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ASPELLA (FAVARTIA) ANGERMEYERAE, N. SP.

By WILLIAM K. EMERSON and ANTHONY D'ATTILIO
American Museum of Natural History

Among material recently received from Mrs. Carmen Angermeyer of Academy Bay, Santa Cruz Island, Galapagos Islands, is an apparently undescribed species of a muricid gastropod of the subfamily Trophoninae. We take extreme pleasure in naming this interesting discovery for Mrs. Angermeyer, an avid collector of shells.

Aspella (Favartia) angermeyerae, new species. Plate 1.

Shell is small, pear-shaped, with 4 whorls, a low spire, and is subangulate at shoulder, descending convexly and turning in towards the siphonal canal, which is moderate in length. The shell is sculptured by 7 rounded axial costae crossed by weaker spiral cords arranged thusly: Following the eroded protoconch, the heavy costae starting at the poorly defined suture descend diagonally towards the shoulder producing rounded pits in the intervening spaces; below the shoulder the costae descend parallel to the axis to form terminally the siphonal fasciole; terminal costae correspond to the consecutively formed earlier siphonal tips. The spiral cords appear first on the penultimate whorl and consist of a smaller cord centrally placed between the heavier cords located at the sutures; the body whorl above the shoulder is similar to the previous whorl; below the shoulder cord are four equal-size cords, and following thereafter is a single larger cord directly above the canal; the intersection of spiral and axial sculpture produces a series of large rounded elevations. Crossing spirally over the entire shell are fine punctured incised striae. The surface of the shell where not eroded consists of a fine chalk-white film which when worn away reveals a black coloration, the black appearing most intense at the intersection of spiral and axial sculpture. The elliptical aperture is lanceolate at both ends, with a moderately well defined posterior groove; the peristome is elevated around the columella; the labrum is crenulate with 6 wide grooves, the interspaces being white between; the aperture is otherwise grey becoming darker in the grooved portions of the labrum. The anterior canal is closed, somewhat recurved, whitish near the aperture but darker grey to black at anterior end. A pseudo-umbilical chink is framed on the left side by the fasciole. Operculum is "muricoid" with a terminal, *i.e.,* basal nucleus.

Measurements: Holotype, length 20.7 mm., width 13.8 mm.; paratype, 20.3 mm. (spire incomplete), width 12.1 mm.

Type locality: Academy Bay, Santa Cruz Island, Galapagos Islands, intertidal zone.

Type specimens: Holotype, A.M.N.H. no. 113526; paratype, A.M.N.H. no. 111856, 10 fathoms off Rabida Island, Galapagos Islands; Mrs. Carmen Angermeyer collector.

In addition to the holotype, a single paratype of apparently younger age was available for study. In this specimen, the surface is sufficiently eroded to remove all traces of the chalky white layer; there are only six axial costae; the area of black coloration is much diminished, being restricted mostly on the upper portions of spiral and axial sculpture, the shell appearing otherwise white; the canal is proportionately longer and is narrowly opened.

Mr. Allyn G. Smith of the California Academy of Sciences kindly lent us Kodachrome transparencies of a third specimen of this new species that is in the collection of Mrs. Jacqueline DeRoy of Academy Bay, Santa Cruz Island, where the specimen was obtained from beach drift. This specimen appears to be quite similar to the holotype and possesses a well defined posterior siphonal groove.

After the first draft of this manuscript was completed, Mrs. DeRoy informed the junior author (in letter, December 2, 1964) that she now possesses two other specimens of this new species in addition to the one photographed by Mr. Smith. One of the additional specimens was taken alive in 6 fathoms on sandy bottom off Floreana Island and the other is a specimen, which was occupied by a hermit crab, that was taken from the beach at Academy Bay, Santa Cruz Island. Photographs kindly provided by Mrs. DeRoy of the three specimens in her collection indicate that two are mature specimens and one is a juvenile specimen (see pl. 1, figs. 3-5).

The new species, although superficially resembling *Maxiwellia gemma* (Sowerby, 1879), which ranges from Santa Barbara, California to Punta San Hipolito, Baja California, Mexico, differs in several significant conchological characters. In *Maxwellia gemma,* the costae above the shoulder consist of blade-like varices recurved and ornamented on their edges with spines; the spines further appearing on the costae of the body whorl. In addition, the spire of *Maxwellia gemma* is more extruded and the rounded aperture lacks the posterior grove of *Aspella (Favartia) angermeyerae,* new species.

Passing mention should be made here to the status of *Murex pumilus* Broderip (1833), an apparently similar species that was briefly described, without an illustration, and was stated to have been collected by Hugh Cuming in the Galapagos Islands, "under stones." To the best of our knowledge, this species has never been figured, and additional specimens have not been reported, although Carpenter (1857) subsequently cited Broderip's original record for the Galapagos Islands. Tryon (1880:135) provided the following translation of the original Latin description of *Murex pumilus,* "Rhomboidal, five varicose, varices flattened, short, subrecurved, crenulate; dark brown, subfasciate with white; canal moderate, subrecurved; lip crenulate. L. 5 inches [sic, = .5 inches], lat. 3 inches [sic, = .3 inches]," and he suggested that it was "Probably a young shell." In an attempt to determine if the type material of this taxon is extent, we inquired of Mr. Norman Tebble, head of the Mollusca Section of the British Museum (Natural History), if the type specimen were in the Cuming collection. He kindly informed us (in letter, December 30, 1964) that the type is not in the British Museum. Therefore, until the identity of Broderip's taxon can be determined, *Murex pumilus* must remain a species inquirenda, and its possible relationship with the new species described herein can not be evaluated.

The generic placement of this new species presents some problems. The presence of a posterior groove suggests affinity with *Aspella* (sensu lato). Although an anal siphon is not developed in the type species of *Favartia,* a weakly formed posterior siphonal groove occurs in some species of *Aspella,* including *Aspella (Aspella) paupercula* (C. B. Adams, 1850) and *Aspella (Favartia) obtusa* (Sowerby, 1894). In addition to other conchological characters, the presence on the surface of the shell of the chalky-white, calcareous layer that is characteristic of *Aspella* lends support to the assignment of this new species to *Favartia.* The nature of the radula, unfortunately, is not known.

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FOUR NEW LAND SNAILS FROM THE SOUTHEASTERN UNITED STATES

BY LESLIE HUBRICHT

MESODON KALMIANUS, new species. Pl. 2, figs. a-c.

Shell subglobose, spire elevated, conic, apex obtuse; tawny-olive, shining, translucent; umbilicate, the umbilicus nearly covered by the reflected peristome; whorls 4½ to 5, regularly increasing, well rounded, last whorl descending and constricted behind the aperture; embryonic whorl nearly smooth, succeeding whorls with rib-striae, last two whorls with incised spiral lines which are more prominent on the base; aperture roundly lunate, oblique, peristome reflected, white.

Penis long, slender, with a small fleshy body in the upper end, without pilasters; vagina very short; spermatheca oblong, about twice as long as wide, duct very slender, about half as long as the penis. Penis 7 mm., vagina 0.3 mm., spermatheca 1 mm., duct 3.5 mm.

Diameter 9.2 mm., height 6.2 mm., aperture width 4.4 mm., aperture height 4.4. mm., whorls 4.8. Holotype.

Distribution: — Kentucky: Laurel Co.: near Laurel River, Lily, holotype 135311 and paratypes 135312 Chicago Natural History

Museum, other paratypes 17922, collection of the author. *Tennessee:* Scott Co.: near creek, 0.5 mile north of Glenmary. Morgan Co.: roadside, 2.3 miles north-northeast of Sunbright.

Mesodon kalmianus is most closely related to *M. downieanus* (Bland). The shell is more strongly rib-striate, and when fresh is darker colored. The penis in *M. downieanus* is only half as long and much stouter with a large fleshy body in the upper end. *M. kalmianus* is found on low ground near streams, while *M. downieanus* is found on the summits of sandstone mountains.

EUCONULUS DENTATUS (Sterki)

Euconulus chersinus dentatus (Sterki), Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monographs 3, 2: 242-243.

Euconulus dentatus is a winter snail, being found from January to April, while *E. chersinus* (Say) is found throughout the year but is rare during the winter. *E. dentatus* is found in dryer habitats than those in which *E. chersinus* is usually found. The shell is smaller and the revolving striae on the base are usually more distinct.

GLYPHYALINIA SPECUS, **new species.** Pl. 2, figs. d-f.

Shell small, depressed; subhyaline, shining; umbilicate, the umbilicus occupying about 23% of the diameter of the shell; whorls 4½, well rounded, regularly increasing; sculptured above with distinct close-set radial striae, weaker on the base; spire very low conoid, sutures moderately impressed, margined; aperture oblique, lunate, a little wider than high, somewhat flattened above, base well rounded, lip simple.

Diameter 4.8 mm., height 2.3 mm., aperture width 2.2 mm., aperture height 1.8 mm, umbilicus diameter 1.1 mm., whorls 4.5. Holotype.

Distribution: — *Kentucky:* Edmonson Co.: in White Cave, Mammoth Cave National Park. Barren Co.: in James Cave, 1.5 miles northwest of Park City; in Beckton Cave, 0.5 mile northwest of Beckton, holotype 135315 C.N.H.M., paratypes 17218, collection of the author. *Tennessee:* Jackson Co.: in Hargis Cave, 1 mile north of Granville (Thomas C. Barr, Jr. coll.). Van Buren Co.: in McElroy Cave, 1.5 miles northeast of Bone Cave P. O. Grundy Co.: in Crystal Cave, 0.5 mile north of Piedmont.

Glyphyalinia specus is most closely related to *G. lewisiana* (Clapp), differing principally in its larger size. The animal is white and apparently blind. It is know only from the total darkness of caves.

PARAVITREA LAPILLA, **new species.** Pl. 2, figs. g-d.

Shell small, pale buff, subhyaline, shining; spire low, convex, with shallow sutures; whorls 7, slowly increasing, last quarter whorl expanded in mature shells; periphery somewhat flattened in young shells, becoming rounded when mature, deflected downward in last quarter whorl; umbilicus deep, well-like, occupying about 20% of the diameter of the shell; aperture oblique, lunate, wider than high, somewhat flattened on the base and above, lip thin, simple; sculpture of irregularly spaced radial grooves and growth wrinkles, distinct above but becoming obsolete on the base; there are two or three pairs of teeth within the last whorl at all stages of growth. Animal white.

Diameter 4.8 mm., height 2.2 mm., umbilicus diameter 1.0 mm., 7 whorls. Holotype.

Distribution: — *Tennessee:* Davidson Co.: Stones River bluff, Todd Knob, Donelson, holotype 135313 and paratypes 135314 C.N.H.M., other paratypes 29589, collection of the author.

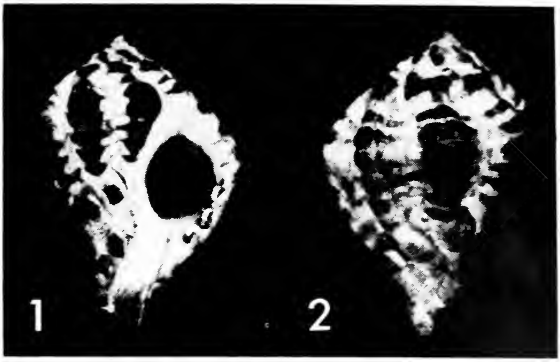
Paravitrea lapilla is most closely related to *P. metallacta* Hubricht and *P. tantilla* Hubricht. It is larger than both, it has teeth in the adult shell as in *P. tantilla,* but the last whorl expands somewhat like *P. metallacta,* although not as much. It is more depressed than *P. capsella* (Gould), and the animal is white rather than pale slate-colored.

HELICODISCUS MULTIDENS Hubricht

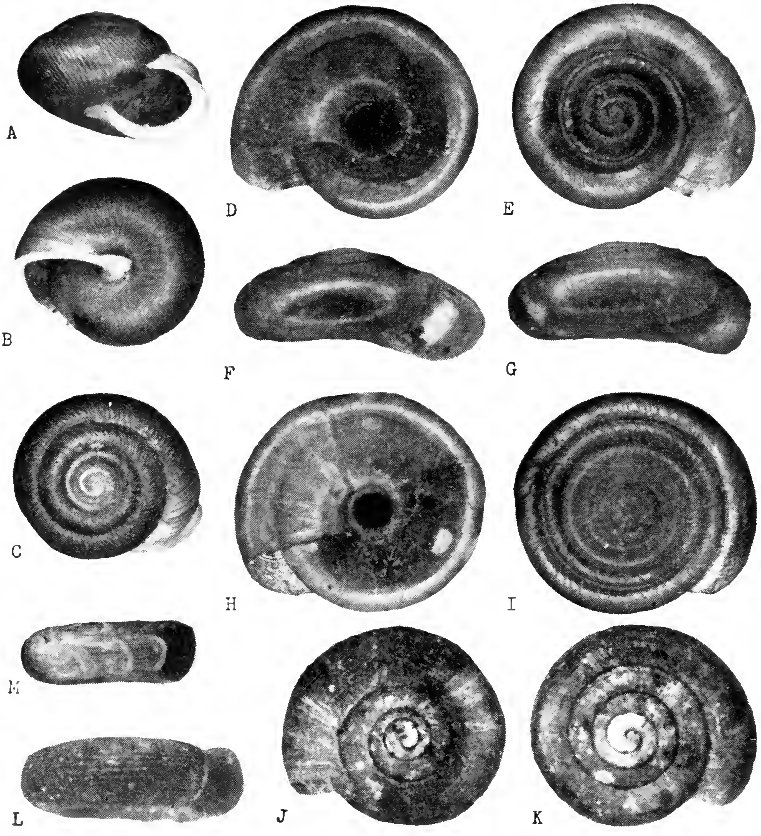
This species was described from specimens collected in caves. It has since been found at the following two epigean localities: *Tennessee:* Claiborne Co.: Indian Creek bluff, 0.5 mile above mouth. Smith Co.: wooded hillside, 1.5 miles southwest of Elmwood. A large series was collected at the last locality.

HELICODISCUS ENNEODON, new species. Pl. 2, figs. j-m.

Shell small, discoidal, spire slightly concave; yellowish to brown, dull, opaque, whorls 4½; umbilicus wide and shallow, showing all the whorls, occupying about 50% of the diameter of the shell; whorls somewhat flattened above the periphery, slowly increasing, the last descending behind the aperture; sculptured with numerous, fine epidermal fringes on lirae; aperture lunate, the peristome simple, somewhat thickened within; within the last quarter whorl there are 9 teeth, 3 pairs of teeth on the outer and basal walls, and alternating with them, 3 teeth on the parietal wall; the teeth on the outer and basal walls are radially elongate, raised on a heavy callous ridge, and separated by a rounded sinus; the parietal teeth are about twice as broad as high, the ends are turned forward, the upper end more so than the lower; of the 3 sets of teeth the center set is usually more fully developed than the others; as the shell grows, the teeth farthest within are absorbed and a new set added near the aperture.



Aspella (Favartia) angermeyerae Emerson & D'Attilio. Figs. 1, 2, holotype, male (A.M.N.H. no. 113526). Figs. 3-5, DeRoy collection. Figs. approximately ×2.



Holotypes. A-C. *Mesodon kalmianus* Hubricht. D-F. *Glyphyalinia specus* Hubricht. G-I. *Paravitrea lapilla* Hubricht. J-L. *Helicodiscus enneodon* Hubricht. M. Paratype opened to show 3 parietal teeth. Photographs by Chicago Natural History Museum.

Diameter 4.3 mm., height 1.5 mm., 4.5 whorls. Holotype.

Distribution: — *Tennessee:* Claiborne Co.: on the undersides of stones, Clinch River bluff, 4.5 miles southeast of Springdale, holotype 135316 and paratypes 135317 C.N.H.M., other paratypes 32382, collection of the author. Anderson Co.: wooded hillside, 1.7 miles northeast of Clinton. Unicoi Co.: near Davis Springs, Limestone Cove, 5 miles east of Unicoi. Cocke Co.: French Broad River bluff, 5 miles east of Newport.

Helicodiscus enneodon is most closely related to *H. multidens* Hubricht. It differs in its depressed spire, heavier sculpture, and the flattened whorls above the periphery. *Helicodiscus enneodon* is probably the most primitive species in the genus. The other species evolving through reduction of teeth and sculpture as a result of a burrowing habit.

TWO GASTROPOD HOSTS OF THE PYRAMIDELLID GASTROPOD ODOSTOMIA BISUTURALIS[1]

By AMELIE H. SCHELTEMA
Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

The number of ectoparasitic pyramidellids seen actually feeding on their hosts has grown considerably since Fretter and Graham's statement (1949, repeated 1962) that the pyramidellids appear to be host-specific. These observations emphasize that many pyramidellid species are not specific in their host selection (Ankel and Christensen, 1963) and that the hosts include a wide variety of invertebrate organisms (Robertson and Orr, 1961). The hosts of *Odostomia bisuturalis* (Say) reported here give further evidence of these non-specific relationships.

Odostomia bisuturalis is commonly found below mean low water in Buzzards Bay in the vicinity of Woods Hole, Massachusetts. It clings to the underside of stones in rock areas where *Littorina littorea* is abundant.

The only host that *O. bisuturalis* has previously been reported to feed upon is the oyster *Crassostrea virginica* (Loosanoff, 1956; Merrill and Boss, 1964). Allen (1958) held *O. bisuturalis* in the laboratory with a variety of organisms, including *Bittium varium* and *C. virginica,* but it was not observed to feed.

I have made repeated collections of *O. bisuturalis* from two areas in Buzzards Bay: the stony shore at the town landing, Parker

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[1] Contribution No. 1564, Woods Hole Oceanographic Institution.

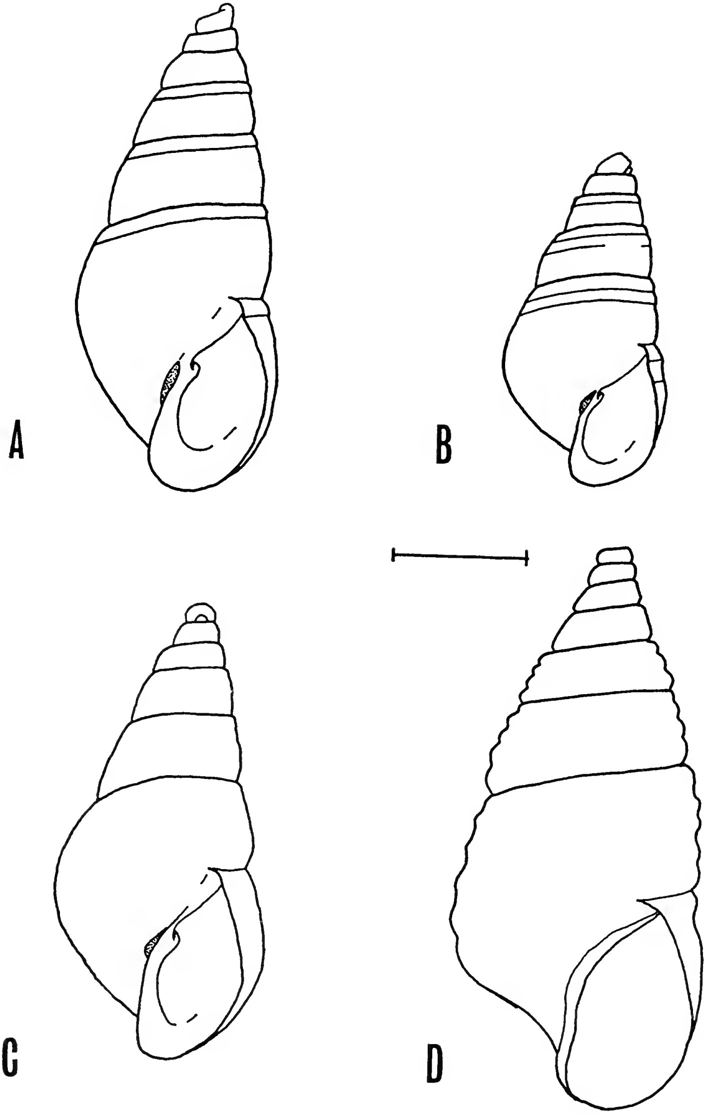

Figure 1. *Odostomia bisuturalis* (Say) (A, B. C) collected from Wood Neck Beach, Sippewissett, Falmouth, Massachusetts in July 1964. Shells oriented so as to show toothed columella. Note the variation in the number of spiral incised lines. All 3 fed concurrently on the *Bittium alternatum* (D, shell ornamentation not shown). Scale line equals 1 mm.

Street, Woods Hole, and a stony section of Wood Neck Beach, Sippewissett. A suspected host, the periwinkle *Littorina littorea,* was collected at the same time. *Bittium alternatum,* commonly found on eel grass, was taken as well from Wood Neck Beach, where eel grass and rocky shore forms are mixed owing to the abrupt changes in shore conditions over short distances.

A dozen or more *O. bisuturalis* were collected and placed together in a bowl with several *L. littorea* or *B. alternatum.* In every instance, *O. bisuturalis* was seen feeding upon the offered host, the long proboscis inserted into the mantle cavity and the buccal pump working. Figure 1 shows shells of three *O. bisuturalis* which fed concurrently on the illustrated *B. alternatum,* which is scarcely larger than its parasites. However, the ratio of *B. alternatum* to *O. bisuturalis* is many-fold greater at Wood Neck than in the laboratory observations. Ankel and Christensen (1963) have shown the same sort of relationship between *O. scalaris* and the diminutive *Hydrobia ulvae,* and Allen (1958) describes *O. impressa* (not a true *Odostomia* according to Robertson and Orr, 1961) feeding upon *Bittium varium.*

O. bisuturalis evidently moves about freely on rocks and can feed upon at least three organisms, the attached oyster and two non-sedentary herbivorous prosobranchs. It is found only subtidally, although two of its known hosts, *Littorina littorea* and the oyster, live both intertidally and subtidally. Egg masses have been found on stones in the collecting area at Parker Street identical to those laid by *O. bisuturalis* in the laboratory. In one instance, an egg mass was laid on the shell of a living *L. littorea* in the laboratory. *O. bisuturalis* was only once found on *L. littorea* in the field.

There is usually a variation in the number of spiral incised lines on the shells of any sample of *O. bisuturalis* collected from the same population, as shown in Figure 1.

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THE REVEREND JOHN LIGHTFOOT, DANIEL SOLANDER, AND THE PORTLAND CATALOGUE

By E. ALISON KAY[1]

The thorny question of the authorship of a number of molluscan names first proposed in the "Portland Catalogue" has been discussed in the recent papers of Dance (1962) and Clench (1964). While zoologists now agree over the propriety of the names used, their authorship is still disputed: Coomans (1963) and Cox (1964) attribute the genus *Isognomon* to Lightfoot, Kohn (1964) attributes several species of the genus *Conus* to Lightfoot and others to "Solander in Lightfoot," while Clench *(op. cit.)* follows the practice of attributing to Solander the sole authorship of the valid volute species identified in the Catalogue by the letter "S.".

The "Portland Catalogue" is well known in malacological circles not only as a sale catalogue of the immense collection of natural history curiosities amassed by Margaret Cavendish Bentinck, 2nd Duchess of Portland which was compiled after her death in 1785, but also as a document of nomenclatural significance. Iredale (1916) pointed out that it includes several validly introduced molluscan species. Although the identity of the compiler of the "Portland Catalogue," and hence the author of some of the valid molluscan names, is not apparent from the Catalogue itself, Dance *(op. cit.)* has presented convincing evidence establishing the Reverend John Lightfoot, librarian and chaplain to the Duchess of Portland, as author.

The problem of the authorship of the molluscan names validly

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introduced in the "Portland Catalogue" is, however, two-fold. In addition to names without an identifying initial and which are presumably the work of the author, there are a number of names identified by the letter "S.". These have generally been attributed to Daniel Solander because of a note in the List of References that " 'S.' after one or more names refers to a manuscript copy of Descriptions of Shells made by the late Dr. Solander, now in the possession of Sir Joseph Banks, Bart., P. R. S." (Lightfoot, 1786). That Solander's authorship of the names identified by the "S." should be questioned was suggested by Dance (1962) as a result of his studies establishing Lightfoot a compiler of the "Portland Catalogue." Dance's *(ibid.)* comparison of the Solander manuscripts with the "Solander species" revealed several discrepancies: a number of species were not included in the manuscripts, the references to some species in the Catalogue differed from those in the manuscripts, and at least three in the Catalogue refer to Martyn's "Universal Conchologist," volume 1, which has an acknowledged publication date of 1784, two years after Solander's death. Dance *(ibid.)* concluded: "These discrepancies indicate that a number of the names bearing an "S." did not originate with Solander and to avoid confusion it may be preferable to attribute all of them to Lightfoot." Clench (1964), however, states that Dance's evidence is circumstantial and ". . . in no way proves that Lightfoot was the author of these discrepancies." Concerning the Martyn references, for example, he feels that since both Solander and Martyn worked on the Portland collection, Solander must have been aware of Martyn's first volume of "The Universal Conchologist" before its publication.

Despite Clench's *(ibid.)* argument, my own feeling is that neither the traditional citing of Solander as author of those species designated by the letter "S." in the Catalogue, nor Kohn's (1964) citation of "Solander in Lightfoot" is appropriate. The lack of congruence between the manuscripts and the Catalogue which was pointed out by Dance (1962) militates against considering Solander the sole author of the "S." species, while in Kohn's *(op. cit.)* usage there is implicit resort to a manuscript, but manuscripts have no legitimacy in nomenclature practice. Thus I favor the suggestion of Dance *(op. cit.)* because it patently reduces the possibility of future confusion.

Unfortunately, the arguments surrounding the authorship of the "S." species in the "Portland Catalogue" are based on scanty evidence. The initial study of the Solander manuscripts by Iredale (1916) was brief: ". . . from a glance over them it seems that Solander hoped to publish a Survey of Natural History, comparable to Linne's *Systema Naturae,* on an even more extensive and accurate scale." Wilkins (1955) also briefly touched on the manuscripts in his work on the Banks collection, and Dance's *(op. cit.)* study cites only selected discrepancies between the manuscripts and the "Portland Catalogue." Since resolution of the problem hinges on the nature of the "Manuscript Copy of descriptions of Shells made by the late Dr. Solander . . .", I have taken the opportunity to compare Solander's manuscripts which are now in the British Museum (Natural History) with a copy of the "Portland Catalogue" and to study early works and documents dealing with Solander's manuscripts in the same institution. The result is the following account of the Solander manuscripts and an interpretation of their relationship to the "Portland Catalogue."

The Solander manuscripts consist of several hundred 3 by 6 inch parchment slips in 27 leather-bound volumes, of which 14 deal with the "Mollusca" (including "Vermes," cirripedes, holothuroids, and coelenterates). Each molluscan genus is introduced by a general description, and is followed by a series of slips, one or more to a species, each with the Latin description, habitat if known, and a notation of the collections containing specimens studied by Solander, "M.C.P." (Duchess of Portland), "J.B." (Joseph Banks), and "M.B." (British Museum). Wilkins (1955) notes that frequently a slip has all three sets of initials—evidence that Solander utilized collections in addition to that of the Duchess of Portland in his ambitious work. Gray (1825) states that Solander also studied the collections of George Humphrey, but there is no indication of this in the manuscripts.

The volumes of the Solander manuscripts dealing with the bivalves and cephalopods appear to be complete: that is, they include not only the genera and species of the 12th edition of the *Systema Naturae,* but also a number of genera and species proposed by Solander. The volumes on the gastropods are manifestly incomplete; they include species descriptions from both the *Sys-*

tema and those which Solander proposed for *Conus, Cypraea, Bulla, Voluta* (including *Mitra* and *Oliva*), and for a portion of *Buccinum*. The last pages of volume 13 and more than half of volume 14 are devoted simply to generic and specific descriptions for *Strombus, Murex, Trochus, Turbo,* and *Helix* from the *Systema;* the latter half of volume 14 includes only generic descriptions for *Haliotis, Patella,* and *Dentalium* from the *Systema.* There are no specific names proposed by Solander for the last 8 genera, nor is there any indication that he studied species of these genera in the London collections.

The manuscripts represent the extent of Solander's work on his project; he died in 1782 before completing the survey of natural history. A note dated Aug. 20, 1778 by Richard Pulteney (1730-1801) records the details of Solander's work on the Duchess of Portland's shell collection and includes a list of the genera completed by Solander which tallies with those listed above from the manuscripts; Pulteney states that ". . . the Buccina were unfinished . . ." (Pulteney Mss. No. 101, British Museum (Natural History)).

The history of the manuscripts subsequent to Solander's death must be inferred from several 18th and 19th century sources. A letter from Sir Joseph Banks to the Duchess of Portland in 1782 indicates that while the Duchess wanted to have Solander's work published Sir Joseph was opposed to the suggestion: ". . . I understand from Mr. Lightfoot that Your Grace is absolutely determined to publish the very unfinished descriptions of shells which my deceas'd friend Dr. Solander made from your collection . . . . I know but too well that to publish them in their present state is absolutely unprofitable, or at least I am sure that Genera, without Characters, or even names, would suggest the idea of ridicule to the common reader." (Banks Letters, British Museum (Natural History)). Sir Joseph's view prevailed; the Solander manuscripts were not published but were available to other workers, first in the Banks library (Dillwyn, 1817), and later in the British Museum. Humphrey acknowledged his debt to the Solander manuscripts in the preparation of the *Museum Calonnianum* in 1797, and the works of Dillwyn *(op. cit.),* Swainson (1822), and Gray (1824-1828; 1858), among others, are replete with Solander manuscript names.

The relationship of the Solander manuscripts to the "Portland Catalogue" can best be clarified by a comparison of the manuscripts and the Catalogue (Table 1). Of the 62 valid molluscan species identified by the letter "S" in the Catalogue, 28 [45%] differ from Solander's manuscript entries: 6 species in the Catalogue are not included in the manuscripts;[2] 14 in the Catalogue are identified by references different from those cited in the manuscripts; seven in the Catalogue are introduced in the manuscripts but without references; and one, *Conus architalassus* of the Catalogue, is spelled differently in the manuscripts *(Conus archithalassus)*. There are other differences: the Catalogue reference to "Martyn" is cited as "Mart." or "Martin." but the same abbreviations in the manuscript refer to Martini's "Conchylien Cabinet" (cf. Wilkins, 1955). While only a single reference is listed for the majority of species in the Catalogue, that reference is usually second or third in a list or four or more references in the manuscripts.

It is apparent that the manuscripts represent an ambitious project and that Solander utilized several natural history cabinets in London for study during the years 1778-1782; the "Portland Catalogue," on the other hand, is a sale catalogue of only one of these natural history collections, that of the Duchess of Portland which was compiled after her death in 1785. The discrepancies existing between the manuscripts and the Catalogue and the selective tenor of the Catalogue entries lead me to suggest that the Catalogue represents the first instance in which the Solander manuscripts were utilized by a worker after Solander's death. If one accepts John Lightfoot as author of the "Portland Catalogue," then one can imagine that when he was called upon in 1786 to compile the sale catalogue for the estate of the Duchess of Portland, he worked from the Solander manuscripts in the library of Sir Joseph Banks. He incorporated some of Solander's names into his manuscript, amended several of the references given by Solander, replaced certain figures with others, and included names of his own invention. He acknowledged his debt to Solander by the letter "S." after certain species, just as Dillwyn,

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[2] Dillwyn (1817) was apparently the first to note a discrepancy between the manuscripts and the Catalogue, observing that *Conus nocturnus* "S." of the Catalogue was not to be found in the manuscripts.

Table 1

Comparison of the valid "S" species from the Portland Catalogue and the Solander manuscripts. Where the Catalogue and the manuscripts are in agreement, the species is merely listed, otherwise discrepancies are indicated. Collections are as Wilkins (1955) indicated: "MCP", Duchess of Portland; "JB", Joseph Banks; "MB", British Museum.

Portland Catalogue			Solander Manuscripts		
Page	Lot	Species and Reference	Vol.	Species and Reference	Collection
42	1001	Arca fusca, S.	5	Arca fusca	MCP; MB; JB
185	3947	Arca labiata, S.	--	NO ENTRY	
98	2158	Arca nodulosa, S.	5	Arca nodulosa	MCP; MB; JB
44	1055	Argonauta hians, S.	7	Argonauta hians	MCP
44	1055	Argonauta navicula, S.	7	Argonauta navicula	MCP
96	2120	Argonauta nodosa, S.	7	Argonauta nodosa	MCP
133	2961	Buccinum calcaratum, S.	12	Buccinum calcaratum	MCP
14	301	Buccinum iris, S.	--	NO ENTRY	
17	372	Buccinum monodon, S.	13	Buccinum monodon	MCP
		Mart. vol. 1 f. 10		NO REFERENCE	
88	1960	Buccinum pustulosum, S.	--	NO ENTRY	
142	3158	Buccinum taurinum, S.	--	NO ENTRY	
98	2148	Buccinum testudo, S.	13	Buccinum testudo	MCP
136	3030	Bulla vesicaria, S.		Bulla vesicaria	MCP; JB; MB
164	3561	Bulla zonata, S.		Bulla zonata	MCP
		Born Mus. Caes tab. ix, fig. 1		Argen. Conch. p. T. 17, F I	
116	2550	Cardium hystrix, S.	3	Cardium hystrix	MCP
155	3389	Cardium impressum, S.	3	Cardium impressum	MCP
		Born Mus. tab. 2 fig. 15, 16		List. Conch. T 320 f. 157	
178	3825	Cardium protrusum, S.	3	Cardium protrusum	MCP
58	1358	Cardium robustum, S.	3	Cardium robustum	MCP
105	2297	Cardium spinosum, S.	3	Cardium spinosum	MCP
		Favanne 52. A. 2		NO REFERENCE	

96	2123	Chama lazarus var. pannosus, S. Rum. 48. 3	--	NO ENTRY	
76	1714	Conus araneosus, S.	8	Conus araneosus	MCP
189	4017	Conus architalassus, S.	8	CONUS ARCHITHALASSUS	MCP
44	1046	Conus augur, S.	8	Conus augur	MCP
160	3491	Conus fuscatus, S.	8	Conus fuscatus	MCP
116	2554	Conus mappa, S.	8	Conus mappa	MCP
156	3411	Conus nocturnus, S.	8	NO ENTRY	
67	1501	Conus quercinus, S.	8	Conus quercinus	MCP
180	3866	Conus undulatus, S. Gualt. 25 I	8	Conus undulatus Gualt.	MCP
50	1206	Cypraea pantherina, S. Lister 681. 28	9	Cypraea pantherina Martin Conch L. P. 334 T. 24, F. 235	MCP; MB
106	2230	Cypraea pustulata, S.	9	Cypraea pustulata	MCP; MB
9	176	Isognoma [Ostrea isognomon L. called Isognoma lignea by S.]	6	Isognomon lignea	MCP; JB
115	2516	Isognoma rigida, S.	6	Isognomon rigida	MCP; JB; MB
101	2216	Lepas cornucopiae, S. D'Argenville, 26. D	2	Lepas Cornu Copiae Argenv. Conch. Suppl. T 7 F. 5 Argenv. Conch. 322 T. 26 F. 2	----
27	626	Mya gigas, S. List. Conch. 414	2	Mya gigas Gualt. Test. T. 90 F. A	MCP
69	1560	Mytilus castaneus, S.	7	Mytilus castaneus	MCP
77	1718	Mytilus lingua, S. New name for Patella unguis L. Humphrey's Conchology, Pl. 2. Fig. 2	7	Mytilus lingua Pet. Gaz. p. 51, T. 32 F. 9.	MCP
182	3906	Nautilus scrobiculatus, S.	7	Nautilus scrobiculatus	MCP

136	3040	Pinna rigida, S.	7	Pinna rigida	MCP
		Knorr II, 26, 1		Seb Mus. 3 p. 181 T. 91. F. 3	
160	3487	Solen rostratus, S.	2	Solen rostratus	MCP
		Valentyn Bivalves, No. 5		NO REFERENCE	
10	187	Tellina cruentae, S.	3	Tellina cruentae	MCP; JB
		Knorr VI. 12. 1		NO REFERENCE	
137	3049	Tellina marginalis, S.	3	Tellina marginalis	MCP; MB
138	3047	Venus arctica, S.	4	Venus arctica	MCP; JB; MB
30	708	Voluta amphora, S.	11	Voluta amphora	MCP
84	1873	Voluta ancilla, S.	11	Voluta ancilla	MCP
		D'Avila's Catalogue Vol. 1 Pl. 8 Fig. 5		Knorr Conch. 5 p. 38 T. 23 F. 2	
76	1448	Voluta angulata, S.	11	Voluta angulata	MCP
		Martyn, Vol. IV 1325		NO REFERENCE	
64	1448	Voluta anguria, S.	11	Voluta anguria	MCP
26	611	Voluta auransiaca, S.	11	Voluta auransiaca	MCP
		Rumph. 37. 2		Martin 3 p. 422 t. 120 F 1098 Cum Synon. Knorr Conch 5 p. T. 1 F. 1	
96	2122	Voluta cithara, S.	11	Voluta cithara	MCP
30	707	Voluta elongata, S.	--	NO ENTRY	
76	1705	Voluta filosa, S.	11	Voluta filosa	MCP
		Martyn, Vol. 1, fig. 221		Martin Conch 4 p. 229. T. 149. F. 1388, 1389. 1391 Cum Synonymie. Gualteri	
103	2274	Voluta gravis, S.	11	Voluta gravis	MCP
137	3054	Voluta haustrum, S.	11	Voluta haustrum	MCP
183	3913	Voluta imperialis, S.	11	Voluta imperialis	MCP
		Martyn, Vol. III. 934, 935		NO REFERENCE	

96	2116	Voluta incompta, S.	11	Voluta incompta	MCP
		Martyn, Vol. 1, fig. 191		NO REFERENCE	
13	264	Voluta incrassata, S.	11	Voluta incrassata	MCP
41	969	Voluta melo, S.	11	Voluta melo	MCP
142	3142	Voluta muricata, S.	11	Voluta muricata	MCP
6	89	Voluta nobilis, S.	11	Voluta nobilis	MCP
		List. 799.6		Martin Conch 3 p. 54 t. 72 f 774 t. 73 f 775.776 cum synonymies	

Gray, and Humphrey acknowledged it with "Sol. Mss." in their works.

Acknowledgments. I am indebted to the Trustees of the British Museum (Natural History) for their kind permission to study the documents which serve as a basis for this paper, to S. P. Dance for bringing to my attention the letter from Sir Joseph Banks to the Duchess of Portland, and to A. J. Bernatowicz for his helpful criticism of the manuscript.

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COMPARISON OF GENITALIA OF TWO SYMPATRIC SPECIES OF HAPLOTREMA

By CLARENCE A. PORTER*

In the Pacific northwest, the family Haplotrematidae is represented by two closely related species *Haplotrema vancouverense* and *Haplotrema sportella*. The species are described by Pilsbry (10) as having "depressed umbilicate and narrowed shells with an expanded peristome. The upper lip margin is usually curved downward." Pilsbry distinguishes *Haplotrema sportella* "as having a shell diameter 11-22 mm., with rather sharply close striae on the spire, whereas *H. vancouverense* has a shell diameter of 22-23 mm., with striations wrinkle-like and irregular."

The basis for identifying Pulmonata has been the shell characteristics; the height/diameter ratio; number of whorls; and radula formula. This system has been satisfactory for most gastropods where the shell characteristics are distinct and color patterns are consistent. In recent studies, the shell characteristics have not always been considered satisfactory for the classification of gastropods (1, 2, 8, & 9). Consequently, other methods have

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* This work was carried out in the laboratory of Dr. Ivan Pratt, Department of Zoology, Oregon State University, Corvallis, Oregon.

been sought in order to solve the problems encountered.

Mead (8 & 9) studied the morphology of the genitalia of the pulmonates *Ariolimax* (Moerch) and *Achatinida*, and found distinct differences in the genital system between genera and species. As a result, he was able to revise the taxonomy of the west coast slugs of the genus *Ariolimax* (Moerch). Similarly, Abdel-Malik (1 & 2) was able to separate into two distant subfamilies *Helisoma trivolvis* and *Biomphalaria boissyi* using the differences found in the histology of the genital organs. Boettger (3), Webb (12), and Franzen (5) used the morphology of the genitalia to separate the genera in the family Succineidae. Watson (11), Fretter (6), Johansson (8) and Creek (4) also found these structures useful and necessary in the identification of prosobranchs.

Because most of the descriptions of the Pacific northwest pulmonates are based upon somewhat inadequate shell and radula characteristics, the purpose of this study was to attempt to correlate the genital characters with radula and shell characters for the identification of these organisms.

Materials and Methods. The snails were collected from 4 stations within a radius of 25 miles from Corvallis, at sites which were characterized by an abundant growth of sword ferns and Douglas fir, in a moist habitat. The stations were located at (1) Woods Creek, 8 miles west of Philomath; (2) along the banks of the Alsea River, west of the town of Alsea; (3) near Burnt Woods, Oregon; and (4) Coffin Butte, north of Corvallis.

The snails were maintained in the laboratory in plastic terraria filled with soil and organic debris from the original habitat. The terraria were kept at approximately 65° F.

The snails were killed by leaving them in an Erlenmeyer flask filled with water for 18-24 hours. By this slow drowning method the snails were killed while in a relaxed state, and hardening and contraction of the tissues were reduced before fixation. The specimens were then dissected and the genitalia removed and measured in millimeters. The tissues were preserved in 70% alcohol and in Bouin's fluid.

A total of more than 35 animals and their shells were examined. All the snails studied were sexually mature and active although not all were fully grown. Drawings were made of the reproductive tracts and distinctive characteristics noted.

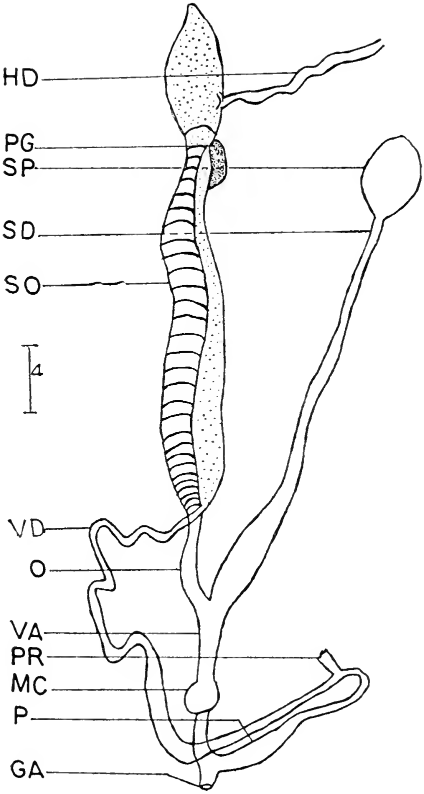

FIG 2

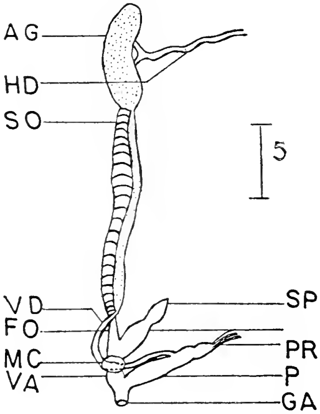

FIG 1

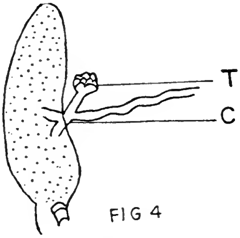

FIG 4

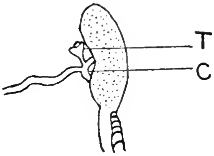

FIG 3

Figs. 1 & 3. *Haplotrema sportella.* 1, reproductive tract. 3, talon and albumen gland. Figs. 2 & 4. *H. vancouverense.* 2, reproductive tract. 4, talon and albumen gland. Key: HD, hermaphrodite duct. AG, albumen gland. SD, spermoviduct. C, region of carrefour. FO, free oviduct. VD, vas deferens. SP, spermatheca. PG, prostate. VG, vagina. GA, genital atrium. P, penis. MC, muscular collar.

It was found that the shell characters alone were not sufficient to determine the identification of the two species. Variations in the reprodutive tracts of these two species proved to be useful in separating them and were used along with conventional methods. The data have been described and illustrated and measurements of the structures that vary in the two species have been made.

Differences in the reproductive tract. There are 3 basic differences in the morphology of the reproductive tracts of *Haplotrema sportella* and *H. vancouverense.* (1) The genus is characterized by a muscular collar on the vagina, but the location and form of the collar varies with the species. In *H. sportella,* the collar almost completely covers the vagina, which is 1-7 mm. long and is thick on the dorsal surface, but reduced to a narrow band on the ventral surface (Fig. 1). In *H. vancouverense,* the collar is large and muscular, covering about one-eighth of the median portion of the long vagina (7-13 mm.), and is incomplete on the ventral surface, (Fig. 2).

(2) The vas deferens is straight and narrow in *H. sportella,* (Fig. 1). In *H. vancouverense* it begins as a narrow tube, the lumen and areas of which increases approximately four times in diameter to the distal end, (Fig. 2). The overall length of the vas deferens is approximately 4 times greater in *H. vancouverense* (47-63 mm.) as compared to 10-21 mm. in *H. sportella.*

(3) The talon is long and has a spherical knob in *H. sportella* (Fig. 3); it is minute and clavate in *H. vancouverense,* (Fig. 4).

SUMMARY

Morphological data of the reproductive tract have been collected and applied to the scheme of classification of the two species of Haplotrematidae of the Pacific northwest to permit their identification.

The comparative location of the muscular collar on the vagina, the size of the vas deferens, and the shape and size of the talon are characteristic for each species. These combined with shell and radula characteristics make a more certain separation of the species possible.

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ON THE IDENTITY OF CONUS PASTINACA

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The confusion surrounding the correct identity of the taxon, *Conus pastinaca* Lamarck, 1810, has persisted for over a century. Lamarck (1810) proposed the taxon under the heading "[No.] 60 Cône panais. *Conus pastinaca*." A brief Latin description was given, followed by further remarks in French. No figures were cited. As to locality, Lamarck stated, "Habite . . . je le crois des même mers que le précédent [*Conus daucus:* Habite les mers de l'Amerique]." Lamarck stated that he felt *Conus pastinaca* "parôit distinct du cône carotte [*Conus daucus*]." Lamarck (1822) repeated virtually the same description. No figures were cited, nor was a locality given (other than "Habite . . . Mon cabinet").

Kiener (1847) subsequently described and figured a shell under the name of *Conus pastinaca* (on the same plate with *Conus daucus*). Reeve (1849) stated that Kiener's figure was "not the shell which I take to be the *Conus pastinaca*." Weinkauff (1875) added that Kiener "gab dafur [*C. pastinaca*] eine blassgelbe varietät des *C. daucus*." Mermod (1947) stated "L'ex[emple] figuré dans Kiener . . . n'a pas été retrouvé. Lamarck dit que la spire n'est pas tachetée; Kiener, par contre, la dit et la figure mouchetée."

Tryon (1884) believed that "*Conus pastinaca* is a doubtful species, the specimens in the Lamarckian collection at Geneva including besides . . . [*Conus virgo,* other specimens with transverse lines, like those appearing on the body whorl of *Conus* *quercinus*]." Mermod (1947) stated that Lamarck "possédait 3 ex[emplaires]. Dans sa coll[ection], un ex. de 31 mm., portant le n° 60, était mêlé aux *C. daucus;* c'est probablement le type du *pastinaca* de Lamarck."

On the basis of the above information, one cannot precisely identify Lamarck's *Conus pastinaca.* If it were of West Indian origin as Lamarck thought, it might be *Conus flavescens* Sowerby or *C. ustickei Miller* (in Usticke, 1959). Inasmuch as part of the Lamarckian collection is preserved in the Geneva Museum, an inquiry was made, and E. Binder of that institution kindly provided two photographs of the specimen mentioned by Mermod. The holotype of *Conus pastinaca* Lamarck is here illustrated for the first time (figs. 3, 4). These figures would indicate that Lamarck's *Conus pastinaca* is merely another form of *Conus daucus* Hwass in Bruguière, 1792. Inasmuch as specimens in the series of *Conus daucus* in the American Museum of Natural History matched Binder's figures, Lamarck's taxon should be added to the synonymy of *C. daucus.*

However, the name *Conus pastinaca* has been applied by many workers to a quite different shell for many years. Reeve (1844) was first to describe and figure a second species under the name *Conus pastinaca.* Reeve's concept was apparently based on a literal interpretation of Lamarck's description. Kiener, however, was probably familiar with the specimens in Lamarck's collection, and his larger, colorful specimen from the collection of de Lessert (*fide* Mermod), was in the original concept. Reeve did not give any locality for his species. Sowerby (1857-58) and Weinkauff (1875) described and figured the same shell as given by Reeve. Tryon (1884) stated that "The shells figured by Reeve, Weinkauff, and Sowerby for *Conus pastinaca,* Lam., are probably worn specimens of [*Conus virgo*]."

In addition, mention should be made of the fact that the name *C. pastinaca* has been incorrectly applied for many years to an entirely different species, now known to occur in New Caledonia. Crosse (1858) proposed the name *Conus coelinae* for a rather large, pale yellowish *Conus* from New Caledonia. Here again, confusion has persisted for over a century as to the correct spelling of the taxon. In the original paper, the name was printed throughout with ligatures for both pairs of vowels, the final "ae" closely resembling that used for the first ligature following the "c." Bernardi (1861) spelled it *C. caelinae,* though amended it to *C. coelinae* on the Errata sheet. Sowerby (1866), Weinkauff (1875), and Barros e Cunha (1933), consistently spelled it *C. caelinae.* Tryon (1884) and Tomlin (1937) employed the *C. coelinae* spelling. Wagner and Abbott (1964) follow Tomlin (1937) in attributing the *C. caelinae* spelling to "Barros e Cunha, 1933," although this spelling was widely used in the 19th Century.

Crosse (1858) placed the name at the beginning of the "C's" in his "Catalogue alphabétique des Cones," as though it were intended to be spelled *Conus caelinae.* Leslie Taylor, Librarian, American Museum of Natural History, is of the opinion (personal communication) that this placement as well as the use of the ligatures to be merely faulty typesetting. The derivation of the specific name, incidentally, *coelia* in Latin, is from the Greek, koilia, a cavity.

For years workers have stated that *Conus coelinae* Crosse together with *C. emaciatus* Reeve, and (more recently) *C. spiceri* Bartsch and Rehder, were probably evolved from the wide-ranging *Conus virgo.* This concept, based entirely on shell characters, has not been verified by anatomical studies.

Synonymies of both species follow:

Conus (Lithoconus) daucus Hwass in Bruguière, 1792, form *pastinaca Lamarck,* 1810.

Conus pastinaca Lamarck, 1810: 266, no. 60.
Conus pastinaca Lamarck, 1822: 469, no. 60.
Conus pastinaca Kiener: 1847: 100. Plate 26, fig. 2.
Conus (Lithoconus) coelinae Crosse, 1858.
Conus pastinaca Lamarck, Reeve, 1844. Plate 46, sp. 257. *Non* Lamarck, 1810.
Conus pastinaca Lamarck, Sowerby, 1857-8: 22. Plate 15, fig. 353.
Conus coelinae Crosse, 1858: 117. Plate 2, fig. 1.
Conus coelinae Bernardi, 1866: 6. Plate 2, fig. 11.
Conus coelinae "Bernard" Crosse, Sowerby, 1866: 326. Plate 26, fig. 623.
Conus pastinaca Lamarck, Weinkauff, 1875: 219. Plate 32, fig. 1, 2. *Non* Lamarck, 1810.
Conus virgo var. *coelinae* Crosse, Tryon, 1884: 43. Plate 13, fig. 46.
Conus virgo caelinae Crosse, Barros e Cunha, 1933: 95.

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NEW RECORDS FOR CYPRAEA SURINAMENSIS

BY WILLIAM K. EMERSON AND WILLIAM E. OLD, JR.
American Museum of Natural History

Cypraea (Propustularia) surinamensis Perry (1811), the least known of the western Atlantic cowries, was previously recorded from several islands in the southern part of the Caribbean Sea and from the adjacent coast of South America at Surinam (Dutch Guiana). However, this taxon, or one of its supposed synonyms: *C. bicallosa* Gray (1831), *C. aubryana* Jousseaume (1869), and

C. ingloria Crosse (1878), was also cited from Vera Cruz, Mexico, and Equatorial Africa, in addition to St. Thomas, Guadaloupe, Marie Galante, Martinique, St. Vincent, Aruba and Curaçao in the Lesser Antilles, and Surinam. The African locality is certainly an error, and the Mexican record has been questioned in recent years.

Coomans (1963), in a review of the literature pertaining to this species, noted that all the then recorded occurrences were based on specimens collected in the nineteenth century, with one exception. A specimen was obtained from a power dredge, in 20 feet, at Barcadera, Aruba (Usticke, 1962). The recent discovery of additional specimens that extend the known range of this species to the Florida Keys, therefore, merits recording at this time. The new records are: 1) Fragments of the basal part of two specimens obtained by Harry G. Lee while skin diving off Punta Arenas, Mona Island, Puerto Rico (A.M.N.H. No. 112713; Jane Zager Collection). 2) A complete, dead specimen, lacking locality data, but presumably from Puerto Rico, where Mr. Lee purchased it (Lee Collection; pl. 3, fig. 1). 3) And a well-preserved, dead specimen that possesses a high gloss, dredged from rocky bottom, at a depth of 150 feet, one mile east of the Alligator Reef Lighthouse, off the Matecumber Keys, Florida by James Moore (A.M.N.H. No. 117176; pl. 3, fig. 2). Dr. R. Tucker Abbott has informed us (in letter) that a dead specimen was recently taken on Seranilla Bank, 300 miles east of Honduras.

The known records, all apparently based on dead specimens, indicate that this species may be expected to occur in suitable habitats from the Florida Keys southward, possibly to the equator. This species, however, will remain a rarity until its ecological station is discovered.

Mention should be made to the striking degree of dimorphism exhibited by the shells of this species. An examination of the illustrations in the literature and the 4 specimens available to us for study indicates that two distinct morphological forms exist. One has a narrow, somewhat compressed shell with weakly developed marginal calluses. The other form is characterized by a stouter, more inflated shell with heavier calluses developed on mature specimens. The two forms are illustrated herein (pl. 3, figs. 1, 2). The taxonomic significance of these forms cannot be determined on the basis of the available data. They may merely represent sexual dimorphism, or possibly ecologically induced phenotypes. On the other hand, subspecific allocations would be indicated for the forms, if an allopatric distribution for the two forms were demonstrable.

Schilder and Schilder (1938) record the occurrence of *Cypraea barbadensis* (Schilder, 1932), which they consider to be the precursor of *C. surinamensis,* from Plio-Pleistocene deposits of Haiti and the Lesser Antilles. They remark that the fossils are smaller than living specimens of *C. surinamensis,* have the right side less margined, the posterior callosity less marked, and the aperture less curved. No mention is made, however, of the presence of shell dimorphism.

It is appropriate here to comment on the nomenclatural problems that confront students of this species. The use of *Cypraea surinamensis* Perry (1811, pl. 20, fig. 4) for this species is based on an extremely fanciful drawing and the stated locality "Surinam." To the best of our knowledge, there is no evidence that this species actually occurs in Surinam.[1] Unfortunately, most of the localities given in Perry's Conchology are wrong. For example, on plate 20, with *C. surinamensis.* only one of the better-executed, recognizable drawings is correctly localized. Note that Gray (1828), who was the first contemporary worker to accept Perry's new taxons and, according to Wilkins (1957), had access to some of the collections on which Perry based his illustrations, did not recognize *C. surinamensis.* In fact, Gray (1831:35) adequately described the present species as *C. bicallosa,* without reference to a locality, on the basis of specimens from 4 private collections. Sowerby (1832, pl. 2, fig. 10) subsequently figured a specimen that is similar to the narrow form of the present species. Inasmuch as there can be no doubt that Gray's taxon is applicable to the present species and Perry's taxon is based on very questionable data, it is unfortunate that *Cypraea surinamensis* was resurrected for the present species by Schilder (1924; 1927), who considered Perry's figure to represent a beach worn specimen of

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[1] Shaw (1909) rejected Surinam. Most workers before Schilder (1932a) cited Perry's *C. surinamensis* from West Africa, believing it to be *C. (Zonaria) gambiensis* Shaw, 1909 [= *C. nebulosa* Kiener, 1843, *non* Gmelin, 1791]. Mörch (1877) recorded Perry's taxon from "Kurachie" [?Pakistan].

C. bicallosa. In our opinion, Perry's taxon, in absence of the type material, should have been considered a "species inquirenda," with *C. bicallosa* Gray retained as the first available name for the present species. We have been constrained, however, to use Perry's taxon for the present species in the interest of nomenclatural stability.

Cypraea aubyrana Jousseaume (1869:348, pl. 18, figs. 1-3) was described from a single specimen that had been ". . . partie d'une collection de la Guadeloupe, achetée par le Musée des colonies." No similar specimens have been subsequently reported from the Caribbean area. In the present century, this taxon has been considered by several writers to be an immature example of *C. bicallosa* or of *C. surinamensis*. The type, however, is a large specimen, measuring 48 mm. in length, that has well-developed apertural teeth. Schilder and Schilder (1964) record it as the largest known specimen of *C. surinamensis*. Although we have not seen the type specimen, our evaluation of the original description and figures leads us to believe that *C. aubyrana* was based on a mature specimen which may be referable to the subgenus *Callistocypraea*, a group represented by living species in the Indo-Pacific province. Whereas the mature specimen of the present species reported above from off the Florida Keys is only 38 mm. long and has 26 labial and 21 columellar teeth, the type of *C. aubyrana* was stated to have only 27 labial and 22 columellar teeth, but it has a shell one-fourth again larger than the smaller Floridian specimen. These differences in shell characters suggest that Jousseaume's taxon probably is not referable to the present species, the stated locality, "Guadeloupe" [French West Indies], being erroneous.

Cypraea ingloria Crosse (1878:166, pl. 3, fig. 2), on the other hand, is apparently referable to the inflated form of the present species. Unaccountably, however, the type locality was given as "Côtes de l'Afrique méridionale." The type specimen measures 30 mm. in length and 19 mm. in width, and possesses 24 labial and 23 columellar teeth, characters which fall into the range of variation known for western Atlantic specimens.

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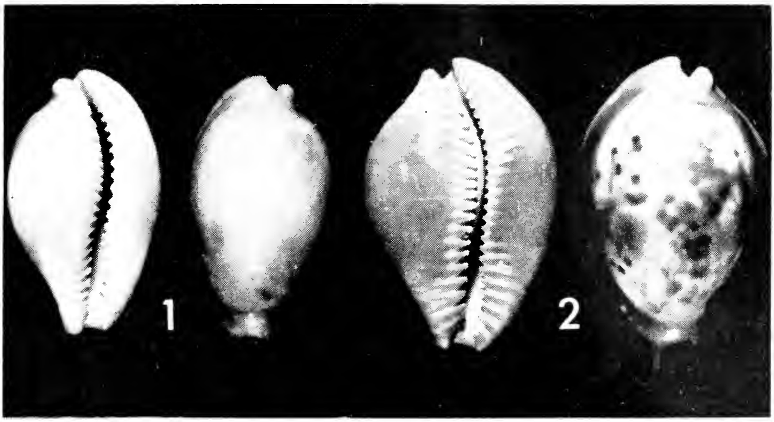
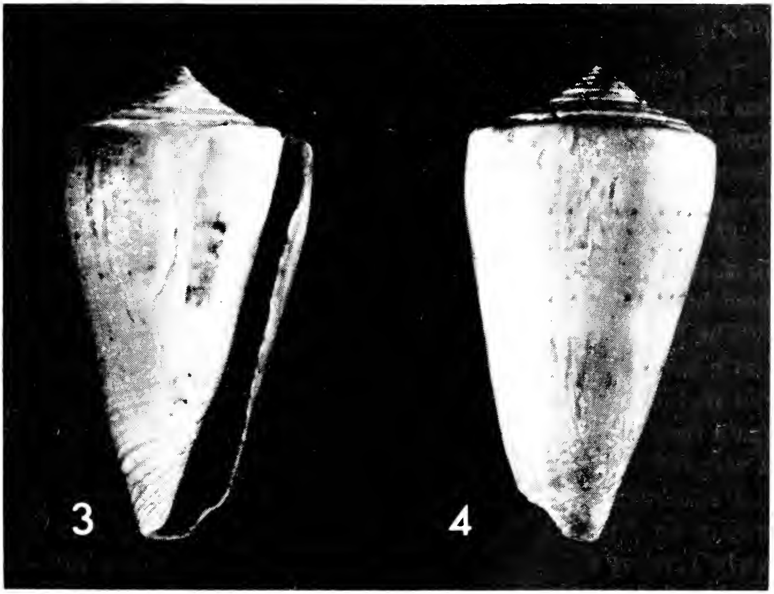
A NEW SPECIES OF LITHASIA FROM MISSISSIPPI

BY WILLIAM J. CLENCH

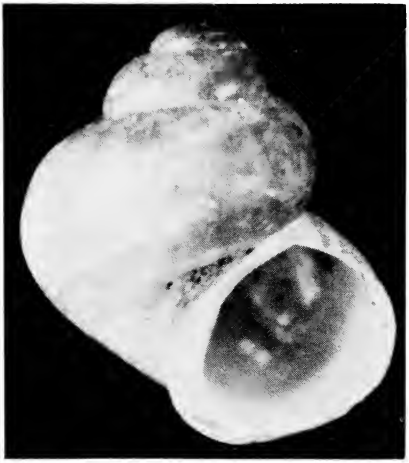
Through the kindness of Mr. Leslie Hubricht of Meridian, Mississippi, I am privileged to report upon a new *Lithasia* from this state, the first species recorded south of the Tennessee River. The few species known under this generic name from the Coosa-Alabama River in Alabama are all members of the genus *Goniobasis.*





Figs. 1, 2. *Cypraea (Propustularia) surinamensis* Perry. Fig. 1, "narrow form," specimen purchased in Puerto Rico (Lee collection). Fig 2, "inflated form," off Matecumbe Keys, Florida (A.M.N.H. No. 117176, *ex* Moore collection). ×1. Figs. 3, 4. *Conus pastinacea* Lamarck, 1810. Fig. 3, apertural view of holotype; fig. 4, dorsal view. Photographs courtesy Geneva Museum. Figs. approximately ×2.

1



2

Fig. 1, *Lithasia hubrichti* Clench (2×). Fig. 2, *Clappia cahabensis* Clench (16×).

The genus *Lithasia*, as presently considered and understood, has heretofore been known only from the vast Ohio River System and in the Black and Spring rivers of Lawrence County, Arkansas. The various species prefer a rocky substrate usually where there is a fair to a swift current.

This new species may well represent a relict species, remaining in this area when this genus had a wider distribution than it now has.

The Mississippi River below the mouth of the Missouri River has a very depauperate molluscan fauna. This, of course, does not include the numerous Oxbow lakes which were parts of the main river in its past history, but even these Oxbow lakes present a very different environment than a flowing river.

If the lower Mississippi River ever had even a modest endemic molluscan fauna, it disappeared during the Cretaceous or the early Tertiary when the Missouri carried into the Mississippi the sand and silt of the Dakota Bad Lands.

Comparatively little is known about the fresh-water gastropods of the state of Mississippi and but little more is known about the fresh-water bivalves.

LITHASIA HUBRICHTI, new species. Fig. 1.

Shell relatively small in size, reaching 20 mm. in length, sculptured and imperforate. Color a dark yellowish brown. Whorls

8 to 9 and moderately convex. Spire extended and produced at an angle of 60°. Aperture subovate. Siphonal canal small. Outer lip simple. Inner lip somewhat thickened in the columellar area. Columella short and vertical. Suture impressed. Sculpture axially tuberculate above the periphery; this in addition to the fine to coarse axial growth lines.

length	width	
20 mm.*	11.2 mm.	Holotype
19	10.4	Paratype
17.5	10.5	"

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* Loss of one to two millemeters by corrosion.

Types. Holotype, Museum of Comparative Zoology no. 250916 from the Big Black River, 3 miles NW of Edwards, Hinds Co., Mississippi, Leslie Hubricht collector, October 12, 1963. Paratypes, Museum of Comparative Zoology no. 233392 from the same locality.

Remarks. This species differs from *Lithasia verrucosa* Rafinesque, its nearest in relationship, by being darker in color, having the tuberculate sculpture axial in arrangement rather than spiral and in having the tuberculate sculpture only above the whorl periphery.

A NEW SPECIES OF CLAPPIA FROM ALABAMA

By WILLIAM J. CLENCH

Clappia cahabensis, new species. Fig. 2.

Shell small, reaching 3 mm. in length, umbilicate, and smooth. Color a yellowish brown, whorls 3.5, strongly convex. Suture indented. Spire extended. Aperture subcircular, slightly flaring, holostomatous and attached to the body whorl only at its upper part. Umbilicus narrow and deep. No sculpture. Periostracum thin. Operculum paucispiral with the nucleus nearly centered. Animal white.

length	width	
3.5 mm.	2.7 mm.	Holotype
3	2.4	Paratype

Types. Holotype, Museum of Comparative Zoology no. 251167, from the Cahaba River, 1 mile north of Centreville, Bibb Co., Alabama, Leslie Hubricht collector, Nov. 18, 1964.

Remarks. This is the second known species in the genus *Clappia*. The type species, *C. clappi* Walker is known from the Coosa River at Duncan's Ripple, The Bar, and Higgin's Ferry, all in Chilton County; and Butting Ram Shoals in Coosa County, Alabama. The Cahaba River at Centreville is 160 river miles from the southmost Coosa locality.

This species differs from *C. clappi* by being proportionately more attenuate, having a smaller umbilicus and a less flaring margin of the aperture. Walker stated that the animal was black in *C. clappi* (Nautilus *22:* 90). The soft anatomy of *C. cahabensis* is white.

NOTES AND NEWS

DATES OF THE NAUTILUS. — Vol. 78, no. 1, pp. 1-36, pls. 1-4, was mailed July 6, 1964. No. 2, pp. 37-72, October 11, 1964. No. 3, pp. 73-108, iii, January 25, 1965. No. 4, pp. 109-144 [iii], pls. 5-9, and Index, pp. iii-vii, April 20, 1965. — H.B.B.

MATINGS BETWEEN POLYGYRA *cereolus carpenterianus* and *P. septemvolvis* — The specimens of the present observations were collected or laboratory raised from specimens taken in the region of Miami, Florida. Here the two seeming species are distinct in shell and body characteristics. The genitalia are quite similar in the two species, and for this reason special efforts were made to see if mating could occur between them. The several observations secured are presented here, but further study should be made before the problem is considered closed. Webb, 1950, has described the eratology of *Polygyra septemvolvis* (Say).

The first possibly successful mating between the two species was noted Augut 3, 1950, when a group of both species were placed in a common cage. Soon thereafter I observed a specimen of *Polygyra cereolus carpenterianus* (Bland) with its sex-organ (penis) engaging that of a specimen of *septemvolvis*. After noting that the pair seemed to have the penes entwisted, I gently disengaged the specimens by pulling them apart from their sexual union to verify actual reciprocal entwistment of the penes. The manipulation confirmed my supposition. The organ of the *septemvolvis* was the longer, and wrapped about the other's organ. This observation indicates that possibly reciprocal insemination can occur between the two species, and if interfertile, hybrids may be produced. Neither genitalia nor behavior are insuperable barriers to inter-matings and possible resultant hybridization.

On March 15, 1951, again a mixture of both species were encaged together. Ultimately a *cereolus* engaged in courtship with a *septemvolvis* as they clung from the cage cover-glass. No biting was observed. The pair soon everted the penes and on 5 different instances tried to entwist them together. The penis of the *septemvolvis* was the larger, and seemed as it everted to volute outward from that of the *cereolus* such that a continuation of entwistment to the climax of mating (semen ejection) was never achieved. Thus preoccupied, I failed to see the courtship of a second pair in the cage, which were first seen with the penes successfully engaged. This pair soon disengaged the united penes in a manner normal for their species. The first pair never succeeded in uniting the sex-organs and ultimately separated.

The last normal attempted inter-species mating I have so far observed occurred March 29, 1951. A *cereolus* was seen courting a specimen of *septemvolvis.* Eight times the pair attempted and failed to entwist the penes. Each time the tip of one's penis everted free of the entwisted basal parts of the penes and partly entwisted on itself. When this occurred the pair separated their organs and tried again. In two of these attempts, I observed that the *cereolus* had the oddly everting organ. The pair briefly separated after these 8 attempts at mating. After a short interval they rejoined and made 3 more successive tries at penis-entwistment, all of these tries also failed as previously noted.

The observed data invite the conclusion that a partial genital isolation exists between these two species. One may also infer that semen ejection cannot be induced until the organs are entwisted reciprocally several times, and not just basally.

My final observation, also of March 29, 1951, records an abnormal courtship involving 3 specimens simultaneously, two *cereolus,* and one *septemvolvis.* Contrary to my expectation, the group reached the penis-entwistment stage in which the penis-bases were seemingly entwisted, but all 3 organs failed to unite properly for continued entwistment; retraction followed, and no further attempts at mating were observed of any of the group. — GLENN R. WEBB, Kutztown State College, Pa.

HELIX POMATIA IN WISCONSIN. — In the spring of 1964, Michael Reineck, a student assistant at the University of Wisconsin, Milwaukee, brought to my attention a colony of *Helix pomatia* located north of Milwaukee. The colony occupies an undeveloped woodland area, approximately 20 feet north of where Pierron Road dead ends in the city of Glendale. The area is bounded on the north and west by houses, on the south by a dry creek bed, and on the east by the Milwaukee River. Members of the Reineck family have observed the colony every summer since 1956, and estimate the summer population to have varied from 50-100. Following information provided by another student, I subsequently located a second colony, one-half mile south on the river. This colony occupies approximately an acre of wooded land in Kletzche Park, just south of Green Tree Road. The wooded area is almost completely surrounded by a parking lot and park grass, and lies 300 feet from the river. A brief survey disclosed about 20 widely scattered animals and many shells.

In 1941, Dr. Robert Washburn of Milwaukee described a colony of *Helix* on the river "some 10 miles north of Milwaukee" (Nautilus 54 (4):145). In conversation with Dr. Washburn, I found this to be the Kletzche Park colony, which has apparently remained essentially unchanged in size and location for over 20 years.

According to William Dickinson of the Milwaukee Public Museum, *Helix* was introduced at the turn of the century to Pierron's Island, which is located in the Milwaukee River about 400 feet upstream from the Glendale colony. Relatives of Pierron who today use the island as a summer residence say that *Helix* is still present on the island. Probably the two mainland colonies were established by snails accidentally or purposefully removed from the island or, as suggested by Dr. Washburn, washed to the mainland by high water. — ANDREW MCCLARY, Mich. State University, East Lansing, Michigan.

PUBLICATIONS RECEIVED

Benthem Jutting, W. S. S. van. 1964. Non-marine Mollusca of west New Guinea. Nova Guinea, Zoology *28:* 1-74, 63 figs. & 2 pls. — New spp. of *Succinea, Paryphantopsis, Durgellina, Lamprocystis, Hemiglyptopsis, Helicarion, Euplecta, Microcystina, Chronos, Ouagapia, Macrocycloides & Papulaoma;*

THE NAUTILUS

Vol. 79 October, 1965 No. 2

TWO NEW SPECIES OF CYPRAEA

By C. M. BURGESS
Honolulu, Hawaii

During the compilation of an illustrated text on the living *Cypraea* soon to be published, two species were noted which seemed different from all others in the genus. The distinguishing characters are all conchological, since no living specimens of either species have so far been recorded. However, these conchological characters are so distinct that by standards in use today description as new species seems justified.

CYPRAEA COHENAE, new species. Plate 4 figs. A-D.

The holotype is well-preserved, fresh but empty. The shell is cylindrical and 25.5 to 29.4 mm. in length. The general shape is like that of *Cypraea edentula* Gray, 1824, but is larger and more elongated. The anterior extremity is attenuated and produced. The spire is depressed and the protoconch has the appearance of a glass bead. The dorsum is marked with sparse, discrete, circular, pale-brown spots 0.5 to 0.7 mm. in diameter, which are more numerous on the margins, but which extend onto both labial and columellar areas of the base. The columella is entirely smooth except for a prominent anterior terminal ridge and two or three weak crenulations immediately adjacent to the terminal ridge. The columellar portion of the posterior canal is short, and curves sharply to the left. It bears a prominent callus. There is a narrow but definite labial callus. The outer lip is well-developed and bears 17 deeply cut teeth which are heavily lined with golden brown. The gray-tan dorsum is faintly banded in the central area with darker tan.

This species is distinguishable from other South African cowries by its edentulous columella and the deeply denticulate labial margin of its aperture.

Paratype A is exactly the same general shape as the holotype. The columella is also smooth and the well-formed teeth on the outer lip number 16. The shell differs from the holotype only in age. The paratype is a pearl-gray shell without other color, and is probably a subfossil.

Both specimens were collected on the beach at Jeffreys Bay, South Africa, by Mrs. Iris Cohen in April, 1964. She has made a careful search of available South African collections, and so far has been unable to discover another similar specimen. Although there are but two examples known, the conchological characters are so distinct that there seems no doubt that these two specimens represent a new species. I propose to call the new cowrie *Cypraea cohenae,* in honor of Mrs. Iris Cohen of Fish Hoek, South Africa. The holotype has been deposited in the Bernice P. Bishop Museum, Honolulu, Hawaii (B.B.M. 8911).

Type locality: The only 2 known specimens were found on the beach in Jeffreys Bay, South Africa.

CYPRAEA CASSIAUI, new species. Plate 4 figs. E-H.

The shell is ovate, heavy and depressed, with prominent sharp margins. The aperture is narrow, slightly curved to the left; the posterior canal, however, is almost straight. The canals are light orange-brown, as is the base. The aperture is lined with coarse, deeply cut teeth. The fossula is deeply curved and ribbed (as is the entire columellar sulcus) and bears 5 or 6 inner denticles. The terminal ridge borders the canal and is slit. The bright, light orange-brown teeth cross the base and are doubly lined with dark orange-brown, which color extends as a single line on the ribs into the fossula and columellar sulcus. The teeth continue as ribs as they cross the lateral margins, fuse, intermingle, and become irregularly tuberculate as they approach the deep, trench-like dorsal groove. The orange-brown lines found on the base change to deep magenta exactly as they cross the lateral margins, where they also fuse into a single line, which broadens to stain the entire ridge joining the tubercles. The tubercles are encircled by magenta-colored lines. The ridges and tubercles end sharply at a trench-like, smooth, deep and sharply cut dorsal groove. No ridge or tubercle infringes into this groove, which extends along the entire dorsum, and the edges of which, even between the tubercles, project to nearly the same height.

About 4 years ago Dr. Pierre Cassiau of Papeete, Tahiti, sent me a specimen of this remarkable cowrie from the Marquesas

Islands for identification. It is a shell which superficially resembles *Cypraea granulata* Pease, 1862. However, there are two striking differences, the most obvious being the color characteristics. The base of the specimen is a brilliant light orange-brown, this color ending sharply at the lateral margins. The entire dorsum of the shell is a deep rose-purple, a color that I have never seen in any other cowrie. Subsequently, Dr. Cassiau sent me 6 additional shells.

I do not believe that general color variation is of significance in the determination of species. I do believe, however, that specific color characteristics limited to a certain area of the shell, i.e. spire blotches or spots, or both, are probably specific. The color combination described is constant even in beach-worn specimens in all 11 shells examined, and I believe it is significant. There is no suggestion of two-tone coloration of any shade in *Cypraea granulata*.

The most significant conchological difference manifested by this species is the dorsal groove. The groove is very deep and smooth because the edges are built up by an uninterrupted wall on each side, traversing the entire length of the shell. The groove is not a simple, shallow one between elevated tubercles such as occurs in *Cypraea granulata*. The extremities of *Cypraea cassiaui* are noticeably more attenuated than those of *Cypraea granulata*, and the shell is more pointed.

Cypraea circercula Linn., 1758, may be differentiated by its more inflated cylindrical shape and its homogeneous yellow-brown color.

Four additional specimens of this species were sent to me for examination by Dr. Tucker Abbott of the Academy of Natural Sciences of Philadelphia. One specimen comparing in every significant conchological character to the holotype bears the number ANSP. 80063, (paratype E), and is from Starbuck Island in the Line Islands. Three more, also comparing in significant conchological characters to the holotype are in ANSP. no. 80860, (paratypes B,C,D), and are from Flint Island in eastern Polynesia (1901). Both lots were from the C. D. Voy collection.

All specimens so far have been beach-collected. Several, however, are fresh and hardly worn, as can be seen from the photo-

cohenae	Length	Width	Height	Dentition		Collection
	(in millimeters)			Labial	Columellar	
Holotype	29.4	17.5	13.7	17	0	Bishop Museum
Paratype A	25.5	15.4	12.0	16	0	Iris Cohen
cassiaui						
Holotype	30.5	22.0	13.9	21	18	Bishop Museum
Paratype A	23.4	16.1	11.6	20	17	Pierre Cassiau
Paratype B	23.3	16.3	10.6	23	14	Academy Nat. Sciences (Flint Island)
Paratype C	24.9	16.8	11.0	21	17	Academy Nat. Sciences (Flint Island)
Paratype D	24.8	14.6	11.0	20	15	Academy Nat. Sciences (Flint Island)
Paratype E	21.8	14.0	9.8	20	16	Academy Nat. Sciences (Starbuck Island)
Paratype F	25.9	16.8	11.5	19	17	Jean Marie Frebault
Paratype G	25.9	17.2	11.5	21	17	Jean Marie Frebault
Paratype H	26.4	19.7	11.9	20	16?	Jean Marie Frebault
Paratype I	28.6	20.5	13.3	20	19	Rereao Krauser
Paratype J	28.1	21.1	13.7	22	?	Rereao Krauser

graph of the holotype. The freshest specimen has no gloss between the ridges and tubercles, in which characteristic it is similar to *Cypraea granulata.*

The species seems specifically different for the reasons listed. I propose to name this cowrie *Cypraea cassiaui* in honor of Dr. Pierre Cassiau of Papeete, Tahiti. The holotype (B.B.M. 8910) has been deposited in the Bernice P. Bishop Museum in Honolulu, Hawaii.

Type locality: This species so far is known only from the Marquesas, Starbuck, and Flint Islands in eastern Polynesia. The Marquesas are designated as the type locality. Paratypes from the Marquesas are also in the Jean Marie Frebault and Rereao Krauser collections in Tahiti.

A NEW CYPRAEA FROM EASTER ISLAND

By RAY SUMMERS, Petaluma, California, and
C. M. BURGESS, Honolulu, Hawaii

CYPRAEA ENGLERTI, **new species.** Plate 4, figs. I-L

Two specimens of a distinctive cowrie were collected by Father Sebastian Englert on Easter Island and kindly forwarded to the senior author. These two apparently live-collected, perfect adult specimens seem adequate to establish a new species without question. It is a privilege to honor that devoted and self-sacrificing padre by giving his name to an endemic mollusk from his beloved island; *Cypraea englerti,* new species. The holotype, (Plate figs. I-L) , has been deposited in the Bernice P. Bishop Museum in Honolulu, Hawaii (number B.B.M. 8909) . The holotype measures (in millimeters) 22.8 in length, 17.0 in width, and 12.8 in height.

The shell of the holotype is solid, ovate and slightly pointed anteriorly where there are 5 right and 2 left lateral pits. The spire is slightly elevated and is covered with rust-colored nacre. There is a discrete white deposit of callus to the right of the spire. The dorsum is inflated and smooth with a prominent dorsal line.

The dorsal color is a homogeneous dark chocolate-brown. marked with discrete, circular, variable-sized, pure-white spots, (1.0 to 0.2 mm.) , which are evenly distributed. The spots are rendered golden brown on the margins by an overlay above and obscured completely by a brownish-tan callus at the margins, both of which are prominent and sharp. This "café-au-lait" color extends across the base, becoming markedly darker in the mid-portion of the columellar base and then fading again to tan at the aperture. The aperture is cream, changing to pure-white in the fossula and columellar sulcus.

The fossula is deeply curved, well developed, and extends well into the interior of the shell. There are 5 strong white inner denticles, confined to the fossula. The heavy tan terminal ridge continues as the prominent anterior edge of the fossula. The columellar sulcus is smooth. The teeth are strong and deep, but only slightly produced. There are 17 labial teeth and 2 posterior crenulations within the posterior canal. There are 16 columellar teeth of similar size and appearance. The base is strongly convex and the aperture is curved slightly to the animal's left posteriorly.

The anterior and posterior canals are stained cafe-au-lait.

The paratype is the same in general appearance as the holotype, except that it is slightly less mature and the calloused margins are not quite so prominent. Labial teeth number 16 with 2 posterior crenulations within the canal. There are 15 columellar teeth. The first 4 have definite ribs extending a short distance into the fossula. There are 5 well developed inner denticles confined to the fossula, as in the holotype. The paratype measures (in millimeters) 24.3 in length, 16.9 in width, and 13.3 in height. The paratype is in the collection of the senior author.

This species is superficially similar to, but can be differentiated from, *Cypraea caputserpentis* Linn., 1758 and *Cypraea caputdraconis* Melvill, 1888. *Cypraea englerti* resembles these latter two species from a dorsal view, but can be separated at once by the presence of a strongly developed fossula. The aperture in *Cypraea englerti* is narrow and does not flare widely anteriorly as in *Cypraea caputdraconis.* Another distinguishing feature is the markedly convex base, which is in contrast to the concave or flat base of *Cypraea caputdraconis.* The teeth of *Cypraea englerti* are about the same width as the white to cream interstices. In *Cypraea caputdraconis* the interstices are much wider and furthermore are stained dark-brown to black. The soft parts are unknown. This is probably a shallow-water species collected on the reef.

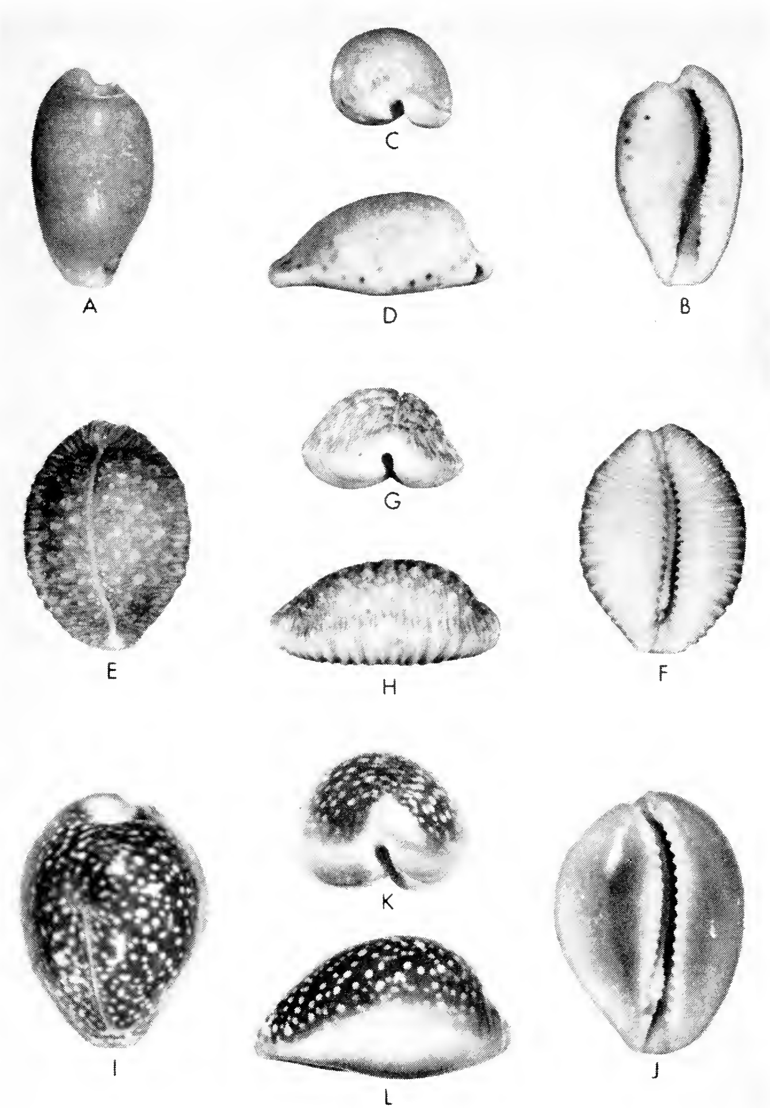
Type locality: This species is known only from Easter Island, eastern Polynesia.

CORRECTIONS OF SPHAERIID NOMENCLATURE

By H. B. HERRINGTON
Westbrook, Ontario

In these notes I wish to alter somewhat the nomenclature used in my monograph (Herrington, 1962).

A number of leading students of the Sphaeriidae continue to use the subgenus *Musculium* for the group containing *Sphaerium lacustre* (Müller), *S. partumeium* (Say), *S. securis* Prime, and *S. transversum* (Say). I consider this reasonable, and am now in the process of gathering the information necessary to provide equal status for other groups within the genus *Sphaerium.* See my monograph, pp. 7-9.



Figs. A-D holotype of *Cypraea cohenae* Burgess (length 29.4 mm.). Figs. E-H, holotype of *Cypraea cassiaui* Burgess (length 30.5 mm.). Figs. I-L, holotype of *Cypraea englerti* Summers and Burgess (length 22.8 mm.). Photography by Gilbert Halpern, Honolulu.

Last October H. B. Baker pointed out (Baker, 1964) that in rejecting the name *Sphaerium simile* (Say) for that of *S. sulcatum* (Lamarck), I erred in my interpretation of old terms (Herrington, 1950) Baker writes, "Herrington . . . seems to have been a bit confused. In bivalves, Say, like many of his contemporaries, for example Isaac Lea, used "breadth" to mean what we now call length, and employed 'length' for what we term height. They used diameter much as we do. This means that the missing type of *similis*, as Say measured it, was about 10.2 mm. long and 8.9 mm. in height (87% of length) . . ."

I put into all these terms a present-day content (as most people do when they read the King James version of the Bible). I acknowledge my error. Henceforth I shall label this species *Sphaerium simile* (Say) 1816, and not *S. sulcatum* (Lamarck) 1818.

Recently both Nils Hj. Odhner and J. G. J. Kuiper, partly in personal correspondence with me, have indicated that *Pisidium ventricosum* Prime and *P. rotundatum* Prime are not synonyms of *P. obtusale* Pfeiffer. In addition, on the basis of the ligament pit and other characters, Kuiper has pointed out that *P. punctiferum* (Guppy), *P. punctatum* Sterki and *P. tenuilineatum* Stelfox are each separate species (see Kuiper, 1962a and 1962b). These decisions are partly based on anatomical characteristics. I am, therefore, reverting to names previously in use in North America, vis. *P. ventricosum* Prime, and *P. ventricosum*, form *rotundarum* Prime, and *P. punctatum* Sterki.

Then there is the matter of *P. henslowanum* (Sheppard) and *P. supinum* Schmidt. Both are introduced species.

Among the shore debris at Athol Bay, Lake Ontario, Prince Edward County, Ontario, I have collected many thousands of *Pisidium* shells. Thousands of these belong to this *henslowanum-supinum* complex. Among these I found some typical *henslowanum* and some typical *supinum* and a multitude that were not typical of either. For this reason, and because I knew of two or three European students who suggested that the relationship between these might be that of species and form, I treated them, in my monograph, as *P. henslowanum* (Sheppard) and *P. henslowanum*, f. *supinum* Schmidt.

Early in 1963 I sent a quantity of these shells to Kuiper. I quote from his reply (May 27, 1963).. "I agree with your identification of the species from the Athol Bay, Ontario Lake. Although not typical, it is, in my opinion, *Pisidium supinum* A. Schmidt. You prefer to consider it only as a form of *P. henslowanum* (Sheppard). I admit that it is often very difficult to separate museum series of both species. On the other hand, on the European continent, there are several localities in which *henslowanum* and *supinum* live together, without intermediate forms. This is the point of view of Ellis, too". As these are European species I am accepting his findings and henceforth will treat them as separate species.

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PALEOECOLOGIC INTERPRETATION AND THE IMPORT OF RECENT FAUNAS

By ERIC PANITZ
Department of Zoology, University of Kentucky, Lexington

Recently in the Nautilus (1964, *78*:17-18), Nicol attempted to show that comparison of living species of major groups with their Paleozoic congeners would not reveal proper palaeoecologic conclusions. It is inferred that species must be compared only on a strictly morphological basis. Nicol infers that insects, known to be extremely large during the Pennsylvanian as compared to the recent, were large only as a stage in their evolutionary development.

It should be pointed out that any species develops as a result of the response of its epigenetic and genetic components to the environment in which it is found (Mayr, 1963), not the reverse as Nicol implies. Since the insects of the Palaeozoic must have evolved in response to their environment, their morphologic evolutionary development will be a reflection of the effect of ecologic conditions (prior to and including that stage of development) on that species epigenesis.

It is an established generalization that the ratio of body surface area to volume is of great importance in the control of metabolism (Bergmann's Rule) by regulation of body heat. The insects, being of large surface area to low volume radiate comparatively more body heat (energy) in warmer climates than animals with lower surface area/volume ratios. The latter animals are generally found in colder climates, where of necessity they must conserve body heat. Thus the interpretation of the Pennsylvanian as having a rather warm tropical climate is quite proper.

The reason that pelecypods began to show their great diversity and adaptive radiation after the Palaeozoic is that ecologic conditions prior to this time were not such to permit the genetic component of these animals to expand into the niches that later became available. Since morphological and physiological characters are under control of the genetic component of the species, one cannot compare Palaeozoic and recent faunas on a strictly morphological basis. These characters must be compared on a basis that considers currently accepted physiological principles whose application may be inferred from the nature of the morphological structures. Thus an increase in the size of a species came about because the environment not only permitted it, but also require the species to undergo these epigenetic changes in order for it to survive in that environment. If the genetic composition of a species could not allow for the gross fluctuations that were gradually taking place in the environment, that species became extinct.

Many, if not all, of the ecogeographical rules can only be applied to terrestrial vertebrates. No parallels are known for aquatic or marine organisms, probably due to the temperature modifying influence of the vast masses of water. Proper inferences on invertebrates can be made if the physiological requirements of their environment are considered. In making interpretations of palaecological conditions, the morphology of any group or species must be considered in light of currently existing physiological principles. Principles which must have been in operation in the past as well as the present. A mere comparison of morphological characters, without consideration of their physiological and genetic implications will, of necessity, lead to a mis-interpretation of the paleo-environment in which the species possessing such characters dwelled.

Nicol may be correct in assuming that shell attached marine pelecypods were not present in Ordovician, Silurian, Devonian and Mississippian strata because they did not exist. Such pelecypods may not be found in colder marine seas today for reasons other than the morphological ones noted by Nicol (1964b). Oxygen or other dissolved gas content, lack of suitable food or the presence of some parasite may all be responsible for the observed lack of shell-attached pelecypods in Arctic and Antarctic seas. Finally, one should remember that far more than one group of marine animals must be considered in all their ecological, physiological and genetic implications and ramifications before such a broad generalization such as the temperatures of vast oceanic areas should be considered.

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GROWTH IN ONE SPECIES OF SPHAERIID CLAM*

By GRACE J. THOMAS
University of Georgia

The growth of organisms in temporary ponds is of great interest because of the restrictions imposed on the animals by the environment. The following study on growth of *Sphaerium (Musculium) partumeium* was undertaken in an effort to find out under what conditions the clams are able to complete their life cycles in such a habitat.

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* This study was a portion of research done in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Michigan. The author wishes to acknowledge the interest and encouragement of Dr. Frank E. Eggleton.

The field study was done during the spring on a pond described in a previous paper (Thomas 1963). The laboratory stock consisted of laboratory-born offspring of clams collected from the same pond.

Methods. Specimens of *Sphaerium partumeium* in the laboratory were grown in isolation, in dishes which contained water saturated with calcium salts, but with no aquatic plants or bottom material (Thomas 1954). The cultures were exposed to a fourteen-hour day and temperatures near 21° Centigrade. Twenty percent of them were aerated.

Young produced in these cultures were measured and isolated immediately. The only measurements which can be made readily on living specimens are of shell growth, so weekly records were made of two dimensions, the length (distance from extreme anterior to posterior ends) and height (distance from umbone to ventral edge).

Growth data on field specimens were obtained from a series of weekly collections begun in March when the pond filled with water and continued until it dried up at the end of July. Quantitative sampling was impossible because of the plant growth in the pond, but an effort was made to take approximately the same amount of bottom material in each collection. The samples were taken into the laboratory, sorted, and the clams found were measured and grouped into size classes.

Growth in Laboratory Cultures. The first sign of growth in latoratory-reared animals is a deposition along the ventral margin of the embryonal shell. Within a week after growth begins, shell material is also being added at the anterior and posterior ends, and for a short time the outline is roughly oval. This new portion is easily distinguishable for it has a delicate, translucent appearance and is deflected toward the midline from the edge of the embryonal shell. The two valves thus form a wide angle at the ventral edge. This angle decreases with the addition of increments at the edge, but at the same time the sulcus which sets off the embryonal shell becomes more distinct and produces the "capped" effect evident at all later stages. When the animal attains a length of about 2.5 mm an additional deposit along the posterior margin produces the somewhat truncated appearance characteristic of the species. In very old specimens, how-

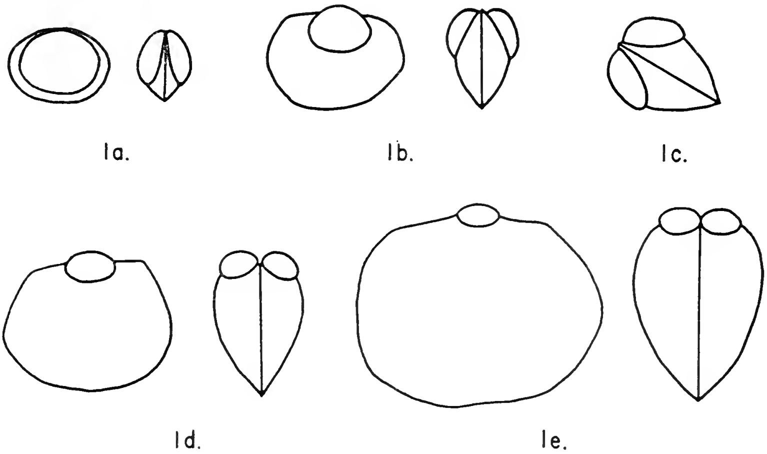

Figure 1. Deposition of shell material in a developing clam. (1a.) at 1.8 mm (1b. and 1c.) at 3.2 mm (1d.) at 5.1 mm (1e.) at 9.0 mm

ever, a rounding of the outline is brought about once again by repeated increments on all free margins. (Figure 1a-e)

Growth of 6 laboratory specimens is plotted in Figure 2. The animals showed varying amounts of initial lag, but the slope of the line representing the 10 to 12 weeks of active growth is very similar in every case. The animals which showed no initial lag produced more generations in a given length of time than the others; their offspring likewise began to grow immediately. This characteristic is not correlated with birth size, age or size of parent.

The ratio of shell length to shell height was constant from the third or fourth week until the end. Although measurement through the umbones was not made, obviously the ratio of this dimension to the others changed markedly during the period of rapid growth. From about the third through the fifth week the animals are so obese that when laid on one side the dorso-ventral axis is inclined at a 35° angle, but as increments are added at the edge the obesity is correspondingly reduced. (Figure 1c)

Maximum size attained by the laboratory-reared clams was 7.17 by 6.92 mm. By arbitrarily taking a length of 4.0 mm as the lower limit of adult size the mean final size of 52 individuals raised was

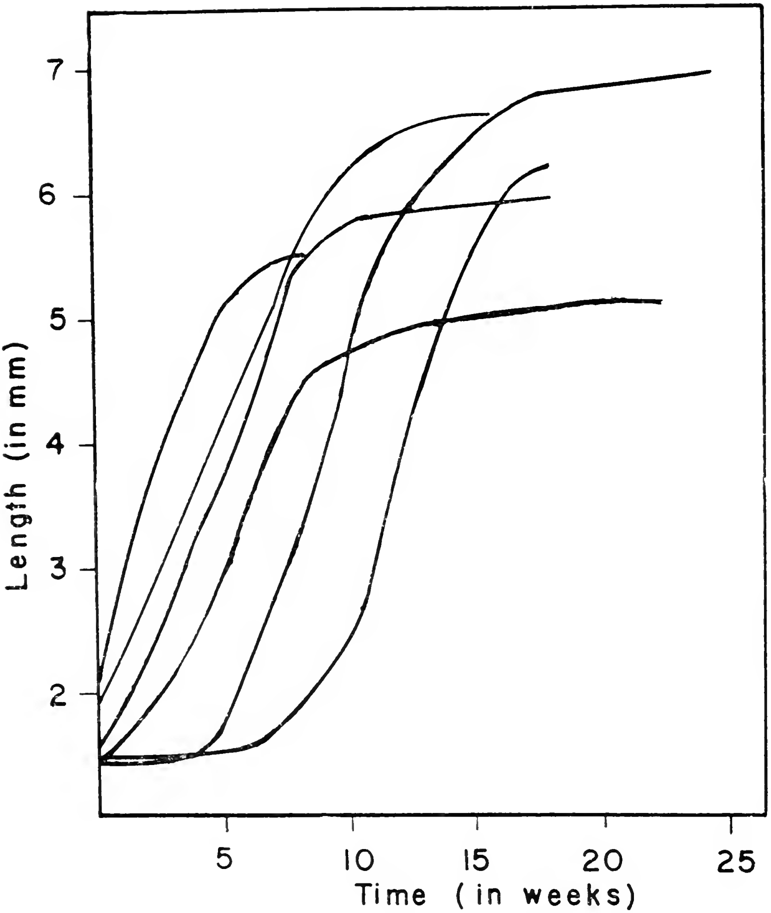

Figure 2. Growth curves based on measurement of shell length for six individuals reared in laboratory cultures.

5.54 by 4.86 mm. Only two of those individuals were in aerated culture dishes. Growth of clams was inhibited by the presence of ciliated protozoans.

Field Collections. At the time of the first collection in March, the pond had been filled with water for only a few days and had a thin ice cover. The water temperature near the bottom beneath the ice was 3° C. At the end of several weeks when the water temperature was elevated to about 8° C large masses of fila-

TABLE I

MEAN GROWTH MEASUREMENTS OF FIELD POPULATION

Collection Date	No. of Specimens	Mean Length (in mm)	Mean Height (in mm)	L/H
3/12	61	1.6	1.2	1.3
3/19	97	1.8	1.4	1.27
3/26	80	2.1	1.6	1.31
4/2	44	2.2	1.8	1.22
4/9	42	2.4	1.9	1.26
4/16	187	3.0	2.4	1.25
4/23	58	3.4	2.8	1.21
4/30	227	4.0	3.3	1.21
5/7	170	4.7	3.9	1.20
5/14	59	5.5	4.6	1.19
5/21	69	5.4	4.5	1.20
5/28	222	5.7	4.8	1.19
6/4	114	6.4	5.5	1.16
6/11	271	6.2	5.1	1.21
6/18	250	7.0	6.0	1.16
6/25	152	7.4	6.5	1.13
7/2	130	7.2	6.1	1.18
7/9	27	7.4	6.3	1.17
7/16	14	7.4	6.3	1.17
7/23	41	7.1	6.0	1.18

mentous algae (principally *Tribonema bombycinium*) appeared. Within these masses the clams moved in large numbers. By the end of the 8th week, after the water temperature had ranged between 12-14° C for 3 weeks, the algal masses began to disintegrate. The clams, however, continued to grow rapidly until the 14th week, when the water temperature was suddenly elevated to 24°C, and at the same time the production of young sphaeriids began. The growth of adults then continued at a much slower rate.

The mean length, mean height, and length-height ratio for each collection is given in Table 1. From the mean lengths of animals in this series of samples a growth curve for the natural population was constructed (Figure 3). The mean length at death was 7.4 mm and the maximum length 9.2 mm.

The ratios of mean length to mean height show the same gen-

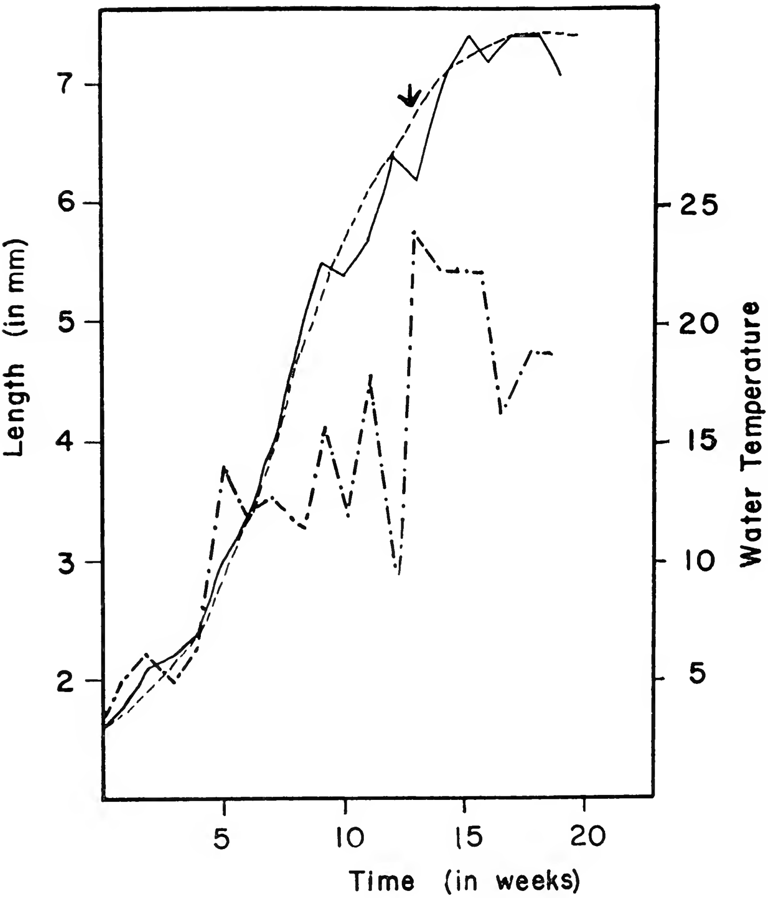

Figure 3. Growth curves for field population using mean of shell lengths for clams of weekly collections. Also included are water temperatures for the same period, and an arrow indicating the point at which young began to appear.

—— growth curve based on actual means
- - - -growth curve constructed by inspection
— . —water temperatures

eral trend as in the laboratory specimens. However, up until the 15th week the animals in the field stock are markedly more elongated than laboratory specimens of the same age and length. (Figure 4). This difference, which is statistically significant was observed in the course of the study long before enough data had

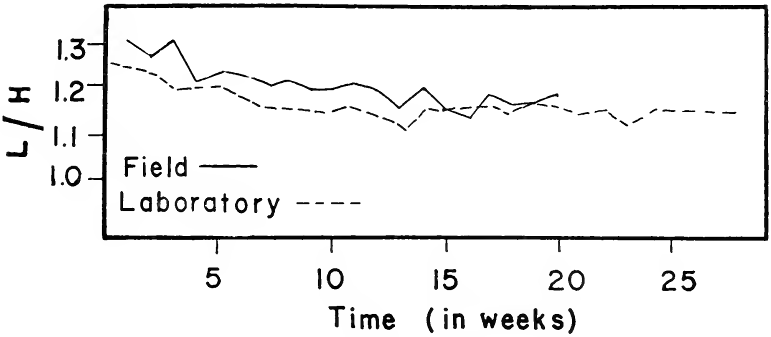

Figure 4. L/H ratios for field and laboratory animals showing a significant difference until the 15th week.

been collected for calculations of the ratios.

Discussion. It appears that under optimal conditions the clams can attain almost full size in seven to ten weeks, and can produce young before the fourteenth week after growth begins. This is of the utmost importance to an organism living in an environment when the water level is as uncertain as in vernal pond. Presumably the individuals that show no lag at the beginning have a selective advantage over others in such a habitat.

The relationship of water temperature to growth in the natural situation is probably related to the growth of food organisms. The fact that shedding of young coincided with a sudden drastic increase in water temperature may or may not be significant. Probably, however, availability of food is responsible for the greater size of clams in the field population. Possibly the food supply in the laboratory cultures was adequate for life and reproduction, but not sufficient to support maximum growth. The ciliated protozoans which inhibited growth in laboratory cultures are obviously competitors for that food.

The difference in L/H ratios in field and laboratory populations is interesting. There is a possibility it is an ecological effect, but there is also a possibility it is genetic since the laboratory animals were produced by self-fertilization from a small number of clams originally brought in from the field (Thomas 1959). This observed difference is a somewhat exaggerated example of the variability exhibited by clams of the same species but from different habitats.

It is significant that of the 50 "adults" reared in laboratory cultures only two were from aerated dishes. All the other specimens in such dishes died or grew only slightly. Whether the deleterious effect of aeration was due to mechanical disturbance by the jet, or poor bacterial (food) growth is not known. Obviously the oxygen requirements of the clams are not great since sufficient oxygen can diffuse from the surface of the culture dish. This also is not surprising in view of foul conditions found late in the growing season in the bottom of the pond, or under ice during years when the pond has standing water all winter. (Kenk, 1947).

SUMMARY

1. Most of the growth of *Sphaerium (Musculium) partumeium* (Say) can be accomplished in 7-10 weeks.
2. Young can be produced before the 14th week of growth.
3. Size of clams grown in the field is greater than that of laboratory specimens in this case (possibly because of a richer food supply).
4. L/H ratios of field animals were different from those of laboratory animals.
5. Oxygen is not a limiting factor in the growth of these animals.

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NOTE ON LIMA (ACESTA) ANGOLENSIS

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Fifteen specimens of *Lima (Acesta) angolensis* Adam and Knudsen were trawled by the U. S. Bureau of Commercial Fisheries vessel *Geronimo* on 9 September, 1963, while participating in the *Equalant II* program. All specimens were taken alive in a depth of 951 meters at *Geronimo* Station 249, 04°40′S and 11°00′E, about 55 miles west of Pointe Noire, Congo Republic (Brazzaville). Neither the bottom type nor any hydrographic data were recorded. The original description of *angolensis* (Adam and Knudsen, 1955) was based on the holotype, which was collected by the Belgian Oceanographic Expedition (1948-1949) at Station 88, 10°45′S, 13°07′E, about 40 miles west of Ponta do Môrro, Angola, in 400-500 meters. The *Geronimo* specimens constitute the second known occurrence of the species, increase the bathymetric range 450 meters, extend the geographic range about 360 miles northward, and add significant information on its biology.

Adam and Knudsen (1955) pointed out that *angolensis* is closely related to *Lima (Acesta) excavata* (Fabricius), an eastern north Atlantic species which ranges from Norway to the Azores in depths of 150-1450 fathoms (Thiele, 1918; Vokes, 1963a). In comparing *excavata* with *angolensis,* Adam and Knudsen noted the differences of the shape of the auricles, the size of the lunule, the strength of the ridges which define the lunule, and the development of the rudimentary lateral teeth. This latter trait was described:

"Le plateau cardinal de la valve droite présente à chaque extrémité un nodule; dans la valve gauche il y a aux endroits correspondants de chaque côté deux nodules allongés et parallèles. Ces nodules sont tous très peu apparents."

Dall (1902) documented the occurrence of lateral teeth in *Lima (Acesta) goliath* Sowerby and *Lima (Acesta) patagonica* Dall, and he mentioned that *excavata* lacked lateral teeth. A comparison of *excavata* from Hardanger Fjord, Norway, with *angolensis* shows that distal marginal irregularities, which could be considered obsolete lateral dental elements, occur in both species, rendering this character diagnostically unsuitable.

Other morphological characters, including conchological measurements, afford further specific parameters which may define the species. Table 1 gives some measurements of *angolensis* and *excavata*. The mean height/length ratio of *angolensis* is less than that of *excavata* but the overlap is considerable. More important are the ratios, breadth/height and breadth/length; both of them indicate that *excavata* has a greater lateral expansion. In these ratios, the amount of overlap is small. As pointed out by Vokes (1963b), the posterior auricle of *angolensis* is shorter than that of *excavata,* giving the outline of the shell a more broadly rounded posterior dorsal margin. Further, in *angolensis* the

	Height	Length	Breadth	Height/length	Breadth/height	Breadth/length
angolensis						
holotype	153	122	49	1.30	0.32	0.40
1	164	127	59	1.30	0.40	0.50
2	162	123	62	1.31	0.40	0.50
3	159	120	66	1.32	0.41	0.60
4	159	119	50	1.33	0.31	0.42
5	156	137	58	1.13	0.40	0.42
6	154	117	59	1.31	0.40	0.50
7	152	116	59	1.31	0.40	0.50
8	148	113	57	1.30	0.40	0.50
9	142	111	57	1.30	0.40	0.51
10	139	114	51	1.21	0.40	0.48
11	133	103	49	1.30	0.40	0.50
12	130	104	44	1.30	0.33	0.42
13	123	103	48	1.20	0.40	0.50
14	105	81	31	1.30	0.30	0.40
mean				1.28	0.38	0.47
excavata						
1	135	101	62	1.33	0.50	0.61
2	122	92	60	1.32	0.50	0.70
3	121	89	48	1.40	0.40	0.53
4	115	86	46	1.33	0.40	0.53
5	106	81	42	1.30	0.40	0.51
6	105	82	52	1.30	0.50	0.63
7	104	80	46	1.30	0.44	0.60
8	103	76	39	1.40	0.40	0.51
9	91	65	35	1.40	0.40	0.53
10	80	71	39	1.30	0.43	0.54
11	88	64	35	1.40	0.40	0.54
mean				1.34	0.43	0.56

Table I. Measurements in millimeters of *Lima (Acesta) angolensis* and *L. (A.) excavata*. Holotype data from original description; specimens of *angolensis* from *Geronimo* Station 249; those of *excavata* from Hardanger Fjord, Norway, in the collection of the U. S. National Museum.

anteroventral ridges which define the periphery of the lunule are stronger and more angular than the less definitive ridges in *excavata*. An internal view of the shell shows that the margin of the lunule of *angolensis* is more concave and lacks the strong proximal lunular notch of *excavata*. The radial sculpture is stronger and more widely spaced in *excavata,* perhaps a reflection of its heavier and thicker shell. The sculpture of *angolensis* is less well developed and finer, and the shell itself is thin and rather fragile.

Some epizoic commensal organisms were observed in association with *angolensis*. Two living specimens of a species of the prosobranch gastropod *Capulus,* here tentatively referred to as *C. ungaricus* (Linnaeus), were found attached to *angolensis* in the region of the margin of the lunule. The site of attachment on one specimen is about 30 millimeters in diameter and is impressed in the shell, forming a scar. Four of the limas exhibited these deformations of the shell, three on the right valves and one on the left. The left valve of the holotype of *angolensis* also possesses a similar disfiguration near the lunular margin. In one of the *Geronimo* specimens, an elongate hole was bored through the shell by *Capulus*. The snail lives with its apex directed away from the edge of the shell of its host, a condition similar to that exhibited by *Capulus ungaricus* on *Chlamys opercularis* (Linnaeus) in Europe (Sharman, 1956).

At least 6 of the specimens of *angolensis* have small, circular depressions which measure from one to three millimeters in diameter, distributed on the surface of the valves. These depressions are occupied by a species of the foraminiferan genus *Rosalina*. A complete penetration of the limid's shell may be effected in these depressions, and the mantle of the mollusk may secrete a conical deposit on the internal surface of the valve in a reaction against the irritation caused by the *Rosalina*. Other foraminiferan species of the genera *Cibicides* and *Placopsilina* may be attached to the shell externally.

The soft parts of all the specimens were preserved. None of them possessed a byssus; however, these limas may possibly attach byssally in the immature stage. The posterior pedal-byssal retractor muscle is small and inserts in the muscular portion of a special axial branchial apparatus which irregularly attaches to the shell posteroventral to the strong adductor muscle.

Acknowledgments. The specimens of *angolensis* were transmitted to the U. S. National Museum by Dr. J. Lockwood Chamberlin of the Bureau of Commercial Fisheries Biological Laboratory, Washington, D. C. Dr. Ruth Todd of the U. S. Geological Survey, Washington, D. C., identified the genera of Foraminifera.

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MOLLUSKS NEW TO SOUTH CAROLINA

By ARTHUR S. MERRILL[1] AND RICHARD E. PETIT[2]

Certain species collected in beach drift along the shores of South Carolina, and other material brought to us by cooperating shrimp fishermen in the past, led us to suspect that many of the mollusks from the Caribbean province inhabit these waters but have never been reported in the literature due to the lack of concentrated collecting. Therefore, we decided to do extensive shore collecting and offshore dredging when possible, in an effort to define properly the fauna. This work has resulted in many range extensions to South Carolina, some of which are here reported.

Many of our range extensions are major ones, commonly extending known ranges northward from southeast Florida, over four hundred miles. These records from South Carolina are particularly important because this state lies between Cape Hatteras and southern Florida, areas where the molluscan fauna has been much more extensively defined. One has only to check the "specimens examined" sections of *Johnsonia* to realize the lack of specific locations for species between these areas. Most of the North Carolina records are from the old *Albatross* dredgings, and those from southern Florida are largely from the McGinty dredgings. Until our recent work, little dredging has been done off the South Carolina coast since the *Albatross* made a few deep water stations in 1885.

We are fortunate to have dredgings from 18 stations offshore to supplement our shore collecting. Our first series of dredgings consisted of a transect of 12 stations off McClellanville, S. C. made in July 1963 aboard the shrimp boat, *Miss Kim,* at depths

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of 1 to 64 meters. Another transect of six stations off Cape Romain, S. C. followed in November 1963 using the Woods Hole Oceanographic Institution R/V *Gosnold* at depths of 36 to 268 meters. A 30-inch Digby scallop dredge, lined with ½ inch mesh, was towed at all stations.

This paper is the first of several in which we will report range extensions to South Carolina. We will also reaffirm or clarify older records when this seems necessary.

In determining the distribution of the mollusks we have consulted the usual references which contain such information. These include, in all cases, Dall (1889), Mazyck (1913), Johnson (1934), Abbott (1954 and 1958), Warmke and Abbott (1961), as well as all *Johnsonia* monographs and all volumes of the *Nautilus.*

At least one collection of each species mentioned in this report has been placed in the Museum of Comparative Zoology, except when only one specimen of a species has been taken. Such specimens are being retained for the purpose of comparison until we have completed our studies, at which time they will also be deposited at the MCZ.

We acknowledge the cooperation of the Woods Hole Oceanographic Institution and Dr. K. O. Emery, geologist and chief scientist of *Gosnold* Cruise no. 33, for allowing us several hours of ship time for the purpose of dredging off Cape Romain, S. C., when the vessel was passing through these waters taking echo soundings and seismic profiles.

We are indebted to the following people for assistance in identifying or confirming identification of species within their special interests: Drs. William J. Clench, Ruth D. Turner, Kenneth J. Boss, Harold A. Rehder, Joseph P. E. Morrison, Joseph Rosewater and Alex A. Olsson.

We particularly wish to thank Drs. R. Tucker Abbott and Robert Robertson for examining some of our material and also for reviewing our manuscript.

GASTROPODA

Calliostoma (*Kombologion*) *marionae* Dall.

Calliostoma marionae Dall 1906, Nautilus, *19:* 131.

One large fresh fragment, about two-thirds of body whorl, 21 mm. in diameter, dredged off Cape Romain, S. C. (N. Lat. 32°-

49.0′; W. Long. 78°16.3′), in 65-80 meters, on Nov. 27, 1963. Another fresh fragment dredged nearby.

Previous northernmost record, "off St. Augustine, Fla." (Clench and Turner, 1960, p. 51).

Turritella exoleta (Linnaeus)

Turbo exoletus Linnaeus 1758, Syst. Nat., ed. 10, p. 766.

Live adult specimens, reaching 35 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°49.4′; W. Long. 78°16.7′), in 55 meters, on Nov. 27, 1963; also found to be common in other nearby dredgings.

Previously recorded as far north as, "south half of Florida" by Abbott (1954, p. 141).

Siliquaria squamata Blainville

Siliquaria squamata Blainville 1827, Dict. Sci. Nat., *49:* 213.

One fresh dead specimen, about 90 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°49.4′; W. Long. 78°16.7′), in 55 meters, on Nov. 27, 1963. Also, a smaller dead specimen from a nearby station.

Northernmost range previously reported, off Palm Beach, Fla. (McGinty and McGinty, 1957, p. 39). Bathymetric range also extended, being previously reported from 80-163 fathoms [ca. 150-300 meters] (Johnson, 1934, p. 105).

Epitonium (Asperiscala) apiculatum (Dall)

Scala apiculata Dall 1889, Bull. Mus. Comp. Zool., *18:* 310.

Four adult specimens, largest measuring 10 mm. in height, collected in beach drift at low tide at Ocean Drive Beach, S. C., in Feb. 1960. Also, one small broken shell dredged off Cape Romain, S. C., Nov. 27, 1963, in 46 meters.

Clench and Turner (1952, p. 292) remark that this species is, "known only from North Carolina." However, their *Albatross* station 2619 record is in fact due east of a point about 5 miles south of Myrtle Beach, S. C. Our record from Cape Romain is a minor range extension; our primary purpose here is to point out that this species reaches a much larger size (over twice as large) than has been reported, and to correct the impression that North Carolina is as far south as it ranges.

It might be well to point out at this time that we have collected *Epitonium (Asperiscala) championi* Clench and Turner at Myrtle Beach, S. C. which Clench and Turner also report as ranging south to North Carolina, although their Frying Pan Shoals record is probably well into the latitude of South Carolina.

Epitonium (Epitonium) krebsii (Mörch)

Scala krebsii Mörch 1874, Vidensk, Medd. Naturhist. Forening i Kjöbenhavn No. 17, p. 252.

One fresh dead specimen, 10.6 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°43.2′; W. Long. 78°09.7′), in 176 meters, on Nov. 27, 1963.

Previous northernmost record, "off Palm Beach, Fla." (Clench and Turner, 1951, p. 258).

Crucibulum auricula (Gmelin)

Patella auricula Gmelin 1791, Syst. Nat., ed. 13, p. 3694.

One fresh dead specimen, 18 mm. in greatest diameter, dredged off McClellanville, S. C. (N. Lat. 32°42.4′; W. Long. 79°06.2′), in 27 meters, on July 2, 1963.

The most northern record listed by most authors is "West Florida," probably as a result of Dall's (1889, p. 152) specific designation of Cedar Keys, Fla. as northern extreme range.

Tugurium (Tugurium) caribaeum (Petit de la Saussaye)

Xenophora caribaea Petit de la Saussaye 1856, Journ. de Conchyl., *5:* 248, pl. 10, fig. 1-2.

One fresh dead adult specimen, 64 mm. in greatest diameter, dredged off Cape Romain, S. C. (N. Lat. 32°43.2′; W. Long. 78°09.7′), in 176 meters, on Nov. 27, 1963.

Previously recorded from the Florida Keys by Johnson (1934, p. 96) and others, but not recorded from the mainland of the United States by Clench and Aguayo (1943, p. 5). However, they did remark that Dall (1889) considered North Carolina as the northern range of this species, but noted that Dall's material apparently included specimens of *T. longleyi* Bartsch, and for that reason they limited the northern range to Cuba. Also reported from off Palm Beach, Fla. (McGinty and McGinty, 1957, p. 40).

Sigatica semisulcata (Gray)

Natica semisulcata Gray, 1839 [in] Beechey, The Zool. of Capt. Beechey's Voyage, p. 136.

Two fresh dead adult shells collected on beach at Ocean Drive Beach, S. C., and one additional specimen inhabited by hermit crab found in old net brought up from 7 meters off Ocean Drive

Beach, S. C.; all collected in the fall of 1959.

Previous northernmost record, Jupiter Inlet, Fla. (Dall, 1889, p. 154).

Cypraea spurca acicularis Gmelin

Cypraea acicularis Gmelin 1791, Syst. Nat., ed. 13, p. 3421.

Several fresh dead to moderately worn adult specimens dredged off Cape Romain, S. C. (N. Lat. 32°49.4′; W. Long. 78°16.7′), in 55 meters, on Nov. 27, 1963; also taken commonly in other nearby dredgings, some badly worn.

Previously recorded as far north as "south half of Florida" by Abbott (1954, p. 180).

Cymatium (Septa) pileare Linnaeus

Murex pileare Linnaeus 1758, Syst. Nat., ed. 10, p. 749.

One fragment of body whorl and outer lip dredged off Cape Romain, S. C. (N. Lat. 32°49.1′; W. Long. 78°16.3′), in 65-80 meters, on Nov. 27, 1963.

Johnson (1934, p. 114) lists the range of this species in the western Atlantic as, "Florida Keys and the West Indies." Abbott (1954, p. 195) extends the range to North Carolina, but Clench and Turner (1957, p. 218) in the latest monograph to include this species shows northernmost record only to Jupiter Inlet, Fla.

Cymatium (Septa) krebsii (Mörch)

Triton krebsii Mörch 1877, Malakozoologische Blätter, *24:* 30.

One fresh dead specimen, 27 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°49.4′; W. Long. 78°16.7′), in 55 meters, on Nov. 27, 1963.

Previous northernmost range, "off Delray Beach, Fla." (Clench and Turner, 1957, p. 221).

Cymatium (Monoplex) parthenopeum (von Salis)

Murex parthenopeus von Salis 1793, Reisen in versch. Prov. Konigreich Neapel, *1:* 370, pl. 7, fig. 4.

One live specimen, 93 mm. in length, taken by trawler *Miss Key,* 40 miles off McClellanville, S. C., in 75 meters, in June 1962.

Previous northernmost range in western Atlantic: U. S. coast, "south end of Lake Worth, Fla."; Bermuda (Clench and Turner, 1957, p. 230).

Cymatium (Linatella) poulsenii (Mörch)

Triton (Linatella) poulsenii Mörch 1877, Malakozoologische Blätter, *24:* 33.

One fresh dead specimen, plus several fragments, dredged off McClellanville, S. C. (N. Lat. 32°31.2′; W. Long. 78°51.0′), in 46 meters, on July 3, 1963.

Previous northernmost range, "off Palm Beach, Fla." (Clench and Turner, 1957, p. 200).

To complete the list of species of the genus *Cymatium* now known from South Carolina we include the following: A juvenile, *Cymatium (Ranularia) caribbaeum* Clench & Turner 1957, was collected alive from a navigation buoy located off Port Royal, S. C. (Merrill, 1962) . A juvenile, *Cymatium (Cabestana) labiosum* (Wood) 1828 was also taken from a navigation buoy from off Cape Romain, S. C., by the senior author in 1948. This record appears in the monograph by Clench & Turner (1957) on page 222. We have taken *labiosum* from off Cape Romain in our recent dredgings.

Bursa thomae (Orbigny)

Ranella thomae Orbigny 1842 [in Sagra], Hist. l'Ile Cuba, *2:* 164, Atlas, pl. 23, figs. 23, 24.

One live 20 mm. adult dredged off Cape Romain, S. C. (N. Lat. 32°43.2′; W. Long. 78°09.7′) , in 176 meters, on Nov. 27, 1963.

Previous northernmost record from Western Atlantic, off Palm Beach, Fla. (Abbott, 1958, p. 57) .

Murex cabritii Bernardi

Murex cabritii Bernardi 1859 ("1858"), Journ. de Conchyl., *7:* 301, pl. 10, fig. 3.

A fresh fragment of a large shell, dredged off McClellanville, S. C. (N. Lat. 32°31.2′; W. Long. 78°51.0′), in 46 meters, on July 3, 1963.

Dall (1889) lists this species as occurring north to Cape Hatteras, N. C. However, Johnson (1934) gives northernmost range as Cedar Keys, Fla., and Clench and Farfante (1945, p. 5) show Pompano, Fla., for their northernmost record. Abbott (1954) also restricts the range to Florida.

Murex rubidus F. C. Baker

Murex messorius var. *rubidum* 'Dall' F. C. Baker 1897, Trans. Acad. Sci. St. Louis, 7 (16) : 377.

One medium-sized live specimen, 30 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°49.4′; W. Lat. 78°16.7′) , in 55 meters, on Nov. 27, 1963.

Previous northernmost record, Lake Worth, Fla. (Clench and Farfante, 1945, p. 9).

Pterynotus pygmaeus Bush

Murex (Pteronotus) pygmaeus Bush 1893, Bull. Mus. Comp. Zool., *23:* 213, pl. 1, figs. 3-4.

One specimen, 14.4 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°43.2′; W. Long. 78°09.7′), in 176 meters, on Nov. 27, 1963.

Previously known only from the holotype which was dredged from *Blake* Station 319, off Charleston, S. C. (N. Lat. 32°25′; W. Long. 77°42′30″), in 262 fathoms [480 meters].

Drupa (Morula) nodulosa (C. B. Adams)

Purpura nodulosa C. B. Adams, 1845, Proc. Boston Soc. Nat. Hist., *2:* 2-3.

Two live specimens, dredged off McClellanville, S. C. (N. Lat. 32°31.2′; W. Long. 78°51.0′), in 46 meters, on July 3, 1963.

Previous northernmost record, "Biscayne Bay, Fla." (Abbott, 1958, p. 63).

Coralliophila aberrans (C. B. Adams)

Purpura aberrans C. B. Adams, 1850, Contrib. to Conch., No. 4, pp. 58-59.

One very fresh, 9.4 mm. specimen, dredged off Cape Romain, S. C. (N. Lat. 32°43.2′; W. Long. 78°09.7′), in 176 meters, on Nov. 27, 1963.

Previous northernmost range, "West Indies" (Warmke and Abbott, 1961, p. 109).

Coralliophila caribaea Abbott

Coralliophila caribaea Abbott 1958, Acad. Nat. Sci. Philadelphia, Monograph 11, pp. 66, 68.

Three live specimens, largest measuring 15 mm. dredged off McClellanville, S. C. (N. Lat. 32°31.2′; W. Long. 78°51.0′), in 46 meters, on July 3, 1963.

Previous northernmost record, off Palm Beach, Fla. (Abbott, 1958, p. 67).

Hyalina (Volvarina) veliei (Pilsbry)

Marginella veliei Pilsbry 1896, Proc. Acad. Nat. Sci. Philadelphia, *71:* 206.

One medium-sized live specimen dredged off McClellanville, S. C. (N. Lat. 32°31.2′; W. Long. 78°51.0′) in 46 meters, on

July 3, 1963. Two fresh fragments also found in dredgings nearby.

Abbott (1954, p. 258) gave range as west coast of Florida, common in shallow water; Johnson (1934, p. 132) restricted it to Boca Ciega Bay, Fla.

In the specimens we collected the color of the shell is reddish brown on the dorsal surface. In specimens we have seen from shallow water off west Florida, the shell is uniformly yellow. On the other hand, dredged specimens from the deeper waters of west Florida are a uniform white color and are smaller than ones from shallow water.

Pyrgocythara coxi Fargo

Pyrgocythara coxi Fargo, 1953 [in] Pliocene Mollusca of southern Florida, Acad. Nat. Sci. Philadelphia, Monograph No. 8, pt. 2, p. 384, pl. 20, figs. 3, 3a.

Two adult specimens about 8 mm. in length, inhabited by hermit crabs, found in seaweed washed ashore at Ocean Drive Beach, S. C., on Feb. 12, 1960. A third specimen was obtained from a tide pool at Myrtle Beach, S. C., about a year later.

This species was described from the Pliocene of St. Petersburg, Fla., but was also noted at the same time as having been found Recent nearby. Range extensions have appeared twice in the literature in the few years since this small species was described. Abbott (1958, p. 97) reported it from Gun Bay, Grand Cayman Island, B. W. I. and Warmke and Abbott (1961, p. 138) noted its occurrence in Puerto Rico. The occurrence of this species as a Neogene fossil in South Carolina will be reported later.

Sayella crosseana Dall

Sayella crosseana Dall 1885, Proc. U. S. Natl. Mus., 8 (18): 286, pl. 18, fig. 10.

One specimen, 4.3 mm. in length, inhabited by hermit crab, found in seaweed washed on shore at Ocean Drive Beach, S. C., on Feb. 12, 1960.

Previous northernmost record, Matecumbe Key, Fla. (Henderson, 1913, p. 59).

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NOTE ON ELLIPTIO SPINOSA IN GEORGIA

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Numerous specimens of *Elliptio spinosa* (Lea) have been collected in recent years from the Altamaha River at Fort Barrington, Long County, Georgia (Tomkins, 1955). We are reporting the extension of the known range to Jessup on the Altamaha River, and into the Ocmulgee River at Jacksonville, Telfair County, and Red Bluff on the Ben Hill-Coffee County line.

All our collections were made from the protected sides of sand bars in the river, and include both living animals and shells. Living specimens ranged from 4.2 mm. to 9.4 mm. in length. Six other species of unionids were associated with *Elliptio spinosus* at one or more stations (Table I).

Table I.

(An X indicates the presence of the species in collections at the given locality.)

Species	Stations		
	Jessup	Red Bluff	Jacksonville
Alasmidonta arcula (Lea)	X		X
Anodonta gibbosa Say	X		
Elliptio hopetonensis (Lea)	X	X	X
Elliptio shepardianus (Lea)			X
Elliptio spinosa (Lea)	X	X	X
Lampsilis dolabraeformis (Lea)	X	X	X
Lampsilis splendida (Lea)	X		X

The species represented by the largest number at every station is *Lampsilis dolabraeformis.* At Jacksonville *Elliptio hopetonensis* and *Lampsilis splendida* also occur in large numbers. *Alasmidonta arcula,* on the other hand, is represented in the collections by a single specimen.

It is interesting to note that these 3 species of *Elliptio,* the 2 of *Lampsilis,* and *Alasmidonta arcula* were described by Lea from shells collected on the lower Altamaha River near Darien. (Lea, 1834, 1838). In view of the fact that these species occur in the Ocmulgee River we must next discover whether they are also to be found in the lower portion of the Oconee River, the other major Altamaha tributary.

The authors wish to express thanks to Ivan R. Tomkins for specimens from Fort Barrington, and to Milton Hopkins II, Milton Hopkins III and Heyward Mathews for collections on the Ocmulgee.

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AMERICAN MALACOLOGICAL UNION THIRTY-FIRST ANNUAL MEETING

The isolation of Wagner College upon a Staten Island, New York, hilltop was no surprise to those who attended the 1955 meeting. Little had changed save for the mighty Verrazano Narrows bridge visible in the distance and the new dormitories and students' union building added to the campus. As before, the New York Shell Club acted as host; its busy members seemed to be everywhere at once, while they ministered to the comfort and convenience of the visitors.

Over the four day period, July 20 to 23, 1965, President Juan J. Parodiz introduced the following papers:

Some inland mollusk records from Nicaragua, M. K. Jacobson. Small beginnings, A. B. Wheel. The surf clam fishery, Arthur E. Merrill. The families of Turridae, J. P. E. Morrison. Sculptural traits in the Tellinacea, Kenneth J. Boss. Coelenterate-associated prosobranchs in the Indian Ocean, Robert Robertson. Starch-gel electrophoresis in oyster sera, A. Rosenfield and C. Sindermann. Results of deep-water testing, Ruth D. Turner. Bacterial epizootics of larval and juvenile pelecypods, H. Tubiash. The naiad fauna of the Green River of Mundfordville, Kentucky, David H. Stansbury. Cytological studies in Stylommatophora, Rajagopala Natarajan. Sexual dimorphism in the radula of *Nassa,* Virginia O. Maes. Deep water oysters from the lower Patuxent River, Maryland, Kenneth Boss and Arthur Merrill. Re-examination of E. S. Morse's study in changes in the shells of *Mya arenaria,* Ralph W. Dexter. Studying living Tridacnidae in the Marshall Islands, Joseph Rosewater. The story of the MSX, outbreaks and oyster mortality in Delaware Bay, H. Haskin. Studies on captive *Prunum apicinum* Menke, Dorothy Raeihle. The naiad fauna in the Little Darby Creek in central Ohio, Carol B. Stein. Pathologic responses of the oyster *Crassostrea virginica* to infection by the protistan parasite MSX., A. Farley. Biological significance of aerial sea surface temperature surveys, R. B. Stone. Ecology of *Tarebia granifera* and *Melanoides tuberculata* in south Texas, Harold D. Murray. Pink sands of Eleuthera, Dorothy and Norman Jensen. Camera close-ups of live mollusks, George Raeihle. Malacological musings, James E. Wadsworth. Maintenance of oyster tissue in vitro, A. Rosenfield. The genus *Cucullaea* (Pelecypoda), past and present, Katherine V. W. Palmer. Electrophoretic studies of some diploid and polyploid Bulinidae, G. L. Place. On the genera of Hipponycidae, J. P. E. Morrison. Marshland is not wasteland; film presentation of the Staten Island Institute of Arts and Sciences. The Marquis de Folin and his work on the Caecidae, Donald R. Moore. Late Cenozoic evolution of the *Aequipecten gibbus* stock, Theodore R. Waller. South American malacology, Dee Dundee. Enzyme histochemistry of the American oyster, *Crassostrea virginica,* A. F. Eble. Freshwater and land snails of St. Lucia, West Indies, Emile A. Malek.

The invitation of the North Carolina Shell Club to hold the 1966 A.M.U. meeting in that state was accepted, exact place and date to be announced.

The following slate of officers was elected to serve during the next year:

President, Ralph W. Dexter. Vice-President, Leo G. Hertlein. Second Vice-President, Alan J. Kohn. Secretary, Margaret C. Teskey. Treasurer, Mae Dean Richard. Publications Editor, M. Karl Jacobson. Councilors-at-Large: Mary Kline, Joseph Rosewater. Robert R. Talmadge, Gordon Usticke. —MARGARET C. TESKEY, Secretary, American Malacological Union, Inc.

NOTES AND NEWS

OTALA LACTEA FROM TIERRA VERDE FLORIDA — On October 24, 1964, 7 living specimens of *Otala lactea* (Müller) were collected on the island of Tierra Verde, Florida (on the former Cabbage Key in a region on the gulf side of the Pinellas Bayway about 1.3 mi. from the bridge at the north end of the island). They were found under boards in an area where construction materials were piled; however, numerous empty shells were also observed and collected in the surrounding brushy areas. (The authors are grateful to R. Tucker Abbott for verifying the identification on these shells and to G. E. Woolfenden for a previously collected living specimen indicating their presence in this area.) Since the region was extremely dry at the time, and the majority of the living snails presumably were secreted in protected places, no impression of the size of the population was obtained.

Although the presence of *Otala* on Cabbage Key has been known for some time (Henderson, 1937, Nautilus *50:* 72; Van Der Schalie, 1938, Nautilus *51:* 132-34), it was considered important by the authors to update the record since the area involved has been undergoing intensive development. Of additional interest was the existence in the sample of what appears to be a number of phases of shell pigmentation. These phases ranged from a complete absence of line and aperture coloration through at least one intermediate group, to individuals exhibiting dark, chocolate-brown lines and apertures. The animals of the first group, although lighter, did not appear to be completely devoid of body color; however, their shells were grossly unpigmented even though textural evidence of line markings could be observed. —FRANK E. FRIEDL and RONALD A. BAYNE, Department of Zoology, The University of South Florida, Tampa 33620.

TWO NEW LAND MOLLUSK RECORDS FROM FLORIDA. — During the course of an investigation of the land mollusks of northwestern Florida, two species were found that do not appear to have been previously recorded from this state.

Mesomphix pilsbryi (Clapp) was found to be quite numerous 0.2 miles due south of the lodge at Florida Caverns State Park, Jackson County, Florida. It was found among moist limestone rubble along with many other land snails. This species was identified by Mr. Leslie Hubricht of Meridian, Mississippi. *Mesomphix pilsbryi* has been reported from several counties in southern Alabama by Walker (1928) and Pilsbry (1946).

Limax flavus Linnaeus was discovered at a single urban locality in Tallahassee, Leon County, Florida. It was quite common under stones and leaf litter around a residence at 208 Fifth Avenue. Numerous similar habitats have been examined in and around Tallahassee without any trace of this slug being discovered, which suggests that it is a recent immigrant to this area. This slug has previously been found as far south as southern Alabama and Georgia (Pilsbry, 1948) and its presence in northern Florida is not surprising. Tallahassee specimens are very dark for the species, almost black, with only scattered yellow spots.

Specimens of both species have been deposited at the Florida State Museum in Gainesville. —LANDON T. ROSS, Dept. of Geology, Fla. State University, Tallahassee.

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THE NAUTILUS

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SEXUAL DIMORPHISM IN THE RADULA OF THE MURICID GENUS NASSA

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In the course of working out differences between two species, *Nassa francolina* (Bruguière, 1789) and *Nassa serta* (Bruguière, 1789), I came upon an interesting case of sexual dimorphism in the radula. As far I know, this has been reported only once before: by Arakawa (1958), who found this phenomenon in another muricid genus, *Drupella*. Both Cooke (1919) and Peile (1937) remarked upon the variation in *Nassa* radulae but did not recognize its meaning. Hollister (1954) described a similar variation in the rachidian of the fasciolariid *Pleuroploca gigantea* but correlated this variation with the size (age) of the shell and not the sex. The similarity of this dimorphism, the increase in size of the central cusp at the expense of the lateral cusps of the rachidian in all 3 cases, leads one to the disturbing conclusion that this type of radular dimorphism may be a rather common phenomenon. Certainly it indicates the importance of keeping all pertinent data with both the radula and the shell and of basing observations on numbers of specimens of both sexes.

Before describing this dimorphism it might be well to clarify a few of the confusing taxonomic problems surrounding my material. For the two species discussed, I use the genus *Nassa* Röding, 1798, type *N. picta* = *Buccinum sertum* Bruguière (both names are referred to the same Chemnitz figures). *Iopas* H. & A. Adams, 1853, type *B. sertum,* is a synonym. This is not *Nassa* of Lamarck, 1799, which is *Nassarius* Duméril, 1806. Both Dall (1909) and Winckworth (1945) have discussed this use of the name *Nassa.*

Confusion between Bruguière's two species *Buccinum francolinum and sertum* is so widespread that literature records on the distribution of the two species are usually worthless. Peile (1937) incorrectly called *francolina,* the Indian Ocean species, *"sertum"* and others have incorrectly called *sertum "francolina."*

Many authors, including Cooke (1919) have believed the species synonyms. As mentioned above, *Nassa francolina* (Pl. 5, f. 1 & 2), is an Indian Ocean species with a range extending from South and East Africa to Western Australia, Sumatra and the western end of Java, with the exception of Cocos - Keeling Islands. In his original description, Bruguière described the fine, continuous, spiral whitish lines by which the smoother shelled *N. francolina* can be separated from *N. serta*. *N. serta* (Pl. 5, f. 3-6), the Pacific Ocean and Cocos - Keeling species, usually has a rougher shell and although the spiral cords may be worn to a pale shade of brown, they are not continuous or as fine. From the Cook Islands and Hawaii to Eastern Polynesia *N. serta* becomes smoother but all specimens lack the fine, continuous lines. Probably Reeve's figure of one of these smooth Polynesian *N. serta* misidentified as *francolina* has been responsible for much of the confusion surrounding the identity of these two species.

As there are greater differences between the radulae of male and female *Nassa francolina* and *serta* than there are between the two species, I will discuss the sexual dimorphism of both species first and then point to the minor specific differences.

The radulae of *Nassa francolina* and *N. serta* usually have about one hundred rows of teeth. Thiele (1869) reported 124 rows in a specimen (probably *serta*) from the Philippines. Peile (1937) reported 83 and 92 "developed" rows of teeth in *Nassa* from Mahe, Seychelles (probably *N. francolina*). As *Nassa* usually has a large number of nascent rows, the two reports do not indicate any marked differences between the two species. Each row consists of one right and one left single-cusped lateral tooth and a rachidian tooth with three major cusps. Peile reported that the radula of the Red Sea species *Nassa situla* (Reeve, 1846) is similar in shape and variability to *"serta" (francolina)*.

In studying 36 radulae of *N. serta* and *N. francolina,* I found that sexual dimorphism is limited to the rachidian tooth. The male rachidian tooth is broader than the female (Text fig. 1) and, with a few exceptions, the breadth of the male rachidian increases relative to shell size more rapidly than that of the female. Thus in males with shells about 30 mm. in length, an average rachidian is about 0.25 mm. while the 40 mm. males average about 0.35 mm. Females of these two size groups average

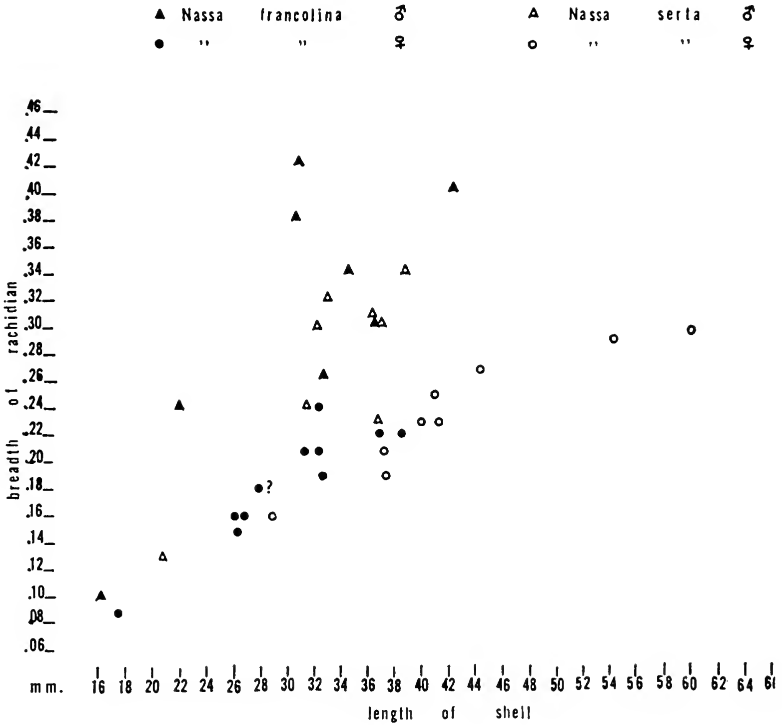

Fig. 1. Scatter diagram of the length of shells and breadth of rachidian teeth of 16 male and 20 female *Nassa* expressed in mm.

from 0.17 to 0.21 mm. respectively. The broadest male rachidian, 0.42 mm., came from a *N. francolina* 33.2 mm. in shell length and the broadest female rachidian, 0.30 mm., came from a *N. serta* 62.4 mm. long. The breadth of the male rachidian is more variable than that of the female.

Besides a difference in size, the male rachidian becomes almost monocuspid in larger (older) specimens. The central cusp becomes longer, more erect, and massive. This is clearly seen in anterior or posterior views of single, detached teeth (Text fig. 2, figs. 1, 2, 8-10). The female rachidian, on the other hand, remains strongly tricuspid, hooked, and unthickened even in very large (old) examples. There is frequently a small denticle on either side of the central cusp of a female rachidian but this may disappear and reappear among the rows of the same radula. The long central cusp and thickened base of the rachidian from a large male makes the preparation of a microscopic slide more difficult than that of a female. The former tends to fall on its side and flattened sections hold the cover slip high above the slide. Individual, separated rachidians fall at characteristic angles shown in Text fig. 2, figs. 3, 4, 12, and 13. Although most of the radulae are colorless, a few females as well as males are light yellow or amber. The radulae of five male *N. francolina* and two male *N. serta* are dark brown. The color appears to be a stain rather than a coating of pigment such as found on the cusps of *Patella*. The males with brown radulae had proportionately broader rachidian teeth than those with colorless radulae.

The tendency for the male rachidian to be broader than the female is found in all size (age) groups. The pronounced enlargement of the central cusp, however, was not apparent in younger shells. The male whose radula is figured Text fig. 2, fig. 5 had a well developed penis although his shell was only 18.1 mm. long. His radula is like a female's. Some others have small inner denticles.

As for differences between the radulae of the two species, it is now apparent that comparisons can be made only between male and male and female and female. The radulae of the two species are difficult to distinguish. The lateral cusps of the female rachidian of *N. serta* tend to be a little larger and bent. In the male, *N. serta* tends to keep the lateral cusps longer then in *N. francolina* and the rachidian does not broaden as rapidly. This is probably because *N. serta* is a larger species than *N. francolina* and of two shells the same size, the *N. serta* is probably younger than *N. francolina*. Attempting to compare similar material, I tried to use radulae from shells of approximately the same size. The difficulties encountered are shown in Text fig. 1 and by the fact that in the A.N.S.P. collection the largest *N. francolina* is 54.6 mm. and the largest *N. serta* is 69.1 mm.

I was unable to find any sexual dimorphism in the shells of *Nassa*. Possibly the females are slightly larger but the limited amount of material available makes any conclusion on a trivial difference unwise.

None of these differences is as great as those Arakawa (1958) found in *Drupella*. However, the *Nassa* radula is a simple, con-

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PLATE 5

1

3

5

2

4

6

Figs. 1, 2. *Nassa francolina* (Brug.) ANSP. 257668, Madagascar. Figs. 3, 4. *N. serta* (Brug.) ANSP. 205730, New Guinea. Figs. 5, 6. *N. serta,* Polynesian form, ANSP. 278464, Cook Ids. Figs. 1, 3, 5 app. 2X. Figs. 2, 4, 6 app. 10X.

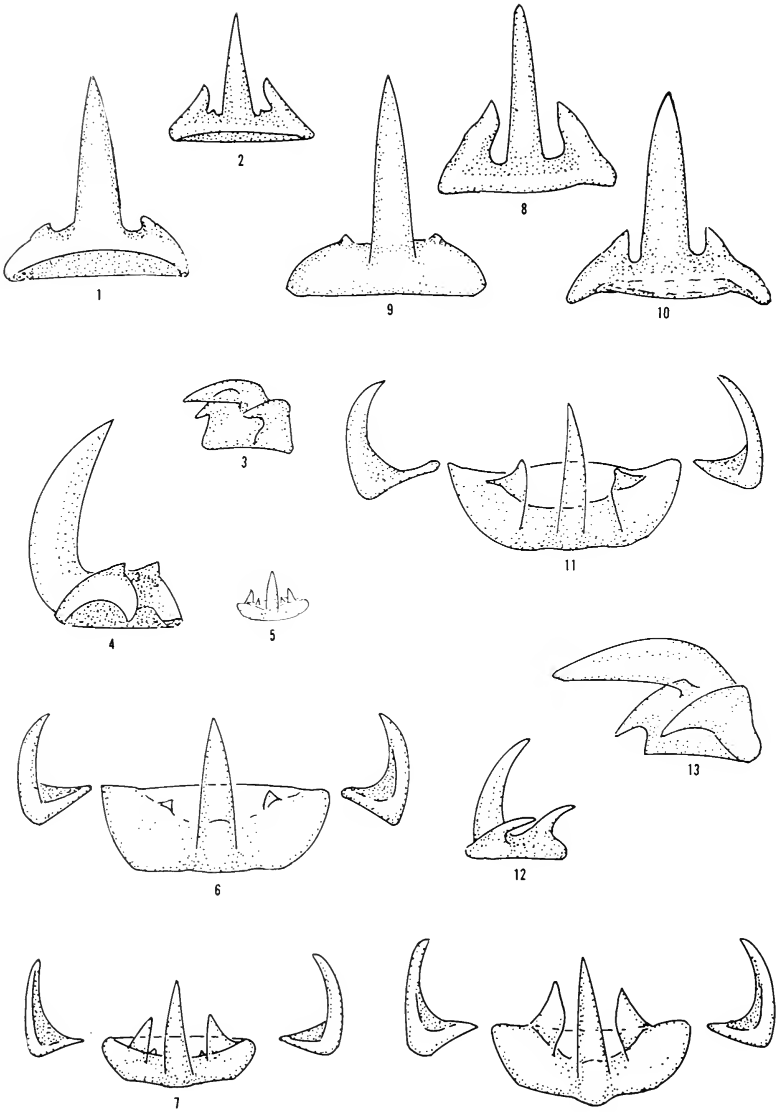

Fig. 2. Radulae of *Nassa* (all to scale X 130). 1-7. *Nassa francolina* (Brug.). 8-14. *Nassa serta* (Brug.).

1. Male, 35.5 mm. ANSP. 257134, Madagascar. Rachidian, anterior view.
2. Female, 40.4 mm. ANSP. 213123, Zanzibar. Rachidian, anterior view.
3. Female, 33.7 mm. ANSP. 283117, East Africa. Rachidian, left side view.
4. Male, 36.8 mm. ANSP. 257668, Madagascar. Rachidian, right side view.
5. Male, yg. 18.1 mm. ANSP. 257134, Madagascar. Rachidian, dorsal view.
6. Male, 35.5 mm. ANSP. 257134, Madagascar. Row, dorsal view.
7. Female, 40.4 mm. ANSP. 213123, Zanzibar. Row, dorsal view.
8. Female, 56.3 mm. ANSP. 278007, Cook Ids. Rachidian, anterior view.
9. Male, 38.7 mm. ANSP. 205730, New Guinea. Rachidian, anterior view.
10. Male, 35.6 mm. ANSP. 202623, Palau Ids. Rachidian, anterior view.
11. Male, 41.0 mm. ANSP. 205730, New Guinea. Row, dorsal view.
12. Male, 33.9 mm. ANSP. 278007, Cook Ids. Rachidian, right side view.
13. Female, 56.3 mm. ANSP. 278007, Cook Ids. Rachidian, left side view.
14. Female, 56.3 mm. ANSP. 278007, Cook Ids. Row, dorsal view.

servative, muricid form while *Drupella* is an aberrant form with denticulate cusps on the rachidian and slender denticulate laterals. But the variations between male and female rachidians are, in essence, the same. The male *Drupella* rachidian is more massive, with a strong central cusp and smaller lateral cusps and lacks an inner denticle always found in the female. The slender lateral teeth of *Drupella* also vary, and this is not found in *Nassa*. They vary in the numbers of lateral rows to rachidian rows, i.e. there are 3 to 5 times more lateral teeth in two species of male *Drupella* than there are rachidians, while the females have an 11 to 10 ratio, i.e. almost the conservative one for one found in *Nassa*. Arakawa also found that the length of the laterals and the color of the radulae varies. The male radula is yellow and the female colorless. My brown male radulae are somewhat analogous to the latter but not as constant in character. Some decidedly male - type *Nassa* radulae are colorless.

It was not clear from Hollister's paper (1954) how much material was studied and whether his large, single - cusped rachidian came from a male or female radula. The form, though in another family, is suspiciously like the sexual dimorphism found in the two groups of muricids.

It is not possible at present to determine whether this radular dimorphism is functional. Too little is known of the habits and genetics of all species examined, but present evidence indicates it is not. Both species of *Nassa* are presumed predators living under rocks in shallow water on reefs. *Drupella* is a shallow water coralliophile but its feeding habits are not known. The late development of an aberrant radula, in male *Nassa* at least, indicates it may not be functional in mating. Several young males, with well developed penes, found near egg-laying females, had radulae indistinguishable from female radulae except for a slightly broader rachidian.

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POSITIVE RHEOTAXIS IN GONIOBASIS PROXIMA

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Introduction. Of the papers encountered on this pleurocerid snail, only Goodrich (1950), Walter (1954), and Hall (1957) make mention of upstream migration or establishment in *Goniobasis proxima* (Say). Data are presented suggesting that this upstream establishment is a rheotactic response and the degree of expression may be influenced by water temperature and water velocity.

Observations were made in a tributary of Bolin Creek north and east of Mt. Bolus, approximately one mile north of Chapel Hill, North Carolina. The sources of this creek are springs and seepages which ensure a continuous flow of water becoming much increased by surface runoff during periods of rain. The creek is characterized, in the area where the snails were encountered, by relatively steep wooded banks, shelving rock, and a rock strewn bed with gravel and coarse sand. The many pools and riffle areas indicate a relatively steep gradient.

I wish to thank Dr. J. E. Adams and Dr. C. J. Umphlett of the Botany Department and Mr. D. G. Alexander of the Zoology Department of the University of North Carolina for their critical reviews of the manuscript.

Materials and Methods. Fifty-three individuals of *G. proxima* were marked by the application of a vinyl-based paint. All marked snails were then placed in a small eddy pool adjacent to the main creek flow. Observations were made each week for 15 weeks from 24 December 1957 to 13 April 1958. Water temperatures were recorded weekly and reported in degrees Fahrenheit. The position of the marked snails was observed, and distance traveled by each snail was measured in feet.

Observations and Results. Frequent observations of this *G. proxima* population revealed that the majority of the individuals were oriented against the current of the creek. This was most conspicuous in certain riffle areas. Furthermore it was noticed that the snails crawling upstream in these riffle areas were not uniformly distributed over the bottom, but were clustered along the outer portion of the stream flow. Many snails were dislodged by strong currents as evidenced by the appearance of large numbers of individuals in the pools located below riffle areas after rain storms. Only those snails crawling along the outer portions of the creek flow apparently were not dislodged. Individuals not oriented against the current were found to be in areas where little or no current existed.

A much higher number of marked snails was found during each sampling period above or adjacent to the eddy pool, than below it (Table 1). Over the 15 week period approximately three times as many marked snails were encountered above the eddy pool as below it, 75 and 28 respectively.

The number of marked snails encountered over the 15 week period declined rather steadily from 37 snails the first week to 5 snails the last week. The rapid decline in the total number of marked snails between the first and third weeks is attributed to rains occurring between those sample dates. The continual decline in the total number of snails during the course of the sample period is thought also to have resulted from subsequent periods of rain.

Other contributing factors accounting for the non response portion of the sample, in addition to the total removal of marked individuals, are high water levels, high turbidities, and snails crawling beneath rocks and debris. This is apparent from a perusal of table 1 where it is seen that on the third and fourth weeks 15 and 12 snails respectively were encountered. This high a recovery was not again duplicated until the eighth week when 13

Table 1 Comparison of total number of marked snails encountered each week with total number of snails above, at or below the eddy pool.

Weekly checks:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total number encountered	37	29	15	12	*	4	9	13	3	9	7	9	*	*	5
Total number above	10	7	7	9	*	4	6	8	3	6	2	8	*	*	5
Total number below	3	2	6	0	*	0	3	5	0	3	5	1	*	*	0
Total number adjacent to or in eddy pool	24	20	2	3	*	0	0	0	0	0	0	0	*	*	0

* indicates no sample taken

Table 2 Comparison of the number of marked snails observed each week with the distances from the point where all marked snails originally were placed and also compared with water temperatures.

	Sampling dates:	24 Dec	4 Jan (1)	11 Jan (2)	18 Jan (3)	28 Jan (4)	9 Feb (6)	14 Feb (7)	21 Feb (8)	1 Mar (9)	7 Mar (10)	16 Mar (11)	23 Mar (12)	13 Apr (15)
Distance upstream (feet)	>100													
	100	-	-	-	-	-	-	-	-	-	-	-	-	1
	/ 70	-	-	-	-	-	-	-	-	-	-	-	-	1
	/ 60	-	-	-	-	-	-	-	-	-	-	-	-	-
	55	-	-	-	-	-	-	-	-	-	-	-	-	1
	50	-	-	-	-	-	-	-	-	-	-	-	2	-
	45	-	-	-	-	-	-	-	-	-	-	-	-	-
	40	-	-	-	-	-	-	-	-	-	-	-	-	-
	35	-	-	-	-	-	-	-	-	-	2	-	1	-
	30	-	-	-	-	-	-	-	-	-	1	-	1	1
	25	-	-	-	-	-	-	-	-	-	-	-	1	-
	20	-	-	-	-	-	-	1	2	-	-	-	-	1
	15	-	1	-	1	1	1	1	2	-	-	1	-	-
	10	-	5	1	6	3	3	4	4	3	3	1	3	-
	5	-	4	6	-	5	-	-	-	-	-	-	-	-
Point of placement	0	53	24	20	2	3	-	-	-	-	-	-	-	-
Distance down-stream (feet)	5	-	-	-	2	-	-	-	-	-	-	-	1	-
	10	-	3	2	1	-	-	-	-	-	1	1	-	-
	15	-	-	-	-	-	-	1	-	-	1	2	-	-
	20	-	-	-	-	-	-	1	2	-	-	-	-	-
	25	-	-	-	-	-	-	1	1	-	1	-	-	-
	30	-	-	-	-	-	-	-	2	-	-	1	-	-
	35	-	-	-	-	-	-	-	-	-	-	1	-	-
	40	-	-	-	1	-	-	-	-	-	-	-	-	-
	45	-	-	-	-	-	-	-	-	-	-	-	-	-
	50	-	-	-	-	-	-	-	-	-	-	-	-	-
	55	-	-	-	1	-	-	-	-	-	-	-	-	-
	60	-	-	-	-	-	-	-	-	-	-	-	-	-
	/ 90	-	-	-	1	-	-	-	-	-	-	-	-	-
	>90													
Water temperature:		-	-	-	-	42F	39F	40F	40F	45F	45F	44F	54F	58F

snails were encountered. The low recoveries observed on the sixth and ninth weeks resulted from high water and high turbidities from rains which occurred during those particular sampling periods. While possibly insufficient sampling time might also account for these low responses, the lengthy and careful searches that were made each time seem adequate.

Discussion and Conclusion. In spite of the washing away of many marked snails and in spite of the marked snails present but missed, from the remaining sample, description of the probable relationship that exists between the relative positions of those marked snails and certain environmental factors is possible. From table 2, those snails found below the eddy pool, show no particular pattern as to the number of individuals or their distribution. However, the rain storms which occurred during the sample period, may be of significance with regard to the down stream distribution of the marked snails. During the sample period rains occurred during the weeks of 4, 11, and 18 January; 9 and 21 February; and 1 and 16 March. An examination of table 2 shows that the number of snails observed below the eddy pool can be correlated to the frequency of rain storms. Thus, supposedly the snails appearing below the eddy pool were washed down from above.

Whereas a poor pattern was observed for those snails encountered below the eddy pool, a very clear pattern is seen for those snails observed above it. (Table 2). The number of snails involved is remarkably constant, the exceptions to this having already been explained. In the distribution of these snails, a rather pronounced tendency for upstream establishment is noted. This tendency is seen as early as the 18 January sample and becomes much more striking after the 7 March sample (Table 2). It is even to be seen from those snails observed below the eddy pool. During periods when no rains fell, fewer marked snails were encountered below the eddy pool, and those that were, generally were found closer to that pool. This non-random distribution very likely demonstrates an oriented behavioral response. Although the causes of this response were not determined, apparently the more pronounced upward establishment might be correlated to the rise in water temperature recorded during this period (Table 2). Also possibly, some snails simply were not washed down during the rain storms and merely continued crawling upstream. Also, for those periods when no rains occurred, there were generally more marked snails encountered above the eddy pool than seen the immediately previous weeks in which rain did fall. This perhaps reflects the increased probability of snails becoming dislodged during periods of high water with higher velocities.

This behavioral response, the orientation to currents especially in streams, is known as rheotaxis (Fraenkel and Gunn, 1961). Whenever such a response occurs toward the source of the stimulus, as is the case here, it is said to be a positive one (Dethier and Stellar, 1961). Many bottom dwelling invertebrates such as isopods, amphipods, turbellarians, pulmonate gastropods, and insects found in lentic habitats are well known for their rheotactic behavior (Fraenkel and Gunn, 1961). However, this appears to be the first report of such a behavioral pattern in this species, and may represent a first report of rheotaxis in a fresh water prosobranch gastropod. In *Planaria alpina,* rheotactic behavior has been shown to have pronounced survival value (Beauchamp, 1933, 1937). This oriented response possibly has survival value for *Goniobasis proxima,* but this is yet to be substantiated.

SUMMARY

From a study of the movements of the snail, *Goniobasis proxima,* in a tributary stream of Bolin Creek, located approximately one mile north of Chapel Hill, North Carolina, data were gathered suggesting that upstream establishment in this snail is an oriented response. Fifty-three snails were marked and returned to an eddy pool adjacent the main stream flow. Checks on the number and position of the marked snails were made weekly for 15 weeks. Those snails in areas of the stream with an appreciable current were oriented against the current whereas those in other areas showed no particular upstream orientation. The presence of nearly 3 times as many snails above the eddy pool as below it indicated a strong tendency toward upstream establishment, a positive rheotactic response. This was even more pronounced during those periods free of rain which means that snails were not so readily dislodged during the rain free periods. This rheotactic response appeared to increase with the rise in water temperature although very possibly some snails escaped, being washed down during rain storms and therefore would attain the distances recorded in spite of the rise in water temperature.

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SUBGENERIC CLASSIFICATION OF PISIDIUM IN NORTH AMERICA

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In view of Boettger's (1961, 1962) and Kuiper's (1962a) efforts to classify the Palearctic and Ethiopian members of the sphaeriid clam genus *Pisidium* C. Pfeiffer, it is of interest to examine and compare the Nearctic and Holarctic species in North America. The soft-part anatomy (except for *P. cruciatum* and *P. insigne*), as well as the shell morphology, of all species listed here has been examined, and life history studies have been carried out on representatives of the 3 North American subgenera (Heard, 1965). All species are confined to the Nearctic Region unless otherwise designated.

Genus *Pisidium* C. Pfeiffer, 1821

Type: *Tellina amnica* Müller, 1774. Animals monoecious and ovoviviparous; only the anal siphon well-developed, the branchial siphon either rudimentary or represented by a cleft in the mantle. Shell inequipartite: anterior end longer than posterior end, beaks occasionally terminal; size comparatively small: 1.5-10 mm in length.

Subgenus 1, *Pisidium* s. str.

Type: *Tellina amnica* Müller, 1774. Branchial siphon rudimentary *(P. dubium)* or represented only by a slit in the partially-fused mantle; large posterior gills present in addition to large anterior gills; posterior gills with inner and outer lamellae; dorsal loop or lobe of each nephridium cleft; size large: 6-10 mm in length. Life history in the central Nearctic Region: one medium- (10 young) to large-sized (20) litter produced each year for several years.

Pisidium amnicum (Müller). Eurasia; introduced into North America.

Pisidium dubium (Say)
Pisidium idahoense Roper

Subgenus 2, *Rivulina* Clessin, 1873

Type: *Pisidium supinum* Schmidt, 1851 (subsequent designation by Clessin, 1879). Partially-fused mantle containing a short slit representing the branchial siphon; small posterior gills present in addition to larger anterior gills; posterior gills with inner lamellae only; dorsal loop or lobe of each nephridium cleft; medium-sized: 2.5-5 mm in length. Life history in the central Nearctic Region: annual species producing one small to large litter (average: 4-20).

Pisidium adamsi Prime
P. *aequilaterale* Prime
P. *casertanum* (Poli). Worldwide (see Herrington, 1962).
P. *compressum* Prime
P. *fallax* Sterki
P. *ferrugineum* Prime. Circumpolar (= P. *hibernicum* of Europe?)?
P. *henslowanum* (Sheppard). Eurasia; introduced into North America.
P. *lilljeborgi* Clessin. Holarctic.
P. *milium* Held. Holarctic.
P. *nitidum* Jenyns. Holarctic.
P. *obtusale* C. Pfeiffer. Holarctic.
P. *subtruncatum* Malm. Holarctic.
P. *supinum* Schmidt. Holarctic (see Herrington, 1962, p. 41).
P. *ultramontanum* Prime
P. *variabile* Prime
P. *walkeri* Sterki

Subgenus 3, *Neopisidium* Odhner, 1921

Type: *Pisidium torquatum* Stelfox, 1918. Complete absence of branchial siphon and of posterior gills; dorsal loop or lobe of each nephridium united; small-sized: 1.5 - 3 mm in length; constant retention of juvenile characters. Life history in the central Nearctic Region: life span unknown; two small litters produced each year.

Pisidium conventus Clessin. Eurasia; Nearctic Region (see Heard, 1963a).
?P. *cruciatum* Sterki. Provisional placement in this subgenus.
?P. *insigne* Gabb. Provisional placement in this subgenus.
P. *punctatum* Sterki
P. *punctiferum* Guppy. Southern North America, Central America, and Caribbean islands.

For specific morphological differences between *P. punctatum* and *P. punctiferum* see Kuiper, 1962b; for their geographic differences see Heard, 1963b.

The subgenera *Afropisidium* Kuiper, 1962a (type: *Pisidium lepas* Kuiper, 1957), and *Odhneripisidium* Kuiper, 1962a (type: *Pisidium stewarti* Preston), have no known representatives in North America. These two taxa are reported to be anatomically closely related to *Neopisidium,* but each differs from the other subgenera in the position of the ligament. In *Pisidium* s.s., *Rivulina,* and *Neopisidium* the ligament is enclosed, contained in the hollow of the hinges of the two valves. However, in *Odhneripisidium* the ligament lies below the hinges of the valves at a right angle to the symmetrical plane of the shell, while the ligament in *Afropisidium* is external.

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SOUTHERN LIMIT OF NASSARIUS TRIVITTATUS[1]

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The southern limit of the range of *Nassarius trivittatus* (Say) has been a matter of some controversy in the literature. Several popular shell books list this species from as far south as South Carolina (Abbott, 1954: 239) or northern Florida (Morris, 1947: 194; Smith, 1951: 121). Other authors, however, have reported that *Nassarius trivittatus* does not occur alive south of Cape Hatteras (Wells, Wells and Gray, 1961: 269; Wells and Richards, 1962: 590).

The purpose of this note is to report the verified collection of *Nassarius trivittatus* from the coastal waters off Georgia. One specimen was collected alive on November 11, 1964 at longitude 31°25′12″N. and latitude 81°12′30″W. (about 1.5 miles east of Sapelo Island). This specimen has been preserved with its soft parts extended and deposited in the United States National Museum (U.S.N.M. No. 636920). It was identified tentatively by the author, and this identification has been checked by Dr. J. P. E. Morrison, Dr. H. A. Rehder, and Dr. J. Rosewater of the U. S. National Museum. Additional specimens of this species had been collected from the same location during August 1964.

The collection of these live specimens of *Nassarius trivittatus* makes it clear that the species range includes Georgia. Numerous

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collections of the shells of this species from Florida waters indicate that the range probably extends south to St. Augustine. This hypothesis is supported by the collections in the U. S. National Museum, which Dr. J. P. E. Morrison has been kind enough to check. One of these collections (U.S.N.M. No. 54645) contains a shell and dried soft parts of a specimen collected off Cumberland Islands, Georgia, (near the Georgia-Florida border); and other collections (US.N.M. No. 46830, and U.S.N.M. No. 415502) contain what appear to be relatively fresh dead shells from areas near the mouth of the St. John's River and the beach at St. Augustine (Dr. J. P. E. Morrison pers. comm.).

It appears therefore that the extreme southern limit of the range of *Nassarius trivittatus* is in Georgia or Florida rather than at Cape Hatteras. The occurrence of this species near the southern limit of its range may be intermittent, but the density of the population off Georgia occasionally reaches 4 individuals per square meter. This population certainly is large enough to provide most of the shells which are found on southern beaches, although some of these shells may come from fossil or sub-fossil deposits.

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NEW RECORDS OF CADULUS (SCAPHOPODA) FROM THE NEW ENGLAND AREA

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Two species of small scaphopod mollusks were obtained from benthic fauna collections taken by the U. S. Bureau of Commercial Fisheries in offshore New England waters during the past few years. One species, *Cadulus (Platyschides) rushi rushi* Pilsbry and Sharp, 1898, occurred in samples from the Gulf of Maine. The other species, tentatively identified as *Cadulus (Platyschides) agassizi* Dall, 1881, occurred in samples from moderately shallow water along the southern side of Georges Bank. Some doubt concerning the identity of those specimens tentatively identified as *C. agassizi* results from their slightly longer length and proportionately greater width than is typical for the species (Dr. W. K. Emerson, personal communication).

These records are noteworthy because (1) the genus *Cadulus* has not heretofore been reported from the Gulf of Maine; (2) *C. r. rushi* has not previously been found in such shallow water or as far north; and (3) *C. agassizi* is a southern form that has not been reported from the New England region.

I wish to thank Dr. Joseph Rosewater, U. S. National Museum, and Dr. William K. Emerson, American Museum of Natural History, for identifying these specimens.

CADULUS R. RUSHI

Twenty-four specimens of *C. r. rushi* were obtained at 11 localities in the north-central section of the Gulf of Maine (Fig. 1) by the research vessel *Delaware* on cruise number 61-10, June 23-29, 1961. Collecting devices were a Smith-McIntyre grab sampler and a naturalist's dredge. Shell length of undamaged specimens ranged between 11 and 13 mm. Eleven specimens were alive at the time of capture. Occurrence records and associated data are listed in Table 1. At the localities where these specimens were taken, the water depths ranged from 210 to 256 m. and the bottom sediment at every station was predominantly a mixture of silt and clay of olive-brown color.

A good indication that *C. r. rushi* is restricted to the deeper portions of the Gulf of Maine was its absence in collections from shallow water. No specimens of this species (or genus) occurred in 86 other samples (76 localities) taken on the same cruise at sampling stations spaced 16 km. apart over the northern half of the Gulf. These collections included 23 samples from depths less than 210 m. A deep-water habitat is not unexpected, since the previously established minimum depth for this species was 361 m. (Johnson, 1934). The bathymetric range for *C. r. rushi,* as presently known, is from 210 to 2,811 m. These figures are from Gulf

Table 1.--Collection and specimen data for *Cadulus r. rushi* from research vessel *Delaware* Cruise 61-10, in the Gulf of Maine, June 23-29, 1961 1/

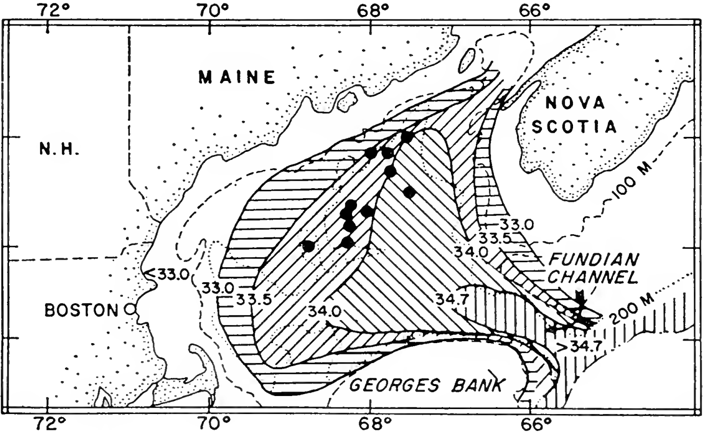
Station number	Location		Water depth (m)	Bottom water temperature (C)	*C. r. rushi* 2/	
	Latitude (North)	Longitude (West)			Number	Length (mm)
26	43°01'	68°45'	220	5.3	2	13, (9-1/2)
55	43°20'	68°01'	247	6.6	1	11
56	43°20'	68°15'	229	6.1	3	13, (5), (2-1/2)
73	43°30'	67°21'	238	6.5	1	(4)
83	43°41	67°46'	238	6.6	1	(5)
91	43°50'	68°00'	210	6.1	1	(9)
92	43°50'	67°45'	256	6.4	5	(9), (6), (6), (2-1/2), (1-1/2)
101	44°00'	67°30'	242	6.1	3	13, 12, (4)
108	43°20'	68°17'	216	6.7	2	12, (4)
109	43°10'	68°17'	234	5.6	3	12, (7-1/2), (4)
110	43°00'	68°15'	210	5.0	2	13, (10)

1/--Bottom sediments at all stations are olive-brown mixture of silt and clay.

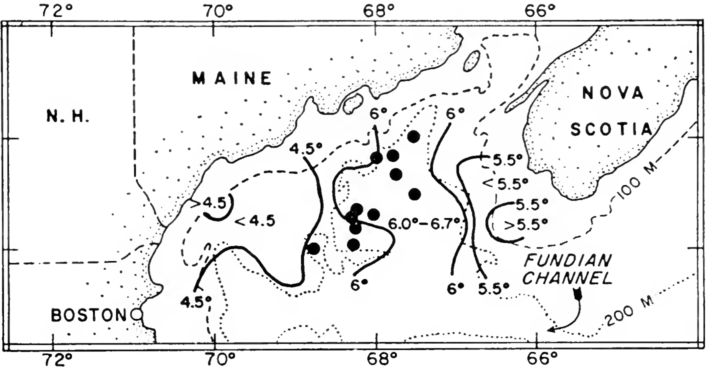
2/--Lengths of incomplete shells are enclosed in parentheses.

of Maine data listed in Table 1, and the maximum depth reported by Henderson (1920) and Clarke (1962).

The geographic range of *C. r. rushi,* as reported by Johnson (1934), extends from Cape Hatteras northward to the vicinity of Georges Bank. Thus its occurrence in the Gulf of Maine — where so far as known it is the only *Cadulus* present — is farther northward than would generally be expected, due to the prominent zoogeographic boundary formed by Cape Cod and Georges Bank. A feature of Gulf of Maine hydrography provides, however, a reasonable explanation why a mollusk from the continental shelf and slope along the eastern coast of the United States could also inhabit certain sections of the Gulf. Bottom water in the deep portions of the Gulf where *C. r. rushi* occurs has a higher salinity than shallower parts. This high-salinity bottom water enters the Gulf through the Funidan (Eastern) Channel (Bigelow, 1927). It spreads northward and westward into the deepest portions of the Gulf (Fig. 1), producing an environment somewhat similar to that on the shelf and slope outside the Gulf. Although salinity measurements were not made at the time these samples were collected, the seasonal and year-to-year changes in bottom-water salinity in the central Gulf are small. The salinity



1. Geographic distribution of *Cadulus r. rushi* in the Gulf of Maine, and the salinity of bottom water. The salinity data were collected August-September 1964.



2. Geographic distribution of *Cadulus r. rushi* in the Gulf of Maine, and the bottom-water isotherms (C), June 1961.

gradient of bottom water illustrated in Figure 1 is based on data collected September 1964 aboard the R/V *Albatross IV* (data provided by J. B. Colton, personal communication). On the basis of the information now available, the minimum salinity of Gulf of Maine waters inhabited by *C. r. rushi* appears to be near 33.5°/00.

The high-salinity bottom water that enters the Gulf of Maine through Fundian Channel also has a higher temperature than other Gulf bottom water. At the stations where *C. r. rushi* occurred the bottom temperature at the time the scaphopods were collected ranged from 5.0 to 6.7 C (41-44 F). The distribution of this species in relation to bottom-water temperature in June 1961 is illustrated in Fig. 2. Low water temperature does not appear to be a major deterrent factor in the geographic distribution of this species in the Gulf of Maine, inasmuch as Henderson (1920) has reported its occurrence in slope waters south of the Gulf of Maine at a temperature as low as 2.7 C (36.9 F). The temperature of bottom water in the central Gulf of Maine is rarely less than 4 C (39.2 F). High temperature, however, may be limiting because the Gulf bottom water in some sectors occasionally rises to 8 C (46.4 F). This value is slightly higher than the maximum water temperature (6.6 C or 44 F) associated with *C. r. rushi* as reported by Henderson (1920).

Shell fragility is indicated by the high percentage of broken shells — 16 of 24. The habitat, which consisted of fine-textured sediments in deep-water areas where water currents are generally weak, would not be expected to handicap seriously a thin-shelled species.

CADULUS AGASSIZI

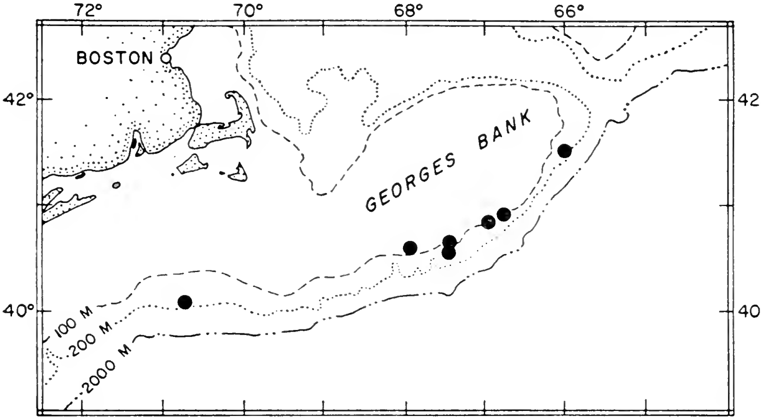
A total of 10 specimens of *C. agassizi* were collected at six stations along the southern periphery of Georges Bank and at one station south of Martha's Vineyard near the edge of the continental shelf. Four of these specimens were collected with a Smith-McIntyre grab sampler, 4 with a trawl, and 2 with a scallop dredge. Shell lengths of the smallest and largest specimens were 7½ and 11 mm. Six of the specimens were alive at capture. The collection data together with the number and size of specimens are listed in Table 2; localities of collection are shown in Fig. 3.

The geographic range for this species has previously been reported as extending from the Florida Keys northward to the Chesapeake Bay region (Johnson, 1934). Thus its occurrence on Georges Bank extends its known range a considerable distance northward and eastward.

Sediments at localities in the Georges Bank region where *C. agassizi* was found were of moderately coarse texture, ranging

Table 2.--Collection and specimen data for Cadulus agassizi from the Georges Bank region, 1955-61

Location		Water depth (m)	Date collected	Bottom sediment	*C. agassizi*	
Latitude (North)	Longitude (West)				Number	Length (mm)
40°35'	67°59'	84	November 17, 1955	Gravelly sand	1	10
40°37'	67°28'	86	August 24, 1957	Coarse sand	1	9-1/2
40°50'	66°58'	91	November 19, 1955	Fine sand and shell	3	11, 9, 8-1/2
40°54'	66°46'	102	August 28, 1957	Fine sand and shell	1	9-1/2
40°33'	67°28'	117	August 24, 1957	Medium sand	1	8
41°30'	66°00'	145	August 26, 1957	Gravelly sand	1	8
40°02'	70°47'	146	January 26, 1961	---	2	9, 7-1/2



3. Geographic distribution of *Cadulus agassizi* in the Georges Bank region.

from mixtures of fine sand with shell fragments to sandy gravels. This finding agrees well with sediment types at points of collections of *C. agassizi* reported by Henderson (1920) off the southeast coast of the United States. A large proportion of the collections he cited were from sand substrates or mixtures of sand with shell or rock.

This species has been reported from depths of 31 to 538 m. (Johnson, 1934), and most of the records are from depths between 91 and 274 m. (Henderson, 1920). It was collected from the Georges Bank region at depths between 84 and 146 m., well within the known depth range for the species.

The absence of broken shells of this species suggests that their shells are more durable than those of *C. r. rushi*. This condition would be advantageous for a species such as *C. agassizi* which lives in coarse-textured sediments and at moderate water depths, where water currents are likely to be stronger than in areas of sediment deposition.

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CHANGES IN PELECYPOD POPULATIONS IN SALT FORK OF BIG VERMILION RIVER, ILLINOIS, 1918-1962[1]

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In the years of 1918 through 1920, Frank Collins Baker made a survey of the mollusks in the upper reaches of the Big Vermilion River in east-central Illinois (Baker and Smith, 1919; Baker, 1922). His study was carried out primarily in the Salt Fork of that river system, and he gave special attention to the pelecypods. He established 30 collecting stations from the headwaters north of Urbana to the junction of this branch with the Middle Fork and the North Fork Rivers just west of Danville where together they form the Big Vermilion River. Baker collected over a stream distance of 45 miles by hand-collecting in shallow water to a depth of two feet. H. J. Van Cleave (1940) studied the bivalve population at one of Baker's stations (Station 25) between 1930-39, and published the results of his annual census. (The junior writer was a member of the survey party for

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[1] This study was supported in part by the University of Illinois Research Board and the Environmental Sciences Branch of the United States Atomic Energy Commission, Contract No. AT (11-1) —411.

TABLE 1. -- Comparison Of Pelecypod Populations In The Salt Fork Of The Big Vermilion River, Illinois, 1918-62
First symbol is number collected by F. C. Baker, 1918-20; second symbol is number collected by R. W. Dexter and/or M. R. Matteson, 1958-62. A = abundant; C = common; S = scarce.

Species	Station Numbers												
	1	2	3	4	5	6	7	8	9	12	13	14	15
Sphaeriidae													
Sphaerium spp.		A-1		C-0									
Sphaerium (Musculium) spp.			A-S	C-0								S-0	
Pisidium spp.												S-0	
Unionidae													
Carunculina parva	C-0			C-0									
Uniomerus tetralasmus	C-0			C-0									
Anodontoides ferussacianus	C-0	C-0		C-1									1-0
Anodonta grandis				A-3									
Anodonta corpulenta				A-0									

TABLE 1 con't.-- Comparison Of Pelecypod Populations In The Salt Fork Of The Big Vermilion River, Illinois, 1918-62

Species	Station Numbers												
	16	17	18	19	20	21	22	23	24	25	26	28	30
Sphaeriidae													
Sphaerium spp.		C-0	A-0	A-0						A-0			
Sphaerium (Musculium) spp.				A-0									C-0
Pisidium spp.				A-0							S-0		
Unionidae													
Carunculina parva			A-0		C-0		C-1			C-S	1-0		
Anodontoides ferussacianus				1-0	1-0					S-0	C-0		C-0
Anodonta grandis		S-0	S-0		C-0		0-3	S-0	S-0	A-3	0-2	0-1	
Lampsilis siliquoidea		S-0	C-0		S-0	S-0	C-2	C-0	A-0	A-5	A-1	A-6	A-2
Micromya lienosa				1-0	S-0			C-0	C-0	A-S	S-0	A-0	S-0
Lasmigona complanata	S-0	S-0	A-0	C-0	A-0	A-0	A-2	A-8	A-15	A-33	0-1	A-5	A-3
Fusconaia flava		2-0	1-0	C-0	1-0		S-0	S-2	S-5	A-38	C-1	A-15	C-1
Amblema costata		C-0	A-0	A-0	1-0	A-0	C-1	A-0	A-5	A-13	A-0	A-2	A-2
Quadrula pustulosa		S-0	S-0					S-2	0-4	C-35	C-1	1-2	C-2
Carunculina glans										S-0			
Strophitus rugosus								S-1	S-0	C-5		0-1	S-0
Lasmigona costata							1-0	C-0	C-0	C-S	C-0	C-1	C-0
Alasmidonta marginata							1-0	S-0	S-0	C-2	C-0	1-1	C-0
Pleurobema coccineum								C-2	S-1	C-13	0-1	0-1	
Lampsilis ventricosa			A-0					C-0	C-0	A-52	A-2	A-19	A-3
Anodonta imbecilis					C-0					C-S			
Lampsilis anodontoides										S-0			
Lampsilis fasciola										2-10	C-0	0-4	C-0
Actinonaias ellipsiformis										S-S	S-0		1-0
Actinonaias carinata										S-39	C-0	0-6	A-1
Quadrula quadrula										S-10		0-2	0-2
Quadrula metanevra										S-1	S-0	2-1	C-0
Cyclonaias tuberculata										S-32		0-1	C-0
Tritogonia verrucosa								0-1	0-2	C-48	C-0	0-7	C-2
Obovaria subrotunda										S-0	S-0	C-0	C-0
Pleurobema clava										1-S	A-1		
Quadrula cylindrica												1-0	
Megalonais gigantea										0-S			
Micromya iris										0-S			
Lasmigona compressa								S-0		S-0			

1934.) The present writers subsequently made a resurvey of all Baker's stations in the Salt Fork proper, but excluded four located in tributaries to the Salt Fork, between 1958-1962. A report has been published on changes in the gastropod populations of the Salt Fork by comparing the recent survey with Baker's results obtained some 40 years earlier (Dexter, 1961). We have combined our recent observations on pelecypods and compared our results with the earlier surveys of Baker and Van Cleave to determine changes which have occurred in the pelecypod populations since their work was completed. An account of the habitats, pollution, and general information concerning the Salt Fork will be found in the earlier reports (Baker, 1922; Dexter, 1961). Pollution enters primarily at Station 5, but the

Table 2. Comparison of Unionidae Collected at Station 25, Salt Fork River, Illinois.

A=abundant; C=common; S=scarce; R=rare

	Baker 1918-20	Van Cleave 1930-39	Matteson-Dexter 1956-62
Lampsilis ventricosa	A	A	A
Tritogonia verrucosa	C	A	A
Lasmigona complanata	A	A	C
Fusconaia flava	A	C	C
Quadrula pustulosa	C	C	C
Amblema costata	A	C	S
Lampsilis siliquoidea	A	S	R
Cyclonaias tuberculata	S	S	C
Actinonaias carinata	S	S	C
Lampsilis fasciola	R	S	S
Pleurobema coccineum	C	S	S
Lasmigona costata	C	S	S
Anodonta grandis	A	S	R
Strophitus rugosus	C	S	R
Alasmidonta marginata	C	S	R
Micromya lienosa	A	S	S
Quadrula metanevra	S	S	R
Carunculina parva	C	R	S
Quadrula quadrula	S	R	S
Pleurobema clava	R	R	S
Ligumia ellipsiformis	S	R	S
Anodonta imbecilis	C	R	S
Carunculina glans	S	R	
Obovaria subrotunda	S	R	
Lasmigona compressa	S	R	
Anodontoides ferrussacianus	S		
Lampsilis anodontoides	S		
Uniomerus tetralasmus		R	
Quadrula cylindrica		R	
Micromya iris		R	S
Megalonais gigantea			S

increasing effluent over the years has been treated with increasing effectiveness so that the total amount of pollution has remained at a fairly uniform level.

Comparison of pelecypod populations (1918-1962)

Tables 1 and 2 summarize the collecting samples of Baker (1918-20) and those of Matteson and Dexter (1958-62). Baker found 3 groups of Sphaeriidae *(Sphaerium, Sphaerium (Musculium),* and *Pisidium)* to be abundant and widely distributed. We found no *Pisidium* and only a few specimens of *Sphaerium* which were confined to the headwaters.

Baker found 30 species of Unionidae. We found 25 species, including two not recorded by Baker *(Megalonais gigantea* and *Micromya iris).* The 7 species found by Baker but not taken in the latter survey are *Uniomerus tetralasmus, Anodonta corpulenta, Carunculina glans, Lasmigona compressa, Lampsilis anodontoides, Obovaria subrotunda,* and *Quadrula cylindrica.* Since the Baker survey, there has been a decrease in abundance for these 20 species.

Carnuculina parva
Anodontoides ferussacianus
Anodonta grandis
Lampsilis siliquoidea
Micromya lienosa
Lasmigona complanata
Fusconaia flava
Amblema costata
Quadrula pustulosa
Strophitis rugosus
Lasmigona costata
Alasmidonta marginata
Pleurobema coccineum
Lampsilis ventricosa
Anodonta imbecilis
Lampsilis fasciola
Actinonaias ellipsiformis
Quadrula metanevra
Tritogonia verrucosa
Pleurobema clava

Two species have remained about the same in abundance *(Actinonaias carinata* and *Cyclonais tuberculata).* A single species increased in abundance *(Quadrula quadrula).* Since the Baker survey, 13 species have become more restricted in range, six species have about the same range, and four species have increased their range in the Salt Fork system.

In the recent survey, we found 16 collecting stations with fewer species; and only one station (No. 28) had more species (17 against 12 formerly). We found 17 stations with less abundance of Unionids, and no station showed an increase in abundance of total populations.

More restricted in range:
Caruncülina parva
Anodontoides ferussacianus
Lampsilis siliquoidea
Micromya lienosa
Lasmigona complanata
Fusconaia flava
Amblema costata
Quadrula pustulosa
Alasmidonta marginata
Lasmigona costata
Lampsilis ventricosa
Anodonta imbecilis
Actinonaias ellipsiformis

About same range:
Strophitis rugosus
Lampsilis fasciola
Actinonaias carinata
Pleurobema clava
Quadrula metanevra
Cyclonaias tuberculata

Increased in range:
Anodonta grandis
Quadrula quadrula
Tritogonia verrucosa
Pleurobema coccineum

Comparison of Van Cleave's study of station 25 (1930-39) and the survey of Matteson and Dexter (1958-62). Lampsilis ventricosa remained the most common species, and *Tritogonia verrucosa* remained the second most common species. *Lasmigona camplanata,* however, has fallen from third place as most numerous and in recent years has been less numerous than *Quadrula pustulosa, Fusconaia flava,* and *Actinonais carinata. Cyclonaias tuberculata* has increased somewhat in abundance. Six species dropped out from the samples. However, these were only rarely collected by Van Cleave, *(Uniomerus tetralasmus, Actinonaias, ellipsiformis, Carunculina glans, Quadrula cyclindrica, Obovaria subrotunda,* and *Lasmigona compressa).*

Comparison of unionids at station 25 sampled by Baker—Van Cleave—Matteson and Dexter. Station No. 25, until recently, was a shoal below an artificial dam. In recent years, the dam has been washed away. This station has been the best collecting site in the Salt Fork system. Baker found 27 species, two of which were not collected in subsequent surveys; but both were scarce in Baker's original collection *(Anodontoides ferussacianus* and *Lampsilis anodontoides).* Baker did not find *Micromya iris,* which was found in both of the later surveys. Baker did not get *Uniomerus tetralasmus* and *Quadrula cylindrica,* which were found only by Van Cleave in small numbers at Station 25, but Baker was able to collect *U. tetralasmus* at Stations 1 and 4, and he collected 1 specimen of *Q. cylindrica* at Station 28. Van Cleave found a total of 28 species, and we found 24 species. In the later years, *Carunculina glans, Obovaria subrotunda,* and *Lasmigona* *compressa,* found rarely by Baker and Van Cleave, were not collected at all. Matteson collected the only record of *Megalonaias gigantea.*

General comparisons. Only Baker collected *Anodonta corpulenta,* which he obtained from Station 4. Matteson collected one specimen of *Anodontoides ferussacianus* at Station 4, but not at Station 25 where Baker found it scarce, and it was unreported by Van Cleave.

No bivalve was collected by anyone from Stations 5-9 and 12-13. These 7 stations follow in sequence along the main channel from the sewage inlet at Urbana. Bivalves were not collected along that stretch up to Station 14, a few miles below St. Joseph. Since 1918-20, 10 species have shown a marked decrease in abundance, and only 2 species have shown an increase in abundance.

CONCLUSIONS

In general, the pelecypod populations declined drastically since 1918. There are fewer species at present, and they have a more restricted distribution. Many species are found in small numbers and in only a few localities. With the exception of Station No. 25, abundance in general has declined; and even at Station 25, ⅓ of the species have declined in abundance since the original survey.

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A NEW STREPTOSTYLA FROM NICARAGUA

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Among molluscan material recently received from the north central part of Nicaragua are specimens representing an apparently undescribed species of *Streptostyla*.

STREPTOSTYLA (CHERSOMITRA) VANCEGREENEI, new species. Fig. 1
Diagnosis: A *Streptostyla* from north central Nicaragua, characterized by having a short, moderately twisted columellar cord with a thinly superposed white callous edge, and a sharply elevated protoconch.

Description: Shell thin, elongate-ovate, orange-brown, glossy, except for moderately coarse, uneven growth lines. Whorls 7, weakly rounded, very gradually descending but somewhat more sharply near the aperture. Protoconch smooth, glossy, same color as the rest of the shell, sharply elevated over the first post nuclear whorl. Body whorl moderately inflated, peristome barely convex, in fully mature specimens almost parallel with the axis. Suture shallow, edged by a regularly outlined, slightly darker, impressed line. Aperture narrow, more than one-half the length of the shell, columella with a moderately twisted, entering columellar fold, thinly edged with a white callous cord.

Holotype: Length 25.6, diameter 12.3, length of aperture 16.5 mm
Paratype: Length 20.2, diameter 9.6, length of aperture 12.5 mm
Paratype: Length 28.3, diameter 13.5, length of aperture 17.5 mm

Discussion: The new species is easily separated from the shell of *S. gabbi* Pilsbry by the more inflated outline, the sharply raised protoconch, the uniformly orange-brown color not becoming paler at the spire, the dark rather than white sutural band, and in having 7 rather than 5 whorls. In addition, the body whorl of *S. vancegreenei* does not descend as sharply at the aperture, and the growth lines are distinctly stronger. It differs from *S. delibuta* Morelet in color, in having a smooth rather than a regularly wrinkled sutural line, and in the nature of the columellar cord. It has the conic spire of *S. obesa* von Martens, but it has a much smaller and smoother shell.

Type Locality: Quemigüas (Quimiqüas) or Tigre Negro, approximately 20 miles northwest of Bonanza, Zelaya Department, Nicaragua, approximately 14° 12′ N., 84° 37′ W., elevation (estimated) 1300′. Collector: Vance Greene, geologist with the Neptune Mining Co., Bonanza, Nicaragua, June 1965, for whom the shell is gratefully named. Mr. Greene added the following ecological notes: Rock type: volcanic flows (andesitic), probably of late Tertiary age: No known limestone in area. Specimens

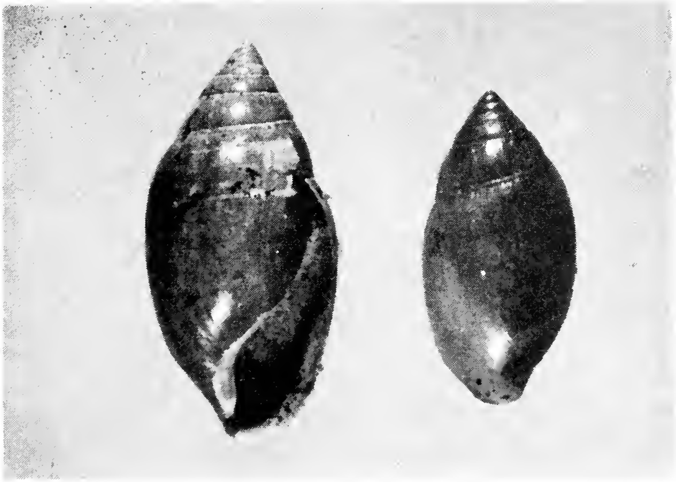

Fig. 1. *Streptostyla (Chersomitra) vancegreenei* Jacobson. Holotype and paratype.

were collected on the flank of a hill having approximately 300′ relief. Almost all the snails collected were found at the base of an outcrop of andesite. Trees in the area were those common to the north central part of Nicaragua: coma negra, guarumo, etc. Associated molluscan species were: *Helicina rostrata* Morelet, *H. oweniana* Pfeiffer, *Neocyclotus bisinuatus* (von Martens) (= *dysoni* Pfeiffer?), *Leptinaria* sp.?

Type Depository: Holotype (121676), 3 paratypes (121677) consisting of one mature, worn specimen, one fresh, immature specimen, and one fragment, all in American Museum of Natural History.

Acknowledgements: I gratefully acknowledge the generous assistance of Dr. Joseph P. E. Morrison of the United States National Museum and of Dr. H. Burrington Baker of the Academy of Natural Science of Philadelphia for making available material for comparison. Dr. William K. Emerson of the American Museum of Natural History kindly read the manuscript.

NOTES AND NEWS

Courtship between Monadenia fidelis and M. infumata: — The pair were noted in courtship at 12:20 P.M., February 16, 1953. I am indebted to Allyn G. Smith for collecting and sending the *M. infumata* (Gould). He collected the two adults June 8, 1952 at Mt. La Salle, above Christian Bros. Winery, Nopa Co., California. The specimen of *M. fidelis* was laboratory reared, and was much smaller than the field-collected *infumata* which measured about 41 mm. in greater diameter.

As first noted in courtship in my fruit-cellar laboratory, the pair were in the head-arching stage of courtship. The *fidelis* and *infumata* were exchanging bite for bite on the foreparts in the typical fashion of courtship pairs of *M. fidelis* (Gray), (Webb, Gastropodia (1952) 1:1:1-3).

The body color of the two specimens is much alike. The edge of the sole of the *infumata* is just a bit more brilliant—being yellowish-gray where that of the *fidelis* is a whiter, clearer gray. The *infumata* was crawling rapidly in a clockwise pivot as it hung from the cage cover-glass. The atrial pore of the *infumata* at 12:45 P.M. was widely dilated and slightly out-bulging. The pair rejoined head-on. The atrial pore of the *fidelis* was dilated and projected outward about 8 mm. At 12:48 P.M. head-arching was resumed; each biting at the other snail's foreparts. This continued until about 1:05 A.M. (Feb. 17) when both pivoted; the bulging of the atrium continued in the *fidelis* but the *infumata* showed only a great dilation of the genital pore without outward convexity.

By 1:12 the *infumata* had gone sufficiently far forward to reach the *fidelis* again, but then, for causes not apparent to me, the pair again pivoted counterclockwise. At the completion of the pivot, the *fidelis* returned to the slim-spot marking the site where the courtship was initiated, and began to gnaw at the slime.

The *infumata* completed its pivot and was bitten by the *fidelis*. I observed that the *fidelis* genitalia were not protruded yet to the bell-shape noted in *fidelis* x *fidelis* matings. At 1:19 head-arching and biting continued; at 1:22 the *fidelis* protruded the genitalia as a bell-shaped organ; at 1:35, the *infumata* crawled around the *fidelis*, but the pair soon rejoined in a rather poor position. At 2:12 A.M. the *fidelis* dilated the exserted vaginal disk widely and pressed it mostly against the foot of the other snail. Then, on the vaginal disk, the dart-organ appeared as a recurved, tubular, loop, immediately followed by an obscuring, copious, whitish, secretion, presumably the ejects of the mucous gland. Then the penis of the *fidelis* began to engage the atrial pore of the *infumata* (which had never everted or protruded its own sex-organ beyond the dilation stage described above). As the *fidelis* tried to insert its penis into the genital pore of the *infumata,* the latter kept moving away so that the penis-contact was disrupted. Under the conditions no spermatophore-transfer was begun. At 2:20 the penis of the *fidelis* was slowly retracted; at 2:21 the *infumata* returned head-on to the *fidelis,* which was lapping up the whitish secretion it had released. Again the *fidelis* inserted its penis, but again the *infumata* broke the contact before spermatophore-egress could be initiated.

At 2:40 the *infumata* still had a dilated genital pore but sex-union between the two snails had not been effected and seemed unlikely. The failure of the organs of the *infumata* to respond is noteworthy and puzzling. Perhaps the necessary courtship process is quite different in *infumata* (I have yet to witness it), and the proceedings did not stimulate the *infumata* to a degree sufficient to enable it to respond. About this time, 2:45 A.M., the observations were discontinued. Although quite unsatisfactory in many respects, the observations do indicate that a decided barrier to matings between these two species probably exists. — GLENN R. WEBB, Kutztown State College, Pa.

POMACEA BRIDGESI (REEVE) IN FLORIDA.—This Brasilian species was received recently from Dr. G. W. Dekle, Entomologist for the State of Florida, Division of Plant Industry, Gainesville. The original live specimen was found in a fish pond by Mr. C. F. Dowling on the eastern shore of Finger Lake, Miami, Florida. This lake is bounded by SW 53rd Avenue and 55th Avenue and 101st Street and 105th Street. The fish pond drains into Finger Lake.

This snail is being sold by aquarium supply dealers and it may be expected to appear elsewhere in time. The M.C.Z. has specimens from Furo Maguary, Belem, Pará; Amazon River at Villa Bella; Obidos; and Santarem, Brasil. —W. J. CLENCH.

POMACEA BRIDGESI IN PUERTO RICO.—This Brasilian species has been introduced into Puerto Rico at Mayagüez. Dr. Rebecca Brown of the School of Medicine, Boston University, brought in a specimen of this species for determination. Several additional specimens were obtained through the kindness of Dr. M. H. Gaskins, officer in charge of the U.S. Department of Agriculture Experiment Station, who had collected them in a small pond back of the main building of the station at Mayagüez in March, 1965. Dr. R. D. Turner collected in this same pond in August, 1956, but found only *Australorbis*. In June, 1958, Dr. Allan Archer of Tift College, Forsythe, Georgia, collected a single specimen of this species in the same pond. This is a possible indication of the approximate date the species was first introduced into Puerto Rico. —W. J. CLENCH.

STRANDED CAMPELOMA.—During March, 1964, the Ohio River had one of the severest floods in recorded history. At Louisville, Kentucky, floodplain areas were inundated for several days and many spots along the bank remained under water long after the higher discharges subsided. Quantitative samples showed that most *Campeloma crassula* were aggregated in shallow water from late February through these floods. Many of the snails had followed rising water up the bank and numerous specimens were collected up to 12 meters from the usual waterline.

On the morning of April 28, 1964, the river began to recede from low areas of the bank. Most *Campeloma* that were left in these areas by the rapidly falling water level, responded by actively migrating toward the waterline. Upon reaching water, most snails burrowed into the sandy bottom where they remained as the water receded further, usually leaving them stranded. Animals on patches of firm clay continued on to deeper water, apparently seeking material to burrow in. The kind of substratum and its moisture content affected the success of these migrations. The average speeds of 19 snails on various surfaces were: 19.2 cm./min. underwater, 13.2 cm./min. out of water on mud, and 7.8 cm./min. on moist sand. Those traveling on sand were often immobilized since the substratum dried quickly, whereas muddy areas dried more slowly and the movement of snails was less impaired. None of the animals attempted to burrow while out of water. All snails were moving toward the river channel. However, tracks indicated that those trapped in isolated pools would first move around the edge of a puddle, then on to its deepest area where they burrowed into the bottom. These directed movements of *Campeloma* were conceivably in response to a moisture gradient in the substratum; however, no experiment was carried out to explore this possibility.

Twenty-seven specimens that were ashore on dry portions of the bank for 52 hrs. were placed in aquaria with river water. Within 20 min., 11 were moving about actively and after 40 min. all had recovered. No live individuals were found among 17 specimens that were similarily treated after about 5 days of exposure. The ability of *C. crassula* to survive out of water for relatively short periods is seemingly due to the moisture retaining capabilities of its shell and tight fitting operculum. Individuals that were partially buried in either sand or mud apparently gained no advantage in survival.

The aggregation of *Campeloma* in shallow areas was presumably a negative response to increased current. During the period that the population was in shallow water, there was a strong current in the main channel from discharges that averaged from 150,000 to 690,000 cfs. Current had decreased and discharges averaged less than 50,000 cfs. at Louisville in mid May when these organisms were again more evenly distributed over the bottom. The numbers of *Campeloma* were not reduced during the flood as were the densities of other mollusks in the area. Relationships, if any, between these responses and the positive rheotactic movements of *C. decisum* demonstrated by Bovbjerg (Ecology *33*:169-176, 1952) remain uncertain. — DAVID BICKEL, The Potamological Institute, University of Louisville, Louisville, Kentucky.

CAMPELOMA CRASSULA WITH REVERSED WHORLS.—During a recent study of the fresh-water mollusks of the Ohio River at Louisville, Kentucky, seven out of the 282 specimens of *Campeloma crassula* Raf. examined had reversed whorls. The 7 sinistral shells had heights of 18.5, 12.0, 6.2, 5.6, 5.4, 3.5, and 3.4 mm. The 4 smaller specimens were among young juveniles born in May and June, 1964. Shell height at birth of *C. crassula* in the Ohio River fell in a 3 mm. size class, with the smallest free-living young measuring 2.6 mm. This was about 1 mm. shorter than the shell heights at birth of *C. rufum* in the Salt Fork River, Illinois, reported by Van Cleave and Altringer (Am. Nat. *71*:167-184, 1937).

The sinistral shells were more loosely coiled than those of normal specimens. However, the number of whorls corresponded with those on dextral animals of similar size, and the juveniles fit into age classes along with normal individuals. The abnormal juveniles accounted for 8% of all the snails with shell heights of 10 mm. and under, while the two larger shells represented less than 1% of the medium and larger sized specimens. Apparently the reversed spiral anomaly occurs more frequently than one might assume from the literature. Possibly related morphological or physiological abnormalities bring about a high degree of mortality among these individuals before they reach adult size. —DAVID BICKEL, The Potamological Institute, University of Louisville, Louisville, Kentucky.

AUTUMN MIGRATION OF HELISOMA TRIVOLVIS IN MONTANA.— Frequent observations were made of a population of *Helisoma trivolvis* (Say) in a roadside pond one mile south of Frenchtown near Missoula, Montana, during the summer and autumn of 1964. The pond is approximately 100 feet long, 10 to 25 feet wide, and slopes sharply from the edges to a depth of nearly six feet in the center. The bottom material along the edges consists of rocks and gravel mostly covered by leaves and fallen branches. Mud and debris covers the deeper sections. At the inlet, which has an autumn flow of approximately 1.5 cubic feet per second, the pond is only a few inches deep and the substrata consists of coarse sand.

During the summer the snail population was concentrated mainly about the periphery of the pond from the surface to a depth of 3 or 4 feet with most specimens one-half to one foot under the surface. Approximately 25 specimens could be collected in an hour of search about the periphery. Few specimens were found near the inlet either on the surface or under the sand.

During October the population seemed to disappear. Very few snails could be collected from the periphery or could be seen on the bottom at deeper levels. Dredging of the bottom at several deeper points in the pond failed to provide living snails although numerous empty shells were recovered. However, dredging to a depth of one or two inches in the coarse sand in a longitudinally

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SIZE OF PELECYPODS IN RECENT MARINE FAUNAS

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In a previous paper (1964, p. 968) the writer made the following statement:

Small species (less than 10.0 mm. in either height or length) are unusually numerous in the antarctic pelecypod fauna.

The purpose of this paper is to show in some detail the size of pelecypods in 14 living Antarctic faunas and to compare these with the arctic shallow-water pelecypod fauna and cool- and warm-water bivalve faunas as well.

Paleoecologists have become interested in fossil assemblages containing an unusual abundance of small specimens (stunted faunas) or such an uncommon assemblage as the *Eurydesma* fauna of Early Permian age which is almost completely restricted to the southern hemisphere. *Eurydesma* is a large pelecypod with a thick shell, but other animals preserved along with *Eurydesma* tend to be stunted (see Ager, 1963, pp. 290-291). In the case of stunted faunas, paleoecologists have attempted to explain these occurrences by mechanical sorting, lack of oxygen on the sea floor, reduction of salinity, and other causes. (For an excellent recent review of this topic, see Hallam, 1965). On the other hand, zoologists seem not to have shown such great interest in this matter. Furthermore, basic data on recent marine pelecypod faunas is surprisingly sparse. Few faunal monographs have a thorough enough coverage of both large and small- sized species to be useful for analysis. Two additional difficulties are encountered when one looks for adequate data to analyze. If shell measurements are given at all, they frequently are not given in the metric system in books written in English. More commonly still, there is no indication whether the measurements are those of an average-sized specimen or of the largest-sized specimen present. For this paper the writer has taken maximum size (either height or length) in every case where it is given. Of the 14 faunas analyzed, I have included 2 which may not have adequate coverage of the small-sized species, namely the tropical west African and the Japanese. The Teredinidae were not included in the faunal analyses because of the difficulty of measuring specimens belonging to that family. Fresh-water pelecypods were, of course, also excluded.

The data were taken from the following sources. The Antarctic sample was taken from the collections at the U. S. National Museum, which number about 2,550 specimens allocated to 36 species. This number of species must be at least one-half of all of the pelecypods found in shallow water (less than 1,829 m) in the entire antarctic region and should be an adequate sample for analysis. The data for the 13 other faunas were taken from the following works: Point Barrow, Alaska, (MacGinitie, 1959) ; east Greenland (Ockelmann, 1958); Iceland (Madsen, 1949) ; New Zealand (Suter, 1913-15); South Australia (Cotton and Godfrey, 1938) ; California Province, i.e., west coast of North America exclusive of Alaska (Oldroyd, 1924) ; western Florida (Perry and Schwengel, 1955); Puerto Rico (McLean, 1951) ; northern Panamic (Keen, 1958) ; southern Panamic (Olsson, 1961) ; tropical west Africa (Nicklès, 1950) ; Morocco (Pasteur-Humbert, 1962) ; Japan (Taki, 1951).

Table 1 is a summary of the basic data analyzed by the writer, and certain inferences can be made from it. Pelecypods living in the cold (no more than 5° C maximum temperature) shallow waters of the arctic and antarctic regions almost never attain a maximum height or length of more than 100.0 mm. The number of species attaining a greater size than 100.0 mm in temperate and warm sea water commonly amounts to about 5 per cent of the total fauna, and it may be even greater than this in truly tropical faunas. The mean shell size of all of the antarctic species is considerably smaller than that of even the east Greenland fauna, and mean shell sizes are commonly smaller in the colder water faunas than in the warmer water faunas. The antarctic fauna clearly has the largest percentage of small species. In compiling the data on this fauna, the writer took the maximum length or height of each species studied so that the data certainly cannot be considered biased toward small shell size. If only average size of each of the 36 species of antarctic pelecypods had been used, the small size of the antarctic species would have been

Table 1.--Number of pelecypod species in each fauna; mean and maximum sizes in mm; and percentage of species of not more than 10.0 mm, 10.1 to 20.0 mm, and more than 100.0 mm.

Region	N	Mean	Max	%1-10mm	%10.1-20mm	%>100mm
Antarctic	36	16.9	90.0	61.0	19.0	0
Point Barrow	36	34.2	80.0	14.0	14.0	0
East Greenland	56	26.3	100.0	28.5	17.8	0
Iceland	87	31.8	160.0	29.9	20.7	5.9
New Zealand	180	33.5	230.0	32.2	15.6	4.5
South Australia	312	27.4	280.0	37.5	19.2	4.8
Californian	317	35.6	240.0	24.4	18.5	5.3
Western Florida	152	38.6	260.0	14.5	26.3	5.9
Puerto Rico	206	36.6	220.0	18.9	19.9	3.5
Northern Panamic	558	39.5	290.0	12.7	17.9	5.4
Southern Panamic	483	43.3	550.0	12.6	14.1	5.1
Morocco	164	43.4	300.0	12.8	18.9	6.1
West Africa	157	54.4	450.0	8.9	10.2	7.6
Japan	330	70.1	420.0	2.4	7.6	13.2

even more striking. Sixty-seven per cent of the antarctic species do not average more than 10.0 mm in height or length and 83 per cent of the species do not attain an average size of more than 20.0 mm. in height or length. Furthermore, even the South Australian and New Zealand pelecypod faunas have an uncommonly large number of species of small size considering the relatively warm temperature of the waters in these regions. Can this be explained merely by the greater attention that Australian and New Zealand malacologists have paid to the small-sized pelecypods in those faunas? The writer doubts that this is a completely satisfactory explanation for the relatively high percentage of small species in South Australian and New Zealand waters. In the case of these three faunas in the southern hemisphere, there is an unusually large number of species belonging to some genera and families that never attain a large size anywhere in their geographic range. The philobryids and cyamiids are common and diverse in a large part of the southern hemisphere but are rare or absent in the northern hemisphere. This appears to be the major factor in the large number of small-sized species in these faunas, although it is true, for example, that the one species of *Astarte* found in the antarctic is less than 10.0 mm in size, but the several species of *Astarte* in the arctic all attain a maximum size of more than 10.0 mm.

Noted also from a study of Table 1 is that in the cold or temperate waters of both northern and southern hemispheres there are at least as many species in these faunas that are in the size range from 1.0 to 10.0 mm. as in the size range from 10.1 to 20.0 mm. The reverse is true for the warm-water pelecypod faunas. In this regard, the South Australian pelecypod fauna would be classed with the temperate ones.

The antarctic pelecypod fauna cannot be considered a stunted one in the strict sense because paleoecologists have consistently attributed direct physical causes to the stunted fossil faunas. If there is a physical cause to explain the large number of small-sized pelecypods in this fauna, it is not readily apparent. Even if one or more physical causes are found, they must be linked with genetic factors in this instance because so many of the small-sized species belong to genera and families whose species nowhere attain a large size.

Bcause of the inadequacy of the basic data which are summarized in Table 1, the writer does not feel justified in attempting any additional inferences.

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OCCURRENCE AND DISTRIBUTION OF ASIATIC CLAM, CORBICULA LEANA, IN PEARL RIVER, LOUISIANA

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The Asiatic clam, *Corbicula,* was originally introduced into the United States several years ago. Pennak (1953) reported that *Corbicula fluminea* (Müller) was occasionally found in sloughs and rivers of Washington, Oregon, and California. Ingram (1959) summarized the known distribution of the Asiatic clam. Sinclair and Ingram (1961) reported the presence of *Corbicula* in the Tennessee River and Sinclair and Isom published a life history (1961) and an additional study two years later (1963). Keup, Horning, and Ingram (1963) extended the range of the Asiatic clam to the Cincinnati reach of the Ohio River.

Early in 1964, one of us (G.E.G.) examined an invertebrate collection taken by the writers from the Pearl River just above the entrance of Coburn Creek, near Bogalusa, Louisiana. Using Pennak's (1953) key to families and genera of Pelecypoda (p. 707), 32 specimens were tentatively identified as *Corbicula fluminea* (Müller). Five of the 32 specimens were sent to Dr. J. P. E. Morrison of the United States National Museum who informed us that the determination was correct according to the literature, but that the literature available at the moment was incomplete. Dr. Morrison stated that our specimens should be referred to *Corbicula leana* Prime (personal communication; March 26, 1964).

Extensive collections of benthic invertebrates have been made on the Pearl River. The purpose of this paper is to show the rapid rate of dispersal and increase in numbers that *Corbicula* has undergone during a one-year period.

Methods. Small pelecypods were collected incidental to the collection of fishes using a ten-foot, ⅛ inch mesh seine. Additional samples were taken by hand-picking or sorting through bottom materials. Although the samples are not strictly quantitative, we attempted to apply equal collecting effort at each station so that they would at least be reasonably comparable.

All valve measurements were made to the nearest 0.5 millimeter.

Results. Table 1 shows the number of specimens of *Corbicula leana* taken at each station during two consecutive years. Evidently *Corbicula* is spreading into new areas within the river system and concomitantly increasing in numbers. Large collections were taken at stations 1, 2, 4 and 7 during 1964; no specimens were taken at these stations during 1963.

Table 2 contains the size distribution of a number of collections made during 1963 at other stations along the Pearl River. The smallest specimen collected measured 4.0 mm total length; the largest specimen in this series of collections measured 28.0 mm total length, although larger specimens were taken elsewhere.

We believe that *Corbicula* invaded the Pearl River during

Table 1. Stations and number of specimens of *Corbicula leana* taken during two consecutive years of collecting on the Pearl River, Louisiana.

Station	Location	Number of Specimens 1963 (Sept.)	 1964 (Aug.-Sept.)
1	Mile 59	0	95
2	Mile 54.4	0	324
3	Mile 52.0	4	51
4	Mile 47.0	0	141
5	Mile 46.0	47	413
6	2.0 miles below Wilson's Slough, West Pearl River	9	35
7	4.0 miles below Wilson's Slough, West Pearl River	0	154
8	Near Mile 27.0; West Pearl River	1	2
9	1.5 miles north of town of Pearl River; West Pearl River	1	2
10	Lower End of Nancy's Reach; East Pearl River	2	432
	Totals	64	1649

Table 2. Maximum valve length in millimeters, anterior to posterior, for selected collections of *Corbicula leana* taken from the Pearl River, Louisiana, during 1963.

Station	Location	Number of Specimens	Mean Length	Range	Standard Deviation
A	Pearl River below Highway 10 crossing; Bogalusa, Louisiana	134	14.0	6.0-23.5	2.0
B	1/2 mile below Station A	27	9.0	4.0-22.0	4.0
C	Mile 52.0	7	14.0	9.5-18.0	3.0
D	Mile 46.0	40	16.0	6.5-28.0	6.0
E	2.0 miles below junction of Wilson's Slough; West Pearl River	9	11.0	7.0-18.5	4.0

1959. One group of specimens taken in 1963 centered around 8.0 mm total length; a second group centered around 14.0 mm total length; a third group centered around 22.0 mm total length; the fourth group centered around 34.0 mm total length. This size-class distribution would indicate four year-classes during 1963: 1959, 1960, 1961, and 1962. Keup, Horning, and Ingram

(1963) reported three year-classes for *Corbicula fluminea* in the Ohio River; it was their opinion that *Corbicula* invaded the Ohio River about 1960.

The largest *Corbicula leana* taken in the Pearl River measured 37.0 mm total length; this specimen was assigned to the 1959 year class.

Discussion. The Asiatic clam is rapidly extending its range in the United States. The presence of this species in large numbers in the Pearl River of Louisiana was an unexpected find. Apparently *Corbicula leana* is rapidly spreading throughout the Pearl River system as indicated by its abundance in collections made during two successive years. Specimens were found to be abundant in sand, gravel, silt, and mixtures of these.

Collections are being made on a continuing basis and hopefully additional work will add to our knowledge of the ecology of this form.

Acknowledgment. Messrs. James Reed, Clyde Barbour, Jerome Shireman, and John Ramsey aided during this study.

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SOME LAND SNAIL RECORDS FROM ARKANSAS AND OKLAHOMA

By LESLIE HUBRICHT

During the spring of 1965 the author spent two weeks collecting land snails in western Arkansas and eastern Oklahoma. Some of the more interesting species found are reported here.

Mesodon clenchi (Rehder).

Arkansas: Izard Co.: White River bluff, 1 mile below Calico Rock. Yell Co.: rock slide, near the falls, Mt. Nebo.

At the type locality they were found living under ledges. On Mt. Nebo several dead shells were found around the edge of a rock slide. One would probably have to go out at night after a rain to find living ones.

Mesodon edentatus (Sampson).

Oklahoma: Sequoyah Co.: upland mixed woods, 2 miles northeast of Short.

Guppya sterkii (Dall).

Oklahoma: Sequoyah Co.: Polecat Creek bluff, 1 mile southwest of Nicut.

Glyphyalinia lewisiana (Clapp).

Arkansas: Izard Co.: under rock, cedar glade, 4 miles northeast of Calico Rock.

This is another southern Appalachian species which was able to reach the Ozark Region through the Pleistocene corridor across southern Mississippi and northern Louisiana.

Glyphyalinia solida (H. B. Baker).

Arkansas: Saline, Scott, Sharp. Oklahoma: Latimer, Pushmataha.

Mesomphix capnodes (W. G. Binney).

Arkansas: Baxter, Benton, Conway, Independence, Logan, Montgomery, Newton, Polk, Pulaski, Scott, Van Buren, Yell. Oklahoma: Cherokee, Le Flore.

Paravitrea significans (Bland).

Arkansas: Baxter, Benton, Lawrence, Polk, Searcy, Yell. Oklahoma: Atoka, Cherokee, Delaware, Latimer, Mayes, Sequoyah.

Paravitrea simpsoni (Pilsbry).

Arkansas: Boone, Carroll, Newton, Van Buren. Oklahoma: Cherokee, Latimer, Le Flore, Mayes, Pittsburg, Pushmataha.

Discus patulus edentulus Hubricht.

Oklahoma: Sequoyah Co.: Polecat Creek bluff, 1 mile southwest of Nicut.

Helicodiscus notius notius Hubricht.

Arkansas: Benton, Carroll, Conway, Logan, Montgomery, Polk, Scott, Sharp, Yell. Oklahoma: Adair, Cherokee, Mayes, Rogers, Sequoyah.

Helicodiscus jacksoni Hubricht.

Oklahoma: Mayes Co.: rocky wooded hillside, 5.5 miles west of Locust Grove.

This is the first time I have found this species alive. The animal is pure white.

Pallifera marmorea Pilsbry.

Arkansas: Benton, Carroll, Columbia, Logan, Polk, Scott, Sharp, Stone. Oklahoma: Atoka, Cherokee, Latimer, Le Flore, Mayes, Sequoyah.

Catinella oklahomarum (Webb).

Arkansas: Logan Co.: southside of Short Mtn., 2 miles northwest of Paris; Cameron Bluff, Magazine Mtn. Oklahoma: Sequoyah Co.: upland mixed woods, 2 miles northeast of Short.

Strobilops aenea Pilsbry.

Arkansas: Baxter, Benton, Logan, Montgomery, Polk, Sharp. Oklahoma: Cherokee, Le Flore, Mayes, Sequoyah.

My specimens from Magazine Mtn. are typical *S. aenea*. I have seen no *S. aenea* which fit Pilsbry's description and figures of *S. aenea spiralis*. The form of *S. texasiana* Pilsbry & Ferriss found in Oklahoma fits it better than anything I have seen.

Pomatiopsis lapidaria (Say).

Oklahoma: Delaware Co.: near Dripping Springs, 3 miles southeast of Flint.

AN 1870 COLLECTION OF MUSSELS FROM THE CALUMET RIVER, ILLINOIS

By LOWELL L. GETZ
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A collection of fresh water mussels taken from the Calumet River, Illinois, 21 September, 1870, has recently been discovered among the mollusk collections of the University of Connecticut. These specimens were obtained by the late Dr. Benjamin F.

Koons, but apparently had not been curated or reported. The specimens have the locality ("Calumet River, Illinois") written on the valves. All the shells were wrapped and tied in 1870 Chicago, Illinois newspapers. From all appearances the specimens had not been worked with from the time they were packed. Since no catalog was associated with the specimens, the original collector is not known. The exact locality of the collecting site was not given. Only 8 miles of the river occur in Illinois, however.

The only published account of mussels from the Calumet River is that of Baker (1902). He listed 7 species from the river. The present collection includes 7 additional species not recorded by Baker. The Calumet River is in an area of special importance in interpretations of post-Pleistocene changes in faunal patterns (Walker, 1913). This river is now so highly polluted that the original fauna is greatly disturbed and most species probably eliminated (W. J. Harth, personal communication). Therefore, it seems desirable to place on record the additional species to describe more completely the original mussel fauna of the Calumet River.

The following species and number of specimens are present in the 1870 collection (those marked with an asterisk have not been previously reported from the Calumet River):

Unioninae:
  ***Amblema costata* Raf., 6.
  Elliptio dilatatus (Raf.), 27.
  **Fusconaia flava* (Raf.), 4½.
  **Pleurobema cordatum coccineum* (Conrad), 1.
  Quadrula pustulosa (Lea), 7.
  **Quadrula quadrula* Raf., 5.
Anodontinae:
  **Lasmigona costata* (Raf.), 1.
  **Strophitus rugosus* (Swainson), 4.
Lampsilinae:
  **Lampsilis siliquoidea* (Barnes), ½.
  Obliquaria reflexa Raf., 1.
  Truncilla truncata Raf., 5.

Baker (1902) records the following additional species from the Calumet River:

Quadrula trigona [=*Fusconaia undata* (Barnes)].
Quadrula verrucosa [=*Tritogonia verrucosa* (Say)].
Anodonta grandis Say.
Lampsilis alatus [=*Proptera alata* (Say)].

Plagiola donaciformis [=*Truncilla donaciformis* (Lea)].

I wish to thank Dr. L. R. Penner for making available the collection. Dr. H. van der Schalie assisted in identification of the material.

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KELAART'S CEYLON OPISTHOBRANCH SPECIES

By HENRY D. RUSSELL

Since the time (1858) that Dr. E. F. Kelaart, staff surgeon, first published his Ceylonese species of nudibranchiate mollusca, a certain amount of confusion as to the original publication dates has existed. The reason for this is that his work was republished several times with only slight title or species name spelling changes, and some of these reprintings are very difficult to obtain. Much of the confusion in regard to these species has been dispelled by the excellent discussions of Kelaart's work by Sir Charles Eliot in 1906 and C. H. O'Donoghue in 1933 (see bibliography). The latter, however, states p. 226 that "in spite of this (studies by Eliot of Kelaart's colored drawings and a number of his actual specimens) however, a good deal remains to be done, and it is to be hoped that, in view of their importance from the systematic and taxonomic points of view someone who has access to the type localities and the same collecting grounds will make an effort to rediscover and describe in satisfactory detail the forms originally described by Kelaart." This work of Kelaart in Ceylon is important not only because it is of a pioneer nature and includes 63 species, but also because it appears in those critical and difficult years for obtaining species references between the termination of the "Index Animalium" by C. D. Sherborn (1850) and the start of the "Zoological Record" (1864). It is also important as being the earliest account of Opisthobranchs from Ceylon and among the earliest on Indo-Pacific forms. The author wishes to acknowledge the assistance of Mr. S. Peter Dance, Section of Mollusca of the British Museum in supplying him with a reproduction of Kelaart's paper in

Journ. Roy. Asiatic Soc. *3,* 1858.

The purpose of the present paper is to list, with original references, dates, pages and localities, Kelaart's "new" Ceylonese species of Opisthobranchiata since, to the author's knowledge, no such concise compilation exists. The species are all from the environs of Trincomalie, Ceylon. Only more detailed localities are so stated. The numbers after the species names refer to pages.

The Annals and Magazine of Natural History (3) *1* (4): 257, 258 April, 1858. *Trevelyana*-257 (N. gen.). *T. Ceylonica*-257, Sober Id.

Journal of the Royal Asiatic Society of Great Britain and Ireland, Ceylon Branch, Colombo *3* (1) : 84-139 with 2 unnumbered plates, May, 1858.

Doris *gloriosa,* 91, Fort Frederick. *D. maccarthyi,* 93. *D. caelestis,* 94, Back Bay. *D. funebris,* 94. *D. gleniei,* 95, Cottair. *D. leoparda,* 96, Dutch Bay. *D. amabilis,* 96. *D. fidelis,* 97. *D. preciosa,* 98. *D. nivea,* 98. *D. marmorata,* 99, Fort Frederick.

Doris cerisa, 99. *D. rufopunctata,* 100. *D. grisea,* 100, Fort Frederick. *D. papillosa,* 101. *D. rubra,* 101. *D. osseosa,* 102. *D. constantia,* 102. *D. luteola,* 103. *D. viperina,* 103, French Battery. *D. atrata,* 103. *D. atroviridis,* 104. *D. variabilis,* 105, Dutch Bay. *D. exanthemata,* 105. *D. carbunculosa,* 106. *D. intecta,* 107. *D. lanuginosa* - 107, Nicholson's Cove. *D. spongiosa,* 108. *D. striata,* 108, Dutch Bay. *D. corrugata,* 109. *D. picta,* 109. *D. bellicosa,* 109. *D. castanea,* 110, Sober Id.

Meliboea viridis, 113. *Scyllaea* (?) *dracaena,* 113. *Polycera* (?) *ceylonica,* 114. *Eolis husseyi,* 115. *E. bicolor,* 115, Back Bay. *E. effulgens,* 116, Dutch Bay. *E. paulinae,* 116. *E. tristis,* 117. *E. nodulosa,* 117. *E. smedleyi,* 117.

Proctonotus orientalis, 118. *Pterochilus viridis,* 118. *Elysia grandifolia,* 119. *E. punctata,* 119. *E. caerulea,* 120. *Phyllidia zeylanicus,* 120. *Diphyllidia formosa,* 121. *Pleurobranchus zeylanicus,* 123. *P. purpureus* - 123.

Ann. and Mag. Nat. Hist. (3) *4:* 267-270 Oct., 1859.

Doris elizabethina, 267, Aripo. *D. diardi* - 267, Aripo. *D. lockyerana,* 268, Aripo. *D. tennentana,* 268, Cheval Paar Pearl Banks. *D. ariponensis,* 268, Aripo. *D. humberti,* 268, Aripo. *Diphyllidia marmorata,* 269, Aripo. *Bornella hancockana,* 269, Ceylon. *Eolis skinneri* - 270, Fort of Colombo.

A list of Kelaart's publications and republications appears below. Only the three references shown above, however, contain the original species descriptions though the others, because of duplication, appear to also. The reader is referred to C. H. O'Donoghue Proc. Malacol. Soc. London *20* (4): 221-226, 1933 for a more detailed discussion of each.

1. Description of a new Ceylonese Nudibranch. Ann. and Mag. Nat. Hist. (3) *1* (4):257, 258, pl. 10B, figs. 1, 2, April, 1858.
2. Description of new and little known species of Ceylon Nudibranchiate Mollusca and Zoophytes. Journ. Roy. Asiatic Soc. Ceylon Branch, Colombo *3* (1): 84-139 with 2 unnumbered plates, May 8, 1858.
3. Descriptions of new and little known species of Ceylonese nudibranchiate mollusks. Ann. and Mag. Nat. Hist. (3) *3:* 291-304, April, 1859.
4. Description of new and little known species of Ceylonese nudibranchiate mollusks. Ann. and Mag. Nat. Hist. (3) *3:* 488-496, June, 1859.
5. On some additional species of nudibranchiate mollusks from Ceylon. Ann. and Mag. Nat. Hist. (3) *4:* 267-270, Oct. 1857, 1859?
6. Pamphlet p. 1-64 "Trincomalie" 1st. November 1857, 1959? (This pamphlet was not available to the public and does not constitute a publication according to O'Donoghue Proc. Malacol. Soc. London *20:* 226, 1933.) It carries the title "Description of new and little known species of Ceylon nudibranchiate molluscs and zoophytes."
7. New and little known species of Ceylon nudibranchiate molluscs and zoophytes. Journ. Roy. Asiatic Soc. Ceylon Branch, 1856-61 *3* (9): 76-125, 1883.
8. Description of new and little-known species of Ceylon nudibranchiate molluscs, and zoophytes. Journ. Roy. Asiatic Soc. Ceylon Branch. Colombo *3* (title only in table of contents in the volume — see O'Donoghue l. c. p. 224, 1933).

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O'Donoghue, C. H. Kelaart's work on the Nudibranchiata of Ceylon. Proc. Malacol. Soc. London *20:* (4): 221-226, 1933.

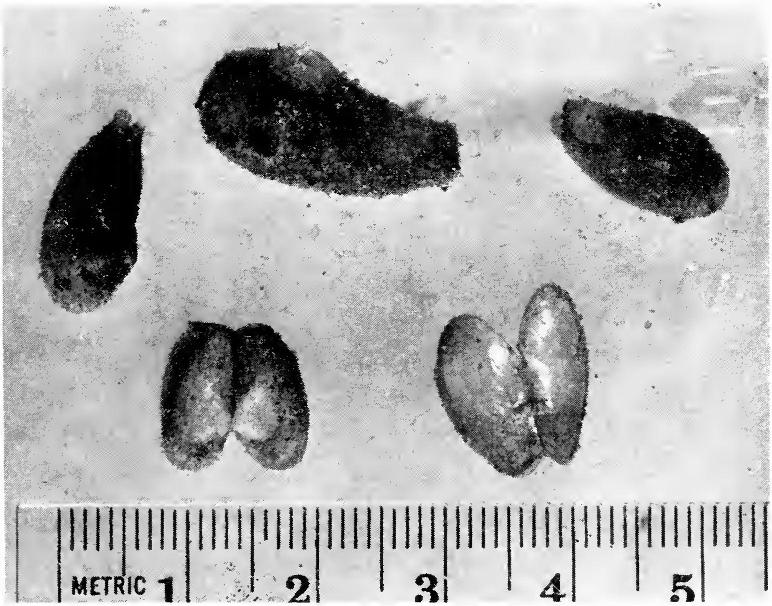

Figure 1. Adult *Lyonsia hyalina*. Top row: Living clams. The one at left and the one at right have siphons extended. Bottom row: Exterior view of empty valves at left. Interior view of empty valves at right.

LARVAL DEVELOPMENT OF THE PELECYPOD LYONSIA HYALINA[1]

By P. CHANLEY and M. CASTAGNA
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Lyonsia hyalina (Conrad) is a small (½ to ¾ inch) odd-shaped clam (Fig. 1) common along the Atlantic Coast from Nova Scotia to South Carolina (Abbott, 1954). It is usually found in sand in shallow water with a coating of small sand grains attached to the periostracum.

The only published description of larval Lyonsiidae is a tentative identification of *Lyonsia norwegica* (Gmelin) found in plankton samples (Rees, 1950). Rees also tentatively identified larvae of *Thracia* sp., and *Cochlodesma praetenue*. These species belong to closely related families and are grouped with the

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[1] Contribution No. 203 from Virginia Institute of Marine Science.

Figure 2. Larval *Lyonsia hyalina*. Scale equals 100 microns.

Lyonsiidae in the super-family Pandoracea. They are described by Rees as being slightly inequivalve and having, in each valve, a single long narrow hinge tooth. The hinge teeth are alternate, rather than opposite, and are poorly defined. A small ligament is located at the posterior end of the hinge. Sullivan (1948) describes juvenile *Pandora gouldiana* Dall, another member of the Pandoracea, and from the shape of the prodissoconch shell concludes that metamorphosis occurs when larvae are 235 microns long and 160 microns high. She notes that a "flattened dorsal edge with no projecting umbones" and "almost black viscera" are characteristic. Her photomicrograph of the hinge structure shows the hinge teeth opposite each other. The larva that Stafford (1912) has tentatively identified as the same species, *Chidiophora (Pandora) gouldiana*, bears no resemblance to Sullivan's account. But, larval *P. inaequivalvis* is similar.

The purpose of this report is to describe the pelagic larvae of

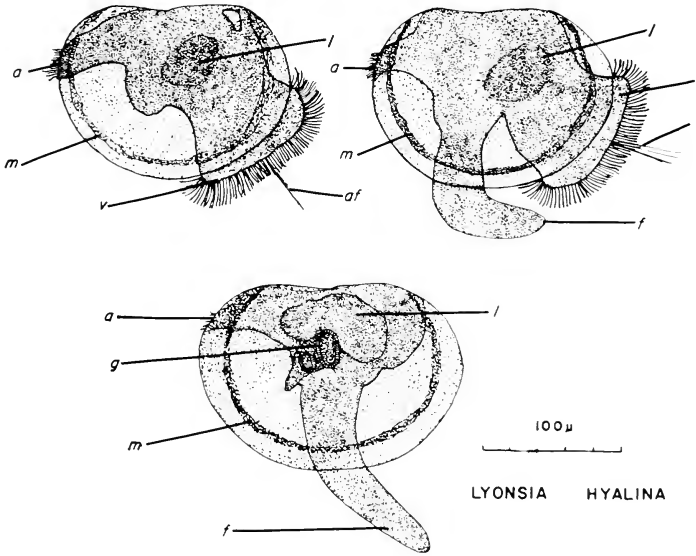

Figure 3. Diagram of major visible anatomical features of larval *Lyonsia hyalina:* a-anus, af-apical flagella, f-foot, g-gills, l-liver or digestive diverticulae, m-mantle edge, v-velum.

L. hyalina so that they can readily be identified in plankton samples. The terms used to describe the larvae are the same as those used for *Barnea truncata* (Chanley, 1965).

Materials and Methods. L. hyalina were collected from Mason's Beach on the Chesapeake Bay side of the Eastern Shore Peninsula of Virginia on 1, 8 and 15 April, 1965. Clams were collected by skimming off a layer of sand, near *Zostera* beds, and screening it. On the day following collection, clams were washed in salt water, to remove adhering grains of sand, and placed in finger bowls with filtered or centrifuged salt water. Spawning was induced by increasing water temperature to 24-25° C. Eggs were cultured in 10-liter polyethylene containers and larvae were fed and examined daily. The food consisted of a mixture of *Isochrysis galbana* and *Phaeodactylum tricornutum.* In some cases, clams were isolated in individual polyethylene containers from the time of collection and the gametes from isolated clams were then cultured separately. On one occasion, clams were reared to metamorphosis without the addition of food. All water (at about 20 o/oo) was

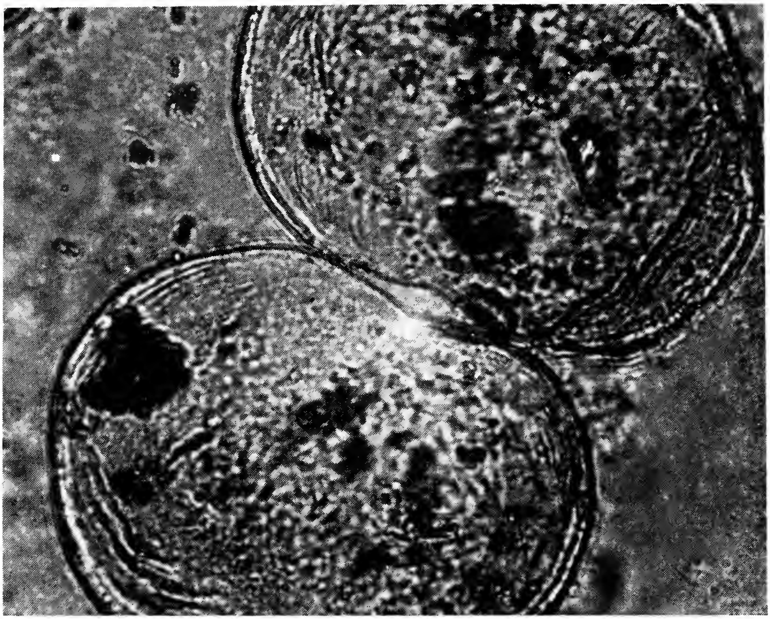

Figure 4. Interior opened valves of *L. hyalina* larvae showing ligament.

either filtered through a one-micron orlon filter or centrifuged by a cream separator. Water temperature of the cultures ranged from 18 to 22° C.

Results. L. hyalina released gametes within a few minutes after an increase in water temperature. Eggs were released in a thin stream through the excurrent siphon. They are sand colored and settle quickly to the bottom even after being stirred vigorously. The yolk is large, dark and opaque, measuring 100 to 115 microns in diameter, and surrounded by a lamellate membrane or membranes. The total egg diameter, including membrane, is 160-175 microns. Individual adults released from 8,000 to 16,500 eggs in a single spawning.

The actual release of sperm was not observed. The spermatozoan head is triangular, with blunted angles. It is 3.5 microns long, 2.5 microns wide at the base and has a tail 45-50 microns long.

L. hyalina is functionally hermaphroditic and autofertilization occurred when individuals were isolated. Larvae obtained from autofertilized eggs developed normally and were reared to metamorphosis. In all spawnings, many eggs did not fertilize or develop normally; however, there was no apparent relation between autofertilization and abnormal development.

Larvae developed to an ovoid "straight hinge" stage 24 hours after fertilization. The hinge line differs from that of most pelecypod larvae in that it is normally slightly indented in the center. The transition from the hinge line to the anterior and posterior slope of the shell is gradual. This results in an oval shape rather than the typical D-shape of most pelecypod straight hinge larvae (Fig. 2). Larvae are dark gray to black and opaque. The internal structure (Fig. 3) is consequently obscured. Usually one to four apical flagella can be seen on the velum.

Larvae range from 155 to 175 microns in length and from 120 to 130 microns in height. Depth is approximately 85 microns. No identifiable hinge teeth are present in the larval shell although a U-shaped ligament 15 microns long and about 11 microns wide extends from one valve to the other (Fig. 4). No appreciable change in shape occurs during the brief larval period and metamorphosis begins in three days. At metamorphosis larvae develop a long ciliated foot, the velum disappears and on the fourth or fifth day, gills begin to develop. Recently metamorphosed individuals attach readily by a byssus thread.

Discussion. Possibly sufficient food occurred naturally in the water to support the development of *L. hyalina* larvae in cultures that were not fed cultured algae. However, the large size of the egg yolk, the small size at metamorphosis and the short pelagic period all suggest that larval requirements for an outside food supply may be negligible.

Larval *L. hyalina* are distinctive and resemble no other known pelecypod larvae except *Pandora gouldiana* (Sullivan, 1948). They can readily be distinguished from the latter by the difference in larval length. *L. hyalina* ranges from 155-175 microns in length while *P. gouldiana* is over 200 microns.

Apparently the tentative identifications of Pandoracea larvae by Stafford (1912) and Rees (1950) are in error since they bear no resemblance to *L. hyalina* or Sullivan's (1948) *P. gouldiana* in either shape or hinge structure.

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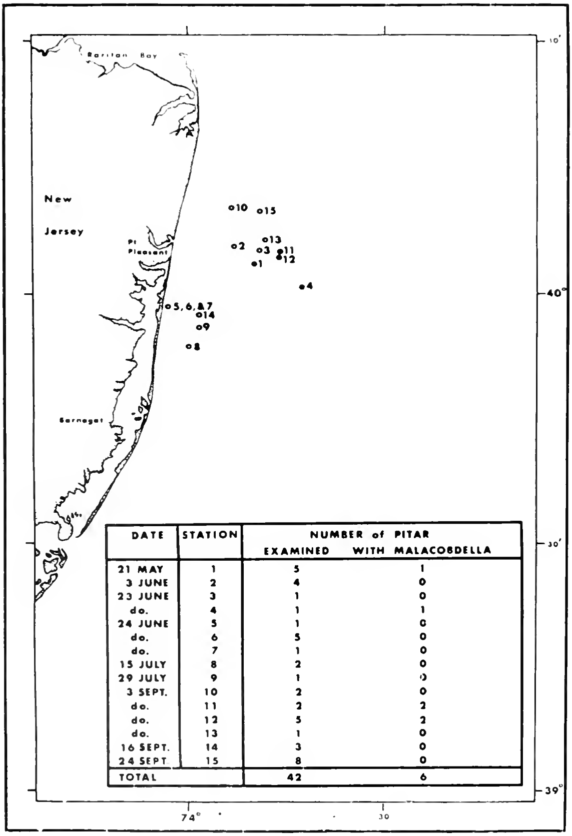

DATE	STATION	NUMBER of PITAR EXAMINED	NUMBER of PITAR WITH MALACOBDELLA
21 MAY	1	5	1
3 JUNE	2	4	0
23 JUNE	3	1	0
do.	4	1	1
24 JUNE	5	1	0
do.	6	5	0
do.	7	1	0
15 JULY	8	2	0
29 JULY	9	1	0
3 SEPT.	10	2	0
do.	11	2	2
do.	12	5	2
do.	13	1	0
16 SEPT.	14	3	0
24 SEPT.	15	8	0
TOTAL		42	6

Figure 1. Localities of collection of *Pitar,* and numbers that contained *Malacobdella grossa,* New Jersey coast, 1964.

PITAR MORRHUANA, NEW HOST FOR MALACOBDELLA GROSSA

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The morrhua venus, *Pitar morrhuana* Linsley, has heretofore not been reported as a host bivalve for *Malacobdella grossa* (O. F. Müller), a widely distributed commensal nemertean. Coe (1943) reported 9 pelecypod species on the European coast and two on the Pacific coast as hosts for the nemertean, but none are of the genus *Pitar*. His monograph lists the nemertean as an inhabitant of the mantle cavity of northern quahogs, *Mercenaria mercenaria*, soft-shell clams, *Mya arenaria*, and occasionally American oysters, *Crassostrea virginica*, from the Atlantic coast. A fourth bivalve host along the Atlantic coast was recorded by Porter (1962), who found a very high incidence of *Malacobdella* in southern quahogs, *Mercenaria campechiensis*, off North Carolina. McCaul (1963) listed no additional hosts in recent collections from the marine and estuarine waters of Virginia. The fol-

Figure 2. The nemertean *Malacobdella* attached to the mantle of *Pitar*. The scale in the lower left corner of the photograph is in millimeters.

lowing is a record of the fifth bivalve host for *M. grossa* along the northwestern Atlantic coast.

Pitar were obtained in the summer of 1964 from catches by commercial and research vessels fishing for Atlantic surf clams, *Spisula solidissima*, off the New Jersey coast. The commercial hydraulic dredges used take large quantities of live bottom fauna, some bottom sand and mud, and debris in a single tow; a similar dredge was used to collect materials for the study of *Malacobdella* in Nantucket Sound, Mass. (Ropes, 1963). *Pitar* and several other bivalve species were sorted out of the dredge catch from New Jersey. After they were measured and opened, a thorough search was made on the surface of the mantle and body mass. Only *Pitar* contanied the nemertean. *M. grossa* occurred in 6 of 42 *Pitar* caught at 15 stations (Fig. 1). The incidence of infection was 14%. Shell-length measurements of the 42 *Pitar* ranged from 32 to 52 mm. and averaged 42 mm.; *Malacobdella* occurred in specimens 33 to 45 mm. long. Several photographs taken within a few minutes after opening the clams showed that the sucking discs of all 6 nemerteans were attached to the mantle (Fig. 2).

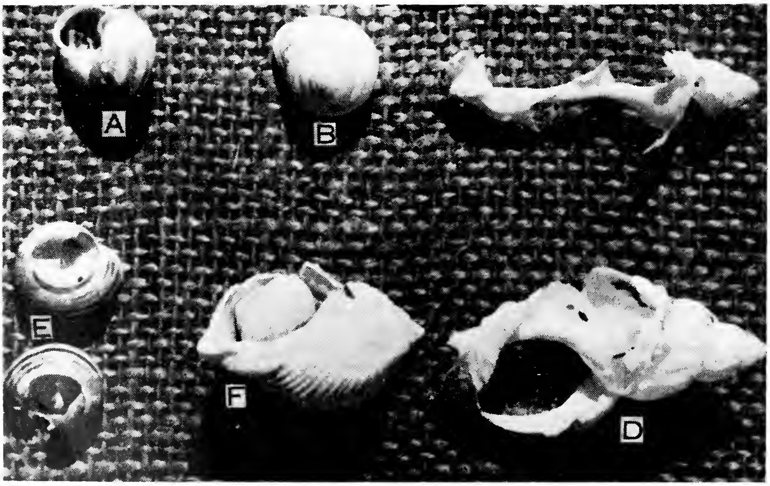

Figure 1. Mollusca from Brier Island, Digby County, Nova Scotia: (a & b) intact shells of *Cepaea hortensis;* (c & d) shells of *Buccinum undatum* fed upon by *C. hortensis;* (e) two *C. hortensis* shells showing where predators have nipped off the spire to extract the snail; (f) dead, bleached *C. hortensis* which grew after feeding inside the *B. undatum* shell and became fatally trapped by the projecting parietal lip of the larger snail.

Each host contained only a single nemertean.

The *Pitar* were dredged from water depths of 40 to 120 ft. (*ca*. 12.2 to 36.6 m.). Clams containing the nemertean were in depths ranging from 84 to 120 ft. (*ca*. 25.9 to 36.6 m.).

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BEHAVIOR OF CALCIPHILIC CEPAEA HORTENSIS ON ACIDIC ISLAND OFF NOVA SCOTIA

BY J. SHERMAN BLEAKNEY

The occurrence of the common European garden snail, *Cepaea hortensis,* along a thousand miles of coastal islands from Newfoundland to Massachusetts has always puzzled zoogeographers (Walden, 1963, in North Atlantic biota and their history, Pergamon Press). Various theories attempting to explain its distribution have been advanced and are summarized by Walden, but he concludes that the only way to solve the problem of *C. hortensis* is through more field investigations.

One basic ecological problem seems to be the question of the source of lime for these snails on the many acidic islands where the species does occur. Pertinent statements in two standard references were not at all specific and at times even contradictory. For example, in Pilsbry's (1939, Academy Natural Science, Philadelphia, Monograph No. 3, vol. I, part I:8) account of this species, he says of this lime-loving European snail, "In America the species does not appear adapted to conditions inland. As Johnson has pointed out it is a calciphile and our northeastern coast is almost exclusively granitic. The barren coastal islands make up in lime and moisture what they lack in vegetation."

This last puzzling sentence is also found in Johnson (1906, The Nautilus *20* (7) :80) who credits islands and headlands as being "continually bathed by the ocean spray" and seems to imply that this salt spray is a source of lime. However, land snails have a marked sensitivity to salt exposure (Walden, 1963). In no case do these authors specifically identify the exact nature of the lime consumed by these land snails.

On October 6, 1963, this author observed many *C. hortensis* (fig. 1, a & b) on Brier Island, Digby County, Nova Scotia, feeding upon limy marine shells that gulls had dropped inland beyond the spray zone. In a search of the literature for similar observations, a passage was finally found in Brooks and Brooks (1940, Annals Carnegie Museum 25:61) referring to *Vertigo alpestris* (another European snail found by Brooks & Brooks on small islands off Newfoundland) "feeding upon the bleached tests of sea urchins and other limy shells dropped by gulls." Apparently the gull-dropped shells were not identified to species nor were any related observations reported. *C. hortensis* was collected at the same time but no mention was made of it feeding on the marine shells.

Brier Island consists of basalt rock with a basic forest cover of spruce and fir with a few acid bogs. The area reported here is on the northeast side of the island bordering the channel between Brier and Long Islands, and consists of a mixture of grassy fields, boggy ground, blackberries and scattered spruce trees, with a ridge of rock running at an acute angle to the shore. Careful examination was made of this rock outcrop as it was obviously a favorite drop area used by the gulls on which to break open marine shellfish prey. Three species of crabs, *Cancer borealis, Cancer irroratus* and *Carcinides meanes* were found, but by far the dominant and only other shell located was that of the marine snail *Buccinum undatum.* The thick limy shells of this snail had accumulated against the sod at the base of the outcrops, and it was here that *C. hortensis* was so abundant and where its labors were evident by the degree to which the thick *B. undatum* shells had been rasped to a paper thin state and even reduced to the central columella (fig. 1, c & d). Evidently the gulls in their efforts to prey upon one species of marine snail were providing a continuing supply of lime for a terrestrial species in what was otherwise a relatively inhospitable acidic habitat.

As specimens of both *C. hortensis* and *B. undatum* were collected, it was soon noted that other ecological relationships were in effect, and they are presented here in the hope that others may be stimulated to observe more closely the phenomena associated with gull shell-drop sites. The numerous *C. hortensis* snails were rasping the *B. undatum* shells from without and within. Those snails active on the outer surface of the sea shells were exposing themselves to some unknown predator which operated by neatly nipping off the low spire of the *C. hortensis* shells and extracting the snail. Numerous brightly banded but spireless shells were scattered about the area (fig. 1, e). There were small mammal runways in the grass, and possibly some species of shrew or rodent was responsible.

A closer examination of the *B. undatum* shells revealed that many of the *C. hortensis* feeding from the inside were not faring much better. They were well protected from the unknown predator, but many of them had died intact within the marine shells. They had added lime to their own shells to such a degree that they were either wedged in place or could not get past the projecting overhang of the parietal lip of the aperture of the *B. undatum* shells. The rich source of essential lime had soon become the snail's sarcophagus. *C. hortensis* individuals were found in various stages of entrapment: actively moving about within the aperture; wedged immobile within the spirals of the shell (and only exposed when several *B. undatum* shells were ground down on an emery wheel) ; inactive and their aperture sealed over by an epiphragm; and dead, bleached individuals (fig. 1, f) . In one case a small live *C. hortensis* was observed within a larger *hortensis* shell, and even though it could turn around completely within the aperture chamber, it was definitely imprisoned. Possibly some of these trapped snails were eventually released by the combined feeding efforts of other individuals for in several *B. undatum* shells, imprisoned *C. hortensis* could be seen through openings rasped from the outside by other snails.

The writer had hoped to locate other similar areas of *C. hortensis* populations in Nova Scotia, but the opportunity for such field work has not arisen. Therefore, these notes are offered here in hope of stimulating others to look for this interesting relationship of a terrestrial snail dependent for its lime upon the shells of a marine snail dropped by gulls on rocks beyond the salt spray zone, and of the mortality experienced by the terrestrial snail in its quest for lime through exposure to predators and inadvertent entrapment within the marine shells.

The author is indebted to Dr. R. G. Moore, Acadia University, and Dr. A. H. Clarke, Jr., National Museum of Canada, for assistance in locating valuable references. The field work was greatly facilitated by the collecting efforts of Jill and Peter Bleakney.

MORTALITY AND APERTURAL ORIENTATION IN ALLOGONA PTYCHOPHORA DURING WINTER HIBERNATION IN MONTANA

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Land mollusks of the family Polygyridae normally overwinter by hibernation on the surface or in slight depressions in the ground. Commonly, they form a thick and calcareous epiphragm at the opening of the aperture. Binney (1851) noted that orientation with aperture up was common for many land mollusks during winter hibernation. Blinn (1963) found a low mortality in both *Allogona profunda* and *Mesodon thyroidus* during overwintering and commented on the upward apertural orientation in these two species. Foster (1936) working with *M. thyroidus* and Fischer (1950) concerning land snails in general also noted low winter mortality. Field observations with a marked population of *A. ptychophora* in Greenough Park near Missoula showed both upward and downward orientation during winter hibernation. Upward orientation was the most common. To test the significance of this orientation 25 snails were placed aperture down and 139 with their aperture up in a circle 3 feet in diameter during October 1964. The plot was visited throughout the winter and in the following spring when mollusk activity again resumed.

The *A. ptychophora* under study were not disturbed throughout the winter, since the heavy cover of snow remained undisturbed. In the spring the leaves that covered the circular plot were removed. Many of the dead snails had their calcareous epiphragms still intact, while in others it was partially broken. There was no evidence of rodents or shrews having disturbed the plot. The living snails were found radiating out from the circular plot in all directions.

Overall mortality during winter hibernation was approximately 18 per cent. This is in contrast to the comments of Blinn (1963), Foster (1936) and Fischer (1950) who found no significant overwintering mortality for land snails. Furthermore the upward orientation during this period as noted by Blinn (1963) and Binney (1851) appears to be important to survival. A Chi-Square analysis comparing dead snails in apertural up and down positions was significant at the two per cent level indicating that the downward orientation definitely contributes or is at least related to the incidence of winter mortality (Tables 1 and 2).

In addition to the above experiment, a random count of 145 empty shells in an adjacent plot revealed 18 per cent. more to be aperture down.

Why orientation seems to have significance is unknown. Perhaps microbes, nematodes or mites gain access to the host when the epiphragm is in contact with the soil. Further examination might reveal a common etiological agent responsible for the overwintering mortality associated with apertural position.

Since no juveniles were placed aperture down in orientation, the significance of age in relation to orientational was not examined. When apertures faced upward there was no significant difference between adult and juvenile mortality, the former being 20 per cent. and the latter 17 per cent.

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TABLE 1
Position in Fall 1964

	Adults	Juveniles
Aperture up	128	11
Aperture down	25	0
Total snails	153	11

TABLE 2
Condition in Spring 1965

	Adults	Juveniles
Dead snails aperture up	20	2
Dead snails aperture down	9	0
Total dead snails	29	2
Alive snails aperture up	108	9
Alive snails aperture down	16	0
Total alive snails	124	9

NOTES AND NEWS

CORRECTION. — On page 39, vol. 79, no. 2, in the first line of the 4th paragraph, "*Cypraea cicercula* Linn., 1758," should read *Cypraea nucleus* Linn., 1758. — C. M. BURGESS, M.D.

DR. LESLIE REGINALD COX, O.B.E., F.R.S., Sc.D., died on 5th August, 1965, at the age of 67. Between 1922 and 1963 he was Curator of fossil molluscs at the British Museum (Natural History), London, and was appointed Deputy Keeper of the Palaeontology Department in 1961. Since his retirement he still worked almost full-time and was in the Museum the day before his death.

He served in the Royal Navy during the first World War and was badly wounded in the raid on Zeebrugge harbour in 1918. He won a scholarship to Queens' College, Cambridge, where he gained a double first. Most of his 160 publications were concerned with Mesozoic faunas from many parts of the world. Latterly, he was a major contributor to the *Treatise on Invertebrate Paleontology*. He had been a corresponding member of the American Museum of Natural History and the Paleontological Society.

In 1925 he married Miss Hilda Lewis and they have a son and daughter.

A more extensive obituary, probably including a bibliography, will appear in the *Proceedings of the Malacological Society of London*.

CELETAIA, NEW GENUS OF VIVIPARIDAE FROM THE ISLAND OF CELEBES, INDONESIA. — In the course of research on the family Viviparidae for the Treatise on Invertebrate Paleontology, the need for a new genus to include a very distinct species of viviparid from Lake Posso, Island of Celebes became apparent.

In 1898, Paul and Fritz Sarasin published a report upon the fresh-water mollusks of the island of Celebes in Indonesia. Four new species of *Viviparus* were described, three of which were typical viviparids; the fourth, *V. persculptus,* appears to be generically distinct. Upon shell characters alone this new genus is distinctly related to certain elements in southeast Asia, such as the *Taia* complex.

Description: Shell medium in size, extended, minutely umbilicate, with convex and shouldered whorls. Colored a dark brown both inside and outside of the shell. Aperture subcircular. Sculptured with 5 to 6 heavy spiral lirae on the whorl below the shoulder, and with numerous and finer lirae on the base of the shell. Axial sculpture of rather coarse growth lines near the aperture. Operculum subcircular, thin, corneous, with numerous concentric growth lines and an excentric nucleus.

Type species, *Vivipara persculpta* P. and F. Sarasin, 1898, Die Süsswasser-Mollusken von Celebes (Wiesbaden), *1:* 62, pl. 10, fig. 129-130; pl. 9, fig. 121. — WILLIAM J. CLENCH.

INTERGLACIAL HENDERSONIA OCCULTA IN CANADA. — Recently, while making identifications of Pleistocene mollusks, the writer discovered a single specimen of *Hendersonia occulta* (Say) in fossiliferous sands from the Don Valley Brickyard in Toronto, Ont. This deposit overlies and channels the Scarborough Beds and underlies the Sunnybrook Till. It is, therefore, probably older than 50,000 years and may be of Sangamon age.

The specimen of *H. occulta* (N.M.C. 15660) is well preserved, measures 4.7 mm. in height and 6.5 mm. in diameter, and is typical of the species in all observable characteristics. It represents a considerable extension in range beyond the closest known neighboring Pleistocene or recent locality (Alleghany Co., Pennsylvania) reported by Pilsbry (1948, Land Mollusca of North America *2* (2) :1088) and constitutes the first Quaternary record of a terrestrial archaeogastropod from Canada. The find also corroborates Pilsbry's speculation. He suggested that since fossil *H. occulta* had apparently been only preserved in loess areas, it probably had a more extensive geographical range than its fossils would indicate.

The writer is grateful to Dr. V. K. Prest, Canada Geological Survey, who collected the sample containing *H. occulta* and to Dr. P. F. Karrow, University of Waterloo, for the opportunity to study this interesting material. — A. H. CLARKE, JR.

CECILIOIDES ACICULA (Müller) in Kutztown, Berks County, Pennsylvania. — One dead specimen (A.N.S.P. 302132) of *Cecilioides acicula* was collected March 28, 1965, at the old Sacony Creek bed, between Normal Avenue and Constitutional Boulevard. It was found under a stone 80 feet from the Blvd., and 15 feet from the creek bed. The species has been found to be very uncommon at this locality. — TERRY L. SINE.

CORBICULA FROM THE MISSISSIPPI RIVER. — A recent report by Parmalee, 1965, Trans. Illinois State Acad. Sci. *58* (1): 39-45, 2 figs., confirms the establishment of *Corbicula* throughout the Illinois section of the Ohio River and up the Wabash River at least to White Co., Illinois, although it was not found near Maunie, White Co., New Harmony, Posey Co., Indiana or Grayville, White Co., Illinois by Parmalee in 1964. On August 9, 1963, I collected near Vincennes, Knox Co., Indiana and found no trace of *Corbicula*. No *Corbicula* have been reported from the Mississippi River above Cairo, Illinois. Parmalee collected at 4 stations in 1964 with negative results. From August 4-7, 1963, I collected at 4 miles south of Chester, Randolph Co.; one-half mile south of Grand Tower, Jackson Co.; one-half mile west of Fayville, Alexander Co.; and at Fort Defiance with negative results.

The only previous Mississippi River record is Parmalee's find of 3 dead pairs and a live juvenile almost directly below the Illinois-Missouri bridge on the Missouri shore. On August 7, 1963, I collected 10 pairs and one valve at Wickliffe, Ballard Co., Kentucky, but failed to find specimens in the vicinity of ferry landings at Columbus, Hickman Co., Kentucky; Belmont and Dorena, Mississippi Co., Missouri; Hickman, Fulton Co., Kentucky; and Tiptonville, Lake Co., Tennessee. In view of the great interest concerning the rapid spread of *Corbicula* in the Ohio Valley, it seems worthwhile to record my 1963 negative records together with the single positive Kentucky collection. The latter material is on deposit in Chicago Natural History Museum, catalogue number 123601.

Most authors, including myself, 1962, Nautilus, *75* (3): 126, have called these clams *Corbicula fluminea* (Müller). Sinclair & Isom (1963, Further studies on the introduced Asiatic clam *Corbicula* in Tennessee, Tennessee Stream Pollution Control Board, Tennessee Department of Public Health, Nashville, 75 pp., figs., summarize Japanese anatomical and life history studies indicating that the name *fluminea* should be restricted to brackish-water populations and that the introduced freshwater populations should be called *Corbicula manilensis* (Philippi, 1844) *(loc. cit.,* pp. 28-35, 50). The two types are conchologically identical.

Sincere appreciation is extended to Dr. Fritz Haas and Dr. Alan Solem for their assistance. — FREDERICK R. FECHTNER, 2105 Edgebrook Drive, Rockford, Illinois, 61107.

TWO SPECIES OF THE BIVALVE GASTROPOD BERTHELINIA FOUND IN PUERTO RICO. — This is the first record of *Berthelinia,* the bivalve gastropod, from Puerto Rico; and to our knowledge, the second record of the genus from the Atlantic. Edmunds (1962, 1963) reported and described *Berthelinia caribbea* from Jamaica. Our search for the bivalve gastropod in Puerto Rico started in 1960, soon after the discovery of the living animal in Japan (Kawaguti & Baba, 1959).

Our first *Berthelinia* specimen (a single valve) was collected on April 18, 1961, while dredging in approximately 15 fathoms, on the west coast of Puerto Rico. Two years of intermittent but diligent collecting of algae and dredging yielded no other specimens of this species.

On November 24, 1964, some 30 specimens of *Berthelinia caribbea* Edmunds were found living on algae, collected by Luís Almodóvar, from mangrove roots at Guayacán Bay, on the south coast of Puerto Rico. The algae from these roots were predominantly *Caulerpa verticilla, C. racemosa, Acanthophora spicifera,* and *Amphiroa fragilissima.*

The shells of the live specimens ranged in length from 1.5 mm. to 4.0 mm. The largest Puerto Rican shell was slightly larger than the largest shell found in Jamaica but the specimens agreed in every other respect. The habitat was also similar to that in Jamaica. The animals were kept alive in the laboratory for several days so that they could be photographed and their activities observed. The living snail is green with brown speckling on the head, neck, and rhiniphores. The mantle as seen through the transparent shell has many dark brown striations and blotches.

The specimens will be divided and sent to the following institutions: Institute of Marine Biology, Mayagüez, P. R.; Academy of Natural Sciences, Philadelphia; U. S. National Museum; Museum of Comparative Zoology, Harvard; Dept. Geology, Stanford University.

The single valve, collected from deep water opposite the Rincón Lighthouse in 1961, was compared with shells of the live specimens, and proves to be distinct. It also has been compared with the descriptions of previously reported *Berthelinia* and appears to be different from all of them.

The dredged specimen is a left valve, with the helicoid tip plainly visible. The shell is 3.4 mm. in length, 2.3 mm. in height (ventral margin slightly chipped) ; it is yellowish, translucent, without evident rays; irregular growth lines are prominent on the surface of the shell. As compared to *B. caribbea* the most striking difference is in the spiral nucleus; in *B. caribbea* the nucleus has 1¼ whorls and is erect, and in ours it has 2 whorls and is flattened over the hinge margin. Designation of a specific name for the new species, will await the collection of additional material. The present specimen will be deposited at the Academy of Natural Sciences in Philadelphia.

Several persons have cooperated in this search for live *Berthelinia* in Puerto Rico. I wish to express special gratitude to Dr. John E. Randall, Director of the Institute of Marine Biology, who personally SCUBA dove to depths of 60-90 feet to collect algae; to Dr. Luís Almodóvar, who collected large quantities of *Caulerpa* to be examined for the presence of *Berthelinia;* and to my husband, who spared no effort to help with this project. —
GERMAINE L. WARMKE, Institute of Marine Biology, University of Puerto Rico, Mayaguez, Puerto Rico.

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EDUARDUS AND LINISA, 1930. — Pilsbry, 1930, Proc. Acad. Nat. Sci. Philadelphia *82:* 315, proposed the genus-group *Eduardus,* type *Polygyra martensiana* (Pilsbry). In 1956, Proc. cit. *108:* 20, he added *Erymodon,* "new subgenus," type *P. ventrosula* (Pfeiffer), also from Mexico. Since in the same paper (pp. 30 & 27), he included *P. martensiana* in this group, *Erymodon* seems to be at least a subjective synonym of *Eduardus,* which apparently includes Pilsbry's *P. texasiana group,* 1940, Acad. Nat. Sci. Philadelphia. Monogr. 3, vol. *1:* 613. In 1930 (loc. cit.) he also proposed *Linisa,* type *P. anilis* (Gabb), but in 1956 (loc. cit.: 27) added *Solidens* with the same type to its synonymy. Incidentally, Clench & Turner, 1962, Acad. Nat. Sci. Philadelphia, Spec. Publ. no. 4, included only the 1956 names. — H. B. B.

UNIONE PEELING. — American shell collectors may be overlooking beautiful native treasures in their own neighborhood. The ones that they most frequently neglect are our plentiful freshwater mussels. Many varieties should merit far more attention from our nation's conchologists.

The first thing the interested collector must do is procure the correct specimens. These may be readily obtained from most of our larger fresh-water streams. Thick shells showing some color are generally better to work on than thin or pure white ones.

Properly seasoning your shells will require a few years. A shaded location on the north or west side of your house is likely the best place. They have been aged enough when you may rather easily flake off some of their bottom of their two other layers with the stout blade of a penknife.

The beauty of these mussels is always a hidden one. Revealing it is often a challenge. Directions for removing the two ugly outer layers that hide it are simple. Take your stout-bladed knife in one hand and firmly grip the shell with the other. Pry off the outer coatings, exposing the inner ones. You may also wish to carve the shell to suit your fancy.

Your best creations could be used for unique plaques. Less lovely ones are always useful as ornaments around your flowers, mixed with seashells, in a special collection of their own, etc. The proper usage could best be shown by the shell itself. No two shells are ever quite the same. — JOHN R. WOEMMEL.

EUGLANDINA ROSEA IN NORTH CAROLINA. — In March, 1965, a former student of mine, Mrs. David Schneider, reported finding a large snail in her back yard in Beaufort, N. C. It turned out to be *Euglandina rosea* (Férussac). Later she found several more. I do not think it has been reported from North Carolina before. Pilsbry (1946) reported the distribution as : La., Miss., Ala., Fla., Ga., and S. Car. — Yemassee. Rehder in 1949 reported finding one young living specimen in Myrtle Beach, S. Car. and noted that this was 130 miles north of the previous record in Yemassee, S. Car. (Some land and freshwater mollusks from the coastal region of Virginia and North and South Carolina. Naut. *62:* 121). — CHARLOTTE DAWLEY.

FURTHER RECORDS OF CORBICULA FLUMINEA (Müller) in the southern United States. — Recent collecting in the southern watersheds has revealed the colonization of five more Gulf drainages by the introduced Asiatic clam, *Corbicula fluminea.* Amite drainage: Amite River at Port Vincent, Livingston Parish, La. (July 6, 1965). Pearl drainage: Pearl River 1 mi. E of Bogalousa, Washington Parish, La. (July 5, 1965). Pascagoula drainage: Leaf River at McLain, Greene Co., Miss. (July 2, 1965). Conecuh-Escambia drainage: Escambia River 3 mi. E of Century, Escambia Co., Fla. (May 14, 1965). Ochlockonee drainage: Ochlockonee River 11 mi. NW of Tallahassee, Leon Co., Fla. (May 28, 1965).

In addition several upstream extensions in previously reported drainages have been discovered. Yazoo drainage (also see Hubricht, 1964 Naut., *77:* 143): Coldwater River 1 mi. E of Marks, Quitman Co., Miss. (July 16, 1965). Alabama River system (also see Hubricht, 1963, Naut., *77:* 31; 1965, Naut., *78:* 106): Tombigbee River 13 mi. E of Silas, Choctaw Co., Ala. (Nov. 25, 1964). Apalachicola drainage (also see Heard, 1964, Naut., *77:* 104): Chipola River 2 mi. E of Clarksville, Calhoun Co., Fla. (May 14, 1965).

Inasmuch as the Cross-Florida Barge Canal is now under construction, before long *C. fluminea* can traverse this man-made confluence from its present occurrence in the Withlacoochee River (see Heard, 1964, Naut., 77: 104) a Gulf drainage, into the St. Johns River drainage which exits into the Atlantic Ocean. — WILLIAM H. HEARD, Florida State University, Tallahassee.

HAPLOTREMA CONCAVUM VS. DEROCERAS GRACILE. — On September 12, 1945, a specimen of *Deroceras gracile* (Rafinesque) was placed in a cage with a specimen of *Haplotrema concavum* (Say). Shortly thereafter the *Deroceras* was noted biting the *H. concavum,* causing it to withdraw into its shell. Subsequently the slow-moving *Haplotrema* was noted trailing the aggressive slug! On an earlier occasion, Sept. 8, 1945, when living *D. gracile* were placed in a cage with 7 *H. concavum,* within 15 minutes, 3 of the *Haplotrema* were feeding on the slugs. During the initial contact by the *H. concavum* the slug was bitten, but was only killed and eaten on the second contact. The attacked slug seemed slowed-up in its actions after being bitten by the *Haplotrema.* It would be desirable for the saliva or freshly extracted radula of *Haplotrema* to be tested for toxicity. Any toxic substance present must not be very potent as I have observed some land-snails to survive being bitten. There is also the possibility of immunities being developed either by individuals or species to any toxic substance released by the attacking *Haplotrema.*

One attack was not in successive stages. The snail's initial attack at the caudal extremity of the slug was continued by its biting and crawling rapidly over the slug's dorsum. In this case the initial attack was lethal, for with its foot, the *Haplotrema* partly enveloped the *Deroceras* and soon completely ingested it. — GLENN R. WEBB, Kutztown State College, Kutztown, Pa.

NEW NORTHERN RECORD FOR PAPYRIDEA MANTAENSIS, Olsson 1961. — One valve of this recently described species (Olsson, Axel A. Panamic-Pacific Pelecypoda, page 250) was collected for me by Dr. Wilbur L. Bullock in May, 1963 at Acapulco, Mexico. Olsson mentions only 5 localities for this species: Bucaro, Panama; Manta and Santa Elena, Ecuador; Zorritos and Mancora, Peru. This additional locality extends the known range about 1300 miles northwest. — ROBERT C. BULLOCK.

CORBICULA MANILENSIS. — Since this often has been misspelled, a trivial correction may be timely. Philippi, 1844, Zeitschr. f. Malak. *1:* 162-163, proposed *Cyrena manilensis* from Manila, which is the approved spelling of the Philippine city, even in English. Incidentally, Sherborn, 1940, Index Animalium, 1801-1850: 3851, quoted the name correctly. — H. B. B.

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