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# THE NAUTILUS

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## MALACOLOGICAL NOTES FROM WESTERN CUBA

By MORRIS K. JACOBSON

In 1948 (*Torreia, 13,* May; not *12,* March, as in ***Revista*** *Soc. Mal. 7:* 67) Aguayo and Jaume described two species of *Cupulella,* a remarkable new genus of land snails from near La Palma in Pinar del Río Province. They provisionally placed the genus in the family Sagdidae. Subsequently in 1950 (***Rev.*** ***Soc.*** *Mal., 7:* 67) on the basis of anatomical examination of living specimens, they decided to put the genus into the Achatinidae near *Lyobasis.*

On July 22, 1953, we paid a visit to the Mogote Talavera at km. 5 to the north of the Viñales-La Palma highway, the type locality of *Cupulella dominguezi.* There had been heavy rains the night before and we collected live snails in large numbers. In a hollow at the base of a tree, we found about twenty live cupulellas and noted with some surprise that the animals were moving about carrying or, rather, dragging the comparatively large shell behind them with the spire down and the large, hollowed basal region facing up. This is probably why the nuclear whorls in most specimens stand out whitish against the predominantly brownish cast of the shell. At home some of these snails revived and here I noted, that in the small jar where I kept them, some also seemed to carry the shell spire up. The animals did not long survive, but from what was seen, the animal can apparently move with its shell either spire up or spire down, with the latter position the one preferred.

The various genera and species of Oleacinidae are the outstanding examples of predatory snails in the mogotes and sierras of western Cuba. The feeding habits of their mainland relatives, *Euglandina,* have frequently been observed and recorded, chiefly by Pilsbry (1907, *Man. Conch.,* Ser. II, *19:* XII—reproduced in *Land Moll. N. A., 2:* 189, 1946) and Ingram & Henning (1942, *Zoologica: 2:* 81–88), who also give a short bibliography of the subject. In these cases, the predator is described as attacking the food snail via the aperture. As far as I could find, only F. C. Baker (1903, *Shells of Land and Water,* p. 51) reported that *Euglandina* "sometimes . . . will make a hole for itself in the shell of the victim and will eat the contents through this aperture" (loc. cit.). This habit might be of little use to *Euglandina* which, north of Mexico at least, has to contend with only two or three small operculate genera. That it definitely is the habit of the Cuban oleacinids, which probably meet with more operculate than inoperculate snails in their daily hunt for food, was demonstrated in San Vicente. There, in the well-known Ensenada del Balneario on July 15, 1953, I collected a specimen of *Oleacina oleacea straminea* (Deshayes) tightly fixed to the base of a *Rhytidothyra bilabiata rosacea* Torre and Bartsch. Upon separating the snails, I found that the *Oleacina* had apparently scraped an irregular hole about one millimeter in diameter at the base of the body whorl near the aperture. The operculum of the *Rhytidothyra* was fixed in place, but soon dropped off, indicating that the predator had not only killed but had also eaten the food snail through this hole. The hole is very different from the countersunk hole that is left in its victims by the marine snail *Natica,* but the irregular edge has a border of a thinned area of shell matter where the outer layers had been scraped away. This hole, which we later found in many dead and bleached shells, may be taken for the result of the natural weathering of dead shells, but the thinned margin betrays its true origin. This Oleacina-produced hole is quite unlike that reported in some land shells of Yucatan by Harry (Occ. Pap. Mus. Zool. U. Mich., 524, p. 27, 1950).

While collecting *Viana regina* (Morelet) in the areas of Viñales, San Vicente, Luis Lazo and La Palma—which here is one of the commonest species although appearing in many different sizes, colorations and types of surface sculpture—we were struck by a thin vermillion-reddish deposit on the posterior portion of the aperture, just where the glazed columellar callus borders on the rest of the body whorl. This deposit did not appear on all specimens, but enough seem to have it to make it quite noticeable. It is a surface deposit and can be removed by a little rubbing. The deposit is irregular in outline and varied in size, and sometimes appears in blotches even on the outer surface of the operculum. Chemical investigation might help give a clue to its origin and significance, if any.

The land shell genus *Proserpina* occurs in Jamaica and Cuba. In Thiele (*Handb. Weichtierk.* p. 90) the genus is divided into two sections, apparently on the presence or absence of apertural lamellae. *Proserpina* s.s. is restricted to Jamaica.

When I collected *Proserpina nitida* Sowerby at Quickstep in Trelawney Parish in July 1949, I noticed that when the snail was active, its mantle completely covered its shell, much like the marine Cypraeidae, so that the shell was quite invisible. As I recall—my notes were mislaid—*P. nitida* has a yellow-greenish mantle heavily speckled with dark spots.[1] But when I collected *Proserpina* (*Despaenella*) *depressa* d'Orbigny in the Ensenada Miranda at the base of El Queque in Viñales, I found no specimen using its mantle in that manner. Apparently this feature, provided that my observations can be corroborated, is more deserving of diagnostic status than the absence or presence of lamellae.

In 1950 (*Rev. Soc. Mal.*, *7:* 70) *Aguayo* described and named a new subspecies, *Cepolis* (*Eurycampta*) *bonplandi pinarensis*, and stated that its limits of distribution are comprised by Viñales and Consolación del Norte southwest to Luis Lazo. However, we have it also from the following localities, all well to the west of Luis Lazo and all representing an extension of range: Mogote de Punta de la Sierra, the mogotes between Tenería and La Muralla on the road to Guane, and finally at the Cueva Oscura of Los Portales. The last named is about 14 miles southwest of Luis Lazo. All told, the subspecies *pinarensis*, as we now know, occupies an area about 35 miles in extent, so that this extension of range is not inconsiderable. At the Paso Real near Guane, we collected only typical *bonplandi*.

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[1] See vol. 47 (4), p. 151, for animals of 4 Jamaican spp. H. B. B.

# LAND AND FRESHWATER MOLLUSKS OF THE ARCTIC SLOPE, ALASKA *

By G. DALLAS HANNA
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The term "Arctic Slope" is Alaska is usually interpreted to mean the relatively low, flat plain extending northward from the Brooks Range to the Arctic Ocean. This covers an area of approximately 50,000 square miles. Most of it is so level that drainage is poor; streams are sluggish; and meandering and uncounted tundra lakes, large and small, occur by the thousand. Very few are more than five or six feet deep, the usual thickness of winter ice.

Vegetation is strictly Arctic with no trees and the only bushes are willows which are confined to the upper portions of the streams draining the north side of the Brooks Range. Mosses and lichens are very abundant and many beautiful flowering plants gladden the landscape. Rainfall is scant. Total precipitation ranges between four and eleven inches per year. Fog and overcast are prevalent in summer along the coast and ice fogs are common in winter. Summer temperatures along the coast are low and snow may fall in all months. In winter, the temperature usually stays in the interval − 20° F to − 30° F and in extreme cases goes as low as − 50° F at Point Barrow and − 70° F inland, as at Umiat. The ground thaws out a foot to 18 inches in summer; below this there is permafrost to depths of 800 to 1300 feet.

The Arctic pack ice is never far off shore and sometimes does not leave. Usually, however, a limited amount of boat travel can be done close to shore during August and September. Flowing streams usually break up in July, and lakes and ponds become ice-free during August and September.

Since 1945 there has been much activity in this region. First, the Navy Department established camps in order to drill and evaluate the potentialities of Petroleum Reserve No. 4 which covers much of the slope. In this connection, the Arctic Research Laboratory was started at the Point Barrow Camp by

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the Office of Naval Research, and it has been in operation continuously ever since. A great many investigators have made this their headquarters for studying a multitude of Arctic problems. Although many of these projects have pertained to studies of the fauna and flora of the tundra and freshwater lakes, little or no attempt has been made to find mollusks.

In 1881–1883, an International Polar Expedition (1) established a station at Point Barrow under the command of Lieut. P. H. Ray, Signal Officer, U. S. Army. The naturalist on the expedition was John Murdoch, a very industrious collector. Dall (2) gave a preliminary list of the mollusks obtained and among these there were recorded three land shells: "*Cochlicopa lubrica* Muller, *Zonites* (*Conulus*) *Stearnsii* Bland and *Zonites* (*Hyalina*) *radiatula* Alder." The records were repeated in the complete report of the expedition (1). These shells had previously been considered by Lehnert (3) under the names "*Cionella subcylindrica*, *Hyalina arctica* and *Hyalina pellucida*," respectively. Dall (4) later used the names "*Cochlicopa lubrica, Vitrea radiatula* and *Pristoloma* (?) *arctica*" for the same records. The species are currently called: "*Cionella lubrica* (Müller) *Pristoloma arcticum* (Lehnert), and *Retinella electrina* (Gould)" by Pilsbry (5, pp. 1047, 401 & 256).

Dall stated (1, p. 178) that these three species were recovered by Lehnert from mosses used by the Expedition personnel for packing other articles. The latter included in his account of the shells, a list of the plants. This list would be interesting to check with modern collections, because during the summers of 1954 and 1955 I collected many batches of the local tundra moss and screened it in an unsuccessful effort to find any of the species listed. The area searched was not only in the vicinity of the site of the 1881–1883 Polar station, but at places as far as 40 miles away.

Although this effort was disappointing, other investigators, who had an opportunity to work over a much wider area, succeeded in finding several species. Their names appear below, and to them I am very grateful.

Only two species of land shells were found.

**Succinea strigata** Pfeiffer. Plate 1, fig. 6.

This widely distributed northern species has often been called *S. chrysis* Westerlund, but Pilsbry (5, pp. 810–814, figs. 438,

439) indicated that the American shells should be united with the ones Pfeiffer described from Port Clarence, Siberia, in 1855.

It was collected on the Arctic slope of Alaska in 1955 at the following localities: Half Moon Three Ranch between Admiralty Bay and Techepuk Lake, August 20, 1955 (Fr. John Ostdiek!). Ocean Point, on the Colville River, August 8, 1955 (Edward Reed and Frederick Jackson!). Three miles up the Colville River from the mouth of Kiligwa River, June 23, 1955 (Edward Reed and Frederick Jackson!). At the junction of the Itkillik and Colville Rivers, August 9, 1955 (Edward Reed and Frederick Jackson!).

DEROCERAS LAEVE (Müller).

This small, almost black slug is widely distributed in North America. It lives from the extreme Arctic to Central America. For many years, the Alaska records were under the name "*Agriolimax hyperboreus* (Westerlund)," but Pilsbry (5, pp. 539–552), in an excellent analysis of available information, considered European and American material to be the same.

Fr. John Ostdiek collected a specimen at Half Moon Three Ranch, between Admiralty Bay and Techepuk Lake, August 20, 1955, and Edward Reed and Frederick Jackson found four specimens beside a pond at the west end of the air strip at Umiat, July 17, 1955. Robert Usinger and Ray Smith found another at the same place, July 23, 1955. Reed and Jackson collected nine specimens, 15 miles north of the junction of Anaktuvik and Colville Rivers, July 26, 1955.

Freshwater mollusks occur frequently in favorable lakes and ponds. Undoubtedly, additional collecting will supply more species than the various parties secured in 1955, which was only seven. However, these were mostly alive when found in shallow water. Dredging would probably yield more, especially if done in the lakes which do not freeze to bottom. The lake from which the Point Barrow camp gets its fresh water has a soft mud bottom and seems to be without shells. The closest place to it where any were found, is one of the pools of the beaded stream which flows into the lagoon just south of camp.

LYMNAEA EMARGINATA Say. Plate 1, figs. 1, 2.

This is the largest of land or freshwater shells thus far found on the Arctic slope. It is very widely distributed in northern

North America and has received many specific names. I follow the treatment here of Bengt Hubendick (6, pp. 132–135) who combined the variants under the above name. Those shells with a high spire, deep suture, and more or less angulated last whorl were given the name *randolphi* by Baker. It has been well illustrated by Dall (4, 1910, p. 71, pl. 1, figs. 3, 4). Apparently this form is found only in the northwest part of the range of the species, but in a large series, there is variation into forms exactly like those of other areas.

It was collected at the following localities on the Arctic Slope in 1955: Lake near Meade River Village, July 10, (Fr. E. J. Long). Half Moon Three Rranch, between Admiralty Bay and Techepuk Lake, July 29 and August 16 (Fr. John Ostdiek!). Pond at west end of air strip at Umiat, June 16 (Edward Reed and Frederick Jackson!). Lake near junction of Kikiakrorak and Colville Rivers, August 1 (Edward Reed and Frederick Jackson!). In old oxbow of Colville River, 15 miles north of junction of Anaktuvik River, July 28 (Edward Reed and Frederick Jackson!). Tundra pond on Colville River delta, August 21 (Edward Reed and Frederick Jackson!). Junction of Itkillik and Colville Rivers, August 14 (Edward Reed and Frederick Jackson!). Colville River drift 1½ miles north of Umiat, July 15 (Philip Seaber!). Kumpa River (Edward Reed and Frederick Jackson!).

LYMNAEA ARCTICA Lea. Plate 1, fig. 3.

Among the shells collected by Reed and Jackson on the Colville River, there is one from eight miles below Umiat which cannot be included with *emarginata*. It corresponds closely with Hubendick's figure (6, 1951, p. 139, fig. 320) of a specimen from Newfoundland.

APLEXA HYPNORUM (Linnaeus). Plate 1, fig. 4.

This sinistral, glossy shell seems to be the most widely distributed of the fresh water snails on the Arctic slope. It replaces *Physa* of more southern latitudes. In the lots collected during 1955, the size of adults ranges from 6 to 17 mm. in length. It was found in the pools of beaded streams and along the grassy margins of fresh water lakes in the near vicinity of Point Barrow and east as far as the investigators went, which was the Colville River.

The localities represented are as follows: Lake near Meade River Village, July 10 (Fr. E. J. Long!). Half Moon Three Ranch between Admiralty Bay and Techepuk Lake, July 29 (Frs. E. J. Long and John Ostdiek!). Pond at foot of Red Hill, Umiat, Alaska, July 16 (Edward Reed and Frederick Jackson!). Ninaluk Creek, a branch of the Colville River. Fifteen miles north of the junction of Anaktuvik and Colville Rivers, July 26 (Edward Reed and Frederick Jackson!). Pools of beaded stream which enters lagoon just south of Navy Camp, Point Barrow, August 13 (John Koranda!). First large lake south of Ikroavik Lake, about six miles south of Point Barrow (Frs. E. J. Long and John Ostdiek!). Oliktok Point, Arctic Ocean, near mouth of Colville River, Alaska, August 25 (Edward Reed and Frederick Jackson!).

PHYSA sp.

Among the shells collected by Reed and Jackson, there are several lots of young sinistral forms which seem to have a lower spire and duller surface than *Aplexa*. They resemble *Physa* but the state of the nomenclature of the genus is too confused to venture giving a specific name at this time. The lots were obtained as follows: Ocean Point near the mouth of the Colville River. Itkillik, Ipnavik, Kumpa and Kiliarorak Rivers.

GYRAULUS PARVUS (Say). Plate 1, figs. 5 and 7.

There is some doubt attached to the naming of smaller planorbs because of lack of adequate keys. However, the Arctic slope specimens do not seem to differ significantly from those found in other parts of the north. Characters given for separation of *arcticus* Möller from *parvus* are not adequate. If the Greenland shells differ from *parvus,* it would be expected that ours might be the same.

Reed and Jackson collected the species at the following places: At the foot of Red Hill near Umiat on the Colville River. Tundra pond 15 miles north of the junction of Anaktuvik River and Colville River. Near mouth of Anaktuvik River. Ocean Point near mouth of Colville River. Itkillik, Ipnavik and Kumpa Rivers.

VALVATA HELICOIDEA Dall. Plate 1, fig. 9.

This is a small, flattened species, well figured by Dall (4, p. 123, pl. 2, figs. 1, 2). It has been called a subspecies of *lewisi.* It is about the same size and color as *Gyraulus parvus,* but does not have a depressed spire, and the umbilicus is narrower.

The species was collected by Reed and Jackson as follows: Pond at end of air strip at Umiat on the Colville River. Ninaluk Creek, a branch of the Colville River. Ocean Point near the mouth of the Colville River. Ipnavik River.

PISIDIUM IDAHOENSIS Roper. Plate 1, fig. 8.

This name is assigned to the only freshwater bivalve thus far found on the Arctic slope. It was described from Old Mission Idaho in 1896 by Roper (Nautilus, vol. 4, p. 85). Five specimens of that lot in the California Academy of Sciences, collected by Henry Hemphill, were labelled "types" by him. The Arctic slope specimens do not differ from these significantly in size or other shell characters. It may be that there is an older name for the species, such as *P. steenbuchii* Möller from Greenland, but this is difficult to determine from published descriptions only.

Reed and Jackson obtained a series of these shells in a lake near the junction of the Kikiakrorak and Colville Rivers, August 2. A small specimen, of what may be the same species, was brought up by a boat anchor in No Luck Lake in the headwaters of one of the tributaries of the Colville River during the summer of 1954 by Dr. Donald E. Vohlschlag.

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### EXPLANATION OF PLATE 1

Fig. 1. *Lymnaea emarginata* Say. Height, 22.7 mm., diameter, 14.5 mm. Fifteen miles north of junction of Anaktuvik and Colville Rivers, Alaska. 2. *Lymnaea emarginata* Say. Height, 22.5 mm., diameter, 19.1 mm. 1½ miles north of Umiat, Alaska. 3. *Lymnaea arctica* Lea. Height, 15.8 mm., diameter 8.3 mm. Colville River, Alaska, 8 miles below Umiat. 4. *Aplexa hypnorum* (Linnaeus). Height, 15.5 mm., diameter, 7.2 mm. 15 miles north of junction of Anaktuvik and Colville Rivers, Alaska. 5. *Gyraulus parvus* (Say), upper surface. Diameter, 5.7 mm. Pond at foot of Red Hill near Umiat on Colville River, Alaska. 6. *Succinea strigata* Pfeiffer. Height, 14.6 mm., diameter, 7.3 mm. Junction of Itkillik and Colville Rivers, Alaska. 7. *Gyraulus parvus* (Say), lower surface. Diameter, 6.0 mm. Pond at foot of Red Hill near Umiat on Colville River, Alaska. 8. *Pisidium idahoense* Roper. Length, 7.8 mm., thickness, 4.6 mm. Lake near junction of Kikiakrorak and Colville Rivers, Alaska. 9. *Valvata helicoidea* Dall. Diameter 4.6 mm., height, 2.1 mm. Pond at end of air strip at Umiat, Alaska.

The shell shown at figure 2 was collected by Philip Saber. All others illustrated were collected by Edward Reed and Frederick Jackson. All photographs by Charles E. Crompton.

## NOTES ON XYLOPHAGA WASHINGTONA BARTSCH AND ON THE GENUS

BY RUTH D. TURNER

Museum of Comparative Zoölogy

Through the kindness of Robert H. Parker and Frank E. Snodgrass of the Scripps Institution of Oceanography, La Jolla, California, I have recently received samples of wood contain-


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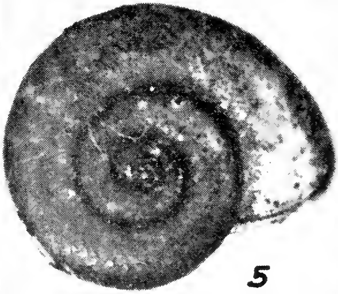
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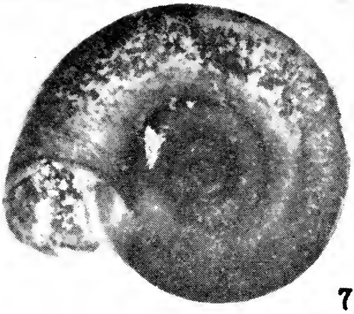
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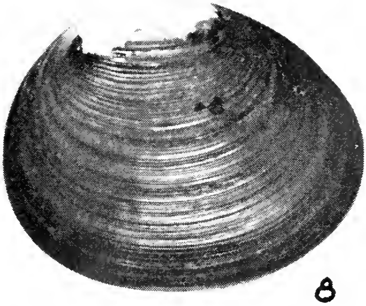
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ing a fine series of *Xylophaga washingtona* Bartsch. These specimens were from a sand-filled anchor box used in securing a cable for underwater wave recorders. The box was set in 325 feet of water three miles off Oceanside, California. It was put in place on September 12, 1955 and taken up on January 7, 1956. At this time the entire box, except the bottom, was completely riddled and the specimens were so closely packed that the larger ends of many of the burrows were touching. The specimens were all small, the largest reaching about 4 mm. in length. On many of the specimens, the golden-brown prodissoconch was still very prominent and on these young specimens the denticulated ridges were widely spaced. All specimens, even the very smallest, had the typical triangular dorsal plates and the characteristic muscle scars of the species.

This material gives us some idea of the rate of growth of *X. washingtona* and the knowledge that breeding takes place at least during the fall. The record from off Oceanside, California, extends the known range of the species about 350 miles farther south. The previous southernmost record was off Point Pinos Light, Monterey Bay, California.

Unfortunately the soft parts were rather brittle and almost impossible to dissect. However, it was possible to determine that the siphons are similar to those of *X. atlantica* Richards, the species to which it is most closely related. The excurrent siphon of *X. washingtona* however, is much shorter than that of *X. atlantica,* being truncated just posterior to the shell. In addition, no papillae were apparent around the openings of either the excurrent or incurrent siphons. As in *X. atlantica,* there are no lappets on the dorsal surface of the incurrent siphon. The incurrent siphon of *X. washingtona* may be extended at least two and one-half times the length of the shell and probably farther, as the burrows of some specimens were over twice the length of the shell. The burrows were completely filled with fecal pellets in a manner similar to that described by Purchon (1941).

The knowledge of the kind of siphons of *X. washingtona* is most interesting and important for it is now possible to state with a reasonable degree of certainty that there are at least two distinct subgenera in the genus *Xylophaga.* The subgenus

*Xylophaga* s.s. contains those species having large ear-shaped dorsal plates and a series of paired lappets which extend along the dorsal surface of the incurrent siphon. This subgenus includes *X. dorsalis* Turton of the Eastern Atlantic, *X. globosa* Sowerby of the Eastern Pacific and *X. japonica* Taki and Habe of the Indo-Pacific.

The subgenus *Neoxylophaga* Taki and Habe includes those species which have small, triangular dorsal plates and which lack the lappets on the dorsal surface of the incurrent siphon. Taki and Habe introduced the name *Neoxylophaga* for *Xylophaga rikuzenica* Taki and Habe, a species having small triangular dorsal plates. Although they did not have the soft parts of this species and could not report on the type of siphons, I can now state with a reasonable degree of certainty that those species having small triangular dorsal plates also lack the lappets on the dorsal surface of the incurrent siphon. This subgenus includes *X. atlantica* Richards of the Western Atlantic, *X. washingtona* Bartsch of the Eastern Pacific and *X. rikuzenica* Taki and Habe of the Indo-Pacific.

One other type of dorsal plate had been described in the genus *Xylophaga;* this is a small, divided, triangular plate which is attached nearly vertically rather than horizontally as in *Neoxylophaga.* This may be just a variation within the subgenus *Neoxylophaga* but until the structure of siphons is known the name *Metaxylophaga* Taki and Habe may be used. At present only one species is known in this subgenus, *Xylophaga* (*Metaxylophaga*) *supplicata* Taki and Habe from Japan.

There are a number of other named forms in the genus *Xylophaga* but for most of them only the valves are known; consequently it is impossible to place them in any particular subgenus.

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# VARIATION OF CARINAE IN VALVATA TRICARINATA

By AURÈLE LA ROCQUE
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The common freshwater snail *Valvata tricarinata* (Say) typically has three well-developed carinae on each whorl after the first two. In the majority of specimens, the carinae appear on the third whorl or even on the last half of the second and persist throughout the growth of the shell. Specimens in which one, two, or even all three carinae are suppressed are not uncommon in living specimens of the species. They are often found in Pleistocene specimens and in these, the variation is nothing short of bewildering. Colonies in which specimens exhibit all possible variation, from the total lack of carinae to possession of all three, have been seen from a number of Pleistocene freshwater assemblages in Ontario, Ohio, Michigan, and other areas. This characteristic seems to have no stratigraphic significance since the variation shows no particular trend from the lowest to the highest Pleistocene deposits examined. On the other hand, the variation is important in describing the composition of a given fauna and some attempt should be made to record it. If the number of carinae remained constant from their appearance to the full development of the shell, the numerous varietal names suggested might be used. Such is not the case; carinae appear or disappear throughout the growth of the shell and one specimen may start out, according to the trinomial nomenclature proposed for this species, as *Valvata tricarinata tricarinata* (Say) and end up, by suppression of the middle carina, as *V. tricarinata perconfusa* Walker.

The late F. C. Baker (1928, p. 15) has rightly pointed out that these variations are not distinct varieties, but "are to be regarded as mutations rather than as distinct varieties." He has also stated that "they are not strictly ecological, for many of the variations may be found in any lot from one locality or habitat." In spite of these statements, Baker recognized a trinomial for each variation, although he was careful to refer to them as mutations or forms.

The unwieldiness of varietal or form names for characteristics which seem to have such minor significance, if any, is one that malacologists would have to accept if there were no better way to solve the problem. The writer believes that a better way exists, one that is not original with him but that has been developed to describe the almost infinite variety of banding in such snails as *Cepaea nemoralis* and *C. hortensis.* The same descriptive method might be applied to *Valvata tricarinata,* as shown in the following table.

| Present method (varieties or mutations) | Proposed method |
|---|---|
| *Valvata tricarinata tricarinata* (Say) | *Valvata tricarinata* (Say) 111 |
| *V. tricarinata perconfusa* Walker | *Valvata tricarinata* (Say) 101 |
| *V. tricarinata mediocarinata* F. C. Baker | *Valvata tricarinata* (Say) 010 |
| *V. tricarinata basalis* Vanatta | *Valvata tricarinata* (Say) 110 |
| *V. tricarinata infracarinata* Vanatta | *Valvata tricarinata* (Say) 001 |
| *V. tricarinata unicarinata* De Kay | *Valvata tricarinata* (Say) 100 |
| *V. tricarinata simplex* Gould | *Valvata tricarinata* (Say) 000 |

The proposed method has the advantage of conciseness, it avoids the implications suggested by the use of trinomials, and it is flexible enough to describe the specimens mentioned above that start out as one ''variety'' and end up as another. Let us suppose that we have before us a group of specimens of *Valvata tricarinata* in which the first two whorls are ecarinate, the third whorl has a superior and basal but no medial carina, the fourth and fifth whorls have three well-developed carinae. These specimens could be called *Valvata tricarinata* (Say) and their carinal variation could be expressed as follows: 1, 2: 000; 3: 101; 4, 5: 111.

The advantages of this method were brought home to the writer during study of numerous Pleistocene faunules, mainly from Ohio, and he proposes to use it in several papers describing these faunules as well as a report on the Pleistocene Mollusca of Ohio, now in preparation.

The use of this method could be extended to all snails with spiral carinae or spiral color bands in which there is sufficient variation to warrant record. Comments on this proposal will be appreciated by the writer.

## REFERENCE CITED

BAKER, FRANK C. 1928. Fresh Water Mollusca of Wisconsin, Part I. Gastropoda. Wisconsin Geol. and Nat. Hist. Survey, Bull. 70, 507 pp., 28 pls., 202 text figs.

# LAND SNAILS OF SHENANDOAH NATIONAL PARK

By LESLIE HUBRICHT

The Shenandoah National Park, located in the Blue Ridge Mountains of northern Virginia, is a region from which land snail records were almost non-existent, due largely to the former inaccessibility of the mountains. The construction of the Skyline Drive along the crest of the mountains has made the region accessible by automobile. During the summers of 1952 and 1953, the author made a number of weekend trips to the Park to study the land snails found there. The results are reported in this paper.

The land snail fauna of the Shenandoah National Park seems of more interest for what is not found there, than for what is found. Most of the species are derived from the surrounding lowlands. Such mountain species as occur apparently have come up from the south. Such northern species as *Mesodon sayanus* (Pils.), *Triodopsis tridentata* (Say), *T. denotata* (Fér.), *T. dentifera* (Binn.), and *Philomycus flexuolaris* Raf. are absent although they are found in the Blue Ridge farther south, and *Mesomphix inornatus* (Say) is found only in the southern part of the Park.

The Skyline Drive traverses the entire length of the Park along the crest of the mountains for a distance of about 105 miles, from near Front Royal to near Waynesboro, Virginia. The lowest elevation near the Drive, about 600 feet, is at the north entrance. The highest point is at Hawksbill Mountain with an elevation of 4049 feet. No attempt was made to study the snails below 2000 feet. Along the Drive are numbered mileposts, starting with post 0 at the north entrance. These were found very convenient for locating collections. In the list of species, the numbers following the names are of the nearest milepost to where the species was found.

*Stenotrema stenotrema* (Pfr.), 6.
*Stenotrema hirsutum* (Say), 25, 40, 46, 48.
*Stenotrema fraternum* (Say), 6, 17, 52, 61.
*Triodopsis fraudulenta* (Pils.), 16, 40, 43, 45, 48, 51, 59, 68, 97.
*Triodopsis juxtidens* (Pils.), 6, 16, 61.
*Triodopsis albolabris* (Say), 6, 16, 42, 43, 45, 61.

*Haplotrema concavum* (Say), 6, 16, 17, 48, 61, 70, 97.
*Euconulus fulvus* (Say), 6, 17, 25, 97, 103.
*Retinella virginica* Morrison, 40, 46, 48, 59, 61.
*Retinella rhoadsi* (Pils.), 6, 17, 20, 25, 29, 48, 59, 68, 71, 97, 103.
*Retinella indentata* (Say), 6, 25, 48, 52, 103.
*Mesomphix inornatus* (Say), 61, 103.
*Paravitrea multidentata* (Binn.), 6, 17, 25, 40, 59, 71, 97, 103.
*Ventridens suppressus* (Say), 40, 46, 59, 97, 103.
*Ventridens suppressus virginicus* (Van.), 6, 25.
*Zonitoides arboreus* (Say), 6, 17, 20, 25, 40, 48, 68, 71, 97, 103.
*Striatura exigua* (Stimp.), 40, 46.
*Striatura meridionalis* (P. & F.), 6, 25, 40, 46, 59, 71, 97, 103.
*Anguispira alternata angulata* Pils., 6, 19, 40, 42.
*Helicodiscus parallelus* (Say), 6, 20, 25, 40, 46, 48, 97.
*Punctum minutissimum* (Lea), 40.
*Philomycus carolinianus togatus* (Gould), 40.

A study of Gould's original description of *Limax togata* shows it to be identical with *P. c. collinus* Hubricht, and the latter must be placed in synonymy.

*Philomycus virginicus* Hubricht, 43, 47.
*Pallifera dorsalis* (Binn.), 68.
*Pallifera varia* Hubricht, 40, 43, 48, 51.
*Strobilops labyrinthica* (Say), 97.
*Gastrocopta pentodon* (Say), 25, 97, 103.
*Gastrocopta contracta* (Say), 97.
*Vertigo parvula* Sterki, 6, 17, 97.
*Columella edentula* (Drap.), 17.
*Cionella lubrica morseana* Doherty, 6, 17, 25, 29, 40, 59, 71, 103.
*Carychium exile* H. C. Lea, 29, 40, 48, 59, 71, 97, 103.
*Hendersonia occulta* (Say), 6, 16.

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## THE MYSTERY OF DISCUS BRUNSONI

By ROYAL BRUCE BRUNSON

Montana State University, Missoula.

In a report to the Southern California Academy of Sciences in 1955 (volume 54, part 1, pages 17 to 19) Dr. S. Stillman Berry gave a description of *Discus* (*Gonyodiscus?*) *brunsoni,* a new species of *Discus* from McDonald Cirque in the Mission Mountains of western Montana. With the naming of this snail, the author now can set forth some of his observations and experiences in collecting this interesting gastropod.

One cannot fully appreciate the mystery of this little snail without having an appreciation of the history of McDonald Cirque and the amount of collecting that has been done in this restricted area, and some information about the slide areas. All told, there are several acres of talus slides in McDonald Cirque. They occur as relatively small unit slides that range in size from 100 feet in diameter to 100 yards wide by 300 yards long. Individual rocks of the slides range in size from five to six inches in diameter to five or six feet in diameter with an average of about one-half a cubic foot. The rocks are loosely piled with open spaces between. No estimate can be made as to the depth of the slides. Lichens and some mosses are the only types of vegetation found in the open slides. *Oreohelix elrodi* and *Discus brunsoni* are the only snails found in the open slides, but *Zonitoides arboreus* is found in the duff emarginating the slide and *Oreohelix depressa* is found in the timbered and brushy areas between some of the slides.

The cirque is well known to conchologists and malacologists in general because it is the type habitat of *Oreohelix elrodi,* which was first discovered by Dr. Morton J. Elrod circa the year 1898 and described by Pilsbry in 1900 as *Pyramidula elrodi* (Nautilus, 14:40). This cirque was a favorite spot of Dr. Elrod's. In the 35 or more years that Dr. Elrod was active at Montana State University, he spent many weeks and days collecting in this area. He was an extremely efficient collector and a capable observer in the field. From his daughter, the author has learned that Dr. Elrod also took many mollusk collectors into the cirque with him. Yet in all the time that he collected in this particular cirque, he did not turn up a specimen, either living or dead, of this particular *Discus.*

It would be impossible to estimate the number of conchologists or malacologists who have camped and collected in McDonald Cirque in the interval between 1925 and 1955. Certainly not a small number nor a small number of trips have been taken to collect the rock slide which is the type habitat of both *Oreohelix elrodi* and *Discus brunsoni.* The author does not know how many trips Dr. Berry made into McDonald Cirque before he finally found the single specimen on August 26, 1948. This shell, incidentally, was not living at the time of collection.

The author moved to Montana in September of 1946. In that month, he made his first collecting trip to McDonald Lake, primarily for the purpose of looking for *Oreohelix elrodi*. In the spring of 1947, he took a class of 17 students into the slide area to collect. Again in the summer of 1947, he visited the cirque with three students to collect on two different occasions. This same process was repeated in 1948 and 1949, both in the springs and in the summers, each time with members of his field zoology class. In addition to these trips in 1948 and 1949, the author also took several independent trips to the same area.

In the spring of 1950, nearly 60 students of his field zoology class accompanied the author on another "routine" collecting trip into McDonald. On this trip, the author and a few of the students found 14 specimens of what appeared to be a new species of snail. These were subsequently turned over to Dr. Berry to supplement the one specimen that he had found, and were used by Dr. Berry as holotype and paratypes. All the specimens were living and were found upon one talus slide which measured approximately 100 yards in diameter.

Finding these 14 specimens moving around on the rocks gave the author the impression that they were fairly common and could be found easily if one collected in the right area. Later, encouraged by Dr. Berry to collect more specimens, the author again returned in the summer of 1950 to the exact slide to collect more specimens. He had with him a class in natural history of invertebrates and although a great many tons of rock were overturned, not a trace of this snail could be found. This was indeed intriguing in view of the ease by which the first collection was made.

In the springs and summers of 1951, 1952, and 1953, the area was revisited to look for more specimens. Not less than four trips were made to the cirque in each of these years. Oddly enough, no other specimens were found, even though again probably hundreds of tons of rock were turned over by members of classes which numbered up to 40 students.

In the spring of 1954, another field zoology class was taken into the cirque to look for this snail as well as to collect other forms. No specimens were turned up after an all-day trip by about 20 students. It so happened that two students, William Harryman and Pete Tyler, could not make the regular class trip.

However, these boys went up the next day, camped all night and collected for both days. When the author looked over their collections after they had returned to Missoula, he found one specimen of *Discus brunsoni*. Following this discovery, the following day the author took three car-loads of students with him, including Harryman and Tyler, who, incidentally could not remember the exact location in which they had found this one specimen. Their entire route was repeated with the class searching diligently. In the last rock slide visited, the author found a living specimen of *Discus*. By the time it was dusk and the party was ready to go home and get out of the hills while it was still light, 39 specimens had been found. All 39 specimens were alive and had been found crawling on the surface of the rocks, but in a different talus slide from that which yielded the specimens in 1950.

Two trips were made to McDonald Cirque in 1955, one of which was an all-day trip with a field zoology class. On the first trip, both rock slides were visited, but no specimens were found. The first visit in the spring was probably unsuccessful because western Montana experienced one of the coldest springs it has had in recorded history. Consequently, the normal emergence of organisms was greatly delayed. On July 2, a field zoology class was taken to the cirque and the students collected with the author during a snowstorm. After hunting diligently for several hours, two specimens were eventually discovered by one student, Unda Osher, and one specimen was found by the author. These three specimens were the only ones found, then, in 1955.

In September of 1955, Mr. W. L. Walton from Glendale, California, made a trip to the rock slide with the author in the hopes of finding some specimens. Although again many tons of rock were overturned, no specimens were found, thus carrying out the earlier predictions of the author. The fascinating intrigue of the whole picture can be summed up by Mr. Walton's words after the day at the rock slide: "If anyone before today had ever told me that I could go to an area less than 200 yards in diameter that contained a species of snail and not find that snail, I would have said he was wrong. It seems impossible that snails occur in this one small rock slide and we were not able to find them."

This then is the history of the intensive collecting that has been done in this one small ecological area. A few factors are noteworthy of recording. In the first place, it is not entirely surprising to the author that a new species of snail would be found in McDonald Cirque. According to geologists, the last glacial advance apparently covered all of the peaks of the Missions except for those three which emarginate McDonald Cirque. This action left remnants of preglacial flora and fauna in McDonald Cirque, many species of which are now examples of discontinuous distribution. *Oreohelix elrodi* is limited in its distribution to this one particular cirque. The range of *Oreohelix alpina* theoretically is limited to McDonald Peak. (However, the author has some unpublished data to show that its distributional pattern might be more extensive than was previously supposed.) Therefore, it is not too surprising to find another new species within this area.

With the exception of the one specimen collected by Dr. Berry, all the other specimens were living at the time of collection. The big question which naturally arises is, what happens to the empty shells? The amazing thing, then, to the author about Dr. Berry's discovery is not that he found a new species but that he found an empty shell. Although the chemical formula of this chitinous-like shell is not known, it seems to be of a material that is easily broken down. Dr. Gladys Baker of the Department of Botany at Vassar College is presently working on fungi which apparently will grow upon the shell, in an attempt to determine whether action by the fungus will completely destroy the shell. This is one possibility at least.

One might venture to guess what the ecological factors are that have kept this interesting snail hidden from collectors for so many years. In retrospect, most of the specimens seemingly were collected during the last few minutes of day in the rock slide area. This suggests the possibilitity that the animals may have a nocturnal habit coupled with a daily migration pattern. At least if it is not nocturnal, apparently they come out only in subdued light. If this is a vertical migration, the animals certainly must go down deep into the rock slides. Evidence to support this idea comes from the fact that at all times of collection, *O. elrodi* could be found as empty shells and in estivation on the various surfaces of rocks when one dug into the slide. *Oreohelix* could be found at varying depths, but *D. brunsoni* could not be found, regardless of how deep one dug.

Relative humidity must play an important role in determining the movements of this snail. There have been times during past summers in western Montana when the relative humidity would reach a point as low as seven to ten percent. This low relative humidity certainly wouldn't be true deep down in the rock slide. However, the snails estivate, as do many of the land gastropods, because the three specimens found in 1955 were in estivation and were found attached on the undersurface of rocks. Also living snails brought into the laboratory estivated on the side of the jar. It is hoped that future studies will shed more light on the ecology of this interesting species. Because McDonald Cirque is approximately 70 miles from Missoula, and because climatic conditions vary so much from one year to another, from one month to another, and even from one day to another, seemingly one would have to spend many days in the cirque in order to get much positive data.

The author is indebted to Dr. Berry for his encouragement, to the research council of Montana State University for supplying the funds to take many of the trips to the cirque, and to those hundreds of students who aided in the collecting process.

## TYPES OF MOLLUSKS DESCRIBED BY F. C. BAKER PART I, UNIVERSITY OF ILLINOIS[1]

By DOROTHEA S. FRANZEN

Illinois Wesleyan University

There are deposited in the Museum of Natural History of the University of Illinois, Urbana, holotypes and paratypes of species and subspecies of Gastropoda and Pelecypoda described by the late Frank C. Baker. Because there has been no listing of such types, I have sorted from the collection of this museum all the holotypes and paratypes and have prepared the following list.

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[1] Expenses incurred in travel to and from the University of Illinois, Urbana, have been covered by Grant-in-Aid of the Illinois State Academy of Science.

The names of the types are precisely as given in the type descriptions and no synonomy is included. Some information pertaining to locality data and names of collectors or donors, which is not included in the type descriptions, is also given. This information has been obtained from either the museum cards of the holotypes or from the museum catalogue in which the entry was made by Mr. Baker.

Although this list includes also the paratypes which have been deposited in other museums, only those of the University of Illinois collection have been checked. Those of other museums are included in this listing as reported in the type descriptions. Paratypes of the species of which the holotypes are not in the University of Illinois museum are not included. Those will be included in subsequent publications of listings of the holotypes of Baker's species which are in other museums.

## Gastropoda

*Amnicola judayi* Baker, 1922, Naut. 36 (1): 19–20.

Type: Z-12651 (one male shell is designated as holotype). Paratypes: Z-12651 (one female); also Univ. Wis. 4549. Cf. 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): pl. 6, figs. 42 (holotype), 43.

Type locality: Wisconsin, off Doemal Point, Winnebago Lake, on a sandy mud bottom in 9 ft. of water.

*Amnicola lustrica decepta* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): 108–109, text fig. 45.

Type: Z-22501 (one male shell is designated as holotype). Paratypes: Z-22502 (3 shells).

Type locality: Silver Lake, Waukesha Co., Wis. (A. R. Cahn!).

*Amnicola lustrica perlustrica* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): 109–110, pl. 6, fig. 15; text fig. 45.

Type: Z-18365a (missing from the collection). Paratypes: Z-18365a; also Univ. Wis. 4535.

Type locality: Lake Michigan shore east of Sturgeon Bay, Door Co., Wis. (F. C. Baker!).

*Amnicola walkeri foxensis* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): 116, text fig. 47, 1, 2.

Type: Z-18374a (one male shell is designated as holotype). Paratypes: Z-18374 (3 shells).

Type locality: Fox River, 1 mi. N. of Portage, Columbia Co., Wis.

*Bulimus tentaculatus magnalacustris* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): 81–89, pl. 5, figs. 22, 23, 26–31.

Type: Z-29449. (Cat. no. Z-18637 as listed in the type description is an error.) Paratypes: Z-29450 (1 shell); also Univ. Wis. 4523, 4524.

Type locality: Winnebago Lake, near Oshkosh, Wis. (C. W. Johnson!).

*Cincinnatia cincinnatiensis chicagoensis* Baker, 1930, Trans. Ill. State Acad., 1929, 22: 189, text fig. 2, 12–15.

Type: Z-28329. Paratypes: Z-28329 (3 shells).

Type locality: Foot of Division St., Chicago, Ill. Not designated in the type description: Information obtained from the museum card of the holotype.

*Cincinnatia emarginata canadensis* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): 130–131, pl. 7, figs. 22, 23; text figs. 54, 7, 8.

Type: Z-22510. Paratype: Z-22510 (one shell).

Type locality: Lake Kakiska near Beaver River west of Great Slave Lake, about latitude 61° (E. J. Whittaker! Aug., 1921).

*Fossaria obrussa rodecki* Baker, 1936, Naut. 49 (4): 130, pl. 7, figs. 7.

Type: Z-38975. Paratypes: Z-38975 (1 shell); also: ANSP[2] 166255; Baker Coll. 3545.

Type locality: Swan Lake, Montana (Junius Henderson and H. J. Rodeck!).

*Gyraulus hornensis* Baker, 1934, The Canadian Field-Naturalist 48 (8): 135, text fig. 135.

Type: Z-13072a. Paratypes: Z-13072a (2 shells).

Type locality: Birch Lake, Horn River, Mackensie District, Canada. Gift of E. J. Whittaker.

*Gyraulus latistomus* Baker, 1932, Naut. 46 (1): 9.

Type: Z-32340. Paratypes: Z-32341 (1 shell); also ANSP 158598.

Type locality: McAree Lake, Rainy River District, western Ontario, Canada (A. R. Cahn! 1931).

*Helisoma anceps rushi* Baker, 1939, Canadian Jour. Research D, 17:94, fig. 1.

Type: Z-25259a. Paratypes: Z-25259 (5 shells).

Type locality: Toad Island, Georgian Bay, Ontario, Canada (R. C. Rush!).

[2] Academy Natural Science of Philadelphia.

*Helisoma antrosa cahni* Baker, 1927, Naut. 40 (3): 85–86.
Type: Z-21124. Paratypes: Z-21124 (5 shells); also ANSP 141567. Cf. 1928, Bull. Wis. Geol. Nat. Hist. Survey, 70 (1), pl. 22, fig. 1, holotype; 2–5, paratypes.
Type locality: Big Muskallonge Lake, Vilas Co., Wis. (A. R. Cahn! July, 1926).

*Helisoma (Planorbella) campanulata canadensis* Baker and Cahn, 1931, Annual Report, 1929, Nat. Mus. Canada: 57–58, pl. 2, top row.
Type: Z-30721a. Paratypes: Z-30721b (3 shells); also Nat. Mus. Canada 4378.
Type locality: Bamaji Lake, Ontario, Canada.

*Helisoma campanulatum collinsi* Baker, 1939, Canadian Jour. Research D, 17: 97–98, fig. 1.
Type: Z-41451. Paratypes: Z-41452 (12 shells).
Type locality: Cameron Lake, N.E. of Kakagi Lake, Lake of the Woods, Kenora District, Ontario, Canada (A. R. Cahn!).

*Helisoma corpulentum multicostatum* Baker, 1928, Naut. 46 (1): 7.
Type: Z-32306. Paratypes: Z-32307 (5 shells); also ANSP 158592.
Type locality: Kahnipiminanikok Lake, Rainy River District, Ontario, Canada (A. R. Cahn! 1928).

*Helisoma infracarinatum* Baker, 1932, Naut. 46 (1): 8–9.
Type: Z-32361. Paratypes: Z-32362 (3 shells); also ANSP 158594.
Type locality: Basswood River rapids, Rainy River District, western Ontario, Canada (A. R. Cahn! 1931).

*Helisoma trivolvis chautauquensis* Baker, 1928, Naut. 42 (2): 57–58.
Type: Z-23780. Paratypes: Z-23780 (1 shell): also ANSP 144806.
Type locality: Chautauqua Assembly, Cheney's Point, Chautauqua Lake, N. Y. (F. C. Baker, 1927).

*Helisoma trivolvis holstonense* Baker, 1945, Baker, F. C., The Molluscan Family Planorbidae: pl. 7, fig. 17 (holotype), 18–20, paratypes.
Type: Z-41443. Paratypes: Z-41443 (3 shells).
Type locality: Middle Fork Holston River, Marion, Smith Co., Va. (Clench and Archer! June 27, 1932).
Remarks: The type description apparently consists of only the illustration noted above.

*Helisoma whiteavesi* Baker, 1932, Naut. 46 (1): 7–8.
Type: Z-32311. Paratypes: Z-32312 (4 shells); also ANSP 158591.
Type locality: Lac des Mille Lac, Thunder Bay District, western Ontario, Canada (A. R. Cahn! 1928).

*Lymnaea caperata warthini* Baker, 1923, Naut. 36 (4): 125–126.
Type: Z-40396. Paratypes: Z-40397 (2 shells); also Coll. of S. S. Berry 5547.
Type locality: Upper Falls, Canyon of Yellowstone, Yellowstone Park, Wyo. (Dr. A. S. Warthin! Sept. 1922).

*Lymnaea* (*Galba*) *minnetonkensis* Baker, 1922, Naut. 36 (1): 23–25.
Type: Z-11827. Paratypes: Z-11827 (7 shells).
Type locality: Lake Minnetonka, Assembly Ground, Hennepin Co., Minn.

*Lymnaea* (*Galba*) *winnebagoensis* Baker, 1922, Naut. 36 (1): 22–23.
Type: Z-11826. Paratypes: Z-11826 (4 shells). Cf. 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): pl. 14, fig. 16 (holotype), 17–19 (paratypes).
Type locality: Lake Winnebago, Oshkosh, Wis.

*Planorbis pseudotrivolvis* Baker, 1920, Naut. 33 (4): 123–125.
Type: Z-11292. Paratypes: Z-11292a (3 shells). Cf. 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): pl. 20, fig. 27 (holotype), 28, 29 (paratypes).
Type locality: Salt Fork, Champaign Co., Ill. Old stream south of cemetery, north of Urbana (F. C. Baker and F. Smith! May 23, 1918). Not designated in type description. Information obtained from museum card. Locality of paratypes: Vermilion River, Ill.

*Planorbula armigera palustris* Baker and Cahn, 1931, Annual Report, 1929, Nat. Mus. Canada: 58.
Type: Z-27094a. Paratypes: Z-27094 (7 shells).
Type locality: Pond near Camp Colfax, LaPorte Co., Ind. (L. E. Daniels! Oct. 16, 1906).

*Polygyra appressa fosteri* Baker, 1932, Naut. 46 (2): 48–49.
Type: Z-32079 (missing from the collection). (Cat. no. Z-23380 as published in type description is an error.) Paratypes: Z-32080 (missing from the collection); also ANSP 157437.
Type locality: 3 mi. N.W. of Elizabethtown in valley of Big Creek, Hardin Co., Ill. (Baker and Foster! Aug., 1931).

*Polygyra tridentata frisoni* Baker, 1933, Naut. 47 (2): 58–59.
Type: Z-34984 (missing from the collection). Paratypes: Z-34982 (missing from the collection); also ANSP 161146.

Type locality: South end Fountain Bluff, Jackson Co., Ill. (F. C. Baker!).

*Stagnicola catascopium kempi* Baker, 1931, Annual Report, 1929, Nat. Mus. Canada: 53–54, pl. 2.
Type: Z-30719. Paratypes: Z-30719 (6 shells); also Nat. Mus. Canada 4377.
Type locality: Bamaji Lake outlet on rocks in rapids, Ontario, Canada.

*Stagnicola couleensis* Baker, 1929, Naut. 42 (40): 122–123.
Type: Z-28049. Paratypes: Z-28049 (2 shells); also Univ. Colo. 17024.
Type locality: Bluffs, south side Park Lake, Grand Coulee, Grant Co., Wash. (Henderson and Nelson!).

*Stagnicola elrodi* Baker and Henderson, 1933, Naut. 47 (1): 30–32.
Type: Z-33780. Paratypes: Z-33780 (2 shells); also Univ. Colo. 19134.
Type locality: West shore of Flathead Lake, 13½ mi. N. of Polson, Montana (J. Henderson! 1932).

*Stagnicola emarginata bryantwalkeri* Baker, 1936, Naut. 49 (4): 127–128, pl. 7, figs. 9.
Type: Z-38973. Paratypes: Z-38973 (2 shells); also: Baker Coll. 1766, ANSP 166257.
Type locality: Millecoquin Lake, Mackinac Co., Mich. (Dr. Bryant Walker!).

*Stagnicola emarginata magnifica* Baker, 1936, Naut. 49 (4): 128–129, pl. 7, fig. 8.
Type: Z-38974a. Paratypes: Z-38974b (1 shell). ANSP 166256, Coll. F. C. Baker 3544.
Type locality: Pelican Lake, Crow Wing Co., Minn. (W. A. Nason!).

*Stagnicola emarginata vilasensis* Baker, 1927, Naut. 40 (3): 82–84.
Type: Z-21678. Paratypes: Z-21679 (5 shells): also ANSP 141864. Cf. 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1), pl. 16, fig. 23, holotype; 21, 22, 24–27, paratypes.
Type locality: Big Muskallonge Lake, Vilas Co., Wis. (A. R. Cahn! 1926).

*Stagnicola palustris wyomingensis* Baker, 1927, Naut. 40 (3): 84–85.
Type: Z-21682. Paratypes: Z-21683 (3 shells); also ANSP 141866, Univ. Colo. (cat. no. unknown).

Type locality: Slough, 10 mi. S. of Lander, Wyo. (Junius Henderson!).

*Valvata lewisi ontariensis* Baker, 1931, Naut. 44 (4): 119–121.
Type: Z-31241a. Paratypes: Z-31241b (1 shell); also ANSP 153471.
Type locality: Shakespeare Island Lake, Ontario, Canada. Gift of Myra W. Cronk, Univ. of Toronto, Toronto, Canada.

*Valvata perdepressa walkeri* Baker, 1930, Trans. Ill. State Acad. 1929, 22:188, text fig. 1, p. 190.
Type: Z-28327. Paratypes: Z-28327 (3 shells).
Type locality: Southern part of Lake Michigan, foot of Oak St., Chicago. Gift of A. R. Cahn.

*Viviparus intertextus illinoisensis* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (1): 38–42, pl. 2, figs. 18–21.
Type: Z-18025. Paratypes: Z-18245 (3 shells).
Type locality: Illinois River, Havana Ill.

## PELECYPODA

*Alasmidonta calceolus danielsi* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (2): 187–188, pl. 69, fig. 2, pl. 72, figs. 7–11.
Type: Z-14301a. Paratypes: Z-14301c (3 shells).
Type locality: Moots Creek, White Co., Ind.

*Carunculina parva cahni* Baker, 1927, Amer. Midl. Nat. 10: 222–223.
Type: Z-17341. Paratypes: Z-17342 (4 shells).
Type locality: Neosha mill pond, Dodge Co., Wis. (A.R. Cahn! 1924).

*Pleurobema coccineum mississippiensis* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (2): 121–123, pl. 53, figs. 1–5.
Type: Z-14019. Paratype: Z-14023 (1 shell).
Type locality: Lake Pepin, Mississippi River.

*Ptychobranchus fasciolaris lacustris* Baker, 1928, Naut. 42 (2): 52.
Type: Z-23779. Paratypes: Z-23779 (2 shells); also ANSP 144807.
Type locality: Assembly grounds, Chautauqua Lake, N. Y. Information obtained from museum card of holotype.

*Strophitus rugosus lacustris* Baker, 1928, Bull. Wis. Geol. Nat. Hist. Survey 70 (2): 207–208, pl. 75, figs. 6–8.
Type: Z-22073. Paratype: Z-22073 (1 shell).
Type locality: Oconomowoc Lake, Waukesha Co., Wis. (A. R. Cahn! 1926).

# FAMILIAL NAMES FOR LAND OPERCULATES

By H. BURRINGTON BAKER

This is an extension of "Family names in Pulmonata," Nautilus 69: 128, to most of the operculate land snails. The references to Pilsbry (LMNA2:1065–1090) and to Thiele, part 1 (HSW:79–152) are made in the same way. Names which are, or would become, synonyms or tribes are in parentheses. The footnotes [1–4] have the same meaning.

Aciculidae [2] Gray, 1850 (Acm-idae & Acme-idae [3] Thiele, 1925, HSW:135). F. of Littorinoidea?

Cyclophoridae Gray, 1847, HSW:95 (-inae Adams, 1855; Annulariidae [4] & -inae Henderson & Bartsch, 1920. Tribes: Cyclotina Gray, 1852; -inae Adams, 1855; -eae Kobelt, 1902, HSW:100. Pterocyclinae Kobelt & Mlldff., 1897; -eae Kobelt, 1902, HSW:101. Spirostomatinae Tielecke, 1940). SubF.: Reali-inae (-ana Gray, 1852; -ea Pfr., 1858; -idae K. & M., 1898; -eae HSW:104. Tribes: Pupininae Adams, 1855, HSW:104; -idae Gill, 1871. Pupinellae K., 1902, HSW:104; -inae Tielecke, 1940. Pollicariae HSW:106). Diplommatininae Stoliczka or Gill, 1871, HSW:108 (-acea Pfr., 1856; -idae K. & M., 1897). Alycae-inae Godwin-Austen, 1886, HSW:107 (-idae K. & M., 1897). Neocyclotinae [4] (& -idae) K. & M., 1897 (Poteri-inae Thiele, 1929, HSW:102; -idae Tielecke, 1940; Aperostominae [3] Torre, Bartsch & Morrison, 1942. Tribes: Amphicyclot-inae [4] K. & M., 1897; -eae K., 1902, HSW:102; -idae Morrison, 1955; Aperostomatinae & -idae HBB., 1922. Megalomastomat-eae Kobelt, 1902, HSW:103; -inae T., B. & M., 1942; Neopupinae "K. & M." Morrison, 1955). Cochlostomatinae Kobelt, 1902, HSW:112 (-idae Tielecke, 1940; Pomatiaina [3] Gray, 1852; see Pomatiidae). Craspedopomat-inae K., 1902, HSW:112 (-idae K. & M., 1898). Hainesiinae Thiele, 1929, HSW:103. Maizaniidae Tielecke, 1940. F. of SuperF. Ampullariidae.

Geomelani-idae Kobelt & Mlldff., 1897; -inae Thiele, 1925. F. of SuperF. Bulimidae or Truncatellidae.

Helicin-ae Férussac, 1822; -idae Latreille, 1825, Gray, 1840, LMNA2:1078, HSW:80 (-adae Guilding, 1828; Oligyradae [4] Gray, 1847. Tribes: Proserpinellidae HBB., 1923; Cererinae Thiele, 1925. Hendersoniinae HBB., 1926. Ceratodiscinae Pilsbry, 1927, HSW:89). SubF.: Proserpininae Thiele, 1929, HSW:90, type genus only (-idae Gray, 1847: Despoenidae [2]

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[1] "Type genus" a homonym,[2] an objective synonym,[3] a misusage, i.e., with wrong type species, and [4] a subjective synonym.

Newton, 1891. Tribes: Stoastomatidae C. B. Adams, 1849; -inae HBB., 1928. Vianinae HBB., 1922, HSW:81. Dimorphoptychiinae Wenz, 1938). F. of Neritoidea.

Hydrocenidae Westerlund, 1885, HSW:79 (Hydrocaen-acea Troschel, 1856; -idae Gill, 1871. Georiss-inae Blanford, 1864; -idae Iredale, 1944). F. of Neritoidea.

Pomati-idae Newton, 1891; Pomatias-idae Pilsbry, 1919, LMNA2:1074, HSW:127 (Cyclostom-iatae [3] Menke, 1828; -acea Menke, 1830; -idae Orbigny, 1837; Gray in Turton, 1840; Cyclostomat-idae [3] Fischer, 1885; Pomatiaina [3] Gray, 1852; Pomatias-inae [3] Adams, 1855; -idae Kobelt & Mlldff., 1898; Pomati-acea [3] Troschel, 1856; -idae Gill, 1871; Pomatiat-ea [3] Pfr., 1858; Ericiidae [2] Clapp, 1919. Cyclotopsinae K. & M., 1898). SubF.: Licin-inae (-ea Pfr., 1858; -einae Gill, 1871; -idae K. & M., 1898; Annulariidae [3] Henderson & Bartsch, 1920; Choanopomateae Thiele, 1929, HSW:133. Tribes: Cistul-ea [3] Pfr., 1858; -inae Gill, 1871; -idae K. & M., 1898; Chondropomatinae H. & B., 1920, LMNA2:1075, HSW:130; -eae HSW:130. Adamsiellinae H. & B., 1920; -eae HSW:133. Rhytidopomatinae H. & B., 1920; -eae HSW:131. Cistulopsinae HBB., 1924; -eae HSW:130). F. of Littorinoidea?

Pomatiops-idae Gill, 1871 (-inae Stimpson, 1865). F. of SuperF.: Bulimidae or Truncatellidae.

Truncatell-idae Gray, 1840, LMNA2:1065 (-inae HSW:149; Acme-idae & -inae [3] Thiele, 1925). F. of SuperF.: Bulimidae or Truncatellidae.

From the preceding synopses, Helicinidae apparently would date from 1822 or 1825. Truncatellidae would go back to 1840, Cyclophoridae to 1847, and Aciculidae [2] to 1850. The last would return instead of Acmidae, which replaced it under the old article 5.

The date of Pomatiidae (or Pomatiasidae?) would depend on the confusing difference between misusages and homonyms. If *Cyclostoma* Draparnaud, 1801, not Lamarck, 1799, be a homonym, the family apparently would start in 1828. If the genus name is a misusage, would the family date from Pomatiaina,[3] 1852, another misusage, as accepted here? Or would Pomatiidae, 1891, itself be a homonym, to be replaced by Ericiidae? Also, would Cyclostomatidae [3] apply to the marine family, usually known as Scalidae (HSW:220) or Epitoniidae? All these questions would have been answered if the Commission had validated *Cyclostoma* Drap., when Dr. Pilsbry and I petitioned such action 3 decades ago.

Hydrocenidae would begin in 1856, Pomatiopsidae in 1865, and Geomelaniidae in 1897.

The two major subfamilies in Helicinidae would become Helicininae and Proserpininae. Due to a regretted attempt (1923) to save a name like Proserpinidae, the next oldest tribe in Helicininae apparently would be based on *Proserpinella,* although the radula of only *Ceres* (Cererinae, 1925) and *Linidiella* (*Cyane* [1] HSW:90) are known. *Lucidella* and *Fadyenia* (see Naut. 48:13, 14 & 62) belong in the same tribe as *Ceratodiscus.* The Proserpininae would include the typical genus and tribe, *Stoastoma* (only 2 species) and *Stoastomops,* and Vianinae.

Within Cyclophoridae, the principal changes in Thiele's subfamily names would be Realiinae, which apparently is prior to Pupininae, and Neocyclotinae [4] instead of Poteriinae, which was the legal name under the old article 5. The position of *Aperostoma* depends on the unknown soft parts of *Amphicyclotus.* "Neopupinae" had no type "genus" in 1898, and even Morrison, 1955, did not mention Neopupina [4] Kobelt, 1902.

In Pomatiidae, the prior name of the American subfamily would be Licininae, 1858. Apparent synonyms would be the misusage Annulariidae,[3] 1920, whch actually is a subjective synonym of Cyclophoridae, and Choanopomateae. Vague quotations in the synonymy of *Cyclostoma* by Herrmannsen, May, 1847, and by H. Beck, 1847, were not accepted by subsequent authors, and Licina Browne, 1756, attained no nomenclatural status until *Licina* Gray, November, 1847.

Seemingly, Cistulea,[3] also 1858, would initiate another tribe, with Chondropomatinae, 1920, as a synonym. Swainson, 1840, Treat Malac., p. 21, listed Cistula "Humphreys" (outlawed by opinion 51) but did not improve its status. Gray, 1847, Proc. Zoo. Soc. London 15:182, added only a nude "Cist. fimbriata" (cf. Mus. Cal., p. 62). Pfeiffer, 1858, quoted the first valid use: *Cistula* Gray, 1850, Cat. Cyclophor. Brit. Mus., p. 57, first species *C. fascia* (Wood). *Turbo fascia* Wood, 1828, Cat., Suppl., pl. 6, fig. 8, is now selected as the type species. Because "Cistula Say" Gray, Sept., 1825, was simply an erroneous subsequent spelling (in synonymy, without later acceptance) of *Cistudo* Say, Jan., 1825 (*Cistuda* Fleming, 1822), *Parachondria* Dall, 1905, was a superfluous replacement and is an objective synonym of *Cistula,* a subgenus of *Chondropoma* (cf. Naut. 48:6). Of course, Cistulea[3] was based on a misusage, since Pfeiffer finally removed all Gray's available species except *C. rufilabris,* which Henderson & Bartsch, 1920, included in *Chondropoma* s.s.

If each superfamily correspond to a "stirps" of Thiele, Neritoidea would date from Rafinesque, 1815. The oldest familial ("family-group") name in Architaenioglossa (HSW:94) would be Ampullariadae Guilding, 1828, followed by Paludinoidea[2] Fitzinger, 1833 (Viviparidae Adams, 1854, HSW:113). Pomatiidae, if dated from 1828, would be earlier than Littorinidae Gray, 1840 (Littorinacea HSW:121).

Bulimidae Guilding, 1828, perhaps a misusage but with only *Succinea* mentioned, apparently might determine the name of Rissoacea, HSW:136 (Rissoidae Adams, 1854) and replace Bithiniadae[2] Gray, 1857 (Hydrobiidae, 1857, HSW:136) unless Ellis (Bull. Zool. Nomencl. 11:275) is successful. Truncatellidae, 1840, is the next name. Amnicolidae Tryon, 1862, would be lost in the shuffle.

## HENRY EDWARD CRAMPTON

### 1875–1956

Professor Henry E. Crampton died on February 27th this year at the age of 81. He was primarily an evolutionist and a malacologist only secondarily. The land pulmonate Partulidae was the subject of his researches for 50 years. From the year 1906, Crampton assiduously pursued those aspects of evolution dealing with processes and results, utilizing as his instruments the numerous forms of the genus *Partula.* A Neo-Darwinian, Crampton took his thesis from chapter two of Darwin's *Origin of Species* (1859) where it is stated that individual variations are the first steps leading towards speciation. Individual differences lead to slight varieties; these lead to distinct and permanent varieties which, in turn, lead to subspecies; from these latter arise species. Distinct and permanent varieties could, therefore, be considered incipient species. A systematic species is one that exists only at a particular point of time. Since new species are continuously in the process of formation, its process ought to be traceable. Crampton also believed in the theory of mutation in the sense of de Vries and in Mendelian heredity.

To him there was no conflict between Darwinism and the doctrine of mutation. Both could take place side by side.

The three volumes on the Partulidae of Tahiti, Marianas, and Moorea (1916, 1925, 1932) are thus documentations of facts which substantiate the thesis above mentioned as Crampton found them in the field and analyzed by the statistical method of Karl Pearson.

Three important results regarding mutation, contemporaneous organic differentiation, and changes in territorial expansion, as exemplified by certain partulids of Moorea, are now described. *Partula taeniata* Mörch is an entirely dextral species distributed throughout Moorea. In 1923 Crampton found two sinistral non-gravid individuals near Maraarii and one non-gravid sinistral in Atimaha. He considered these as mutations of the greatest importance. Reproduction in *Partula* is such that the embryos within a single parent are either dextral or sinistral but never mixed in an ambidextrous species, regardless of parental coiling. In the ambidextrous *Partula suturalis* Pfeiffer, he found embryos which were *like* the parents 1133, *unlike* the parents 184, and mixed (i.e. one dextral and one sinistral) 5. Of these 5 parents, four were dextral, one sinistral. The mixed broods Crampton considered mutations.

Contemporaneous differentiation is best exemplified by *P. suturalis,* which simultaneously extended its range greatly over a period of nearly 50 years. Utilizing Garrett's work on his *Partula* collections, his maps, and his widely scattered specimens, Crampton determined the forms then extant (1861–1888) and their probable distribution. He then compared these with those of his own (1906–1909, 1919, 1923, 1924) and their distribution. His conclusion was that significant differentiation had taken place in that the species had become predominantly sinistral in its newly extended range. In his own experience (1907 vs. 1923) this species had invaded Maharepa Valley where it did not exist previously.

Dr. Crampton was born in New York City January 15th, 1875. He attended City College and Columbia University where he obtained his A.B. in 1893; Ph.D. 1899, Sc.D. 1929. He taught in various capacities at Columbia from 1893 to 1900, with one year at M.I.T. From 1900 to 1943, he was at Barnard College, as full professor since 1904. At the same time he served as curator of invertebrates at the American Museum of Natural History, 1909–1921. He was honorary Associate for many years with the A.M.N.H., Carnegie Institution at Washington, and the Bishop Museum. The presidency of the N.Y. Academy of Sciences was one of the offices he held (1926–28) at the termination of which he presented a memorable address on speciation (Science, June, 1928). In the pursuance of his researches he conducted expeditions into South America, West Indies, Polynesia, Micronesia, P.I., China, Siam, Java, Australia. His partulid researches were underwritten by the Carnegie Institution largely, with supplementary aid from the American and Bishop Museums. His studies on *Partula* at the Bishop Museum were carried on in 1929, 1935, 1947, 1949, and 1952 from which resulted two papers in collaboration with Dr. C. Montague Cooke, Jr. Since the Moorea volume, Crampton had been at work on the Raiatean species in the anticipation of the completion of which he published a paper on 10 new species (Am. Mus. Nov. 1956). Raiatea is probably the most important island in the Society group as regards *Partula* for there are at least 36 species on this particular island in contrast to 10 in Moorea, 6 in Tahiti and lesser numbers in Huahine, Tahaa, and Borabora.

Crampton's earliest paper dealt with the reversal of cleavage in a sinistral gastropod (1894). From then until 1900, he published nine papers on the early development of gastropods and ascidians, and on variation and grafting in certain saturnid moths. He published a book entitled *The Doctrine of Evolution* (1924) based on his Hewitt Lectures of 1906–07. In casting about for a subject to correlate with his experiments on moths, he read A. G. Mayer's paper (1902) on certain species of Tahitian *Partula* but his decision to do similar studies on the Hawaiian Achatinellidae was transferred to the Partulidae after a conference with Dr. Cooke.

Among other species, Mayer studied *Partula otaheitana* Bruguière, the variegated forms of which were given no less than 19 specific names on color alone. His investigations of the embryos showed that several color forms were borne within a single brood pouch. Crampton reduced *P. otaheitana* to eight subspecies. Recent anatomical work on this species (Kondo, 1955) has shown that there are two forms of genitalia in this group, indicating that further investigations are necessary.

Crampton's most important contribution to malacology is his employment of the statistical method. The validity of the Garrett-Crampton comparative data regarding morphological as well as areal changes on the species of Moorea is open to debate. These data can be accepted in the broad sense with certain reservations. He has given stability to the taxonomy of most of the species with which he worked and has thus saved many hours of work for future researchers on the group. In certain instances Crampton's flexible concept of what constitutes a species has led him to give a specific rank to a variety but this is consonant with his views on evolution and in nowise detracts from his main accomplishment. During his years of collecting he faithfully preserved the soft parts and these have proved very valuable to anatomists. The Crampton collection of some quarter million specimens will be housed permanently and as an entirety at the American Museum of Natural History.—YOSHIO KONDO, Bishop Museum, Honolulu.

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## NOTES AND NEWS

DATES OF THE NAUTILUS.—Vol. 69, no. 1, pp. 1–36, pls. 1 & 2, was mailed Aug. 1, 1955. No. 2, pp. 37–72, pls. 3 & 4, Nov. 5, 1955. No. 3, pp. 73–108, pl. 5, Feb. 11, 1956. No. 4, pp. 109–144, i–vi, pls. 6, 7 & 8, May 10, 1956.—H. B. B.

FAMILIES OF PULMONATA.—The following are addenda and errata for Naut., vol. 69, pp. 128–139:

Auriculidae: Change "Risso, 1826," a vernacular, to Gray, 1840.
Buliminidae: Enidae Woodward, 1903.
Cionellidae: Azecidae Kuroda & Habe, 1949, is a synonym.
Eulotidae: Aegistinae K. & H., 1949.
Helicarionidae: Ereptinae Godwin-Austen, 1908.
*Lucerna:* Add Dipnelicidae I., 1937, to his synonyms.
*Lymnaea:* Change "Risso, 1826," to Gray, 1840.
Orthalicidae: Liguidae Pilsbry, 1891, is a synonym.
Paryphantidae vs. Rhytididae: Paryphantinae Godwin-Austen, 1893, seems to determine the prior name for the family and the superfamily.
Streptaxidae, SubF.: O-inae (Orthogibbidae[4] Germain, 1921; Gibbinae & Gonidominae Steenberg, 1936).

—H. BURRINGTON BAKER.

Muséum Demidoff.—Through the courtesy of P. L. Merklin, Senior Scientific Worker of the Paleontological Institute of the Academy of Sciences of U.S.S.R., information regarding the mollusks of the collection of Pavel Grigor'evich Demidoff [Paul G. Demidoff] (1738–1821) [1] has been obtained. A descriptive catalogue was published by Gotthelf Fischer [Fischer von Waldheim (sometimes de Waldheim)] (1771–1853), Professor and Director of the museum of the University of Moscow, in 1806–1807, under the title "Museum Demidoff, ou catalogue systématique et Raissonné des curiosités de la Nature et de l'Art. Donneés a l'Université impériale de Moscou par Son Excellence Monsieur Paul de Demidoff," 3 tomes; 2d ed. 1817.

The collection of shells is stored in the zoölogical museum of the University of Moscow. The University of Moscow was badly damaged by the fire of 1812 and the shells and labels still show the evidence of that fire. Mr. Merklin has kindly furnished photographs of some of the available shells.

Thanks are due to Mrs. Anastasia Romanoff of Ithaca, New York, for translation of the correspondence concerning the collection.

The only printed copy of the Muséum-Demidoff, volume 3, 1807 [plants and animals], known in the libraries of North America, is in the Academy of Natural Sciences at Philadelphia. This statement has been verified by contact with the librarians of Acad. Nat. Sci., Philadelphia, Amer. Mus. Nat. Hist., Amherst, Univ. California, Univ. Chicago, John Crerar Library, Columbia Univ., Library of Congress, Cornell Univ., Johns Hopkins Univ., McGill, Univ. Michigan, Mus. Comp. Zool., Princeton, Smith Coll., Stanford Univ., and U. S. Geol. Sur. The writer has a photographed copy of volume 3 made from a bibliofilm furnished by the British Museum (Nat. Hist.). The shells, including the new species and genera, were discussed in volume 3.

The rarity of the book makes the information regarding the collection of greatest importance.—Katherine V. W. Palmer, Paleontological Research Institution, Ithaca, N. Y.

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[1] Noble, wealthy, and distinguished family of Russia; founded by a serf, Nikita (c. 1665 [c. 1656]–c. 1725), fortune amassed through arms and mines. Besides the gift of museum of natural history to the University of Moscow, Paul G., traveller and scientist, also presented a Demidoff-Muséum to Yaroslavl.

## PUBLICATIONS RECEIVED

A PRELIMINARY SURVEY OF THE LAND AND FRESH-WATER GASTROPODS OF CAPE BRETON, NOVA SCOTIA. By Gordon K. MacMillan (Proc. Nova Scotian Institute of Science **23**: 389. 1955). Including four Sphaeriidae, some 64 species and subspecies are enumerated, a considerable number being first records for Nova Scotia.

THE GENUS BIOMPHALARIA AND ITS RELATIONS TO OTHER PLANORBIDAE. By Hugh Watson. Rev. Zool. Bot. Afr. 49: 209–220. 1954.—A subfamily Biomphalariinae, including *Planorbina* (*Australorbis*), *Tropicorbis* and possibly *Taphius*, seems intermediate between Bulininae and other Planorbidae.—H. B. B.

MEXICAN MOLLUSKS COLLECTED FOR DR. BRYANT WALKER IN 1926. XI. DRYMAEUS. By Alan Solem. Oc. P. Mus. Zoo. Univ. Mich. 566: 1–20, pls. 1–5. 1955.—Anatomical notes, with *D. droueti deletus* and *D. nexacanus* as new.—H. B. B.

A HISTORICAL REVIEW OF THE MOLLUSKS OF LINNAEUS. Part 3. The genera *Bulla* and *Voluta* of the class Gastropoda. By Henry Dodge. Bull. Amer. Mus. Nat. Hist. 107 (1): 1–157. 1955.—Thorough discussions of the synonymy and present systematics of the species lumped in these two composite genera are presented. Would not the discussions be more usable if the accepted species names were also included in the titles, e.g., *Bulla ovum = Ovula ovum?*—H. B. B.

MARINE MOLLUSKS COLLECTED DURING THE "ASKOY" EXPEDITION TO PANAMA, COLUMBIA, AND ECUADOR IN 1941. By Leo George Hertlein and A. M. Strong. Bull. Amer. Mus. Nat. Hist. 107 (2): 165–317, 3 pls. 1955.—This report gives synonymies, type localities, ranges, materials examined and often habitats of the forms collected. New spp. and subsp. are: *Tellina eburnea askoyana, Ensis tropicalis, Cymatosyrinx roseola, Lioglyphostoma armstrongi* and *Natica caneloensis.* New genera are: *Hindsiclava* and *Notocytharella,* both in Turridae.—H. B. B.

COMPARATIVE MORPHOLOGICAL INVESTIGATIONS INTO THE SPERMIOGENESIS AMONG MOLLUSCA. By Åke Franzén. Zoo. Bidrag Uppsala 30: 399–456, 2 pls. 1955.—The primitive kind of metazoan sperm is found in chitons, solenogastres, pelecypods and scaphopods. In gastropods, it occurs in Diotocardia, except Neritidae. In most other prosobranchs, including "*Scala*" and *Janthina,* the middle piece is more elongate. In the Pulmonata, Opisthobranchia and the (related?) Pyramidellidae, it develops a spiral structure.—H. B. B.

# THE NAUTILUS

Vol. 70 OCTOBER, 1956 No. 2

## NATURAL BIOLOGICAL CONTROL OF A MYA PREDATOR

BY ARTHUR HADDLETON CLARKE, JR.

Dead shells of *Nassarius trivittatus* (Say) [1a] are often abundant in beach drift throughout New England, but because they are inconspicuous burrowers, ordinary collecting methods usually yield only a few living specimens, and often none at all. Dead shells of this species are commonly perforated with small round holes, presumably drilled by *Lunatia heros* Say,[1b] a snail well known for its widespread predation of *Mya arenaria* Linné and other mollusks.

On July 17, 1955 while wading on the sand flats of Dane Street Beach in Beverly, Massachusetts, the writer and his family observed *Nassarius trivittatus* swarming on the under sides of "sand collars," egg masses of *Lunatia heros.* Many of the sand collars were almost completely denuded of eggs, and all visible sand collars were under mass attack. Forty-six *Nassarius* were removed from a single sand collar, and approximately 2000 of these snails were collected alive in less than 30 minutes.

Although not necessarily conclusive, these observations indicate that predation of *Lunatia heros* eggs by *Nassarius trivittatus* may be an important mechanism by which populations of this *Mya* predator are kept within reasonable limits. *Lunatia heros* occurs from the intertidal zone to over 200 fathoms, far beyond the bathymetric range of *Nassarius trivittatus,* and if *Lunatia* reproduction takes place at such depths the eggs are probably subject to predation by other gastropods, possibly by various species of *Lora.*

It should be mentioned here that although *Mya arenaria* is rare at Dane Street Beach, *Tellina agilis* Stimpson [1c] is common, and there is an exceedingly dense population of *Gemma gemma*

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[1] Formerly (a) *Nassa trivittatus* (Say), (b) *Natica heros* Say and *Polineces heros* (Say), and (c) *Tellina tenera* Say, of authors.

(Totten). These species, together with *Nassarius trivittatus,* probably constitute the main food supply of *Lunatia heros*[2] at this locality.

Five hundred specimens of *Nassarius trivittatus* were randomly selected from the above sample and the length of each was measured to the nearest millimeter in an effort to determine the age group structure of the population. No discrete age groups were apparent. The number of individuals in each size group is included below for the use of future investigators.

7 mm.: 1
8 mm.: 11
9 mm.: 39
10 mm.: 85
11 mm.: 112
12 mm.: 99
13 mm.: 82
14 mm.: 35
15 mm.: 19
16 mm.: 8
17 mm.: 7
18 mm.: 2

In addition to normal sculpture, most of the specimens exhibited one or more, somewhat irregular, variously placed, longitudinal grooves or ridges. Such irregularities were often seen on the body whorl near the aperture, but occurred with similar frequency on individuals from all size groups. These markings are probably indicative of discontinuous growth, but are apparently useless for age determination.

## NOTES ON THE FRESHWATER MUSSELS OF NEW GUINEA

By DONALD F. McMICHAEL

The Australian Museum, Sydney[1]

The freshwater mussels of New Guinea have been studied in connection with a forthcoming revision of the group in the Australasian region. While our knowledge of the Australian and New Zealand species is still not complete, the problems remaining for solution are mainly those of distribution and the status (species or subspecies) to be accorded the known forms. On the other hand, New Guinea remains virtually an unexplored territory as far as this group of mollusks is concerned. This

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[2] Young *Polineces duplicatus* (Say) can subsist on *Gemma gemma.* See Turner, H. J. (1951), Fourth Report on Investigations of the Shellfisheries of Massachusetts. Commonwealth of Massachusetts, Department of Conservation, Division of Marine Fisheries.

[1] By permission of the Trustees.

island has an area of over 300,000 square miles, yet all the material available to me and also that which has been recorded in literature has been collected from no more than 17 localities (see map).

The following notes represent a tabulation of our knowledge to date of the New Guinea freshwater mussels, including all the records in literature known to me, as well as those which have been found in the several collections studied, but not yet recorded. Two or three lots have been found which greatly extend the range of known species, and one of these is described herein as a new subspecies. In addition, a new genus is necessary for the reception of one bizarre species.

In the locality records which follow each species, the following abbreviations for museum collections are used:

A.M. = Australian Museum, Sydney.
Q.M. = Queensland Museum, Brisbane.
S.A.M. = South Australian Museum, Adelaide.
M.C.Z. = Museum of Comparative Zoology, Cambridge, Mass.
M.Z.U.M. = Museum of Zoology, University of Michigan, Ann Arbor, Michigan.
A.N.S.P. = Academy of Natural Sciences, Philadelphia, Pennsylvania.
C.N.H.M. = Chicago Natural History Museum, Chicago, Illinois.
B.M. = British Museum (Natural History), London.

### Family MUTELIDAE—Subfamily VELESUNIONINAE

### Genus *Velesunio* Iredale, 1934

VELESUNIO SENTANIENSIS (Haas), 1924, (New Combination).

*Nova Guinea,* 15: 72–74, pl. 2, fig. 6, text-figs. 4–12, (based on paratypes of *Unio beauforti* Bavay, 1908, *Nova Guinea,* 5: 291); Jutting, 1933, *Nova Guinea,* 17: 73–74, text figs. 3–10.

*Type Locality:* Lake Sentani, Dutch New Guinea. *Records:* Lake Sentani (Bavay, 1908; Haas, 1924); Moaif, Dutch New Guinea (Haas, 1924); Hollandia, Dutch New Guinea (Jutting, 1933; M.Z.U.M.; C.N.H.M.); Aitape, Australian Territory of New Guinea, (M.C.Z.); Watut River at junction of Markham River, Australian Territory of New Guinea (S.A.M.), Buna Bay, Papua (S.A.M.).

This relatively well known little species is very similar to certain forms of *Velesunio angasi* (Sowerby) from northern

Australia, and I have no hesitation in assigning it to this genus. Haas (1924) has given details of the anatomy which confirms this opinion.

Velesunio ovatus (Haas), 1910, (New Combination).

*Nachr. Bl. deutsch. Mal. Gesellsch.*, 42: 100; Haas, 1913, *Conch. Cab.*, 9, Abt. 2, Pt. 2: 161, pl. 16, fig. 5; Haas, 1924, *Nova Guinea*, 15: 71.

*Type Locality:* New Guinea (Fly River?) (? = Konstantinhafen, Australian Territory of New Guinea, fide Haas, 1924). Known only from the types.

The doubtful locality of this species and the remarkable resemblance it bears to the Australian species *Velesunio ambiguus* suggest that some error has occurred and that the shells were, in fact, Australian. It has not been recorded again since its description, but considering the paucity of material from New Guinea, this does not rule out the possibility of its being from that island. Until we have further knowledge of this faunula, it is left among the New Guinea species.

Velesunio wilsonii (Lea), 1859, (New Combination).

*Proc. Acad. Nat. Sci. Philadelphia* for 1859 (Vol. 11): 153; Haas, 1924, *Nova Guinea*, 15: 75, pl. 2, fig. 3; Johnson, 1948, *Nautilus*, 62: 47.

*Type Locality:* Eastern Branch of Isaac's Plains, N.S.W. (= Isaac's River, Queensland).

Haas, 1924, recorded a specimen from the Bailala River (= Vailala River), Papua, under the name *Hyridella wilsonii* (Lea) but the figure does not look much like the typical Australian form of this species. However Johnson, 1948, recorded a specimen under the name *Hyridella anodontaeformis* (Tapp. Canefri) from the Marco River at Merauke, Dutch New Guinea, which belongs here. I have examined Johnson's specimen (M.C.Z. No. 158459) and although it differs in a number of ways from the normal Australian form, it is not described as a new race on the grounds of lack of adequate material and the fact that the characters may be only ecophenotypical. The locality is comparatively near the Australian mainland, and a population of this species could have been established there by passive dispersal from Australia.

## Genus *Microdontia* Tapparone Canefri, 1883

MICRODONTIA ANODONTAEFORMIS Tapparone Canefri, 1883.

*Ann. Mus. Civ. Stor. Nat. Genova,* 19: 295–296, pl. 11, figs. 3–5; Haas, 1913, *Conch. Cab.,* 9, Abt. 2, Pt. 2: 162, pl. 16, fig. 6; Haas, 1924, *Nova Guinea,* 15: 69–71, pl. 2, figs. 1 & 2, text fig. 3. *Synonym: Unio beauforti* Bavay, 1908, *Nova Guinea,* 5: 291, pl. 14, fig. 16, (According to Haas, 1924).
*Type Locality:* Fly River, Papua (*U. beauforti* = Jamur Lake, Dutch New Guinea, not Lake Sentani, fide Haas, 1924). *Records:* Fly River, Papua (Tapparone Canefri, 1883); Attack Point, Fly River (A.M.); Bailala River, Papua (Haas, 1924); Jamur Lake, Dutch New Guinea (Bavay, 1908); Sepik River, Australian Territory of New Guinea (A.M.).

Haas (1924) placed the subgenus *Microdontia* Tapp. Canefri in the synonymy of "*Hyridella* Swainson," but it is here considered to be worthy of generic rank. A large series in the Australian Museum reveals that the rostration of the shell is constant and that the characters of the hinge teeth and muscle scars are sufficient for generic separation from *Hyridella* auct. (not of Swainson, see McMichael, 1955). The form described as *Unio beauforti* Bavay is considered by Haas (1924) to be a synonym of the present species. The correct type locality of *U. beauforti* is Jamur Lake (on the authority of the collector, de Beaufort, fide Haas, 1924), not Lake Sentani as given by Bavay. Specimens from the latter locality have been renamed by Haas (see *Velesunio sentaniensis* above). Despite the fact that Haas examined the type of *U. beauforti* and claimed Bavay's figure and description to be imperfect, I find it difficult to believe that the two forms are synonymous, especially in view of Haas' figure 3.

## Genus *Westralunio* Iredale, 1934

WESTRALUNIO FLYENSIS (Tapparone Canefri), 1883, (New Combination).

*Ann. Mus. Civ. Stor. Nat. Genova,* 19: 293–294, text fig. 1; Simpson, 1914, *Catalogue of the Naiades,* 3: 1295; Haas, 1924, *Nova Guinea,* 15: 7, pl. 2, fig. 4 and ? fig. 5.
*Type Locality:* Fly River, Papua. *Records:* Fly River, Papua (Tapp. Canefri, 1883; A.M.); Sabang Lager, Dutch New Guinea (= Sabang Village, 4° 47′ S. Lat., 138° 47′ E. Long.)

(Haas, 1924, after Schepman, 1919); Strickland River, Papua (A.M.); Aipiana, St. Joseph's River, Papua (Q.M.).

This distinctive species bears a close resemblance to the Western Australian species *W. carteri* Iredale in several characters, though it is separated by an immense geographical gap from that species. Comparatively recent changes in the climate of Australia may account for this, and the species are therefore considered congeneric for the time being. Simpson (1914) in assigning *flyensis* to the Australian group *Diplodon* (*Hyridella*) was the first to suggest any close relationship between a New Guinea species and the Australian mussel fauna. The shell from Sabang considered by Haas to belong here appears, from the figure, to be quite different and is only provisionally referred to this species.

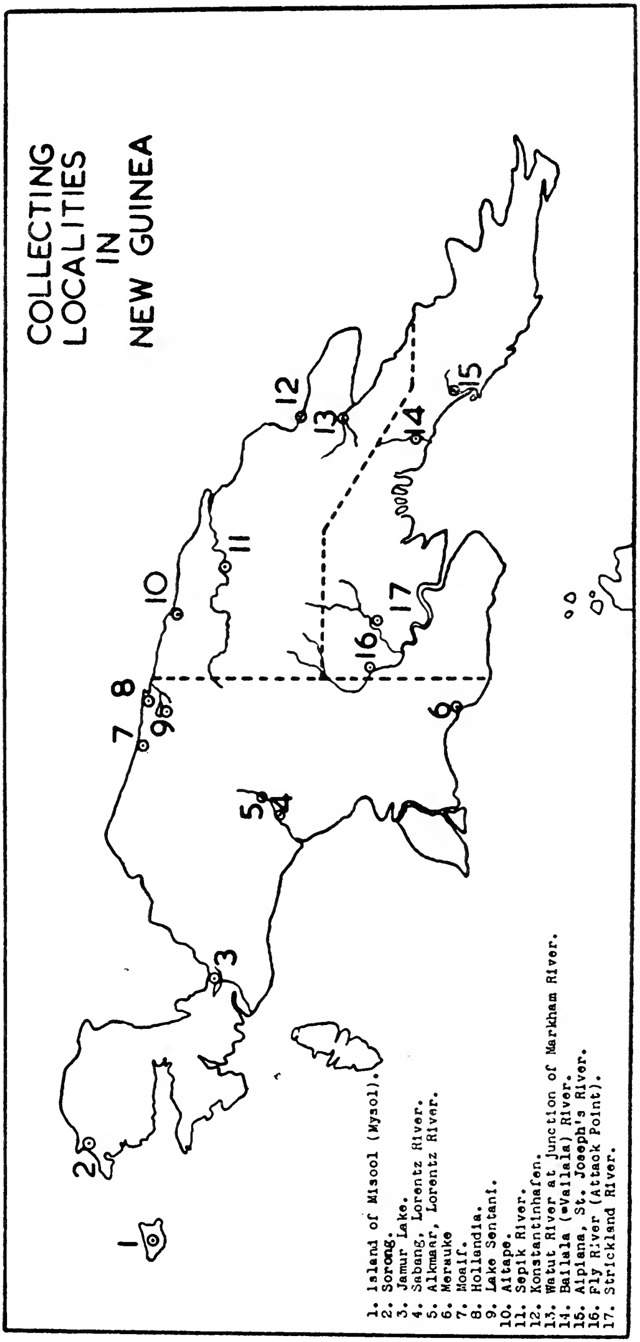
### Subfamily HYDRIDELLINAE

### Genus *Leiovirgus* Haas, 1912

LEIOVIRGUS MISOOLENSIS (Schepman), 1897. Pl. 2, figs. 6 & 7.

*Notes Leyden Museum,* 18: 259, text fig.; Drouet, 1897, *Journ. de Conchyl.,* 45: 125–126; Simpson, 1900, *Proc. United States National Mus.,* 22: 852; Haas, 1912, *Conch. Cab.,* 9, Abt. 2, Pt. 2: 133, pl. 13, fig. 3; Haas, 1923, *Abh. Senckenberg. Nat. Gesellsch,* 58: 193; Haas, 1924, *Nova Guinea,* 15: 67; Riech, 1937, *Arch. Naturgesch.* (Leipzig), 6: 86–87.
*Type Locality:* Island of Misool (Mysol), Dutch New Guinea.
*Records:* Misool (Schepman, 1897); Sorong, Dutch New Guinea (C.N.H.M.); Fly River, Papua (A.M.).

The unfortunate association of the genus *Leiovirgus* with *Virgus* Simpson has obscured the true relationship of the present group. While *Leiovirgus* belongs with the Australian forms of the genus *Hyridella* Swainson, *Virgus* is of quite different affinity, belonging with the subfamily Cucumerunioninae (see below). The present form was considered by Riech to belong in a rassenkreis with *L. lorentzi* (Schepman) and *L. guppyi* (Smith), on the grounds that there is a progressive increase in relative height of the shell from *misoolensis* in the west to *guppyi* in the east. However, the shells differ in other characters, especially *guppyi,* which is here ranked as an eastern representative of *Leiovirgus,* the main distribution of the species


COLLECTING
LOCALITIES
IN
NEW GUINEA
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1. Island of Misool (Mysol).
2. Sorong.
3. Jamur Lake.
4. Sabang, Lorentz River.
5. Alkmaar, Lorentz River.
6. Merauke
7. Moaif.
8. Hollandia.
9. Lake Sentani.
10. Aitape.
11. Sepik River.
12. Konstantinhafen.
13. Watut River at Junction of Markham River.
14. Bailala (=Vailala) River.
15. Aipiana, St. Joseph's River.
16. Fly River (Attack Point).
17. Strickland River.

being the Solomon Islands, with a new race to be described below from the New Guinea mainland. On the other hand, *lorentzi* and *misoolensis* are rather similar, and I had intended to list them as subspecies, but the discovery of the right valve of a shell which agrees closely with the figured type of *misoolensis,* on a native ornament from the Fly River district, has led me to believe that typical *misoolensis* occurs right along the southwestern coast of New Guinea from the Vogelkop to the Fly River, and that *lorentzi* is probably a different species. It may be, on the other hand, only an ecophenotypical variant of *misoolensis,* its appearance suggesting a shell which has grown under optimal conditions (judging from Schepman's figure). The Fly River shell, here figured, is more sinuate along the ventral margin than the figured type of *misoolensis,* but it appears to be somewhat distorted through injury. As should be mentioned here, *Leiovirgus* Haas, 1912, Conch. Cab., 9, Abt. 2, Pt. 2: 132, type species *U. misoolensis* Schepman, 1897, has priority over *Nesonaia* Haas, 1912, Conch Cab., 9, Abt. 2, Pt. 2: 137, type species, *Unio guppyi* Smith, 1885, because the names were published in separate livraisons, the former dated 15-2-12 and the latter 25-2-12. The names are undoubtedly subjective synonyms.

### LEIOVIRGUS LORENTZI (Schepman), 1919.

*Nova Guinea,* 13: 186–187, pl. 7, fig. 2; Haas, 1923, *Abh. Senckenberg. Nat. Gesellsch.,* 38: 194; Haas, 1924, *Nova Guinea,* 15: 67–68, pl. 2, fig. 9, text figs. 1 & 2; Riech, 1937, *Arch. Naturgesch.* (Leipzig), 6: 86–87.

*Type Locality:* Alkmaar, Dutch New Guinea (Alkmaar village, Lat. 4° 40′ S., Long. 138° 43′ E., on the Lorentz River. This locality and Sabang (see above under *W. flyensis*) are shown on the map in Van Nouhuys, 1913, *Nova Guinea,* 7, Livr. 1, Taf. 4). Known only from the types.

For discussion of the systematic position of this species see above under *L. misoolensis.* Haas (1924) gives details of the anatomy of this species.

### LEIOVIRGUS GUPPYI AIPIANUS **ssp. nov.** Pl. 2, figs. 1 & 2.

The species *L. guppyi* (Smith), 1885, has been known for many years from the several islands of the Solomon Group.

The following locality records are available: *Shortland Island:* (Types, B.M.; Haas, 1912; M.Z.U.M.; *Guadalcanal:* Aola and Marassa (Riech, 1937), Aola, Cavaga Creek, and Marovovo (M.C.Z.); *Malaita:* Buma (Riech, 1937; Haas, 1930), Fui (? = Fiu) (A.N.S.P.); *San Cristoval:* Kira Kira (Riech, 1937); *Bougainville:* Mamalomino (Reich, 1937); *Santa Isabel:* Fulakora (M.C.Z.); *Ugi Island* (A.M.).

Notably two large islands are not included in these records, *Choiseul* and *New Georgia.*

In the Queensland Museum are two shells from Aipiana on the St. Joseph's River (= Angabunga River), collected by Charles Hedley in 1890. These shells differ from the two forms described from the western part of New Guinea (*misoolensis* and *lorentzi*) but are quite similar in form, sculpture and hinge characters to *guppyi.* The shells are a little less winged than typical *guppyi,* and the hinge teeth are not quite so strongly developed, though they are juveniles. The beaks are more medially situated, being about one-quarter of the length from the anterior end, whereas in typical *guppyi* they are between one-sixth and one-seventh. The Aipiana shells are relatively higher at the position of the beaks than typical *guppyi,* this being the cause of the absence of the winged appearance. Thus, while the maximum height of the Aipiana shells relative to the length is similar to *guppyi* (about 50%), the height at the beaks relative to total length is only 36% in *guppyi,* while it is 45% in the present form.

| Specimen | Total Length | Beak Length | $\frac{B.L.}{T.L.}$ | Maximum Height | Beak Height | $\frac{B.H.}{T.L.}$ | Width |
|---|---|---|---|---|---|---|---|
| *L. g. aipianus*<br>Holotype | 44 | 10 | 23% | 22 | 20 | 45% | 10 |
| Paratype | 43 | 11 | 26% | 22 | 21 | 49% | 10 |
| *L. g. guppyi*<br>Holotype | 75 | 12 | 16% | 36 | 27 | 36% | 20 |
| *L. g. guppyi*<br>Cavaga Creek,<br>Guadalcanal (MCZ) | 42 | 7 | 17% | 22 | 15 | 36% | 11 |

The Aipiana population is here named as a new subspecies, *Leiovirgus guppyi aipianus,* the holotype being No. Mo.2798 in the collection of the Queensland Museum, while the paratype has been lodged in the Australian Museum, No. 62203. The dimensions in mm. of the types, and of comparable specimens of *L. guppyi guppyi* are given below.

The discovery of a population of *Leiovirgus guppyi* in the southern part of New Guinea suggests that the species may be much more widely distributed than had been thought previously. It may occur over much of southern New Guinea and possibly on the larger islands of the Bismarck Archipelago.

## Subfamily CUCUMERUNIONINAE

### Genus *Virgus* Simpson, 1900

VIRGUS BECCARIANUS (Tapparone Canefri), 1883.

*Ann. Mus. Civ. Stor. Nat. Genova,* 19: 291–292, pl. 11, fig. 2. *Synonym: Unio mattirolii* Tapparone Canefri, 1883, *Ann. Mus. Civ. Stor. Nat. Genova,* 19: 292–293, text fig. i. *Simpson,* 1900, *Proc. United States Nat. Mus.,* 22: 852; Haas, 1912, *Conch. Cab.,* 9, Abt. 2, Pt. 2: 129, pl. 13, fig. 1, and p. 131, pl. 13, fig. 2; Haas, 1924, *Nova Guinea,* 15: 66 & 67.

*Type Locality:* Fly River, Papua (both *beccarianus* and *mattirolii*). *Records:* Fly River (Tapparone Canefri, 1883; A.M.); "British New Guinea" (M.Z.U.M.).

As suggested above, the genus *Virgus* is considered to have nothing to do with *Leiovirgus,* but to belong with the Australian species *Cucumerunio novaehollandiae* (Gray) and certain New Zealand forms in the subfamily Cucumerunioninae. The two species *U. beccarianus* and *U. mattirolii* were described together by Tapp. Canefri, from the same lot. Tapp. Canefri considered that the species were separable in large series even though each showed some variability. The two forms are, however, very similar and a large series in the Australian Museum reveals that the characters on which they were separated are so variable as to be of little taxonomic value at this level. Possibly the two forms represent different ecophenotypes, or variants of a polymorphic species. In either case, I have no hesitation in placing *mattirolii* as a subjective synonym of *beccarianus.* Although the two names were published simultaneously, *beccarianus* has page priority, is the more common form, and was named as the type of *Virgus.* I therefore select it as the name to be used for this species.

## Family UNIONIDAE—subfamily *Rectidentinae*

### *Haasodonta* gen. nov.

*Type Species: Hyridella fannyae* Johnson, 1948, *Nautilus*, 62: 47–48.
*Description:* Freshwater mussels, of almost anodontine facies, probably belonging to the subfamily Rectidentinae Modell. Hinge line long and straight; hinge simple, with elongate, lamellar, lateral and cardinal teeth; shells compressed anteriorly, swollen posteriorly, particularly along the posterior ridge which is greatly expanded; posterior-dorsal margin winged, so that the greatest length posterior to the beaks is just below the dorsal margin (hinge-line); periostracum brown; shell substance of moderate thickness.

This genus is apparently allied to *Physunio* Simpson from which it may have been derived. It may be distinguished from that genus by the heavier shell and much more swollen posterior ridge. The hinge line is straight, whereas in *Physunio* it is gently curved. There is no evidence of the development of a third lateral tooth in *Haasodonta.* Since this new genus is based on the single known specimen of *H. fannyae,* its precise limits cannot be defined. Anatomical investigation will prove or disprove the suggested relationship with *Physunio* and the subfamily Rectidentinae, as that group differs greatly in anatomy from the other New Guinea and Australian groups. Meanwhile, the peculiarity of form in the species, which bears little resemblance to any of the species of *Hyridella* or *Velesunio,* demands the erection of a new genus for its reception.

HAASODONTA FANNYAE (Johnson), 1948, (New Combination). Pl. 2, figs. 3 to 5.

*Nautilus,* 62: 47–48, pl. 3, fig. 1.
*Type Locality:* Marco River at Merauke, Dutch New Guinea.
*Records:* Known only from the unique holotype (M.C.Z. No. 160663).

The affinity with *Physunio* suggested above, if proven, means that the species is a member of the family Unionidae, as distinct from the family Mutelidae which includes all the remainder of the Australasian species. It seems probable that the Australian-New-Zealand-New Guinea mutelids have been isolated in this region along with the marsupials and other ancient groups since the Cretaceous and that *Haasodonta fannyae* is a relatively recent immigrant from Indo-Malaya. To date it is the only non-Australasian element in this faunula. (The family Mutelidae occurs in Africa, southern South America and Australasia, while the Unionidae is found in Europe, Asia, North America, northern South America and Africa. The Indo-Malayan species are all Unionidae, with the exception of a few aberrant forms of the family Mycetopodinae.)

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## DISTRIBUTION OF LIVING GLYCYMERIDS WITH A NEW SPECIES FROM BERMUDA

By DAVID NICOL

U. S. National Museum [1]

Living members of the pelecypod family Glycymeridae can be divided into two large groups of species, and in a general way these two groups can be distinguished on the basis of the ornamentation on the exterior of the shell or, more specifically, the kind of ribs each has. The more ancient, more widely distributed geographically, and more numerous in species is the group typified by *Glycymeris, sensu stricto.* This group has shown relatively little change in ornamentation since the Glycymeridae first appeared in the early Cretaceous. Basically, the *Glycymeris* group has wide and relatively flat radial ribs with superimposed radial striae. Furthermore, living specimens usually have a luxuriant development of hair-like periostracum. Other genera and subgenera that can be placed in the *Glycymeris* group are *Glycymerula* Finlay and Marwick, 1937; *Veletuceta* Iredale, 1931; *Glycymerella* Woodring, 1925; and *Pseudaxinea* Monterosato, 1892. *Pseudaxinea* does not have radial striae on the large ribs, but the remaining morphologic characters

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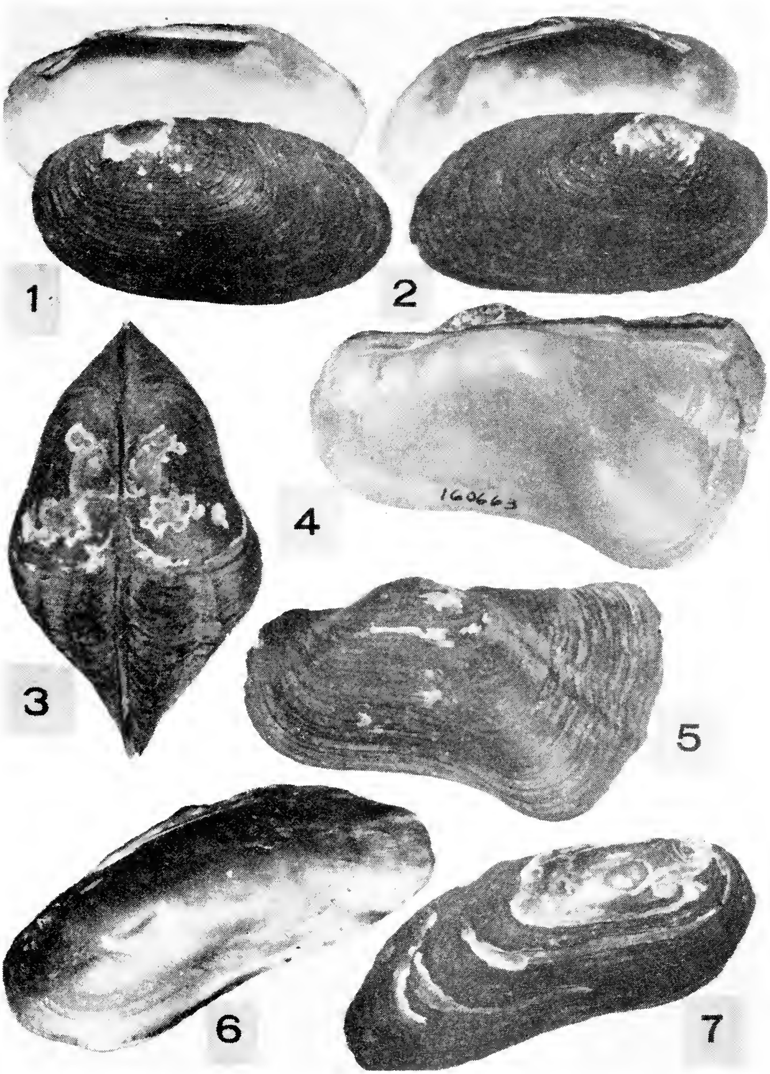
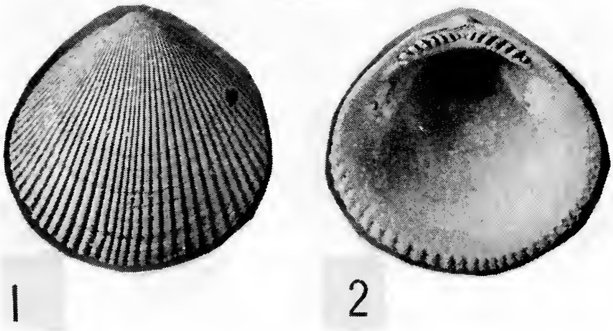
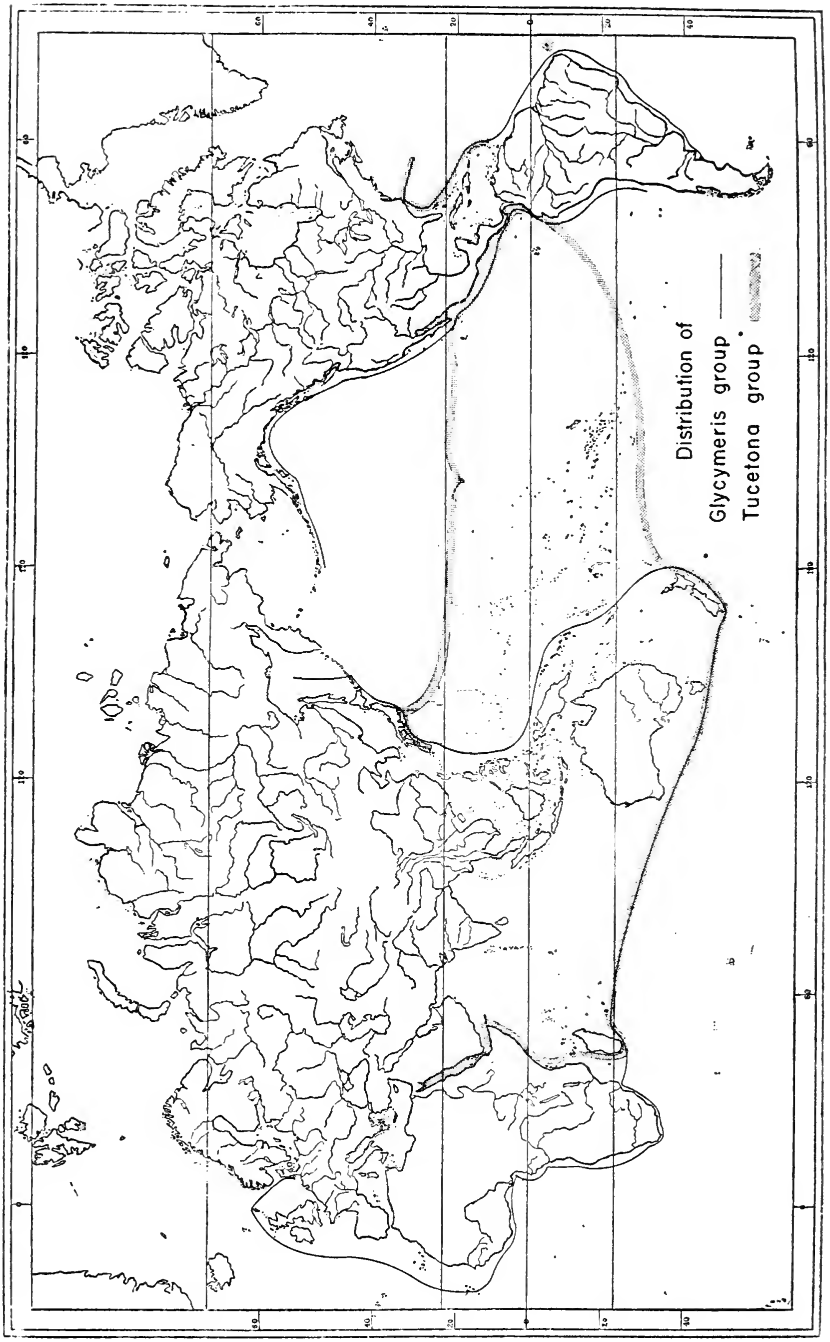
[1] Published by permission of the Secretary of the Smithsonian Institution.



1, *Leiovirgus guppyi aipianus* ssp. nov., type, Q.M. Number Mo. 2798. (× 1.2). 2, *Leiovirgus guppyi aipianus* ssp. nov., A.M. Number C. 62203. (× 1.2). 3–5, *Haasodonta fannyae* (Johnson), type, M.C.Z. Number 160663. (× .8). 6–7, *Leiovirgus misoolensis* (Schepman), Fly River, Papua; A.M. Number C.62204. (× 8).



Both figures × 3; holotype of *Tucetona subtilis* Nicol, n. sp.; U. S. N. M. 610128. 1. Exterior view. 2. Interior view.


Distribution of
Glycymeris group —
Tucetona group ▨
60
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40

are like *Glycymeris, sensu stricto.* This large group has species in tropical and temperate waters and a few in cold waters, but it is never found in true arctic conditions.

The second group is typified by the genus *Tucetona.* The radial ribs are raised and are either simple or divided. Superimposed radial striae are never present, and there is little or no periostracum on living specimens. Besides *Tucetona* Iredale, 1931, other genera and subgenera belonging to this group are *Axinactis* Mörch, 1861; *Grandaxinaea* Iredale, 1931; and very likely *Melaxinaea* Iredale, 1930; and *Tucetilla* Iredale, 1939. This group does not appear in the geologic record before the Eocene, and it is not abundantly represented by species before late Oligocene. Except around Australia and New Zealand, the *Tucetona* group is confined to warm waters; and where this group invades cooler waters, the prominent raised ribs tend to become flatter, as exemplified by *Grandaxinaea,* New Zealand, and *Tucetona flabellata* (Tennison-Woods), Victoria and Tasmania, the type species, by original designation, of *Tucetona* Iredale, 1931.

The map included with this paper brings out further details concerning the distribution of the Glycymeridae. The *Tucetona* group is found in the Indo-Pacific area, including all of Australia, New Zealand, and southern Japan; it is also found in the Panamic province, in the Caribbean province, and along the Atlantic coast of North America as far north as Cape Hatteras and as far east as Bermuda. I have recorded one occurrence off the coast of Brazil but have not recorded a very questionable report of the *Tucetona* group from southwestern Africa. It is interesting to note that the *Tucetona* group probably does not occur in the eastern Atlantic Ocean and the Mediterranean Sea and is poorly represented, as to number of species, in the Caribbean region. However, the *Tucetona* group may be the only one represented in the islands of the central and eastern Pacific Ocean; for example, although several species of glycimerids have been reported from Hawaii, none belongs to the *Glycymeris* group. In general, glycymerids of both groups are poorly represented around coral atolls.

The *Glycymeris* group is more widely distributed, although the exact limits of distribution in the northern Pacific Ocean and along the coast of northern Europe could not be ascertained by the published records, some of which are obsolete and inaccurate, particularly those on the western European region. The exact southern limits along the coasts of South America may also be somewhat inaccurate, but in all cases the general pattern of distribution is clear. Included in the references are my main sources of information on geographic distribution outside of the collection at the U. S. National Museum.

At least two species belonging to the *Tucetona* group occur in the western Atlantic region. One of them is the widely distributed and variable species *Tucetona pectinata* (Gmelin); the other is a new species from Bermuda, described as follows.

TUCETONA SUBTILIS Nicol, **n. sp.** Pl. 3, figs. 1–2.

Type specimens—Holotype U. S. N. M. 610128. Paratypes (18) U. S. N. M. 610129. Paratypes (8) U. S. N. M. 610130.

Description—Shell porcellaneous; largest specimen height 11.5 mm., length 12.0 mm.; outline circular in small and medium-sized specimens, posterior end somewhat produced in large specimens; length greater than height in large specimens, more nearly equal in small and medium-sized specimens; ratio of convexity to height in 27 specimens ranges from 0.51 to 0.66, averaging 0.60; number of ribs ranges from 44 to 58, averaging 50; ribs raised, nearly equal in size, gently rounded on top, crossed by fine concentric striae which tend to give an imbricated appearance, ribs generally wider than interspaces at ventral border, no radial striae on ribs; crenulations on interior ventral border small, numerous, ranging from 24 to 39, averaging 32, rectangular, generally narrower than interspaces; umbones not prominent, beaks directed slightly toward the posterior side; ligament amphidetic, ligamental chevrons ranging in number from 1 to 4, ligamental area small; hinge teeth symmetrically arranged, ranging in number from 6 to 21, averaging 14, generally fewer teeth in smaller specimens.

The most closely related species morphologically, geographically, and chronologically to *Tucetona subtilis* is *Tucetona pectinata* (Gmelin). The most striking difference between the two species on casual observation is the ribbing. *Tucetona subtilis* has more numerous and finer ribs than *Tucetona pectinata*. In number, the average for *Tucetona subtilis* is 50 and for *Tucetona pectinata* 32. However, there are some specimens of *Tucetona pectinata* (including variety *carinata* Dall) that have tiny intercalated ribs, which are best seen with the aid of a hand lens; five such specimens were included in the 27 specimens examined. When these intercalated ribs are added to the number of primary ribs, the average number of radial ribs in *Tucetona pectinata* is 41; one of the 27 specimens had 60; and one specimen had only 23. The number of ribs in *Tucetona subtilis* is much less variable.

The most consistent difference between *Tucetona subtilis* and *Tucetona pectinata* is in the number of crenulations on the interior ventral border. Crenulations are important in glycymerids because they commonly reflect the primary ribs. Specimens of *Tucetona pectinata* examined ranged from 11 to 23 crenulations per shell, averaging 18. Examined specimens of *Tucetona subtilis* exhibited a range of 24 to 39 crenulations per shell, averaging 32. Generally, the crenulations on shells of *Tucetona pectinata* are larger and the interspaces proportionately smaller than those of *Tucetona subtilis*.

*Tucetona arata* (Conrad) has fewer ribs (about 28), which are more widely spaced than in *Tucetona subtilis*. Furthermore, *Tucetona arata* has only about 15 crenulations on the interior ventral border. *Tucetona charlestonensis* (Holmes) and *Tucetona arata floridana* (Olsson and Harbison) have even fewer ribs than *Tucetona arata;* thus they are quite unlike *Tucetona subtilis*.

The 27 specimens of *Tucetona subtilis* came from two dredging stations located off the south shore of Bermuda: station S2 (Lowenstam) at about 100 fathoms (the holotype was selected from this lot); and station S6 (Lowenstam) at about 50 fathoms. The specimens all are Recent in age.

I wish to thank Dr. Heinz A. Lowenstam of the California Institute of Technology for the privilege of describing this new species of glycymerid which he discovered in Bermuda waters. The drafting on the distribution map was done by Mr. Lawrence B. Isham, and the photographs of the new species were made by Dr. G. Arthur Cooper, both of the U. S. National Museum.

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# THE POLYMORPHISM OF THE JAPANESE LITTLENECK CLAM

By R. F. SHAW

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In a polymorphic species, it is desirable to know whether the polymorphism is environmentally or genetically controlled and what adaptive value, if any, is associated with the different forms.

These questions are taken up here for the Japanese littleneck clam, *Tapes semidecussata.* This species has been introduced on the Pacific Coast in recent years from Japan where the variability of its shell patterns was described by Taki (1941). The biology and synonymy are summarized by Fitch (1953) and Cahn (1951).

*Heredity and Environment.* This clam shows a great variety of different shell patterns, and in the young there are also a number of different colors. The colors fade with time or on drying of the shell, so very large clams show only a dull brown

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[1] Adapted from master's thesis. Present address: Dept. Biostatistics, Graduate School of Public Health, University of Pittsburgh.

or tan color, but the pattern of pigment deposition is still distinguishable. Some patterns are found again and again. The most prominent of these are named and shown in Plates 4 and 5.

It might be thought that different patterns of pigmentation of the complexity shown here must be genetically determined. But the environment is known to produce a great effect on the appearance of some mollusks. Purchon (1939) showed a relationship between the number of ribs in *Cardium edule* and the nature of the substrate and degree of salinity of the water. Miller (1922) showed a marked effect of salinity on shell form in the shipworm, *Teredo navalis;* and Moore (1936) has shown that both shell form and pigmentation in *Purpura lapillus* vary with the nature of the diet. The demonstration of such effects in other mollusks makes it necessary to determine whether or not the pattern types of the Japanese littleneck vary with factors of the environment. This was done in the following way.

In 1948 and 1949 a number of samples of this species were collected at San Mateo Point in San Francisco Bay where the animal was most abundant. The environmental factors selected for consideration were (1) intertidal height and (2) texture of the substrate, since these factors are usually of great importance in the biology of marine intertidal organisms.

Samples were taken on a falling tide and at the water's edge so that by knowing the time, the intertidal height could be computed. Information concerning the tidal curve for this locality was supplied by the U. S. Coast and Geodetic Survey.

In order to have the same area for each sample, a rectangular sieve with an area of 2.2 square feet was used to mark off the area to be sampled. All the mud and gravel together with the clams buried in it were removed from each sample area down to a depth of about three inches or at least far enough to include all the clams.

Samples so collected were removed in buckets and treated in the following manner. The material from each sample was measured out in quarts into a sieve with 1/8 inch mesh. All the fine material was then sluiced out with a garden hose, the gravel and all the clams being left. The clams were removed, and the remaining gravel measured in quarts. The percentage of gravel in the sample was computed and this value recorded as an index of the nature of the substrate. The clams were measured and classified according to pattern.

Altogether eighteen samples including 1713 clams were collected in the manner described. These are summarized in Table I. The samples come from diverse substrates and varying intertidal heights. If, therefore, intertidal height and nature of the substrate are factors in the determination of the patterns, this situation should be apparent from the samples.

TABLE 1

| Sample[2] | Intertidal Height in feet | % Gravel in Substrate | Total Clams |
|---|---|---|---|
| A | 1.7 | 0 | 34 |
| B | 1.7 | 6 | 178 |
| C | 1.7 | 28 | 189 |
| D | 2.2 | 13 | 156 |
| E | 1.2 | 14 | 171 |
| F | 3.0 | 3 | 38 |
| G | 3.0 | 1 | 48 |
| H | 1.6 | 0 | 86 |
| J | 1.6 | 0 | 91 |
| K | 1.6 | 19 | 138 |
| L | 2.0 | 18 | 192 |
| M | 2.0 | 2 | 3 |
| N | 2.4 | 23 | 24 |
| O | 1.8 | 51 | 245 |
| P | 2.0 | 45 | 96 |
| Q | 3.6 | 40 | 14 |
| R | 4.2 | 71 | 6 |
| S | 4.0 | 77 | 4 |

The whole series was analyzed by the chi-square test to see if the frequencies of the different pattern categories vary significantly from one sample to another. Table 2 gives the observed frequencies of pattern groups and the results of the test. The chi-square value obtained corresponds to a probability of about 0.15 which does not indicate a significant deviation. In other words, the different pattern groups are randomly distributed through the sample series.

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[2] No sample was designated by the letter "I".

### Table 2[3]

| | Asymmetric | White cap | Lined | Spot | Others | Total |
|---|---|---|---|---|---|---|
| A | 1 | 5 | 3 | 0 | 25 | 34 |
| B | 10 | 34 | 1 | 8 | 125 | 178 |
| C | 14 | 27 | 0 | 7 | 141 | 189 |
| D | 9 | 17 | 2 | 3 | 125 | 156 |
| E | 10 | 25 | 2 | 2 | 132 | 171 |
| F | 3 | 3 | 0 | 0 | 32 | 38 |
| G | 5 | 6 | 0 | 1 | 36 | 48 |
| H | 9 | 8 | 0 | 1 | 68 | 86 |
| J | 5 | 15 | 1 | 3 | 67 | 91 |
| K | 10 | 21 | 0 | 1 | 106 | 138 |
| L | 17 | 30 | 1 | 3 | 141 | 192 |
| M | 0 | 2 | 0 | 0 | 1 | 3 |
| N | 0 | 3 | 1 | 0 | 20 | 24 |
| O | 23 | 34 | 1 | 5 | 182 | 245 |
| P | 10 | 10 | 0 | 3 | 73 | 96 |
| Q | 2 | 2 | 0 | 1 | 9 | 14 |
| R | 0 | 1 | 0 | 0 | 5 | 6 |
| S | 0 | 1 | 0 | 0 | 3 | 4 |
| Totals | 128 | 244 | 12 | 38 | 1291 | 1713 |

The chi-square test considers only the magnitude of the deviations from the expected values, and not the direction of the deviations. It might therefore be that the pattern type frequencies in the different samples really do not deviate randomly from the mean frequencies, but show a consistent, though small, change with some environmental factor. For this reason, graphs were made showing the percentages of the different pattern groups in relation to the two main environmental factors studied.

These graphs showed no trend for the pattern group frequencies in relation to any of the environmental factors or number in the sample. The conclusion drawn from the chi-square test that the series of samples was drawn from a uniform population with regard to the frequencies of the different pattern groups was thus accepted as correct.

One would say from this that the environmental factors in-

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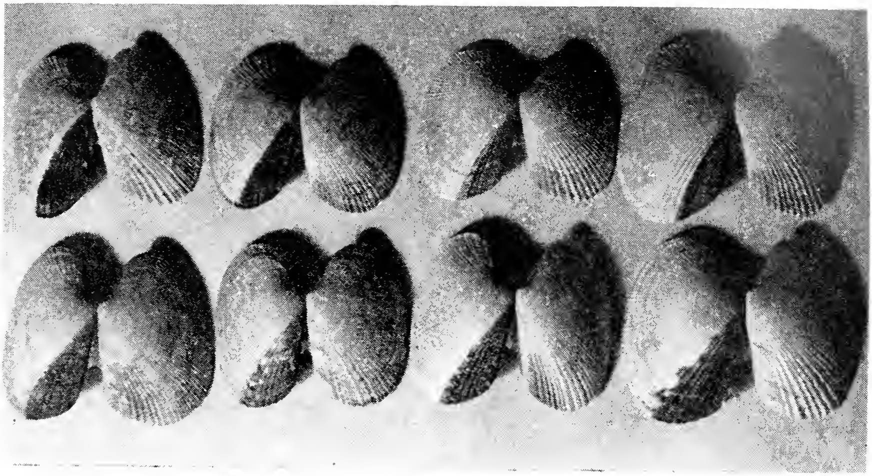
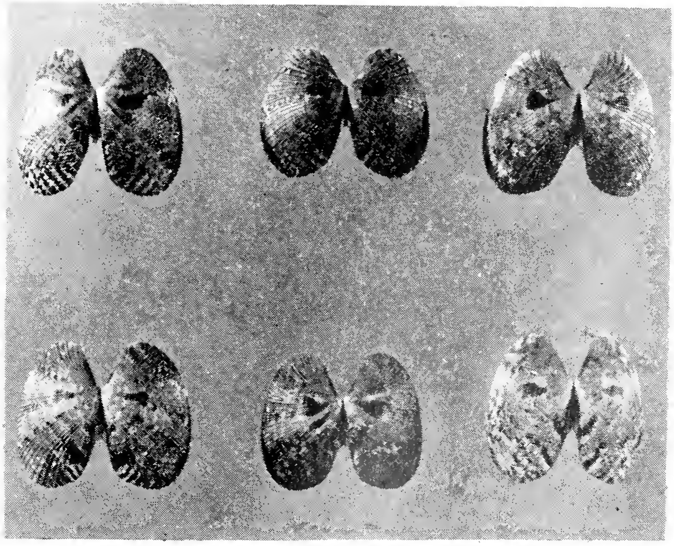
[3] Chi-square test on the null hypothesis: $X^2 = 85.37$, $n = 68$, $p = 0.15$. Conclusion: Differences from sample to sample not greater than expected by chance.





Upper: ''asymmetric'' pattern; only one out of 128 had the stripe on the right valve. Lower: ''spot'' pattern, characterized by spot near umbo.

Upper: "white cap" pattern, characterized by unpigmented region at umbo. Lower: "lined" pattern, characterized by irregular parallel lines.

vestigated, intertidal height and gravel content of the substrate, as well as density of the population, do not influence the pattern group frequencies. However, a broader conclusion may be suggested. I believe that no environmental factor operating after the time the larva settles on the beach determines the patterns.

The reason for this view is as follows: Intertidal height and substrate are really complexes of environmental factors. Temperature, for example, certainly varies with intertidal height. Associated plants and animals are more common on certain substrates and at certain intertidal heights. For the species studied and the beach on which it was studied, I believe there is no variable environmental factor not associated with either intertidal height or substrate. It would follow from this that if the pattern groups do not show correlation with intertidal height and substrate that they are not determined by any factor of the environment.

*Differential Mortality.* The fact ascertained in the preceding, that the different pattern groups are randomly distributed with regard to environmental factors, bears on another question besides that just considered. This is the question of relative mortality rates for the different patterns.

Clams differing in pattern might differ in more fundamental ways. Clams of a particular pattern might for physiological reasons be poorly suited to a given intertidal level or type of substrate and have a higher mortality in these circumstances. But this is not the situation reflected in the sample data, since the different pattern groups do not vary significantly in frequency with environmental factors.

Another possibility is that clams of different patterns have different viabilities whatever the environment. Figure 1 shows a frequency distribution for size for each pattern group. If one takes into account the number of individuals, all the pattern groups show essentially the same size distribution. At least within the range of sizes represented, one pattern group does not die off at a greater rate than another.

Further support for this conclusion is found in the following observation. There occurred in the early months of 1949 a period of heavy mortality of unknown cause. The beach at San Mateo Point was covered with putrefying clams and empty shells. In order to see if any selective mortality according to

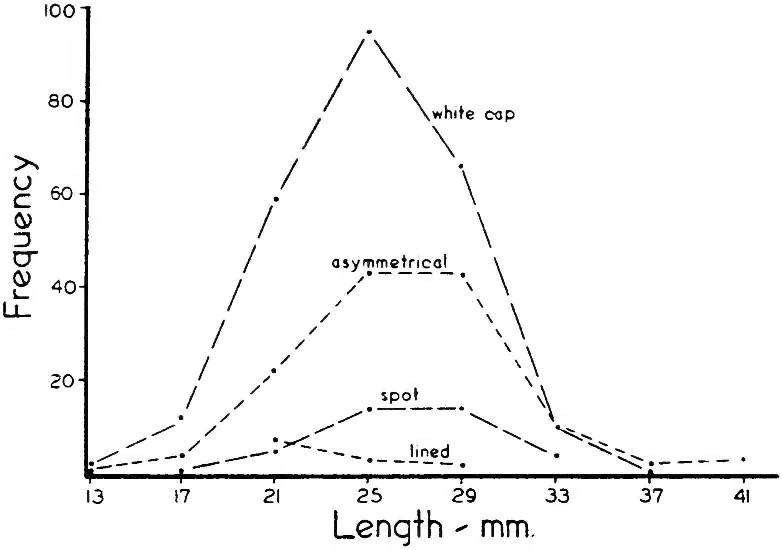


FIG. 1. Frequency distribution.

pattern could be demonstrated, dead clams were collected for comparison with the sample series of Table 2. In two areas every shell or dead clam at the surface was collected and these collections pooled, making a total of 372 individuals. In Table 3 these are tabulated according to pattern group and compared by the chi-square test to the 1713 taken alive. The probability found indicates no significant difference; that is, the dead clams have the same frequencies of different pattern groups as those collected alive.

TABLE 3[4]

| | Dead | Alive |
|---|---|---|
| Asymmetric | 34 | 128 |
| Spot | 9 | 38 |
| White cap | 62 | 244 |
| Lined | 4 | 12 |
| Others | 263 | 1291 |
| Total | 372 | 1713 |

[4] Chi-square test: $X^2 = 3.82$, $n = 4$, P between 0.3 and 0.5. Conclusion: Differences between the two collections not greater than expected by chance.

Thus the different patterns must be equally viable so far as can be determined from the data.

*Summary.* The Japanese littleneck clam has complex patterns of pigment deposition on the shell. A systematic collection of 1713 individuals of this species made at San Mateo Point on San Francisco Bay was analyzed statistically for the effect of intertidal height. The analysis of this data together with that from a smaller sample taken at a time of heavy mortality shows no effect of environment in the production of the different patterns, and no differences in viability of the different pattern groups.

In conclusion, the pattern categories are apparently either genetically determined or determined by some factor of the environment which operates prior to the settling of the larvae. Also, the different pattern groups are, in post-larval life, equally viable so far as can be determined by a samples series of the size reported on here.

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# DISTRIBUTION OF LAND SNAILS IN PLANT ASSOCIATIONS IN EASTERN VIRGINIA[1]

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Most of our land snails feed upon vegetable matter, such as foliage, the woody parts of seed plants in various stages of decay, fungi, and probably to some extent on microörganisms living in the soil and humus. The species composition and abundance of fungi and soil microörganisms in turn are dependent, among other things, on the type of vegetation. "Most of the species [of snails] found in soil consume organic debris. . . (Lutz and Chandler, 1946). Strandine (1937, 1938, 1941) and Burch (1955b) found a marked correlation between amount of organic matter in the soil and humus and the distribution and abundance of land snails. Since the bulk of organic residues in every soil is furnished by plants, "the general character of vegetation will be a major factor in determining the quantity, distribution, and general quality of soil organic matter, including humus" (Nikiforoff, 1938). Organic matter in the soil is not only significant in nutritional relationships but also in the physical and mechanical properties of the soil such as structure, color, consistency, and moisture-holding capacity. In forests, trees furnish the principal source of organic matter in the soil and "the contribution made by shrubby and herbaceous vegetation is smaller. . ." (Lutz and Chandler, *op. cit.*). Thus, it is readily apparent that the general ecology of forest snails is intimately associated with the dominant plant cover. This study relates the distribution and abundance of land snails in eastern Virginia to major plant associations there.

*Description of the Area.*[2] Except for a few small tracts, Virginia's forests are now second-growth timber (Craig, 1949).

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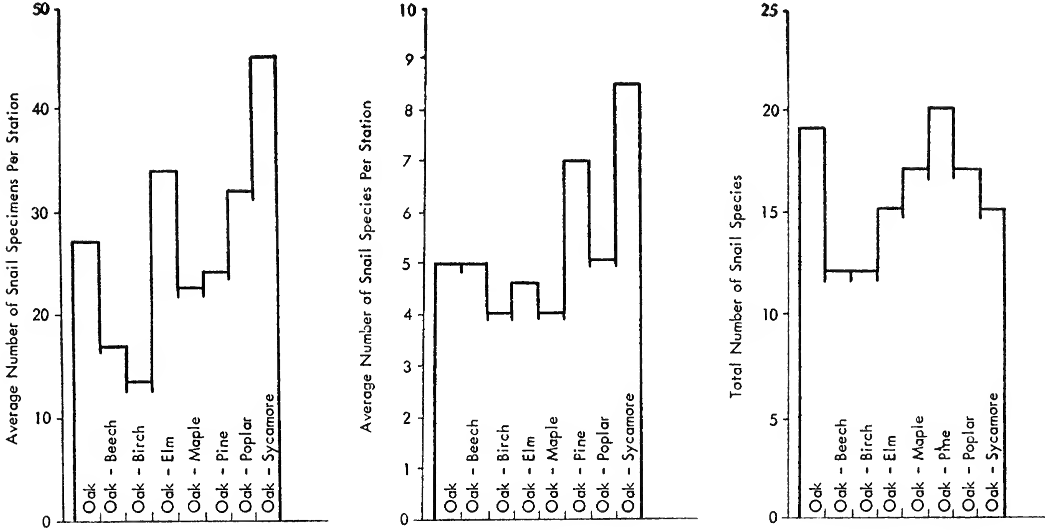
[1] From a M.S. thesis submitted to the Department of Biology, University of Richmond, June, 1954. The cost of collecting this material was partly defrayed by a grant from the Virginia Academy of Science. The author wishes to express thanks to the Biology staff of the University of Richmond for criticism, encouragement and advice, and to Dr. Henry van der Schalie, Museum of Zoology, University of Michigan, for reading the manuscript.

[2] A topographic and geologic description of the area investigated has been published previously (Burch, 1955a,b) and will not be given here.

| SPECIES | PLANT ASSOCIATION | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | APPLE - WILD CHERRY *Pyrus malus - Prunus serotina* | BEECH - BIRCH *Fagus grandifolia - Betula nigra* | BEECH - CHESTNUT *Fagus grandifolia - Castanea dentata* | BEECH - ELM *Fagus grandifolia - Ulmus fulva* | BEECH - SYCAMORE *Fagus grandifolia - Platanus occidentalis* | BIRCH - ELM *Betula nigra - Ulmus fulva* | BIRCH - POPLAR *Betula nigra - Liriodendron tulipifera* | BIRCH - SYCAMORE *Betula nigra - Platanus occidentalis* | CATALPA - SYCAMORE *Catalpa sp. - Platanus occidentalis* | CHESTNUT - PINE *Castanea dentata - Pinus virginiana* | ELM - HICKORY *Ulmus fulva - Carya cordiformis* | ELM - MAPLE *Ulmus fulva - Acer rubrum* | ELM - SYCAMORE *Ulmus fulva - Platanus occidentalis* | MAPLE *Acer rubrum* | MAPLE - SWEETGUM *Acer rubrum - Liquidambar styraciflua* | OAK *Quercus spp.* | OAK - BEECH *Quercus spp. - Fagus grandifolia* | OAK - BIRCH *Quercus spp. - Betula nigra* | OAK - CEDAR *Quercus spp. - Juniperus virginiana* | OAK - ELM *Quercus spp. - Ulmus fulva* | OAK - MAPLE *Quercus spp. - Acer rubrum* | OAK - PINE *Quercus spp. - Pinus spp.* | OAK - POPLAR *Quercus spp. - Liriodendron tulipifera* | OAK - SWEETGUM *Quercus spp. - Liquidambar styraciflua* | OAK - SYCAMORE *Quercus spp. - Platanus occidentalis* | WILLOW *Salix nigra* | WILLOW - SYCAMORE *Salix nigra - Platanus occidentalis* |
| *Anguispira alternata angulata* | • | | | 1 | | | | | | | 1 | | | | | 1 | | 1 | | 1 | | | | | | | |
| *Anguispira fergusoni* | | | | | | | | | | | 1 | 1 | | | | 1 | 1 | | | 2 | 1 | | | | | | |
| *Carychium exiguum* | | | | | | | | | | | | | | | | 1 | | | | 1 | | 1 | 1 | | | | |
| *Cionella lubrica morseana* | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | |
| *Columella edentula* | | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | | | |
| *Euconulus chersinus* | | 1 | | | | | | | | | | | | | | 1 | 1 | 1 | | | | 1 | 1 | | | | |
| *Gastrocopta armifera* | | | | | | | | | 1 | | | | | | | | | | | | 1 | | | | | | |
| *Gastrocopta contracta* | | | | | | | | 1 | | | | | | 1 | | 3 | | 1 | | 1 | | 1 | 3 | | 2 | | |
| *Gastrocopta pentodon* | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | 1 | | |
| *Hawaiia minuscula* | 1 | | | | | | | 1 | 1 | | | | | 1 | | 1 | | | | 1 | 2 | | | | 3 | 1 | 1 |
| *Helicodiscus parallelus* | | 1 | 1 | 1 | 1 | | 1 | | 1 | 1 | | | | 1 | 1 | 3 | 4 | 2 | 2 | 3 | 4 | 7 | 5 | 3 | 3 | 1 | 2 |
| *Mesodon appressus sculptior* | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | 2 | 2 |
| *Mesodon thyroidus* | | | | | | | | | | | | | | 1 | | 2 | 1 | 2 | | 1 | 3 | 3 | 5 | | 1 | 1 | 1 |
| *Punctum minutissimum* | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | | | | |
| *Pupoides albilabris* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *Retinella burringtoni* | | | | | | | | | | 1 | | | | 1 | | 1 | 5 | 1 | | | 1 | 3 | 2 | 2 | 3 | | |
| *Retinella indentata* | | 1 | 1 | 1 | 2 | | | | 1 | 1 | | | 1 | | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 4 | 7 | | 4 | | 1 |
| *Retinella rhoadsi* | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | 1 |
| *Stenotrema hirsutum* | | | | | | | | | | 1 | 1 | 1 | 1 | | | 2 | 1 | 1 | | 1 | | 3 | 1 | 1 | 1 | | |
| *Striatura milium* | | | | | | | | | | | | | | | 1 | 2 | | | | 1 | | 3 | 4 | | 3 | | |
| *Strobilops aenea* | | 1 | | | 1 | | | 1 | | | | | | 1 | | 2 | 4 | 2 | | 3 | | 6 | 2 | | 3 | | |
| *Strobilops labyrinthica* | | | | | | | | | | 1 | | | | | | | | | | | 2 | 2 | | | | | |
| *Triodopsis albolabris* | | | | | | | | | | | | | | | | 1 | 1 | | | | 3 | 1 | 1 | | | | |
| *Triodopsis fallax* | 1 | | | | | | | | 2 | | | | | | | 1 | | | | | 4 | 2 | | | | | |
| *Triodopsis hopetonensis* | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | 1 |
| *Triodopsis tridentata juxtidens* | | | | | | | | | | | 1 | 1 | 2 | 1 | | 2 | 3 | 1 | 1 | 2 | 1 | 3 | 4 | | 3 | | 1 |
| *Vallonia excentrica* | | | | | | | | | 1 | | | | | | | | | | | | 1 | | | | | | |
| *Ventridens suppressus magnidens* | | 1 | | | | | | | 1 | 1 | | | | | 1 | 3 | 2 | | 1 | | 2 | 4 | | | 1 | | |
| *Ventridens ligera* | | 1 | | | 1 | | | | | | | | | 1 | | | | 1 | | | 1 | 3 | | | 3 | 1 | 1 |
| *Vertigo ovata* | | | | | | | | | | | | | | | | | | | | | 1 | | 2 | | | | |
| *Zonitoides arboreus* | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | 3 | 3 | 2 | 2 | 4 | 4 | 7 | 5 | 2 | 3 | 1 | 2 |
| TOTAL NUMBER OF STATIONS | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 7 | 6 | 4 | 3 | 5 | 9 | 8 | 7 | 3 | 4 | 3 | 3 |
| TOTAL NUMBER OF SPECIES | 3 | 7 | 2 | 3 | 5 | 1 | 2 | 4 | 8 | 7 | 5 | 3 | 3 | 9 | 6 | 19 | 12 | 12 | 5 | 15 | 17 | 20 | 17 | 4 | 15 | 7 | 10 |
| AVERAGE NUMBER OF SPECIES PER STATION | 3 | 7 | 2 | 3 | 3 | 1 | 2 | 4 | 4.5 | 7 | 5 | 3 | 2 | 9 | 6 | 5 | 5 | 4 | 3.5 | 4.6 | 4 | 7 | 5 | 4 | 8.5 | 3 | 4.3 |
| AVERAGE NUMBER OF SPECIMENS PER STATION | 22 | 42 | 13 | 6 | 5.5 | 1 | 11 | 67 | 48.5 | 15 | 15 | 14 | 4.5 | 133 | 60 | 27 | 17.3 | 13.5 | 5 | 34 | 22.5 | 23.9 | 31.7 | 15 | 45 | 12.3 | 15.3 |
| KEY TO COLLECTING STATION SYMBOLS IN FIGURE 1. | ◇1 | ◇2 | ◇3 | ◇4 | ◇5 | ◇6 | ◇7 | ◇8 | ◇9 | ◇10 | ◇11 | ◇12 | ◇13 | ◇14 | ◇15 | ◇16 | ◇17 | ◇18 | ◇19 | ◇20 | ◇21 | ◇22 | ◇23 | ◇24 | ◇25 | ◇26 | ◇27 |

• NUMBER OF STATIONS THIS SNAIL SPECIES WAS FOUND WITH THIS PLANT ASSOCIATION.

TABLE 1. Distribution of snails in major plant associations.



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ca § | 1 | 2 | 3 | 2 | 1 | 3 | * |
| Mg | .2 | .3 | | .4 | .2 | .4 | ** |
| K | .6 | .7 | | .4 | .2 | .9 | *** |
| Ash | 7 | | | 11 | 3 | 11 | **** |

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 2 | 1 | 3 |
| .2 | .3 | | .4 | .2 | .4 |
| .6 | .7 | | .4 | .2 | .9 |
| 7 | | | 11 | 3 | 11 |

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 2 | 1 | 3 |
| .2 | .3 | | .4 | .2 | .4 |
| .6 | .7 | | .4 | .2 | .9 |
| 7 | | | 11 | 3 | 11 |

§ Data on chemical content of leaves after Lutz and Chandler (1946).

* Numbers represent leaves with less than 1% (percentage of dry weight) (1), between 1% and 2%, (2), and more than 2% (3), calcium content for the trees listed in association with oak. Oak leaves have a calcium content of about 1.4% of dry wt.

** Percentage of dry weight; value for oak →0.24 - 0.25%.

*** Percentage of dry weight; value for oak →0.52 - 0.65%.

**** Percentage of dry weight; value for oak →5.71 - 6.84%.

TABLE 2. Abundance of snails in plant associations with 4 or more stations.

The forests contain a wide variety of species, each physiographic province having a definite pattern of forest cover. The most prevalent species in the Coastal Plain is loblolly pine (*Pinus taeda* Linnaeus), growing both in mixture with other pines and hardwoods and in pure stands. Sweetgum (*Liquidambar styraciflua* L.) is the second commonest species and it grows best in river bottoms. The oaks, mainly red (*Quercus marilandica* Muench., *Q. nigra* L., *Q. phellos* L., *Q. rubra* L., *Q. velutina* Lamarck) and white (*Q. alba* L., *Q. stellata* Wang.), rank next to sweetgum in prevalence, being widespread throughout the Coastal Plain in mixed stands with pines or other hardwoods. Additional common hardwoods are yellow-poplar (*Liriodendron tulipifera* L.) and beach (*Fagus grandifolia* Ehrh.).

The natural forest stands of the Piedmont province are mixed pine and hardwood. Old-field stands are either pine-hardwood or pure pine. Oaks and hickories were originally the dominant species in the Piedmont but, following rather intense cutting, shortleaf pine (*Pinus echinata* Mill.) and Virginia pine (*P. virginiana* Mill.) reseeded more quickly and completely and they eventually replaced the hardwoods. Recently there has been a great demand for pine pulpwood and if present cutting practices continue the Piedmont may again be predominantly a hardwood area. The most prevalent hardwood species are the red and white oaks. Yellow-poplar, gums (*Nyssa sylvatica* Marsh. and *Liquidambar styraciflua* L.), and hickory(*Carya cordiformis* Koch.) are the other common hardwoods.

*Methods.* The dominant forest stands at eighty collecting stations in Hanover, Henrico, and Chesterfield counties, Virginia, were recorded. In order to obtain some quantitative measure by which to compare the snails collected at these stations, a nine-square-foot section of the habitat, which appeared to the collector as most favorable for land snails were selected. All the snails found in this area were recorded. No snails were found in pure pine stands.

*Results.* Thirty-one species of land snails from twenty-seven major plant associations were recorded (Table I).[3] Twelve (almost one-half) of the associations were encountered only once as favorable habitats for snails and only eight plant associations

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[3] *Haplotrema concavum* (Say), generally considered a carnivorous species, is not included in this report.

were dominant at more than three stations. Associations represented only once or several times by collections were either very scarce or certain other ecological conditions made them unfavorable for snails (*e.g.,* lack of moisture, poor drainage or too rapid run-off, ground subject to clearing, etc.). Stations which were most favorable for snails in regard to cover, moisture, etc. usually had an abundance of oaks. Those plant associations which were dominant at four or more stations were pure oak stands and oak in combination with beech, birch (*Betula nigra* L.), elm (*Ulmus fulva* Michx.), maple (*Acer rubrum* L.), pine and sycamore (*Platanus occidentalis* L.). Of these both the greatest average number of species and specimens per station was in oak-sycamore communities (Table 2). As is interesting to note, although snails were absent from pure pine stands, the greatest total number of species and the second largest average number of species per station was from oak-pine associations. The largest number of species from a single station was from an oak and an oak-elm association with 13 apiece, followed closely by an oak-pine community with 12 species. The greatest number of specimens found at any station was 133 from a pure maple stand. At that station, however, *Zonitoides arboreus* (Say) was represented by 81 specimens. This record may not be an accurate reflection of snails' preference for maple since the data represents only one station. Elm-maple and oak-maple communities do not show a similar abundance of snails.

The most common snails, *viz., Zonitoides arboreus* (Say), *Helicodiscus parallelus* (Say), and *Retinella indentata* (Say), were found in almost every plant association although somewhat more abundant in some plant associations than in others, *e.g., H. parallelus* in oak-pine. Distribution of some of the less common snails, such as *Gastrocopta contracta* (Say), *Mesodon thyroidus* (Say), *Retinella burringtoni* (Pilsbry), *Striatura milium* (Morse), *Strobilops aenea* Pilsbry, *Triodopsis albolabris* (Say), and *T. tridentata juxtidens* (Pilsbry), appears to be more or less restricted to communities with oak as a dominant tree. This restriction may be somewhat superficial since most of the collecting stations had an abundance of oak. In view of the data on the commoner species, the data on rarer species, *e.g., Columella edentula* (Draparnaud), *Punctum minutissimum* (Lea), may be inconclusive as to what plant-association they preferred. (To be concluded.)

# PREDATORS NEED DEFENDING

By ALBERT R. MEAD

University of Arizona

My recent paper in the NAUTILUS, Vol. 69, No. 2, October, 1955, pages 37–40, has given rise to comments and reactions which in some cases, regretfully, are still giving off more heat than light. At the risk of dwelling on the obvious, I would like to set straight some misconceptions which have clouded right from the very outset the whole problem of molluscan biological control. My comments are not directed to Dr. Pemberton and his recent article entitled "Defense of a Predator," in the NAUTILUS, Vol. 69, No. 4, April, 1956, so much as they are to the school of thought for which he has acted as spokesman. For the record, it should be pointed out that a number of leading malacologists in this country and abroad have been outspoken in their approval of the stand I have taken.

First of all, let me reiterate that I have no quarrel with insect biological control. I have nothing but the utmost praise for this field of investigation, as I clearly indicated in the November 1949 *Atlantic.* And this is said with understanding for it, based on 73 unit hours of formal training in entomology.

The stepping off point in the problem seems to be the application of the principles of *insect* biological control to the absolutely new field of molluscan biological control as a sort of common denominator. The citing of years of experience in the field of insect biological control as *ipso facto* qualification for taking irreversible steps in a wholly different and biologically little known group of animals, is hardly convincing, to say the least. I submit that no one can safely reason *a priori* from the results of experiments in one phyletic group to comparatively similar experiments in another, especially in an area of biology that is as treacherous as it has proven itself to be so often in the past.

Insect biological control is notoriously blessed with parasites and even predators (*e.g.* the ladybird beetles) with a truly remarkable, and even classical, high degree of specificity in the animals they will attack. This "safety" element of specificity has been the single greatest asset to the investigators in the field of insect biological control; without it, their progress would have been only a fraction of what it is today. This same "safety" element of specificity of appetite is conspicuously absent or very greatly reduced in the predators in other animal groups, including the carnivorous pulmonate gastropods. This point has been emphasized by malacologists who have participated in the "Gonaxis Problem."

The assumptions that the same principles would apply, and that years of experience in another phyletic group were ample qualifications, have been submerged in an atmosphere of urgency to precipitate a series of relatively quick actions about which some of us have grown increasingly more apprehensive. *Gonaxis* snails were introduced into Agiguan before an ecological survey could be made. The ecology of Agiguan went into a series of significant but baffling changes. The rats virtually disappeared; the monitor lizards and the hermit crabs went into a definite decline; and the coconut crabs, the feral goats, and *Gonaxis* increased markedly. But even before these changes on Agiguan could be determined, *Gonaxis* was introduced into Oahu. Later, in the face of conflicting evidence submitted by a malacologist and several entomologists, *Gonaxis* was introduced ahead of schedule in Guam and Maui. Concurrently other invertebrate predators of the giant African snail (and incidentally, of *Gonaxis*) were being released in the Hawaiian Islands. With announced immediate plans to introduce *Gonaxis* into other islands of the Trust Territory of the Pacific and even into California, it is little wonder that there is a need to sound a second note of caution, following the first one in the August, 1949, *Atlantic*. The question is: "How far is this going to go?" The obvious answer evidently is: "As far as those in charge feel it should go." Yet some have the impelling conviction that those in charge are relying on inapplicable bases for evaluation of the experimental results.

Compounding the disturbing elements of this picture appears to be evidence of preconception in weighing the results of recent experiments conducted in a new and unknown field. Actually, only two major indisputable items have been added to the plus side of the ledger, viz., 1) *Gonaxis will* eat *Achatina,* and 2) *Gonaxis* will build up in great numbers within two years' time under the conditions present on Agiguan. The first point was already known in East Africa. The second point is distinctly encouraging; but it is traveling in the company of some findings that pose serious questions. Why has *Gonaxis* virtually disappeared along with *Achatina fulica* in the area where it was first released six years ago on Agiguan? Why has *A. fulica* similarly disappeared in areas on that island where *Gonaxis* has *not* penetrated? Why have the populations of the other major animal types on the island undergone marked fluctuations in the past few years? An earlier announced disease of the giant African snails is undoubtedly present. What effect is that having upon these two snail species? As has been demonstrated, *Gonaxis* has a preference for *Omphalotropis erosa*. What has happened to that and other native species? Many other questions have taken prominent positions in this confused ecological picture. Some of the questions have been answered provisionally in terms which pointedly favor the prevailing hypothesis. The provisional answers, however, have taken on the form of final answers and antithetic explanations somehow seem to have become lost.

In other words, that which has been desired has been found; that which has not fit the picture has been set aside. Justification for this setting aside has been explained by calling attention to the urgency of the situation. With the knowledge of a definite "decline" going on in the populations of the giant African snail in many areas of the world, and with the knowledge of a disease present in many and perhaps all of the populations of the giant snails, the urgency is much less acute than one might be led to believe. No one denies that it is acute in the newly invaded areas, such as Hawaii. Understandably, something must be done. The question, however, is not whether something should be done, but whether the urgency is so pressing as to warrant embarking on a program based on known conflicting information and evaluated by those manifestly unacquainted with malacology. As should not be forgotten, those who take upon themselves the responsibility for introducing foreign species, also, by their very acts, take upon themselves the full responsibility for whatever consequences follow—good, bad, or indifferent. In this entire problem, too little attention has been paid to the malacologists who, by training and experience, are in position to provide the required counsel. Under the circumstances, I think that those interested in the problem should re-evaluate the results in the light of true scientific investigation.

There is ample evidence of the results of past tragic mistakes made by ill conceived attempts at biological control. New Zealand, visited during the 7th Pacific Science Congress by several who have taken exception to my views, is a symbolic living example of presumably well thought out introductions of animals which went through an ecological chain reaction to produce time and time again completely inconceivable, unpredictable, and unfortunately irreversible results. But we need not rely on New Zealand for examples. There are many cases of recent unexpected results right in the Pacific Islands. As an example, the introduction of the giant toad *Bufo marinus* in some islands has been indirectly responsible, in a totally unexpected way, for a lowered production of coconuts!

The problem, then, is not so much what else *Gonaxis* might feed upon (if we are willing to forget the ecological value of the endemic snails), but what indirect effects it may ultimately precipitate in bringing about imbalance, as both prey and predator, in an existing series of interconnected ecological equilibria. When we get out of the relatively unique field of insect biological control, irrespective of the urgency, I insist that we are playing with biological fire when we introduce predators. The introduction of parasites with high host specificity is quite another matter. In the new field of molluscan biological control, even the experienced investigator would do well to move cautiously. The present apparent lack of caution is obviously not negligence but unawareness of the fact that a new field has been entered. Herein lies the very crux of the present misunderstanding!

Now to get a bit of perspective. The "Gonaxis Program," conceived in the fondest hopes and the greatest expectations, has been implemented on essentially *prima facie* evidence and estimates. Irrespective of the obviously confusing, intercurrent element of a "decline" taking place in the populations of the giant snails, this biological control program may actually prove successful. I sincerely and honestly hope that it will. But if it does, I will fear the results of extending the same type of rationale to other biological control programs in malacology. The proposed introduction of *Gonaxis* into California is a specific case in point. The real concern, then, centers not so much on the present program of distributing *Gonaxis* far and wide, as it does on the fact that an incautious program of this sort is a disturbing example of a basically dangerous policy which, if pursued, sooner or later is bound to run into inextricable trouble. At such a time invoking the reasons of urgency and necessity for action of some sort will be of little scientific help indeed.

Finally, I should say something in response to the rejection of the announcement that there might be enough genetic variability in *Gonaxis kibweziensis,* and enough in the way of variable selecting forces in the different environments, to bring into existence populations of individuals with appreciably different appetites. To dwell upon the inference made is only to give dignity to a suggestion which is completely incompatible with our modern accepted concepts of speciation and population genetics. In fact, through the recognition of such concepts, we learn to respect and allow more fully for the inherent capacity in populations, and especially expanding populations, to make changes and to keep pace with the ever changing environment. Such possible changes cannot be ignored scientifically. But they appear to have been ignored in the present situation.

## NOTES AND NEWS

Land Shells of Barbuda Island, Lesser Antilles. Through the kindness of Dr. G. A. Seaman of the Pittman-Robertson Wildlife Restoration, St. Croix, Virgin Islands, I have been privileged to work up a collection of land shells which he had collected in October 1955, on the island of Barbuda. So far as I can trace, the only published record for this island is *Bulimulus guadeloupensis* (Brug.). I append certain of his field notes.

*Helicina fasciata* Lam. Abundant after rain east of Codrington. In addition to this record from Barbuda, we have this species from the islands of Nevis, St. Eustatius, St. Kitts and Saba.

*Adamsiella antiguensis* (Shutt.). Not abundant.

*Gastrocopta pellucida* (Pfr.). Dry forest floor east of Codrington on limestone bluff.

*Subulina octona* (Brug.). Not abundant.

*Lamellaxis gracilis* (Hutton). With *Gastrocopta.*

*Lacteoluna selenina* (Gould). With *Gastrocopta.*
*Bulimulus guadeloupensis* (Brug.). Fairly common.
*Drymaeus elongatus* (Röding). Fairly common.
*Pseudopineria viequensis* (Pfr.). Rare.
*Pleurodonte formosa* (Fér.). In the moist center of the epiphyte *Tillandsia* in brush country south of Codrington.

—William J. Clench.

Twenty-second annual meeting, American Malacological Union.—The Pacific Division of the American Malacological Union played host to the parent organization when in July (1956) the twenty-second annual meeting was held in the beautiful city of San Diego, California. The registration was 115, the greatest in A.M.U. history; twenty came from east of the Mississippi, another record for western meetings of which this was the third. If all pledges are kept, the 1957 meeting at Yale University will see an even greater number of western members in attendance.

The program occupied three full days and part of another; from the time that President Allyn G. Smith rapped the gavel (a loan from the Pacific Division) to call the meeting to order on Wednesday morning until he tendered his official and personal farewells on Saturday the days were packed with interest. Twenty-three scientific papers were interspersed with an early morning field trip, a visit to the San Diego Museum, the annual dinner and a half-day tour of the Scripps Institution of Oceanography at La Jolla. The western members left nothing undone which might in any way further the enjoyment of their eastern guests. Every day was Christmas as shells of the west coast of the United States, of Mexico and Hawaii were handed out, first as welcoming gifts at the reception given by the Conchological Club of Southern California, then at nearly every intermission during the sessions when specimen shells were distributed by one or another generous collector. An even more valued gift was the opportunity to become acquainted with people who in the past had been a name signed to a letter or heading a scientific article.

During the business meeting, three constitutional by-laws drafted to provide a nominating committee, to define the duties of said committee and to make necessary a quorum of five voting members before business may be transacted at an executive session were announced as having been adopted by the Executive Council. The following were elected to serve as officers during 1956–57: President, Ruth D. Turner; Vice-president, Aurele LaRocque; 2nd Vice-president, Edward P. Baker; Secretary-treasurer, Margaret C. Teskey; Publications Editor, George M. Moore; Councillors-at-Large, Charlotte Dawley, Leo G. Hertlein, Eugene H. Schmeck, Germaine L. Warmke. At a second business meeting, the members of the Pacific Division voted to retain the present slate of officers for the following year (President, Edward P. Baker; Vice-president, Albert R. Mead; Secretary-treasurer, Ruth E. Coats).

In April of 1956 the American Malacological Union embarked upon its second quarter-century. The fact that one-fifth of the fast growing list of members attended the 1956 annual meeting speaks of an active interest and a bright future for the A.M.U., its Pacific Division and its member clubs.—MARGARET C. TESKEY, SECRETARY.

SECOND HELIX ASPERSA IN HAWAII AND DATA ON CARNIVOROUS SNAILS.—On April 6 or 7, 1956, a second specimen of *Helix aspersa* was discovered on the edge of Honolulu in a residential area called Tantalus. This specimen was mature and when submitted to Dr. C. E. Pemberton of the Hawaiian Sugar Planters experiment station he dissected it. The snail contained one mature egg and a number of immature ones.

In the April 1956 issue of the NAUTILUS two possible reasons were given for the accidental introduction of this agricultural pest (page 142). Mr. William Look, head of the division of Plant Quarantine of the local Board of Agriculture, reports that on September 2, 1954, four adult *H. aspersa* were intercepted in the baggage of a San Francisco-Honolulu airplane passenger. The snails were on some plants that the passenger was bringing here apparently for propagation.

*Achatina fulica* Bowdich, commonly referred to as the Giant African Snail, is considered an agricultural pest of some importance. Through the efforts of the Pacific Science Board with funds provided mainly by the Office of Naval Research and by means of manpower supplied by numerous institutions, possible predators and parasites were investigated. The predator selected was an East African streptaxid known as *Gonaxis* *kibweziensis* (E. A. Smith), due primarily to its ability to survive conditions which all others were unable to, including confinement in the laboratory. It is a small snail averaging about 20 mm., with a low reproductive potential of 11 maximum per year (in laboratory), and an apparently low index of predation. Simultaneous experimentation on the small uninhabitated island of Agiguan, 83 miles north of Guam, from 1950 to 1952, convinced the Invertebrate Consultants Committee of the Pacific that *G. kibweziensis* was an effective control of *A. fulica.*

Between 1952 and 1955 four evaluations on the abundance and effectivity of *G. kibweziensis* were made. In 1952 this snail was estimated to exercise 20 percent control over *Achatina fulica.* The 1954 figure for control was estimated at 60 percent. By biological control standards 50 percent control is considered good. Consequently on November 1955 a team of collectors spent seven days on Agiguan and collected over 5000 specimens for distribution to *Achatina*-infected islands of the Trust Territory and Hawaii. A number were sent to Riverside, California, for testing on *Helix aspersa.*

Distribution of *Gonaxis kibweziensis* was as follows:

California, 200; Hawaii, 2000; Guam, 1080; Trust Territory of the U. S., 2160.

Trust Territory, 12 releases, two per island, of 180 specimens on each island, viz., Saipan, Tinian, Rota, Palau, Ponape, and Truk.

Hawaiian Islands (including 1952 and 1954 releases). *Oahu:* Kaneohe 20 ('52), 498 ('54); Makiki 200, Waimanalo South 200, Pali golf course 400, Old Kaneohe Road 200, Haiku Road 200, Heeia Kea 200, Kahaluu 200, all November 1955. *Maui:* Haiku 40 (March '55), Haiku School 200, Pawela Gulch 50, Grove Ranch 50, all November 1955.

The Territory of Hawaii Board of Agriculture and Forestry has experimented with and released two carnivorous snails from Florida and Cuba, viz., *Euglandina rosea* (Ferussac) and *Oleacina oleacea* var. straminea (Deshayes). In November and December of 1955 the Board released 365 *E. rosea* at Hauula, Oahu. In November 1955 and March 1956, 156 were released at the Kailua-Waimanalo Junction of the highway. In March this year 95 were released at Makiki.

In January 1956, at Kualoa, Oahu, 25 specimens of *O. oleacea* var. *straminea* were released by the Board.—YOSHIO KONDO, Bishop Museum.

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# ON THE STATUS OF FASCIOLARIA DISTANS LAMARCK

By S. C. HOLLISTER

The beginning of shrimping operations in the waters to the north of the Dry Tortugas and on the Campeche Banks in 1950 brought to light what at first appeared to be a new form of *Fasciolaria,* not quite like the *F. distans* of authors found from Hatteras to Mobile Bay. The "new" shell was larger, with a more extended spire, with more brown spiral lines on the whorls, and with axial costae on the early postnuclear whorls. It looked, in fact, strikingly like *F. apicina* Dall, of the Pliocene Caloosahatchee marl. What was this shell? In the course of its determination the following facts were developed and conclusions reached.

When Lamarck described *F. distans* in 1822 he had before him a shell from his own cabinet, collected from the Bay of Campeche. He did not figure the specimen, but referred to a shell in Martin Lister's Historia Conchyliorum of 1685–97, Fig. 910 (text-fig.). On Lister's plate the habitat of the shell is given as Campeche. The shell from which the Lister figure was made is in the British Museum; and through the kind permission of Guy L. Wilkins, I publish a photograph of it (Pl. 6, fig. 1). It shows a shell similar to those brought in by the shrimpers.

One other writer had described a similar shell before Lamarck. In 1807 Fischer von Waldheim prepared a catalog of the collection of Count Demidoff in Moscow. By way of illustration of a shell be found there, which he named *F. lilium,* he referred to the same figure in Lister to which Lamarck had referred. The catalog written in French was carefully done, and is recognized as a scientific contribution. It appears to be very rare. The copy in the Academy of Natural Sciences in Philadelphia is the only one I know in this country.

So far I have not dealt with the better-known shell now commonly called *F. distans,* and found in the coastal range between Mobile Bay and Cape Hatteras. In 1811 George Perry published a book on Conchology, in which he figured and described a shell purporting to come from New Holland (New South Wales), and which he named *Pyrula hunteria* (Pl. 6, fig. 2). The description helps little; but the figure presents, though somewhat overdone in color, the shell of Florida and the Carolinas commonly known as *F. distans.* There is no similar shell found in Australian waters.

In November 1951, Rehder and Abbott named a new form from Campeche, *Fasciolaria distans branhamae,* which is a larger shell, having certain distinctive characters differentiating it from both the Campeche and the Florida forms at present going under the name *F. distans.* The writer was not aware of this new form when he brought to the attention of Messrs. Rehder and Abbott, in January 1952, his belief that the name *F. distans* Lam. should belong to the original Campeche form and that the Florida form should be called *F. hunteria* (Perry). Dr. Rehder offered to obtain from Geneva, if possible, a photograph of Lamarck's type; and it is through his courtesy and that of M. G. Mermod, Curator of the Museum of Natural History in Geneva, that there are here included figures of Lamarck's type of *F. distans* (Pl. 6, figs. 3–4). At a later time, the writer came upon the name *F. lilium* F. v. Wald. in a manuscript card catalog of Deshayes in the U. S. National Museum.

Attempts to locate Perry's shell have not met with success. The Demidoff collection, now in the Academy of Sciences in Moscow, was badly damaged by fire in 1812. *F. lilium* is missing.

Subsequent to the publication by Lamarck of the name *F. distans* in 1822, the name next appeared in Kiener's Species in 1840, with a handsome colored figure of Lamarck's holotype. The portion on Mollusca of Lamarck's Animaux sans Vertebres was re-edited by Deshayes in 1843; and here Deshayes placed Perry's *P. hunteria* in synonymy with *F. distans.* There is no mention there of *F. lilium.*

In 1847 Reeve published a figure of what he called *F. distans,* showing a specimen of the Florida-Carolina shell called *P. hunteria* by Perry. By this time shells were no longer coming into Europe from Campeche, but were arriving in increasing numbers from the southeastern United States. I have not seen an author since Reeve who figured a Campeche shell, either under *F. lilium* or *F. distans,* until 1951. In fact, not until after the shrimpers began to bring shells from Campeche in 1950, representing the true *F. distans,* did there seem to be an awareness of the error in calling the Florida-Carolina form by this name.

Under the priority rule there appears no doubt that the name *F. lilium* F. v. Wald. takes precedence over *F. distans* Lam. The long use of the name *F. distans* as applied to the Florida form has been in error. Lamarck's type of *F. distans* is preserved, and clearly represents the Campeche form. Three courses of action present themselves:

(1) Suppress the name *F. lilium* and hope that over the years the wrong use of the name *F. distans* for the Florida form would fade out and the name *F. hunteria* replace it. *F. distans* would continue as the name of the Campeche form.

(2) Invoke the law of priority, thus replacing *F. distans* with *F. lilium* for the Campeche form, and use the name *F. hunteria* for the Florida form. The name *F. distans* would thus be dropped.

(3) Request the International Commission on Zoological Nomenclature to transfer the name *F. distans* Lam. to the Florida form and approve the name *F. lilium* F. v. Wald. for the Campeche form. This would have the effect of continuing the name *F. distans* for the Florida form, as has been erroneously done for a hundred years.

In the interest of achieving clarification as early as possible, apparently the second course is best. While the third course would, so far as names are concerned, accord most readily with present usage concerning the Florida form, it would separate Lamarck's name from his type, leaving such type wholly forsaken. Such practice, if continued, would, in my opinion, bring about in time a chaotic condition. A type should not be abandoned as basis for a final reference.

In the following systematic arrangement I have followed the second course. It is taken in part from a larger monograph on *Fasciolaria,* now in preparation.

### Genus *Fasciolaria* Lamarck

*Fasciolaria* Lamarck, 1799, Prod. nouv. classif. coq., Mem. soc. hist. nat. Paris, p. 73. Type species: by monotypy, *Murex tulipa* Linné, 1758, Syst. Nat., ed. 10, p. 754. Recent from Cape Hatteras south to the Caribbean and Southwest Florida.

Shell fusiform, medium to very large. Spire elevated, protoconch of a little less than two whorls, the first globose, smooth, caplike, the second smooth or with fine axial riblets. Aperture oval, columella arcuate, glazed, with three oblique plications near the canal. The canal open, usually twisted, no umbilicus. Operculum corneous, unguiculate, nucleus at the pointed anterior end; unattached at the margin. Periostracum light or dark brown, smooth.

The syntypes of *Fasciolaria tulipa* (Linné) are in the collection of the Linnean Society of London.

### Subgenus *Cinctura* **new subgenus**

Type species: *Pyrula hunteria* G. Perry, 1811. Recent from Cape Hatteras southward to Florida and westward to Mobile Bay. (See description below.)
Shell of medium size, fusiform, the whorls convex, the spire extended. Suture simple. A prominent spiral ridge emerges from the aperture in front of the suture and extends across the parietal wall to the margin of the callus.

This subgenus differs from *Fasciolaria, s. s.,* in that the latter has no pre-sutural rib on the parietal wall.

FASCIOLARIA (CINCTURA) LILIUM Fischer von Waldheim. Pl. 6, figs. 1, 3–5.

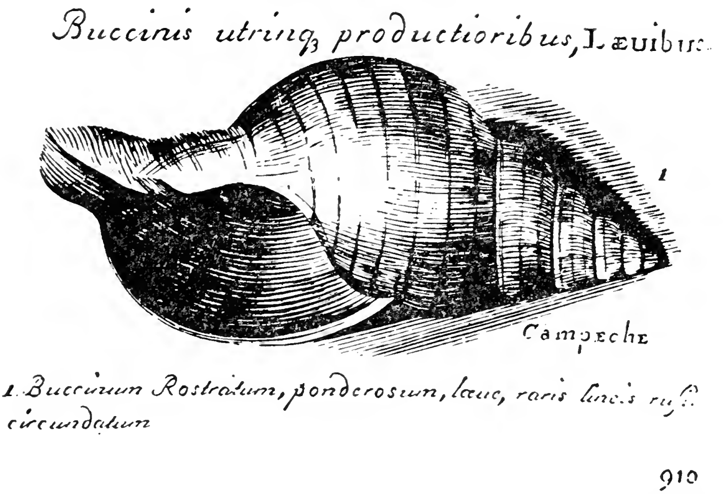
*F. lilium* Fischer von Waldheim, 1807, Mus. Demidoff Cat., tom. 3, p. 205, no. 15.

*F. distans* Lamarck, 1822, Hist. Nat. Anim. s. Vert., vol. 7, p. 119, no. 2; Kiener, 1840, Spec. Gen. Icon. Coq. Viv., vol. 6, *Fasciolaria,* p. 4, pl. 3; Wilkins, 1953, Cat. Sloane Coll., Brit. Mus. (N.H.), Hist. Ser., vol. 1, no. 1, p. 19, no. 1481, figs. 36–38.

Original description: "Fasciolaire lys, ventrue, oblongue, unie; les tours de spire arrondise; la suture simple, la queue courte et lisse.
"*Fasciolaria lilium,* mihi; elle est blanche, et couverte de lignes transversales, rares, brunes. Buccinum rostratum pon-

derosum laeve lineis raris rufis circumdatum. Lister t. 910."—Fischer von Waldheim.

The last (Latin) sentence above is similar to one on Lister's fig. 910, except that the latter reads in part "laeve, raris lineis rufis" (see text-fig.). Lister took it verbatim from Sloane's original catalog entry.



The description of a figured topotype, Paleontological Research Institution, No. 20825 (Pl. 6, fig. 5.), follows:

Shell with 8¼ whorls; stout, fusiform, the spire forming more than half the height of the shell. The first whorl is smooth, globose, caplike. The second whorl begins smooth and rounded; then about seven axial riblets appear, being stronger at the forward suture. At the half turn the nucleus ends; and the post-nuclear remainder of the whorl has axial costae, about 13 to the turn, with four or five spiral threads overriding them. These costae continue for another half-whorl, during which they evanesce; but the spiral threads continue for about one more turn before fading out. Thereafter the shell whorls are rounded and smooth, except for the back of the beak which has spiral threads growing more oblique anteriorly. The suture is simple. There are nine (on some shells, ten) chocolate-brown to reddish-brown spiral primary lines on the body whorl; and three on each of the three whorls preceding it. (On some shells secondary, less prominent, lines are interposed between primaries.) These spiral lines begin after the axial costae, and they end on the lip, reflected over its edge for a few millimeters on the inner surface. The background color of the shell is creamy white, with narrow, pale mauve or yellowish flammules running axially. These flammules are usually fainter between the second and third spiral lines, thus forming a lighter spiral band between these lines. The interior is white, glazed, and finely lirate. A thin white glaze extends over the parietal wall. A prominent ridge in front on the suture emerges from the aperture and extends to the edge of the glaze on the parietal wall. This ridge forms one side of the groove wherein lies the anal canal. The beak is short and the canal is open. There are three oblique plications just above the entrance to the canal. The groove between the two posterior plications is the more prominent. The operculum is brown, unguiculate, pointed at the anterior end; the margin is unattached and the pointed end serves as a claw. The nucleus is at the anterior end. The entire shell is covered with a thin periostracum when alive. Length of shell, 85 mm., width, 38 mm., angle of spire, 50°.

*Type:* Lister's Fig. 910, referred to by von Waldheim, was drawn by his daughter Anna from the specimen shown in Pl. 6, fig. 1, Sloane Cat. No. 1481 (*ex* Courten), in the British Museum (Natural History). I designate this shell the lectotype, in the absence of the shell in the Demidoff collection. The shell was among those originally collected by William Courten, at whose death in 1702 they were bequeathed to Sir Hans Sloane and at the latter's death in 1753 acquired by the Museum. It was thus among those shells that formed the beginning of that Museum's great conchological collection. Mr. Wilkins says it "is a very ancient specimen and rather worn, but there is a certain amount of apical sculpture still visible."

William Courten's paternal grandfather, by the way, was the discoverer and colonizer of the island Barbados. He himself lived much abroad, and had substantial interests in Barbados. He began collecting probably about 1660, and apparently was very careful in cataloguing and storing the shells in his collection.

It should be recalled that Campeche was a native port when visited by Cordoba in 1517. In 1540 the Spanish town was established; in 1659 it was sacked by the British, and by pirates in 1678 and 1685. It was one of the three open ports on the Gulf during the Spanish regime, the others being Vera Cruz and Tampico. In those early days only St. Augustine was an established colony on our coast south of Hatteras, Charleston not having been settled until 1680.

*Type locality:* Fischer von Waldheim does not give a type locality; but his figure reference is to Lister, Fig. 910, on which appears the word "Campeche"; and Sloane's entry for the shell No. 1481, as "from the bay of Campeche," fixes the type locality at that place. Its presence there has been confirmed by recent dredgings.

This shell is particularly characterized by axial costae on the first postnuclear whorl, with spiral striae overriding them and continuing for a whorl or two beyond. Sculpture of this nature was reported by Dall on *F. apicina* from the Caloosahatchee Pliocene. Both possess a presutural ridge that emerges from the aperture on the parietal wall, a feature possessed also by *F. hunteria* but not by *F. tulipa.*

There is a "race" that has been noted in the material gathered by the shrimpers. One shell from off the Dry Tortugas and another from Yucatan waters are practically devoid of spiral markings, and the flammules are very pale yellow-orange. These shells are smaller and somewhat more slender than the type. These differences seem not to be of subspecific rank.

Lamarck's holotype of *F. distans* (Pl. 6, figs. 3–4) was the shell from which Kiener prepared his Pl. 3. The apex of the shell is eroded to such an extent, according to M. Mermod, that the presence of axial riblets or costae is difficult to verify. There is a paratype in the collection, however, having a length of 64 mm., on which the spiral and axial sculpture is discernable.

*Range:* From the Mississippi Delta west and southward to Yucatan and the northern side of the Dry Tortugas, in 2 to 25 fathoms. I have seen specimens from off the Mississippi Delta (25 fms.), but none found farther east.

### FASCIOLARIA (CINCTURA) LILIUM TORTUGANA **new subspecies.** Pl. 6, figs. 9–10.

This shell is one with the same general outline and with the same apical sculpture as *F. lilium.* There are six primary spiral lines on the body whorl and two each on the three preceding whorls, these lines being heavier than on *F. lilium* and nearly black. The flammules are a bright terra cotta red against a creamy white background, and are wider, giving the shell a blotched appearance. The flammules are sparse between the first and second, and the fourth and fifth spiral lines, thus forming two light spiral bands around the body. On the columella, there are three oblique plications, the middle one and the groove behind it strong, the posterior one nearly obsolete. In other respects the shell resembles *F. lilium*. Length, 98 mm., width, 43 mm., angle of spire, 47°.

Holotype in the Paleontological Research Institute, No. 20824; paratypes in the United States National Museum, the Academy of Natural Sciences of Philadelphia, and the Museum of Comparative Zoology at Harvard University. *Type locality:* Off the Dry Tortugas, to the northwest.

The following tables reveal the more slender form of this shell:

*F. lilium tortugana* Hollister

| Length | Width | Length/ Width | Apical Angle | Whorls | |
|---|---|---|---|---|---|
| 93 | 39 | 2.30 | 44 | 9± | ANSP paratype |
| 94 | 41 | 2.29 | 46 | 8.4 | PRI paratype |
| 84 | 38 | 2.21 | 50 | 8.3 | USNM paratype |
| 96 | 43 | 2.23 | 46 | 9.0 | MCZ paratype |
| 98 | 43 | 2.28 | 47 | 9± | PRI holotype |
| 90 | 40 | 2.25 | 47 | 9± | PRI paratype |

*F. lilium* F. v. Wald.

| Length | Width | Length/ Width | Apical Angle | Whorls | |
|---|---|---|---|---|---|
| 84 | 40 | 2.10 | 50 | 8.2 | |
| 88 | 42 | 2.10 | 50 | 8.2 | |
| 73 | 38 | 1.92 | 49 | 8.1 | |
| 68 | 31 | 2.19 | 48 | 8.2 | |
| 61 | 30 | 2.04 | 50 | 8± | |
| 86 | 41 | 2.10 | 50 | 8.4 | Yellow |
| | | av. 2.08 | | | |

*F. lilium* F. v. Wald. (Pale form)

| | | | | | |
|---|---|---|---|---|---|
| 75 | 35 | 2.14 | 49 | 7.8 | Campeche |
| 72 | 32 | 2.25 | 49 | 9± | Tortugas |

*Range:* Thus far I have not seen specimens found beyond the type locality.

Fasciolaria (Cinctura) branhamae Rehder and Abbott. Pl. 6, figs. 6–8.

*F. distans branhamae* Rehder and Abbott, 1951, Rev. Soc. Mal., Habana, vol. 8, no. 2, p. 59, pl. 8, figs. 4–5.

Original description: "Resembling the typical *distans* (Lamarck), but differing in having its siphonal canal two to three times as long and proportionately more slender. The first whorl of the protoconch is smooth, and is followed by ¾ of a whorl with about 15 small but distinct axial riblets. This is followed by ¾ of the first portnuclear whorl with about 5 indistinct spiral threads; the remainder of the postnuclear whorls are smooth except for microscopic growth lines. In *distans* these nuclear axial riblets are nearly obsolete or entirely absent. Color of shell similar to that in *distans* but with an orange-brown siphonal canal. There are 9 to 12 distinct solid, spiral lines of dark purple-brown on the body whorl, with the lower 2 or 3 on the upper third of the siphonal canal. In *distans* there are 5 to 7 major lines, occasionally with 1 or 2 additional very weak lines, and they do not extend down on the siphonal canal. The spiral threads on the siphonal canal in *branhamae* are quite weak or obsolete, while in *distans hunteria* they are pronounced. An 8-whorled *branhamae* reached a length of 125 mm., while *distans hunteria*, with the same number of whorls, range from 70 to 90 mm."

[The measurements in the quoted tables are in mm.]

*F. branhamae*

| Length | Width | Length/Width | Whorls |
|---|---|---|---|
| 128 | 54 | 2.4 (2.37) | 8.2 |
| 126 | 52 | 2.4 (2.42) | 8.3 Holotype |
| 113 | 47 | 2.4 (2.41) | 8.1 |
| 109 | 44 | 2.5 (2.48) | 8.1 |
| | | (av. 2.42) | |

*F. distans hunteria*

| | | | |
|---|---|---|---|
| 94 | 45 | 2.1 (2.09) | 8.1 Beaufort, N. C. |
| 75 | 37 | 2.0 (2.03) | 8.1 Beaufort, N. C. |
| 82 | 40 | 2.0 (2.05) | 8.0 Beaufort, N. C. |
| 64 | 32 | 2.0 (2.00) | 7.5 Beaufort, N. C. |
| | | (av. 2.04) | |

"*Type locality:* Off Puerto Alvaro Obregon, Tabasco, Mexico. Dredged by shrimp fishermen in 1951.

"*Types:* The holotype is U. S. N. M. No. 597513. A paratype from off Port Isabel, Texas, is in Mrs. Hugh Branham's Museum, Fort Myers Beach, Florida. Two paratypes were returned to Mrs. H. Taylor Raines.

"*Remarks:* The specimens from off Alvaro Obregon, Yucatan, Mexico, and Port Isabel, . . . Texas, are very distinctive, and can readily be separated from the typical *distans* that occurs along the shores of the eastern end of the Gulf of Mexico, and north to North Carolina. However, we have specimens from the northern section of the Gulf (Galveston, Texas; 28 miles ENE of Freeport, Texas, in 9 fathoms, and from Chandeleur Id., Louisiana) which show transitional stages. The siphonal canal is midway in length between those of *distans* and *branhamae.* The spiral color lines are 8 to 9 in number, and are also intermediate in character. For this reason, we have considered *branhamae* a geographical race or subspecies."

"It is interesting to note that this species more closely resembles *F. tulipa* (Linné) in having distinct axial riblets in the protoconch and in having a long siphonal canal. However, the smooth area below the suture and the color pattern seem to ally it to *distans* Lamarck."—Rehder and Abbott.

In the foregoing discussion, the "*distans*" of Beaufort, N. C., and the eastern Gulf, is *F. hunteria;* and the "intermediate" form of the northern section of the Gulf is *F. lilium* F. v. Wald. The table should be compared to one given below under *F. hunteria.*

The differentiating characters of *F. branhamae* that separate it from *F. lilium* are the axial riblets on the second whorl of the protoconch, and no axial costae on the postnuclear whorls; it has a longer canal, is generally larger, and has more and stronger spiral lines.

Thus far the known range is from Port Isabel, Texas, southward to the Bay of Campeche.

FASCIOLARIA (CINCTURA) HUNTERIA (G. Perry). Pl. 6, figs. 2, 11–13.

*Pyrula hunteria* G. Perry, 1811, Conch., p. 50, no. 4, fig. 4.

*Fasciolaria distans* Lamarck, Reeve, 1847, Conch. Icon., vol. 4, Mon. *Fasciolaria,* p. 4, figs. 10a, 10b, not of Lamarck.

Original description: "Shell of a blue and purple color, richly marbled and striped with white and black, forming in the whole a rich and lively appearance; the mouth, blue. This shell has been lately imported from New Holland (New South Wales), and being hitherto without a name, I have denominated it *Hunteria,* in honor of the Governor of that colony, whose exertions in the prosecution and encouragement of its natural history have been so particularly eminent.''—Perry.

In the absence of a holotype, I here designate two specimens of this species, collected near Charleston, S. C., by Dr. E. Ravenel, and deposited in the United States National Museum, No. 615769, as neotypes. Their description follows:

The shell is fusiform, stout, with extended spire and smooth, convex whorls. The nucleus is smooth, globose, caplike, of about one and a half whorls. The suture is simple. There is no spiral sculpture except for oblique threads on the back of the canal, and no axial sculpture except very fine growth lines. The color is ivory overlaid with longitudinal flammules of mauve. There are distant spiral lines of maroon, six primary ones on the body whorl and two on each of the earlier whorls. The aperture is oblique, ovate, pale blue-white within, and finely lirate. The columella in arcuate. There are three oblique plications just above the entrance to the canal, the middle one most prominent and the posterior one nearly obsolete. There is a glaze over the parietal wall, and a strong ridge emerges just in front of the suture and extends to the edge of the glaze. The canal is short, oblique. The operculum, missing from these specimens, is unguiculate.

The measurements of these shells follow:

| Length | Width | Length/ Width | Apical Angle | Whorls |
|---|---|---|---|---|
| 86 | 40 | 2.15 | 56° | $7\frac{5}{8}$ |
| 66 | 32 | 2.06 | 58.5° | $7\frac{1}{8}$ |

This shell differs from *F. lilium* in that it has no axial or spiral sculpture on the protoconch or postnuclear whorls. It generally has two dark brown spiral lines on the penultimate whorl, while *F. lilium* usually has three. The apex is also more blunt (see also table under *F. lilium branhamae* above).

Governor John Hunter was a captain (later, admiral) in the British navy, and was stationed at Sydney near the end of the eighteenth century.

Perry's mistake in habitat is understandable when one contemplates the fact that on the voyage from Australia to England made under sail in that day, whether around the Horn or the

## Description of Plate 6

Fig. 1, *F. lilium,* Fischer v. Wald., lectotype, Brit. Mus. Sloane Coll. No. 1481. Length 82 mm. Fig. 2, Type figure, *F. hunteria* (G. Perry). Figs. 3–4, *F. lilium* F. v. Wald., Lamarck's holotype of *F. distans.* Length 103 mm. Fig. 5, *F. lilium* F. v. Wald., Pal. Res. Inst. Cat. No. 20825, apical detail of shell in fig. 3. Figs. 6–8, *F. branhamae* R. and A., holotype. Length 126 mm. Figs. 9–10, *F. lilium tortugana* Hollister, n. subsp., holotype. Length 98 mm. Figs. 11–12, *F. hunteria* (G. Perry), larger of two neosyntypes, U. S. N. M. No. 615769. Length 86 mm. Fig. 13, *F. hunteria* (G. Perry), apical detail of smaller neosyntype, U. S. N. M. No. 615769. Length 65 mm.

Cape of Good Hope, almost certainly the vessel put into the Caribbean or American ports for water and supplies. Opportunity for mixing with shells from these places was amply provided. Whether Captain Hunter himself brought the shell home is not known.

*F. hunteria* is found living from Cape Hatteras south and westward to Mobile Bay. I have not seen a record of it south of the Florida Strait.

# THE CROWN CONCH, MELONGENA CORORNA, AS A PREDATOR UPON THE VIRGINIA OYSTER

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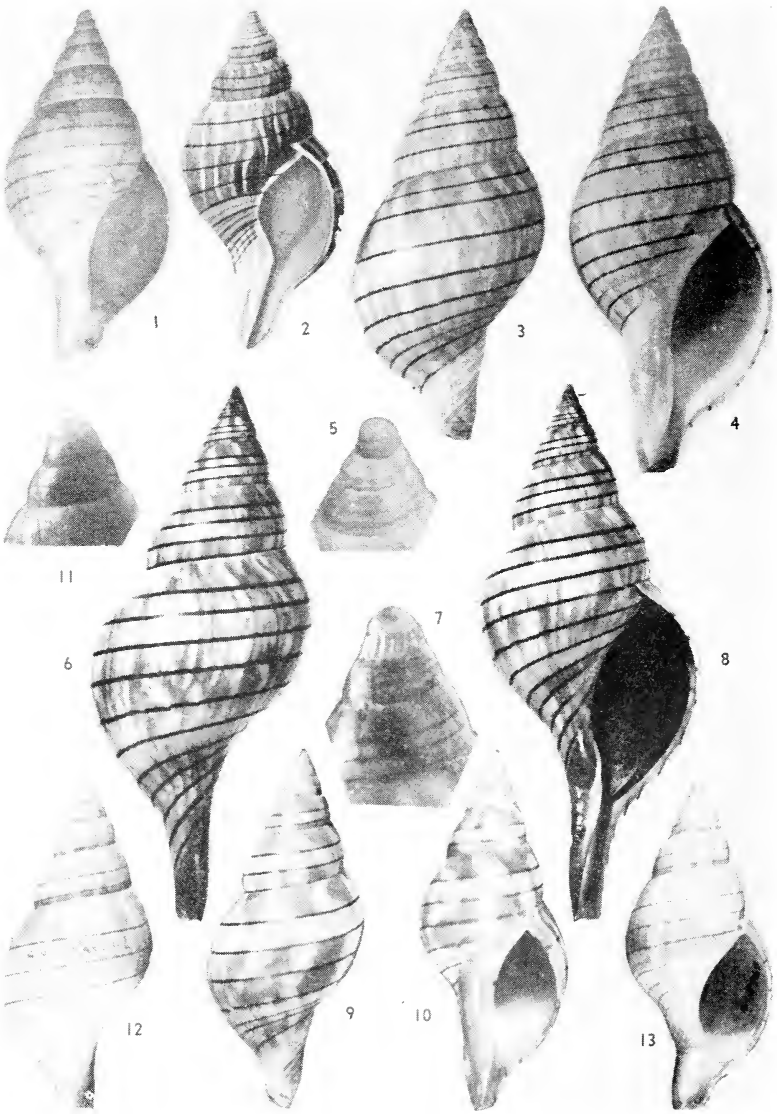
The crown conch, *Melongena corona* Gmelin, extends from Gulf Shores, Alabama, on the east side of Mobile Bay, to Matanzas Inlet near St. Augustine, Florida on the East Coast. Thus, except for a few miles in Alabama, this prosobranch is confined to the mainland shores of Florida. It has been searched for west of Alabama but so far it has not been found. This somewhat restricted distribution may be due to the fact that the animal leaves the egg case in the adult form and has no free-swimming stage (Clench and Turner, 1956, p. 162). This restricted distribution is in considerable contrast to that of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Upper fig. Snail shells (*Melampus*) and debris accumulated at the periphery of a salt marsh as the result of high tides.

Lower fig. Snails (*Melampus*) on blades of grass, 13 June 1953, in Chesapeake Bay (Woolford Creek, branch of Little Choptank, Cambridge, Maryland).

the widespread, notorious oyster predator, *Thais haemastoma.* The lack of a free-swimming stage is also the most plausible explanation for the existence of different rather local populations, which Clench and Turner (*op. cit.*) believe are sub-species, but which Smith (1945, p. 125) believes are only ecological variants.

Moore (1897) thought that *M. corona* might be an important oyster predator. Aldrich and Snyder (1936, p. 79) say that "The coon oysters that cling to mangrove roots are also a favorite food." In another part of this work, the authors list the coon oyster as *Ostrea spreta,* but the common coon oyster of the Florida mangroves is now generally recognized to be nothing more than the common oyster, *Crassostrea virginica.* Morris (1947) repeats this statement, saying that perhaps coon oysters are the favorite food. Clench and Turner (1956, p. 161) say that crown conchs in certain areas "may be sufficiently abundant on oyster bars to be a rather serious menace." Whether or not direct observations were made by these authors is not clear from their accounts.

In 1935–36 the senior author was on the staff of the Indian Pass Laboratory of the U. S. Bureau of Fisheries on Apalachicola Bay. Certain observations were made on *Melongena corona* and the following words are quoted from a corrected copy of an unpublished report submitted to the Bureau officials in 1936.

"These animals were present in the fall only in Indian Pass Lagoon on coon oyster reefs. In December they were not present and few dead shells were seen. They had either died or migrated. They were kept in the laboratory with oysters from Sept. 27, 1935 to Oct. 19, 1935 but did not attack or eat them at all."

On March 17 the writer collected over 200 animals from coon reefs in Dickson's Bay, an arm of Apalachee Bay. They were kept in the laboratory with oysters from then until April 8. They were observed to attack oysters in much the same manner as *Thais* does. Some shells were gnawed and some were not. Many animals would attack at the same time. They did not always hide the proboscis with the foot as *Thais* did and one was seen lying on its back at least five inches from an oyster with its proboscis inserted into it, being joined in its meal by three other animals, one of which had probably killed the oyster in the first place.

Why this species would not attack oysters in the first trial is not known, unless it was due to the salinities being too low. During the first experiment the salinities ranged from 19.42–32.05 and averaged 24.40 pro mille. During the second experiment they ranged from 20.26–34.37 and averaged 29.00 pro mille. The temperatures during the second trial were lower than they were during the first. The air temperatures ranged from 49.5 to 74.0° F. then, while during the first they ranged from 63.0 to 78.0° F. These were taken at 8:00 A.M.

When placed in water of salinity 9.99 pro mille *Melongena* did not open the foot and attach to the substrate, but lived for a period of 22 days without losing sensitivity and apparently was little harmed by the experience.

These animals ranged in length from 3.6 cm. to 10.9 cm. Length-frequency curves were not made, but there seemed to be more than one year class present.

Oystermen in Dickson's Bay, who do most of their fishing on dry bars at low tide, say that they kill all *Melongena* caught for it does lots of damage, but this does not seem to lessen the numbers. Men who could not read have described how *Melongena* kills oysters and sucks them out through a long tube. Evidently they have observed *Melongena* attacking oysters on the bars just as the writer did in the laboratory.

Some of these observations are slightly at variance with the junior author's. He has kept crown conchs caged with oysters at Alligator Harbor, Florida. He found that they killed oysters but that marks were not present on the shells, indicating that they do not drill the shell as *Thais* often does. In any case the feeding habits of these two prosobranchs are different and the habits of *Melongena* deserve some comment.

Aldrich and Snyder (1936, p. 79) say that these snails feed on dead crabs and are very aggressive in attacking live bivalves and whelks and that the method of attack is unique. "When the chosen victim opens its shell to breathe, the crown forces in its long black snout and destroys the controlling muscle of its prey." They add that the giant band shell, *Fasciolaria gigantea,* is the only mollusk capable of overcoming *Melongena.* Perry (1940) says this conch even attacks living horeshoe crabs. She also records the observations of fishermen at Sanibel Island who say that *Melongena* approaches scallops so as to get close enough to "leap" upon them. They then hold the bivalve by the foot and insert the proboscis near the hinge. Morris (1947, p. 156) says they do not hesitate to attack and devour *Busycon* and other large gastropods. Clench and Turner (1956, p. 163) say that the radula of *Melongena* is surprisingly small but that the individual teeth are strong. They say a three-inch specimen can eject the proboscis to six inches. They record (p. 179) *Ensis minor* Dall and *Tagelus divisus* Spengler as prey of this conch.

The crown conch evidently varies its tactics with the prey. The second author and his students have observed attacks on *Anadara ovalis* Brugière in aquaria. At times the ark shell was examined meticulously at the gape for one and a half hours. The antennae were inserted within the shell so carefully that the ark seemed to be unaware of the fact. At times, however, it decidedly closed, apparently pinching the antennae but these were retracted effortlessly by the *Melongena*. Finally the attack was made suddenly. The head of the conch became turgid and the proboscis shot out as rapidly as the flick of a finger, between the open valves of the ark. Within fifteen minutes after penetration, the ark gaped open as if paralyzed or dead and it was soon consumed.

The crown conch is certainly one of the most active and aggressive of the predaceous snails, and the smaller specimens of its own species are not spared when no other food is available. In aquaria the larger specimens devour the smaller ones quite efficiently.

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# MURACYPRAEA, NEW SUBGENUS OF CYPRAEA[1]

By W. P. WOODRING

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In the widely used classification of living cowries by F. A. Schilder and M. Schilder (1938–39, p. 174, 1938) and in F. A. Schilder's arrangement of fossil cowries (1932, p. 118), *Cypraea mus* Linné and its fossil allies are assigned to *Siphocypraea.* Indeed, in a recent handsomely illustrated book on the cowries of the world, *C. mus* is cited as the type of *Siphocypraea* (Allan, 1956, p. 29).

*Siphocypraea,* as a subgenus of *Cypraea,* was proposed by Heilprin (1887, p. 86) for *Cypraea* (*Siphocypraea*) *problematica* Heilprin (1887, pp. 87, 133, pl. 4, figs. 12, 12*a, b,* pl. 16*a,* fig. 73), a Pliocene species from Florida. Heilprin adequately described and illustrated the type species, a remarkable cowry. The aperture has an astonishing posterior outlet which forms a deep coma-shaped channel partly encircling the concealed apex of the shell. No other cowry has such a posterior outlet and *Siphocypraea* is a monotypic genus. This exceptional feature of *S. problematica* was discussed by Dall (1890–1903, pt. 1, pp. 167–168, pl. 5, figs. 10, 10*b,* 1890) and by Olsson and Harbison (1953, p. 262, pl. 27, figs. 2, 2*a*) in their recent monograph on the Pliocene mollusks of southern Florida. *S. problematica* is not a rare species; there are 90 specimens in the collections of the U. S. National Museum. It is one of the distinctive species that make the rich fauna of the Caloosahatchee marl the most distinctive Pliocene marine fauna in the Americas. These distinctive species are narrowly endemic and left no descendants.

Though some 70 generic and subgeneric names are available for fossil and living cypraeids, none is suitable for *Cypraea mus* and its fossil allies. Therefore the new subgeneric name *Muracypraea* is proposed for this closely knit group of species.

## Genus *Cypraea* Linné

Linné, Systema Naturae, 10th ed., p. 718, 1758. Type (Montfort, Conchyliologie Systématique, vol. 2, p. 631, 1810):

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[1] Publication authorized by the Director, U. S. Geological Survey.

*Cypraea tigris* Linné, Recent, tropical western Pacific Ocean. (Montfort spelled the generic name *Cyprea.*)

### *Muracypraea* Woodring, n. subgen.

Type: *Cypraea mus* Linné, Recent, south border of Caribbean Sea.

Pyriform cowries of medium size to moderately large (45 to 75 mm.). Posterior part of dorsal surface smooth, roughened, warty, or bituberculate. Outer lip wide, slightly constricted near anterior end; teeth short, moderately strong. Terminal ridge (bordering siphonal canal) narrow. Fossula indistinct, wide, shallow, smooth. Teeth on inner lip weak to strong. Posterior outlet long, wide, deep.

*Muracypraea* first appeared in strata of early Miocene age in Trinidad, Venezuela, and Peru. It reached its maximum distribution during the middle Miocene: Jamaica, Dominican Republic, Trinidad, Venezuela, Colombia, Panama, Ecuador, and Baja California. The known distribution in late Miocene time included Trinidad, Venezuela, and Panama, dwindling to Venezuela and Ecuador in early Pliocene time. The occurrences so far mentioned represent the lineage of *Cypraea henekeni*[2] Sowerby (1850, p. 45, pl. 9, fig. 3). None of the members of that lineage is a likely immediate predecessor of *C. mus*, which is unknown before the Pleistocene and now has a limited range along the south border of the Caribbean Sea from Colombia to Venezuela.

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[2] The original orthography of the trivial name is *henikeri*. Mr. Arthur Greig, Assistant Secretary of the Geological Society of London, informs me that the name of the collector, who later became a Fellow of the Society, was Col. T. S. Heneken. Therefore, *henikeri* was an unintentional error, presumably due to misreading of the collector's handwriting, and alteration to *henekeni* is justified. Both spellings have been used.

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## LIFE HISTORY OF THE SALT-MARSH SNAIL, MELAMPUS BIDENTATUS SAY.*

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Asst. Prof., U. of Notre Dame

Studies concerning the snails of the genus *Melampus* have been limited primarily to shell characteristics. So little has been written, other than shell characteristics, that Morrison (1950) stated regarding the entire family *Ellobiidae*, "the life history of members of this family is still almost completely unknown. Even the simplest observations on populations, rate of growth, or discovery of the eggs of any species will be important in filling this blank." The only major publications on *M. bidentatus* are those of Hausman (1932, 1936). This paucity of information stimulated the work here reported, which is based on experiments with living snails under both laboratory and field conditions.

*Materials.* Laboratory studies were restricted to snails collected from southern Maine, New Hampshire, and northern Massachusetts. The most successful laboratory substitute for salt-marsh conditions was a shallow glass dish with the bottom covered with an inch of Cellu-cotton (absorbent wadding), overlaid with an ink blotter. This substratum was saturated with salt water.

Field conditions were studied extensively in the same areas, and briefly in Canada along the south shore of the St. Lawrence

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* This work is a portion of a dissertation by the senior author in partial fulfillment of the requirements for the degree of doctor of philosophy from the University of Notre Dame.

River south of Quebec City, the shores of Prince Edward Island, Nova Scotia, and New Brunswick, and along the coastline of the United States as far south as Cape Hatteras, North Carolina.

*Habitat.* *Melampus* was found only in salt marshes flooded by normal tides. Empty shells, often bleached, among the debris deposited along the periphery of a salt marsh by high tides indicate a population in the vicinity (Pl. 7). Living snails were found underneath matted grass during the bright hours of the day or in relatively exposed areas at times of reduced light. The snails favor a grass cover of *Spartina,* although any vegetation and/or debris which provides shade suffices. The salt-marsh substratum is always peat. Usually the surface is covered with silt and algae. The pH and salinity vary with the tides.

*Northern range.* Although the most northern locality from which *M. bidentatus* has been obtained is Buctouche, New Brunswick, probably snails might be found as far north as Ricibucto, New Brunswick. Salt marshes are present and conditions appeared satisfactory. Snails were collected from Prince Edward Island and Nova Scotia.

In a survey of the south shore of the St. Lawrence River in August, 1953, several salt marshes were found between Ste. Anne de la Pocatiere and Rimouski, Quebec. Each superficially appeared suitable for populations of salt-marsh snails, yet no snails were found.

*Abundance.* Quantitative measurements of the abundance of living snails in three localities were made periodically throughout the years 1953–1955. The maximum number per square foot and the range in size for each of the three localities are summarized in Table 1.

| | Max. No. of Snails per Sq. Ft. | Length of Shells (mm.) |
|---|---|---|
| Portsmouth, N. H. | 27 | 9.1–11.3 |
| Rowley, Mass. | 764 | 4.6– 8.5 |
| Salisbury, Mass. | 614 | 3.5– 7.9 |

TABLE 1. Population density and size range.

*Activity.* Salt-marsh snails frequently avoid submersion by tidal waters by ascending blades of grass and piles of debris.

This vertical migration (Pl. 7) was observed on the 13th of June 1953, in Chesapeake Bay (Woolford Creek, branch of Little Choptank, Cambridge, Maryland). Heavy rains several hours prior to high tide provided dilution of the incoming salt water and a higher level. Other snails, *Littorina irrorata, Succinea aurea,* and *Paludestrina salsa,* were submerged. According to Marshall (1937), the early settlers of the eastern seaboard were more than casually familiar with this activity, finding them a problem while harvesting "salt-marsh hay":

> "Occasionally work was held up by countless millions of snails which had climbed the blades of grass to drink the drops of dew that had collected there and afforded their only taste of freshwater. No scythe could compete with the multitude of hard little shells, but after a half hour they would be gone, having climbed back down to their usual saline existence."

This migration occurred also in areas that did not become submerged. On several occasions, small numbers of snails were seen climbing tall sticks and blades of grass, although the tide brought no water near them. However, this behavior was noted only in areas where unusually high tides submerged all vegetation.

Other movements also coordinated with the tides were observed on twelve occasions from June through October 1955 in the salt marshes of Salisbury and Rowley, Massachusetts. As the tide began to rise in the drainage ditches, many snails migrated into crevices and small spaces adjacent to the roots of the salt-marsh grass. The former remained in hiding while the area was submerged in salt water but began to reappear a few minutes after the area became exposed again. Hourly (and some quarter-hourly) records were taken of the temperature, salinity, and pH of the substratum and water in the drainage ditches. Although these varied with the tide, no direct correlation with movements could be determined.

The horizontal migration of *M. bidentatus* seems limited. Twenty-four hours after the release of marked snails, the maximum distance traveled was 3 feet. After 6 months, marked snails were recovered, one of which had migrated more than 25 feet from the point of release.

*Growth.* Since the growth rate of the salt-marsh snail had never been recorded, the following experiment was tried in 1953. In the spring, several salt-marsh areas were selected as experimental sites: Portsmouth, New Hampshire (ca. 43°03′N, 70°46.3′W); Rowley, Massachusetts (ca. 42°42.2′N, 70°52′W); and Salisbury, Massachusetts (ca. 40°51.5′N, 70°49.3′W). The snails from each collecting site were divided into 3 groups and released into these same 3 areas. A total of 1,633 were released in May. Marked snails were collected in October (6 months growth period). Only 50 marked snails were recovered. Thirty-five of these were from two areas. Consequently, the numbers in these two areas were significant to indicate growth rate. The data are as follows: 20 of the 190 snails taken from Salisbury and returned to the same area were recovered. The mean length when released was 6.3 mm; 6.4 mm when recovered. Thus, a growth of 0.1 mm in 6 months. Fifteen out of 425 taken from Rowley and released in the same area showed a similar growth of 0.1 mm (9.2 mm to 9.3 mm mean lengths).

For comparison, growth under laboratory conditions was observed, beginning in the spring of 1955. A total of 280 snails with shell lengths ranging from 6.4 mm to 12.0 mm were divided among 27 containers. Although the average mortality rate was 40%, several lots survived with no loss at all. Three of these lots had been collected on the same day from the three different sites. The growth rate of these lots is shown in Table 2.

| | Date Measured | | | | | | |
|---|---|---|---|---|---|---|---|
| | 22 May | 2 August | | 11 October | | Mean Increase | Greatest Increase |
| | Shell Length | Mean Length | Range | Mean Length | Range | | |
| I | 7.5 | 7.7 | 0.3 | 8.6 | 0.2 | 1.1 | 1.2 |
| II | 6.4 | 6.7 | 0.3 | 7.0 | 0.5 | 0.6 | 1.0 |
| III | 6.4 | 6.9 | 0.4 | 7.0 | 1.0 | 0.6 | 1.1 |

Table 2. Growth rate of snails under laboratory conditions. Each lot consisted of 10 snails collected 22 May from each of the following sites: (I) Portsmouth, N. H.; (II) Rowley, Mass.; and (III) Salisbury, Mass. Measurements in mm.

Hausman (1932) described the eggs of *M. bidentatus*. He did not mention the time of oviposition, nor whether or not he had seen any eggs hatch.

In this research, observations of oviposition were made in both field and laboratory. Ninety or more snails from each of three localities were brought to the laboratory, as noted in Table 3. These collections began 8 April, and were continued at biweekly intervals. The first oviposition was noted on the nights of 20 and 22 May, but none of these eggs hatched. A few were taken for experimental study.

A second oviposition period was noted in mid-June. This included masses deposited by some of the same populations of snails that had produced eggs in May. It is noteworthy that all these snail populations producing a second batch were specimens collected on 28 April. Most of the mid-June egg masses, however, were from snails collected after 22 May.

A third oviposition period occurred early in July, but only among snails collected later than the mid-June period.

In all instances, the snails spent at least a week in the laboratory prior to oviposition. Ten snails collected on 2 June from Rowley, Massachusetts were the most productive: 189 egg masses altogether.

Egg masses were observed in all salt marshes 20 June.

Eggs reached the 16-cell stage within 24 hours, became an active trochophore within 48 hours, and formed a distinctly shelled veliger within 72 hours. At the 4-cell stage, the embryo measures about 85$\mu$ in width.

The eggs developed well in air and water. The salinity appeared unimportant, since development continued to the shelled veliger stage in clutches which were submerged in fresh water, salt water, and a 1:1 mixture. In only one lot (in salt water), however, did the veligers free themselves from the albuminous mass.

In another instance, evaporation of water from a salt-water medium resulted in deposition of salt crystals on the egg mass. The shelled veligers were observed to be inactive. When an equal amount of fresh water was added to the remaining solution, the veligers were active again after a period of 24 hours.

Snails in the laboratory were provided with lettuce and carrots. Both were eaten with no noticeable preference. The paper blotters were often consumed.

|  |  |  | Number of Clutches Present on |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | May |  | June |  |  |  |  | July |  |
|  | Date Collected | No. | 20 | 22 | 11 | 12 | 14 | 16 | 17 | 1 | 2 |
| I | 8 April | 10 |  |  |  |  |  |  |  |  |  |
|  | 17 April | 11 | 57 |  |  |  |  |  |  |  |  |
|  | 28 April | 12 |  | 73 |  |  |  | 11 |  |  |  |
|  | 11 May | 11 |  |  |  |  |  | 7 |  |  |  |
|  | 22 May | 11 |  |  | 17 |  |  |  | 84 |  |  |
|  | 22 May | 10 |  |  |  | 17 |  |  |  |  |  |
|  | 2 June | 10 |  |  | 34 | 86 |  |  | 157 |  |  |
|  | 17 June | 10 |  |  |  |  |  |  |  | 32 |  |
|  | 24 July | 10 |  |  |  |  |  |  |  |  |  |
| II | 8 April | 8 |  |  |  |  |  |  |  |  |  |
|  | 17 April | 10 |  |  |  |  |  |  |  |  |  |
|  | 28 April | 12 |  | 52 |  |  |  | 95 |  |  |  |
|  | 11 May | 10 |  |  |  |  | 4 | 21 |  |  |  |
|  | 22 May | 11 |  |  |  | 44 |  |  | 73 |  |  |
|  | 22 May | 10 |  |  |  | 59 |  |  | 83 |  |  |
|  | 2 June | 10 |  |  | 40 | 119 |  |  | 189 |  |  |
|  | 17 June | 11 |  |  |  |  |  |  |  |  | 17 |
|  | 24 July | 11 |  |  |  |  |  |  |  |  |  |
| III | 8 April | 7 | 5 |  |  |  |  |  |  |  |  |
|  | 17 April | 10 |  |  |  |  |  |  |  |  |  |
|  | 28 April | 12 | 68 |  |  |  |  | 131 |  |  |  |
|  | 11 May | 10 |  |  |  |  | 1 |  | 63 |  |  |
|  | 22 May | 11 |  |  |  | 38 |  |  | 112 |  |  |
|  | 22 May | 10 |  |  |  |  |  | 25 |  |  |  |
|  | 17 June | 11 |  |  |  |  |  |  |  |  | 13 |
|  | 24 July | 10 |  |  |  |  |  |  |  |  |  |

TABLE 3. Oviposition of snails collected from the following sites: (I) Portsmouth, N. H.; (II) Rowley, Mass.; and (III) Salisbury, Mass.

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# GASTROPOD HOST OF AN ODOSTOMIA

By ROBERT ROBERTSON

Species in the opisthobranch family Pyramidellidae have been recorded as ectoparasites on a variety of organisms, chiefly polychaetes and pelecypods (Ankel, 1936, 1938, 1948, 1949; Fretter & Graham, 1949). They often, but not invariably, show marked specificity to their hosts.

In the vicinity of Woods Hole, Massachusetts, *Odostomia* (*Chrysallida*) *seminuda* (C. B. Adams) was found to be an abundant parasite on *Crepidula fornicata* (Linné). This *Odostomia* was described from four specimens collected on single valves of *Aequipecten* (*Plagioctenium*) *irradians* (Lamarck) (C. B. Adams, 1839). Subsequently, it has been recorded from the upper valves of the same pecten, presumably as a parasite (Hackney, 1944). As this species shows a marked divergence in choice of host, and because *Crepidula* appears to be the first gastropod host of pyramidellids to be reported, the present paper was prepared.

Many specimens of *Aequipecten irradians* were examined near Woods Hole for pyramidellid parasites, but none were found. On the other hand, nearly every *Crepidula fornicata* observed had *Odostomia seminuda* either on or near the shell. Typically, they collect at the edge of the shell, where they can extend the long proboscis underneath to attach it for periods of several seconds to the mantle (text-fig.) The proboscis is quickly withdrawn when the *Crepidula* clamps down. These animals are active, and when not feeding may move around, sometimes away from the host for a short distance.

These observations were made during the first half of August, 1956. Adult *Odostomia seminuda* are up to 4 mm. in length. At this time juveniles, some less than 1 mm. in length, were abundant, so spawning had recently taken place.

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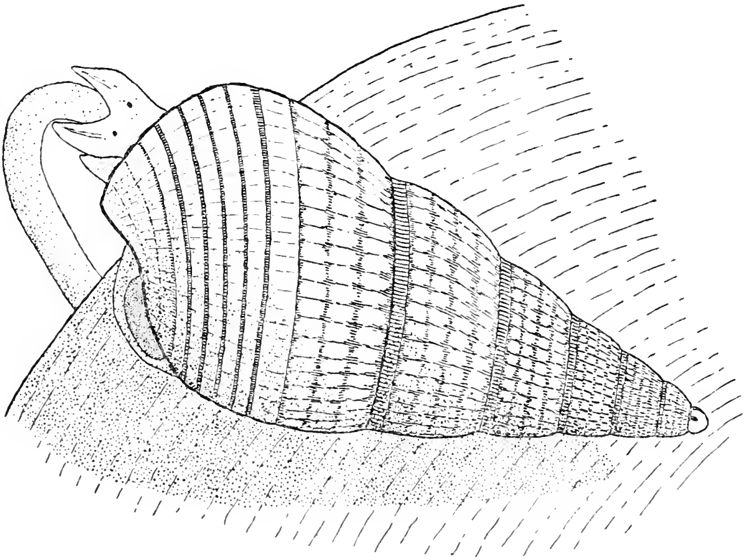

# A COLLECTION OF LAND AND FRESH-WATER MOLLUSKS FROM TABASCO, MEXICO

By FRED G. THOMPSON

Museum of Zoology, University of Michigan

The molluscan fauna of the various states of Mexico is so poorly known that even small and incidental collections from almost any area are apt to add several species to the faunal list of the state in which the collection was made. During December, 1955, I had an opportunity to gather a small collection of land and freshwater gastropods from the immediate vicinity of Teapa, Tabasco. Although this collection is not extensive, and H. H. Smith had previously collected at the same locality, several of the species in my collection are new additions to the faunal list of that state.

The town of Teapa lies on the foothills of the mountains of northern Chiapas. The geological composition of the hills is of limestone and calcareous shales, and over much of the area rapid weathering of the rock has resulted in the formation of mogotes which rise to elevation of 500–1,000 feet above the surrounding land surface. Many of these mogotes are honeycombed with solution caverns, and they drain into the Rio Grijalva by way of numerous small streams in the area. The land to the north of Teapa is a low level plain with many meandering rivers; the area is also supplied with many small lakes and swamps.

During the few days that I was at Teapa, there was an abundance of rain. Showers occurred twice a day; usually at about 10 A.M. and again at 3 P.M. The rainfall was heavy and it lasted approximately an hour. Soon after these showers, the sky would clear and the ground water drained off rapidly.

The vegetation of the area has been drastically altered by man. No forests with any large trees were seen, and most of the hills and valleys were used for banana and cacao groves. Where the land was not being cultivated, the surface was frequently burned over to consume the tall grass and shrubs and prepare it for pasturage. This has been done every year during the dry season.

Collections were made at the following six stations:

1. along the Rio Grijalva, 4 miles south of Villahermosa; Dec. 28, 1955. The land here was low and level and covered with many ponds and small lakes. There was very little surface vegetation, except for grasslands which were over grazed.
2. about 19 miles north of Teapa; Dec. 30, 1955. The collection at this locality was made in a small stream by the roadside. The land and vegetation were very similar to that at locality 1.
3. about 14 miles north of Teapa; Dec. 30, 1955. Here several square miles of land had recently been cleared of its forests, and many logs and stumps remained in the area which was being used for grazing. The ground was level and extensively covered with marsh.
4. between ½ and 1 mile east of Teapa; Dec. 28 and 30, 1955. These collections were made along the bases of the mogotes on talus slopes which were fairly well shaded by a thick growth of vines and trees growing on the sides and at the bases

of the mogotes. However, very little undergrowth grew on the thick layer of mulch and debris that covered the ground.

5. Teapa, in cacao groves; Dec. 31, 1955. The cacao trees were planted on the hillsides, and they were shaded by larger trees. The sandy soil contained chunks of sandstone and limestone, and it was exposed to much sunlight. The ground cover consisted only of a thin layer of cacao leaves.

6. about 1 mile south of Teapa; Dec. 29, 1955. A collection was made here in a small stream that flowed between two mogotes. The stream bed was rocky, and flowed over limestone for most of its distance. Although there was much dead vegetation on the ground and in the water, the stream was clear, and silt deposits were lacking even in the eddies.

Among the six stations at which collections were made, the mogotes at locality 4 had by far the richest fauna. Shell material was abundant along the bases of the limestone ledges, and live specimens were easily encountered in crevices and in the mulch. Besides the mogotes, the fruit groves and streams immediately around Teapa also had a large fauna, but mollusks were not concentrated in any place as they were along the bases of the mogotes. The biota to the north of Teapa apparently has been so drastically affected by human economy that only a few widespread species of mollusks remain.

All the material upon which this report is based has been deposited in the collection of the Museum of Zoology, University of Michigan, except for a few specimens of *Pomacea flagellata ghiesbrechti,* which were sent to Dr. Joseph Bequaert at the Museum of Comparative Zoology, Harvard College.

I am indebted to Mr. Malcolm Gordon of Yale University for making the trip to Tabasco possible for me; he also proved to be an excellent and co-operative field companion. I also wish to thank Drs. H. Burrington Baker, Joseph Bequaert, Henry van der Schalie and Alan Solem, who assisted me in identifying the material upon which this report is based.

*Pomacea flagellata ghiesbrechti* (Reeve). Specimens were found at locality 1 and 3, and dead shells were seen at several other places. Live animals were observed only at night, when they were common on the bottom of small ponds and in the shallow waters of the Rio Grijalva. Probably this large snail is used extensively as food by *Staurotypus salvini* Gray. This turtle was found to occupy the same habitat as the snail. Five turtles were kept in captivity, and they were observed to pass large numbers of opercula and sizeable shell fragments (up to 1½ inches in diameter) in their feces.

*Chondropoma martensianum* Pils. This species was quite abundant at locality 4. Dead shells were very common at the bases of the mogotes and in crevices in the limestone ledges. Live specimens were found under flakes of limestone that were still in place on the cliffs and ledges.

*Neocyclotus dysoni ambiguum* (Martens). This species was found to be common at localities 4 and 5. This snail did not appear to be concentrated in large numbers in any one area as was *Chondropoma martensianum,* nor was it as closely associated with the limestone. Specimens were encountered by raking through leaf mold and debris at the bases of the mogotes, and in drift piles along the streams.

*Helicina ghiesbrechti* Pfr. Only shells of this species were collected at locality 4. Although specimens were found at the bases of the mogotes, they did not seem to be concentrated in any one niche.

*Helicina oweniana* Pfr. The most common snail collected was *H. oweniana,* which was found in large numbers at locality 4. This snail was found along the bases of limestone ledges and in debris on the slopes of the mogotes.

*Helicina tenuis* Pfr. Only seven specimens were collected at localities 4 and 5. Its lack of concentration in any one area may be due to its apparent arboreal tendencies. Live specimens were found in rotted holes and crevices of trees.

*Lucidella lirata* (Pfr.). Only a single shell of this wide ranging species was found at locality 4.

*Pachychilus* sp. In a small stream flowing between two mogotes, a large species of *Pachychilus* was very common. An examination of comparative material suggests that it is an undescribed species. However, because of my lack of knowledge about the variation that exists among species in this genus, I hesitate to introduce another name into this confusing group until the validity of various shell characters can be proven.

*Polygyra yucatanea* (Morelet). This snail was common at localities 3 and 5. At both localities, they were found in rather open situations, and were most frequently encountered by digging through the pulp in dry rotted logs.

*Leptarionta trigonostoma salleana* (Pfr.). Dead shells of this large snail were found at locality 4, where they were occasionally found on the ground at the bases of large trees.

*Euglandina cumingi* (Beck). This species was common at localities 4 and 5. The few live specimens that were collected were found under logs and scraps of lumber.

*Euglandina* sp. A badly worn shell of a snail of this genus was found at locality 4. Specific allocation was not possible.

*Streptostyla meridana cobanensis* (Tristram). Dead shells of this species were found at locality 4. All the specimens were collected in a small cavern in a limestone cliff at the base of a mogote.

*Streptostyla nigricans* (Pfr.). Specimens of this species were recovered by raking through the dead vegetation on slopes at the bases of the mogotes at station 4.

*Salasiella subcylindrica* Pils. Three shells were found at locality 4.

*Subulina octona* (Brug.). This species was found at locality 5 in drift piles along the Rio Grijalva.

*Lamellaxis micra* (Orb.). Two shells of this species were found at locality 4.

*Synopeas beckianum* (Pfr.). Two shells were found along with *Streptostyla meridana cobanensis* in a limestone cavern at locality 4.

*Spiraxis scalariopsis* (Mo.). One shell of this *Spiraxis* was found at locality 4. It was examined and identified tentatively by Dr. H. Burrington Baker.

*Averellia suturalis* (Pfr.). This snail was common in the mulch at the bases of the mogotes at locality 4.

*Coelocentrum clava* (Pfr.). This large urocoptid was found to be quite common around the bases of the mogotes at locality 4. Although extensive effort was made to find live specimens, none were found. All the shells collected were encountered in rain gullies along the bottom of limestone ledges.

*Aplexa aurantia* Carp. This species was found to be very common in ditches and pools along the road at locality 2. At the time they were collected many were seen crawling on sticks and logs, others were along the shore in shallow water, and a couple of masses of live specimens, nearly a foot in diameter, were seen floating freely on the surface of the water. Two days later when I returned to this locality not a single specimen could be found.

Of the above list of species the following six are additions to the faunal list of Tabasco: *Leptarionta trigonostoma salleana, Streptostyla meridana cobanensis, Salasiella subcylindrica, Synopeas beckianum, Spiraxis scalariopsis,* and *Coelocentrum clava.* In general, the fauna appears to be similar to that reported in other areas of south-eastern Mexico and northern Guatemala.

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# DISTRIBUTION OF LAND SNAILS IN PLANT ASSOCIATIONS IN EASTERN VIRGINIA

BY JOHN B. BURCH

(Concluded from October number)

*Discussion.* An analysis of the data is difficult owing to the large number of plant associations encountered and because many of the associations were found only once. The habitats most generally favorable for land snails in this area are those which receive a substantial part of their organic matter from oaks. However, snails were found in abundance at stations having a variety of other trees in which oak was absent, when conditions such as moisture, substratum, etc. were favorable for their existence. Should there exist any differences in snail distribution and abundance directly correlated with plant cover, the most obvious factors would be nutrition and/or physical properties of the soil and humus. There are some data available concerning the inorganic composition of the leaves of various species of trees, leaves being by far the largest single source forest soil organic matter. These data (summarized by Lutz and Chandler, 1946: 145–150) furnish no correlation with the distribution and abundance of land snails in the present investigation, except possibly some slight correlation between average number of specimens per station and calcium content of the leaves (Table 2). However, there is a marked correlation between the amount of calcium, magnesium, potassium, and organic matter in this area and the abundance of land snails (Burch, 1955b). Although species differences are recognized in the composition of plant material, the availability of the resultant nutrients is affected by such factors as amount of moisture, aeration, rate of decomposition, forest stand quality, size of soil particles, temperature (*e.g.*, as influenced by rocks), and soil organisms. These factors may cause wide variations in both nutrients and physical properties of the humus among the same associations at different sites and may account for the difficulty in correlating snail distribution.

The abundance of snails in oak-pine communities may be the result of an improved humus layer by the mixture of these two trees. Natural mixtures between trees producing poor and good humus layers tend to improve the structure and consistency of the humus (Diebold, 1935). Lang (1926) has suggested that a mixture of hardwood leaves and coniferous needles may favor better aeration and thereby influence decomposition.

*Summary and Conclusions.* 1. The distribution and abundance of thirty-one species of land snails from twenty-seven major plant associations in Hanover, Henrico, and Chesterfield counties, Virginia, have been recorded.

2. The habitats most generally favorable for land snails in this area have an abundance of oaks.

3. In plant associations represented by at least four stations

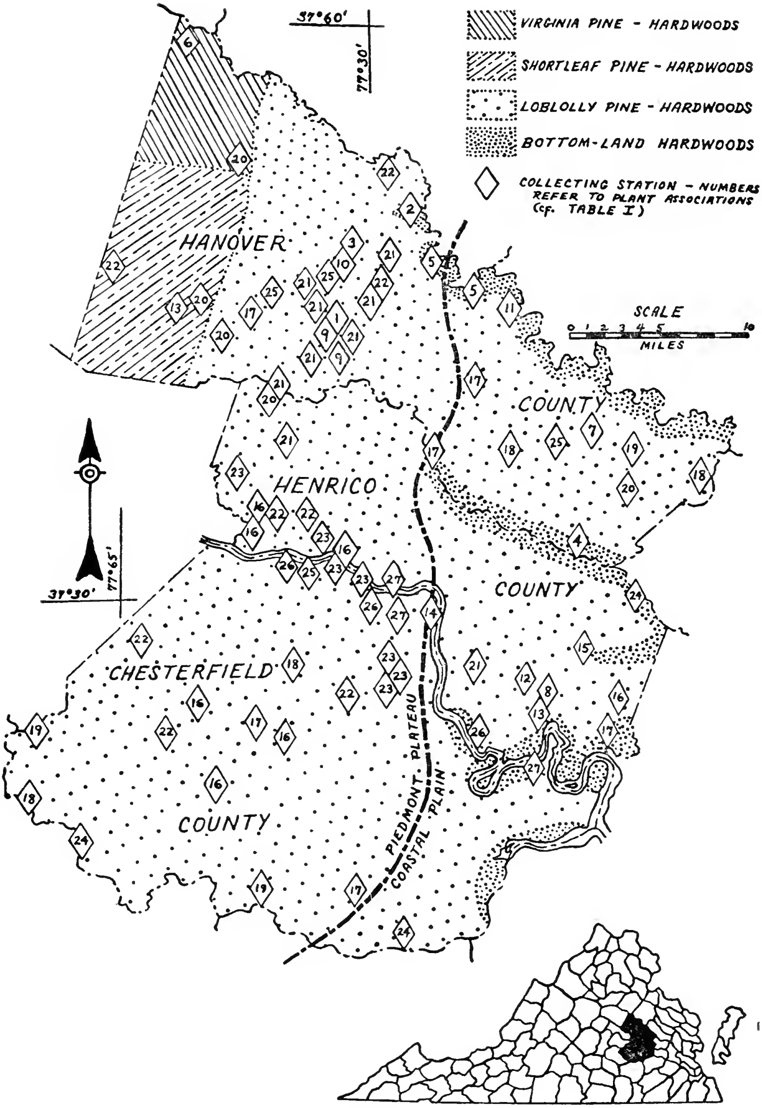

FIG. 1. Vegetation map of area investigated.

the greatest number of snails were found in oak-sycamore communities.

4. The largest total number of species were recorded from oak-pine communities.

5. Dominant plant cover is intimately associated with the ecology of forest snails by influencing physical properties of

their habitats; it also has a bearing, both directly and indirectly, on their nutrition.

6. Snails in this area may be found in a wide variety of plant associations, but correlation of their distribution with definite plants is difficult because of the variations in other factors.

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## PAUL P. McGINTY

The many friends of Mr. McGinty will be grieved to hear of his death on July 1, at the age of 78, at his home in Ocean Ridge, Florida.

Mr. McGinty was born in Athens, Georgia, on October 26, 1877, and had the distinction of having been brought into the world by Dr. Crawford W. Long, famous pioneer in anesthesia. While still a youth he succeeded in building an exceptional collection of bird eggs from the Georgia region. In later years he delighted in recalling the pleasant memories of those collecting days and his correspondence and exchanges. He studied architecture at the Georgia School of Technology, and for some years was associated with his father in building numerous courthouses and large buildings in Georgia. Later he became U. S. Supervising Architect on government buildings and travelled extensively. After his marriage to Miss Ella Marshall Ladue, of Detroit, Michigan, he resigned from the government post and engaged in private business for a number of years in that city.

Being partially disabled by an accidental spinal injury he set up a winter residence in Florida in 1923, later making it his permanent home. While combing the beach adjacent to his Florida home he early became interested in conchology. A meeting with Dr. Maxwell Smith, who lived nearby, ripened into a warm friendship and further stimulated his interest in shells. He built up a very good general collection, largely by exchanges abroad for the handsome Florida shells. In time the McGinty residence became a stop-over for many collectors who were always welcome. Dr. Carlos de la Torre, Dr. and Mrs. B. R. Bales, Dr. Joshua Baily, Dr. Jeanne Schwengel, Dr. William J. Clench, Dr. H. A. Pilsbry, Dr. Paul Bartsch, and many prominent collectors paid him the honor of numerous visits.

Mr. McGinty is survived by his two sons, Paul L. and Thomas L. McGinty, with whom he lived at Ocean Ridge, near Palm Beach. On account of his disability he was able to do little collecting himself and the gathering of material as well as the technical investigations of the shells was largely the work of his son, Thomas, assisted by Paul. The McGinty collection of Florida shells is now without doubt the most complete and valuable in existence.

Mr. McGinty's cordial and kindly nature endeared him to Florida malacologists and shell collectors, nearly all of whom he knew personally. Burial was at Athens, Georgia, in beautiful old Oconee Hill Cemetery, not far from his boyhood home.

## NOTES AND NEWS

Vagabond cuttlebones.—On January 2, 1956, Dr. Howard J. Teas and I were beachcombing along the north coast of Anegada, the northeasternmost island of the British Virgin Islands. The wind was strong from the northeast as we walked eastward from Loblolly to Cooper Rock.

In one section of sand beach where large breakers reached the shore from an opening in the reef, we found several cuttlebones high up the beach. They were all imperfect and seemed worn by the sea. One or two of the white bones had a greenish tinge in cross section, indicating perhaps some algal growth. Wallace Van der Pool, old timer on Anegada, called these bones "whale spew."

A specimen was sent to Dr. Gilbert L. Voss at the Marine Laboratory of the University of Miami. In a letter to me dated April 6, Dr. Voss says that he is "quite sure that it is the bone of *Sepia officionalis* Linnaeus. I do not believe, however, that it came from a living animal in the Western Atlantic, but rather that it has drifted across from the Azores or the African coast. I have several of these bones from the Florida coast, but all have evidence of being at sea for long periods of time."

I have not yet found cuttlebones on the north or east coast of Puerto Rico, where I have done considerable collecting from time to time. The cuttlebones check well with Text fig. 22, *Sepia officionalis* L., ventral view of gladius, p. 344 of Bull. Vanderbilt Marine Museum, Vol. III, by Lee Boone, Huntington, N. Y., 1938.—DONALD S. ERDMAN, Fisheries Biologist, Depart. de Agric. y Com., Box 412, Lajas, P. R.

THAUMASTUS CONSPICUUS (Pils.), originally from near Huasimal in the region of Tumbez, Peru, at about 4,000 ft., has been found by Mr. A. A. Olsson in the Pleistocene Mancora tablazo at the Seminario road out of the Quebrada Parinas (near Negritos, Peru). This species was originally described as a *Plekocheilus,* but it apparently is a *Thaumastus* of the subgenus *Zara* Strebel. The Pleistocene specimens are about 40 to 50 mm. long, being smaller than the type lot.—H. A. P.

ST. PETERSBURG SHELL CLUB.—Meetings will be held in the Assembly Room, City Hall, at 7:30 P.M., on the following dates: Jan. 11, Jan. 25, Feb. 1, Feb. 15, Mar. 8, Mar. 22. There will be entertaining and instructive programs at each meeting. Shell Club field trips will be under the leadership of Mr. Alger Blaine. This year he will have several assistants and frequent trips will be made. Membership in the Club is one dollar per year. The only necessary qualification for membership is that you are interested in shells. The annual Shell Show will be held Feb. 27 to Mar. 4 at Treasure Island Auditorium, Treasure Island.—Nellie Coleman, President, 5308 Third Avenue South. Ernest Klein, Treasurer, 201 Fifth Street South, St. Petersburg, Florida.

Nassa delosi Woodring.—Dr. W. P. Woodring, in his paper on the Geology and Paleontology of the Palos Verdes Hills, U. S. G. S. Professional Paper No. 207, proposed the name *Nassa delosi* for the Pleistocene shell which Ralph Arnold illustrated under the name *Nassa californiana* Conrad in Paleontology and Stratigraphy of San Pedro, 1903.

This name has been quite generally accepted. The shell is quite common in the Del Ray exposure at the west end of the Baldwin Hills and is found in several of the Pleistocene exposures in the San Pedro and Long Beach areas.

So far as I know *Nassa delosi* Woodring has never been reported from the Recent fauna except for one specimen that was reported as *N. californiana* Conr. in the Minutes of the Conchological Club of Southern California No. 51, August 1945. That specimen was given to me by a neighbor who found it in a tide pool at Balboa, California. The specimen was alive and I personally removed the animal. It is very close to Arnold's figure 3, plate IV, in Paleontology & Stratigraphy of San Pedro, 1903, and to the figure given by Dall in Bulletin 112, plate 11, fig. 4. It is now No. 11458 in the conchological collection of the San Diego Society of Natural History, Natural History Museum, Balboa Park, San Diego. Dall's record of *N. californiana* Conr. is probably based in part on the shells that we now know as *Nassarius rhinetes* Berry, 1953.

Dr. William Emerson tells me that there is a Pleistocene exposure at or near the high tide line at San Quintin Bay, Lower California, and that specimens of *N. delosi* Woodring from it, which have worked out onto the beach, could easily be mistaken for recent shells.—E. P. Chace.

Introduced species in South Carolina.—*Rumina decollata* (L.) has been reported from a few inland localities (e.g. Dallas, Texas), but most records are from coastal cities. I collected two specimens of this species in an urban yard at Columbia, South Carolina (approximately 100 miles inland) in 1951. I was unable to determine its abundance in this and adjoining yards,

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# HALIOTIS RUFESCENS AT SUNSET BAY, OREGON

By RICHARD B. LYONS

Oregon Institute of Marine Biology

Hitherto, the occurrence of *live* specimens of *Haliotis rufescens* Swainson (the red abalone) in Oregon has not been recorded in the literature. Since *H. rufescens* often resembles *H. wallalensis* in the color of the shell, care must be taken not to confuse the two species and accounts of divers having seen "red abalones" should be considered with caution unless actual specimens are available. The recent article by McCauley and Marriage (1955) has reported a range extension based on *shells* of this species. While worthwhile to report the location of a species of shell, this must be done with great care and descriptions of such shells must also be cautious unless the shells are in excellent condition. The mere presence of a shell washed up on the beach, particularly if it is a solitary specimen, is certainly not an accurate range extension in view of the fact that such a shell could have been placed there (and this often happens) by some traveler or even a resident who has obtained the shell at some distant point and just discarded it on the beach.

McCauley and Marriage (1955) must surely be credited with first reporting *H. rufescens* shells from Oregon and, in all probability, their data can be accepted as extending the northern range of this species to ". . . Chetco Cove on the south side of Cape Ferrelo . . ." which is near Brookings, Oregon. However, the first *live* specimen of *H. rufescens* to be reported in the literature from Oregon (thus positively establishing a new northern range limit) is now to be described from a specimen collected by the author at Squaw Island on the northern side of Sunset Bay (near Cape Arago, Oregon).

In early July of 1956, while assisting at the Oregon Institute of Marine Biology, the author discovered the specimen on a morning collecting trip. The animal was located on the wall of a tall dark tunnel on the northern tip of Squaw Island. Though the abalone was just below the water line, the tunnel was quite high and far removed (about ten yards) from active surf at the time. *Diadora aspera* (the rough keyhole limpet) and several species of sponges were quite numerous along the wall of the tunnel. The abalone was removed from shallow water at a point approximately six feet below the lower limit of the barnacle (*Balanus glandula*) zone.

After being collected, the animal was returned to the marine station and placed in a pan of sea water where it was kept alive for about one and a half days and observed by students and faculty members. While alive, the abalone was photographed with color film and after dying it was placed in formaldehyde solution. Several days later, the shell was removed from preservative and only the animal remained in formaldehyde.

Descriptions of *H. rufescens* have been provided by numerous authors (see Bonnot, 1948; Oldroyd, 1927; Tryon and Pilsbry, 1890; and for excellent descriptions of the internal anatomy of the animal, see Palmer, 1907, dealing mainly with this species and *H. cracherodii,* and Crofts, 1929). Here follows, for comparison, a short description of the specimen found at Squaw Island in July, 1956.

*Shell.* The brick-red shell is 23.2 cm long and 18.1 cm wide with a circumference of 65 cm, and depth of about 5 cm. Four large tubular holes are open (largest is 1.1 cm by 0.6 cm). A thin red line encircles ventral edge of shell and a large muscle scar is present (11.5 cm long and 9.1 cm wide). Dorsal surface of shell is rough due to upraised portions of shell forming ''tubercules'' and to presence of marked concentric lines (especially in younger part of shell). Many small barnacles and holes of burrowing organisms are present on dorsal surface.

*Body.* Ventral surface of foot is 24.2 cm long and 15.2 cm wide. In life, ventral surface of foot is dark yellow and dorsal surface is black. Mantle edge is striped with alternating light olive-green and blackish dorso-ventral lines.

As pointed out by Carlisle (1945), *H. rufescens* has such a rapid development that in a matter of about a week after fertilization, small adults are formed. Because of this speedy development, the parents of this animal probably must have lived near Sunset Bay. The large size of this specimen is indication of its adaptability to the environment of Squaw Island and, quite assuredly, *H. rufescens* Swainson must be established as far north as Squaw Island, Oregon (43°20′ North).

The author is indebted to Keith W. Cox at Stanford for his very kind help and suggestions and also to Dr. Robert L. Bacon at the University of Oregon Medical School, Mrs. Dorothy McKey-Fender at Linfield College, and Mrs. Dody Orendurff.

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## EASTER ISLAND SHELLS

### BY PAUL H. STEELE

The letters following the specific names indicate the sources of the records: D, Dall; O, Odhner; L, Lamy; and E, Padre Englert.

*Acanthopleura brevispinosa* Rve., L.
*Smaragdinella viridis* Rang., D. O. L. E.
*Terebra inconstans* Hinds, L. E.
*Terebra venosa* Hinds, L. E.
*Conus miliaris* Hwass, D. O. L. E.
*Mitra (Strigatella) amphorella* Lam., L.
*Mitra,* cf. *M. michelinii* Guerin, E.
*Mitra (Cylindrica) nucea,* D.
*Columbella lutea* Quoy, D.
*Columbella margarita* Rve., L. E.
*Columbella (Seminella) striatula* Dkr., L.

*Columbella* (*Mitrella*) *impolita* Sby., L. E.
*Columbella* cf. *C. diminuta* C. B. Adams, E.
*Mitrella* sp., E.
*Trophon* (*Pascula*) *citricus* Dall, D. L.
*Sistrum morus* Lam., E.
*Sistrum ricinus* L., E.
*Sistrum*, cf. *S. concatenata* Lam., E.
*Purpura* (*Polytropa*) *scobina* Q. & G., L.
*Thais nesiotes* Dall, D. E.
*Colubraria decollata* Sby., D.
*Cassis vibex* L., D.
*Triton* (*Epidromus*) *cylindricus* Pse., L.
*Marginella sandwichensis* Pse., O. E.
*Pisania ignea* L., O.
*Trivia oryza* Lam., var. *scabriuscula* Gray., E.
*Cypraea caputdraconis* Melv., D. O. L. E.
*Strombus maculatus* Nut., D. L. E.
*Cerithium atromarginatum* (Desh.) Vignal., L.
*Triforis levukensis* Watson, O. L. E.
*Triforis*, sp., D.
*Cerithiopsis* sp., E.
*Vermetus* sp., D. E.
*Planaxis mollis* Sby., D. O. L. E.
*Tectarius nodulosus* Gmel., D. O. L. E.
*Torinia dorsuosa* Hinds., L.
*Rissoina turricula* Pse., L. E.
*Rissoa plicatula* Gould., O.
*Rissoa tridentata* Michaud., O. E.
*Hipponix antiquatus* L., D. L. E.
*Hipponix barbatus* Sby., D. O. L. E.
*Hipponix grayanus* Menke, D. O. E.
*Cheilea equestris* Menke, D. E.
*Polinices sebae* Soul., D.
*Natica*, cf. *N. sagittifera* Recluz, E.
*Janthina communis* (*fragilis*) Lam., D. L. E.
*Scala perplexa* Pse., L. E.
*Eulima cumingi* A. Ad., D. L. E.
*Nerita plicata* L., L. E.
*Nerita atrata* Rve., L.
*Nerita morio* Sby., O. L. E.
*Nassa*, cf. *N. compta* A. Ad., E.
*Euchelus foveolatus* A. Ad., O.
*Euchelus gemmatus* Gould., L. E.
*Gena varia* A. Ad., O. E.
*Glyphis exquisita* Rve., L.
*Glyphis foveolata* Garrett, O. E.
*Fissurella* sp., D.
*Siphonaria pica* Sby., O. L. E.

*Puncturella* sp., E.
*Emarginula* sp., E.
*Melampus philippii* Küster, D. O. L. E.
*Melampus pascus* Odhner., O.
*Septifer* sp., E.
*Pecten (Hinnites) pascus* Dall., D. E.
*Pecten patagonicus* King., E.
*Lucina divergens* Phil., D. O. L. E.
*Lima lima* L., D.
*Lima (Matellium) fragilis* Chem., L.
*Chama broderipi* Rve., D. E.
*Saxicava australis* Lam., L.
*Semele australis* Sby., D.
*Limax arborum* B. Ch., O.
*Milax gagates* Drap., O.
*Pacificella variablis* Odhner, O.
*Bertella brocki* Vayssiere, O.

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## MARINE SHELLS FROM ALTONA LAGOON, ST. CROIX, VIRGIN ISLANDS

BY G. W. NOWELL-USTICKE

Very little serious shell collecting would seem to have been done in the island of St. Croix, the largest of the Virgin Island group, situated at the hinge between the Greater and the Lesser Antilles. This island is somewhat off the more or less regular string of West Indian islands, and seems to have a great variety of shells, many of which have never been recorded from that vicinity.

Henry Krebs of Kopenhagen, Denmark did publish in 1864 *The West Indian Marine Shells,* listing shells mainly from St. Thomas, but included some from St. Croix. Also a very complete list of bivalve mollusks was published by the N. Y. Academy of Sciences (Vol. 17, part 1, 1951) in one of their books on Puerto Rico, and the Virgin Islands, but St. Croix was not well covered.

What follows is a short story of one small lagoon on the north shore of St. Croix, about one-half mile east of the town of Christiansted. Altona Lagoon is about a mile long, narrow, from one quarter to one half mile wide, and is lined with a species of mangrove tree. For the most part it is quite shallow, with sand bars inside the very narrow entrance, through which the tides usually flow. Storms in late 1955 completely blocked the only entrance, so that the lagoon is now landlocked; and due possibly to retaining ponds built above the far end, little water, and that fresh, is now entering; also due to evaporation, the level is slowly sinking, and exposing more and more of the bottom of the lagoon.

Aided by these helpful conditions, I spent several days collecting shells under very favorable circumstances, helped by my wife, whose nostrils were far from happy due to the vast quantity of dead and dying marine life of all forms lying on the exposed sand bars. Huge barracudas are reputed to lurk under the mangrove roots in deeper water, and large bone fish abound. Many egrets and other birds fish in the lagoon.

As I write this in September 1956, the situation has changed. Digging reopened and filled the lagoon, only to have it closed once more, but now there seems to be almost no shell life, only dead bones.

Such an opportunity is not likely to occur often, and I am glad I was able to get a practically complete listing of the shells that were either taken alive, or that I feel positive actually lived in the lagoon. A great many shells other than those listed were found, but I believe that in most cases their presence was adventitious.

I hope the following list will prove of interest and value. An asterisk (*) indicates the shell was not taken alive, but I have every reason to believe they inhabited the lagoon.

*Turbo castaneus* Gmelin—includes the form *crenulatus* Gmelin, without tubercles.
* *Tegula hotessierana* Orbigny.
*Astrea longispina* Lamarck.
*A. brevispina* Lamarck.

*Neritina meleagris* Lamarck. The most plentiful shell in the lagoon, very similar to *virginea,* mostly small with tremendous color variation.

*Littorina angulifera* Lamarck.

*Modulus modulus* Linné. Mostly rather small, with no axial nodules, may be *M. carchedonius* Lamarck, with which it agrees rather closely; it is very different to the *Modulus modulus* found elsewhere on the island.

*Batillaria minima* Gmelin. Common.

*Cerithium literatum* Born.

*C. eburneum* Bruguière. Common.

*Crepidula convexa* Say, not plentiful.

*C. aculeata* Gmelin. Scarce.

*Strombus gigas* Linné. Usually immature shells.

*Polinices lacteus* Guilding. With wine red operculum.

*Natica livida* Pfeiffer. Very scarce, white operculum.

*Eugoniphos uncinatus?* Rather like *Nassarius vibex.*

*Nassarius vibex* Say. Large shells, strongly marked.

*Fasciolaria tulipa* Linné. Up to about 8 inches; mottled with black, brown and white. There is a very distinct variety in dark orange-brown with black bands.

*Conus stearnsi* Conrad. Some with rich red coloration.

*C. verrucosus* Hwass. Scarce, rarely with red markings.

*Bulla occidentalis* A. Adams. Common, large shells (*solida?*)

* *Hydatina versicaria* Sowerby. Rare.

*Haminoea elegans* Gray(?). Large, 23 mm. purplish shells.

*H. antillarum* Orbigny. Pale amber color.

*Melampus flavus* Gmelin, plentiful.

* *Murex pomum* Gmelin, quite scarce.

* *Cymatium femorale* Linné. Scarce.

* *C. cynocephalum* Lamarck. Scarce.

* *C. chlorostomum* Lamarck. Scarce.

*C. muricinum* Roeding. Scarce, in oozy mud.

*Anadara notabilis* Roeding. Not common.

*Pteria colymbus* Roeding. Rare.

*Pinctada radiata* Leach. Rare.

*Isognomon alata* Gmelin. Quite large shells, both plain and with purplish markings.

*Codakia orbicularis* Linné. Large.

* *C. costata* Orbigny.

*Phacoides pectinatus* Gmelin. In mud, both orange and white.

*Trachycardium muricatum* Linné. Color variations, and a small colony of pure white shells.

*Diplodonta punctata* Say. Scarce.

*Laevicardium laevigatum* Linné. Not common.

* *Papyridea semisulcata* Sowerby. Scarce.

*Pitar albida* Gmelin. Very plentiful, three color forms, yellowish, pure white, and rayed.

*P. fulminata* Menke. Rare.
*Chione cancellata* Linné. Extremely plentiful, with a great variety of markings.
*Anomalocardia brasiliana* Gmelin. In mud.
*Tellina radiata* Linné. With pink rays.
*T. radiata unimaculata* Lamarck.
*T. interrupta* Wood. Common.
*T. laevigata* Linné. Scarce, three color forms, white, yellowish and rayed.
*T. angulosa* Gmelin. Usually pink, sometimes almost white.
*T. martinicensis* Orbigny. Not common in mud, usually white, sometimes pinkish.
*T. caribaea* Orbigny. A pretty yellow shell, with very unusual markings for a *Tellina.*
*T. sybaritica* Dall. Usually prettily marked with pink rays.
*T. promera* Dall. Not very common.
*Arcopagia fausta* Pultney.
*Tagelus divisus* Spengler. Common.
*Mactra fragilis* Gmelin.
*Ervilia nitens* Montagu scarce.
* *Basterotia quadrata granatina* Dall. Scarce, a very oddly shaped shell.

The commonest shells among the bivalves are the chiones, then the pitars, mactras and cardiums. *Neritina meleagris* is by far the commonest gasteropod, immense quantities mostly small are present; after this species comes the battilarias, cerithiums *Nassarius* and *Bulla.*

I have noticed that most of the scarcer shells seem to live in small colonies close together, and the presence of one usually leads to the discovery of others nearby. *Conus stearnsi* likes to lie on top of small sand hills, just under the surface, one to a mound. Many of the shells seem to prefer living along the banks of underwater streams, and cannot be found elsewhere.

## ECOLOGY OF VITRINA LIMPIDA GOULD

By EDWARD J. KARLIN

Cornell University

The nearctic gastropod, *Vitrina limpida* Gould, is only infrequently mentioned in the literature. Its failure to appear regularly in local faunal lists or collections results in part from its northern range but chiefly from local and seasonal limitations on its distribution. Discussed herein are some of the factors affecting the distribution of *V. limpida* and some observations of its feeding habits. The collections of the Philadelphia Academy of Natural Sciences, the Museum of Zoology of the University of Michigan, the United States National Museum and the Museum of Comparative Zoology at Harvard were all examined in compiling data for this paper and sincere thanks are offered to the curators of those institutions for making the material available. Although many suppositions and speculations are set forth herein, additional research will be necessary to eliminate some unclear aspects. However, since the collections of four of the major museums have already been examined, probably no large amounts of additional data will become available in the near future. Therefore, the information which is available at this time is presented.

*Seasonal distribution:* Pilsbry (1946) and others have indicated that *V. limpida* probably has a one-year life cycle. Adult snails are found in the fall and winter and egg-laying has been observed at such times (Clapp, 1903). Clapp suggested that the eggs hatch in the spring and that the snails mature before autumn since he never saw a living immature individual in the fall. This author found a similar situation in the vicinity of Ithaca, N. Y., where in three years of observations no living specimen of *V. limpida* was found earlier than mid-September nor later than mid-December. Laboratory colonies composed of adult snails collected early in December survived only until early January under a variety of temperature and food conditions although snails of several other species including members of the same family as *Vitrina* remained alive far longer under the same environmental conditions. It appears that irreversible physiological factors produce death of *V. limpida* in the fall and winter.

Many lots of snails from the author's collection and from those of the aforementioned museums were examined. Only shells accompanied by the date and locality of collection were selected for measurement. In addition, in order for a lot to be used in compiling data, the snails must have been alive when collected. This was assumed to have been the case if the majority of shells in a lot contained the dried remains of the soft parts of the snails. Field observations indicate that the bodies of dead *Vitrina* usually dry rather than decompose. This is particularly true of fall and winter collections when the cold weather conditions help to preserve the bodies of the snails and also help to reduce the number of scavengers in the locality. It was believed that measurements of snails which were alive when captured could be used to verify or disprove, indirectly, the proposed one-year life cycle of this species. Only 20 lots of snails which were accompanied by adequate data could be found although several hundred shells were included in the lots. The lots did not include any snails which had been collected in March, April and May. One lot had been collected in June, one in July and six, each, in August, September and October. No records occurred for December or January and only two lots had been collected in February.

The size of each shell in a lot was recorded by measuring across its major diameter and an average size was computed from all the shells collected in any one month. In addition, the monthly medians and modes, in millimeters, were calculated. The yearly curves drawn from all three measurements of size, i.e., monthly averages, medians and modes, were so similar that the average figures have arbitrarily been chosen for discussion here. The average size of *V. limpida* for July was 1.7 mm. From this there was an increase to an average size of 3.6 mm. for August following which the curve, drawn from the averages, levelled off and even dropped somewhat although it remained relatively constant until February. The monthly average-size measurements follow. There are no records for those months followed by dashes.

| | | | |
|---|---|---|---|
| July | 1.7 mm. | Jan. | — |
| Aug. | 3.6 mm. | Feb. | 3.7 mm. |
| Sept. | 3.2 mm. | Mar. | — |
| Oct. | 3.2 mm. | Apr. | — |
| Nov. | — | May | — |
| Dec. | 3.5 mm. | June | 6.3 mm. |

The single lot of shells collected in June has been ignored in interpreting the data since the shells averaged 6.3 mm. in diameter. If a one-year life cycle for *V. limpida* actually occurs as suggested by the fact that living adult-sized snails have been found mainly in the fall, one must consider the size of the shells in the June collection to be exceptionally large for that time of year. Since the shells are from an extremely northern locality, possibly they represent snails which died in the fall and were preserved by snow cover and low temperatures until spring. While the same might be said for any of the museum lots examined, it is highly unlikely that the monthly data would have been as uniform and consistent as it was unless the presence of dried snail bodies in the shells actually indicated, in most instances, the collection of living specimens.

In order to ascertain whether the snails grew at a uniform rate throughout their lives, the monthly average sizes were examined. Evidently such was not the case. Realizing that air temperatures probably influence the dates of hatching of *Vitrina* eggs and the rates of growth of the snails, the author attempted to compensate for the varying latitudes and temperatures at which the snails had been collected. Northern North America was divided into three zones on the basis of the 60- and 70-degree July isotherms. Snails from the northernmost zone were arbitrarily considered to be approximately four weeks behind those from the southernmost zone in their development; those from the middle zone were considered to be two weeks behind. New monthly averages were computed on this basis and a new curve drawn. This new curve closely resembled the one drawn from the figures previously presented although the corrected curve was somewhat smoother. If a more accurate correction figure than the arbitrarily chosen two weeks per zone could be computed, a still smoother curve might be expected.

Apparently two facts may be concluded from the foregoing data:

1) *Vitrina limpida* does have a one-year life cycle. This is confirmed by the fact that living adult *Vitrina* were only found in the fall and winter months (with one possible exception).

2) Growth of the snails does not occur at a uniform rate. Instead, the amount of growth increases sharply in July and August and practically ceases thereafter. The minute size of the snails prior to the growth increase probably accounts, in part, for the infrequency with which the snails are collected in early summer.

While both of these facts have been suggested by previous authors, this apparently is the first attempt to use museum collections of *Vitrina* to corroborate field observations.

*Local distribution:* It appears that *V. limpida* may have an extremely discontinuous distribution approaching that of *Hender-*

*sonia occulta* (Say) (van der Schalie, 1939). The author has six separate localities represented by lots of *V. limpida* in his personal collection. Four of the six lots were found within six feet of permanent streams while the other two were taken on a floodplain within sight of running water. Three of the lots were collected on the concrete walls of culverts over small streams. *Vitrina* have been observed in these same culverts for three successive years but have not been found in several other similar culverts in the same area. At least five lots from the various museum collections were accompanied by data complete enough to indicate their collection along stream or river banks. Only one record is known where the snails were not collected in the vicinity of water. Thus, the distribution of *Vitrina* limpida appears to be ecologically limited by the nearness of a permanent body of water. Since Clapp (1903) observed egg-laying in the same type of habitat, each snail perhaps spends its life cycle in one locality and does not move to and from drier areas.

*Food:* Little is known of the food habits of *Vitrina limpida.* Pilsbry's (1946) figure of the radula of this species suggests neither a highly specialized carnivore nor a highly specialized herbivore. *Vitrina* is usually classified as a genus of the family Zonitidae, which includes both plant- and meat-eating forms. Frömming (1954) discussed the closely related European form, *Vitrina pellucida* (Müller), and quoted observations of many authors. A compiled list of foods, reported to have been accepted by *V. pellucida* includes living snails, insects and worms, dead animal and vegetable matter, and mosses. If *V. limpida* is of similar habits, one would expect it to be a predator or scavenger, selectively rejecting living or fresh plant matter.

The author has two lots of *V. limpida* in his collection which were found on freshly-killed mice in the Gaspe peninsula. The mice had been trapped during the night and had been dead for less than 12 hours.

Several *V. limpida* were also collected on bloody pieces of liver placed as baits on the soil near known colonies of the snails. Others apparently fed on pieces of liver when an attempt was made to maintain colonies of *V. limpida* in the laboratory. Lettuce, rotting oak leaves, living sowbugs and living and dead earthworms were all rejected as food by the laboratory-reared snails.

All these limited observations tend to indicate that *V. limpida* actually is a scavenger as suggested.

*Summary:* Measurements were made of *Vitrina limpida* shells which, on the basis of various specifications, were assumed to have been collected as living snails. These measurements indicated that a one-year life cycle of *V. limpida,* as proposed by several authors, most likely occurs.

Most of the growth of the snails is accomplished in a relatively short period of time in the late summer. Prior to that time, presumably the snails are so small that they are overlooked by collectors, thus accounting, in part, for the rarity of spring and early summer records.

It is proposed that *V. limpida* has a discontinuous distribution within its range associated with nearness to a permanent body of running water.

Limited observations indicate that *V. limpida* is a scavenger.

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# HAPLOTREMA FROM WESTERN MONTANA

BY ROYAL BRUCE BRUNSON AND UNDA OSHER

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With the aid of a grant from the Washington Water Power Company, the senior author has undertaken a program of surveying the fauna now occuring in that area along the Clark Fork River which is to be inundated by the Noxon Dam. This area is between Noxon and Thompson Falls, Montana.

On a routine collecting trip to the site on May 12, 1956, the senior author found a complete shell of *Haplotrema vancouverense* (Lea). (The authors are indebted to Dr. Henry A. Pilsbry for the identification.) The shell was found across the river from Noxon (Sec. 19—T26N-R32W, Sanders County). Apparently the snail had been turned out by the action of a bull-dozer and had died in the early spring weather.

On June 26, 1956, the junior author found a living, mature specimen of *Haplotrema vancouverense* on moss growing on the banks of Government Creek, a typical, small, rushing, mountain stream. Government Creek (Sec. 20 T26N-R32W, Sanders County) is near the area in which the other specimen was found. Both areas are at an elevation of 2175 feet.

Pilsbry (Land Mollusca of North America, Vol. 2, page 223) gives no record of this snail from Montana, although he cites collections by H. B. Baker from Kootenai, Benewah, Shoshone, Bonner, Umatilla, and Clearwater counties of Idaho. To find this ''coastal'' snail in Montana is not surprising because Noxon is only twenty-five miles from the Idaho border. The Clark Fork River valley, as well as the valley of the Kootenai to the north, forms a natural access between Montana and Idaho and thence west to the coast. Remnants of the coastal forests are found in the Clark Fork valley and even as far east as the Continental Divide. In the Noxon-Thompson Falls area, there is an interdigitation of the ponderosa pine, Douglas fir, and arborvitae-hemlock zones. (See R. F. Daubenmire's account on pages 7, 8 and 9 of R. J. Davis' Flora of Idaho, William C. Brown Company, Publishers.) Both specimens of *Haplotrema* were found in the undergrowth of the mixed woods of arborvitae (*Thuja plicata*), hemlock (*Tsuga heterophylla*), and Douglas fir (*Pseudotsuga taxifolia*).

Although this snail has been reported from six counties of Idaho, it is interesting to note that it has not yet been reported from Boundary, the northern-most county of that state and only from the southern part of Bonner county, which is adjacent to Boundary. These two counties lie just to the north of the spot where the Clark Fork River crosses the Idaho-Montana border.

A review of the geology of the region (see W. C. Alden, Physiography and Glacial Geology of Western Montana and Adjacent Areas, U. S. Geological Survey Professional Paper 231, 1953) would indicate a possible correlation between the distribution of *Haplotrema* to the geological history of the area. Boundary and Bonner counties of Idaho as well as the area of Northwestern Montana north of Noxon, were covered by the Cordilleran ice sheet of the Wisconsin stage of the Pleistocene. In other words, *Haplotrema* has not yet been found in any area of Montana or Idaho that was covered by the Cordilleran ice sheet except for the southern part of Bonner county which was covered with the southern edge of the ice sheet. Furthermore, in the valley areas of Northern Idaho the soil is largely silt of Glacial Lake Kootenai, whereas silt of Glacial Lake Missoula is found in the area of Noxon as well as in the areas of Idaho in the southern part of Bonner county and south of Pend Oreille Lake.

Other land mollusks collected in the same area by the junior author are: *Allogona ptychophora* (A. D. Brown), *Anguispira kochi* (Pfeiffer), *Oxyloma nuttalliana* (Lea), *Zonitoides arboreus* (Say), and *Discus cronkhitei* (Newcomb). All specimens are in the collection of the senior author.

## A NOTE ON CUNA DALLI

By DONALD R. MOORE

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Charles Hedley established the genus *Cuna* in 1902 for four species of minute bivalves. All four species were Australian shells that had been collected off the coast of New South Wales by the H.M.C.S. "Thetis." He placed the genus in the family Crassatellidae although there seems to be some doubt as to its true affinities.

E. G. Vanatta described *Cuna dalli* from the northwest Florida coast in 1904. In 1915 Bartsch described *Cuna concentrica* from South Africa. Oddly enough, this was the same name used by Hedley thirteen years before for the type species of *Cuna*. The African species, if it has not been renamed, is then nameless although described. Several additional species have been described from Australia and New Zealand waters in recent years, but the genus appears to be rare in other seas.

In March, 1956, I visited Dauphin Island, Alabama, where I collected samples of the beach sand. Later, a close examination of the sand revealed hundreds of tiny purple bivalves. Identification was difficult since I could not find a description of the species in any of the major taxonomic works on this region, and it was not listed in Johnson's checklist of marine Mollusca. In spite of its abundance in shallow water, it is a virtually unknown species. The only reference that I could find was the original description where it was described as *Cuna dalli.*

Vanatta gave the localities of his specimens as Indian Pass, Apalachicola Bay; St. Joseph Bay; and Crooked Island, off St. Andrews Bay, Florida. This takes in approximately fifty miles of the northwest Florida coast.

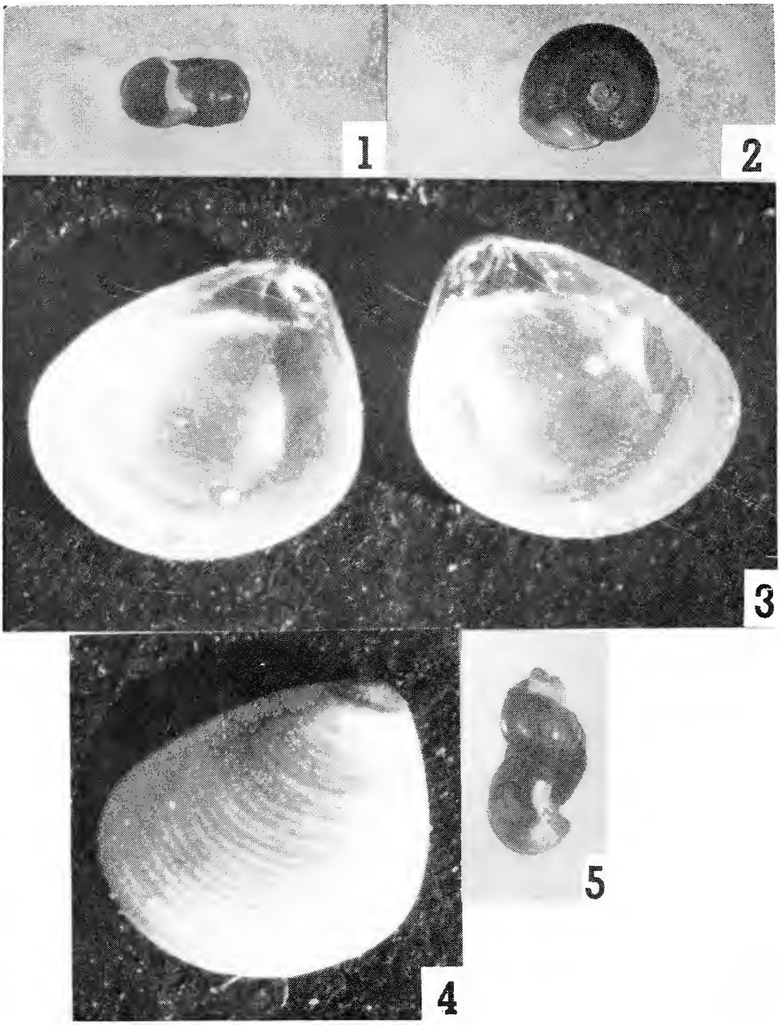
In addition to Dauphin Island, I found a few worn shells of *C. dalli* in beach sand at Horn Island, Mississippi, and a specimen was found in Ship Island Pass, Mississippi. This extends the westward range about 200 miles. Whether or not it exists in the Chandeleur Islands or west of the Mississippi is unknown. The list of marine invertebrates found at Grand Isle, Louisiana, published by Louisiana State University Marine Laboratory, does not mention this species. However, this list is by no means complete.

Live specimens were not found, but paired valves with some meat remaining inside were taken. Presumably the specimens lived not far offshore from where they were collected. This little mollusk has not been found inside Mississippi Sound and the present known distribution indicates that it is not an estuarine species, but inhabits high salinity waters just off the outer beaches of the northeastern Gulf.

Since *C. dalli* is extremely small, 2 to 2.5 mm., it is perhaps significant that Vanatta's specimens were collected in February and March, the same time of year that I noticed the species. At any rate in June, 1956, I found no specimens at Dauphin Island. This suggests that the species is an annual and reaches maturity sometime during the winter.

Since a description is not readily available, I include Vanatta's original description as well as a photograph of a specimen from Dauphin Island. A shell is figured, plate 8, figures 3 and 4.

"Shell subtriangular, inequilateral, purple in the center becoming lighter near the edge, surface sculptured with concentric costae, ventral margin smooth, adductor muscle scars rather large, hinge strong and broad. The right valve has three cardinals, the anterior is long and low, the central large and triangular, the posterior short and narrow, situated at the edge of the large ligament pit. In the left valve the anterior cardinal is long and low, the curved central is smaller than the central of



1 and 2, *Helisoma anceps*, apertural and apical views of normal shell, × 2. 3 and 4, *Cuna dalli*, alt. 1.6 mm., interior (3) and exterior (4). 5, *Helisoma anceps*, mutant, × 2.

the opposite valve, the posterior cardinal is a small ridge at the edge of the ligament. Pallial line entire.

Alt. 2.5, length 2.4, thickness of one valve, 8 mm."

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# A BULINUS–LIKE SHELL ANOMALY IN HELISOMA ANCEPS

BY EDWARD H. MICHELSON

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Although malformations of the gastropod shell are not unusual, reports of anomalies in the Planorbidae are rare. It was of interest, therefore, to observe an individual in our laboratory colony of *Helisoma anceps* (Menke) which developed a shell similar in shape (Pl. 8, fig. 5) to members of the genus *Bulinus*. The nature of this anomaly resembled the mutant condition described by Boettger (1949) for specimens of *Anisus leucostoma* (Millet).

Malformations frequently occur as a result of trauma, parasitism, or changes in the environment (Bayer, 1950; Boettger, 1952). There are but few observations which attribute shell malformities to genetic mutation and, so far as we are aware, only Boettger (1949) has indisputably demonstrated this condition in the Planorbidae.

The specimen to be described was isolated from a tropical fish aquarium which contained a large colony (100–150 snails) of *H. anceps*. This aquarium was originally maintained in the office of Professor James S. Simmons, late Dean of the Harvard School of Public Health; however, the origin of the stock colony of snails is unknown. We maintained and observed the colony for three years prior to the occurrence of the anomaly. The aquarium in which the mutation occurred is of rectangular construction with glass walls and contains approximately ten gallons of water. The bottom of the aquarium has a substrate of marble chips and sand in which a large *Sagittaria* plant was rooted. Water temperature varied with the room temperature between 72–80° F. Thirty-five common guppies (*Lebistes* sp.) constituted the fish population.

With the exception of one abnormal snail, the individuals of the colony appeared normal (pl. 8, figs. 1, 2), although some specimens were slightly scalariform. This condition is not unusual in laboratory-reared planorbids and has been previously observed by Baker (1945). Precht (1939) bred scalariform specimens of *Planorbis planorbis* and *P. leucostoma* that had been obtained from field collections, but observed only normal individuals in the $F_1$ and $F_2$ generations. Certain *Helisoma* species of the subgenus *Seminolina* are physoid in their natural habitats; however, the degree of scalarformity in some of the species appears to be influenced by the local environment.

Our specimen differs in shape from the scalariform condition of the *Seminolina* species in having the whorls more loosely coiled so that a rather high spire is produced. The edges of the whorls are well rounded and differ in this respect from the sharp, flattened edges found in the whorls of the *Seminolina* species. Four whorls can be counted in our specimen which has an altitude of 11.4 mm. and a diameter of 8.1 mm. The aperture is irregularly crescentric in shape and has a strongly reflected peristome which forms a pronounced columella. An open but deep umbilical area is formed by the reflection of the peristome. Gross examination of the internal structures revealed that all the organs appeared normal with the exception of the preputium and the ovotestis. These showed a marked degree of atrophy.

During the isolation period, the snail laid seven egg masses consisting of the following numbers of eggs: 8, 10, 17, 8, 5, 3, 12. Five of the masses failed to develop past the fourth cleavage stage. The remaining masses developed nearly to the point of hatching and then died. In every egg of the developing masses, the shells were grossly malformed.

Boettger (1949) attributed the mutation in *Anisus leucostoma* to thermal shock encountered by transferring field snails to laboratory conditions. Excessive thermal change cannot be correlated with the anomaly observed in this instance.

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# CATALOGUE OF THE LAND MOLLUSCA OF ARGENTINA

BY J. J. PARODIZ

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In this catalogue are listed for the first time all the known species and subspecies of terrestrial mollusks of Argentina and the bordering areas of Bolivia, Paraguay, Uruguay, southern Brazil, and some of Chile. It covers almost all the fauna east of the Andes and south of the 22° parallel, from subtropical regions to the subantarctic tip of the continent.

The first known list about these mollusks was published by A. Doering in 1875, and contained only 30 terrestrial species. The present work includes 45 genera, 19 subgenera, with 222 species and subspecies. Synonyms are omitted by limitation of space, but for each species and subspecies the original reference and nomenclature is given, followed by that in which the new combination was made, according to its present status, or the last occasion, (if any), where the species was fully revised. Also the type locality, the names of the Argentine provinces where the species occur, and names of the countries when the distribution is wider, are indicated.

The systematic arrangement of families is according to Pilsbry 1948 (Land Mollusca of North America). Most of the species have been identified and verified in their distribution by the writer, including many types in South and North America museums. In few cases, as in the *Veronicellidae* and *Succineidae,* a further and more intensive revision is necessary, therefore the status of the species of these families are given here as provisory.

### Cyclophoridae

*Adelopoma tucma* Doering, 1885, p. 458. Type loc.: San Javier, Tucumán. Distr.: Salta, Jujuy, Tucumán, Catamarca.
*A. paraguayana* Parodiz, 1944, p. 1, fig. 1. Type loc.: Villarrica, Paraguay.

### Helicinidae

*Helicina carinata* Orbigny, 1835, p. 28; 1837, p. 360, pl. 360, pl. 46, figs. 6–9. Type loc.: Yungas, Bolivia. Distr.: Bolivia; Paraguay; Misiones.

### Veronicellidae

*Veronicella soleiformis* (Orbigny). *Vaginulus s.* Orb., 1835, p. 2; 1837, *V. solea* Orb., p. 220, pl. 21, figs. 1–4. Type loc.: S. of Buenos Aires. Distr.: Buenos Aires to Corrientes, Tucumán; Bolivia; Uruguay.
*V. s. bonariensis* (Strobel). *Vaginulus b.* Str., 1868, p. 4, figs. 1–2; *Vaginula s. b.* Cockerell, 1893, p. 194. Type loc.: near Buenos Aires.
*V. paranensis* (Burmeister). *Vaginulus p.* Bur., 1861, p. 494. Type loc.: Paraná, Entre Rios. Distr.: Entre Rios, Santa Fe, Tucumán.
*V. salamandra* (Holmberg). *Vaginula s.* Hol., 1913, p. 171, fig. 2. Type loc.: Delta of Paraná River, N.E. Buenos Aires.
*V. deltae* (Holmberg). *Vaginula d.* Hol., 1913, p. 173. Type loc.: Jorge Island, Arroyo Barca Grande, Delta of Paraná, N.E. Buenos Aires.
*V. tucumana* (Holmberg). *Vaginula t.* Hol., 1913, p. 177. Type loc.: Tucumán.
*V. missionium* (Holmberg). *Vaginula m.* Hol., 1913, p. 178. Type loc.: Posades, S.W. Misiones.
*V. borelliana* (Colosi). *Vaginula b.* Col., 1922, p. 487, figs. 1–8. Type loc.: San Pablo, Tucumán.
*V. difficilis* (Colosi). *Vaginula d.* Col., 1922, p. 504, figs. 33–36. Type loc.: Tucumán.
*V. erinacea* (Colosi). *Vaginula e.* Col., 1922, p. 504, figs. 37–40. Type loc.: Tucumán.
*V. laurentiana* (Colosi). *Vaginula l.* Col., 1922, p. 513, figs. 51–53. Type loc.: San Lorenzo, Salta.

### Pupillidae

*Pupoides (Ichnopupoides) paredesii* (Orbigny). *Helix p.* Orb., 1835, p. 21; 1837, p. 322, pl. 44, figs. 3–6. Type loc.: Los Obrajes, near La Paz, Bolivia. Distr.: Peru; Bolivia; Jujuy.

*P.* (*I.*) *chordatus* (Pfeiffer). *Bulimus c.* Pfr., 1856, p. 46; *P. c.* Martens, 1901, p. 330. Type loc.: Mazatlan, Mexico. Distr.: La Rioja, probably introduced.

*Gastrocopta nodosaria* (Orbigny). *Helix n.* Orb., 1835, p. 22; *G. n.* Pilsbry, 1916, p. 94, pl. 17, fig. 10. Type loc.: Pampa Ruiz, Laguna, Bolivia. Distr.: Jujuy, Catamarca, La Rioja, Buenos Aires.

*G. servilis oblonga* (Pfeiffer). *Pupa o.* Pfr., 1853, p. 536; *G. o.* Pilsbry, 1916, p. 90. Type loc.: unknown. Distr.: Brazil; Uruguay; Santa Fe, Córdoba, San Luis.

*G. microdonta* (Doering). *Pupa m.* Doer., 1879, p. 82; *G. m.* Pilsbry, 1916, p. 92. Type loc.: La Paz, N.W. Entre Rios. Distr.: Corrientes, E. Rios.

*G. clessini* (Doering). *Pupa c.* Doer., 1879, p. 83; *G. c.* Pilsbry, 1916, p. 93. Type loc.: Rio Primero Valley, Córdoba. Distr.: Córdoba, S. Luis.

*G. crucifera* Hylton Scott, 1948, p. 245, fig. 1. Type loc.: Sierra de Velazco, central N. La Rioja.

*G. pulvinata* Hylton Scott, 1948, p. 246. fig. 2. Type loc.: Urundel, N.E. Salta. Distr.: Salta, Jujuy, Tucumán.

*G.* (*Immersidens*) *dicrodonta* (Doering). *Pupa d.* Doer., 1879, p. 83; *G. d.* Pilsbry, 1916, p. 100. Type loc.: Villavicencio, Mendoza. Distr.: Catamarca, Córdoba, San Luis, Mendoza.

*Ulpia venusta* Hylton Scott, 1955, p. 67, figs. 1–4. Type loc.: Lumbrera, Salta.

*Vertigo frenguellii* Hylton Scott, 1946, p. 360, fig. text. Type loc.: Cerro Colorado, Sierra Norte, Córdoba (subfossil).

### Valloniidae

*Vallonia pulchella* (Müller). *Helix p.* Müll., 1874, p. 30; *V. p.* Binney, 1878, p. 344. Type loc.: Denmark. Distr.: cosmopolitan; in Argentina: Jujuy, La Rioja, Buenos Aires.

### Clausiliidae

*Nenia argentina* Hylton Scott, 1954, p. 2, figs. 1–7. Type loc.: Las Capillas, Jujuy.

### Succineidae

*Succinea meridionalis* Orbigny, 1837, p. 711 (additions et correct.; in text, p. 235, under *S. oblonga* Draparnaud). Type loc.: (here selected) Rio de la Plata. Distr.: from Rio de Janeiro, Brazil to N. Patagonia. Distr.: Corrientes, Entre Rios, Santa Fe, Buenos Aires, Rio Negro; Uruguay; also Chile and Peru after Orbigny.

*S. m. cornea* Doering, 1881, p. 62. Type loc.: Sierra de la Ventana, S.W. Buenos Aires. Distr.: Buenos Aires, Rio Negro.

*S. burmeisteri*[1] Doering, 1873, p. 59. Type loc.: Springs on Rio Chico, above Rio Chalía, Santa Cruz (selected by Pilsbry, 1911).

*S. labiosa* Philippi, 1860, p. 164, pl. 7, fig. 7. Type loc.: Atacama, Chile. Distr.: San Luis, after Doering 1875.

*S. porrecta* Doering, 1875, p. 76. Type loc.: Valley Juntas, Tucumán.

*S. magellanica* Gould, 1852, p. 24, fig. 22. Type loc.: Orange Bay, Magellan Strait.

*S. ordinaria* E. A. Smith, 1905, p. 338, fig. 4. Type loc.: T. del Fuego.

*S. aurita* Hylton Scott, 1952, p. 29 (n.n. pro *S. aurea* Scott, 1945; not *S. aurea* Lea 1841). Type loc.: Los Manantiales, Tilcara, Jujuy.

*Omalonyx unguis* Orbigny. *Helix* (*Cochlohydra*) *u.* "Ferussac" Orb., 1835, p. 2; S. (*O.*) *u. Orb.*, 1837, p. 229. Type loc.: flooded margins of Paraná Riv. near Corrientes. Distr.: Corrientes, Entre Rios, Santa Fe; Bolivia; Uruguay, Brazil; (Paraguay?). The species *O. patera* Doering, 1873, p. 67 from Corrientes, and *Succinea convexa* Martens, 1868, p. 183 from Porto Alegre, Brazil, are forms of *O. unguis.*

## Zonitidae

*Zonitoides arboreus* (Say). *Helix a.* Say, 1816, p. 4, fig. 4; *Z. a.* Henderson 1924, p. 13, Type loc.: not indicated. Distr.: All Americas; introduced in Europe, S. Africa, Australia, Japan and Hawaii; in Argentina: Buenos Aires, Misiones, Córdoba, Jujuy; Uruguay.

*Habroconus* (*Pseudoguppya*) *semenlini* (Moricand). *Helix s.* Moric., 1845, p. 55, fig. 17. Type loc.: Brazil. Distr.: N.E. Entre Rios.

*H.* (*P.*) *lilloana* (Hylton Scott). *Guppya l.* H. Scott, 1948, p. 267, fig. 12. Type loc.: Palmar San Pedro, Jujuy. Distr.: Jujuy, Tucumán.

*H.* (*P.*) *aenea* (Hylton Scott). *Guppya a.* H. Scott, 1948, p. 270, fig. 13. Type loc.: Urundel, N.E. Salta. Distr.: Salta, Jujuy. The inclusion of the last two species in *H.* (*Pseudoguppya*) is based on the resemblance in shell, jaw and radula to the type of *Pseudoguppya*), *H.* (*P.*) *cassiquensis* Pfeiffer (see H. B. Baker, 1925, p. 10).

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[1] Systematics and distribution of these *Succinea* are poorly known; according to Doering, 1875, *S. burmeisteri* could be synonym of *meridionalis.* Also *S. rosarinensis* Doering 1873, p. 75, from Rosario, Santa Fe, may be *meridionalis.* *S. felipponei* Marshall, 1926, is very doubtful.

## Limacidae

*Deroceras reticulatum* (Müller). *Limax r.* Müll., 1774, p. 10. Type loc.: Germany. Distr.: palearctic; introduced in temperate countries; Buenos Aires.

*D. laeve* (Müller). *Limax l.* Müll., 1774, p. 2; *D. l.* H. B. Baker, 1930, p. 41, pl. 11, figs. 1–7. Type loc.: Denmark. Distr.: All Americas. In Argentina: Buenos Aires, Mendoza, Córdoba, Jujuy. *Limax argentinus* Strobel and *L. andecolus* Orbigny, belong to this species.

## Endodontidae

*Amphidoxa* (*Stephanoda*)[2] *patagonica* (Suter). *Pyramidula p.* Sut., 1900, p. 329; *S. p.* Pilsbry, 1900, p. 387, pl. 12, figs. 9–11. Type loc.: Santa Cruz. Distr.: S. Patagonia, Tierra del Fuego.

*A.* (*S.*) *jujuyensis* (Hylton Scott). *Stephanoda j.* H. Scott, 1948, p. 251, fig. 4. Type loc.: Ravines of Rio Chico, Jujuy.

*Discus costellata* (Orbigny). *Helix c.* Orb., 1837, p. 252, pl. 26, figs. 6–9. Type loc.: Montevideo. Distr.: Uruguay; Buenos Aires. Unidentified specimens, different from *costellata* were found at Totoral and Chumbicha, Catamarca.

*Austrodiscus*[3] *twomeyi* (Parodiz). *Araucania t.* Par., 1954, p. 17, fig. 1. Type loc.: Rio la Pascua, S. Chile. Distr.: probably Santa Cruz.

*Radiodiscus magellanicus* (E. A. Smith). *Helix m.* Smith, 1881, p. 36; *R. m.* Pilsbry, 1905, p. 517, pl. 42, fig. 1. Type loc.: Tom Bay, near Madre de Dios Island, S. Chile. Distr.: very probably in Lake Argentino region and Tierra del Fuego.

*R. riochiquensis* Crawford, 1939, p. 115. Type loc.: Rio Chico region, S. Santa Cruz.

*R. katiae* Hylton Scott, 1948, p. 253, fig. 5. Type loc.: Ravines of Rio Chico, city of Jujuy.

## Achatinidae

*Cecilioides consobrina* (Orbigny). *Achatina c.* Orb., 1837, p. 89, pl. 11 (bis), figs. 10–12; *C.* (*Caecilianopsis*) *c.* Pilsbry, 1908, p. 38, pl. 5, figs. 81–82. Type loc.: near Matanzas, Cuba. Distr.: Entre Rios, Salta, Jujuy, Tucumán, Córdoba, San Luis.

*Lamellaxis* (*Allopeas*) *gracilis* (Hutton). *Bulimus g.* Hutton, 1834, J. As. Soc. Bengal, 3, p. 93; *L.* (*A.*) *g.* H. B. Baker, 1935, p. 84. Type loc.: Mirzapur, India. Distr.: "tropics of both hemispheres" (Pilsbry 1948); in Argentina: Buenos

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[2] This status of *Stephanoda* is according to Thiele. Other authors maintain it as a separate genus.

[3] **Austrodiscus, new name** pro *Araucania* Parodiz, 1954, not *Araucania* Pate 1946, Hymenoptera, Sapygidae.

Aires, Martín Garcia Island in Rio de la Plata; the loc. for the syn. *O. martensi* Doering is Buenos Aires.

*Leptinaria bacterinoides* (Orbigny). *Helix b.* Orb., 1835, p. 9, *L. p.* H. Scott, 1948, p. 255, fig. 7. Type loc.: Pampa Ruiz, Bolivia. Distr.: Salta, Jujuy; Bolivia; Paraguay.

*Stenogyra goodalli* Miller (= *Opeas pumilum* Pfr.) referred by Doering, 1875, from Uruguay, was probably accidental, since this widely introduced species has not been found again in the region.

*Obeliscus* (*Rectobelus*) *birabeni* Hylton Scott, 1946, p. 363, figs. 1–3, pl. fig. 1–4. Type loc.: Vicinities of Jujuy city.

### Strophocheilidae

*Strophocheilus* (*Megalobulimus*) *oblongus haemastomus* (Scopoli) *Bulimus h.* Scop., 1786, Delic. Faun. Fl. Insubricae, 1, p. 67, pl. 25, figs. $1^{b-2}$; *S.* (*M.*)*o. h.* Bequaert, 1948, p. 74, pl. 6, fig. 2, pl. 21, fig. 4, pl. 24, fig. 5. Type loc.: ? Distr.: Corrientes, Entre Rios; Uruguay; Paraguay; S. Brazil.

*S.* (*M.*) *o. elongatus* Bequaert, 1948, p. 78, pl. 1, fig. 4, pl. 2, fig. 4. Type loc.: Nueva Palmira, Uruguay. Distr.: Uruguay; Paraguay; E. Rios ?

*S.* (*M.*) *o. lorentzianus* (*Doering*). *Bulimus* (*Borus*) *l.* Doer., 1875, p. 336; *S.* (*M.*) *o. l.* Bequaert, 1948, p. 80, pl. 27, fig. 5. Type loc.: Sierras de Tucumán. Distr.: N.W. Argentina from Salta to Córdoba.

*S.* (*M.*) *o. musculus* Bequaert, 1948, p. 82, pl. 12, fig. 6, pl. 20, fig. 1, pl. 31, fig. 4. Type loc.: Villarrica, Paraguay; Distr.: Salta, Jujuy, Corrientes, E. Rios; S.E. Brazil; Paraguay; probably Uruguay.

*S.* (*M.*) *intertextus* Pilsbry, 1895, p. 32, pl. 17, figs. 30–31, as *S.* (*Borus*) *capillaceus i.; S.* (*M.*) *i.* Bequaert, 1948, p. 84, pl. 18, fig. 3. Type loc.: Corumba, Brazil; Distr.: Brazil; Uruguay; Santa Fe ?

*S.* (*M.*) *sanctipauli* Pilsbry & Ihering, 1900, p. 390, as *S. oblongus s.; S.* (*M.*) *s.* Bequaert, 1948, p. 137. Type loc.: Botucata, Sao Paulo, Brazil. Distr.: S. Brazil; Paraguay; Misiones, Corrientes.

*S.* (*M.*) *s. eyerdami* Bequaert, 1948, p. 139, pl. 24, fig. 2. Type loc.: Tartagal, Salta.

*S.* (*M.*) *globosus* (Martens). *Bulimus g.* Mart. in Pfeiffer, 1876, p. 17; *S.* (*M.*) *g.* Bequaert, 1948, p. 142, pl. 4, fig. 7, pl. 15, fig. 2, pl. 20, fig. 2. Type loc.: near Montevideo ? Distr.: Uruguay (living); subfossil in pleistocene of Entre Rios and Buenos Aires.

*S.* (*Austroborus*) *lutescens* (King & Broderip). *Bulimus l.* King & Brod., 1832, p. 340; *S.* (*A.*) *l.* Parodiz, 1949, p. 189. Type loc.: Maldonado, Uruguay. Distr.: S. Uruguay.

*S.* (*A.*) *l. d'orbignyi* Doer., 1876, p. 366; *S.* (*A.*) *l. d.* Parodiz, 1949, p. 190. Type loc.: Sauce Chico Valley, S.W. Buenos Aires. Distr.: Sierra de la Ventana and around Bahia Blanca.

*S.* (*A.*) *cordillerae* (Doering). *Bulimus* (*Borus*) *lutescens c.* Doer., 1876, p. 385; *S.* (*A.*) *c.* Parodiz, 1949, p. 190 and 219. Type loc.: Sierra Achala, Córdoba. Distr.: W. Córdoba, in alluvional beds; subfossil in pleistocene of Uruguay. Living specimens are rare.

*Gonyostomus* (*Anthinus*) *turnix albolabiatus* Jaeckel, 1927, p. 136. Type loc.: Santa Rosa, Rio Grande do Sul. Distr.: S. Brazil; Misiones, N. Corrientes.

### Macrocyclidae

*Macrocyclis laxata* (Ferussac). *Helicella l.* Fer., 1820, p. 39; *M. l.* Pilsbry, 1894, p. 165. Type loc.: "Chile." Distr.: in Argentina: Nahuel Huapí National Park, Neuquen-Rio Negro.

### Bulimulidae

*Bulimulus rushii* Pilsbry, 1896, p. 78. Type loc.: Maldonado, Uruguay. Distr.: Entre Rios, Corrientes; subfossil at La Plata.

*Bulimulus bonariensis* (Rafinesque). *Siphalomphis b.* Raf., 1833, no. 5, p. 165. Type loc.: Buenos Aires. This is the species known as *B. sporadicus* Orb., which typical form is the named *B. s. bonariensis* Str.

*B. b. sporadicus* (Orbigny). *Helix s.* Orb., 1835, p. 12; *B. sporadicus* of authors. Type loc.: not indicated; Orbigny mentioned several loc. now belonging to other species or subspecies, but those figured in 1837, pl. 32, figs. 12–14 are the typical from Chiquitos, Bolivia. Distr.: Bolivia; Paraguay; Salta, Tucumán, Chaco, Formosa, Stgo. del Estero, Santa Fe, Corrientes, Entre Rios.

*B. b. montevidensis* (Pfeiffer). *Bulimus m.* Pfr., 1846, p. 33; *B. s. m.* Pilsbry, 1897, p. 68, pl. 11, fig. 19. Type loc.: Montevideo, Uruguay.

*B. b. morenoi* Preston. *B.* (*Drymaeus*) *m.* Pr., 1907, p. 494. Type loc.: "Argentina" (probably Buenos Aires).

*B. b. schadei* Schlesch, 1935, p. 86, as *sporadicus s.* Type loc.: Villarrica, Paraguay.

*B. b. gracilis* Hylton Scott, 1948, p. 238, pl. 2, fig. 3, as *sporadicus g.* Type loc.: Cerro Colorado, S.E. Salta.

*B. vesicalis uruguayanus* Pilsbry, 1897, p. 69, pl. 12, figs. 38–39. Type loc.: Montevideo, Uruguay; pleistocene of Buenos Aires.

*B. apodemetes* (Orbigny). *Helix a.* Orb., 1835, p. 10; *B.* (*Bostryx-Lissoacme*) *a.* Pilsbry, 1897, p. 187, pl. 51, figs. 1–4. Type loc.: Santa Fe. Distr.: Bolivia, Paraguay; Uruguay;

Salta, Formosa, Chaco, Tucumán, Stgo. del Estero, Santa Fe, Catamarca, Corrientes, Entre Rios.

*B. a. dispar* Hylton Scott, 1952, p. 23. Type loc.: Pocitos, Salta.

*B. gorritiensis* Pilsbry, 1897, p. 18. Type loc.: Gorriti Id., coast of Uruguay. Distr.: Gorriti and Lobos islands.

*B. jujuyensis* Holmberg. *B.* (*Thaumastus*) *jujuyensis* Hol., 1909, p. 11; *B.* (*B.*) *j.* H. Scott, 1945, p. 207, pl. 1, figs. 8–9. Type loc.: Quebrada de Humahuaca, Jujuy. Distr.: Jujuy, (Salta ? ), Formosa.

*B. flossdorfi* Holmberg, 1909, p. 11. Type loc.: Nueva Pompeya, Formosa.

*B. prosopidis* Holmberg, 1912, p. 148, as *B.* (*Mesembrinus*) *p.* Type loc.: Margins of Pilcomayo Riv. Distr.: Argentina-Paraguay border.

*B. eliator* Hylton Scott, 1952, p. 21, pl. 2, fig. 4. Type loc.: Laguna Yema, Formosa.

*B.* (*Scansicochlea*) *pastorei* Holmberg, 1912, p. 22, as *B.* (*Mesembrinus*) *p.* Type loc.: Cerro Varela, San Luis.

*B.* (*S.*) *jorgenseni* Holmberg, 1912, p. 150, as *B.* (*Leptomerus*) *j.* Type loc.: Bompland, Misiones. Distr.: common in tobacco plantations.

*B.* (*S.*) *montagnei* (Orbigny). *Bulimus m.* Orb., 1837, p. 286, pl. 32, figs. 5–7. Type loc.: Santa Cruz, Bolivia. Distr.: Argentina-Bolivia.

*B.* (*S.*) *hyltonscottae* Parodiz, 1956, p. 59, figs. 1–4. Type loc.: El Zapallar, Quines, San Luis.

*B.* (*S.*) *strobeli* Parodiz, 1956, p. 62, fig. 5. Type loc.: Cerro del Morro, San Luis.

*Thaumastus* (*Scholvienia*) *argentinus* Bequaert, 1949, p. 114, pl. 7, fig. 6. Type loc.: N. of "Pique" (for Pigüé), S.W. Buenos Aires; this southernmost loc. for a living *Thaumastus* needs confirmation. Very close to *T.* (*S.*) *weyrauchi* Pilsbry, 1944, p. 121, pl. 11, fig. 2 from Peru.

*Scutalus tupacii* (Orbigny). *Helix t.* Orb., 1835, p. 16; *Bulimulus* (*S.*) *t.* Pilsbry, 1897, p. 19, pl. 3, figs. 27–31. Type loc.: Yunacacha, Yungas, Bolivia. Distr.: Salta, Jujuy, Tucumán, Stago. del Estero.

*Neopetraeus stelzneri* (Dorhn). *Bulimulus* (*Scutalus*) *s.* Dorhn, 1875, p. 202; *N. s.* Parodiz, 1946, p. 349. Type loc.: Yocotula, Catamarca. Distr.: Catamarca, La Rioja, Salta. The typical subspecies includes the forms described by Parodiz, 1948: *hybrida,* p. 12, Sierra Velazco, La Rioja; *nonogastanus,* p. 13, Nonogasta, La Rioja; *tinogastanus,* Tinogasta, Catamarca; *scaber,* p. 14, Cachi, Salta.

*N. s. conispirus* (Doehring). *Bulimulus* (*Scutalus*) *c.* Doer., 1879, p. 67. Type loc.: Sierra de Tucamán. Distr.: Catamarca, Tucumán, La Rioja (San Luis?). Form *minuta* Parodiz, 1948, p. 18, Fiambala, Cat.

*N. s. peristomatus* (Doering). *Scutalus p.* Doer., 1879, p. 4; *N. s. p.* Parodiz, 1948, p. 14. Type loc.: Sierra Pocho, Córdoba. Form *paraconispirus* Parodiz, 1948, p. 16, from Sierra Gigante, San Luis.

*N. s. hector* (Holmberg). *Bulimulus h.* Holm., 1909, p. 11. Type loc.: Tilcara, Jujuy. Distr.: Jujuy, Salta. *B. h. multicincta* Holm., 1909, p. 12, from same loc., is banded form of this subspecies.

*N. s. apertus* Hylton Scott, 1948, p. 238, pl. 2, figs. 4–5. Type loc.: Cerro Colorado, N.E. Salta.

(*To be continued*)

# LAND AND FRESH WATER MOLLUSKS OF UNION COUNTY, NEW JERSEY

By SAM FREED

Union County, located in the north-eastern part of the State has an area of 102.1 square miles. It is bounded on the north by Essex County, east by Middlesex County and west by Somerset and Morris Counties. The ground is generally level with marsh land toward the coast while the western section is broken by a range of hills known locally as the Watchung Mountains. The highest point is located at the Second Mountain north of Feltville and has an elevation of 553 feet above sea level. The principal rivers draining the county are the Rahway and Elizabeth, both flowing into the Arthur Kill.

The Watchung Mountains are abrupt ridges which rise above the general level of the Piedmont Belt. The crests and upper slopes of the Watchungs are composed of diabase and basalt. In the northwestern part of the county the Terminal Moraine is characterized by especially uneven topography. The westernmost part of the county is located in the Passaic River Basin. This is the bed of old glacial Lake Passaic, distinguished particularly by extensive silt and clay sediments.

Total annual precipitation is 56.08 inches. May is the wettest month with an average of 6.52 inches. Temperature ranges from an average of 79.2 degrees in the summer to 36.0 degrees in the winter.

Most of the county is highly industrialized and the building of factories and homes is at a peak. Well-developed farm patterns however still persist. The collecting of shells was carried out over a period of several years mostly in the county park system. The largest park is Watchung Reservation with 1946 acres.

Major collecting sites: Bryant Park Pond, Warinanco Park Lake, Lake Surprise, Watchung Reservation, Black Brook, Rahway River, Nomahegan Park, Galloping Hill Park and Tuscan Dairy Farm.

Specimens have been deposited with The Academy of Natural Sciences of Philadelphia and Smithsonian Institution, U. S. National Museum.

I wish to thank Dr. Charles B. Wurtz and Dr. J. P. E. Morrison, Associate Curator of Mollusks, U. S. National Museum, for assistance in identifying the material.

Terrestrial Mollusks: *Succinea ovalis* Say. *Vallonia pulchella* (Müller). *Cionella lubrica* (Müller). *Zonitoides nitidus* (Müller). *Zonitoides arboreus* (Say). *Oxychilus cellarius* (Müller). *Helicodiscus parallelus* (Say.) *Mesodon thyroidus* (Say). *Triodopsis tridentata* (Say). *Triodopsis albolabris* (Say). *Anguispira alternata* (Say). *Mesomphix cupreus* (Rafinesque). *Oxyloma effusa subeffusa* Pilsbry.

Aquatic Mollusks: *Helisoma anceps* (Menke). *Helisoma trivolvis* (Say). *Viviparus malleatus* (Reeve). *Campeloma decisum* (Say). *Physa heterostropha* (Say). *Lymnaea palustris* (Müller). *Lymnaea parva* Lea. *Lymnaea humilis* Say. *Pseudosuccinea columella* (Say). *Planorbula armigera* (Say). *Menetus dilatatus* (Gould). *Sphaerium transversum* (Say). *Anodonta cataracta* Say.

## References

Alexander, Robert C. 1952. Nautilus, 66 (2): 54–59.

Pilsbry, Henry A. 1939–48. Land Mollusca of North America, etc. Vols. 1 and 2, Acad. Nat. Sci., Philadelphia, 2006 pp.

Quakenbush, Granville A. 1955. Bulletin 775, N. J. Agricultural Experiment Station, Rutgers University.

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# PUBLICATION DATES OF TROSCHEL'S "DAS GEBISS DER SCHNECKEN"

By ROBERT ROBERTSON

Museum of Comparative Zoölogy

*Das / Gebiss der Schnecken / zur / Begründung einer Natürlichen Classification / untersucht von / Dr. F. H. Troschel,* which appeared in Berlin from 1856 to 1893, is the largest comparative study of molluscan radulae ever published. The basis of our modern classification of gastropods rests in part on this monumental work. Troschel introduced a few new generic and subgeneric names in the book, and in a very few cases may have made valid subsequent selections of generic types. The main criticism that should be made is that conchologists have to rely entirely on Troschel's identifications, for no shells were figured. Troschel died in 1882, and the last two parts of vol. 2 were written and illustrated by J. Thiele. For an obituary of Troschel, see H. Von Dechen. 1883. Correspondenzblatt no. 1, naturhist. Vereines d. preussischen Rheinlande u. Westfalens. Bonn. [In] Verhandlungen, 40, pp. 35–54.

Since the dates of publication of the various parts of *Das Gebiss der Schnecken* cannot be determined from the book itself, and are not readily available elsewhere, the following collation has been prepared.

| Part | Pages | Plates | Date |
|---|---|---|---|
| | | VOL. 1 | |
| 1 | 1–72 | 1–4 | 1856 |
| 2 | 73–112 | 5–8 | 1857 |
| 3 | 113–152 | 9–12 | 1858 |
| 4 | 153–196 | 13–16 | 1861 |
| 5 | 197–252 | 17–20 | 1863 |
| | i–viii | | 1863 |
| | | VOL. 2 | |
| 1 | 1–48 | 1–4 | Dec. 1865 |
| 2 | 49–96 | 5–8 | Dec. 1867 |
| 3 | 97–132 | 9–12 | 1869 |
| 4 | 133–180 | 13–16 | 1875 |
| 5 | 181–216 | 17–20 | Sept. 18, 1878 |
| 6 | 217–246 | 21–24 | Sept. 2, 1879 |
| 7 | 249–334 | 25–28 | 1891 (by Thiele) |
| 8 | 337–409 | 29–32 | 1893 (by Thiele) |
| Title and i–ix. | | | 1893 |

Wrappers to parts 1 and 2 are dated 1866 and 1868.
Pages 247–248 and 335–336 omitted.

### SOURCES OF INFORMATION

Copy in MCZ library with original wrappers to vol. 2 and MS bibliographic notes.

Reviews in Malak. Blätt. (1). 3, pp. 251–255, 1857; 4, pp. 223–225, 1857; 5, pp. 232–234, 1858; 8, pp. 113–117, 1861; 10, pp. 240–244, 1863.
Zoological Record (Mollusca) for 1865, 1867.

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## THEODORE THOMAS DRANGA

### 1901–1956

On October 29, 1956, Theodore T. Dranga died suddenly at Mahe, Seychelles, Indian Ocean. He was nearing the finish of a trip of several months, covering the Canary Islands, Coast of Spain, Mediterranean, the western part of the Indian Ocean and South Africa, the last fields in the world where he had not previously collected mollusks.

He was born August 19, 1901, in Hilo, Hawaii, the son of Helen Thomas Dranga, born in England; and Thomas A. Dranga, born in California. He and his parents lived near the ocean, and naturally he learned to swim and dive when very young, and became almost semi-amphibious; often spending the major portion of the day in the water, collecting shells and corals. Ted, as he is known by collectors all over the world, was first known as "The Coral Man" of Honolulu, having collected a number of rare species among the caves around the Hawaiian Islands, and later, in other spots of the world. He also collected sea shells, and one day, when about twelve, his Mother took him to call upon Mr. Ditlev D. Thaanum to see his shells, and after that, whenever he found a new shell, he went to Mr. Thaanum for identification. He had a brilliant scientific mind, and learned rapidly the Latin names of the corals and mollusks. He also developed an excellent knowledge of botany and ornithology. In fact, he was called a Nature Boy, in fact and in practice.

In 1924, after the tutelage of Mr. Thaanum, he went to work as collector and cataloguer for the Bishop Museum and went on an Expedition to the line islands, Howland and Baker, etc., and made several trips with the Tanager Expedition to the outlying Hawaiian Islands, to Laysan, Gardner and other good collecting areas. In 1925 he accompanied Dr. Cooke on a long trip to Samoa, collecting land shells, and afterwards did considerable land shell collecting on Kauai. In 1925 and 1926 he was invited by Mr. L. A. Thurston and Mr. D. D. Thaanum to accompany them on a collecting trip to Palmyra Island, preparing himself for the trip with only fifteen minutes notice. Afterwards, he stayed on with Mr. Thurston as an assistant collector, making many trips; one very important expedition in 1927 included the Pearl and Hermes Reef and many of the South Pacific Islands.

After these many collecting trips, it was only natural that he should begin to sell corals and mollusks to collectors in Hawaii, and eventually to dealers all over the world. The number of correspondents grew, until finally he decided to visit the mainland, and deal with these contacts personally. In 1935 he came to California, visiting up and down the Coasts, collecting as far south as Bahia California, and selling. Late in 1936 he went to Florida where he visited extensively among the dealers he had known. Early in 1937 we went to Sanibel, calling upon Dr. Louise M. Perry, who was doing extensive dredging and collecting in the Gulf. For several winters he came to Sanibel, helping with the dredging and collecting, and, at Dr. Perry's suggestion, taught Jeanne Schwengel the business of collecting, cleaning and naming the shells found on and around the Islands.

Early in 1938 Ted went back to Hawaii, and in 1940 he and Mr. Thaanum visited many of the little known islands of the South Pacific; and when Mr. Thaanum returned to Hawaii, Ted continued on to Bali, Fiji and Australia. While walking on the shore collecting on the unpopulated northwest coast of Australia near Broome; after camping out for three nights and travelling on the shore farther away from civilization every day, he was rudely jabbed in the ribs by a uniformed Australian soldier and taken in for questioning. He was informed that a war was on, and after assuring the authorities that his was a peaceful mission, he was released, and forthwith hurried back to Hawaii, and from there on back to Florida where he settled in Coral Gables, and later in Miami. After his marriage, he opened a beautiful shop in Miami, "Treasures of the Sea," where he sold shells and South Seas novelties.

During this time he made numerous trips to the West Indies, Mexico, Costa Rica, Panama and Honduras with his wife, Anna; and alone, to practically all parts of South America and the

Galapagos Islands; always coming back with the best shells available. Many of these trips were very rugged, with food and water almost unobtainable. But collecting was of first importance to him, and food could always be had from the sea, if no other source was near. In 1955, he and Anna joined Dr. Axel A. Olsson on an expedition for the Academy of Natural Sciences of Philadelphia. This expedition covered the Ecuadorian coast from the southern-most tip to the northern boundary; transportation being by native canoe, busses, on foot and on banana boats. Many new records were established on this trip.

Later, Ted decided that he should collect in the Mediterranean, South Africa and the Indian Ocean, so, planning a fast, grueling trip, he did not take his wife along, and left last June for the Canary Islands, Spain, the Mediterranean, Seychelles and South Africa. The latter part of October he wrote that he would be home for Christmas, but gave no details of his immediate plans.

Due to the troubled conditions in that part of the world, information about the cause of his death has been difficult to obtain, but we have assumed that his strenuous collecting and diving had affected his heart, and, probably having overdone in his anxiety to cover as much of the field as possible before his departure for home, had collapsed.

He was a member of The American Malacological Union; The Philadelphia Shell Club; The Hawaiian Shell Club and The St. Petersburg Shell Club. He is survived by his widow, Anna H. Dranga, 1260 S. W. First Street, Miami 35, Florida.

All collectors, the world over, will miss him, for he loved mollusks, and always had the best to offer; beautifully cleaned, with all collecting data. If Ted had had his choice, he would have chosen to go doing the thing he enjoyed most; collecting sea shells, and the completion of his world-wide travels. (Information from Anna Dranga, Detlev D. Thaanum and correspondence over the last twenty years.) J. S. Schwengel.

## WILLIAM G. FARGO

On Feb. 9, 1957, science lost a kind friend and colleague with the passing of William G. Fargo in Pass-a-Grille, Florida, at the age of 90. Mr. Fargo, a civil engineer and a former resident of Jackson, Michigan, was particularly interested in the fossil and recent mollusks of Florida. He led the geological investigation of the Pliocene outcropping at St. Petersburg, Florida, which resulted in the large monograph on the "Pliocene Mollusca of Southern Florida" published in 1953 by the Academy of Natural Sciences of Philadelphia. He contributed the chapter on the Turridae. Mr. Fargo was exceedingly generous in his support of publications and collections in a number of our leading institutions.

## GUY L. WILKINS

We have received a brief notice of the premature passing of Mr. Guy L. Wilkins of the British Museum of Natural History during the first week of March, 1957.

## NOTES AND NEWS

Wrong address.—Recently The Nautilus received a properly addressed envelope, which forwarded two letters: one from Canada and the other from a Swedish bookstore. Although both enclosures contained our yellow invoices with complete directions, each was addressed simply to: The Nautilus, Philadelphia 4, Pa. This forwarding was accompanied by a nice note from the Commanding Officer, *U.S.S. Nautilus*, whom we wish to thank for his trouble.—H. A. P. and H. B. B.

Families of Pulmonata, no. 3.—The following addenda and errata for Naut. 69, pp. 128–139, and vol. 70, p. 34, have been noted:

Acavidae (1895) Mlldff., 1898. SubF. Caryodinae (Anoglyptidae Allan, 1950).

Achatinidae: (Ampullidae Winckworth, 1945). SubF. Stenogyrinae (Obeliscinae, 1931, not A. Adams, 1863, based on a homonym). SubF. Coeliaxinae (-idae Germain, 1917).

Acroreidae (Acroriidae Cossm., 1893, on a homonymous emendation).

Ancylidae (1815) Brown, 1845.

Auriculidae: SubF. Cassidulinae, 1925, based on a synonym but not a homonym; not Troschel, 1867, on a homonym.

"Cerionidae": Ceriidae (1818?) Winckworth, 1945 (Pupacea Fleming, 1818, on a homonym of "*Pupa* Roeding") would be the correct spelling. F. of Cerioidea.

Clausiliidae: SubF. Alopiinae (Garnieriinae Ehrmann, 1927). SubF. Phaedusinae (Megalophaeduseae, Serrulinae & Xaptycheae Zilch, 1954).
Cochlostylidae Mlldff., 1890, on a subjective synonym (Helicostylinae Ihering, 1909). SubF. Eulotidae Mlldff., 1898, on a synonym.
Dorcasi-idae: -inae Connolly, 1915. F. of Cerioidea.
Euconulinae: (Durgellinidae, 1941, on a subj. syn.; Coneuplectinae Habe, 1948).
Eulotidae: see Cochlostylidae.
Gadiniidae (1840) Martens, 1866, on a synonym.
Helicidae: (Murellinae Hesse, 1918. Tacheocampylaeinae Germain, 1929). SubF. Ariantidae, 1864 (Helicigoninae Germain, 1929), both on synonyms. SubF. Helicodontinae Hesse, 1907.
Helixarionidae Bourguignat, 1883 (Helicarioninae, 1888, on an emendation).
Hygromiidae: SubF. Leucochroidae (Helicellinae Ihering, 1909, not Adams, 1855. Albeidae Llabador, 1950, on a subj. syn.).
Lati-idae Hutton, 1881.
Limacidae: -ideae Gray, 1821 (Agriolimacinae; Deroceratinae Magne, 1952).
*Lucerna:* (Lampadiidae Winckworth, 1945, on a misusage).
Orthalicidae: SubF. Bulimulinae (Bothiembry-ontidae Allan, 1950).
Planorbidae (1815) Bgt., 1883. SubF. Bulinulinae, 1847 (Bullin-ea "Oken, 1815" Herrm., 1847, -idae Germain, 1919, not Bullin-itia Raf., 1815, both on emendations, of *Bulinus* and *Bullaea,* respectively. Miratestidae Sarasin, 1897).
Plectopyl(id)-idae Mlldff., 1898. F. of Cerioidea.
Punctidae: SubF. Phenacohelicidae, 1892 (Flammulinidae Crosse, 1894).
Rathouisi-idae Heude, 1885.
Rhytididae Pilsbry, Feb. 25, 1893, would be prior to Paryphantinae Godwin-Austen, "Oct., 1893." F. of SuperF. Rhytididae.
Streptaxidae: (Artemonidae Bgt., 1889, on a subj. syn.). SubF. Enneidae Bgt., 1883 (Streptostelidae Bgt., 1889).
Thyrophorellidae Girard, 1895.
Xanthonych-idae: SubF. Cepoliinae Pilsbry, 1939? (Cepolinae, 1928, not Raf., 1815, or Bon., 1831).
Xestidae: SubF. Girasiidae Collinge, 1902.—H. BURRINGTON BAKER.

ZACHRYSIA PROVISORIA (*Pfr.*),[1] a species common around Nassau, Bahamas, has been found living in Miami, Florida (in the

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[1] I wish to thank Mr. Ralph Jackson for the identification.

N. W. section) for the past two years. It was found in a coral-rock mound (area approximately thirty-six sq. feet) where formerly grew a large oleander bush, but now replaced by a thick moist growth of rain violets and coral vines. (I understand that these violets were purchased from a nurseryman some years ago who made trips to Nassau at that time.) However, the snails did not appear until two years ago. These snails have also been found in a mouldy wet area around a rock fountain in a nearby yard. They have not been reported from other localities in that area but they are definitely established in this one place as I've had over forty shells and snails from juveniles to full-grown adults. At present I'm attempting to raise these in bowls in the house and they have ravenous appetites for anything that is offered.

If any shell collector desires some of the shells, write Dr. R. Clarke, P.O. Box 221, Deland, Florida.

## PUBLICATIONS RECEIVED

Indo-Pacific Sea Shells by Sally D. Kaicher. Privately published (4642 Livingston Rd., Wash. 20, D. C.). 1956.—Each part $1.00. A series of pamphlets is now being published which contains excellent illustrations of the commoner marine shells of the Indo-Pacific region. Five of the intended eight booklets have been issued. The author has presented a series of beautiful pencil sketches with a correct scientific name, size of shell, and geographic range. The completed eight parts will be of immense help in identifying about 600 of the commoner Pacific species.—R. T. Abbott.

Cowry Shells of World Seas by Joyce Allan. X + 170 pp., 15 pls. Georgian House, Melbourne. 1956 (63 shillings).—Specialists in cowrie shells will welcome this book for several reasons. All of the known species and varieties of Cypraeacea are listed, together with the author's name, date, geographical range, brief description, and an illustration. Approximately 350 forms are illustrated by colored or black-and-white paintings, and, although some of them are grossly distorted, there should be little difficulty in identifying most species. There is a wealth of interesting historical data scattered throughout the text, as well as an interesting and informative introduction. The nomenclature follows the extremes of Iredale and the Schilders, and although the author frequently presents legitimate arguments against certain ''splittings,'' she obviously did not wish to offend her scientific acquaintances by synonymizing or ''lumping.'' However, the gem-collecting type of amateur will enjoy pigeon-holing the numerous forms and so-called genera. Contrary to most authorities, the author accepts Gronovius' name of *Amphiperas,* although I believe that *Ovula* is the earliest valid name. It may interest cowrie specialists to know that a second specimen of *Cypraea leucodon* Broderip is in the Museum of Comparative Zoölogy, Cambridge, Mass.—R. T. ABBOTT.

SEASONAL VERTICAL MOVEMENTS OF OYSTER DRILLS (*Urosalpinx cinerea*). Proc. Nat. Shellfish. Asso. 1954, pp. 190–198. By Melbourne R. Carriker.—At least 75 per cent of the drills bury partly or completely in the bottom during the colder months of the year in the New York–New Jersey area. Only the tip of the siphon remains at the surface. Complete inactivity probably does not occur except at water temperatures below 35° F.

SEA TREASURE. By Kathleen Y. Johnstone. 242 pp., 8 pls., text figs. Houghton Mifflin Co., Boston. $4.00. This is an excellent book for those being introduced to mollusks for the first time. It is well organized, accurate, and entertainingly written, and not only covers the rudiments of conchology, but also presents a great deal of new information on mollusks in art, literature, history and Indian lore. The eight colored plates depict 63 species in excellent paintings by Rudolf Freund. The term ''genotype'' is incorrectly defined on p. 56, but other than this the book is very free of errors.—R. T. A.