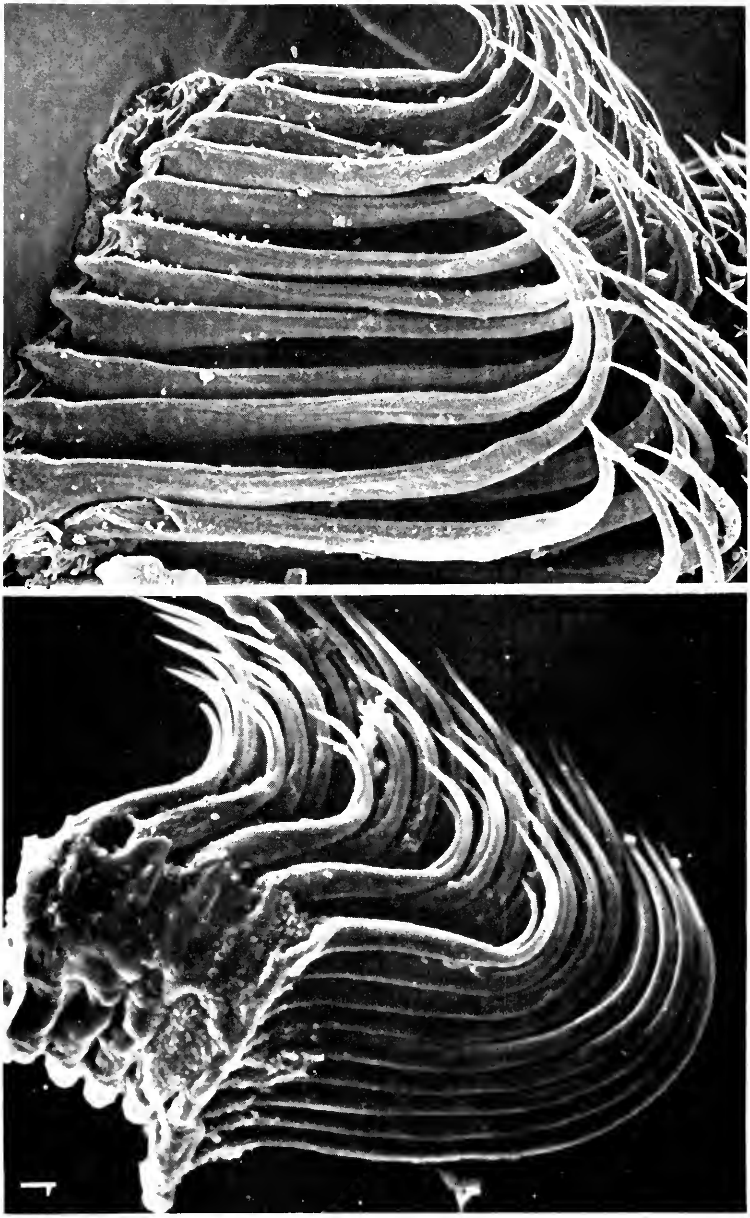


Plate 63

Plate 64. The radular of *Architectonica perspectivum* from between Du Rowa and Kai Dulah Is., Kai Islands, Moluccas, Indonesia (USNM 747000).

Fig. 1. Portion of radula showing entanglement of individual teeth (230 ×). Circle indicates area of enlargement in fig. 3.

Fig. 2. Enlargement of central field showing absence of anything distinguishable as a central tooth (800 ×).

Fig. 3. Enlargement of circled area of fig.1 to show bicuspid teeth (a) (1700 ×).

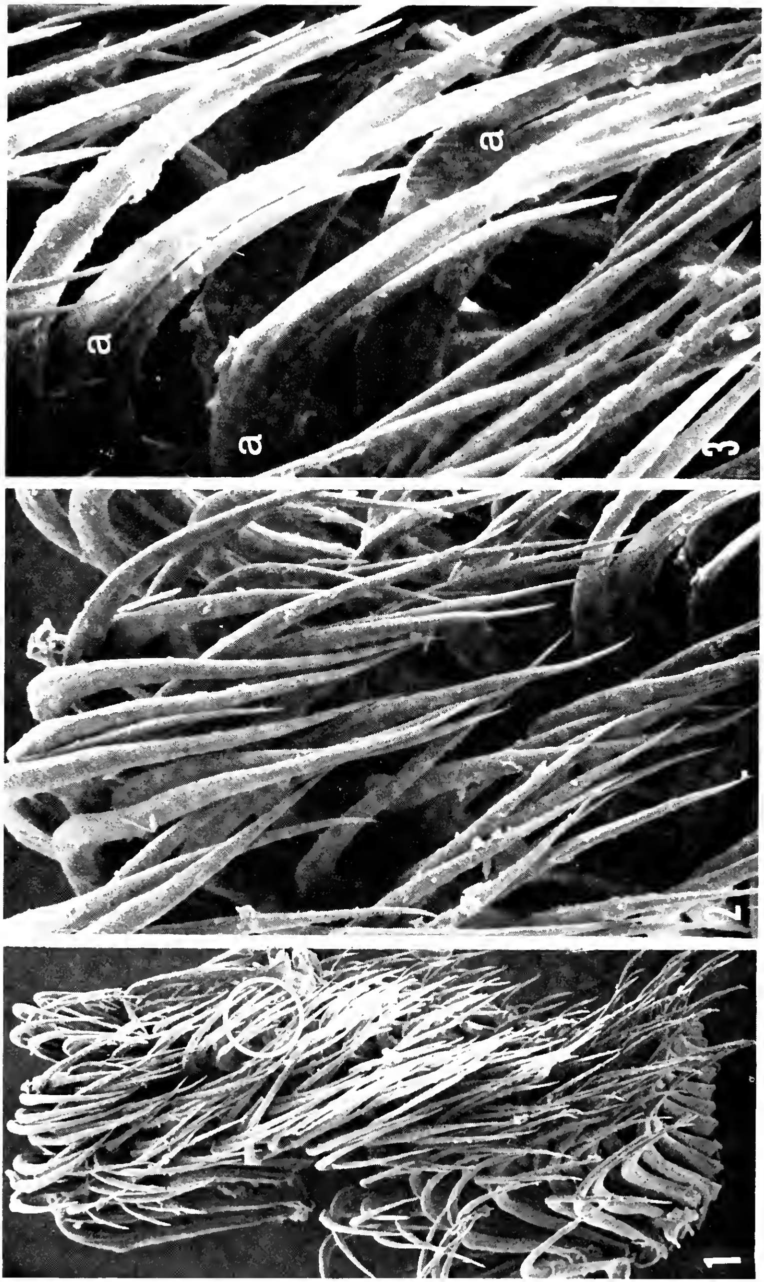


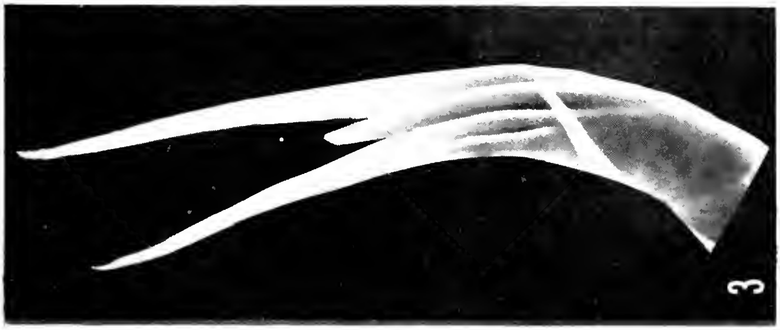
Plate 64

Plate 65

Fig. 1. Portion of radular ribbon of *Architectonica nobilis* from M/V *Silver Bay* Sta. 2399 (160 ×) showing central field somewhat spread open.

Fig. 2. Enlargement of circled area of fig. 1 showing two hooked teeth of central portion of the radula (1700 ×).

Fig. 3. The central tooth of *Philippia hybrida* from Sicily (2750 ×).



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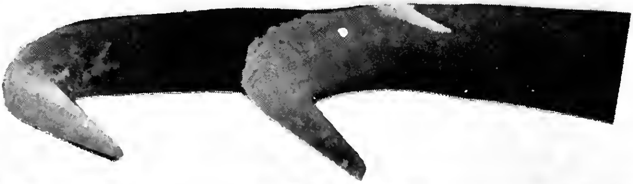

2

1

Plate 65

Plate 66. The radula of *Architectonica c.f. laevigata* from near Trangan, Aru, Moluccas, Indonesia (USNM 747441). a = Lateral tooth. c = Central tooth.

Fig. 1. Whole mount of the radula (240 ×).

Fig. 2. Rows of radular teeth showing individual central teeth and bicuspid lateral teeth (800 ×).

Fig. 3. Enlargement of rows of radula to show single pronged central tooth and bicuspid lateral teeth with seven on each side (1000 ×).

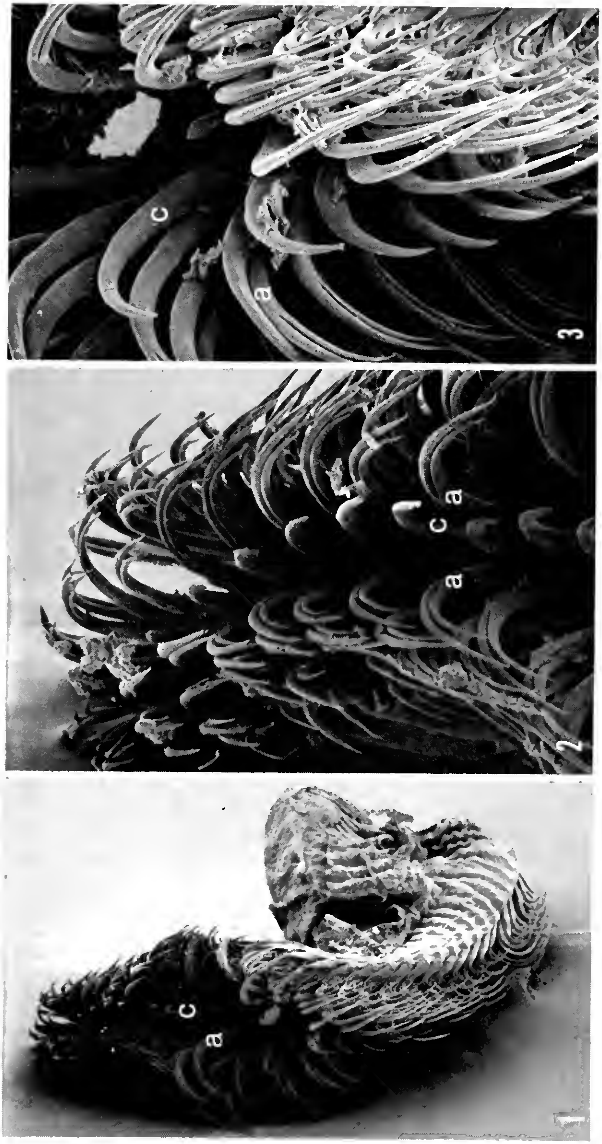

Plate 66

Plate 67

Fig. 1. Portion of the upperside of the distal edge of the jaw of *Architectonica nobilis* from Brazil to show pointed tips of the jaw elements (about 2200 ×).

Fig. 2. Portion of the underside of the jaw of *A. nobilis* to show hexagonal pattern of base of jaw elements (about 2800 ×).

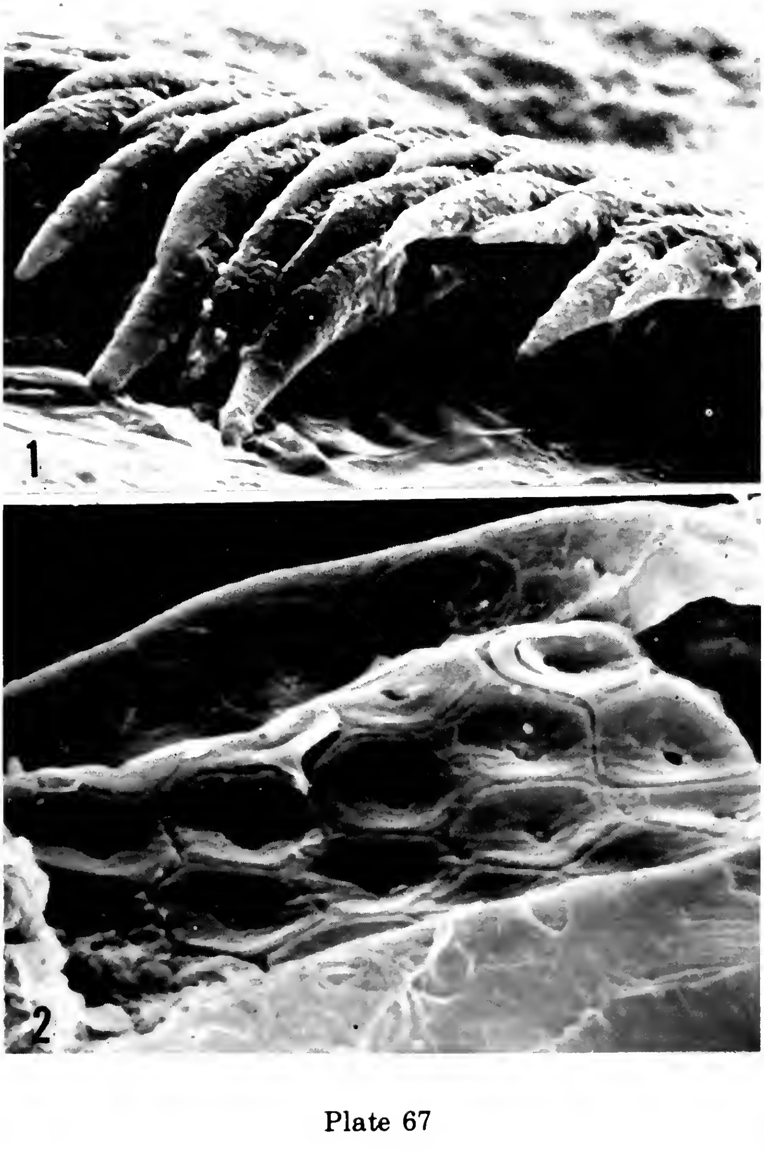

Plate 67

Plate 68

Fig. 1. Portion of the upperside of the distal edge of the jaw of *Philippia hybrida* from Sicily (USNM) to show incised pointed tips of the jaw elements (2000 ×).

Fig. 2. Portion of the underside of the jaw of *P. hybrida* to show papillose bulbous bases of jaw elements (2000 ×).

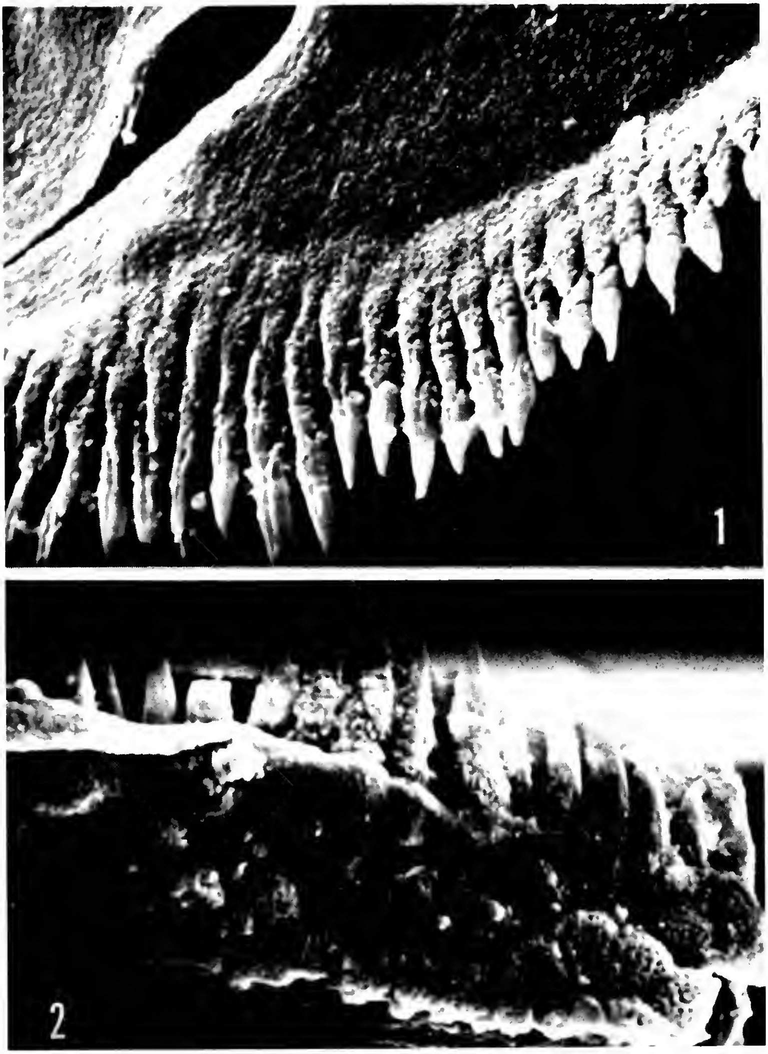

Plate 68

MISCELLANY

The first popular shell book.

The first illustrated book, devoted entirely to shells, was Filippo Buonanni's (1638–1725) *Ricreatione dell' occhio e della mente nell' osservation' delle Chiocciole* (1681), which may be translated as,"Refreshment for the eyes and mind through the study of shells." Buonanni was born in Rome. He was a Jesuit priest, and a student of Athanasius Kircher (1602–1680). Kircher was a German Jesuit who became learned in many branches of the humanities and sciences; among these were deciphering hieroglyphics, optics, and astronomy. Kircher published on many subjects and became well known. He was called to Rome by Pope Urban VIII and was appointed professor of mathematics at the Roman college of the Society of Jesus in 1638, the year Buonanni was born. Like many of his learned contemporaries, he collected rarities of nature, art, and superstition, which he added to the college's earlier collections. In time the collection became known as the Kircher Museum. Buonanni succeeded to the post occupied by Kircher on the latter's death in 1680, and while he published his *Ricreatione* the following year, based on Kircher's shells, he did not become curator of the Museum until 1689. Those shells which remained extant were deposited, during the early part of the present century, in the Museo dell' Instituto di Geologia e Paleontologe in Rome.

Buonanni's classification is of nugatory interest. He promulgated many of the mythical beliefs of the earlier commentators. For example, he believed, like Aristotle, that "all [shelled mollusks] are generated spontaneously by the mud—oysters by dirty mud, and others by sandy mud," and that they were heartless and bloodless. He was convinced that both observation and authority supported spontaneous generation, though this erroneous theory had been disproved by two other Italians, Francesco Redi and Marcello Malpighi, some years before. The illustrations are reasonably accurate, but reversed.

Richard I. Johnson

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The index which follows does not include all of the names covered in this volume. Other omitted names are easily found in the various numbers which are alphabetically arranged and are thus self-indexed. These are:

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