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SPIDERS OF BERMUDA

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ABSTRACT. Fifty-nine species from 22 spider families are currently known to occur on Bermuda, the majority being widely distributed, cosmopolitan and cosmotropical species. Collections of Bermudian spiders from the Peabody Museum, the Academy of Natural Sciences of Philadelphia, and the Bermuda Department of Agriculture & Fisheries were studied. Newly collected material (July 1983, May 1988), deposited at the Natural History Museum of Bermuda, was incorporated. *Lycosa atlantica* Marx, 1889, is a junior synonym of *Trochosa ruricola* (DeGeer, 1778); *Anyphaena verrilli* Banks, 1902, and *Oonops bermudensis* Banks, 1902, are junior synonyms of *Aysha velox* (Becker, 1879) and *Heteroonops spinimanus* (Simon, 1891) respectively. A new anyphaenid species, *Anyphaena bermudensis*, is described.

INTRODUCTION

Bermuda consists of an isolated group of seven large and numerous smaller islands, situated at 32°18'N, 64°46'W in the Atlantic Ocean, about 1000 km east-southeast of Cape Hatteras, North Carolina, USA. Due to the nearby Gulf Stream, the climate is mild and frost-free. Annual rainfall averages 1400 mm and is spread evenly throughout the seasons.

The spider fauna of Bermuda is known from three previous collections by Blackwall (published 1868, nomenclature revised by Simon, 1883), Heilprin (published by Marx, 1889) and Verrill (published by Banks, 1902). In total, twenty-eight species of spiders had been recorded from Bermuda previously [additionally, Banks listed six unidentified species]. The present study adds twenty-six new species records. Together with one salticid species recorded by Griswold and four unidentified species, a total of 59 species of spiders from 22 families are known to occur on Bermuda.

An identification key to the spiders of Bermuda is not presented here. The reader is referred to Levi (1987) for family-level determinations, and

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to Roth (1985) for genus-level identification. Identification to species can only be reached by comparison of copulatory organs. For this purpose, the specialized, taxonomic literature cited under each species should be consulted.

This paper is part of an informal series on the Bermudian fauna and flora initiated by the Bermuda Department of Agriculture & Fisheries.

MATERIALS AND METHODS

Existing Collections of Bermudian Spiders

This study includes the following material:

1) the Heilprin collection, collected 1888; deposited in the Academy of Natural Sciences of Philadelphia (12 species); identified and results published by Marx, 1889 [only parts of the original Heilprin material were found in the collection].

2) The Verrill collection, collected 1901-1902; deposited in the Peabody Museum of Natural History, Yale University; identified and results published by Banks, 1902 (23 species, plus six genus records based on immature specimens).

3) Collections of the Natural History Museum of Bermuda: a) collection of the Department of Agriculture & Fisheries [collections made mainly by Dr. I. W. Hughes, Francis Monkman and Dr. D. J. Hilburn]; b) material collected in July 1983 and May 1988 by the author. Additional duplicate material was deposited in the USNM as indicated.

Blackwall's collection could not be located (Hope Entomological Collections, Oxford, Great Britain).

Text conventions

Under each species, references are made to diagnostic figures of ♀ and ♂ for identification purposes. Synonyms in brackets are names used by other authors in previous publications on Bermudian spiders. If the species was originally described in a different genus, that generic name is added (e.g., sub *Aranea*). The specimen listings are ordered according to the months (abbreviated, first three letters) in which adults were found.

Abbreviations

INSTITUTIONS:

AMNH	American Museum of Natural History, New York
ANSP	Academy of Natural Sciences of Philadelphia
BBS	Bermuda Biological Station
BG	Botanical Gardens, Paget, Bermuda
NHMB	Natural History Museum, Bermuda

PMNH	Peabody Museum of Natural History, Yale University, New Haven, Connecticut
USNM	National Museum of Natural History, Smithsonian Institution, Washington, D.C.

LOCALITY LISTINGS:

DP	Devonshire Parish
HP	Hamilton Parish
PP	Paget Parish
PBP	Pembroke Parish
SP	Smith's Parish
SAP	Sandy's Parish
SHP	Southampton Parish
SGP	St. George's Parish
WP	Warwick Parish
w/o	without locality
——	same locality as previous sample

FIGURE CITATIONS:

co	copulatory organs
cp	color pattern
ep	eye pattern
h	habitus
sp	spination

Each sample is indicated by a preceding "★". "♀" and/or "♂" indicate adult females and/or males in the sample, "juv." indicates juveniles, "sa" indicates subadults. New Bermuda records are indicated by "■" in front of species name.

LIST OF BERMUDIAN SPIDERS

Families and genera are listed alphabetically.

Agelenidae

Tegenaria domestica (Clerck, 1758), sub *Araneus*
[= *Tegenaria derhami* (Scopoli, 1763), see Roth, 1956]

★ HP: Walsingham, May 1901, PMNH 2327 ♀. ★ w/o, PMNH 2326 ♀. Distribution: All species of *Tegenaria* are considered cosmopolitan (Roth, 1968: 4). Figures: Roberts, 1985, **1**: figs. 72b (co ♀♂); **3**, plate 92 (h).

Anyphaenidae

■ *Anyphaena fraterna* (Banks, 1896), sub *Gayenna*

★ SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♂. Distribution and figures: North America: southern New York west to eastern Kansas, south to western Florida and eastern Texas; Platnick, 1974: 234, figs. 52, 56, 60, 77, 78 (co ♀♂, h♂).

■ *Anyphaena bermudensis* n. sp.

* SAP: Ft. Scaur, Jan 1988, NHMB ♀ (paratype IX). * SAP: Heydon Trust, sweeping, Jan 1988, USNM ♀ (holotype), USNM ♂ (paratype I). * PP: Point Finger Road, garden, at night, May 1988, AMNH ♂ (paratype II). * HP: Walsingham jungle, sweeping, Jul 1983, NHMB ♂ (paratype III), NHMB ♀ (paratypes IV, V, VI). * SP: Spittal Pond Park, Oct 1987, NHMB juvenile. * PBP: Admiralty House Park, sweeping, Oct 1987, NHMB ♀ (paratype VIII). * PP: Camden, BG, sweeping, Dec 1987, AMNH ♀ (paratype VII).

Distribution: known from Bermuda only. Figures: 1-5. See description below.

Aysha velox (Becker, 1879), sub *Anyphaena*
[= *Anyphaena verrilli* Banks, 1902] NEW SYNONOMY

* SAP: Ft. Scaur, sweeping, Jan 1988, NHMB ♂. * HP: Walsingham, May 1901, PMNH 2346 ♀ (holotype of *Anyphaena verrilli*). * SGP: Tucker's Town, sweeping, Jul 1983, NHMB juv. [*Aysha* cf. *velox*]. * PP: Berry Hill Road, in house, Oct 1987, NHMB ♀. * several juveniles from other Parishes.

Distribution and figures: North America and West Indies: North Carolina west to Arkansas, south to eastern Texas and Florida; Cuba, Haiti, Dominican Republic and Bermuda; Platnick, 1974: 259, figs. 110, 111, 122, 125 (co ♀♂).

Note: Banks (1902: 270) mentioned that he had "... seen specimens [of "*Anyphaena verrilli*"] from parts of the West Indies."

Araneidae

Cyclosa turbinata (Walckenaer, 1841), sub *Epeira*
[= *Cyclosa caudata* Hentz, 1850]

* SHP: Horseshoe Bay, sweeping, Jan 1988, NHMB ♀. * HP: Shelly Bay, Mar 1988, sweeping, NHMB ♀. * PP: Hinson's Island, in web in orchard, Apr 1969, NHMB ♀♂. * HP: Walsingham jungle, May 1901, PMNH 2329 ♀, ♂sa. * —— May 1901, PMNH 2350 ♂. * SAP: [Tucker's Island Cave, now part of the U.S. Naval Annex], May 1901, PMNH 2328 juv. * —— PMNH 2358 juv. * HP: Walsingham jungle, on webs, Jul 1983, NHMB ♀♂, juv. * SGP: Tucker's Town, sweeping, Jul 1983, NMHB ♀♂. * —— web in mangroves, Jul 1983, NHMB juv. * HP: Flatts Village, on web, Jul 1983, NHMB ♀. * SGP: Hill Park, among rocks, Jul 1983, NHMB ♀♂. * PP: Hinson's Island, Jul 1969, NHMB ♀♂. * SP: Spittal Pond Park, sweeping, Oct 1987, NHMB ♀. * SGP: Ferry Point Park, sweeping, Oct 1987, NHMB ♂. * HP: Shelly Bay, mangrove swamp,

Nov 1987, NHMB ♀♂. * w/o, PMNH 2339 juv. * w/o, Heilprin Coll., USNM ♀.

Distribution and figures: North and Central America, West Indies; Levi, 1977: 82, figs. 20, 38-50 (co, cp, h ♀♂).

■ *Eustala anastera* (Walckenaer, 1841), sub *Epeira*

* SGP: Smith's Island, May 1988, NHMB ♀. * SGP: Tucker's Town Grove, Jul 1983, NHMB ♀. * SP: Spittal Pond Park, NHMB juv.

Distribution and figures: North America: widely distributed; Levi, 1977a: 115, figs. 205-232, 280-285, 298-302, 314-315 (co, cp, h ♀♂; variability of co).

■ *Gasteracantha cancriformis* (Linné, 1767), sub *Aranea*

* SGP: Nonsuch Island, Feb 1967, NHMB ♀. * PBP: Tulo Valley, in web, May 1969, NHMB ♂. * PP: Camden, BG, May 1988, NHMB ♂. * PP: Hinson's Island, in web in cherry hedge, Jun 1969, NHMB ♂. * SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♀. * SGP: Hill Park, among rocks, Jul 1983, NHMB juv. * HP: Flatts Village, sweeping in grass and shrubs, Jul 1983, USNM ♀♂. * SGP: Tucker's Town Grove, Jul 1983, NHMB ♀. * SAP: Sep 1969, NHMB ♂. * SAP, Shrewsbury, in web in banana patch, Sep 1969, NHMB ♂sa. * PP: Wreck Hill, Dec 1965, NHMB ♀. * PP: Point Finger Road, garden, May 1988, NHMB juv. * several juveniles from different locations throughout Bermuda.

Distribution and figures: North and South America: North Carolina west to southern California, south to northern Argentina; Levi, 1978: 441, figs. 69-84 (co, cp, h ♀♂). Note: In 1969, 1983 and 1988, *Gasteracantha cancriformis* was found to be common and occurring in various habitats on the islands (forests, mangroves, tall shrubs and grass, banana plantations, gardens and among rocks). The species was first reported in 1934 in records of the Bermuda Department of Agriculture & Fisheries.

Metepeira labyrinthea (Hentz, 1847), sub *Epeira*

* Heilprin Coll. [not in ANSP, *non vidi*].

Distribution and figures: widely distributed in eastern United States, Ontario, Canada, south to Florida; Levi, 1977b: 198, figs. 14-20 (co, cp, ep, h ♀♂).

cf. *Neoscona moreli* (Vinson, 1863)

* w/o, Blackwall Coll., det. by Blackwall as *Epeira gracilipes* Blackwall, 1862 [*non vidi*].

Note: Banks (1902: 267) suggested that Blackwall's species *Epeira gracilipes* is a synonym of "*Araneus theis* (Walckenaer, 1841)". Grasshoff (1986: 69) pointed out that *Neoscona theisi* occurs only in Asia (Malaysia, China, Japan and Pacific Islands). The specimen collected by Blackwall might have been a *Neoscona moreli* (Vinson, 1863). Grasshoff (1986: 56, figs. 71-78) suggested that this widespread African species had been transported by ships from West Africa to the West Indies. It is known to occur on the Antilles. In the past, *Neoscona moreli* has often been misidentified as *Neoscona theisi* (see citations in Grasshoff).

Clubionidae

■ *Clubiona reclusa* O. Pickard-Cambridge, 1863
* SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♂.
Distribution: Northern and Middle Europe, Siberia (Roewer, 1954, 2a: 499). Figures: Roberts, 1985, **1**: 30b (co ♀♂).

■ *Corinna abnormis* Banks, 1930
* HP: Bailey's Bay, in house, NHMB ♂.
Distribution and figures: previously only known from the male type specimen from Puerto Rico [*non vidi*]; Petrunkevitch, 1930: 103, fig. 86 (co ♂).

■ *Corinna humilis* (Keyserling, 1887), sub *Hypsinotus*
* PP: Camden, BG, under bark of Australian Pine (*Casuarina equisetifolia* L.), May 1988, NHMB ♀; USNM ♀. * SHP: in grass, Dec 1969, NHMB ♂. * w/o, PMNH 2309 ♀, ♀sa.
Distribution and figures: widely distributed in the West Indies; Petrunkevitch, 1930: 95, figs. 78, 79 (co ♀♂; vulva not figured).

Desidae

Paratheuma insulana (Banks, 1902), sub *Eutichurus*
* w/o, May 1901, PMNH 2362 ♀ (holotype). * SGP: Whalebone Bay, in rock crevices above hightide line at shore, May 1988, NHMB ♀. * —— Jul 1983, NHMB ♂.
Distribution and figures: West Indies: Cuba, Haiti; Bermuda, Florida Keys; Platnick, 1977: 200, figs. 3, 4 (co ♀); Beatty and Berry, 1988: 50, figs. 1, 4, 7, 10 (co ♂♀); Banks, 1902: fig. 3 (♀ epigynum).

Dictynidae

■ *Dictyna altamira* Gertsch & Davies, 1942
* DP: Middle Road, May 1988, USNM ♀♂. * PP: Camden, BG, May 1988, NHMB ♀. * SGP: Whalebone Bay, rocks along shore, May 1988, NHMB ♀. * SGP: Tucker's Town, sweeping shrubs, Jul

1983, NHMB ♀. * SGP: Ferry Reach, BBS, hedge, sweeping, Jul 1983, NHMB ♀. * SP: Spittal Pond Park, Nov 1987, sweeping, NHMB ♂.

Distribution and figures: North America and West Indies: widely distributed in eastern United States, Mexico and the West Indies; Chamberlin & Gertsch, 1958: 117, figs. 1-4 (co ♀♂).

Dysderidae

Dysdera crocata C. L. Koch, 1839

* PP: Camden, in rain catch bottle, BG, Mar 1966, NHMB ♀. * SP: Spittal Pond Park, May 1988, USNM ♀. * SGP: Smith's Island, May 1988, USNM ♂. * HP: Walsingham, May 1901, PMNH 2347 juv. * SGP: Tucker's Town, under stones, Jul 1983, NHMB juv. * SP: Spittal Pond Park, under rocks, Jul 1983, NHMB ♀ juv. * PP: in house, Nov 1987, NHMB ♂. * w/o, PMNH 2308 ♀, ♂, juv. * —— PMNH 2376 ♂. * —— PMNH 2371 ♀. * —— Heilprin Coll., ANSP, several females, poor condition.

Distribution: cosmopolitan, widely distributed in Europe, Asia and the Americas (Roewer, 1942: 296). Figures: Roberts, 1985, **1**: figs. 19b, d, f, h (co ♀♂, sp femur).

Filistatidae

Kukulcania hibernalis (Hentz, 1842), sub *Filistata*
[= *Filistata depressa* (C.L. Koch, 1842)]

* HP: Walsingham, May 1901, PMNH 2322 ♂ [*non vidi*]. * SAP: Tucker's Island Cave, May 1901, under stones, PMNH 2321 ♀sa. * PBP: Mount Hill, night, outside on wall, Jul 1969, NHMB ♀. * SGP: Ferry Reach, BBS, in house, Jul 1983, NHMB ♂. * w/o, PMNH 2331 ♀sa. * —— PMNH 2324 ♀. * —— PMNH 2332 juv. * w/o, Blackwall Coll. [*non vidi*]. * several juveniles from various localities.

Distribution: North and South America (Roewer, 1954, **2b**: 1281). Figures: Comstock, 1910: fig. 1 (co ♂); Lehtinen, 1967: fig. 19 (co ♂). Note: Lehtinen (1967: 242) transferred all American species formerly assigned to *Filistata* to a new genus *Kukulcania* Lehtinen, 1967. Banks (1902: 267) synonymized *F. depressa* with *hibernalis*.

Gnaphosidae

■ *Camellina elegans* (Bryant, 1940), sub *Eilicina*

* SGP: Tucker's Town, under rocks, Jul 1983, NHMB ♀. * SGP: Whalebone Bay, under rocks, Jul 1983, NHMB juv.

Distribution and figures: North and Central America, Pacific, Africa:

Florida south to Curaçao, Hawaii, Marshall Islands, Angola; Platnick & Shadab, 1982: 6, figs. 1-4 (co ♀♂).

Callilepis sp.

  * SAP: Tucker's Island Cave, May 1901, PMNH 2356 ♀sa (specimen dessicated and damaged.

Note: Revision of the genus *Callilepis* by Platnick, 1975.

Linyphiidae

This large family (150 genera, 872 species; Roth, 1988) is in need of revision. Identification is hampered and nomenclatural problems exist.

■ *Bathyphantes approximatus* (O. Pickard-Cambridge, 1871), sub *Linyphia*

  * WP: Warwick Pond, May 1988, NHMB ♀. * SP: Spittal Pond Park, under rocks, May 1988, USNM ♀. * SP: Spittal Pond Park, under rocks, Jul 1983, NHMB ♀. * w/o, PMNH 2344 ♀. * —— PMNH 2341 ♀sa. * —— PMNH 2338 ♀sa.

Distribution: Europe, Siberia (Ivie, 1969: 54; Roewer, 1942: 596). Figures: Roberts, 1985, **3**: plate 218; 1987: fig. 70a (co, cp ♀♂); Ivie, 1969: figs. 102-104. Note: Roewer (1942: 596) listed this species in the genus *Stylophora* Menge, 1899.

■ *Erigone autumnalis* Emerton, 1882

  * PP: Camden, BG, May 1988, NHMB ♂.

Distribution: throughout the United States (Roth, 1988). Figures: Kaston, 1981: pl. XXVIII figs. 616-618 (co, h ♂).

■ *Erigone brevidentata* Emerton, 1909

  * PP: Camden, Dept. Agriculture, on floor in lab, Jul 1970, NHMB ♂. * SP: Spittal Pond Park, sweeping, Nov 1987, USNM ♂.

Distribution: eastern United States (Roth, 1988). Figures: Kaston, 1981: pl. XXIX fig. 628, pl. XXXI figs. 662-663 (co, h ♂).

■ *Erigone* cf. *promiscua* (O. Pickard-Cambridge, 1872), sub *Neriene*

  * w/o, PMNH 2335 ♀

Distribution: western Europe (Roewer, 1942: 720). Figures: Roberts, 1987: figs 43b, 45c (co ♀♂). Note: The epigynum shows resemblance to Roberts' figures of *Erigone promiscua*.

■ *Lepthyphantes leprosus* (Ohlert, 1865), sub *Linyphia*

  * SGP: Tucker's Town, sweeping shrubs, Jul 1983, NHMB ♀.

Distribution: holarctic: Europe, Siberia, North America (Roewer, 1942: 549). Figures: Zorsch, 1937: figs. 7-13 (co ♀♂); Roberts, 1985, **3**: plate 229a, b; 1987: fig. 77b (co ♀♂, h ♀♂).

■ *Lepthyphantes obscurus* (Blackwall, 1841), sub *Linyphia*

* SP: Spittal Pond Park, forest, on web, Jul 1983, NHMB ♂.

Distribution: Europe (Roewer, 1942: 552). Figures: Roberts, 1985, **3**: plate 229d; 1987: fig. 78b (co, h ♀♂).

Loxoscelidae

Loxosceles rufescens (Dufour, 1820), sub *Scytodes*

* PP: Camden, Dept. Agriculture, laboratory, May 1988, NHMB ♂. * SGP: Ferry Reach, BBS, in house, Jul 1983, NHMB ♀. * w/o, Blackwall Coll., as *Scytodes pallida* Blackwall, 1865 [*non vidi*].

Distribution and figures: cosmopolitan: widespread in Europe, North America, and Africa; of European-north African origin; Roewer, 1942: 319; Gertsch & Ennik, 1983: 354, figs. 341-343, 348-351 (co ♀♂, h♀).

Lycosidae

■ *Gladicosa gulosa* (Walckenaer, 1837), sub *Lycosa*

* Parish?: Outer Island [location unknown], Coll. Verrill 1902, PMNH without number ♀.

Distribution and figures: southern Canada south to eastern Texas; Brady, 1986: 298, figs. 4, 6-9, 35, 36 (co, cp, h ♀♂).

■ *Lycosa* cf. *lenta*-group

* w/o, G. Brown Goode leg., 1876-1877, PMNH 2304 ♂sa.

Distribution and figures: spiders of the *Lycosa lenta*-group are widely distributed in south-eastern United States; Wallace, 1942, 25 figs. (co ♀♂). Note: Banks identified this specimen as *Lycosa atlantica* [= *Trochosa ruricola*]. The specimen is too large to be conspecific with *T. ruricola*. The black venter of the specimen allows the recognition of the species group.

Trochosa ruricola (DeGeer, 1778), sub *Aranea*
[= *Lycosa atlantica* Marx, 1889] NEW SYNONYMY

* PP: Hungry Bay, Apr 1901, PMNH 2351 juv. * SAP: Tucker's Island Cave, May 1901, PMNH 2357 juv. * HP: Walsingham, May 1901, PMNH 2372 ♂, ♀ damaged. * SGP: Smith's Island, May 1988, USNM ♀♂. * SP: Spittal Pond Park, May 1988, NHMB ♀. * SGP: BBS, pitfall trap, Jul 1983, NHMB ♀ with egg sac. * SGP: Great Head Park, forest litter, Jul 1983, NHMB ♂, ♀ with egg sac. * SGP: Whalebone Bay, pitfall trap, Jul 1983, NHMB ♂, juv. * Parish?: Pen Slow's Cave [location unknown], PMNH 2375 ♀. * w/o, under stones,

Heilprin Coll., ANSP 2 ♀ (syntypes *Lycosa atlantica*). * w/o, PMNH 2307 ♀, ♀sa. * —— PMNH 2325 ♀ with egg sac. * —— PMNH 2369 ♂, ♀sa, juv. * —— PMNH 2405 ♀ adult. * w/o, USNM ♀.

Distribution: palearctic (Roewer, 1954, 2a: 299). Figures: Roberts, 1985, **1**: figs. 62c, 63a (co ♀♂); Marx, 1889: fig. 4 (epigynum).

Note: The *Trochosa* specimens found on Bermuda are conspecific with *Trochosa ruricola* of Europe. Aside from the structure of the copulatory organs, a broad, low tooth on the fang of the male's chelicerae (Roewer, 1928: 130) serves as an identification character. Roewer (1954, **2**a: 247) transferred *Lycosa atlantica* (without examination of type material) to a new genus *Hoggicosa* Roewer, [1954 *nom. nud.*] 1960 [1960: 772].

Oonopidae

Heteroonops spinimanus (Simon, 1891), sub *Oonops*
[= *Oonops bermudensis* Banks, 1902] NEW SYNONYMY

* w/o, PMNH 2340 ♀ (holotype).

Distribution and figures: West Indies and northern South America, Florida; Petrunkevitch, 1929: 67, figs. 53-57 (co ♀♂, ep, h, ♀ palp); Chickering, 1969: 156, figs. 28-32 (co, ep, spination ♀♂); Banks, 1902: figs. 1 a-c (ep, co, leg ♀).

■ *Orchestrina* sp.

* SP: Spittal Pond Park, May 1988, NHMB juv.

Figures: Chickering, 1969; figs. 35-39 (ep).

Oxyopidae

Oxyopes salticus Hentz, 1845

* SP: Spittal Pond Park, sweeping, Jan 1988, NHMB ♀♂. * SHP: Horseshoe Bay, sweeping, Jan 1988, NHMB ♀♂. * SP: Spittal Pond Park, sweeping, Feb 1988, NHMB ♂. * SGP: Whalebone Bay, sweeping grass, Jul 1983, NHMB ♀♂. * SGP: Ferry Point Park, sweeping grass, Jul 1983, NHMB ♀♂. * SGP: Great Head Park, sweeping grass, Jul 1983, NHMB ♀♂. * SP: Spittal Pond Park, sweeping grass, Jul 1983, NHMB ♀; USNM ♀♂. * HP: Flatts Village, sweeping grass, Jul 1983, NHMB ♀♂. * SP: Spittal Pond Park, sweeping, Oct 1987, NHMB ♂. * PP: Camden, BG, sweeping, Dec 1987, NHMB ♀. * w/o, PMNH 2345 juv.

Distribution and figures: North America: distributed throughout the United States; Brady, 1964: 482, figs. 80-86, 91-96, 104-105 (co, cp, h, ep ♀♂).

Pholcidae

■ *Pholcus phalangioides* (Fuesslin, 1775), sub *Aranea*

* SAP: Tucker's Island Cave, 3 May 1901, PMNH 2315 ♂ (det. by Banks as *Pholcus tipuloides* L. Koch, 1872).

Distribution: cosmopolitan (Roewer, 1942: 338; Emerton, 1902: 128). Figures: Roberts, 1985, **1**: figs. 21a; **3**: plate 18 (co, cp, h ♀♂)

Smeringopus elongatus (Vinson, 1863), sub *Pholcus*
[= *Pholcus tipuloides* L. Koch, 1872]

* PP: Camden, in old building, Jan 1965, NHMB ♀♂. * —— Jan 1966, NHMB ♀♂. * PBP: BHSG-Gymnasium, on wall, Mar 1988, NHMB ♀. * SGP: Whalebone Bay, rocks close to shore, May 1988, NHMB ♀. * SGP: Ferry Reach, BBS, in house, Jul 1983, NHMB ♀♂; USNM ♀♂. * SGP: Tucker's Town, on ground, NHMB ♀sa. * SAP: Tucker's Island Cave, PMNH 2320 ♀ with egg sac. * —— PMNH 2361 ♀ damaged. * w/o, Heilprin Coll., ANSP ♂sa.

Distribution: cosmotropical (Roewer, 1942: 343). Figures: Petrunkevitch, 1929: figs. 136-138; Marx, 1889: figs. 5a-b (co, ep, h ♀).

Salticidae

■ cf. *Metaphidippus* sp.

* SP: Spittal Pond Park, sweeping, Jan 1988, NHMB ♀. * HP: Shelly Bay, sweeping, Mar 1988, NHMB ♀. * SP: Spittal Pond Park, sweeping, Nov 1987, NHMB ♀.

Note: Specimens are members of the Dendryphantinae. Specific identification is currently not possible; the group is under revision (Griswold, pers. comm.).

■ *Habronattus coecatus* (Hentz, 1846)

* SAP: Heydon Trust, sweeping, Jan 1988, NHMB ♀. * DP: Devonshire Marsh, Middle Road, May 1988, NHMB ♂. * SP: Somerset, Jul 1971, AMNH ♂ [*non vidi*]. * PP: Berry Hill Road, Nov 1987, NHMB ♀sa. * several immature specimens from various localities.

Distribution and figures: Eastern United States from New York to northern Florida, west to edge of the Great Plains, north eastern Mexico; Griswold, 1987: 97, fig. 79 (♂ leg).

Habronattus nesiotus Griswold, 1987

* w/o, Jul 1905, MCZ ♂ (holotype) [*non vidi*].

Distribution and figures: known only from male holotype from Bermuda; Griswold, 1987: 227, figs. 37, 174, 222 (cp, co ♂).

Hentzia vernalis (Peckham, 1893), sub *Anoka*
[= *Wala vernalis*]

* PP: Paget Marsh, sweeping, Jan 1988, NHMB ♂sa. * SHP: Horseshoe Bay, sweeping, Jan 1988, NHMB ♂sa. * SP: Penhurst Peak, sweeping, Jan 1988, USNM ♂. * SAP: Heydon Trust, sweeping, Jan 1988, NHMB ♀. * SAP: Gilberts Nature Preserve, May 1988, NHMB ♀. * SP: Spittal Pond Park, May 1988, NHMB ♀. * SAP: Somerset Island, railway path, sweeping shrubs, Jul 1983, USNM ♀. * SAP: Ft. Scaur, sweeping, Nov 1987, NHMB ♂. * HP: Flatts Village, Aquarium, Nov 1987, NHMB ♀. * several immature specimens from various localities.

Distribution and figures: common on Haiti, Puerto Rico, St. Vincent, Cuba; Petrunkevitch, 1930: 139, figs. 120-129 (co, cp, h ♀♂).

Menemerus bivittatus (Dufour, 1831), sub *Salticus*
[= *Menemerus melanognathus* (Lucas, 1838)]

* DP: south shore under stones, Dec 1968, NHMB ♀, ♂sa. * w/o, Heilprin Coll., ANSP ♂.

Distribution: cosmopolitan (Roewer, 1954, 2b: 1263). Figures: Petrunkevitch, 1930: figs. 165-168, Marx, 1889: figs 3a-b (co, cp ♀♂).

Plexippus paykulli (Audouin, 1827), sub *Attus*
[= *Salticus diversus* Blackwall, 1868]

* SGP: Ferry Point Park, under stones, Jul 1983, NHMB ♂♀ in nest. * SAP: Somerset Island, Black Bay, under stones, Jul 1983, NHMB ♀. * SGP: Whalebone Bay, under rocks, Jul 1983, NHMB ♀, juv. * HP: Walsingham, PMNH 2373 juv. * SAP: Tucker's Island Cave, PMNH 2374 juv. * w/o, PMNH 2310 ♀. * —— PMNH 2311 ♀ with nest. * —— PMNH 2312 ♂. * —— PMNH 2336 juv. * —— PMNH 2337 damaged, juv. * —— PMNH 2359 ♀. * —— PMNH 2370 ♀, ♂. * —— Dec 1901, PMNH 2402 ♂. * —— Heilprin Coll. (sub *Menemerus*) [not in ANSP, *non vidi*]. * —— Blackwall Coll. (♂, ♂sa, type of *Salticus diversus*) [*non vidi*].

Distribution: cosmopolitan (Roewer, 1954, 2b: 1086). Figures: Petrunkevitch, 1930: figs. 140-143; Marx, 1889: figs. 2a-b (co, cp, h ♀♂; vulva not figured).
Note: Banks (1902) synonymized *Salticus diversus* Blackwall, 1868, with *Plexippus paykulli*.

Scytodidae

Scytodes fusca Walckenaer, 1837

* HP: Jan 1976, NHMB ♀. * PBP, Mount Hill, in house, Apr 1966, NHMB ♀. * —— Apr 1969, NHMB ♀. * SGP: Ferry Reach, BBS, in house, Jul 1983, USNM ♀.

Distribution: cosmotropical (Roewer, 1942: 323). Figures: Valerio, 1981: figs. 1, 10, 19 (co, cp ♀♂).

Scytodes longipes Lucas, 1845

* HP: under building, Jan 1970, NHMB ♀♂. * PBP: Hamilton, under ridge, Jan 1976, NHMB ♀♂. * SGP: Smith's Island, May 1988, USNM ♀. * SHP: Seymour's Pond, under tree trunk in woods, May 1988, NHMB ♀. * SAP: Tucker's Island Cave, May 1901, PMNH 2319 ♂. * PBP: Mount Hill, in house, Jul 1969, NHMB ♀ with spiderlings. * w/o PMNH 2343 juv. * w/o PMNH 2360 ♂.

Distribution: cosmopolitan (Roewer, 1942: 323). Figures: Roberts, 1985, **1**: 18c; **3**: plate 14; Petrunkevitch, 1929: figs. 99, 100 (co, cp ♀♂).

Sparassidae

Heteropoda venatoria (Linné, 1767), sub *Aranea*
[= *Olios antillianus* Walckenaer, 1837]

* SGP: BBS, in house, Jul 1983, NHMB ♂. * w/o, Dec 1901, PMNH 2398 ♀. * —— PMNH 2317 ♀♂. * —— PMNH 2342 juv. * —— Heilprin Coll., ANSP juv. * —— Blackwall Coll., as *Olios antillianus* [*non vidi*].

Distribution: cosmotropical (Roewer, 1954, 2a: 712). Figures: Järvi, 1914: plate 8, figs. 3-6; text-fig. 61 (co ♀); Pickard-Cambridge, 1905, II: pl VII, figs. 22a-c, 23 a-f [*non vidi*]. Note: Hilburn (pers. comm.) has frequently observed *H. venatoria* in bee hives on Bermuda.

Tetragnathidae

Leucauge, *Metellina* and *Nephila* are placed in Tetragnathidae (instead of Araneidae) after Levi & Coddington (pers. comm.).

Leucauge venusta (Walckenaer, 1841), sub *Epeira*
[= *Argyroepeira hortorum* Hentz, 1847)

* HP: Walsingham woods, May 1901, PMNH 2330 ♀. * SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♂. * HP: Walsingham woods May 1901, PMNH 2348 juv. * w/o, PMNH 2364 juv. * —— PMNH 2365 juv. * —— PMNH 2366 juv.

Distribution and figures: North and Central America: New Hampshire west to South Dakota, south to Panama; coast of California; Levi, 1980: 28, figs. 44-59.

■ *Metellina mengei* (Blackwall, 1869), sub *Epeira*

* SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♀♂.

Distribution and figures: Europe; Levi, 1980: 38, figs. 105-107 (co ♀♂); Roberts, 1985, **1**: figs. 90b,g, 91b; **3**: plate 133, 134 (co, cp, h ♀♂, sp metatarsus, tarsus).

Nephila clavipes (Linné, 1767), sub *Aranea*

* SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♂ and juv. * DP: Arboretum, Sep 1969, NHMB ♂. * w/o, PMNH 2399 ♀. * SP: Spittal Pond Park, forest, Jul 1983, NHMB juv. * w/o, Heilprin Coll. [not in ANSP, *non vidi*].

Distribution and figures: North and South America: southeastern United States south to northern Argentina; Levi, 1980: 23, figs. 23-43 (co, cp, h ♀♂).

■ *Tetragnatha laboriosa* Hentz, 1850

* SGP: Stokes Point Nature Preserve, Jan 1988, NHMB ♀♂. * SGP: Ferry Reach, sweeping, Jan 1988, NHMB ♂. * SP: Spittal Pond Park, sweeping, Jan 1988, NHMB ♀♂. * HP: Shelly, Bay, sweeping, Mar 1988, NHMB ♀♂. * DP: Devonshire Marsh, sweeping, May 1988, NHMB ♀♂. * SP: Spittal Pond Park, May 1988, NHMB ♀♂, USNM ♀♂. * SGP: Ferry Reach, BBS, meadow, sweeping, Jul 1983, NHMB ♀♂. * —— hedge, sweeping, Jul 1983, NHMB ♀♂. * HP: Walsingham, sweeping, Jul 1983, NHMB juv. * HP: Shelly Bay, mangrove swamp, Nov 1987, NHMB ♀. * SP: Spittal Pond Park, sweeping, Nov 1987, NHMB ♀♂. * SP: Spittal Pond Park, Nov 1987, sweeping, NHMB ♀♂. * PP: Camden, BG, Dec 1987, sweeping, NHMB ♀♂.

Distribution and figures: widespread, Alaska to Panama; Levi, 1981: 308, figs. 16-22, 120-128, pl. 6 figs. h,i.

■ *Tetragnatha versicolor* Walckenaer, 1841

* SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♀♂.

Distribution and figures: Alaska to Nicaragua and Cuba; Levi, 1981: 304, figs. 90-109, pl. 3 figs. upper left and bottom, pl. 6 figs. a-f.

Theridiidae

Achaearanea tepidariorum (C.L. Koch, 1841), sub *Theridium*

* w/o, Dec 1901, PMNH 2401 ♀. * —— PMNH 2407 ♀. * Parish?: Outer Island [location unknown], PMNH without number ♀. * w/o, Heilprin Coll., ANSP ♀♂.

Distribution and figures: cosmopolitan; Levi, 1955: 33, figs. 69-70, 83-84; Roberts, 1985, **1**: fig. 81a.

Anelosimus studiosus (Hentz, 1850), sub *Theridion*

* HP: Walsingham, May 1901, PMNH 2349 ♀. * —— Jul 1983, with eggs and parts of nest, NHMB ♀.

Distribution and figures: widely distributed in North and South America; Levi, 1956: 420, figs. 21-23, 37-39 (co, cp, h ♀♂).

Argyrodes nephilae Taszanowski, 1872

* PP, Hinson's Island, in "crab spider" [= ? *Gasteracantha*] web, Apr 1969, NHMB ♂. * HP: Flatts Village, sweeping grass and shrubs, Jul 1983, NHMB ♀. * HP: Walsingham jungle, Jul 1983, NHMB ♀, ♂. * SGP: Tucker's Town, Jul 1983, NHMB ♂. * SGP: Ferry Reach, BBS, sweeping hedge, Jul 1983, NHMB ♀♂. * SGP: Hill Park, among rocks, Jul 1983, NHMB ♂. * SP Spittal Pond Park, forest, Jul 1983, ♀. * SGP: Nonsuch Island, in web in low shrubs, Jul 1969, NHMB ♀♂. * SAP: Shrewsbury, in *Nephila* web, Sep 1969, NHMB ♀♂. * HP: Shelly Bay, mangrove swamp, Nov 1987, USNM ♀♂. * w/o, Heilprin Coll. [not in ANSP, *non vidi*].

Distribution and figures: Eastern Florida, Caribbean, South America; Exline & Levi, 1962: 141, figs. 133-137 (co, h ♀♂).

■ *Argyrodes trigonum* (Hentz, 1850), sub *Theridion*

* SGP: Ferry Reach, BBS, garden, Jul 1983, NHMB ♀.

Distribution and figures: eastern United States, Ontario, Canada, south to Florida; Exline & Levi, 1962: 124, figs. 66-78 (co, h ♀♂).

■ *Coleosoma floridana* Banks, 1900

* SAP: Heydon Trust, sweeping, Jan 1988, NHMB ♀. * PP: Camden, BG, Feb 1966, USNM ♀♂; NHMB ♀♂. * SP: Spittal Pond Park, May 1988, NHMB ♀. * PP: Point Finger Road, garden, night, May 1988, NHMB ♀. * SGP: Tucker's Town, sweeping shrubs, Jul 1983, NHMB ♀. * SGP: Whalebone Bay, under rocks, Jul 83, NHMB ♀.

Distribution and figures: cosmotropical, probably distributed by man; Levi, 1959b: 8, figs. 12-17.

Latrodectus geometricus C. L. Koch, 1841

* HP: Paynter's Vale, Apr 1901, PMNH 2352 ♂. * —— PMNH 2353 ♀. * SHP: Zero, Oct 1968, NHMB ♀. * w/o, PMNH 2323 ♀.

Distribution: cosmopolitan (Roewer, 1942: 425). Figures: Levi, 1959a: figs. 8-10, 28, 37 (co, h ♀♂). Note: Levi (1983) pointed out that there are unresolved difficulties in the discrimination of *Latrodectus* species.

■ *Theridion cheimatos* Gertsch & Archer, 1942

* SGP: Ferry Reach, BBS, sweeping meadow, Jul 1983, NHMB ♀, USNM ♀.

Distribution and figures: southeastern United States; Levi, 1957: 98, figs. 335, 336, 354-357 (co, cp ♀♂).

Theridion rufipes Lucas, 1849

* PP: Camden, BG, Feb 1966, NHMB ♀♂. * PBP: Feb 1988, NHMB ♀. * PP: Camden, Dept. Agriculture, in laboratory, Mar 1988, NHMB ♀. * SAP: Tucker's Island Cave, May 1901, PMNH 2354 ♂. * PP: Berry Hill Road, in house, May 1988, NHMB ♀♂. * SGP: Ferry Reach, BBS, in house, Jul 1983, NHMB ♂♀. * PP: Berry Hill Road, in house, Oct 1987, NHMB ♂, USNM ♀♂. * PP: Berry Hill Road, in house, Nov 1987, NHMB ♀.

Distribution and figures: cosmotropical; Levi, 1957: 58, figs. 188-193 (co ♀♂).

■ *Thymoites marxi* (Crosby, 1906), sub *Paidisca*

* SP: Spittal Pond Park, May 1988, NHMB ♀.

Distribution and figures: eastern United States to central Mexico; Levi, 1957: 111, figs. 393-395 (co ♀♂). Note: Generic placement of *marxi* in *Thymoites* is according to Levi (pers. comm.).

Thomisidae

Thomisus pallens Blackwall, 1868

* w/o, Blackwall Coll., 1 ♀sa (holotype), lost [*non vidi*].

Note: Roewer (1954, 2b: 1690) lists this species as *nomen dubium* ("nicht zu deuten").

■ *Xysticus ferox* (Hentz, 1847), sub *Thomisus*

* Parish?: Outer Island [location unknown], 1902, Verrill coll., PMNH without number ♂.

Distribution and figures: Alaska to Nova Scotia, south to Utah, Texas and Georgia; Turnbull et al., 1965: 1251, figs. 44, 47, 126, 129, 175 (co, cp ♀♂).

Uloboridae

Zosis geniculatus (Olivier, 1789), sub *Aranea*
[= *Uloborus zosis* Walckenaer, 1841]

* w/o, PMNH 2404 ♀, ♂sa, juv. * —— PMNH 2406 ♂. * w/o, Heilprin Coll. [not in ANSP, *non vidi*].

Distribution and figures: cosmopolitan; Opell, 1979: 510, figs. 443-549; Marx, 1889: figs. 1a-c (co, h, cp, ep ♀♂).

DESCRIPTION OF *ANYPHAENA BERMUDENSIS* n. sp.

(Figures 1-5)

Female (7 specimens): overall color of animal pale yellow; head and chelicerae, maxillae and labium darkened to light brown; black eye pigments clearly visible. Life animal: prosoma and opisthosoma with green pattern (Fig. 4); pattern fading in alcohol.

COPULATORY ORGANS: epigynum with central atrium-like area, copulatory openings in anterior part of epigynum; copulatory ducts wide; spermathecae at posterior end of vulva.

MEASUREMENTS (in mm): holotype (USNM): total length [tl] 3.08, prosoma length [prosl] 1.32, prosoma width [pw] 0.92. Legs: I: Femur [Fe] 1.76, Patella-Tibia [PaTi] 2.6, Metatarsus-Tarsus [MeTa] 2.4, total length [tl] 6.76. II: Fe 1.12, PaTi 1.6, MeTa 1.36, tl 4.08. III: Fe 0.84, PaTi 0.96, MeTa 1.2, tl 3. IV: Fe 1.4, PaTi 1.72, MeTa 1.88, tl 5. Paratype IV: tl 3.4, prosl 1.36, pw 1. Legs: I: Fe 1.92, PaTi 2.4, MeTa 2.4, tl 6.72. II: Fe 1.36, PaTi 1.48, MeTa 1.6, tl 4.44. III: Fe 1, PaTi 1.16, MeTa 1.28, tl 3.44. IV: Fe 1.56, PaTi 1.8, MeTa 2, tl 5.36. Range (paratypes IV-IX): tl 2.9-4.2, prosl 1.28-1.6, pw 1-1.2.

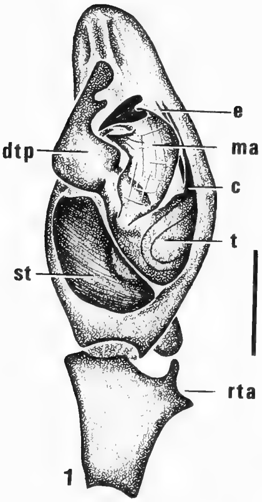
Male (3 specimens): color pattern as in female, chelicerae distinctly light brown; prolateral spine of first ventral spine pair of metatarsus III thick and thornlike, no modified spines or processes at coxae III and IV.

COPULATORY ORGANS: median apophysis and distal tegular projection elaborate and distinct, presumably species-typical; conductor long, thin, lamelliform and translucent, parallel to embolus.

MEASUREMENTS: Paratype I (USNM): tl 2.72, prosl 1.2, pw 0.92. Legs: I: Fe 1.96, PaTi 2.72, MeTa 3, tl 7.68. II: Fe 1.12, PaTi 1.64, MeTa 1.52, tl 4.28. III: Fe 0.96, PaTi 1, MeTa 1.4, tl 3.36. IV: Fe 1.48, PaTi 1.6, MeTa 1.8, tl 4.88. Paratype II: tl 3 prosl 1.3, pw 1.08. Legs: I: Fe 1.96, PaTi 2.68, MeTa 3.04, tl 7.68. II: Fe 1.28, PaTi 1.8, MeTa 1.76, tl 4.48. III: Fe 1, PaTi 1.2, MeTa 1.4, tl 3.6. IV: Fe 1.72, PaTi 1.92, MeTa 2.2, tl 5.84. Paratypes II and III: tl 2.96-3.6, prosl 1.68-1.32, pw 1.08-1.12.

Male and Female: Eyes: posterior eye row procurved, anterior eye row recurved, posterior median eyes = posterior lateral eyes > anterior lateral eyes > anterior median eyes.

CHELICERAE: ♀: three teeth at anterior margin, the innermost the largest; ♂: no teeth, but pointed hump at anterior margin. Chelicerae of ♂ distinctly larger than those of ♀.



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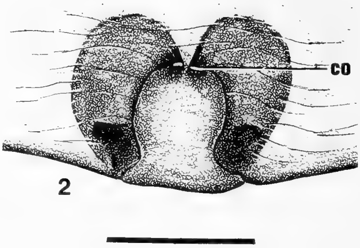

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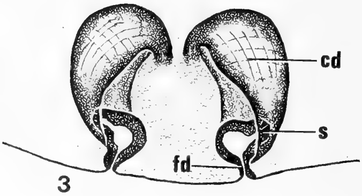

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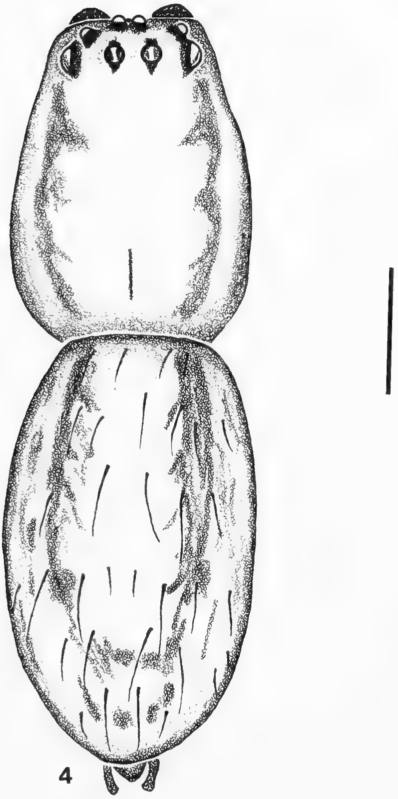

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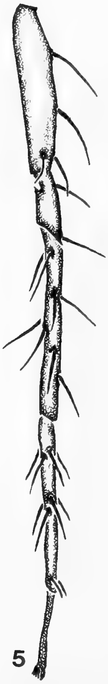

5

Spination of Legs: Fe I: dorsal [d] 111, prolateral [pl] 1(long) 1(apical), retrolateral [rl] 1(apical). Fe II-IV: d 111, pl 1 (apical), rl 1(apical). Pa I-IV: d 11. Ti I,II,IV: d 11, pl 11, rl 11, ventral [v] 22. Ti III: d 11, pl 1(apical), rl 1(apical), v 2. Me I,II: pl 111, rl 111, v 22. Me III,IV: pl 111, rl 111, v 2 and brush of stiff hairs (apical). Me III ♂: pl 111, rl 111, v thorn-like spine and 1 normal spine as pair, apically with brush as ♀.

Spination of Pedipalps: Fe: d 1 2(apical), pl 1(apical). Pa: d 11, pl 1(proximal). Ti: d 1(proximal), pl 2.

Leg Formula: I, IV, II, III.

Natural History: collected during both day and night at various localities and habitats, mostly found while sweeping. Presumably living predominantly in low vegetation.

Type Locality: Bermuda; Sandy's Parish: Heydon Trust.

Discussion: The male copulatory organs show resemblance to the species of the *Anyphaena pacifica* species-group (Platnick, 1974). It is possible that *Anyphaena bermudensis* is widely distributed in the West Indies. Most genera with numerous species of the family Anyphaenidae are currently unrevised, and it is beyond the scope of this study to review each described species of the family. Nevertheless, it seems justified to describe these specimens as a new species and make diagnostic figures available for future taxonomic work in the Anyphaenidae.

DISCUSSION

Due to its small size (54 km^2) and isolation, Bermuda's terrestrial fauna and flora are depauperate, with only few endemic species. With 59 species, the total number of recorded spider species is rather small.

[In comparison, on the Madeira Islands (32°45'N, 17°00'W) 145 spider species occur (in 92 genera, 30 families; Wunderlich, 1987). The Madeira Islands, situated

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Figures 1-5: *Anyphaena bermudensis* n. sp.

1. left male palp, ventral view [paratype III]
2. female epigynum [paratype IV]
3. female vulva [paratype IV]
4. female, color pattern [paratype VIII]
5. spination of leg II, lateral view [paratype II, male]

Scale bars: Figs. 1-3 = 0.2 mm; Figs. 4-5 = 0.5 mm. Abbreviations: c = conductor, cd = copulatory duct, co = copulatory opening, dtp = distal tegular projection, e = embolus, fd = fertilization duct, ma = median apophysis, rta = retrolateral tibial apophysis, s = spermatheca, st = subtegulum, t = tegulum.

at the same latitude as Bermuda, have a significantly drier climate (average of 660 mm rainfall, mainly in autumn and winter; average temperatures 17°C in winter and 21°C in summer), are larger (797 km^2), with much higher elevations (Pico Ruivo 1,830 m) and the distance to the coast of Africa is only 600 km.]

The present study adds 26 new records to the 28 previously known spider species of Bermuda. Sixteen species of the Bermudian spiders are cosmopolitan or cosmotropical; 12 species are widely distributed in North, Central and South America and in the West Indies; 15 species are of North American origin; seven species are European or palearctic. Three species of Bermudian spiders occur throughout the West Indies. Two species, *Corinna abnormis* (Clubionidae) and *Habronattus nesiotus* (Salticidae), are known from single specimens only. The high number of widely-distributed species, which are often closely related to human activities, lead to the conclusion that the majority of Bermudian spiders were introduced by man. Apparently, some of the species recorded did not establish permanent populations on Bermuda, since they were only collected once [e.g., *Tegenaria domestica, Neoscona moreli* and *Metepeira labyrinthea*].

Nephila clavipes and *Smeringopus elongatus* may be 'native' to Bermuda, as these species were noted by early settlers (Jourdain, 1610, and Strachey, 1625, fide Kevan, 1981; Hughes, 1977). Apparently, *Argyrodes nephilae* was already present in the webs of *Nephila clavipes*. Richard Norwood [manuscript written about 1622, published in 1945; see Kevan, 1981: 10] described in the web of the "yellow Spider ... her yong ... like little balls of quick-silver," thus mistaking *Argyrodes nephilae* for the spiderlings of *Nephila. Gasteracantha cancriformis* was first recorded in 1934. No mygalomorph spiders have been found on Bermuda so far.

Presumably due to the constant mild climate, several spider species are active year-round. Adults of the following species were collected throughout the year: *Anyphaena bermudensis, Aysha velox, Cyclosa caudata, Gasteracantha cancriformis, Oxyopes salticus, Hentzia vernalis, Tetragnatha laboriosa, Argyrodes nephilae* and *Theridion rufipes*. The frost-free climate allows the occurrence of subtropical species (comprised by cosmotropical and West Indian forms) that do not inhabit the mainland at the same latitude.

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NOTES ON THE BIRDS COLLECTED IN THE PHILIPPINES DURING THE STEERE EXPEDITION OF 1887/1888

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ABSTRACT. Of the 5000 bird specimens obtained during the Steere Expedition to the Philippines of 1887/1888, nearly 70% have been located. In this paper, we show that some specimens from the Expedition obtained from E. L. Moseley, and F. S. Bourns and D. C. Worcester, were retained by these collectors, and therefore not available to Steere (1890), and should not be considered syntypes of taxa described by Steere. We also recommend the deletion of 10 island records of 9 species due to error or lack of evidence; tabulate 9 records apparently based solely upon the Steere Expedition's findings for which we have been unable to locate the supporting specimens; report 30 new and/or first island records of 26 species; substantiate 14 earlier records by reference to the specimens; comment on 6 species and 2 genera with doubtful records or confused histories; and finally, designate a lectotype of *Phylloscopus olivaceus*.

INTRODUCTION

Joseph Beal Steere, Professor of Zoology at the University of Michigan in Ann Arbor, Michigan first visited the Philippines in 1874 and 1875. His collection of birds made on this trip was fully reported by Sharpe (1877) and most of the type specimens are in Ann Arbor. Later Steere led

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an Expedition to the Philippines that lasted from August 1887 until July 1888. He was accompanied by three students – Frank S. Bourns and Dean C. Worcester, who were to have a close association with Philippine birds for many years, and Edward L. Moseley – and by Mateo Francisco, a Filipino who had been with Steere since 1875. Steere (1890, 1891a, 1894) reported on the ornithological results of the second expedition. Although he described 53 new avian taxa, his main account (Steere, 1890) was not much more than a list with brief descriptions of the new forms. Additional information on the expeditions appeared separately in more popular accounts (Steere, 1888a, b, c, 1889, 1891b, c). In his chronology of islands visited, Steere (1890) did not give the exact dates that the party was on each island. Rather, he gave only the main months of such visits often omitting parts of months at the beginning or end of a visit. For example, he gave April 1888 for Samar but the party arrived there well before the end of March. In fact, there were times when the party separated thus adding to the confusion.

Over 5000 bird specimens were taken during the expedition (Steere, 1894). We have located about 70% of these. The largest share, about one third of the original collection, is now in the British Museum of Natural History. The rest is widely scattered (Table 1).

As we searched for the dispersed collection and its type material, we discovered that Steere (1890) had made several errors in identification and had omitted many important distributional records. In addition, we learned that many museum curators were confused about the type status of specimens obtained not from Steere but from other members of the expedition.

In this paper, we address the errors and omissions and clarify the type status of specimens from Steere's colleagues. Finally, we comment on a few species with doubtful records or confused history, and in one case designate a lectotype. Latin names are almost all from duPont (1971).

ABBREVIATIONS USED

AMNH	American Museum of Natural History, New York
BMNH	British Museum (Natural History), London
ISB	Institut Scientifique d'Histoire Naturelle, Brussels
OSUMZ	Ohio State University Museum of Zoology, Columbus, Ohio
USNM	(United States) National Museum of Natural History, Smithsonian Institution, Washington, DC

Table 1. Present location of bird specimens from the 1887/1888 Steere Expedition to the Philippines.

Museum	No. of Skins	Origin
British Museum of Natural History	1773	Steere (1562) Moseley (211)
National Museum of Natural History, Smithsonian Institution	658	Worcester (625)[1] Bell Museum (33)
Field Museum of Natural History	178	Steere
Museum of Comparative Zoology	83	? Moseley
Cambridge University	18	? Moseley
Rijksmuseum van Natuurlijke Historie, Leiden	82	Moseley
Carnegie Museum of Natural History	16	Bell Museum (5) Purdue (10) Ohio Wesleyan (1)
American Museum of Natural History	54[2]	? Moseley ex Rothschild
Royal Ontario Museum	32	Moseley
University of Michigan Museum of Zoology	?[3]	Steere
Purdue University, Indiana	15[4]	Steere
Denver Museum of Natural History	298	Chicago Academy of Science
Chicago Academy of Science	1[5]	Moseley (12), Steere (287)
Bowling Green State University Museum	88	Moseley
Bell Museum of Natural History	9[6]	? Worcester
Ohio State University Museum of Zoology	65	Moseley

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[1] Bell Museum now holds the rest and the Menage Expedition catalogue into which these were entered, but acquisition was from the Minneapolis Public Library.

[2] The AMNH may hold some 500 or more specimens, this is the number of relevant types held.

[3] Steere taught here, so many may be here.

[4] Remaining after exchanges to the Carnegie Museum.

[5] Remaining after sending 298 to Denver.

[6] Remaining from at least 53 of which 33 went to USNM and 5 to the Carnegie Museum.

ELIGIBILITY FOR TYPE STATUS

Steere originally intended that all specimens should be given to him to write up (Hachisuka, 1931). However, some skins were retained by Moseley and others by Bourns and Worcester.

Evidence that Moseley had held onto some skins came when he described two new forms (Moseley, 1891). In addition, had Steere had Moseley's material, he would certainly have included the male, as well as the female, when he (Steere, 1890) described *Philemon* [= *Arachnothera clarae*] *philippensis*. Moseley's male spiderhunter and the types of his two forms were among 211 specimens that were catalogued at the BMNH as early as 1890 and 1891. The catalogue dates are important because they further show that these skins could not have been in front of Steere (1890) when he described his new forms. Moseley appears to have retained most of his specimens and to have sold these directly to various institutions and none of these can be considered syntypes of Steere's new taxa.

After the Steere Expedition, Bourns and Worcester returned to the Philippines from 1890-1893 on the Menage Expedition. When they published their results, however, they (Bourns & Worcester, 1894) included a few new records based on 1887-1888 material and not upon specimens taken in 1890-1893 (Worcester & Bourns, 1898). This clearly suggests that they had kept these skins from Steere. In 1897, the ownership and possession of Steere Expedition material by Bourns and Worcester was confirmed when Worcester presented 625 skins from that expedition to the United States National Museum.

We believe museum material from this Expedition can only be considered to include syntypes of Steere's new taxa if it can be shown that the material was obtained from Steere; such material may however include skins taken by Bourns, Moseley or Worcester. Curators should be aware of this and adjust their collections accordingly.

COMMENTS ON RECOMMENDED DELETIONS

In this section, we recommend the deletion of ten island records of nine species (see Table 2) due to a high probability of error or, in one case, to lack of supporting evidence.

***Ardea cinerea* Linné, 1758:** Steere (1890) recorded this species from Guimaras but the skin that must have served as the basis for this record (BMNH 1896.6.6.1360) is in fact *Ardea sumatrana* (see under New Records). The sole record of *A. cinerea* for Guimaras must therefore be deleted.

Table 2. Recommended deletions of records solely dependant upon the Steere Expedition.

	BASILAN	BOHOL	GUIMARAS	MARINDUQUE	MASBATE	MINDANAO	NEGROS	PANAY
Ardea cinerea			×					
Egretta intermedia		×						
Dupetor flavicollis				×				
Spizaetus philippensis					×			
Porzana paykullii	×							
Charadrius alexandrinus								×
Charadrius peronii							×	
Calidris temminckii							×	
Anthus cervinus	×					×		

***Egretta intermedia* (Wagler, 1829):** Steere (1890) listed *Ardea intermedia* from Bohol and Samar. He also listed *Ardea jugularis* – which Bourns & Worcester (1894) showed to be *Egretta sacra* (Gmelin, 1789) – from the islands of Balabac, Bohol, Cebu and Marinduque. The BMNH register shows eight specimens of *Demiegretta* [*sic*] *sacra* from these four islands, plus Samar. These eight specimens appear to represent both of Steere's listed species. Of these, five (BMNH 1896.6.6.1402, 1403, 1404, 1407 and 1408) are dark phase *Egretta sacra*. The three white ones (BMNH 1896.6.6.1401, 1405 and 1406) are not white-phase *E. sacra* but have been shown to be *Egretta eulophotes* (Swinhoe, 1860) (see Amadon, 1951). In summary *E. sacra* is represented from the four islands that Steere (1890) listed for his *Ardea jugularis*, whilst Steere's records of *E. intermedia* from Bohol and Samar, which were subsequently used by McGregor (1909), should be deleted. However, there are now two ringing recoveries of *E. intermedia* from Samar (McClure, 1974).

***Dupetor flavicollis* (Latham, 1790):** Steere (1890) listed this, as *Ardetta flavicollis*, from Marinduque and Mindanao but did not include the related species *Ixobrychus sinensis* (Gmelin, 1789) or *I. eurhythmus* (Swinhoe, 1873) in his list. There are Steere Expedition specimens of *I. sinensis* (BMNH 1896.6.6.1393 and 1394) from Marinduque and Mindoro, and specimens of *I. eurhythmus* from Mindanao (BMNH 1896.6.6.1399 and 1400) – one of which was correctly re-identified by Ogilvie Grant, as mentioned in McGregor (1909). It appears that Steere overlooked his Mindoro specimen and took all these birds to be *D. flavicollis*. Therefore, Steere's records of *D. flavicollis* should be deleted, which leaves the species unrecorded for Marinduque.

***Spizaetus philippensis* Gould, 1863:** Steere (1890) listed this species from Basilan, Masbate and Negros. The record from Basilan was apparently based on a specimen (BMNH 1896.4.15.8) originally identified as *S. philippensis*, since reidentified as *Pernis celebensis steerii* Sclater, 1919. The Masbate record, if represented by a single skin, is probably based on a Steere specimen in the Institut Scientifique d'Histoire Naturelle, Brussels (ISB 9390), that is also believed to be *P. c. steerii*. The Negros specimen (BMNH 1896.4.15.40) was misidentified as well. In fact, Sclater (1919) used this as the type specimen when he described *P. c. steerii*. Clearly Steere (1890) listed *S. philippensis* in error and his records should be deleted. However, there remain valid records of this species from Basilan (Worcester & Bourns, 1898) and Negros (Tweeddale, 1878), but not from Masbate.

***Porzana paykullii* (Ljungh, 1813):** Dickinson (1984) pointed out that the bird from Basilan listed as this species by Steere (1890) is *Rallina fasciata*.

***Charadrius alexandrinus* Linné, 1758:** Steere (1890) listed this species, as *Aegialites cantianus*, from Bohol, Palawan and Panay. None of these three islands is represented by Steere skins in the BMNH; his only specimens of *C. alexandrinus* are from Negros and Siquijor. Steere's "*A. cantianus*" seems almost certain to have been *C. mongolus* for there are Steere skins of this from Bohol and Panay in the BMNH. McGregor (1909) listed other collectors of *C. alexandrinus* from Bohol and Palawan but listed only the Steere Expedition as the source of a Panay record. As the Steere record must be deleted there now no records of this species from Panay.

***Charadrius peronii* Schlegel, 1865:** Steere (1890) listed this species, as *Aegialites peronii*, for Mindanao, Negros and Siquijor. McGregor (1909) cited the Steere Expedition as the only collectors from Negros. The birds before Steere seem likely to have been a composite collection of *C. alexandrinus* - the skins mentioned above - and *C. peronii*. There are indeed Steere skins of confirmed *C. peronii* from Mindanao in the BMNH, and a Siquijor skin in the USNM taken on the Steere Expedition by Bourns or Worcester; but no *C. peronii* skin has been traced from Negros. Probably, Steere's Negros record was based on a skin of *C. alexandrinus*.

***Calidris temminckii* (Leisler, 1812):** Parkes (1986a) has shown that Steere's (1890) record from Negros is based on a specimen of *C. minuta*; thus there is no valid record of *C. temminckii* from Negros.

***Anthus cervinus* (Pallas, 1811):** Listed by Steere (1890) from Mindanao and Basilan, but the Basilan record was not listed by McGregor (1909). No skins in the BMNH substantiate these records from either island; indeed it seems probable that Steere was confused between *A. gustavi* Swinhoe, 1863, and *A. cervinus*. As there are no other records of *A. cervinus* from either Basilan or Mindanao, it seems best to delete Steere's records until proof can be found.

COMMENTS ON RECORDS NEEDING SUBSTANTIATION

Because we have not located all of the specimens collected by the Steere Expedition, we were not surprised that we could not find the specimens to substantiate nine key records (see Table 3). However, the number is remarkably small since the BMNH has obtained a representative collection. We feel that each record will eventually be confirmed and thus we do not recommend their deletion.

NEW OR FIRST ISLAND RECORDS

In all we have identified 30 new and/or first island records for 26 species that Steere and his colleagues either misidentified, or for one reason or another, failed to report in their publications.

***Ardea sumatrana* Raffles, 1822:** Guimaras: BMNH 1896.6.6.1360 taken 28 December 1887. Misidentified by Steere (1890) as *A. cinerea* (see above).

Table 3. Island records dependant upon Steere (1890) that have not been substantiated so far.

	GUIMARAS	MARINDUQUE	MASBATE	MINDANAO	SAMAR	SIQUIJOR
Anas luzonica						×
Falco peregrinus				×		
Rallus striatus	×					
Ducula poliocephala			×			
Ninox philippensis		×				
Pelargopsis capensis	×					
Halcyon winchelli					×	
Motacilla cinerea		×[1]				
Anthus gustavi	×					

[1] This record was not reported by Steere (1890) but was by McGregor (1909).

***Ixobrychus sinensis* (Gmelin, 1789):** Marinduque: BMNH 1896.6.6.1393 taken 17 May 1888. Appears to have been treated as *Dupetor flavicollis* by Steere (1890).

***Pernis celebensis* Wallace, 1868:** Masbate: ISB 9390. As shown above, Steere's specimens of what he believed to be *Spizaetus philippinensis* appear to have been *P. c. steerii*. We have not examined the specimen from

Masbate but the ISB register shows an annotation correcting Steere's identification to *P. c. steerii*. If correctly identified, this appears to be the first record of this species from Masbate.

***Haliaaetus leucogaster* (Gmelin, 1788):** Panay: USNM 161108 taken in January 1888. Previously known only by sight records from islets near Panay (Rabor, 1938; Alcala & Alviola, 1970).

***Circus melanoleucos* (Pennant, 1769):** Panay: BMNH 1891.4.25.2 taken in January 1888. Not mentioned by Steere (1890), this skin was purchased from Moseley.

***Accipiter soloensis* (Horsfield, 1821):** Guimaras: BMNH 1896.4.15.3 taken 25 January 1888, and omitted by Steere (1890).

***Turnix suscitator* (Gmelin, 1789):** Guimaras: BMNH 1896.6.6.1229 taken 17 January 1888, and omitted by Steere (1890).

***Rallina eurizonoides* (Lafresnaye, 1845):** Guimaras: BMNH 1896.6.6.1265 taken 6 January 1888. Marinduque: BMNH 1896.6.6.1266 taken 5 May 1888. Samar: BMNH 1896.6.6.1268 taken 2 April 1888. Siquijor: BMNH 1896.6.6.1267 taken 14 February 1888. All of these specimens were omitted by Steere (1890), with the possible exception of the juvenile Siquijor bird, which Steere may have listed as "*Porzana erythrothorax*."

***Amaurornis olivacea* (Meyen, 1834):** Marinduque: BMNH 1890.12.1.115 taken 11 May 1888; a Moseley specimen, not listed by Steere (1890).

***Charadrius alexandrinus* Linné, 1758:** Negros: BMNH 1896.6.6.1313 taken 7 February 1888. This first specimen record of *C. alexandrinus dealbatus* (Swinhoe, 1870), from Dumaguete, was probably listed by Steere (1890) as *Aegialites (= Charadrius) peronii* (see above). McClure (1974) reported a recent banding recovery of this species from Negros. DuPont (1976) based his record of the race *C. a. alexandrinus* on this recovery.

***Charadrius mongolus* Pallas, 1776:** Panay: BMNH 1896.6.6.1299 taken 1 January 1888. As mentioned earlier, Steere (1890) identified this specimen as "*Aegialites cantianus*".

***Gallinago megala* Swinhoe, 1861:** Samar: BMNH 1896.6.6.1341 taken 26 March 1888; omitted by Steere (1890).

***Chlidonias hybridus* (Pallas, 1811):** Guimaras: BMNH 1896.6.6.1436 taken 6 January 1888; omitted by Steere (1890). Bourns & Worcester (1894) claimed new records of *C. hybridus* for 15 islands, including Guimaras, but only as a result of two errors; first, at the foot of page 30 only Luzon, Samar and Mindanao should have appeared–the islands listed after the full stop that follows Mindanao are a duplication by the printer of the islands listed correctly for *Sterna bergii* at the top of page 31, as may be found by checking the table in Worcester & Bourns (1898); secondly, that same table shows *C. hybridus* only for Luzon and Palawan, so that the 1894 listing for Samar and Mindanao was presumably found later to be based on misidentified specimens. We know of no other record of this species from Guimaras.

***Phapitreron leucotis* (Temminck, 1823):** Marinduque: BMNH 1896.6.6.1109 taken 15 May 1888; omitted by Steere (1890). Identified as *P. l. leucotis*.

***Macropygia phasianella* (Temminck, 1821):** Malamaui: USNM 161089 taken 10 November 1887; probably listed by Steere (1890) under Basilan, which Malamaui adjoins.

***Cacomantis variolosus* (Vigors & Horsfield, 1826):** *C. v. everetti* Hartert, 1825–Malamaui: USNM 161189 taken 9 November 1887. *C. v. sepulcralis* (S. Müller, 1843)–Panay: BMNH 1896.6.6.956 taken 14 January 1888. Steere (1890) did not list this species, but did list *C. merulinus* Scopoli, 1786, from both Basilan (which could have comprised Basilan and Malamaui) and Panay. It was only recently recognized that *C. variolosus* occurred sympatrically with *C. merulinus* almost throughout the Philippines. Of the ten islands that Steere listed for *C. merulinus*, based on Steere Expedition skins in the AMNH, the BMNH and the USNM, records from Basilan, Cebu, Leyte, Luzon, Masbate, Palawan and Panay are authentic. We have also found Steere Expedition skins of *C. variolosus* from Basilan, Malamaui, Mindanao, Panay and Samar; those from Malamaui and Panay appear to be first records. No Steere Expedition skin of either species from Negros has been found.

***Otus megalotis* (Walden, 1875):** Marinduque: OSUMZ (not numbered) in May 1888 by E. L. Moseley from Boac, Marinduque. This first specimen record has been identified by RSK and J. T. Marshall as a juvenile red phase of *O. m. megalotis*. Marshall (1978) has reported on two more recent specimens (in the Philippine National Museum) of this species from Marinduque.

***Collocalia esculenta* (Linné, 1758):** Guimaras: BMNH 1896.6.6.786-87 taken 8 January 1888; omitted by Steere (1890).

***Pericrocotus divaricatus* (Raffles, 1822):** Balabac: BMNH 1896.6.6.108 taken 29 September 1887; omitted by Steere (1890).

***Corvus macrorhynchos* Wagler, 1827:** Malamaui: OSUMZ 10537 taken 11 November 1887 by E. L. Moseley.

***Copsychus saularis* (Linné, 1758):** Marinduque: BMNH 1896.6.6.276 taken 11 May 1888; BMNH 1896.6.6.277 taken 18 May 1888; omitted by Steere (1890). The amount of buff on the underparts of females is said to distinguish *C. s. deuteronymus* Parkes, 1963, of Luzon from *C. s. mindanensis* (Boddaert, 1783) of the southern islands (duPont, 1971). Judging from material in the BMNH this character varies clinally and the Marinduque birds are intermediate.

***Gerygone sulphurea* Wallace, 1864:** Basilan: BMNH 1896.6.6.129 and 130 taken 22 November 1887; omitted by Steere (1890). These two specimens from Basilan are of the race *G. s. rhizophorae* Mearns, 1905, which Parkes (1986b) has shown to be distinct.

***Acrocephalus stentoreus* (Ehrenberg, 1833):** Mindanao: BMNH 1896.6.6.222 taken 25 October 1887. Presumably this is the specimen listed for this date under *A. arundinaceus* by Steere (1890).

***Acrocephalus* [*arundinaceus*] *orientalis* (Temminck & Schlegel, 1847):** Marinduque: BMNH 1896.6.6.223 taken 16 May 1888, wing length 86 mm, the wing formula confirming the identity. Steere (1890) listed only Mindanao (the specimen discussed above) and Cebu. McGregor (1909) cited both the Steere Expedition (which was not valid) and Goodfellow as collectors of *A.* [*a.*] *orientalis* from Mindanao. There are three skins in the BMNH taken by Goodfellow near Davao that support his Mindanao records. Steere's Cebu specimen has not been traced. However, McGregor (1909) named himself and Meyer as other collectors of *A.* [*a.*] *orientalis* from Cebu. We have located Meyer's supporting specimen in the BMNH.

***Pachycephala cinerea* (Blyth, 1847):** Mindanao: BMNH 1896.6.6.345 taken 10 December 1887; omitted by Steere (1890). This specimen taken at Ayala near Zamboanga, appears to match specimens of *P. c. homeyeri* (Blasius, 1890) from the Sulu Archipelago.

***Dicaeum bicolor* (Bourns & Worcester, 1894):** Guimaras: BMNH 1896.6.6.563 taken 30 December 1887; omitted by Steere (1890). *D. bicolor* was described by Bourns & Worcester (1894) from their Menage Expedition material, and yet the Steere Expedition had taken a male (BMNH

1896.6.6.562) in Negros and the above mentioned female (BMNH 1896.6.6.563) in Guimaras. The latter has upperparts more like *D. b. inexpectatum* (Hartert, 1895) and underparts like the nominate form and thus closely matches the description of *D. b. viridissimum* Parkes, 1971, of Negros.

SUBSTANTIATION OF UNUSUAL RECORDS FROM THE EXPEDITION

In our review of the important island records from the Steere Expedition, we identified 14 published records that were either questioned or omitted by subsequent authors because the accounts lacked sufficient supporting data. Here we substantiate these records by providing details on the supporting specimens.

***Sula sula* (Linné, 1766):** The synonymy of *Sula* spp. in the Philippine literature is confused; for this reason the skin (BMNH 1896.6.6.1414) listed by Steere (1890) as "*Sula piscatrix*" has been re-examined. It was collected at Ayala, Mindanao on 10 October 1887, and is an immature *Sula sula*.

***Megapodius freycinet* Gaimard, 1823:** Steere (1890) listed this species from Masbate, but McGregor (1909) omitted the record. A specimen (BMNH 1896.6.6.1225) taken 2 May 1888 substantiates the record.

***Turnix suscitator* (Gmelin, 1789):** Although not listed by Steere (1890) from Negros, McGregor (1909) credited the Expedition with a record from there and mentioned eggs supposedly taken on 10 November [1887], when in fact the Expedition was in Guimaras. M. P. Walters (*in litt.*) confirms that the eggs, now in the BMNH, were in fact taken on 10 February 1888, at which date the Expedition was indeed in Negros.

***Porzana pusilla* (Pallas, 1776):** DuPont (1972) did not accept the Marinduque record for this species. It was published, not by Steere, but by Hachisuka (1931), and is confirmed by a specimen (BMNH 1896.6.6.1270) collected on 12 May 1888.

***Charadrius dubius* Scopoli, 1786:** McGregor (1909) credited the Steere Expedition with a specimen from Panay, although this was not listed by Steere (1890). A skin (BMNH 1890.12.1.132) collected on 18 January 1888 by Moseley confirms this.

***Charadrius veredus* Gould, 1848:** Not listed by Steere (1890). However, three skins (BMNH 1896.6.6.1317 and 1318 and USNM 314793) were taken in Palawan by the Steere Expedition between 12 and 22 September

1887. The USNM skin no doubt provided the record in McGregor (1909), credited to Bourns & Worcester; the date on the specimen label shows it was collected by them during the Steere Expedition, not the Menage Expedition as implied by the table in Worcester & Bourns (1898).

Numenius minutus **Gould, 1841:** Bourns & Worcester *in* McGregor (1909) reported it taken in Marinduque in 1888 by Bourns. A specimen (USNM 314815) taken on 15 May 1888 supports this.

Limosa limosa **Linné, 1758:** McGregor (1909) correctly credited the Steere Expedition with a record of this species from Negros, in addition to a record of *Limosa lapponica,* although Steere (1890) claimed only the latter. Specimen BMNH 1890.12.1.124, purchased from Moseley and registered as *L. melanura,* is *L. limosa melanuroides* Gould, 1846, while BMNH 1896.6.6.1346 received from Steere and registered as *L. novaezeelandiae* is *L. lapponica baueri* Naumann, 1836.

Calidris tenuirostris **(Horsfield, 1821):** Omitted by Steere (1890), but he, and also Bourns & Worcester, are given as collectors in Negros by McGregor (1909). The record credited to Steere is a specimen (BMNH 1896.6.6.1338) collected on 4 February 1888. Moseley collected a further specimen (BMNH 1890.12.1.127) on 6 February. A third specimen, once given the Menage Expedition no. 4489, taken on 7 February 1888 is in the Bell Museum (uncatalogued there), Minneapolis (*per* K.C. Parkes).

Tanygnathus sumatranus **(Raffles, 1822):** Listed only from Mindanao by Steere (1890), but Bourns & Worcester (*in* McGregor, 1909) mentioned that Moseley collected this species in Panay. The supporting specimen is BMNH 1890.12.1.80, taken on 16 January 1888.

Chrysococcyx russatus **Gould, 1868:** Listed as *C. basalis* by Steere (1890) and apparently overlooked by McGregor (1909), Parker (1981) reidentified the specimen (BMNH 1896.6.6.963), collected in Basilan on 21 November 1887.

Ninox scutulata **(Raffles, 1822) subsp.:** Listed from Guimaras as *Ninox lugubris* by Steere (1890) but not included by McGregor (1909). A specimen (BMNH 1896.4.15.51) from Guimaras taken 25 January 1888 has not been identified to subspecies.

Rhabdornis mystacalis **(Temminck, 1825):** DuPont (1971) omitted Basilan from the range of *R. m. minor* Ogilvie-Grant, 1896, although McGregor (1909) listed Basilan on the basis of a Celestino record. In addition there is an unreported Steere Expedition specimen (USNM 161551) of *R. m. minor* collected in Basilan in November 1887.

Megalurus timoriensis **Wallace, 1864:** Although McGregor (1909) listed this species from Masbate duPont (1971) omitted it. However Moseley collected a specimen (BMNH 1890.12.1.29) at Palanog on 30 April 1888 during the Steere Expedition.

COMMENTS ON OTHER SPECIMENS COLLECTED BY THE STEERE EXPEDITION

Below we comment on six species and two genera with doubtful records or confused history.

Ixobrychus eurhythmus **(Swinhoe, 1873):** Not previously known from Panay but a specimen (USNM 160965), supposedly taken on 18 January 1888, very probably came from Panay as the Expedition was there at that time. Unfortunately, the label says "Palawan" and "Jan. 18" [1888]. Collecting in Palawan seems to have ended about 26 September 1887, but it could be the date rather than the island that is in error on the label.

Accipiter **sp.:** Of the various species of small *Accipiter*, Steere (1890) listed only *Accipiter soloensis* (Horsfield, 1821) from Mindanao, but in fact he probably did not have a specimen of this species from Mindanao. The BMNH holds four skins of small *Accipiter* taken on the Steere Expedition, two coming from Moseley and two from Steere. The two from Moseley (BMNH 1890.12.1.8 from Guimaras and BMNH 1890.12.1.9 from Mindanao), which were almost certainly not available to Steere (1890), were registered as *A. virgatus*. The Guimaras specimen could not be found but the Mindanao bird has been re-examined and is *A. virgatus confusus* Hartert, 1910. Neither of Steere's specimens is from Mindanao, which may imply that a further specimen exists in another institution. One of Steere's, from Luzon (BMNH 1896.4.15.5), is a third specimen of *A. v. confusus* and the other (BMNH 1896.4.15.3) has been listed earlier as the first record of *A. soloensis* from Guimaras. Steere (1890) omitted these two specimens or at least did not think that either was *A. soloensis*. He was probably confused by the existing literature (see Hartert, 1910) and we cannot be sure what species he took from Mindanao. However, there are satisfactory records of *A. soloensis* from Mindanao (AMNH 532719 collected by Waterstradt, and AMNH 532720 collected by Goodfellow) so that Steere's (1890) record is not critical.

Porzana fusca **(Linné, 1766):** Steere (1890) listed *P. fusca* from Luzon and Mindanao and *P. erythrothorax* – now considered the Chinese race of *P. fusca* – from Guimaras. McGregor (1909) apparently doubted this record because he omitted it. There is no skin now in the BMNH that throws any light upon this unless it is the juvenile *Rallina eurizonoides* (Lafresnaye, 1845) (BMNH 1896.6.6.1265) from Guimaras.

Fulica atra **Linné, 1758:** Not listed by Steere (1890). There is a specimen (BMNH 1896.6.6.1442), purportedly from the Steere Expedition, dated 15 April when the Expedition was in Leyte. The words "Laguna" and "old skin" appear on the label of this and of Steere Expedition specimens of *Falco peregrinus* Tunstall, 1771, (BMNH 1896.4.15.37) and *Ninox scutulata* (Raffles, 1822) (BMNH 1896.4.15.54), all seem to have been bought from a taxidermist. No record can be safely based on any of these specimens.

Centropus bengalensis **(Gmelin, 1788):** Steere (1890) listed his Palawan material as *Centrococcyx affinis* following Sharpe (1888), who reported that Whitehead had taken *C. affinis* in Palawan; *C. affinis* was later synonymised with *C. bengalensis javanensis* (Dumont, 1818). As discussed by Parkes (1957, 1965) and Mees (1971), the birds of Palawan and the Sulu Islands are *C. b. javanensis* and those of other islands *C. b. philippinensis* Mees, 1971 (of which the type was taken in Mindoro by the Steere Expedition). Steere (1890) did not list his other material of "*C. affinis*" but the BMNH has Steere Expedition birds from Bohol, Cebu, Mindoro and Negros.

Collocalia **sp.:** Apart from *C. troglodytes* G. R. Gray & Mitchell, 1845, over which no mistakes are likely to have been made, Steere (1890) listed only *C. francica* (Gmelin, 1789) and did so for Cebu, Mindoro, Negros and Panay. Hartert (1892) included Steere (1890) records of *C. francica* in his synonymy of *C. fuciphaga* (Thunberg, 1812), probably based solely on birds in the BMNH taken by Moseley. However, it has long been known that the Steere Expedition took at least two other species of swiftlets. In fact, McGregor (1909) credited it with the following; *C. lowi* (Sharpe, 1879) from Palawan; *C. fuciphaga* from Cebu, Mindoro, Negros, Palawan and Panay; *C. germani* Oustalet, 1878, from Cebu and Negros; and *C. troglodytes* from Guimaras, Marinduque and Negros. The records of *C. lowi* (see Ogilvie Grant, 1895) and *C. troglodytes* are correct, but there seems to be no basis for the Cebu and Negros listings of *C. germani* – upon which McGregor (1909) was probably misled by Oberholser (1906), who wrote "… all Philippine records of both *C. francica* and *C. inexpectata* refer of course to *germani*."

In a separate publication one of us (Dickinson, in press) will review the larger species of *Collocalia* that occur in the Philippines; several taxa will be treated under specific names that differ from duPont (1971). The Steere Expedition material includes the following:

■ Four generally dark forms:

☐ *a long winged, square tailed swiftlet with feathered tarsi:* BMNH 1890.12.1.87 from Palawan. This has been shown by Ogilvie Grant (1895) to be *lowi*, a race of *C. maxima* Hartert, 1892, — a species omitted by duPont (1971).

☐ *a long winged swiftlet with naked tarsi:* BMNH 1890.12.1.86, 1896.6.6.798 and 799; USNM 161296 (once labelled 161299), 161297 and 161298 from Palawan. These belong to the form *palawanensis* Stresemann, 1914. DuPont (1971) treated this as a race of *C. brevirostris*.

☐ *a medium sized swiftlet with feathered tarsi:* BMNH 1890.12.1.88, 1896.6.6.794 and 795 from Negros; this has traditionally been called *C. mearnsi* Oberholser, 1912, although it was treated by duPont (1971) as a synonym of the following form.

☐ *a medium sized swiftlet with naked tarsi:* BMNH 1896.6.6.791, 792 and 797 from Cebu; BMNH 1896.6.6.796 from Mindoro; USNM 161295 from Mindanao (the label shows the collecting date as November 1887 and the register entry showing June 1888 is an error). These represent *amelis* Oberholser, 1906; treated by duPont (1971) as a form of *C. vanikorensis* (Quoy & Gaimard, 1830).

■ Two forms with distinct plumage:

☐ *a medium sized swiftlet with a buffy rump patch:* USNM 161299 from Panay (once mislabelled 161296); this represents *germani*, considered a form of *Collocalia fuciphaga*. This specimen was the basis for the record by Bourns & Worcester (1894) but it is not a Menage Expedition specimen. The record from Panay of Steere (1890)–which this pale rumped bird, almost certainly not known to Steere, would not represent, is the only Steere *Collocalia francica* record we have not been able to substantiate.

☐ *a small swiftlet with white underparts:* BMNH 1896.6.6.786 and 787 from Guimaras, BMNH 1896.6.6.789 from Mindanao and BMNH 1896.6.6.788 from Negros all of which are forms of *C. esculenta* (Linné, 1758).

***Parus semilarvatus* (Salvadori, 1865):** Parkes (1971) discussed the attribution of an old Negros record to the Steere Expedition by McGregor (1909), and has pointed out that Steere (1890) did not list it. No supporting specimen has been found.

***Phylloscopus olivaceus* (Mosely, 1891):** This species was described by Moseley (1891) as *Abrornis olivacea* based on a female (BMNH 1891.4.25.47) from Negros and a male (BMNH 1891.4.25.30) from Samar. However, the female is in fact a specimen of *Phylloscopus cebuensis* (Dubois, 1900). Rand & Rabor (1952) remarked upon this when restricting the type locality to Samar–they also incidentally provided satisfactory records of *P. olivaceus* from Negros. We now consider it desirable to hereby formally designate the presumed male *P. olivaceus* (BMNH 1891.4.25.30) taken on 12 April 1888 at Catbalogan, Samar as the lectotype so as to ensure citation of a type specimen that is truly representative of the species.

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NOTES ON THE MENAGE COLLECTION OF PHILIPPINE BIRDS

1. REVISION OF *PACHYCEPHALA CINEREA* (PACHYCEPHALIDAE) AND AN OVERLOOKED SUBSPECIES OF *DICAEUM TRIGONOSTIGMA* (DICAEIDAE)

Kenneth C. Parkes[1]

ABSTRACT. The Philippine whistlers currently considered conspecific with *Pachycephala cinerea* are divided into three species, with only the Palawan race *plateni* being retained in *cinerea*. The other two species are *P. homeyeri* of the southern and central Philippines and *P. albiventris* of Luzon and Mindoro. Study of specimens from the historic Menage Collection and later material results in the revival of *Hyloterpe major* Bourns and Worcester as a valid subspecies of *P. homeyeri* endemic to the island of Cebu, Philippines. The population of *Dicaeum trigonostigma* from the island of Tablas, Philippines, suggested as probably distinct by Bourns and Worcester, is described as a new subspecies. Lectotypes are designated for *Hyloterpe winchelli*, *Hyloterpe major*, and *Dicaeum intermedia*, all of Bourns and Worcester (1894).

INTRODUCTION

Two of the participants in the pioneering Steere Expedition to the Philippines (1887-1888), Frank S. Bourns and Dean C. Worcester, were convinced that much more ornithological collecting was needed in the archipelago, "both in the discovery of new species and in the working out of the exact distribution of species already known" (Bourns and Worcester,

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1894: 5). Through the generosity of Mr. Louis F. Menage of Minneapolis, a businessman and member of the Minnesota Academy of Sciences, they were able to return to the Philippines in the summer of 1890. The specimens obtained during the following three years were donated to the Minnesota Academy of Sciences, and the fruits of the expedition are generally referred to as the "Menage Collection." Almost 4500 bird specimens (in addition to numerous mammals) were obtained in the Philippines, and 81 more birds in Borneo at the end of the expedition.

Bourns and Worcester (1894) published "Preliminary Notes" on the birds and mammals collected by the Menage Expedition, in which they described 36 new "species" of birds, most of which are now considered subspecies and a few as synonyms. They had intended to publish a full account of their expedition, with field notes, but were unable to find funds to support such a publication. Their notes were made available to Richard McGregor of the Philippine Bureau of Science, and are quoted extensively in McGregor's "Manual" (McGregor, 1909).

The Minnesota Academy of Sciences transferred ownership of the collection, at first to the Minneapolis Public Library where selected mounted specimens were displayed for many years. Eventually the collection, including the mounts, was deposited in the Minnesota Museum of Natural History, University of Minnesota, now called the James Ford Bell Museum of Natural History (for which the old acronym MMNH is still used). Beginning in 1911, the majority of the Menage Collection was transferred to the United States National Museum of Natural History (USNM). Between 1958 and 1963, 539 Menage specimens were exchanged to Carnegie Museum of Natural History (CM). Several dozen were exchanged to other museums from MMNH, USNM or CM, and several dozen more have been destroyed or have yet to be traced.

This is the first of several proposed papers based on my long-term studies of the Menage Collection. Later papers will reconstruct the unpublished itinerary of the Menage expedition, and will analyze the type material of Bourns and Worcester's new taxa. Bourns and Worcester (1894) did not designate holotypes, and several of their new taxa were described from long series. Most of these syntypes are now in the USNM, and were discussed by Deignan (1961). Unfortunately Deignan made many errors and unjustified assumptions in connection with the Menage types, which I hope to clarify in my proposed paper on these type specimens.

In the present paper I call attention to two valid subspecies, one of which, "*Hyloterpe major*," was described (as a species) by Bourns and Worcester (1894:22) but synonymized by McGregor (1909: 603), Deignan (1961: 471), Mayr (1967: 13), and duPont (1971: 351). In order to determine the correct name to use for the species to which *major* belongs, I present a brief review of this group of whistlers. The other overlooked subspecies, a race of the highly polytypic flowerpecker *Dicaeum trigonostigma,* was suggested as possibly separable by Bourns and Worcester (1894: 19) and Deignan (1961: 505).

All measurements are in mm to the nearest 0.5 mm (Bourns and Worcester published theirs in inches and tenths). I measured the wing flattened on the ruler, and the bill along the culmen from its base at the forehead. Altitudes taken from the literature are given in feet as published.

SYSTEMATICS

Pachycephala cinerea (Blyth, 1847) (Pachycephalidae)

In most of the current literature, (Mayr, 1967; duPont, 1971), all of the Philippine whistlers except *Pachycephala philippinensis* (Walden, 1872) are considered conspecific with *P. cinerea* (Blyth, 1847), which inhabits southeast Asia from Calcutta to Indonesia. White and Bruce (1986) and some other authors (references in White and Bruce) advocate the use of *Tephrodornis grisola* Blyth, 1843, for this species; Mayr (1967) considered *grisola* unidentifiable. I have not studied the nomenclatural arguments, and for convenience I follow the nomenclature of the standard "Peters" check-list (Mayr, 1967).

Delacour and Mayr (1946: 216) had earlier written of the Philippine populations "Whether or not these 5 forms [*albiventris, mindorensis, crissalis, winchelli, homeyeri*] are actually members of a single species, and whether or not they are conspecific with *cinerea* (Malaysia) still remains to be determined." I have examined specimens of all of the Philippine races, and have come to the conclusion that they are best treated as three species.

The first of these is a relatively small, primarily grayish race, *plateni* (Blasius, 1888), which is confined to the island of Palawan. It is a lowland forest bird that is similar to the adjacent Bornean subspecies *P. cinerea secedens* Stresemann, 1913, differing chiefly in its browner (less gray) crown. It is the only Philippine race that I would continue to assign to the species *cinerea*. This makes zoogeographic sense, as the birds of Palawan are frequently more closely related to those of Borneo than to those of the main Philippine archipelago (Delacour and Mayr, 1946).

The second species is characterized by distinctly rufous plumage colors, absent in *P. cinerea*. Part of its range consists of quite small islands, so it cannot be said to be confined to highlands, but on Canlaon Volcano, Negros, it occurs from 2500 feet to 7500 feet elevation (Ripley and Rabor, 1956). Members of this reddish group inhabit the Sulu Archipelago and the central Philippine islands of Cebu, Masbate, Negros, Panay, Sibuyan, Tablas, and Ticao. The oldest available name for this group of subspecies is *homeyeri* Blasius, 1890 (type locality Jolo Island, Sulu Archipelago). Subspecific variation in *Pachycephala homeyeri* will be discussed below.

The third species is found in the mountains of the northern Philippines, from 2500 feet (762 meters) upward, and is quite different in appearance. It is greenish dorsally and gray below, with yellow under tail coverts. There are three subspecies in this species, with the oldest name being *albiventris* Ogilvie Grant, 1894, for the race of northern Luzon. This name has six months priority over *mindorensis* Bourns and Worcester, 1894, the name for the valid Mindoro race. The third subspecies, *P. a. crissalis* Zimmer, 1918, appears to be confined to the vicinity of Mount Banahao, Laguna Province, south-central Luzon, where the holotype and paratype were collected at 3000 feet elevation.

The English name for *P. cinerea* (*s.l.*) in many handbooks is "Mangrove Whistler." Although primarily found in mangroves in much of its non-Philippine range, this species also inhabits lowland and foothill forests. In most of the Philippines, however, the whistlers of this group are chiefly birds of mountain forests. With the division of the former *Pachycephala cinerea* into three species, I propose retaining the English name Mangrove Whistler for *P. cinerea* in the restricted sense used here; even though not wholly appropriate for some populations, it has nevertheless been so widely used that I do not venture to recommend any change. White-bellied Whistler, as used by Delacour and Mayr (1946) and duPont (1971) for the combined Philippine forms, I would retain for *P. homeyeri*. An appropriate new English name for *P. albiventris*, not previously used in this very large genus, is Green-backed Whistler.

Bourns and Worcester (1894) described three species in the genus *Hyloterpe*, now considered a synonym of *Pachycephala*. Of these, one (*H. mindorensis*), is a subspecies of *P. albiventris*, and one (*H. winchelli*) of *P. homeyeri*. The third, *Hyloterpe major*, has been synonymized with *winchelli* by McGregor (1909), Mayr (1967), and duPont (1971).

Bourns and Worcester (1894) attributed *major* to the Philippine islands of Cebu, Tablas, and Sibuyan. They commented that this was a somewhat peculiar distribution, as it was interrupted by the range they attributed to *winchelli*, namely Negros, Panay, and Masbate. Furthermore, they called attention to differences in both size and color between Cebu and Tablas/Sibuyan specimens of *major*, but stated that they did "not think [Tablas and Sibuyan populations] can be specifically separated." This represented a change of opinion for these authors, as both in the original catalogue of the Menage Collection and on the specimen labels, the Tablas and Sibuyan specimens are identified as "Hyloterpe minor," a name they never published, although in their catalogue they went so far as to designate a male from Tablas (their no. 1454, now USNM 316148) and a female from Sibuyan (their no. 1461, now USNM 316147) as "types" of "minor."

I have restudied the Menage Collection material of this species, supplemented by additional specimens at the USNM. I find the name *major* Bourns and Worcester to be valid for a subspecies of *Pachycephala homeyeri* restricted to the island of Cebu alone. The universal failure to recognize *major* is undoubtedly based on its authors' allocation of the islands of Tablas and Sibuyan to its range.

As originally stated by its authors, *major* of Cebu is substantially larger than *winchelli* (see measurements below), and differs slightly in color. Bourns and Worcester stated that *major* differs from *winchelli* in "the white of the throat less sharply defined;" my notes taken at USNM state that Cebu specimens are "more heavily washed with brownish across the chest" than are *winchelli* from Negros, Panay, and Masbate.

Bourns and Worcester (1894: 21) gave the distribution of *winchelli* as Panay, Masbate and Negros, and did not mention any variation within their series. I find that specimens from Negros average slightly longer-tailed than those from the other islands, but the overlap is extensive, and measurements of the series from the three islands are combined for the comparisons below. Color variation within *winchelli* is puzzling; as Ralph Browning (pers. comm.) has also noted, the Menage specimens from Negros are more reddish (less brownish) on the sides of the head than those from other islands, but this difference is not apparent in Negros specimens collected in the 1960's.

Deignan (1961: 471) listed USNM 316149 from Negros as the "type" of *winchelli*, but his discussion of the Bourns and Worcester series was based on several false premises that I intend to clarify in my future paper on the Menage type material. Nevertheless, in view of the slight geographic variation within *winchelli* it would be useful to restrict the type locality of the subspecies. I therefore formally designate as the lectotype of *Hyloterpe winchelli* Bourns and Worcester, 1894, the same specimen listed by Deignan (1961), namely USNM 316149 (Menage 1440), adult male, collected by D. C. Worcester and F. S. Bourns at Bais, Negros, Philippine Islands, on 12 January 1891. I also formally designate as the lectotype of *Hyloterpe major* Bourns and Worcester the "type" listed by Deignan, USNM 316145 (Menage 1450), adult male, collected by Worcester and Bourns at Toledo, Cebu, Philippines, on 16 June 1892.

The status of the populations of Tablas and Sibuyan remains to be discussed. These are the birds for which Bourns and Worcester used but later abandoned the manuscript name "minor". In their publication (1894:

22) they included these birds in their new "species" *major*, although commenting on their smaller size. They gave only the measurement means for their entire series of *winchelli*, and separate means for their Cebu and Tablas series attributed to *major*. In remeasuring all of this material, I find that sex for sex (males being larger), the wing lengths of Cebu specimens do not even overlap with those from any of the other islands under consideration (see table). There is also a gap in the tail measurements of males, although in females there is a slight overlap. The only discrepancy lies in the bill measurements. Contrary to Bourns and Worcester, the tail and especially the wing measurements of Tablas and Sibuyan birds, although averaging slightly larger than those of *winchelli*, more closely match that race rather than Cebu *major*. The bills of the Tablas/Sibuyan series, however, match those of *major* in length. The Tablas/Sibuyan populations could conceivably be separated as an additional subspecies, with the wing and tail measurements of *winchelli* and the bill measurement of *major*. I prefer to consider those populations merely as the long-billed extremes of *winchelli* rather than recognize a third subspecies, as they also match *winchelli* in color. Combining these populations with *winchelli* rather than *major* also corrects the apparent zoogeographic anomaly of a split range for *major* mentioned by Bourns and Worcester.

Measurements: *winchelli* (Negros, Panay, Masbate; n=22) wing, males 83-89 (85.6); females 79.5-86 (83.5). Tail, males 64.5-71.5 (67.8); females 62-71.5 (66.6). Bill, males 17-18.5 (17.8); females 16.5-19 (17.6).

winchelli (Tablas, Sibuyan ["minor"]; n=10) wing, males 86-89.5 (87.8); females 81.5-90 (85.1). Tail, males 70-72.5 (71.4); females 65.5-72.5 (68.2). Bill, males 19.5-21.5 (20.3); females 18.5-20 (19.0).

major (Cebu; n=8) wing, males 94.5-99 (96.5); females 90-94.5 (91.5). Tail, males 72.5-78 (75.8); females 70.5-73 (72.0). Bill, males 20-21.5 (20.6); females 19.5-20.5 (20.2).

Dicaeum trigonostigma (Scopoli, 1786) (Dicaeidae)

In their description of *Dicaeum intermedia* [*sic*], Bourns and Worcester (1894: 19) gave the range as Romblon and Tablas. They implicitly restricted the type locality to Romblon, however, in stating "It may ultimately prove that the Tablas birds are distinct, the four specimens secured by us in that island having a much heavier wash of yellow on the throat than the Romblon birds." The reference to "four specimens secured" is an error even if intended to refer to adult males only, as the Menage Expedition collected five such males. In all, they collected eleven specimens of this species on Tablas, of which five are now in USNM, two in CM, one in

MMNH, and three are unaccounted for.

Deignan (1961: 506) quoted Bourns and Worcester's statement about the Tablas birds, and formally restricted the type locality of *Dicaeum intermedia* to Romblon. He listed only one of the syntypes from Romblon, erroneously stating that it was "Bourns and Worcester's own lectotype." According to the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature, 1985), Articles 72 (b) (vii) and 73 (b) (i), "The mere citation of 'Type' . . . in a list of types . . . or on a label is not to be construed alone as evidence that a specimen is or is fixed as any of the kinds of types referred to in this Chapter . . . Syntypes may include specimens labelled 'cotype' or 'type' . . ." There are in fact *four* specimens from the original syntypical series of *Dicaeum intermedia* in the USNM on which the word "type" appears, two each from Romblon and Tablas. The same notation appears, in the same handwriting, with the entries for these four specimens in the Menage Collection catalogue. However, the handwriting is not that of the original labels and catalogue entries themselves, and appears to be that of W. A. Bryan, who signed himself in the Menage Collection catalogue in 1907 as "Curator Pac. Orn., Minn. Ac. Sci." Bourns and Worcester wrote "sp. n." on the labels of each of their specimens of their new taxa, some of which bear red original labels and others white. Of the syntypes of *intermedia*, three from Romblon and three from Tablas bear red original labels. Although all of the series rank formally as syntypes, it can be deduced that Bourns and Worcester gave special status to the red-labelled specimens, perhaps intending them as "cotypes," although this designation was never published. The specimen listed by Deignan as the Bourns and Worcester "lectotype" of *Dicaeum intermedia*, USNM 316172 (Menage 2699), bears a *white* label, whereas USNM 316182 (Menage 2698) bears a red original label, and also bears the later entry as "type" in the same (Bryan) handwriting as that on the alleged lectotype. It appears more appropriate to designate formally as lectotype of *Dicaeum intermedia* one of the specimens to which Bourns and Worcester had attached a red label, so I therefore so designate USNM 316182 (Menage 2698), adult male, collected on Romblon Island, Philippines, 6 September 1892 by the Menage Expedition.

Bourns and Worcester and Deignan were correct in believing that the specimens from Tablas are separable from *Dicaeum trigonostigma intermedium* of Romblon. In addition to his tentative suggestion in his USNM type catalogue (Deignan, 1961: 506), Deignan left a handwritten note in the tray containing the USNM specimens from Tablas, reading "Should be named — like *intermedium* but throat washed with yellow (HGD)." The Tablas subspecies is appropriately named as follows:

Dicaeum trigonostigma cnecolaemum, new subspecies

HOLOTYPE: USNM 315770, adult male, collected at "Badajos" [=Badajoz], Tablas Island, Philippines, on 29 September 1892, by D. C. Worcester and F. S. Bourns (Menage Expedition no. 2690 $^1/_2$).

DIAGNOSIS: Similar to *D. t. intermedium* of Romblon Island, but adult males with throat washed with yellow instead of being pale neutral gray, and breast slightly deeper orange-yellow; blue of dorsum slightly less blackish, especially on the forehead. Immature males have chins distinctly yellow rather than gray as in *intermedium*, and the green of the dorsum is slightly less grayish. No females from Romblon were available, but females from Tablas are yellowish on the throat, and the subspecific differences probably parallel those of the immature males. The two subspecies do not differ in size.

RANGE: The island of Tablas, Philippines.

ETYMOLOGY: From the Greek, *knekos*, meaning pale yellow, and *laimos*, meaning throat, the distinguishing character of the subspecies in all known plumages.

SPECIMENS EXAMINED: *D. t. cnecolaemum*, adult males 6, immature males 2, adult females 2, unsexed immature 1. *D. t. intermedium*, adult males 5, immature males 2.

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The exchange whereby CM obtained Menage Collection specimens was arranged by Dwain W. Warner and by Robert W. Dickerman, who was then a graduate student at the University of Minnesota. David F. Parmelee of the Bell Museum of Natural History generously allowed Dr. Dickerman to hand-carry the Menage Collection catalogue from Minneapolis for me, and was most hospitable while I was studying the Menage specimens at the Bell Museum. Specimens were examined at the USNM through the courtesy of the curatorial staff at that museum. The manuscript was critically read by M. R. Browning, E. C. Dickinson, R. S. Kennedy, C. A. Ross, and D. S. Wood.

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NOTE ADDED IN PROOF: Upon further investigation, I find that *Tephrodornis grisola* Blyth, 1843, must indeed replace *M[uscitrea] cinerea* Blyth, 1847, as the name for the Mangrove Whistler. Mayr and others who have considered *grisola* unidentifiable were apparently not aware that Blyth's holotype is extant. See Mukherjee, 1970, Journal of the Bombay Natural History Society, **67:** 112-113.

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JOHANNES THIELE AND HIS CONTRIBUTIONS TO ZOOLOGY.

PART 1. BIOGRAPHY AND BIBLIOGRAPHY

Rüdiger Bieler[1] and Kenneth J. Boss[2]

ABSTRACT. The first part of an evaluation of Johannes Thiele's (1860-1935) contributions to zoology provides a biographical sketch of his life and a complete listing of his publications with special emphasis on the exact dates of publication. During his professional career, most of which was spent at the Zoological Museum in Berlin, Germany, Thiele produced 155 zoological publications. The majority of his papers (129) dealt with the systematics and anatomy of Mollusca, but he made numerous important contributions to the study of Crustacea (12) and Porifera (8). Six publications treated miscellaneous zoological subjects.

INTRODUCTION AND BIOGRAPHY

One of the preeminent malacologists of the twentieth century, Johannes Thiele, has been an inspiration to generations of students of the Phylum Mollusca. Probably no other individual researcher has been more influential, and his *Handbuch der systematischen Weichtierkunde* has left an indelible imprint on innumerable investigations in malacology. Not only did this work treat thousands of generic-level names with individual diagnoses, but it placed them in a newly established hierarchy of higher taxa. At the time, this *magnum opus* was the only work which dealt extensively with anatomical characteristics as well as conchological or hard-part features; it replaced Fischer's *Manuel de Conchyliologie* of fifty years before. With a detailed acquaintance of most groups and a profound knowledge of the diverse literature on the systematics and anatomy of mollusks, Thiele was

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fortunately well prepared for his task. For over half a century, he published critical studies on many diverse molluscan taxa from widely differing geographical regions of the world, prompting Winckworth (1938) to remark: "In no group, in no fauna was his knowledge superficial; steady work prosecuted with that thoroughness in detail that is akin to genius made him the great master of his subject."

That one man could have intellectually embraced the entire diversity of the Phylum Mollusca in such detail seemed so astonishing to us that we resolved to review his career and research contributions and to compile a comprehensive list of his publications and the new molluscan taxa, both generic and specific, which he introduced. The decision to accomplish this task was attended by a curious coincidence: we began searching for remarks and obituaries on Thiele, came across Lamy's Nécrologie (1938) on 5 August 1985, and read "Ses dernières années furent consacrées à l'élaboration de son grand ouvrage *Handbuch der systematischen Weichtierkunde* (1931-1935), qu'il put achever quelques mois avant sa mort survenue le 5 août 1935." Thus, on the fiftieth anniversary of Thiele's death, we initiated our investigation of his life and work.

In addition to Lamy's obituary in the *Journal de Conchyliologie* (1938), Winckworth (1938) published one in the *Proceedings of the Malacological Society of London* which also provided a supplementary list to the *Festnummer* in the *Archiv für Molluskenkunde* issued by Rensch (1930) on the occasion of Thiele's seventieth birthday. Rensch's delineation of Thiele's malacological publications numbered 93 items while Winckworth provided some additions which were overlooked and completed the list to include papers published by Thiele from 1930 to his death in 1935. More recently, Kiss (1985) contributed a short vignette in Hungarian on the life of Thiele.

Emil Karl Hermann Johannes Thiele was born on 1 October 1860 in Goldap (Goldapp), then in East Prussia, not far from the Masurian Lakes and now part of Poland. As a young student, he showed an avid interest in animals, particularly insects. His higher education was pursued in the natural sciences, initially at Berlin and later at Heidelberg. Studying under Professor Franz Eilhard Schulze, Director of the Zoological Institute in Berlin and an expert on sponges, he produced his thesis in 1886 on the nature of labial palps in bivalve mollusks. This consisted of a detailed investigation of these structures and their probable function in many families of lamellibranchs. Later in 1886, he spent six months at the Zoological Institute in Naples. Also at about this time he met Miss Fanny Wolle, whom he married in October 1888 and who, along with his daughter and three sons, survived after his death.

In 1891, he accepted an appointment as an assistant in the invertebrate section of the Dresden Museum where he was mainly occupied in arranging the collection of mollusks. At about this time he commenced working on the unfinished manuscripts of 1879 left by Franz Hermann Troschel, the originator of *Das Gebiss der Schnecken*, and began his interest in the study of Solenogastres which culminated in a number of subsequent studies [he did not consider them to be mollusks and therefore did not treat them in such works as the *Handbuch*]. By July 1895, Thiele had taken up residence at Strassburg's Zoological Institute where he was responsible for studying and arranging the Japanese sponges collected by Ludwig Döderlein during his tenure as Professor of Natural Sciences in Tokyo. In October 1896 he moved on to Göttingen's Zoological Institute where he remained only briefly since by the spring of 1898, he took a position as a Lecturer in the Faculty of Entomology at the Zoological Institute of the Agricultural College in Berlin. Thiele apparently never actually lectured here, because he directly moved on to the Zoological Museum in Berlin in the spring of 1899, where he remained for the rest of his professional career. At first he was a scientific collaborator or helper (*wissenschaftlicher Hilfsarbeiter*), then in 1900 a Research Assistant, and by 1903, Head or Keeper (*Kustos*) of the Crustacea Section. In 1905, after the death of Eduard von Martens, he took charge of the Mollusk Section. Reaching the mandatory age of retirement, Bismarck's *Altersgrenze*, he formally left his position as Professor of Zoology in 1925 but actively continued research until his death in 1935.

As can be seen from the following bibliography, Thiele sustained an enviable outpouring of papers and monographs. To certain groups he paid particular attention, contributing significant items on the Solenogastres and the phylogeny of mollusks (1902b). He wrote a detailed revision of Solenogastres in *Das Tierreich* (1913e), as well as a two-part monograph of chitons (1909d,i).

For Martini-Chemnitz's second edition of the *Conchylien-Cabinet*, he pursued several different groups such as the Cocculinoidea (1909g), Scissurellidae and Fissurellidae (1912a, 1913f, 1916b, 1919), and Limidae (1918, 1920a). Taxonomic monographs on other individual families or superfamilies included his revisions of the Trochacea (1924a), Columbellidae (1924b), Assimineidae (1927a), and the Hydrobiidae and Melaniidae (1928c). As for geographically circumscribed faunal reports, mention should be made of his studies of the land and freshwater shells of Borneo (with E. von Martens, 1908a), Brazil (1927c), central Africa (1911d), Abyssinia (1933c), the West Indies (1910f), and southwest Australia (1911e). He was an outstanding contributor to several of the great German Imperial expeditions, having studied both the gastropods and bivalves of the German Deep-Sea or *Valdivia* Expedition; the first portion of this work was in collaboration with Eduard von Martens (1904a). A subsequent long and extensive study was completed on the smaller and more obscure gastropods (1925b), illustrated by Thiele's own drawings. The bivalves were monographed in collaboration with Jaeckel (1931b). Additionally, he produced the reports on most of the mollusks obtained by the German South Polar Expedition (1908c, 1912b, 1920b).

In further preparation for the *Handbuch der systematischen Weichtierkunde* and for his authoritative contributions to the *Handwörterbuch der Naturwissenschaften* and to Kükenthal's *Handbuch der Zoologie*, Thiele compiled a list of molluscan *nomina conservanda*, which, although not put before the International Committee for authorization, was published by Apstein (1915c). According to Winckworth (1938), he also prepared the list of molluscan generic names for inclusion in F.E. Schulze & W. Kükenthal's *Nomenclator animalium generum et subgenerum.*

In this first of a series of papers on Thiele and his contributions, we provide a revised bibliography of his publications on mollusks and other animal groups, adding several which were overlooked by both Rensch (1930) and Winckworth (1938). We were aided in compiling our inventory not only by our colleagues' previous work but also by careful appraisals of entries in the reviews of literature in the *Archiv für Naturgeschichte, Bibliographia Zoologica, Zentralblatt für Zoologie, Zoological Record, Zoologischer Jahresbericht,* and *Zoologisches Centralblatt.* We also consulted lists of publications given by Buschmeyer (1938), Scheele and Natalis (1981), Bürk and Jungbluth (1985), and Vosmaer (1928).

BIBLIOGRAPHY

Thiele's bibliography comprises 155 papers, some of which are parts of works published over a period of time. His journal publications appeared almost exclusively in German serials, the majority in general biological or zoological journals [e.g., *Zeitschrift für wissenschaftliche Zoologie, Zoologischer Anzeiger, Zoologisches Centralblatt* (all published in Leipzig), and the *Archiv für Naturgeschichte* (Berlin)]. The only exceptions were a contribution on the chitons of the Antarctic Expedition of Dr. Charcot, which appeared (in two versions) in French journals (1906e,f), a contribution to the reports on the *Albatross* Expedition in the *Bulletin of the Museum of Comparative Zoology* (1908b), and a paper on Solenogastres of the Russian Polar Expedition in a St. Petersburg journal (1911f). All but the 1906 French papers were published in German (an English translation of one of his works on the branchial sense organs of Patellidae was subsequently published in *The Annals and Magazine of Natural History,* 1893b).

Thiele's publications are listed below in four sections, as papers on Mollusca, Crustacea, Porifera, and miscellaneous zoological topics. Emphasis was placed on the malacological contributions, i.e., a paper is listed in that section whenever Mollusca are involved, even though it may contain data on other phyla. Examples are Thiele's discussion on whether chaetognaths are to be considered mollusks (1907b) and his publication on the phyletic interrelationships of several unsegmented animal groups (1922).

Throughout the listing a uniform spelling was used for the *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft*, which in the original was frequently and inconsistantly modified between volumes, numbers and off-prints.

As will be shown in later parts of this study, Thiele introduced a large number of new taxonomic names. Not all of them are clearly designated as such, and taxonomically important statements can be found in odd places, such as indices of book publications (1931c) and footnotes of seemingly unrelated works (1890b). A record for obscurity was set when he proposed replacement names in footnotes of a literature review (1913a) covering one of his earlier papers (1912b). In the following sections, an asterisk (*) indicates publications containing new species- and genus-group names.

In addition to standard citations (title, book or serial reference, place and date of publication), English translations of the titles and additional information (e.g., subsequent reviews) are provided. Special effort has been made to determine the exact publication dates. In cases of journal publications these were usually readily available. However, several book publications and especially the taxomically important *Valdivia* Expedition volumes were only dated by year. Since the publishing house Gustav Fischer Verlag, where most of Thiele's books and monographs were published, was unable to provide more exact dates, we are supplying ancillary information (such as the dates of receipt by major libraries) for the earliest date "on which the work is demonstrated to be in existence as a published work" [ICZN Article 21(c)].

A. Publications on Mollusca

1886. **Die Mundlappen der Lamellibranchiaten.** Zeitschrift für wissenschaftliche Zoologie, **44**: 239-272, pls. 17-18; Leipzig, 1 October 1886 [separately issued as Ph.D. dissertation (Inaugural-Dissertation zur Erlangung der philosophischen Doktorwürde der Philosophischen Fakultät der Friedrich-Wilhelms-Universität Berlin): 34 (+2) pp., pls. 17-18; Leipzig (Wilhelm Engelmann); before 24 June 1886)]. [The labial palps of lamellibranchs.] Reviews: Journal of the Royal Microscopical Society, London, **1887**: 200 (English); Zoologischer Jahresbericht (Berlin) für **1886** (1888) (Mollusca): 5, 24 (German).

1887. **Ein neues Sinnesorgan bei Lamellibranchiern. Vorläufige Mitteilung.** Zoologischer Anzeiger, **10**(257): 413-414; Leipzig, 1 August 1887. [A new sense organ in lamellibranchs. Preliminary report.] Reviews: Journal of the Royal Microscopical Society, London, **1887**: 942 (English); Zoologischer Jahresbericht (Berlin) für **1887** (1888) (Mollusca): 5, 17 (German).

1889. **Die abdominalen Sinnesorgane der Lamellibranchier.** Zeitschrift für wissenschaftliche Zoologie, **48**(1): 47-59, pl. 4; Leipzig, 5 April 1889. [The abdominal sense organs of lamellibranchs.] Reviews: Journal of the Royal Microscopical Society, London, **1889**: 374-375 (English); Zoologischer Jahresbericht (Berlin) für **1889** (1891) (Mollusca): 8, 27 (German).

*1890a. **Über Sinnesorgane der Seitenlinie und das Nervensystem von Mollusken.** Zeitschrift für wissenschaftliche Zoologie, **49**(3): 385-432, pls. 16-17; Leipzig, 14 February 1890. [On the sense organs of the lateral line and the nervous system of mollusks.] Review: Zoologischer Jahresbericht (Berlin) für **1890** (1892) (Mollusca): 7, 9 (German).

1890b. **Die Stammesverwandtschaft der Mollusken. Ein Beitrag zur Phylogenie der Tiere.** Jenaische Zeitschrift für Naturwissenschaft, **25** (= new series **18**) (3-4): 480-543; Jena, 30 May 1890. [The phyletic relationships of the mollusks. A contribution to the phylogeny of animals.] Reviews: Journal of the Royal Microscopical Society, London, **1891**(6): 721-722 (English); Zoologischer Jahresbericht (Berlin) für **1891** (1893) (Mollusca): 14, 20 (German).

1890c. **Erwiederung.** Zoologischer Anzeiger, **13**(346): 559-561; Leipzig, 13 October 1890. [A reply (to Rawitz's criticism).] Review: Zoologischer Jahresbericht (Berlin) für **1890** (1892) (Mollusca): 7, 12 (German).

1891a. **Bericht über die wissenschaftlichen Leistungen im Gebiete der Malakologie während des Jahres 1888. I. Bericht über Allgemeines, Physiologie, Anatomie und Entwicklungsgeschichte.** Archiv für Naturgeschichte, **55**(2.1) (1889): 378-428; Berlin, October 1891. [Report on the scientific work in the realm of malacology during the year 1888. I. Report on general subjects, physiology, anatomy and embryology.]

1891b. **Das Integument der Chitonen.** Biologisches Centralblatt, **11**(23): 722-726; Leipzig, 15 December 1891. [The integument of chitons.] Review: Zoologischer Jahresbericht (Berlin) für **1891** (1893) (Mollusca): 7, 20 (German).

*1891c. [Fortsetzung von / Continuation of:] Troschel, F. H.: **Das Gebiss der Schnecken zur Begründung einer natürlichen Classification.** Vol. **2**(7) [Rhipidoglossa cont., Docoglossa]: 249-334, pls. 25-28; Berlin (Nicolaische Verlags-Buchhandlung), 1891. [The dentition of snails as a foundation for a natural classification.] Reviews: Zoologischer Jahresbericht (Berlin) für **1891** (Mollusca): 7, 37 (German); Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft, **26**(1-2) (1894): 25-27 (German). [continued in 1893e]

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*1895b. ***Hemitrichia guimarasensis* n. sp.** Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft, **27**(7-8): 131-132; Frankfurt am Main, August 1895.

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*1906c. ***Archaeomenia prisca* n. g., n. sp.** Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899, **9**(2): 315-324 [1-10], pl. 28; Jena (after 14 March 1906, date of manuscript submission). Review: Zoologischer Jahresbericht (Berlin) für **1906** (1907) (Mollusca): 6, 7 (German).

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1908b. **Ueber die Anatomie und systematische Stellung von *Bathysciadium, Lepetella,* and *Addisonia.*** Reports on the scientific results of the Expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U.S. Commission Steamer "Albatross," from October, 1904, to March, 1905, Lieut. Commander L. M. Garrett, U.S.N., commanding, XV. Bulletin of the Museum of Comparative Zoology at Harvard College, **52**(5): 81-89, pls. 1-2; Cambridge, October 1908. [On the anatomy and systematic position of *Bathysciadium, Lepetella,* and *Addisonia.*] Review: Zoologischer Jahresbericht (Berlin) für **1908** (1909) (Mollusca): 6, 12 (German).

*1908c. **Die antarktischen und subantarktischen Chitonen.** Deutsche Südpolar-Expedition 1901-1903, **10** (Zool., 2)(1): 7-23, pl. 1; Berlin (Georg Reimer), October 1908. [The antarctic and subantarctic chitons.]

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Frankfurt am Main, 20 July 1909. [On a few chitons from New Zealand.]

1909c. **Zum Namen Unio.** [In:] Kobelt, W. (ed.): Beiträge zur Kenntniss der mitteleuropäischen Najadeen, 3. Beilage zum Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft, **41**: 48; Frankfurt am Main, July 1909. [On the (generic) name *Unio* . . . Contributions to the knowledge of Central European naiades.]

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*1910c. **Eine arabische *Ennea* und Bemerkungen über andere Arten.** Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **6**: 280-284, pl. 10; Berlin, June 1910. [An Arabic *Ennea* and remarks on other species.]

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*1910g. **Polyplacophora, Gastropoda marina, Bivalvia.** [In:] Schultze, L.: Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Südafrika ausgeführt in den Jahren 1903-1905 mit Unterstützung der Kgl. Preussischen Akademie der Wissenschaften zu Berlin, **4** (Systematik und Tiergeographie) (1). Denkschriften der medicinisch-naturwissenschaftlichen Gesellschaft zu Jena, **16**: 269-270, 1 text-fig.; Jena (Gustav Fischer), 1910.

1910h. **Über die Anatomie von *Hydrocena cattaroensis* Pf.** Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft, **32** (Festschrift Kobelt): 349-358, pl. 25, 2 text-figs.; Frankfurt am Main, 1910. [On the anatomy of *Hydrocena cattaroensis* Pf.] Review: Zoologischer Jahresbericht (Berlin) für **1910** (1911) (Mollusca): 6, 14 (German).

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1911b. **Die Solenogastres der Russischen Polar-Expedition 1900-1903.** Mémoires de l'Académie Impériale des Sciences de St.-Pétersbourg, (8)**29**(5); Résultats scientifiques de l'Expédition Polaire Russe en 1900-1903 sous la direction du Baron E. Toll, Sect. E, Zool., 2(5): 1-4, 1 pl.; St. Petersburg, July 1911. [The Solenogastres of the Russian Polar Expedition of 1900-1903.]

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*1911d. **Mollusken der Deutschen Zentralafrika-Expedition.** Wissenschaftliche Ergebnisse der deutschen Zentral-Afrika-Expedition 1907-1908 unter Führung Adolf Friedrichs, Herzog zu Mecklenburg, **3** (Zool.): 175-214, pls. 4-6; Leipzig (Klinkhardt & Biermann), 1911. [Mollusks of the German Central African Expedition.]

*1911e. **Polyplacophora.** [In:] Michaelsen, W. & R. Hartmeyer (eds.): Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905, **3**(2): 397-406, 1 pl.; Jena (Gustav Fischer), 1911. [Polyplacophora . . . The fauna of southwest Australia.]

*1912a. **Familia Scissurellidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H.C. & W. Kobelt, eds.), **2/4a**(558): 1-36, pls. 1-4; Nürnberg (Bauer & Raspe), 1912 (dates imprinted on individual sheets: 5 April–23 May).

*1912b. **Die antarktischen Schnecken und Muscheln.** Deutsche Südpolar-Expedition 1901-1903, **13** (Zool., 5) (2): 183-285, pls. 11-19, 18 text-figs.; Berlin (Georg Reimer), August 1912. [The antarctic snails and bivalves.]

1912c. **Amphineura.** Handwörterbuch der Naturwissenschaften, **1**: 347-354, 12 text-figs.; Jena (Gustav Fischer), 1912.

1912d. **Lamellibranchiata.** Handwörterbuch der Naturwissenschaften, **6**: 6-21, 19 text-figs.; Jena (Gustav Fischer), 1912.

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*1913a. [Literature review of 1912b:] **Thiele, J., Die antarktischen Schnecken und Muscheln.** Zentralblatt für Zoologie, allgemeine und experimentelle Biologie, 2(3): 86-87; Leipzig and Berlin, 10 January 1913.

1913b. **Dr. Naef und das "Cölom" der Mollusken.** Zoologischer Anzeiger, **41**(6): 251-252; Leipzig, 31 January 1913. [Dr. Naef and the "coelom" of mollusks.]

*1913c. **Ein neuer Solenogaster von Spitzbergen.** Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1913**(2): 160-162, 2 text-figs.; Berlin, February 1913. [A new solenogaster from Spitzbergen.]

*1913d. **Antarktische Solenogastren.** Deutsche Südpolar-Expedition 1901-1903, **14** (Zool., 6)(1): 35-65, pls. 4-8, 2 text-figs.; Berlin (Georg Reimer), May 1913. [Antarctic solenogasters.]

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*1913f. **Familia Fissurellidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H.C. & W. Kobelt, eds.), **2/4a**(568): 37-68, pls. 5-8; Nürnberg (Bauer & Raspe), 1913 (dates imprinted on individual sheets: 11-30 September). [continued in 1915b, 1916b and 1919]

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*1915b. **Familia Fissurellidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H.C. & W. Kobelt, eds.), **2/4a**(577): 69-104, pls. 9-12; Nürnberg (Bauer & Raspe), 1915 (dates imprinted on individual sheets: 3-19 May). [continued from 1913f; continued in 1916b and 1919]

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*1916a. **Bemerkungen über die Systematik der achtarmigen Cephalopoden.** Zoologischer Anzeiger, **48**(1): 3-4; Leipzig, 19 September 1916. [Remarks on the systematics of the eight-armed cephalopods.]

*1916b. **Familia Fissurellidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H.C. & W. Kobelt, eds.), **2/4a**(578): 105-144, pls. 13-16; Nürnberg (Bauer & Raspe), 1916 ("1917" on title page; dates imprinted on individual sheets: 28 October – 30 November 1916). [continued from 1913f and 1915b; continued in 1919]

*1917a. **Bemerkungen über das "Tierreich" und den Nomenclator Generum Animalium.** Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft, **49**(1): 19-24; Frankfurt am Main, 2 January 1917. [Remarks on the "Animal Kingdom" and the Nomenclator Generum Animalium.]

*1917b. **Marine und litorale Mollusken von Madagascar, den Comoren und Ostafrika (Sammlung Voeltzkow 1903-05).** [In:] Voeltzkow, A.: Reise in Ostafrika in den Jahren 1903-1905. Wissenschaftliche Ergebnisse. Band **III**. Systematische Arbeiten, **5**: 561-564; Stuttgart (E. Schweizerbart'sche Verlagsbuchhandlung), 1917. [Marine and littoral mollusks of Madagascar, the Comores and East Africa (collection Voeltzkow 1903-05).]

*1918. **Familia Limidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H.C., W. Kobelt & F. Haas, eds.), **7/2a**(579): 1-24, pls. 1-5; Nürnberg (Bauer & Raspe), 1918 (dates imprinted on individual sheets: 10-19 July). [continued in 1920a]

*1919. **Familia Fissurellidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H. C., W. Kobelt & F. Haas, eds.), **2/4a**(580): 145-168 [ends in the middle of a sentence], pls. 17-20; Nürnberg (Bauer & Raspe), 1919 (dates imprinted on individual sheets: 18-24 May). [continued from 1913f, 1915b, and 1916b]

⋆1920a. **Familia Limidae.** Systematisches Conchylien-Cabinet von Martini und Chemnitz (Küster, H.C., W. Kobelt & F. Haas, eds.), **7/2a**(583): 25-66, pls. 6-10; Nürnberg (Bauer & Raspe), 1920 (dates imprinted on individual sheets: 1 September 1919–19 June 1920). [continued from 1918]

⋆1920b. **Die Cephalopoden der deutschen Südpolar-Expedition 1901-1903.** Deutsche Südpolar-Expedition 1901-1903, **16** (Zool., 8)(4): 433-465, pls. 52-55; Berlin and Leipzig (Vereinigung wissenschaftlicher Verleger), December 1920. [The cephalopods of the German South Polar Expedition of 1901-1903.]

1921a. **Ueber die Radula und systematische Stellung von *Nautilinus clymene* (Shuttl.).** Archiv für Molluskenkunde, **53**(1/2): 111-112; Frankfurt am Main, 12 April 1921. [On the radula and the systematic position of *Nautilinus clymene* (Shuttl.).]

⋆1921b. **Zur Systematik der Mollusken.** Archiv für Molluskenkunde, **53**(3): 140-163, pl. 4; Frankfurt am Main, 12 July 1921. [On the systematics of mollusks.]

1922. **Über die Verwandtschaftsbeziehungen einiger ungegliederter Tiergruppen.** Zoologischer Anzeiger, **54**(5/6): 140-144; Leipzig, 14 February 1922. [On the phyletic interrelationships of several unsegmented animal groups.]

⋆1923. **Über die Gattung *Philobrya* und das sogenannte Buccalnervensystem von Muscheln.** Zoologischer Anzeiger, **55**(11/13): 287-292; Leipzig, 16 January 1923. [On the genus *Philobrya* and the so-called buccal nervous system of bivalves.]

⋆1924a. **Revision des Systems der Trochacea.** Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 49-72, 1 pl.; Berlin, February 1924 (frequently cited as of 1921, even by Thiele; manuscript was submitted in 1921). [Revision of the systematics of the Trochacea.]

⋆1924b. **Ueber die Systematik der Columbelliden.** Archiv für Molluskenkunde, **56**(5): 200-210, pl. 9; Frankfurt am Main, 15 October 1924. [On the systematics of columbellids.]

1925a. **Ueber *Diala leithii* Edg. Smith.** Archiv für Molluskenkunde, **57**(3): 111-112; Frankfurt am Main, 7 May 1925. [On *Diala leithii* Edg. Smith.]

*1925b. **Gastropoda der Deutschen Tiefsee-Expedition. II. Teil.** Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899, **17**(2): 35-382 [1-348], pls. 13-46 [1-34], 31 text-figs.; Jena (Gustav Fischer), 1925 (introduction signed "Februar 1925"; received by Zoologisches Museum in Berlin: 10 November). [Gastropoda of the German Deep-Sea Expedition. Part 2.]

1925c. **Solenogastres.** [In:] Kükenthal, W. & T. Krumbach (eds.): Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches, **5**(1): 1-14, text-figs. 1-7; Berlin and Leipzig (Walter de Gruyter & Co.), 1 November 1925.

1925d. **Mollusca = Weichtiere.** [In:] Kükenthal, W. & T. Krumbach (eds.): Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches, **5**(1): 15-96, text-figs. 8-109; Berlin and Leipzig (Walter de Gruyter & Co.), 1 November 1925. [continued in 1926a,b]

1926a. **Mollusca = Weichtiere.** [In:] Kükenthal, W. & T. Krumbach (eds.): Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches, **5**(2): 97-176, text-figs. 110-269; Berlin and Leipzig (Walter de Gruyter), 20 February 1926. [continued from 1925d; continued in 1926b]

1926b. **Mollusca = Weichtiere.** [In:] Kükenthal, W. & T. Krumbach (eds.): Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches, **5**(3): 177-256, text-figs. 270-340; Berlin and Leipzig (Walter de Gruyter), 30 June 1926. [continued from 1925d and 1926a]

*1927a. **Über die Schneckenfamilie Assimineidae.** Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere, **53**(1/3): 113-146, pl. 1, 13 text-figs.; Jena, 17 February 1927. [On the gastropod family Assimineidae.]

1927b. **Ueber die Gattung *Ceratodiscus*.** Archiv für Molluskenkunde, **59**(2): 155-157, pl. 9; Frankfurt am Main, 1 March 1927. [On the genus *Ceratodiscus*.]

*1927c. **Über einige brasilianische Landschnecken.** Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft, **40**(3) (Ergebnisse einer zoologischen Forschungsreise in Brasilien 1913-1914 von Prof. Dr. E. Breslau, 1. Teil): 305-329, pl. 26, 7 text-figs.; Frankfurt am Main, 30 December 1927. [On a few Brazilian land snails.]

*1928a. **Mollusken vom Bismarck-Archipel, von Neu-Guinea und Nachbar-Inseln.** Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere, **55**(1-3): 119-146, pl. 5, 1 text-fig.; Jena, 25 April 1928. [Mollusks from the Bismarck Archipelago, New Guinea, and neighboring islands.]

*1928b. **Arktische Loricaten, Gastropoden, Scaphopoden und Bivalven.** Fauna Arctica. Eine Zusammenstellung der arktischen Tierformen, mit besonderer Berücksichtigung des Spitzbergen-Gebietes auf Grund der Ergebnisse der Deutschen Expedition in das Nördliche Eismeer im Jahre 1898, **5**(2): 561-632, pl. 10; Jena (Gustav Fischer), 3 August 1928. [Arctic loricates, gastropods, scaphopods and bivalves.]

*1928c. **Revision des Systems der Hydrobiiden und Melaniiden.** Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Zoogeographie der Tiere, **55**(5-6): 351-402, pl. 8, 63 text-figs.; Jena, 12 September 1928. [Revision of the systematics of hydrobiids and melaniids].

1928d. **Über ptenoglosse Schnecken.** Zeitschrift für wissenschaftliche Zoologie, **132** (Korschelt-Festband): 73-94, 11 text-figs.; Leipzig, September 1928. [On ptenoglossate snails].

*1929. **Handbuch der systematischen Weichtierkunde.** Vol. **1**(1) [Loricata; Gastropoda: Prosobranchia]: 1-376, 470 text-figs.; Jena (Gustav Fischer) ("1931" on title page of hard-cover edition; published after 4 September 1929 teste Thiele, 1931c, p. 739; received by Zoologisches Museum in Berlin: 21 October 1929). Reprinted by A. Asher & Co., Amsterdam, 1963. [Handbook of systematic malacology. English language translation by Bieler, R. & P. M. Mikkelsen (eds.), Smithsonian Institution Libraries & National Science Foundation, Amerind Publishing Co., New Delhi, in press.] [continued in 1931c, 1934 and 1935]

*1930. **Gastropoda und Bivalvia.** [In:] Michaelsen, W. & R. Hartmeyer (eds.): Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905, 5(8): 561-596, pl. 4, 1 text-fig.; Jena (Gustav Fischer), 1930. [Gastropoda and Bivalvia . . . The fauna of southwest Australia].

*1931a. **Ueber einige hauptsächlich afrikanische Landschnecken.** Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1930**: 392-403, 1 pl., 7 text-figs.; Berlin, 1 March 1931. [On a few, principally African land snails.]

*1931b. Thiele, J. & S. Jaeckel: **Muscheln der Deutschen Tiefsee-Expedition.** Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899, **21**(1): 159-268 [1-110], pls. 6-10 [1-5]; Jena (Gustav Fischer), 1931 (received by Zoologisches Museum in Berlin: 14 July 1931). [Bivalves of the German Deep-Sea Expedition.]

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1931d. **Bivalvia.** Handwörterbuch der Naturwissenschaften. Zweite Auflage [2nd ed.], **1**: 996-1010, 18 text-figs.; Jena (Gustav Fischer), 1931 (received by Zoologisches Museum in Berlin: 15 January 1932).

*1932a. **Das *Gonaxis*-Problem.** Archiv für Molluskenkunde, **64**(1): 11-12; Frankfurt am Main, 1 January 1932. [The *Gonaxis* problem.]

1932b. **Loricata.** Handwörterbuch der Naturwissenschaften. Zweite Auflage [2nd ed.], **6**: 550-552, 3 text-figs.; Jena (Gustav Fischer), 1932 (received by Zoologisches Museum in Berlin: 15 January 1932).

1932c. **Die Solenogastres des arktischen Gebietes.** Fauna Arctica. Eine Zusammenstellung der arktischen Tierformen, mit besonderer Berücksichtigung des Spitzbergen-Gebietes auf Grund der Deutschen Expedition in das Nördliche Eismeer im Jahre 1898, **6**(4): 379-382; Jena (Gustav Fischer), 18 October 1932. [The Solenogastres of the arctic region.]

1932d. **Mollusca.** Handwörterbuch der Naturwissenschaften, Zweite Auflage [2nd ed.], **6**: 1079-1083, 2 textfigs; Jena (Gustav Fischer), 1932.

1933a. **Scaphopoda.** Handwörterbuch der Naturwissenschaften. Zweite Auflage [2nd ed.], **8**: 997-999, 2 text-figs.; Jena (Gustav Fischer), 1933 (before November, listed as "ausgegeben bis Oktober" in Vol. **9**).

1933b. **Solenogastres.** Handwörterbuch der Naturwissenschaften. Zweite Auflage [2nd ed.], **9**: 144-146, 2 text-figs.; Jena (Gustav Fischer), 1933 (received by Zoologisches Museum in Berlin: 15 November 1933).

*1933c. **Die von Oskar Neumann in Abessinien gesammelten und einige andere afrikanische Landschnecken.** Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1933**(4-7): 280-323, pls. 1-2, 13 text-figs.; Berlin, 30 December 1933. [On a few African land snails, including those collected by Oskar Neumann in Abyssinia.]

*1934. **Handbuch der systematischen Weichtierkunde.** Vol. **2**(3) [Scaphopoda; Bivalvia; Cephalopoda; additions and corrections for parts 1 and 2; index for part 3]: 779-1022, 110 text-figs.; Jena (Gustav Fischer), 1934 ("1935" on title page of hard-cover edition; received by Zoologisches Museum in Berlin: 19 January 1934). Reprinted by A. Asher & Co., Amsterdam, 1963. [Handbook of systematic malacology.] [continued from 1929 and 1931c; continued in 1935]

*1935. **Handbuch der systematischen Weichtierkunde.** Vol. **2**(4) [general part; corrections for parts 1-3]: i-iv, 1023-1154, 4 text-figs., pp. i-vi for vol. **1** (1929-1931), unnumbered divider pages for parts 1-4; Jena (Gustav Fischer), 1935 (received by Zoologisches Museum in Berlin: 27 March 1935). Reprinted by A. Asher & Co., Amsterdam, 1963. [Handbook of systematic malacology. Partial English language translation of pp. 1099-1110 by Jacobson, 1953.] [continued from 1929, 1931c, and 1934]

B. Publications on Crustacea

*1900a. **Diagnosen neuer Arguliden-Arten.** Zoologischer Anzeiger, **23**(606): 46-48; Leipzig, 22 January 1900. [Diagnoses of new argulid species.] Review: Journal of the Royal Microscopical Society, London for **1900**: 201 (English).

*1900b. **Ueber einige Phyllopoden aus Deutsch Ost-Afrika.** Zoologische Jahrbücher, Abtheilung für Systematik, Geographie und Biologie der Thiere, **13**(6): 563-578, pls. 37-38; Jena, 10 October 1900. [On a few phyllopods from German East-Africa.]

*1904a. **Ueber eine von Herrn O. Neumann gefundene Phyllopoden-Art.** Zoologische Jahrbücher, Abtheilung für Systematik, Geographie und Biologie der Thiere, **20**(4): 371-374, pl. 13; Jena, 23 June 1904. [On a phyllopod species found by Mr. O. Neumann.]

*1904b. **Beiträge zur Morphologie der Arguliden.** Mitteilungen aus dem Zoologischen Museum in Berlin, **2**(4): 1-51, pls. 6-9; Berlin, 22 December 1904. [Contributions to the morphology of argulids.]

*1904c. **Die Leptostraken.** Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899, **8**(1): 1-26, pls. 1-4; Jena (Gustav Fischer), 1904. [The leptostracans.] Review: Zoologischer Jahresbericht (Berlin) für **1905** (Arthropoda): 19, 35 (German).

*1905a. **Über die Leptostraken der Deutschen Südpolar-Expedition 1901-1903.** Deutsche Südpolar-Expedition 1901-1903, **9** (Zool. 1)(1): 59-68, pl. 2, 1 map; Berlin (Georg Reimer), June 1905. [On the leptostracans of the German South Polar Expedition of 1901-1903.]

1905b. **Betrachtungen über die Phylogenie der Crustaceenbeine.** Zeitschrift für wissenschaftliche Zoologie, **82**: 445-471, pls. 26-27, 1 text-fig.; Leipzig, 10 November 1905. [Considerations on the phylogeny of the legs of crustaceans.] Review: Zoologischer Jahresbericht (Berlin) für **1905** (1906) (Arthropoda): 19, 24 (German).

1905c. **Über einige stieläugige Krebse von Messina.** Zoologische Jahrbücher, Supplement **8** (Festschrift Möbius): 443-474, pls. 14-16; Jena, 1905. [On a few stalk-eyed crabs from Messina.] Review: Zoologischer Jahresbericht (Berlin) für **1905** (Arthropoda): 19, 36, 38 (German).

*1907a. **Einige neue Phyllopoden-Arten des Berliner Museums.** Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1907**(9): 288-297, pls. 1-2; Berlin, November 1907. [A few new phyllopod species in the Berlin Museum.]

1907b. **Crustacea. IV. - Leptostraca.** National Antarctic Expedition. 1901-1904. Natural History. Vol. **III**, Zoology and Botany (Invertebrata: Marine Algae, Musci). 2 pp., 2 figs.; London (British Museum [Natural History]), 1907.

1926. **Leptostraca**. [In:] Grimpe, G. & E. Wagler. Die Tierwelt der Nord- und Ostsee. Lieferung VII, Teil X-g_1, pp. 1-8, figs. 1-6; Leipzig (Akademische Verlagsgesellschaft), 1926 ("1927" on title page, p. 8 stating: "X.g_1: Oktober 1926").

1927a. **1. und einzige Ordnung der "Reihe Phyllocarida" der Crustacea Malacostraca. 6. Ordnung der Crustacea: Leptostraca.** [In:] Kükenthal, W. & T. Krumbach. Handbuch der Zoologie. **3**(1:5): 567-592, figs. 537-591; Berlin and Leipzig (Walter de Gruyter), 10 June 1927. [First and only order of the "series Phyllocarida" of the Crustacea Malacostraca. 6th order of the Crustacea: Leptostraca.]

C. Publications on Porifera

*1898. **Studien über pazifische Spongien.** Zoologica. Original-Abhandlungen aus dem Gesammtgebiete der Zoologie, **24**(1): 1-72, pls. 1-8, 1 text-fig.; Stuttgart, 1898 (received by Museum of Comparative Zoology, Cambridge: 27 June). [Studies on Pacific sponges.] [continued in 1899b]

1899a. **Ueber *Crambe crambe* (O. Schmidt).** Archiv für Naturgeschichte, **65**(1.1): 87-94, pl. 7; Berlin, April 1899. [On *Crambe crambe* (O. Schmidt).] Reviews: Journal of the Royal Microscopical Society, London, for 1899: 399 (English); Zoologischer Jahresbericht (Berlin) für **1899** (Porifera): 2, 7 (German).

*1899b. **Studien über pazifische Spongien.** Zoologica. Original-Abhandlungen aus dem Gesammtgebiete der Zoologie, **24**(2): 1-33, pls. 1-5; Stuttgart, 1899. [Studies on Pacific Ocean sponges.] Review: Zoologischer Jahresbericht (Berlin) für **1899** (1900) (Porifera): 2, 7 (German). [continued from 1898]

*1900. **Kieselschwämme von Ternate. I.** [In:] Kükenthal, W.: Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. Zweiter Teil: Wissenschaftliche Reiseergebnisse. Band **III**. Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft, **25**(1): 17-80, pls. 2-3, 1 text-fig.; Frankfurt am Main, 1900. [Siliceous sponges of Ternate. Part 1.] Review: Zoologischer Jahresbericht (Berlin) für **1900** (1901) (Porifera): 2, 6 (German).

*1903a. **Beschreibung einiger unzureichend bekannten monaxonen Spongien.** Archiv für Naturgeschichte, **69**(1.3): 375-398, pl. 21; Berlin, August 1903. [Description of a few insufficiently known monaxonal sponges.] Review: Zoologischer Jahresbericht (Berlin) für **1903** (1904) (Porifera): 1, 5 (German).

*1903b. **Kieselschwämme von Ternate. II.** [In:] Kükenthal, W.: Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft, **25**(4): 931-968, pl. 28; Frankfurt am Main, 1903. [Siliceous sponges of Ternate. Part 2.]. Review: Zoologischer Jahresbericht (Berlin) für **1903** (1904) (Porifera): 1, 5 (German).

*1905. **Die Kiesel- und Hornschwämme der Sammlung Plate.** Zoologische Jahrbücher, Supplement **6**, Vol. **3**(3) (Fauna Chilensis. Abhandlungen zur Kenntniss der Zoologie Chiles nach den Sammlungen von Dr. L. Plate): 407-496, pls. 27-33; Jena, 16 June 1905. [The silicious and corneous sponges of the Plate collection.] Review: Zoologischer Jahresbericht (Berlin) für **1905** (1906) (Porifera): 1, 6 (German).

1921. **Über das System der Demospongien.** Zoologischer Anzeiger, **53**(1/2): 28-30; Leipzig, 3 June 1921. [On the systematics of demospongeans.]

D. Miscellaneous zoological publications

1887. **Der Haftapparat der Batrachierlarven.** Zeitschrift für wissenschaftliche Zoologie, **46**(1): 67-79, pl. 10, 1 text-fig.; Leipzig, 25 November 1887. [The adhesive apparatus of batrachian larvae.] Review: Zoologischer Jahresbericht (Berlin) für **1887** (1888) (Vertebrata): 31, 87 (French).

1893. **Die primitivsten Metazoen.** Sitzungsberichte und Abhandlungen der Naturwissenschaftlichen Gesellschaft Isis in Dresden, **1892** (Jul.-Dec.): 54-57; Dresden, 1893 (received by the Museum of Comparative Zoology, Cambridge: 8 June 1893). [The most primitive metazoans.]

1905. [Diskussion in:] Ziegler, H.E.: Das Ectoderm der Plathelminthes. Verhandlungen der Deutschen Zoologischen Gesellschaft auf der fünfzehnten Jahreshauptversammlung zu Breslau, den 13. bis 16. Juni 1905, **15**: 35-41, 4 text-figs.; Leipzig, 1905 [Discussion by Korschelt, Schulze, Spengel, Woltereck and Thiele, pp. 41-42. The ectoderm of Platyhelminthes.]

1909. **Brachiopoda für 1906.** Archiv für Naturgeschichte, **73**(2.3) (1907): 2 pp.; Berlin, September 1909. [(Literature on) Brachiopoda in 1906.]

1910a. **Brachiopoda für 1907.** Archiv für Naturgeschichte, **74**(2.3) (1908): 1 p.; Berlin, January 1910. [(Literature on) Brachiopoda in 1907.]

1910b. **Brachiopoden für 1908.** Archiv für Naturgeschichte, **75**(2.3) (1909): 1 p.; Berlin, September 1910. [(Literature on) brachiopods in 1908.]

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MORPHOLOGY AND HOMOLOGOUS FEATURES IN THE MALE PALPAL ORGAN IN PISAURIDAE AND OTHER SPIDER FAMILIES, WITH NOTES ON THE TAXONOMY OF PISAURIDAE (ARACHNIDA: ARANEAE)

Petra Sierwald[1]

> "The question as to whether the genitalic characters on which this subfamily [Otiothopinae; Araneae, Palpimanidae] is based are primitive or derived cannot be answered with certainty. Although it is often comparatively easy to make this decision regarding somatic characters in spiders, the opposite is generally true for genitalic characters. Our understanding of the evolution of spider genitalia is extremely limited, because of the astounding diversity of structures . . . "
>
> N. I. Platnick (1975: 2)

ABSTRACT. A detailed morphology of the male copulatory organs, the genital bulb, in *Architis, Charminus, Dolomedes, Paradossenus, Pisaura, Pisaurina, Staberius, Thaumasia* and *Trechalea* is presented. The homology of several palpal elements within the Pisauridae is established; possible homology with those in various other spider families is discussed. Homology concepts concerning the median apophysis, the conductor, and the spiral embolus are discussed. The character states are evaluated and polarized. The groundplan of the pisaurid genital bulb is compared with the bulb in Mesothelae. An update on the systematics of the family Pisauridae is presented and systematic implications from the analysis of the male copulatory organs are discussed. Two large monophyletic genus-groups, a mainly African *Pisaura* genus-group including about 20 genera, and a *Trechalea* genus-group comprising eleven South American genera, are recognized. *Paradossenus taczanowskii* Caporiacco, 1948, is a junior synonym of *P. nigricans* F. O. Pickard-Cambridge, 1903. The validity of two nominal genera, *Architis* and *Staberius,* is discussed. The genera are likely to be synonymous. The structure of the egg sacs of *Syntrechalea, Dyrines* and *Hesydrus* are described for the first time.

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INTRODUCTION

The copulatory organs in male spiders are located at the distal segment of their pedipalps. They are secondary organs serving the transfer of sperm. They are not connected to the testes but have to be charged prior to copulation. The male copulatory organs form a highly complex morphological structure, the genital bulb. It functions hydraulically and is composed of inflatable membranes (hematodochae) and larger sclerites (subtegulum and tegulum). Additionally, projections and processes, often called apophyses, are attached to various parts of the palp. Inside the genital bulb lies the sperm duct that serves as a storage place for sperm. The sperm duct opens at the tip of the embolus, an intromittant organ. During copulation, the embolus is partly or totally inserted in the female epigynum to transfer sperm.

The male genital bulbs are diverse in structure and in most cases species-typical. They have been used for species identification since the study of male sexual organs started with the works by Westring (1861), Blackwall (1843) and Menge (1843, 1866-1879). An important work on details of their morphology was published by Comstock (1910). He studied unexpanded and expanded bulbs of different spider groups and introduced a nomenclature of hematodochae, sclerites and apophyses that is still used today. There are numerous taxonomic monographs that illustrate male (and female) copulatory organs. But accurate labelling of those figures is rare. Often, Comstock's nomenclature is applied uncritically, with the result that homology of sclerites is inevitably implied but seldom discussed. Since homology of many elements in the male genital bulbs has never been clearly established, the use of these organs for phylogenetic reconstruction is hampered.

The theme of this paper arose from a study on the systematics of the spider family Pisauridae. The systematics of the Pisauridae is unsatisfactorily resolved. The sister group is unknown, the superfamilial position is in dispute, and currently used subdivisions within the family are not monophyletic. In this study, characters of the male copulatory organs will be analyzed to clarify systematic problems of Pisauridae.

In this endeavor, there are two main obstacles. First, the structures of male genital bulbs of Pisauridae are poorly known. Roewer's (1955) drawings and labelling are not accurate enough to reveal the morphology of the genital bulb in African pisaurid genera he revised and are useless for systematic and phylogenetic conclusions. Blandin's (1974–1979) work on African and Carico's (1972–1981) work on American Pisauridae provide better insight into the morphology of palps of particular genera. However, male organs were rarely studied in their expanded form. Therefore, the serial relationships of palpal sclerites and apophyses are mostly unknown. Secondly, morphological features found in genital bulbs have to be evaluated regarding the question of homology. Only homologous characters with their character states furnish data for a cladistic analysis. The main objective of the present study is the definition of homologous structures and homologous sectors of the male genital bulb within Pisauridae and to discuss some aspects of homology of palpal structures in Araneae in general.

Although the male copulatory organs in spiders show, as Eberhard (1985) discussed, rapid and divergent evolution, the morphological groundplan of palps appears to be unexpectedly old. In the third part of the DISCUSSION some rather provocative (and speculative) hypotheses concerning the homology of embolus, median apophysis and conductor are presented. Homology concepts are discussed in the light of other such hypotheses put forward by Kraus (1978), Haupt (1983), Raven (1985) and Coddington [in press].

MATERIALS AND METHODS

Genital bulbs of the following species were studied (locality and collection included):

Architis cymatilis Carico, 1981. ♂ preserved with expanded palp [Peru: Madre de Dios, Zona Reservada Pakitza (11°58'S, 71°18'W); Museo de Historia Natural, Universidad Nacional Mayor de San Marcos (MHNSM), Lima, Peru].

Architis tenuis Simon, 1898 [Brazil: Mato Grosso, Vila Vera, Oct. 1973; American Museum of Natural History (AMNH), New York. Colombia: Mata, Puerto Lopez; Museum of Comparative Zoology (MCZ), Cambridge, USA].

Charminus camerunensis Thorell, 1899 [Cameron: Kitta; syntypes; Naturhistoriska Riksmuseet (NHR), Stockholm].

Dyrines striatipes (Simon, 1898) [Peru: Madre de Dios, Zona Reservada de Manu, Puesto de Vigil. Pakitza, quebrada El Bano (11°58'S, 71°18'W) 5.X.1987; National Museum of Natural History (USNM), Washington, DC. ♀ with egg sac; Peru: Amazonas, alto Rio Comaina, Puesto de Vigilancia, 850-1150m; MHNSM].

Dolomedes scriptus Hentz, 1845 [USA: Virginia, Lynchburg, April 1985; USNM].

D. tenebrosus Hentz, 1843 [USA: Washington, DC; USA: Virginia, Lynchburg, April/May 1985; USNM].

D. triton (Walckenaer, 1837) [USA: Virginia, Lynchburg; USNM].

Enna O. Pickard-Cambridge, 1897, unidentified species [Bolivia: USNM. Peru: Piura, Rio Mangas, 1500m; MHNSM].

Hesydrus Simon, 1898, unidentified species [Peru: Amazon, Cordillere del Condor, alto Rio Comaina, Puzz, Falso Paynisha, November 1987; MHNSM. ♀ with egg sac; Venezuela: Muséum Nationale d'Histoire Naturelle, Paris (MNHN) Boc 2042, Boc 2043, Boc 2044].

Paradossenus nigricans F. O. Pickard-Cambridge, 1903 [Guyana: Two Mouths, Essequibo River; Museo Zoologico della Specola (MZS), Firenze, Italy. Guyana: Tibicuri-Cuyaha, Demerara River; Caporiacco's specimens, type of *P. tascanowskii* Caporiacco, 1948; MZS].

Pisaura mirabilis (Clerck, 1758) [Austria: Tirol, Innsbruck, June 1964; USNM].

Pisaurina mira (Walckenaer, 1837) [USA: Virginia, Lynchburg; USNM. USA: New York, Bear Mt., May 1947; AMNH].

Staberius spinipes (Taczanowski, 1873) [Peru: Pucallpa, Nov. 1946; AMNH].

Syntrechalea F. O. Pickard-Cambridge, 1902, unidentified species. ♀ with egg sac [Peru: Cusco, Atacaya; MHNSM].

Syntrechalea porschi Reimoser, 1939 [Costa Rica: Limón, Hamburg Farm; Naturhistorisches Museum, Wien, Austria (NHMW)].

Thaumasia cf. *uncata* F. O. Pickard-Cambridge, 1901 [South America, country unknown, "San Esteban"; MNHN Boc. 2047b, No. 11750. Mexico: Veracruz (95°07'W, 18°36'N); MCZ]. Carico (1981: 150) states that *Thaumasia argenteonotatus* (Simon, 1898) is a senior synonym of *Thaumasia uncata*.

Thaumasia cf. *velox* Simon, 1898 [Colombia(?): "Col. Alpine"; MNHN, Boc. 2047b, No. 19190. Ecuador: Morona-Santiago, Sucúa, 1000m, June/July 1979, N. Engler; MCZ].

Tinus peregrinus (Bishop, 1924) [Mexico: Nuevo Leon, Linares, July 1956; AMNH].

Thalassius spinosissmus (Karsch, 1879) [South Africa: Natal, Pietermaritzburg; USNM].

Trechalea Thorell, 1870, unidentified species [Venezuela: Miranda, Guatopo, National Park Santa Cruzita, 450m, J. Coddington; USNM].

Expansion of genital bulbs

Palps were submerged overnight in a weak watery solution of potassium hydroxide (KOH), in which they expanded to varying degrees. They were then transferred to distilled water, where further inflation occurred. The structure of unexpanded bulbs was studied by submerging them in Hoyer's mounting medium for the time of observation. They became partly translucent. The drawings were made with aid of a dissecting microscope with drawing tube.

Homology

Classical criteria were applied to reach decisions on the homologous status of features: (a) criterion of position, (b) criterion of special, morphological similarity, and (c) criterion of concordance with other characters (Remane, 1952; Wiley, 1981: 130-138; Patterson, 1982). To allow comparison of the positions of apophyses on the tegulum in different genera, the terms proximal and distal are used as defined below in order to accommodate criterion (a).

Terms

Differing from common usage, the terms proximal and distal in the tegulum here refer to the position of a particular part in relation to the trajectory of the sperm duct. Following the course of the sperm duct, starting at the fundus, apophyses inserting on the tegulum near the fundus are considered proximally located. Apophyses inserting closer to the ejaculatory duct are referred to as being distal. The terms dorsal and ventral refer to the position of a particular part within the depth of the genital bulb. Parts nearest to the dorsal surface of the cymbium are located dorsally; ventrally located parts are mostly visible in the unexpanded bulb in ventral view (as they are figured here).

In descriptions of pisaurid palps, the terms median apophysis and conductor are used to name tegular apophyses that are proposed to be homologous within (at least) all Pisauridae. The term terminal apophysis is used for any apophysis of the apical division; thus homology among different pisaurid genera is not implied.

The term homologous refers to the actual structures (= character, e.g., conductor) that are proposed to be based on an identical evolutionary event. The particular structure may appear in several character states. Similar character states of a character in several taxa may be based on the same evolutionary event, thus the character state in question is considered homologous and representing a synapomorphy. Apparently similar character states of one character based on different evolutionary events have to be considered homoplasous, and thus do not indicate phylogenetic relationship (*see* Patterson, 1982: 25).

Text conventions

All statements of positions of sclerites refer to the unexpanded left bulb in ventral view, unless indicated otherwise.

All references to figures presented in this paper are made using the abbreviation "Fig."; references to figures in other publications are abbreviated as "fig." Terms used by other authors to describe parts of the male copulatory organs are added in parentheses to facilitate finding the cited text.

Abbreviations (including terms of authors)

ad I, II, III	bulbous sections of the apical division in *Pisaurina*
an	anelli of the subtegulum
bmt	basal membraneous tube of apical division
bl	broad lamella at sclerite III in *Liphistius sensu* Kraus, 1978 (Haupt, 1983: Basalkante des Embolus)
c	conductor (Menge, 1866: Spermophorum; Kraus, 1978, and Raven, 1985: sclerite III [in part])

cy	cymbium (= Schiffchen, by many German authors)
da	distal apophysis in the *Pisaura* genus-group
db	dorsal branch of distal apophysis in *Pisaura* and *Charminus*
dtp	distal tegular projection
dst	distal sclerotized tube of apical division
e	embolus (Menge, 1866: Eindringer; Harm, 1931, 1934: Stylus; Kraus, 1978, and Raven, 1985: sclerite III [in part])
f	fundus of sperm duct
fu	fulcrum
hl	hyaloid lamella *sensu* Kraus, 1978, at the embolus of *Liphistius*
la	lateral subterminal apophysis in *Dolomedes*
ma	median apophysis (Haupt, 1983: Kontrategulum)
mh	median hematodocha (Osterloh, 1922: Haematodochula)
p	petiolus (Osterloh, 1922: Chitinretraktor)
pa	palea in Lycosidae
pf	pars fundi of the subtegulum (Loerbrocks, 1984: 386; Chamberlin, 1904: lunate plate; Osterloh, 1922: vallum chitinosum; Lamoral, 1973: ental boss of subtegulum)
pl	prolateral (ental)
pp	pars pendula of the embolus (Comstock, 1910: 183)
ptp	proximal tegular projection in *Thaumasia* and *Tinus*
rl	retrolateral (= ectal)
rta	retrolateral tibial apophysis
sIII	sclerite III in *Liphistius*
sa	saddle (in *Dolomedes*)
ssa	sail-shaped apophysis in *Pisaurina*
sd	sperm duct (Osterloh, 1922: Spermakanal; Bertkau, 1875: Spermophor; Wagner, 1888: Receptaculum seminis)
st	subtegulum (Wagner, 1888: s.Teg.; Osterloh, 1922: Basalschale, Patina basalis; Harm, 1931, 1934: Basalschale; Gassmann, 1925: Samenkapsel [in part]; Kraus, 1978, and Raven, 1985: sclerite I)
sta	subtegular apophysis
t	tegulum (Osterloh, 1922; Harm, 1931, 1934: Spermakanalkapsel; Gassmann, 1925: Samenkapsel [in part]; Kraus, 1978, and Raven, 1985: sclerite II)
ta	terminal apophysis
tr	truncus of the embolus (Comstock, 1910: 183; Osterloh, 1922: Chitinfaden)
vb	ventral branch of distal apophysis in *Pisaura* and *Charminus*
vta	ventral tibial apophysis

SYSTEMATICS OF THE FAMILY PISAURIDAE, AN UPDATE

The nursery-web, a web built by the female for the freshly hatched spiderlings, is assumed to be a characteristic feature of members of the family Pisauridae. Pisaurid females carry the spherical egg sac in their chelicerae[1] until the spiderlings are due to hatch. They then produce an irregular web and place the egg sac in its center. To date, a nursery-web has been reported from nine of the 55 pisaurid genera belonging to all three subfamilies *sensu* Simon, Pisaurinae, Dolomedinae and Thalassiinae, *see* Table I (*Afropisaura* Blandin, 1976 [*see* Blandin, 1976 and 1979b: 82]; *Dolomedes* Latreille, 1804, and *Pisaura* Simon, 1885 [*see* Gerhardt & Kästner, 1938]; *Thalassius,* Simon, 1885 [*see* Sierwald, 1989a]; *Pisaurina* Simon, 1898 [*see* Carico, 1972: 303]; *Tinus* F. O. Pickard-Cambridge, 1901 [*see* Carico, 1976: 301]; *Megadolomedes* Davies & Raven, 1980 [*see* Davies & Raven, 1980: 139]; *Architis* Simon, 1898 [*see* Nentwig, 1985: 301] and *Ancylometes* Bertkau, 1880 [*see* Merrett, 1988: 200]). So far, the nursery-web is the only synapomorphy proposed for the family Pisauridae. Thus, to assign a genus to the Pisauridae requires either the discovery of the nursery-web in such a genus or the demonstration of morphological synapomorphies relating such a genus to at least one of the nine genera listed above.

Carico (1986: 305) suggested that "a large group" of South American pisaurid genera, including the genus *Trechalea,* constitute a distinct monophyletic group, but gave no further details on the group's possible apomorphic characters. Simon described the family Trechaleidae (1890: 82; consisting of the genera *Trechalea* and *Dendrolycosa* Doleschall 1859); later he (1898: 278) listed *Trechalea* under Pisauridae. If these South American genera can be recognized as a distinct group, the family name Trechaleidae could be used (Carico's [1986: 305] statement that the name Trechaleidae is not available because it is a nomen oblitum is not corroborated by the third edition of the International Code of Zoological Nomenclature [ICZN, 1985: 260]). The spiders of this group are poorly known; all genera are currently unrevised (revisions of these genera are in preparation, *teste* Carico & Minch, 1981: 154).

The females of *Trechalea* carry the egg sac attached to the spinnerets. The egg sac is hemispherical and possesses a seam. The upper-surface is vaulted and consists of thick silk. The bottom layer is flat and the silk is thin, the eggs are visible through that bottom layer (Simon, 1898: 281; Berkum, 1982: 120). The scar of the attachment to the spinnerets is visible on the upper-surface of the egg sac even in preserved specimens. The same type of egg sac and mode of attachment was found in preserved specimens of *Hesydrus* (Venezuela; MNHN), *Dyrines striatipes* (Peru;

MHNSM), and *Syntrechalea* (Peru; MHNSM) [pers. observ.]. Apparently, *Trechalea* does not produce a nursery-web, but the spiderlings remain on the egg sac and opisthosoma of the female after hatching (Carico et al., 1985: 292, fig. 5; and pers. observ., Panama, Barro Colorado Island). It is proposed here that the structure of the egg sac represents a synapomorphy for these South American "pisaurid" genera. They all may lack a nursery-web. Unless synapomorphies can be found linking the *Trechalea* genus-group and any nursery-web pisaurid, both groups may not even be closely related[2].

The majority of the remaining pisaurid genera (circa 25) occur in Africa. Some genera (circa 5, e.g., *Perenethis* L. Koch, 1878, *Thalassius* Simon, 1885, *Euprosthenops*, Pocock, 1897) contain African and Asian species. A few genera are known from Asia and the palearctic region, with some species also in Africa (e.g., *Eurychoera* Thorell, 1897, *Pisaura* Simon, 1885, *Polybaea* Thorell, 1895, *Eucamptopus* Pocock, 1900, and *Hygropoda* Thorell, 1894). The family is represented in the Australian region (e.g., *Megadolomedes* Davies & Raven, 1980, *Inola* Davies, 1982, *Anoteropis* L. Koch, 1878). The more than 100 nominal species of *Dolomedes* Latreille, 1804, are distributed worldwide. Five genera (*see* below) of nursery-web Pisauridae (and *Dolomedes*) occur in the Americas.

Monophyletic subunits have not been defined for Pisauridae. Simon's (1898) subdivisions of Pisauridae (Pisaurinae, Dolomedinae, Thalassiinae) are still in use; Sierwald (1987) showed that his Thalassiinae is not a monophyletic clade. This study identifies one monophyletic unit within the nursery-web pisaurids, the *Pisaura* genus-group, based on apomorphies in the copulatory organs.

Thus far, the monophyly of Pisauridae is unsupported by morphological synapomorphies. The sister group is unknown. Several families have been proposed as relatives of Pisauridae: Dondale (1986: 328) used Pisauridae as a sister group to Lycosidae; Brady (1964: 436) suggested a close relationship to Oxyopidae. Lehtinen (1967) assigned the pisaurid genera to three different families, Dolomedidae (= Thaumasiinae *auct.*), Pisauridae *sensu stricto* (Pisaurinae *auct.*), and Thalassiinae in the Ctenidae. He placed Dolomedidae and Pisauridae in two different superfamilies.

Lehtinen (1967: 372) based the placement of Dolomedidae (in Lycosoidea, *see* Table 1) and of Pisauridae (in Pisauroidea; 1967: 379) on the presence or absence of a secondary conductor. Lehtinen's definitions of primary and secondary conductor (1967: 412) are ambiguous. While he defines a primary conductor "as a tegular process of variable shape and structure that acts as the primary support for the distal part of the embolus", his definition of the secondary conductor lacks details about its structure and place of attachment within the genital bulb, thus making it impossible to identify a primary or secondary conductor. As Lehtinen's phenogram shows (page 285, fig. 6), he did not consider the conductor of *Dolomedes* and *Pisaura* as homologues but as analogous structures. The opposite position is taken in this paper as discussed later and the placement of nursery-web pisaurid genera in three families and two superfamilies is rejected.

"In cases where the primary conductor of the group concerned has lost its function, the analogous structure is called the secondary conductor (some Amaurobioidea [*sensu* Lehtinen] and Gnaphosoidea as well as all Lycosoidea), unless it is a sclerite or part of one that is generally named in another way" (Lehtinen, 1967: 412). He states (1967: 412) that "it is usually impossible to show absolute homology between different superfamilies and thus the term conductor refers to homological structures only in restricted groups." The diversity of apophyses, either reductions in certain genera or the appearance of apophyses unique to a subunit, may be great within certain families, as it will be shown in this study. Detailed data on the morphology of palpal apophyses are extremely limited and, at this point, do not allow predictions concerning homology within larger groups.

Homann (1971: 263) included Pisauridae, Ctenidae and Rhoicininae at the level of subfamilies in the Lycosidae. So far, Homann's definition of the Lycosoidea (Table 1) based on the grate-shaped tapetum of the secondary eyes, is the only suggestion for the placement of Pisauridae that is founded on a clear synapomorphy. Therefore, the palpal structures of other Lycosoidea are of special importance, since the sister group of Pisauridae is most likely to be found within Lycosoidea.

Table 1: Comparison of the classifications of Pisauridae and pisaurid subunits by Simon, Lehtinen and Levi.

Simon, 1898	Lehtinen, 1967	Levi, 1982 (based on Homann, 1971)
	Lycosoidea	**Lycosoidea**
	Cycloctenidae	
	Selenopidae	
	Lycosidae	Lycosidae
	Zoridae	Zoropsidae
Pisauridae		
Thalassiinae	Ctenidae incl. Thalassiinae,	Ctenidae
	Acanthocteninae	Acanthoctenidae
Dolomedinae	Dolomedidae (= Thaumasiinae of authors)	Pisauridae *sensu lato*, incl. Thalassiinae, Dolomedinae, Rhoicininae, Pisaurinae
	Pisauroidea	
Pisaurinae	Pisauridae (*sensu stricto*)	
	Oxyopidae	Oxyopidae
	Senoculidae	Senoculidae
	Homalonychidae	
	Toxopidae Psechridae (isolated and derived)	Toxopidae Psechridae
	Amaurobioidea	
	Amaurobiidae	
	Stiphidiinae	Stiphidiidae
	Rhoicininae	
	(and Miturgidae, Amaurobiidae, Liocranidae, Agelenidae, Dictynidae, and Hahniidae)	

Forster & Wilton (1973: 15-17) listed Lycosidae, Dolomedidae and Pisauridae as having "probably been derived from Amaurobioid stock." Their Amaurobioidea include Amaurobiidae, Agelenidae, Stiphidiidae, Amphinectidae, Neolanidae, Psechridae, Ctenidae, and Cycloctenidae.

REVIEW: HOMOLOGY IN PALPAL STRUCTURES

(1) Hypotheses on the Evolution of the Male Genital Bulb

Wagner (1886, cited from Osterloh, 1922: 329) presented the following hypothesis. A cavity in the metatarsus of the pedipalp was used originally for the transfer of sperm. The metatarsus differentiated later in phylogeny to form the genital bulb. The basal hematodocha originates from the membrane of the joint between the metatarsus and tarsus; the cavity of the tarsal joint is the predecessor of the alveolus. Later (1888: 65), Wagner rejected this hypothesis and suggested that an accidental projection of the tarsus preceded the genital bulb.

Considering the structure of the intima of the sperm duct, Comstock (1910: 163) concluded that the sperm duct was an invagination of the body wall "like a trachea," surrounded by a specialized tip of the tarsus, the genital bulb.

Barrows (1925) considered the genital bulb as a homologue of the palpal claw and its teeth to be the predecessors of accessory structures (sclerites and apophyses) of the genital bulb. Harm (1931, 1934), Kraus (1978, 1984) and others followed Barrows. Kraus (1984: 374, figs. 1a-f) presented a hypothetical transformation series from a simple tarsal claw to a tripartite hydraulic bulb. Harm (1934: 133) stated that the embolus is a homologue of the tarsal claw. Raven (1985: 15) argued that the plesiomorphic state of the embolus is fully sclerotized (versus flexible and soft), since "the embolus was presumed to have been derived from the totally sclerotized tarsal claw" [*see* DISCUSSION under (**3**)].

The ontogenetic evidence (*see* below) reveals that the genital bulb is formed by the claw fundament at the distal end of the tarsus. Coddington [in press] stated that the "hypothesis that the genital bulb is a literal, transformed homologue of the palpal claw is rather decisively refuted", since rudimentary palpal claws are often contemporaneous with the developing genital bulb.

Until recently, the simple pyriform genital bulbs of Mygalomorphae and "haplogyne" spiders were considered primitive for all spiders, meaning phylogenetically old (e.g., Wagner, 1888: 65; Osterloh, 1922: 329; Gerhardt & Kästner, 1938: 530; Wiehle, 1960: 458; Barnes, 1980: 632). The more complex bulbs of entelegyne spiders were considered derived. As Gertsch (in Platnick & Gertsch, 1976) and Kraus (1978) pointed out, this hypothesis was challenged by the fact that primitive, segmented spiders (Mesothelae, Liphistiidae) possess a complex, clearly tripartite genital bulb. The Mesothelae (family Liphistiidae) are believed to be very similar to the earliest known Araneae from the Carboniferous period (300 million years ago; Foelix, 1987: 261). Today, the pyriform and simple bulbs of

Mygalomorphae and "haplogyne" spiders are regarded as secondarily simplified and therefore derived (Platnick & Gertsch, 1976; Kraus, 1978; Schult, 1983a, 1983b; Haupt, 1983; Raven, 1985; Coddington [in press]).

(2) Literature Overview

Early Studies. — The study of the structure of the male palpal organs began with the works by Blackwall (1843), Westring (1861), and Menge (1843, 1866-1879). Menge (1843: 35, pl. III figs. 13-27) distinguished three divisions and apophyses within the genital bulb. Bertkau (1875) produced the first histological sections of palps (*Segestria*) and described for the first time pores in the wall of the sperm duct. Hasselt (1889) analyzed the fine structure of the hematodocha. He found that the hematodocha does not consist of musculature as Menge believed. Wagner (1888: 65) gave schematic drawings of different palp types, and drawings of expanded genital bulbs. He used (1) the shape of the cymbium to divide the Araneae into four subgroups, and (2) the shape and the processes of the tegulum to define families.

Comstock (1910), who studied *Filistata, Hypochilus, Loxosceles, Pachygnatha, Araneus, Linyphia,* and *Dolomedes*, produced the most influential work on spider palps. His extensive nomenclature is still in use today. Since he developed the more elaborate terms for members of the Araneoidea, the use of his terms in other, unrelated groups led to serious misapplications (e.g., the median apophysis *sensu* Baum [1972, figs. 62-64] in Oecobiidae is definitely no homologue of the median apophysis *sensu* Comstock in *Dolomedes* or *Araneus* [Comstock, 1910: figs. 22, 23]). Comstock (1910: 161) was concerned about homology as his introduction showed, "we find different terms applied to homologous parts...." Obviously, he intended to apply identical terms to homologous structures. But he himself used some terms inconsistently (e.g., in *Dolomedes* [fig. 22] and *Araneus* [figs. 19, 21], the conductor clearly inserts at the tegulum, while in *Linyphia* [fig. 10], it is part of the apical division).

Osterloh's (1922) study on palps of *Linyphia, Agelena, Lycosa,* and *Meta* included histological sections as well. His drawings of the expanded palps are excellent. He assumed that the genital bulb would consist of homologous parts and tried to identify them within the species he studied. He recognized (1922: 352) the homology of subtegulum and tegulum based on morphological similarity and position within the genital bulb. He also proposed homologies of processes (= retinacula), e.g., homology of terminal apophyses in *Lycosa* and *Linyphia* (1922: 356, stema-retinaculum), but those proposals were not convincing. He described in detail the function of both male and female copulatory organs during copula.

The function of the genital bulb is still poorly understood. The modes of sperm intake and ejaculation are not known with certainty (Harm, 1931: 645; Osterloh, 1922: 415; Wiehle, 1967: 480; Cooke, 1966; Lamoral, 1973: 638-644). Few studies have dealt with the role of particular parts of the genital bulb during copula (Heimer, 1982; Levi, 1961; Loerbrocks, 1983, 1984; Schult & Sellenschlo, 1983; Sierwald & Coddington, 1988; Gering, 1953).

Recent Studies on the Homology of Palpal Sclerites. — In numerous taxonomic monographs, the male (as well as the female) copulatory organs are well figured, but in the form of finger-print patterns for identification purposes only. Detailed morphological analyses that include discussions on homology of elements and labelling of elements are often lacking. Such drawings may furnish only limited data for future comparative and analytical studies. Several authors (e.g., Baum, 1972: figs. 49, 62-64; Gering, 1953: figs. 4, 6; Grasshoff, 1968: fig. 33; Haupt, 1983: figs. 1a-e; Heimer, 1986: fig. 1; Loerbrocks, 1984: figs. 8, 12; Merrett, 1963: figs. 1-3; Saaristo, 1971: figs. 1; Millidge, 1977: figs. 1-8; Schult, 1983a: fig. 16) produced schematic or generalized drawings of palps of the groups under study. Such drawings are especially valuable, since they present the authors concept of homology within the group studied. Additionally, such drawings illustrate more clearly the serial relationships of sclerites and apophyses. The notion that simple bulbs are primitive and complex bulbs are derived often caused the listings of plesiomorphic characters as characteristics (i.e., apomorphic) of a particular group (e.g., Millidge, 1980: 98).

Statements on homology are sometimes vague, making it difficult for subsequent workers to evaluate the presented data and conclusions (e.g., Haupt [1983: 277]: "a conductor can be found in Heptathelidae as well as in entelegynes ... [citation translated]." Judging from the context, Haupt intended to imply homology).

[In order to solve systematic problems in Linyphiidae, several attempts have been made using genitalic characters (Blauvelt, 1936; Merrett, 1963; Saaristo, 1971; Millidge, 1977; for discussion *see* Coddington [in press]). Saaristo (1971) illuminated an important autapomorphy of the linyphiid palp: the **suprategulum**, a distal prolongation of the tegular ring, which had been named median apophysis by previous authors. Saaristo showed that the suprategulum surely is not a homologue of the araneid median apophysis. All authors emphasized the problems and uncertainties of homologizing apophyses of the apical division between linyphiid genera. But especially the complex structure of the apical division (and of apophyses of the suprategulum) present the most reliable generic characters in Linyphiidae. Thus, the problems of homologizing hamper the use of these characters for phylogenetic reconstruction.]

With the general acceptance of the hypothesis that the tripartite genital bulb is plesiomorphic and that pyriform bulbs are derived, Haupt (1983, figs. 1a-e) produced a scheme in which he homologized sclerites and processes of genital bulbs in Mesothelae (*Liphistius, Heptathela*), Mygalomorphae (*Atypus, Amblyocarenum*) and Araneomorphae (*Nuctenea*, Araneidae). His proposed homologies were refuted by Raven (1985: 14-17) [*see* DISCUSSION under (**3**)].

Recently, the question of homology of palpal elements has received more attention. Griswold [in press], in his taxonomic revision of Phyxelidinae (Amaurobiidae), discussed the homology of palpal elements (and female copulatory organs) for the subfamily in detail and based taxonomic decisions on synapomorphies found in copulatory organs. Coddington [in press] presented an extensive study focusing on the homology of palpal structures, dealing with orb-weaving families (Orbiculariae) and their possible outgroups. For the first time, the homologies of median apophysis, conductor, and radix within the orb-weavers have been analyzed. He showed that these terms were often applied to structures which are not homologous even among orb-weavers but are autapomorphies for certain groups. He reviewed the available data on the ontogeny of the male spider palp and discussed their implications on homology and phylogeny for Orbiculariae. Relevant results of the ontogenetic evidence are summarized here (*see* below).

(3) Ontogenetic Evidence

The available ontogenetic evidence does not reflect the general pattern of palp ontogeny, since only very few species in disparate families have been studied (*Salticus* [Salticidae] by Wagner [1886]; *Agelena similis* [Agelenidae] by Szombathy [1915]; *Steatoda borealis* [Theridiidae], *Phidippus audax* [Salticidae], and *Lycosa nidicola* [Lycosidae] by Barrows [1925]; *Lepthyphantes nebulosa* [Linyphiidae] by Gassmann [1925]; *Segestria bavarica* [Segestriidae] and *Evarcha marcgravi* [Salticidae] by Harm [1931, 1934]; *Latrodectus curacaviensis* [Theridiidae] by Bhatnagar & Rempel [1962]; *Lycosa chaperi* [Lycosidae] by Sadana [1971]).

The claw fundament, responsible for the secretion of the dorsal claw extensor and the ventral flexor tendon, produces the male genital bulb. At a very early stage, the cell mass of the claw fundament is already divided into a dorsal and ventral lobe. The ventral lobe will form basal, middle, and apical division of the palp, including the sperm duct. The ventral lobe divides two times, first early in the development to separate the apical division from the still undivided basal and middle division of the bulb. The separation of basal and middle division (= subtegulum and tegulum) is a late event. The apophyses of the apical division develop late in ontogeny.

The dorsal lobe of the claw fundament bifurcates very late in ontogeny (studied in *Latrodectus* only) to form two tegular apophyses (the median apophysis and the conductor in *Latrodectus*). Important in the context of this study is the status of the theridiid median apophysis. As Levi (1961: 3) already suspected, the tegular apophyses in different theridiid genera may not be homologues. Coddington [in press] concluded that those "theridiid median apophyses containing loops of the sperm duct" may just be projections or outgrowths of the tegular wall [called theridiid tegular apophysis (TTA) by Coddington]. But in certain theridiid genera (e.g., *Archaearanea, Theridion*, and *Latrodectus*), the sperm duct does not pass through the median apophysis. It is most parsimonious to assume that the tegular apophysis in *Latrodectus* is a homologue of the median apophysis as it is found in different groups of Orbiculariae (*see* Coddington [in press]) and in Pisauridae. But its homology is not established. Therefore, the ontogenetic evidence concerning the origin of the median apophysis and the conductor from the dorsal lobe of the claw fundament in *Latrodectus* allows at present no conclusions for other spider groups, not even for other Theridiidae [*see* DISCUSSION under (**3**)].

The ontogenetic evidence suggests that a tripartite palp is primitive and therefore subtegulum and tegulum are homologous within Araneae. The complex palpal structures in Mesothelae and in *Atypus* among the Mygalomorphae are concordant with this hypothesis.

RESULTS

(1) Morphology of Palpal Elements

The genital bulb of male spiders lies in a cavity (alveolus) of the cymbium, the modified tarsus of the pedipalp. Projections or outgrowths may occur at the patella, tibia (tibial apophyses) or cymbium (paracymbium). The genital bulb itself consists of three divisions, the basal, middle and apical (= embolic) divisions. The basal division contains a usually large, inflatable, membraneous tube, the basal hematodocha, and an often funnel-shaped sclerite, the subtegulum. Parts of the wall of the basal hematodocha may be sclerotized, forming the petiolus. The middle division consists of the median hematodocha and the sclerotized, often ring-like tegulum. The median hematodocha, connecting subtegulum and tegulum, may be large or small. The upper-surface of the tegular ring may be membraneous and sometimes inflatable. It can also be partly or totally sclerotized and more or less continuous with the tegular ring. In such cases, the tegulum appears plate-like or like an upside-down bowl.

Habitually, all structures distal to the tegulum are assigned to the apical division (= embolic division; Osterloh [1922], Gassmann [1925]: Stema). The apical division may contain as little as the embolus alone (e.g., *Paradossenus*, Fig. 47; *Heriaeus* [Thomisidae, Loerbrocks, 1983: fig. 6]; *Evarcha* [Salticidae, Harm, 1934: figs. 1-5]; *Loxosceles* [Loxoscelidae, Comstock, 1910: fig. 4]). In certain families, it is very elaborate (e.g., in Linyphiidae and Araneidae), consisting of sclerotized tubes and membraneous tubes (often labelled distal hematodocha, Comstock, 1910: 177, figs. 13, 14; Osterloh, 1922: Stemablase), bearing the embolus and none to several processes of various size (often labelled terminal apophyses). The apical division in Pisauridae is moderately complex.

Distal Hematodocha. — The term distal hematodocha has been used for various membraneous, more or less inflatable parts within the embolic division, being either connected to the embolus or to terminal apophyses. Therefore, the term is strictly descriptive and only ambiguously defined. It is not used in the present paper.

Embolus. — The term embolus is used for that part of the genital bulb where the sperm duct opens. Comstock (1910: 182, fig. 25) described three different types of emboli, based on their shape and supposed function: the spiral embolus (occurring in many spider families, including Pisauridae), the coniform embolus (e.g., in Araneidae) and a lamelliform embolus (e.g., in Linyphiidae). He described only the spiral embolus in detail, distinguishing different structures (a sclerotized truncus and a membraneous pars pendula). Wiehle's study (1960) on different types of emboli is devoted to the function and does not give morphological details of different emboli.

At this point, it is important to note that the emboli in different families are not necessarily fully homologous [*see* DISCUSSION, (**3**), under Embolus].

Sperm Duct. — In most spiders, the sperm duct follows a smooth spiral from its blind end (fundus) in the subtegulum to the end of the tegulum, where it becomes very thin (ejaculatory duct). It opens at or near the tip of the embolus. More complex trajectories of sperm ducts with several switchbacks occur in a few disparate groups and are surely of non-homologous origin (and are apomorphies, whenever and wherever they are found).

Processes of the Genital Bulb

Morphological Structure. — Besides the two large, basic sclerites, subtegulum and tegulum, several sclerotized processes have been described for male palps, occurring in the middle division of the bulb as tegular processes, and in the apical division[3]. These processes have often been named apophyses, e.g., median and terminal apophyses (labelled Retinaculum[4] by several German authors). The **homology of such processes** between and within different spider groups is the most ambiguous, yet crucial issue for phylogenetic reconstructions. While labelling processes many incorrect homologies have been implied.

Different **structural types of processes** can be distinguished. A process can either be formed as a distinct sclerite, separated from other sclerites by a flexible and somewhat inflatable membrane, or may be a mere projection or outgrowth of a sclerite and directly connected to it. These projections may be large and strongly sclerotized, as is the conductor in *Tinus* (Figs. 11, 13), or occur as a low hump or prominence, as the conductor in *Architis* (Fig. 42). Outgrowths of the tegulum may (or may not) contain loops of the sperm duct (e.g., in several genera of Theridiidae, Levi, 1961: figs. 5, 8, 9; labelled median apophysis). Such morphological differences, as criterion of special similarity together with the criterion of position, can be applied to recognize homologous processes. Such morphological qualities of processes are rarely considered in taxonomic monographs, descriptions and drawings.

Median Apophysis. — A median apophysis has been labelled in the palps of many spider families (e.g., Pisauridae, Araneidae, Theridiosomatidae, Oecobiidae [including Urocteidae], Lycosidae, Theridiidae, Agelenidae, Anyphaenidae, Gnaphosidae, Ctenidae, Sparassidae). The term is used almost always for a tegular apophysis. The homology of these structures is, for many groups, unstudied.

Conductor. — A conductor has always been defined by its proposed function: to protect and support the tip of the embolus (Comstock, 1910: 181; Wiehle, 1960: 460; Lamoral, 1973: 616). To my knowledge, there are no data available to support this functional assumption. It is, however, noteworthy that in many spider groups at least the tip of the embolus is in close proximity to either the tip of a tegular or an apical apophysis. Since such apophyses are usually labelled "conductor", this term has been used frequently for **surely non-homologous apophyses**, some of them inserting at the tegulum (e.g., Araneidae, Pisauridae), some of them being part of the apical division (e.g., Linyphiidae).

Terminal Apophyses. — Homologies of terminal apophyses have not been established so far. Merrett (1963) and Saaristo (1971) discussed the problems for Linyphiidae (*see* above: Literature Overview, Recent Studies). Osterloh's attempt (1922) did not yield convincing results (*see* above: Literature Overview, Early Studies).

(2) Groundplan of the Pisaurid Palpal Organ

The *Dolomedes* bulb (Fig. 2) serves as a preliminary basis of the groundplan of the pisaurid palp. It is **not necessarily thought to be**

primitive or plesiomorphic among Pisauridae. But, the *Dolomedes* palp is rich in structure and apparently not secondarily simplified. For this study, tegulum and embolic divisions are broken into discrete sectors with clear, recognizable limits and characteristic features. While analyzing bulbs of other pisaurid genera, I attempt to identify the equivalent and homologous sectors as defined in the *Dolomedes* bulb. Criteria to identify homologous elements are (a) their position within the bulb, (b) similarities

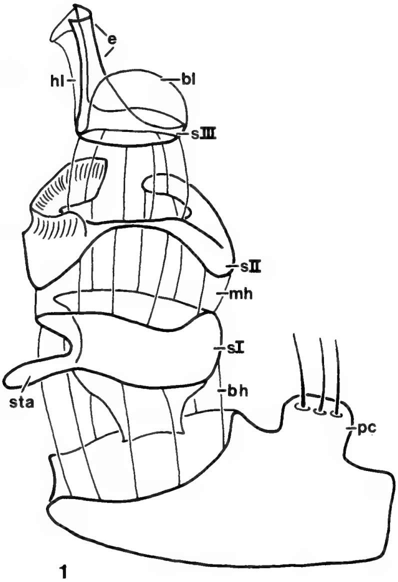
Tibial Apophysis. — The majority of Pisauridae possess an apophysis on the tibia of the male palp[5]. Usually, the tibial apophysis arises retrolaterally, at the distal end of the tibia. Its shape may be simple or very complex, but it is species-typical in all Pisauridae studied to date (e.g., Figs. 20, 21; *Thaumasia*).

Basal Division of Genital Bulb. — All Pisauridae studied possess a well-developed petiolus (Figs. 2, 13, 28; p). The petiolus is a strongly sclerotized and thickened region within the wall of the basal hematodochal membrane on the prolateral-ventral side. Its proximal tip is rounded and fits into a complementary notch in the alveolus edge (Fig. 2). Its distal tip is connected to the proximal end of the subtegulum via a tough membrane.

The subtegulum (Figs. 2, 8, 10, 11, 16, 22, 27, 31; st) is very similar in all Pisauridae studied. It forms a funnel-shaped cup. The ventral-prolateral part of the subtegulum is enlarged and often visible in the unexpanded bulb. Under this conspicuous boss (= lunate plate *sensu* Chamberlin, 1904: 174; Comstock, 1910: 176; pars fundi *sensu* Loerbrocks, 1984: 391; pf) lies the fundus (Figs. 2, 11, 37-47; f) of the sperm duct. The prolateral side of the subtegulum bears the anelli (an). The anelli are thickened sclerotized ridges. Between the anelli, the subtegular wall is split. During inflation of the bulb, the clefts are spread (Figs. 2, 13, 32). The margin of the subtegulum is a thick sclerotized rim that serves as a region of attachment for the basal and median hematodochae. The basal hematodocha is usually large. The median hematodocha is present in most genera, but sometimes only weakly developed.

Middle Division of Genital Bulb. — The tegulum (Figs. 2, 5, 14, 37-47; t) [and the apical division of the genital bulb] differs considerably among pisaurid genera and is described in detail for each genus. The tegulum is a tubular, ring-like or plate-like sclerite. The upper-surface (or distal surface) of the tegulum is membraneous and inflatable in some pisaurid genera. In other pisaurid genera, it is partly sclerotized (Fig. 37, saddle) and partly membraneous. In some Pisauridae, the distal end of the open tegular ring is enlarged to form a distinct projection (Figs. 2, 5, 16, 22, 27, 35, 49; distal tegular projection, dtp).

In many genera, the apical division is attached below the tip of the distal tegular projection by a membraneous tube. The distal end of the



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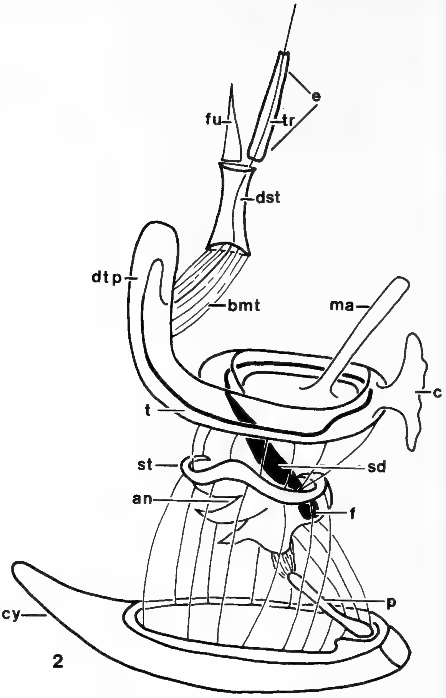

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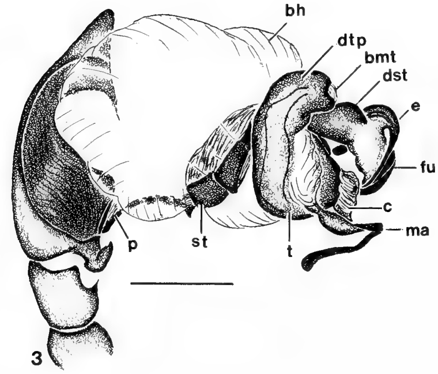

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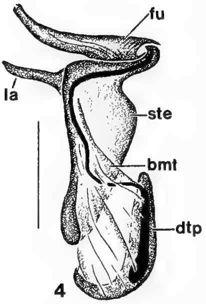

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Figure 1. Schematic drawing of the male genital bulb of *Liphistius batuensis* (drawing made after descriptions and SEM-photographs by Kraus, 1978: 237, figs. 3, 4). **Figure 2.** Schematic drawing of the left expanded genital bulb of *Dolomedes.* **Figures 3, 4.** *Dolomedes tenebrosus.* **3.** Expanded left genital bulb, ventral-prolateral view. **4.** Apical division of left expanded genital bulb, retrolateral view. Scale bars: Fig. 3, 1 mm; Fig. 4, 0.5 mm.

tegulum is defined here by the distal margin of the tegular sclerite. The membraneous tube is therefore considered as the proximal part of the apical division. There are two tegular apophyses, differing both morphologically and in their relative position on the tegulum (*see* below under Tegular Apophyses).

Trajectory of Sperm Duct. — The sperm duct runs clockwise with a spiral trajectory within the subtegulum and tegulum. The fundus is located ventrally in the subtegulum, beneath the pars fundi. The sperm duct enters the dorsal part of the tegular ring (Figs. 37-47), follows the dorsal part to the retrolateral corner of the tegulum and continues its trajectory in the ventral part of the tegular ring. The sperm duct extends nearly to the tip of the distal tegular projection, turns and enters the apical division, thus forming a loop (Figs. 2, 17, 23, 30, 44). The sperm duct narrows in this region and becomes the ejaculatory duct. The loop of the sperm duct identifies the distal tegular projection.

Tegular Apophyses. — An apophysis at the retrolateral corner of the tegulum is traditionally (Comstock, Blandin, Carico) called conductor (c). The conductor inserts directly on the tegulum and appears to be a mere extension (e.g., in *Pisaura*, Figs. 7, 45) of the tegular wall. In Pisauridae, the conductor is often genus-specific, but never species-typical as the median apophysis frequently is.

Approximately halfway along the ventral part of the tegular ring, there is a second apophysis, traditionally called median apophysis (Figs. 2, 3, 5, 7-11, 16, 22, 27, 31, 34, 48, 49; ma)[6]. Positionally, the insertion of the median apophysis on the tegulum is always closer to the apical division than the insertion of the conductor. The median apophysis is attached to the tegulum via an inflatable membrane. During expansion of the genital bulb, this membrane is inflated and moves the median apophysis out of its resting position. This different mode of attachment distinguishes the median apophysis clearly from the conductor, which, as it is defined here, is immovably attached to and continuous with the tegular wall. Often, the tip of the median apophysis is distinctly sclerotized. The shape of the tip may be genus-specific (as in *Thaumasia, Pisaura*), species-group-specific (as in the *tenebrosus*- and *fimbriatus*-groups of *Dolomedes*; Carico, 1973: figs. 25-33) or species-typical (as in *Thalassius*; Sierwald, 1987: figs. 1, 2, 54, 55, 58-68, 126, 127).

The terms median apophysis and conductor, as defined here, denote homologous structures in all pisaurid genera.

Apical Division. — The apical division consists of a basal membraneous tube (bmt) and a distal sclerotized tube (dst). The ejaculatory duct extends through the basal membraneous and the distal sclerotized tubes. Proximally, the basal membraneous tube is connected directly to the distal tegular projection. Distally, it is connected to the sclerotized tube. The distal end of the sclerotized tube bears the embolus. None to several apophyses may be attached to both the basal membraneous [e.g., the distal apophysis (da) in *Pisaura*; Fig. 7] and distal sclerotized tubes [e.g., the fulcrum (fu) in *Dolomedes*; Fig. 6].

Embolus. — In most Pisauridae studied to date, the embolus can be described as the spiral type *sensu* Comstock (1910: 181, 183). It consists of a strongly sclerotized, gutter-like sclerite on its convex side (truncus of the embolus, tr; Figs. 2, 14, 15). The truncus is basally broad and scoop-shaped. It narrows distally. The concave side is covered by a membrane (pars pendula, pp; Figs. 15, 17, 27, 30), thus forming a tube. The pars pendula is large and inflatable in certain genera (members of the *Pisaura* genus-group).

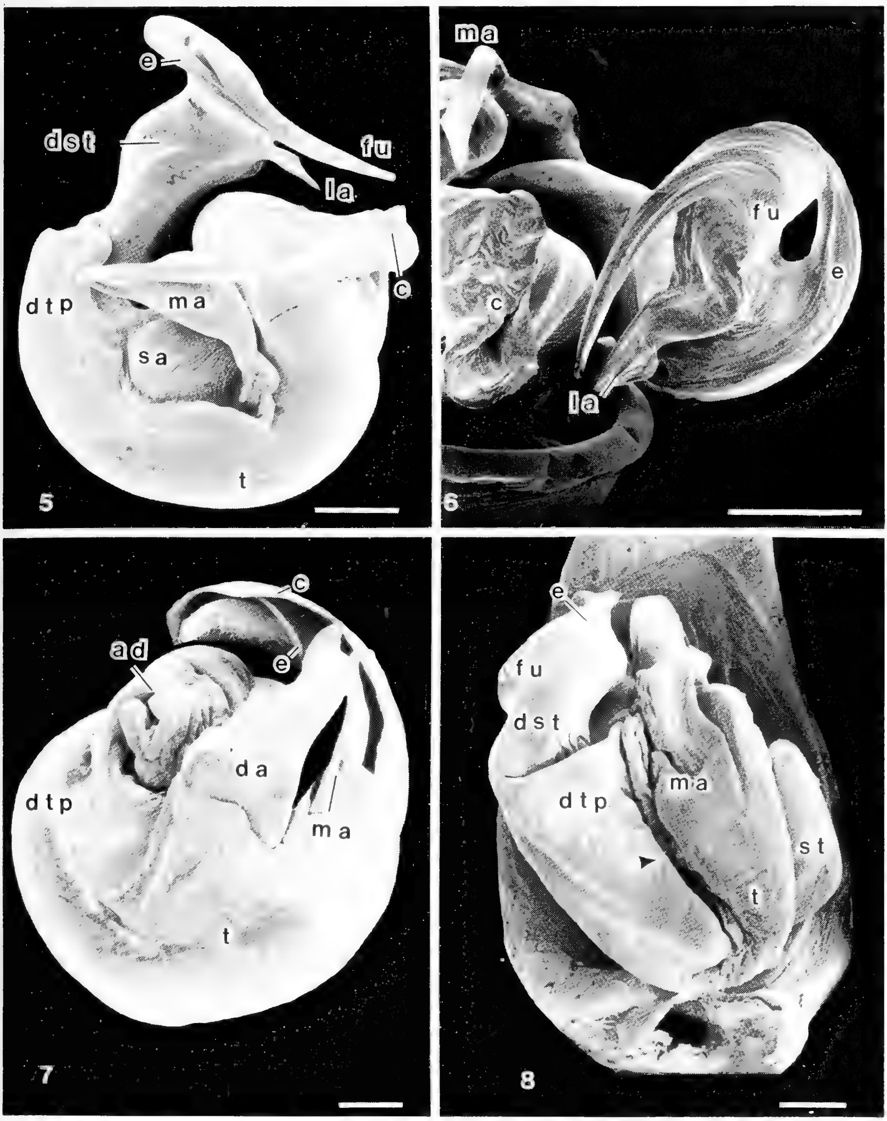
(3) Palp Morphology in American Nursery-Web Pisauridae

Carico (1973, 1972, 1976, 1981) provided good illustrations of the male copulatory organs in the American species of *Dolomedes, Pisaurina, Tinus, Architis*, and *Staberius*. The results obtained through the present study suggest new and different interpretations of certain parts of the organs. The genus *Thaumasia*, distributed in Central and South America, is unrevised (revision in preparation, Carico, pers. communic.). Therefore, the use of *Thaumasia* species-names has to be regarded as provisional. Their copulatory organs are still poorly known.

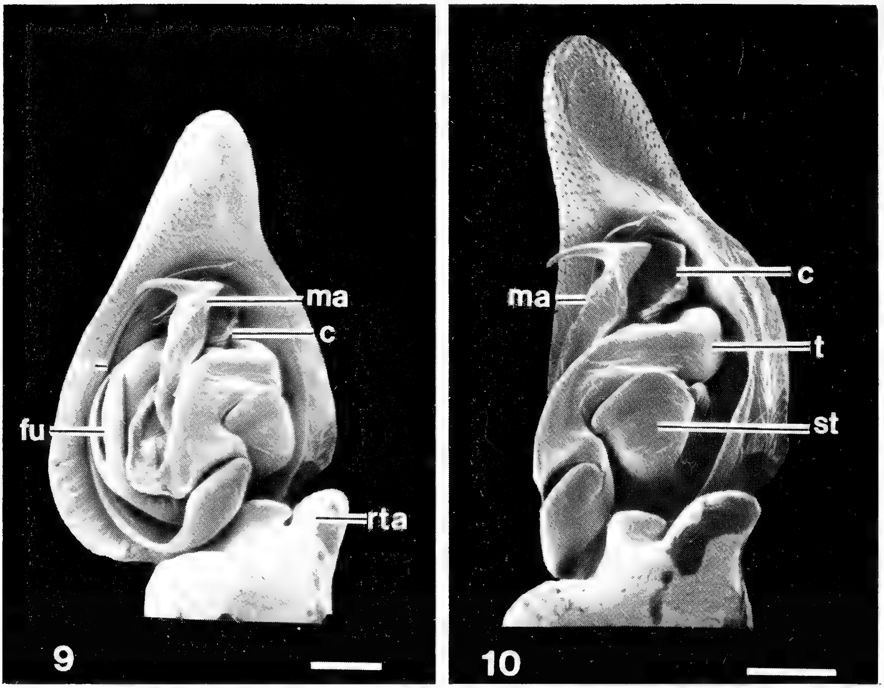
Dolomedes Latreille, 1804 (Figs. 2-6, 37)

The tibial apophysis is large. The median hematodocha is present. The tegulum is an open spiral (Fig. 37), not a closed ring, with a single loop. The distal end of the tegular ring somewhat overlaps the proximal end and forms a distinct distal tegular projection. The outer margins of the tegular ring are rounded and U-shaped in cross section with the closed portion being peripherally located. The upper-surface of the tegular ring is partly sclerotized forming a saddle (Fig. 37, sa). The conductor is thin, membraneous and lamelliform (Figs. 3, 5). The tip of the median apophysis is sclerotized and flat. The apical division of the bulb (Figs. 3-6) contains the basal membraneous tube (bmt) and the distal sclerotized tube (dst). In the *tenebrosus*-group, the latter is very large and clearly visible in the unexpanded palp (Fig. 5); it is somewhat smaller in the *fimbriatus*-group.

The distal end of the sclerotized tube (Figs. 4-6) bears a sclerotized lamelliform apophysis (= lateral subterminal apophysis, Comstock, 1910: 181; lsta). Juxtaposed to this apophysis, another terminal apophysis called fulcrum (Comstock, 1910: 181; fu) and the embolus arise (Figs. 4-6). In



Figures 5-8. SEM-photographs, unexpanded left genital bulb. **5.** *Dolomedes tenebrosus*. **6.** *Dolomedes tenebrosus*, apical division. **7.** *Pisaura mirabilis*. **8.** *Thalassius rubromaculatus*. Scale bars: 0.25 mm.



Figures 9, 10. *Thalassius spinosissimus*, unexpanded left genital palp. **9.** ventral view. **10.** retrolateral view. Scale bars: 0.25 mm.

the *tenebrosus*-group, the distal margin of the fulcrum is tightly wrapped around the embolus. In the *fimbriatus*-group, the embolus follows a furrow of the convex side of the fulcrum.

In *Dolomedes*, the embolus appears to consist of the truncus alone, the pars pendula is not well developed.

Tinus F. O. Pickard-Cambridge, 1901 (Figs. 11-15, 38)

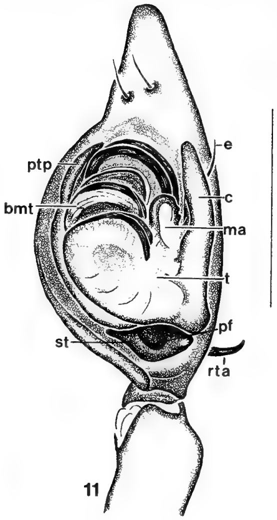
The conspicuous tibial apophysis in *Tinus* arises in a more dorsal position and bends retrolaterally. The median hematodocha is well developed. The tegulum bears three processes (Fig. 11). Following the sperm duct from the fundus in the subtegulum into the dorsal portion of the tegulum, one encounters a large process of the tegulum on the prolateral side of the bulb (proximal tegular projection, ptp; Figs. 11, 12, 14, 38). This process is stiff and sclerotized. Next to the large conductor on the retrolateral side is the median apophysis in the ventral sector of the tegular ring. The median apophysis is rather short, flat, rounded at the tip and shaped like a spatula. Only its tip is slightly sclerotized.

After passing the median apophysis, the sperm duct enters a large membraneous sac (= tegulum *sensu* Carico, 1976: figs. 6, 7). The sperm duct is very slender in this section, thus forming the ejaculatory duct. It follows the outer margin of the sac. In the unexpanded bulb, this sac is coiled. The number of loops is species-typical (Fig. 15; Carico, 1976: figs. 8-17). In the left, unexpanded palp (ventral view), the tegular sac is twisted ascending-counterclockwise (Fig. 38). Distally, the sac is closed by a small, strongly sclerotized tubercle (Fig. 15). Additionally, the tip bears a sclerotized rounded projection. The long embolus arises here. Its proximal part shows clearly that it consists of a peripheral sclerite on the convex side, the truncus, and a membraneous part on the concave side, the pars pendula. The remaining part of the embolus is long, whip-like and forms three loops. It is coiled ascending-clockwise (left unexpanded palp in ventral view; Figs. 15, 38).

Thaumasia Perty, 1833 (Figs. 16-21, 41)

In the genus *Thaumasia*, the tibial apophyses of different species are large and complex. They appear to be species-typical (Fig. 20: *Thaumasia* cf. *uncata*, and Fig. 21: *Th.* cf. *velox*). A median hematodocha was not observed during inflation of the bulb. [This may be due to incomplete inflation, since old preserved material was used. The basal hematodocha also did not expand well.]

The tegulum (Fig. 41) is rather similar in structure and position to the one in *Tinus*. Immediately upon the entry of the sperm duct into the tegulum on the prolateral side, the tegular wall bears a low broad hump (Fig. 41). This hump is not visible in the unexpanded bulb, since it lies behind the large distal tegular projection. In *Thaumasia* cf. *velox* this hump is scoop-shaped and its form is similar to the proximal tegular apophysis (ptp) in *Tinus* in the same position, hence considered homologous. The tegulum bears three conspicuous processes that are visible in the unexpanded bulb (Figs. 16, 17). At the retrolateral side, there is a long, slender apophysis that is slightly sclerotized. Its tip is swollen, sclerotized, and tilted. Because of its position and its type of connection to the tegular ring, it is considered to be the conductor. The conductors in *Tinus* and *Thaumasia* are similarly large, but in *Tinus* strongly sclerotized and of different shape. The median apophysis is short, broad, flat and similar to the one found in *Tinus*. In *Thaumasia* however, it is bifurcated (in cf. *uncata* and cf. *velox*). The third process on the retrolateral side of the bulb is long, shaped like a duckbill and sclerotized. The sperm duct extends to its tip and undergoes a large loop within it. On its dorsal side, the sperm duct narrows and runs down to enter the embolic division.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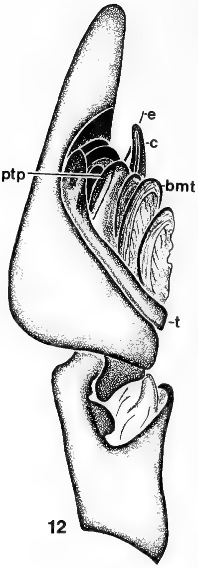
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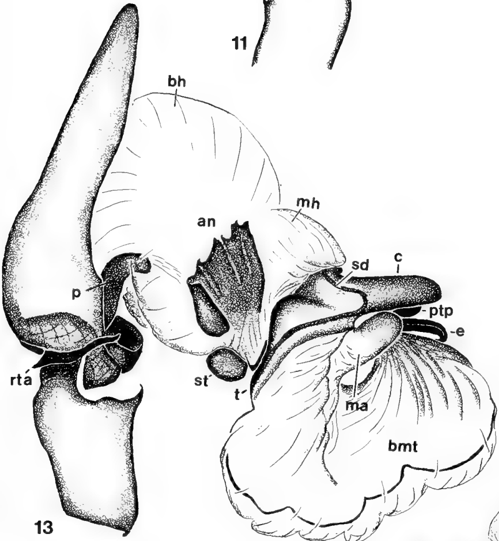
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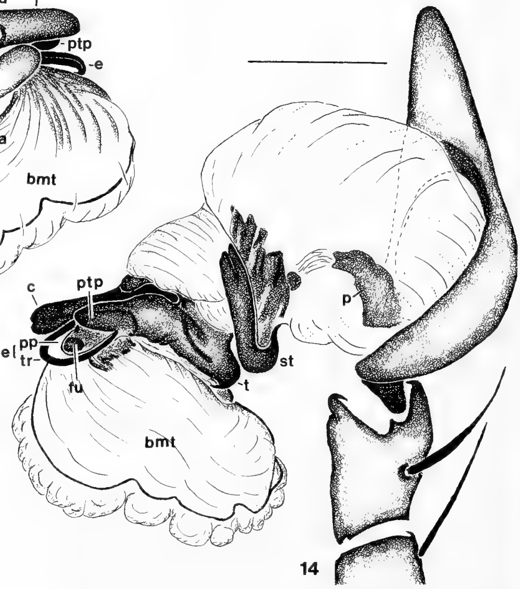
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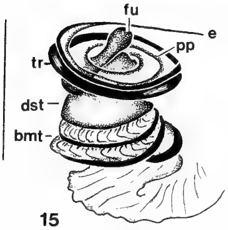
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From its position and the trajectory of the sperm duct this process is clearly the distal tegular process, homologous to that found in *Dolomedes*.

The apical division consists mainly of the embolus. The embolus arises at the basal part of the distal tegular projection and branches off it in a nearly right angle. The embolus is connected to the distal tegular projection by a membrane. Within this membrane lie two small sclerites (Fig. 18; sc). Both are connected to the basal section of the embolus, the retrolateral sclerite is attached via a membraneous bridge, and the prolateral sclerite is directly attached to the base of the embolus. The proximal section of the embolus (Figs. 16, 17) shows clearly the truncus at the convex side and the pars pendula at the concave side. The base of the truncus is enlarged; its base fits into a notch in the proximal tegular projection (ptp).

Architis Simon, 1898, and ***Staberius*** Simon, 1898 (Figs. 22-26, 39, 42)

The morphology of the genital bulbs in both genera is very similar. Whereas *Architis* currently contains seven species, *Staberius* is monotypic (Carico, 1981). Therefore, synapomorphies for *Architis* (excluding *Staberius*) cannot be defined at this point. Characters listed here for *Staberius* may be autapomorphies for a single species and do not justify a separate genus.

In *Architis*, the tibial apophyses are complex and species-typical. In *Staberius spinipes*, the tibia bears a large hammer-shaped ventral apophysis in addition to the retrolateral apophysis (*see* Carico, 1981: figs. 34, 35). The ventral tibial apophysis is connected to the tibia via a flexible membrane. The retrolateral apophysis in *Staberius* is a conspicuous process pointing laterally.

In the unexpanded bulb (Fig. 22; Carico, 1981: figs. 12-23, 34) the tegulum and its distal projection are the prominent structures. The tegular ring is rather small; its distal projection is large. There are two small apophyses on the tegulum, barely visible in the unexpanded bulb (Figs. 22, 39, 42). The conductor, juxtaposed to the distal tegular projection, is a small hump-shaped tubercle. The median apophysis is short and membraneous. Only its tip is slightly sclerotized. The sperm duct does not progress straight through the tegular ring, but performs two curves. The sperm duct extends to the tip of the distal tegular projection and performs a loop. At that point, it starts to narrow becoming the ejaculatory duct (Figs. 25, 26). The ejaculatory duct enters a large, less sclerotized hump that is mesally attached to the distal tegular projection. The

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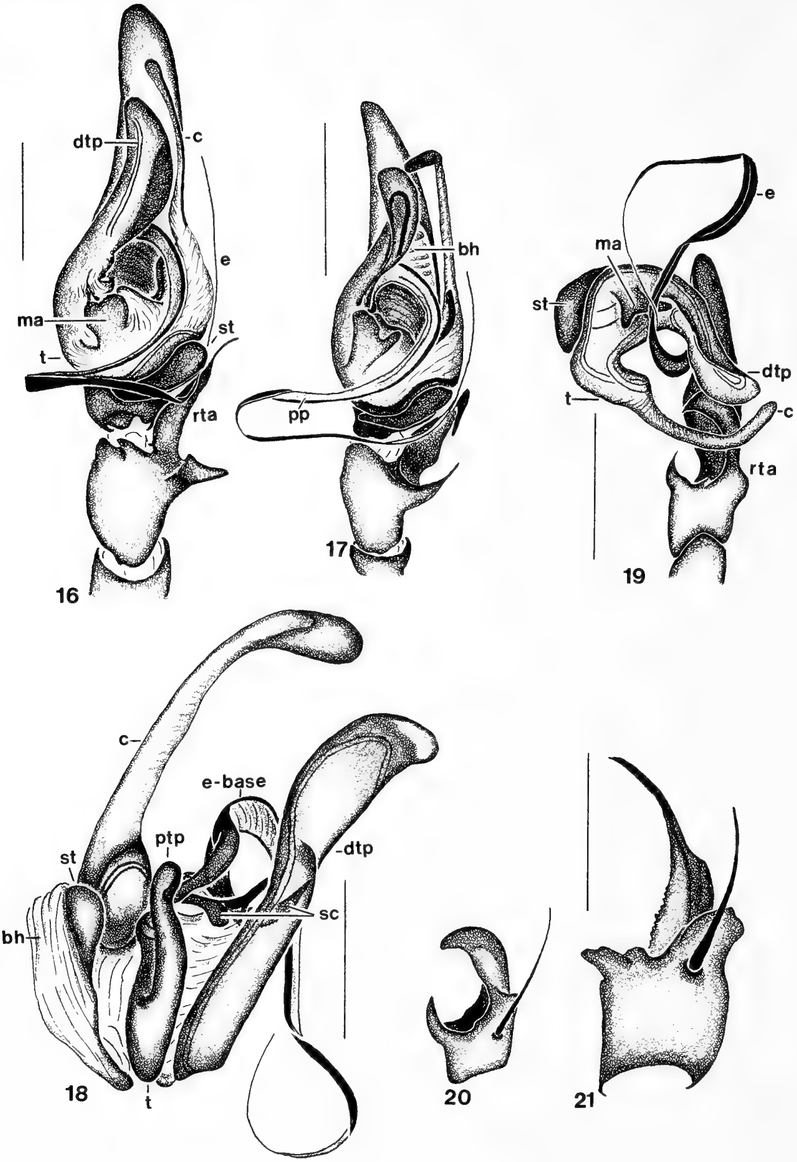
Figures 11-15. Left palp of *Tinus peregrinus*. **11.** Unexpanded bulb, ventral view. **12.** Unexpanded bulb, prolateral view. **13.** Expanded bulb, retrolateral view. **14.** Expanded bulb, prolateral view. **15.** Apical division. Scale bars: Figs. 11-14, 1 mm; Fig. 15, 0.5 mm.



Figures 16-21. Left palp of *Thaumasia*. **16.** *T.* cf. *velox*, unexpanded, ventral view. **17.** *T.* cf. *uncata*, unexpanded, ventral view. **18.** *T.* cf. *uncata*, genital bulb, partly expanded, prolateral view, sc = sclerites. **19.** *T.* cf. *uncata*, expanded, retrolateral view. **Figures 20, 21.** Tibial apophyses. **20.** *T.* cf. *uncata*. **21.** *T.* cf. *velox*. Scale bars: Figs. 16, 17, 19-21, 1 mm; Fig. 18, 0.5 mm.

sclerotized embolus branches off dorsally from this hump (Figs. 39, 42). The base of the embolus is broad, consisting of the truncus and pars pendula.

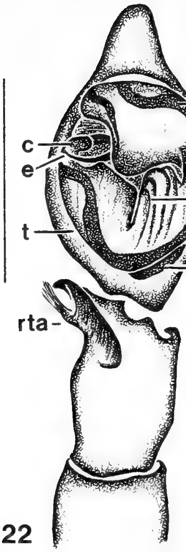
Pisaurina Simon, 1898 (Figs. 27-29, 44)

In this genus, the tibial apophysis is small. At the distal tip of the tibia in *Pisaurina mira*, there is a broad, flat, sclerotized structure. It can be considered a ventral tibial apophysis (Fig. 27, vta). The petiolus is very broad (Fig. 28). The tegulum is plate-like (Fig. 44) and lies flat in the alveolus, thus its position is very different from all other American Pisauridae. The tubular outer rim of the tegulum containing the sperm duct is strongly sclerotized, the upper-surface is sclerotized to a lesser degree, but not membraneous. On its retrolateral side the tegulum produces a hump with a spur (Figs. 27, 44; dtp). The sperm duct extends to the distal tip of this hump and performs a loop turning back.

The apical division of *Pisaurina* consists of three sclerotized bulbous sections (ad I, II, III). The prolateral side of these three sections is membraneous; the membrane visible at the proximal end of the genital bulb (Fig. 27, bmt) is part of it. At the distal end of the second bulbous section the sperm duct narrows to become the ejaculatory duct. Attached to the distal region of the third bulbous section is a membrane, regarded here as the pars pendula of the embolus. The pars pendula is clearly separated by a sclerotized section from the bmt-membrane. The embolus is extremely long, thin and whip-like. Over much of its course, it appears to consist of the ejaculatory duct alone. The broader, basal part of the truncus appears to be fused to the third bulbous section of the apical division.

There are two conspicuous apophyses, one of which can be identified as the median apophysis. The latter possesses a bifurcated sclerotized tip (similar to *Thaumasia*) and a membraneous base. It is attached to the membraneous central area of the plate-like tegulum. Its tip rests in the spur of the distal tegular hump.

The second apophysis, labelled here sail-shaped apophysis (ssa; labelled conductor by Carico, 1972), is large, flat and sail-shaped, ending in a long spur. Its base is membraneous, with a sclerotized strap attached to the second bulbous section of the apical division. Its outer margin is sclerotized and lamellar. It is wrapped around the thin embolus. In the undisturbed bulb, the embolus extends to the tip of the sail-shaped apophysis. Apparently, this feature caused its misidentification as a conductor. But neither its position nor its mode of attachment to the tegulum and to the second bulbous section of the apical divisions warrants this homology-



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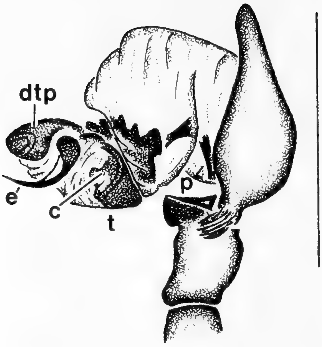

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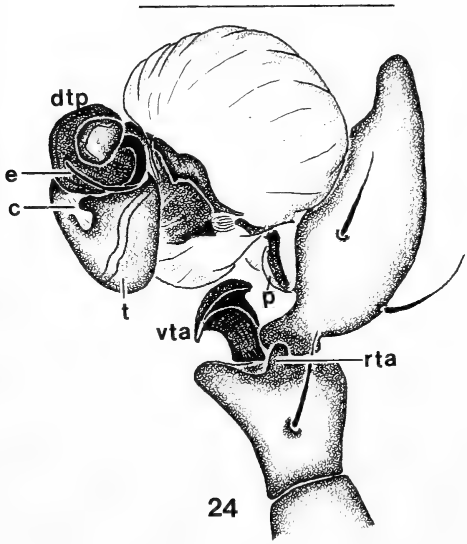

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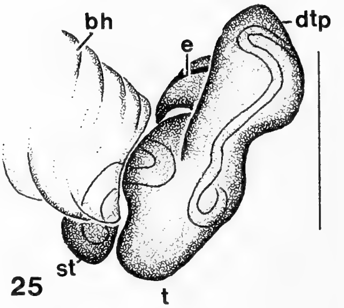

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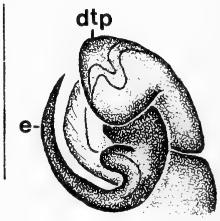

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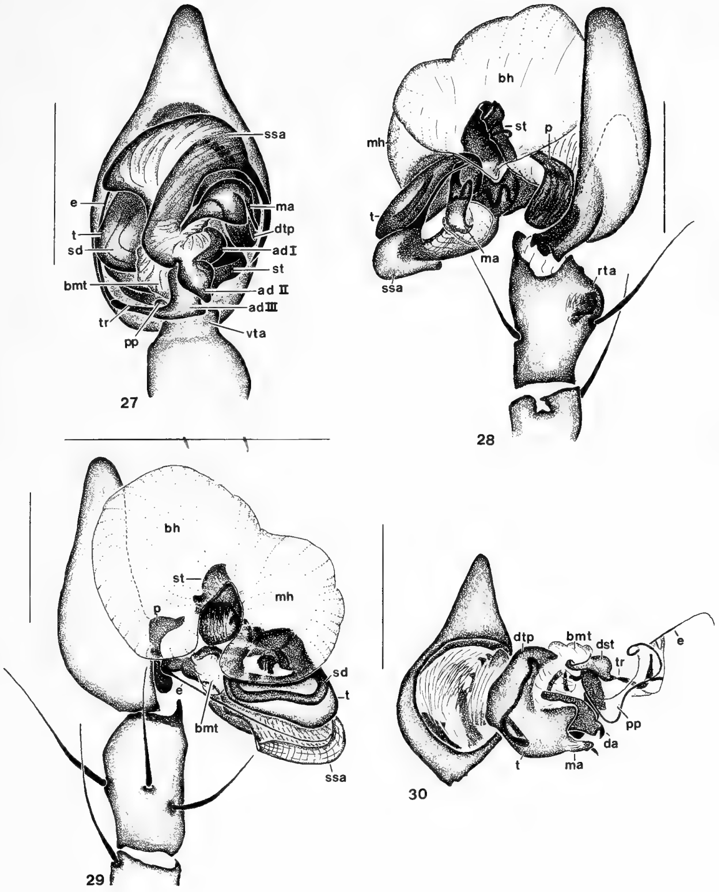
Figures 22, 23. *Architis tenuis.* **22.** Unexpanded right bulb, ventral view. **23.** Expanded left palp. **Figures 24-26.** *Staberius spinipes.* **24.** Expanded left palp, retrolateral view. **25.** Tegulum, prolateral view. **26.** Distal tegular projection and apical division, retrolateral-dorsal view. Scale bars: Figs. 22, 25, 26, 0.5 mm; Figs. 23, 24, 1 mm.



Figures 27-29. *Pisaurina mira,* left palp. **27.** Unexpanded, ventral view. **28.** Expanded, retrolateral view. **29.** Expanded, prolateral view. **Figure 30.** *Pisaura mirabilis,* left expanded palp, ventral view. Scale bars: 1 mm.

hypothesis. The tip of the sail-shaped apophysis lies parallel to the upper branch of the tip of the median apophysis.

(4) Palp Morphology in Other Nursery-Web Pisauridae

Pisaura Simon, 1885 (Figs. 7, 30, 45)

The tibial apophysis is thick and tubular, bearing brushes of hair in some species. The upper-surface of the tegulum is mostly sclerotized, thus the tegulum is bowl-like, with the sperm duct following the outer margins of the bowl. The upper-surface of the tegulum surrounding the distal tegular projection is membraneous, strongly inflatable, and continues to become the basal membraneous tube (Fig. 30). The most prominent features of the *Pisaura* bulb are **three** conspicuous apophyses (Fig. 7; c, ma, da). The conductor at the retrolateral side of the genital bulb is large and sclerotized. The next apophysis is smaller, with a hook-shaped tip. Because of its position and membraneous attachment to the tegulum, it is considered to be the median apophysis.

The distal apophysis, situated distad of the median apophysis (Figs. 7, 45) is large, consisting of a dorsal branch and a ventral branch (Fig. 45, db, vb). The dorsal and ventral branch are fused distally and form a distinct hook. The ventral branch anchors the distal apophysis in the tegulum with a membraneous connection. The dorsal branch is attached to the membraneous upper-surface of the tegulum and extends towards the distal sclerotized tube of the apical division. From the ventral branch a sclerotized clasp, also attached to the membraneous upper-surface of the tegulum around the distal tegular projection, extends to the basal membraneous tube of the apical division. Therefore, the distal apophysis is connected to both the middle and apical division of the genital bulb.

The apical division (Fig. 30) consists of a rather large basal membraneous tube, the distal, sclerotized tube and a spiral embolus with a large, flag-like pars pendula. The truncus of the embolus is fused to the distal end of the sclerotized tube. Within the wall of the pars pendula lies a thin, T-shaped sclerite.

Blandin (1976) described the genus *Afropisaura* for African species formerly assigned to *Pisaura*. He based his decision on differences in features of male and female copulatory organs (Blandin, 1976: 928, figs. 17, 18). The species remaining in *Pisaura* comprise four to six species besides *mirabilis*, occurring in the palearctic region (*see* Brignoli, 1984). The genus *Pisaura* is in need of revision.

Approximately 20, mainly African genera possess the same basic bulb configuration as *Pisaura* (Fig. 45): a bowl-like tegulum, a large conductor, a slender median apophysis with a pointed, curved tip, and a large distal apophysis comprised of two branches. In certain genera, such as *Charminus* Thorell, 1899 (Figs. 49-51), the conductor is morphologically more complex. It consists of a sclerotized convex retrolateral part. This sclerotized part is connected directly to the tegular ring. The inner, concave side is an inflatable membrane, and actually a continuation of the upper-surface of the tegulum. During inflation, this inner part of the conductor, and also the basal membraneous sections of the median apophysis are expanded.

The apical divisions of the genera of the *Pisaura* genus-group show a wide range of diversity and are genus-specific.

Thalassius Simon, 1885 (Figs. 8-10, 40, 43)

The tibial apophysis is reduced (*see* Sierwald, 1987). The tegulum (Figs. 40, 43) forms a tubular ring with a membraneous center. The conductor is membraneous and very similar to the one found in *Dolomedes*. The median apophysis is large; its tip is heavily sclerotized and species-typical (Sierwald, 1987, figs. 54-55, 58-61, 126, 127).

In the *rubromaculatus*-group, the distal tegular projection is large; it possesses a somewhat less sclerotized zone (Fig. 8, arrowhead; Fig. 40, meandering line). The apical division consists of a single, solid sclerite, whose shape is very similar to the distal sclerotized tube and fulcrum combined as it occurs in *Dolomedes tenebrosus* (Fig. 3). The apical division is connected to the distal tegular projection via a short basal membraneous tube.

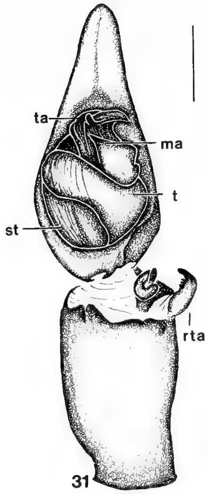
In the *spinosissimus*-group, the distal tegular projection appears to be reduced. The apical division consists of a basal bulbous section, a conspicuous, sclerotized finger-shaped apophysis (Fig. 43, fu), and a long, whip-like embolus. The finger-shaped apophysis is attached to the sclerotized bulbous section via a membrane and is considered here a homologue of the fulcrum.

(5) Palp Morphology in the South American *Trechalea* genus-group

For many of the genera in this group, the copulatory organs have never been figured in sufficient detail. For the present study, the palps of *Trechalea* (22 nominal species) and *Paradossenus* (three nominal species) are analyzed. Additionally, I conducted preliminary studies on palps of *Dyrines striatipes, Enna* sp., *Hesydrus* sp. and *Syntrechalea porschi*. The results reveal features justifying the separation of these spiders from the remaining nursery-web Pisauridae.

Trechalea Thorell, 1870 (Figs. 31-33, 46)

The tibial apophysis consists of two branches (Fig. 31; Carico & Minch, 1981, figs. 1, 2). The body wall between both branches is membraneous. The tegulum forms a ring. The ventral section of the tegular ring is broad; the sperm duct performs seven loops within this section of the tegulum. The conductor is a broad, low hump and only visible in the expanded palp. The median apophysis is a massive structure with two stout branches. Its shape and structure is considerably different from the median apophyses occurring in nursery-web Pisauridae, thus representing another character state. The apical division consists of a short thin embolus and a large terminal apophysis, bearing three small finger-shaped projections.



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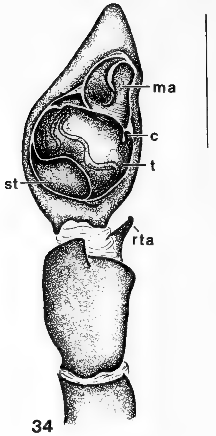

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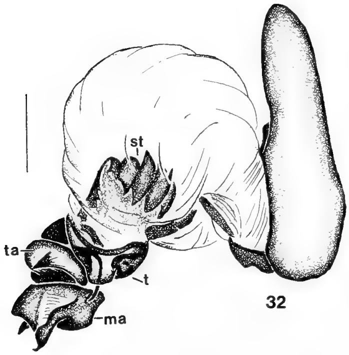

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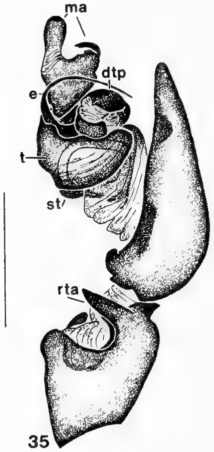

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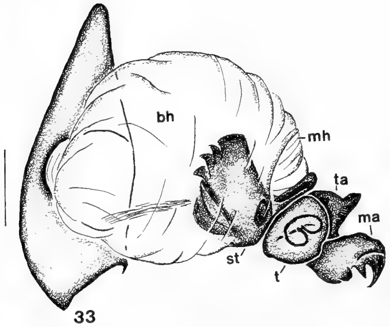

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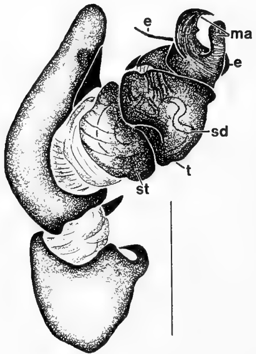

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Paradossenus F. O. Pickard-Cambridge, 1903 (Figs. 34-36, 47)

The tibial apophysis consists of a spur pointing ventrally. The body wall beneath it forms a deep membraneous pit. The tibial apophysis of *P. taczanowskii* Caporiacco, 1948, agrees with the figure given by F. O. Pickard-Cambridge (1903: figs. 7-9) in the original description of *P. nigricans*. These species are here regarded to be synonymous. The tegulum is ring-like, the ventral section is well developed as in *Trechalea*. The sperm duct performs five loops in the ventral section of the tegulum. The conductor is a small, inconspicuous projection of the tegular wall. As in *Trechalea*, the median apophysis forms a massive cubic structure with two stout branches. The distal tegular projection is well developed (Fig. 35). The apical division consists of a short basal membraneous tube and a slender sclerotized tube, which is fused to the embolus. There are no terminal apophyses (Fig. 47).

The palps of *Dyrines*, *Enna*, *Hesydrus* and *Syntrechalea* possess several identical characters with *Trechalea* and *Paradossenus*: a small, reduced conductor, the massive median apophysis with two branches, a coiled sperm duct with several switchbacks (except perhaps *Dyrines*), and a conspicuous membraneous pit at the distal end of the tibia.

DISCUSSION

(1) Homology of Palpal Elements Within Pisauridae and Evaluation of Character States

Tibial Apophysis. — The *Trechalea* genus-group possesses a synapomorphic character in the form of a membraneous pit that accompanies the tibial apophysis. A membraneous pit is also present in *Rhoicinus* Simon, 1898 (*see* Exline, 1960: fig. 2), whose relationship is uncertain, but has been placed in the Pisauridae by various authors.

Distal Tegular Projection. — The distal tegular projection can be identified by the loop of the sperm duct within it, its distal position and the attachment site of the apical division being below the tip of the projection. It occurs clearly in *Dolomedes*, *Pisaura*, *Architis/Staberius*, *Thaumasia*, the *Thalassius rubromaculatus*-group, and *Paradossenus*. In *Pisaurina*, the retrolaterally situated hump with the spur is considered here

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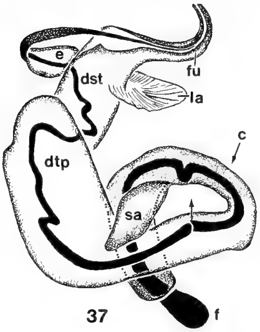
Figures 31-33. *Trechalea* sp., left palp. **31.** Unexpanded, ventral view. **32.** Expanded, retrolateral view. **33.** Expanded, prolateral view. **Figures 34-36.** *Paradossenus nigricans*, left palp. **34.** Unexpanded, ventral view. **35.** Expanded, retrolateral view. **36.** Expanded, prolateral view. Scale bars: 1 mm.



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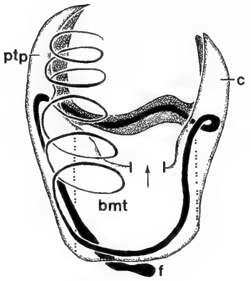

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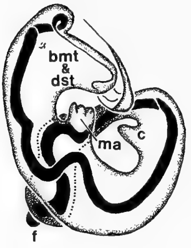

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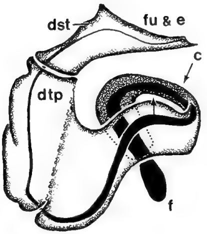

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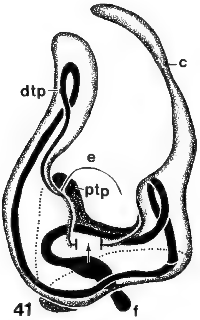

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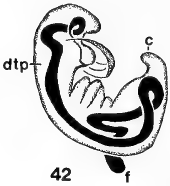

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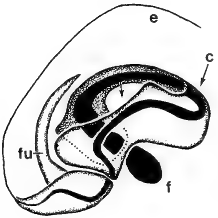

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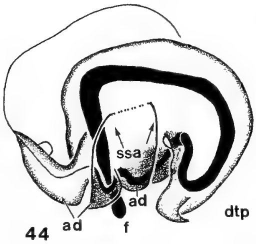

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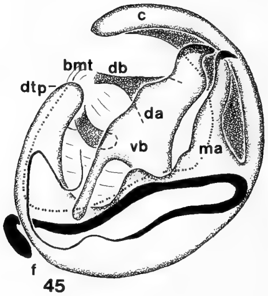

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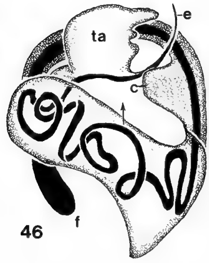

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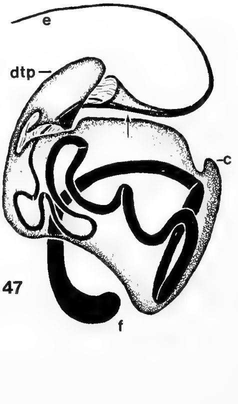

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to be homologous with the distal tegular projection of the other genera because it contains the loop of the sperm duct and because its position relative to the attachment of the apical division. The genital bulbs of *Tinus* and the *Thalassius spinosissimus* species-group probably lost this feature secondarily and independently. The distal tegular projection is absent in the *Trechalea* genus-group.

Median Apophysis. — All genera studied here possess a median apophysis. The median apophysis occurs in a variety of different character states, its general structure being always autapomorphic at the generic level. Additionally, it can be species-typical (*Thalassius*), or species-group specific (*Dolomedes*). The character state of the median apophysis in *Architis/Staberius* is considered a reduction, therefore derived. In the *Trechalea* genus-group, the morphology of the median apophysis differs distinctly from the median apophysis of the nursery-web Pisauridae, thus this character state is a synapomorphy for the South American *Trechalea* genus-group.

Conductor. — The conductor occurs in several morphological conditions (character states): it is membraneous in *Dolomedes* and *Thalassius* (synapomorphy); it is long in *Thaumasia*, and large, stiff, and heavily sclerotized in *Tinus*. In the *Pisaura* genus-group it is large as well, but in several genera the concave side of the conductor consists of an inflatable membrane of variable size, which is a continuation of the upper-surface of the tegulum. The conductor is small in *Architis/Staberius* and the *Trechalea* genus-group, and absent in *Pisaurina*. These reductions are independently derived.

Apical Division. — The apical division of the genital bulb shows a wide range of diversity: its appearance is usually genus-specific. The basal membraneous tube occurs in all pisaurid genera studied so far: the sclerites of the apical division were always found to be connected to the distal tegular process via an inflatable membrane. The basal membraneous tube

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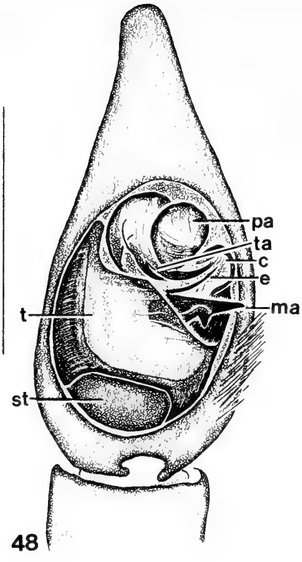
Figures 37-47. Schematic drawings of tegula, trajectory of sperm duct black, arrows indicate insertion of conductor (c), sail-shaped apophysis (ssa) and median apophysis (unmarked arrow). **37.** *Dolomedes tenebrosus*, conductor and median apophysis omitted. **38.** *Tinus peregrinus*, median apophysis omitted, embolus cut off. **39.** *Staberius spinipes*. **40.** *Thalassius rubromaculatus*, conductor and median apophysis omitted. **41.** *Thaumasia* cf. *uncata*, median apophysis omitted, embolus cut short. **42.** *Architis tenuis*. **43.** *Thalassius spinosissimus*, conductor and median apophysis omitted. **44.** *Pisaurina mira*, median apophysis and sail-shaped apophysis omitted. **45.** *Pisaura mirabilis*, tegulum including conductor, median apophysis and distal apophysis. **46.** *Trechalea* sp., median apophysis omitted. **47.** *Paradossenus nigricans*, median apophysis omitted.



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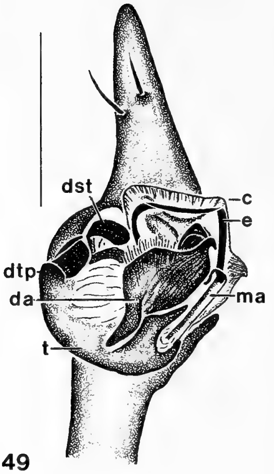

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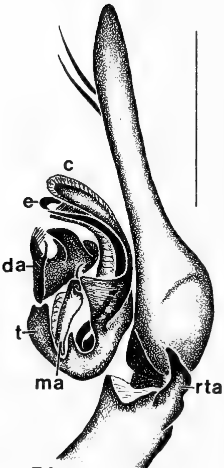

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Figure 48. *Trochosa ruricola*, left unexpanded palp, ventral view. **Figures 49-51.** *Charminus camerunensis*. **49.** Left unexpanded palp, ventral view. **50.** Expanded left palp, retrolateral view. **51.** Unexpanded left palp, retrolateral view. Scale bars: 1 mm.

varies in size. It is very small in *Thalassius*. The membraneous sac in *Tinus* is interpreted as a complexly developed basal membraneous tube of the apical division, based on the fact that the sperm duct forms the ejaculatory duct within it.

The distal sclerotized tube is clearly present in *Dolomedes, Tinus,* and the *Pisaura* genus-group; the *Thalassius rubromaculatus*-group possesses a homologue that is fused to the distal tegular projection and to the fulcrum. The presence of the distal sclerotized tube is considered the plesiomorphic condition. In *Pisaurina,* it may be represented by the second bulbous section of its apical division (*see* below). In *Thaumasia,* several small sclerites are present at the base of the embolus; they may represent homologues of the sclerotized tube and/or terminal apophysis. In *Architis* and *Staberius,* the basal membraneous tube and the distal sclerotized tube appear to be fused to the broad hump that is attached to the distal tegular projection. In *Paradossenus,* the distal sclerotized tube is reduced in size and fused to the base of the embolus. The distal sclerotized tube is absent in *Trechalea.*

Apophyses of the Apical Division. — The genera in question show a variety of terminal apophyses. The fulcrum is defined as an apophysis attached to the distal end of the distal sclerotized tube. The fulcrum in both *Thalassius* species-groups is considered homologous to the *Dolomedes* fulcrum because of its position and similarity in shape. The club-shaped terminal apophysis in *Tinus* (Fig. 15) is considered here to represent a homologue of the fulcrum as well. The subterminal lateral apophysis in *Dolomedes* is an autapomorphic feature of this genus.

Distal Apophysis and Sail-Shaped Apophysis. — The distal apophysis in the *Pisaura* genus-group may be homologous to the sail-shaped apophysis in *Pisaurina.* Both are attached to the tegulum in the membraneous area surrounding the distal tegular projection. Their position and connections to the middle and apical divisions support this hypothesis. Since the sail-shaped apophysis in *Pisaurina* is connected (via the sclerotized strap) to the second bulbous section of the apical division, the second bulbous section could be considered a homologue of the distal sclerotized tube. This homology-hypothesis is speculative. It could be supported or refuted by the presence or absence of further concordant homologies in the female copulatory organs or somatic characters. *Pisaurina* displays a sexual behavior (using silk to wrap the female's legs [Bruce & Carico, 1988[7]]) that is different from the copulatory behavior in *Pisaura mirabilis.*

Blandin (1976: 923, figs. 8, 9, 13, 14) labelled the distal apophysis in *Pisaura* as the fulcrum. Since the term fulcrum is used for an apophysis attached to the distal end of the sclerotized tube of the apical division, the fulcrum *sensu* Comstock is not homologous to the distal apophysis in

Pisaura.

Trajectory of Sperm Duct. — In most genera studied, the sperm duct forms a simple loop, which presumably represents the plesiomorphic condition. The *Trechalea* genus-group is characterized by several switchbacks of the duct in the well-developed ventral section of the tegulum.

The Spiral Embolus. — The spiral embolus, consisting of a truncus and a pars pendula as in *Thaumasia, Architis/Staberius*, and the *Pisaura* genus-group, occurs in many other spider families and is perhaps traceable in *Liphistius* [Fig. 1; *see* below under (**3**)]. In several pisaurid genera, the pars pendula is reduced and the truncus appears to be very thin, especially distally, thus producing a whip-like embolus (as in *Thalassius spinosissimus, Pisaurina* and the *Trechalea* genus-group).

(2) Systematic Implications

A definitive cladistic analysis of the approximately 55 pisaurid genera based on genitalic characters would be premature. Too many pisaurid genera, especially from Asia, are not known in sufficient detail and analyses of the female copulatory organs in both the *Pisaura* and the *Trechalea* genus-group are lacking. But the results obtained to date suggest the following phylogenetic conclusions:

The *Pisaura* genus-group includes at least: *Afropisaura* Blandin, 1976; *Caripetella* Strand, 1926; *Charminus* Thorell, 1899; *Cispius* Simon, 1898; *Cladycnis* Simon, 1898; *Euprosthenops* Pocock, 1897; *Euprosthenopsis* Blandin, 1974; *Maypacius* Simon, 1898; *Perenethis* L. Koch, 1878; *Pisaura*; *Pisaurellus* Roewer 1961; *Tetragonophthalma* Karsch, 1878; *Thalassiopsis* Roewer, 1955; *Vuattouxia* Blandin, 1979 (1979a); *Walrencea* Blandin, 1979 (1979a); and presumably also: *Chiasmopes* Pavesi, 1883; *Dendrolycosa* Doleschall, 1859; *Paracladycnis* Blandin, 1979 (1979a); *Phalaeops* Roewer, 1955; *Ransonia* Blandin, 1979 (1979a); *Rothus* Simon, 1898; *Tallonia* Simon, 1889. The group is characterized by the distal apophysis, thus it appears to form a well-supported monophyletic clade. Features in the female copulatory organs (Sierwald, in prep.) support this hypothesis through more synapomorphies. It would be important to study the copulatory behavior of other genera of the *Pisaura* genus-group. The copulatory behavior of *Pisaura mirabilis* is complex: the male presents a prey item to the female (Gerhardt & Kästner, 1938: 543). If similar behavioral features are found in other members of the *Pisaura*-group, they would provide additional synapomorphies.

The *Trechalea* genus-group contains presumably the nominal genera *Demolodes* Mello-Leitao, 1943; *Dossenus* Simon, 1898; *Dyrines* Simon, 1903; *Dyrinoides* Badcock, 1932; *Enna*; *Hesydrus*; *Paradossenus*; *Sisenna* Simon, 1898; *Syntrechalea*; *Trechalea*; and *Xinguisella* Mello-Leitao, 1940. The group is well supported as a clade through the synapomorphies found in the male palp, the structure of the egg sac, and through the parental behavior. Preliminary studies on the female copulatory organs (Sierwald, unpubl.) provide further evidence. In general, this group is poorly known. *Rhoicinus* and its relative *Barrisca* Chamberlin and Ivie, 1936 (*see* Platnick, 1979), might belong to the *Trechalea* genus-group as well. The systematic position of the *Trechalea* genus-group is unknown at this point. The assignment of the genera of this group to the family Pisauridae was based on plesiomorphic characters like the eye pattern, and similarities in the general habitus and habitats (occurrence near fresh water). Thus, the *Trechalea* genus-group is certainly not the sister group of the *Pisaura* genus-group, but the latter is more closely related to the remaining nursery-web pisaurid genera.

The remaining American nursery-web Pisauridae do not represent a monophyletic group; the affinities and relationships of single members are not known at this point. *Architis* and *Staberius* surely are monophyletic. In case more *Staberius*-species are found (*Staberius* is currently monotypic) synapomorphies will have to be discovered to warrant the existence of two separate genera (*see* Platnick, 1976). These then would represent sister taxa. Otherwise, the two nominal genera *Architis* and *Staberius* would be synonyms and the nomenclatural priority will need to be established, since both genera were described by Simon in 1898. *Architis* is the only member of the American nursery-web Pisauridae that hunts on snares (Nentwig, 1985). Webs for prey capture occur in several pisaurid genera around the world, e.g., in the African *Euprosthenops* (*see* Gerhardt & Kästner, 1938: 619), in the Asian *Eurychoera* and *Polyboea* (*see* Koh, 1989: 97, 100) and others, and also in juveniles, e.g., in *Pisaurina* (*see* Carico, 1985) and *Pisaura* (*see* Lenler-Eriksen, 1969). Web types and occurrences in pisaurid genera are not been studied in sufficient detail to allow phylogenetic conclusions. But Carico (1985) pointed out that the juvenile webs of *Pisaurina* and *Pisaura*, and the web of *Architis* are strikingly similar, which could indicate relationship.

Thalassius and *Dolomedes* share a greater number of characters with each other than with any other pisaurid. Their genital bulbs, spine-pattern on the legs (Sierwald, 1987), and the hunting behavior of most of their species on the surface of the water provide additional evidence. *Dolomedes* and *Thalassius* are considered close relatives. *Tinus* and *Thaumasia* share the proximal tegular projection and a large conductor, but no other features in the bulb are synapomorphic. The female copulatory organs of both genera display similarities (Sierwald, 1989b: figs. 11-12, 13-16; *see* also Carico, 1976: figs. 18-31): in both genera the copulatory duct is long and at least in some species, complexly coiled. Additional similarities are:

habitus and color pattern (white longitudinal stripes along the lateral sides of the body), as well as the hunting on the water surface in several species of *Tinus* (Carico, 1976; Sierwald, pers. observ. in Belize, Central America) and *Thaumasia* (Sierwald, pers. observ. on Barro Colorado Island, Panama). These features could be evidence for a closer relationship of both genera.

The genus *Pisaurina* is isolated. If its sail-shaped apophysis is a homologue of the distal apophysis in the *Pisaura* genus-group, it may be a the sister taxon of the latter.

The present study shows that monophyletic units (*Pisaura* genus-group, *Trechalea* genus-group) can be found using homologous morphological elements of the male copulatory organs. These hypotheses can be tested by finding corroborating features in female copulatory organs, somatic characters and other evidence such as behavioral data (e.g., structure of the egg sac in the *Trechalea* genus-group, mating behavior in the *Pisaura* genus-group, hunting behavior in *Thalassius* and *Dolomedes*). A study of the copulatory organs in potential sister taxa of Pisauridae either among the Amaurobioidea *sensu* Forster & Wilton (1973) or Lycosoidea *sensu* Homann (1971) will provide data to test homology-concepts of palpal elements within a more inclusive taxon, i.e., at the superfamilial level.

(3) Homology of Pisaurid Palpal Elements with Those of Other Families

Hypotheses on the homology of pisaurid palpal elements with those in other families rely nearly exclusively on data furnished by other authors, either in the form of descriptions or drawings. In the course of this study, it became evident that unequivocal interpretations of drawings and descriptions can not always be achieved: actual attachment points of membranes (or hematodochae) and of apophyses, especially at the tegulum in relation to the course of the sperm duct, are not always presented clearly. Likewise, the actual limits of sclerites can not always be determined with certainty from drawings. Therefore, the following homology concepts have to be considered with caution. But certain striking morphological similarities among unrelated groups should be mentioned.

Retrolateral Tibial Apophysis. — Apophyses at the distal end of the tibia occur in many spider families[8]. Their shape and structure are often species-typical and have been figured in many taxonomic studies. The function of tibial apophyses is uncertain and not necessarily the same in all groups. One observation in *Dolomedes tenebrosus* revealed that its retrolateral apophysis arrests the expanded bulb during copula (Sierwald & Coddington, 1988). If the retrolateral tibial apophyses in the different groups are homologous, they represent a synapomorphy for a large taxon within the Araneoclada *sensu* Platnick (1977; including Araneomorphae except Hypochiloidea and Austrochiloidea). Lehtinen (1967: 285, fig. 6) suggested such a taxon including his Amaurobiides and Zodariides, but his analysis regarding morphology and exact position of tibial apophyses in the male palp (e.g., table 8, page 310; table 29, page 351) is too vague to draw conclusions on homology/non-homology. Griswold [in press] distinguished between apophyses at different positions on the male palpal tibia, and also reached the conclusion that the retrolateral tibial apophyses may be a synapomorphy for a large taxon within the Araneoclada. A retrolateral tibial apophysis is present in *Liphistius* (Mesothelae) (*see* Platnick & Sedgwick, 1984: 3, fig. 7), but its homology with the retrolateral apophysis within Araneoclada is doubtful.

Basal and Middle Divisions of the Genital Bulb. — Subtegulum, basal hematodocha (basal division), and tegulum (middle division) are considered homologous among all spiders. The male genital bulb of *Liphistius* already contains these basic elements (Kraus, 1978; Haupt, 1983). Furthermore, subtegulum and tegulum occur in most entelegyne spider groups. Lack of tegulum and subtegulum as distinct sclerites (in certain Mygalomorphae and "haplogyne" spiders) is currently interpreted as secondary loss (either by fusion of formerly distinct sclerites or by paedomorphosis during ontogeny, *see* Coddington [in press]). The ontogenetic evidence supports this conclusion.

Subtegulum. — The pisaurid type of subtegulum with a sclerotized distal ridge and anelli occurs in other families as well (Agelenidae [Comstock, 1910: fig. 24; Gering, 1953: figs. 27, 31; *see* Bennett, 1987, for a detailed description of the subtegulum in Agelenidae], Thomisidae [Loerbrocks, 1984: fig. 9], and Phyxelidinae [Griswold, in press]). The morphological structure of the subtegulum often does not receive detailed attention in monographic studies. Details on its morphological diversity are therefore lacking.

Distal Tegular Projection. — Enlargements and elaborate structure of the distal tegular area occur in several spider groups independently. In Linyphiidae, the suprategulum corresponds in its position to the distal tegular projection as it is found in Pisauridae. The linyphiid suprategulum does not contain a loop of the sperm duct, thus the complex structure and enlargement of the distal tegular area in both families is obviously homoplasous. Griswold [in press] described an embolic sclerite (EBS) in some genera of Phyxelidinae that also corresponds to the distal tegular area.

Median Apophysis. — Haupt (1983: 276, figs. 1a-e) presented hypotheses that (a) the median apophysis is a homologue in all spiders, and (b) it can be traced back to the Kontrategulum in *Liphistius* and *Heptathela*. The Kontrategulum *sensu* Haupt is a ring-segment broken out of the ring-like tegulum in *Liphistius*. Haupt did not present any further details on the Kontrategulum = median apophyses hypothesis (e.g., by comparing it in various families, giving morphological criteria or describing different character states of the Kontrategulum in other spiders). He only presented the araneid median apophysis as the representative for the "median apophysis" in all entelegyne spiders. Raven (1985: 15) argued convincingly that the segmentation of the tegular ring in liphistiids appears to be an autapomorphy of subunits within the group or of certain *Liphistius* species. Haupt's claim that the median apophysis of all other spiders is a derivative of the Kontrategulum of *Liphistius* is therefore unsubstantiated.

Nevertheless, Haupt's concept of the median apophysis as an old structure, and therefore homologous in a large clade within Araneoclada, appears to be valid. The median apophysis as it occurs in Pisauridae – a distinct sclerite, at a certain position on the tegulum, connected to the tegulum via an inflatable or flexible membrane – occurs in many and unrelated families (e.g., in Amaurobiidae [Griswold, in press]; in Araneidae [Coddington, in press], in Anyphaenidae [Sierwald, 1988: fig. 1]; in Lycosidae, Fig. 48). Lehtinen (1967: 285, fig. 6, and 289, table 1) placed the "origin of the median apophysis with movable joint at the base" as a synapomorphy for his Amaurobiides, thereby excluding the Araneoidea from possessing a homologue. He did not comment on the striking similarity between the araneid median apophysis with the median apophysis in Amaurobiides.

Conductor. — As mentioned before, the term conductor has been used for tegular as well as for apical apophyses. In the Linyphiidae, the term conductor was used for a structure of the apical division. Because of doubtful homology, Saaristo (1971: 465) recommended avoiding the term conductor for Linyphiidae. Another example for inconsistent use of the term conductor appears in the family Lycosidae. Whereas in most lycosid genera a tegular process is labelled conductor (e.g., *Trochosa ruricola*, Fig. 48), the membraneous "conductor" in *Pardosa* (*see* Dondale & Redner, 1984, figs. 5-7) is an apophysis of the apical division and clearly not homologous.

Haupt (1983) considered the conductor homologous in all entelegyne spiders, but did not discuss morphological and positional differences of conductors in the various groups, and thus gave no evidence for his claim. He homologized the mygalomorph conductor with the Kontrategulum. Raven (1985: 16, and fig. 11) presented convincing evidence that the mygalomorph conductor (as in *Atypus*) may be a homologue of the stiff, prominent ridges of the distal margin of the tegulum in the mesothelid *Liphistius* (*see* Fig. 1), since "the mygalomorph conductor is a sclerotized process arising opposite the embolus, separated from it by an extensive haematodocha...." Such tegular ridges occur in several *Liphistius*- and

Heptathela-species (Kraus, 1978: figs. 2-4; Platnick & Sedgwick, 1984: figs. 39, 41, 66; Haupt, 1983: figs. 4c, 7).

Lehtinen (1967: 285, fig. 6) proposed "a membraneous, secondary conductor" exclusively for Lycosoidea and Amaurobioidea *sensu* Lehtinen (including Miturgidae, Amaurobiidae, Liocranidae, Agelenidae, Dictynidae and Hahniidae). As discussed earlier, his argumentation lacks convincing morphological details to distinguish between a primary and a secondary conductor.

The pisaurid conductor as an immovable, tegular outgrowth is considered here homologous in many spider groups (e.g., Lycosidae, Anyphaenidae, Amaurobiidae, Psechridae, Araneidae). It is suggested that the basic pattern of the genital bulb in Araneoclada contains two tegular apophyses (median apophysis and conductor), as Coddington [in press] presumed as well. Coddington [in press] considered the conductor to be a homologue in Dictynoidea, Orbiculariae, and Amaurobioidea *sensu* Forster & Wilton.

Conductor and Median Apophysis. — Independent modifications, reductions or losses of one or both may have frequently occurred in various groups. If only one tegular apophysis is present, it may be difficult to identify which (the median apophysis or the conductor) has been lost. Likewise, if both are present in two not closely-related spider groups, it may be difficult or impossible to decide whether the conductor in one group is homologous to the median apophysis in the other group or vice versa. Slight changes in the growth pattern of the tegulum could result in rather different insertion points of the tegular apophyses in relation to the trajectory of the sperm duct in the mature genital bulb.

Apical Division. — In many Mygalomorphae and "haplogyne" spiders the apical division consists of the embolus, forming a mere continuation of the middle division rather than being separated from it (connate type of embolus *sensu* Comstock, 1910: 182). The mygalomorph conductor, often assigned to the apical division, appears to be a tegular apophysis, as Raven (1985) showed (*see* above). In entelegyne spiders, the apical division is often a complex structure.

Basal Membraneous Tube of Apical Division. — The large sclerites of the genital bulb are usually connected via less sclerotized, membraneous tubes, which are called hematodochae, when they are large and inflatable. The column, as described by Saaristo (1971) for Linyphiidae (called duct membrane by Merrett, 1963), connecting the tegulum and the apical division corresponds in position to the basal membraneous tube as found in Pisauridae. The character state as an inflatable, rather large membraneous tube is supposedly independently derived.

Distal Sclerotized Tube of Apical Division. — In Araneidae, the apical division consists of two tubes with the ejaculatory duct running through them (Grasshoff, 1968: figs. 33a, b). The proximal tube, called the radix, is fully sclerotized. The second, distal tube is partly sclerotized and partly membraneous (*see* below, Stipes). A radix has been described for other spider families (e.g., Uloboridae, Oecobiidae, Theridiidae) but Coddington [in press] considered none of these homologues to the araneid radix based on major morphological differences and arguments involving parsimony. He argues that the true radix is most likely a synapomorphy for Araneidae and Linyphiidae. The distal sclerotized tube of the apical division in Pisauridae appears to be similar to the araneid radix, morphologically and positionally. A similar sclerite was described by Gering (1953: fig. 6) in *Agelenopsis*. The possible homology of these sclerotized tubes of the apical division deserves further attention.

Embolus. — A detailed study on the morphology of emboli in spiders is lacking. Whether emboli contain one or several sclerites, the shape of such sclerites, and the extent of membraneous sections are often missing in morphological descriptions. As mentioned earlier, only Comstock (1910) described different morphological types of emboli. The opening of the sperm duct always identifies the embolus itself unambiguously. But the opening of the sperm duct only identifies the terminal end of the embolus, not the proximal end of the structure.

A survey of 53 araneomorph spider families showed that spine-like emboli are most common. Comstock called these spiral emboli, consisting of a gutter-like sclerite, the truncus, and a membraneous pars pendula. Together they form a tube. The typical spiral embolus has a broad base and a tapering terminal section (e.g., in *Architis*, Fig. 42). The length of the terminal section varies. Long terminal sections may perform a loop as *Thaumasia* (Figs. 16, 17). Such loops of the terminal section occur also independently in e.g., Linyphiidae (*Lasiargus*, Whiele, 1960: fig. 21a), Theridiidae (*Achaearanea*, Levi, 1961: fig. 7), and Stiphidiidae (*Stiphidion*, Davies, 1988: fig. 23). Very long emboli often form multispiral coils as in *Tinus* (Fig. 11). Such coiled emboli are broadened and tape-like. This type occurs independently in e.g., Deinopidae (*Deinopis*, Kraus, 1956: fig. 4), Symphytognathidae (*Patu*, Forster & Platnick, 1977: fig. 53), Linyphiidae (*Labulla*, Merrett, 1963: fig. 33), Mysmenidae (*Mysmenopsis*, Gertsch, 1960: fig. 45, 46), Pacullidae (*Sabahya*, Deeleman-Reinhold, 1980: fig. 10), and Theridiidae (*Latrodectus*, Wiehle, 1960: fig. 11).

In addition to a sclerite, emboli often contain membraneous parts, especially in the basal region (e.g., Figs. 18, 23). Gering (1953: 26, figs. 29, 30; Agelenidae), Loerbrocks (1983: figs. 4, 6; Thomisidae), and Griswold (in press; Amaurobiidae) labelled membraneous parts of emboli pars pendula. Comstock (1910: fig. 6) used the term in a theraphosid embolus, obviously implying homology. Often, membraneous sections in the base of the embolus are indicated in drawings, but not confirmed in descriptions (e.g., Senoculidae [*Senoculus*, Petrunkevitch, 1925: fig. 105], Linyphiidae [*Cornicularia*, Wiehle, 1960: fig. 10], Lycosidae [*Schizocosa*, Dondale & Redner, 1978: fig. 10; *Sosippus*, Brady: 1962, fig. 36]).

It is my current hypothesis that all spine-like emboli, containing the truncus and a pars pendula, are in fact homologous. The question is at what level are they homologous?

Since the genital bulb of Mesothelae already contains the two large sclerites, subtegulum and tegulum, the structure of its apical division is of special importance. In *Liphistius* (Fig. 1), the apical division consists of a large sclerite (sclerite III *sensu* Kraus, 1978) bearing one elongated sclerotized projection and two lamellae (bl = broad lamella and hl = hyaloid lamella; after Kraus, 1978). The sclerotized projection is U-shaped in cross section and forms three sides of the embolus. The fourth, open side is closed by the hyaloid lamella, thus forming a tube-like embolus[9]. Haupt (1979: 360) described the embolus of *Ryuthela nishihirai* (Haupt, 1979)[10] as " strongly sclerotized except for a longitudinal groove... [citation translated]," presumably describing a homologue of the hyaloid lamella *sensu* Kraus of *Liphistius*.

The resemblance of the liphistiid embolus to the "spiral type of embolus" as described above is striking. This morphological similarity could imply homology of at least the projection of the sclerite III (*sensu* Kraus) with the truncus of the spiral embolus in entelegyne spiders.

Since all emboli in spiders seem to contain a sclerite or form a sclerotized tube, I propose that it is most parsimonious to assume that the embolic sclerite in all spiders is a homologue of either the complete sclerite III or the projection of sclerite III in *Liphistius*. This hypothesis is in concordance with the homology of subtegulum and tegulum in all spiders. The pars pendula could be a homologue of the hyaloid lamella, but I am less confident of such a hypothesis. Supporting evidence for the latter hypothesis could come from ontogenetic studies of genital bulbs, or from the occurrence of membraneous sections in the emboli of Paleo- and/or Neocribellate spiders. But even then, homology may be difficult to hypothesize since a membraneous section is not complex in structure. Therefore, morphological similarity may not offer supportive evidence for homology. If the pars pendula in the emboli of entelegyne spiders is not homologous with the hyaloid lamella in *Liphistius*, the spiral embolus may be a synapomorphy for a large group within the Araneoclada *sensu* Platnick. A re-examination of the embolic area of spider groups with other types of emboli (e.g., coniform and lamelliform *sensu* Comstock) may reveal unexpected morphological similarities and may lead to new homology concepts as the following indicates.

Stipes in Araneidae. — In addition to the proximal sclerotized tube called the radix, the apical division of some araneids contains a second, distal tube. The latter tube carries none to several terminal apophyses and an embolus. Part of the wall of the second tube is sclerotized, forming a sclerite called the stipes. The remaining part of the tube wall is membraneous and inflatable (called distal hematodocha by Grasshoff, 1968: fig. 33), carrying terminal apophyses and a short embolus. This embolus was figured by Comstock (1910: fig. 25) and called the coniform embolus. It is possible that the stipes-section of the araneid bulb is an enormously developed spiral embolus, with the stipes representing the truncus and the membraneous part representing the pars pendula, thus the distal hematodocha would be the homologue of the pars pendula. If this is true, the traditional araneid embolus corresponds only to a part of the embolus in Pisauridae and other groups with spiral emboli.

Haupt (1983) and Heimer (1986) both discussed the striking similarities in morphology of the genital bulbs in Mesothelae and entelegyne spiders. Because of the "presumed great phylogenetic distance between Araneoidea and Liphistiidae...," Heimer (1986: 119) explicitly avoided the term homologous but attributed the morphological similarity to homoiology. This term, meaning analogous structures in homologous organs, is not part of the current set of terms used in phylogenetic systematics. Although divergent definitions exist[11], the term basically means parallelism. Heimer's statement makes it difficult to recognize on what level he considers parts of the genital bulb homologous within Araneae.

As shown above in the discussion on the conductor, median apophysis, and spiral embolus, I believe that careful morphological analysis and comparison will enable us to establish homologies of palpal structures within Araneae at all taxonomic levels. This knowledge of homologous elements in the male palpal organ, as well as in the female copulatory organ, will greatly advance the reconstruction of the phylogeny of Araneae.

SUMMARY

Morphology and Homology of Palpal Elements

It is now generally accepted that the tripartite genital bulb in male spiders is plesiomorphic (genital bulb structure in Mesothelae, ontogenetic evidence; *see* Platnick & Gertsch, 1976, Kraus, 1978, and Haupt, 1983). The large sclerites (subtegulum and tegulum) are therefore homologous in all spiders.

It is proposed here that morphological similarity and position of tegular apophyses and processes often provide sufficient evidence for homology concepts (process connected via membrane to tegulum or mere outgrowth of tegulum; process containing a loop of the sperm duct or lacking such). The basic pattern in Araneoclada *sensu* Platnick (1977) contains two tegular apophyses (median apophysis and conductor). A conductor found in the apical division (as described in e.g., Linyphiidae) is not a homologue of the true conductor.

It is suggested here that the spiral embolus *sensu* Comstock (1910) is a plesiomorphic feature and homologous for a large clade. The sclerite of the spiral embolus, the truncus, is considered to be a homologue of the projection or the entire sclerite III in the apical division of *Liphistius*. Furthermore, it is suggested that other types of emboli, e.g., the coniform embolus of Araneidae, may only be partly homologous to the spiral embolus, but that the araneid stipes may represent a homologue of the truncus. The araneid radix of the apical division is compared to the distal sclerotized tube as it occurs in the apical division of Pisauridae and possible homology is discussed.

The retrolateral tibial apophysis as it occurs in Pisauridae is homologous wherever it is found in other spider families and therefore represents a synapomorphy for a large clade within Araneoclada.

Palp Morphology of American Nursery-Web Pisauridae

Architis/Staberius, Pisaurina, Thaumasia, Tinus, and *Dolomedes* constitute the American nursery-web Pisauridae. Only *Dolomedes* is distributed worldwide, the remaining genera are restricted to the Americas. All American nursery-web Pisauridae possess a well-developed and species-typical retrolateral tibial apophysis. The subtegulum bears a sclerotized ridge and anelli. The tegulum is ring-like (bowl-like in *Pisaurina*). The distal end of the tegulum (distal tegular projection) is enlarged and contains a loop of the sperm duct.

Dolomedes possesses a membraneous conductor, the median apophysis is flat, lamelliform, and species-group specific. *Thaumasia* and *Tinus* have a large conductor, heavily sclerotized in *Tinus*; the genus-typical median apophyses are short with a slightly sclerotized distal region. The conductor is independently reduced in *Pisaurina* and *Architis/Staberius*. The median apophysis in the latter is very similar to the one found in *Tinus* and *Thaumasia*. *Pisaurina* possesses a well-developed, species-typical median apophysis and an additional, tegular, sail-shaped apophysis that is presumably a homologue of the distal apophysis as found in the *Pisaura* genus-group. *Tinus* and *Thaumasia* both possess a sclerotized, proximal, tegular process that is large in *Tinus* and short in *Thaumasia*.

The apical division of Pisauridae consists of a basal membraneous tube connected to the distal end of the tegulum, a sclerotized distal tube and a spiral embolus *sensu* Comstock (1910). *Dolomedes* carries a terminal apophysis called the fulcrum. A homologue of the fulcrum is found in *Tinus* in form of a small club-shaped apophysis. In *Tinus,* the basal membraneous tube of the apical division is large, forming a species-typical, coiled, inflatable sac.

The bulb structure of the African genus *Thalassius* is very similar to *Dolomedes,* indicating closer relationship.

Palp Morphology of the *Pisaura* Genus-Group

The tegulum is bowl-like. The conductor is sclerotized and well developed. The conspicuous, distal tegular apophysis in addition to the median apophysis, and structure of the apical division are synapomorphies of the group. Preliminary studies of the female copulatory organ corroborate monophyly of this clade.

Palp Morphology of the *Trechalea* Genus-Group

The *Trechalea* genus-group possesses the following synapomorphies in the genital bulb: a small, reduced conductor, a median apophysis with two branches, a sperm duct with several switchbacks, a well-developed ventral section of the tegulum and a conspicuous membraneous pit at the distal end of the palpal tibia. Preliminary studies of the female copulatory organs, the structure of the egg sac and maternal behavior (attaching the egg sac to the spinnerets) corroborate the monophyly of this clade.

Systematics of the Family Pisauridae

So far, no morphological synapomorphies have been found to unite the 55 genera assigned to the family Pisauridae. An assumed apomorphy, the nursery-web, built by the female for the newly hatched spiderlings has been observed to date in nine genera belonging to all three subfamilies of Pisauridae. Thus, to define monophyletic units among pisaurid genera, morphological synapomorphies have to be found. The sister group to Pisauridae is unknown, but should be among the Lycosoidea *sensu* Homann (1971), since this superfamily is united by the synapomorphy of a grate-shaped tapetum in the secondary eyes. Lehtinen's (1967) separation of Pisauridae *sensu lato* in Dolomedidae and Pisauridae *sensu stricto,* placed in two different superfamilies, is rejected at this point. The main distinction between the two, the primary conductor in Pisauridae *sensu stricto* and the secondary conductor in Dolomedidae appears to be unsubstantiated.

Based on the structure of the genital bulb, the *Pisaura* genus-group contains at least: *Afropisaura* Blandin, 1976; *Caripetella* Strand, 1926; *Charminus* Thorell, 1899; *Cispius* Simon, 1898; *Cladycnis* Simon, 1898; *Euprosthenops* Pocock, 1897; *Euprosthenopsis* Blandin, 1974; *Maypacius* Simon, 1898; *Perenethis* L. Koch, 1878; *Pisaura* Simon, 1885; *Pisaurellus*

Roewer, 1961; *Tetragonophthalma* Karsch, 1878; *Thalassiopsis* Roewer, 1955; *Vuattouxia* Blandin, 1979 (1979a); *Walrencea* Blandin, 1979 (1979a); and perhaps also: *Chiasmopes* Pavesi, 1883; *Dendrolycosa* Doleschall, 1859; *Paracladycnis* Blandin, 1979 (1979a); *Phalaeops*, Roewer, 1955; *Ransonia* Blandin, 1979 (1979a); *Rothus* Simon, 1898; *Tallonia* Simon, 1889.

The remaining American nursery-web Pisauridae do not represent a monophyletic clade. *Tinus* F. O. Pickard-Cambridge, 1901, and *Thaumasia* Perty, 1833, are closely related to each other and that clade is related to *Dolomedes* Latreille, 1804, and *Thalassius* Simon, 1885. The affinities of *Architis* Simon, 1898, and *Staberius* Simon, 1898, are unknown. The genus *Pisaurina* Simon, 1898, is presumably most closely related to the *Pisaura* genus-group.

The *Trechalea* genus-group contains presumably the nominal genera *Demolodes* Mello-Leitao, 1943; *Dossenus* Simon, 1898; *Dyrines* Simon, 1903; *Dyrinoides* Badcock, 1932; *Enna* O. Pickard-Cambridge, 1897; *Hesydrus* Simon, 1898; *Paradossenus* F. O. Pickard-Cambridge, 1903; *Sisenna* Simon, 1898; *Syntrechalea* F. O. Pickard-Cambridge, 1902; *Trechalea* Thorell, 1870; and *Xinguisella* Mello-Leitao, 1940. Based on features in the copulatory organs of both sexes, the structure of the egg sac, and parental care, the *Trechalea* genus-group is not a close relative of the nursery-web Pisauridae.

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ENDNOTES

[1] Members of Sparassidae (e.g., *Heteropoda venatoria* Linnaeus, 1767; pers. observ.) carry the flat, discus-shaped egg sac in their chelicerae as well.

[2] The egg sac of Lycosidae is also attached to the spinnerets. Although the lycosid egg sac possesses a seam, it consists of two equally shaped and equally constructed halves, thus is significantly different from the egg sac of the *Trechalea* genus-group. Attaching the egg sac to the spinnerets occurs also in the ctenid *Cupiennius* Simon, 1891 (*see* Melchers, 1963).

[3] Processes at the subtegulum are very rare. The only ones known to me occur in *Liphistius langkawi* and *L. murphyorum* (*see* Platnick & Sedgwick, 1984: figs. 31-35, 38-42).

[4] Osterloh (1922: 333) distinguished between apophyses that arrest the bulb (Retinulum) and those which engage in the female epigynum (Retinaculum).

[5] Exception: *Thalassius* Simon, 1885, is the only member of Pisauridae with a reduced tibial apophysis (Sierwald, 1987).

[6] Roewer (1955) called the median apophysis in *Thalassius* conductor.

[7] This behavior occurs also in *Ancylometes* (*see* Merrett, 1988) and *Thalassius* (*see* Sierwald, 1989a).

[8] A superficial count of spider families with such retrolateral tibial apophyses exceeded over 20 families, including: Acanthoctenidae, Agelenidae, Amaurobiidae, Ammoxenidae, Anyphaenidae, Clubionidae, Ctenidae, Dictynidae, Gallieniellidae, Gnaphosidae, Hahniidae, Heteropodidae, Homalonychidae, Oxyopidae, Pisauridae, Philodromidae, Psechridae, Salticidae, Selenopidae, Senoculidae, Tengellidae, Thomisidae, Toxopidae, Zodariidae.

[9] Raven (1985: 15) misidentified the hyaloid lamella at the embolus of *Liphistius* as being the mesothelid conductor.

[10] *See* Song & Haupt, 1984, for the taxonomic position of *R. nishihirai*.

[11] Dzwillo, 1978: 96; Riedl, 1975: 60. Ax (1984: 63) considered the terms parallelism, homoplasy, and homoiology superfluous. Patterson (1982: 45-48) gives an enlightening analysis of the terms homology, homoiology, homonomy, parallelism, and convergence.

Reviewers of this paper: Dr. Jonathan Coddington, National Museum of Natural History, Washington, DC; Dr. Robert Raven, Queensland Museum, South Brisbane, Australia; and Dr. William A. Shear, Hampden-Sydney College, Hampden-Sydney, Virginia.

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ANNOTATED CATALOG OF TYPE SPECIMENS IN THE MALACOLOGICAL COLLECTION OF THE DELAWARE MUSEUM OF NATURAL HISTORY.

GASTROPODA (PROSOBRANCHIA AND OPISTHOBRANCHIA)

Rüdiger Bieler[1,2] and Alison Bradford[1]

ABSTRACT. A brief outline of the history and sources of the malacological collection at the Delaware Museum of Natural History is given. All type material (as defined by ICZN Article 72) was separated from the main collection. This paper reviews and lists the type holdings of Recent prosobranch and opisthobranch gastropods. The type status of each specimen was studied by comparison with the original publications. A total of 191 type lots of 160 species-group taxa from 65 authors is recognized; 55 of these are holotypes or syntype lots. The majority of name-bearing types consists of marine caenogastropod prosobranchs. An annotated list of all type lots as well as an author index are given. The list of references contains all papers in which the taxa are first described and also other major publications based on the collection.

INTRODUCTION

The malacological collection of the Delaware Museum of Natural History (DMNH) with currently about 190,000 catalogued lots is one of the largest of its kind in the country. In 1982, then containing 135,000 catalogued lots, it was ranked eighth in size among the U.S. collections in a survey by Thompson (1982: 44).

The marine shell-bearing gastropods are the main strength of the collection (about 52% of total lots), followed by land and freshwater gastropods (27%), marine bivalves (16%), freshwater bivalves (4.5%),

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and miscellaneous other molluscan groups (0.5%). In addition to this material in dry lots, there is a small alcoholic collection. The dry collection is housed in steel cabinets and arranged in taxonomic order by families, largely following the traditional arrangement based on the Thiele (1929-1935), Wenz (1938-1944) and Zilch (1959-1960) monographs. It contains some fossil (mainly Tertiary) specimens, interfiled with the Recent material. There is no geographical specialization. At present, data for approximately 30% of the lots have been entered into a micro-computer-based relational database system (*dBase III+*, commercially available from Ashton-Tate).

The DMNH malacological collection, amassed during only 30 years (the museum was founded in 1959 and opened to the public in 1972), came from various sources. The main origin has been donations and purchases from private collectors and exchanges with other institutions. The large collection storage areas (13,000 square feet), designed with a holding capacity of 1.4 million lots, made it possible to absorb orphaned collections from other institutions as well as extensive material originating from expeditions and ecological studies. Additional deposited specimens were collected as part of research projects of DMNH staff and associates, or were placed here because of the publications associated with the museum (*Indo-Pacific Mollusca, The Nautilus, Delaware Museum of Natural History Monograph Series, Nemouria*).

In addition to the large original collection by DMNH's founder, John E. du Pont, major private collections were obtained, by donation or purchase, from the following individuals (3,000–100,000 specimens each): W. Andrews, C. Aguayo, H. Boswell, M. P. Breithaupt, W. J. Clench, T. Crow, W. E. Dodd, E. Doremus, L. Grantier, B. K. Harris, R. Jackson, H. G. Jewell, C. L. Kauffman, G. & M. Kline, N. W. Lermond, C. A. Long, P. M. Mikkelsen, J. E. Morrison, J. E. Norton, R. E. M. Ostheimer, W. Over, J. D. Parker, E. Quammen, C. L. Richardson, F. Schilling, H. L. Sears, M. & H. Schriner, D. Steger, M. L. Walton, and R. E. Winter. Also, significant collections (1,500–3,000 specimens each) came from: J. C. Alexander, J. & C. Bennett, A. Chadwick, H. Du Shane, W. M. Heilman, W. M. Ingram, J. W. Lippincott, C. V. MacCoy, H. & M. Minzak, B. J. Piech, B. Roth, G. M. Seymour, C. Weaver, and A. Westerfield.

Significant quantities of exchange material and donations were received from the Academy of Natural Sciences of Philadelphia (ANSP, Pennsylvania), the National Museum of Natural History (USNM, Washington, DC), and the Ohio State University Museum (Columbus); orphaned collections came from University of Kansas (Lawrence), Mystic Seaport Museum (Mystic, Connecticut), Portland Society of Natural

History (Portland, Maine), Stamford Museum (Stamford, Connecticut), and the Division of Historical and Cultural Affairs, State of Delaware. The museum holds one permanent loan, the eastern U.S. Unionidae collection of Stanford University (Stanford, California).

The type material (holo-, para-, syn-, lecto-, paralecto- and neotypes, as defined by ICZN Article 72) has recently been separated from the main collection. This allows us to comply with Recommendation 72G(4) of the International Code of Nomenclature (ICZN, 1985: 72): "Every institution in which name-bearing types are deposited should . . . publish lists of name-bearing types in its possession or custody." As can be expected from the collections of a relatively young museum, the DMNH type holdings are small when compared to other institutions. The type material can be sorted into two groups. The first comprises specimens that were in possession of the museum at the time of the original description of the respective taxon. This usually is material based on research by DMNH staff and associates, by outside scientists working on DMNH material or using DMNH as a repository, or it is material described in journals currently or in the past published by the museum. The second group consists of material that reached DMNH subsequent to the original publication date. For type specimens that have changed ownership several times a type catalog such as this may be the only means of locating the current repository.

It might come as a surprise that the DMNH holdings contain type lots of taxa described by Australian and New Zealand authors, such as W. O. Cernohorsky, B. C. Cotton, H. J. Finlay, C. Hedley, F. W. Hutton, T. Iredale, and A. W. B. Powell.

This is not a *critical* catalog in the sense that the current taxonomic status for the nominal taxa involved has not been researched in detail. However, the *type status* was critically evaluated by comparison with the original description and in strict application of the ICZN rules. Many specimens previously recognized as para- and syntypes because they were part of the original material of the describing author, were excluded from the type collection when the original description explicitly restricted the number or repository of types (ICZN Art. 72(b)(vi)). This type material "grey zone" most often originated from retained, but not cited, specimens in the collections of the original collector or author. In accordance with ICZN Article 73(b), DMNH specimens were recognized as syntypes in cases when the original author failed to designate a holotype and we were unable to locate a subsequent lectotype designation.

All recognized or suspected type specimens were measured. Specimens with an overall size larger than 3 mm were measured using calipers, smaller specimens with the aid of a dissecting microscope and calibrated eye piece (accuracy ± 0.1 mm in both cases). "Height" (H) was defined as the largest dimension parallel to the columellar axis, and "width" (W) the largest dimension perpendicular to that axis. In cases when these measurements were meaningless or the shell axis was obscured (e.g., Caecidae, Patellidae), other dimensions are given and individually indicated. The new measurements not only provide additional information when dimensions were not given in the original publication, but also serve to evaluate identity of type material. Minor discrepancy between the original measurements and ours may reflect different techniques (e.g., measurements without reference to shell axis) or accuracy (e.g., original measurement by ruler instead of calipers). Large discrepancies, however, indicate either error in the original publication or, worse, a subsequent confusion of type material. In cases where the originally given dimensions differ from ours, they are noted in parentheses and quotes. In all other cases, the measurements agree, or there was no such information in the original description.

Reflecting the strength of the general collection, the majority of the DMNH type specimens, including most name-bearing types (holo-, lecto-, neotypes and syntypic series), belong to the shell-bearing Prosobranchia and Opisthobranchia (191 lots of 160 species-group taxa, all of them of Recent forms). Of these, 38 are recognized as holotypes, 61 as syntypes in 17 lots, and more than 350 as paratypes or paralectotypes in 134 lots.

The listings in this catalog are arranged as follows:

(1) new species-group name, (2) original generic (subgeneric) and/or species-level placement, (3) original status (e.g., "[as n. ssp.]"), (4) original author and short bibliographic reference, with figure reference to DMNH specimen(s), (5) number and kind of types, (6) DMNH collection catalog number, (7) locality data for specimen in type lot, taken from label and/or original description [discrepancies noted, metric conversion of depth data where originally missing]; in the case of paratypes, a note whether this location is the type locality, (8) dimensions as described above, (9) remarks, (10) family placement.

The 'Remarks' section provides a variety of information. In case the original publication does not indicate DMNH as type repository, the history of the lot as known to us is given (e.g., "ex T. L. McGinty, via D. Steger"). Other data include references to figures in publications other than the original, and recognized errors in the original publication.

The family placement is given in its originally published form, and often an updated family placement is added in square brackets (for prosobranch family-group taxa according to Ponder & Warén, 1988).
The following listing of types is arranged in alphabetical order of species,

with Prosobranchia and Opisthobranchia listed separately. In addition, an index by author as well as complete bibliographic references are provided.

TYPE CATALOG

CLASS GASTROPODA
SUBCLASS PROSOBRANCHIA

abrolhosensis, *Acmaea (Collisella)* [as n. sp.]
Petuch, 1979b: 513.
4 paratypes: DMNH 121797; south side of Santa Barbara Island, Abrolhos Archipelago, Bahia State, Brazil (19°57′S, 38°42′W); type locality. Dimensions (greatest lengths): 20.9 [1 shell]; 21.4, 19.6, 18.8 [3 complete alcohol-preserved specimens] ("lengths 21 mm, 21 mm, 20 mm, 19 mm"). Patellidae [Acmaeidae].

adamsianum, *Vexillum (Costellaria)* [as n. sp.]
Cernohorsky, 1978: 64, fig. 9.
1 paratype: DMNH 118026; Keehi Lagoon, Oahu, Hawaiian Islands, 50 fathoms [91.5 m]; type locality. Dimensions: H= 9.0, W= 3.6 ("3.7"). Costellariidae.

ahiparana, *Turritella (Zeacolpus)* [as n. sp.]
Powell, 1927: 297.
6 paratypes: DMNH 027852; off Ahipara, Ninety Mile Beach, New Zealand, 23 fathoms [42.1 m]; type locality. Dimensions: (1) H= 17.4, W= 5.2; (2) H= 17.1, W= 4.7; (3) H= 17.0, W= 5.4; (4) H= 16.9, W= 4.8; (5) H= 16.2, W= 4.9; (6) H= 14.6, W= 4.1. Remarks: Ex J. H. Alexander. Turritellidae.

allyni, *Terebra* [as n. sp.]
Bratcher & R. D. Burch, 1970: 298.
1 paratype: DMNH 022421; California Academy of Sciences station 237792, east shore of Maria Madre Island, Tres Marias Group, Baja California, Mexico (21°35′N, 106°26′W), 5-10 fathoms [9.1-18.3 m]; type locality. Dimensions: H= 28.4, W= 7.2. Terebridae.

amosi, *Metula* [as n. sp.]
Vanatta, 1913: 22.
2 syntypes: DMNH 024523; Panama. Dimensions: (1) H= 35.9, W= 11.8 [apex broken]; (2) H= 28.9, W= 10.9 [apex broken].

Remarks: Ex S. N. Rhoads, via ANSP 316700. Buccinidae.

aphrodite, *Conus* [as n. sp.]
Petuch, 1979a: 11, figs. 34-35 (holotype).
Holotype: DMNH 126398; off Panglao, Bohol Island, Philippines, approximately 250 m. Dimensions: H= 20.8 ("21"), W= 11.3 ("11").
1 paratype: DMNH 126399; type locality. Dimensions: H= 13.9 ("13"), W= 7.3.
Conidae.

arcas, *Terebra (Strioterebrum)* [as n. sp.]
Abbott, 1954: 40.
1 paratype: DMNH 104984; 35 miles E.N.E. of Arcas Cays, 17 fathoms [31.1 m] [or] 25 miles N.N.W. of Arcas Cays, sandy mud, 26 fathoms [47.6 m]; southern Campeche Bank, Mexico. Dimensions: H= 8.9, W= 2.5. Remarks: Ex D. Steger.
2 paratypes: DMNH 118028; off Arcas Cays, southern Campeche Bank, Mexico. Dimensions: (1) H= 7.4, W= 2.5; (2) H= 5.4, W= 2.0. Remarks: Ex D. Steger.
Terebridae.

atkana, *Littorina sitkana* [as n. var.]
Dall, 1886: 211.
2 syntypes: DMNH 043607; Kyska Island, Alaska. Dimensions: (1) H= 16.0, W= 13.7 [with operculum]; (2) H= 16.0, W= 13.5. Remarks: Ex USNM. Littorinidae.

aureola, *Pyrene* [as n. sp.]
Howard, F. B., 1963: 2.
1 paratype: DMNH 066821; Norse Beach, Punta Penasco, Sonora, Mexico (31°20'N, 113°38'W); type locality. Dimensions: H= 17.6, W= 11.0. Columbellidae.

aurora, *Columbarium (Peristarium)* [as n. sp.]
Bayer, 1971: 180.
1 paratype: DMNH 153519; R/V 'Pillsbury' station P-1309, northeast of Fowey Light, Straits of Florida (25°40'N, 80°02'W), 247 m; type locality. Dimensions: H= 42.9 [apex missing], W= 11.0. Remarks: Ex Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. Columbariidae [Turbinellidae].

axelrodi, *Conus* [as n. sp.]
Walls, 1978: 1, fig. p. 5.

Holotype: DMNH 123127; Palawan, Philippines. Dimensions: H= 16.0, W= 8.7. Remarks: Figure of holotype (Walls, 1978: fig. p. 5 upper right) erroneously labeled "topotypic paratype." Also described by Walls (1979b: 183 ff.) without reference to earlier publication. Conidae.

baileyi, *Oliva* [as n. sp.]
Petuch, 1979a: 10, figs. 18-19 (holotype).
Holotype: DMNH 126395; off Russell Island, Solomon Islands, 180 m. Dimensions: H= 30.3 ("30"), W= 14.6 ("8" [sic]).
1 paratype: DMNH 126396; type locality. Dimensions: H= 29.0 ("28"), W= 13.7. Remarks: Erroneously cited as plural "paratypes" in the original description. This is not the specimen figured as "paratype" by Petuch (1979a: 13, figs. 16, 17).
Olividae.

barbarae, *Brachycythara* [as n. sp.]
Lyons, 1972: 4.
1 paratype: DMNH 047902; R/V 'Hourglass' station D, off Egmont Key, Florida (27°37'N, 83°58'W), 55 m; type locality. Dimensions: H= 3.2, W= 1.7.
1 paratype: DMNH 107553; type locality. Dimensions: H= 2.9, W= 1.5. Remarks: Ex D. Steger.
Turridae.

barnardi, *Fusivoluta* [as n. sp.]
Rehder, 1969: 207, pl. 40 fig. 9, pl. 43 figs. 40-41.
Holotype: DMNH 010751; off Natal coast, South Africa, 120 fathoms [220 m]. Dimensions: H= 115.2, W= 34.6.
1 paratype: DMNH 010750; off mouth Tugela River, South Zululand, South Africa, 160-180 fathoms [293-329 m]. Dimensions: H= 96.5, W= 35.0. Remarks: "Early whorls and anterior end missing" (Rehder, 1969: 208).
Volutidae.

bermudensis, *Rissoina* [as n. sp.]
Peile, 1926: 98.
2 paratypes: DMNH 135069; "Near Baeotia, St. Georges" [label], Bermuda. Dimensions: (1) H= 5.6, W= 2.4; (2) H= 5.2, W= 2.1. Remarks: Ex J. D. Parker. Rissoidae.

berryi, *Anachis* [as n. sp.]
Shasky, 1970: 190.

2 paratypes: DMNH 040849; El Pulmo Reef, Baja California, Mexico (23°26'N, 109°25'W), 1-3 m. Dimensions: (1) H= 9.0, W= 3.3; (2) H= 8.5, W= 3.2. Remarks: Ex D. Shasky. Columbellidae.

betsyae, *Hastula (Punctoterebra)* [as n. sp.]

R. D. Burch, 1965: 243.

2 paratypes: DMNH 006001; off Honokohau, Maui, Hawaii (21°04'N, 156°38'W), 20 feet [6.1 m]; type locality. Dimensions: (1) H= 29.7, W= 6.6; (2) H= 22.7, W= 5.9.

4 paratypes: DMNH 010141; locality data as above. Dimensions: (1) H= 35.7, W= 7.2; (2) H= 26.5, W= 5.6; (3) H= 23.1, W= 5.4; (4) H= 22.6, W= 5.3.

Remarks: Ex R. D. Burch collection no. 172. Terebridae.

blanesi, *Olivella* [as n. sp.]

Ford, 1898: 66.

2 syntypes: DMNH 136363; Cardenas, Cuba. Dimensions: (1) H= 9.2, W= 4.2; (2) H= 6.3, W= 3.1. Remarks: Ex J. Parker. Olividae.

boholensis, *Conus* [as n. sp.]

Petuch, 1979a: 12, figs. 20-21 (holotype).

Holotype: DMNH 126400; off Panglao, Bohol Island, Philippines, approximately 250 m. Dimensions: H= 37.7 ("38"), W= 17.3 [lip damaged] ("18").

2 paratypes: DMNH 126401; type locality. Dimensions: (1) H= 25.6 ("26"), W= 11.3; (2) H= 18.5 ("17"), W= 8.6.

Remarks: Holotype figured by Coomans et al. (1982: 62, fig. 250), as junior synonym of *Conus borneensis* Adams & Reeve, 1848. Conidae.

boschi, *Cymatium* [as n. sp.]

Abbott & Lewis, 1970: 87, figs. 1-4.

Holotype: DMNH 022862; Al Masirah Island, Oman Protectorate, southeast Arabia. Dimensions: H= 75.0, W= 41.0. Cymatiidae [Ranellidae].

boswellae, *Pirenella* [as n. sp.]

Barnard, 1963: 140.

Holotype: DMNH 011370; *ex pisce*, off Durban, South Africa. Dimensions: H= 53.2 ("52"), W= 19.8 ("19"). Remarks: Ex H. Boswell. Holotype figured by Barnard (1969: 650, figs. 25 a, b). Potamididae.

boswellae, *Volutocorbis* [as n. sp.]

Rehder, 1969: 202.

1 paratype: DMNH 019308; off Saint Sebastian Bay, South Africa, in 80-100 fathoms [146-183 m]. Dimensions: H= 24.7, W= 10.9 (juvenile). Volutidae.

bouvetia, *Margarella* [as n. sp.]

Powell, 1951: 97.

2 paratypes: DMNH 106921; R/V 'Discovery II' station 456, 1 mile east of Bouvet Island, 40-45 m; type locality. Dimensions: (1) H= 7.0, W= 7.8; (2) H= 5.4, W= 6.5; both with dried animals. Remarks: Ex A. W. Powell. Trochidae.

brasiliana, *Borsonia* [as n. sp.]

Tippett, 1983: 136.

2 paratypes: DMNH 161061; R/V 'Oregon' station 4226, 200 miles north of Sao Luis, Brazil (00°18'N, 44°17'W), on the edge of the continental shelf in 150 fathoms [274.5 m]; type locality. Dimensions: (1) H= 11.1, W= 4.2; (2) H= 10.6, W= 4.0. Remarks: In the original description, longitude erroneously given as "004x17'W." Turridae.

burgessi, *Distorsio* [as n. sp.]

Lewis, 1972: 46.

1 paratype: DMNH 051956; Barber's Point, S.W. Oahu Island, Hawaii; type locality. Dimensions: H= 42.8, W= 28.8.

1 paratype: DMNH 093303; Haleiwa, Oahu, Hawaii. Dimensions: H= 60.5, W= 36.0. Remarks: Ex C. Weaver.

Cymatiidae [Ranellidae].

clarkei, *Fusivoluta* [as n. sp.]

Rehder, 1969: 206, pl. 40 fig. 8, pl. 43 fig. 37 (holotype), pl. 43, figs. 38, 39 (paratype DMNH 019307).

Holotype: DMNH 012833; off Joao Belo, District Gaza, Mozambique, 240 fathoms [439 m]. Dimensions: H= 96.7, W= 31.3.

2 paratypes: DMNH 019305, 80 km east of Inhaca Island, District Laurenço Marques, Mozambique. Dimensions: (1) H= 75.6, W= 26.9; (2) H= 74.3 ("74.5"), W= 25.7.

1 paratype: DMNH 019307; 92 km east of Inhaca Island, Mozambique. Dimensions: H= 79.8, W= 27.1.

Volutidae.

cloveri, Conus [as n. sp.]

Walls, 1978: 2, fig. p. 5 bottom left.

Holotype: DMNH 123128; harbor near Anse Bernard, Dakar, Senegal. Dimensions: H= 25.7, W= 13.3. Remarks: Also described by Walls (1979b: 338 ff.) without reference to earlier publication. Conidae.

cloveriana, *Lyria* [as n. sp.]
Weaver, 1963b: 31.
1 paratype: DMNH 010139; 20 miles from Tangalla, southern Ceylon, 50 feet [15.2 m]. Dimensions: H= 43.6, W= 18.0 ("17,3") [juvenile]. Remarks: Ex R. Jonklaas. Subsequently figured by Weaver & du Pont (1970: pl. 4 figs. M-N). Volutidae.

cona, *Acmaea* [as n. sp.]
Test, 1945: 92.
1 paratype: DMNH 023433; Point Fermin, San Pedro, California; same locality data as "type series." Dimensions: greatest length= 15.1, width= 11.7, height= 4.1. Remarks: Ex A. R. G. Test, via ANSP 181024. Author mentions a "type series" of 20 specimens in addition to numerous "paratypes." Only the California Academy of Sciences in San Francisco and the United States National Museum are originally listed as repositories. Acmaeidae.

corticata, *Acmaea* [as n. sp.]
Hutton, 1880: 89.
1 paralectotype: DMNH 023489; New Zealand. Dimensions: greatest length= 12.0, width= 9.5, height= 5.1. Remarks: Ex F. W. Hutton, via ANSP 50047. Powell (1979: 47), in the redescription of *Patelloida corticata* (Hutton, 1880), refers to a "type of *corticata*" with a length of 14 mm and the type locality "Dunedin." This (or an earlier reference of this kind) qualifies as designation of lectotype (ICZN Art. 74(b)). Acmaeidae.

cosmani, *Chicoreus* [as n. sp.]
Abbott & C. J. Finlay, 1979: 159, fig. 8.
1 paratype: DMNH 028503; Discovery Bay, Jamaica, 35-100 feet [10.7-30.4 m]. Dimensions: H= 39.0, W= 18.5. Muricidae.

crakei, *Duplicaria (Duplicaria)* [as n. sp.]
R. D. Burch, 1965: 245.
2 paratypes: DMNH 006002; in fine sand at low tide on Cable Beach, Broome, Western Australia (18°00′S, 122°15′E). Di-

mensions: (1) H= 19.6, W= 4.5; (2) H= 16.8, W= 4.1. Remarks: Ex R. D. Burch collection no. 336. Terebridae.

crosnieri, *Cancilla scrobiculata* [as n. ssp.]
Cernohorsky, 1970: 95, fig. 1 (holotype).
Holotype: DMNH 022392; Point Noire, Congo, West Africa (4°57′S, 11°22′E), 135 m. Dimensions: H= 73.1, W= 18.5.
2 paratypes: DMNH 028221; Coast of Dahomey (6°05′N, 2°37′E), West Africa; 150-200 m. Dimensions: (1) H= 71.0 ("71.4"), W= 18.8; (2) H= 56.4, W= 14.6.
Mitridae.

cuvierensis, *Microvoluta* [as n. sp.]
H. J. Finlay, 1930: 242.
1 paratype: DMNH 012209; off Cuvier Island, Bay of Plenty, New Zealand, 38 fathoms [69.5 m]; type locality. Dimensions: H= 5.7, W= 2.4. Volutomitridae.

daisyae, *Volutoconus hargreavesi* [as n. ssp.]
Weaver, 1967: 302, pl. 41 figs. 5-6 (holotype), fig. 7 (paratype DMNH 010557), figs. 8-9 (paratype DMNH 010142).
Holotype: DMNH 010022; southwest of North West Cape, central Western Australia (22°00′S, 113°45′E), 80 fathoms [146 m]. Dimensions: H= 85.3, W= 34.3.
1 paratype: DMNH 010557; Houtman Abrolhos Islands, southern Western Australia; 85 fathoms [155 m]. Dimensions: H= 106.7 ("96.0" [sic]), W= 42.6 ("39.0"). Remarks: Ex H. Boswell.
1 paratype 010142; off Point Cloates, central Western Australia, 118 fathoms [216 m]. Dimensions: H= 85.2 ("85.5"), W= 34.2 ("35.0"). Remarks: Ex C. Weaver.
Volutidae.

dalli, *Latiaxis (Babelomurex)* [as n. sp.]
Emerson & D'Attilio, 1963: 4.
2 paratypes: DMNH 105930; locality description: "southwest of Egmont Key, Florida, 220-230 fathoms [403-421 m]"; Steger collection label: "from 120 fathoms [220 m], about 200 miles SW of St. Petersburg, Fla." Dimensions: (1) H= 35.7, W= 37.2 (incl. spines); (2) H= 34.5, W= 32.2 (incl. spines) [with opercula]. Remarks: Ex D. Steger. Coralliophilidae [Muricidae].

dalliana, *Acmaea* [as n. sp.]

Pilsbry, 1891: 13.

1 paratype: DMNH 023404; La Libertad, Sonora, Mexico. Dimensions: greatest length= 39.3, width= 27.0, height= 8.0. Remarks: Ex H. N. Lowe, via ANSP 167967. This locality not listed in original description. Acmaeidae.

dampieria, *Amoria (Amoria)* [as n. sp.]

Weaver, 1960: 1, 3.

1 paratype: DMNH 010140; 25 miles off Bezout Island, Dampier Archipelago, Western Australia, 25 fathoms [45.8 m]. Dimensions: H= 33.2 ("33.3"), W= 15.2 ("15.0"). Remarks: Ex C. Weaver. Originally introduced in *Hawaiian Shell News* by Weaver (1960: 1, 3) when referring to "*Amoria (Amoria) dampieria* Iredale, 1914, nomen nodum [sic]," with figure and short description. Redescribed by Weaver (1963a: 28). DMNH paratype figured and listed by Weaver (1963a: pl. 5, two center figures; table 1, "paratype #2"). Also figured by Weaver & duPont (1970: pl. 63 figs. C-D). Volutidae.

darwini, *Cancellaria* [as n. sp.]

Petit, 1970: 85.

1 paratype: DMNH 027196; south of Academy Bay, Isla Santa Cruz, Galápagos Islands, 170-200 m; type locality. Dimensions: H= 17.6, W= 10.1. Remarks: Ex R. E. Petit. Cancellariidae.

delli, *Penion benthicola* [as n. ssp.]

Powell, 1971: 222.

1 paratype: DMNH 026798; off Aldermen Islands, northern New Zealand, 350 fathoms [640.5 m]. Dimensions: H= 68.4, W= 29.3. Remarks: Ex A. W. Powell. Buccinidae.

dispar, *Neritina* [as n. sp.]

Pease, 1867: 285.

6 syntypes: DMNH 153352; Rarotonga, Cook Islands. Dimensions (heights): 7.2, 6.8, 6.8, 6.6, 6.3, 4.5 (with opercula). Remarks: Ex N. W. Lermond. Neritidae.

disparilis, *Volutocorbis* [as n. sp.]

Rehder, 1969: 203, pl. 41 figs. 20-21.

3 paratypes: DMNH 010760; off Agulhas Bank, South Africa, 300 fathoms [549 m]. Dimensions: (1) H= 31.5, W= 17.1 ("17.4"); (2) H= 30.9, W= 13.5; (3) H= 30.2, W= 13.9 ("14.0"). Remarks: Specimens in DMNH 10760 match the

original description and measurements but do not fully agree with the original figures (Rehder, 1969: pl. 41 figs. 20-21). An additional specimen (DMNH 10761), figured by Weaver & duPont (1970: pl. 3 figs. N-O) and cited as "paratype," is from the type locality but does not qualify as type material because it was not included in the original description. Volutidae.

donmoorei, *Caecum* [as n. sp.]
Mitchell-Tapping, 1979: 105, figs. 29, 30.
Holotype: DMNH 119521; Sprat Bay, Water Island, United States Virgin Islands, 5 m. Dimensions (greatest length): 2.2 ("1.4" [sic]). Remarks: According to the original description (Mitchell-Tapping, 1979: 105), the holotype was "deposited in 1977 in the Delaware Museum of Natural History #119521." The DMNH specimen matches the published figure, but measures 2.2 mm overall length instead of the dimension given in the text ("1.4 mm") and those deduced from the scale accompanying the published figure (also 1.4 mm). Caecidae.

dorothyae, *Terebra* [as n. sp.]
Bratcher & R. D. Burch, 1970: 297.
1 paratype: DMNH 022422; Allan Hancock Foundation station 770-38, 7-11 fathoms [12.8-20.1 m] on black sand off San Jose Point, Guatemala (13°53'N, 91°09'W). Dimensions: H= 20.9, W= 5.6. Remarks: DMNH number erroneously given as "22421" in original publication. Terebridae.

duponti, *Festilyria* [as n. sp.]
Weaver, 1968: 444, pl. 60 figs. 1-2.
Holotype: DMNH 013706; off Boa Paz, Mozambique, 40 fathoms [73 m]. Dimensions: H= 124.4, W= 56.5. Volutidae.

eccentricus, *Zelippistes* [as n. sp.]
Petuch, 1979a: 5, figs. 7-9.
Holotype: DMNH 126391; China Strait, off Samarai Island, Eastern Papua, Papua New Guinea, 250 m. Dimensions: H= 11.0 ("width 11 mm"), W= 17.9 ("length 18 mm"). Remarks: Erroneously cited as "DMNH No. 123691" in original description. Trichotropidae [Capulidae].

echinophilus, *Africonus* [as n. sp.]
Petuch, 1975: 180.
1 paratype: DMNH 121795; N'Gor, Cape Verde, Senegal, West

Africa (14°43'N, 17°33'W); type locality. Dimensions: H= 10.9, W= 6.1. Conidae.

ecphoroides, *Fulgurofusus (Fulgurofusus)* [as n. sp.]
Harasewych, 1983a: 20, fig. 28.
1 paratype: DMNH 153515; R/V 'Oregon' station 4226, 180 miles N.E. of Tijoca, Pará, Brazil (0°18'N, 44°17'W), 150 fathoms [274 m]; type locality. Dimensions: H= 15.9 ("16"), W= 6.1. Turbinellidae.

electra, *Columbarium (Peristarium)* [as n. sp.]
Bayer, 1971: 176.
1 paratype: DMNH 153517; R/V 'Gerda' station G-289, S.S.E. of Key West, Straits of Florida, (24°11'N, 81°36'W), 594-604 m; type locality. Dimensions: H= 16.2, W= 4.0. Remarks: Ex Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. Protoconch of paratype illustrated by Harasewych (1983a: 28, fig. 41). Columbariidae [Turbinellidae].

elegans, *Vitrinella (Striovitrinella)* [as n. sp.]
Olsson & McGinty, 1958: 31.
1 paratype: DMNH 104277; Bocas Island, Panama [Caribbean]. Dimensions: H= 3.5, W= 1.6. Remarks: Ex D. Steger. Vitrinellidae.

exquisita, *Pseudocypraea* [as n. sp.]
Petuch, 1979a: 6, figs. 5, 6.
Holotype: DMNH 126392; 250 m depth off Panglao, Bohol Island, Philippines. Dimensions: H= 8.8 ("9"), W= 5.4 ("5"). Ovulidae.

fayae, *Anachis (?Costanachis)* [as n. sp.]
Keen, 1971: 579.
2 paratypes: DMNH 047037; Playa Caracol, Nuevo Guayamas, Sonora, Mexico; type locality. Dimensions: (1) H= 7.6, W= 2.9; (2) H= 6.6, W= 2.5. Remarks: Ex F. B. Howard, via Santa Barbara Museum. The original description mentions a holotype and "[a]bout 200 specimens." Three illustrations (Keen, 1971: 953, fig. 1178) are labeled "holotype," "paratype," and "hypotype," the two former from the type locality, the last from San Marcos, California. Columbellidae.

finlayi, *Murex (Murex)* [as n. sp.]
Clench, 1955: 1.

1 paratype: DMNH 105880; Matanzas Bay, Cuba, 200 fathoms [366 m]; type locality, but holotype is from "100 fathoms [183 m]." Dimensions: H= 74.7, W (apertural aspect, incl. spines)= 44.7; with operculum. Remarks: Ex C. J. Finlay, via D. Steger. Muricidae.

finlayi, *Neritopsis* [as n. sp.]
Hoerle, 1974: 104.
1 paratype: DMNH 099360; Banes Sands, Piñar del Rio Province, Cuba. Dimensions: H= 18.4, W= 17.3. Neritopsidae.

floridana, *Stenacme* [as n. sp.]
Pilsbry, 1945: 114.
1 paratype: DMNH 103823; Lake Worth, Boynton Beach, Florida. Dimensions: H= 8.0, W= 4.9. Remarks: Ex T. L. McGinty, via D. Steger. Described as a pulmonate in the nominal family Stenacmidae; the species was subsequently recognized as a member of the family Epitoniidae (Robertson & Oyama, 1958: 68-69).

floridanus, *Microdochus* [as n. sp.]
Rehder, 1943: 193.
70+ paratypes: DMNH 023747; Missouri Key, Florida. Dimensions: heights from 1.6 to 2.5 mm. Remarks: Ex B. R. Bales, via ANSP 220264. Rissoidae [Elachisinidae].

fragilissimus, *Conus* [as n. sp.]
Petuch, 1979a: 14, figs. 22-23 (holotype), figs. 24-25 (paratype DMNH 126403).
Holotype: DMNH 126402; off south coast of Harmil Island, Dahlak Archipelago, Eritrea Province, Ethiopia, Red Sea, 3 m. Dimensions: H= 34.0 ("30"), W= 15.6 ("12").
3 paratypes: DMNH 126403; type locality. Dimensions: (1) H= 30.2, W= 13.5 (figured); (2) H= 28.4, W= 12.8; (3) H= 26.8, W= 13.5 ("Lengths 34 mm, 31 mm, 26 mm").
Conidae.

gaylordi, *Olivella gracilis* [as n. var.]
Ford, 1895: 104.
2 syntypes: DMNH 024743; Gulf of California. Dimensions: (1): H= 9.9, W= 3.9; (2) H= 8.5, W= 3.3. Remarks: Ex J. Ford, via ANSP 316716. Olividae.

germonae, *Tractolira* [as n. sp.]
Harasewych, 1987: 3.

2 paratypes: DMNH 169441; R/V 'Islas Orcada' cruise 575, station 75, E.N.E. of Zavadovski Island, South Sandwich Islands (56°03.5′S, 26°58.3′W), 2128-2161 m. Dimensions: (1) H= 48.7, W= 19.6; (2) H= 41.6, W= 16.6. Remarks: Both specimens alcohol-preserved. Volutidae.

girardi, *Cerodrillia* [as n. sp.]
Lyons, 1972: 3.
1 paratype: DMNH 047901; R/V 'Hourglass' station D, off Egmont Key, Florida (27°37′N, 83°58′W), 55 m; type locality. Dimensions: H= 8.0, W= 3.5. Turridae.

gracilior, *Benthovoluta* [as n. sp.]
Rehder, 1967: 185.
1 paratype: DMNH 015456; U.S.B.F. 'Albatross I' station 5423, off Cagayan Islands, northern Sulu Sea, Philippines (9°38'30″N, 121°11′E), 508 fathoms [930 m]. Dimensions: H= 49.9, W= 12.8. Remarks: Ex USNM 238408. Volutidae [Turbinellidae].

greegori, *Cypraea cruenta* [as n. var.]
Ford, 1893: 112.
1 syntype: DMNH 043613; no locality given. Dimensions: greatest length= 24.2, width= 18.3. Remarks: Ex USNM (from I. Greegor, via J. Ford). Cypraeidae.

guesti, *Natica (Natica)* [as n. sp.]
Harasewych & Jensen, 1984: 99, figs. 8, 10.
7 paratypes: DMNH 164500; 2.5 miles off Castle Roads, South Shore, Bermuda, Lightbourn-Guest 'Northstar' expeditions; in traps set in 347 m. Remarks: Lot contains 7 paratypes, largest (H= 26.5, W= 27.0) illustrated in original fig. 8, plus SEM stub with mounted shell apex shown in fig. 10.
1 [0] paratype: DMNH 096986; 2.5 miles off Castle Roads, South Shore, Bermuda, Lightbourn-Guest 'Northstar' expeditions; in traps set in 402 m. Remarks: Cited in original description (1984: 100); not located.
Naticidae.

guesti, *Pterynotus (Pterynotus)* [as n. sp.]
Harasewych & Jensen, 1979: 3, figs. 6, 14.
Holotype: DMNH 122258; E.S.E. of Key West, Florida, 275 m. Dimensions: H= 28.6. Muricidae.

habei, *Assiminea habei* [as n. sp.]
Abbott, 1958b: 251.

2 paratypes: DMNH 025311; estuary, 2 miles south of Tanauan, Leyte Island, Philippines; type locality. Dimensions: (1) H= 3.8, W= 2.5; (2) H= 3.6, W= 2.4. Remarks: Ex R. T. Abbott, via ANSP 193366. Assimineidae.

habei, *Distorsio constricta* [as n. ssp.]

Lewis, 1972: 38.

1 paratype: DMNH 050943; Tosa Bay, Shikoku, Japan; type locality. Dimensions: H= 50.6, W= 29.0. Cymatiidae [Ranellidae].

hancocki, *Terebra* [as n. sp.]

Bratcher & R. D. Burch, 1970: 299.

1 paratype: DMNH 051367; off La Libertad, Ecuador (2°08′S, 81°00′W); type locality. Dimensions: H= 27.4, W= 7.8. Terebridae.

harrisae, *Columbarium* [as n. sp.]

Harasewych, 1983b: 28.

1 paratype: DMNH 153524; east of Lady Musgrave Island, Queensland, Australia, 140 fathoms [256 m]. Dimensions: H= 99.2 ("99"), W= 29.5. Remarks: With operculum. Turbinellidae.

haysae, *Thais floridana* [as n. ssp.]

Clench, 1927: 6.

2 paratypes: DMNH 060612; Grand Bayou, Mississippi Delta, Lousiana; type locality. Dimensions: (1) H= 84.3, W= 51.8; (2) H= 78.1, W= 46.3.

2 paratypes: DMNH 152981; type locality. Dimensions: (1) H= 75.7, W= 44.3; (2) H= 66.5, W= 44.4.

Remarks: According to the original description, an unspecified number of paratypes was originally deposited in the collections of Museum of Comparative Zoology (Cambridge, MA), ANSP, and Museum of Zoology, University of Michigan. DMNH collection contains specimens labelled "paratypes" ex E. Doremus (DMNH 060612) and ex N. W. Lermond (DMNH 152981).

Muricidae.

hesperina, *Blasicrura coxeni* [as n. ssp.]

Schilder & Summers, 1963: 68.

1 paratype: DMNH 121541; Talasea, New Britain, Australia; type locality. Dimensions: greatest length= 14.4, width= 7.9. Remarks: Ex R. Summers. Cypraeidae.

hoffmeyeri, *Terebra (Strioterebrum)* [as n. sp.]
Abbott, 1952: 78.
1 paratype: DMNH 024990; Manila Bay, Luzon Island, Philippines; type locality. Dimensions: H= 19.8, W= 4.8. Remarks: Ex E. M. Wistar, via ANSP 234286. Terebridae.

huttonii, *Trochus* (*Canthiridus* [sic, error for *Cantharidus*]) [as n. sp.]
E. A. Smith, 1876: 558.
2 syntypes: DMNH 136368; New Zealand. Dimensions: (1) H= 11.4, W= 10.5; (2) H= 9.1, W= 9.8. Remarks: Both with dried animals. Trochidae.

inglei, *Oceanida* [as n. sp.]
Lyons, 1978: 543.
1 paratype: DMNH 121798; off St. Augustine, St. Johns County, Florida, 38 m. Dimensions: H= 2.2, W= 0.9. Eulimidae.

johnstonei, *Melongena corona* [as n. ssp.]
Clench & Turner, 1956: 178.
1 paratype: DMNH 126416; Little Lagoon, Gulf Shores, Alabama; type locality. Dimensions: H= 82.5, W= 48.3.
1 paratype: DMNH 186770; type locality. Dimensions: H= 82.0, W= 49.6.
5 paratypes: DMNH 072197; type locality.
2 paratypes: DMNH 092770; type locality.
Remarks: According to the original description, an unspecified number of paratypes is said to be in several institutional and private collections. DMNH collection contains specimens labelled "paratypes" ex H.I. Johnstone (DMNH 126416, 186770), ex G. & M. Kline (DMNH 072197) and ex H. & M. Minzak (DMNH 092770). Melongenidae [Buccinidae].

kaicherae, *Vexillum (Costellaria)* [as n. sp.]
Petuch, 1979b: 523.
2 paratypes: DMNH 121796; south end of Guaratibas Reefs, Abrolhos reef complex, Bahia State, Brazil (17°25′S, 39°08′W), 1 m; type locality. Dimensions: (1) H= 9.1 ("9"), W= 3.1; (2) H= 8.5 ("9"), W= 3.1. Costellariidae.

kellneri, *Aulica* [as n. sp.]
Iredale, 1957: 91.
1 paratype: DMNH 010032; Arnhem Land, Northern Territory, Australia; type locality. Dimensions: H= 65.5, W= 34.5. Remarks: Ex C. Weaver. Volutidae.

kermadecensis, *Haurakia* [as n. sp.]
Oliver, 1915: 518.
3 paratypes: DMNH 025359; off Sunday Island, Kermadec Islands; type locality. Dimensions: (1) H= 1.8, W= 0.9; (2) H= 1.6, W= 0.8; (3) H= 1.5, W= 0.8. Remarks: Ex R. S. Bell, via ANSP 257017. Rissoidae.

kerstitchi, *Conus* [as n. sp.]
Walls, 1978: 2, fig. p. 6.
Holotype: DMNH 123130; Nayarit, off Isla Tres Marias (between Isla San Juanito and Isla Maria Madre), Mexico. Dimensions: H= 31.5 ("31.8"), W= 15.9. Remarks: Also described by Walls (1979a: 615 ff.) without reference to earlier publication, with a poor figure of the holotype on p. 618. Conidae.

kingae, *Xenoturris* [as n. sp.]
Powell, 1964: 325 [= p. 22-965].
2 paratypes: DMNH 010138; Waikiki, Oahu, Hawaiian Islands, 100 feet [30.4 m]. Dimensions: (1) H= 18.4, W= 7.0; (2) H= 15.6, W= 5.7. Remarks: Ex C. N. Cate. Original description lists Waikiki material in D. Thaanum collection. Turridae.

koto, *Lamellaria* [as n. sp.]
Schwengel, 1944: 17.
1 syntype: DMNH 024084; Bra[i]denton Beach, Florida. Dimensions: H= 16.8, W= 14.0. Remarks: Ex J. S. Schwengel, via ANSP 254013.
1 syntype: DMNH 139447; Bra[i]denton Beach, Florida. Dimensions: H= 17.6, W= 14.0. Remarks: Ex J. Finlay.
Lamellariidae.

kurzi, *Guildfordia* [as n. sp.]
Petuch, 1979a: 2, figs. 1-2 (holotype).
Holotype: DMNH 126389; off Balicasag, Bohol Island, Philippines, 300 m. Dimensions: H= 22.0, W (incl. spines)= 48.0 ("length 49 mm, width 47 mm"). Remarks: With operculum.
4 paratypes: DMNH 126390; type locality. Dimensions: W (measured incl. spines)= 49.5, 48.4, 46.5, 42.2. Remarks: With opercula.
Turbinidae.

kurzi, *Morum (Oniscidia)* [as n. sp.]
Petuch, 1979: 7, figs. 10-13.
Holotype: DMNH 126393; off Panglao, Bohol Island, Philippines,

250 m. Dimensions: H= 22.4 ("23"), W= 15.2 ("15"). Cassidae [Harpidae].

lahainaensis, *Volva (Phenacovolva)* [as n. sp.]
Cate, C., 1969: 365.
2 paratypes: DMNH 041616; off the southwest shore of the Hawaiian Island of Maui, "Lahaina Roads" between Lanai and Maui (20°52'N, 156°41'E), on black coral, 185 feet [56.4 m]; type locality. Dimensions (greatest length and width): (1) 27.6, 8.5; (2) 14.5, 3.8 (juvenile, "expelled from the large shell during cleaning" according to label). Remarks: Ex C. N. Cate. Ovulidae.

langi, *Thais (Thaisella)* [as n. sp.]
Clench & Turner, 1948: 1.
6 paratypes: DMNH 068665; Lohito Bay, Angola, Africa; type locality. Dimensions: (1) H= 47.8, W= 34.1; (2) H= 47.5, W= 35.4; (3) H= 47.0, W= 35.0; (4) H= 44.1, W= 33.0; (5) H= 42.3, W= 30.6; (6) H= 39.9, W= 32.0. Remarks: Ex G. & M. Kline. With opercula. Muricidae.

lenoreae, *Phenacovolva (Subsimnia)* [as n. sp.]
Cardin & Walls, 1980: 1, fig. p. 2.
Holotype: DMNH 157331; Isla Gobernador, Perlas Islands, Panama (Pacific coast). Dimensions: H= 16.6 ("16.5"), W= 7.3. Ovulidae.

lightbourni, *Conus (Floraconus)* [as n. sp.]
Petuch, 1986: 16, figs. 1-2 (holotype).
Holotype: DMNH 134938; 1.5 miles (2.5 km) due south of Castle Island, Bermuda, from 180 fathoms [translates to 329.4 m, not "497 m" as given in original description]. Dimensions: H = "35", W= "16".
3 paratypes: DMNH 134939; type locality. Dimensions: (1) H= 47.8, W= 21.9; (2) H= 46.9, W= 22.0; (3) H= 39.7, W= 17.8; ("lengths 26.0 mm [sic]–47.7 mm").
Remarks: Holotype was listed in original description as deposited in DMNH 134938, but has not been received. The original publication mentions five additional paratypes ("lengths 22.4–44 mm") in the collection of Mr. J. R. H. Lightbourn, Bermuda. In an attempt to trace the missing holotype and to explain the mismatch of the DMNH paratypes with the original description, Mr. Lightbourn's material was re-examined by us. It consists of four specimens. Three of these

are apparently part of the paratype series: (1) H= 36.7, W= 17.5 [lip damaged]; (2) H= 36.5, W= 17.2 [lip damaged]; (3) H= 34.0, W= 15.9. A fourth, much larger, specimen (H= 50.5, W= 22.0) was presumably added later. None of the specimens studied matches the original illustration of the holotype or the figure given by Röckel (1987: no. 78 Suppl. [581]) as of a DMNH paratype ("45×19.5 mm"). Conidae.

lightbourni, *Fusinus* [as n. sp.]
Snyder, 1984: 28, figs. 1-2 (holotype), fig. 3 (paratype DMNH 154462).
Holotype: DMNH 154461; crabbed specimen from fish pot in 100-120 fathoms [183-220 m] taken 1.5 miles south of Gurnet Rock, South Shore of Bermuda. Dimensions: H= 60.9 ("61"), W= 20.5.
3 paratypes: DMNH 154462; type locality, but "depths down to 200 fms." [366 m]. Dimensions: (1 [figured]) H= 66.4 ("66"); (2) H= 60.6 ("61"); (3) H= 45.8 ("46").
Fasciolariidae [Buccinidae].

lightbourni, *Pterynotus (Pterynotus)* [as n. sp.]
Harasewych & Jensen, 1979: 8, fig. 7.
Holotype: DMNH 122259; off St. David's, Bermuda, 275-600 m. Dimensions: H= 33.8. Muricidae.

lyalliana, *Rissoia (Alvania) plicata* [as n. var.]
Suter, 1898: 6.
1 paratype: DMNH 135066; Lyall Bay, near Wellington, New Zealand; type locality. Dimensions: H= 2.5, W= 1.05. Remarks: Ex J. D. Parker. Rissoidae.

macleani, *Calliostoma* [as n. sp.]
Shasky & Campbell, 1964: 117.
1 paratype: DMNH 040850; N.W. side of Ensenada Lalo, Guaymas, Sonora, Mexico, 30-45 feet [9.1-13.7 m]. Dimensions: H= 10.1, W= 9.0. Remarks: Ex D. Shasky. Trochidae.

macleani, *Coralliophila* [as n. sp.]
Shasky, 1970: 189.
2 paratypes: DMNH 040846; Saladita Bay, Guaymas, Sonora, Mexico (27°53'15"N, 110°59'W), 3-4 m, on the bases of white gorgonid sea whips; type locality. Dimensions: H= 10.9, W= 8.1. Remarks: Ex D. Shasky. Coralliophilidae [Muricidae].

macquariensis, *Trophon* [as n. sp.]

Powell, 1957: 143.

3 paratypes: DMNH 106911; B.A.N.Z.A.R.E. station 83, off Lusitania Bay, Macquarie Island, 69 m; type locality. Dimensions: (1) H= 22.7, W= 10.6; (2) H= 19.8, W= 11.0; (3) H= 16.4, W= 9.0. Remarks: Ex A. W. Powell. Muricidae.

major, *Buccinum pemphigus* [as n. var.]

Dall, 1919: 325.

1 syntype: DMNH 043618; U.S. Fish Commission ('Albatross') station 3643, in the western part of Bering Sea, S.E. of Kamchatka, in 100 fathoms [183 m]. Dimensions: H= 65.5, W= 34.7. Remarks: Ex USNM. Buccinidae.

marmosa, *Olivella minuta* [as n. ssp.]

Olsson & McGinty, 1958: 38.

1 paratype: DMNH 104276; Bocas Island, Bocal del Toro, Panama, Caribbean; type locality. Dimensions: H= 6.0, W= 2.7. Remarks: Ex T. L. McGinty, via D. Steger. Olividae.

martini, *Latirus* [as n. sp.]

Snyder, 1988: 54, fig. 2.

1 paratype: DMNH 169442; north coast, Roatan Island, Honduras, 15-20 feet [4.6-6.1 m]. Dimensions: H= 23.8, W= 11.9. Fasciolariidae [Buccinidae].

maryleeae, *Hastula (Hastula)* [as n. sp.]

R. D. Burch, 1965: 242.

2 paratypes: DMNH 006003; in sand at low tide, Surfside Beach, Freeport, Texas (28°57'N, 95°38'W). Dimensions: (1) H= 21.6, W= 4.7; (2) H= 15.8, W= 4.1. Remarks: Ex R. D. Burch collection no. 023. Terebridae.

masirana, *Persicula* [as n. sp.]

Roth & Petit, 1972: 80, figs. 1, 2.

Holotype: DMNH 051327; Ras Jidufah (local name: Monument Beach) at northeast tip of Masirah Island (21°N, 59°E), Arabian Sea, off the coast of the Sultanate Muscat and Oman. Dimensions: H= 9.8 ("10.0"), W= 6.9 ("7.2"). Marginellidae.

mauiensis, *Cypraea* [as n. sp.]

Burgess, 1967: 6.

2 paratypes: DMNH 048221; reef at Olowalu, Maui Island, Hawaii (20°48.5'N, 156°37.3'W); type locality. Dimensions [greatest lengths]: (1) 13.9; (2) 13.4. Remarks: Ex C. S. Weaver. Cypraeidae.

mazatlanica, *Ruthia* [as n. sp.]
Shasky, 1970: 192.
1 paratype: DMNH 040848; east side of Chivos Island, Mazatlan, Sinaloa, Mexico. Dimensions: H= 7.8, W= 2.6. Remarks: Ex D. Shasky. Columbellidae.

mcgintyi, *Eubela* [as n. sp.]
Schwengel, 1943: 76.
1 paratype: DMNH 108007; off Lake Worth, Palm Beach County, Florida, 400-500 feet [122-152 m, label] or 80 fathoms [146.4 m, description]; type locality. Dimensions: H= 6.4, W= 2.4. Remarks: Ex T. L. McGinty, via D. Steger. Turridae.

mendozana, *Strombina (Cotonopsis)* [as n. sp.]
Shasky, 1970: 194.
1 paratype: DMNH 040847; Gulf of Fonseca, El Salvador (15°57'N, 95°32'W), 33-73 m; type locality. Dimensions: H= 23.1, W= 9.3. Remarks: Ex D. Shasky. Columbellidae.

merope, *Columbarium (Peristarium)* [as n. sp.]
Bayer, 1971: 178.
1 paratype: DMNH 153518; R/V 'Gerda' station G-970, south of Marquesas Keys, Straits of Florida (24°24'N, 82°08'W), 512 m. Dimensions: H= 23.3, W= 6.1. Remarks: Ex Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. Paratype illustrated by Harasewych (1983a: 34, fig. 54). Columbariidae [Turbinellidae].

meyeri, *Conus biliosus* [as n. ssp.]
Walls, 1979b: 3.
Holotype: DMNH 122117; Genezzano, Natal, South Africa. Dimensions: H= 44.0, W= 25.3 ("24.6"). Remarks: The original description refers to a figure by Walls ("1978b" [error for 1979a]: 160, bottom). This is in error, the holotype was figured by Walls (1979a: 161, bottom left). Conidae.

michaeli, *Ocinebra* [as n. sp.]
Ford, 1888: 188.
2 syntypes: DMNH 152945; Cayucos, San Luis Obispo County, California. Dimensions: (1) H= 14.3, W= 7.3; (2) H= 14.3, W= 7.1. Remarks: Ex W. E. Webb, via N. W. Lermond. Muricidae.

nanus, *Strombus raninus* [as n. ssp.]
Bales, 1942: 19.

5 paratypes: DMNH 001490; southern end of Lake Worth, Palm Beach County, Florida; type locality. Dimensions: (1) H= 57.4, W= 38.0; (2) H= 52.7, W= 37.1; (3) H= 51.5, W= 38.7; (4) H= 51.0, W= 33.6; (5) H= 48.8, W= 33.9. Remarks: Original description lists types in ANSP, and further paratypes in "the Bales, McGinty and Koto collections." DMNH records do not indicate origin of material. Strombidae.

nereis, *Conus* [as n. sp.]
Petuch, 1979a: 18, figs. 32-33 (holotype).
Holotype: DMNH 126404; off Panglao, Bohol Island, Philippines, approximately 250 m. Dimensions: H= 22.8 ("23"), W= 12.3 ("12").
1 paratype: DMNH 126405; type locality. Dimensions: H= 14.7 ("14"), W= 7.1.
Conidae.

nivosa, *Ovirissoa* [as n. sp.]
Powell, 1957: 141.
3 paratypes: DMNH 106944; B.A.N.Z.A.R.E. station 83, off Lusitania Bay, Macquarie Island, 69 m; type locality. Dimensions: (1) H= 2.5, W= 1.4; (2) H= 2.3, W= 1.4; (3) H= 2.3, W= 1.3. Remarks: Ex A. W. Powell. Rissoidae.

nodosivaricosa, *Agatrix (Olssonella)* [as n. sp.]
Petuch, 1979a: 11, figs. 26, 27.
Holotype: DMNH 126397; off Balicasag, Bohol Island, Philippines, 300 m. Dimensions: H= 12.9 ("11"), W= 8.4 ("9"). Cancellariidae.

orcutti, *Caecum* [as n. sp.]
Dall *in* Orcutt & Dall, 1885: 541.
2 syntypes: DMNH 161855; San Diego, California. Dimensions (greatest lengths): 2.1; 1.7. Remarks: Ex N. W. Lermond. Caecidae.

parkinsoni, *Terebra* [as n. sp.]
Cernohorsky & Bratcher, 1976: 137.
1 paratype: DMNH 112104; Nordup, East New Britain, Papua New Guinea; type locality. Dimensions: H= 28.1, W= 5.3. Terebridae.

parvatus, *Conus musicus* [as n. ssp.]
Walls, 1979b: 4.
Holotype: DMNH 122118; Natal, South Africa. Dimensions: H=

21.5 ("21.4"), W= 13.0. Remarks: The original description refers to figures by Walls ("1978b" [error for 1979a]: 485 bottom left, 752) which are not of the holotype specimen. Ex DMNH 017449.

6 paratypes: DMNH 133931; type locality. Dimensions: H= 21.9; 21.7; 19.6; 18.9, 18.2; 17.4. Remarks: The original description refers to figures by Walls ("1978b" [error for 1979a]: 485, bottom left; 752) which are not of these specimens. Ex DMNH 017449.

Conidae.

patae, *Conus* [as n. sp.]

Abbott, 1971: 49, fig. 1 (holotype), figs. 4-5 (paratypes DMNH 040595), fig. 6 (paratype DMNH 044095).

Holotype: DMNH 044097; off Pompano Beach, Broward County, Florida, 10 fathoms [18.3 m]. Dimensions: H= 24.4, W= 14.1 ("13.8"). Remarks: Holotype also figured by Walls (1979a: 524, upper left).

1 paratype: DMNH 044096; type locality. Dimensions: H= 23.9, W= 14.4.

3 [2] paratypes: DMNH 040595; 0.5 miles off Lauderdale-by-the-Sea, Florida, 50-100 feet [15.2-30.4 m]. Dimensions: (1) H= 25.2 ("25.0"), W= 14.5 ("14.2"); (2) H= 24.7 ("24.5"), W= 13.6. Remarks: Original description cites three paratypes under this lot number. Only two were originally catalogued. The smaller one was figured by Walls (1979a: 524, upper right).

2 [1] paratypes: DMNH 044095; Ocho Rios, north central coast of Jamaica. Dimensions: H= 24.0, W= 13.3 ("13.0"). Remarks: The original description cites two paratypes under this lot number. Both were entered into the museum's catalog, but only one specimen remains in the lot. It is not the shell figured by Walls (1979a: 524, bottom).

Conidae.

perplicata, *Voluta* [as n. sp.]

Hedley, 1902: 309.

1 syntype: DMNH 062301; "taken . . . either on the neighbouring reefs of the Great Barrier, or on one of the atolls of the Coral Sea." Dimensions: H= 59.5, W= 28.7. Remarks: Ex Australian Museum, Sydney, no. C.9679. Hedley mentioned three specimens and did not select one as holotype. Weaver & duPont's (1970: 96) erroneous reference to a "holotype" does

not qualify as lectotype designation (ICZN Art. 74[b]).

philippinensis, *Axymene* [as n. sp.]
Petuch, 1979a: 8, figs. 14, 15.
Holotype: DMNH 126394; off Panglao, Bohol Island, Philippines, 250 m. Dimensions: H= 15.0 ("16"), 7.7 ("8"). Muricidae.

pseudanaloga, *Puncturella* [as n. sp.]
Powell, 1957: 140.
2 paratypes: DMNH 022463; off Macquarie Island, Sub-Antarctica, 69 m; apparently from type locality. Dimensions [height from aperture, greatest shell length]: (1) 6.3, 10.5; (2) 5.8, 9.3; both with dried animals. Remarks: Ex J. E. du Pont.
3 paratypes: DMNH 106910; B.A.N.Z.A.R.E. station 83, off Lusitania Bay, Macquarie Island, Sub-Antarctica; type locality. Dimensions [height from aperture, greatest shell diameter]: (1) 7.5, 11.5; (2) 5.3, 9.4; (3) 5.1, 9.1; all with dried animals. Remarks: Ex A. W. Powell.
Fissurellidae.

queenslandica, *Leucosyrinx* [as n. sp.]
Powell, 1969: 338.
2 paratypes: DMNH 026584; off Cape Moreton, Queensland, Australia, in 100 fathoms [183 m]; type locality. Dimensions: (1) H= 48.5, W= 15.0; (2) H= 47.6, W= 13.3. Turridae.

radwini, *Pterynotus (Pterynotus)* [as n. sp.]
Harasewych & Jensen, 1979: 11, figs. 10, 18 (radula).
Holotype: DMNH 122424; R/V "Pillsbury" station P-610, east of Turneffe Islands, Belize, 296-329 m [17°2.0'N, 87°38.4'W]. Dimensions: H= 30.9. Muricidae.

randalli, *Cymbiola* [as n. sp.]
Stokes, 1961: [3].
1 paratype; DMNH 010136; 3 miles from Undine Reef, North Queensland, Australia; type locality. Dimensions: H= 39.1, W= 20.3. Remarks: Ex A. J. Stokes, via C. Weaver. DMNH paratype figured by Weaver & duPont (1970: pl. 41 fig. C). Volutidae.

reductaspiralis, *Conus nielsenae* [as n. ssp.]
Walls, 1979b: 5, fig. p. 5.
Holotype: DMNH 122119; Geraldton, Western Australia. Dimensions: H= 33.3 ("33.4"), W= 18.3. Remarks: The original description refers to figures in Walls ("1978b" [error for

1979a]: 496, bottom right; 762) which are not of the holotype specimen.
Conidae.

rejecta, *Oliva* [as n. sp.]
J. Q. Burch & R. L. Burch, 1962: 166.
1 paratype: DMNH 005398; tide flats at La Paz, Baja California, Mexico; type locality. Dimensions: H= 37.6, W= 16.3. Olividae.

riosi, *Adelomelon (Weaveria)* [as n. sp.]
Clench & Turner, 1964: 162.
1 paratype: DMNH 010767; about 150 miles E.S.E. of Cabo San Antonio, Argentina (36°40'S, 53°08'W [54°08'W?]), 95 fathoms [174 m]. Dimensions: H= 231.0, W= 103.0. Remarks: This is not the specimen illustrated under this DMNH number by Weaver & duPont (1970: pl. 44, figs. C-D). Volutidae.

rosselli, *Zoila* [as n. sp.]
Cotton, 1948: 30.
1 paratype: DMNH 005403; beach near North Wharf, Fremantle, Western Australia. Dimensions: greatest length= 54.5, width= 34.4. Remarks: Ex Rossell via C. Weaver. Cypraeidae.

rubra, *Alcyna* [as n. sp.]
Pease, 1860: 436.
2 syntypes: DMNH 022968; Sandwich Islands [Hawaiian Islands]. Dimensions: (1) H= 2.8, W= 1.8; (2) H= 2.6, W= 1.7. Remarks: Ex ANSP 37834. Trochidae.

salisburyi, *Mitrolumna* [as n. sp.]
Cernohorsky, 1978: 66.
1 paratype: DMNH 112101; Maile Point, Oahu, Hawaiian Islands, 32 fathoms [58.6 m]; type locality. Dimensions: H= 4.0 ("3.9"), W= 1.9. Turridae.

salisburyi, *Vexillum (Pusia)* [as n. sp.]
Cernohorsky, 1976: 114.
3 paratypes: DMNH 112102; Pupukea beach, Oahu, Hawaiian Islands; type locality. Dimensions: (1) H= 5.0, W= 2.4; (2) H= 5.0, W= 2.3; (3) H= 4.8, W= 2.3. Mitridae [Costellariidae].

sandwichensis, *Conus suturalis* [as n. ssp.]

Walls, 1978: 3, figs. p. 7.
Holotype: DMNH 123126; Pokai Bay, Oahu, Hawaii. Dimensions: H= 14.4, W= 7.2 (juvenile).
Conidae.

scalaroides, *Rissoa* [as n. sp.]
C. B. Adams, 1850: 113.
7 paralectotypes: DMNH 135070; Jamaica; type locality. Dimensions: (1) H= 4.6, W= 2.0; (2) H= 4.6, W= 2.0; (3) H= 4.6, W= 1.9; (4) H= 4.5, W= 1.8; (5) H= 4.2, W= 2.0; (6) H= 3.6, W= 1.6; (7) fragment. Remarks: Ex J. D. Parker. Lectotype in Museum of Comparative Zoology (Cambridge, Massachussetts), number 177103, see Clench & Turner (1950: 340, pl. 33 fig. 6). Rissoidae.

scotiana, *Sinuber sculpta* [as n. ssp.]
Powell, 1951: 120.
2 paratypes: DMNH 106920; R/V 'Discovery II' station 167, off Signy Island, South Orkneys (60°50'30"S, 46°15'00"W), 244-344 m; type locality. Dimensions: (1) H= 9.1, W= 7.2; (2) H= 7.6, W= 6.5; both with dried animals. Remarks: Ex A. W. Powell. Naticidae.

signeyana, *Chlanidota* [as n. sp.]
Powell, 1951: 141.
1 paratype: DMNH 106917; R/V 'Discovery II' station 167, off Signy Island, South Orkneys (60°50'30"S, 46°15'00"W), 244-344 m; type locality. Dimensions: H= 28.6, W= 17.8. Remarks: Ex A. W. Powell. Buccinulidae [Buccinidae].

smithi, *Prodallia* [as n. sp.]
Bartsch, 1942: 11.
1 paratype: DMNH 015454; U.S. Bureau of Fisheries ('Albatross') station 5124, Maestre de Campo Island, 281 fathoms [514 m, off east coast of Mindoro, Philippines]. Dimensions: H= 51.0, W= 14.5. Remarks: Ex USNM 235394. Volutidae.

stegeri, *Daphnella* [as n. sp.]
McGinty, 1955: 76.
1 paratype: DMNH 119526; W.S.W. of John's Pass, Gulf Beaches, W. Florida, 35 fathoms [64 m]. Dimensions: H= 17.2, W= 7.1. Remarks: Ex D. Steger. Turridae.

stegeri, *Olivella (Olivella)* [as n. sp.]
Olsson, 1956: 176.

4 paratypes: DMNH 105286; S.W. of Egmont Key, Florida, 78-90 fathoms [143-165 m]. Dimensions: (1) H= 11.1, W= 5.0; (2) H= 10.3, W= 4.5, (3) H= 9.7, W= 4.9, (4) H= 9.5, W= 4.5. Remarks: Ex D. Steger. Olividae.

stegeri, *Terebra (Myurella) floridana* [as n. ssp.]
Abbott, 1954: 39.
1 paratype: DMNH 105856; W.N.W. of Progresso, Mexico, 18 fathoms [32.9 m]. Dimensions: H= 78.4, W= 15.5. Remarks: Ex D. Steger. Terebridae.

stilesi, *Neptunea* [as n. sp.]
A. G. Smith, 1968: 117.
1 paratype: DMNH 106558; between La Perouse Bank and Cape Scott, Vancouver Island, British Columbia, ca. 100 fathoms [183 m]; type locality. Dimensions: H= 80.0 (apex broken), W= 60.0. Remarks: Ex E. C. Stiles, via California Academy of Sciences and A. Smiley. Buccinidae.

summersi, *Bistolida (Blasicrura) pallidula* [as n. ssp.]
Schilder, 1958: 85.
1 paratype: DMNH 121540; Nukalofa, Tonga-Tabu, Tonga; type locality. Dimensions: greatest length= 16.7, width= 9.4. Remarks: Ex J. M. Ostergaard, via R. Summers. Cypraeidae.

teaguei, *Olivancillaria* [as n. sp.]
Klappenbach, 1964: 132.
1 paratype: DMNH 024729; La Coronilla, Department of Rocha, Republic of Uruguay. Dimensions: H= 18.9, W= 10.2. Remarks: Ex ANSP 290783. Olividae.

textimattum, *Epitonium (Asperiscala)* [as n. sp.]
DuShane, 1977: 89.
1 paratype: DMNH 121769; Playa Los Angeles, Tenacatita Bay, Jalisco, Mexico (19°18'N, 104°50'W), 7-18 m; type locality. Dimensions: H= 10.9, W= 3.5. Epitoniidae.

thompsoni, *Eudolium* [as n. sp.]
McGinty, 1955: 80.
1 paratype: DMNH 105924; off Tampa, Florida, Gulf of Mexico [publication], approx. 125 miles SW Egmont Key, Florida [label]. Dimensions: H= 38.8 [apex missing], W= 27.2. Remarks: Ex D. Steger. Tonnidae.

timor, *Fulgurofusus (Peristarium)* [as n. sp.]

Harasewych, 1983a: 34, fig. 49.
1 paratype: DMNH 153516; off North Carolina, deep water. Dimensions: H= 53.6, W= 12.4. Turbinellidae.

tokyoensis, *Rissoa* [as n. sp.]
Pilsbry, 1904: 26.
1 syntype: DMNH 136367; Tokyo Harbor, Japan. Dimensions: H= 2.2, W= 1.0. Remarks: "From type lot" ex Y. Hirase, via J. Parker [ANSP 70910]. Rissoidae.

tribblei, *Conus* [as n. sp.]
Walls, 1977: 2, figs. p. 3.
Holotype: DMNH 123125; China Sea, off Taiwan. Dimensions: H= 62.4 ("62.3"), W= 30.4.
Conidae.

trujilloi, *Oliva* [as n. sp.]
Clench, 1938: 111.
7 paratypes: DMNH 063513; Puerto Plata, Santo Domingo, dredged at about 5 fathoms [9.1 m]; type locality. Dimensions (heights): 41.6, 39.2, 38.7, 37.6, 36.5, 35.4, 31.8. Olividae.

venustula, *Pareuthria* [as n. sp.]
Powell, 1951: 134.
1 paratype: DMNH 106912; R/V 'Discovery II' station 388, between Cape Horn and Staten Island (56°19.5'S, 67°09"W), 121 m; type locality. Dimensions: H= 14.8, W= 6.5. Remarks: Ex A. W. Powell. Buccinulidae [Buccinidae].

veracruzensis, *Cerithidea pliculosa* [as n. ssp.]
Bequaert, 1942: 5.
1 paratype: DMNH 023859; Estero de Espantaperros, Isthmus of Tehuantepec, Mexico. Dimensions: H= 17.2, W= 7.5 [apex broken]. Remarks: Ex ANSP 178508 [= old number ANSP 124569, as cited in original publication]. Potamididae [Cerithideidae].

vernicosum, *Mangilia (Calliotectum)* [as n. sp.]
Dall, 1889: 304.
1 syntype: DMNH 010135; U.S. Fish Commission ('Albatross') station 2807, near the Galapagos Islands, Pacific, 812 fathoms [1486 m]. Dimensions: H= 47.0, W= 18.7. Remarks: Ex C. Weaver. Pleurotomidae [Turridae].

vina, *Assiminea succinea* [as n. ssp.]

Marcus, Eveline & Ernst Marcus, 1965: 51.
31 syntypes: DMNH 033740; Cananéia, Brazil (25°01'S, 47°50'W). Dimensions: heights from 1.2 to 1.7 mm. Remarks: Original description is based on "a great number" of specimens. Assimineidae.

weaveri, *Turridrupa* [as n. sp.]
Powell, 1967: 423.
1 paratype: DMNH 010143; Mokumanu Island, north shore of Oahu, Hawaiian Islands, 65-70 feet [19.8-21.3 m]. Dimensions: H= 17.6, W= 7.1. Turridae.

wittigi, *Conus* [as n. sp.]
Walls, 1977: 1, figs. p. 3.
Holotype: DMNH 123129; Lesser Sunda Islands north of Timor ["Straits of Flores" according to specimen label]. Dimensions: H= 31.7 ("31.8"), W= 15.7.
Conidae.

wolfei, *Vexillum (Costellaria)* [as n. sp.]
Cernohorsky, 1978: 63.
1 paratype: DMNH 112103; Pokai Bay, Oahu Island, Hawaiian Islands, 60-70 fathoms [110-128 m]; type locality. Dimensions: H= 5.9 ("6.0"), W= 2.3 ("2.2"). Mitridae [Costellariidae].

wormaldi, *Columbarium (Coluzea)* [as n. sp.]
Powell, 1971: 221.
1 paratype: DMNH 026797; Aldermen Island, northern New Zealand, 350 fathoms [640.5 m]. Dimensions: H= 82.3, W= 28.5. Remarks: Localities given in description: East of Poor Knights Islands, 549 m (holotype), and 23 miles NE of Cuvier Island, 260-270 fathoms [476-494 m]. Columbariidae [Turbinellidae].

xenismatis, *Fulgurofusus (Histricosceptrum)* [as n. sp.]
Harasewych, 1983a: 26, fig. 36.
1 paratype: DMNH 153523; R/V 'Pillsbury' station P-1354, off northeastern Nicaragua (14°21'N, 81°55'W), 192-263 m; type locality. Dimensions: H= 32.4 ("33"), W= 12.4. Turbinellidae.

zebrina, *Zediloma (Fractarmilla) corrosa* [as n. ssp.]
Powell, 1946: 137.
3 paratypes: DMNH 022483; Beach Harbour, Breaksea Sound,

Fiordland, W. Ortago, New Zealand; type locality. Dimensions: (1) H= 11.0, W= 12.7; (2) H= 11.0, W= 12.5, (3) H= 10.3, W= 12.2. Remarks: Ex J. E. du Pont.

3 paratypes: DMNH 027487; type locality. Dimensions: (1) H= 12.2, W= 12.5, (2) H= 11.3, W= 12.5, (3) H= 11.0, W= 12.5. Remarks: Ex J. H. Alexander.

Trochidae.

zulu, *Conus* [as n. sp.]

Petuch, 1979a: 19, figs. 28-29 (holotype), figs. 30-31 (paratypes DMNH 126407).

Holotype: DMNH 126406; off the mouth of the Umfolozi River, Zululand coast, Natal, South Africa, approximately 40 m. Dimensions: H= 62.3 ("62"), W= 37.0 ("35").

4 [3+2] paratypes: DMNH 126407; type locality. Dimensions: (1) H= 57.3, W= 33.9 [figured]; (2) H= 61.6, W= 35.6; (3) H= 57.2, W= 30.8. Remarks: The original description cites four paratypes in DMNH 126407 ("Lengths 58 mm, 62 mm, 65 mm, 68 mm"). The lot contains five specimens: three of them bearing the lot number (listed above), and two smaller, unnumbered ones (H= 56.4, W= 33.1; H= 56.2, W= 30.9) of dubious status.

1 paratype: DMNH 126408; off Inhaca Island, Mozambique, 35 m. Dimensions: H= 66.3 ("74" [sic]), W= 39.5.

Conidae.

SUBCLASS OPISTHOBRANCHIA

eloiseae, *Acteon* [as n. sp.]

Abbott, 1973: 91, figs. 1-3 (holotype).

Holotype: DMNH 027213; Al Masirah Island, Oman Protectorate, southeast Arabia. Dimensions: H= 30.9 ("31.0"), W= 20.0 ("19.5"). Remarks: With operculum.

2 paratypes: DMNH 067746; type locality. Dimensions: (1) H= 34.5, W= 22.2; (2) H= 31.0, W= 19.5.

Acteonidae.

mauganuica, *Austrodiaphana* [as n. sp.]

Powell, 1952: 185.

10 paratypes: DMNH 022727; *ex pisce*, 2.5 miles north of Mount Maunganui, Bay of Plenty, New Zealand; type locality. Dimensions: lengths ranging 1.17–1.92. Remarks: Ex J. E. duPont.

9 paratypes: DMNH 027082; type locality. Dimensions: lengths ranging 1.33–1.67. Remarks: Ex G. Williams.

19 paratypes: DMNH 027428; type locality. Dimensions: lengths ranging 1.08–1.75. Remarks: Ex J. H. Alexander. One *Atys*-like shell removed from this lot.

Austrodiaphanidae [Diaphanidae].

tenerum, *Parvaplustrum* [as n. sp.]

Powell, 1951: 180.

6 paratypes: DMNH 106916; R/V 'Discovery II' station WS-219, north-west of Falkland Islands (47°06′S, 62°12′W), 114-116 m; type locality. Dimensions: lengths= 2.92, 2.83, 2.75, 2.67, 2.50, 2.17. Remarks: Ex A. W. Powell. All specimens with dried animals. Aplustridae [Hydatinidae].

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johnstonei, Melongena corona, Melongenidae [Buccinidae]
langi, Thais (Thaisella), Muricidae
riosi, Adelomelon (Weaveria), Volutidae

Cotton, B. C.
rosselli, Zoila, Cypraeidae

Dall, W. H.
atkana, Littorina sitkana, Littorinidae
major, Buccinum pemphigus, Buccinidae
vernicosum, Mangilia (Calliotectum), Pleurotomidae [Turridae]

Dall, W. H. *in* **C. R. Orcutt & W. H. Dall**
orcutti, Caecum, Caecidae

D'Attilio, A. (see under Emerson, W. K.)

DuShane, H.
textimattum, Epitonium (Asperiscala), Epitoniidae

Emerson, W. K. & A. D'Attilio
dalli, Latiaxis (Babelomurex), Coralliophilidae [Muricidae]

Finlay, C. J. (see under Abbott, R. T.)

Finlay, H. J.
cuvierensis, Microvoluta, Volutomitridae

Ford, J.
blanesi, Olivella, Olividae
gaylordi, Olivella gracilis, Olividae
greegori, Cypraea cruenta, Cypraeidae
michaeli, Ocinebra, Muricidae

Harasewych, M. G.
ecphoroides, Fulgurofusus (Fulgurofusus), Turbinellidae
germonae, Tractolira, Volutidae
harrisae, Columbarium, Turbinellidae
timor, Fulgurofusus (Peristarium), Turbinellidae
xenismatis, Fulgurofusus (Histricosceptrum), Turbinellidae

Harasewych, M. G. & R. H. Jensen
guesti, Natica (Natica), Naticidae
guesti, Pterynotus (Pterynotus), Muricidae
lightbourni, Pterynotus (Pterynotus), Muricidae
radwini, Pterynotus (Pterynotus), Muricidae

Hedley, C.
perplicata, Voluta, Volutidae

Hoerle, R. C.
finlayi, Neritopsis, Neritopsidae

Howard, F. B.
aureola, Pyrene, Columbellidae

Hutton, F. W.
corticata, Acmaea, Acmaeidae

Iredale, T.
kellneri, Aulica, Volutidae

Jensen, R. H. (see under Harasewych, M. G.)

Keen, A. M.
fayae, Anachis (?Costanachis), Columbellidae

Klappenbach, 1964: 132.
teaguei, Olivancillaria, Olividae.

Lewis, H. (see also under Abbott, R. T.)
burgessi, Distorsio, Cymatiidae [Ranellidae]
habei, Distorsio constricta, Cymatiidae [Ranellidae]

Lyons, W. G.
barbarae, Brachycythara, Turridae
girardi, Cerodrillia, Turridae
inglei, Oceanida, Eulimidae

Marcus, Ernst (see under Marcus, Eveline)

Marcus, Eveline & Ernst Marcus
vina, Assiminea succinea, Assimineidae

McGinty, T. L. (see also under Olsson, A. A.)
stegeri, Daphnella, Turridae
thompsoni, Eudolium, Tonnidae

Mitchell-Tapping, H. J.
donmoorei, Caecum, Caecidae

Oliver, W. R. B.
kermadecensis, Haurakia, Rissoidae

Olsson, A. A.
stegeri, Olivella (Olivella), Olividae

Olsson, A. A. & T. L. McGinty
elegans, Vitrinella (Striovitrinella), Vitrinellidae
marmosa, Olivella minuta, Olividae

Pease, W. H.
dispar, Neritina, Neritidae
rubra, Alcyna, Trochidae

Peile, A. J.
bermudensis, Rissoina, Rissoidae

Petit, R. E. (see also under Roth, B.)
darwini, Cancellaria, Cancellariidae

Petuch, E. J.

abrolhosensis, Acmaea (Collisella), Patellidae [Acmaeidae]
aphrodite, Conus, Conidae
baileyi, Oliva, Olividae
boholensis, Conus, Conidae
eccentricus, Zelippistes, Trichotropidae [Capulidae]
echinophilus, Africonus, Conidae
exquisita, Pseudocypraea, Ovulidae
fragilissimus, Conus, Conidae
kaicherae, Vexillum (Costellaria), Costellariidae
kurzi, Guildfordia, Turbinidae
kurzi, Morum (Oniscidia), Cassidae [Harpidae]
lightbourni, Conus (Floraconus), Conidae
nereis, Conus, Conidae
nodosivaricosa, Agatrix (Olssonella), Cancellariidae
philippinensis, Axymene, Muricidae
zulu, Conus, Conidae

Pilsbry, H. A.

dalliana, Acmaea, Acmaeidae
floridana, Stenacme, Stenacmidae [Epitoniidae]
tokyoensis, Rissoa, Rissoidae

Powell, A. W. B.

ahiparana, Turritella (Zeacolpus), Turritellidae
bouvetia, Margarella, Trochidae
delli, Penion benthicola, Buccinidae
kingae, Xenoturris, Turridae
macquariensis, Trophon, Muricidae
mauganuica, Austrodiaphana, Austrodiaphanidae [Diaphanidae]
nivosa, Ovirissoa, Rissoidae
pseudanaloga, Puncturella, Fissurellidae
queenslandica, Leucosyrinx, Turridae
scotiana, Sinuber sculpta, Naticidae
signeyana, Chlanidota, Buccinulidae [Buccinidae]
tenerum, Parvaplustrum, Aplustridae [Hydatinidae]
venustula, Pareuthria, Buccinulidae [Buccinidae]
weaveri, Turridrupa, Turridae
wormaldi, Columbarium (Coluzea), Columbariidae [Turbinellidae]
zebrina, Zediloma (Fractarmilla) corrosa, Trochidae

Rehder, H. A.
barnardi, Fusivoluta, Volutidae
boswellae, Volutocorbis, Volutidae
clarkei, Fusivoluta, Volutidae
disparilis, Volutocorbis, Volutidae
floridanus, Microdochus, Rissoidae [Elachisinidae]
gracilior, Benthovoluta, Volutidae [Turbinellidae]

Roth, B. & R. E. Petit
masirana, Persicula, Marginellidae

Schilder, F. A.
summersi, Bistolida (Blasicrura) pallidula, Cypraeidae

Schilder, F. A. & R. Summers
hesperina, Blasicrura coxeni, Cypraeidae

Schwengel, J. S.
koto, Lamellaria, Lamellariidae
mcgintyi, Eubela, Turridae

Shasky, D. R.
berryi, Anachis, Columbellidae
macleani, Coralliophila, Coralliophilidae [Muricidae]
mazatlanica, Ruthia, Columbellidae
mendozana, Strombina (Cotonopsis), Columbellidae

Shasky, D. R. & G. B. Campbell
macleani, Calliostoma, Trochidae

Smith, A. G.
stilesi, Neptunea, Buccinidae

Smith, E. A.
huttonii, Trochus (Cantharidus), Trochidae

Snyder, M. A.
lightbourni, Fusinus, Fasciolariidae [Buccinidae]
martini, Latirus, Fasciolariidae [Buccinidae]

Stokes, A. J.
randalli, Cymbiola, Volutidae

Summers, R. (see under Schilder, F. A.)

Suter, H.
lyalliana, Rissoia (Alvania) plicata, Rissoidae

Test, A. R.
cona, Acmaea, Acmaeidae

Tippett, D. L.
brasiliana, Borsonia, Turridae

Turner, R. D. (see under Clench, W. J.)

Vanatta, E. G.
amosi, Metula, Buccinidae

Walls, J. G. (see also under Cardin, J.)
axelrodi, Conus, Conidae
cloveri, Conus, Conidae
kerstitchi, Conus, Conidae
meyeri, Conus biliosus, Conidae
parvatus, Conus musicus, Conidae
reductaspiralis, Conus nielsenae, Conidae
sandwichensis, Conus suturalis, Conidae
tribblei, Conus, Conidae
wittigi, Conus, Conidae

Weaver, C. S.
cloveriana, Lyria, Volutidae
daisyae, Volutoconus hargreavesi, Volutidae
dampieria, Amoria (Amoria), Volutidae
duponti, Festilyria, Volutidae

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REDISCOVERY OF *MARGINELLONA GIGAS* (MARTENS, 1904), WITH NOTES ON THE ANATOMY AND SYSTEMATIC POSITION OF THE SUBFAMILY MARGINELLONINAE (GASTROPODA: MARGINELLIDAE)

M. G. Harasewych[1] and Yuri I. Kantor[2]

ABSTRACT. Based on anatomical data, the genus *Sigaluta* Rehder, 1967, and its type species *S. pratasensis* Rehder, 1967, originally described in the Volutidae, are synonymized with the genus *Marginellona* Martens, 1904, and its type species *M. gigas* (Martens, 1904), of the family Marginellidae. The originally questionable inclusion of this species in Marginellidae is supported by additional anatomical characters. The subfamily Marginelloninae, type genus *Marginellona*, differs from other marginellids not only in its much larger size and distinctive radular morphology, but also in having a relatively unmodified neogastropod alimentary system with a large valve of Leiblein, and a large gland of Leiblein that lacks a separate duct to the buccal cavity.

Key words: Marginellidae; *Marginellona*; *Sigaluta*; South China Sea; anatomy.

INTRODUCTION

The genus *Sigaluta* and its type species *S. pratasensis* were described from two shells and provisionally assigned to the volutid subfamily Cymbiinae on the basis of general conchological similarities (Rehder, 1967). An additional, larger specimen, also without preserved animal, was reported by Rehder (1970). Weaver and duPont (1970: 99) followed Rehder's subfamilial assignment, but remarked that *Sigaluta pratasensis* " . . . does not resemble any other species in the family Volutidae."

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Rokop (1972) assigned a second species, from abyssal depths off Baja California, to this genus, also on the basis of shell characters.

During our recent visit to the Zoological Institute in Leningrad, Dr. Boris Sirenko brought to our attention several specimens of *Sigaluta pratasensis*, three with preserved animal. Preliminary dissections revealed this species to have a marginellid radula. A survey of the literature on Marginellidae disclosed that *Sigaluta pratasensis* is a synonym of *Marginellona gigas* (Martens, 1904).

As *Marginellona gigas* is the type species of the type genus of the small and poorly known subfamily Marginelloninae Coan, 1965, we take this opportunity to describe the anatomy of this unusual marginellid, to compare it with that of other marginellids, and to discuss its relationship within the family Marginellidae. The systematics of *Sigaluta cukri* Rokop, 1972, is discussed in Harasewych & Kantor (1991).

MATERIALS AND METHODS

In addition to the holotype and paratype of *Sigaluta pratasensis* in the collections of the National Museum of Natural History, Smithsonian Institution (USNM), we examined six specimens in the collections of the Zoological Institute, Leningrad (ZIN). Anatomical data is based on gross dissections of three of these specimens, a large, mature male (fig. 3), a small female (fig. 4), and an immature male (fig. 5). The terminology for shell ultrastructure follows Hedegaard (1990).

SYSTEMATICS

Family MARGINELLIDAE Fleming, 1828

Subfamily MARGINELLONINAE Coan, 1965

The subfamily was proposed by Coan (1965: 186) to include the monotypic genera *Marginellona* Martens, 1904, and *Afrivoluta* Tomlin, 1947, and was characterized by having unusually large (>4 cm) shells and short radulae consisting of extremely broad rachidian teeth with numerous (60-90) cusps. The unique radular morphology has been termed "Type 7 radula" by Coovert (1989: 33). The two species comprising this subfamily have a Type 1 animal in the terminology of Coovert (1987: 19).

Genus *Marginellona* Martens, 1904.

Marginella (Marginellona) Martens, 1904: 108-109, pl. 5, fig. 16; Thiele, 1904: 170, pl. 9, fig. 64; Tomlin, 1917: 268 [type species: *Marginella (Marginellona) gigas* Martens, 1904, by monotypy].

Marginellona Martens, 1903 [*sic*], Thiele, 1929: 355-356, fig. 431; Wenz, 1943: 1380, fig. 3903.

Marginelloma Cossmann, 1906: 225 [error in spelling].
Sigaluta Rehder, 1967: 182-183, text-figs. 1-4 (type species: *Sigaluta pratasensis* Rehder, 1967, by original designation).

Martens (1904) observed that his taxon had affinities to the Volutidae, but included it in the Marginellidae on the basis of radular and shell morphology. Although *Marginellona* was originally described as a subgenus of *Marginella*, Thiele (1929: 355-356) considered it to be one of but three genera within Marginellidae.

Marginellona gigas (Martens, 1904)
Figures 1-19, Table 1

Marginella (Marginellona) gigas Martens, 1904: 108-109, pl. 5, fig. 16; Thiele, 1904: 170, pl. 9, fig. 64; Tomlin, 1917: 268.
Marginellona gigas Martens, Thiele, 1929: 356; Wenz, 1943: 1380, fig. 3903.
Sigaluta pratasensis Rehder, 1967: 182-183, text-figs. 1-4.

Description: Shell (Figs. 2-5, Table 1) to 157 mm, thin, translucent, porcellaneous, narrowly ovate. Protoconch of 2-2½ rapidly expanding (diameter 0.5 mm to 11.5 mm in 2 whorls), smooth, conical, glassy whorls, deflected from coiling axis of teleoconch by up to 15°. Transition to teleoconch abrupt, marked by growth line (Fig. 6, t), and accompanied by formation of thin parietal callus (Fig. 6, c). Teleoconch with up to 3 smooth, inflated, convex, rapidly descending whorls. Suture with abutting whorls. Shell surface smooth, glazed, lacking spiral and axial sculpture. Aperture ovate, narrow posteriorly, broad anteriorly. Outer lip smooth. Inner lip smooth, with thin, whitish inductural overglaze in some specimens. Columella with single sharp, axially oriented columellar fold (Fig. 3, cf) and sharp siphonal fold (Fig. 3, sf) of nearly equal magnitude. Outer shell surface uniformly tan to greenish-tan; aperture darker brown.

Ultrastructure: Shell composed of five crystalline layers (Fig. 7). Innermost layer (Figs. 7, 9, i), thin (to 65 μm), of simple prismatic crystals. Subsequent layer (Figs. 7, 9, t) thickest (to 300 μm), composed of linear simple crossed lamellar crystals oriented perpendicular to growing edge. Next outer layer (Figs. 7, 8, c) nearly as thick (to 250 μm), orthogonally oriented, with faces of linear simple crossed lamellar crystals parallel to growing edge. Next outer layer (Figs. 7, 8, p) thin (to 20 μm), with intersected crossed platy structure. Outermost layer (Fig. 8, o) thin (to 70 μm), again of simple prismatic crystals.

External anatomy: Soft parts of largest and only complete specimen (Figs. 3, 14) comprising 2 ½ whorls, excluding foot. Mantle cavity spanning

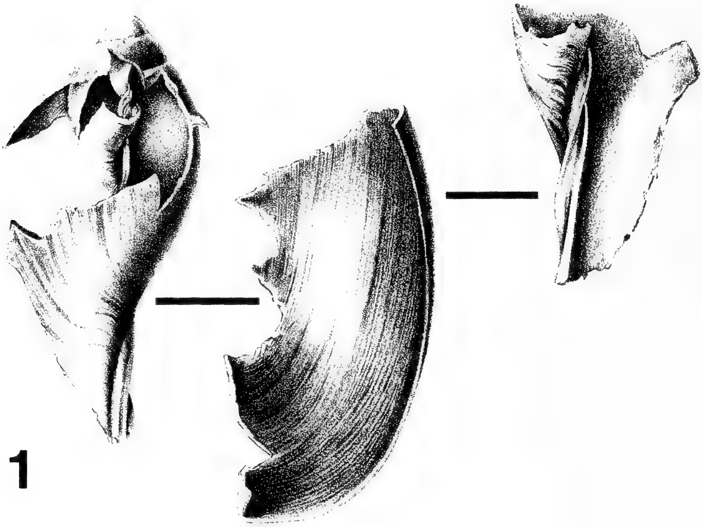

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Figure 1. *Marginellona gigas* (Martens). Original illustration of holotype, reproduced at 0.9 X.

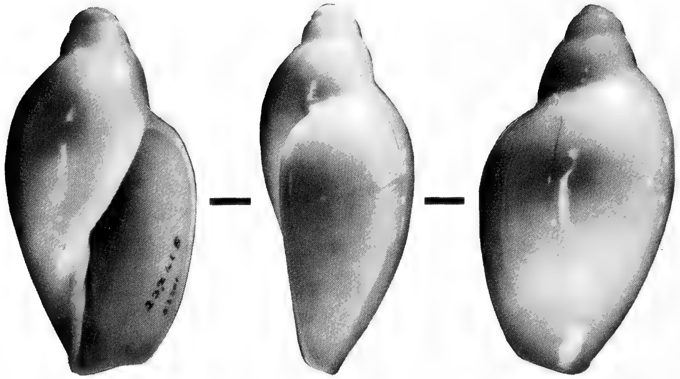

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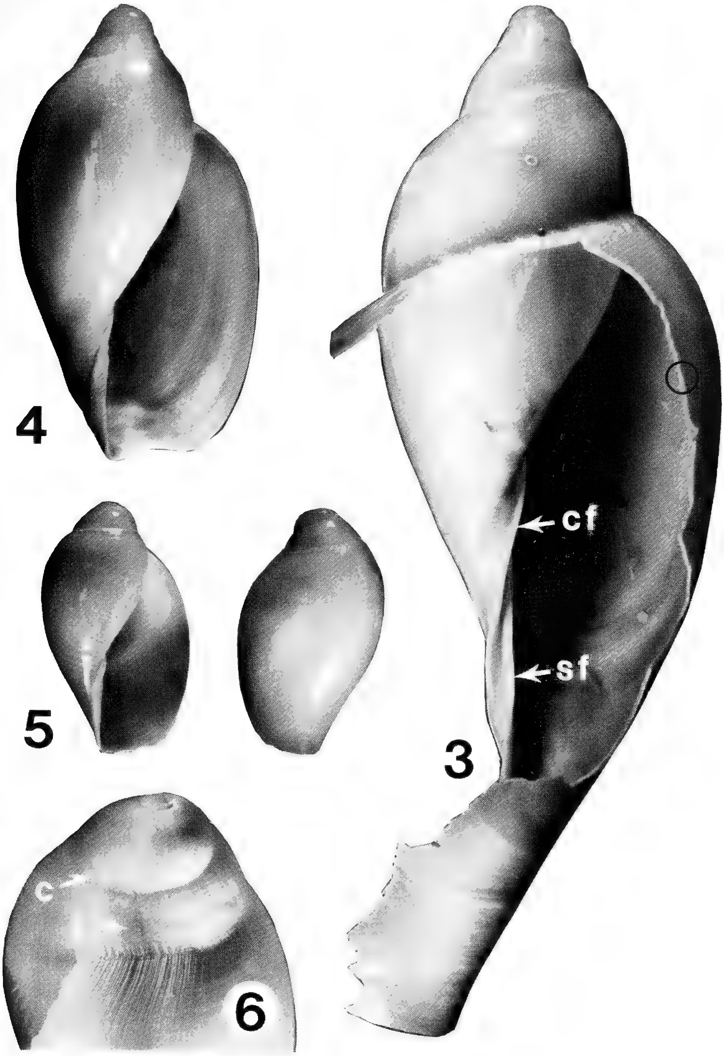
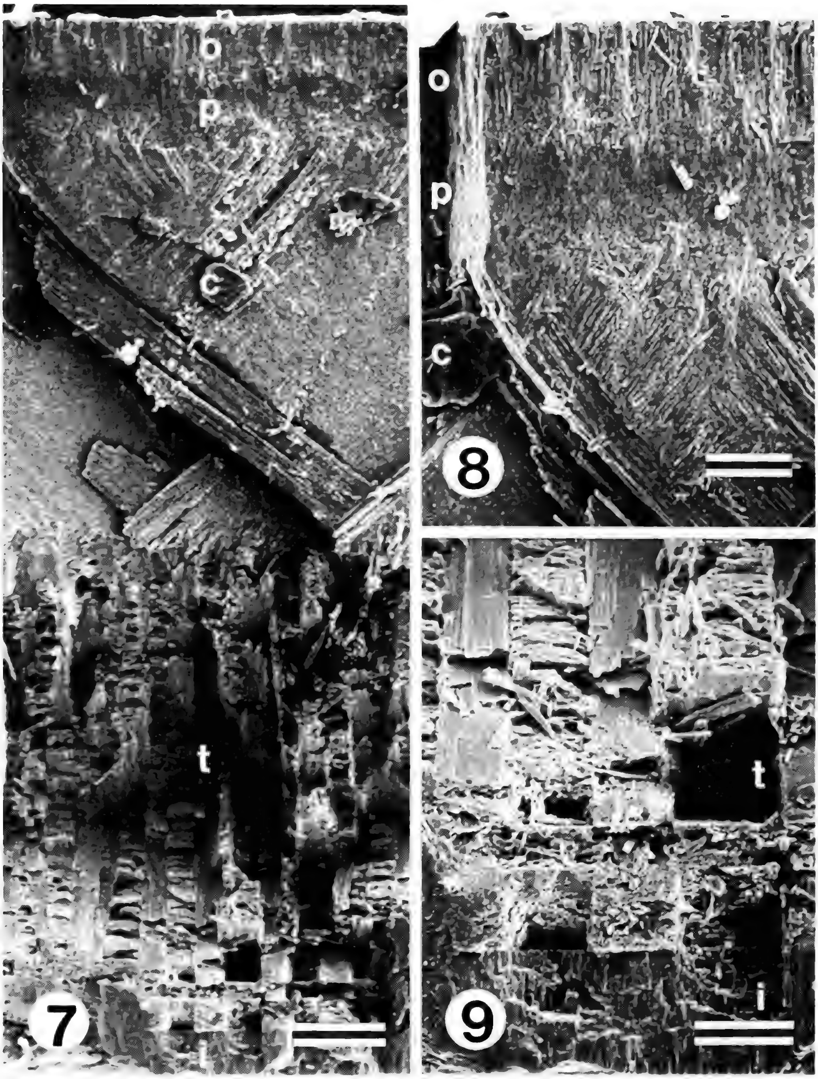
Figure 2. Holotype of *Sigaluta pratasensis* Rehder, 1967, apertural, lateral and dorsal views. W. of Pratas Reef, South China Sea, 20°37′N, 115°43′E, in 380 m, gray mud and sand bottom, 0.9 X.



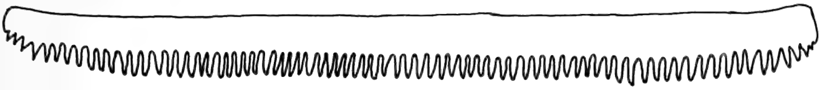
Figures 3-6. *Marginellona gigas* (Martens). **3.** ZIN 44141, E. of Phan Thiet, Vietnam, South China Sea, 10°41′08″N, 109°53′08″E, in 495-500 m, ♂, 0.85 X. **4.** ZIN 56353, E. of Phan Ly, Vietnam, South China Sea, 11°10′00″N, 110°10′00″E, in 1280-1000 m, mud, ♀, 0.85 X. **5.** ZIN 45513, E. of Phan Ly, Vietnam, South China Sea, 11°09′06″N, 110°02′00″E, in 700 m, immature ♂, 0.85 X. **6.** Protoconch of specimen in Fig. 5, 2.6 X.

c, parietal callus; cf, columellar fold; sf, siphonal fold; t, transition from protoconch to teleoconch.



Figures 7-9. Shell ultrastructure of *Marginellona gigas*. **7.** Fracture surface parallel to growing edge, ¼ whorl behind aperture, circled region in Fig. 3. Scale bar = 50 µm. **8.** Enlargement, showing outer surface of shell. Scale bar = 20 µm. **9.** Enlargement, showing inner surface of shell. Scale bar = 20 µm.

c, colabrally oriented crossed lamellar crystals; i, innermost layer of simple prismatic crystals; o, outermost layer of simple prismatic crystals; p, layer with crossed platy structure; t, transversely oriented crossed lamellar crystals.



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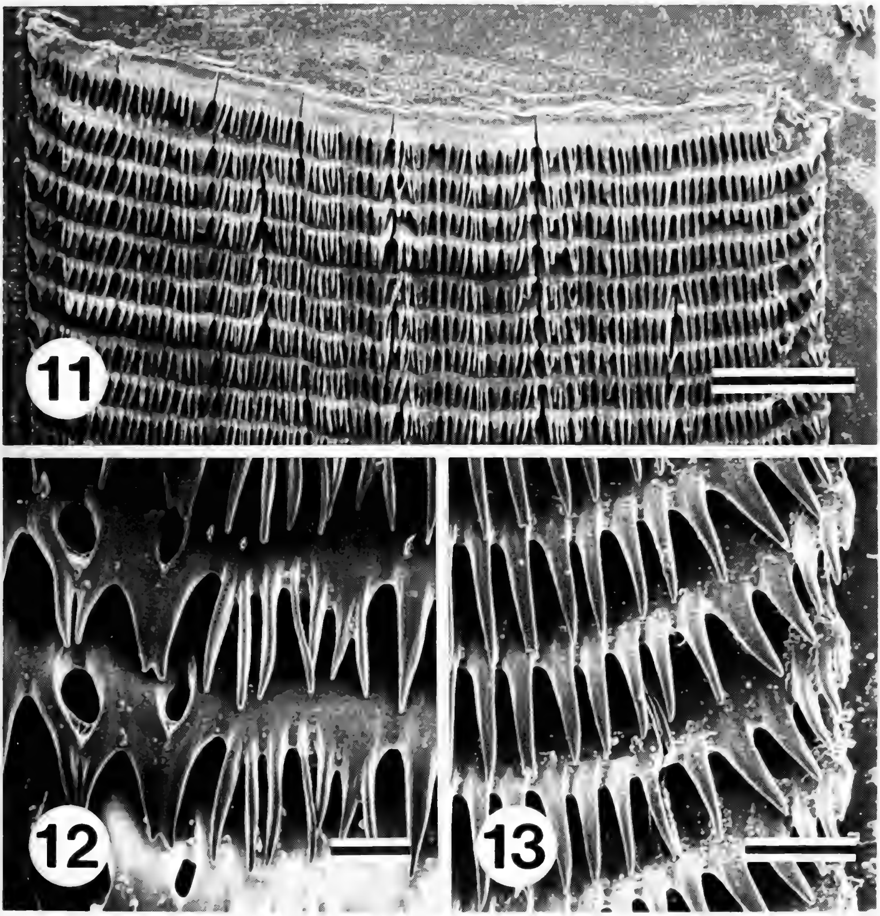
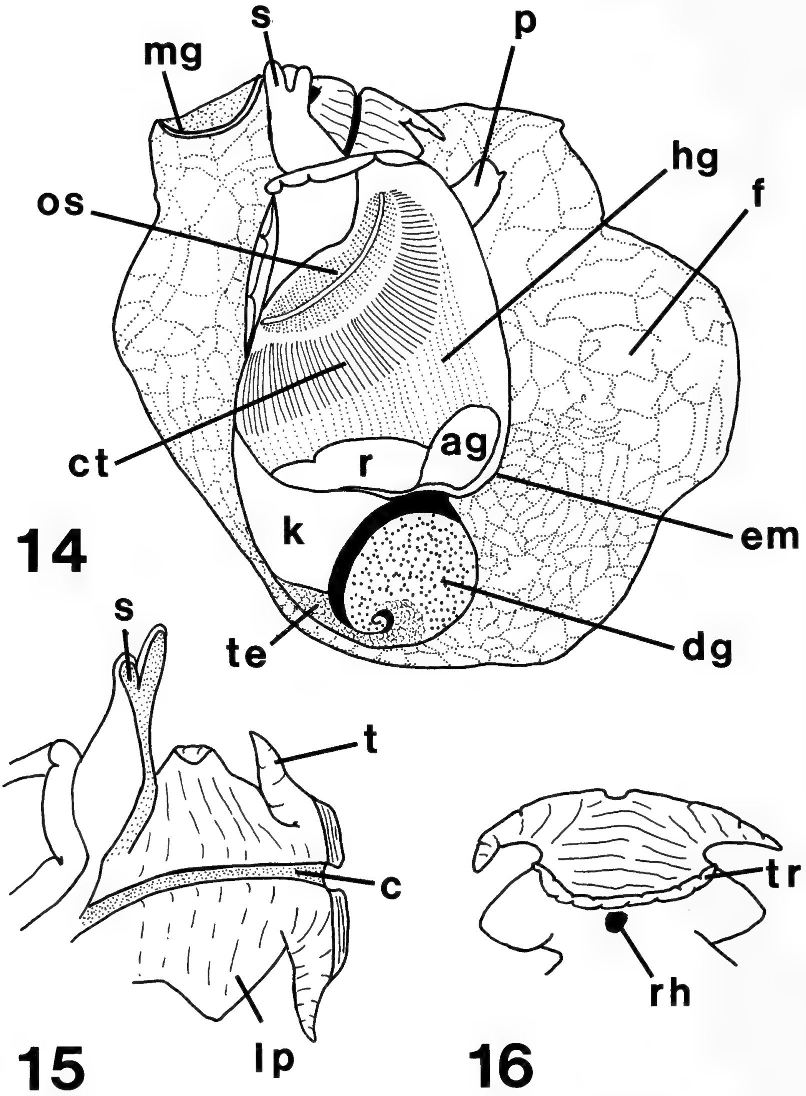


Figures 10-13. Radular morphology. **10.** Radular tooth of holotype of *Marginellona gigas*, redrawn from Thiele (1904: pl. 9, fig. 64). Scale bar = 500 µm. **11-13.** Radula of specimen in Fig. 3. **11.** Distal end of radula. Scale bar = 500 µm. **12.** Region along central portion of tooth. Scale bar = 50 µm. **13.** Region along right margin of tooth. Scale bar = 100 µm.



Figures 14-16. External anatomical features of *Marginellona gigas*. **14.** Shell-less animal from specimen in Fig. 3, dorsal view, 0.65 X. **15.** Dorsal view of head, 1.0 X. **16.** Ventral view of head, 1.0 X.

ag, anal gland; c, channel along mid-line of head; ct, ctenidium; dg, digestive gland; em, efferent margin of mantle cavity; f, foot; hg, hypobranchial gland; k, kidney; lp, lateral lappets; mg, anterior mucus gland; os, osphradium; p, penis; r, rectum; rh, rhynchostome; s, siphon; t, tentacle; te, testis; tr, transverse ridge.

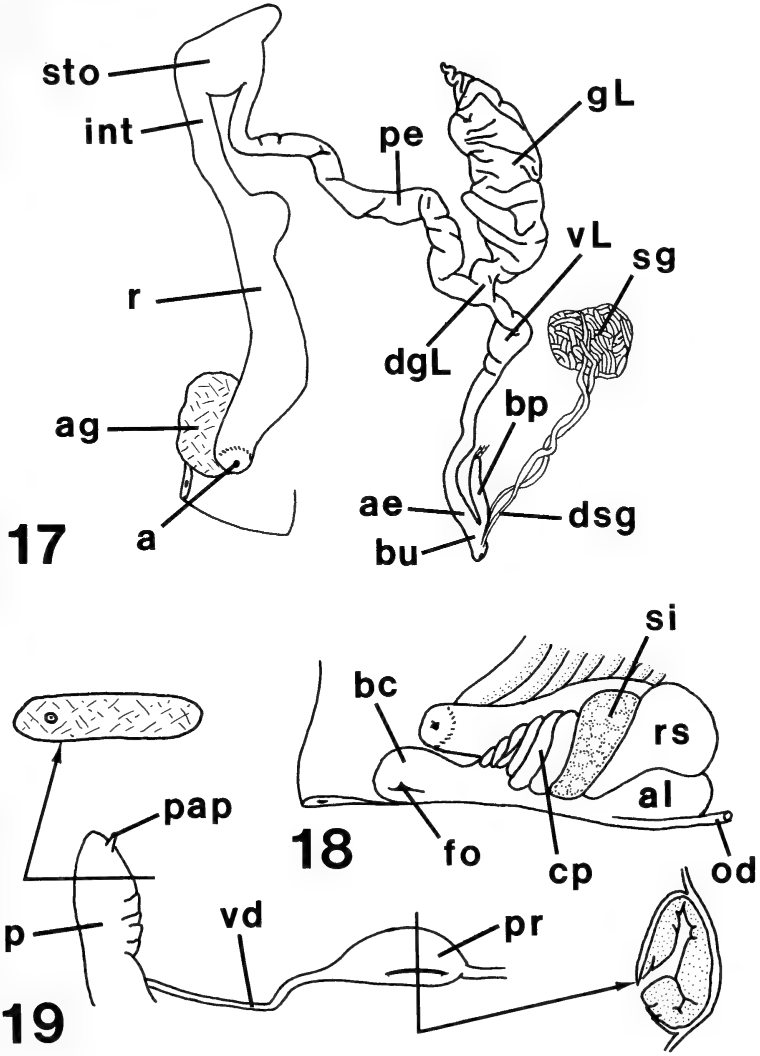


Figure 17-19. Anatomical features of *Marginellona gigas*. **17.** Alimentary system, 0.66 X. **18.** Female pallial oviduct, 1.1 X. **19.** Male pallial gonoduct, 0.9 X.

a, anus; ae, anterior esophagus; ag, anal gland; al, albumen gland; bc, bursa copulatrix; bp, buccal pouch; bu, buccal cavity; cp, capsule gland; dgL, duct of gland of Leiblein; dsg, duct of salivary gland; fo, female opening; gL, gland of Leiblein; int, intestine; od, oviduct; p, penis; pap, penial papilla; pe, posterior esophagus; pr, prostate; r, rectum; rs, receptaculum seminis; sg, salivary glands; si, sperm ingesting gland; sto, stomach; vd, vas deferens; vL, valve of Leiblein.

Table 1. Measurements of shells and radulae of specimens of *Marginellona gigas* in Figs. 3-5. All measurements in mm.

Specimen in Figure no.	3	4	5
Shell length	157.0	68.3	37.2
Aperture length	109.9	51.6	30.7
No. protoconch whorls	2⅓	2¼	2⅓
No. teleoconch whorls	2¾	1¾	$1\frac{1}{16}$
Radula length	10.1	5.3	3.4
Radula width	2.5	1.6	1.0
No. rows teeth	80	56	44
No. cusps/tooth*	83-85	58-59	69-71

* Number varies among teeth within the same radula.

approximately ½ whorl; kidney (Fig. 14, k) ¼ whorl; digestive gland (Fig. 14, dg) and testis (Fig. 14, te) 1 ¾ whorl. Foot (Fig. 14, f) extremely large (≈ 1.2×aperture length), broad (L/W ≈ 1.0), with deep medial indentation along anterior edge, tapering posteriorly. Anterior mucus gland (Fig. 14, mg) deep. Dorsal surface of foot uniformly colored in preserved specimens, rugose in large specimen, smoother in smaller specimens. Operculum absent. Sole of foot thin, glandular. Tentacle bases fused ventrally, producing deep, tubular channel along dorsal mid-line of head (Fig. 15, c). Ventral surface of head with transverse ridge (Fig. 16, tr) anterior to rhynchostome (Fig. 16, rh). Proximal region of head with large, triangular lateral lappets (Fig. 15, lp). Eyes absent. Tentacles (Fig. 15, t) long, laterally directed. Siphon (Figs. 14,15, s) fused to head just left of posterior margin of mid-line channel. Siphon bifurcated in largest specimen, possibly due to injury; simple, tubular in smaller two specimens.

Mantle cavity: Mantle cavity spanning approximately ½ whorl, with right side substantially foreshortened due to posterior displacement of its efferent margin (Fig. 14, em). Arrangement of mantle cavity organs as in generalized muricacean neogastropod (Ponder, 1973: fig. 5). Mantle edge thickened, smooth, particularly broad and thick along columellar margin. Osphradium (Fig. 14, os) dark greenish-brown, half as wide and ¾ as long as ctenidium (Fig. 14, ct). Hypobranchial gland (Fig. 14, hg) of parallel, deep, pendent folds. Pallial gonoduct and rectum short. Anal gland (Figs. 14, 17, a) large.

Alimentary system: Proboscis short, broad, pleurembolic, extending through rhynchostome (Fig. 16, rh) at base of head. Proboscis retractor muscles attached to dorsal and left walls of asymmetrical cephalic hemocoel. Mouth large, leading to buccal cavity (Fig. 17, bu). Buccal cavity joined dorsally by anterior esophagus (Fig. 17, ae), ventrally by buccal pouch (Fig. 17, bp). Buccal pouch, containing buccal mass, extending nearly to rear of retracted proboscis. Radula (Figs. 11-13, Table 1) short (3-10 mm), broad (1.0-2.5 mm), uniserial, with 44-80 asymmetrical teeth. Teeth comb-like, with slightly curved basal plates that give rise to numerous (58-85) short cusps. Cusps shorter at margins (Fig. 13), irregular in thickness and occasionally fused along central portions of teeth (Fig. 12). Anterior esophagus thin, muscular, extending from buccal pouch to large, muscular valve of Leiblein (Fig. 17, vL). Posterior to valve of Leiblein, esophagus doubling in diameter and becoming sacculate, further expanding posterior to duct from gland of Leiblein before constricting to original diameter at rear of cephalic hemocoel. Gland of Leiblein (Fig. 17, gL) dark brown, extremely large, sacculate, broad anteriorly, tapering posteriorly, with large central lumen, joined to mid-esophagus posterior to nerve ring by thick, glandular stalk with narrow duct (Fig. 17, dgL). Salivary glands (Fig. 17, sg) paired, composed of extremely long, highly convoluted and intertwined tubules, situated dorsal to the gland of Leiblein in expanded right anterior portion of cephalic hemocoel. Ducts of salivary glands (Fig. 17, dsg) running anteriorly along floor of proboscis, emptying into buccal cavity laterally. Posterior esophagus reflected dorsally before joining stomach (Fig. 17, sto). Stomach simple, sack-like, with ducts from digestive gland joining to form single broad opening. Intestine (Fig. 17, int) short, narrow, running anteriorly from stomach to form rectum (Fig. 17, r). Rectum more than doubled in diameter alongside kidney, expanding further upon entering mantle cavity. Anal gland (Fig. 17, ag) extremely large, cavernous in large male, disproportionally smaller in smaller specimens, spanning the pallial portion of the rectum, entering rectum by single duct near anus.

Female reproductive system: [Only a single, poorly preserved pallial oviduct was available for examination. The functions of the two glandular structures between the capsule and albumen glands are surmised on the basis of positional homologies with the pallial oviduct of *Volvarina taeniolata* Mörch, 1860 (Fretter, 1976: fig. 2A) and will require verification when additional specimens become available.] Oviduct (Fig. 18, od) joining albumen gland (Fig. 18, al) at rear of mantle cavity. Pallial oviduct joined by sperm ingesting gland (?) (Fig. 18, si), seminal receptacle (?) (Fig. 18, rs) before expanding into broad capsule gland

(Fig. 18, cp). Bursa copulatrix (Fig. 18, bc) large, situated ventral to anus. Female opening (Fig. 18, fo) along lateral wall of bursa copulatrix.

Male reproductive system: Testis large, tan colored, lining anteriormost $^1/_3$ of digestive gland, broadest adjacent to rear wall of kidney. Testicular duct convoluted along kidney, passing adjacent to pericardium before entering mantle cavity. Prostate (Fig. 19, pr) large, glandular, not joined to rectum by connective tissue, with slit-like opening extending along posterior 3/5 of length. Vas deferens (Fig. 19, vd) descending abruptly, running anteriorly to base of penis, surrounded by layer of muscle beneath mantle floor. Penis (Fig. 19, p) long, broad, dorsoventrally compressed, with terminal papilla (Fig. 19, pap) along right distal edge.

Type Locality: W. of Sombrero Channel, Nicobar Islands, Indian Ocean, 07°48'N, 92°07'E, in 805 m, coarse sand.

Material examined: USNM 237018 [holotype *Sigaluta pratasensis*], 54.1 mm, USNM 637251 [paratype *S. pratasensis*] 61.1 mm, both from W. of Pratas Reef, South China Sea, 20°37'N, 115°43'E, in 380 m, gray mud and sand bottom, U.S.B.F. Albatross I, sta. 5301; ZIN 44141, E. of Phan Thiet, Vietnam, South China Sea, 10°41'08"N, 109°53'08"E, in 495-500 m, R/V Odessey, trawl no. 55, 1 male specimen, 157.0 mm; ZIN 45513, E. of Phan Ly, Vietnam, South China Sea, 11°09'06"N, 110°02'00"E, in 700 m, R/V Odessey, trawl no. 52, 1 immature male specimen, 37.2 mm; ZIN 56351, E. of Phan Thiet, Vietnam, South China Sea, 11°01'00"N, 109°55'00"E, in 460 m, mud, R/V Odessey, 2 shells, 98.5 mm, 106.9 mm; ZIN 56352, E. of Ba Ria, Vietnam, South China Sea, 10°40'08"N, 110°03'00"E, in 760-800 m, mud, R/V Odessey, 1 shell, 108.8 mm; ZIN 56353, E. of Phan Ly, Vietnam, South China Sea, 11°10'00"N, 110°10'00"E, in 1280-1000 m, mud, R/V Odessey, trawl no. 51, 1 female specimen, 68.3 mm.

Distribution: This species has been collected in the eastern Indian Ocean (Nicobar Islands) and on the upper continental slope along the western margin of the South China Sea. The bathymetric range is 380-1000 m, with a mean station depth (n=7) of 661 m.

Ecology: Little is known of the ecology of this species other than it inhabits substrates ranging from coarse sand to fine mud. Gut contents of three dissected specimens were not identifiable.

Remarks: *Marginellona gigas* is the largest known marginellid. The largest specimen of *Marginellona gigas* recorded in this study measures 157 mm in length, significantly larger than the published record size of 130.9 mm for *Afrivoluta pringlei* (Wagner & Abbott, 1990: 80-039).

DISCUSSION

The genus *Marginellona* and its type species *M. gigas* were described largely on the basis of anatomical and radular characters, supplemented with a shell description reconstructed from fragments of the unique holotype. *Sigaluta* and its type species *S. pratasensis*, on the other hand, were erected exclusively on features of shell morphology. The availability of preserved specimens in which the shell morphology matches that of *S. pratasensis* (compare Figs. 2 and 4), while the unusual morphologies of the radula (compare Figs. 10 and 11), head, and external anatomy agree with published descriptions of these features in *M. gigas* (Martens, 1904: 109; Thiele, 1904: 170; 1929: 356) leaves little doubt of the synonymy of these two species and the nominal genera based upon them.

Martens (1904: 109) and Thiele (1904: 170; 1929: 356) noted the similarities of *M. gigas* to certain volutids, especially in features of the head and columellar folds, but both authors included this taxon in Marginellidae on the basis of radular morphology, absence of operculum, polished shell surface and glazed suture. Tomlin (1917: 268) disputed the inclusion of this taxon in Marginellidae, but did not offer an alternative familial placement. It is interesting to note that *Afrivoluta pringlei* (Tomlin, 1947), the only other species in the subfamily Marginelloninae, was also originally described as a volutid based on shell morphology. This genus and species were subsequently transferred to the Marginellidae when its radula was examined (Barnard, 1963).

In a survey of the literature dealing with anatomy of marginellids, we have identified a number of anatomical features of possible utility for phylogenetic inference (Table 2), and noted their distribution among the few taxa studied to date (Table 3). *Marginellona gigas* has several features that distinguish it from other marginellids, while possessing others that appear to be widespread in the family and may prove to be diagnostic of the Marginellidae.

As noted by Ponder (1970: 61), the fusion of the siphon to the left side of the head appears to be an adaptation for burrowing. This feature occurs in each of the three Recent marginellid subfamilies, and is likely symplesiomorphic within Marginellidae. A deep channel on the dorsal surface of the head, apparently formed by fusion of the ventral surfaces of the tentacle bases, occurs in *Marginellona*, and in several genera within Cystiscinae (Coovert, 1987: 19-22). This feature has not been reported in *Afrivoluta* (Barnard, 1963; Liltved, 1985), but a similar cleft occurs in the volutid subfamilies Scaphellinae (Clench & Turner, 1964: 135), Athletinae (Woodward, 1900: 121) and Calliotectinae (Pace, 1902: 25). The lateral lappets on the proximal portion of the head of *Marginellona*

Table 2. Survey of anatomical features reported to vary within the family Marginellidae. Sources for data listed in Table 3.

1) Siphon: (0) to left of head; (1) fused to head.
2) Tentacles: (0) separate; (1) fused, with dorsal furrow.
3) Wing-like folds at bases of tentacles: (0) absent; (1) present.
4) Buccal caecum: (0) present; (1) absent.
5) Radula: (0) present; (1) absent.
6) Salivary glands: (0) ascinous; (1) tubular.
7) Accessory salivary gland: (0) absent; (1) single gland present.
8) Valve of Leiblein: (0) present; (1) absent.
9) Esophageal caecum: (0) absent; (1) present.
10) Gland of Leiblein ("Poison Gland"): (0) broad, sacculate, lacking terminal bulb; (1) narrow, glandular, without terminal bulb; (2) narrow, tubular, with terminal bulb.
11) Duct from gland of Leiblein: (0) entering esophagus posterior to nerve ring; (1) bypassing valve of Leiblein.
12) Number of glandular structures joining pallial oviduct between albumen gland and capsule gland: 1, 2, or 3.
13) Prostate gland opening to mantle cavity via: (0) slit; (1) tube.
14) Prostate gland: (0) along right wall of mantle cavity; (1) in penis.
15) Penis: (0) simple, with one lobe; (1) bilobed.

Table 3. Comparison of anatomical features of marginellids. Sources for data footnoted. ? indicates that character state could not be inferred from cited text or figure. Assignment of genera to subfamilies follows Coan (1965). Species nomenclature updated according to Coovert (1989).

	Characters from Table 1														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Subfamily: Marginellinae Fleming, 1828															
Prunum marginata (Born 1778) (as *Marginella marginata*)[1]	1	0	0	0	0	0	0	1	1	2	1	?	?	?	0
Marginella desjardini (Marche-Marchad, 1957)[1]	0	0	0	1	1	?	1	1	0	2	1	2	?	?	0

Table 3. *(continued)*

	Characters from Table 1														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Prunum martini (Petit, 1853) (as *Marginella fraterculus*) E. A. Smith, 1915[2]	0	0	0	0	0	1	0	?	1	2	1	?	0	0	0
Hyalina hyalina (Thiele, 1913)[3]	0	0	0	?	1	1	?	?	?	2	?	?	?	?	0
Hyalina pallida (Linné, 1758)[4]	?	0	0	?	1	?	?	?	?	2	1	?	?	?	?
Volvarina taeniolata Mörch, 1960[5]	?	0	0	0	0	0	1	1	1	2	1	2	?	1	0
Haloginella mustelina (Angas, 1871) (as *Volvarina mustelina*)[6]	1	0	0	0	0	1	1	0	0	2	0	2	0	1	0
Dentimargo cairoma (Brookes, 1924) (as *Volvarinella cairoma*)[6]	1	0	0	1	1	1	1	1	0	2	1	3	1	0	1
Mesoginella pygmaea (Sowerby, 1846)[6]	1	0	0	0	0	1	0	0	0	2	0	2	1	0	0
Subfamily: Cystiscinae Stimpson, 1865															
Granula sp.[6]	1	1	0	0	0	1	1	0	0	1	1	1	1	0	0
Subfamily: Marginelloninae Coan, 1965															
Marginellona gigas (Martens)[8]	1	1	1	0	0	1	0	0	0	0	0	2	0	0	0

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[1]Graham, 1966; [2]Marcus & Marcus, 1968; [3]Eales, 1923; [4]Coan & Roth, 1976; [5]Fretter, 1976; [6]Ponder, 1970; [7]Ponder, 1970, as *Diliculum* sp., see Coovert, 1989: 13; [8]herein.

and *Afrivoluta* (Barnard, 1963) appear to be restricted to the subfamily Marginelloninae within the Marginellidae, but are widespread throughout the family Volutidae.

The presence of a buccal caecum or pouch, which contains the buccal mass including odontophores and radula, with a sphincter at its opening to the buccal cavity is a feature unique to marginellids and toxoglossans (Fretter, 1976: 333). This structure may, however, be reduced or lost in aradulate species. Marginellid radular morphology has recently been reviewed by Coovert (1989), who defined seven radular types. Although the loss of a radula is believed to be polyphyletic, all aradulate taxa known to date are in the subfamily Marginellinae.

Salivary glands within the family Marginellidae may be ascinous or tubular. Ascinous salivary glands appear to be uncommon and restricted to the subfamily Marginellinae. A single, medial accessory salivary gland has been reported in several marginelline and the only cystiscine taxon studied thus far.

Within the family Marginellidae, the reduction and loss of the valve of Leiblein appears to be correlated with the modification of the gland of Leiblein to form a long, tubular "poison gland" that empties, via a separate duct, into the buccal cavity. *Marginellona gigas*, which has a very large, ascinous gland of Leiblein that empties into the mid-esophagus posterior to the nerve ring, also has a very large and muscular valve of Leiblein. Progressive stages in the development of a duct from the gland of Leiblein that bypasses the valve of Leiblein have been documented by Ponder (1970; 1973: fig. 3, L-O). Those marginellid taxa that lack a valve of Leiblein all have a "poison gland" with a separate duct that empties into the buccal cavity. Two of three taxa with an esophageal caecum posterior to the nerve ring lack a valve of Leiblein. The third species, *Prunum martini*, was reported to have an "inconstant valve of Leiblein" based on a slight swelling of the esophagus observed in 3 of 5 specimens dissected (Marcus & Marcus, 1968: 65, as *Marginella fraterculus*).

The pallial oviduct of marginellids differs from that of most other neogastropods (Ponder, 1973: fig. 6) in having two glandular structures between the capsule and albumen glands. The male genital ducts agree in general respect with those of most other neogastropods, but exhibit infrafamilial variation in: position and size of prostate gland (rear of mantle cavity vs. in penis), type of opening to pallial cavity (duct or slit), and penis morphology (simple vs. bilobed).

Anatomical features of *Marginellona gigas*, including the presence of a buccal caecum, a uniserial radula with broad, comb-like rachidian teeth, a simple stomach with single, broad opening to the digestive gland, a large rectal gland, and a pallial oviduct with separate ingesting gland and seminal receptacle, further support the original assignment of this taxon to the family Marginellidae. However, the relationship of the Marginelloninae to the Marginellinae and Cystiscinae remains unclear. Coovert (1989: 30) suggested that Cystiscinae is the most primitive subfamily in Marginellidae, based on the occurrence of a triserial radula in a species tentatively ascribed to the genus *Cystiscus*. *Marginellona gigas* has an unspecialized alimentary system, containing a large gland of Leiblein without terminal bulb, as well as a large valve of Leiblein. These are primitive neogastropod features previously unrecorded in the Marginellidae. *Marginellona gigas* also lacks both the glandular duct that bypasses the valve of Leiblein, and the single accessory salivary gland that are present in Marginellinae and in the only species of Cystiscinae to be studied to date. Thus, the morphology of the anterior alimentary system suggests that Marginelloninae may be the most primitive subfamily in Marginellidae.

Although members of the Marginellidae share features with the Toxoglossa (buccal caecum, Fretter, 1976: 333), Volutomitridae (single accessory salivary gland, Ponder, 1973: 330) and Volutidae (furrowed head with lateral lappets, Martens, 1904: 109; Thiele, 1929: 356), we agree with Fretter, (1976: 335) that our knowledge of this family is, as yet, too scanty to deduce its sister group.

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FOOTNOTE

[1]–Although the title page is dated 1903 and many earlier authors, including Thiele, had cited this date, the work was published in January, 1904 (see Bieler & Boss, 1989: 12).

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TENEBRINCOLA FRIGIDA, A NEW GENUS AND SPECIES OF ABYSSAL VOLUTE FROM THE NORTHERN PACIFIC OCEAN (GASTROPODA: VOLUTIDAE)

M. G. Harasewych[1] and Yuri I. Kantor[2]

ABSTRACT. *Tenebrincola frigida*, a new genus and species of volute, is described on the basis of a specimen taken from the Aleutian Trench at a depth of 5020 meters. It differs from its only congener, *T. cukri* (Rokop, 1972), in having a broader shell with a distinct shoulder. *Tenebrincola* is included in the subfamily Fulgorariinae on the basis of the morphology of its radula, operculum, accessory salivary glands, and male reproductive system. The eastern Australian genus *Ericusa* is tentatively considered to be the sister group, based on conchological similarity.

Key words: Volutidae, Fulgorariinae, *Tenebrincola*, abyssal, anatomy, systematics.

INTRODUCTION

In the course of examining the collections of the Institute of Oceanology, Academy of Sciences of the U.S.S.R., in Moscow, a single specimen of an unusual, operculate volutid, collected by the R/V Vityaz in the Aleutian Trench, was discovered. This specimen represents a new species that most closely resembles *Sigaluta cukri* Rokop, 1972, which occurs in abyssal depths off Baja California. Because the genus *Sigaluta* Rehder, 1967, recently has been shown to be a synonym of *Marginellona* Martens, 1904, of the family Marginellidae (Harasewych & Kantor,

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1991), a new genus is proposed to include both abyssal species. *Tenebrincola* is referable to the subfamily Fulgorariinae, and represents the first record of this subfamily in the abyssal fauna.

SYSTEMATICS

Family Volutidae Rafinesque, 1815
Subfamily Fulgorariinae Pilsbry and Olsson, 1954

Tenebrincola new genus

Type species: *Tenebrincola frigida* new species [described below].
Description: Shell to at least 68.4 mm, ovately to elongate fusiform, extremely thin and fragile. Protoconch of about 2 inflated whorls, nucleus deflected about 45° from shell axis, transition to teleoconch indistinct. Teleoconch with up to 3 whorls. Outer lip smooth. Columella without folds. Color ivory to white, internally and externally. Periostracum smooth, extremely thin. Operculum small, corneous, ovate, with tapering, terminal nucleus. Eyes absent. Siphonal appendages tapering, symmetrical. Accessory salivary glands short, broad posteriorly. Radula uniserial, with tricuspid rachidian teeth having broadly U-shaped attachment region; lateral cusps much broader but slightly shorter than central cusp. Pallial sperm duct closed. Penis with broad, lateral flap.
Etymology: L. *tenebra*–darkness + L. *incola*–inhabitant.

Tenebrincola frigida new species

Figures 1, 4-10

Description: Shell (Fig. 1) to at least 68.4 mm, extremely thin, fragile, translucent, ovately fusiform, with low, blunt spire. Protoconch large, bulbous, eroded, of about 2 whorls. Nucleus deflected from shell axis by 43°. Transition to teleoconch indistinct. Teleoconch with about 3 convex, weakly shouldered whorls. Suture adpressed. Surface sculpture limited to very fine growth striae. Aperture ovate, rounded anteriorly, sharply tapered posteriorly. Outer lip smooth, thin, sinuous. Inner lip smooth, parietal region not thickened. Columella lacking columellar or siphonal folds. Periostracum (Fig. 4) very thin (≈ 1.5 μm), smooth, continuous, imparting lustrous, ivory color to outer surface of shell. Aperture white. Operculum (Fig. 7) small (0.2×aperture length), corneous, narrowly ovate, with tapering terminal nucleus (abraded away in holotype).
Ultrastructure: Shell thin (≈ 85 μm), composed of three layers of

orthogonally oriented, crossed-lamellar crystals (Fig. 5): outer layer 50 µm thick, crystal planes perpendicular to growing edge; middle layer 33 µm thick, crystal planes parallel to growing edge; inner layer 2.5 µm thick, crystal planes perpendicular to growing edge.

Anatomy: [The soft tissues of the single, male specimen were very friable. The visceral mass and portions of the mantle cavity disintegrated during extraction from shell.] Animal uniformly rust-colored. Foot ¾ length of shell aperture, broad (L/W ≈ 2.3), with small anterior lateral expansions delimiting propodial mucous gland, rounded posteriorly. Siphon (Fig. 8, S) short, stout, with paired, symmetrical, tapering siphonal appendages (Fig. 8, SA) on either side of siphon near base. Head broad, with long, narrow, tapering tentacles (Fig. 8, T) on either side of thin, medially furrowed hood (Fig. 8, MF) extending over rhynchostome. Outer edges of tentacles with short, narrow, wing-like lobes (Fig. 8, W). Eyes absent. Mantle cavity broad, shallow, with large, dark osphradium (L/W ≈ 2.8); ctenidium as wide and twice as long as osphradium; hypobranchial gland large, transversely pleated; rectum broad with conspicuous rectal gland along anterior half of dorsal surface. Proboscis short, broad, pleurombolic, with thick, muscular walls. Proboscis retractor muscles thick, paired, extending from lateral mid-points of

Figure 1. *Tenebrincola frigida*, new species. Holotype, ZMUM N Lc 16252, Aleutian Trench, SW of Agattu Island, Near Islands, 51°30′06″N, 172°04′30″E, in 5020 m. 0.8 X.

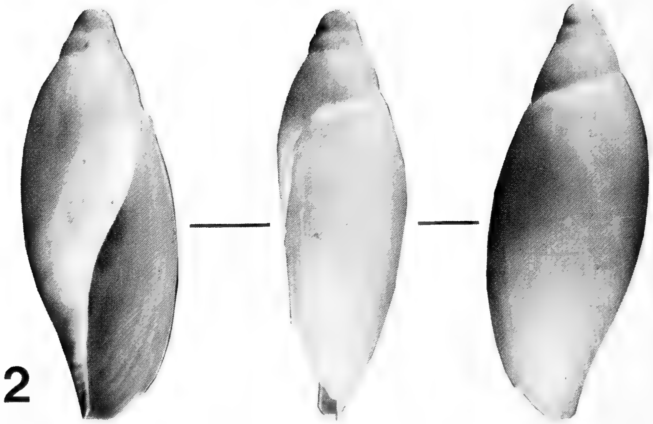


Figure 2. *Tenebrincola cukri* (Rokop, 1972). Holotype, USNM 701261, WSW of Cortes Bank, approximately 225 miles W. of Ensenada, Baja California, Mexico, 32°05'N, 120°29'W to 32°03'N, 120°30'W, in 3775-3789 m. 0.8 X.

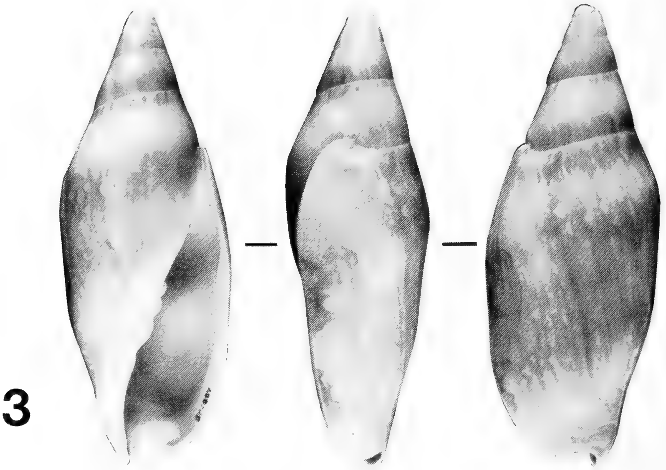
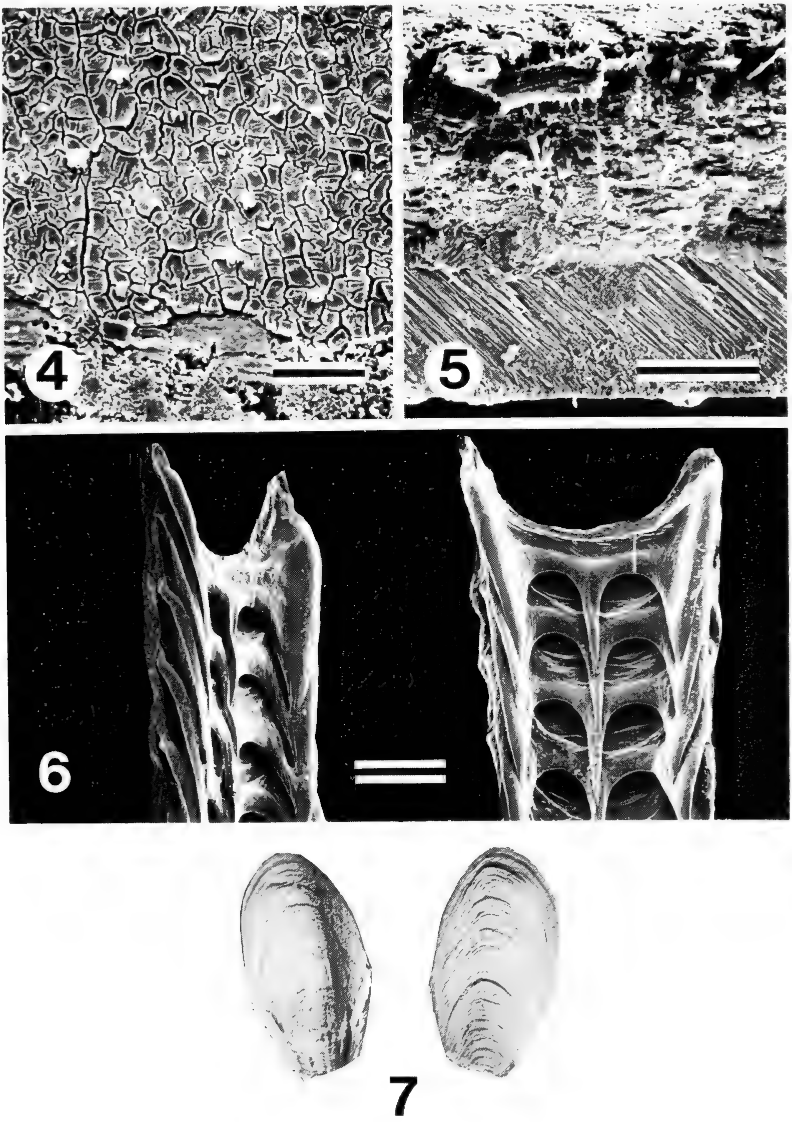
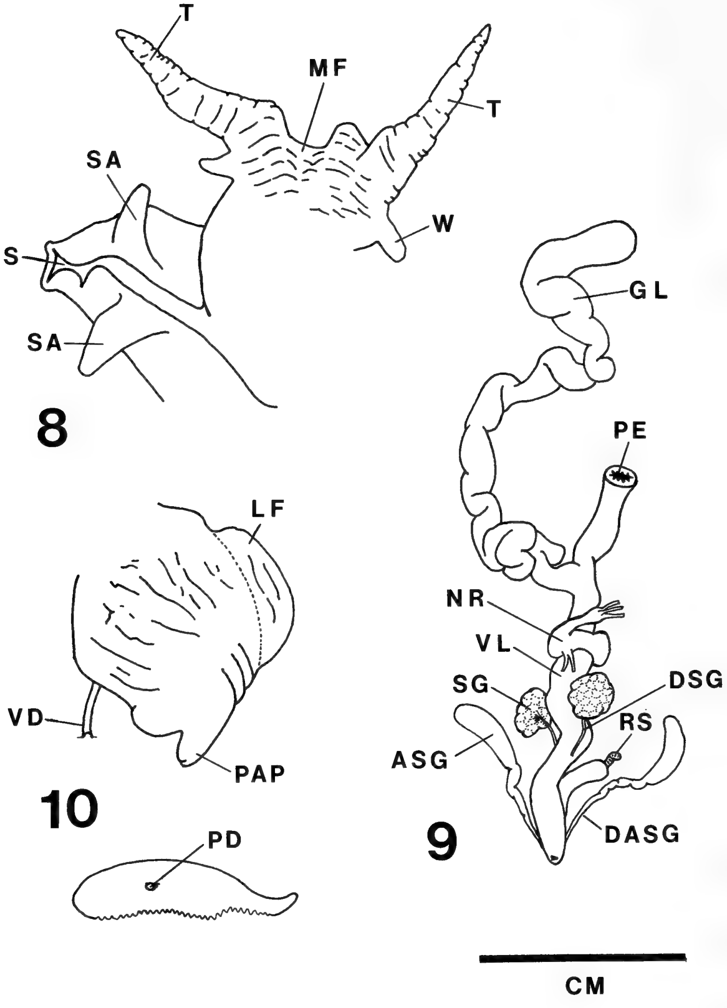


Figure 3. *Ericusa sericata* Thornley, 1951. USNM 845887, off Cape Moreton, Queensland, Australia, in 180 m. 0.55 X.



Figures 4-7. *Tenebrincola frigida*, new species. **4.** Periostracum on shell fragment from dorsal surface of body whorl (see Fig. 1). Scale bar = 30 µm. **5.** Shell ultrastructure (same fragment as in Fig. 4). Fracture surface parallel to growing edge, inner surface at bottom of photograph, periostracum at top. Scale bar = 30 µm. **6.** Lateral (55°) and dorsal views of radula. Scale bar = 100 µm. **7.** Inner and outer surfaces of operculum. 2.6 X.



Figures 8-10. *Tenebrincola frigida,* new species. Anatomical features. **8.** Dorsal view of head, with siphon reflected to left. **9.** Anterior portion of alimentary system. **10.** Penis, dorsal view and transverse section at mid-length. Scale bar = 1 cm for all drawings.

ASG, accessory salivary gland; DASG, duct of accessory salivary gland; DSG, duct of salivary gland; GL, gland of Leiblein; LF, lateral flap; MF, medial furrow; NR, nerve ring; PE, posterior esophagus; PAP, papilla; PD, penial duct; RS, radular sac; S, siphon; SA, siphonal appendage; SG, salivary gland; T, tentacle; VD, vas deferens; VL, valve of Leiblein; W, wing-like projection.

inner proboscis wall to walls of cephalic hemocoel. Buccal mass muscular. Anterior esophagus broad, thick-walled. Radula (Fig. 5) short (4.2 mm), uniserial, with 44 teeth; teeth tricuspid, with narrow, anteriorly recurved basal plates; lateral cusps broadly triangular, thickened along lateral edges, slightly shorter than narrow, flexible central cusp. Accessory salivary glands (Fig. 9, ASG) short, tubular, distally expanded, lying dorsal and anterior to salivary glands and entering buccal cavity by separate ducts (Fig. 9, DASG). Salivary glands (Fig. 9, SG) small, acinous, with ducts running laterally along esophagus before becoming embedded in the walls at rear of retracted proboscis. Valve of Leiblein (Fig. 9, VL) large, inflated. Gland of Leiblein (Fig. 9, GL) long, highly convoluted, tubular, as wide as posterior esophagus (Fig. 9, PE). [Stomach and intestine not preserved in dissected specimen.] Rectum large, inflated, distally tapered, with green rectal gland lining anterior half of dorsal surface. Anus with long, ventral papilla. Penis (Fig. 10) as broad as long, dorsoventrally flattened, with short, terminal papilla (Fig. 10, PAP) and thin lateral flap (Fig. 10, LF). Vas deferens (Fig. 10, VD) leading to base of penis and proximal 2/3 of penial duct closed (Fig. 10, PD). Distal 1/3 of penis with penial duct running along ventral surface forming groove extending to tip of papilla. Nerve ring (Fig. 9, NR) highly concentrated, of Type 2 (Ponder, 1970: 159).

Type Locality: Aleutian Trench, SW of Agattu Island, Near Islands, 51°30′06″N, 172°04′30″E, in 5020 m. R/V Vityaz sta. 3359, Sigsbee trawl, 8 June 1955.

Material examined: Holotype, Zoological Museum, University of Moscow (ZMUM) N Lc 16252, 68.4 mm.

Distribution: This species is known only from the type locality.

Ecology: Although this species lives below both the calcite and aragonite compensation depths (Morse & Berner, 1979), there is no evidence of pitting or dissolution on the shell surface. Regions of the protoconch are eroded, possibly by abrasion. Rectal contents included polychaete spicules, sand, and foraminiferans.

Etymology: L. *frigidus*–cold.

Comparative remarks: This species is distinguished from *Tenebrincola cukri* (Rokop, 1972), its only congener, by its proportionally broader shell, by the presence of a weak shoulder on the body whorl, and by the slightly concave region between the shoulder and suture. Because *T. cukri* is known only from a single specimen lacking soft parts, comparisons of radula or anatomical features cannot be made.

DISCUSSION

Although Stuardo and Villarroel (1974: 146) regarded the radular morphology of the volutid subfamilies Zidoninae and Fulgorariinae to be convergent, the three-dimensional topology of radular teeth, elucidated by scanning electron microscopy, clearly distinguishes these two subfamilies. Radular teeth of Zidoninae are generally flat or convex on their dorsal surface, with central cusps that are longer and as broad or broader than the lateral cusps (Harasewych, 1991). Those members of Fulgorariinae examined to date (Harasewych, 1991) are characterized by rachidian teeth that have strongly curved basal plates and lateral cusps that are thickest along the lateral edges and broader and generally longer than the central cusps, forming a trough along the mid-line of the radular ribbon. The radula of *Tenebrincola frigida* is of the fulgorariine type, but is unusual in having very thin and somewhat flexible central cusps that are slightly longer than the lateral cusps.

Comparatively few of the ten Recent subfamilies of Volutidae have been studied anatomically in any detail. The best known are the Zidoninae and Odontocymbiolinae (Clench & Turner, 1964; Ponder, 1970; Harasewych, 1987; Leal & Bouchet, 1989). The Volutinae, Scaphellinae, Calliotectinae, Lyriinae and Athletinae are less well known (Fischer, 1867; Woodward, 1900; Pace, 1902; Clench & Turner, 1964), while knowledge of the remaining subfamilies is largely limited to radular or gross external morphology (summarized in Weaver & duPont, 1970).

The presence of an operculum, short accessory salivary glands that are not wound around the salivary glands, and a closed vas deferens and penial duct prevent inclusion of *Tenebrincola* in the Zidoninae, but support its assignment to Fulgorariinae.

The shallow, medial furrow in the head of *Tenebrincola frigida* is regarded as a plesiomorphic volutid character that is shared with members of the subfamilies Calliotectinae, Athletinae and Scaphellinae. The long tentacles, absence of functional eyes, thin shell, and lack of columellar or siphonal folds are all convergently derived adaptations for abyssal life.

The protoconch and teleoconch morphology of both species of *Tenebrincola* most closely resembles that of *Ericusa sericata* Thornley, 1951 (Fig. 3), from 80 to 200 m off eastern Australia. Thus, the genus *Ericusa* H. & A. Adams, 1858, is tentatively considered to be the sister group.

Of the abyssal volutes known to date (List 1) all but *Arctomelon benthalis* are members of genera that are endemic to abyssal depths. *Tenebrincola* is the first record of the subfamily Fulgorariinae in the abyssal fauna. *Tenebrincola frigida* is the deepest dwelling volutid yet discovered, and the only volutid known to occur in a trench.

List 1. Members of the family Volutidae reported from abyssal (≥ 2000 m) depths. Subfamily assignment in square brackets [ ]. Geographic and bathymetric distributions based on references in {}.

Arctomelon benthalis (Dall, 1896) [Zidoninae] 3058 m. Peru Basin. {Clarke, 1962: 27}.

Guivillea alabastrina (Watson, 1882) [Zidoninae] 2688-4063 m. Southern Ocean, from Drake Passage east to Croizet Basin, and north to Mozambique Channel. {Knudsen, 1973; Dell, 1990: 220-221}.

Tractolira sparta Dall, 1896 [Odontocymbiolinae] 2990-4082 m. Peru, Guatemala and Central Pacific Basins. {Rokop, 1972}.

Tractolira germonae Harasewych, 1987 [Odontocymbiolinae] 1976-3944 m. South Antilles and Atlantic-Indian-Antarctic Basins. {Dell, 1990: 217}.

Tractolira tenebrosa Leal & Bouchet, 1989 [Odontocymbiolinae] 2370-3270 m. Brazil Basin. {Leal & Bouchet, 1989: 6-7}.

Tractolira sp. [Odontocymbiolinae] 1772-3596 m. Ross Sea, Pacific Antarctic Basin. {Dell, 1990: 217}.

Tenebrincola cukri (Rokop, 1972) [Fulgorariinae] 3775-3789 m. Central Pacific Basin. {Rokop, 1972: 16-17}.

Tenebrincola frigida Harasewych & Kantor, 1991 [Fulgorariinae] 5020 m. Aleutian Trench. {herein}.

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JOHANNES THIELE AND HIS CONTRIBUTIONS TO ZOOLOGY.
PART 2. GENUS-GROUP NAMES (MOLLUSCA)

Kenneth J. Boss[1] and Rüdiger Bieler[2]

ABSTRACT. This is the second part of a series on the German zoologist Johannes Thiele (1860-1935) and comprises a critical listing of the genus-group taxa which he described as new to malacology. Each of these names is accompanied by author and bibliographic references, original status, type-species with its original binominal spelling and bibliographic source and some data on subsequent taxonomic placements. Thiele introduced a total of 291 such names in the Phylum Mollusca, distributed as follows: 11 Aplacophora; 39 Polyplacophora; 200 Gastropoda (138 Prosobranchia; 20 Opisthobranchia and 42 Pulmonata); 31 Bivalvia; 10 Cephalopoda; there were no new scaphopod or monoplacophoran names. Of these, later authors recognized as valid 85 at the generic level, 110 at the subgeneric level; 71 are considered to be synonyms, and the remaining 25 are unjustified emendations or errors.

INTRODUCTION

As part of a series on the scientific contributions of Johannes Thiele, the eminent German zoologist, we provide here an alphabetical listing and analysis of all the genus-group taxa introduced by him in his publications on mollusks as delineated by Bieler & Boss (1989). A total of 291 names is included in the following format: (1) genus-group name; (2) author(s); (3) year of publication; (4) condensed bibliographic reference; (5) original status as given by Thiele; (6) subsequent status

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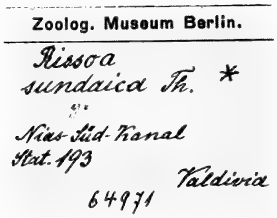
Portrait of Johannes Thiele (undated, but photograph probably taken shortly before his seventieth birthday in 1930) and sample of his distinctive handwriting on specimen label.



Zoolog. Museum Berlin.

Rissoa
sundaica Th. *

Nias-Süd-Kanal
Stat. 193
Valdivia
64971

as assigned by Thiele himself or other authors; (7) method of designation of the type-species; (8) name of the type-species as originally given by Thiele; (9) the exact or correct binominal combination of the type-species with its original author and page and other appropriate citations [Thiele's own species names of mollusks will be covered in future parts of this series]; (10) family-level placement (a family name without brackets indicates an original placement at the time of the original description; names enclosed by brackets are subsequent placements either by Thiele or other authors); and (11) class and/or other higher category.

For each taxon we have paid special attention to the type-species: its original binomen is given along with a reference to its original introduction into the literature and, in most cases, a citation of its first illustration or figure. In addition, we provide data on the subsequent hierarchical placement of the genus-group taxon; reference here is given to certain classic authoritative texts (e.g., Wenz, Zilch, etc.), all of which are listed in the bibliography.

NOTES ON RANKING OF TAXA

Usually, Thiele clearly indicated that he was establishing a new genus-group taxon and introduced his new names as genera, subgenera, or 'sections.' In some cases he omitted a rank and/or just referred to a new "Gruppe" or "Untergruppe." According to the International Code of Zoological Nomenclature (ICZN, 1985), Article 10(e), the term 'section' is deemed to be a subgeneric name. Thiele himself often obfuscated the problem of ranking when the sectional or subgeneric name, instead of the generic name, was used in figure captions. Nevertheless, we have retained his original ranking to illustrate the intended position in relation to genus *and* subgenus.

THIELE'S TYPE CONCEPT

Thiele's concept of the type-species and its designation is somewhat at variance with the present, more rigorous regulations of the International Code of Zoological Nomenclature (ICZN, 1961, 1985; Article 68), wherein the listing of the first of several species in a new genus-group taxon does not constitute a type designation. Part of the difficulty in the interpretation of type-species for Thiele's genus-group taxa stems from his German usage, namely "typische Art" for both "typical species" in the sense of an example, as well as "type-species" in the nomenclatural sense.

In his early publications such as *Das Gebiss*, Thiele (1893e: 376, see also 372) sometimes considered the first species mentioned under a generic name to be the type-species: "Ausser der typischen Art, die ich wie gewöhnlich zuerst beschreibe . . .". At other times, he apparently cited a particular species as "a good example." Further, he did not necessarily restrict the example to a single species, but sometimes even mentioned two typical species such as in the case of his new genus *Radsiella* (1893e: 368-369): "Als typische Vertreter der Gattung sehe ich die beiden ersten Arten . . . an." Such departures from current requirements and usage are occasionally still true for his later works (e.g., 1925b: 268): "von den typischen Arten . . .".

The more exacting concepts which we now employ with regard to type-species, their designation and the like had yet to be universally adopted by the community of systematists in Thiele's time. Also, the formal publication of the International Code of Zoological Nomenclature in 1961 contained regulations (especially Articles 68 and 69), concerning the boundary year 1931; this particularly affected taxa established in the *Handbuch der systematischen Weichtierkunde* which was published during this time; these names had to be treated differently with reference to "original designation."

In our treatment of Thiele's genus-group names, we utilized the following interpretations: If Thiele explicitly used the word "type" or its equivalents (e.g., *Ischnochiton*: "Typus einer eigenen Untergattung . . ."; *Lissarca*: "typische Art ist . . ."), we credited this as type-species by original designation. When Thiele positively included only one species in a new genus-group taxon, this was treated as "type by monotypy." We did not acknowledge Thiele with an original designation if he used such phraseology as: "I place this in a new genus"; "I introduce this for . . ."; rather, if the higher taxon was represented only by a single species, then we accordingly considered the designation, as noted above, to be one of monotypy; if two or more species were included, a subsequent designation had to be found.

SOME PROBLEMS AND INCONSISTENCIES

Certain problems arise in the dating of a taxon, ascertaining the method of designation of the type-species and attributing authorship to the name. Thiele occasionally erred, and some of his mistakes were simply matters of orthography. Others were occasioned by his lack, at the time he worked, of modern published resources on animal taxa such as Sherborn's *Index Animalium* and Neave's *Nomenclator Zoologicus*. Additional problems were caused by our current application of rules and interpretations not in use during Thiele's career, and still more were associated with his having numerous papers in press simultaneously in which new names might be repeatedly used. The following are examples of some of the problems encountered.

Mistakes in spelling: This includes misspellings of names introduced by other authors which have or could have caused problems; an example is Thiele's erroneous "*Cleovitrea*" for Iredale's *Cleotrivia.*

Further, there is difficulty in distinguishing between misspellings with no nomenclatural standing (indicated in our listing by placing the name in quotation marks [". . ."]) and deliberate, but unjustified emendations. This may be compounded with Thiele's usage of another author's taxon (usually without his naming the other author) in a broadened, restricted, different or incorrect sense, a so-called "taxon sensu Thiele." With regard to these, several genus-group names of earlier authors have been later attributed to him; these were usually Thiele's misconception, or were subsequently perceived as his misconception of the taxon of the original author.

Thus, we have Thiele's misconception of *Beanella* Dall 1882, erroneously referred to (by some authors) as *Beanella* Thiele rather than more precisely as "*Beanella* 'Dall' Thiele *in* Troschel & Thiele 1893, *non* Dall 1882." These so-called misconstrued taxa of Thiele do not have type-species, although frequently they have had them designated by subsequent authors. We, of course, cannot list all genus-group taxa falling into this category. However, we have included a few of these, e.g., *Ariocaelatura* 'Germain' Thiele 1931, *non* Germain 1921; *Beanella* 'Dall' Thiele *in* Troschel & Thiele 1893, *non* Dall 1882; *Clathropleura* 'Tiberi' Thiele *in* Troschel & Thiele 1893, *non* Tiberi 1877; and *Silicula* 'Jeffreys' Thiele 1934, *non* Jeffreys 1879.

New names were not always clearly marked as such by Thiele. In the case of his larger contributions such as the *Handbuch der systematischen Weichtierkunde,* some are not properly indicated in the index.

Original authorship was sometimes confused by Thiele: he claimed taxa of others (e.g., *Pyrunculus*); he credited authors of manuscript names (e.g, *Arcopella*); and he attributed authorship to workers whose publications were later rejected (e.g., Chemnitz).

Thiele occasionally cited the wrong dates for some of his own taxa (e.g., 1921 instead of 1924a) or he described taxa twice in subsequent or "simultaneous" publications (e.g., *Tonicina*). Some of these errors can be attributed either to having several descriptions of the same new taxa in press simultaneously or to having articles in press for many years. In a letter to an unnamed colleague at the British Museum (Natural History), dated 14 February 1923, he complained of a delay in publication: "Scientific work in Germany has now become very difficult and completed manuscripts usually can be published only after a longer period. During the war [1914-1918] I had sorted out and worked on many gastropods from the material of the German Deep-Sea Expedition, but the work which was completed in the fall of 1918 has not yet been published" [our translation]. Thiele here referred to one of his major works, the *Gastropoda der Deutschen Tiefsee-Expedition*, which was finally published in 1925.

In having published so many papers, especially those in disparate and obscure journals, Thiele sometimes apparently forgot taxa (e.g., *Prochiton*) or subsequently decided to correct or emend in odd or inappropriate places (e.g., footnote in 1890b, index of 1931c).

ASSESSMENT OF THE TAXA

Probably the most important result of delineating all of Thiele's genus-group taxa is that an evaluation of his contribution can be more accurately made based on the work of later authors. As we remarked earlier, Thiele was one of the greatest researchers in malacology in the early twentieth century (Bieler & Boss, 1989); however, even he was aware that some of the genus-group names he introduced were unnecessary emendations or outright synonyms.

We assessed the subsequent status of Thiele's genus-group names on their treatment in several authoritative works in malacology. For each class or subclass, we utilized the following works: Aplacophora (Boss, 1982; Salvini-Plawen, 1978); Polyplacophora (A. G. Smith, 1960; Belle, 1983; Kaas & Belle, 1980; 1985a and b; 1987; 1990); Gastropoda Prosobranchia (Wenz, 1938-1944); Pulmonata (Zilch, 1959-1960); Opisthobranchia (Odhner, 1968; Pruvot-Fol, 1954); Bivalvia (Chavan, Haas, Hertlein, Keen, or Newell *in* Moore, 1969; Vokes, 1980); Cephalopoda (Nesis, 1987). We additionally referred to other sources such as Vaught (1989).

TABULATION OF THIELE'S GENUS-GROUP NAMES

MOLLUSCA (Grand total: 291)

APLACOPHORA: Total: 11 names
  11 Genus-level

POLYPLACOPHORA: Total: 39 names
  1 Genus-level
  3 Subgenus-level
  30 Synonyms

- 2 Unjustified emendations
- 2 Errors
- 1 Unclear

GASTROPODA: Total: 200 names

- Prosobranchia: Total: 138 names
  - 44 Genus-level
  - 74 Subgenus-level
  - 15 Synonyms
  - 5 Errors
- Opisthobranchia: Total: 20 names
  - 8 Genus-level
  - 6 Subgenus-level
  - 5 Synonyms
  - 1 Emendation
- Pulmonata: Total: 42 names
  - 15 Genus-level
  - 17 Subgenus-level
  - 10 Synonyms

BIVALVIA: Total: 31 names

- 4 Genus-level
- 10 Subgenus-level
- 10 Synonyms
- 3 Unjustified emendations
- 3 Errors
- 1 Unclear

CEPHALOPODA: Total: 10 names

- 2 Genus-level
- 6 Unjustified emendations
- 1 Synonym
- 1 Error

Thiele introduced a total of 291 genus-group names; of these, 85 were recognized subsequently at the generic, and 110 at the subgeneric, level; 71 names are now considered synonyms and 25 were unjustified emendations or errors. Despite the great contributions made by Thiele, almost one third of his genus-group names were superfluous. Considering the current annual increase in the establishment of new molluscan generic-taxa (Boss, 1989), we hope this analysis of the fate of the names of someone of such eminent stature as Thiele will constitute a warning to contemporary and future workers that not only are many new names probably unnecessary synonyms but they also burden the literature, obfuscate reality and seriously encumber one of the foremost roles of our system of classification, namely information retrieval.

With more than 15,000 genus-group names now available for Recent mollusks (Vaught, 1989) and with probably fewer than 60,000 Recent species in the Phylum Mollusca (Boss, 1971) there are already clearly too many genus-group names. Such an overburden of our taxonomy is unfortunately all too well documented: Ponder and Warén (1988) list nearly 1,000 family-group names for only part of the Prosobranchia.

ALPHABETICAL LISTING OF FAMILIES WITH TREATED GENUS-GROUP NAMES

(reflecting original and subsequent family-level placements):

APLACOPHORA

Acanthomeniidae: *Acanthomenia*
Amphimeniidae: *Amphimenia*
Chaetodermatidae: *Metachaetoderma, Prochaetoderma*
Dondersiidae: *Heathia*
Hemimeniidae: *Archaeomenia*
Lepidomeniidae: *Acanthomenia, Heathia, Notomenia, Phyllomenia, Sandalomenia*
Limifossoridae: *Metachaetoderma*
Neomeniidae: *Archaeomenia*
Pararhopaliidae: *Metamenia*
Phylomeniidae: *Phyllomenia*
Prochaetodermatidae: *Prochaetoderma*
Proneomeniidae: *Amphimenia, Metamenia, Pruvotia*
Rhopalomeniidae: *Pruvotia*

POLYPLACOPHORA

Acanthochitonidae: *Acanthochiton, Aristochiton, Mecynoplax, Thaumastochiton*
Callistoplacidae: *Notochiton*
Callochitonidae: *Icoplax, Mopaliella*
Chaetopleuridae: *Calloplax, Helioradsia*
Chitonidae: *Adriella, Amaurochiton, Anthochiton, Chondroplax, Clathropleura, Diochiton, Georgus, Helioradsia, Icoplax, Leptopleura, Lophyriscus, Lophyropsis, Mecynoplax, Mopaliopsis, Onithoplax, Poeciloplax, Prochiton, Radsiella, Rhodoplax, Rhopalopleura, Rhyssoplax, "Slerochiton," Stereoplax, Sypharochiton, Toniciella, Toniciopsis, Triboplax*
Cryptoplacidae: *Acanthochiton, Aristochiton, Thaumastochiton*
Ischnochitonidae: *Adriella, Anthochiton, Beanella, Calloplax, Chondropleura,*

Helioradsia, Icoplax, Lepidochiton, Lepidopleuroides, Leptopleura, Lophyriscus, Lophyropsis, Mopaliella, Mopaliopsis, Notochiton, Radsiella, Rhodoplax, Stereoplax, "Toniciella," Tonicina
Lepidochitonidae: *Beanella, Lepidochiton, Mopaliella*
Lepidopleuridae: *Parachiton*
Leptochitonidae: *Beanella, Lophyropsis, Notochiton, Parachiton*

BIVALVIA

Arcidae: *Noetiella, Paranoetia*
Cardiidae: *Microcardium*
Cyamiidae: *Ptychocardia*
Dreissenidae: *Sinomytilus*
Ledidae: *Silicula*
Limopsidae: *Hochstetterina, Limopsilla, Lissarcula*
Mactridae: *Electromactra*
Mutelidae: *Jheringella*
Mytilidae: *Sinomytilus*
Noetiidae: *Paranoetia, Noetiella*
Nuculidae: *Brevinucula, Lionucula*
Ostreidae: *Dioeciostraea, Monoeciostraea*
Pectinidae: *Adamussium, Arctinula*
Philobryidae: *Hochstetterina*
Semelidae: *"Punigapia"*
Tellinidae: *Arcopella, Clathrotellina, Hemimetis, Pistris, Striotellina, Tellinangulus*
Unionidae: *Jaronia, Luteacarnea, Plagiolopsis, Pustulosa, Venustaconcha*
Verticordiidae: *Acreuciroa, "Lyonsiela"*
Vesicomyidae: *Ptychocardia*

GASTROPODA

Prosobranchia

Aclidae: *Trochaclis*
Aclididae: *"Pherusiana"*
Adeorbidae: *Mörchiella [Moerchiella], Mörchinella [Moerchinella]*
Amphiperatidae: see Cypraeidae
Assimineidae: *Austropilula, Conacmella, Crossilla, Leucostele, Macrassiminea, Metassiminea, Nanivitrea, Oriella, Ovassiminea, Pseudassiminea, Pseudocyclotus, Rupacilla, Sculptassiminea, Suterilla, Turbacmella*
Bithyniidae: *Emmericiopsis*

Buccinidae: *Appisania, Bathydomus, Buccinella, Chlanidotella, Eosipho, Ficulina, Fusinella, Macroniscus, Meteuthria, Notoficula, Probuccinum, Proneptunea, Prosipho*
Bulimidae: *Emmericiopsis*
Bursidae: *Bufonariella*
Cancellariidae: *Mericella*
Capulidae: *"Amathinoidas"*
Cerithiidae: *Cerithiopsilla, Eumetula, Ischnocerithium, Proclava*
Cerithiopsidae: *Cerithiopsilla, Eumetula, Proseila*
Cingulopsidae: *Eatonina, Eatoniopsis, Watsonella*
Columbellidae: *Cilara, Metanachis, Paratilia, Pseudanachis*
Cominellidae: *Meteuthria*
Conidae: *Acrobela, Anticlinura, Benthomangelia, Citharella, Clinuropsis, Conasprella, Fusiturris, Micropleurotoma, Ptychobela, Ptychosyrinx, Strioconus, Typhlosyrinx*
Cyclostomidae: *Pseudocyclotus*
Cyclostrematidae: *Bothropoma, Chunula*
Cymatiidae: *Charoniella*
Cypraeidae: *"Cleovitrea," Pediculariella, Primovula, Procalpurnus*
Epitoniidae: *Chuniscala, Cirsotremopsis, Opaliopsis*
Fossaridae: *Fossarella, Iphitella*
Hydrobiidae: *Caspiella, Emmericiopsis, Hydrococcus, Indopyrgus, Lithoglyphopsis, Pachydrobiella, Probythinella, Walkerilla*
Hydrococcidae: *Hydrococcus*
Lacunidae: *Carinolacuna*
Lepetellidae: *Cocculinella*
Littorinidae: *Iphitella, Lissoconchus*
Lyocyclidae: *Lyocyclus*
Melaniidae: *Cubaedomus, Pseudocleopatra*
Micromelaniidae: *Caspiella*
Muricidae: *Drupella, Gracilimurex*
Nassariidae: *Naytiopsis, Plicarcularia, Profundinassa, Proneritula*
Nassidae: see Nassariidae
Naticidae: *Frovina, Prolacuna, Sublacuna*
Olividae: *Gracilancilla, Olivellopsis, Parvoliva, Zemiropsis*
Ovulidae: *Primovula, Procalpurnus*
Patellidae: *Patellidea, Patellona, Patellopsis, Patinastra*
Pediculariidae: *Pediculariella*
Planaxidae: *Proplanaxis, Supplanaxis*
Pleurotomidae: see Turridae
Pomatiasidae: *Pseudotopoma*
Potamididae: *Batillariella, Cerithideopsilla, Cerithideopsis, "Zeacumanthus"*

Pyramidellidae: *Bacteridium, Ebalina, Euparthenia, Oopyramis, Stylopyramis*
Ranellidae: *Charoniella*
Rissoellidae: *Jeffreysiella, Jeffreysilla, Jeffreysina, Jeffreysiopsis*
Rissoidae: *Alcidiella, Boogina, Eatonina, Eatoniopsis, Watsonella*
Scalidae: see Epitoniidae
Skeneopsidae: *Microdiscula*
Stomatiidae: *Pseudostomatella*
Strombidae: *Aliger, Rostellariella*
Thiaridae: *Cubaedomus, Pseudocleopatra*
Tornidae: *Mörchinella [Moerchinella]*
Trichotropidae: *Lyocyclus*
Triphoridae: *Euthymella*
Trochaclididae: *Trochaclis*
Trochidae: *Callumbonella, Calotropis, Margarella, Margaritella, Margaritopsis, Mörchiella [Moerchiella], Nanula, Prothalotia, Pseudostomatella, Umbotrochus*
Turbinidae: *Bothropoma, Subninella*
Turridae: *Acrobela, Anticlinura, Benthomangelia, Citharella, Clinuropsis, Fusiturris, Micropleurotoma, Ptychobela, Ptychosyrinx, Typhlosyrinx*
Turritellidae: *Mesaliopsis, Protomella*
Vermetidae: *Segmentella*
Vitrinellidae: *Microdiscula*
Viviparidae: *Callinina*
Volutidae: *Harpovoluta*

Opisthobranchia

Actaeonidae: *Metactaeon, Neactaeonina, Pseudactaeon*
Atyidae: *Haminella*
Cadlinidae: *Cadlinella*
Charcotiidae: *Pseudotritonia*
Coryphellidae: *Himatina*
Diaphanidae: *Odostomiopsis*
Dorididae: *Cadlinella*
Dotonidae: *Iduliella*
Echinochilidae: *Cadlinella*
Flabellinidae: *Himatina*
Goniaeolididae: *Goniaeolis*
Haminoeidae: *Haminella*
Hedylidae: *Hedylopsis, Parhedyle*
Hedylopsidae: *Hedylopsis*
Iduliidae: *Iduliella*

Lamellidoridae: *Prodoridunculus*
Microhedylidae: *Parhedyle*
Notaeolidiidae: *Pseudotritonia*
Notodiaphanidae: *Diaphanella, Notodiaphana*
Onchidoridae: *Prodoridunculus*
Oxynoidae: *Lophopleura*
Philinidae: *Lophopleura*
Pleurobranchidae: *Pleurobranchella*
Polyceridae: *Prodoridunculus*
Retusidae: *Pyrunculus, Semiretusa, Utriculastra*
Scaphandridae: *Sphaerocylichna*

Pulmonata
Ariophantidae: *Ariocaelatura, Conibycus, Durgellina, Hemiglyptopsis, Parasitala, Rhinocochlis, Sitalina, Sitalinopsis, Striokaliella*
Bulimulidae: *Macrodontopsis, Scansicochlea*
Camaenidae: *Baudinella*
Clausiliidae: *Proreinia, Roseniella*
Ellobiidae: *Cassidulella, Cassidulina*
Endodontidae: *Garrettina, Nesodiscus, Notodiscus, Paryphantopsis*
Enidae: *Paracerastus, Rhachidina, Zebrinops*
Euconulidae: *Conibycus, Durgellina, Parasitala, Sitalina*
Haplotrematidae: *Proselenites*
Helicarionidae: *Ariocaelatura, Hemiglyptopsis, Sitalinopsis*
Lymnaeidae: *Pseudisidora*
Odondostomidae: *Macrodontopsis*
Orculidae: *Pagodinella*
Planorbidae: *Afroplanorbis*
Pleurodontidae: *Baudinella*
Polygyridae: *Daedalocheila*
Streptaxidae: *Afristreptaxis, Augustula, Macrogonaxis, Mirellia, Paucidentella, Pseudogonaxis*
Subulinidae: *Ochrodermatina, Striosubulina*
Systrophiidae: *Microhappia, Prohappia, Proselenites*
Urocoptidae: *Spiraxilla*
Vaginulidae: *Novovaginula*
Vertiginidae: *Pagodinella*
Vitrinidae: *Arabivitrina*
Zonitidae: *Geodiaphana*

CEPHALOPODA

Alluroteuthidae: *Parateuthis*

Gonatidae: *"Berryiteuthis"*
Psychroteuthidae: *Psychroteuthis*
Sepiidae: *Acanthosepia, Ascarosepia, Doratosepia, Lophosepia, Rhombosepia, Spathidosepia*
Vampyroteuthidae: *Hymenoteuthis*

ALPHABETICAL LISTING OF GENUS-GROUP NAMES:

Acanthochiton Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 14; emendation pro *Acanthochitona* Gray 1821, as genus; A. G. Smith 1960: I69 credited the spelling to Iredale 1915 and listed the name as a "*nomen vanum.*" Cryptoplacidae [Acanthochitonidae, teste A. G. Smith 1960: I69]. Polyplacophora.

Acanthomenia Thiele 1913d.

Deutsche Südpolar-Expedition 1901-1903, **14**(6)(1): 61; as new genus. Type-species by monotypy: *Acanthomenia gaussiana* Thiele 1913. Lepidomeniidae [Acanthomeniidae, teste Boss 1982: 952]. Aplacophora.

Acanthosepia Thiele 1934.

Handbuch der systematischen Weichtierkunde, **2**(3): 954; emendation pro *Acanthosepion* Rochebrune 1884; as section of *Sepia* Linnaeus 1758. Sepiidae. Cephalopoda.

Acreuciroa Thiele *in* Thiele & Jaeckel 1931b.

Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **21**(1): 250 (92); as new section of *Euciroa* Dall 1881 [subgenus of *Euciroa*, teste Keen *in* Moore 1969: N857]. Type-species by monotypy: *Euciroa (Acreuciroa) rostrata* Thiele *in* Thiele & Jaeckel 1931b. Subsequently attributed to Jaeckel & Thiele, Thiele & Jaeckel, and to Thiele alone by various authors. Verticordiidae. Bivalvia.

Acrobela Thiele 1925b.

Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 238 [204]; as new subgenus of *Bela* Gray 1847 [genus, teste Thiele 1929: 362]. Type-species by original designation: *Bela (Acrobela) optima* Thiele 1925. Pleurotomidae [Conidae, teste Thiele 1929: 362; Turridae, teste Wenz 1943: 1413]. Gastropoda: Prosobranchia.

Adamussium Thiele 1934.

Handbuch der systematischen Weichtierkunde, **2**(3): 807; as new genus. Type-species by monotypy: *Adamussium colbecki* (E. Smith) [*Pecten colbecki* E. A. Smith 1902: 212, pl. 25 fig. 11]. Pectinidae. Bivalvia.

Adriella Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 391; as new genus [= *Trachydermon* Carpenter 1864, teste Thiele 1909d: 4; = *Lepidochitona* Gray 1821, s.s., teste Thiele 1929: 8]. Type-species by monotypy: *Adriella variegata* Philippi [*Chiton variegatus* Philippi 1836, p. 107; 1844: 83, pl. 19 fig. 13; non Röding 1798, nec de Blainville 1825, nec Leach 1852; = *Lepitochitona cinerea* (Linnaeus 1767), teste Kaas & Belle 1980: 138]. Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I56, Belle 1983: 96]. Polyplacophora.

Afristreptaxis Thiele 1932a.
Archiv für Molluskenkunde, **64**(1): 12; as new genus [= *Eustreptaxis* L. Pfeiffer 1878, teste Zilch 1960: 559]. Type-species by original designation: *vosseleri* (Thiele) [*Streptaxis vosseleri* Thiele 1911]. Streptaxidae. Gastropoda: Pulmonata.

Afroplanorbis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 480; as new section of *Planorbis* O. F. Müller 1774. Type-species by original designation: *sudanicus* Martens [*Planorbis sudanicus* Martens 1870: 35]. Planorbidae. Gastropoda: Pulmonata.

Alcidiella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 163; nomen novum pro *Alcidia* Monterosato 1890, non Westwood 1879, nec Bourguignat 1889 [Thiele apparently renamed this without knowing of the emendation to *Alcidiella* by Cossmann (1921)]. Rissoidae. Gastropoda: Prosobranchia.

Aliger Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 254; as new section of *Strombus (Strombus)* Linnaeus 1758. Type-species by monotypy: *Strombus (Aliger) gallus* Linnaeus [*Strombus gallus* Linnaeus 1758: 743]. Strombidae. Gastropoda: Prosobranchia.

"Amathinoidas" [1929].
Handbuch der systematischen Weichtierkunde, **1**(1): 246; error pro *Amanthinoides* Sacco, 1896; as subgenus of *Thyca* H. & A. Adams 1854. Capulidae. Gastropoda: Prosobranchia.

Amaurochiton Thiele *in* Troschel & Thiele 1893e.

Das Gebiss der Schnecken, 2(8): 362; as new genus [= *Chiton* Linnaeus 1758, s.s., teste Thiele 1909d: 2, and Belle 1983: 123; = section of *Chiton* s.s., teste Thiele 1929: 19; subgenus of *Chiton*, teste A. G. Smith 1960: I66]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton olivaceus* [Frembly 1827: 199, Suppl. pl. 16 fig. 4], non Spengler 1797, [= *striatus* Barnes 1824, non Brusina 1870; = *magnificus* Deshayes 1822, = *latus* G. B. Sowerby I 1825, non Lowe 1825, nec Leach 1852, = *murrayi* Haddon 1886, teste Kaas & Belle 1980: 125]. Chitonidae. Polyplacophora.

Amphimenia Thiele 1894b.

Zeitschrift für wissenschaftliche Zoologie, 58(2): 244, 272; as new subgenus of *Proneomenia* Hubrecht 1880 [genus, teste Thiele 1913e: x, 39]. Type-species by monotypy: *Proneomenia neapolitana* Thiele 1894. [Proneomeniidae, teste Thiele, 1913e: x, 39; Amphimeniidae, teste Boss 1982: 952]. Aplacophora.

Anthochiton Thiele *in* Troschel & Thiele 1893e.

Das Gebiss der Schnecken, 2(8): 377; as new genus [= *Chiton (Clathropleura)*, teste Thiele 1909d: 3; = section of *Chiton (Rhyssoplax)* Thiele 1893, teste Thiele 1929: 20; = *Chiton (Rhyssoplax)*, teste A. G. Smith 1960: I65, Belle 1983: 124]. Type-species by monotypy: *Anthochiton tulipa* Quoy & Gaimard [*Chiton tulipa* Quoy & Gaimard 1835: 389, pl. 74 figs. 35, 36 = *C. tulipa alfredensis* Ashby 1828, teste Kaas & Belle 1980: 135]. Chitonidae [Ischnochitonidae, teste Belle 1983: 124]. Polyplacophora.

Anticlinura Thiele 1934.

Handbuch der systematischen Weichtierkunde, 2(3): 1002; nomen novum pro *Clinuropsis* Thiele 1929 *(q.v.)*, non *Clinuropsis* E. Vincent 1913; [subgenus of *Pleurotomella*, teste Wenz 1943: 1460]. Conidae [Turridae, teste Wenz 1943: 1460]. Gastropoda: Prosobranchia.

Appisania Thiele 1929.

Handbuch der systematischen Weichtierkunde, 1(1): 314; as new section of *Metula* H. & A. Adams 1853 [subgenus of *Metula*, teste Wenz 1941: 1195]. Type-species by monotypy: *Metula (Appisania) montrouzieri* (Crosse) [*Pisania montrouzieri* Crosse 1862: 251, pl. 10 fig. 5 [sic, 7]]. Buccinidae. Gastropoda: Prosobranchia.

Arabivitrina Thiele 1931c.

Handbuch der systematischen Weichtierkunde, 1(2): 600; as new section of *Vitrina* Draparnaud 1801 [subgenus of *Phenacolimax*, teste Zilch 1959: 238]. Type-species by monotypy: *Vitrina (Arabivitrina) arabica* Thiele [*Vitrina arabica* Thiele 1910]. Vitrinidae. Gastropoda: Pulmonata.

Archaeomenia Thiele 1906c.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **9**(2): 315 ff. [1 ff.]; as new genus. Type-species by monotypy: *Archaeomenia prisca* Thiele 1906. [Neomeniidae, teste Thiele 1913e: x, 27; Hemimeniidae, teste Boss 1982: 950]. Aplacophora.

Arcopella Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 914; as new section of *Arcopagia (Arcopagia)* T. Brown 1827 [listed by Thiele as "Sectio *Arcopella* Monterosato in sched."; subgenus of *Tellina* Linnaeus 1758, teste Keen *in* Moore, 1969: N614]. Type-species by monotypy: *Arcopagia (Arcopella) balaustina* (Linné) [*Tellina balaustina* Linnaeus, 1758: 676]. Tellinidae. Bivalvia.

Arctinula Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 806; as new section of *Propeamussium (Palliolum)* Monterosato 1884 [synonym of *Pecten (Delectopecten)* Stewart 1930, teste Hertlein *in* Moore 1969: N354]. Type-species by monotypy: *Propeamussium (Arctinula) groenlandicum* [sic] (Sowerby) [*Pecten greenlandicus* G. B. Sowerby II 1842: 57, pl. 13 fig. 40]. Pectinidae. Bivalvia.

Ariocaelatura "Germain" Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 615; non Germain 1921 [Zilch (1959: 307) listed *Pseudocaelatura* Wenz 1947, with *Ariocaelatura* Thiele 1931, non Germain 1921, as a synonym; Zilch (1960: 730) noted that *Pseudocaelatura* Wenz 1947 was preoccupied by *Pseudocaelatura* Germain 1921, and replaced the name by *Dancea*; subgenus of *Dancea* Zilch 1960, teste Vaught 1989: 96]. See Introduction, p. 5. Ariophantidae [Helicarionidae, teste Zilch 1959: 307]. Gastropoda: Pulmonata.

Aristochiton Thiele 1909d.
Zoologica, **22**(56/1): 35; as new genus [= *Craspedochiton* Shuttleworth 1853, teste A. G. Smith 1960: I69; = *Notoplax* H. Adams 1861, teste Kaas & Belle 1980: 60]. Type-species by monotypy: *Aristochiton hirtus* Thiele 1909. [Cryptoplacidae, teste Thiele 1909i: 116; Acanthochitonidae, teste A. G. Smith 1960: I69, Belle 1983:

144]. Polyplacophora.

Ascarosepia Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 954; emendation pro *Ascarosepion* Rochebrune 1884; as section of *Sepia* Linnaeus, 1758. Sepiidae. Cephalopoda.

Augustula Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 727; as new genus. Type-species by monotypy: *Imperturbatia braueri* Martens [*Streptaxis (Imperturbatia) braueri* Martens *in* Martens & Wiegmann 1898: 13, pl. 2 fig. 8]. Streptaxidae. Gastropoda: Pulmonata.

Austropilula Thiele 1927a.
Zoologische Jahrbücher, **53**(1/3): 122, 126; as new section of *Assiminea* Fleming 1828 [subgenus of *Assiminea*, teste Wenz 1939: 634]. Type-species by original designation: *Assiminea beddomeana* Nevill [G. Nevill 1880: 163; 1881a: 158, pl. 7 fig. 3]. Assimineidae. Gastropoda: Prosobranchia.

Bacteridium Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 236; as new subgenus of *Eulimella* Gray 1847 [genus, teste Wenz 1940: 867]. Type-species by monotypy: *Eulimella (Bacteridium) praeclara* Thiele [*Eulimella praeclara* Thiele 1925]. Pyramidellidae. Gastropoda: Prosobranchia.

Bathydomus Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(5): 247; as new genus [section of *Chlanidota* Martens 1878, teste Thiele 1929: 315; subgenus of *Chlanidota*, teste Wenz 1943: 1201]. Type-species by monotypy: *Bathydomus obtectus* Thiele 1912. [Buccinidae, teste Thiele 1929: 315]. Gastropoda: Prosobranchia.

Batillariella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 208; as new subgenus of *Batillaria* Benson 1842. Type-species by monotypy: *Batillaria (Batillariella) estuarina* (Tate) [*Bittium estuarinum* Tate 1893: 190, pl. 5 fig. 12]. Potamididae. Gastropoda: Prosobranchia.

Baudinella Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 685; as new section of *Angasella* A. Adams 1863 [subgenus of *Angasella*, teste Zilch 1960: 619]. Type-species by monotypy: *Angasella (Baudinella) baudinensis* (E. Smith) [*Helix (Gonostoma) baudinensis* E. A. Smith

1893: 97]. Pleurodontidae [Camaenidae, teste Zilch 1960: 619]. Gastropoda: Pulmonata.

Beanella "Dall" Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 388; non Dall 1882 [as synonym, listed as *Beanella* Dall 1881, nomen nudum, of *Middendorffia* Dall 1882; Boss, Rosewater & Ruhoff 1968, listed *Beanella* Dall as of 1882, a new name for *Beania* "Carpenter" Dall 1879; *Beanella* Thiele = *Ischnochiton* Gray 1847, teste A. G. Smith 1960: I55; = *Leptochiton* Gray 1847, s.s., teste Belle 1983: 52, with *rissoi* Payraudeau 1826 [= *Chiton algesirensis* Capellini, 1859] as type species by subsequent designation]. [Lepidochitonidae, teste Thiele 1929: 9; Ischnochitonidae, teste A. G. Smith 1960: I55; Leptochitonidae, teste Kaas & Belle 1985: 36]. See Introduction, p. 5. Polyplacophora.

Benthomangelia Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 208 [174], 220, 225; as new section of *Mangelia* Risso 1826 [subgenus of *Cythara* Schumacher 1817, teste Thiele 1929: 367]. Type-species by original designation: *Mangelia trophonoidea* (Schepman) [*Surcula trophonoidea* Schepman 1911 [1913]: 426, pl. 28 fig. 3]. Pleurotomidae [Conidae, teste Thiele 1929: 367; Turridae, teste Wenz 1943: 1437]. Gastropoda: Prosobranchia.

"Berryiteuthis" [1926b].
Handbuch der Zoologie, **5**(3): 252; error pro *Berryteuthis* Naef 1923. Gonatidae. Cephalopoda.

Boogina Thiele 1913a.
Zentralblatt für Zoologie, **2**(3): 86; nomen novum pro *Watsonella* Thiele 1912 *(q.v.)*, non Grabau 1900. Rissoidae. Gastropoda: Prosobranchia.

Bothropoma Thiele 1924a.
Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 63, 71; as new genus. Type-species by monotypy: *Bothropoma isseli* Thiele 1924. Turbinidae [Cyclostrematidae, teste Thiele 1925d: 76]. Gastropoda: Prosobranchia.

Brevinucula Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 786; as new subgenus of *Nucula* Lamarck 1799 [genus, teste Keen *in* Moore 1969: N231]. Type-species by monotypy: *Nucula (Brevinucula)*

guineensis Thiele [*Nucula guineensis* Thiele & Jaeckel 1931]. Nuculidae. Bivalvia.

Buccinella Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 244, 246; as new genus [non *Buccinella* Perry 1811; *Buccinella* Thiele replaced by *Fusinella* Thiele 1917, *(q.v.)*]. Type-species by original designation: *Buccinella jucunda* Thiele 1912. Buccinidae. Gastropoda: Prosobranchia.

Bufonariella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 284; "nomen novum" [error pro "new section"?]; listed as section [subgenus of *Bursa* Röding 1798, teste Wenz 1941: 1072]. Type-species by monotypy: *Bursa (Bufonariella) scrobiculator* (Linnaeus) [*Murex scrobiculator* Linnaeus 1758]. Bursidae. Gastropoda: Prosobranchia.

Cadlinella Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 431; as new genus. Type-species by monotypy: *Cadlinella ornatissima* (Risbec) [*Cadlina ornatissima* Risbec 1928: 163, text-fig. 47, pl. 8 fig. 4]. Dorididae [Echinochilidae, teste Odhner in Franc, 1968: 866; Cadlinidae, teste Vaught 1989: 89]. Gastropoda: Opisthobranchia.

Callinina Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 747; nomen novum pro *Callina* Hannibal 1912 [as listed by Thiele 1929: 114], non Lowe 1855; subgenus of *Viviparus* Montfort 1810, teste Wenz 1939: 490]. See also Tomlin 1936: 136. Viviparidae. Gastropoda: Prosobranchia.

Calloplax Thiele 1909d.
Zoologica, **22**(56/1): 19; as new genus [subgenus of *Callistochiton* Dall 1879, teste Belle 1983: 82]. Type-species by monotypy: *Chiton janeirensis* Gray 1828 [p. 6, pl. 3 fig. 8]. [Ischnochitonidae, teste Thiele 1909i: 116; Chaetopleuridae, teste A. G. Smith 1960: I62]. Polyplacophora.

Callumbonella Thiele 1924a.
Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 58, 69; nomen novum pro *Umbotrochus* (Monterosato MS) Thiele 1924 *(q.v.)*, non Perner 1904. Trochidae. Gastropoda: Prosobranchia.

Calotropis Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 49; nomen novum pro *Calliotropis* Oliver 1926, non Seguenza, 1903; as section of *Calliostoma* Swainson 1840, s.s. Trochidae. Gastropoda: Prosobranchia.

Carinolacuna Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 122; as new subgenus of *Lacuna* Turton 1827 [genus, teste Wenz 1939: 513]. Type-species by monotypy: *Lacuna (Carinolacuna) carinifera* A. Adams [*Lacuna carinifera* A. Adams 1851 [1853]: 225]. Lacunidae. Gastropoda: Prosobranchia.

Caspiella Thiele 1928c.

Zoologische Jahrbücher, 55(5-6): 353, 381; as new genus. Type-species by original designation: *Rissoa conus* Eichwald [1838: 155]. Micromelaniidae or Hydrobiidae [?Micromelaniidae, teste Thiele 1929: 159; Micromelaniidae, teste Wenz 1939: 606]. Gastropoda: Prosobranchia.

Cassidulella Thiele 1934.

Handbuch der systematischen Weichtierkunde, **2**(3): 1004; nomen novum pro *Cassidulina* Thiele 1931 *(q.v.)*; non *Cassidulina* Orbigny 1826; non *Cassidulella* Strand 1928, which was replaced by *Cassidulta* Strand 1942 [= *Cassidulta* Strand 1942, teste Zilch 1959: 76]. Ellobiidae. Gastropoda: Pulmonata.

Cassidulina Thiele 1931c.

Handbuch der systematischen Weichtierkunde, **1**(2): 467; as new subgenus of *Cassidula* Férrussac 1821 [non *Cassidulina* Orbigny 1826; *Cassidulina* Thiele replaced by *Cassidulella* Thiele 1934 *(q.v.)*; = *Cassidulta* Strand 1942, teste Zilch 1959: 76]. Type-species by monotypy: *Cassidula (Cassidulina) doliolum* (Petit) [*Auricula doliolum* Petit de la Saussaye, 1843: 201]. Ellobiidae. Gastropoda: Pulmonata.

Cerithideopsilla Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 206; as new section of *Cerithidea (Cerithideopsis)* Thiele 1929 *(q.v.)* [subgenus of *Cerithidea* Swainson 1840, teste Wenz 1940: 742]. Type-species by monotypy: *Cerithidea (Cerithideopsilla) fluviatilis* (Potiez & Michaud) [*Cerithium fluviatile* Potiez & Michaud 1838: 363, pl. 31 figs. 19, 20; = *Murex cingulata* Gmelin 1791, teste Wenz 1940: 742]. Potamididae. Gastropoda: Prosobranchia.

Cerithideopsis Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 206; as new subgenus and section of *Cerithidea* Swainson 1840 [subgenus of *Cerithidea*, teste Wenz 1940: 742]. Type-species by monotypy: *Cerithidea (Cerithideopsis) iostoma* (Pfeiffer) [*Potamides iostomus* L. Pfeiffer 1839: 357]. Potamididae. Gastropoda: Prosobranchia.

Cerithiopsilla Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 202, 204; as new subgenus of *Cerithiopsis* Forbes & Hanley 1849, or as new genus [subgenus of *Cerithiopsis*, teste Thiele 1925b: 121 [87]]. Type-species by original designation: *Cerithiopsilla cincta* Thiele 1912. Cerithiopsidae [Cerithiidae, teste Powell 1960: 140]. Gastropoda: Prosobranchia.

Charoniella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 283; as new section of *Charonia* Gistel 1848; non *Charoniella* Powell & Bartrum 1929; [synonym of *Negyrina* Iredale 1929, teste Wenz 1941: 1066]. Type-species by monotypy: *Charonia (Charoniella) subdistorta* (Lamarck) [*Triton subdistortum* Lamarck 1822: 186]. Cymatiidae [= Ranellidae]. Gastropoda: Prosobranchia.

Chlanidotella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 317; as new subgenus of *Thalassoplanes* Dall 1908. Type-species by monotypy: *Thalassoplanes (Chlanidotella) modesta* (Martens) [*Cominella modesta* Martens 1885: 91]. Buccinidae. Gastropoda: Prosobranchia.

Chondroplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 363; as new genus [section of *Chiton*, teste Thiele 1909d: 2, 5; = *Chiton* s.s. Linnaeus 1758, teste A. G. Smith 1960: I65; Belle 1983: 123]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton granosus* [Frembly 1827: 200, suppl. pl. 17 fig. 1]. Chitonidae. Polyplacophora.

Chondropleura Thiele 1906d.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **9**(2): 334; as new subgenus of *Ischnochiton* Gray 1847 [= *Ischnochiton (Stenosemus)* Middendorff 1847, teste Belle 1980: 69; Kaas & Belle 1990: 60]. Type-species by subsequent designation (A. G. Smith 1960: I56): *Lophyrus exaratus* G. O. Sars 1878 [p. 113, pl. 3 fig. 1]. [Ischnochitonidae, teste Thiele 1929: 18]. Polyplacophora.

Chuniscala Thiele 1928d.

Zeitschrift für wissenschaftliche Zoologie, **132**: 93; new subgroup of *Scala* (Klein 1753) Bruguière 1792 [= *Epitonium* Röding 1798] [section of *Scala (Cirsotrema)* Mörch 1852, teste Thiele 1929: 222; subgenus of *Cirsotrema*, teste Wenz 1940: 798]. Type-species by original designation: *Scala agulhasensis* Thiele 1925. Scalidae [= Epitoniidae]. Gastropoda: Prosobranchia.

Chunula Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 62 [28], 58 [24]; as new genus [nom. nud. in Thiele 1924a: 60, 71]. Type-species by original designation: *Chunula typica* Thiele 1925. Cyclostrematidae. Gastropoda: Prosobranchia.

Cilara Thiele 1924b.
Archiv für Molluskenkunde, **56**(5): 202, 210; as new section of *Pyrene (Mitrella)* Risso 1826 [subgenus of *Mitrella*, teste Wenz 1941: 1139]. Type-species by monotypy: *Buccinum secalinum* Philippi [1846: 53]. Columbellidae. Gastropoda: Prosobranchia.

Cirsotremopsis Thiele 1928d.
Zeitschrift für wissenschaftliche Zoologie, **132**: 92; as new section of *Scala* (Klein 1753) Bruguière 1792 [= *Epitonium* Röding 1798] [sect. of *Scala (Cirsotrema)* Mörch 1852, teste Thiele 1929: 222; subgenus of *Cirsotrema*, teste Wenz 1940: 795]. Type-species by monotypy: *Scalaria cochlea* Sowerby [G. B. Sowerby II 1844: 103, pl. 35 fig. 142]. Scalidae [= Epitoniidae]. Gastropoda: Prosobranchia.

Citharella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 366; probable emendation pro *Cyharella* Monterosato 1875; as section of subgenus *Cythara* Schumacher 1817 s.s. [Wenz 1943: 1432 listed this as *Cytharella*, a subgenus of *Cythara*; the spelling *Cyharella* by Monterosato was considered a *lapsus calami* by Wenz (1943: 1432)]. Conidae [Turridae, teste Wenz 1943: 1432]. Gastropoda: Prosobranchia.

Clathropleura "Tiberi" Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 367; non Tiberi 1877 [*Clathropleura* Tiberi 1887 *part.* = *Chiton (Rhyssoplax)* Thiele 1893, teste Thiele 1929: 20; *Clathropleura* Thiele 1893, non Tiberi 1877, = *Rhyssoplax*, teste Belle: 90]. Type species by original designation: *Chiton siculus* Gray 1828 [p. 5]. See Introduction, p. 5. Polyplaco-

phora.

Clathrotellina Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 917; as new subgenus of *Merisca* Dall 1900 [subgenus of *Tellina* Linnaeus 1758, teste Keen 1969: N615]. Type-species by monotypy: *Merisca (Clathrotellina) pretiosa* (Deshayes) [*Tellina pretiosa* Deshayes 1855: 360, *non* Eichwald 1830; = *T. pretium* Salisbury 1934]. Tellinidae. Bivalvia.

"Cleovitrea" [1931c].
Handbuch der systematischen Weichtierkunde, **1**(2): 739; error pro *Cleotrivia* Iredale 1930 [corrected by Thiele 1934: 1010]. Cypraeidae [Triviidae, teste Vaught 1989: 34]. Gastropoda: Prosobranchia.

Clinuropsis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 372; as new section of *Pleurotomella* Verrill 1873 [non *Clinuropsis* E. Vincent 1913; *Clinuropsis* Thiele replaced by *Anticlinura* Thiele 1934, *(q.v.)*]. Type-species by original designation: *Clinura monochorda* Dall [1908: 214, 292, pl. 13 fig. 1]. Conidae [Turridae, teste Wenz 1943: 1460]. Gastropoda: Prosobranchia.

Cocculinella Thiele 1909g.
Systematisches Conchylien-Cabinet von Martini und Chemnitz, **2**(11a): 21; as new genus. Type-species by monotypy: *Acmaea minutissima* E. Smith 1904 [E. A. Smith 1904b: 4]. Lepetellidae. Gastropoda: Prosobranchia.

Conacmella Thiele 1927a.
Zoologische Jahrbücher, **53**: 123, 126; as new genus. Type-species by original designation: *Acmella vagans* Pilsbry [(Pilsbry MS) Thiele 1927]. Assimineidae. Gastropoda: Prosobranchia.

Conasprella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 373; as new subgenus of *Conus* Linnaeus 1758 [subjective synonym of *Hemiconus* Cossmann 1889, teste Wenz 1943: 1466]. Type-species by monotypy: *Conus (Conasprella) cancellatus* Bruguière [*Conus cancellatus* Hwass *in* Bruguière 1792: 712-713]. Conidae. Gastropoda: Prosobranchia.

Conibycus Thiele 1928a.
Zoologische Jahrbücher, **55**(1-3): 136; as new genus. Type-species by original designation: *Conibycus dahli* Thiele 1928. Ariophantidae

[Euconulidae, teste Zilch 1959: 282]. Gastropoda: Pulmonata.

Crossilla Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 123, 126; as new section of *Assiminea* Fleming 1828 [subgenus of *Assiminea*, teste Wenz 1939: 633]. Type-species by original designation: *Assiminea caledonica* (Crosse) [*Hydrocena caledonica* Crosse 1869: 24, pl. 2 fig. 4]. Assimineidae. Gastropoda: Prosobranchia.

Cubaedomus Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 397, 401; as new subgenus of *Hemisinus* Swainson 1840. Type-species by monotypy: *Melania brevis* Orbigny [*Melania brevis* A. Orbigny *in* Sagra 1842: 10; non I. Lea 1842]. Melaniidae [Thiaridae, teste Wenz 1939: 719]. Gastropoda: Prosobranchia.

Daedalocheila Thiele 1931.
Handbuch der systematischen Weichtierkunde, **1**(2): 580; emendation pro *Daedalochila* Beck 1837; as subgenus of *Polygyra* Say 1818. Polygyridae. Gastropoda: Pulmonata.

Diaphanella Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 277; as new group [non *Diaphanella* Clessin 1880; *Diaphanella* Thiele replaced by *Notodiaphana* Thiele 1917 *(q.v.)*; non *Diaphanella* P. Hesse 1916, replaced by *Geodiaphana* Thiele 1917 *(q.v.)*]. Type-species by monotypy: *Bulla fragilis* Vélain [1877: 128, pl. 4 fig. 31]. [Notodiaphanidae, teste Thiele 1931c: 383]. Gastropoda: Opisthobranchia.

Diochiton Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 364; as new genus [= *Chiton* Linnaeus 1758, s.s., teste Thiele 1909d: 2, A. G. Smith 1960: I65, and Belle 1983: 123; = section of *Chiton* s.s., teste Thiele 1929: 20]. Type-species by monotypy: *Diochiton albilineatus* [sic] Sowerby [*Chiton albolineatus* Broderip & G. B. Sowerby I 1829: 368]. Chitonidae. Polyplacophora.

Dioeciostraea Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 814; emendation pro *Dioeciostrea* Orton 1928, as synonym of *Ostrea (Crassostrea)* Sacco 1897; Stenzel (1971: N1128) listed this as a *nomen nullum* in the synonymy of *Crassostrea*. Ostreidae. Bivalvia.

Doratosepia Thiele 1934.

Handbuch der systematischen Weichtierkunde, **2**(3): 954; emendation pro *Doratosepion* Rochebrune 1884; as section of *Sepia* Linnaeus 1758. Sepiidae. Cephalopoda.

Drupella Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 171 [137]; as new subgenus of *Purpura* Bruguière 1789 [subgen. of *Drupa* Röding 1798, teste Thiele 1929: 295]. Type-species by designation under plenary powers (ICZN Opinion 1154, 1980: 85): *Purpura elata* Blainville 1832: 207, pl. 11 fig. 1]. Muricidae. Gastropoda: Prosobranchia.

Durgellina Thiele 1928a.
Zoologische Jahrbücher, **55**(1-3): 135; as new genus. Type-species by original designation: *Durgellina vitrina* Thiele 1928 [= *Helix calculosa* "Couthouy" Gould 1852, teste Zilch 1959: 281]. Ariophantidae [Euconulidae, teste Zilch 1959: 281]. Gastropoda: Pulmonata.

Eatonina Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 279; as new subgenus of *Eatoniella* Dall 1876 [genus, teste Thiele 1929: 167]. Type-species by monotypy: *Eatoniella (Eatonina) pusilla* Thiele 1912. [Rissoidae, teste Thiele 1925d: 80; Cingulopsidae, teste Ponder 1985: 100]. Gastropoda: Prosobranchia.

Eatoniopsis Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 237; as new genus [= *Skenella* Pfeffer 1886, teste Ponder 1985: 100]. Type-species by monotypy: *Eatoniella paludinoides* E. Smith [E. A. Smith 1902: 205, pl. 24 fig. 18]. [Rissoidae, teste Thiele 1925d: 80; Cingulopsidae, teste Ponder 1985: 100]. Gastropoda: Prosobranchia.

Ebalina Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 236; as new section of *Eulimella (Ebala)* Leach 1847 [subgenus of *Ebala*, teste Wenz 1940: 866]. Type-species by monotypy: *Eulimella (Ebalina) monolirata* (Folin) [*Aclis monolirata* de Folin *in* Fischer, de Folin & Périer 1872 [1873]: 178, pl. 7 fig. 6]. Pyramidellidae. Gastropoda: Prosobranchia.

"Electromactra" [1934].
Handbuch der systematischen Weichtierkunde, **2**(3): 901; error pro *Electomactra* Iredale 1930, as section of *Mactra (Mactrella)* Gray

1853. Mactridae. Bivalvia.

Emmericiopsis Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 357, 380; as new section of *Bythinia (Gabbia)* Tryon 1865 [subgenus of *Bulimus* Scopoli 1777, teste Wenz 1939: 590]. Type-species by monotypy: *Pachydrobia lacustris* Martens [*Pachydrobia lacustris* Martens 1897: 26, pl. 9 figs. 12-15]. Hydrobiidae [Bulimidae, teste Wenz 1939: 590; = Bithyniidae]. Gastropoda: Prosobranchia.

Eosipho Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 307; as new subgenus of *Sipho* Bruguière 1792 [genus, teste Wenz 1941: 1154]. Type-species by monotypy: *Sipho (Eosipho) smithi* (Schepman) [*Chrysodomus (Sipho) smithi* Schepman 1911: 300, pl. 19 fig. 6, pl. 23 fig. 11]. Buccinidae. Gastropoda: Prosobranchia.

Eumetula Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 202, 205; as new subgenus of *Eumeta* Mörch 1868 [non Walker 1855] [synonym (p. 122 [88]) or probable synonym (p. 125 [91]) of *Metaxia* Monterosato 1884, teste Thiele 1925b; genus, teste Thiele 1929: 217]. Type-species by monotypy: *Eumeta (Eumetula) dilecta* Thiele 1912. Cerithiopsidae [Cerithiidae, teste Powell 1960: 140]. Gastropoda: Prosobranchia.

Euparthenia Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 233; nomen novum pro *Parthenia* Lowe 1840 [*part.*], non Robineau-Desvoidy 1830; [subgenus of *Kleinella* A. Adams 1860, teste Wenz 1940: 850]. Pyramidellidae. Gastropoda: Prosobranchia.

Euthymella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 219; nomen novum pro *Euthymia* Jousseaume 1884, non Stål 1876 [subgenus of *Triphora* Blainville 1828, teste Wenz 1940: 786]. Triphoridae. Gastropoda: Prosobranchia.

Ficulina Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 271; as new subgenus of *Cominella* Gray 1850 or as new genus [non *Ficulina* Gray 1867; *Ficulina* Thiele replaced by *Notoficula* Thiele 1917, *(q.v.)*]. Type-species by monotypy: *Chlanidota bouveti* Thiele 1912. [Buccinidae, teste Thiele 1929: 315]. Gastropoda: Prosobranchia.

Fossarella Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 96 [62]; as new genus. Type-species by original designation: *Fossarella pacifica* Thiele 1925. Fossaridae. Gastropoda: Prosobranchia.

Frovina Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 196; as new genus. Type-species by monotypy: *Frovina soror* Thiele 1912. [Naticidae, teste Thiele 1929: 259]. Gastropoda: Prosobranchia.

Fusinella Thiele 1917a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **49**(1): 24; nomen novum pro *Buccinella* Thiele 1912 *(q.v.)*, non Perry 1811. Buccinidae. Gastropoda: Prosobranchia.

Fusiturris Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 361; as new section of *Turris (Turris)* O. F. Müller 1766 [sic] [subgenus of *Turris* Röding 1798, teste Wenz 1943: 1404]. Type-species by monotypy: *Turris (Fusiturris) undatiruga* (Bivona) [*Pleurotoma undatiruga* Bivona *in* Philippi 1844: 171, pl. 26 fig. 13]. Conidae [Turridae, teste Wenz 1943: 1404]. Gastropoda: Prosobranchia.

Garrettina Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 572; nomen novum pro *Garrettia* Cossmann 1900 non (Pease) Paetel 1873 [synonym of *Libera* Garrett 1881, teste Zilch 1959: 215; see also Pilsbry 1932: 70]. Endodontidae. Gastropoda: Pulmonata.

Geodiaphana Thiele 1917a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **49**(1): 23; nomen novum pro *Diaphanella* P. Hesse 1916, non Clessin 1880, nec Thiele 1912 *(q.v.)*; = *Hydatina* Westerlund 1886, non Schumacher 1817, nec Ehrenberg 1830 [= *Mediterranea* Clessin 1880, teste Thiele 1931c: 590; subgenus of *Oxychilus* Fitzinger 1833, teste Zilch 1959: 254]. [Zonitidae, teste Thiele 1931c: 590]. Gastropoda: Pulmonata.

Georgus Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 366; as new genus [= *Chiton (Clathropleura)*, teste Thiele 1909d: 2, 5; = *Chiton* Linnaeus 1758, s.s., teste A. G. Smith 1960: I65, Belle 1983: 123]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton rusticus* [Deshayes 1863: 39, pl. 4 figs. 1-3; = *mauritianus* Quoy & Gaimard

1835, teste Belle 1983: 123]; Thiele (1909d: 2, 5) subsequently re-identified the material previously called *Chiton rusticus* as *Chiton (Clathropleura) angusticostatus* Quoy & Gaimard 1835, resulting in a misidentified type species in the sense of ICZN 1985, Art. 70]. Chitonidae. Polyplacophora.

Goniaeolis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 450; emendation for *Goniëolis* M. Sars 1859 [Thiele (1931c: 450) also changed *Goniëolis* M. Sars 1859 to *Gonieolis*]. Goniaeolididae. Gastropoda: Opisthobranchia.

Gracilancilla Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 188 [154]; as new subgenus of *Ancilla* Lamarck 1799. Type-species by original designation: *Ancilla sumatrana* Thiele 1925. Olividae. Gastropoda: Prosobranchia.

Gracilimurex Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 289; as new subgenus of *Murex* Linnaeus 1758 [genus, teste Wenz 1941: 1087]. Type-species by monotypy: *Murex (Gracilimurex) bicolor* Thiele 1929. Muricidae. Gastropoda: Prosobranchia.

Haminella Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 267 [233]; as new subgenus of *Haminea* Gray 1847 [subgenus of *Haminaea* [sic] Turton & Kingston 1830, teste Zilch 1959: 42]. Type-species by original designation: *Haminea maltzani* Thiele 1925. Atyidae [Hamineidae [sic, Haminoeidae], teste Vaught 1989: 65]. Gastropoda: Opisthobranchia.

Harpovoluta Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 213; as new genus. Type-species by original designation: *Harpovoluta vanhöffeni* [*vanhoeffeni*] Thiele 1912. Volutidae. Gastropoda: Prosobranchia.

Heathia Thiele 1913e.
Das Tierreich, **38**: ix, 17; as new genus. Type-species by monotypy: *Ichthyomenia porosa* Heath 1911 [p. 48, figs.]. Lepidomeniidae [Dondersiidae, teste Boss 1982: 949]. Aplacophora.

Hedylopsis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 443; as new genus. Type-species by monotypy: *Hedylopsis spiculifera* (Ko-

walevsky) [*Hedyle spiculifera* Kowalevsky 1901b: 21-25, pl. 4 figs. 49-51, pl. 5 figs. 56-69]. Hedylidae [Hedylopsidae, teste Pruvot-Fol 1954: 165]. Gastropoda: Opisthobranchia.

Helioradsia Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 385; as new genus [= *Chaetopleura* s.s. Shuttleworth 1853, teste Belle 1983: 85; = *Chaetopleura (Palliochiton)* Dall 1879, teste Kaas & Belle 1987: 103]. Type-species by monotypy: *Helioradsia gemma* Carpenter [*Chaetopleura gemma* "Carpenter" Dall 1879: 78, fig. 9]. Chitonidae [Chaetopleuridae, teste Belle 1983: 85; Ischnochitonidae, teste Kaas & Belle 1987: 103]. Polyplacophora.

Hemiglyptopsis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 624; as new subgenus of *Antinous* Robson 1914. Type-species by monotypy: *Antinous (Hemiglyptopsis) foullioyi* (Guillou) [*Helix foullioyi* Le Guillou 1845: 187]. Ariophantidae [Helicarionidae, teste Zilch 1959: 298]. Gastropoda: Pulmonata.

Hemimetis Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 915; as new subgenus of *Apolymetis* Salisbury 1929 [subgenus of *Tellina* Linnaeus 1758, teste Keen *in* Moore 1969: N615]. Type-species by monotypy: *Apolymetis (Hemimetis) plicata* (Valenciennes) [*Tellina plicata* Valenciennes *in* Lamarck 1827: 154; see also Lamarck 1798: pl. 287 fig. 3]. Tellinidae. Bivalvia.

Himatina Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 453; nomen novum pro *Himatella* Bergh 1891, non Zittel 1879 [= *Coryphella* Gray 1850, teste Odhner *in* Franc 1968: 881]. Flabellinidae [Coryphellidae, teste Odhner *in* Franc 1968: 881]. Gastropoda: Opisthobranchia.

Hochstetterina Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 796; [listed by Thiele as "nom. nov." pro *Hochstetteria* Vélain 1877 *part.*; subgenus of *Philobrya* Carpenter 1872, teste Keen *in* Moore 1969: N269]. Type-species by monotypy: *Hochstetterina crenella* (Vélain) [*Hochstetteria crenella* Vélain, 1877: 131-132, pl. 5 figs. 5, 6]. Limopsidae [Philobryidae, teste Keen *in* Moore 1969: N270]. Bivalvia.

Hydrococcus Thiele 1928c.

Zoologische Jahrbücher, **55**(5-6): 375, 380; as new genus. Type-species by monotypy: *Hydrococcus graniformis* Thiele 1928, new name for *Paludina granum* Menke 1843, non Say 1822 [= *Rissoa (Setia) brazieri* Tenison-Woods 1876 = *Hydrococcus brazieri* (Tenison-Woods 1876), teste Ponder 1982: 65]. Hydrobiidae [Hydrococcidae, teste Wenz, 1939: 588]. Gastropoda: Prosobranchia.

Hymenoteuthis Thiele 1916a.
Zoologischer Anzeiger, **48**(1): 4; as new genus or subgen. of *Vampyroteuthis* Chun 1903 [genus, teste Thiele 1934: 984; subjective synonym of *Vampyroteuthis*, teste Nesis 1987: 276]. Type-species by monotypy: *Cirroteuthis macrope* Berry 1910 [1911: 589]. Vampyroteuthidae. Cephalopoda.

Icoplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 392; as new genus [subgenus of *Callochiton* Gray 1847, teste Thiele 1929: 9; = *Callochiton* Gray 1847, s.s., teste A. G. Smith 1960: I58, Belle 1983: 90]. Type-species by monotypy: *Icoplax punicea* Couthouy [*Chiton puniceus* (Couthouy MS) Gould 1846: 143; = *Trachydermon steinenii* Pfeiffer (sic, err. pro Pfeffer) 1886, teste Belle 1983: 90]. Chitonidae [Callochitonidae, teste A. G. Smith 1960: I58; Ischnochitonidae, teste Kaas & Belle 1985b: 11]. Polyplacophora.

Iduliella Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 449; nomen novum pro *Dotilla* Bergh 1879, non Stimpson 1858. Iduliidae [Dotonidae, teste Odhner *in* Franc 1968: 877]. Gastropoda: Opisthobranchia.

Indopyrgus Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 373, 378; as new subgenus of *Pomatopyrgus* Stimpson 1865. Type-species by monotypy: *Pomatopyrgus (Indopyrgus) nevilli* Thiele 1928. Hydrobiidae. Gastropoda: Prosobranchia.

Iphitella Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 93 [59]; nomen novum pro *Iphitus* Jeffreys 1883, non Rafinesque 1815. Fossaridae [? Littorinidae, teste Thiele 1929: 127]. Gastropoda: Prosobranchia.

Ischnocerithium Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 212; as new subgenus of *Colina* H. & A. Adams 1854. Type-species by

monotypy: *Colina (Ischnocerithium) rostrata* (Sowerby) [*Cerithium rostratum* G. B. Sowerby II 1855: 861, pl. 180, fig. 104]. Cerithiidae. Gastropoda: Prosobranchia.

Jaronia Thiele 1934.
Handbuch der systematischen Weichtierkunde, 2(3): 818; emendation pro *Iaronia* Pallary 1924 [German spelling of "I"]; as section of *Caelatura* Conrad 1853. Unionidae. Bivalvia.

Jeffreysiella Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 239; as new genus [subgen. of *Rissoella*, teste Thiele 1925b: 91 [57]]. Type-species by monotypy: *Jeffreysiella notabilis* Thiele 1912. [Rissoellidae, teste Thiele 1925b: 91 [57]]. Gastropoda: Prosobranchia.

Jeffreysilla Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 92 [58]; n. subgroup of *Rissoella* Gray 1847 [subgenus of *Rissoella*, teste Thiele 1929: 179]. Type-species by monotypy: *Rissoella (Jeffreysilla) zebra* Thiele 1925. Rissoellidae. Gastropoda: Prosobranchia.

Jeffreysina Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 92 [58]; as new subgenus of *Rissoella* Gray 1847. Type-species by subsequent designation (Wenz 1939: 649): *Rissoella (Jeffreysina) globularis* (Jeffreys) [*Jeffreysia globularis* Jeffreys MS. Forbes & Hanley 1853: 268-269, pl. 133 fig. 5; teste Warén 1980: 24]. Rissoellidae. Gastropoda: Prosobranchia.

Jeffreysiopsis Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 276; as new subgenus of *Jeffreysia* Alder 1849 [*Jeffreysiopsis* Thiele = *Rissoella* Gray 1847, s.s., teste Thiele 1925b: 91 [57]]. Type-species by monotypy: *Paludestrina duperrei* Vélain [1877: 115, pl. 3 figs. 18, 19]. [Rissoellidae, teste Thiele 1925b: 91 [57]]. Gastropoda: Prosobranchia.

Jheringella Thiele 1934.
Handbuch der systematischen Weichtierkunde, 2(3): 841; emendation pro *Iheringella* Pilsbry 1893 [German spelling of "I"]; as genus. Mutelidae. Bivalvia.

Lepidochiton Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 8; emendation

pro *Lepidochitona* Gray 1821, non *Lepidochiton* Carpenter 1857; as genus [= *Lepitochitona*, teste A. G. Smith 1960: I56]. Lepidochitonidae [Ischnochitonidae, teste A. G. Smith 1960: I56]. Polyplacophora.

Lepidopleuroides Thiele 1928b.
Fauna Arctica, **5**(2): 564; as new subgenus of *Ischnochiton* Gray 1847 [= *Ischnochiton (Stenosemus)* Middendorff 1847, teste A. G. Smith 1960: I55, Belle 1983: 69; Kaas & Belle 1990: 60]. Type-species by original designation: *Ischnochiton (Lepidopleuroides) albus* (Linnaeus) [*Chiton albus* Linnaeus 1767: 1107]; see Kaas & Belle 1980: 6, for synonyms. Ischnochitonidae. Polyplacophora.

Leptopleura Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 381; as new genus [= *Ischnochiton* Gray 1847, teste Thiele 1909d: 3; A. G. Smith 1960: I55; Belle 1983: 66; Kaas & Belle 1990: 78]. Type-species by monotypy: *Leptopleura catenulata* Sowerby [*Chiton catenulatus* G. B. Sowerby 1832: 104]; material subsequently re-identified as *Ischnochiton fraternus* Thiele 1909, by Thiele 1909i: 77. Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I55; Kaas & Belle 1990: 78]. Polyplacophora.

Leucostele Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 123, 126, 129; as new section of *Paludinella* L. Pfeiffer 1841 [introduced as as new section, but Thiele referred to *Leucostele* Semper on pp. 126, 129; listed by Thiele 1929: 170 as "*Leucostele* (Semper) Thiele 1927"; subgenus of *Paludinella*, teste Wenz, 1939: 633]. Type-species by original designation: *Paludinella (Leucostele) vitrea* Thiele 1927. Assimineidae. Gastropoda: Prosobranchia.

Limopsilla Thiele 1923.
Zoologischer Anzeiger, **55**(11/13): 289; as new genus [= *Limopsis* Sassi 1827, teste Newell *in* Moore 1969: N265]. Type-species by monotypy: *Limopsis pumilio* E. Smith [E. A. Smith, 1904a: 43, pl. 3 figs. 27, 28]. Limopsinae [Limopsidae, teste Thiele 1926b: 186]. Bivalvia.

Lionucula Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 786; emendation pro *Leionucula* W. Quenstedt 1930; as subgenus of *Nucula* Lamarck 1799. Nuculidae. Bivalvia.

Lissarcula Thiele 1923.

Zoologischer Anzeiger, **55**(11/13): 290; as new genus [?= *Limopsis* Sassi, 1827, teste Newell *in* Moore 1969: N265]. Type-species by original designation: *Lissarcula australis* Thiele 1923. Limopsinae [Limopsidae, teste Thiele 1926b: 186]. Bivalvia.

Lissoconchus Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 125; as new subgenus of *Cremnoconchus* Blanford 1869. Type-species by monotypy: *Cremnoconchus (Lissoconchus) conicus* Blanford [*Cremnoconchus conicus* W. T. Blanford 1870: 10, pl. 3 fig. 3]. Littorinidae. Gastropoda: Prosobranchia.

Lithoglyphopsis Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 366, 379; as new genus. Type-species by original designation: *Lithoglypha modestus* Gredler [*Lithoglyphus modestus* Gredler 1887: 17]. Hydrobiidae. Gastropoda: Prosobranchia.

Lophopleura Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 279; as new subgenus of *Lobiger* Krohn 1847 [genus, teste Thiele 1925b: 281 [247]]. Type-species by monotypy: *Lobiger (Lophopleura) capensis* Thiele 1912. [Philinidae, teste Thiele 1925b: 281 [247]; Oxynoidae, teste Thiele 1931c: 412]. Gastropoda: Opisthobranchia.

Lophosepia Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 954; emendation of *Lophosepion* Rochebrune 1884; as section of *Sepia* Linnaeus 1758. Sepiidae. Cephalopoda.

Lophyriscus Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 377; as new genus [= section of *Ischnochiton* Gray 1847, teste Thiele 1909d: 3, 7; = *Ischnochiton* s.s. teste Thiele 1929: 17; Kaas & Belle 1990: 78]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton textilis* [Gray 1828: 5, pl. 6 fig. 20]; material subsequently re-identified as *C. oniscus* Krauss 1848, by Thiele 1909d: 3, 6; Belle 1983: 66]. See Kaas & Belle (1980: 93, 131) for additional homonyms and synonyms. Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I55; Kaas & Belle 1990: 78]. Polyplacophora.

Lophyropsis Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 387; as new genus [= *Lepidopleurus* Risso 1826, teste Thiele 1909d: 4; = *Lepidopleurus (Leptochiton)* Gray 1847, teste Thiele 1929: 6; = subgenus of *Ischnochiton* Gray

1847, teste A. G. Smith 1960: I56; = *Leptochiton* Gray 1847, s.s., teste Belle 1983: 52]. Type-species by monotypy: *Lophyropsis imitatrix* [sic] E. Smith [emendation pro *Chiton (Ischnochiton) imitator* E. A. Smith 1881]; Thiele (1909d: 4, 7) subsequently re-identified the material previously called *Lophyropsis imitatrix* as *Lepidopleurus medinae* Plate 1899, resulting in a misidentified type species in the sense of ICZN 1985, Art. 70]. See Kaas & Belle (1980: 62) for homonyms of *Chiton imitator.* Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I56; Leptochitonidae, teste Kaas & Belle 1985a: 36]. Polyplacophora.

Luteacarnea Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 827; nomen novum pro *Striata* Frierson 1927, non O. Boettger 1878; as subgroup of *Quadrula* Rafinesque 1820. Unionidae. Bivalvia.

Lyocyclus Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 116 [82]; as new group [genus, teste Wenz 1940: 896]. Type-species by original designation: *Lyocyclus solutus* Thiele 1925. Lyocyclidae Thiele 1925 [Trichotropidae, teste Thiele 1929: 242]. Gastropoda: Prosobranchia.

"Lyonsiela" [1912b].
Deutsche Südpolar-Expedition 1901-1903, **13**(5): 232; error pro *Lyonsiella* Sars 1872. [Verticordiidae, teste Thiele 1934: 944]. Bivalvia.

Macrassiminea Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 122, 126; as new section of *Assiminea* Fleming 1828 [subgenus of *Assiminea,* teste Wenz 1939: 632]. Type-species by original designation: *Assiminea francesi* (Gray) [*Turbo francesii* Gray 1828: suppl. p. 18, pl. 6 fig. 28]. Assimineidae. Gastropoda: Prosobranchia.

Macrodontopsis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 662; as new section of *Macrodontes* Swainson 1840 [subgenus of *Odontostomus* Beck 1837, teste Zilch 1960: 509]. Type-species by monotypy: *Macrodontes simplex* Thiele 1906. Bulimulidae [Odondostomidae, teste Zilch 1960: 509]. Gastropoda: Pulmonata.

Macrogonaxis Thiele 1932a.
Archiv für Molluskenkunde, **64**(1): 11; as new section of *Tayloria (Pseudogonaxis)* Thiele 1932 [subgenus of *Tayloria* Bourguignat

1889, teste Zilch 1960: 558]. Type-species by original designation: *enneoides* (Martens) [*Streptaxis enneoides* Martens 1878: 295, pl. 2 figs. 5, 6]. [Streptaxidae, teste Zilch 1960: 558]. Gastropoda: Pulmonata.

Macroniscus Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 316; as new subgenus of *Macron* H. & A. Adams 1853. Type-species by monotypy: *Macron (Macroniscus) lividus* A. Adams [*Pseudoliva livida* A. Adams 1855: 136]. Buccinidae. Gastropoda: Prosobranchia.

Margarella Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 406; nomen novum pro *Margaritella* Thiele 1891 *(q.v.)*, non Meek & Hayden 1860, nec Schmidt 1880 [subgenus of *Margarites* Gray 1847, teste Thiele 1912b: 189]. See also notes concerning *Margarella/Margaritella* in Thiele 1906a: 13, 1912b: 188, and 1924a: 67. Trochidae. Gastropoda: Prosobranchia.

Margaritella Thiele *in* Troschel & Thiele 1891c.
Das Gebiss der Schnecken, **2**(7): 259; as new genus, non *Margaritella* Meek & Hayden 1860, nec Schmidt 1880 (Porifera) [*Margaritella* Thiele replaced by *Margarella* Thiele 1893, *(q.v.)*]. Type-species by subsequent designation (Thiele 1924a: 67, for replacement name *Margarella*): *Margarita expansa* Sowerby I 1838. Trochidae. Gastropoda: Prosobranchia.

Margaritopsis Thiele 1906a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **38**(1): 15; as new genus [section of *Margarites* Gray 1847, teste Thiele 1924a: 50, 67; subgenus of *Margarites*, teste Wenz 1938: 270]. Type-species by subsequent designation (Thiele 1924a: 50, 67): *Margarita frielei* Krause [*Margarita frielei* Krause 1885: 263; = *M. argentata gigantea* Leche 1878, teste Thiele 1924a: 50]. [Trochidae, teste Thiele 1924a: 67]. Gastropoda: Prosobranchia.

Mecynoplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 393; as new genus [= *Acanthochites (Notoplax)* H. Adams 1861, teste Thiele 1909d: 4, 7; Belle 1983: 144; = *Cryptoconchus (Notoplax)* H. Adams 1861, s.s., teste Thiele 1929: 14; = *Craspedochiton* Shuttleworth 1853, teste A. G. Smith 1960: I69]. Type-species by monotypy: *Mecynoplax acutirostrata* Reeve [*Chiton acutirostratus* Reeve 1847b: 25]. Thiele (1909d: 4, 40) subsequently re-identified the material previously called *Mecyno-*

plax acutirostrata as *Acanthochites (Notoplax) hilgendorfi* Thiele 1909, resulting in a misidentified type species in the sense of ICZN 1985, Art. 70]. Chitonidae [Acanthochitonidae, teste A. G. Smith 1960: I69]. Polyplacophora.

Mericella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 352; as new section of *Cancellaria (Narona)* H. & A. Adams 1854 [subgenus of *Narona*, teste Wenz 1943: 1364]. Type-species by monotypy: *Cancellaria (Mericella) jucunda* Thiele [*Cancellaria (Merica) jucunda* Thiele, 1925]. Cancellariidae. Gastropoda: Prosobranchia.

Mesaliopsis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 181; as new section of *Mesalia* Gray 1842 [subgenus of *Mesalia*, teste Wenz 1939: 651]. Type-species by monotypy: *Mesalia (Mesaliopsis) opalina* (Adams & Reeve) [*Turritella opalina* A. Adams & Reeve 1850: 48, pl. 12 fig. 7]. Turritellidae. Gastropoda: Prosobranchia.

Metachaetoderma Thiele 1913e.
Das Tierreich, **38**: ix, 12; as new genus. Type-species by monotypy: *Chaetoderma challengeri* Nierstrasz 1903 [p. 359, pl. 35 figs. 1-26]. Chaetodermatidae [Limifossoridae, teste Boss 1982: 948]. Aplacophora.

Metactaeon Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 378; as new subgenus of *Actaeon* Montfort 1810 or as new genus. Type-species by monotypy: *Actaeon (Metactaeon) aequatorialis* Thiele 1925 [*Actaeon aequatorialis* Thiele 1925]. Actaeonidae. Gastropoda: Opisthobranchia.

Metamenia Thiele 1913d.
Deutsche Südpolar-Expedition 1901-1903, **14**(1): 52; as new genus. Type-species by monotypy: *Metamenia intermedia* Thiele 1913. Proneomeniidae [Pararhopaliidae, teste Boss 1982: 951]. Aplacophora.

Metanachis Thiele 1924b.
Archiv für Molluskenkunde, **56**(5): 207, 210; as new section of *Columbella* Lamarck 1799 [subgenus of *Pterygia* Röding 1798, teste Wenz 1941: 1150]. Type-species by original designation: *Columbella jaspidea* Sowerby [G. B. Sowerby II 1844: 132, pl. 39 fig. 125]. Columbellidae. Gastropoda: Prosobranchia.

Metassiminea Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3), 122, 126; as new section of *Assiminea* Fleming 1828 [subgenus of *Assiminea*, teste Wenz 1939: 633]. Type-species by original designation: *Assiminea philippinica* O. Boettger [1887: 195]. Assimineidae. Gastropoda: Prosobranchia.

Meteuthria Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 243; as new genus [subgenus of *Thalassoplanes* Dall 1908, teste Thiele 1929: 317]. Type-species by original designation: *Euthria (Glypteuthria) martensi* Strebel [1905: 630, pl. 21 fig. 13]. Buccinidae. Gastropoda: Prosobranchia.

Microcardium Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 878; as new genus [subgenus of *Nemocardium* Meek 1876, teste Keen *in* Moore 1969: N589]. Type-species by subsequent designation (Keen 1937: 155, with emended spelling *peramabile*): *Cardium (Fulvia) peramabilis* Dall [1881: 132]. Cardiidae. Bivalvia.

Microdiscula Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 199; as new genus. Type-species by monotypy: *Microdiscula vanhöffeni* [*vanhoeffeni*] Thiele 1912. [Vitrinellidae, teste Thiele 1925d: 79; Skeneopsidae, teste Thiele 1929: 176]. Gastropoda: Prosobranchia.

Microhappia Thiele 1927c.
Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft, **40**(3): 320; as new genus [section of *Miradiscops* H. B. Baker 1925, teste Thiele 1931c: 598; subgenus of *Miradiscops*, teste Zilch 1960: 545]. Type-species by monotypy: *Microhappia brasiliensis* Thiele 1927. Systrophiidae. Gastropoda: Pulmonata.

Micropleurotoma Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 362; as new subgenus of *Turris* O. F. Müller 1766 [sic] [genus, teste Wenz 1943: 1412]. Type-species by monotypy: *Turris (Micropleurotoma) spirotropoides* (Thiele) [*Pleurotoma spirotropoides* Thiele 1925]. Conidae [Turridae, teste Wenz 1943: 1412]. Gastropoda: Prosobranchia.

Mirellia Thiele 1933c.
Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1933**(4-7): 283; as new section of *Ptychotrema* L. Pfeiffer

1853 [subgenus of *Ptychotrema*, teste Zilch 1960: 577]. Type-species by monotypy: *Ennea prodigiosa* E. Smith [E. A. Smith 1903: 316, pl. 4 fig. 11]. Streptaxidae. Gastropoda: Pulmonata.

Mörchiella [Moerchiella] Thiele 1924a.
Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 71; nomen novum *pro* Mörchia A. Adams 1860 (non Albers 1850) [non *Mörchiella* G. Nevill 1884; *Mörchiella* Thiele replaced by *Mörchinella* Thiele 1931 *(q.v.)*]; also introduced as new name by Thiele 1925b: 59 [25], and cited by Thiele 1929: 175 as of that date. See also Tomlin 1936: 136. Trochidae [Adeorbidae, teste Thiele 1929: 175]. Gastropoda: Prosobranchia.

Mörchinella [Moerchinella] Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 763; nomen novum pro *Mörchiella* Thiele 1924 *(q.v.)*, non G. Nevill 1884. Adeorbidae [Tornidae, teste Wenz 1939: 645]. Gastropoda: Prosobranchia.

Monoeciostraea Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 814; emendation pro *Monoeciostrea* Orton 1928, as synonym of *Ostrea* Linnaeus 1758, s.s.; Stenzel (1971: N1138) listed this as a *nomen nullum* in the synonymy of *Ostrea*. Ostreidae. Bivalvia.

Mopaliella Thiele 1909d.
Zoologica, **22**(56/1): 16; as new genus [= *Cyanoplax* Pilsbry 1892, teste A. G. Smith 1960: I58; subgenus of *Lepidochitona* Gray 1821, teste Kaas & Belle 1980: [ix]; = *Lepidochitona* s.s., teste Belle 1983: 96-97]. Type-species by monotypy: *Chiton bipunctatus* Sowerby [G. B. Sowerby I 1832: 104]. [Callochitonidae, teste Thiele 1909i: 116; Lepidochitonidae, teste Thiele 1925d: 36; Ischnochitonidae, teste A. G. Smith 1960: I58, Belle 1983: 96]. Polyplacophora.

Mopaliopsis Thiele *in* Troschel & Thiele 1893c.
Das Gebiss der Schnecken, **2**(8): 393; as new genus [= *Cyanoplax* Pilsbry 1892, teste Thiele 1909d: 4, 7, 16; = *Lepidochitona* Gray 1821, s.s., teste Belle 1983: 96]. Type-species by monotypy: *Mopaliopsis cingillata* Reeve [*Chiton cingillatus* Reeve 1847a: pl. 23 fig. 160]; Thiele (1909d: 4, 7) subsequently re-identified the material previously called *Mopaliopsis cingillata* as *Cyanoplax hartwegii* (Carpenter 1856), resulting in a misidentified type species in the sense of ICZN 1985, Art. 70]. Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I58, Belle, 1983: 96]. Polyplacophora.

Nanivitrea Thiele 1927a.

Zoologische Jahrbücher, **53**(1-3): 123, 126; as new section of *Paludinella* Pfeiffer 1841 [subgenus of *Paludinella*, teste Wenz 1939: 633]. Type-species by original designation: *Paludinella helicoides* Gundlach [Gundlach in Poey 1865: 70]. Assimineidae. Gastropoda: Prosobranchia.

Nanula Thiele 1924a.

Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 54, 69; as new genus. Type-species by monotypy: *Gibbula tasmanica* Petterd [1879: 103]. Trochidae. Gastropoda: Prosobranchia.

Naytiopsis Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 324; as new subgenus of *Nassa* Lamarck 1799 [genus, teste Wenz 1943: 1232]. Type-species by monotypy: *Nassa (Naytiopsis) granum* Lamarck [*Buccinum grana* Lamarck 1822: 274]. Nassidae [Nassariidae, teste Wenz 1943: 1232]. Gastropoda: Prosobranchia.

Neactaeonina Thiele 1912b.

Deutsche Südpolar-Expedition 1901-1903, **13**(2): 219; as new genus or subgen. of *Actaeonina* Orbigny 1850. Type-species by monotypy: *Actaeonina cingulata* Strebel [1908: 8, pl. 2, fig. 17a-c]. [Actaeonidae, teste Thiele 1926a: 105]. Gastropoda: Opisthobranchia.

Nesodiscus Thiele 1931c.

Handbuch der systematischen Weichtierkunde, **1**(2): 571; as new genus. Type-species by monotypy: *Nesodiscus fabrefactus* (Pease) [*Helix fabrefacta* Pease 1865: 669]. Endodontidae. Gastropoda: Pulmonata.

Noetiella Thiele & Jaeckel 1931b.

Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **21**: 176 (18); as new section of *Arca* [section of *Arca (Noetia)* (Gray) H. & A. Adams 1857, teste Thiele 1934: 793; synonym of *Noetia* Gray 1857, teste Newell *in* Moore 1969: N261]. Type-species by monotypy: *Arca (Noetiella) congoensis* Thiele & Jaeckel, 1931. Subsequently attributed by various authors to Jaeckel & Thiele, Thiele & Jaeckel or to Thiele alone (e.g., Thiele 1934: 793). Arcidae [Noetiidae, teste Newell *in* Moore 1969: N260]. Bivalvia.

Notochiton Thiele 1906d.

Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . .

"Valdivia", **9**(2): 332; as new genus [subgenus of *Nuttallochiton* Plate, 1899, teste Thiele 1929: 9; = *Nuttallochiton*, teste A. G. Smith 1960: I60; Belle, 1983: 88; Kaas & Belle: 116]. Type-species by monotypy: *Notochiton mirandus* Thiele, 1906. [Lepidochitonidae, teste Thiele, 1925c: 36; Callistoplacidae, teste A. G. Smith 1960: I60; Ischnochitonidae, teste Kaas & Belle 1987: 116]. Polyplacophora.

Notodiaphana Thiele 1917a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **49**(1): 23; nomen novum pro *Diaphanella* Thiele 1912 *(q.v.)*, non Clessin 1880, nec Hesse 1916. [Notodiaphanidae, teste Thiele 1931c: 383]. Gastropoda: Opisthobranchia.

Notodiscus Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 575; as new genus. Type-species by monotypy: *Notodiscus hookeri* (Reeve) [*Helix hookeri* Reeve 1854: pl. 208, no. 1474]. Endodontidae. Gastropoda: Pulmonata.

Notoficula Thiele 1917a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **49**(1): 24; nomen novum pro *Ficulina* Thiele 1912, non Gray 1867 [section of *Chlanidota* Martens 1878, teste Thiele 1929: 315; subgenus of *Chlanidota*, teste Wenz 1943: 1201]. [Buccinidae, teste Thiele 1925b: 179]. Gastropoda: Prosobranchia.

Notomenia Thiele 1897b.
Zoologischer Anzeiger, **20**(542): 398; as new genus. Type-species by original designation: *Notomenia clavigera* Thiele 1897. [Lepidomeniidae, teste Thiele 1913e: ix, 22; family position uncertain, teste Boss 1982: 949]. Aplacophora.

Novovaginula Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 491; as new subgenus of *Pseudoveronicella* Germain 1908. Type-species by monotypy: *Pseudoveronicella (Novovaginula) carinata* (Thiele) [*Veronicella (Vaginula) carinata* Thiele 1927]. Vaginulidae. Gastropoda: Pulmonata.

Ochrodermatina Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 552; as new section of *Ochroderma* Ancey 1885 [subgenus of *Ochroderma*, teste Zilch 1959: 350]. Type-species by monotypy: *Ochroderma (Ochrodermatina) carolinum* (Martens) [*Stenogyra carolina* Martens, 1880:

147]. Subulinidae. Gastropoda: Pulmonata.

Odostomiopsis Thiele *in* Martens *in* Martens & Thiele 1904a.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **7A**: 68 (also, Thiele *in* Martens & Thiele 1904b: 156 [10]); as new genus [= *Toledonia* Dall 1902, teste Thiele 1931c: 382]. Type-species by indication (ICZN, 1985, Article 68c): *Odostomiopsis typica* Thiele *in* Martens *in* Martens & Thiele 1904. [Diaphanidae, teste Thiele 1931c: 382]. Gastropoda: Opisthobranchia.

Olivellopsis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 333; as new section of *Belloliva* Peile 1922 [subgenus of *Belloliva*, teste Wenz 1943: 1272]. Type-species by monotypy: *Belloliva (Olivellopsis) simplex* (Pease) [*Olivella (Callianax) simplex* Pease 1868: 281, pl. 23 fig. 24]. Olividae. Gastropoda: Prosobranchia.

Onithoplax Thiele 1909d.
Zoologica, **22**(56/1): 3; as new subgenus of *Tonicia* Gray 1847 [section of *Acanthopleura (Onithochiton)* Gray 1847, teste Thiele 1909i: 117; section of *Tonicia (Lucilina)* Dall 1882, teste Thiele 1929: 22; = *Lucilina*, teste A. G. Smith 1960: I66]. Type-species by subsequent designation (Belle 1983: 133, who erroneously credited the designation to Thiele 1929): *Chiton mallardi* Deshayes 1863 [1863: 38, pl. 5 fig. 14]. [Chitonidae, teste Thiele 1909i: 117]. Polyplacophora.

Oopyramis Thiele 1930.
Die Fauna Südwest-Australiens, **5**(8): 580; as new genus, or new subgenus of *Tiberia* Monterosato 1875. Type-species by monotypy: *Oopyramis biplicata* Thiele 1930. [Pyramidellidae, teste Wenz 1940: 876]. Gastropoda: Prosobranchia.

Opaliopsis Thiele 1928d.
Zeitschrift für wissenschaftliche Zoologie, **132**: 92; as new subgroup of *Scala* (Klein 1753) Bruguière 1792 [= *Epitonium* Röding 1798] [section of *Scala (Cirsotrema)* Mörch 1852, teste Thiele 1929: 222; subgenus of *Cirsotrema*, teste Wenz 1940: 798]. Type-species by monotypy: *Scala elata* Thiele 1925. Scalidae [= Epitoniidae]. Gastropoda: Prosobranchia.

Oriella Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 124, 127; as new subgenus or new section of *Omphalotropis* Pfeiffer 1851 [section, teste Thiele 1929:

172]. Type-species by original designation: *Omphalotropis submaritima* Quadras & Möllendorff [1894: 33]. Erroneously spelled "*Oviella*" by Wenz 1939: 636. Assimineidae. Gastropoda: Prosobranchia.

Ovassiminea Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 122, 125; as new section of *Assiminea* Fleming 1828 [subgenus of *Assiminea*, teste Wenz 1939: 632]. Type-species by original designation: *Assiminea dohrniana* Nevill [G. Nevill 1880: 162; fig. in Yen 1939: pl. 4 fig. 37]. Assimineidae. Gastropoda: Prosobranchia.

Pachydrobiella Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 367, 379; as new genus. Type-species by monotypy: *Pachydrobia brevis* Bavay [1895: 87, pl. 5 fig. 2]. Hydrobiidae. Gastropoda: Prosobranchia.

Pagodinella Thiele 1917a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **49**(1): 24; nomen novum pro *Pagodula* Hesse 1916, non Monterosato 1884 [*Pagodinella* Thiele = *Pagodina* Stabile 1864, non Beneden 1853; and = *Pagodulina* Clessin 1876, teste Thiele 1931c: 510]. [Vertiginidae, teste Thiele 1926a: 139; Orculidae, teste Zilch 1959: 156]. Gastropoda: Pulmonata.

Paracerastus Thiele 1933c.
Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1933**(4-7): 308; as new subgenus of *Cerastus* Albers 1860 [subgenus of *Mabilliella* Ancey 1886, teste Zilch 1959: 195]. Type-species by monotypy: *Ena drymaeoides* Thiele [*Ena (Rachisellus) drymaeoides* Thiele 1911]. Enidae. Gastropoda: Pulmonata.

Parachiton Thiele 1909d.
Zoologica, **22**(56/1): 14; as new subgenus of *Lepidopleurus* (Leach MS) Risso 1826 [subgenus of *Leptochiton* Gray 1847, teste Belle 1983: 54]. Type-species by monotypy: *Lepidopleurus (Parachiton) acuminatus* Thiele 1909. [Lepidopleuridae, teste Thiele 1909i: 116; Leptochitonidae, teste Belle 1983: 54; Kaas & Belle 1990: 14]. Polyplacophora.

Paranoetia Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 793; as new section of subgenus *Arca (Noetia)* (Gray) H. & A. Adams 1857 [= *Sheldonella* Maury 1917, teste Newell *in* Moore 1969: N262]. Type-species by monotypy: *Arca (Paranoetia) lateralis* Reeve [*Arca*

lateralis Reeve 1844: pl. 17 fig. 115]. Arcidae [Noetiidae, teste Newell *in* Moore 1969: N262]. Bivalvia.

Parasitala Thiele 1931c.
Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1930**: 397, 398; as new genus. Type-species by original designation: *Parasitala osumiensis* Thiele 1931. [Ariophantidae, teste Thiele 1931c: 635; Euconulidae, teste Zilch 1959: 281]. Gastropoda: Pulmonata.

Parateuthis Thiele 1920b.
Deutsche Südpolar-Expedition 1901-1903, **16**(8)(4): 463; as new genus [possible senior synonym of *Alluroteuthis* N. Odhner 1923, teste Thiele 1934: 970; genus incertae sedis, teste Nesis 1987: 260]. Type-species by monotypy: *Parateuthis tunicata* Thiele 1920. [?Alluroteuthidae, teste Thiele 1934: 970]. Cephalopoda.

Paratilia Thiele 1924b.
Archiv für Molluskenkunde, **56**(5): 204, 210; as new section of *Pyrene (Mitrella)* Risso 1826 [subgenus of *Mitrella*, teste Wenz 1941: 1139]. Type-species by monotypy: *Columbella alizona* Melvill [*Columbella (Mitrella) alizonae* Melvill & Standen 1901: 402, pl. 21 fig. 5]. Columbellidae. Gastropoda: Prosobranchia.

Parhedyle Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 443; as new genus. Type-species by monotypy: *Parhedyle tyrtowii* (Kowalevsky) [*Hedyle tyrtowii* Kowalevsky 1900: 200-202]. Hedylidae [Microhedylidae, teste Pruvot-Fol 1954: 167]. Gastropoda: Opisthobranchia.

Parvoliva Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 335; as new section of *Oliva* Bruguière 1789 [subgenus of *Oliva*, teste Wenz 1943: 1281]. Type-species by monotypy: *Oliva (Parvoliva) dubia* Schepman [*Oliva dubia* Schepman 1903: 68]. Olividae. Gastropoda: Prosobranchia.

Paryphantopsis Thiele 1928a.
Zoologische Jahrbücher, **55**(1-3): 125; as new section of *Flammulina* Martens 1873 [subgenus, teste Thiele 1931c: 576; genus, teste Zilch 1959: 223]. Type-species by original designation: *Flammulina (Paryphantopsis) lamelligera* Thiele 1928. Endodontidae. Gastropoda: Pulmonata.

Patellidea Thiele *in* Troschel & Thiele 1891c.

Das Gebiss der Schnecken, **2**(7): 315; as new genus [subgroup of *Patella (Scutellastra)* H. & A. Adams 1854, teste Thiele 1929: 40; subgenus of *Patella*, teste Wenz 1938: 215]. Type-species by monotypy: *Patella granularis* Linnaeus [1758: 782]. Patellidae. Gastropoda: Prosobranchia.

Patellona Thiele *in* Troschel & Thiele 1891c.
Das Gebiss der Schnecken, **2**(7): 317; as new genus [subgroup of *Patella (Cymbula)* H. & A. Adams 1854, teste Thiele 1929: 41]. Type-species by subsequent designation (Kobelt 1894: 26): *Patella granatina* [Linnaeus 1758: 782]. Patellidae. Gastropoda: Prosobranchia.

Patellopsis Thiele *in* Troschel & Thiele 1891c.
Das Gebiss der Schnecken, **2**(7): 324; as new genus, non *Patellopsis* Nobre 1886. Type-species: no nominal taxa included; description based on the radula of an unnamed South African species. Homonymy recognized by Thiele 1931c: 766; never renamed. Patellidae. Gastropoda: Prosobranchia.

Patinastra Thiele *in* Troschel & Thiele 1891c.
Das Gebiss der Schnecken, **2**(7): 325; as new genus [section of *Helcion (Patina)* Leach 1852, teste Thiele 1929: 41; subgenus of *Helcion* Montfort 1810, teste Wenz 1938: 214]. Type-species by monotypy: *Patella pruinosa* Krauss 1848 [p. 56, pl. 3 figs. 9a, b]. Patellidae. Gastropoda: Prosobranchia.

Paucidentella Thiele 1933c.
Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1933**(4-7): 285; as new section of *Gulella* L. Pfeiffer 1856 [subgenus of *Gulella*, teste Zilch 1960: 569]. Type-species by original designation: *Gulella conica* (Martens) [*Ennea conica* Martens 1876: 264, pl. 4 figs. 6, 7]. Streptaxidae. Gastropoda: Pulmonata.

Pediculariella Thiele 1925d.
Handbuch der Zoologie, **5**(1): 88; as new group [subgenus of *Pedicularia* Swainson 1840, teste Wenz 1941: 1001]. Type-species by monotypy: *californica* (Newcomb) [*Pedicularia californica* Newcomb 1864: 121]. Cypraeidae [Amphiperatidae, teste Wenz 1941: 1001; Pediculariidae, teste Vaught 1989: 33]. Gastropoda: Prosobranchia.

"Pherusiana" [1929].
Handbuch der systematischen Weichtierkunde, **1**(1): 226; error pro *Pherusina* (Norman MS) Chaster 1898. Aclididae. Gastropoda:

Prosobranchia.

Phyllomenia Thiele 1913d.
Deutsche Südpolar-Expedition 1901-1903, **14**(1): 38, 45; as new genus. Type-species by monotypy: *Phyllomenia austrina* Thiele 1913. Lepidomeniidae [Phyllomeniidae, teste Boss 1982: 950]. Aplacophora.

Pistris Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 917; nomen novum pro *Pristis* Lamy 1918, non Linck 1790 (Latham 1794), nec (Lepeletier MS) Brullé 1846 [subgenus of *Tellina* Linnaeus 1758, teste Keen *in* Moore 1969: N619]. Tellinidae. Bivalvia.

Plagiolopsis Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 834; new genus [introduced by Thiele as "nom nov." pro *Plagiola* sensu Stimpson; = *Plagiola* Rafinesque 1819, teste Haas *in* Moore 1969: N455; = *Ellipsaria* Rafinesque 1820, teste Johnson 1978: 248]. Type-species by monotypy: *P. securis* (Lea) [*Unio securis* Lea 1829: 437, pl. 11 fig. 17]. Unionidae. Bivalvia.

Pleurobranchella Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 283 [249]; as new genus or new subgenus of *Euselenops* Pilsbry 1896 [section of *Pleurobranchaea (Euselenops)*, teste Thiele 1931c: 419]. Type-species by monotypy: *Euselenops (Pleurobranchella) nicobarica* Thiele 1925. Pleurobranchidae. Gastropoda: Opisthobranchia.

Plicarcularia Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 324; as new section of *Nassa (Arcularia)* Link 1807 [subgenus of *Arcularia*, teste Wenz 1943: 1232]. Type-species by monotypy: *Nassa (Plicarcularia) thersites* (Bruguière) [*Nassa thersites* Lamarck 1816: pl. 394, liste, p. 1]. Nassidae [Nassariidae, teste Wenz 1943: 1232]. Gastropoda: Prosobranchia.

Poeciloplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 365; as new genus [section of *Chiton*, teste Thiele 1909d: 2; = *Chiton (Amaurochiton)* Thiele 1893, teste A. G. Smith 1960: I66; = *Chiton* Linnaeus 1758, s.s., teste Belle 1983: 123]. Type-species by monotypy: *Poeciloplax glauca* Gray [1828: p. 5], non Quoy & Gaimard 1835 [= *viridus* Quoy & Gaimard 1835, non Spengler 1797, = *quoyi* Deshayes 1836, = var.

limosus (Suter MS) Nierstrasz 1905; teste Kaas & Belle 1980: 54]. Chitonidae. Polyplacophora.

Primovula Thiele 1925d.
Handbuch der Zoologie, 5(1): 88; as new group [genus, teste Wenz 1941: 1009, 1010]. Type-species by monotypy: *beckeri* (Sowerby) [*Amphiperas beckeri* G. B. Sowerby III 1900: 5, pl. 1 fig. 13]. Cypraeidae [Amphiperatidae, teste Wenz 1941: 1009, 1010; Ovulidae, teste Vaught 1989: 33]. Gastropoda: Prosobranchia.

Probuccinum Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 207, 211; as new genus or new subgenus of *Neobuccinum* E. Smith 1879 [section of *Glypteuthria* Strebel 1905, teste Thiele 1929: 318; subgenus of *Glypteuthria*, teste Wenz 1943: 1207]. Type-species by subsequent designation (Wenz 1943: 1207): *Glypteuthria (Probuccinum) tenera* E. A. Smith [*Neobuccinum tenerum* E. A. Smith 1907: 2, pl. 1, figs. 2, 2a). Buccinidae. Gastropoda: Prosobranchia.

Probythinella Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 370, 378; as new subgenus of *Cincinnatia* Pilsbry 1891 [later (footnote p. 370 and p. 378) as section of *Hoyia* F. C. Baker 1925]; subgenus of *Hoyia*, teste Wenz 1939: 569]. Type-species by monotypy: *Cincinnatia emarginata* (Küster) [*Paludina emarginata* "Say" Küster 1852: 50, pl. 10 figs. 3, 4]. Hydrobiidae. Gastropoda: Prosobranchia.

Procalpurnus Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 272; as new section of *Calpurnus* Montfort 1810 [subgenus of *Calpurnus*, teste Wenz 1941: 1010]. Type-species by monotypy: *Calpurnus (Procalpurnus) lacteus* (Lamarck) [*Ovula lactea* Lamarck 1810: 111]. Cypraeidae [Ovulidae, teste Vaught 1989: 33]. Gastropoda: Prosobranchia.

Prochaetoderma Thiele 1902b.
Zeitschrift für wissenschaftliche Zoologie, **72**(2-3): 275; as new genus. Type-species by monotypy: *Chaetoderma raduliferum* Kowalevsky 1901 [*Chaetoderma radulifera* Kowalevsky 1901a: 264, pl. 10 figs. 1-20]. [Chaetodermatidae, teste Thiele 1913e: ix, 10; Caudofoveata, Prochaetodermatidae, teste Boss 1982: 948]. Aplacophora.

Prochiton Thiele 1890a.

Zeitschrift für wissenschaftliche Zoologie, **49**(3): 428; as new genus [listed by Belle 1983: 155 as a hypothetical taxon of Plate 1901]. Type-species by monotypy: *Chiton rubicundus* O. G. Costa 1829 [pl. 1 fig. 3] [= *Chiton (Rhyssoplax) corallinus* Risso 1826, teste Kaas & Belle 1980: 31, 112]; Thiele (1902b: 284) subsequently re-identified the material previously called *Chiton rubicundus* as *Callochiton doriae* (Capellini 1859) [= *Callochiton septemvalvis* (Montagu 1803) subsp. *euplaeae* (O. G. Costa 1829), teste Kaas & Belle 1980: 40], resulting in a misidentified type species in the sense of ICZN 1985, Art. 70].

Proclava Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 212; as new subgenus of *Cerithium* Bruguière 1789 [subgenus of *Clava* Martyn 1784, teste Wenz 1940: 761, 1943: 1501]. Type-species by monotypy: *Cerithium (Proclava) pfefferi* Dunker [*Vertagus pfefferi* Dunker 1877: 75]. Cerithiidae. Gastropoda: Prosobranchia.

Prodoridunculus Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 218, 222; as new genus. Type-species by monotypy: *Prodoridunculus gaussianus* Thiele 1912. [Polyceridae, teste Thiele 1931c: 427; Onchidoridae, teste Powell 1960: 165; Lamellidoridae, teste Odhner *in* Franc 1968: 861]. Gastropoda: Opisthobranchia.

Profundinassa Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 323; as new subgenus of *Nassa* Lamarck 1799 [genus, teste Wenz 1943: 1231]. Type-species by monotypy: *Nassa (Profundinassa) babylonica* Watson [*Nassa (Aciculina) babylonica* Watson 1882: 366; 1886: 185, pl. 11 fig. 8]. Nassidae [Nassariidae, teste Wenz 1943: 1231]. Gastropoda: Prosobranchia.

Prohappia Thiele 1927c.
Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft, **40**(3): 313; as new subgenus of *Happia* Bourguignat 1889. Type-species by monotypy: *Happia besckei* (Dunker) [*Helix besckei* Dunker *in* Pfeiffer 1847: 81]. Systrophiidae. Gastropoda: Pulmonata.

Prolacuna Thiele 1913a.
Zentralblatt für Zoologie, **2**(3): 86; nomen novum pro *Sublacuna* Thiele 1912 *(q.v.)*, non Pilsbry 1895, nec Cossmann 1899 [subgenus of *Frovina* Thiele 1912, teste Wenz 1941: 1028].

[Naticidae, teste Thiele 1929: 260]. Gastropoda: Prosobranchia.

Proneptunea Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 246; as new genus [subgenus of *Thalassoplanes* Dall 1908, teste Thiele 1929: 317]. Type-species by monotypy: *Proneptunea amabilis* Thiele 1912. Buccinidae. Gastropoda: Prosobranchia.

Proneritula Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 324; as new section of *Nassa (Cyclope)* Risso 1826 [subgenus of *Cyclope*, teste Wenz 1943: 1234]. Type-species by monotypy: *Nassa (Proneritula) westerlundi* (Brusina) [*Cyclope westerlundi* Brusina 1900: 89]. Nassidae [Nassariidae, teste Vaught, 1989: 49]. Gastropoda: Prosobranchia.

Proplanaxis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 203; as new subgenus of *Planaxis* Lamarck 1822. Type-species by monotypy: *Planaxis (Proplanaxis) planicostatus* Sowerby [*Planaxis planicostatus* G. B. Sowerby I 1825, Appendix p. xiii]. Planaxidae. Gastropoda: Prosobranchia.

Proreinia Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 531; as new section of *Reinia* Kobelt 1876 [subgenus of *Reinia*, teste Zilch 1959: 391]. Type-species by monotypy: *Reinia (Proreinia) eastlakeana* (Möllendorff) [*Clausilia eastlakeana* Möllendorff 1882: 187; 1883: 262, pl. 8 figs. 7a-c]. Clausiliidae. Gastropoda: Pulmonata.

Proseila Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 218; as new section of *Seila* A. Adams 1861 [subgenus of *Seila*, teste Wenz 1940: 781]. Type-species by monotypy: *Seila (Proseila) capitata* Thiele [*Seila capitata* Thiele 1925]. Cerithiopsidae. Gastropoda: Prosobranchia.

Proselenites Thiele 1927c.
Abhandlungen herausgegeben von der Senckenbergischen Naturforschenden Gesellschaft, **40**(3): 313; as new subgenus of *Haplotrema* Ancey 1881 [= *Geomene* Pilsbry 1927, teste Zilch 1960: 549]. Type-species by subsequent designation (Baker 1928: 124; see also Baker 1941: 132, and Pilsbry 1946: 208): *Helix concava* Say 1821 [p. 159]. Systrophiidae [Haplotrematidae, teste Zilch 1960: 549]. Gastropoda: Pulmonata.

Prosipho Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 206; as new group [genus, teste Thiele 1929: 319]. Type-species by subsequent designation (Wenz 1943: 1210): *Prosipho gaussianus* Thiele 1912. Buccinidae. Gastropoda: Prosobranchia.

Prothalotia Thiele 1930.
Die Fauna Südwest-Australiens, **5**(8): 566; as new section of *Cantharidus* Montfort 1810 [subgenus of *Thalotia* Gray 1847, teste Wenz 1938: 305]. Type-species by original designation: *Cantharidus (Prothalotia) flindersi* (P. Fischer) [*Trochus flindersi* P. Fischer 1878: 65]. [Trochidae, teste Thiele 1931c: 735]. Gastropoda: Prosobranchia.

Protomella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 182; as new section of *Protoma* Baird 1870 [subgenus of *Protoma*, teste Wenz 1939: 659]. Type-species by monotypy: *Protoma (Protomella) pulchra* Sowerby [*Protoma pulchra* G. B. Sowerby III 1905: 279]. Turritellidae. Gastropoda: Prosobranchia.

Pruvotia Thiele 1894b.
Zeitschrift für wissenschaftliche Zoologie, **58**(2): 272; as new genus. Type-species by monotypy: *Proneomenia sopita* Pruvot 1891 [p. 721, pl. 30 fig. 50, pl. 31 fig. 84]. [Proneomeniidae, teste Thiele 1913e: x, 52; Rhopalomeniidae, teste Boss 1982: 952]. Aplacophora.

Pseudactaeon Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 257 [223]; as new group [genus, teste Thiele 1931c: 378; genus *Pseudacteon* (sic), teste Odhner *in* Franc 1968: 835]. Type-species by monotypy: *Actaeon albus* (Sowerby 1873) [*Tornatella albus* G. B. Sowerby II 1873: 720, pl. 59 fig. 6]. Actaeonidae. Gastropoda: Opisthobranchia.

Pseudanachis Thiele 1924b.
Archiv für Molluskenkunde, **56**(5): 208; as new genus [also described as new by Thiele 1925b: 172 [138]]. Type-species by monotypy: *Columbella duclosiana* Sowerby [G. B. Sowerby II 1844: 113, pl. 36 figs. 15, 16; non *Columbella duclosiana* Orbigny *in* Sagra 1842: 136, pl. 21 figs. 31-33]. ?Columbellidae. Gastropoda: Prosobranchia.

Pseudassiminea Thiele 1927a.

Zoologische Jahrbücher, **53**: 123, 127; as new genus. Type-species by original designation: *Omphalotropis waigiouensis* Sykes [1903: 67]. Assimineidae. Gastropoda: Prosobranchia.

Pseudisidora Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 476; as new subgenus of *Lymnaea* Lamarck 1799 [genus, teste Zilch 1959: 93]. Type-species by monotypy: *Lymnaea (Pseudisidora) rubella* Lea [*Lymnea rubella* Lea 1844: 12; non Clessin 1873]. Lymnaeidae. Gastropoda: Pulmonata.

Pseudocleopatra Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 394, 400; as new genus. Type-species by monotypy: *Pseudocleopatra togoensis* Thiele 1928. Melaniidae [Thiaridae, teste Wenz 1939: 703]. Gastropoda: Prosobranchia.

Pseudocyclotus Thiele 1894a.
Nachrichtsblatt der Deutschen Malakozologischen Gesellschaft, **26**(1-2): 23. Type-species by original designation: *Cyclostoma novaehiberniae* Quoy & Gaimard [*Cyclostoma novae hiberniae* [sic] Quoy & Gaimard 1832: 182, pl. 12 figs. 15-19]. Cyclostomidae [Assimineidae, teste Thiele 1929: 173]. Gastropoda: Prosobranchia.

Pseudogonaxis Thiele 1932a.
Archiv für Molluskenkunde, **64**(1): 11; as new subgenus of *Tayloria* Bourguignat 1881. Type-species by original designation: *nsendweenis* [sic] (Putzeys) [*Streptaxis nseudweensis* Putzeys 1899: lv, fig. 3]. [Streptaxidae, teste Zilch 1960: 558]. Gastropoda: Pulmonata.

Pseudostomatella Thiele 1924a.
Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 59, 70; as new section of *Stomatia* Helbling 1779 [subgenus of *Stomatia*, teste Wenz 1938: 322]. Type-species by original designation: *Pseudostomatella papyracea* (Chemnitz) [*Stomatella papyracea* "Chemnitz" A. Adams 1850b: 31]. Trochidae [Stomatiidae, teste Wenz 1938: 322]. Gastropoda: Prosobranchia.

Pseudotopoma Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 128; as new section of *Cyclotopsis* Blanford 1864 [subgenus of *Cyclotopsis*, teste Wenz 1939: 532]. Type-species by monotypy: *Otopoma hinduorum* Blanford [1864: 464]. Pomatiasidae. Gastropoda: Prosobranchia.

Pseudotritonia Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 218, 224; as new

genus. Type-species by monotypy: *Pseudotritonia quadrangularis* Thiele 1912. [Notaeolidiidae, teste Thiele 1926a: 113; Charcotiidae, teste Odhner *in* Franc 1968: 880]. Gastropoda: Opisthobranchia.

Psychroteuthis Thiele 1920b.
Deutsche Südpolar-Expedition 1901-1903, **16**(8)(4): 440; as new genus. Type-species by monotypy: *Psychroteuthis glacialis* Thiele 1920. Psychroteuthidae. Cephalopoda.

Ptychobela Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 215 [181]; as new subgenus of *Bela* Gray 1847 or as new genus. [= *Brachytoma* Swainson 1840, teste Thiele 1929: 362]. Type-species by original designation: *Pleurotoma crenularis* Lamarck [*Clavatula crenularis* Lamarck 1816: pl. 440, liste p. 9]. Pleurotomidae [Conidae, teste Thiele 1929: 362; Turridae, teste Wenz 1941: 1412]. Gastropoda: Prosobranchia.

Ptychocardia Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 232; as new genus. Type-species by monotypy: *Ptychocardia vanhöffeni* [*vanhoeffeni*] Thiele 1912. [Cyamiidae, teste Thiele 1934: 857; Vesicomyidae, teste Powell 1960: 177; Cyamiidae, teste Chavan *in* Moore 1969: N539]. Bivalvia.

Ptychosyrinx Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 210 [176]; as new group [synonym of *Subulata* Martens 1901, teste Wenz 1943: 1402]. Type-species by monotypy: *Drillia bisinuata* (Martens) [*Pleurotoma (Subulata) bisinuata* Martens 1901: 17]. Pleurotomidae [Conidae, teste Thiele 1929: 359; Turridae, teste Wenz 1943: 1402]. Gastropoda: Prosobranchia.

"Punigapia" [1934].
Handbuch der systematischen Weichtierkunde, **2**(3): 911; error pro *Punipagia* Iredale 1930; as genus. Semelidae. Bivalvia.

Pustulosa Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 827; nomen novum pro *Bullata* Frierson 1927, non Jousseaume 1875; as subgroup of *Quadrula* Rafinesque 1820 [synonym of *Quadrula (Amphinaias)* Crosse & Fischer 1894, teste Haas *in* Moore 1969: N437]. Unionidae. Bivalvia.

Pyrunculus "Thiele."

Indicated by Thiele (1925b: 381 [347]) as being new, but was introduced by Pilsbry (1895: 229) as new name for *Sao* H. & A. Adams 1854, non Billberg 1820. Retusidae. Gastropoda: Opisthobranchia.

Radsiella Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 368; as new genus, non *Radsiella* Pilsbry *in* Tryon & Pilsbry 1892 [*Radsiella* Thiele = *Ischnochiton* Gray 1847, teste Thiele 1909d: 2, 6; = *Ischnochiton (Haploplax)* Pilsbry 1894, teste A. G. Smith 1960: I56]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton punctatissimus* [sic] [*Chiton punctulatissimus* G. B. Sowerby I 1832: 58 [= *Chiton pusio* Sowerby 1832, teste Belle 1983: 66]]. Chitonidae [Ischnochitonidae, teste A. G. Smith: I56; Kaas & Belle 1990: 78]. Polyplacophora.

Rhachidina Thiele 1921b.
Archiv für Molluskenkunde, **53**(3): 150; as new group [genus *Rhachidina* Thiele 1911 (sic), teste Zilch 1959: 194]. Type-species by original designation: *R. tumefacta* (Reeve) [*Bulimus tumefacta* Reeve 1848: *Bulimus*, no. 374]. Date given as "1911" by Thiele 1931c: 524. [Enidae, teste Thiele 1926a: 139]. Gastropoda: Pulmonata.

Rhinocochlis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 633; as new genus. Type-species by monotypy: *Rhinocochlis nasuta* (Metcalfe) [*Helix nasuta* Metcalfe 1851: 70]. Ariophantidae. Gastropoda: Pulmonata.

Rhodoplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 384; as new genus [section of *Ischnochiton (Stenoplax)* (Carpenter MS) Dall 1878, teste Thiele 1909i: 112, 116; = *Ischnochiton* Gray 1847, teste A. G. Smith 1960: I55; Belle 1983: 66; Kaas & Belle 1990: 78]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton squamulosus* [C. B. Adams 1845: 8; = *Chiton striolatus* Gray 1828, teste Thiele 1909d: 3, Belle 1983: 66]. Chitonidae [Ischnochitonidae, teste Thiele 1909i: 116; Kaas & Belle 1990: 78]. Polyplacophora.

Rhombosepia Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 954; emendation pro *Rhombosepion* Rochebrune 1884; as section of *Sepia* Linnaeus 1758. Sepiidae. Cephalopoda.

Rhopalopleura Thiele *in* Troschel & Thiele 1893e.

Das Gebiss der Schnecken, **2**(8): 373; as new genus [= *Acanthopleura (Mesotomura)* Pilsbry 1893, teste Thiele 1909d: 3, 6; = *Acanthopleura* Guilding 1830, teste A. G. Smith 1960: I67, Belle 1983: 127]. Type-species by monotypy: *Rhopalopleura aculeata* Linnaeus [*Chiton aculeatus* Linnaeus 1758: 667; = *Chiton echinatus* Barnes 1824, teste Belle 1983: 127; for synonyms of *echinatus*, see Kaas & Belle 1980: 41]. Chitonidae. Polyplacophora.

Rhyssoplax Thiele *in* Troschel & Thiele 1893.

Das Gebiss der Schnecken, **2**(8): 368; as new genus. Type-species by designation under the plenary powers (ICZN 1971, Opinion 951): *Chiton affinis* Issel 1869 [:234] [= *Chiton janeirensis* sensu Thiele, non Gray 1828]. *Calloplax* Thiele 1909 *(q.v.)* was established on the real *Chiton janeirensis* Gray 1828. Chitonidae. Polyplacophora.

Roseniella Thiele 1931c.

Handbuch der systematischen Weichtierkunde, **1**(2): 536; nomen novum pro *Thalestris* Lindholm 1913, non Claus 1863, nec Gistl 1868, = *Rosenia* P. Hesse 1916 non Waagen & Wentzel 1886, nec Schepman 1914, nec Kieffer 1921, nec Schawerda 1922 [subgenus of *Acrotoma* O. Boettger 1881, teste Zilch 1960: 441]. Clausiliidae. Gastropoda: Pulmonata.

Rostellariella Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 253; as new section of *Rostellaria* Lamarck 1799 [subgenus of *Tibia* Röding 1798, teste Wenz 1940: 934]. Type-species by monotypy: *Rostellaria (Rostellariella) delicatula* Nevill [*Rostellaria delicatula* G. Nevill 1881b: 262]. Strombidae. Gastropoda: Prosobranchia.

Rupacilla Thiele 1927a.

Zoologische Jahrbücher, **53**(1-3): 123, 126; as new section of *Paludinella* Pfeiffer 1841 [subgenus of *Paludinella*, teste Wenz 1939: 633]. Type-species by original designation: "*Omphalotropis*" *filocincta* Quadras & Möllendorff [*Omphalotropis filocincta* Quadras & Möllendorff 1896: 14]. Assimineidae. Gastropoda: Prosobranchia.

Sandalomenia Thiele 1913d.

Deutsche Südpolar-Expedition 1901-1903, **14**(6)(1): 41, 38; as new genus. Type-species by subsequent designation (Salvini-Plawen 1978: 48): *Sandalomenia papilligera* Thiele 1913. Lepidomeniidae [Sandalomeniidae, teste Boss 1982: 949]. Aplacophora.

Scansicochlea Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 656; emendation pro *Scansicohlea* Pilsbry 1931; as subgenus of *Bulimulus* Leach 1815. Bulimulidae. Gastropoda: Pulmonata.

Sculptassiminea Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 126; as new section of *Assiminea* (Leach) Fleming 1828 [subgenus of *Assiminea*, teste Wenz 1939: 632]. Type-species by original designation: *Assiminea microsculpta* Nevill [G. Nevill 1880: 165, 1881b: 158, pl. 7 fig. 5]. Assimineidae. Gastropoda: Prosobranchia.

Segmentella Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 110 [76]; as new subgenus of *Vermetus* Daudin 1800. Type-species by subsequent designation (Wenz 1939: 676): *Stephopoma (Segmentella) agulhasensis* (Thiele) [*Vermetus (Segmentella) agulhasensis* Thiele 1925]. Vermetidae ["should probably be classed as annelids," teste Keen, 1961: 184]. Gastropoda: Prosobranchia.

Semiretusa Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 268 [234]; as new group [subgenus of *Retusa* T. Brown 1827, teste Thiele 1931c: 390]. Type-species by subsequent designation (Zilch 1959: 46): *Retusa (Semiretusa) borneensis* (A. Adams) [*Bulla (Utriculus) borneensis* A. Adams 1850a: 572, pl. 120 fig. 23]. Retusidae. Gastropoda: Opisthobranchia.

Silicula "Jeffreys" Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 790; as genus; see comments above on *Beanella*. See Introduction, p. 5. Ledidae. Bivalvia.

Sinomytilus Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 801; as new section of *Mytilus (Chloromya)* Mörch 1853. Type-species by monotypy: *Mytilus (Sinomytilus) crosseanus* (Morlet) [*Dreissena crosseana* L. Morlet 1884: 402, pl. 13 figs. 5-5c]. Mytilidae [Dreissenidae, teste Brandt 1974: 307]. Bivalvia.

Sitalina Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 635; as new genus. Type-species by monotypy: *Sitalina circumcincta* (Reinhardt) [*Conulus circumcinctus* Reinhardt 1883: 85]. Ariophantidae [Euconu-

lidae, teste Zilch 1959: 281]. Gastropoda: Pulmonata.

Sitalinopsis Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 612; as new subgenus of *Kaliella* Blanford 1863 [genus, teste Zilch 1959: 296]. Type-species by monotypy: *Kaliella (Sitalinopsis) conulus* (Blanford) [*Nanina (Kaliella?) conula* W.T. Blanford 1865: 73]. Ariophantidae [Helicarionidae, teste Zilch 1959: 296]. Gastropoda: Pulmonata.

"Slerochiton" [1909i].
Zoologica, **22**(56/2): 95; error pro *Sclerochiton* (Carpenter MS) Dall 1882, non Kraatz 1859. [Chitonidae, teste A. G. Smith 1960: I66]. Polyplacophora.

Spathidosepia Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 954; emendation pro *Spathidosepion* Rochebrune 1884; as subgroup of *Sepia* Linnaeus 1758. Sepiidae. Cephalopoda.

Sphaerocylichna Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 276 [242]; as new subgroup of *Cylichna* Lovén 1846 [section of *Cylichna* s.s., teste Thiele 1931c: 391]. Type-species by subsequent designation (Zilch 1959: 25): *Cylichna (Sphaerocylichna) atyoides* Thiele [*Cylichna atyoides* Thiele 1925]. Scaphandridae. Gastropoda: Opisthobranchia.

Spiraxilla Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 773; nomen novum pro "*Spiraxis* Pilsbry 1903" [as listed by Thiele 1931c: 675], non *Spiraxis* C. B. Adams 1850; this was found by Thiele (1935: 1154) to have been an unnecessary replacement: "*Spiraxis*" was an error pro *Gyraxis* Pilsbry 1903. See also Tomlin 1936: 136. Urocoptidae. Gastropoda: Pulmonata.

Stereoplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 383; as new genus [= *Ischnochiton* Gray 1847, teste A. G. Smith 1960: I55; = *Ischnochiton (Ischnoplax)* (Carpenter MS) Dall 1879, teste Belle 1983: 71]. Type-species by monotypy: *Stereoplax multicosiata* [sic] C. B. Adams [*Chiton multicostatus* C. B. Adams 1845: 8 = *Chiton pectinatus* G. B. Sowerby I 1840, teste Belle 1983: 71]. Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I55]. Polyplacophora.

Strioconus Thiele 1929.

Handbuch der systematischen Weichtierkunde, **1**(1): 374; as new section of *Conus* Linnaeus 1758 [= *Dendroconus* Swainson 1840, teste Thiele 1931c: 742]. Type-species by monotypy: *Conus (Strioconus) striatus* Linnaeus [*Conus striatus* Linnaeus 1758: 716]. Conidae. Gastropoda: Prosobranchia.

Striokaliella Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 613; as new section of *Kaliella* Blanford 1863 [subgenus of *Kaliella*, teste Zilch 1959: 296]. Type-species by original designation: "*Sitala*" *crenicincta* Godwin-Austen [*Sitala crenicincta* Godwin-Austin 1883: 75, pl. 13 fig. 2]. Ariophantidae. Gastropoda: Pulmonata.

Striosubulina Thiele 1933c.
Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, **1933**(4-7): 301; as new section of *Homorus (Neoglossula)* Pilsbry 1909 [subgenus of *Homorus*, teste Zilch 1959: 343]. Type-species by monotypy: *striatella* Rang [*Helix striatella* Rang 1831: 38, pl. 3 fig. 7], non Anthony 1840]. Subulinidae. Gastropoda: Pulmonata.

Striotellina Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 917; as new section of *Quadrans* Bertin 1878 [objective junior synonym of *Serratina* Pallary 1922, teste Keen *in* Moore 1969: N620]. Type-species by monotypy: *Quadrans (Striotellina) serratus* (Renieri) [*Tellina serrata* Brocchi 1814: 510]. Tellinidae. Bivalvia.

Stylopyramis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 236; as new genus. Type-species by monotypy: *Stylopyramis cerithioides* Thiele 1929. Pyramidellidae. Gastropoda: Prosobranchia.

Sublacuna Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 195; as new genus [non *Sublacuna* Pilsbry 1895; *Sublacuna* Thiele replaced by *Prolacuna* Thiele 1913, *(q.v.)*]. Type-species by monotypy: *Sublacuna indecora* Thiele 1912. [Naticidae, teste Thiele 1929: 260]. Gastropoda: Prosobranchia.

Subninella Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 68; as new section of *Turbo* Linnaeus 1758 [subgenus of *Turbo*, teste Wenz 1938: 351]. Type-species by monotypy: *Turbo (Subninella) undulatus* Martyn [*Turbo undulatus* Gmelin 1791: 3597]. Turbinidae. Gastro-

poda: Prosobranchia.

Supplanaxis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 203; as new subgenus and section of *Planaxis* Lamarck 1822. Type-species by monotypy: *Planaxis (Supplanaxis) nucleus* (Lamarck) [*Buccinum nucleus* Bruguière 1789: 254]. Planaxidae. Gastropoda: Prosobranchia.

Suterilla Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 124, 127; as new section of *Omphalotropis* Pfeiffer 1851 [subgenus of *Omphalotropis*, teste Wenz 1939: 636]. Type-species by monotypy: "*Cirsonella*" *neozelanica* Murdoch [*Cirsonella neozelanica* Murdoch 1899: 320, pl. 16 figs. 2-6]. Assimineidae. Gastropoda: Prosobranchia.

Sypharochiton Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(9): 365; as new genus [section of *Chiton*, teste Thiele 1909d: 2; subgenus of *Chiton*, teste A. G. Smith 1960: I66; = *Chiton* Linnaeus 1758, s.s., teste Belle 1983: 123]. Type-species by monotypy: *Sypharochiton pellisserpentis* [sic] Quoy & Gaimard [*Chiton pelliserpentis* Quoy & Gaimard 1835: 381, pl. 74 figs. 17-22]. For synonyms of *pelliserpentis*, see Kaas & Belle 1980: 97. Chitonidae. Polyplacophora.

Tellinangulus Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 919; as new subgenus of *Angulus* Megerle von Mühlfeld 1811 [subgenus of *Tellina* Linnaeus 1758, teste Keen *in* Moore 1969: N620]. Type-species by monotypy: *Angulus (Tellinangulus) aethiopicus* (Jäckel & Thiele [sic]) [*Tellina (Tellinella) aethiopica* Thiele & Jaeckel 1931]. Tellinidae. Bivalvia.

Thaumastochiton Thiele 1909d.
Zoologica, **22**(56/1): 34; as new subgenus of *Craspedochiton* Shuttleworth 1853 [= *Craspedochiton*, teste A. G. Smith 1960: I69; = *Notoplax (Spongiochiton)*, teste Belle 1983: 145]. Type-species by monotypy: *Craspedochiton (Thaumastochiton) möbiusi* [*moebiusi*] Thiele 1909 [= *Onithochiton isipingoensis* Sykes 1901, teste Kaas & Belle 1980: 86]. [Cryptoplacidae, teste Thiele, 1909i: 116; Acanthochitonidae, teste A. G. Smith 1960: I69]. Polyplacophora.

"*Toniciella*" [1893e].
Das Gebiss der Schnecken, **2**(8): 389; error pro *Tonicella* Carpenter 1873. Chitonidae [Ischnochitonidae, teste A. G. Smith 1960: I58].

Polyplacophora.

Tonicina Thiele 1906e.
Expédition Antactique Française . . . Sciences naturelles: documents scientifiques, p. [i]; as new genus [subgenus of *Nuttalina* (Carpenter MS) Dall 1871, teste Belle 1983: 101]. Type-species by monotypy: *Chiton zschaui* Pfeffer 1886 [Pfeffer *in* Martens & Pfeffer 1886: 105, pl. 3 fig. 2]. Also described as new by Thiele 1906f: 549. [Ischnochitonidae, teste Thiele 1908c: 20]. Polyplacophora.

Toniciopsis Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 371; as new genus [= *Tonicia (Lucilina)* Dall 1882; teste Thiele 1909d: 3, 6]. Type-species by subsequent designation (Kobelt 1894: 26): *Chiton pictus* Reeve 1847 [1847a: pl. 15 fig. 29], non Blainville 1825, nec Bean in Thorpe 1844, [= *Chiton lamellosus* Quoy & Gaimard 1835, teste Belle 1983: 132]. Chitonidae. Polyplacophora.

Triboplax Thiele *in* Troschel & Thiele 1893e.
Das Gebiss der Schnecken, **2**(8): 366; as new genus [section of *Chiton*, teste Thiele 1909d: 2; = *Sypharochiton* Thiele 1893, teste Thiele 1929: 20; = *Chiton* Linnaeus 1758, s.s., teste Belle 1983: 123]. Type-species by monotypy: *Triboplax scabricula* Sowerby [*Chiton scabriculus* G.B. Sowerby I 1832]; Thiele (1909d: 2) subsequently re-identified the material previously called *Triboplax scabricula* as *Chiton pelliserpentis* Quoy & Gaimard 1835, resulting in a misidentified type species in the sense of ICZN 1985, Art. 70]. Chitonidae. Polyplacophora.

Trochaclis Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 192; as new genus. Type-species by monotypy: *Trochaclis antarctica* Thiele 1912. ?Aclidae, teste Thiele 1925d: 85; ?Trochaclididae, teste Thiele 1929: 179]. Gastropoda: Prosobranchia.

Turbacmella Thiele 1927a.
Zoologische Jahrbücher, **53**(1-3): 123, 126; as new genus. Type-species by original designation: "*Adelomorpha*" *dohertyi* Fulton [*Adelomorpha dohertyi* Fulton 1899: 219, pl. 11 fig. 19]. Assimineidae. Gastropoda: Prosobranchia.

Typhlosyrinx Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 218 [184]; as new subgroup of *Pleurotomella*

Verrill 1873 [genus, teste Thiele 1929: 365]. Type-species by monotypy: *Pleurotomella (Typhlosyrinx) vepallida* Martens [*Pleurotoma (Leucosyrinx) vepallida* Martens 1903: 204, 1904: pl. 2 fig. 6]. Pleurotomidae [Conidae, teste Thiele 1929: 365; Turridae, teste Wenz 1943: 1425]. Gastropoda: Prosobranchia.

Umbotrochus (Monterosato MS) Thiele 1924a.
Mitteilungen aus dem Zoologischen Museum in Berlin, **11**(1): 58, 69; as genus, based on "*Umbotrochus* Monterosato in coll." [non *Umbotrochus* Perner 1904; *Umbotrochus* Thiele replaced by *Callumbonella* Thiele 1924 *(q.v.)*]. Type-species by monotypy: *Gibbula gorgonarum* P. Fischer [1883: 393]. Trochidae. Gastropoda: Prosobranchia.

Utriculastra Thiele 1925b.
Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition . . . "Valdivia", **17**(2): 269 [235]; as new subgenus of *Retusa* T. Brown 1827 [synonym of *Acteocina* Gray 1847, teste Mikkelsen & Mikkelsen 1984: 168]. Type-species by original designation: *Retusa canaliculata* (Say) [*Volvaria canaliculata* Say 1826: 211]. Retusidae [not a member of Retusidae, teste Mikkelsen & Mikkelsen 1984: 164-165]. Gastropoda: Opisthobranchia.

Venustaconcha Thiele 1934.
Handbuch der systematischen Weichtierkunde, **2**(3): 837; nomen novum pro *Venusta* Frierson 1927, non O. Boettger 1877, nec Barrande 1881; as subgroup of *Lampsilis* Rafinesque 1820 [subgenus of *Lampsilis*, teste Haas *in* Moore 1969: N450]. Unionidae. Bivalvia.

Walkerilla Thiele 1928c.
Zoologische Jahrbücher, **55**(5-6): 372, 379; as new section of *Birgella (Somatogyrus)* Gill 1863 [subgenus of *Somatogyrus*, teste Wenz 1939: 576]. Type-species by monotypy: *Somatogyrus coosaensis* Walker [*Somatogyrus coosaensis* Walker 1915: 40]. Hydrobiidae. Gastropoda: Prosobranchia.

Watsonella Thiele 1912b.
Deutsche Südpolar-Expedition 1901-1903, **13**(2): 237; as new group [non *Watsonella* W. Grabau 1900; *Watsonella* Thiele replaced by *Boogina* Thiele 1913, *(q.v.)*]. Type-species by monotypy: *Rissoa (Setia) sinapi* Watson [1886: 610, pl. 46 fig. 13]. [Rissoidae, teste Thiele 1929: 167; Cingulopsidae, teste Ponder 1985: 100]. Gastropoda: Prosobranchia.

"Zeacumanthus" [1929].

Handbuch der systematischen Weichtierkunde, **1**(1): 208; error pro *Zeacumantus* Finlay 1927. Potamididae. Gastropoda: Prosobranchia.

Zebrinops Thiele 1931c.
Handbuch der systematischen Weichtierkunde, **1**(2): 525; as new genus. Type-species by monotypy: *Zebrinops revoili* (Bourguignat) [*Limicolaria revoili* Bourguignat *in* Revoil 1882: 42, pl. 2 figs. 24, 25 (26)]. Enidae. Gastropoda: Pulmonata.

Zemiropsis Thiele 1929.
Handbuch der systematischen Weichtierkunde, **1**(1): 332; as new genus [= *Babylonia* Schlüter 1838, teste Barnard 1959: 60, 147]. Type-species by monotypy: *Zemiropsis papillaris* (Sowerby) [*Eburna papillaris* G. B. Sowerby I 1825: Appendix, p. xxii]. ? Olividae. Gastropoda: Prosobranchia.

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We thank Prof. Dr. Rudolf Kilias (Museum für Naturkunde, Humboldt Universität, Berlin) for providing Thiele's photograph as well as the sample of his handwriting, and Ms. Kathie Way (The Natural History Museum, London) for a copy of Thiele's 1923 letter to that museum. Dr. Alan Kabat (National Museum of Natural History, Washington) directed our attention to omissions in our previous paper; Ms. Paula M. Mikkelsen kindly supplied information on Thiele's opisthobranch taxa, and Mr. Richard I. Johnson commented expertly on an earlier draft of the manuscript.

The manuscript was reviewed by Dr. Alan R. Kabat (National Museum of Natural History, Washington, DC), Ms. Paula M. Mikkelsen (Harbor Branch Oceanographic Museum, Ft. Pierce, FL) and Mr. Richard E. Petit (North Myrtle Beach, SC).

ADDITIONS AND CORRECTIONS TO PART 1
(Nemouria, **34**, 1989):

Page 3, fourth paragraph: for 1960, read 1860.

Page 5, last paragraph: for 1911f, read 1911b.

Add asterisks to the following entries in section **A. Publications on Mollusca**: 1925d (p. 21), 1928d (p.22).

Previously omitted malacological publications by J. Thiele:

Carl Chun (1852-1914) is best known among malacologists for his fundamental monograph on the 'Valdivia' cephalopods. He died before completing this work and Thiele wrote several sections toward the end. Thiele should be credited with the authorship of those new taxa (as "Thiele *in* Chun 1915"):

* 1915d. *Polypus* (pp. 485-487, English edition pp. 378-380), Bolitaenidae (pp. 490-494, English edition pp. 383-386), Amphitretidae (pp. 531-533, English edition pp. 415-416), Vampyroteuthidae (pp. 534-536, English edition pp. 419-420), Cirroteuthidae (pp. 536-538, English edition pp. 421-422). [In:] Chun, C. Die Cephalopoden. II. Teil: Myopsida, Octopoda. Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899, **18**(2); Jena (Gustav Fischer). [English language translation: Carl Chun (C. F. E. Roper & I. H. Roper, eds.), The Cephalopoda. Israel Program for Scientific Translations, Keter Publishing House Jerusalem Ltd., 1975]

Another posthumous publication contains some of Thiele's contributions to the Kükenthal-Krumbach *Handbuch der Zoologie*. As this work was issued in signatures, his last portion on cephalopods (pp. 257-258) was not published until 1956; it was apparently issued with S. Jaeckel's addendum to the Mollusca (pp. 259-275):

1956. **Mollusca = Weichtiere.** [In:] Kükenthal, W. & Krumbach, T. (eds.): Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches, **5**(4): 257-258, text-figs. 341-343; Berlin and Leipzig (Walter de Gruyter), 1956 [posthumously continued from 1925d, 1926a and 1926b].

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A SMALL COLLECTION OF BIRDS FROM THE PHILIPPINES WITH NOTES ON BODY MASS, DISTRIBUTION, AND HABITAT

Johannes Erritzoe[1]

ABSTRACT. The importance of avian body mass is well understood. In this paper, masses of 199 individuals from 84 species of Philippine birds are reported, along with sex, month, and the bird's condition; interesting occurrences and plumage notes are presented for 12 other specimens.

INTRODUCTION

Many have already outlined the value of avian body mass data as one of the most important avian measurements (e.g., Clench & Leberman, 1978; Thomas, 1982; Dunning, 1984; Smith, et al., 1986). Several papers have supplied weight data for Philippine birds. For example, Amadon & Jewett (1946) gave the mass of 31 species; Ripley & Rabor (1958), 483; Ripley & Rabor (1962), 7; and Parkes (1988), 1. But I know of no papers where the sex, month, and the bird's condition have been reported.

The mass of a bird is biologically more meaningful when related to its fat index (Clench & Leberman, 1978). In this paper, masses of 199 individuals from 84 species are listed; 12 others for which the mass is not given but which have other interesting information are discussed at the end of the paper along with the more unusual cases.

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MATERIALS AND METHODS

The birds were all collected on Luzon and Palawan between 1965 and 1980, most of them by Hartvig Jensen, and are now housed in Denmark. The collection is available for scientific research.

Masses were obtained using Pesola spring balances of 50, 100 and 300 g. Only birds which were sexed by dissection and by gonad measurement are included in this paper, with one exception (*Porzana pusilla*). Age determination was made by studying skull ossification, the size of gonads, the form of the oviduct, and the presence or absence of bursa Fabricii, all methods described by Erritzoe (1985). When the color of bare parts described on the bird-skin labels differed from the literature (du Pont, 1971; Ripley, 1977; Hayman, et al., 1986), it is so stated in the species account. Any interesting information about stomach contents is also given. Taxonomy follows Dickinson, et al. (1991), with one exception (*Pluvialis fulva*). Birds were identified only to species level.

Abbreviations used are: ad, adult; bF, bursa Fabricii; P, purchased in the bird pet-market in Manila; imm, immature; l, lean (breastbone keen, lacking 1/3 or more of breast-muscle); l-n, a little lean (breastbone a little sharp); n, normal (no or only very little fat visible); n-f, a little fat; f, fat (fat fills furcula area which is level); vf, very fat (furcular area bulges with fat).

Sites (all Luzon except Iwahig) mentioned in the text are: Alicia (16° 80′ N, 121° 75′ E); Apalit (14° 57′ N, 120° 46′ E); Aparri (18° 22′ N, 121° 39′ E); Bataan Province (14° 30′ N, 120° 25′ E); Bulacan Province (15° 00′ N, 121° 05′ E); Cabanatuan (15° 29′ N, 120° 58′ E); Cagayan Province (18° 00′ N, 121° 50′ E); Casq (14° 40′ N, 121° 30′ E); Chico River (17° 37′ N, 121° 30′ E); Clayeria (18° 37′ N, 121° 05′ E); Conner (17° 50′ N, 121° 10′ E); Gonzaga (18° 15′ N, 122° 20′ E); Isabela Province (17° 00′ N, 122° 00′ E); Iwahig, Palawan (09° 45′ N, 118° 40′ E); Jones (16° 50′ N, 121° 70′ E); Laguna de Bai (14° 23′ N, 121° 15′ E); Laguna Kaliraya (14° 10′ N, 121° 35′ E); Los Baños (14° 13′ N, 121° 11′ E); Maddela (16° 21′ N, 121° 41′ E); Magot River (16° 25′ N, 121° 17′ E); Malamag Province (17° 17′ N, 121° 48′ E); Mt. Maquiling (14° 08′ N, 121° 12′ E); Munting Buhangin (14° 02′ N, 120° 30′ E); Nassiping (17° 58′ N, 121° 37′ E); Palaui Island (18° 35′ N, 122° 08′ E); Pata (17° 38′ N, 121° 30′ E); Peña Blanca (17° 40′ N, 121° 45′ E); Punta (12° 50′ N, 121° 37′ E); San Mariano (17° 00′ N, 122° 00′ E); Santa Ana (18° 30′ N, 122° 20′ E); Santa Fe (16° 10′ N, 120° 57′ E); Santa Teresita Beach (18° 30′ N, 122° 00′ E); Tabang (17° 50′ N, 121° 30′ E).

SYSTEMATIC LIST

FAMILY **RALLIDAE**

Gallirallus philippensis (Linné, 1766)

♀ ad, 15 October, Apalit. 172 g (n-f); largest eggs in ovary 7.9, 6.8, 4.4, and 3.9 mm.

Gallirallus striatus (Linné, 1766)

♂ ad, 13 February, Laguna de Bai. 98 g (n); iris brown, bill reddish-brown, legs and feet slate-grey.

♂ ad, 01 March, Laguna de Bai. 128 g (n). Stomach contents: freshwater snails.

Gallirallus torquatus (Linné, 1766)

♂ ad, 25 February, Laguna de Bai. 276 g (f).

Rallina eurizonoides (Lafresnaye, 1845)

♀ ad, 20 April, Peña Blanca. 79 g (n).

Porzana pusilla (Pallas, 1776)

♂, 06 February, Laguna de Bai. Found decayed. Det. Kenneth C. Parkes.

♀, 21 October, Santa Fe. 39 g (f); iris orange-red, bill and legs greenish. Habitat: tall grass. Stomach contents: rice.

Porzana fusca (Linné, 1766)

♂ imm, 03 December, Santa Fe. 51 g, bF 9.0 x 3.7 mm. Stomach contents: rice.

♂ imm, 06 December, Santa Fe. 51 g, bF 7.5 x 3.5 mm.

♀ imm, 03 December, Santa Fe. 40 g (n), bF approx. 4.4 x 1.9 mm; iris and eye-ring orange-red, bill dark green, legs dirty red.

Porzana tabuensis (Gmelin, 1789)

♂ imm, 04 December, Santa Fe. 33 g (f), bF 7.3 x 3.9 mm; iris orange, legs red-brown.

Porzana cinerea (Vieillot, 1819)

♂, 21 May, Alicia. 65 g.

♀ ad, 21 May, Alicia. 72 g.

Amaurornis phoenicurus (Pennant, 1769)

♀ ad, 08 February, Laguna de Bai. 120 g, bF 11.6 x 5.4 mm.
♀ imm, 13 February, Laguna de Bai. 141 g.

Gallicrex cinerea (Gmelin, 1789)

♂ ad, 20 May, Alicia. 443 g (n); testes: left 19.4 x 13.8, right 21.0 x 11.5 mm; iris brown.
♀ ad, 20 May, Alicia. 292 g; largest egg 4.7 mm.

FAMILY **ROSTRATULIDAE**

Rostratula benghalensis (Linné, 1758)

♂ ad, 12 February, Tabang. 145 g; iris brown.
♂ ad, 13 February, Laguna de Bai. Iris dark brown.
♀ ad, 26 March, Cabanatuan. 163 g; largest egg 8.0 mm.
♀ ad, 24 April, Chico River.
♀ ad, 20 May, Alicia. 178 g (n); small feathers in molt; largest eggs: 12.8, 7.7, and 4.3 mm.

FAMILY **CHARADRIIDAE**

Pluvialis fulva (Gmelin, 1789)

♂ ad, 24 April, Chico River. 136 g (f).
♀ imm, 08 March, Cagayan. Legs blue-grey. Stomach contents: small snails.
♀ imm, 31 March, Aparri. Stomach contents: small snails.

Charadrius dubius Scopoli, 1786

♂ ad, 26 May, Chico River. 33 g (n).
♀ ad, 10 March, Magot River. 34 g (n); largest eggs: 2.6, 2.5, 2.2, and 1.7 mm.

Charadrius alexandrinus Linné, 1758

♂ imm, 31 March, Aparri. 43 g (l).
♀ imm, 03 March, Aparri. 39 g (l).
♀ imm, 22 March, Aparri. 38 g (l).

Charadrius peronii "Temminck" Schlegel, 1865

♂ ad, 22 February, Casq. Was alone.

Charadrius mongolus Pallas, 1776

♂ ad, 25 May, Aparri. 53 g (n-f). Stomach contents: small insects, maggots, and snails.

♀ imm, 03 May, Aparri. Legs blue-grey.

Charadrius leschenaultii Lesson, 1826

10♂♂, 31 March - 22 April, Aparri. 60-81 g (mean 68.8 g).

4 ♀♀, 03-21 April, Aparri. 70-81 g (mean 75.8 g).

FAMILY **SCOLOPACIDAE**

Tringa stagnatilis (Bechstein, 1803)

♂ ad, 11 May, Chico River. 76 g; testes: left 7.5 x 4.2 mm, right 7.5 x 4.6 mm.

Tringa nebularia (Gunnerus, 1767)

♂ ad, 09 April, Aparri. 154 g (n).

Tringa glareola Linné, 1758

♂ ad, 23 March, Isabela. 58 g (l).

♀ imm, 12 March, Chico River. 77 g (vf); in molt. Stomach contents: small snails.

2 ♀♀ imm, 12 March, Chico River. 77 and 65 g.

♀ imm, 31 March, Aparri. 58 g.

Actitis hypoleucos (Linné, 1758)

♀ ad, 23 April, Chico River. 49 g (vf).

Arenaria interpres (Linné, 1758)

♂ imm, 20 September, Aparri. 92 g (vf). Stomach contents: maggots.

Gallinago megala Swinhoe, 1861

♂ imm, 07 October, Pata. 134 g (f), bF 7.5 x 5.0 mm.

Calidris alba (Pallas, 1764)

♂ ad, 09 April, Aparri. 58 g (f). Stomach contents: small snails.

♂ ad, 21 May, Santa Teresita Beach. 55 g (f).

♀ ad, 07 May, Aparri. 54 g (n).

Calidris ruficollis (Pallas, 1776)

3 ♂♂, 02-10 April, Aparri. 25, 26, and 29 g.

♂, 20 May, Chico River. 28 g.
♂, 02 September, Aparri. 31 g.
♂, 05 September, Aparri. 30 g.
♂, 04 October, Aparri. 27 g.
6 ♀♀, 21-24 April, Chico River. 24-34 g (mean 29.3 g).
2 ♀♀, 16 and 20 May, Chico River. 37 and 34 g.
♀, 04 September, Aparri. 31 g.

Calidris subminuta (Middendorff, 1853)
2 ♂♂, 25 and 26 March, Chico River. 26 g and 27 g (n).
♂, 02 April, Chico River. 28 g (vf).
♂, 21 April, Chico River. 30 g (f).
♂, 24 April, Chico River. 25 g (f).
♂, April, Chico River. 30 g (vf).
♀, 26 March, Chico River. 28 g (n).
♀, March, Chico River. 28 g (n).
♀, 02 April, Aparri. 30 g (f).
♀, April, Chico River. 30 g.

Calidris acuminatus (Horsfield, 1821)
2 ♂♂ ad, 21 and 24 April, Chico River. 72 g and 73 g (f).
♂ ad, 05 May, Chico River. 69 g (vf) (fat = 6 g).
♀ imm, 20 April, Chico River. 62 g.
♀ imm, 06 May, Chico River. 55 g.
♀ imm, 20 May, Chico River. 66 g (f).

Calidris ferruginea (Pontoppidan, 1763)
♂ ad, 04 May, Chico River. 56 g.
♂ ad, 10 May, Chico River. 55 g.

Calidris alpina (Linné, 1758)
♀ ad, 01 March, Aparri. 61 g (n-f).

FAMILY **STERNIDAE**

Sterna albifrons Pallas, 1764
♀ ad, 14 April, Aparri. 56 g (f).

FAMILY **PSITTACIDAE**

Prioniturus discurus (Vieillot, 1822)
♂, 26 October, P. 86 g (l).

Tanygnathus lucionensis (Linné, 1766)
♂, June, P. 168 g (l-n).
♂ ad, June, P. 148 g (l).
♂, 30 December, P. 168 g (l).

Tanygnathus sumatranus (Raffles, 1822)
♂, 06 June, P. 173 g (l).

Loriculus philippensis (P. L. S. Müller, 1776)
♂ imm, 06 June, P. 31 g.
♀ imm, 07 December, P. 35 g (n).

FAMILY **CUCULIDAE**

Phaenicophaeus superciliosus Dumont, 1823
♂ ad, 20 April, Cagayan. 100 g (n). Stomach contents: large indeterminable insects and locusts.
♂ ad, 15 August, Bulâcan. 112 g (n).

Phaenicophaeus curvirostris (Shaw, 1810)
♂ ad, 16 May, Iwahig. 144 g (n).

Phaenicophaeus cumingi Fraser, 1839
♀ ad, 15 March, P. 139 g.
♀ ad, 15 May, P. 104 g (l).

Centropus bengalensis (Gmelin, 1788)
♂, 12 April, Pata. In molt; iris yellow (!). Stomach contents: large indeterminable insects and locusts.

Centropus unirufus (Cabanis & Heine, 1863)
♀ ad, 19 June, Santa Fe. 162 g (n); legs slate grey. Stomach contents: passerine bird (!) and insects.

FAMILY **APODIDAE**

Collocalia esculenta (Linné, 1758)
3 ♂♂ imm, 28 August, Clayeria.
♀, 17 April, Malamag.

FAMILY **ALCEDINIDAE**

Alcedo atthis (Linné, 1758)
♂ ad, 14 April, Santa Fe. 29 g (f).
♂, 09 October, Chico River. 24 g (n); breast feathers in molt.
♀, 29 March, Chico River. 27 g (f).

Halcyon coromanda (Latham, 1790)
♂, 21 April, Palaui Island. 108 g. Stomach contents: snails.
♀, 18 October, Santa Fe. 87 g (f); primaries on left wing very worn.

Halcyon smyrnensis (Linné, 1758)
♂ ad, May, Bulâcan. 68 g.

Halcyon chloris (Scopoli, 1786)
♂ ad, 16 April, Laguna de Bai. 55 g (n). Stomach contents: caterpillar and other insects.
♀ ad, 18 April, Santa Fe. 57 g.

FAMILY **MEROPIDAE**

Merops viridis Linné, 1758
♀ ad, 04 April, Punta. 40 g.

Merops philippinus Linné, 1766
♂ ad, 29 March, Chico River. 36 g (n).

FAMILY **PITTIDAE**

Pitta erythrogaster Temminck, 1823
♂ ad, 16 June, Santa Fe. 49.7 g (n).
♀ ad, 23 November, Santa Fe. 47 g (n).
♀ imm, 04 December, Santa Fe. 47 g (n), bF 5.0 x 3.1 mm.
♀ imm, 09 December, Santa Fe. 46 g (n).

Pitta sordida (P. L. S. Müller, 1776)
♂ ad, 25 April, Santa Fe. 59 g (f).
♂ ad, 16 May, Iwahig. 64 g.
2 ♀♀ ad, 17 and 18 April, Santa Fe. 45.4 g (l-n) and 48 g (n).

FAMILY **ALAUDIDAE**

Mirafra javanica Horsfield, 1821

♂ ad, 24 May, Pata. 21 g (n).

2 ♂♂, 13 and 19 October, Santa Fe. 23 g (n) and 19 g. Stomach contents: rice.

3 ♂♂, 06 and 11 December, Santa Fe. 20, 21, and 21 g. Stomach contents: rice, insects and plant matter.

Alauda gulgula Franklin, 1831

♂ ad, 25 March, Chico River. 26 g. Stomach contents: insects.

FAMILY **HIRUNDINIDAE**

Hirundo daurica Linné, 1771

♂ ad, 13 May, Santa Ana. 31 g (f).

FAMILY **PYCNONOTIDAE**

Pycnonotus urostictus (Salvadori, 1870)

♂ ad, 20 April, Peña Blanca. 26 g (n); eye-ring lemon-yellow.

Pycnonotus goiavier (Scopoli, 1786)

♀ ad, 31 October, Peña Blanca. 31 g (n).

FAMILY **ORIOLIDAE**

Oriolus chinensis Linné, 1766

♀ ad, 12 February, Bulâcan. 106 g (vf). Stomach contents: larvae, fruit, berries.

FAMILY **PARIDAE**

Parus elegans Lesson, 1831

♂ ad, 18 April, Laguna de Bai. 15 g (n).

♂ ad, 11 May, Santa Fe. 14 g (n).

FAMILY **SITTIDAE**

Sitta frontalis Swainson, 1820

♂ ad, 11 May, Santa Fe. 17 g (n).

FAMILY **RHABDORNITHIDAE**

Rhabdornis mystacalis (Temminck, 1825)
♂ ad, 19 April, Laguna de Bai. 28 g (n).

FAMILY **TURDIDAE**

Copsychus luzoniensis (Kittlitz, 1832)
♂ ad, 04 March, Mt. Maquiling. 25 g.

Copsychus niger (Sharpe, 1877)
♂ ad, 16 May, Iwahig. 30 g (n).

Saxicola caprata (Linné, 1766)
♂ ad, 01 February, Luzon. 15 g.
♂ ad, 04 May, Maddela. 14 g (n).
♂ ad, 26 May, Pata. 14 g.
♂ imm, 06 September, Pata. Stomach contents: berries.
♀ ad, 07 March, North Luzon. 16 g.

Monticola solitarius (Linné, 1758)
♂, 24 January, Santa Fe. 41 g (l); right side of breast in molt.
♀ ad, October, Chico River. 52 g (n).

Turdus chrysolaus Temminck, 1831
♂, February, Santa Fe. 71.5 g.

FAMILY **SYLVIIDAE**

Phylloscopus borealis (Blasius, 1858)
♀ imm, 18 October, Santa Fe. 8 g (l).

Acrocephalus stentoreus (Ehrenberg, 1833)
♂, 29 March, Laguna de Bai. 23 g.
2 ♀♀, 13 and 20 March, Laguna de Bai. 21 g (n) and 19.8 g (n).

Acrocephalus orientalis (Temminck & Schlegel, 1847)
♂, 20 March, Laguna de Bai. 24 g (n).
♂, 03 April, Laguna de Bai. 27 g.
♂, 19 October, Santa Fe. 25 g (n).
♂, 06 November, Santa Fe. 26 g (f).
2 ♀♀ imm, 13 and 19 October, Santa Fe. 21 g (n) and 26 g.

Locustella ochotensis (Middendorff, 1853)
♂ imm, 06 November, Santa Fe. 17 g (n).

Locustella lanceolata (Temminck, 1840)
2 ♂♂, 03 and 07 December, Santa Fe. 12 g (f) and 10 g (f).
2 ♀♀, 08 and 18 October, Santa Fe. 11 g and 10 g (f).

Megalurus palustris Horsfield, 1820
♂ ad, 24 February, Jones. 47 g. Stomach contents: plant matter and insects.
♂ ad, 03 April, Magot River. 58 g.
♀, 03 April, Laguna de Bai. 35 g (n).
♀ imm, 02 October, Laguna de Bai. 35 g (n), bF 7.7 x 3.4 mm.

Cisticola juncidis (Rafinesque, 1810)
♂ ad, 25 May, Gonzaga. 10 g (n).

FAMILY **MUSCICAPIDAE**

Cyornis rufigastra (Raffles, 1822)
♂, 17 February, Nassiping. 17 g.
♂, 29 December, Munting. 20 g.
♀, 28 December, Munting. 17 g; one albino feather on back.

Rhipidura cyaniceps (Cassin, 1855)
♂, 03 January, Laguna de Bai. 16 g (n).
♂, 01 December, Los Baños. 18 g (n).
♀, 18 April, Laguna Kaliraya. 14 g.
♀ ad, 19 May, Santa Fe. 13 g (n); legs slate-grey.

Rhipidura javanica (Sparrman, 1788)
♂, 27 December, Bataan. 18 g (n).
♀, 26 December, Bataan. 18 g (n).

Hypothymis azurea (Boddaert, 1783)
♂ ad, 01 April, Pata. Mouth and tongue yellow.
♀ ad, 21 April, Palaui Island. 12 g (n).

FAMILY **MOTACILLIDAE**

Motacilla flava Linné, 1758
♂, 03 February, Magot River. 15 g.
♂, 18 May, Santa Fe. 31 g (vf).

Anthus novaeseelandiae (Gmelin, 1789)
♂ ad, 06 March, Pata. 28 g.
♂ ad, 24 May, Pata. 25 g.
♂ ad, 25 May, San Mariano. 22 g.
2 ♂♂, 26 May, Chico River. 24 g and 27 g (n).
♂ ad, 10 September, Isabela. 27 g.
♀, 08 March, North Luzon. 27 g.
♀ ad, 25 May, Aparri. 26 g (n).
♀ imm, 07 September, Pata. 27.5 g.

FAMILY **ARTAMIDAE**

Artamus leucorhynchus (Linné, 1771)
♂ ad, 24 April, Conner. 42 g (n).

FAMILY **LANIIDAE**

Lanius schach Linné, 1758
♂ imm, 02 October, Luzon. 37 g.
♀ ad, 26 May, Pata. 36 g (n).

FAMILY **STURNIDAE**

Sarcops calvus (Linné, 1766)
♀ ad, 18 February, P. 82 g (l).

Acridotheres cristatellus (Linné, 1766)
♂ ad, 06 May, Santa Fe. 122 g (n-f).

FAMILY **NECTARINIIDAE**

Nectarinia jugularis (Linné, 1766)
♂ ad, 06 March, Laguna de Bai. 9 g.
♂ ad, 01 June, Santa Fe. 9 g (n).
♀ ad, 07 March, Laguna Kaliraya. 8 g (n).

FAMILY **DICAEIDAE**

Dicaeum australe (Hermann, 1783)
♂ ad, 19 April, Laguna Kaliraya. 9 g (n).
♀ ad, 12 March, Laguna Kaliraya. 9 g (n).

FAMILY **ZOSTEROPIDAE**

Zosterops montanus Bonaparte, 1851

♂♂, 02 and 03 January, Laguna de Bai. 11 g (f) and 12 g.

FAMILY **PLOCEIDAE**

Passer montanus (Linné, 1758)

♂ ad, 10 January, Cagayan. 19.5 g (l).

FAMILY **ESTRILDIDAE**

Lonchura punctulata (Linné, 1758)

♀ ad, 03 April, Laguna de Bai. 13 g.

DISCUSSION

Not surprisingly, the Rallidae with their hidden habits offered the most interesting records. Among 16 skins and one skeleton, seven species are uncommon to rare (Dickinson, et al., 1991):

Uncommon resident: *Rallina eurizonoides* (n = 1); *Porzana fusca* (n = 3).

Uncommon, probably winter visitor: *Porzana pusilla* (n = 2).

Rare and extremely secretive resident: *Porzana tabuensis* (n = 1).

In all cases, except the Baillon's Crake (*Porzana pusilla*) found dead and decomposed, the local people had caught the birds in snares for consumption.

The large *Gallicrex cinerea* male was still in its non-breeding plumage without any trace of molt despite the large gonads and breeding reported to start only one month later (Ripley, 1977).

The Greater Painted-snipe, *Rostratula benghalensis,* is an uncommon, local resident (Dickinson, et al., 1991). The five specimens collected one-at-a-time on Luzon suggest that the population on this island is overlooked and more common than previously believed.

The Marsh Sandpiper, *Tringa stagnatilis,* is a passage migrant or winter visitor (Dickinson, et al., 1991). The late date, 11 May, and the low body mass (76 g; range 55.0 - 120.0 g, Dunning, 1993) indicate that it may have been a summer visitor. The record of a Common Greenshank, *Tringa nebularia,* is also noteworthy because it is reported as an uncommon passage migrant and winter visitor (Dickinson, et al., 1991).

The Sanderling, *Calidris alba,* is classified as rare and only seen on Luzon between November and May (Dickinson, et al., 1991). All three Sanderlings were from April-May with small- (April) to medium-sized gonads. The record from 21 May might possibly have been a non-breeding summer visitor because many non-breeders remain south all year (Hayman, et al., 1986). The most remarkable shorebird is the Dunlin, *Calidris alpina*, found dead on the sand beach at Aparri, 01 March 1988, the first record of this species for the Philippines (Erritzoe, 1994).

The single record of a Little Tern, *Sterna albifrons*, from Aparri is also interesting, because this bird is an uncommon winter visitor and a rare resident only breeding on Mindoro (Dickinson, et al., 1991).

The female Ruddy Kingfisher, *Halcyon coromanda*, collected on 18 October was abnormal in having all primaries new except three in the right wing, primaries 7-8 with normal wear, and primary 10 about 2 mm shorter. Compared with this, the primaries on the left wing were all worn and shortened, some about one-quarter of the normal length, and the outer webs on most primaries had notches. It looked most similar to the feather-eating commonly seen, for instance, in captive parrots, but I have never seen this reported in kingfishers. The bird was otherwise in quite normal condition.

I compared a White-breasted Kingfisher, *Halcyon smyrnensis*, from Selangor, Malaysia, and another skin from Bangkok, Thailand [both of the subspecies *fusca* (Boddaert, 1783)], with the specimen from the Philippines [subspecies *gularis* (Kuhl, 1820)], and found a surprising detail. On an area of the lower breast, where the nominate and *H. s. fusca* are white and the Philippine bird is typically red-brown, a faint tinge of white was visible. On the same area, the bases of the feathers were black. On the other hand, on the upper breast and lower throat, the bases of the red-brown feathers were white, but here the feathers had no white tinge. This color pattern has not been mentioned in other works (Forshaw & Cooper, 1985; Fry, et al., 1992).

The two males of *Zosterops montanus* were determined to belong to this species in spite of the lowland locality because of black lores which in *Z. meyeni* Bonaparte, 1850, are paler (Mees, 1957: 170).

ACKNOWLEDGMENTS

This paper is dedicated to my dear brother, Thorkild Erritzoe, who for many years was the Danish Consul General for the Philippines. I acknowledge Dr. Kenneth C. Parkes and Prof. Anders Pape Møller for making valuable comments on an earlier draft of this manuscript.

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ANNOTATED CATALOG OF TYPE SPECIMENS IN THE MALACOLOGICAL COLLECTION OF THE DELAWARE MUSEUM OF NATURAL HISTORY

PART II. ADDITIONS AND CORRECTIONS TO PART I (PROSOBRANCHS, HETEROSTROPHA, AND OPISTHOBRANCHIA), PLUS BIVALVIA, SCAPHOPODA, AND POLYPLACOPHORA

Paula M. Mikkelsen[1] and Alison Bradford[2]

ABSTRACT. An annotated catalog of name-bearing type specimens in the mollusk collection at Delaware Museum of Natural History is continued. This contribution is Part II of the series, following Part I (marine prosobranchs and opisthobranchs) by Bieler & Bradford (1991, Nemouria, No. 36, 1-48). This part lists all remaining type specimens, excluding Pulmonata. A total of 143 type lots of 122 species-group taxa is recognized, and taxonomic and author indices to all taxa in Parts I and II are provided.

INTRODUCTION

In accordance with Recommendation 72G(4) of the International Code of Zoological Nomenclature (ICZN, 1985), this publication continues the annotated catalog of name-bearing type specimens [holotypes, paratypes, lectotypes, and syntypes (= cotypes)] in the mollusk collection of the Delaware Museum of Natural History (DMNH). Part I (Bieler & Bradford, 1991) included 189 lots of marine "Prosobranchia" (now recognized as an artificial taxon; Bieler, 1992) and Opisthobranchia. This part includes corrections and additions to Part I plus entries for 143 lots of non-pulmonate mollusks not previously listed. Following completion of a project to isolate all name-bearing

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types from the main collection storage cabinets into a segregated type collection, it became obvious that, contrary to an earlier statement (Bieler & Bradford, 1991: 1, 4), most of the DMNH types were <u>not</u> marine prosobranchs and opisthobranchs, but rather pulmonates. At present, presumed types of Pulmonata comprise 788 lots, or 70% of the total type collection; these have not yet been verified and await future study.

Since the previous catalog, the malacological collection at DMNH has surpassed 208,000 cataloged lots, maintaining its status within the top ten largest mollusk collections in the U. S. A. Moreover, DMNH undoubtedly ranks among the most completely computerized of major molluscan collections (now surpassing 72%), and still claims a remarkable capacity for collection growth in terms of available collection storage space. Contributing toward this catalog since 1991 were significant private collections containing type material donated by Dr. Lawrence F. Kienle (Medford, New Jersey; Cypraeidae), Helene Eker (Phoenix, Arizona; Mitridae and Costellariidae), and Eugenia I. Wright (Phoenix, Arizona; Muricidae). Type specimens of newly named species were also received from B. J. Piech (DMNH), D. Tippett (National Museum of Natural History), and J. K. Tucker (Illinois Natural History Survey, Wood River). In addition, one archival resource of particular note was acquired as part of the Eker donation. This is a set of approximately 2,000 10 x 16.5 cm alphabetically arranged index cards maintained as a research tool by Walter O. Cernohorsky, listing most of the described species of Mitridae and Costellariidae. Type material, original description information, geographical distribution, and Cernohorsky's own research notes are included on each card. DMNH also acquired approximately 1,300 color photographic transparencies, photographed by Cernohorsky, of type specimens of Mitridae and Costellariidae in the world's museum collections.

Following a short list of additions and corrections to Part I (Bieler & Bradford, 1991), this list is arranged in the same general format as that of Bieler & Bradford (1991). Alphabetical order of taxa is used within major molluscan groups: Polyplacophora, prosobranchs (additions to Part I + non-marine taxa), Heterostropha, Opisthobranchia (additions to Part I), Bivalvia, and Scaphopoda. Each entry includes the original combination, original status (exactly as expressed), full citation, number and kind of types, DMNH catalog number, locality data, source of DMNH material (with source lot catalog number if known), specimen dimension(s), present (and original) family placement, and remarks (justification of type status if not cited specifically by original description, condition of specimens, etc.). The locality information given is as cited on the collection label, not modified according to the original description or other source, unless so noted. Like Part I, this is not a critical catalog in that no attempt has been made to fully research each taxon with regard to present systematic status, other type material, etc.; however, the valid name, if different from the original through known synonymy or as used in the DMNH or ANSP collections, is given following the family status.

As in Part I, we excluded specimens that were previously recognized as types simply because they were part of the original material of the author if the original description specifically restricted the type repositories. Much of the type material in this catalog originated as "split lots" from the Academy of Natural Sciences of Philadelphia (ANSP); the ANSP collection and its catalog records were consulted as additional evidence either for or against type status of the DMNH lots. Many of the ANSP source lots are now divided into "type + paratypes"; although these cases are noted as such in the text below, none of these notations (nor any other statement herein) are intended to be, nor should they be interpreted as, lectotype designations.

The specimen dimensions were determined to the nearest 0.1 mm either with calipers or a calibrated eye-piece in a dissecting stereomicroscope. Dimensions are presented slightly differently for the different shell forms reflected by the various classes. Polyplacophorans are given as L x W, where L = anteroposterior length, and W = lateral width; gastropods, as H x W, where H = anteroposterior height, and W = lateral width; bivalves, as L x H, where L = anteroposterior length, and H = dorsoventral height; and scaphopods, as L x W, where L = length of the long axis, and W = maximum width or diameter of the tube. Generally, a range is provided if the lot contains more than four specimens. Discrepancies between published and actual dimensions are also noted.

The entry format of this paper differs from Part I (Bieler & Bradford, 1991) in only two minor ways: (1) Each original citation includes all pages and figures, not just those figuring DMNH type material. Any DMNH specimens that are believed to be figured types are listed as such. (2) Family placement is expressed differently for ease of readability. Part I listed the original family, followed by the current family (in brackets) according to the classification of Ponder & Warén (1988). In this Part, the current family is presented first, followed by the original placement, if different, in brackets. Current family assignment was guided by Ponder & Warén (1988, prosobranchs only), Vaught (1989), and Turgeon, *et al.* (in press).

This list includes 122 taxa, 143 lots, 880 specimens, and 8 holotypes. Polyplacophora comprise 3 lots (3 taxa), additional prosobranchs 79 lots (62 taxa), Heterostropha 1 lot (1 taxon), additional Opisthobranchia 1 lot (1 taxon), Bivalvia 58 lots (54 taxa), and Scaphopoda 1 lot (1 taxon). No cephalopod types presently reside at DMNH. Parts I and II of this catalog (all species except Pulmonata) comprise a total of 277 taxa, 334 lots, 1,339 specimens, and 46 holotypes. Four taxa are covered by both parts of this catalog.

The type entries are followed by two indices, taxonomic (new in this Part) and author (total = 105), which include names from both published parts of this catalog. The Literature Cited includes all original citations plus any other cited references.

Abbreviations used throughout the text are: AIM, Auckland Institute & Museum, New Zealand; AMNH, American Museum of Natural History, New York; ANSP, Academy of Natural Sciences of Philadelphia, Pennsylvania; DMNH, Delaware Museum of Natural History, Wilmington; D[T]MNH, Dallas Museum of Natural History, Texas; FLMNH, Florida Museum of Natural History, Gainesville; FMNH, Field Museum of Natural History, Chicago; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; UF, University of Florida [= FLMNH]; USNM, National Museum of Natural History [United States National Museum], Smithsonian Institution, Washington, D. C.; WAM, Western Australian Museum, Perth, Western Australia.

TYPE CATALOG

ADDITIONS AND CORRECTIONS TO PART I (BIELER & BRADFORD, 1991)

Page 6, ***aureola***, *Pyrene*, Howard, 1963. Add: (non Duclos in Chenu, 1846). Emended (one month after original description) by Howard (1963) to *aureomexicana.*

Page 7, ***axelrodi***, *Conus*, Walls, 1978. Next-to-last sentence should read "Also described by Walls (1979a: 183 ff.) with reference to earlier publication (Walls, 1978)."

Page 8, ***boholensis***, *Conus*, Petuch, 1979. DMNH 126400 (holotype, 38.4 mm) and 126401 (2 paratypes, 26 and 17 mm) were examined and measured by Coomans, *et al.* (1982: 32) and determined to be synonymous with *C. borneensis* Adams & Reeve, 1848.

Page 8, ***boschi***, *Cymatium*, Abbott & Lewis, 1970. Add: DMNH holotype listed by Henning & Hemmen (1993: 74).

Page 10, ***cloveri***, *Conus*, Walls, 1978. Next-to-last sentence should read "Also described by Walls (1979a: 338 ff.) with reference to earlier publication (Walls, 1978)."

Page 14, ***fayae***, *Anachis* (*?Costanachis*), Keen, 1971. Read (*?Costoanachis*).

Page 15, ***floridanus***, *Microdochus*, Rehder, 1943. Exact number of paratypes is 78.

Page 16, ***guesti***, *Pterynotus*, Harasewych & Jensen, 1979. Add: DMNH holotype listed by Houart (1994).

Page 19, ***kerstitchi***, *Conus*, Walls, 1978. Next-to-last sentence should read

"Also described by Walls (1979a: 615 ff.) with reference to earlier publication (Walls, 1978)..."

Page 21, ***lightbourni***, *Pterynotus*, Harasewych & Jensen, 1979. Add: DMNH holotype listed by Houart (1994).

Page 26, ***philippinensis***, *Axymene*, Petuch, 1979. Add: DMNH holotype listed by Houart (1994, as *A. philippensis* [*sic*]), and by Bouchet & Warén (1986) who synonymized the species with *Eosipho dentatus* (Schepman, 1911) of Buccinidae.

Page 26, ***radwini***, *Pterynotus*, Harasewych & Jensen, 1979. DMNH holotype listed by Houart (1994).

Page 27, ***sandwichensis***, *Conus suturalis*, Walls, 1978. Read *suturatus*.

Page 30, ***vernicosum***, *Mangilia* (*Calliotectum*), Dall, 1889. Read Dall, 1890. Add: Placed in Volutidae by subsequent authors, *e. g.*, Weaver & duPont (1970), Emerson & Sage (1986), Poppe & Goto (1992).

Page 43, Dall, W. H., 1889. Read 1890.

POLYPLACOPHORA

andersoni, *Acanthochitona* [as new species]

Watters, 1981: 173-176, pls. 2e-g, 4i.

1 figured paratype: DMNH 095383; 35 ft [published as 10.6 m], by scuba, west of Picquet Rocks, Bimini Island, Bahamas. Coll. G. Watters; ex G. Watters. Dimensions (L x W, greatest dimensions of strongly curved, dried animal): 4.8 x 2.8 mm.

Remarks: "On *Strombus gigas*" and "April 17, 1973" were in the original description of this type lot, but are not on the specimen label. Three illustrations of this paratype appear in pls. 2e-g, which although they look like dissociated plates, were presumably drawn from this still-intact specimen.

Acanthochitonidae [originally Cryptoplacidae].

lineata, *Acanthochitona* [as sp. nov.]

Lyons, 1988: 90-92, figs. 42-51.

1 paratype: DMNH 095381; Water Island, Virgin Islands. Coll. Weber, July 1959; ex G. Watters. Dimensions (L x W): 8.5 x 4.3 mm [published as 9.7 mm].

Acanthochitonidae.

portobelensis, *Callistochiton* [as new species]

Ferreira, 1976: 46-49, figs. 1-6.

1 paratype: DMNH 102101; 1-5 ft, under side of loose rock, about 5 mi

[published as 5 km] west of Portobelo, Panama. Coll. A. J. Ferreira, 15 February 1975; ex A. J. Ferreira. Dimensions (L x W): 5.5 x 3.0 mm.

Remarks: The original description mentioned paratypes in the author's collection, the source of this material.

Ischnochitonidae [originally Callistoplacidae].

PROSOBRANCHS (ADDITIONS TO PART I; BIELER & BRADFORD, 1991)

acanthus, *Mirachelus* [as new species]

Quinn, 1991b: 168, figs. 4-6.

Holotype (figured): DMNH 187589; dredged, off Castle Roads, Bermuda. Coll. A. Guest (lot #582); ex J. E. Quinn. Dimensions (H x W): 3.1 x 2.5 mm [published as 3.45 x 2.95 mm].

3 paratypes: DMNH 187590; dredged, off Castle Roads, Bermuda. Coll. A. Guest (lot #582) via J. E. Quinn. Dimensions (H x W): (1) 2.9 x 2.4 mm, (2) 2.8 x 2.4 mm, (3) 2.7 x 2.3 mm.

Remarks: Although the caption to the published scanning electron micrographs (Quinn, 1991b: figs. 4-6) indicated "Paratype, DMNH 187590," it is the holotype (DMNH 187589) that has been coated for SEM. The published depth of 100 m is not indicated on the DMNH labels.

Trochidae [originally Trochidae: Eucyclinae: Chilodontini].

alcaldei, *Chondropoma* (*Chondropoma*) [as n. sp.]

Jaume & Sánchez de Fuentes, 1943a: 17-18, pl. 2, fig. 1.

4 paratypes: DMNH 135179; Mogote Las Damas, Central Dolores, Pedro Betancourt, Matanzas, Cuba. Ex O. Alcalde (Jackson catalog) via R. W. Jackson (#6628). Dimensions (H x W): (1) 14.8 x 9.1 mm, (2) 14.5 x 8.7 mm, (3) 14.2 x 9.1 mm, (4) 13.1 x 8.8 mm.

Remarks: The original description mentioned paratypes in private collections, *i. e.*, "en las colecciones de los autores y en la del Sr. Oscar Alcalde Ledón." The Jackson collection catalog in the DMNH archives indicates the source of these specimens as Alcalde.

Annulariidae [none specified originally].

alcaldei, *Chondrothyrium* (*Plicathyrium*) [as nueva especie]

Jaume & Sánchez de Fuentes, 1943c: 24-25, pl. 4, fig. 1.

1 paratype: DMNH 135184; Palmarito de Gonzales, Cienfuegos, Las Villas, Cuba. Ex O. Alcalde via R. W. Jackson [#6613, as *C. (P.) alcaldei alcaldei*]. Dimensions (H x W): 14.6 x 10.2 mm.

Remarks: The original description mentioned paratypes in "las colecciones de los autores y en la del Sr. O. Alcalde."

Annulariidae [none specified originally].

alcoviensis, *Somatogyrus* [as new species]

Krieger, 1972: 120-125, figs. 1-4.

12 paratypes (including figured): DMNH 041741; Cedar Shoals, Yellow River, Newton County, Georgia. Coll. K. A. Krieger, 1968-1971; ex K. A. Krieger. Dimensions (range): H = 2.2-4.3 mm, W = 2.1-3.6 mm.

12 paratypes: DMNH 041742; Newton Factory Shoals, Alcovy River, Newton County, Georgia. Coll. K. A. Krieger, 1970-1971; ex K. A. Krieger. Dimensions (range): H = 1.5-3.0 mm, W = 1.6-2.9 mm.

Remarks: Krieger's (1972) fig. 1 showed three views of two paratypes from DMNH 041741; they measure 4.3 x 3.6 mm [the largest specimen] and 4.1 x 3.6 mm (both larger than the stated dimensions from fig. 1 of 3.0 x 2.9 mm). Most of the paratypes have opercula plus dried soft parts inside the shell.

Hydrobiidae.

backae, *Scabricola* (*Scabricola*) [as sp. n.]

Cernohorsky, 1973: 133-135, figs. 1-5.

1 paratype: DMNH 197613; Flinders Bay, Augusta, southwestern Australia. Coll. Mrs. F. Back, 13 September 1972; ex W. O. Cernohorsky via H. Eker. Dimensions (H x W): 22.0 x 9.1 mm.

1 paratype: DMNH 197616; Flinders Bay, Augusta, southwestern Australia. Ex Auckland Institute & Museum via H. Eker. Dimensions (H x W): 23.3 x 9.0 mm. Remarks: The original label indicates two paratypes, but this lot contains only one, with "E" written in pencil on inside of outer lip.

Remarks: The Cernohorsky index card in DMNH does not list the Eker collection, but the original description mentioned two paratypes in the Eker collection (including one at 23.1 x 9.0 mm = DMNH 197616), and one in Cernohorsky's collection (given as 22.0 x 9.0 mm = DMNH 197613), all from Flinders Bay.

Mitridae [originally Mitridae: Imbricariinae]. This is now a synonym of *Scabricola sowerbyi melvilli* (Sowerby, 1882) (Cernohorsky, 1991).

barretti, *Odostomia* [as new species]

Morrison, 1965: 220, fig. 4.

2 paratypes: DMNH 108366; 4 ft, northeast corner of Heron Bay, Mississippi. Coll. J. P. E. Morrison; ex USNM 635631 (*vidi*). Dimensions (H x W): (1) 2.0 x 1.0 mm (worn shell, apertural lip broken), (2) 1.7 x 0.9 mm (fresh shell).

Remarks: These also serve as types for the replacement name *Hydrobia booneae* Morrison (1973: 28) [new name for *Odostomia barretti* Morrison, 1965, non *O. bareti* L. Morlet, 1885].

Hydrobiidae [originally Pyramidellidae].

bermudense, *Calliostoma* [as new species]

Quinn, 1992: 86, figs. 23-24.

Holotype (figured): DMNH 187591; dredged, 45 fms, off Castle Roads, Bermuda. Coll. A. Guest & J. R. H. Lightbourn, 1975-1976; ex J. E. Quinn. Dimensions (H x W): 11.6 x 8.5 mm [published as 11.9 x 8.9 mm].

9 paratypes: DMNH 187592; dredged, 45 fms, off Castle Roads, Bermuda. Coll. A. Guest & J. R. H. Lightbourn, 1975-1976; ex J. E. Quinn. Dimensions (range): H = 5.7-8.8 mm, W = 4.8-7.0 mm.

Trochidae [originally Trochidae: Calliostomatinae].

britoi, *Eutudora limbifera* [as nueva subespecie]

Jaume & Sánchez de Fuentes, 1943b: 19-20, pl. 3, fig. 1.

6 paratypes: DMNH 135217; El Hatillo, San Miguel de los Baños, Matanzas, Cuba. Ex O. Alcalde (Jackson catalog) via R. W. Jackson (#6641). Dimensions (range): H = 10.1-12.7 mm, W = 9.7-9.8 mm.

Remarks: The original description mentioned paratypes in private collections, *i. e.,* "en las colecciones de los autores y del Sr. Oscar Alcalde y Ledón." The Jackson collection catalog in the DMNH archives indicates the source of these specimens as Alcalde. All specimens have opercula in place, possibly with dried soft parts.

Annulariidae.

caribaea, *Coralliophila* [as new species]

Abbott, 1958: 66-67, text-fig. 3 (1-2), pl. 1g-h.

3 paratypes: DMNH 024282; Vera Cruz, Mexico. Coll. Heilprin & F. C. Baker, 1890; ex ANSP 61054 (*vidi*). Dimensions (H x W): (1) 19.4 x 15.1 mm, (2) 18.9 x 11.9 mm, (3) 18.2 x 12.7 mm.

Remarks: All live-collected, with dried soft parts in shells.
Muricidae [originally Magilidae].

carinatus, *Lamellitrochus* [as new species]
Quinn, 1991a: 84-85, figs. 7-12, 34-35.
Holotype: DMNH 179393; southwest of Egmont Key, Florida, 200-230 fms. Coll. J. Moore, May 1962; ex D. Steger. Dimensions (H x W): 2.3 x 2.5 mm [published as 2.50 x 2.70 mm]. Remarks: Split from DMNH 104803 [*Lamellitrochus lamellosus* (Verrill & Smith, 1880)].
31 paratypes: DMNH 179392; 80 fms, rubble, 100 mi southwest of Egmont Key, Florida. Ex D. Steger. Dimensions (range): H = 1.1-2.5 mm, W = 1.2-2.6 mm. Remarks: Split from DMNH 104814 [*L. lamellosus* (Verrill & Smith, 1880)].
22 paratypes (including figured): DMNH 186768; southwest of Egmont Key, Florida. Coll. J. Moore, May 1962; ex D. Steger. Dimensions (range): H = 1.3-2.5 mm, W = 1.7-2.6 mm. Remarks: Includes two specimens gold-coated for scanning electron microscopy (figs. 7-9). Split from DMNH 179393; this is now the holotypic lot (above) of this species, but which according to DMNH cataloging records initially comprised 16 specimens. The discrepancy in the number of specimens (15 versus 22; initially miscounted? additional specimens added from original lot, DMNH 104803?) is unresolved.
Trochidae [originally Trochidae: Solariellinae].

casta, *Notocypraea* [as nov. spec.]
Schilder & Summers, 1963: 66.
1 paratype (labeled "e"): DMNH 196180; Port MacDonnell, South Australia. Coll. by Ian Carrison, 1960; ex P. Trenberth via L. F. Kienle. Dimensions (H x W): 21.0 x 12.8 mm [original label as 12.3 mm].
Remarks: This specimen is pure white. The original description mentioned paratypes (although un-numbered or -lettered) "in colls. Schilder, Summers, Trenberth, *et.* [*sic*] *al.*"
Cypraeidae [none specified originally]. This is a junior synonym of *C. comptonii* Gray, 1847 (Burgess, 1985).

chocolatum, *Incidostoma* [as n. sp.]
Morrison, 1955: 158-159, figs. 10-12.
5 paratypes: DMNH 135098; Papallagta, Ecuador. Ex R. W. Jackson (#6382). Dimensions (range): H = 12.2-14.3 mm, W = 17.7-22.6

mm.

Remarks: The original description noted "additional paratypes from the original lot are in the collection of Mr. Jackson." The Jackson collection catalog indicates "det. Dr. Morrison."

Poteriidae [originally Cyclophoridae: Neocyclotinae]. Curated in the genus *Cyrtotoma* in the DMNH collection.

cloveri, *Cancilla* (*Ziba*) [as sp. n.]

Cernohorsky, 1971: 133-135, figs. 4-8.

1 figured paratype: DMNH 197615; 70 fms, 75 mi southwest of Kaushiung, Formosa Strait, Taiwan. Coll. 1969; ex W. O. Cernohorsky via H. Eker. Dimensions (H x W): 17.0 x 5.5 mm.

Remarks: The DMNH specimen is "paratype no. 2" described as "in the author's coll." and figured in the original description (fig. 6). Its intact protoconch was also illustrated in a line drawing (fig. 8). The paratype is listed as in Cernohorsky's collection on Cernohorsky's index card at DMNH, but was not included in the list of type material given by Cernohorsky (1991).

Mitridae [originally Mitridae: Imbricariinae].

colombiensis, *Aroapyrgus* [as n. sp.]

Malek & Little, 1971: 20-25, fig. 1.

Holotype: DMNH 041542; tributaries of Rio Pichende, near Pichende, Municipio de Cali, Departamento de Valle de Cauca, Colombia. Coll. E. A. Malek, 1968; ex E. A. Malek. Dimensions (H x W): 3.2 x 1.4 mm.

91 paratypes: DMNH 041543; tributaries of Rio Pichende, near Pichende, Municipio de Cali, Departamento de Valle de Cauca, Colombia. Coll. E. A. Malek, 1968; ex E. A. Malek. Dimensions (range): H = 2.0-3.1 mm, W = 1.0-1.6 mm.

Hydrobiidae.

crosnieri, *Cancilla scrobiculata* [as new subspecies]

Cernohorsky, 1970a: 95, 98-99, figs. 1-2.

1 paratype ("No. 3"): DMNH 197604; 150-200 m, 06°05'S, 02°37'E, coast of Dahomey, West Africa. Coll. A. Crosnier, 24 October 1963; ex H. Eker. Dimensions (H x W): 75.1 x 19.9 mm; height of aperture = 38.0 mm [published as 76.8 x 21.0 mm, height of aperture = 38.6 mm].

Remarks: The holotype (DMNH 022392) and paratype (nos. 4-5, DMNH 028221) lots were described in Part I (Bieler & Bradford, 1991: 11). At the time that paper was published, this paratype was "in the author's collection, Auckland Institute & Museum"; Cernohorsky's numbered collection label accompanies the lot. "Paratype No 3 of *crosnieri*, coasts of Dahomey" is written in ink on the inner lip of the shell. Cernohorsky (1991) listed the DMNH holotype, but omitted mention of the two DMNH paratypic lots.

Mitridae.

diminutum, *Incidostoma* [as n. sp.]

Morrison, 1955: 159, figs. 7-9.

1 paratype: DMNH 146762; Papallagta, Ecuador. Ex R. W. Jackson (#6383) via M. L. Walton (#8951). Dimensions (H x W): 12.7 x 18.8 mm.

12 paratypes: DMNH 149232; Papallagta, Ecuador. Coll. R. W. Jackson; ex R. W. Jackson (#6383). Dimensions (range): H = 8.3-12.7 mm, W = 10.5-20.0 mm.

Remarks: The original description mentioned paratypes "in the Jackson collection." The Jackson collection catalog indicates "det. Dr. Morrison."

Poteriidae [originally Cyclophoridae: Neocyclotinae]. Curated in the DMNH collection as a junior synonym of *Cyrtotoma granulatum* (Pfeiffer, 1862).

dondani, *Mitra* [as sp. n.]

Cernohorsky, 1985: 56-58, figs. 19-24.

1 paratype: DMNH 197607; dredged at 100 fms, Panglao, Bohol, Philippines. Coll. January 1985; ex H. Eker. Dimensions (H x W): 51.1 x 12.3 mm.

Remarks: Original label indicates a "51.56 mm giant" of *Mitre* [*sic*] *deynseri* Cernohorsky for the price of $150.00 from Derry's Shell Shelter, La Habra, California. Paratypes from the type locality were given in the original description as in several private collections, including that of Eker. The original description listed the maximum recorded shell length as 50.0 mm.

Mitridae.

earlei, *Mitra* (*Nebularia*) [as sp. n.]

Cernohorsky, 1977: 121-123, figs. 1-5.

1 paratype: DMNH 197617; 100 fms, Pokai Bay, Oahu, Hawaii. Coll. R. Salisbury, 11 October 1976; ex Auckland Institute & Museum via H. Eker. Dimensions (H x W): 13.8 x 4.9 mm.

Remarks: The original description listed paratypes in the Eker collection, the source of this specimen. Cernohorsky (1977, 1991) twice listed

DMNH among repositories for paratypes, without number reference; because no specimens of this species were part of the DMNH collection prior to the Eker donation in September 1995, it is assumed that DMNH never received the intended paratypic lot. The specimen contains dried blackened material within the shell, perhaps dried soft parts.

Mitridae.

edgerlyi, *Gyrineum perca* [as n. var.]

Richards, 1933: 57, pl. 6, fig. 2.

Holotype (figured): DMNH 195251; Japan. Ex Mrs. E. R. Edgerly via Mystic Museum. Dimensions (H x W): 62.9 x 45.7 mm [published as 6.6 x 3.7 cm].

Remarks: Although this specimen does not exactly match the published dimensions, it very closely approximates the orignal figure, including several visible breaks and growth flaws.

Ranellidae [none specified originally]. Placed in synonymy with *G. perca* (Perry, 1811) by Henning & Hemmen (1993), but without citing any type material for *G. perca* or *G. edgerlyi*.

ekerae, *Scabricola* (*Swainsonia*) *ocellata* [as subsp. n.]

Cernohorsky, 1973: 135-137, figs. 8-12.

1 paratype: DMNH 197605; 22°43'30"S, 113°40'E, southwest of Point Cloates, Western Australia, Australia. Coll. Ningaloo Expedition, 07 September 1968; ex WAM via H. Eker. Dimensions (H x W): 33.0 x 10.1 mm.

Remarks: This specimen is listed here as a possible paratype. The Cernohorsky index card in the DMNH collection does not list the source (Eker) collection specifically; neither was mention made of the Eker collection in the list of paratypes in the original description. However, the original description listed six paratypes from Point Cloates, five in WAM (confirmed by Wells, 1977) and one "in author's collection." The paratype listed as in the author's collection closely approximates the dimensions of this specimen (33.0 x 10.0 mm); we assume that this is the DMNH specimen.

Mitridae [originally Mitridae: Imbricariinae].

eugeniae, *Notadusta* [as spec. nov.]

C. N. Cate, 1975: 260, fig. 5.

1 paratype: DMNH 196224; Hopetoun, southern Western Australia, Australia. Ex L. F. Kienle. Dimensions (H x W): 27.1 x 15.2 mm.

1 paratype ("No. 1"): DMNH 201199; Hopetoun, southern Western

Australia, Australia. Coll. 14 March 1974; ex E. Wright (#C290, "paratype 1, sub-adult, 27.5 mm, $75.00"). Dimensions (H x W): 27.6 x 17.1 mm.

Remarks: The measurements of DMNH 201199 exactly match those cited in the original description ("paratype I").

Cypraeidae [originally Cypraeidae: Erroneinae]. Synonymized with *Cypraea declivis* Sowerby, 1870 (Burgess, 1985).

fergusoni, *Acmaea* [as sp. nov.]

Wheat, 1913: 17-20, pl. 1.

1 syntype: DMNH 023402; Hempstead Bay, Long Island, New York. Ex Brooklyn Museum via ANSP 185472 (*vidi*). Dimensions (H x W): 19.3 x 14.8 mm; depth = 6.5 mm.

Remarks: This specimen is listed here as a possible syntype. The original description listed "Types from the north shore of Long Island, N. Y., in the Museum of The Brooklyn Institute of Arts and Sciences, Accession No. 12656." The Brooklyn Museum collection was subsequently transferred to ANSP (Robertson, *et al.*, 1981: 19). Hempstead Bay was not listed among the author's collecting sites. The source lot (ANSP 185472) is labelled "types" and now contains 61 specimens filed as *Acmaea testudinalis* var. *fergusoni*; other labels with the lot indicate "Central Museum," catalog no. 12656, and "Hempstead Bay, VI.17.13" (June 17, 1913?). Robertson, *et al.* (1981) listed the source lot as syntypic.

Lottiidae [none specified originally]. Now known as *Tectura testudinalis fergusoni* (*fide* Jacobson & Emerson, 1971; Lindberg, 1986).

filiareginae, *Vexillum regina* [as subspec. nov.]

J. M. Cate, 1961: 80-81, pl. 18, figs. 6a-b, pl. 19, fig. 6, pl. 20, figs. 1-10, table.

1 figured paratype (#6): DMNH 197602; Zamboanga, Philippines. Ex H. Eker. Dimensions (H x W): 67.0 x 17.0 mm [published as 67.4 x 17.5 mm]. Remarks: A sticker inside the aperture indicates "124 Para #6." The specimen has a complete thickened outer lip. This specimen was figured by Cate on pl. 19, fig. 6 and pl. 20, fig. 7.

1 figured paratype (#7): DMNH 197603; Zamboanga, Philippines. Ex H. Eker. Dimensions (H x W): 65.0 x 15.0 mm [published as 65.2 x 15.4 mm].). Remarks: A sticker inside the aperture indicates "124 Para #7." The specimen has a thin, chipped outer lip. This specimen was figured by Cate on pl. 20, fig. 8.

Remarks: The original description listed paratypes #6 and #7 as in the d'Attilio collection. Although these specimens, from the Eker collection, do not indicate a source, they are clearly paratypes #6 and #7 (via stickers in the aperture and matching the published figures).

Costellariidae [originally Mitridae]. This subspecies was synonymized with *Vexillum regina* (Sowerby, 1828) by Cernohorsky (1970b).

fuentesi, *Chondropoma* (*Chondropoma*) [as spec. nov.]

Jaume & Alcalde y Ledón, 1944: 39-40, pl. 6.

3 paratypes: DMNH 124279; finca de Lewis, Arimao, Cienfuegos, Las Villas, Cuba. Ex O. Alcalde (Jackson catalog) via R. W. Jackson (#6633). Dimensions (H x W): (1) 14.5 x 8.5 mm, (2) 12.9 x 8.4 mm, (3) 12.2 x 8.2 mm.

Remarks: The original description mentioned paratypes in private collections, *i. e.,* "en las colecciones del Dr. Luis Sánchez de Fuentes y de los autores." The Jackson collection catalog in the DMNH archives indicates the source of these specimens as Alcalde. All specimens have "4153" written on them; significance of this number is unknown.

Annulariidae [none specified originally].

fuentesi, *Chondrothyrium crenimargo* [as nueva subespecie]

Alcalde y Ledón, 1943: 11-13, pl. 1, fig. 1.

1 paratype: DMNH 135185; Loma #3 del Marañón, Gavilán, Cienfuegos, Las Villas, Cuba. Ex O. Alcalde via R. W. Jackson (#6612). Dimensions (H x W): 15.0 x 10.5 mm.

Remarks: The original description mentioned paratypes "en las collectiones del autor, del Dr. Luis Sánchez de Fuentes y de Miguel L. Jaume." The DMNH shell has "1449" written on it; the original [non-DMNH] labels have "6612" inscribed. The Jackson collection catalog in the DMNH archives indicates Alcalde as the source for #6612. The DMNH specimen does not match the dimensions of any of the 12 specimens cited in the original description.

Annulariidae [none specified originally].

guamensis, *Favartia* [as n. sp.]

Emerson & D'Attilio, 1979: 4-5, figs. 11-12.

1 paratype: DMNH 201173; 60 ft, under dead coral, scuba, Orote Cliffs, Orote Peninsula, Guam Is., Mariana Islands. Coll. 1978 [published as 1977]; ex A. Deynzer via E. Wright (#M991, "6.4 mm, $25.00"). Dimensions (H x W): 6.7 x 4.3 mm.

Remarks: Although A. Deynzer's collection label is not present, Wright's collection catalog indicates that this specimen was purchased from Deynzer.

Muricidae [originally Muricidae: Muricopsinae]. This is "probably a junior synonym of *Favartia crouchi* (Sowerby, 1894)" according to Houart (1994: 54).

guesti, *Calliostoma* [as new species]

Quinn, 1992: 106-107, figs. 92-93.

Holotype: DMNH 096994; 100-120 fms, 2.5 mi off South Shore, Bermuda. Coll. A. Guest & J. R. H. Lightbourn, 21 September 1973; ex A. Guest & J. R. H. Lightbourn. Dimensions (H x W): 27.4 x 27.1 mm [published as 27.5 x 27.5 mm].

3 paratypes (including figured): DMNH 187588; 100-120 fms, 2.5 mi off South Shore of Bermuda. Coll. A. Guest & J. R. H. Lightbourn, 21 September 1973; ex A. Guest & J. R. H. Lightbourn. Dimensions (H x W): (1) 23.1 x 22.7 mm, (2) 22.7 x 21.9 mm [figured specimen], (3) 16.2 (apex broken) x 17.4 mm. Remarks: Split from DMNH 096994.

Remarks: The figured specimen (Quinn, 1992: figs. 92-93) is not the holotype as stated, but rather is the second largest paratype, photographed when the specimen was still part of lot DMNH 096994. The cited dimensions of the holotype in the figure caption, although not exactly matching measurements presented here, are presumably those of the holotype and not the figured paratype.

Trochidae [originally Trochidae: Calliostomatinae].

hadari, *Drupa ricinus* [as new subspecies]

Emerson & Cernohorsky, 1973: 23-24, pl. 2, figs. 9-10, pl. 18.

2 paratypes: DMNH 051118; on coral reefs, Eilat, Gulf of Aqaba, Israel. Coll. D. Peled, April 1971; ex D. Peled. Dimensions (H x W, including spines): (1) 35.0 x 36.8 mm, (2) 27.1 x 29.2 mm.

Remarks: The original description indicated DMNH 051119 as a paratypic lot with (at least) one specimen of 28.0 mm length x 29.0 mm width - roughly equal to the smaller specimen in this lot. The original specimen label (ex Auckland Institute & Museum) indicates "2 paratypes DMNH 51118/9." DMNH 051119 was assigned to a lot of another species, so we believe this is the type lot.

Muricidae [originally Muricidae: Thaidinae].

hansenae, *Vexillum* (*Pusia*) [as sp. n.]

Cernohorsky, 1973: 138, figs. 13-16.

1 paratype: DMNH 197620; Cape Riche, ca. 90 mi east of Albany, Western Australia. Coll. M. P. Marrow, 26 December 1971; ex H. Eker. Dimensions (H x W): 10.3 x 4.2 mm (worn). Remarks: Lot listed (not as type) on the Cernohorsky index card at DMNH. The original description listed ten specimens from Cape Riche from the collection of M. Marrow, including one measured as 10.8 x 4.7 x 5.9 mm, which could be this one.

2 paratypes: DMNH 197624; Augusta, southwestern Australia. Ex Auckland Institute & Museum via H. Eker. Dimensions (H x W): (1) 15.6 x 6.0 mm, (2) 16.0 x 6.2 mm. Remarks: Lot listed (not as type) from Sarge Bay (= type locality) on the Cernohorsky index card at DMNH. The original AIM label indicates three paratypes, but only two are in this lot.

Remarks: The original description mentioned paratypes in the Eker collection, the source of these two lots.

Costellariidae [originally Vexillidae].

hilli, *Anachis* (*Glyptanachis*) [as n. sp.]

Pilsbry & Lowe, 1932: 73, pl. 5, fig. 6.

2 paratypes: DMNH 024377; Mazatlan, Mexico. Coll. H. N. Lowe; ex ANSP 154677 (*vidi*). Dimensions (H x W): (1) 8.2 x 4.0 mm, (2) 7.2 x 3.4 mm.

Remarks: The original description mentioned "paratypes in Lowe collection." The ANSP source lot (originally ten specimens, now eight) was donated by H. N. Lowe and is presently considered paratypic in that collection.

Columbellidae.

inspinata, *Melongena corona* [as n. var.]

Richards, 1933: 57, pl. 6, fig. 1.

Holotype (figured): DMNH 195252; Gulf of Mexico, Florida. Coll. J. R. Holmes; ex Mystic Museum. Dimensions (H x W): 93.2 x 62.8 mm [published as 10.1 x 6.2 cm].

Remarks: Although this specimen does not exactly match the published dimensions, it very closely approximates the orignal figure, including several visible growth flaws. DMNH records do not reflect the original location of the material ["collection of Mrs. E. R. Edgerly, of Trenton, N. J."].

Melongenidae [none specified originally]

***jacksoni**, Incidostoma* [as n. sp.]

Morrison, 1955: 158, figs. 13-15.

16 paratypes: DMNH 135090; Mera, Oriente, Ecuador. Ex R. W. Jackson (#6384). Dimensions (range): H = 11.6-16.1 mm, W = 18.2-24.9 mm.

2 paratypes: DMNH 146761; Mera, Oriente, Ecuador. Ex R. W. Jackson (#6384) via M. L. Walton (#8952). Dimensions (H x W): (1) 15.4 x 25.7 mm, (2) 13.0 x 22.9 mm.

Remarks: The original description noted "numerous paratypes comprising the remainder of this lot are in Mr. Jackson's collection." The Jackson collection catalog indicates "det. Dr. Morrison."

Poteriidae [originally Cyclophoridae: Neocyclotinae]. Curated in the DMNH collection in the genus *Cyrtotoma.*

***jacksoni**, Scissurella* [as n. sp.]

Melvill, 1904: 160-161, pl. 10, fig. 5.

1 syntype: DMNH 023171; Gulf of Oman, Arabia. Coll. F. W. Townsend, "1935"; ex ANSP 164838 (*vidi*). Dimensions (H x W): 1.4 x 1.5 mm.

Remarks: No repository was designated in the original publication. The source lot, ANSP 164838, was listed as a syntypic lot by Robertson, *et al.* (1981) and by Trew (1987); the DMNH lot was not acknowledged by Trew (1987). The date 1935 associated with this lot is that of acquisition/purchase [by ANSP], not the year collected.

Scissurellidae [none specified originally].

***jaumei**, Chrondrothyrium violaceum* [as nueva subespecie]

Alcalde y Ledón, 1943: 14-16, pl. 1, fig. 2.

4 paratypes: DMNH 135092; La Travesada, Rio Chiquito, Cienfuegos, Las Villas, Cuba. Ex R. W. Jackson. Dimensions (range): H = 18.3-21.3 mm, W = 13.5-15.1 mm.

Remarks: The original description mentioned paratypes "en la collección del autor, y en las de M. L. Jaume y Dr. L. Sánchez de Fuentes." Each DMNH specimen has "1381" written on the shell; two original [non-DMNH] labels have "6614" inscribed. The DMNH specimens do not match the dimensions of any of the 12 specimens cited in the original description. The Jackson collection catalog in the DMNH archives indicates Alcalde as the source for no. 6614.

Annulariidae [none specified originally].

jaumei, *Eutrochatella* (*Troschelviana*) [as spec. nov.]

Aguayo & Jaume ["Torre (in sched)"], 1957: 120-121, pl. 1, fig. 8.

4 paratypes: DMNH 161859; "La Esperanza," San Andres, Consolacion del Norte, Pinar del Rio, Cuba. Leg. M. L. Jaume (Jackson catalog), ex R. W. Jackson (#4198). Dimensions (H x W): (1) 7.4 x 5.4 mm (flaring outer lip), (2) 7.1 x 5.1 mm (flaring outer lip), (3) 6.8 x 4.8 mm, (4) 5.9 x 4.4 mm.

Remarks: The original description mentioned paratypes in the collection of M. L. Jaume. Specimens received in the Jaume Collection (*e. g.*, ANSP 167331), were considered paratypic by Robertson, *et al.* (1986). All four specimens are with opercula.

Helicinidae. Curated as a junior synonym of *Troschelviana* (*Troschelviana*) *chrysochasma* Poey, 1853, in the DMNH collection.

jenniernestae, *Distorsio* (*Distorsio*) [as sp. nov.]

Emerson & Piech, 1992: 111-114, figs. 5-8, 16-18, 24.

2 paratypes: DMNH 189600; dredged between Cébaco and Coiba Islands, Pacific Panama, 240 ft. Coll. Ernest, 1990; ex B. J. Piech. Dimensions (H x W): 58.5 x 36.3 mm (cleaned), (2) 55.3 x 35.2 mm (with periostracum).

Remarks: Both specimens are with opercula.

Personidae.

lopesi, *Mitra* (*Cancilla*) [as sp. n.]

Matthews & Coelho, 1969: 3-6, figs. 1-3.

3 paratypes: DMNH 197614; 16 fms, *ex pisces* [from digestive tract of toadfish, *Amphichthys cryptocentrus* (Cuvier & Valenciennes, 1837)], off Mucuripe, Fortaleza, Ceará, Brazil. Coll. by fishermen, April 1968; ex H. R. Matthews via W. O. Cernohorsky via H. Eker. Dimensions (H x W): (1) 22.6 x 8.9 mm (worn, apex broken, hole in ventral body whorl), (2) 19.4 x 7.5 mm (worn, apex broken), (3) 17.7 x 7.1 mm (fresh specimen, broken outer lip, hole in spire).

Remarks: Four specimens listed as *ex pisces* from this locality (collected in 1969, not 1968) were cited in the original description from other depositories [Instituto Oswaldo Cruz (IOC), Rio de Janeiro; Laboratório de Ciências do Mar da Universidade Federal do Ceará (LABOMAR), Fortaleza; Museu Nacional (MN), Rio de Janeiro; and Museu Oceanográfico de Rio Grande (MORG), Rio Grande do Sul]. Although the original description therefore did not specifically allow for the DMNH specimens, they are listed as paratypes in the Cernohorsky collection on Cernohorsky's index card in DMNH, therefore they are retained here as possible type material.

Mitridae. This is a junior synonym of *Ziba candida* (Reeve, 1845) according to Cernohorsky (1991).

louisianae, *Vioscalba* [as new species and type species of new genus]

Morrison, 1965: 217, 219-220, figs. 1-2.

23 paratypes: DMNH 108365; off Frenier Beach, Lake Ponchartrain, Louisiana. Coll. 05 November 1959, J. P. E. Morrison; ex USNM 635629 (with label indicating DMNH donation, *vidi*). Dimensions (range): H = 2.7-3.4 mm, W = 1.7-2.1 mm.

Remarks: The original description mentioned "more than twenty-five additional paratype lots" in USNM.

Hydrobiidae. Curated as a junior synonym of *Probythinella protera* (Pilsbry, 1953) in the USNM collection.

mactanensis, *Murexiella* [as n. sp.]

Emerson & D'Attilio, 1979: 7, figs. 7-8.

1 paratype: DMNH 201172; 100+ fms, Panglao, Bohol Island, Philippines. Coll. 1977-1978 [published as 1977]; ex A. Deynzer via E. Wright (#M939, "19.5 mm, w/o [with operculum], $35.00"). Dimensions (H x W): 19.7 x 12.7 mm.

Remarks: Deynzer's collection label is present.

Muricidae [originally Muricidae: Muricopsinae].

marrowi, *Vexillum* (*Pusia*) [as sp. n.]

Cernohorsky, 1973: 140-142, figs. 19-23.

2 paratypes: DMNH 197626; Margaret River, southwestern Australia. Ex Auckland Institute & Museum via H. Eker. Dimensions (H x W): (1) 10.0 x 5.7 mm, (2) 9.4 x 4.7 mm. Remarks: The original AIM label indicates four paratypes, but only two are found in this lot. Lot listed (not as type, from south of Cape Naturaliste) on the Cernohorsky index card at DMNH.

1 paratype: DMNH 197627; Rottnest Island, Western Australia, Australia. Coll. Kendrick, 1969; ex W. O. Cernohorsky via H. Eker. Dimensions (H x W): 11.1 x 6.2 mm. Remarks: Listed (not as type, from Lady Adeline Bay) on the Cernohorsky index card at DMNH.

1 paratype: DMNH 197628; North Beach, Perth, Western Australia. Coll. Rossell, 1950; ex W. O. Cernohorsky via H. Eker. Dimensions (H x W): 11.1 x 6.2 mm (apex and outer lip broken). Remarks: Listed (not as type) on the Cernohorsky index card at

DMNH.

1 paratype: DMNH 197629; South Cottesloe Beach, Western Australia. Coll. T. Whitehead, November 1966; ex W. O. Cernohorsky via H. Eker. Dimensions (H x W): 11.7 x 5.7 mm (outer lip chipped). Remarks: Listed (not as type) on the Cernohorsky index card at DMNH.

Remarks: The original description mentioned paratypes in the Eker collection, the source of all four of these lots. Margaret River was listed as the locality of four specimens "in H. Eker coll.," presumably including the two in DMNH 197626. Lady Adeline Bay - Rottnest Island, North Beach - Perth, and South Cottesloe Beach - Perth were each listed as including "1 spec. in author's coll." = DMNH 197627, 197628 and 197629, respectively.

Costellariidae [originally Vexillidae].

martinorum, *Vexillum* (*Costellaria*) [as sp. n.]

Cernohorsky, 1986: 50-52, figs. 15-20.

1 paratype: DMNH 197611; 183-207 m, off Coamen Island, west Bohol reef, Philippines. Coll. R. Martin, 1986; ex H. Eker. Dimensions (H x W): 19.6 x 6.7 mm.

Remarks: The original description mentioned paratypes in the Martin collection.

Costellariidae.

mawsoni, *Parmaphorella* [as n. sp.]

Powell, 1958: 180-181, text-figs. 1-3, pl. 3, fig. 9.

1 paratype: DMNH 023360; off Enderby Land, Antarctica. Coll. A. W. B. Powell; ex ANSP 226808 (BANZARE sta. 41, 193 m, *vidi*). Dimensions (H x W): 21.0 x 11.3 mm; depth = 5.1 mm.

Remarks: The original description indicated type material only in the South Australian Museum (Adelaide), so under strict interpretation, this could not be type material. However, the ANSP source lot was listed by Robertson, *et al.* (1981: 22), as syntypic, and the "catalog shows two specimens received. Only one specimen is now in the collection." Because the original description designated a holotype, remaining type specimens must be considered paratypes, not syntypes.

Fissurellidae. Curated in the DMNH collection in *Tugali* (*Parmaphorella*).

morenoi, *Chondrothyrium* (*Chondrothyrium*) *violaceum* [as n. s. sp.]

Jaume & Sánchez de Fuentes, 1943d: 50-51, pl. 8.

2 paratypes: DMNH 135187; loma #3 del Marañón, Gavilán, Cienfuegos, Las Villas, Cuba. Ex O. Alcalde (Jackson catalog) via R. W. Jackson (#6619). Dimensions (H x W): (1) 16.9 x 11.5 mm, (2) 14.2 x 10.0 mm.

Remarks: The original description mentioned paratypes in private collections, *i. e.,* "en las colecciones de los autores y en la del Sr. Oscar Alcalde Ledón." The Jackson collection catalog indicates Alcalde as the source of these specimens. Both specimens have "1414" written on them.

Annulariidae [none specified originally].

nanus, *Strombus raninus* [as new subspecies]

Bales, 1942: 19, pl. 4, figs. a-b.

2 paratypes: DMNH 201259; southern end of Lake Worth, Palm Beach County, Florida. Ex R. T. Abbott (#1544 on label that states "rec'd from R. T. Abbott"). Dimensions (H x W): (1) 49.9 x 33.4 mm ("1544" written on thin but fully developed outer lip); (2) 37.8 x 26.7 ("1082" written on thickened outer lip).

Remarks: The original description indicated [holo]type and paratypes in ANSP, MCZ, and private collections of Bales, McGinty, and Koto. The origin of this material, other than R. T. Abbott, is unrecorded. Another paratypic lot, DMNH 001490, was described in Part I (Bieler & Bradford, 1991: 23-24). These specimens are listed here as possible paratypes.

Strombidae [none specified originally].

nodospiculum, *Vexillum* (*Costellaria*) [as new species]

Cernohorsky, 1970a: 101-102, figs. 6, 7, 11.

1 paratype ("No. 47"): DMNH 197618; U. S. Bureau of Fisheries Sta. 5592, 305 fms, green mud, 43.3°F, off Silungan Island, Borneo, Indonesia. Ex H. Eker. Dimensions (H x W): 6.0 x 2.1 mm (with intact, but somewhat encrusted, protoconch).

1 paratype ("No. 13"): DMNH 197622; U. S. Bureau of Fisheries Sta. 5394, 153 fms, green mud, off Pt. Dumurug, Masbate, Philippines. Ex H. Eker. Dimensions (H x W): 5.4 x 2.2 mm (with intact protoconch).

Remarks: At the time of publication, both paratypes were "in the author's collection, Auckland Institute & Museum"; Cernohorsky's numbered collection labels are with both lots. No paratypes are listed on the Cernohorsky index card for this species at DMNH.

Costellariidae [originally Mitridae].

orri, *Muricopsis* [as sp. n.]

Cernohorsky, 1976: 116-119, figs. 12-20.

2 paratypes (including figured): DMNH 201174; dredged, 30 fms, south of the Andaman Islands, Indian Ocean. Coll. January 1974; ex Auckland Institute & Museum/W. O. Cernohorsky via E. Wright (#M783). Dimensions (H x W, including spines): (1) 32.3 x 22.1 mm, (2) 28.8 x 22.6 mm (with operculum in place, figured).

Remarks: These specimens were mentioned in the original description from the Wright collection. The measured dimensions differ slightly from those listed for Wright paratypes 1-3 in Cernohorsky's text: 32.5 x 20.0, 29.1 x 22.0, and 29.0 x 20.2 mm. These specimens are apparently paratypes 1 and 3; Cernohorsky's figs. 14-15 are of paratype 3 = DMNH paratype (2). According to Wright's collection catalog, four specimens were originally purchased from Vic Wee for $5.00 each as *Muricopsis infans* (E. A. Smith, 1884) (as 26, 26, 27 [circled], and 30 mm). The entry also indicates "2 w/o [with operculum], trawled in 30 fms, one specimen kept as holotype, others paratypes; 1 paratype sent to John Orr, 12/21/76."

Muricidae. Now in the genus *Attiliosa* according to Houart (1994).

petiti, *Fenimorea* [as new species]

Tippett, 1995: 133, figs. 17, 33.

1 paratype: DMNH 202363; dredged, 30 fms, Gulf of Mexico west of Crystal River, Florida. Coll. Jim Moore, May 1963; ex D. Tippett. Dimensions (H x W): 14.7 x 5.1 mm.

Turridae.

rhecta, *Meganipha* [as new species]

F. G. Thompson, 1978: 43-48, figs. 1-4.

3 paratypes: DMNH 111264; 700 m, Loma del Puerto, Yaroa, Puerto Plato Province, Dominican Republic, Hispaniola. Coll. F. G. Thompson & B. E. Johnson (#2659), 12 January 1976; ex FLMNH (= UF) 22747. Dimensions (H x W): (1) 10.3 x 8.0 mm (with operculum), (2) 9.9 x 9.1 mm, (3) 2.1 x 2.5 mm (juvenile).

Remarks: The source lot, UF 22747, originally contained 114 paratypes, according to the original description.

Annulariidae [originally Annulariidae: Annulariinae].

salisburyi, *Vexillum* (*Pusia*) [as sp. n.]

Cernohorsky, 1976: 114-116, figs. 6-9, 11.

1 paratype: DMNH 155900; Pupukea Beach, Oahu, Hawaii. Coll. R. Salisbury, April 1976; ex C. Kauffman. Dimensions (H x W): 3.8 x 1.9 mm (protoconch missing, outer lip badly broken).

2 paratypes (#47): DMNH 197619; in beach sand, Pupukea, Hawaiian Islands. Coll. R. Salisbury, 1975; ex Auckland Institute & Museum via H. Eker. Dimensions (H x W): (1) 4.3 x 2.0 mm (very pale pink, outer lip broken), (2) 4.0 x 2.0 mm.

Remarks: Paratypic lot DMNH 112102 was described in Part I (Bieler & Bradford, 1991: 27); these are the paratypes mentioned (without number) in the original description as in DMNH. The two lots above were mentioned in the original description from the collections of Eker and Salisbury.

Costellariidae. Considered a junior synonym of *Vexillum* (*Pusia*) *capricornea* (Hedley, 1907) by Kay (1979).

schereri, *Helicina* [as n. sp.]

F. Baker, 1913: 625-626, pl. 21, figs. 1-2.

4 paratypes: DMNH 135243; Ceará-Mirim, Brazil. Leg. F. Baker; ex R. W. Jackson (#2400). Dimensions (H x W): (1) 4.4 x 5.3 mm (with operculum), (2) 4.4 x 5.1 mm, (3) 3.6 x 4.5 mm (with operculum), (4) 2.6 x 3.6 mm (thin outer lip).

Remarks: The original description mentioned [holo]types of all new species in ANSP, and that "cotypes of many will be" deposited in the Leland Stanford Jr. University (Palo Alto, CA) and the Museu Goeldi (Para, Brazil). This allows for additional type material retained by Baker, thus these are here considered possible paratypes (Baker's original "cotypes" can be considered paratypes because he formally designated [holo]types). The [holo]type lot was given as ANSP 109341a by Baker (1964).

Helicinidae.

serranum, *Farcimen* (*Farcimen*) *auriculatum* [as n. subsp.]

Alcalde y Ledón, 1945: 14, pl. 1, fig. 6.

Holo(?)type: DMNH 135223; Aguada de La Piedra, La Sierra, Cienfuegos, Las Villas, Cuba. Ex O. Alcalde via R. W. Jackson (#6562). Dimensions (H x W): 26.4 x 13.2 mm.

Remarks: The original description mentioned only one type specimen, which would thus be the holotype, in the collection of the author (no. 3467) and of dimensions close to those of this specimen (27 x 13 mm). The DMNH specimen was listed as a "paratype" in the Jackson collection catalog. This could therefore be the holotype.

Megalomastomidae [originally Cyclophoridae: Megalomastominae].

sphoni, *Mitra* (*Strigatella*) [as spec. nov.]
Shasky & Campbell, 1964: 118-119, pl. 22, figs. 13-14.
1 paratype: DMNH 197625; 30-40 ft, under rocks, between Punta Colorada and Punta Lobos, Guaymas, Sonora, Mexico. Coll. D. R. Shasky, 1964; ex W. O. Cernohorsky via H. Eker. Dimensions (H x W): 16.9 x 6.0 mm.
Remarks: This specimen is listed here as a possible paratype. The original description mentioned two paratypes, one each in the B. Campbell and D. Shasky collections; we suspect the latter is this specimen. The Cernohorsky index card in the DMNH collection does not list this specimen.
Costellariidae [originally Mitridae]. Curated in the DMNH collection as a junior synonym of *Vexillum crenata* (Broderip, 1836).

sprucecreekensis, *Melongena* [as new species]
Tucker, 1994: 197-202, figs. 6A-C.
10 paratypes: DMNH 155535; Spruce Creek, 4 miles north of New Smyrna Beach, Florida. Coll. J. K. Tucker, 07 June 1983 [other labels give 9-1983 and 6/17/83]. Dimensions (range): H = 89-169 mm, W = 46-90 mm.
Remarks: Formerly DMNH 161854. All specimens are with opercula.
Melongenidae.

superbum, *Chondropoma* [no status specified in original description]
Henderson & Simpson, 1902: 88-89, 1 text-fig.
4 syntypes: DMNH 043596; Thomazeau, Haiti. Coll. Henderson & Simpson; ex USNM. Dimensions (range): H = 22.1-24.6 mm, W = 12.2-13.4 mm.
Remarks: No type material was specifically cited in the original description. These specimens are from the type locality and are within the size range given. The source of this lot (USNM) is that expected for type specimens of both J. B. Henderson and C. T. Simpson, by virtue of their simultaneous association with USNM (Abbott, *et al.,* 1973). In spite of the lack of more concrete evidence, these specimens are listed here as possible syntypes.
Annulariidae [none specified originally].

tagbilleranus, *Geophorus* (*Diplopinax*) [as n. sp.]
Bartsch, 1918: 655-656.
6 syntypes: DMNH 043615; Tagbileran, Bohol Island, Philippines. Ex USNM 258760. Dimensions (range): H = 6.2-7.0 mm, W = 9.8-

11.3 mm.

Remarks: Although the original description discussed the dimensions of the "type," obviously referring to a single specimen, the original label in this lot indicates that it was split from the cited type lot. The type lot was listed by Ruhoff (1973) as USNM 258760.

Helicinidae [originally Helicinidae: Helicininae].

toroensis, *Rissoa* [as new species]

Olsson & McGinty, 1958: 26, pl. 4, fig. 5.

5 paratypes: DMNH 023673; Bocas Island, northeastern Panama. Coll. Olsson and McGinty; ex ANSP 211886 (*vidi*). Dimensions (range): H = 1.3-2.1 mm, W = 1.0-1.2 mm.

Remarks: The ANSP source lot was cited as paratypic by the original description; it is curated in ANSP in the genus *Odostomia*, and contains *ca.* ten specimens.

Rissoidae.

torrei, *Chondrothyrium* (*Plicathyrium*) [as nueva especie]

Jaume & Sánchez de Fuentes, 1943c: 25-27, pl. 4, fig. 2.

1 paratype: DMNH 124280; Loma Ventana, San Blas, Cienfuegos, Las Villas, Cuba. Ex O. Alcalde via R. W. Jackson [#6621, as *C.* (*P.*) *torrei torrei*]. Dimensions (H x W): 13.9 x 14.0 mm.

Remarks: "1460" is written on the shell. The original description mentioned paratypes in the collections of the authors and O. Alcalde.

Annulariidae [none specified originally].

vicdani, *Scabricola* [as sp. n.]

Cernohorsky, 1981: 193-195, figs. 1-3.

1 paratype: DMNH 197606; trawled by fishermen, Punta Engaño, Mactan Island, Cebu, Philippines. Coll. May 1981; ex H. Eker. Dimensions (H x W): 36.1 x 13.9 mm (anterior end of outer lip broken).

Remarks: The original description did not specifically allow for type material of this species in the Eker collection, and Cernohorsky (1991) did not list Eker among the repositories of type material. However, the Cernohorsky index card at DMNH indicates paratype #4 as in the H. Eker collection, from the type locality, and measuring 37 mm; paratype #4 was deposited in the Auckland Institute and Museum, according to the original description. Because of this evidence plus the fact that Eker received several other of her type specimens discussed here from the AIM, we believe that this specimen is paratype #4.

Mitridae.

wolfei, *Drillia* [as new species]

Tippett, 1995: 127, 129, figs. 1, 28, 31.

1 paratype: DMNH 202362; 20 fms, 15 km east of Cape Lookout, North Carolina, from the Elmer Dewey Willis scallop plant, Williston, North Carolina. Coll. Dr. Douglas Wolfe, March-May 1971; ex D. Tippett. Dimensions (H x W): 14.9 x 5.2 mm.

Turridae.

wolfei, *Vexillum* (*Costellaria*) [as new species]

Cernohorsky, 1978: 63-64, figs. 4-5.

1 paratype: DMNH 197623; 60-70 fms, Pokai Bay, Oahu, Hawaiian Islands. Coll. R. Salisbury, 1975; ex Auckland Institute & Museum via H. Eker. Dimensions (H x W): 5.0 x 2.2 mm.

Remarks: Paratypic lot DMNH 112103 was described in Part I (Bieler & Bradford, 1991: 31). The original description mentioned paratypes in "AIM and other institutions and collections."

Costellariidae.

yoshidai, *Katayama nosophora* [as new subspecies]

Bartsch, 1925: 72; 1936: 23-24, pl. 1, fig. 1, pl. 2, fig. 9, pl. 4, fig. 2.

6 paratypes: DMNH 043606; Kurume, Kyushu [published as Kiushiu] Island, Japan. Coll. S. Yoshida, February 1919; ex USNM. Dimensions (range): H = 4.7-6.6 mm, W = 2.2-2.6 mm (3 specimens, immature lip), 2.5-3.0 mm (3 specimens, mature lip).

Remarks: These specimens are listed here as possible paratypes. The original description cited the [holo]type (USNM 362024) plus "several hundred additional specimens from the type locality" (USNM 340953, subsequently called paratypes; Bartsch, 1936: 23). Although the USNM number is not recorded in the DMNH lot, the USNM label indicates "paratypes" and it is not inconceivable that these specimens were originally part of USNM 340953. The USNM label indicates "= *Oncomelania nosophora* Robson."

Pomatiopsidae [none listed originally]. Curated in the genus *Oncomelania* in the DMNH collections.

HETEROSTROPHA

weberi, *Odostomia* [as new species]

Morrison, 1965: 221, fig. 3.

2 paratypes: DMNH 108364; north of Bayou Chene Fleur, northern part of Barataria Bay, Louisiana. Coll. J. P. E. Morrison; ex USNM 635639 (with label noting DMNH donation, *vidi*). Dimensions (H x W): (1) 1.3 x 0.7 mm (fresher shell), (2) 1.2 x 0.7 mm (very worn).

Pyramidellidae.

OPISTHOBRANCHIA
(ADDITIONS TO PART I; BIELER & BRADFORD, 1991)

carolynae, *Platydoris* [as n. sp.]

Mulliner & Sphon, 1974: 209-212, figs. 2-5.

1 paratype (in alcohol): DMNH 064524; SA-3, Long Beach, northern Santa Cruz Island, Galapagos Islands, Ecuador. Leg. S. Andrews, 21 December 1972; ex S. Andrews. Dimensions (L x W, preserved): 56 x 33 mm.

Remarks: The measurements of this specimen are larger than the largest size given in the original description. The length of the highly curled slug was crudely measured as the length of a string laid upon the specimen from anterior to posterior.

Platydorididae [originally Dorididae].

BIVALVIA

acapulcensis, *Leda* (*Saccella*) [as new species]

Pilsbry & Lowe, 1932: 107, pl. 17, figs. 1-2.

1 paratype: DMNH 020361; 20 fms, Acapulco, Guerrero, Mexico. Coll. H. N. Lowe, 1930; ex ANSP 155634 (*vidi*). Dimensions (L x H): 9.6 x 5.1 mm.

Remarks: The original figures (one inside view, one outside view) were labelled "type" by Pilsbry & Lowe, constituting a holotype designation. The DMNH specimen (split from the ANSP "type" lot), therefore, can be considered a paratype.

Nuculanidae [originally Ledidae]. Curated as *Nuculana* in the DMNH collection.

angasi, *Corbicula* [as nouvelle espèce]

Prime, 1864: 151-152, pl. 7, fig. 6.

1 paralectotype: DMNH 020859; Murray River, South Australia. Ex ANSP 123556 (Charles M. Wheatley Collection, deposited by University of Pennsylvania, *vidi*). Dimensions (L x H): 10.3 x 7.9 mm.

Remarks: The original description did not cite a depository. The DMNH and ANSP source lot were cited by Counts (1991: 8) as "paratypes," although a lectotype has been designated (MCZ 176917; Johnson, 1959). This therefore is a paralectotype. The ANSP source lot is now incorrectly labelled as "lectotype," with four original specimens recataloged as "paralectotypes" (ANSP 358422).

Corbiculidae [none specified originally].

awajiensis, *Corbicula* [as n. sp.]

Pilsbry, 1901b: 407; 1907: 159, pl. 7, figs. 13-14.

1 syntype: DMNH 020846; Noda, Awaji Island, Japan. Coll. Y. Hirase, 1901; ex ANSP 89378 (*vidi*). Dimensions (L x H): 15.0 x 11.3 mm.

Remarks: No repository, catalog number, or original number of specimens was provided in the original description, however, the data match the stated type locality and source/collector. Both the DMNH and ANSP source lots were cited as syntypic by Counts (1991: 9). ANSP 89378 is now the labelled "holotype" lot in ANSP, with three specimens recataloged as a "paratype" lot (ANSP 358424); this statement is not a lectotype designation.

Corbiculidae [originally Cyrenidae].

brunnea, *Tindaria* [as n. sp.]

Dall, 1916: 401.

1 syntype: DMNH 020368; ALBATROSS Sta. 3604, between St. Paul and Unnak Islands, Bering Sea, off Alaska. Ex USNM via ANSP 190943 (*vidi*). Dimensions (L x H): 7.35 x 5.8 mm.

4 syntypes: DMNH 043603; ALBATROSS Sta. 3604, midway between St. Paul and Unnak Islands, Bering Sea, Alaska. Ex USNM. Dimensions (L x H): (1) 7.1 x 5.6 mm, (2) 7.0 x 5.5 mm, (3) 6.9 x 5.2 mm, (4) 5.5 x 4.1 mm.

Remarks: These specimens are listed here as possible syntypes. The original description specified USNM 226333, of length 7.5, height 6, diameter 4 mm (which could have been an average), but without specifying number of specimens. USNM 226333 was also given as the sole type lot by Boss, *et al.* (1968). USNM 226333, ANSP 190943, and both DMNH lots are from the same ALBATROSS station, no. 3604.

Tindariidae [none specified originally].

bryanae, *Congeria* [as n. sp.]

Pilsbry, 1921: 323.

4 syntypes (single unmatched valves): DMNH 020569; Mokuaula Island, Hawaii. Coll. C. M. Cooke; ex ANSP 144011 (*vidi*). Dimensions (range): L = 6.9-8.3 mm, H = 3.8-5.0 mm.

Remarks: These specimens are listed here as possible syntypes. No type specimens were specifically cited in the original description, however, Pilsbry's types were generally deposited in ANSP; the source ANSP lot is labelled as type material in the ANSP collection.

Mytilidae [none specified originally]. Now placed in the genus *Septifer* (Kay, 1979).

calcicola, *Nucula* [as new species]

Moore, 1977: 120-122, figs. 1-3.

7 paratypes (6 intact + 1 single unmatched valve, in paleoslide): DMNH 120581; 2 m, Chancanab Lagoon, Cozumel, Mexico. Coll. D. R. Moore, 29 November 1971; ex D. R. Moore. Dimensions (range): L = 0.6-1.4 mm, H = 0.4-1.0 mm.

Nuculidae.

congo, *Iphigenia* [as new species]

Pilsbry & Bequaert, 1927: 373-374, text-figs. 83a-c.

2 paratypes: DMNH 021548; Malela, Belgian Congo [now Zaire], Africa. Coll. J. Bequaert; ex ANSP 133884. Dimensions (L x H): 21.5 x 14.2 mm.

Remarks: These specimens are listed here as possible paratypes. The original description gave dimensions of the "type" (27.2 x 18.0 mm), one "paratype" (24.0 x 16.1 mm), and two other specimens (22.0 x 14.3 and 20.3 x 14.0 mm). However, the ANSP source lot (the type lot?) contains many more specimens; it has now been split into holotype (2 valves, ANSP 133884) and paratypes (17 valves, ANSP 399290) (N. Gilmore, in litt., 1997).

Donacidae.

cranmerorum, *Somalipecten* [as new species]
Waller, 1986: 42-45, figs. 1-13.
1 paratype: DMNH 170849; taken by Taiwanese trawler, off Somalia coast at 150-300 m. Coll. 1985; ex D. Dan. Dimensions (L x H): 67.6 x 62.7 mm.
Pectinidae.

cynthiae, *Condylonucula* [as new species]
Moore, 1977: 123-124, figs. 6-7.
2 paratypes (1 intact + 1 single unmatched valve, in paleoslide): DMNH 120580; 1.5 m, behind outer reef, Courtown Cays, western Caribbean. Coll. D. R. Moore, 12 May 1966; ex D. R. Moore. Dimensions (L x H): (1) 0.6 x 0.5 mm (single unmatched valve), (2) 0.5 x 0.5 mm (intact).
Remarks: The original description listed these specimens as one 570 μm long, and one left valve 620 μm long.
Nuculidae.

diegensis, *Limopsis* [as n. sp.]
Dall, 1908: 395, pl. 15, figs. 13, 15.
3 syntypes (1 intact + 2 single unmatched valves): DMNH 020487; ALBATROSS Sta. 2923, off San Diego, California. Ex USNM 111422 (*fide* ANSP catalog, and A. Kabat, pers. comm., 1996) via ANSP 190954. Dimensions (L x H): (1) 9.1 x 8.4 mm (intact), (2) 8.3 x 7.9 mm (single unmatched valve), (3) 6.9 x 6.3 mm (single unmatched valve).
4 syntypes: DMNH 043614; ALBATROSS Sta. 2923, 822 fms, mud, 39°F, off San Diego, California. Ex USNM. Dimensions (range): L = 8.6-11.6 mm, H = 7.8-11.0 mm.
Remarks: Although the original description (also Boss, *et al.*, 1968) mentioned only lot USNM 122585, A. Kabat called these lots "assuredly valid syntypes" as a result of his research into Dall's ALBATROSS species (A. Kabat, pers. comm., 1996), noting that "Drs. Morrison and Rosewater routinely split off "paratypes" for various other institutions..." Both lots were cited as type material by Kabat (1996). All specimens have thick intact periostracum.
Limopsidae. A synonym of *L. panamensis* Dall, 1902 (E. V. Coan, pers. comm.).

diegensis, *Thracia* [as new species]
Dall, 1915: 443.

1 syntype: DMNH 022250; near Beacon 10, San Diego Bay, San Diego County, California. Coll. Kelsey; ex ANSP 162047 [4 fms, Dr. Fred Baker (Kelsey!), *vidi*]. Dimensions (L x H): 6.5 x 5.1 mm.

Remarks: This specimen is listed here as a possible syntype. The type lot is USNM 73604 (Boss, *et al.*, 1968), with type locality San Diego Bay, 1-5 fms, in sandy mud. The ANSP source lot is marked "part of type lot," although no reference is made to USNM (N. Gilmore, in litt., 1997).

Thraciidae. Now placed in the genus *Asthenothaerus* (E. V. Coan, pers. comm.).

ecuadoriana, *Crassinella* [as new species]

Olsson, 1961: 182-183, pl. 25, figs. 6-6e.

1 paratype: DMNH 020775; Puerto Calle [published as Callo], Ecuador. Coll. A. A. Olsson, 1958; ex ANSP 218934 (see Remarks, *vidi*). Dimensions (L x H): 3.0 x 2.5 mm.

Remarks: ANSP 218934 is the holotypic lot, as stated in the original description; ANSP 218934a (*vidi*) includes four paratypic specimens and is the source of this specimen. Olsson (1961: 4) stated "the holotypes ... have been deposited at the Academy of Natural Sciences in Philadelphia, and where additional material is available, the paratypes of the same species will be placed in other museum collections."

Crassatellidae.

ensifera, *Yoldia* [as n. sp.]

Dall, 1897: 9, pl. 2, fig. 4.

1 syntype: DMNH 020398; ALBATROSS Sta. 3133, Monterey Bay, California. Ex ANSP 190960 (*vidi*). Dimensions (L x H): 20.0 x 9.6 mm.

2 syntypes: DMNH 043602; ALBATROSS Sta. 3133, 37 fms, Monterey Bay, California. Ex USNM. Dimensions (L x H): (1) 20.5 x 9.5 mm, (2) 18.8 x 8.9 mm.

Remarks: These specimens are listed here as possible syntypes, although no specific type locality or depository was published in the original description (or by Boss, *et al.*, 1968). The distributional range was originally given as "Vancouver Island and Puget Sound, southward to Monterey, California, in from 0 to 135 fathoms." ANSP 190960 (the source of DMNH 020398) is considered type material at that institution. Dall's types were generally deposited in USNM (the source of DMNH 043602), and although not listed by Boss, *et al.* (1968), the USNM collection includes six syntypes (USNM

107644). Original dimensions were listed as 35 x 16 mm, substantially larger than the DMNH specimens.

Sareptidae [none specified originally]. This is a synonym of *Y. (Cnesterium) seminuda* Dall, 1871 (E. V. Coan, pers. comm.).

exoptata, *Leda* (*Adrana*) [as new species]

Pilsbry & Lowe, 1932: 107-108, pl. 17, figs. 8-9.

1 paratype: DMNH 020378; 20 fms, Guaymas, west Mexico. Coll. H. N. Lowe, 1930; ex ANSP 155633. Dimensions (L x H): 14.7 x 4.7 mm.

Remarks: Pilsbry & Lowe's fig. 8 was specifically called "type" in the legend, while fig. 9 was labelled "paratype." The ANSP source lot is labelled "type and paratypes" and includes two vials, one with a single specimen (= holotype) and one (not recataloged) containing three valves (= paratypes).

Nuculanidae [originally Ledidae]. Curated as *Nuculana* in the DMNH collection.

gabbi, *Strigilla* [as new species]

Olsson & McGinty, 1958: 50-51, pl. 5, figs. 3, 3a.

1 paratype: DMNH 021741; Atlantic coast of Costa Rica. Coll. W. M. Gabb; ex ANSP 53379 (*vidi*). Dimensions (L x H): 35.1 x 31.3 mm.

Remarks: The DMNH specimen has "53379" penned on the inside of one valve. The original description cited ANSP 53379 as paratypic, containing one specimen of 35 x 30.5 mm. ANSP 53379 originally contained two specimens, identified as *S. sincera* Hanley; it now contains two unmatched valves [plus a note indicating that the published exterior view of the holotype was from this lot; this actually belongs with the holotypic lot, ANSP 218881 from Colon, Panama (N. Gilmore, in litt., 1997)]. The DMNH lot is a confirmed matched pair.

Tellinidae.

gerrardi, *Transenella* [as new species]

Abbott, 1958: 130-131, text-fig. 7, pl. 4a-c.

2 paratypes: DMNH 021194; 8 fms, 3/4 mi southwest of Low Point, Grand Cayman Island. Coll. A. J. Ostheimer; ex ANSP 199509 (Sta. D13-14, *vidi*). Dimensions (L x H): (1) 9.4 x 7.3 mm, (2) 8.3 x 6.6 mm.

Remarks: Both live-collected with dried soft parts inside shells.

Veneridae [originally Veneridae: Meretricinae].

hawaiensis, *Solecardia* [as n. sp.]

Pilsbry, 1921: 324-325, text-figs. 6a-c.

1 syntype: DMNH 021111; Hilo, Hawaii. Coll. D. Thaanum; ex ANSP 83102 (*vidi*). Dimensions (L x H): 6.2 x 4.3 mm.

Remarks: No type material was specifically mentioned in the original description, however, Pilsbry's types were generally deposited in ANSP. Although the ANSP source lot is labelled "type + paratypes," no [holo]type is segregated and no lectotype designation has been published to our knowledge, therefore all specimens must be considered syntypes.

Kelliidae [none specified originally]. Considered a junior synonym of *Nesobornia bartschi* Chavan, 1969 [nomen novum pro *Erycina (Poronia) ovata* Gould, 1850, *non* Gray, 1825, *nec* Philippi, 1836; Chavan, 1969: N525] according to Kay (1979).

impar, *Leda* [as new species]

Pilsbry & Lowe, 1932: 106, pl. 17, figs. 3-6.

1 paratype: DMNH 020360; Guaymas, west Mexico. Coll. H. N. Lowe, 1930; ex ANSP 155636 (20 fms, *vidi*). Dimensions (L x H): 11.7 x 5.7 mm.

Remarks: Pilsbry & Lowe's figs. 3-5 (three views) were specifically labelled "type," which constitutes a holotype designation; fig. 6 was simply called "young shell." The ANSP source lot is labelled "type + paratypes" and includes two vials, one with two valves (presumably one specimen, the holotype) and another (not recataloged) containing three specimens plus three valves (= paratypes).

Nuculanidae [originally Ledidae]. Curated as *Nuculana* in the DMNH collection.

inflatula, *Macoma* [as n. sp.]

Dall, 1897: 11-12, pl. 1, figs. 19-20.

4 syntypes (3 single right valves + 2 fragments of a fourth valve): DMNH 043610; Captain's Bay, Unalaska Island, Alaska, 12 fms. Ex USNM. Dimensions (L x H): (1) 15.7 x 12.2 mm, (2) 13.6 x 9.9 mm, (3) 12.8 x 10.0 mm; fragments not measured.

Remarks: The original description (and Boss, *et al.,* 1968) did not specifically mention type material, a type locality, or a depository; Boss, *et al.* (1968: 166) cited only the distributional range "Aleutian Islands to Puget Sound." Dall's types, however, were generally deposited in USNM, the source of this material, and indeed, that collection was found to include one syntype (USNM 107643, from 5 fms) labelled "figured type." The DMNH specimens are listed here as possible syntypes.

Tellinidae [none specified originally]. In the DMNH collection, this is considered a junior synonym of *Macoma frigida* (Hanley, 1844).

Krebsiana, *Corbula* [no status specified in original description]

C. B. Adams, 1852: 234.

1 paralectotype: DMNH 021941; Jamaica. Coll. C. B. Adams; ex ANSP 297148 (*vidi*). Dimensions (L x H): 4.0 x 3.3 mm.

Remarks: This specimen is listed here as a possible paralectotype. The original description mentioned no type material or depository for the original "about 60 specimens." The ANSP source lot (now with two specimens) bears a red dot (indicating type status) but type designation is absent from labels. Clench & Turner (1950: 400) figured a lectotype (MCZ 155611, *vidi*); another lot in MCZ (155612, *vidi*, labelled "paratypes") contains another 60+ valves, which are thus paralectotypes.

Corbulidae [none specified originally].

lermondi, *Pisidium* [as n. sp.]

Sterki, 1913: 138-139.

22 syntypes ("part of type lot"): DMNH 139931; Duck Pond, Warren, Maine. Coll. V. Sterki, October 1909; ex N. W. Lermond (#3059). Dimensions (range): L = 2.3-3.2 mm, H = 2.2-2.6 mm.

145 syntypes (143 intact + 2 single unmatched valves): DMNH 160045; ditch in Ellis Stahl's field, Warren, Knox County, Maine. Ex N. W. Lermond. Dimensions (range): L = 1.3-2.6 mm, H = 1.0-2.2 mm.

Remarks: Types were mentioned in the original description as "No. 6364, and in the collection of Mr. Lermond." This catalog number probably referred to "the special collection of Sphaeriidae" (Sterki, 1912: 6) [the Sterki Sphaeriidae collection of ca. 15,000 lots is now housed at the Carnegie Museum of Natural History (Pittsburgh) (A. Bogan, in litt., 1997), but *P. lermondi* was not listed in Carnegie's type catalog (Parodiz & Tripp, 1988)]. The type locality ("Hab.") was given as "Duck Pond, Warren, Me.," but the author also stated "at other places in the vicinity of Warren, Me." Because of this ambiguity, DMNH 160045 (labelled cotypes in the Lermond collection) is retained here as possible syntypes. "Cotypes" also were recognized at MCZ (20082, ex N. W. Lermond/V. Sterki; Johnson, 1959).

Sphaeriidae. This species is a junior synonym of *Pisidium nitidum* Jenyns, 1832 (*fide* Herrington, 1962).

maya, *Condylonucula* [as new species]
Moore, 1977: 124-125, figs. 4-5.
4 paratypes (3 intact + 1 as separated valves, in two paleoslides): DMNH 120579; 2 m, Chancanab Lagoon, Cozumel, Mexico. Coll. D. R. Moore, 29 November 1971; ex D. R. Moore. Dimensions (range): L = 0.4-0.5 mm, H = 0.3-0.4 mm.
Remarks: The original description indicated lengths of the four paratypes as 380, 490, 500, and 510 µm.
Nuculidae.

mediafricana, *Eupera* [as new species]
Pilsbry & Bequaert, 1927: 355-357, text-figs. 79a-f, 80a.
1 paratype: DMNH 021012; Stanleyville, Belgian Congo [now Kisangani, Haut-Zaïre, Zaire], Africa. Coll. Lang & Chapin, 1915; ex ANSP 133826 (coll. February 1915, donor AMNH 1924, *vidi*). Dimensions (L x H): 4.0 x 2.9 mm.
Remarks: No type material was listed in original description. The ANSP lot is labelled "type and paratypes"; ANSP's source is recorded as AMNH, but the latter contains no type lot of this species (Boyko & Sage, 1996; C. B. Boyko, pers. comm., 1997). According to Boyko (pers. comm., 1997), the ANSP specimens most likely originated in an AMNH expedition, not from the registered AMNH collections themselves.
Sphaeriidae.

micella, *Pleuromeris* [as new species]
Olsson & McGinty, 1958: 45, pl. 5, figs. 7, 7a.
4 paratypes (single unmatched valves, 3 right + 1 left): DMNH 020822; Bocas Island, northeastern Panama. Coll. Olsson and McGinty, 1953; ex ANSP 211907 (*vidi*). Dimensions (L x H): (1) 1.7 x 1.7 mm, (2) 1.6 x 1.5 mm, (3) 1.5 x 1.6 mm, (4) 1.5 x 1.6 mm.
Remarks: The original description cited ANSP 211907 as the holotypic lot and 211908 as the "paratype"; according to the ANSP collection catalog, 211908 originally contained 35 specimens.
Carditidae.

montereyensis, *Yoldia* [as n. s.]
Dall, 1893: 29-30.
2 syntypes (1 intact + 1 single unmatched valve): DMNH 043608;

ALBATROSS Sta. 3202, 382 fms, 41°F, Monterey Bay, California. Ex USNM. Dimensions (L x H): (1) 21.3 x 13.2 mm (intact), (2) 28.2 x 16.3 mm (single unmatched valve).

Remarks: These specimens are from the original lot (ALBATROSS sta. 3202) and are ex USNM, the location of the known type material (USNM 106972; Boss, *et al.*, 1968).

Sareptidae [none specified originally]. Now placed in the subgenus *Megayoldia* (*fide* E. V. Coan, pers. comm.).

mulawana, *Tivela* [as n. sp.]

Biggs, 1969: 205-206, figs. 1-2.

4 paratypes (single unmatched valves, 3 left, 1 right): DMNH 098136; Masirah Island, South Arabia. Ex P. Cambridge. Dimensions (range): L = 28.7-33.8 mm, H = 17.2-21.6 mm.

Remarks: The original description cited paratypes "in collection of Mr. Philip Cambridge."

Veneridae.

nonuranus, *Modiolus* (*Modiolus*) [as n. sp.]

Pilsbry & Olsson, 1935: 16, pl. 1, fig. 3.

1 paratype: DMNH 020572; beach of Nonura Bay, near Punta Aguja, Peru. Coll. A. A. Olsson; ex ANSP 164613 (South Bayovar near Punta Aguja, *vidi*). Dimensions (L x H): 27.4 x 15.0 mm.

Remarks: The original description listed the [holo]type as ANSP 164612 plus "paratypes in the Olsson collection"; the source lot (ANSP 164613) is listed in the ANSP collection catalog as containing 12 paratypes (valves), collected and donated by A. A. Olsson.

Mytilidae. Curated in the DMNH and ANSP collections as a junior synonym of *Semimytilus algosus* (Gould, 1850).

nux, *Egeria* [as new species]

Pilsbry & Bequaert, 1927: 367-368, pl. 29, figs. 4-7.

1 paratype: DMNH 021488; Malela, Congo River, Belgian Congo [now Zaire], Africa. Coll. H. Lang; ex ANSP 133889. Dimensions (L x H): 35.0 x 29.7 mm.

Remarks: The original description listed three specimens, consisting of the type plus two paratypes. The ANSP source lot presently consists of 66 valves labelled as paratypes (N. Gilmore, in litt., 1997), and was listed as paratypic by Boyko & Sage (1996).

Donacidae. Curated in the genus *Galatea* in the DMNH collection.

omissa, *Macrocallista* (*Chionella*) [as new species]

Pilsbry & Lowe, 1932: 102, pl. 17, figs. 13-16.

1 paratype: DMNH 021196; San Juan del Sur, Nicaragua. Coll. H. N. Lowe; ex ANSP 155597 (see Remarks, *vidi*). Dimensions (L x H): 6.1 x 5.1 mm.

Remarks: Pilsbry & Lowe's (1932: pl. 17, figs. 13-16) figure legend considered the specimen in figs. 13-14 as "type" and the remainder "paratypes." The ANSP source lot (ANSP "155590," corrected on the label to 155597, in the ANSP collection catalog as 155596) is labelled "type + 2 paratypes." The collection catalog entry (ANSP 155596) indicates "type + cotypes." The lot now consists of two vials, one with one specimen, and another (as paratypes, not recataloged) containing two valves (one specimen?). The [holo]type has in all these instances been segregated; the remaining (including the DMNH specimen) can be considered paratypes.

Veneridae. Curated as *Transenella* in the DMNH and ANSP collections.

pacis, *Macoma* [as new species]

Pilsbry & Lowe, 1932: 95, pl. 10, figs. 1, 1a, 2-3.

1 paratype: DMNH 021695; La Paz, Baja California Sur, Mexico. Coll. H. N. Lowe, 1930; ex ANSP 152070 (*vidi*). Dimensions (L x H): 33.3 x 20.5 mm.

Remarks: The original description cited the ANSP source lot specifically as paratypes. This specimen corresponds to the "long form" illustrated in pl. 10, fig. 3.

Tellinidae. A junior synonym of *Psammotreta viridotincta* (Carpenter, 1856) according to Keen (1971).

panamensis, *Cyrenoida* [as new species]

Pilsbry & Zetek, 1931: 69, pl. 3, fig. 4.

1 paratype: DMNH 020969; near Punta Paitilla, close to Panama City, Republic of Panama. Coll. J. Zetek; ex ANSP 155419 (*vidi*). Dimensions (L x H): 17.8 x 16.5 mm.

Remarks: The type locality was given merely as "near Panama City." The specimen is dirt-filled.

Cyrenoididae [none specified originally].

patagonicum, *Pisidium* [as sp. nov.]

Pilsbry, 1911: 607-608, pl. 47, figs. 8-10.

5 paratypes (3 intact + 2 single unmatched valves): DMNH 021008; spring on Rio Chico, 25 mi [same on ANSP label; published as 15 mi] above Sierra Oveja, Patagonia, Argentina. Coll. J. B. Hatcher;

ex ANSP 88808. Dimensions (range): L = 5.3-6.8 mm, H = 4.4-5.4 mm.

Remarks: These specimens are listed here as possible paratypes. No specific type lot was cited in the original description, but Pilsbry's types are generally considered to be at ANSP. The "type lot" at ANSP is 88810 (two valves). There are nine other lots with similar data, including ANSP 88807 and 88809 labeled as syntypes and the source lot 88808 (10+ specimens) labeled "co-types" (N. Gilmore, in litt., 1997).

Sphaeriidae. Curated in the DMNH collection in the genus *Sphaerium* (*Musculium*); curated in the ANSP collection as *Musculium*.

penistoni, *Cytherea* [as new species (in title)]

Heilprin, 1889: 142, pl. 8, fig. 4.

2 syntypes (single unmatched valves): DMNH 021176; Bermuda. Coll. A. Heilprin; ex ANSP 69644 (*vidi*). Dimensions (L x H): (1) 14.3 x 11.7 mm, (2) 12.9 x 11.4 mm.

Remarks: No type material or depository was designated in the original description. The ANSP source lot is labelled "types."

Veneridae [none specified originally]. Curated as a junior synonym of *Pitar fulminatus* (Menke, 1828) in the DMNH collection; curated as *Pitar* (*Pitar*) *penistoni* in the ANSP collection.

platyptycha, *Tapes* [as n. sp.]

Pilsbry, 1901a: 206-207; 1901b: 400, pl. 19, fig. 6.

1 syntype: DMNH 021363; Hirado Island, Hizen, Japan. Coll. Y. Hirase, 1901; ex ANSP 81218 ("1196," one segregated pair + two pairs of valves, *vidi*). Dimensions (L x H): 48.2 x 32.2 mm.

Remarks: No repository, catalog number, or original number of specimens was provided in the original description, however, the data match the stated type locality and source/collector. Pilsbry's (1901b) subsequent text cited ANSP 81218 [also Hirase's collection no. 1196].

Veneridae.

pontchartrainensis, *Mulinia* [as new species]

Morrison, 1965: 222-223, figs. 5-9.

6 paratypes: DMNH 108367; Middle Ground, eastern part of Lake Pontchartrain, Louisiana. Coll. J. P. E. Morrison; ex USNM 635644. Dimensions (range): L = 5.4-7.4 mm, H = 3.9-5.1 mm.

Mactridae.

redondoensis, *Aligena* [as sp. nov.]

T. Burch, 1941: 50-51, pl. 4, figs. 5-7.

1 paratype (right valve broken): DMNH 021105; Redondo Beach, Los Angeles County, California, 75 fms. Coll. T. and J. Q. Burch, 1938; ex ANSP 178027 (#3833, coll. 7-31-38, *vidi*). Dimensions (L x H): 1.9 x 1.7 mm.

Remarks: The original description mentioned paratypes in several repositories, including ANSP (without number). The source lot is considered paratypic in the ANSP collection.

Thyasiridae [none specified originally]. Now placed in the genus *Axinodon* (Coan & Scott, 1997).

redondoensis, *Nuculana* [as new species]

J. Q. Burch, 1944: 9-10, fig.; 1945: 32 [as *N. penderi redondoensis*].

2 paratypes (single unmatched valves): DMNH 020353; off Redondo Beach, California. Coll. B. R. Bales; ex ANSP 222225 (*vidi*). Dimensions (L x H): (1) 6.0 x 3.5 mm (left valve), (2) 5.1 x 3.1 mm (right valve).

Remarks: These specimens are listed here as possible paratypes. Burch (1945) stated that "a type specimen" had been deposited in the USNM, and that "paratypes will be available for all western museums wishing them." The source lot, ANSP 222225 (ex B. R. Bales Coll. #16501, J. S. Schwengel, donor, 1958), is considered a paratypic lot at that institution.

Nuculanidae. Considered a junior synonym of *Nuculana* (*Saccella*) *hindsii* (Hanley, 1860) according to Keen (1971).

Reiniana, *Corbicula* [as n. sp.]

Clessin in Küster, 1878: 196-197, pl. 39, figs. 8-9.

2 "paratypes" (1 intact + 1 single unmatched valve): DMNH 056392; E-416, [Yokohama according to original description], Japan. Ex E. Doremus. Dimensions (L x H): (1) 19.5 x 16.4 mm (single unmatched valve), (2) 17.2 x 14.7 mm (intact, one valve broken).

Remarks: This lot was cited as paratypic by Counts (1991: 31). Both specimens are smaller than the size range given in the original description (length 27-32 mm, width 24-28 mm).

Corbiculidae [originally Cycladea].

rhypis, *Pandora* (*Kennerlia*) [as new species]

Pilsbry & Lowe, 1932: 105, pl. 16, figs. 8-11.

1 paratype: DMNH 021989; La Union, Gulf of Fonseca, San Salvador, El Salvador. Coll. H. N. Lowe; ex ANSP 155503a (coll. 1931,

vidi). Dimensions (L x H): 18.6 x 16.1 mm.

Remarks: Pilsbry & Lowe's original figures (figs. 8-11) were labelled "type and paratypes." The ANSP source lot is the paratypic portion of the original lot ANSP 155503, the latter number now applied to the segregated holotype.

Pandoridae.

Rushii, *Thracia* [as n. sp.]

Pilsbry, 1897: 292-293, pl. 7, fig. 30.

1 syntype: DMNH 022252; Maldonado Bay, Uruguay. Coll. W. H. Rush; ex ANSP 70502 ("types," *vidi*). Dimensions (L x H): 18.6 x 12.3 mm.

Remarks: The original description gave length and height of three specimens, without type designation or catalog number.

Thraciidae [none specified originally].

sablensis, *Aequipecten* (*Plagioctenium*) *irradians* [as ssp. n.]

A. H. Clarke, 1965: 175-176, pl. 1, figs. 1-6.

1 paratype (1 valve): DMNH 020650; Sable Island, Nova Scotia. Coll. Mrs. F. Andrewschuk, July 1962; ex ANSP 290900 (ex National Museum of Canada 14153, approx. 43.59° N, 60.00° W, *vidi*). Dimensions (L x H): 41.5 x 40.2 mm.

Remarks: The original description mentioned paratypes in USNM, ANSP, and MCZ (without numbers). The ANSP source lot is considered paratypic in that collection.

Pectinidae [none specified originally]. Curated in the genus *Argopecten* in the ANSP collection.

sadoensis, *Corbicula* [as n. sp.]

Pilsbry, 1901a: 206-207; 1907: 158, pl. 7, figs. 15-16.

1 paralectotype: DMNH 020855; Sado Island, Japan. Coll. Y. Hirase, 1901; ex ANSP 89379 (*vidi*). Dimensions (L x H): 30.7 x 25.5 mm.

Remarks: No repository, catalog number, or original number of specimens was provided for this species in the original description, however, the data match the stated type locality and source/collector. Counts (1991: 32) called ANSP 89379 (the source of the DMNH specimen) the "holotype," resulting in a lectotype designation [this lot presently contains one segregated valve pair (= the lectotype) plus three additional sets (= paralectotypes, although not mentioned by Counts, 1991)]. Counts (1991) called the DMNH specimen a paratype, but it is

actually a paralectotype.
Corbiculidae [originally Cyrenidae].

sororcula, *Transenella* [as new species]
Pilsbry & Lowe, 1932: 102, pl. 9, figs. 12-16.
1 figured paratype: DMNH 021190; San Juan del Sur, Nicaragua. Coll. H. N. Lowe, 1931; ex ANSP 155599 (*vidi*). Dimensions (L x H): 11.3 x 8.3 mm.
Remarks: The legend to Pilsbry & Lowe's figs. 12-16 (as *Macrocallista sorocula* [*sic*]) designated figs. 13 and 13a as "type," and the remaining figured specimens as "paratypes." The source lot in the ANSP collection was originally labelled "type + 9 paratypes"; a single specimen (= holotype) is now segregated under the original number, and the remaining specimens (two intact specimens and 11 valves) have been separated (but not recataloged) as paratypes. The DMNH specimen can be considered a paratype. From the color pattern, this specimen appears to be that illustrated by Pilsbry & Lowe in fig. 12.
Veneridae. Curated as a junior synonym of *T. modesta* (Sowerby, 1835) in the DMNH collection.

Sterkianum, *Pisidium* [as n. sp.]
Pilsbry, 1897: 291-292, pl. 6, figs. 1-4.
2 syntypes: DMNH 020994; creek in "Prado," Montevideo, Uruguay. Coll. W. H. Rush; ex ANSP 70490 ("types," *vidi*). Dimensions (L x H): (1) 4.5 x 3.6 mm, (2) 4.5 x 3.5 mm.
Remarks: "Many specimens were collected," but none were designated specifically as types in the original description. This lot matches the original locality and collector. "Cotypes" from this locality also were recognized at MCZ (78076, ex B. Walker; Johnson, 1959).
Sphaeriidae [none specified originally].

sulfurea, *Pitar* [as n. sp.]
Pilsbry, 1904: 553, pl. 39, figs. 7-9.
1 syntype: DMNH 021167; Fukura, Awaji Island, Hyogo Prefecture, Hyogo, Japan. Coll. Y. Hirase, 1901; ex ANSP 82135 (*vidi*). Dimensions (L x H): 25.8 x 22.8 mm.
Veneridae [none specified originally].

Swiftiana, *Corbula* [no status specified in original description]
C. B. Adams, 1852: 236-237.
1 paralectotype: DMNH 021936; east part of Kingston Harbor,

Kingston, Jamaica. Coll. C. B. Adams; ex Adams Collection via MCZ via ANSP 182627 (3-4 fms, *vidi*). Dimensions (L x H): 7.7 x 5.1 mm.

Remarks: This specimen is listed here as a possible paralectotype. No type material or depository were given in the original description for the original "about 250 specimens"; the ANSP source lot is considered type material in that collection. Clench & Turner (1950: 400) figured a lectotype (MCZ 186103) and a paralectotype (MCZ 155602, as "paratype").

Corbulidae [none specified originally]. Considered a junior synonym of *C. caribaea* Orbigny, 1846.

thaanumi, *Cardium* [as n. sp.]

Pilsbry, 1921: 323-324, pl. 12, fig. 24.

1 paratype: DMNH 020918; off Waikiki, Oahu Id., Hawaii. Coll. D. Thaanum, 1916; ex D. B. Kuhns via ANSP 47179 (35-50 fms, *vidi*). Dimensions (L x H): 9.8 x 9.1 mm.

Remarks: No type material was designated in the original text description, although the legend to the original figure (a photograph) indicates "Type. 47179." This indication consititutes a holotype designation. The ANSP source lot is now labelled "type + paratypes," and the DMNH specimen is from the paratypic portion of this lot.

Cardiidae [none specified originally]. Now placed in the genus *Nemocardium* (Kay, 1979; Moretzsohn & Kay, 1995).

troglodytes, *Divariscintilla* [as sp. nov.]

Mikkelsen & Bieler, 1989: 186-187, figs. 2, 4, 7, 12-15, 27.

3 paratypes (in alcohol): DMNH 175517; Sta. PMM-930, mud flat, < 0.5 m by yabby pump from stomatopod burrow, 1100-1130 hrs, Sebastian Inlet, Brevard County, Florida. Coll. P. M. Mikkelsen, *et al.,* 30 December 1987; ex P. M. Mikkelsen. Dimensions (L x H; preserved mantle): (1) 5.1 x 3.9 mm [published as 4.9 mm], (2) 4.6 x 4.1 mm [published as 4.8 mm], (3) 4.5 x 3.9 mm.

Galeommatidae.

Uruguayensis, *Semele* (*Abra* ?) [as n. sp.]

Pilsbry, 1897: 293, pl. 7, figs. 27-29.

2 syntypes (single left valves): DMNH 021617; Maldonado Bay, Uruguay. Coll. W. H. Rush; ex ANSP 70493 (*vidi*). Dimensions (L x H): (1) 8.6 x 7.0 mm, (2) 7.4 x 6.5 mm.

Remarks: No type material or depository was designated in the original description although Maldonado Bay (in 3-6 fms) was given as the original locality; original dimensions were listed as 9.5 x 8 mm. The source ANSP lot is not labelled as a type lot but has a red dot on the box indicative of same; it consists of one segregated specimen plus others. In the absence of a formal lectotype designation, all specimens must continue to be considered as syntypes.

Semelidae [none specified originally]. Curated in the DMNH collection in the genus *Abra*.

viola, *Corbicula* [as n. sp.]

Pilsbry, 1907: 158, pl. 7, figs. 7-10.

1 syntype: DMNH 020858; Lake Biwa, Japan. Coll. T. Isakawa, 1905; ex ANSP 89371 (see Remarks, *vidi*). Dimensions (L x H): 24.0 x 21.3 mm.

Remarks: No type specimens were listed specifically in the original description. Both DMNH and ANSP lots were mentioned and called syntypic by Counts (1991: 38). In the ANSP collection, lot 89371 is now labelled as "holotype"; six valves were removed and recataloged as "paratype" lot 358423. This does not here constitute a lectotype designation.

Corbiculidae [none specified originally].

vulgaris, *Leda* [as n. sp.]

Brown & Pilsbry, 1913: 499, fig. 3.

232 syntypes (44 intact + 188 single unmatched valves): DMNH 135065; Pleistocene, Mt. Hope, Panama Canal Zone. Coll. W. B. Scott; ex J. Parker. Dimensions (range): L = 3.8-12.0 mm, H = 2.3-6.2 mm.

Remarks: These specimens are listed here as possible syntypes. No type material or repository was mentioned in the original description.

Nuculanidae [none specified originally]. Curated as *Nuculana* in the DMNH collection.

webbianus, *Unio* (*Elliptio*) [as sp. nov.]

Wright, 1934: 94-95, pl. 10, figs. 1-2.

1 paratype: DMNH 150106; Citrus County, Lake Consuelo, Florida. Ex W. F. Webb via M. L. Walton (#4195). Dimensions (L x H): 42.2 x 27.4 mm.

Unionidae [none specified originally].

yokohamensis, *Raeta* [as n. sp.]

Pilsbry, 1895: 119, pl. 3, figs. 4-5.

1 syntype: DMNH 021479; Yokohama, Kanagawa, Honshu Island, Japan. Coll. F. Stearns, 1895; ex ANSP 70873 (*vidi*). Dimensions (L x H): 16.7 x 12.3 mm.

Remarks: The ANSP source lot is labelled "types" in that collection.

Mactridae.

yoyo, *Divariscintilla* [as sp. nov.]

Mikkelsen & Bieler, 1989: 177-186, figs. 1, 3, 5-6, 8-11, 26.

2 paratypes (in alcohol): DMNH 175516; Sta. PMM-924, sand flat, < 0.5 m, by yabby pump from stomatopod burrow, Ft. Pierce Inlet, St. Lucie County, Florida. Coll. P. M. Mikkelsen, *et al.,* 31 August 1987; ex P. M. Mikkelsen. Dimensions (L x H, preserved mantle): (1) 4.8 x 2.5 mm [published as 5.7 mm], (2) 3.7 x 2.8 mm [published as 4.7 mm].

Galeommatidae.

SCAPHOPODA

teliger, *Cadulus* [as "n. sp." for *Cadulus spretus* Suter *non* Tate & May]

C. J. Finlay, 1927: 444, figs. 52-54.

1 paratype: DMNH 022370; north of Auckland Islands, New Zealand Subantarctic Islands. Ex A. W. B. Powell via ANSP 232249 (10 mi N of Auckland Island, 86677, 51° S, 168° E, 95 fms, *vidi*). Dimensions (L x W): 4.3 x 0.7 mm.

Remarks: This specimen is listed here as a possible paratype. The original description stated that "types of all new species described are in the Finlay collection; paratypes wherever possible have been deposited in the Australian Museum, Sydney" (Finlay, 1927: 330). This would seem to exclude these specimens from type status, however, the ANSP source lot was listed as paratypic by Spamer & Bogan (1992).

Gadilidae [none specified originally]. This species is curated as the genus *Gadila* in the ANSP collection.

ALPHABETIC INDEX BY AUTHOR (PARTS I AND II: BIELER & BRADFORD, 1991, AND THIS PAPER)

Families reflect current placement.

Abbott, R. T.
arcas, Terebra (Strioterebrum), Terebridae (Part I)
caribaea, Coralliophila, Muricidae
eloiseae, Acteon, Acteonidae (Part I)
gerrardi, Transenella, Veneridae
habei, Assiminea habei, Assimineidae (Part I)
hoffmeyeri, Terebra (Strioterebrum), Terebridae (Part I)
patae, Conus, Conidae (Part I)
stegeri, Terebra (Myurella) floridana, Terebridae (Part I)

Abbott, R. T. & C. J. Finlay
cosmani, Chicoreus, Muricidae (Part I)

Abbott, R. T. & H. Lewis
boschi, Cymatium, Ranellidae (Part I)

Adams, C. B.
Krebsiana, Corbula, Corbulidae
scalaroides, Rissoa, Rissoidae (Part I)
Swiftiana, Corbula, Corbulidae

Aguayo, C. G. & M. L. Jaume
jaumei, Eutrochatella (Troschelviana), Helicinidae

Alcalde y Ledón, O. (see also under Jaume)
fuentesi, Chondrothyrium crenimargo, Annulariidae
jaumei, Chrondrothyrium violaceum, Annulariidae
serranum, Farcimen (Farcimen) auriculatum, Megalomastomidae

Baker, F.
schereri, Helicina, Helicinidae

Bales, B. R.
nanus, Strombus raninus, Strombidae (Part I and this paper)

Barnard, K. H.
boswellae, Pirenella, Potamididae (Part I)

Bartsch, P.
smithi, Prodallia, Volutidae (Part I)
tagbilleranus, Geophorus (Diplopinax), Helicinidae
yoshidai, Katayama nosophora, Pomatiopsidae

Bayer, F. M.
aurora, Columbarium (Peristarium), Turbinellidae (Part I)
electra, Columbarium (Peristarium), Turbinellidae (Part I)
merope, Columbarium (Peristarium), Turbinellidae (Part I)

Bequaert, J. C. (see also under Pilsbry)
veracruzensis, Cerithidea pliculosa, Cerithideidae (Part I)

Bieler, R. (see under Mikkelsen)

Biggs, H. E. J.
mulawana, Tivela, Veneridae

Bratcher, T. (see under Cernohorsky)

Bratcher, T. & R. D. Burch
allyni, Terebra, Terebridae (Part I)
dorothyae, Terebra, Terebridae (Part I)
hancocki, Terebra, Terebridae (Part I)

Brown, A. P. & H. A. Pilsbry
vulgaris, Leda, Nuculanidae

Burch, J. Q.
redondoensis, Nuculana, Nuculanidae

Burch, J. Q. & R. L. Burch
rejecta, Oliva, Olividae (Part I)

Burch, R. D. (see also under Bratcher)
betsyae, Hastula (Punctoterebra), Terebridae (Part I)
crakei, Duplicaria (Duplicaria), Terebridae (Part I)
maryleeae, Hastula (Hastula), Terebridae (Part I)

Burch, R. L. (see under J. Q. Burch)

Burch, T.
redondoensis, Aligena, Thyasiridae

Burgess, C. M.
mauiensis, Cypraea, Cypraeidae (Part I)

Campbell, G. B. (see under Shasky)

Cardin, C. & J. G. Walls
lenoreae, Phenacovolva (Subsimnia), Ovulidae (Part I)

Cate, C. N.
eugeniae, Notadusta, Cypraeidae
lahainaensis, Volva (Phenacovolva), Ovulidae (Part I)

Cate, J. M.
filiareginae, Vexillum regina, Costellariidae

Cernohorsky, W. O. (see also under Emerson)
adamsianum, Vexillum (Costellaria), Costellariidae (Part I)
backae, Scabricola (Scabricola), Mitridae
cloveri, Cancilla (Ziba), Mitridae
crosnieri, Cancilla scrobiculata, Mitridae (Part I and this paper)
dondani, Mitra, Mitridae
earlei, Mitra (Nebularia), Mitridae
ekerae, Scabricola (Swainsonia) ocellata, Mitridae
hansenae, Vexillum (Pusia), Costellariidae
marrowi, Vexillum (Pusia), Costellariidae
martinorum, Vexillum (Costellaria), Costellariidae
nodospiculum, Vexillum (Costellaria), Costellariidae
orri, Muricopsis, Muricidae
salisburyi, Mitrolumna, Turridae (Part I)
salisburyi, Vexillum (Pusia), Costellariidae (Part I and this paper)
vicdani, Scabricola, Mitridae
wolfei, Vexillum (Costellaria), Costellariidae (Part I and this paper)

Cernohorsky, W. O. & T. Bratcher
parkinsoni, Terebra, Terebridae (Part I)

Clarke, A. H., Jr.
sablensis, Aequipecten (Plagioctenium) irradians, Pectinidae

Clench, W. J.
finlayi, Murex (Murex), Muricidae (Part I)
haysae, Thais floridana, Muricidae (Part I)
trujilloi, Oliva, Olividae (Part I)

Clench, W. J. & R. D. Turner
johnstonei, Melongena corona, Melongenidae (Part I, as Buccinidae)
langi, Thais (Thaisella), Muricidae (Part I)
riosi, Adelomelon (Weaveria), Volutidae (Part I)

Clessin, S. *in* H. C. Küster
Reiniana, Corbicula, Corbiculidae

Coelho, A. C. dos Santos (see under Matthews)

Cotton, B. C.
rosselli, Zoila, Cypraeidae (Part I)

Dall, W. H.
atkana, Littorina sitkana, Littorinidae (Part I)
brunnea, Tindaria, Tindariidae
diegensis, Limopsis, Limopsidae
diegensis, Thracia, Thraciidae
ensifera, Yoldia, Sareptidae
inflatula, Macoma, Tellinidae
major, Buccinum pemphigus, Buccinidae (Part I)
montereyensis, Yoldia, Sareptidae
vernicosum, Mangilia (Calliotectum), Volutidae (Part I, as Turridae)

Dall, W. H. *in* C. R. Orcutt & W. H. Dall
orcutti, Caecum, Caecidae (Part I)

D'Attilio, A. (see under Emerson)

DuShane, H.
textimattum, Epitonium (Asperiscala), Epitoniidae (Part I)

Emerson, W. K. & W. O. Cernohorsky
hadari, Drupa ricinus, Muricidae

Emerson, W. K. & A. D'Attilio
dalli, Latiaxis (Babelomurex), Muricidae (Part I)

guamensis, Favartia, Muricidae
mactanensis, Murexiella, Muricidae

Emerson, W. K. & B. J. Piech
jenniernestae, Distorsio (Distorsio), Personidae

Ferreira, A. J.
portobelensis, Callistochiton, Ischnochitonidae

Finlay, C. J. (see also under Abbott)
teliger, Cadulus, Gadilidae

Finlay, H. J.
cuvierensis, Microvoluta, Volutomitridae (Part I)

Ford, J.
blanesi, Olivella, Olividae (Part I)
gaylordi, Olivella gracilis, Olividae (Part I)
greegori, Cypraea cruenta, Cypraeidae (Part I)
michaeli, Ocinebra, Muricidae (Part I)

Harasewych, M. G.
ecphoroides, Fulgurofusus (Fulgurofusus), Turbinellidae (Part I)
germonae, Tractolira, Volutidae (Part I)
harrisae, Columbarium, Turbinellidae (Part I)
timor, Fulgurofusus (Peristarium), Turbinellidae (Part I)
xenismatis, Fulgurofusus (Histricosceptrum), Turbinellidae (Part I)

Harasewych, M. G. & R. H. Jensen
guesti, Natica (Natica), Naticidae (Part I)
guesti, Pterynotus (Pterynotus), Muricidae (Part I)
lightbourni, Pterynotus (Pterynotus), Muricidae (Part I)
radwini, Pterynotus (Pterynotus), Muricidae (Part I)

Hedley, C.
perplicata, Voluta, Volutidae (Part I)

Heilprin, A.
penistoni, Cytherea, Veneridae

Henderson, J. B., Jr. & C. T. Simpson
superbum, Chondropoma, Annulariidae

Hoerle, R. C.
finlayi, Neritopsis, Neritopsidae (Part I)

Howard, F. B.
aureola, Pyrene = aureomexicana, Pyrene, Columbellidae (Part I and this paper)

Hutton, F. W.
corticata, Acmaea, Lottiidae (Part I, as Acmaeidae)

Iredale, T.
kellneri, Aulica, Volutidae (Part I)

Jaume, M. L. (see under Aguayo)

Jaume, M. L. & O. Alcalde y Ledón
fuentesi, Chondropoma (Chondropoma), Annulariidae

Jaume, M. L. & L. Sánchez de Fuentes
alcaldei, Chondropoma (Chondropoma), Annulariidae
alcaldei, Chondrothyrium (Plicathyrium), Annulariidae
britoi, Eutudora limbifera, Annulariidae
morenoi, Chondrothyrium (Chondrothyrium) violaceum, Annulariidae
torrei, Chondrothyrium (Plicathyrium), Annulariidae

Jensen, R. H. (see under Harasewych)

Keen, A. M.
fayae, Anachis (?Costoanachis), Columbellidae (Part I)

Klappenbach, M. A.
teaguei, Olivancillaria, Olividae (Part I)

Krieger, K. A.
alcoviensis, Somatogyrus, Hydrobiidae

Lewis, H. (see also under Abbott)
burgessi, Distorsio, Personidae (Part I, as Ranellidae)
habei, Distorsio constricta, Personidae (Part I, as Ranellidae)

Little, M. D. (see under Malek)

Lowe, H. N. (see under Pilsbry)

Lyons, W. G.
barbarae, Brachycythara, Turridae (Part I)
girardi, Cerodrillia, Turridae (Part I)
inglei, Oceanida, Eulimidae (Part I)
lineata, Acanthochitona, Acanthochitonidae

Malek, E. A. & M. D. Little
colombiensis, Aroapyrgus, Hydrobiidae

Marcus, Ernst (see under Marcus, Eveline)

Marcus, Eveline & Ernst Marcus
vina, Assiminea succinea, Assimineidae (Part I)

Matthews, H. R. & A. C. dos Santos Coelho
lopesi, Mitra (Cancilla), Mitridae

McGinty, T. L. (see also under Olsson)
stegeri, Daphnella, Turridae (Part I)
thompsoni, Eudolium, Tonnidae (Part I)

Melvill, J. C.
jacksoni, Scissurella, Scissurellidae

Mikkelsen, P. M. & R. Bieler
troglodytes, Divariscintilla, Galeommatidae
yoyo, Divariscintilla, Galeommatidae

Mitchell-Tapping, H. J.
donmoorei, Caecum, Caecidae (Part I)

Moore, D. R.
calcicola, Nucula, Nuculidae
cynthiae, Condylonucula, Nuculidae
maya, Condylonucula, Nuculidae

Morrison, J. P. E.
barretti, Odostomiae = booneae, Hydrobia, Hydrobiidae
chocolatum, Incidostoma, Poteriidae
diminutum, Incidostoma, Poteriidae

jacksoni, Incidostoma, Poteriidae
louisianae, Vioscalba, Hydrobiidae
pontchartrainensis, Mulinia, Mactridae
weberi, Odostomia, Pyramidellidae

Mulliner, D. K. & G. G. Sphon
carolynae, Platydoris, Platydorididae

Oliver, W. R. B.
kermadecensis, Haurakia, Rissoidae (Part I)

Olsson, A. A. (see also under Pilsbry)
ecuadoriana, Crassinella, Crassatellidae
stegeri, Olivella (Olivella), Olividae (Part I)

Olsson, A. A. & T. L. McGinty
elegans, Vitrinella (Striovitrinella), Vitrinellidae (Part I)
gabbi, Strigilla, Tellinidae
marmosa, Olivella minuta, Olividae (Part I)
micella, Pleuromeris, Carditidae
toroensis, Rissoa, Rissoidae

Orcutt, C. R. (see under Dall)

Pease, W. H.
dispar, Neritina, Neritidae (Part I)
rubra, Alcyna, Trochidae (Part I)

Peile, A. J.
bermudensis, Rissoina, Rissoidae (Part I)

Petit, R. E. (see also under Roth)
darwini, Cancellaria, Cancellariidae (Part I)

Petuch, E. J.
abrolhosensis, Acmaea (Collisella), Lottiidae (Part I, as Acmaeidae)
aphrodite, Conus, Conidae (Part I)
baileyi, Oliva, Olividae (Part I)
boholensis, Conus, Conidae (Part I)
eccentricus, Zelippistes, Capulidae (Part I)
echinophilus, Africonus, Conidae (Part I)
exquisita, Pseudocypraea, Ovulidae (Part I)

fragilissimus, Conus, Conidae (Part I)
kaicherae, Vexillum (Costellaria), Costellariidae (Part I)
kurzi, Guildfordia, Turbinidae (Part I)
kurzi, Morum (Oniscidia), Harpidae (Part I)
lightbourni, Conus (Floraconus), Conidae (Part I)
nereis, Conus, Conidae (Part I)
nodosivaricosa, Agatrix (Olssonella), Cancellariidae (Part I)
philippinensis, Axymene, Muricidae (Part I)
zulu, Conus, Conidae (Part I)

Piech, B. J. (see under Emerson)

Pilsbry, H. A. (see also under Brown)
awajiensis, Corbicula, Corbiculidae
bryanae, Congeria, Mytilidae
dalliana, Acmaea, Lottiidae (Part I, as Acmaeidae)
floridana, Stenacme, Epitoniidae (Part I)
hawaiensis, Solecardia, Kelliidae
patagonicum, Pisidium, Sphaeriidae
platyptycha, Tapes, Veneridae
Rushii, Thracia, Thraciidae
sadoensis, Corbicula, Corbiculidae
Sterkianum, Pisidium, Sphaeriidae
sulfurea, Pitar, Veneridae
thaanumi, Cardium, Cardiidae
tokyoensis, Rissoa, Rissoidae (Part I)
Uruguayensis, Semele (Abra?), Semelidae
viola, Corbicula, Corbiculidae
yokohamensis, Raeta, Mactridae

Pilsbry, H. A. & J. C. Bequaert
congo, Iphigenia, Donacidae
mediafricana, Eupera, Sphaeriidae
nux, Egeria, Donacidae

Pilsbry, H. A. & H. N. Lowe
acapulcensis, Leda (Saccella), Nuculanidae
exoptata, Leda (Adrana), Nuculanidae
hilli, Anachis (Glyptanachis), Columbellidae
impar, Leda, Nuculanidae
omissa, Macrocallista (Chionella), Veneridae
pacis, Macoma, Tellinidae

rhypis, Pandora (Kennerlia), Pandoridae
sororcula, Transenella, Veneridae

Pilsbry, H. A. & A. A. Olsson
nonuranus, Modiolus (Modiolus), Mytilidae

Pilsbry, H. A. & J. Zetek
panamensis, Cyrenoida, Cyrenoididae

Powell, A. W. B.
ahiparana, Turritella (Zeacolpus), Turritellidae (Part I)
bouvetia, Margarella, Trochidae (Part I)
delli, Penion benthicola, Buccinidae (Part I)
kingae, Xenoturris, Turridae (Part I)
macquariensis, Trophon, Muricidae (Part I)
mauganuica, Austrodiaphana, Diaphanidae (Part I)
mawsoni, Parmaphorella, Fissurellidae
nivosa, Ovirissoa, Rissoidae (Part I)
pseudanaloga, Puncturella, Fissurellidae (Part I)
queenslandica, Leucosyrinx, Turridae (Part I)
scotiana, Sinuber sculpta, Naticidae (Part I)
signeyana, Chlanidota, Buccinidae (Part I)
tenerum, Parvaplustrum, Aplustridae (Part I, as Hydatinidae)
venustula, Pareuthria, Buccinidae (Part I)
weaveri, Turridrupa, Turridae (Part I)
wormaldi, Columbarium (Coluzea), Turbinellidae (Part I)
zebrina, Zediloma (Fractarmilla) corrosa, Trochidae (Part I)

Prime, T.
angasi, Corbicula, Corbiculidae

Quinn, J. F., Jr.
acanthus, Mirachelus, Trochidae
bermudense, Calliostoma, Trochidae
carinatus, Lamellitrochus, Trochidae
guesti, Calliostoma, Trochidae

Rehder, H. A.
barnardi, Fusivoluta, Volutidae (Part I)
boswellae, Volutocorbis, Volutidae (Part I)
clarkei, Fusivoluta, Volutidae (Part I)
disparilis, Volutocorbis, Volutidae (Part I)

Snyder, M. A.
lightbourni, Fusinus, Fasciolaridae (Part I, as Buccinidae)
martini, Latirus, Fasciolariidae (Part I, Buccinidae)

Sphon, G. (see under Mulliner)

Sterki, V.
lermondi, Pisidium, Sphaeriidae

Stokes, A. J.
randalli, Cymbiola, Volutidae (Part I)

Summers, R. (see under Schilder)

Suter, H.
lyalliana, Rissoia (Alvania) plicata, Rissoidae (Part I)

Test, A. R.
cona, Acmaea, Lottiidae (Part I, as Acmaeidae)

Thompson, F. G.
rhecta, Meganipha, Annulariidae

Tippett, D. L.
brasiliana, Borsonia, Turridae (Part I)
petiti, Fenimorea, Turridae
wolfei, Drillia, Turridae

Tucker, J. K.
sprucecreekensis, Melongena, Melongenidae

Turner, R. D. (see under Clench)

Vanatta, E. G.
amosi, Metula, Fasciolariidae (Part I, as Buccinidae)

Waller, T. R.
cranmerorum, Somalipecten, Pectinidae

Walls, J. G. (see also under Cardin)
axelrodi, Conus, Conidae (Part I)
cloveri, Conus, Conidae (Part I)

kerstitchi, Conus, Conidae (Part I)
meyeri, Conus biliosus, Conidae (Part I)
parvatus, Conus musicus, Conidae (Part I)
reductaspiralis, Conus nielsenae, Conidae (Part I)
sandwichensis, Conus suturalis, Conidae (Part I)
tribblei, Conus, Conidae (Part I)
wittingi, Conus, Conidae (Part I)

Watters, G. T.
andersoni, Acanthochitona, Acanthochitonidae

Weaver, C. S.
cloveriana, Lyria, Volutidae (Part I)
daisyae, Volutoconus hargreavesi, Volutidae (Part I)
dampieria, Amoria (Amoria), Volutidae (Part I)
duponti, Festilyria, Volutidae (Part I)

Wheat, S. C.
fergusoni Wheat, 1913, *Acmaea,* Lottiidae

Wright, B. H.
webbianus, Unio (Elliptio), Unionidae

Zetek, J. (see under Pilsbry)

TAXONOMIC INDEX
(PARTS I AND II: BIELER & BRADFORD, 1991, AND THIS PAPER)

(numbers of lots/specimens in parentheses; * = includes holotype)
Listed by original epithet within current families.

POLYPLACOPHORA:

Acanthochitonidae
andersoni Watters, 1981, *Acanthochitona* (1/1)
lineata Lyons, 1988, *Acanthochitona* (1/1)
Ischnochitonidae
portobelensis Ferreira, 1976, *Callistochiton* (1/1)

GASTROPODA: PROSOBRANCHS:

Acmaeidae - see Lottiidae
Annulariidae
alcaldei Jaume & Sánchez de Fuentes, 1943, *Chondropoma*

(*Chondropoma*) (1/4)
alcaldei Jaume & Sánchez de Fuentes, 1943, *Chondrothyrium* (*Plicathyrium*) (1/1)
britoi Jaume & Sánchez de Fuentes, 1943, *Eutudora limbifera* (1/6)
fuentesi Jaume & Alcalde y Ledón, 1944, *Chondropoma* (*Chondropoma*) (1/3)
fuentesi Alcalde y Ledón, 1943, *Chondrothyrium crenimargo* (1/1)
jaumei Alcalde y Ledón, 1943, *Chrondrothyrium violaceum* (1/4)
morenoi Jaume & Sánchez de Fuentes, 1943, *Chondrothyrium* (*Chondrothyrium*) *violaceum* (1/2)
rhecta Thompson, 1978, *Meganipha* (1/3)
superbum Henderson & Simpson, 1902, *Chondropoma* (1/4)
torrei Jaume & Sánchez de Fuentes, 1943, *Chondrothyrium* (*Plicathyrium*) (1/1)

Assimineidae
habei Abbott, 1958, *Assiminea habei*, Part I (1/2)
vina Marcus & Marcus, 1965, *Assiminea succinea*, Part I (1/31)

Buccinidae
delli Powell, 1971, *Penion benthicola*, Part I (1/1)
major Dall, 1919, *Buccinum pemphigus*, Part I (1/1)
signeyana Powell, 1951, *Chlanidota*, Part I (1/1)
stilesi Smith, 1968, *Neptunea*, Part I (1/1)
venustula Powell, 1951, *Pareuthria*, Part I (1/1)

Caecidae
donmoorei Mitchell-Tapping, 1979, *Caecum*, Part I (*1/1)
orcutti Dall *in* Orcutt & Dall, 1885, *Caecum*, Part I (1/2)

Cancellariidae
darwini Petit, 1970, *Cancellaria*, Part I (1/1)
nodosivaricosa Petuch, 1979, *Agatrix* (*Olssonella*), Part I (*1/1)

Capulidae
eccentricus Petuch, 1979, *Zelippistes*, Part I (*1/1)

Cerithideidae
veracruzensis Bequaert, 1942, *Cerithidea pliculosa*, Part I (1/1)

Columbellidae
aureola Howard, 1963, *Pyrene* = *aureomexicana* Howard, 1963, *Pyrene*, Part I (1/1)
berryi Shasky, 1970, *Anachis*, Part I (1/2)
fayae Keen, 1971, *Anachis* (?*Costoanachis*), Part I (1/2)
hilli Pilsbry & Lowe, 1932, *Anachis* (*Glyptanachis*) (1/2)
mazatlanica Shasky, 1970, *Ruthia*, Part I (1/1)
mendozana Shasky, 1970, *Strombina* (*Cotonopsis*), Part I (1/1)

Conidae

aphrodite Petuch, 1979, *Conus*, Part I (*2/2)
axelrodi Walls, 1978, *Conus*, Part I (*1/1)
boholensis Petuch, 1979, *Conus*, Part I (*2/3)
cloveri Walls, 1978, *Conus*, Part I (*1/1)
echinophilus Petuch, 1975, *Africonus*, Part I (1/1)
fragilissimus Petuch, 1979, *Conus*, Part I (*2/4)
kerstitchi Walls, 1978, *Conus*, Part I (*1/1)
lightbourni Petuch, 1986, *Conus* (*Floraconus*), Part I (*2/4)
meyeri Walls, 1979, *Conus biliosus*, Part I (*1/1)
nereis Petuch, 1979, *Conus*, Part I (*2/2)
parvatus Walls, 1979, *Conus musicus*, Part I (*2/7)
patae Abbott, 1971, *Conus*, Part I (*4/7)
reductaspiralis Walls, 1979, *Conus nielsenae*, Part I (*1/1)
sandwichensis Walls, 1978, *Conus suturalis*, Part I (*1/1)
tribblei Walls, 1977, *Conus*, Part I (*1/1)
wittigi Walls, 1977, *Conus*, Part I (*1/1)
zulu Petuch, 1979, *Conus*, Part I (*3/6)

Costellariidae

adamsianum Cernohorsky, 1978, *Vexillum* (*Costellaria*), Part I (1/1)
filiareginae Cate, 1961, *Vexillum regina* (2/2)
hansenae Cernohorsky, 1973, *Vexillum* (*Pusia*) (2/3)
kaicherae Petuch, 1979, *Vexillum* (*Costellaria*), Part I (1/2)
marrowi Cernohorsky, 1973, *Vexillum* (*Pusia*) (4/5)
martinorum Cernohorsky, 1986, *Vexillum* (*Costellaria*) (1/1)
nodospiculum Cernohorsky, 1970, *Vexillum* (*Costellaria*) (2/2)
salisburyi Cernohorsky, 1976, *Vexillum* (*Pusia*), Part I (1/3) and this paper (2/3)
sphoni Shasky & Campbell, 1964, *Mitra* (*Strigatella*) (1/1)
wolfei Cernohorsky, 1978, *Vexillum* (*Costellaria*), Part I (1/1) and this paper (1/1)

Cypraeidae

casta Schilder & Summers, 1963, *Notocypraea* (1/1)
eugeniae Cate, 1975, *Notadusta* (2/2)
greegori Ford, 1893, *Cypraea cruenta*, Part I (1/1)
hesperina Schilder & Summers, 1963, *Blasicrura coxeni*, Part I (1/1)
mauiensis Burgess, 1967, *Cypraea*, Part I (1/2)
rosselli Cotton, 1948, *Zoila*, Part I (1/1)
summersi Schilder, 1958, *Bistolida* (*Blasicrura*) *pallidula*, Part I (1/1)

Elachisinidae

floridanus Rehder, 1943, *Microdochus*, Part I (1/78)

Epitoniidae

floridana Pilsbry, 1945, *Stenacme*, Part I (1/1)
textimattum DuShane, 1977, *Epitonium* (*Asperiscala*), Part I (1/1)

Eulimidae

inglei Lyons, 1978, *Oceanida*, Part I (1/1)

Fasciolariidae

amosi Vanatta, 1913, *Metula*, Part I (1/2)
lightbourni Snyder, 1984, *Fusinus*, Part I (*2/4)
martini Snyder, 1988, *Latirus*, Part I (1/1)

Fissurellidae

mawsoni Powell, 1958, *Parmaphorella* (1/1)
pseudanaloga Powell, 1957, *Puncturella*, Part I (2/5)

Harpidae

kurzi Petuch, 1979, *Morum* (*Oniscidia*), Part I (*1/1)

Helicinidae

jaumei Aguayo & Jaume, 1957, *Eutrochatella* (*Troschelviana*) (1/4)
schereri Baker, 1913, *Helicina* (1/4)
tagbilleranus Bartsch, 1918, *Geophorus* (*Diplopinax*) (1/6)

Hydrobiidae

alcoviensis Krieger, 1972, *Somatogyrus* (2/24)
barretti Morrison, 1965, *Odostomia* = *booneae* Morrison, 1973, *Hydrobia* (1/2)
colombiensis Malek & Little, 1971, *Aroapyrgus* (*2/92)
louisianae Morrison, 1965, *Vioscalba* (1/23)

Lamellariidae

koto Schwengel, 1944, *Lamellaria*, Part I (2/2)

Littorinidae

atkana Dall, 1886, *Littorina sitkana*, Part I (1/2)

Lottiidae

abrolhosensis Petuch, 1979, *Acmaea* (*Collisella*), Part I (1/4)
cona Test, 1945, *Acmaea*, Part I (1/1)
corticata Hutton, 1880, *Acmaea*, Part I (1/1)
dalliana Pilsbry, 1891, *Acmaea*, Part I (1/1)
fergusoni Wheat, 1913, *Acmaea* (1/1)

Marginellidae

masirana Roth & Petit, 1972, *Persicula*, Part I (*1/1)

Megalomastomidae

serranum Alcalde y Ledón, 1945, *Farcimen* (*Farcimen*) *auriculatum* (*1/1)

Melongenidae

inspinata Richards, 1933, *Melongena corona* (*1/1)
johnstonei Clench & Turner, 1956, *Melongena corona*, Part I (4/9)

sprucecreekensis Tucker, 1994, *Melongena* (1/10)

Mitridae

backae Cernohorsky, 1973, *Scabricola* (*Scabricola*) (2/2)
cloveri Cernohorsky, 1971, *Cancilla* (*Ziba*) (1/1)
crosnieri Cernohorsky, 1970, *Cancilla scrobiculata*, Part I (*2/3) and this paper (1/1)
dondani Cernohorsky, 1985, *Mitra* (1/1)
earlei Cernohorsky, 1977, *Mitra* (*Nebularia*) (1/1)
ekerae Cernohorsky, 1973, *Scabricola* (*Swainsonia*) *ocellata* (1/1)
lopesi Matthews & Coelho, 1969, *Mitra* (*Cancilla*) (1/3)
vicdani Cernohorsky, 1981, *Scabricola* (1/1)

Muricidae

caribaea Abbott, 1958, *Coralliophila* (1/3)
cosmani Abbott & Finlay, 1979, *Chicoreus*, Part I (1/1)
dalli Emerson & D'Attilio, 1963, *Latiaxis* (*Babelomurex*), Part I (1/2)
finlayi Clench, 1955, *Murex* (*Murex*), Part I (1/1)
guamensis Emerson & D'Attilio, 1979, *Favartia* (1/1)
guesti Harasewych & Jensen, 1979, *Pterynotus* (*Pterynotus*), Part I (*1/1)
hadari Emerson & Cernohorsky, 1973, *Drupa ricinus* (1/2)
haysae Clench, 1927, *Thais floridana*, Part I (2/4)
langi Clench & Turner, 1948, *Thais* (*Thaisella*), Part I (1/6)
lightbourni Harasewych & Jensen, 1979, *Pterynotus* (*Pterynotus*), Part I (*1/1)
macleani Shasky, 1970, *Coralliophila*, Part I (1/2)
mactanensis Emerson & D'Attilio, 1979, *Murexiella* (1/1)
macquariensis Powell, 1957, *Trophon*, Part I (1/3)
michaeli Ford, 1888, *Ocinebra*, Part I (1/2)
orri Cernohorsky, 1976, *Muricopsis* (1/2)
philippinensis Petuch, 1979, *Axymene*, Part I (*1/1)
radwini Harasewych & Jensen, 1979, *Pterynotus* (*Pterynotus*), Part I (*1/1)

Naticidae

guesti Harasewych & Jensen, 1984, *Natica* (*Natica*), Part I (2/8 [7])
scotiana Powell, 1951, *Sinuber sculpta*, Part I (1/2)

Neritidae

dispar Pease, 1867, *Neritina*, Part I (1/6)

Neritopsidae

finlayi Hoerle, 1974, *Neritopsis*, Part I (1/1)

Olividae

baileyi Petuch, 1979, *Oliva*, Part I (*2/2)
blanesi Ford, 1898, *Olivella*, Part I (1/2)

gaylordi Ford, 1895, *Olivella gracilis*, Part I (1/2)
marmosa Olsson & McGinty, 1958, *Olivella minuta*, Part I (1/1)
rejecta Burch & Burch, 1962, *Oliva*, Part I (1/1)
stegeri Olsson, 1956, *Olivella* (*Olivella*), Part I (1/4)
teaguei Klappenbach, 1964, *Olivancillaria*, Part I (1/1)
trujilloi Clench, 1938, *Oliva*, Part I (1/7)

Ovulidae

exquisita Petuch, 1979, *Pseudocypraea*, Part I (*1/1)
lahainaensis Cate, 1969, *Volva* (*Phenacovolva*), Part I (1/2)
lenoreae Cardin & Walls, 1980, *Phenacovolva* (*Subsimnia*), Part I (*1/1)

Personidae

burgessi Lewis, 1972, *Distorsio*, Part I (2/2)
habei Lewis, 1972, *Distorsio constricta*, Part I (1/1)
jenniernestae Emerson & Piech, 1992, *Distorsio* (*Distorsio*) (1/2)

Pomatiopsidae

yoshidai Bartsch, 1925, *Katayama nosophora* (1/6)

Potamididae

boswellae Barnard, 1963, *Pirenella*, Part I (*1/1)

Poteriidae

chocolatum Morrison, 1955, *Incidostoma* (1/5)
diminutum Morrison, 1955, *Incidostoma* (2/13)
jacksoni Morrison, 1955, *Incidostoma* (2/18)

Ranellidae

boschi Abbott & Lewis, 1970, *Cymatium*, Part I (*1/1)
edgerlyi Richards, 1933, *Gyrineum perca* (*1/1)

Rissoidae

bermudensis Peile, 1926, *Rissoina*, Part I (1/2)
kermadecensis Oliver, 1915, *Haurakia*, Part I (1/3)
lyalliana Suter, 1898, *Rissoia* (*Alvania*) *plicata*, Part I (1/1)
nivosa Powell, 1957, *Ovirissoa*, Part I (1/3)
scalaroides Adams, 1850, *Rissoa*, Part I (1/7)
tokyoensis Pilsbry, 1904, *Rissoa*, Part I (1/1)
toroensis Olsson & McGinty, 1958, *Rissoa* (1/5)

Scissurellidae

jacksoni Melvill, 1904, *Scissurella* (1/1)

Strombidae

nanus Bales, 1942, *Strombus raninus*, Part I (1/5) and this paper (1/2)

Terebridae

allyni Bratcher & Burch, 1970, *Terebra*, Part I (1/1)
arcas Abbott, 1954, *Terebra* (*Strioterebrum*), Part I (2/3)
betsyae Burch, 1965, *Hastula* (*Punctoterebra*), Part I (2/6)

crakei Burch, 1965, *Duplicaria* (*Duplicaria*), Part I (1/2)
dorothyae Bratcher & Burch, 1970, *Terebra*, Part I (1/1)
hancocki Bratcher & Burch, 1970, *Terebra*, Part I (1/1)
hoffmeyeri Abbott, 1952, *Terebra* (*Strioterebrum*), Part I (1/1)
maryleeae Burch, 1965, *Hastula* (*Hastula*), Part I (1/2)
parkinsoni Cernohorsky & Bratcher, 1976, *Terebra*, Part I (1/1)
stegeri Abbott, 1954, *Terebra* (*Myurella*) *floridana*, Part I (1/1)

Tonnidae

thompsoni McGinty, 1955, *Eudolium*, Part I (1/1)

Trochidae

acanthus Quinn, 1991, *Mirachelus* (*2/4)
bermudense Quinn, 1992, *Calliostoma* (*2/10)
bouvetia Powell, 1951, *Margarella*, Part I (1/2)
carinatus Quinn, 1991, *Lamellitrochus* (*3/54)
guesti Quinn, 1992, *Calliostoma* (*2/4)
huttonii Smith, 1876, *Trochus* (*Canthiridus*), Part I (1/2)
macleani Shasky & Campbell, 1964, *Calliostoma*, Part I (1/1)
rubra Pease, 1860, *Alcyna*, Part I (1/2)
zebrina Powell, 1946, *Zediloma* (*Fractarmilla*) *corrosa*, Part I (2/6)

Turbinellidae

aurora Bayer, 1971, *Columbarium* (*Peristarium*), Part I (1/1)
ecphoroides Harasewych, 1983, *Fulgurofusus* (*Fulgurofusus*), Part I (1/1)
electra Bayer, 1971, *Columbarium* (*Peristarium*), Part I (1/1)
gracilior Rehder, 1967, *Benthovoluta*, Part I (1/1)
harrisae Harasewych, 1983, *Columbarium*, Part I (1/1)
merope Bayer, 1971, *Columbarium* (*Peristarium*), Part I (1/1)
timor Harasewych, 1983, *Fulgurofusus* (*Peristarium*), Part I (1/1)
wormaldi Powell, 1971, *Columbarium* (*Coluzea*), Part I (1/1)
xenismatis Harasewych, 1983, *Fulgurofusus* (*Histricosceptrum*), Part I (1/1)

Turbinidae

kurzi Petuch, 1979, *Guildfordia*, Part I (*2/5)

Turridae

barbarae Lyons, 1972, *Brachycythara*, Part I (2/2)
brasiliana Tippett, 1983, *Borsonia*, Part I (1/2)
girardi Lyons, 1972, *Cerodrillia*, Part I (1/1)
kingae Powell, 1964, *Xenoturris*, Part I (1/2)
mcgintyi Schwengel, 1943, *Eubela*, Part I (1/1)
petiti Tippett, 1995, *Fenimorea* (1/1)
queenslandica Powell, 1969, *Leucosyrinx*, Part I (1/2)
salisburyi Cernohorsky, 1978, *Mitrolumna*, Part I (1/1)
stegeri McGinty, 1955, *Daphnella*, Part I (1/1)

weaveri Powell, 1967, *Turridrupa*, Part I (1/1)
wolfei Tippett, 1995, *Drillia* (1/1)

Turritellidae

ahiparana Powell, 1927, *Turritella* (*Zeacolpus*), Part I (1/6)

Vitrinellidae

elegans Olsson & McGinty, 1958, *Vitrinella* (*Striovitrinella*), Part I (1/1)

Volutidae

barnardi Rehder, 1969, *Fusivoluta*, Part I (*2/2)
boswellae Rehder, 1969, *Volutocorbis*, Part I (*1/1)
clarkei Rehder, 1969, *Fusivoluta*, Part I (*3/4)
cloveriana Weaver, 1963, *Lyria*, Part I (1/1)
daisyae Weaver, 1967, *Volutoconus hargreavesi*, Part I (*3/3)
dampieria Weaver, 1960, *Amoria* (*Amoria*), Part I (1/1)
disparilis Rehder, 1969, *Volutocorbis*, Part I (1/3)
duponti Weaver, 1968, *Festilyria*, Part I (*1/1)
germonae Harasewych, 1987, *Tractolira*, Part I (1/2)
kellneri Iredale, 1957, *Aulica*, Part I (1/1)
perplicata Hedley, 1902, *Voluta*, Part I (1/1)
randalli Stokes, 1961, *Cymbiola*, Part I (1/1)
riosi Clench & Turner, 1964, *Adelomelon* (*Weaveria*), Part I (1/1)
smithi Bartsch, 1942, *Prodallia*, Part I (1/1)
vernicosum Dall, 1889, *Mangilia* (*Calliotectum*), Part I (1/1)

Volutomitridae

cuvierensis Finlay, 1930, *Microvoluta*, Part I (1/1)

GASTROPODA: HETEROBRANCHIA: HETEROSTROPHA:

Pyramidellidae

weberi Morrison, 1965, *Odostomia* (1/2)

GASTROPODA: HETEROBRANCHIA: OPISTHOBRANCHIA:

Acteonidae

eloiseae Abbott, 1973, *Acteon*, Part I (*2/3)

Aplustridae

tenerum Powell, 1951, *Parvaplustrum*, Part I (1/6)

Diaphanidae

mauganuica Powell, 1952, *Austrodiaphana*, Part I (3/38)

Hydatinidae - see Aplustridae

Platydorididae

carolynae Mulliner & Sphon, 1974, *Platydoris* (1/1)

BIVALVIA:

Cardiidae
- *thaanumi* Pilsbry, 1921, *Cardium* (1/1)

Carditidae
- *micella* Olsson & McGinty, 1958, *Pleuromeris* (1/4)

Corbiculidae
- *angasi* Prime, 1864, *Corbicula* (1/1)
- *awajiensis* Pilsbry, 1901, *Corbicula* (1/1)
- *Reiniana* Clessin in Küster, 1878, *Corbicula* (1/2)
- *sadoensis* Pilsbry, 1901, *Corbicula* (1/1)
- *viola* Pilsbry, 1907, *Corbicula* (1/1)

Corbulidae
- *Krebsiana* Adams, 1852, *Corbula* (1/1)
- *Swiftiana* Adams, 1852, *Corbula* (1/1)

Crassatellidae
- *ecuadoriana* Olsson, 1961, *Crassinella* (1/1)

Cyrenoididae
- *panamensis* Pilsbry & Zetek, 1931, *Cyrenoida* (1/1)

Donacidae
- *congo* Pilsbry & Bequaert, 1927, *Iphigenia* (1/2)
- *nux* Pilsbry & Bequaert, 1927, *Egeria* (1/1)

Galeommatidae
- *troglodytes* Mikkelsen & Bieler, 1989, *Divariscintilla* (1/3)
- *yoyo* Mikkelsen & Bieler, 1989, *Divariscintilla* (1/2)

Kelliidae
- *hawaiensis* Pilsbry, 1921, *Solecardia* (1/1)

Limopsidae
- *diegensis* Dall, 1908, *Limopsis* (2/7)

Mactridae
- *pontchartrainensis* Morrison, 1965, *Mulinia* (1/6)
- *yokohamensis* Pilsbry, 1895, *Raeta* (1/1)

Mytilidae
- *bryanae* Pilsbry, 1921, *Congeria* (1/4)
- *nonuranus* Pilsbry & Olsson, 1935, *Modiolus* (*Modiolus*) (1/1)

Nuculanidae
- *acapulcensis* Pilsbry & Lowe, 1932, *Leda* (*Saccella*) (1/1)
- *exoptata* Pilsbry & Lowe, 1932, *Leda* (*Adrana*) (1/1)
- *impar* Pilsbry & Lowe, 1932, *Leda* (1/1)
- *redondoensis* Burch, 1944, *Nuculana* (1/2)
- *vulgaris* Brown & Pilsbry, 1913, *Leda* (1/232)

Nuculidae
- *calcicola* Moore, 1977, *Nucula* (1/7)

- *cynthiae* Moore, 1977, *Condylonucula* (1/2)
- *maya* Moore, 1977, *Condylonucula* (1/4)

Pandoridae

- *rhypis* Pilsbry & Lowe, 1932, *Pandora* (*Kennerlia*) (1/1)

Pectinidae

- *cranmerorum* Waller, 1986, *Somalipecten* (1/1)
- *sablensis* Clark, 1965, *Aequipecten* (*Plagioctenium*) *irradians* (1/1)

Semelidae

- *Uruguayensis* Pilsbry, 1897, *Semele* (*Abra* ?) (1/2)

Sphaeriidae

- *lermondi* Sterki, 1913, *Pisidium* (2/167)
- *mediafricana* Pilsbry & Bequaert, 1927, *Eupera* (1/1)
- *patagonicum* Pilsbry, 1911, *Pisidium* (1/5)
- *Sterkianum* Pilsbry, 1897, *Pisidium* (1/2)

Tellinidae

- *gabbi* Olsson & McGinty, 1958, *Strigilla* (1/1)
- *inflatula* Dall, 1897, *Macoma* (1/4)
- *pacis* Pilsbry & Lowe, 1932, *Macoma* (1/1)

Tindariidae

- *brunnea* Dall, 1916, *Tindaria* (2/5)

Thraciidae

- *diegensis* Dall, 1915, *Thracia* (1/1)
- *Rushii* Pilsbry, 1897, *Thracia* (1/1)

Thyasiridae

- *redondoensis* Burch, 1941, *Aligena* (1/1)

Unionidae

- *webbianus* Wright, 1934, *Unio* (*Elliptio*) (1/1)

Veneridae

- *gerrardi* Abbott, 1958, *Transenella* (1/2)
- *mulawana* Biggs, 1969, *Tivela* (1/4)
- *omissa* Pilsbry & Lowe, 1932, *Macrocallista* (*Chionella*) (1/1)
- *penistoni* Heilprin, 1889, *Cytherea* (1/2)
- *platyptycha* Pilsbry, 1901, *Tapes* (1/1)
- *sororcula* Pilsbry & Lowe, 1932, *Transenella* (1/1)
- *sulfurea* Pilsbry, 1904, *Pitar* (1/1)

Sareptidae

- *ensifera* Dall, 1897, *Yoldia* (2/3)
- *montereyensis* Dall, 1893, *Yoldia* (1/2)

SCAPHOPODA:

Gadilidae

- *teliger* Finlay, 1927, *Cadulus* (1/1)

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THREE NEW CHITONS OF THE GENUS *LEPIDOZONA* PILSBRY, 1892 (POLYPLACOPHORA: ISCHNOCHITONIDAE) FROM THE ALEUTIAN ISLANDS

Roger N. Clark*

ABSTRACT. The genus *Lepidozona* Pilsbry, 1892 in Aleutian waters is discussed. In addition to the three species already recorded from the area, *L. trifida* (Carpenter, 1864), *L. ima* Sirenko, 1975, and *L. allyni* (Ferreira, 1977), three new species, *L. baxteri*, *L. beringiana* and *L. attuensis* are described, and the range of one additional species, *L. abyssicola* (Smith & Cowan, 1966) is extended west into the region. The new species are compared to known members of the genus from the Aleutians, as well as to *L. lindbergi* (Yakovleva, 1952) from the Russian, Kurile Islands.

Key words: Chiton, Ischnochitonidae, *Lepidozona*, Aleutian Islands.

INTRODUCTION

The genus *Lepidozona* Pilsbry, 1892 has a worldwide distribution, and contains more than 50 known species. Kaas and Van Belle (1987) reviewed the genus globally, and divided its members into two subgenera based on the number of slits in the intermediate valves. The members of the subgenus *Lepidozona* (*sensu stricto*) have a single slit per side. Members of the subgenus *Tripoplax* Berry, 1919 have two or more slits per side. In their review, Kaas and Van Belle recorded five species from Alaska, including two, *L. (T.) allyni* and *L. (T.) ima* from the Aleutians.

The distributions of Alaskan taxa, particularly those of the Aleutian Islands, have remained poorly defined. Berry (1917) first recorded three species of

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Lepidozona (as a subgenus of *Ischnochiton* Gray, 1847) in Alaskan waters, but placed two other species in the genera *Ischnochiton* Gray, 1847 and *Ischnoradsia* Shuttleworth, 1853 (again as subgenera of *Ischnochiton*). Smith and Cowan (1966) described *Ischnochiton abyssicola* from the Gulf of Alaska and remarked on its affinities with *Ischnochiton trifidus*, suggesting that both species should perhaps be placed in the subgenus *Tripoplax*. Ferreira (1977) described *Ischnochiton allyni* from Amchitka Id. in the Aleutians and suggested that his new species might be a member of *Lepidozona*, or perhaps *Gurjanovillia* Yakovleva, 1952 (now recognized as a synonym of *Tripoplax*). Baxter (1987) recorded only *L. allyni* (as *Gurjanovillia*) from the Aleutians, but used *Lepidozona, Tripoplax, Ischnochiton,* and *Stenosemus* Middendorff, 1847 for other taxa presently assigned to this genus. Sirenko (1975) described *L. ima* from the vicinity of the Commander Is., west of the Aleutians. Clark (1991) reported *L. scabricostata* (Carpenter, 1864) from the Gulf of Alaska, and *L. ima* and *L. trifida* from the Aleutians.

Presently seven species of *Lepidozona* are known from the Aleutian Islands, all of them members of *Tripoplax*: *L. (Tripoplax) abyssicola* (Smith & Cowan, 1966), *L. (T.) allyni* (Ferreira, 1977), *L. (T.) ima* Sirenko, 1975, *L. (T.) trifida* (Carpenter, 1864), *L. (T.) beringiana* new species, *L. (T.) baxteri* new species, and *L. (T.) attuensis* new species.

MATERIALS AND METHODS

Chitons were collected intertidally by hand and to a depth of 18 m by SCUBA. Deep-water specimens (85-350 m) were collected during National Marine Fisheries Service triennial Aleutian Islands Trawl Surveys (1994 & 1997) carried out by the chartered fishing Vessels F/V Vesteraalen and F/V Dominator. Collections were made by otter trawl and by small dredges consisting of a heavy mesh bag (open at the tail end), with a small (12.5 mm) mesh liner, tied at the tail end and held open by a heavy chain at the mouth hung from the foot rope of the otter trawl, just behind the 35 cm “roller gear” (rock rollers).

National Marine Fisheries Service data are recorded in the material sections by a series of numbers: vessel number, cruise number, and haul number. For example 23-971-199 would be 23, F/V Dominator, Cruise 971 (1997-1) (some vessels do more than one cruise per year), Haul (or trawl) number 199. Vessel number 23 is the F/V Dominator, vessel 94 is the F/V Vesteraalen, and vessel 57 is the F/V Morning Star. Additional survey data are available upon request to Dr. Gary Stauffer, division director, Resource Assessment and Conservation Engineering Division, National Marine Fisheries Service, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Bin C-15700, Bldg. 4, Seattle, Washington 98115, U.S.A.

The specimens were relaxed in cool seawater, tied flat and preserved in 75% ethanol. The valves of disarticulated specimens were cleaned in household bleach, rinsed in distilled water and dried. Radulae and girdle fragments were mounted on scanning electron microscope (SEM) stubs, sputter coated with gold-palladium for 2 minutes and examined at 10 kv, with a Hitachi S-2100 scanning electron microscope at the Department of Biology at Southern Oregon University.

Abbreviations used in the text are: CAS, California Academy of Sciences; DMNH, Delaware Museum of Natural History; LACM, Los Angeles County Museum of Natural History; NMFS, National Marine Fisheries Service; NMFS-AB, Auke Bay Laboratory; OS&S, Of Sea and Shore Museum; RMNH, National Museum of Natural History, Leiden; RNC, the author's collection; SBMNH, Santa Barbara Museum of Natural History; SOU, Southern Oregon University; UAF, University of Alaska, Fairbanks; USNM, United States National Museum (Smithsonian); and ZISP, Zoological Institute, Saint Petersburg.

SYSTEMATICS

Class: POLYPLACOPHORA Gray, 1821
Family: ISCHNOCHITONIDAE Dall, 1889
Genus: *Lepidozona* Pilsbry, 1892

Chitons of small to medium size (10-60 mm), terminal valves and lateral areas of intermediate valves with radial ribs or rows of pustules; central areas of valves with longitudinal ribs, often crossed by similar but smaller riblets forming a lattice; interior of valves (articulamentum) with sutural plate, separated (often obscurely) from the sutural laminae by small notches or slits; insertion plate slit formula is many/one or more/many; dorsal surface of girdle with convex, usually ribbed or striated scales, often with a nipple-like process at the apices.

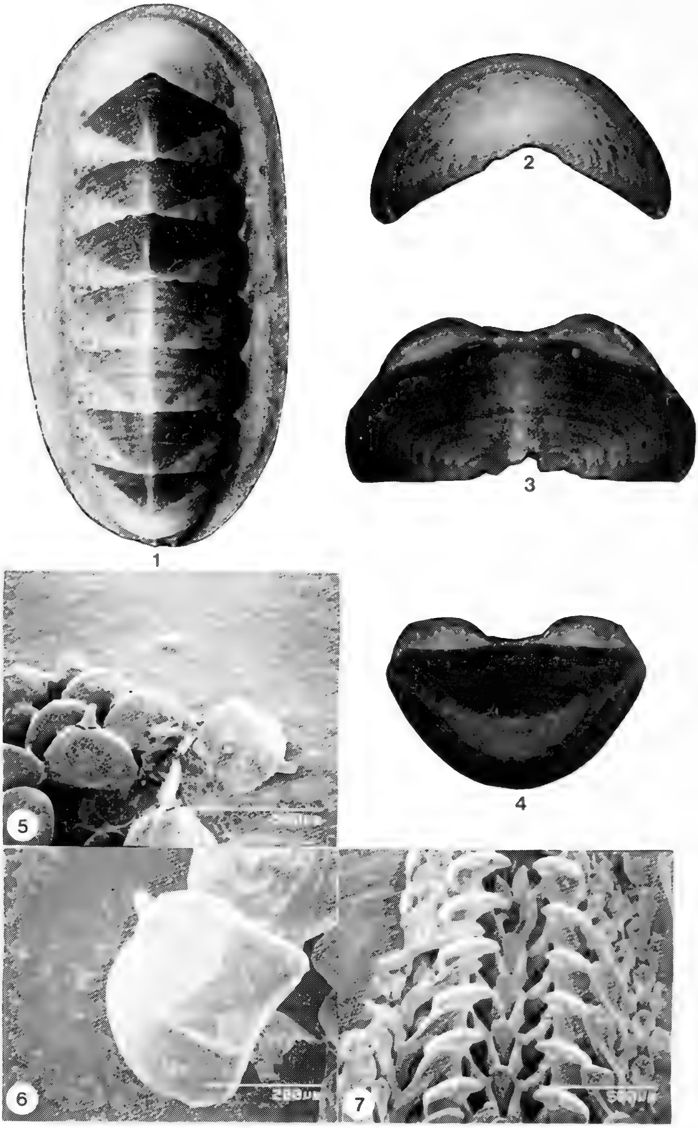
Aleutian Islands species: *Lepidozona (Tripoplax) trifida, L. (T.) abyssicola, L. (T.) ima, L. (T.) allyni, L. (T.) beringiana* n. sp., *L. (T.) baxteri* n. sp., *L. (T.) attuensis* n. sp.

Lepidozona (Tripoplax) beringiana **new species**

(Figures 1-7)

Lepidozona (Tripoplax) ima Sirenko; Clark, 1991: 93 (in part) non *L. ima* Sirenko, 1975.

Diagnosis: Chitons of medium size (to 4.5 cm), oval to elongate-oval in outline, Tegmentum brick red, often with paler terminal and lateral areas, and darker specks. Girdle with small (275 µm x 225 µm) scales, slightly bent and striated along the upper half, topped with a long mammillation about 35 µm in length.



Figures 1-7. *Lepidozona (Tripoplax) beringiana* new species. **1.** Whole animal, paratype, RNC 2993; 30.0 mm x 14.5 mm. **2-4.** Paratype, RNC 3010. **2.** Head valve, width 10.2 mm. **3.** Intermediate valve five, width 12.0 mm. **4.** Tail valve, width 9.0 mm. **5-7.** Holotype, LACM 2798. **5,6.** Dorsal girdle scales. **7.** Radula.

Description: Body (Fig. 1) oval in outline, valves microgranular, carinated, unbeaked, side slopes slightly convex; tegmentum brick red often with darker specks, terminal and lateral areas often paler; girdle light brown to reddish.

Head valve (Fig. 2) semicircular and bearing about 40 low, faint, rounded radial ribs capped by a row of very minute (0.1 mm in diameter), low, rounded granules (often obsolete), especially on older portion of shell; posterior margin widely V-shaped; insertion plate with 15-17 slits.

Intermediate valves (Fig. 3) oblong in outline, central areas with very fine pitting; lateral areas well-defined, slightly raised, cut by two or three shallow sulci into three or four low, rounded (often bifurcated) ribs frequently bearing a few very minute granules like those on the head valve; insertion plates with 2-4 slits.

Tail valve (Fig. 4) semicircular, slightly elongated posteriorly; mucro central, post-mucronal slope straight to slightly concave; insertion plate with 15 slits.

Interior of valves (articulamentum) white; sutural laminae short, slightly rounded, connected across the jugal sinus by a narrow, concave jugal plate notched at the sides; insertion teeth short and sharp, those on the head valve smooth, those on the tail valve slightly rugose.

Girdle about 1/4 as wide as fifth valve at intermediate valves, much narrower at ends; dorsal side covered with overlapping scales (Figs. 5 & 6) slightly longer than wide, up to about 275 µm x 225 µm, with about 18 striations along the upper half and capped by a long nipple about 35 µm in length; ventral surface covered by radiating rows of elongated, rectangular, transparent scales of about 100 x 20 µm; margin of girdle with long, slender spicules up to 500 µm long.

Radula (fig. 7, holotype) 8 mm in length and bearing about 30 mature rows of teeth; rachidian tooth spatulate, distally dilated, distal edge about 90 µm wide; blade of major lateral teeth relatively large and heavy, bicuspid, the inner denticle much longer than the outer one.

Gills holobranchial, adanal, 30 per side.

Type locality: South of Semisopochnoi Island, Rat Islands, Aleutian Islands, Alaska (51°53.34'N, 179°45.58'E), 121 m.

Material examined: Type material: Holotype, LACM 2798 (leg. Rae Baxter, 7 September 1986); twenty paratypes: 1, LACM 2799 (disarticulated valves only), from type locality; 1, LACM 2800, W of Amatignak Island, Andreanof Islands, Aleutians (51°14.46'N, 179°11.84'W), 241 m (leg. Rae Baxter, 17 August 1986); 1, ZIAS 2149, W of Kiska Island, Rat Islands, Aleutians (52°04.29'N, 177°15.33'E), 91 m (leg. RNC, 31 July 1997) (NMFS 23-971-199); 1 USNM 880313, (also from W of Kiska); 1, CAS 120751, S of Tanaga Island, Andreanof Islands, Aleutians (51°44.50'N, 178°07.68'W), 95 m (leg. RNC, 15 July 1997) (NMFS 23-971-137); 1, DMNH 210608, Petrel Bank (near type locality) (52°19.18'N, 179°50.08'E), 116 m (leg. RNC, 21 July 1997) (NMFS 23-971-162);

1, SBMNH 345415, S of Tanaga (as above) (NMFS 23-971-137); 1, RNC 1216, Petrel Bank, N of Semisopochnoi Island, Rat Islands, Aleutian Islands, Alaska (52°10.60'N, 179°43.77'E), 92 m (leg. RNC, 10 July 1994) (NMFS 94-941-151); 4, RNC 2992, S of Tanaga (as above) (NMFS 23-971-137); 2, RNC 3010, Petrel Bank (near type locality) (52°19.18'N, 179°50.08'E), 116 m (leg. RNC, 21 July 1997) (NMFS 23-971-162); 3, RNC 3016, W of Kiska Island, Rat Islands, Aleutians (52°04.29'N, 177°15.33'E), 91 m (leg. RNC, 31 July 1997) (NMFS 23-971-199).

Additional material: 2, RNC 2993, S of Tanaga Island, Andreanof Islands, Aleutians (51°46.69'N, 178°10.59'W), 89 m (leg. RNC, 17 July 1997) (NMFS 23-971-141); 1, RNC 2994, SSW of Tanaga Island, Andreanof Islands, Aleutians (51°43.17'N, 178°17.23'W), 215 m (leg. RNC, 17 July 1997) (NMFS 23-971-142); 1, RNC 3005, SE of Kiska Island, Rat Islands, Aleutians (51°53.86'N, 178°20.82'E) 143 m (leg. RNC, 28 July 1997) (NMFS 23-971-185); 1, RNC 3006, E of Kiska Island, Rat Islands, Aleutians (52°03.44'N, 178° 18.62'E), 352 m (leg. RNC, 29 July 1997) (NMFS 23-971-187); 1, RNC 3021, W of Buldir Island, Aleutians (52°19.77'N, 175°48.56'E), 226 m (leg. RNC, 9 August 1997) (NMFS 23-971-241).

Distribution: Endemic to the central Aleutian Islands, Alaska [178°W (near Tanaga Island) to 175°E (W of Buldir Island)] (Fig. 30).

Habitat: Lives at 85-352 m on cobbles, bivalve shells (*Chlamys* sp.) and bryozoans.

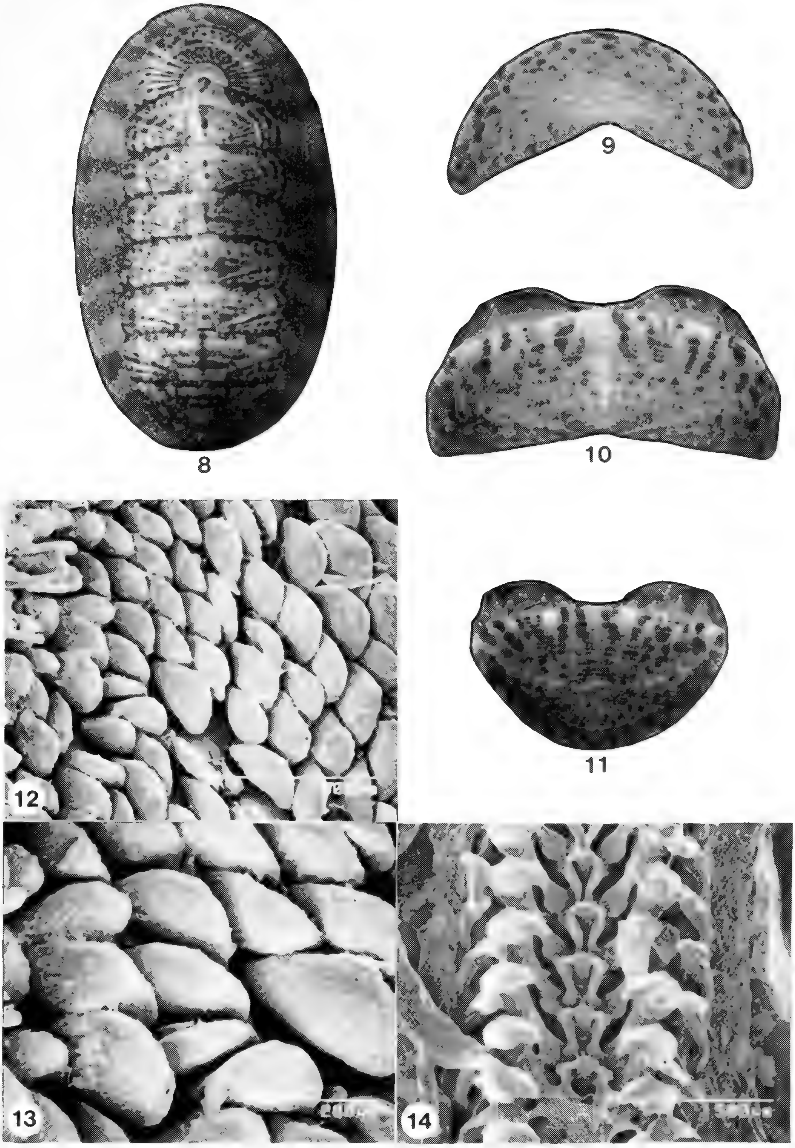
Remarks: This species was originally thought to be *Lepidozona (Tripoplax) ima* (Clark, 1991: 93). Close examination revealed it instead to be distinct, and morphologically more similar to *L. (T.) allyni* (Figs. 25 & 26). These two species are characterized by the very long mammillation on the girdle scales. *L. (T.) beringiana* is also similar to *L. (T.) lindbergi* (Yakovleva, 1952) of the Kurile Is. (Fig. 27), but may be distinguished by the fine pitting of the central areas and the differently proportioned girdle scales.

Lepidozona (Tripoplax) baxteri new species

(Figs. 8-14)

Diagnosis: Chitons of medium size (to 3.5 cm), oval to elongate-oval in outline, valves whitish or tan with speckles or concentric rings of reddish-brown or (rarely) pink. Girdle with small (325 µm x 250 µm) scales bearing 22-25 striations, with slight, if any mammillation.

Description: Body (Fig. 8) (holotype) oval in outline; valves microgranular, carinated, unbeaked (juveniles may be slightly beaked), side slopes convex; tegmentum whitish to tan or light brown, with dark brown, reddish-brown or



Figures 8-14. *Lepidozona (Tripoplax) baxteri* new species. **8.** Whole animal, holotype, LACM 2796; 27.5 mm x 16.0 mm. **9-11.** Paratype, LACM 2797. **9.** Head valve, width 9.0 mm. **10.** Intermediate valve five, width 10.5 mm. **11.** Tail valve, width 7.6 mm. **12-14.** Paratype, RNC1230. **12, 13.** Dorsal girdle scales. **14.** Radula, RNC 1230 (25 mm specimen).

(rarely) pink-lavender speckles and/or concentric rings; girdle unicolored whitish to light brown, or with alternating bars of reddish-brown and tan.

Head valve (Fig. 9) semicircular, bearing 21-27 low, faint ribs capped by an often incomplete or obsolete row of minute (about 80-100 µm in diameter), widely-spaced granules, three to eight in a series; interstices are granular, posterior margin widely V-shaped; insertion plate with 15 slits.

Intermediate valves (Fig. 10) oblong in outline, central areas with fine pitting, lateral areas with three or four radiating, sub-triangular ribs capped by an often incomplete or obsolete row of minute granules of the same nature and number as those on the head valve; insertion plates with 2 slits.

Tail valve (Fig. 11) semicircular; mucro post-central, post-mucronal area flattened and bearing about 18 faint or obsolete radiating ribs of the same nature as those on the head and lateral areas; insertion plate with 15 slits (teeth prone to splitting).

Interior of valves (articulamentum) white, translucent; sutural laminae short, thin, sharp, connected across the jugal sinus by a narrow, concave jugal plate, slightly notched at the sides in juveniles, but not in adults; insertion teeth short, solid, smooth; those of head valve blunt, rugose on the anterior side, those of the tail valve still rather blunt, but somewhat sharper.

Girdle nearly one half as wide as fifth valve at sides, much narrower at ends; dorsal side covered with overlapping, bent, near-pentagonal scales, wider than long (Figs. 12-13), (imperceptibly mammillated) and bearing 22-25 striations, reaching about 325 µm x 250 µm; ventral surface covered with radiating rows of elongated, rectangular, transparent scales of about 100 x 20 µm; marginal spicules slender, cylindrical or nearly cylindrical to about 220 µm long.

Radula (Fig. 14) 8 mm long and bearing about 33 mature rows of teeth; rachidian tooth relatively small, oblong, about 108 µm long, working edge about 70 µm wide; blade of major lateral teeth bicuspid, the inner cusp much longer than the outer one.

Gills holobranchial, adanal, about 30 per side in specimens 24 mm or greater in length.

Range of morphological variation: In some specimens the granules on the ribs and sometimes the ribs themselves are obsolete. Although most specimens are whitish to tan with speckles and/or concentric rings of reddish-brown, in a few specimens the reddish-brown is replaced with pinkish or pale lavender; some specimens are uniform whitish.

Type locality: Eider Point, west side of entrance to Unalaska Bay, Bering Sea side of Unalaska Island, Aleutian Islands, Alaska (53°57'40"N, 166°35'30"W).

Material Examined: Type material: Holotype, LACM 2796 and 100+ paratypes (leg. RNC, 21 June 1993); other paratypes: 10, LACM 2797; 4, USNM 880161;

4, CAS 105915; 4, SBMNH 143146; 4, ZISP 1935; 3, UAF Mo-5570; 60+, RNC 1230; 1, H.L. Strack Coll.; 2, B. Dell Angelo Coll.; 4, H. Saito Coll.; 3, R.A. Van Belle Coll.; 2, D.J. Eernisse Coll.; 2, OS&S Coll.

Additional material: 2, LACM 152676; and 6, RNC 3160, Channel at south end of Amacknak Island (Dutch Harbor), Unalaska Bay, Unalaska Island, Alaska, 10-15 m.

Distribution: Known so far from only two localities within Unalaska Bay, Unalaska Island, Aleutian Islands, Alaska (Fig. 30).

Habitat: Lives at 0-15 m on cobbles encrusted with bryozoans, resting on or slightly buried in sand.

Remarks: This species somewhat resembles *Lepidozona ima* (Figs. 23-24) but may be distinguished by the unique color patterns of the valves, larger (dorsal) girdle scales, which bear many more striations (22-25 compared to 12-14 in *L. ima*), and relatively smaller (central and minor lateral) teeth of the radula.

Lepidozona (Tripoplax) attuensis new species

(Figs. 15-21)

Diagnosis: Chitons of small size (to 2.5 cm), oval in outline; valves whitish with a few faint, rusty-orange, longitudinal markings; head valve, lateral areas, and post-mucronal area of tail valve with numerous, low, rounded, radiating ribs, lacking pustules or granules. Girdle with relatively large, smooth, imperceptibly mammillated scales.

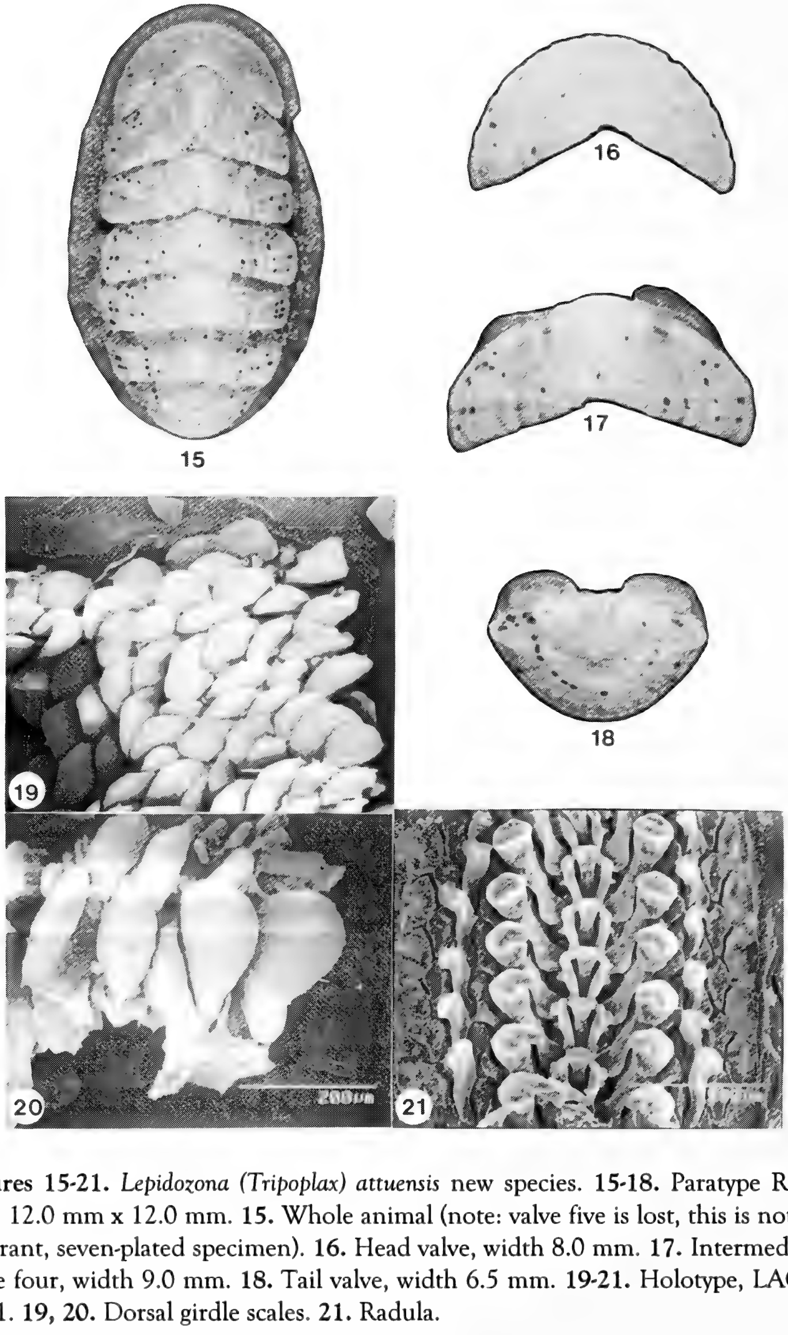
Description: Body (Fig. 15) oval in outline; valves granular, subcarinated, unbeaked, side slopes slightly convex; tegmentum whitish (holotype) or whitish with pale rust sub-jugal stripe and a few faint rust mottlings on the central areas; girdle uniformly whitish.

Head valve (Fig. 16) semicircular, posterior margin widely V-shaped; bearing 23-26 low, rounded, radiating ribs; insertion plate with 15-17 slits.

Intermediate valves (Fig. 17) oblong, central areas with fine pitting; lateral areas slightly raised, defined by three to four low, rounded ribs (nearly obsolete on some valves of the holotype) crossed by concentric growth lines; insertion plates with 2 slits.

Tail valve (Fig. 18) semicircular, mucro central, post-mucronal slope slightly convex; post-mucronal area bearing about 14 low, rounded, well spaced radiating ribs or undulations; insertion plate with 14-15 slits.

Interior of valves (articulamentum) white; sutural laminae fairly short, rounded at edges, connected across the jugal sinus by a concave jugal plate, sometimes notched at sides; insertion teeth very short and blunt, those on the head valve smooth, the ones on the tail valve rugose on the anterior side.



Figures 15-21. *Lepidozona (Tripoplax) attuensis* new species. **15-18.** Paratype RNC 317; 12.0 mm x 12.0 mm. **15.** Whole animal (note: valve five is lost, this is not an aberrant, seven-plated specimen). **16.** Head valve, width 8.0 mm. **17.** Intermediate valve four, width 9.0 mm. **18.** Tail valve, width 6.5 mm. **19-21.** Holotype, LACM 2801. **19, 20.** Dorsal girdle scales. **21.** Radula.

Girdle about 1/4 as wide as fifth valve at sides, much narrower at ends; dorsal side covered with smooth, bent, proximally rounded scales (Figs. 19 & 20), about 275 µm long and 150 µm wide; ventral surface covered with radiating, rectangular, transparent scales of about 100 x 20 µm; marginal spicules slender, bluntly pointed, about 150 µm in length.

Radula (Fig. 21) 7.8 mm long (in the 21 mm holotype) and bearing about 30 mature rows of teeth; rachidian tooth oblong, about 265 µm long, constricted in the middle to about 60 µm and broadening again at the base, working edge about 130 µm wide; blade of major lateral teeth bicuspid, the inner cusp about twice as long as the outer one.

Gills holobranchial, adanal, 26 per side in the holotype (curled length ca. 23 mm) and 25 per side in the paratype (21 mm long).

Type locality: Murder Point, Massacre Bay, Pacific side of Attu Island, Near Islands, Aleutian Islands, Alaska (52°47.6'N, 173°11.0'E).

Material Examined: Type material: Holotype, LACM 2801 and one paratype, RNC 317 (leg. David R. Lindberg, 20 July 1979; intertidal).

Distribution: Known so far only from the type material.

Remarks: This species is very similar to *Lepidozona ima* (Figs. 23-24), especially in the characters of the radula. *L. attuensis* differs from *L. ima* by the prominent radial ribs on the valves, which lack pustules, the larger, smooth, differently proportioned girdle scales, and fewer gills. Also *L. ima* is usually found much deeper (100-250 m).

DISCUSSION

The chiton fauna of the Aleutian Islands is very rich and diverse, containing 35 known species [including one as yet undescribed species (unpublished notes)]. The genus *Lepidozona* with seven species makes up 20% of this fauna. Five of these (71%) are endemic to the Aleutian faunal province. Two of these *L. (Tripoplax) attuensis* and *L. (T.) baxteri* appear to be short range endemics, restricted to a single island or island group. These species appear to be divisible into two (natural?) groups based on their dorsal girdle scales. Group one contains species with mammillated scales, *L. (T.) allyni* and *L. (T.) beringiana*. Group two contains species with non-mammillated scales, *L. (T.) abyssicola*, *L. (T.) ima*, *L. (T.) baxteri*, *L. (T.) attuensis*, and *L. (T.) trifida*.

The radula of *Lepidozona (Tripoplax) allyni* (Fig. 25) described from Amchitka Island, in the Aleutians was described and illustrated (drawn) as having unicuspid major lateral teeth. However, a study of the paratypes as well as another specimen

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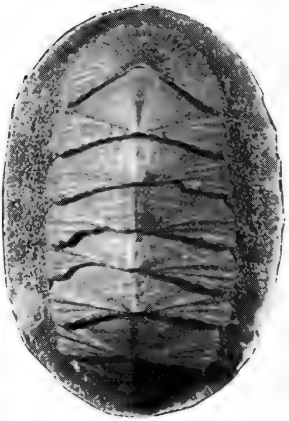

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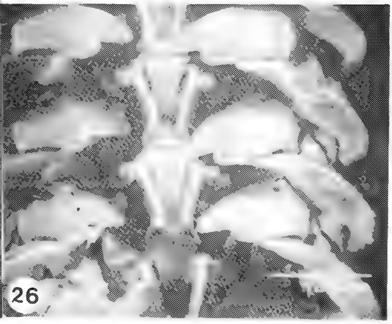

Figures 22-26. *Lepidozona* spp. **22-24** *Lepidozona (Tripoplax) ima* Sirenko, 1975. **22.** Whole animal, RNC 3172 (Stalemate Bank, W of Attu Id., 114 m); 18.5 mm x 10.5 mm. **23-24.** Specimen from near Cooper Id., Commander Is., Russia, 130-200 m; RNC 2363. **23.** Dorsal girdle scales. **24.** Radula. **25-26.** *Lepidozona (Tripoplax) allyni* (Ferreira, 1977). **25.** Whole animal. Amchitka Id., 25 m (topotype), AB 73-25. **26.** Radula. Paratype, CAS 016564.


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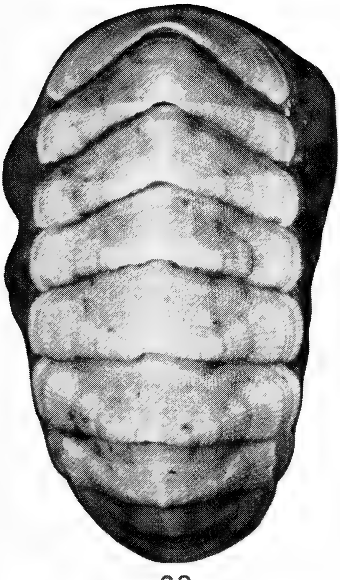
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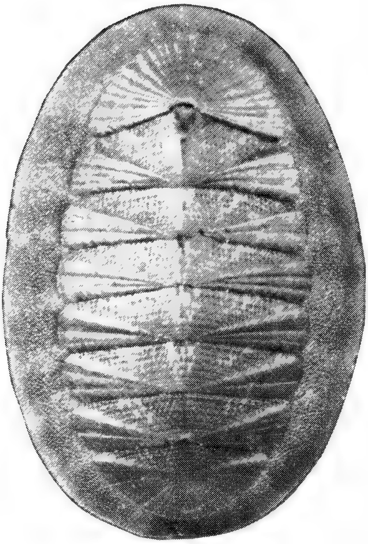
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Figures 27-29. *Lepidozona* spp. **27.** *L. (Tripoplax) lindbergi* (Yakovleva, 1952), RNC 120; whole animal, Simushir Id., Kurile Is., Russia, 50-60 m; curled, ca. 20.0 mm. **28.** *L. (T.) abyssicola* (Smith & Cowan, 1966), RNC 3106; whole animal, near Farallon Is., California, 2750 m; curled, ca. 50 mm. **29.** *L. (T.) trifida* (Carpenter, 1864); RNC 2417; whole animal, Ketchikan, Alaska, 25 m; 35 mm x 24 mm.

taken with the types (but apparently not seen by Ferreira) in the collection of the National Marine Fisheries Service, Auke Bay, Alaska Laboratory (AB 73-25) revealed that the major lateral teeth of this species are in fact bicuspid (Fig. 26). It is not known whether Ferreira erred in his description, or if the radula of the holotype was aberrant, because the slide containing the holotype's radula could

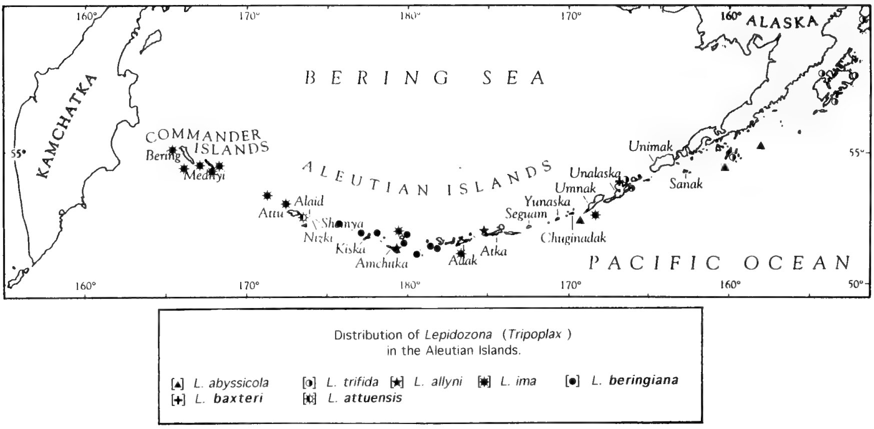

Figure 30. Map of Aleutian Islands showing distributions of *Lepidozona* species.

not be found (E. Kools, pers. comm., 18 March, 1996). However, due to the bicuspid condition of the paratypes and other material, Ferreira's description must be amended.

Three specimens of *Lepidozona (T.) allyni* were collected at a depth of 15 m off the point at the east side of the entrance to Crescent Bay, Atka Island, Aleutian Islands (52°02'15"N, 175°14'00"W), on the bottom of stones resting on sand (leg. RNC, 8 July 1997). One of these has been deposited as a voucher (LACM 152584); the remaining two were retained (RNC 3026). Additionally a single curled juvenile (length ca. 6.0 mm) taken at 18 m at Kiska Island, Aleutian Islands, was found in the collection of the United States National Museum (USNM 208587). The new records extend the known range of the species approximately 125 km to the west, and 375 km to the east.

As already discussed in the species descriptions, *Lepidozona (Tripoplax) ima* is morphologically similar to both *L. (T.) baxteri*, and *L. (T.) attuensis*, but differs in the details of the valve sculpture, girdle scales and radula. *L. (T.) ima* and its girdle scales and radula are illustrated in Figs. 22-24.

Smith & Cowan (1966: 8) described the tegmental coloration of *Lepidozona (Tripoplax) abyssicola* (Fig. 28) as dark reddish-brown. However this description is misleading, because the reddish-brown (or blackish) appearance is due to deep sea deposits present on most specimens. The tegmentum of this species is white. The range of *L. (T.) abyssicola* is here extended west into the eastern Aleutian Islands, to south of Samalga Pass (west end of Umnak Island) (52°36.2'N, 169°25.2'W) based on a single specimen (CAS 120748), trawled, F/V Morning Star, 199 m on rocks (NMFS Gulf of Alaska Trawl Survey, 57-991-3). The new record extends the known range approximately 825 km to the west.

Lepidozona (Tripoplax) trifida is also found in the (eastern) Aleutians, and although it probably would not be confused with any of the other members the genus due to the unique sculpturing of its valves [broad, flattened radial ribs (three on lateral areas) separated by distinct sulci], it is illustrated for comparison (Fig. 29).

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THE CHITON FAUNA OF THE GULF OF CALIFORNIA RHODOLITH BEDS (WITH THE DESCRIPTIONS OF FOUR NEW SPECIES)

Roger N. Clark*

ABSTRACT. The shallow water rhodolith beds of the Gulf of California have a rich and diverse fauna. However, there are no published studies the chiton fauna of this unique habitat. The present paper reports on eight species of chitons (four new to science) found living on the rhodoliths: *Stenoplax mariposa* (Bartsch MS, Dall, 1919), *Callistochiton* sp., cf. *C. elenensis* (Sowerby, 1832), *Lepidochitona beanii* Carpenter, 1857, *Acanthochitona avicula* (Carpenter, 1864), *Lepidochitona corteziana* new species, *Ischnochiton rhodolithaphilus* new species, *Ischnochiton tomhalei* new species, and *Acanthochitona burghardtae* new species.

Key words: Chiton, Gulf of California, rhodoliths.

INTRODUCTION

Rhodoliths are free-living, often branched, nongeniculate coralline red algae found in dense concentrations (or beds) worldwide, from the low intertidal zone to over 100 m depth (Bosence, 1983). Extensive shallow water (2-12 m) rhodolith beds of the southwestern Gulf of California were discussed by Bosence (1983) and their ecological parameters defined. Steller & Foster (1995) and Foster *et al.* (1997) further documented the rich biodiversity associated with these specialized habitats.

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In April of 1995, Mr. Barry F. Putman of Cuesta College in San Luis Obispo, California sent me his rough manuscript, which described an apparently new species of chiton from rhodolith beds at Isla El Requeson, Bahia Conception, Baja California Sur. Mr. Putman requested that I re-write the manuscript, and submit it for publication. He also put me in contact with Dr. Michael S. Foster of Moss Landing Marine Laboratories (California). Dr. Foster provided 30+ additional chiton specimens collected at various localities between Punta Bajo and La Paz, from November 1994 to April 1995 by Mr. Marco Medina-Lopez, a student at Universidad Autonoma de Baja California Sur (La Paz). All specimens were among the often closely spaced branches of individual rhodoliths as part of their diverse cryptofauna. This paper reports the study of these specimens, as well as three additional specimens collected at Punta Chivato in March of 1998, and received subsequently from Dr. Foster. The map in figure 26 shows the collection sites.

MATERIALS AND METHODS

Numerous very small chitons (2-10 mm) were collected from rhodoliths taken with SCUBA at depths of 4-12 m at several locations along the SE shore of Baja California Sur, and preserved in 70% ethanol. The specimens were studied using a light and a scanning electron microscope (SEM), and their characters compared with species known to occur in the region (Skoglund, 1997; Kaas and Van Belle, 1985, 1990, 1994).

Specimens were prepared for SEM examination by boiling whole in 10% KOH and separating out the radula, valves, and epidermal layers of the girdle. The valves were air dried, and the radula and girdle fragments were dehydrated in an acetone series, rinsed, dried and mounted on SEM viewing stubs. The specimens were then sputter coated for 2 minutes with gold-palladium and examined with at 10-15 kv with a Hitachi 2100 S SEM at the Department of Biology at Southern Oregon University, Ashland, Oregon.

Whole animals were photographed using a Nikon SLR camera with macro lens and bellows attachment.

Abbreviations used in the text are LACM, Los Angeles County Museum of Natural History; CAS, California Academy of Sciences; SBMNH, Santa Barbara Museum of Natural History; RNC, Private collection of the author.

RESULTS

Eight species of chitons were identified, representing four families and four genera, including four species new to science. The species are described and illustrated herein, and are compared to similar species that co-occur in the Gulf of California region.

SYSTEMATICS

The systematic arrangement in this paper follows the recent system of revisions proposed by Sirenko (1993,1997).

- Class: POLYPLACOPHORA Gray, 1821
  - Order: CHITONIDA Theile, 1910
    - Suborder: CHITONINA Theile, 1910
      - Superfamily: CHITONOIDEA Rafinesque, 1815
        - Family: ISCHNOCHITONIDAE Dall, 1889
          - Genus: *Ischnochiton* Gray, 1847
            - *I. rhodolithophilus* new species
            - *I. tomhalei* new species
          - Genus: *Stenoplax* Carpenter in Dall, 1879
            - *S. mariposa* (Bartsch MS, Dall, 1919)
        - Family: CALLISTOPLACIDAE Pilsbry, 1892
          - Genus: *Callistochiton* Carpenter in Dall, 1879
            - *C.* sp. cf. *elenensis* (Sowerby, 1832)
    - Suborder: ACANTHOCHITONINA Bergenhayn, 1930
      - Superfamily: MOPALIOIDEA Dall, 1889
        - Family: TONICELLIDAE Simroth, 1894
          - Genus: *Lepidochitona* Gray, 1841
            - *L. beanii* Carpenter, 1857
            - *L. corteziana* new species
      - Superfamily: CRYPTOPLACOIDEA H. & A. Adams, 1858
        - Family: ACANTHOCHITONIDAE Pilsbry, 1893
          - Genus: *Acanthochitona* Gray, 1821
            - *A. avicula* (Carpenter, 1864)
            - *A. burghardtae* new species

Stenoplax mariposa (Bartsch MS, Dall, 1919)
(Figs. 1 & 2)

Three specimens (2.8-10 mm in length) (RNC 3130) of this common Gulf species were taken at El Pardito (leg. Marco Medina-Lopez, SCUBA,12 m, 7 April, 1995). All specimens appear typical, and although the tiny juveniles are nearly identical in color pattern (variegated with brown, black, pale green and white, with brilliant blue spots on the pleural areas) with *Ischnochiton rhodolithophilus*,

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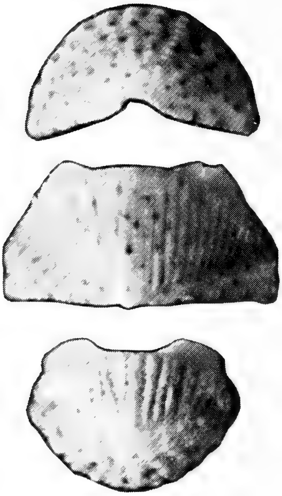

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Figures 1-5. Chiton species. 1-2. *Stenoplax mariposa* (Barstch MS, Dall, 1919), RNC 3130. **1.** Whole animal, length 4.2 mm. El Pardito. **2.** Valve fragment from 10 mm specimen. El Pardito. **3.** *Callistochiton* sp., cf. *C. elenensis* (Sowerby, 1832), RNC 3131. First, fourth and eighth valves. Valve eight width 3.8 mm. Canal de San Lorenzo. **4.** *Lepidochitona beanii* Carpenter, 1857, RNC 3132. Whole animal, length 3.0 mm. Canal de San Lorenzo. **5.** *Acanthochitona avicula* (Carpenter, 1864), RNC 3133. Whole animal, length 7.0 mm. Coronados Id.

they are easily distinguished by the ribbed central areas, and rugose lateral areas of the valves.

Ischnochiton rhodolithophilus Putman MS, Clark, new species
(Figs. 6-10)

Diagnosis: Very small chitons (to 6.0 mm), elongate-oval in outline, elevated; valves roundly arched, moderately beaked; tegmentum mostly smooth, but with some quincuntial pitting on pleural areas, color variegated, dark-brown and cream with blue spots on terminal and pleural areas; sutural laminae short, bluntly triangular; girdle medium wide, with short, wide scales (to 100 µm x 60 µm) with 12-18 deep incisions on middle 1/3; radula with heavy, tricuspid major lateral teeth.

Description: Very small chitons (to 6.0 mm), elongate-oval in outline, moderately elevated; valves roundly arched, moderately beaked (Fig. 6); tegmentum mostly smooth, with some pitting (Fig. 7); articulamentum thin, white, slit formula 8-1-8; color, variegated with dark brown and cream, terminal valves and pleural areas of intermediate valves with brilliant blue spots.

Head valve semicircular, slightly convex, posterior margin widely v-shaped; insertion teeth short, sharp, fairly thick; intermediate valves rectangular, about 1/3 as long as wide; weakly beaked, slightly indented at jugal sinus; lateral areas poorly defined, slightly if at all raised, smooth; jugum smooth, pleural areas quincuntially punctate (to varying degrees, depending on size of specimen) especially on the lower portions; sutural laminae fairly long, narrow, bluntly triangular; jugal sinus very wide; insertion teeth short, thin, sharp; slit ray grooved, porous. Tail valve about 3/4 the width of the head valve, anterior margin slightly convex; mucro central, post-mucronal slope concave; ante-mucronal area quincuntially punctate, terminal area smooth; sutural laminae fairly long, rounded; jugal sinus moderately wide; insertion teeth short, relatively thick, sharp.

Girdle moderately wide, about 1/4 as wide as valve 5, clothed dorsally with relatively wide, bluntly rounded, bent scales 70-100 µm wide x 40-60 µm long, with 12-18 narrow ribs on the central 1/3, deeply incised between (Figs. 8 & 9); ventral scales rectangular, about 38 µm x 18 µm (Fig. 9); marginal spicules broad, bluntly pointed, 50 µm x 20 µm, with 5-6 oblique striations (Fig. 9).

Radula (Fig. 10, paratype 1) curled, ca. 5.0 mm long, 1.2 mm long with about 35 mature rows of teeth; central tooth very small, slender, elongated, slightly dilated distally, about 20 µm long, distal end about 5 µm wide; minor lateral teeth wing shaped, about 40 µm x 15 µm; major lateral teeth heavy, rugged, tridentate, deeply (and rather widely) indented between, about 30 µm x 25 µm; denticles very

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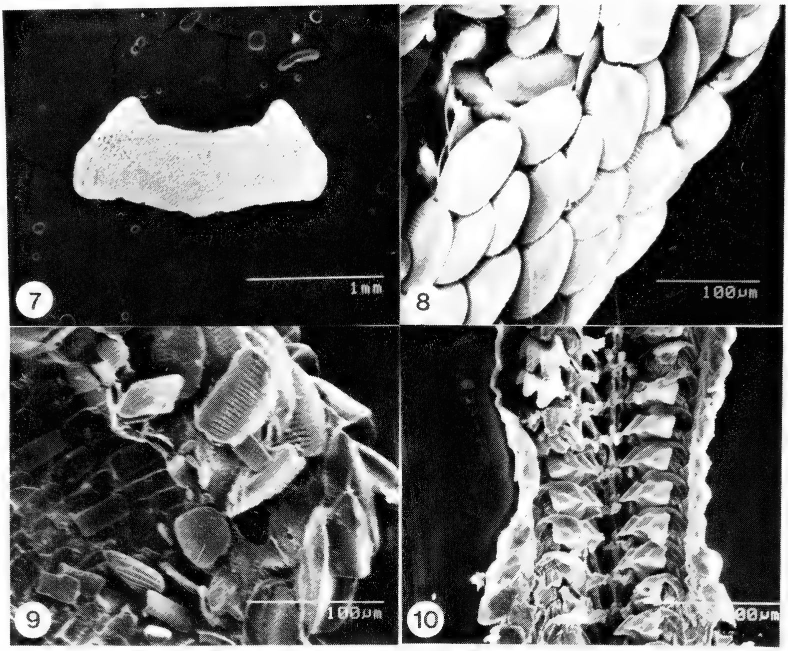


Figures 6-10. *Ischnochiton rhodolithaphilus* Clark, spec. nov. **6.** Whole animal, length 3.9 mm. Paratype, RNC 3134, Isla San Jose. **7.** Intermediate valve five (scale on figure), Paratype, CAS 098787, Bahia Concepcion. **8.** Dorsal girdle scales (scale on figure), Paratype, RNC 3138, Punta Bajo. **9.** Girdle scales (scale on figure), Paratype, RNC 3138. **10.** Radula (scale on figure), Paratype, RNC 3138.

blunt, finger-like in appearance, inner one the longest, central one slightly shorter, the outer one about 1/2 as long as the inner one.

Ctenidia about 12-15 per side in specimens 2.8-5.0 mm in length.

Type Locality: Gulf of California, Isla El Requeson, Bahia Conception, Baja California Sur, Mexico (26°43'N, 111°46'W); 4-9 m.

Type Material: Holotype (CAS 098786) and 22 Paratypes (leg. Michael S. Foster, SCUBA, January 1990) (10, CAS 098787); (10, Barry Putman, private collection); (2,RNC 3134).

Additional Material: 10 additional specimens, 3, RNC 3148, Canal de San Lorenzo, 12 m (leg. Marco Medina-Lopez, SCUBA, 2 February, 1995); 1, RNC 3149, S side of SW tip of Isla San Jose, 12 m (leg. Marco Medina Lopez, SCUBA,10 February, 1995); 4, RNC 3150, Punta Bajo, 12 m (leg. Marco Medina-Lopez, SCUBA, 11 November, 1994); 1, RNC 3151, El Pardito, N of Isla San Francisco, 12 m (leg. Marco Medina-Lopez, SCUBA, 7 April, 1995); 1, RNC 3152, N side of SW tip of Isla San Jose, 5 m (leg. Marco Medina-Lopez, SCUBA, 10 February 1995).

Distribution: Gulf of California, SE coast of Baja California Sur from the type locality, S to Canal de San Lorenzo, about 40 km N of La Paz (24°21'N, 111°15'W); 4-12 m.

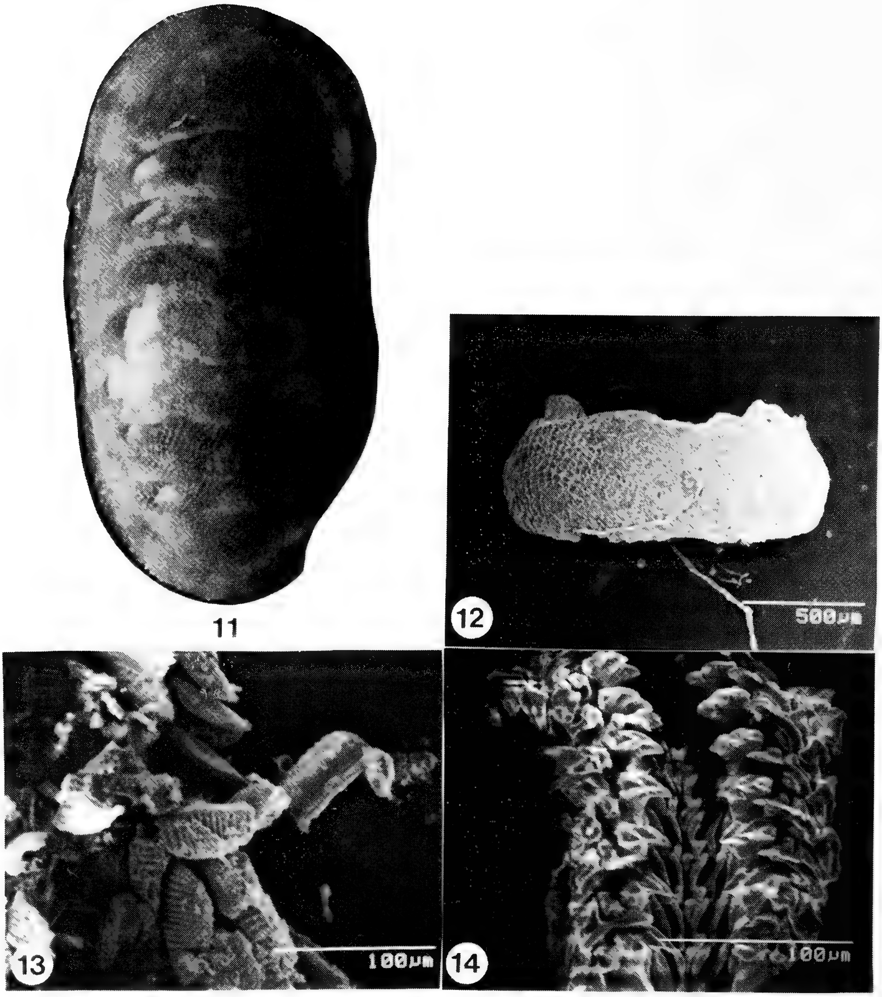
Discussion: *Ischnochiton rhodolithophilus* is very similar to *Stenoplax mariposa* (Bartsch MS, Dall, 1919), and might be mistaken for a juvenile of that species, however it may be distinguished by 1) lack of ribbing or lirae on valves; 2) less numerous, heavier ribs on the girdle scales, 12-18 instead of 45-50. Both species may be found together in the rhodolith habitat.

Etymology: The specific name is derived from the Latin rhodo (red) + the Greek lithos (stone) and philia (love); the lover of red stones (rhodoliths).

Ischnochiton tomhalei new species
(Figs. 11-14)

Diagnosis: Very small chitons (to 4.0 mm), oval in outline, valves roundly arched, not carinated, only slightly beaked; tegmentum reticula-granular; mucro of tail valve at ante-central, post-mucronal slope straight to slightly concave; girdle medium wide, about 1/3 of valve 5 width, dorsal scales with 12-16 strong ribs; radula with relatively heavy, tricuspid major lateral teeth.

Description: Very small chitons (to 4.0 mm), oval in outline, valves roundly arched, not carinated, barely if at all beaked (Fig. 11); tegmentum reticula-granular; slit formula 9-1-8; color reddish-brown to light brown or cream, with white flame-like markings, especially at the valve apices.



Figures 11-14. *Ischnochiton tomhalei* Clark, spec. nov. **11.** Whole animal, length 4.0 mm, RNC 3135, Isla San Jose. **12.** Intermediate valve five (scale on figure), Holotype, LACM 2877. **13.** Dorsal girdle scales (scale on figure), Holotype. **14.** Radula (scale on figure), Holotype.

Head valve semicircular, slightly convex, posterior margin widely v-shaped; sculpture, evenly reticula-granular; insertion teeth fairly short, wide and thick. Intermediate valves (Fig. 12) rectangular, about 1/3 as long as wide; lateral areas poorly defined, slightly raised, often with faint growth costae; central areas with reticula-granular sculpture, becoming obsolete at valve apices; articulamentum thin, white; sutural laminae rather short, narrow, rounded, jugal sinus very wide; insertion teeth short, thick, triangular. Tail valve slightly wider than long, inflated, anterior margin convex, mucro ante-central, post-mucronal slope straight to slightly concave; ante-mucronal area reticula-granular, posterior area granular; insertion teeth short, thick.

Girdle moderately wide, about 1/3 the width of valve 5, clothed dorsally with broad, short, bent scales about 60-75 µm x 32 µm, with 12-16 fairly narrow ribs, deeply incised between (Fig. 13); ventral scales very small, rectangular about 25 µm x 12 µm; marginal spicules relatively short, broad, flattened, bluntly pointed, about 40 µm x 12 µm, with three oblique striations.

Radula (Fig. 14) about 800 µm long, with 20-25 mature rows of teeth; central tooth slender, elongated about 25 µm long, distal end dilated, working edge about 4 µm wide; wing shaped, elongate about 25 µm x 10 µm; major laterals fairly heavy, tricuspid, central cusp slightly longer than lateral two; cusps rather short and broad.

Ctenidia 12-16 per side in specimens 2.8-4.0 mm in length.

Type Locality: Gulf of California, Punta Bajo (about 10 km N of Loreto), Baja California Sur, Mexico (approx. 26°05'N, 112°42'W); 12 m.

Type Material: Holotype (LACM 2877), and one paratype (RNC 3142) (leg., Marco Medina-Lopez, SCUBA, 11 November, 1994).

Additional Material: 1, RNC 3139, Punta Chivado, 10-12 m (leg. Michael S. Foster, SCUBA, 18 March, 1998); 3, RNC 3140, Canal de San Lorenzo, 12 m (leg. , Marco Medina-Lopez, 2 February, 1995); 1, RNC 3141, W side of Isla Coronados, 7 m (leg. , Marco Medina-Lopez, SCUBA, "December, 1994"); 1, RNC 3153, S side of SW tip of Isla San Jose, 12 m (leg., Marco Medina-Lopez, SCUBA, 10 February, 1995).

Distribution: Gulf of California, east coast of Baja California Sur, Mexico, from Punta Chivado (about 25 km N of Mulege)(27°05'N, 112°05'W) to Canal de San Lorenzo, about 40 km N of La Paz (24°21'N, 111°15'W); 7-12 m.

Discussion: The only eastern Pacific iscnochitonid that *Ischnochiton tomhalei* is likely to be confused with is juveniles of *I. tridentatus* Pilsbry, 1893, which (rarely) may be similarly colored. However, the coarser sculpture and fewer slits in the insertion plates (8-1-9 instead of 12-18/ 2/ 11-13 in *I. tridentatus*) will distinguish them.

Etymology: It is with great pleasure that I name this species after Mr. Thomas S. Hale of Portland, Oregon, a long time shell collector who for many years has educated and inspired a great many people in the sciences of conchology and marine biology.

Callistochiton sp. cf. *C. elenensis* (Sowerby, 1832)

(Fig. 3)

A single small (9 mm) specimen (RNC 3131) taken at Canal de San Lorenzo (leg. Marco Medina-Lopez, SCUBA, 12 m, 2 February 1995) is tentatively identified as a juvenile of this species, but may represent an undescribed species. The valves are more highly elevated and the side-slopes more convex than in specimens of *C. elenensis* that I have examined. Also I can detect no jugal laminae, another character present in (adult) *C. elenensis* , but this may be due to the size of the specimen. The valves are rust colored with dark brown specks. More material is required before a solid conclusion can be made on its identification.

The genus *Callistochiton* Carpenter, in Dall, 1879 in the tropical west-American region is in need of revision. The views of Ferreira (1979) and Kaas and Van Belle (1994) differ on several points, and there appear to be more species in the region than are currently recognized.

Lepidochitona beanii Carpenter, 1857

(Fig. 4)

Two tiny specimens (3.0 & 4.0 mm long)(RNC 3132) of this widespread species were taken at El Bajo (leg. Marco Medina-Lopez, SCUBA, 14 m, 30 March 1995). The specimens are typical in all characters, and are readily distinguished from the similar *Lepidochitona corteziana* by the presence of large (to 350 µm long) hyaline spicules on the girdle.

Lepidochitona corteziana new species

(Figs. 15-19)

Diagnosis: Very small chitons (to 3.5 mm); roundly oval in outline; tegmentum microscopically lirate; intermediate valves beaked, about 1/4 as long as wide; tail valve small, about 1/2 as long as wide, mucro prominent, at anterior 1/3, post-mucronal slope concave; girdle medium wide, fleshy, bearing no large spicules.

Description: Very small chitons (to 3.5 mm); roundly oval in outline; valves subcarinate, beaked, slopes slightly convex (Fig. 15); tegmentum very spongy; microscopically lirate, lirae low, broad, flattened and bearing a nearly imperceptible medial sulcus; slit formula 10-1-12; color light orange to pink-orange.

Head valve semicircular, convex, bearing about 80+ radial micro-lirae;

posterior margin widely v-shaped, insertion teeth fairly short, thick. Intermediate valves (Figs. 16,17) rectangular, central areas with 120 + micro-lirae; lateral areas barely defined, bearing about 20-25 micro-lirae; articulamentum (Fig. 17) thin, white; sutural laminae relatively short, narrow, roundly triangular, jugal sinus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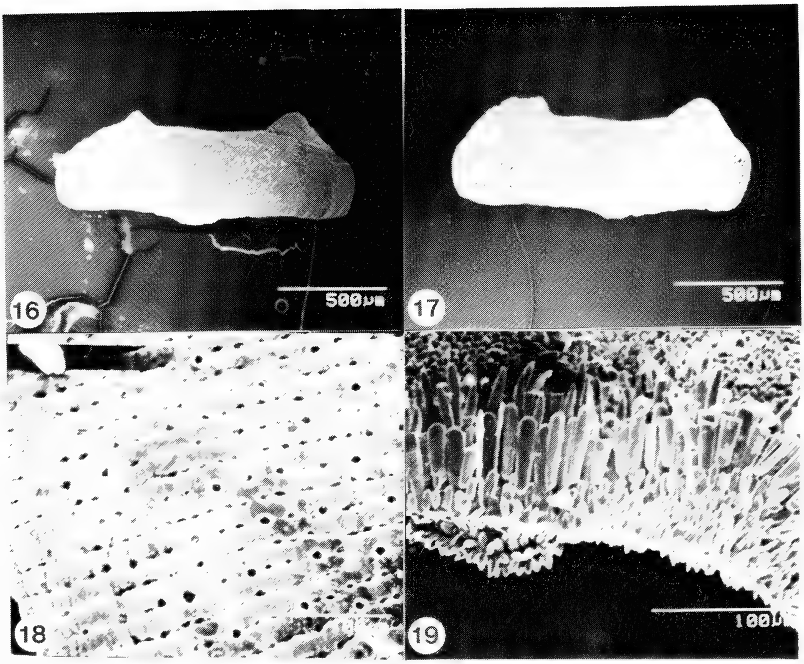

Figures 15-19. *Lepidochitona corteziana* Clark, spec. nov. **15.** Whole animal, length 3.0 mm, Paratype, RNC 3136, Canal de San Lorenzo. **16.** Intermediate valve five (scale on figure), Holotype, LACM 2878. **17.** Interior of valve five. **18.** Close-up of valve five tegmentum, showing esthete pores. Holotype. **19.** Girdle (scale on figure), Holotype.

wide, porous; insertion teeth short, broad, thick, bounded on both sides by porous slit rays. Tail valve small, about 1/2 as long as wide, low; mucro prominent, located at anterior 1/3, post-mucronal slope concave; ante-mucronal area with about 60 longitudinal micro-lirae; post-mucronal area with about 60+ radial lirae; sutural laminae short, fairly wide, anterior. edge straight, jugal sinus wide.

Macresthetes round, about 7 µm in diameter, located in single, linear row, atop the micro-lirae, each separated by two micresthetes about 3.5-4 µm in diameter; micresthetes also located in single linear row, separate by about one diameter, in grooves between micro-lirae (Fig. 18).

Girdle medium wide (somewhat less than 1/2 of valve 5 tegmentum), fleshy appearing (Fig. 19); dorsally clothed with tiny, close-set, erect, pointed spicules, about 15 µm x 5 µm; ventral surface of girdle covered with very minute, bluntly rounded granules measuring about 5 µm x 3 µm; marginal spicules about 50-60 µm in length, and up to about 12.5 µm in width, relatively slender, elongated, flattened, bluntly pointed or slightly broadened and rounded at the distal end.

Radula unknown.

Type Locality: Gulf of California, Canal de San Lorenzo, about 40 km N of La Paz, Baja California, Mexico (24°21'N, 111°15'W); 12 m.

Type Material: Holotype (LACM 2878) & three Paratypes (1, LACM 2879); 2, RNC 3154 (leg. , Marco Medina-Lopez, SCUBA, 2 February, 1995).

Additional Material: Two (RNC 3143), Punta Chivado, 10-12 m (leg. Michael S. Foster, 18 March, 1998); two (RNC 3144), S side of SW tip of Isla San Jose, 12 m (leg. Marco Medina-Lopez, SCUBA, 10 February, 1995); RNC 3136, Punta Bajo, 12 m (leg. Marco Medina-Lopez, SCUBA, 11 November, 1994).

Distribution: East coast of Baja California Sur, from Punta Chivado (about 25 km N of Mulege) (27°05'N, 112°05'W) S to the type locality at depths of 10-12 m.

Discussion: *Lepidochitona corteziana* bears a close resemblance to *Lepidochitona beanii* Carpenter, 1857, of the same size, with which it may occur, but may be easily distinguished by 1) the sculpture of the valves, and 2) the lack of large hyaline needles (up to 250 x 30 µm long) on the girdle (especially bunched at the sutures). It also shows affinities with the South African *L. turtoni* (Ashby, 1928), which likewise has fine radial micro-sculpture and a secondary slit ray behind the insertion tooth. The overall sponginess of the valves, especially the articulamentum with its multiple slit rays, and the armature of the girdle (although greatly reduced dorsally in *L. corteziana*) shows affinities with *Spongioradsia aleutica* (Dall, 1878) from the Aleutian Is. *Spongioradsia aleutica* also has a coralline algal habitat.

Etymology: Named for the Sea of Cortez (Gulf of California) where the species lives.

Acanthochitona avicula (Carpenter, 1864)
(Fig. 5)

Two specimens of this small species were taken, one at El Pardito, 12 m (RNC 3145)(leg. Marco Medina-Lopez, 7 April, 1995), and one at Coronados Id., 7 m (RNC 3146)(leg. Marco Medina-Lopez, "Winter" 1994-95). The specimens measure 7.5 mm and 7.0 mm in length respectively and appear typical.

Acanthochitona burhardtae new species
(Figs. 20-25)

Diagnosis: Very small chitons (to 3.5 mm), broadly oval in outline, intermediate valves twice as wide as long; lateral areas barely raised; tegmentum with coarse, close-set, flattened granules; granules of the central areas arranged in 15-17 longitudinal rows; girdle fleshy, with scattered spicules (to 350 µm in length).

Description: Very small chitons (up to 3.5 mm), broadly oval in outline (Figs. 20,21); tegmentum consisting of coarse, flattened, close-set granules; slit formula 5-1-2; color of tegmentum light orange, or white with brown markings.

Head valve semi-circular, posterior margin broadly v-shaped; insertion teeth short, wide, fairly thick. Intermediate valves (Fig. 22) about 1/2 as long as wide, beaked; granules arranged in longitudinal rows on central areas (often obsolete at the jugum), with distinct grooves between; lateral areas poorly defined, slightly raised and bearing smaller granules than central areas; granules of jugal areas more or less obsolete; articulamentum thin, white; sutural laminae short, fairly wide; jugal sinus wide; insertion teeth very short. Tail valve (Fig. 23) small, rather oval shaped, mucro at posterior 1/3, post-mucronal slope straight or slightly convex; insertion teeth fairly short, thick, with medial sinus; sutural laminae fairly long, extending well around antero-lateral edge, jugal sinus fairly wide.

Macresthete sub central, oval about 7-8 µm x 5 µm; micresthetes six (three per side) in linear rows, about the same size as macresthete (Fig. 24).

Girdle (Fig. 25) of medium width, about 1/4 the width of valve five tegmentum, fleshy, beset dorsally with scattered long, slender, pointed spicules up to 350 µm long and 25 µm in diameter at the base, occurring singularly or in groups of two to four; ventral surface of girdle covered with rectangular scales measuring 20 µm x 7.5 µm; margin of girdle armed with pointed spicules 125-150 µm long and 20 µm wide at the base.

Radula about 800 µm long; the number of mature rows of teeth is unknown; major lateral teeth relatively small, caps tridentate, about 25 µm x 20 µm, central cusp slightly longer than lateral cusps. Unfortunately, the SEM preparation of the

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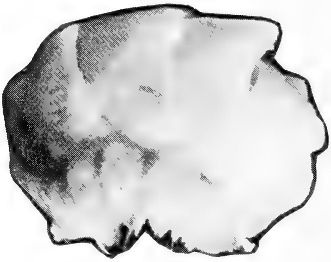

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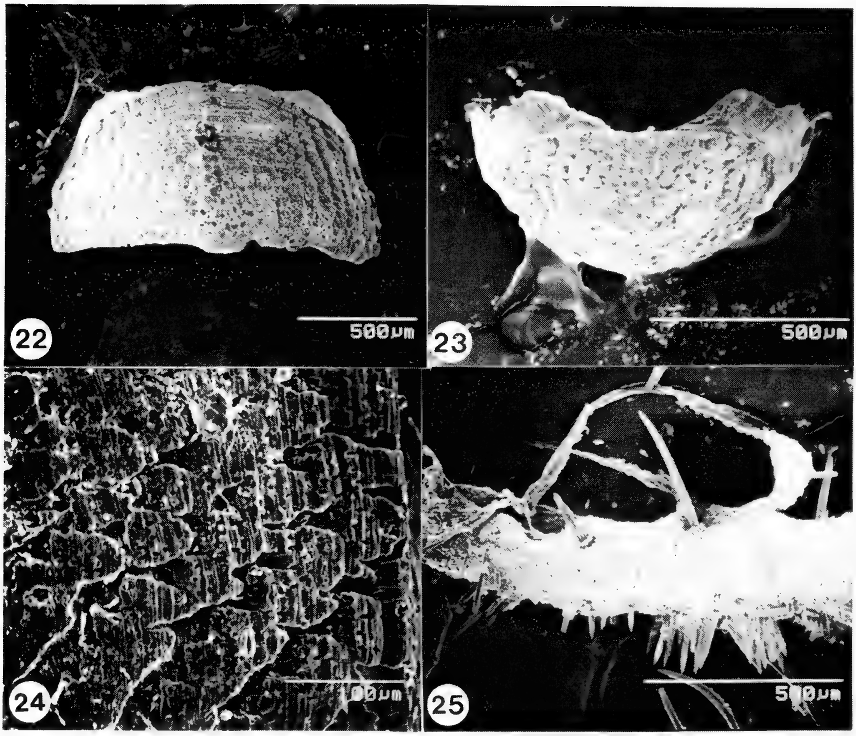

Figures 20-25. *Acanthochitona burghardtae* Clark, spec. nov. **20.** Whole animal, length 2.4 mm, RNC 3137. Isla San Jose. **21.** Whole animal, length (curled) ca. 3.0 mm, Paratype, LACM 2880. **22.** Intermediate valve five (scale on figure), Holotype, LACM 2881. **23.** Tail valve (scale on figure), Holotype. **24.** Close-up of tegmentum (valve five) showing esthete pores, Holotype. **25.** Girdle (scale on figure), Holotype.

radula of this species was unsuccessful, so the details of the radula are largely unknown.

Type Locality: Gulf of California, Canal de San Lorenzo, about 40 km N of La Paz, Baja California Sur, Mexico (24°21'N, 111°15'W); 12 m.

Type material: Holotype (LACM 2880) and two paratypes (1, LACM 2881); (1, RNC 3147).

Additional Material: One specimen (RNC 3137) N side of SW tip of Isla San Jose, 7 m. (leg. Marco Medina-Lopez, SCUBA, 10 February 1995).

Distribution: Gulf of California, east coast of Baja California Sur, vicinity of Bahia de La Paz, from the N side of the SW tip of Isla San Jose (approx. 24°52'N, 110°38'W) to the type locality. At depths of 7-12 m.

Discussion: At first this species appears to be a juvenile *Dendrochiton lirulatus* Berry, 1963, but close examination of the tegmental sculpture and the insertion teeth show that it is in fact an acanthochitonid. Due to the shape of the valves and the peculiar sculpture of the tegmentum *A. burghardtae* cannot be confused with any of the known members of *Acanthochitona* from the eastern Pacific.

Etymology: It is with great pleasure that I name this chiton after Laura and Glenn Burghardt of Oakdale, California whose book "A Collector's guide to West Coast Chitons" inspired me and many others to study these fascinating creatures.

DISCUSSION

The shallow water rhodolith beds provide good habitat for many invertebrates. Steller (1993) reports that 75 species of invertebrates had been identified from the Gulf of California rhodolith beds. The chiton fauna is particularly rich and diverse, with eight species in four genera and three families. Four of these species appear to be exclusive to the rhodolith habitat. It is likely that the investigation of rhodolith beds in other areas of the world, as well as the deeper water beds in the Gulf of California could yield many more species of chitons.

The molluscan faunas of the central eastern Pacific and Caribbean regions have many affinities. This is particularly true of many of the tropical elements of their respective chiton faunas, and at least one species *Stenoplax boogii* (Haddon, 1886) is present in both faunas. Most of the chitons found in the rhodolith habitat have affinities in the Florida-Caribbean area, however it is not known whether any of the Caribbean species occur on rhodoliths. *Ischnochiton tomhalei* shows a possible kinship with *I. papillosus* (C. B. Adams, 1843), and *I rhodolithophilus* is very similar to *I. pseudovirgatus* Kaas, 1972 particularly in the small size, color of the tegmentum, and relatively large, heavy major lateral teeth

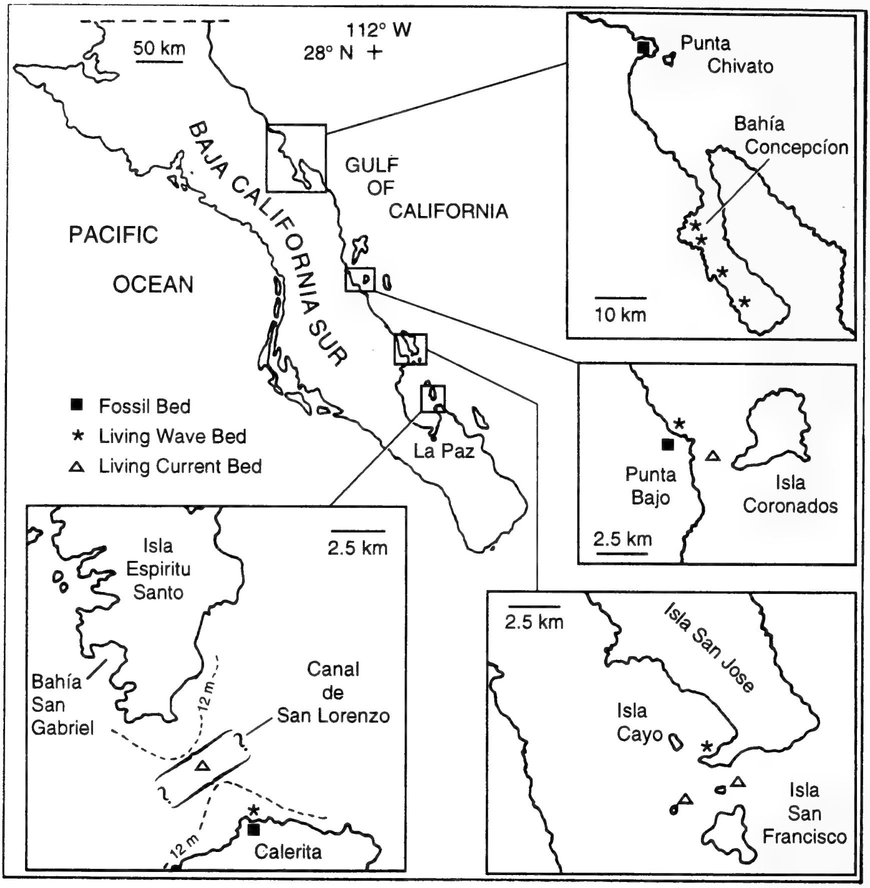

Figure 26. Map of collecting sites (after Foster *et al.*, 1997).

of the radula. *Callistochiton* sp., cf. *C. elenensis* is similar to *C. porosus* Neirstrasz, 1905 from Brazil especially in the sculpture of the radial ribs, which are topped with small pustules. *Lepidochitona* beanii shows an affinity with *L. liozonis* (Dall & Simpson, 1901) and *L. rosea* Kaas, 1972. *Lepidochitona corteziana* with its lower profile, shorter, wider valves and lack of large needle-like spicules on the girdle appears to be more distantly related to this group. *Acanthochitona avicula* is part of a complex of several closely related Panamic and Caribbean species.

Acanthochitona burghardtae is particularly interesting, and is unique among eastern Pacific acanthochitonids in the shape and form of its valves, and the distribution and sparse number of its girdle spicules. This species appears to be similar to *Acanthochitona terezae* Guerra Junior, 1983 from the Caribbean, both species have similarly shaped and proportioned valves (including their sutural laminae, which are quite short), ill-defined juga covered with pustules and apparently similar girdle spicules. However I have not seen any specimens of *A. terezae*. *Acanthochitona minutus* Leloup, 1980 from Brazil also shows affinities with *A. burghardtae*, particularly in the ill-defined, pustulose juga, however the sutural laminae of *A. minutus* are much longer and rounder than either *A. burghardtae*, or *A. terezae*. The arrangement of the girdle spicules appears similar also.

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A CASE STUDY FOR THE DEVELOPMENT OF AN ISLAND FAUNA: RECENT TERRESTRIAL MOLLUSKS OF BERMUDA

Rüdiger Bieler[1] and John Slapcinsky[1,2]

ABSTRACT. The isolated western Atlantic island group of Bermuda provides a model case for the development of an island snail fauna. A unique combination of factors, such as an excellent Pleistocene fossil record, late (and precisely dated) human colonization, and extensive historic collecting and documentation efforts (last published in 1926), provide the background for this study. New field collecting, a survey of museum collections, and a critical review of published and unpublished information (resulting in several synonymies and reinterpretations of previously assumed endemics), were used to determine the presence and range of all terrestrial mollusks on Bermuda. At least 49 species of snails and slugs from 22 families are now known from Bermuda, including 11 endemic, 6 native non-endemic, 28 accidentally introduced and 4 intentionally introduced species.

Starting in 1958, several exotic predatory snails including *Gonaxis quadrilateralis* and *Euglandina rosea* were released in ill-advised attempts at biologically controlling the accidentally introduced snail species *Otala lactea* and *Rumina decollata*. *Euglandina rosea* is implicated in the extinction of several land snails native to the Pacific islands where it was also introduced. In Bermuda, densities of the three extant species in the endemic land snail genus *Poecilozonites* have been reported declining since the early 1960s and the group now appears to be nearly extinct. Individuals (or fresh shells) of two *Poecilozonites* species (*P. circumfirmatus* and *P. bermudensis*) were found although neither is common. This faunal survey finds *E. rosea* spread from its original release sites and generally distributed on the larger islands of Bermuda, with the possible exception of the

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southeastern corner of the main island. *Gonaxis* is beginning to spread beyond its release area. Several endemic and native non-endemic species including *P. reinianus, Vertigo marki, V. bermudensis*, and *Strobilops hubbardi* have only been found in the southeastern portion of the main island near caves and remnant native vegetation. The present study records three species new to Bermuda, *Tornatellides* sp., *Streptostele musaecola*, and *Opeas hannense*. *Zonitoides bermudensis*, previously recorded as an endemic species, is here synonymized with *Z. arboreus* and is recognized as a species introduced through human commerce. *Gastrocopta barbadensis crassilabris* is synonymized with *G. pellucida*, and recognized as a native non-endemic species. *Strobilops pilsbryi*, described as a species endemic to Bermuda, is synonymized with *S. hubbardi*. *Pupisoma macneilli, Punctum bristoli*, and *Striatura meridionalis*, previously known from Pleistocene fossils, are here recorded as members of Bermuda's extant fauna for the first time.

Key words: Bermuda, endemic, exotic, fauna development, land snails.

INTRODUCTION

Bermuda, a crescent-shape group of several large and numerous smaller western Atlantic islands, lies over 900 kilometers east of the nearest landfall at Cape Hatteras, North Carolina, and is among the most isolated island groups in the world. This remoteness is reflected in its depauperate native fauna (Wallace, 1895), especially by the near absence of non-avian vertebrates, represented by only one native species, the Bermuda Rock Skink, *Eumeces longirostris* (Cope, 1861).

Land snails are a major component of the native fauna and comprise nearly all of the Pleistocene fossils from terrestrial deposits (Gould, 1971b). Pulmonate snails are arguably among the most common and diverse animals on Bermuda. Previous authors (Pilsbry, 1900; Verrill, 1902) estimated the number of native species at 15 or 13 respectively (but, as will be shown below, included several species now known to be introduced through human commerce). Bermuda's land snail fauna is best known for its endemic zonitid genus, *Poecilozonites*. This group of several nominal extinct and extant species became the focus of numerous taxonomic, morphometric, and evolutionary studies (e.g., Peile, 1924, 1925; Kutchka, 1934; Pilsbry, 1934; Gould, 1966, 1968, 1970a,b, 1971a, b). The postulated rapid adaptive radiation of the *P. bermudensis* complex was cited as one of the two evidential examples for the Punctuated Equilibrium hypothesis (Eldredge & Gould, 1972), although the hypothesized evolutionary scenario for this "Darwin's finch among mollusks" (Gould, 1991: 12), based on ice-age climatic oscillations, has not remained undisputed (Brown, 1987; Glaubrecht, 1990).

The rich history of faunal surveys before 1926 has provided a remarkably complete picture of Bermuda's terrestrial snail fauna to that date. The lack of recently published surveys, the rapid decline of Bermuda's cedar forests, and the deliberate introductions of four species of predatory snails as agents of biological control make the current survey especially timely.

Bermuda was one of the few landmasses uninhabited by humans in Pre-Columbian times and was not settled until 1612. Late colonization and good written records have made the human-mediated changes to Bermuda's flora and fauna among the best documented of any region. Human intervention in Bermuda's ecosystem began long before settlement, in 1515, with the release of pigs by Bermudez who had discovered the islands in 1503. The first settlers, after 1612, added cats and dogs. Between 1614 and 1618, large populations of introduced rats, *Rattus rattus* (Linné, 1758), led to crop failures and the starvation of many colonists (Lefroy, 1876, cited from Verrill, 1902). Deliberate burns to eradicate the rats eliminated most of the already heavily logged primary cedar forest. Early last century, only a small tract of unburned native forest remained at Walsingham Jungle (Verrill, 1902). Several land snails appear to have been limited to this; however with only one previously published distributional study (Vanatta, 1911) among those merely recording "Bermuda," actual snail distributions in the island group were poorly known. This survey is the first since the remaining stands of the Bermuda cedar (*Juniperus bermudensis*) were severely damaged by scale blight, shortly after World War II.

Slightly east of the Gulf Stream (at 32°18'N, 64°46'W), Bermuda's climate is frost-free and mild, with about 1400 mm of evenly distributed rainfall annually. This mild climate has allowed the introduction and naturalization of many agricultural and ornamental plants, and with these, of numerous foreign plants and animals, including terrestrial mollusks. It is thus no surprise that many of today's non-native land snails in Bermuda are species commonly found associated with greenhouses and nurseries. Land snail introductions on Bermuda are particularly well documented with more than a dozen qualitative faunal surveys published between 1852 and 1926, leading Tomlin to assert "There is probably no island in the world that has been more thoroughly combed for non-marine shells than Bermuda" (1932: 98). Already by the time of the first faunal survey of Bermuda, at least six introduced species were present (Prime, 1853). By 1926, the date of the last published survey, at least 14 species of native and 22 species of introduced land snails inhabited Bermuda (Peile, 1926). During that 73-year period, little if any turnover in species had occurred. Each survey found nearly all but the smallest (< 3 mm) of the species previously recorded for the islands, despite the fact that many of these surveys were short and secondary to other projects.

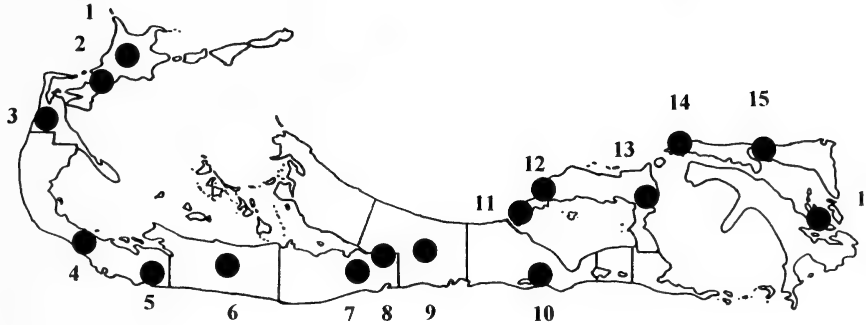
Pilsbry (1900) saw three origins for Bermuda's land snail fauna: (a) "Autocthonous species, peculiar to the islands," (b) "Drift waifs from the West Indies," and (c) "Species imported by the agency of man." We have categorized our records (and our interpretations of earlier records) in four different groups: (1) endemic species (species not known from elsewhere, and also present in Bermuda's good Pleistocene fossil record), (2) native, but not endemic, species (species that were present before the arrival of the first settlers), (3) accidentally introduced species, and (4) deliberately released species. Some of these might no longer have viable populations on the islands, as will be discussed below.

Several additional introductions have been recorded since the most recent faunal survey. *Rumina decollata* – an omnivorous snail now widely distributed in tropical and subtropical areas through human commerce – was originally native to the Mediterranean region and is considered a crop pest. This snail, introduced accidentally with plants in the late 1870s has become a widespread agricultural pest in Bermuda (Bennett & Hughes, 1959). In 1928, a second important horticultural pest was introduced. The Milk Snail *Otala lactea*, imported in 1928 for food, escaped and became naturalized (Bennett & Hughes, 1959). By the 1950s, the Bermuda Department of Agriculture was looking into methods to control these crop pests. With help from the Hawaiian Department of Agriculture several species of predatory snails were introduced in ill-fated attempts at controlling *Otala* and *Rumina* (Simmonds & Hughes, 1963). One of these predatory species, *Euglandina rosea*, is implicated in the extinction and endangerment of many land snails endemic to the Pacific Islands (Hadfield & Mountain, 1981; Clarke *et al.*, 1984; Murray *et al.*, 1989) and can also impact upon freshwater snails (Kinzie, 1992). The same fate might have befallen Bermuda's endemic genus *Poecilozonites*. Numbers of *Poecilozonites bermudensis* have been declining since the early 1960s (Gould, 1969, 1991).

The unique situation of Bermuda's historically well-documented land snail fauna provides an opportunity to track each species through recorded time – in several cases even establishing the exact event of first introduction. A complete bibliography for Bermuda land mollusks is also provided. This paper is part of an informal series on the terrestrial flora and fauna of Bermuda initiated by the Bermuda Department of Agriculture and Fisheries. Previous studies have included spiders (Sierwald, 1988), Coleoptera (Hilburn & Gordon, 1989), Lepidoptera (Ferguson *et al.*, 1991), and Diptera (Woodley & Hilburn, 1994).

MATERIALS AND METHODS

The core of the material for the present survey stems from intensive collecting efforts during one week in May of 1988. That survey involved three collectors (RB, Dr. Daniel Hilburn, Dr. Petra Sierwald), and most of the collecting sites are identical to those reported by Sierwald (1988) in a survey of Bermuda's spider fauna. Additional data originate from preliminary collections made by RB during a visit to the Bermuda Biological Station in 1983, from the



Map 1. Collecting localities.

collections previously held at the Department of Agriculture (now at the Natural History Museum, Bermuda), the Natural History Museum, Bermuda, and the Neil Fahy (Daly City, California) private collection.

Unique or questionable literature records were verified based on available voucher material, as indicated. In addition, Bermuda land snail holdings of the Academy of Natural Sciences of Philadelphia, the American Museum of Natural History, the California Academy of Sciences, the Delaware Museum of Natural History, the Field Museum of Natural History, the Florida Museum of Natural History, and the University of Michigan Museum of Zoology were studied. The existing literature on Bermuda land snails and all original species descriptions were researched, leading to new synonymies and re-interpretations of earlier records.

Maps: The distributions of all Recent species found on Bermuda are plotted using locality data from this survey and data from non-fossil museum specimens (see map 1 and museum collections studied).

This survey:

■ Closed squares: Live specimens.

▣ Partly filled squares: Recently dead specimens (with periostracum).

☒ X-filled squares: Long dead specimens.

Other records:

● Closed circles: Museum specimens (nearly all collected prior to 1926), and in the case of the four deliberately introduced species (*Euglandina rosea*, *Gonaxis kibweziensis*, *G. quadrilateralis* and *Natalina cafra*) from surveys and annual reports of Bermuda's Department of Agriculture.

R Release sites of deliberately introduced predatory snails.

Specimens collected during the 1983/1988 survey (map 1) are deposited at Field Museum of Natural History (FMNH 224755-224920 and 227001-227056), with duplicate voucher series deposited at BAMZ and DMNH.

1988 Survey sites:

01 Sandy's Parish	Gilbert Nature Reserve
02 Sandy's Parish	Fort Scaur
03 Sandy's Parish	Hog Bay Level
04 Southampton Parish	Seymour's Pond
05 Southampton Parish	Horseshoe Bay
06 Warwick Parish	Warwick Pond
07 Paget Parish	Que Sera Guesthouse
08 Paget Parish	Botanical Garden
09 Devonshire Parish	Devonshire Marsh
10 Smith's Parish	Spittal Pond
11 Hamilton Parish	Bermuda Aquarium
12 Hamilton Parish	Shelly Bay
13 Hamilton Parish	Walsingham Pond
14 St. George's Parish	Whalebone Bay
15 St. George's Parish	Mullet Bay Park
16 St. George's Parish	Smith's Island

Museum collections cited:

AMNH	American Museum of Natural History, New York
ANSP	Academy of Natural Sciences, Philadelphia
BAMZ	Bermuda Aquarium, Natural History Museum and Zoo
BPBM	Bernice P. Bishop Museum, Honolulu
CAS	California Academy of Sciences, San Francisco
DMNH	Delaware Museum of Natural History, Wilmington
FMNH	Field Museum of Natural History, Chicago
MCZ	Museum of Comparative Zoology, Cambridge
UF	Florida Museum of Natural History, Gainesville
UMMZ	University of Michigan Museum of Zoology, Ann Arbor

LIST OF RECENT BERMUDIAN TERRESTRIAL MOLLUSKS

The taxonomic arrangement in superfamilies and families follows Smith & Stanisic (1998) and Turgeon *et al.* (1998), respectively. In addition, Agriolimacidae Wagner, 1935 (see Wiktor, 2000), and Cochlicellidae Schileyko, 1972 (see Schileyko & Menkhorst, 1997) are used. Within superfamilies, families, genera, and species are each arranged alphabetically. The listings of synonyms and subsequent citations are restricted to records with relevance to Bermuda and those impacting taxonomic decisions. Species known from Bermuda only as fossils were not included. All species listed below were found in the current survey unless otherwise indicated.

Species were determined to be either (1) endemic to Bermuda, (2) native, but not endemic, (3) accidentally introduced by human activities, or (4) intentionally introduced for pest control. All native species are found in Bermuda's Pleistocene deposits which are among the best sampled and studied of their kind. Species missing from the fossil deposits are considered introduced. This assumption is reasonable in this case given that (1) all endemic species are found as fossils, (2) even uncommon or patchily distributed native non-endemic species are present in fossil deposits, and (3) most species without a fossil record in Bermuda are well known adventive species.

Distributions for all species on Bermuda were plotted using (1) new records from the present survey, (2) published surveys, especially that of Vanatta (1911), (3) museum and private collection records, including most voucher specimens of previous surveys, and (4) unpublished records of the Bermuda Department of Agriculture & Fisheries. The notes for each species include information about species ranges, habitat preferences, and method of introduction.

NERITIMORPHA: NERITOIDEA

HELICINIDAE

Oligyra convexa (Pfeiffer, 1849)

(Map 2, Fig. 1)

Helicina convexa Pfeiffer, 1849: 120-121 ("Locality unknown").

Helicina ---, - Redfield, 1853: 17;

Helicina variabilis, - Prime, 1853: 55; Jones, 1859: 107; Tristram, 1861: 405 [*non Helicina variabilis* Wagner in Spix, 1827: 25, pl. 16, figs. 3-4, Brazil];

Helicina subdepressa Poey, 1851: 420; - Jones, 1864: 9 [*non Helicina subdepressa* Poey, 1851];

Helicina convexa, - Bland, 1861: 351; Rein, 1867: 77; Mörch, 1878: 3; Bartram, 1878: 108; Kobelt, 1880: 286; Bland, 1881: 257; E. A. Smith, 1884: 277; Heilprin, 1889: 184; Bland, 1895: 271; Gulick, 1904: 421; Pilsbry, 1900: 506, pl. 62, figs. 15, 15a; Verrill, 1902: 728, fig. 69; Vanatta, 1911: 665-668; Honigmann, 1914: 377; Olmsted, 1917: 225; Vanatta, 1923: 33; Peile, 1926: 76 ["the only true land operculate in the islands"]; Hughes, 1968: 1;

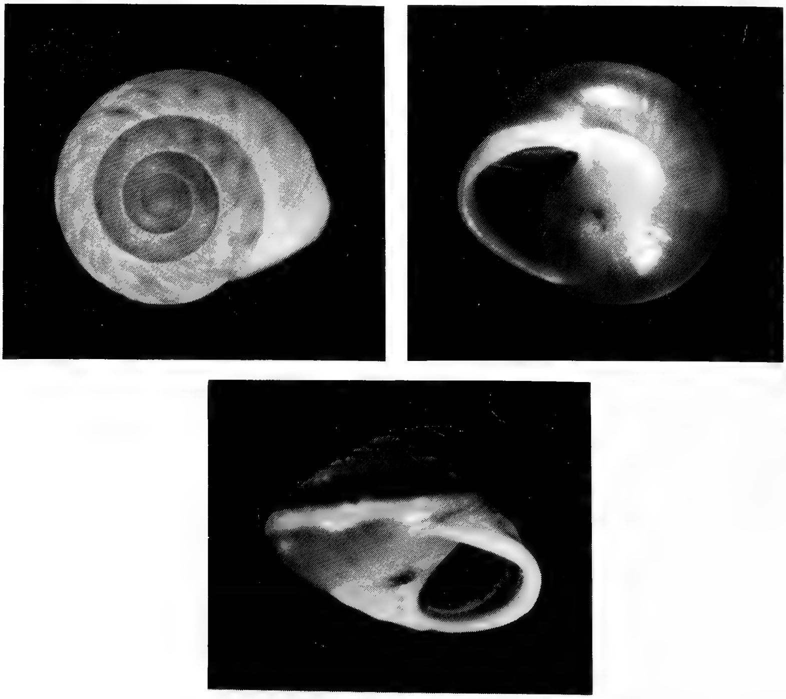
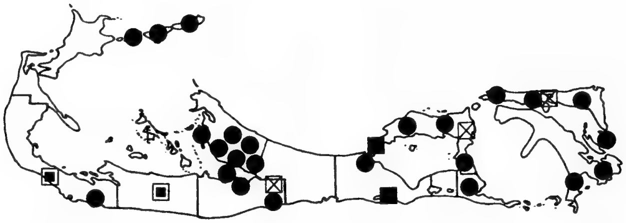


Figure 1. *Oligyra convexa.* - FMNH 29795, St. George's Parish, Bermuda; diameter = 7.7 mm (apical view); diameter = 7.4 mm (basal and apertural views).



Map 2. *Oligyra convexa.*

Helecina [*sic*] *convexa*, - Jones, 1876: 139;

Helicinia varibilis [*sic*], - Bartram, 1878: 108;

Helicina (Pachystoma) fasciata, - Angas, 1884: 597 [placed *H. convexa* in synonymy of *Helicina fasciata* Lamarck, 1822: 102 (type locality "Puerto Rico"; ? Guadeloupe, see van der Schalie, 1948: 21)];

Helix Convexus, - Lane, 1891: 1, pl. 2, fig. 9 [plate not seen];

Oligyra convexa, - Baker, 1922: 44 [based on material collected in Bermuda by Gulick in 1903];

Helicina fasciata convexa, - Wagner, 1911: 335, pl. 67, figs. 8, 9.

Helicina (Helicina) fasciata convexa, – Haas, 1952: 104.

Bermuda Material Studied: BAMZ 1994-118-006, 1995-132-023, 1998-166-021, 1998-166-034, 1998-166-049, 1998-166-066, 1998-166-068, 1998-166-080, 1998-166-104; DMNH 210240, 210265, 210270, 210328, 210330, 210331, 210333; FMNH 3624, 3625, 5473, 8835, 13485, 13499, 13510, 13521, 13528, 13541, 13548, 13552, 13560, 13563, 13567, 13571, 13574, 13576, 13594, 13683, 16465, 28193, 28615, 28769, 29795, 29796, 41737, 59081, 92869, 98243, 98251, 98286, 98317, 103289, 115079, 126379, 130912, 147968, 216085, 224764, 224778, 224795, 224796, 224820, 224833, 224880, 224897, 224911, 227019, 227025.

Note: *Accidentally Introduced* - One of the earliest introductions, this species was recorded for the year 1852 by Prime (1853) and by nearly every survey since. A very common species, it is found under rocks and on vegetation often in gardens and plantings. Hughes' (post 1969: 1) reference to fossil material is erroneous; the complete lack of helicinids in Bermuda's thoroughly investigated Pleistocene deposits suggests a more recent arrival. Bermuda's small high-spired helicinids are similar to forms found on the islands of the Lesser Antilles. Bermuda's early governors promoted the importation of exotic vegetation from other British colonies to provide food sources for early colonists (Verrill, 1902) and it is likely that this species was imported with these agricultural products. Revision of the West Indian helicinids is necessary before the source of *O. convexa* can be determined. The species was transferred to *Oligyra* by Baker (1922) based on characters of the radula and operculum.

BASOMMATOPHORA: ELLOBIOIDEA

CARYCHIIDAE

Carychium bermudense Gulick, 1904

(Map 3, Fig. 2)

Carychium bermudense Gulick, 1904: 415, pl. 36, figs. 11, 12 (Bermuda; fossil).

Carychium exiguum (Say, 1822) – Davis, 1904: 126 [*non Pupa exigua* Say, 1822: 375, which was cited by Pfeiffer, 1841b: 224. as *Carychium exiguum* "m[ihi]"];

Carychium bermudense, – Verrill, 1906: 171, figs. 54a, b (type specimen; fossil); Vanatta, 1924: 7; Gould, 1970b: 490, fig. 1h (fossil); Gould, 1970a: 572 (fossil);

Carychium bermudensis [*sic*], – Vanatta, 1911: 666-668; Vanatta, 1923: 33; Peile, 1926: 88.

Figure 2. *Carychium bermudense.* – BAMZ 1995-133-003, Bermuda; height = 2.0 mm.

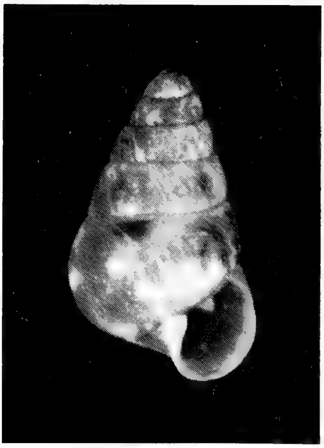
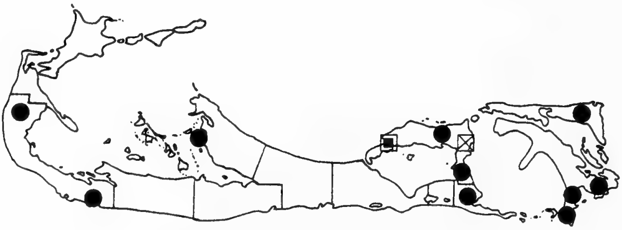


Figure 3. *Tornatellides* sp. – FMNH 227039, Sandy's Parish, Bermuda; height = 2.9 mm.

Bermuda Material Studied: ANSP 88559; BAMZ 1995-133-003; FMNH 30340, 227028, 227029; MCZ Gould Station 1 (fossil), Gould Station 11 (fossil), Gould Station 21 (fossil), Gould Station 21b (fossil), Gould Station 30 (fossil), Gould Station 41 east (fossil), Gould Station 48 (fossil).

Note: *Endemic* – This species was described from fossil material collected during expeditions sponsored by the then new Bermuda Biological Station (Gulick, 1904). Recent specimens were later collected by Stewerdson Brown (Vanatta, 1911). Specimens can be sifted from leaf litter, especially in the vicinity of marshland. The heavily callused and flared lip, tapered whorls, fine spiral striae, as well as the strongly dilated internal lamella which emerges strongly on the parietal wall and as a low basal thickening on the columellar wall, are similar to



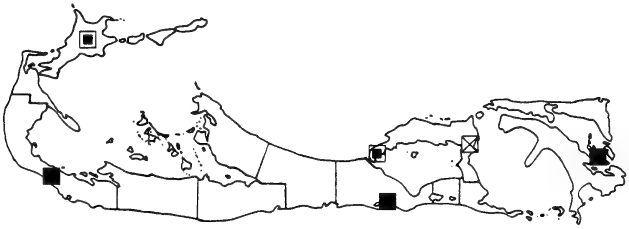
Map 3. *Carychium bermudense.*

Carychium mexicanum of the coastal region of southeastern North America; the relationship between the two nominal taxa needs further study.

STYLOMMATOPHORA: ACHATINELLOIDEA
ACHATINELLIDAE
Tornatellides sp. NEW RECORD
(Map 4, Fig. 3)

Bermuda Material Studied: BAMZ 1998-166-120, 1998-166-091, 1998-166-089, 1998-166-067, 1998-166-015; DMNH 210255, 210259, 210275, 210310; FMNH 224809, 224810, 227013, 227014, 227015, 227016, 227017, 227030, 227039.

Note: *Accidentally Introduced* – The genus *Tornatellides* is native to the Pacific Basin. This species (here treated as *Tornatellides* "sp." because of the current unresolved taxonomic situation of the genus) probably arrived in Bermuda sometime after the last faunal survey (Peile, 1926). It is now widespread on Bermuda and can be collected in great numbers from the bark of trees, suggesting possible importation through horticulture. This is the first record of this family in the Atlantic Basin.



Map 4. *Tornatellides* sp.

PUPILLOIDEA
PUPILLIDAE
Gastrocopta pellucida (Pfeiffer, 1841)
(Map 5, Fig. 4)

Pupa pellucida Pfeiffer, 1841a: 46 (Cuba).

? *Pupa bermudensis* Prime, 1853: 55 [*nomen nudum*];

Pupa jamaicensis C. B. Adams, 1849, – Bland, 1861: table 2, p. 351; Jones, 1876: 139; Kobelt, 1880: 286; Bland, 1881: 257; Bland, 1895: 271; Heilprin, 1889: 182 [*non Pupa jamaicensis* C. B. Adams, 1849];

? *Pupa Bermudensis* Jones, 1859: 107 [*nomen nudum*; based on Prime's list, but indicated as "n.s."];

Pupa pellucida, – Jones, 1876: 139; Kobelt, 1880: 286;

Pupa barbadensis, – Bland, 1881: 257; Bland, 1895: 271; Heilprin, 1889: 183 [*non Pupa barbadensis* Pfeiffer, 1853: 69 (Barbados)];

Pupa (Bifidaria) jamaicensis, – Pilsbry, 1900: 498 [*non* pl. 62, fig. 7 = *G. rupicola*]; Verrill, 1902: 729 [*non* fig. 74b];

Bifidaria jamaicensis, – Gulick, 1904: 415;

Bifidaria pellucida hordeacella (Pilsbry, 1890), – Vanatta, 1911: 665-668;

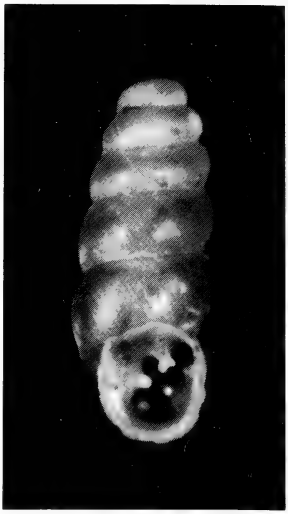


Figure 4. *Gastrocopta pellucida*. – FMNH 224832, Hamilton Parish, Bermuda; height = 2.6 mm.

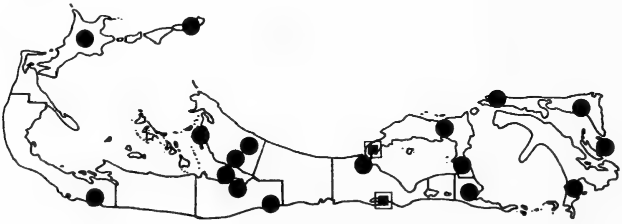
Gastrocopta barbadensis crassilabris Pilsbry, 1916: 85-86, pl. 18, figs. 6-9 (Bahamas and Bermuda), **new synonymy**;

Gastrocopta barbadensis crassilabris, – Peile, 1926: 88;

Gastrocopta barbadensis (Pfeiffer, 1853), – Vanatta, 1923: 33;

Gastrocopta pellucida hordeacella, – Vanatta, 1923: 33; Peile, 1926: 88; Gould, 1970b: 490, fig. 1b (fossil);

Gastrocopta (Gastrocopta) pellucida hordeacella, – Haas, 1952: 104.



Map 5. *Gastrocopta pellucida*.

Bermuda Material Studied: ANSP 3816, 143338; BAMZ 1995-133-008; FMNH 29802, 30201, 30203, 41009, 41010, 41011, 48647, 59074, 224832, 227040, 227048; MCZ Gould Station 4 (fossil), Gould Station 41 east (fossil), Gould Station 63 lower (fossil), Gould Station 73 (fossil); UMMZ 106756.

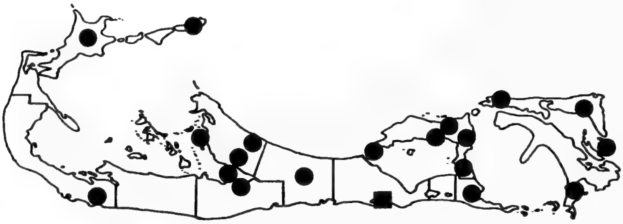
Note: *Native Non-Endemic* - This species ranges over much of the West Indies and North America from Florida north along the coast to New Jersey, west to southern California and southern Mexico. This and the following species are the most common *Gastrocopta* species on Bermuda and can be found on rocks in open areas. "*Pupa bermudensis*" probably refers to *Gastrocopta pellucida*, as the only material originally labeled "*Pupa bermudensis*" found in this study is a lot of *G. pellucida*, collected by A. D. Brown (ANSP 3816). *Gastrocopta pellucida* is extremely variable, not only in overall shell shape and size but also in the thickness of the peristome and apertural barriers, as was pointed out by Pilsbry (1916: 79). Several names have been applied to Bermuda's *Gastrocopta pellucida* depending on the thickness of the lamellae and peristome and the length of apertural plicae. These names include *Gastrocopta pellucida hordeacella* (for larger forms similar to those of the North American mainland with longer palatal plicae and a slight crest behind the lip), as well as forms misidentified as *G. barbadensis* (with thicker lamellae including a strongly bifid angulo-parietal barrier). Those specimens also having a thickened peristome have been described under the name *G. barbadensis crassilabris*. Pilsbry (1916: 85) stated: "In shape and size, *crassilabris* resembles *pellucida*, but the thick lip and the teeth are more like *marginalba*, the peristome being thicker and the crest stronger than in *barbadensis*." However, large series both from the North American mainland (FMNH 232835) and Bermuda (ANSP 143338) contain individuals that range from those similar to the holotype and paratypes of *pellucida hordeacella* (ANSP 60460) to individuals with stronger barriers and well developed bifid angulo-parietal teeth and thick peristomes that could be identified as *G. barbadensis crassilabris*. This variation is well illustrated by Vanatta (1912: plate 2; later reprinted by Pilsbry, 1948: fig. 495). Differences noted by Pilsbry between these nominal taxa, including the strength of the lamellae and plicae, the degree of bifurcation of the angulo-parietal lamellae, and the color differences between thin translucent yellowish shells and thicker brown shells can all potentially be caused by differences in calcium availability or by the age of individuals within a population. This view is supported by evidence of far greater changes in shell form due to differences in calcium availability within populations of other Bermuda species (Gould, 1970b, 1971a). The nominal subspecies *Gastrocopta barbadensis crassilabris* Pilsbry, 1916, is here synonymized under *G. pellucida*.

Gastrocopta rupicola (Say, 1821)
(Map 6, Fig. 5)

Pupa rupicola Say, 1821: 163 (East Florida).

Pupa pellucida Pfeiffer, 1841 (in part; see also G. *servilis*, below), - Bland, 1861: 351; Rein, 1867: 77; Bland, 1881: 257; Bland, 1895: 271; Jones, 1876: 139; Heilprin, 1889: 183 [*non Pupa pellucida* Pfeiffer, 1841];
Gastrocopta (Gastrocopta) barbadensis, – Haas, 1952: 104 [*non Pupa barbadensis* Pfeiffer, 1853];
Pupa (Bifidaria) rupicola, – Pilsbry, 1900: 498, pl. 62, figs.7 [*sic*], 8; Verrill, 1902: 729, figs. 4b [*sic*], 74c; Verrill, 1906: 170, fig. 68c;
Bifidaria rupicola, – Gulick, 1904: 414; Vanatta, 1911: 665-668; Vanatta, 1912: 12;
Gastrocopta rupicola duplex Pilsbry, 1916: 60, pl. 11, figs. 4, 7, 9 (Bermuda);
Pupa marginalba Pfeiffer, 1840: 253 (Cuba);
Gastrocopta rupicola marginalba (Pfeiffer, 1840), - Pilsbry, 1916: 61, pl. 11, figs. 10,11; Vanatta, 1924: 7; Peile, 1926: 88 (fossil);
Gastrocopta rupicola, - Vanatta, 1923: 33; Peile, 1926: 88; Gould, 1970a: 572 (fossil); Gould, 1970b: 490, fig. 1d (fossil);
Pupa rupicola, - Hughes, post 1969: 1;
Gastrocopta (Gastrocopta) rupicola, - Pilsbry, 1948: 905, 906.

Figure 5. *Gastrocopta rupicola*. - FMNH 224805, Smith's Parish, Bermuda; height = 2.5 mm.



Map 6. *Gastrocopta rupicola*.

Bermuda Material Studied: BAMZ 1995-133-007; FMNH 30200, 41012, 59075, 224805, 224806, 227049; MCZ Gould Station 1 (fossil), Gould Station 4 (fossil), Gould Station 11 (fossil), Gould Station 21 (fossil), Gould Station 21b (fossil), Gould Station 30 (fossil), Gould Station 41 east (fossil), Gould Station 48 (fossil), Gould Station 63 lower (fossil), Gould Station 73 (fossil).

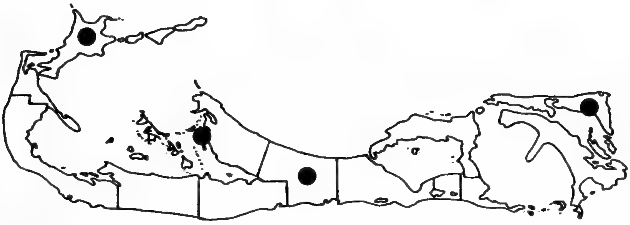
Note: *Native Non-Endemic* - This species is usually found in open, dry areas under rocks, often together with *Gastrocopta pellucida* and *Pupoides albilabris*. *Gastrocopta rupicola* ranges along the extreme southeastern coast of North America from North Carolina to Texas and the West Indies. Like the previous species it is widespread on Bermuda. Old individuals in calcareous areas often develop very thick lips, lamellae and plicae.

Figure 6. *Gastrocopta servilis*. - FMNH 30302, Devonshire Parish, Bermuda; height = 2.6 mm (lip chipped).

Gastrocopta servilis (A. A. Gould, 1843)
(Map 7, Fig. 6)

Pupa servilis Gould, 1843: 356, pl. 16, fig. 14 (Mexico).

Pupa pellucida Pfeiffer, 1841 (in part; see also G. *rupicola*, above), - Bland, 1861: 351; Bland, 1881: 257; Bland, 1895: 271; Heilprin, 1889: 183 [*non Pupa pellucida* Pfeiffer, 1841];



Map 7. *Gastrocopta servilis*.

Pupa (Bifidaria) servilis, – Pilsbry, 1900: 497, pl. 62, fig. 6; Verrill, 1906: 169-170, fig. 68a; Verrill, 1902: 729, fig. 74a;
Bifidaria servilis, – Gulick, 1904: 414; Vanatta, 1911: 665-668;
Gastrocopta servilis, – Peile, 1926: 88.

Bermuda Material Studied: FMNH 30202.

Note: *Accidentally Introduced* - Gulick (1904: 414) reported a single fossil specimen from Bermuda. However, no additional records were recorded by Gould (1970b) or located in his samples from stations 4, 41, and 48. Gulick's record is likely due to contamination with Recent material as this common Neotropical species has been widely introduced through commerce (Hubricht, 1985).

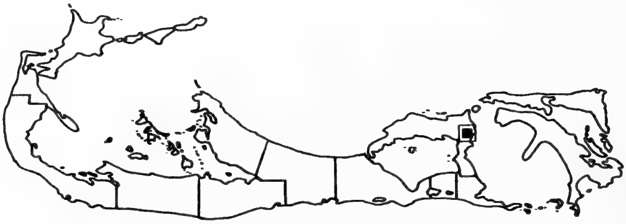
Figure 7. *Pupisoma macneilli*. – FMNH 227043, Hamilton Parish, Bermuda; height = 1.08 mm (aperture damaged).

Pupisoma macneilli (Clapp, 1918) NEW EXTANT RECORD
(Map 8, Fig. 7)

Thysanophora macneilli Clapp, 1918: 74, pl. 8, fig.1 (Alabama).

Pupisoma sp., – Gould, 1970b: 490 (fossil).

Bermuda Material Studied: FMNH 227043; MCZ Gould Station 4 (fossil),



Map 8. *Pupisoma macneilli*.

Gould Station 11 (fossil), Gould Station 41 east (fossil), Gould Station 48 (fossil), Gould Station 73 (fossil). This present study records the first Recent specimens of this species for Bermuda (fresh specimens with periostracum, collected in surface sand samples from Walsingham Pond; FMNH 227043). Also studied was the *Pupisoma* material as cited by Gould (1970b: 490).

Note: *Native Non-Endemic* - This widespread Neotropical species ranges from the southeastern United States to Central and South America and the West Indies. *Pupisoma macneilli* can be found on smooth-barked tree trunks and under leaves (Hubricht, 1985: 12). *Pupisoma* was first recorded from Bermuda by Gould (1970b) from Pleistocene deposits. Material examined from Gould stations 4, 41, and 48 (S. J. Gould research collection, specimens not individually numbered or sorted) are here identified as *P. macneilli*.

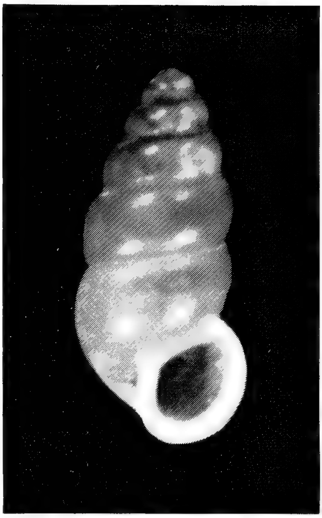
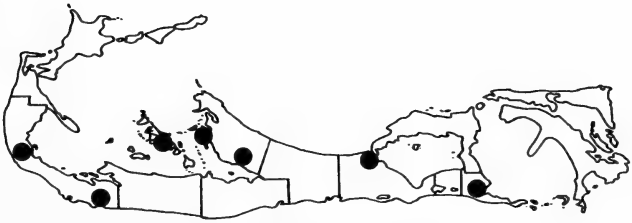


Figure 8. *Pupoides albilabris*. – BAMZ 1995-132-004, Bermuda; height = 4.6 mm.

Pupoides albilabris (C. B. Adams, 1841)
(Map 9, Fig. 8)

Pupa albilabris C. B. Adams, 1841 [new name for *Cyclostoma marginata* Say, 1821: 172-173, *non Cyclostoma marginatum* G. Fischer, 1807: 219] (Cuba).



Map 9. *Pupoides albilabris*.

Bulimus nitidulus Pfeiffer, 1839: 352 (Cuba) [not to be confused with *Bulimulus nitidulus* Beck, 1837: 67];

? *Bulimus Sandysii* Prime, 1853: 55 [*nomen nudum*];

? *Bulimus Sandysii* Jones, 1859: 107 [*nomen nudum*; based on Prime's list, but indicated as "n.s."];

Bulimus nitidulus, – Bland, 1861: table 2, p. 351; Rein, 1867: 77; Bland, 1881: 256; Bland, 1895: 271;

Pupa fallax Say, 1825, – Jones, 1876: 139; Bartram, 1878: 108;

Bulimulus fallax Say (*nitidulus* Pfr.), – Kobelt, 1880: 286;

Pupoides fallax, – Heilprin, 1889: 183;

Pupoides marginatus (Say, 1821), – Pilsbry, 1900: 498, pl. 62, fig. 16; Verrill, 1902: 729, fig. 73; Gulick, 1904: 415; Vanatta, 1911: 666-668; Peile, 1926: 89 [*non Pupa marginata* Draparnaud, 1801: 58; *nec Cyclostoma marginata* G. Fischer, 1807; see Pilsbry, 1948: 923];

Pupoides (Pupoides) albilabris, – Pilsbry, 1948: 921;

Pupoides albilabris, – Gould, 1970b: 490, fig. 1c (fossil);

Pupoides nitidulus, – Abbott, 1989: 64, fig.

Bermuda Material Studied: BAMZ 1995-132-004; Gould Station 63 lower (fossil), Gould Station 73 (fossil).

Note: *Native Non-Endemic - Pupoides albilabris* ranges over much of eastern and southern North America from southeastern Canada to Mexico (Pilsbry, 1948) and has been introduced in California (Hanna, 1966). It is a calciphile often found in glades and other open areas (Hubricht, 1985). This species appears to be patchily distributed on Bermuda (Jones, 1876, recorded it as rare) and was not found in this survey.

Vertigo bermudensis Pilsbry, 1919
(Map 10, Fig. 9)

Vertigo bermudensis Pilsbry, 1919: 149, pl. 13, figs. 8-10, 12 (Bermuda).

Vertigo eyriesii (Drouët, 1859), – Vanatta, 1911: 666 [*non Pupa eyriesii* Drouët, 1859];

Vertigo bermudensis, – Peile, 1926: 89.

Bermuda Material Studied: ANSP 91159, 105610; BAMZ 1995-132-001.

Note: *Endemic* - To date, the only specimens of this species with verifiable data were collected in the early 1900s from the vicinity of Church Cave near Tuckerstown. Pilsbry (1919: 149, 150) compared this species to the similar *Vertigo milium* (Gould, 1840) of eastern North America.

Figure 9. *Vertigo bermudensis*. – BAMZ 1995-132-001, Bermuda; height = 1.3 mm.

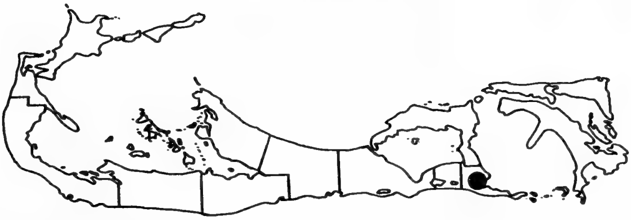
Vertigo marki Gulick, 1904
(Map 11, Fig. 10)

Vertigo marki Gulick, 1904: 414, pl. 36, fig. 7 (Bermuda, fossil).

Vertigo marki, – Verrill, 1906: 170, fig. 54d (type; fossil); Vanatta, 1911: 666; Pilsbry, 1919: 107, pl. 13, fig. 17; Peile, 1926: 89 (fossil); Gould, 1970b: 490 (fossil).

Bermuda Material Studied: ANSP 85574, 91156; BAMZ 1995-132-002; MCZ Gould Station 4 (fossil).

Note: *Endemic* - This species has never been documented alive, although empty Recent shells are recorded from leaf litter around Church Cave (Pilsbry, 1919). This species is believed to be most closely related to *Vertigo tridentata* Wolf, 1870, of eastern North America (Pilsbry, 1919).



Map 10. ***Vertigo bermudensis.***

Figure 10. *Vertigo marki.* - BAMZ 1995-132-002, Bermuda; height = 2.2 mm.

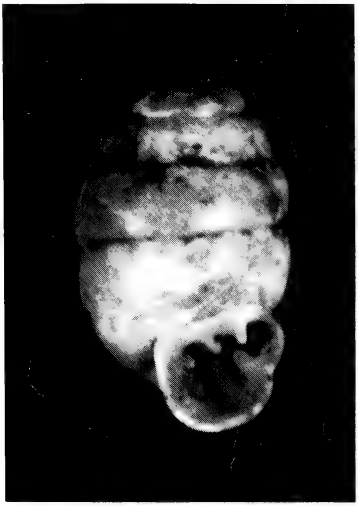


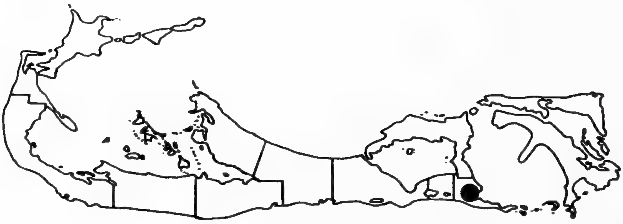
Figure 11. *Vertigo numellata.* - ANSP 105611, Hamilton Parish, Bermuda; height = 1.7 mm.

Vertigo numellata **Gulick, 1904**
(Map 12, Fig. 11)

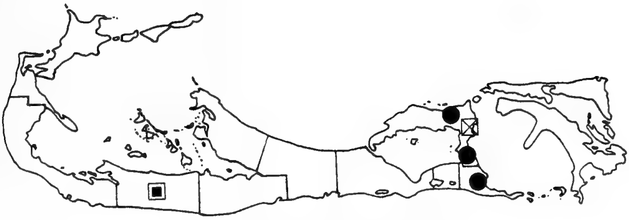
Vertigo numellata Gulick, 1904: 413-414, pl. 36, fig. 6 (Bermuda, fossil).

Vertigo numellata, - Verrill, 1906: 170, fig. 54c (type); Vanatta, 1911: 666; Pilsbry, 1919: 91, pl.13, figs. 14, 15; Vanatta, 1924: 7; Peile, 1926: 88; Hughes, post 1969: 1; Gould, 1970b: 490, fig. 1e.

Bermuda Material Studied: ANSP 85583, 91158, 105611, 85583; BAMZ 1995-132-003; FMNH 224903; MCZ Gould Station 1 (fossil), Gould Station 4 (fossil),



Map 11. *Vertigo marki.*



Map 12. *Vertigo numellata.*

Gould Station 11 (fossil), Gould Station 21 (fossil), Gould Station 21b (fossil), Gould Station 30 (fossil), Gould Station 41 east (fossil), Gould Station 48 (fossil), Gould Station 63 lower (fossil), Gould Station 73 (fossil).

Note: *Endemic* - Originally described from fossil material, this is the most common living *Vertigo* species on Bermuda. Recent specimens were first reported by Vanatta (1911) from collections by Stewerdson Brown (ANSP 91158). Although previously considered similar to *Vertigo oralis* Sterki, 1898 (Pilsbry, 1919), and *V. ovata* Say, 1822 (Gulick, 1904), the strong contraction and large oblique crest behind the shell aperture as well as the long lower palatal fold indicate this species' close affinity with *V. bermudensis*. Both *V. numellata* and *V. bermudensis* have been collected around caves and not along the margins of wetlands as would be expected of *V. oralis* or *V. ovata*. Shells of *V. numellata* differ only slightly from those of *V. bermudensis*, having less deeply impressed sutures, larger size and a stronger basal fold.

STROBILOPSIDAE

Strobilops hubbardi **(A. D. Brown, 1861)**

(Map 13, Fig. 12)

Helix Hubbardi A. D. Brown, 1861: 333, figs. 1, 2 (Texas).

Strobilops hubbardi, - Gulick, 1904: 413 (fossil); Verrill, 1906: 169 ("not known as a recent shell in Bermuda"); Vanatta, 1911: 666; Vanatta, 1912: 12; Vanatta, 1924: 7; Peile, 1926: 89 (fossil); Pilsbry, 1948: 865-868; Gould, 1970b: 490, fig. 1g (fossil).

Strobilops pilsbryi Morrison, 1953: 53-54, pl. 6, figs. 1-3 (Bermuda), **new synonymy.**

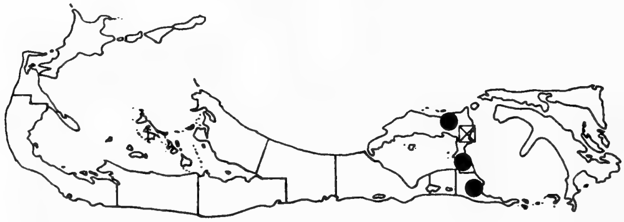
Bermuda Material Studied: BAMZ 1995-133-009; FMNH 227033; MCZ Gould Station 4 (fossil), Gould Station 21b (fossil), Gould Station 30 (fossil), Gould

Figure 12. *Strobilops hubbardi.* - BAMZ 1995-133-009, Bermuda; diameter = 2.7 mm.

Station 41 east (fossil), Gould Station 63 (fossil); USNM 251195 (paratypes of *Strobilops pilsbryi*). Only one empty shell was located in this latest survey (FMNH 226908, Walsingham Pond).

Note: *Native Non-Endemic* - This species ranges over southeastern North America from coastal Georgia south to Central America and east to Jamaica, Cuba and the Bahamas (Pilsbry, 1948).

Adult *Strobilops hubbardi* specimens from Bermuda usually have four basal



Map 13. *Strobilops hubbardi.*

lamellae and a weak columellar lamella. Morrison (1953), citing the presence of this columellar lamella, larger shell size and umbilical width, described *Strobilops pilsbryi* as endemic to Bermuda. However, mainland populations of *Strobilops hubbardi* also contain individuals with such lamellae (UF 110589). Furthermore, there is ontogenetic variation in the number and strength of lamellae in *Strobilops hubbardi* (UF 110593). Only the second and fourth basal lamellae are found in many immature individuals (see Pilsbry, 1948, p. 849, for numbering and terminology of *Strobilops* lamellae). Four lamellae are found in most adults, however some adults do not develop all lamellae (see Pilsbry, 1948, fig. 468). The columellar lamella is the smallest and latest lamella to develop. The prevalence of this structure in the Bermuda populations is likely due to the high calcium content of many of Bermudas soils allowing complete and pronounced development of apertural barriers.

This species is usually found on rotting logs and branches in open woods.

VALLONIIDAE

Vallonia pulchella (Müller, 1774)

(Map 14, Fig. 13)

Helix pulchella Müller, 1774: 30-31 (Europe).

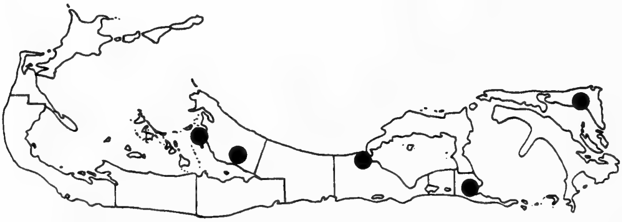
? *Helix paludosa* da Costa, 1778: 59 [see Gerber, 1996: 68; Gerber erroneously stated "Locus typicus?"; however, da Costa (1778: 59) clearly indicated several localities in Britain, "in Oxendon and Arthingworth, in Northamptonshire"];
? *Helix palludosa* [*sic*; no author given], - Prime, 1853: 55; Jones, 1859: 106 [citing Prime];
? *Helix paludosus* Say [*sic*]—Tristram, 1861: 405;
Helix putchella [*sic*] Müller, - Rein, 1867: 77;
Helix pulchella, - Jones, 1876: 138; Bland, 1881: 256; Bland, 1895: 271;
Helix (Vallonia) pulchella, - Heilprin 1889: 182;
Vallonia pulchella, - Sterki, 1893: 278; Pilsbry, 1900: 495; Verrill, 1902: 732, 733, fig.; Bryant, 1905: 129-130; Vanatta, 1911: 665-666; Peile, 1926: 89; Pilsbry, 1948: 1023-1025; Glaubrecht, 1990: 218; Gerber, 1996: 56 [based on Pilsbry, 1948].

Bermuda Material Studied: BAMZ 1995-132-005.

Note: *Accidentally Introduced* - "*Helix paludosa*" of Prime's (1853) list and "*Helix paludosus*" Say of Tristram's list (1861) probably refer to this species rather than to

Figure 13. *Vallonia pulchella*. – BAMZ 1995-132-005, Bermuda; diameter = 2.3 mm.

Polygyra plana (Dunker, 1843) as surmised by Pilsbry (1900). The source of this confusion stems from Prime's omission of the species authority for his record of *Helix paludosa*. Tristram later amended Prime's record to *paludosus* and erroneously attributed it to Say. Unfortunately, *H. paludosa* has two homonyms: *Helix paludosa* Pfeiffer, 1839, was associated with *Polygyra plana* (Dunker, 1843) by Pilsbry (1900: 506), while *Helix paludosa* da Costa, 1778, is a synonym of *Vallonia excentrica* Sterki, 1893, a species very similar to and often confused with *V. pulchella*. Both *Vallonia pulchella* and *Polygyra plana* are found on Bermuda. Pilsbry may have overlooked *H.*



Map 14. *Vallonia pulchella*.

paludosa da Costa when he concluded that the early authors were looking at *Polygyra plana*. This view is supported by the fact that Tristram recorded both *paludosa* and *microdonta* (see *Polygyra plana* synonymy).

Vallonia excentrica ranges over much of the Northern Hemisphere. In North America it is native to the Northeast from southern Ontario (Oughton, 1948) to Missouri (Hubricht, 1985), and has been introduced to Texas, New Mexico, the Rocky Mountain States, California, and Oregon (Bequaert & Miller, 1973). It is found in open areas including meadows, marshes and sand dunes (Kerney & Cameron, 1979), as well as on roadsides and lawns (Hubricht, 1985), usually under cover of boards, wood or on house foundations and other cement structures.

Figure 14. *Cecilioides acicula*. - BAMZ 1995-133-002, Bermuda; height = 4.3 mm.

ACHATINOIDEA

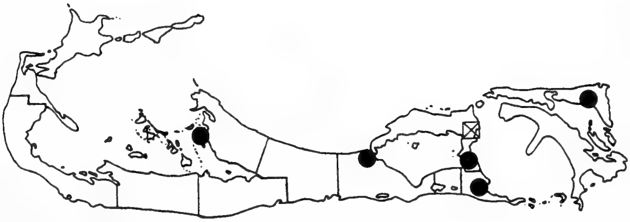
FERUSSACIIDAE

Cecilioides acicula (Müller, 1774)

(Map 15, Fig. 14)

Buccinum acicula Müller, 1774: 150-151 (Europe).

Bulimus acicula, - Bland, 1861: table 2;
Achatina acicula, - Bland, 1861: 351;
Cionella acicula, - Jones, 1876: 139; Bartram, 1878: 108; Bland, 1881: 256;
Caecilianella acicula, - Kobelt, 1880: 257, 286; Glaubrecht, 1990: 218.
Caecilianella (Cionella) acicula, - Heilprin, 1889: 183;
Coecilianella acicula, - Bland, 1895: 271;



Map 15. *Cecilioides acicula*.

Cecilioides acicula, – Bryant, 1905: 130; Pilsbry, 1946: 185, 186;
Caecilioides acicula, – Pilsbry, 1900: 497; Verrill, 1902: 731, 732, fig. 78a; Vanatta, 1911: 665-667; Peile, 1926: 90; Abbott, 1989: 84, fig.

Bermuda Material Studied: BAMZ 1995-133-002; FMNH 227024.

Note: *Accidentally Introduced* - First recorded in Bermuda by Bland in 1861, this small snail is native to Europe. Its burrowing habits might explain the small number of collection records on Bermuda and its easy transport between greenhouses and plant nurseries across the world.

SPIRAXIDAE

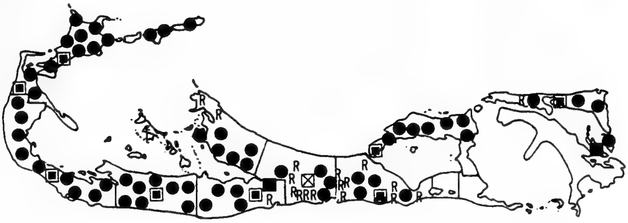
Euglandina rosea (Férussac, 1821)

(Map 16, Fig. 15)

Helix (Cochlicopa) rosea Férussac, 1821: 50 [or p. 54, depending on issue] (Florida).

Euglandina rosea, – Bennett & Hughes, 1959: 432; Hughes, 1962; Hughes, 1963; Simmonds & Hughes, 1963: 219 ff.; Hughes, post 1968: 1; Monkman, 1982a: 1; Monkman, 1982b: 71; Cock, 1985: 138; Glaubrecht, 1990: 221, fig. 11.

Figure 15. *Euglandina rosea*. – left: BAMZ 1994-118-010, Pembroke Parish, height = 48.6 mm; right: FMNH 224776, Paget Parish, Bermuda, height = 50.0 mm.



Map 16. *Euglandina rosea.*

Bermuda Material Studied: BAMZ 1998-166-002, 1998-166-005, 1998-166-026, 1998-166-039, 1998-166-046, 1998-166-051; DMNH 210302, 210308, 210316, 210323, 210338; FMNH 224761, 224792, 224814, 224831, 224844, 224853, 224855, 224861, 224866, 224869, 224879, 224896, 224905, 224913, 224920, 227001.

Note: *Intentionally Introduced* - This native of the southeastern United States was introduced on many islands of the Pacific as a biological control against the agricultural pest snail *Achatina fulica. Euglandina rosea* specimens – mostly from Florida (Davis & Butler, 1964), not from Cuba as stated by Cock (1985) – were released in the Hawaiian Islands in 1955 and were established there by 1957 (Krauss, 1964). In 1958, the Bermuda Department of Agriculture received a shipment of about 50 adult *Euglandina rosea* from Hawaii via the West Indian Station CIBC (Commonwealth Institute of Biological Control) in Trinidad to breed and release in efforts to control *Otala lactea* and, secondarily, *Rumina decollata*, two accidentally introduced horticultural pests. Later that year, after brief tests to ascertain that *Euglandina* would consume *Rumina*, *Otala* and other local snails when captive with them, *Euglandina rosea* was released on Bermuda. Between January and April of 1958, 329 snails were released, and by 1960, a total of 841 animals had been set free (Hughes, 1962 unpubl.). Releases of specimens received via Hawaii and Trinidad continued for a few more years. By 1962, the Department of Agriculture reported "excellent control of *Otala lactea* [had] been achieved." At that time, *E. rosea* had become so abundant that the Department exported nearly 1,000 specimens to various countries, ranging from the Bahamas to India (Hughes, 1962 unpubl.). Although ultimately failing to control either *Otala* or *Rumina*, *Euglandina* has become widespread in Bermuda and might be responsible for the decline of several of Bermuda's native snails, including the members of the now nearly extinct endemic genus *Poecilozonites*.

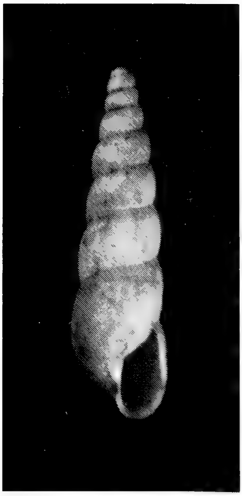


Figure 16. *Allopeas gracile.* – FMNH 227044, Sandy's Parish, Bermuda; height = 10.8 mm.

Figure 17. *Allopeas micrum.* – FMNH 30195, St. George's Parish, Bermuda; height = 6.3 mm.

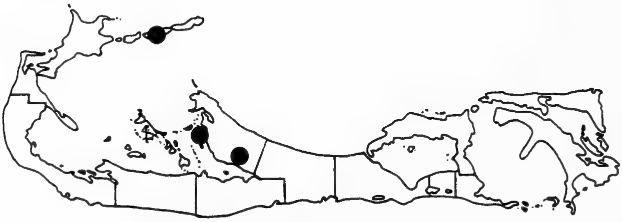
SUBULINIDAE

Allopeas gracile (Hutton, 1834)

(Map 17, Fig. 16)

Bulimus? gracilis Hutton, 1834: 84, 93 (India).

Opeas gracile, – Vanatta, 1911: 666-667; Peile, 1926: 90;
Opeas (Opeas) gracile, – Haas, 1952: 104;
Allopeas gracile, – Naggs, 1992: 258-259; ICZN, 1994: 162-163; Naggs, 1994: 187.



Map 17. *Allopeas gracile.*

Bermuda Material Studied: BAMZ 1994-118-016; FMNH 227044.

Note: *Accidentally Introduced* - Probably originally from the Neotropical region (Solem, 1964: 134), *Allopeas gracile* has been introduced worldwide in cultivated areas of the tropics and in greenhouses and was first described from India. Deisler & Abbott (1984: 13) stated that this "species probably is the most widely distributed land snail." In North America, this species is found from South Carolina to Texas (Karlin & Naegele, 1966; Dundee, 1970).

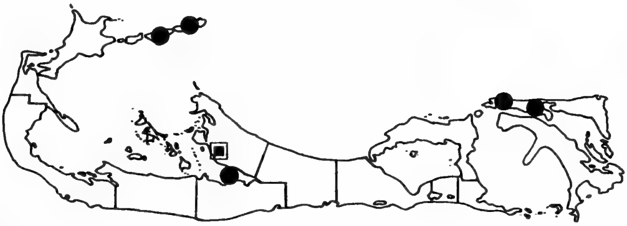
Allopeas micrum (Orbigny, 1835)
(Map 18, Fig. 17)

Helix micra Orbigny, 1835: 9 (Central America).

Opeas octonoides (C. B. Adams, 1845), - Pilsbry, 1900: 497; Verrill, 1902: 732 [*Bulimus octonoides* C. B. Adams, 1845, *non Bulimus octonoides* Orbigny in Sagra, 1841];
Opeas micra, - Vanatta, 1911: 666-667; Peile, 1926: 90;
Opeas (Opeas) micrum, - Haas, 1952: 104.

Bermuda Material Studied: FMNH 30194, 30195.

Note: *Accidentally Introduced* - Probably native to Central America, the West Indies, and northern South America, this species has been introduced into the southeastern United States and the Bahamas (Deisler & Abbott, 1984). On Bermuda, *Allopeas micrum* was first collected by the Heilprin party in 1888, but not included in their publication of 1889 (Pilsbry, 1900). This species is often found near greenhouses and in urban areas.



Map 18. *Allopeas micrum*.

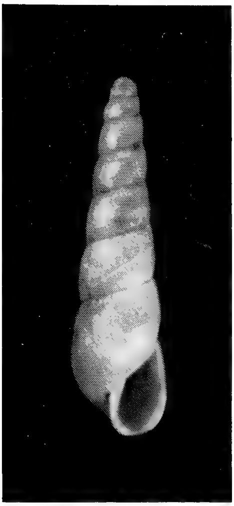


Figure 18. *Opeas hannense*. – FMNH 278023, St. George's Parish, Bermuda; height = 9.2 mm.

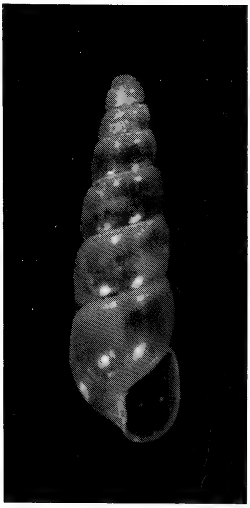


Figure 19. *Obeliscus swiftianus*. – FMNH 30197, St. George's Parish, Bermuda; height = 7.3 mm.

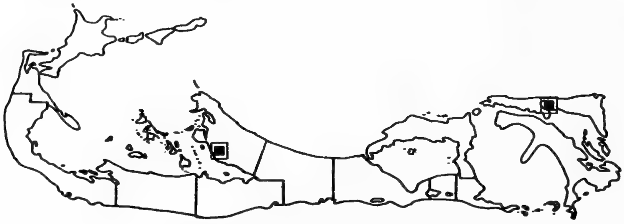
Opeas hannense **(Rang, 1831)** **NEW RECORD**

(Map 19, Fig. 18)

Helix hannensis Rang, 1831: 41-42, pl. 3, fig. 8 (Cape Vert peninsula, Senegal).

Opeas hannensis [*sic*] (Rang, 1831), – Proschwitz, 1983: 283; Proschwitz, 1994: 184.

Bermuda Material Studied: FMNH 278023 (Mullet Bay Park), 227034 (city of Hamilton).



Map 19. *Opeas hannense*.

Note: *Accidentally Introduced* - A native of the New World tropics, this species is now widely distributed. In North America it has been introduced to southern Florida and greenhouses in New York, Pittsburgh and Chicago (Pilsbry, 1946). *Bulimus pumilus* Pfeiffer, 1840, first described from Cuba, is a synonym (Proschwitz, 1994: 184). This species is here recorded from Bermuda for the first time.

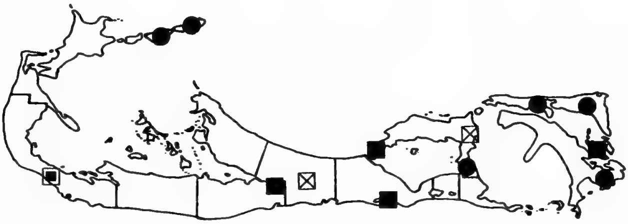
Obeliscus swiftianus (Pfeiffer, 1852)
(Map 20, Fig. 19)

Bulimus Swiftianus Pfeiffer, 1852: 150 (St. Thomas).

Opeas swiftianum, - Pilsbry, 1900: 497, pl. 62, fig.5; Verrill, 1902: 731, 732, fig. 78;
Obeliscus swiftianus, - Vanatta, 1911: 665; Vanatta, 1923: 33; Peile, 1926: 90.

Bermuda Material Studied: BAMZ 1998-166-004, 1998-166-018, 1998-166-024, 1998-166-031, 1998-166-045, 1998-166-077, 1998-166-082, 1998-166-085, 1998-166-086, 1998-166-087; DMNH 210251, 210252, 210264, 210278, 210282; FMNH 3632, 13493, 29794, 30197, 224773, 224811, 224812, 224822, 224835, 224846, 224857, 224863, 227023, 295082.

Note: *Accidentally Introduced* - Like the previous two species, *Obeliscus swiftianus* is native to the American tropics and has been widely distributed through commerce. This species was collected by the Heilprin expedition but not included in their 1889 publication (Pilsbry, 1900). *Obeliscus swiftianus* is usually found under cover in urban areas and near horticulture.



Map 20. *Obeliscus swiftianus*.

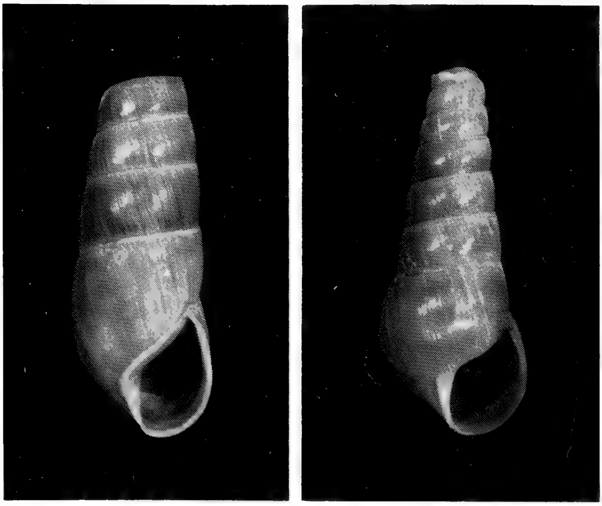
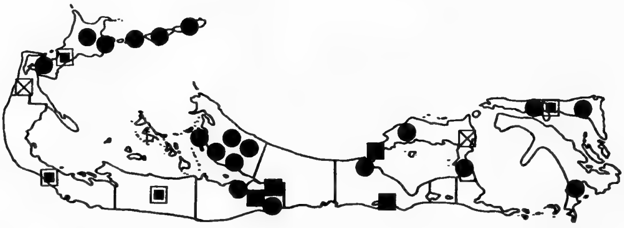


Figure 20. *Rumina decollata*. - FMNH 224777; Paget Parish, Bermuda; left: height = 28.5 mm; right (subadult): diameter = 18.4 mm.

Rumina decollata (Linné, 1758)
(Map 21, Fig. 20)

Helix decollata Linné, 1758: 773 (Europe).

Subulina decollata, - Bartram, 1878: 108;
Bulimulus decollatus, - Heilprin, 1889: 183; Frith, 1891: 14; Peniston, 1891: 21;
Stenogyra decollata, - Aldrich, 1889: 9; Lane, 1891: 3; Bland, 1895: 271;



Map 21. *Rumina decollata*.

Rumina decollata, – Riley & Howard *in* Hastings, 1892: 334; Johnson, 1900: 117; Pilsbry, 1900: 496; Verrill, 1902: 730, 731, figs. 75a-c, 76a, b, 79e; Vanatta, 1911: 665-668; H. H. Smith, 1912: 4; Honigmann, 1914: 376; Vanatta, 1923: 33; Peile, 1926: 90; Pilsbry, 1946: 170-172; Bennett & Hughes, 1959: 432; Simmonds & Hughes, 1963: 219-220; Monkman, 1982a: 1; Monkman, 1982b: 71; Bennett et al., 1985: 138; Cock, 1985: 138.

Bermuda Material Studied: BAMZ 1998-166-007, 1998-166-013, 1998-166-040, 1998-166-058, 1998-166-062, 1998-166-065, 1998-166-076, 1998-166-099, 1998-166-105, 1998-166-108, 1998-166-110; DMNH 210271, 210294, 210300, 210313, 210324, 210337; FMNH 3630, 8670, 8836, 13501, 13527, 13531, 13537, 13556, 13582, 13591, 13679, 13686, 16473, 16474, 29793, 41014, 112230, 135326, 216093, 224755, 224762, 224793, 224794, 224826, 224839, 224870, 224889, 224900, 224907, 227057, 227008, 227009, 227027.

Note: *Accidentally Introduced - Rumina decollata*, a ground dweller, is often found in gardens and orchards and is among the most common of Bermuda's snails. *Rumina decollata* is a common pest species introduced worldwide to subtropical areas, and is well established in the southern U.S. (Dundee, 1970). This native of the Mediterranean region is believed to have been introduced on plants from Madeira or the Cape Verde Islands by Bermuda Governor John H. Lefroy in the late 1870s (Frith, 1891: 16). By 1879, *Rumina* was abundant in Hamilton (Aldrich, 1889: 9, cited it as "so common it threatens to become injurious to the crops there"), and a few years later Hastings (1892: 334) described it as "literally eating up the island." By the 1950s it was common throughout the larger islands of Bermuda and considered a minor crop pest. Efforts were made by the Bermuda Department of Agriculture to biologically control crop pests including *Rumina decollata* using several species of predatory snails (Bennett & Hughes, 1959). Although original reports were promising (Simmonds & Hughes, 1963), later Bermuda Department of Agriculture surveys found little or no evidence of control (Monkman, 1982a). Fisher *et al.* (1980) showed that this omnivorous species itself is a predator of half-grown Brown Garden Snails in California ("*Helix*" *aspersa* Müller, 1774; recently placed in genus *Cantareus* by Giusti *et al.*, 1995: 491). *Rumina decollata* is still advocated as a control agent in California's citrus industry (UC-IPM, 1999). Its impact on Bermuda's native snail population is unknown.

Subulina octona (Bruguière, 1789)
(Map 22, Fig. 21)

Bulimus octonus Bruguière, 1789: 325 (Antilles).

? "*Achatina aetona* [*sic*] "Chemnitz", – Prime, 1853: 76;
Stenogyra octona, – Bland, 1881: 256; Aldrich, 1889: 9; Heilprin, 1889: 183; Bland, 1895: 271;
Subulina octona, – Pilsbry, 1900: 497, pl. 62, fig. 4; Verrill, 1902: 731, 732, fig. 77; Vanatta, 1911: 665-667; Peile, 1926: 90.

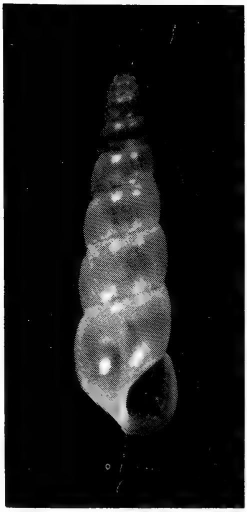
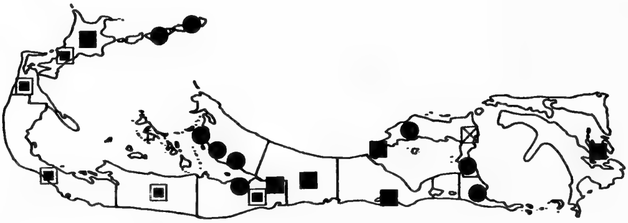


Figure 21. *Subulina octona*. – FMNH 224890, Southampton Parish, Bermuda; height = 13.3 mm.

Bermuda Material Studied: BAMZ 1998- 166-006, 1998- 166- 011, 1998- 166- 019, 1998- 166-020, 1998- 166- 023, 1998- 166- 028, 1998- 166-037, 1998- 166- 061, 1998- 166- 071, 1998- 166-072, 1998- 166- 073, 1998- 166- 078, 1998- 166-090, 1998- 166- 103, 1998- 166- 112, 1998- 166-125; DMNH 210242, 210247, 210257, 210267, 210283, 210285, 210286, 210297, 210298, 210305, 210309, 210311, 210326; FMNH 104119, 224770, 224771, 224783, 224803, 224804, 224827, 224843, 224852, 224854, 224860, 224860, 224862, 224865, 224874, 224890, 224901, 224908, 227010, 227011, 227020, 227026.

Note: *Accidentally Introduced* – *Subulina octona* often is listed as a native of Latin America (Robinson, 1999), but other species of this genus are native to Africa. *Subulina octona* is now widely distributed in tropical areas, including southern Florida and the Bahamas (e.g., Deisler & Abbott, 1984). It was first recorded in Bermuda by Bland in 1881 and is now found throughout the larger islands of Bermuda under boards, garbage and stones.



Map 22. *Subulina octona*.

STREPTAXOIDEA

STREPTAXIDAE

Gonaxis kibweziensis (E. A. Smith, 1894)

(Fig. 22)

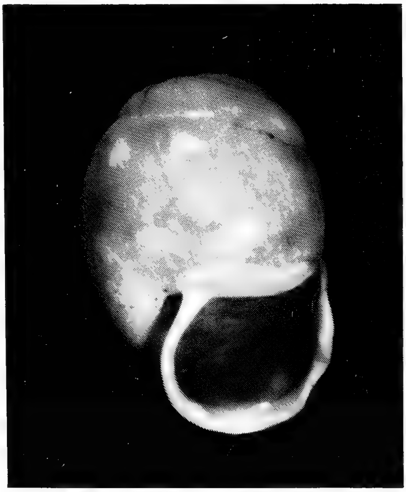


Figure 22. *Gonaxis kibweziensis*. – BPBM 217478, Marianas Islands; height = 19.8 mm.

Streptaxis Kibweziensis E. A. Smith, 1894: 165, 166, fig. 1 (Kenya).

Gonaxis (*Streptaxis*) *kibweziensis*, – Simmonds & Hughes, 1963: 222;
Gonaxis kibweziensis, – Monkman, 1982a: 1; Cock, 1985: 138;
Eustreptaxis kibweziensis, – Richardson, 1988: 198.

Bermuda Material Studied: None.

Note: *Intentionally Introduced* - This predatory snail was brought to Hawaii in 1952 from Diana Beach, Kenya by Hawaii's Department of Agriculture (Krauss, 1964) in attempts at controlling populations of the introduced Giant African Snail, *Achatina fulica* Bowdich, 1822. In 1959, about one hundred *Gonaxis kibweziensis* specimens were sent from Hawaii via the West Indian Station CIBC (Commonwealth Institute of Biological Control) to Bermuda's Department of Agriculture to be used to control *Otala lactea* and *Rumina decollata*. In 1960, these snails were released at four sites (Simmonds & Hughes, 1963). Subsequent monitoring of these sites by Bermuda's Department of Agriculture has failed to recover individuals of this species (Monkman, 1982a), as has this survey.

Gonaxis quadrilateralis (Preston, 1910)

(Map 23, Fig. 23)

Ennea quadrilateralis Preston, 1910: 527, pl. 7, fig. 2 (British East Africa [Kenya]).

Gonaxis quadrilateralis, – Hughes, post 1968: 1; Monkman, 1982a: 1; Monkman 1982b: 71; Cock 1985: 138;

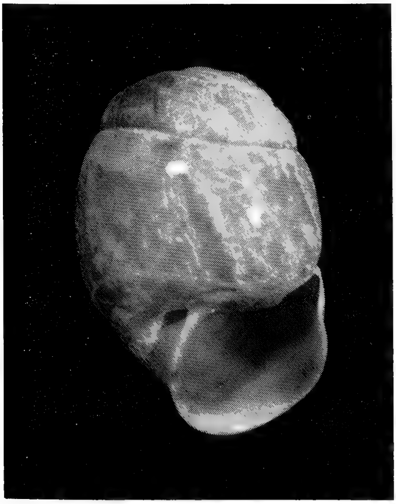


Figure 23. *Gonaxis quadrilateralis.* – Bermuda Department of Agriculture, now BAMZ; Bermuda; height = 25.0 mm.

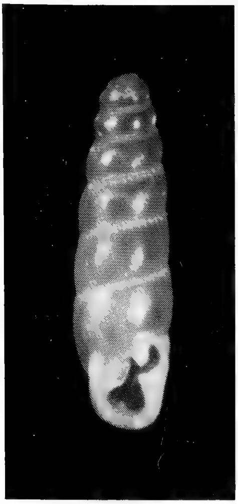
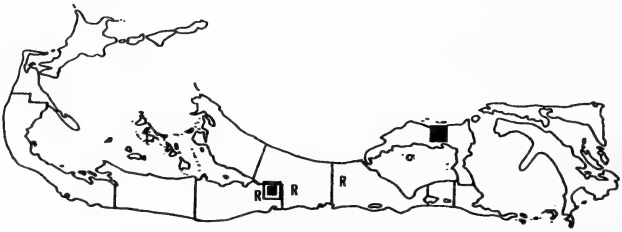


Figure 24. *Gulella bicolor.* – ANSP 48654, ex Heilprin Expedition 1888, Bermuda; height = 6.7 mm.

Eustreptaxis quadrilateralis, – Richardson, 1988: 202.

Bermuda Material Studied: BAMZ 1995-127-012, 1998-166-014, 1998-166-088; DMNH 210276; FMNH 224785, 227036, 227037, 227038.

Note: *Intentionally Introduced* - Like the previous species, *Gonaxis quadrilateralis* was introduced to Bermuda from Hawaii by the Bermuda Department of Agriculture. G. *quadrilateralis* was collected from Kwale, Kenya, and brought to Hawaii in 1957 in attempts to control *Achatina fulica* (see Krauss, 1964). In 1968 and again in 1972, G. *quadrilateralis* specimens sent from Hawaii were released at eight sites on



Map 23. *Gonaxis quadrilateralis.*

Bermuda in continuing efforts at controlling *Rumina decollata* and *Otala lactea*. [Cock (1985: 138) cited 260 specimens obtained from Hawaii in 1968 and 1972]. Since that time, G. *quadrilateralis* individuals have been collected at several of the original release sites (Monkman, 1982a). This study records the first spread of G. *quadrilateralis* beyond the original release sites.

Gulella bicolor (Hutton, 1834)
(Fig. 24)

Pupa bicolor Hutton, 1834: 86, 93 (India).

Ennea bicolor, - Pilsbry, 1900: 499; Verrill, 1902: 732;
Huttonella bicolor, - Peile, 1926: 90;
Gulella bicolor, - Naggs, 1989: 165-168 (discussion of generic placement).

Bermuda Material Studied: ANSP 48654.

Note: *Accidentally Introduced* - Native to the Indian subcontinent (Naggs, 1989), this species has been introduced around the world in the tropics and subtropics including the southeastern United States (Dundee, 1970; Auffenberg & Stange, 1986) and Caribbean (van der Schalie, 1948). Records of this species on Bermuda are based on a single shell (ANSP 48654), collected by the Heilprin party in 1888 and first mentioned in publication by Pilsbry in 1900. The species was not found in the present survey and may not be established on Bermuda (note, however, that its burrowing habits make it difficult to find).

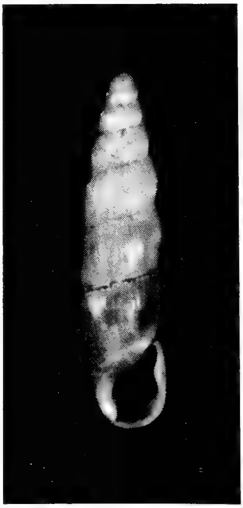
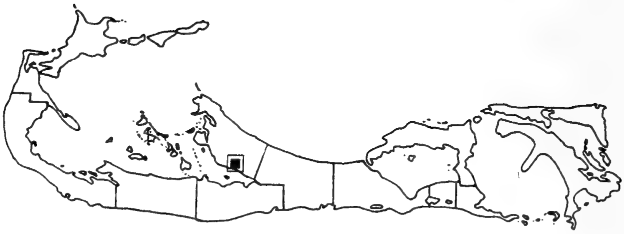


Figure 25. *Streptostele musaecola*. - FMNH 227045, Paget Parish, Bermuda; height = 6.0 mm.

Streptostele musaecola (Morelet, 1860) NEW RECORD
(Map 24, Fig. 25)

Achatina musaecola Morelet, 1860: 190 (Guinea).

Bermuda Material Studied: FMNH 227045.



Map 24. *Streptostele musaecola.*

Note: *Accidentally introduced* - Originally described from West Africa, this species was accidentally introduced to several islands in the Pacific (Solem, 1989). A specimen from the city of Hamilton (FMNH 227045), collected in 1992, is the first record of this species from the western Atlantic region.

RHYTIDOIDEA

RHYTIDIDAE

Natalina cafra (Férussac, 1821)

(Map 25, Fig. 26)

Helix (Helicophanta) cafra Férussac, 1821: 25 [or p. 29, depending on issue] (South Africa).

Natalina cafra, - Simmonds & Hughes, 1963: 221;
Natalina caffra [*sic*] - Hughes, 1962; Hughes, 1963; Hughes, post 1968: 1; Monkman, 1982a: 1; Cock, 1985: 138.

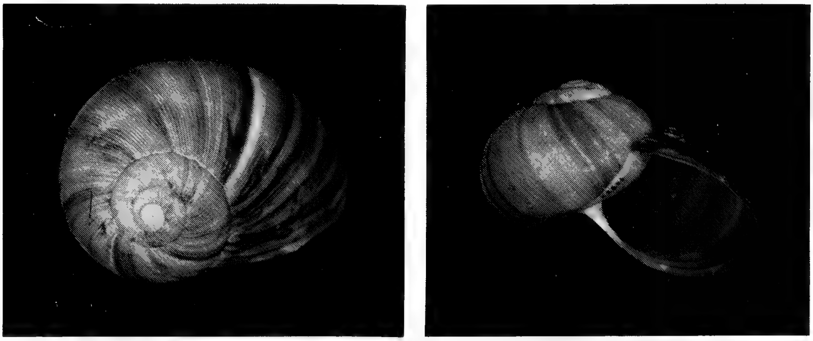
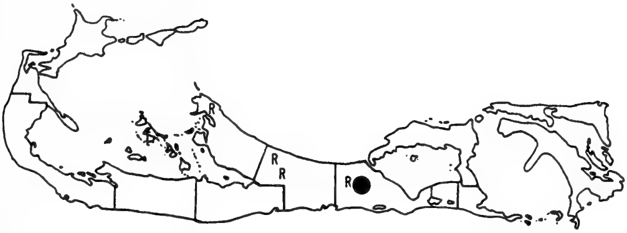


Figure 26. *Natalina cafra.* - left: FMNH 199492, Natal, South Africa, diameter = 65.4 mm; right: FMNH 76882, South Africa, diameter = 70.1 mm.



Map 25. *Natalina cafra.*

Bermuda Material Studied: None.

Note: *Intentionally Introduced* - About sixty individuals of this South African species were released in Smith's Parish on Bermuda beginning in 1960, as part of continuing efforts to control populations of *Otala* and *Rumina* (Simmonds & Hughes, 1963; Hughes, post 1968). Shipments were discontinued in 1962 when surveys recorded only one live individual at Bermuda's Arboretum, one of the original release sites (Hughes, unpubl. reports for 1962, 1963). Since that time no additional individuals have been recorded (Monkman, 1982a).

ARIONOIDEA

PUNCTIDAE

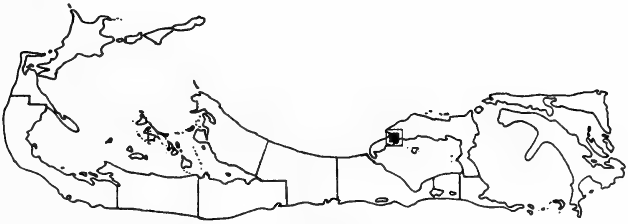
Punctum bristoli (Gulick, 1904) NEW EXTANT RECORD

(Map 26, Fig. 27)

Zonitoides bristoli Gulick, 1904: 421, pl. 36, fig. 13 (Bermuda, fossil).

Zonitoides bristoli, – Verrill, 1906: 168, fig. 51 (after Gulick; fossil); Vanatta, 1912: 12 (fossil); Hughes, post 1969: 1 (fossil); Gould, 1970b: 491, fig. 1f (fossil);

Punctum bristoli, – Vanatta, 1924: 7 (fossil);



Map 26. *Punctum bristoli.*

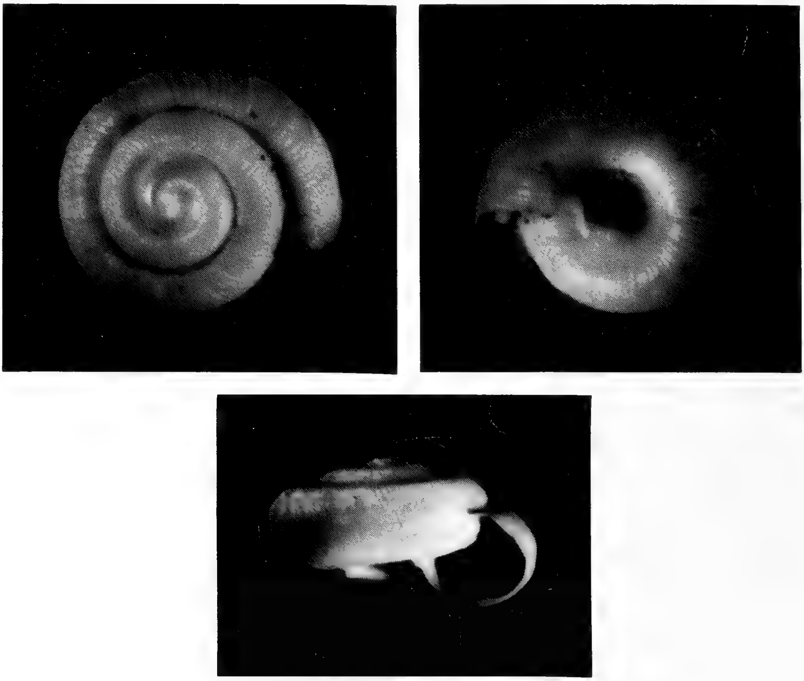


Figure 27. *Punctum bristoli.* - BAMZ 1995-132-013, Bermuda, diameter = 1.28 mm.

Punctum (?) bristoli, - Peile, 1926: 89 (fossil).

Bermuda Material Studied: ANSP 85572 (fossil); BAMZ 1995-132-013 (fossil); FMNH 227042; MCZ Gould Station 1 (fossil), Gould Station 4 (fossil), Gould Station 21 (fossil), Gould Station 21b (fossil), Gould Station 41 east (fossil), Gould Station 48 (fossil), Gould Station 63 (fossil).

Note: *Endemic* - This study records the first Recent specimens of this small-shelled species (FMNH 227042). Pleistocene specimens are commonly found in siftings from Bermuda's fossil deposits. The lack of Recent records of this species is probably due to insufficient efforts to sort such micromollusks from soil and leaf litter samples.

HELICODISCIDAE

Helicodiscus singleyanus (Pilsbry, 1889)

(Map 27, Fig. 28)

---, Pilsbry, 1888: pl. 17, figs., M, M, M;
Zonites singleyanus Pilsbry, 1889: 84 (Texas).

Zonitoides singleyanus, - Peile, 1926: 89.

Bermuda Material Studied: FMNH 227047.

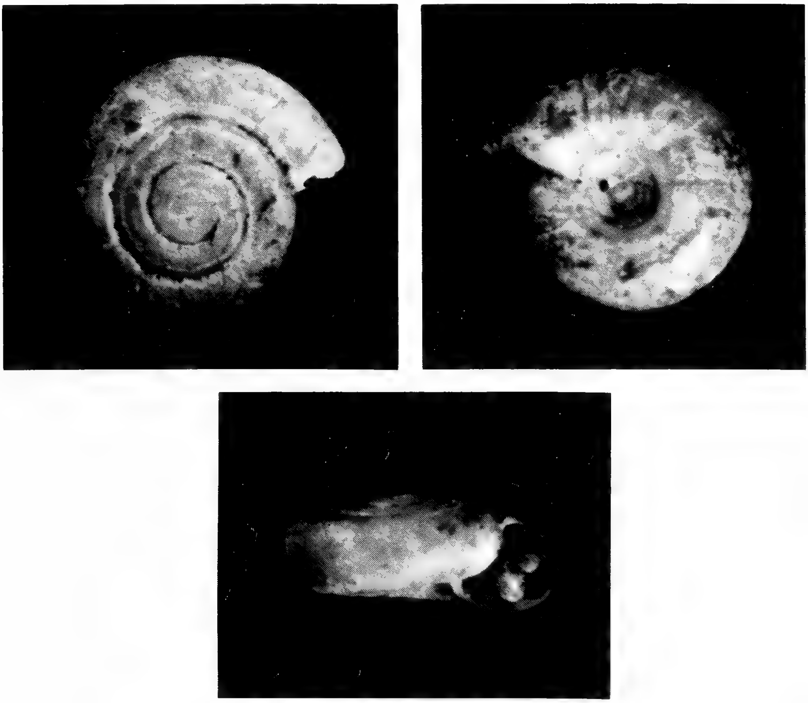
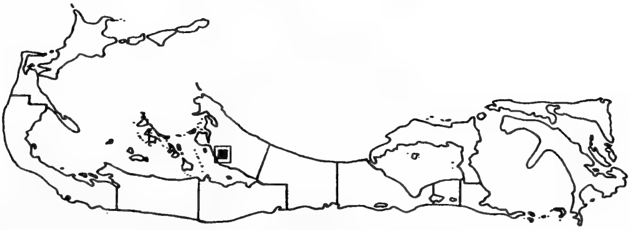


Figure 28. *Helicodiscus singleyanus*. - FMNH 227047, Paget Parish, Bermuda; diameter = 2.0 mm.



Map 27. *Helicodiscus singleyanus*.

Note: *Accidentally Introduced* – Native to eastern and central North America (Hubricht, 1985), this species has been introduced throughout Europe and into North Africa (Seddon & Holyoak, 1993). It is subterranean and can be sifted from loose soil around the roots of grasses and herbaceous plants along roadsides and other open areas. This elusive species was previously recorded from Bermuda only by Peile (1926). The present survey found one specimen in the city of Hamilton (FMNH 227047). Like other soil-inhabiting species, *Helicodiscus singleyanus* is probably much more common than the sparse records indicate.

SUCCINEOIDEA

SUCCINEIDAE

Succinea bermudensis Pfeiffer, 1857

(Map 28, Fig. 29)

Succinea bermudensis Pfeiffer, 1857: 110 (Bermuda).

Succinea ---, Redfield, 1853: 17; Tristram, 1861: 405;
Succinea Bermudensis Prime, 1853: 55 [*nomen nudum*];
Succinea Bermudensis Jones, 1859: 107 [*nomen nudum*; based on Prime's list, but erroneously indicated as "n.s."];

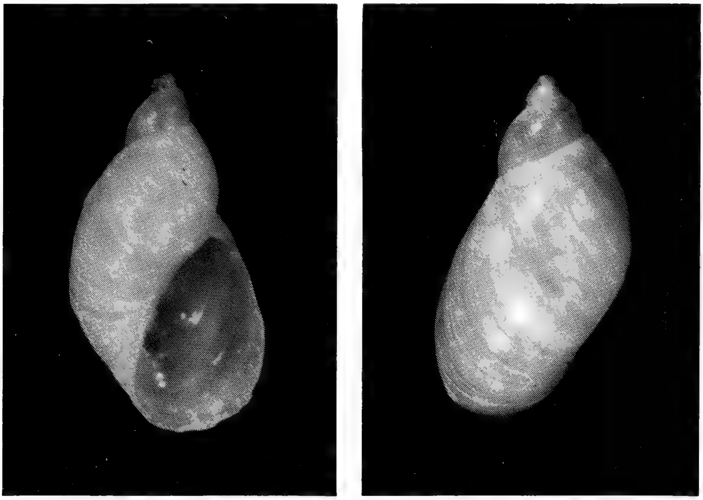


Figure 29. *Succinea bermudensis*. – BAMZ 1995-132-006, Bermuda; left, height = 12.6, right, height = 12.0 mm.

Succinea bermudensis, – Pfeiffer, 1859: 817; Bland, 1861: table 2, p. 351; Rein, 1867: 76; Jones, 1876: 139; Mörch, 1878: 3; Kobelt, 1880: 286; Bland, 1881: 256 E. A. Smith, 1884: 277; Heilprin, 1889: 182; Bland, 1895: 270; Gulick, 1904: 421; Davis, 1904: 125; Verrill, 1906: 171; Vanatta, 1911: 665-668; Peile, 1926: 91; Tomlin, 1932: 98-100, figs. C, D; Hughes, post 1968: 1; Gould, 1970b: 500 (fossil);

Succinea fulgens Lea, – Bland, 1861: table 2, p. 351; Jones, 1876: 139; Kobelt, 1880: 286; Bland, 1881: 256; Heilprin, 1889: 182; Bland, 1895: 270 [*non Succinea fulgens* Lea, 1841];

Succinea margarita Pfeiffer, – Bland, 1861: 351; Jones, 1876: 139; Kobelt, 1880: 286; Bland, 1881: 256; Heilprin, 1889: 182; Bland, 1895: 270, table 2 [*non Succinea margarita* Pfeiffer, 1853];

Succinea texasiana Pfeiffer, 1848, – Jones, 1864: 9 [*non Succinea texasiana* Pfeiffer, 1848];

Sucinea [*sic*] *putris*, – Bartram, 1878: 108 [*non Helix putris* Linné, 1758: 774];

Succinea barbadensis Guilding, 1828, – Pilsbry, 1900: 502; Verrill, 1902: 729, 732, 733, figs. 80a, b; Vanatta, 1923:33; [? *non Succinea barbadensis* Guilding, 1828];

Succinea (*Tapada*) *bermudensis*, – Clessin in Pfeiffer, 1879: 416;

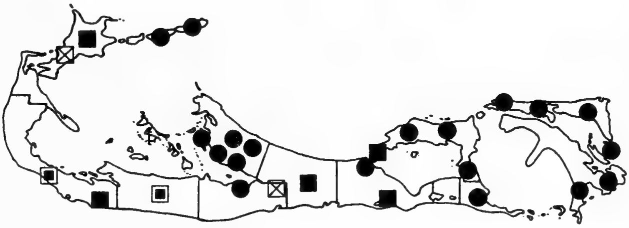
Succinea gabrieli Tomlin, 1932: 99-100, figs, A, B, pl. 9A (Bermuda);

Succinea barbadensis "Gould", – Kutchka, 1934: 295;

Succinia [*sic*] *bermudensis*, – Hughes, post 1969: 1.

Bermuda Material Studied: BAMZ 1998-166-052, 1998-166-057, 1998-166-113; DMNH 210268, 210290, 210319; FMNH 3628, 13483, 13496, 13509, 13511, 13516, 13519, 13526, 13549, 13569, 13572, 13575, 13578, 13681, 16462 (fossil), 16463, 29800, 30191, 30216, 41016, 49546, 104491, 104612, 141807, 224780, 224798, 224828, 224841, 224891, 224902, 224909, 227012.

Note: *Endemic* – Pilsbry (1900: 492) considered this species to be conspecific with *Succinea barbadensis* of Barbados. However, identifications based on shell



Map 28. *Succinea bermudensis*.

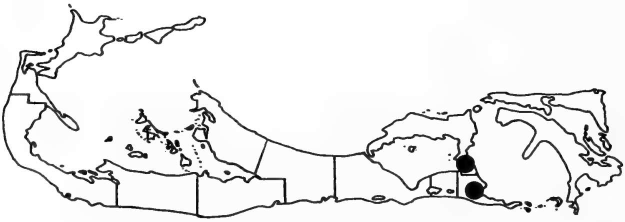
characteristics in species with reduced shells, such as those of the succineids, are notoriously unreliable. Comparisons of anatomical features are necessary to determine if *S. barbadensis* and *S. bermudensis* are indeed conspecific. Pending this, we have considered the two nominal species distinct and *Succinea bermudensis* endemic to Bermuda. *Succinea gabrieli* Tomlin, 1932, introduced based on slight differences in shell morphology and radular tooth counts, is most likely conspecific with *S. bermudensis*. *Succinea bermudensis* is common on grasses and on the bark of trees, often in open areas, and is also commonly found as a Pleistocene fossil.

Figure 30. "*Euconulus*" *turbinatus*. – ANSP 91153, Hamilton Parish, Bermuda; height = 3.65 mm.

LIMACOIDEA
HELICARIONIDAE
"*Euconulus*" *turbinatus* Gulick, 1904
(Map 29, Fig. 30)

Euconulus turbinatus Gulick, 1904: 420, pl. 36, figs. 8-10 (Bermuda, fossil).

Euconulus turbinatus, – Verrill, 1906: 168, figs. 55a, b (types; "not known to be living"); Gould, 1970b: 491;



Map 29. "*Euconulus*" *turbinatus*.

Kaliella turbinatus, - Vanatta, 1911: 665;

Kaliella turbinata, - Pilsbry & Vanatta, 1909: 64; Vanatta, 1911: 666-667; Peile, 1926: 89.

Bermuda Material Studied: ANSP 91153; FMNH 43379; MCZ Gould Station 1 (fossil), Gould Station 41 east (fossil).

Note: *Endemic* - Described from fossils on Bermuda and tentatively placed in the genus *Euconulus* (Gulick, 1904), this species was later found living around Church Cave (Pilsbry & Vanatta, 1909). Using shell and radular characteristics, Godwin Austen (in Pilsbry & Vanatta, 1909) determined this species to belong to the Asian genus *Kaliella*, leading Pilsbry & Vanatta to consider Gulick's specimens subfossil and the species a very early introduction. Studies of the Pleistocene fossils of Bermuda confirm this species' presence in Pleistocene deposits and its endemic status (Gould, 1971b). Anatomical material is needed to establish its generic position and relationships with other helicarionids.

AGRIOLIMACIDAE
Deroceras laeve (Müller, 1774)
(Map 30, Fig. 31)

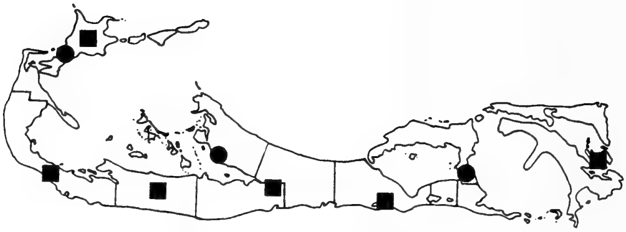
Limax laevis Müller, 1774: 1-2 (Europe).

Agriolimax campestris (Binney, 1842), - Cockerell in Bland, 1895: 271 [described as *Limax campestris* Binney, 1842];

Figure 31. *Deroceras laeve*. - FMNH 224864, St. Georges Parish; lateral view; body length = 14 mm.

Agriolimax laevis, - Pilsbry, 1900: 501; Verrill, 1902: 734; Vanatta, 1911: 665-668;

Malino laevis, - Peile, 1926: 90.



Map 30. *Deroceras laeve.*

Bermuda Material Studied: BAMZ 1998-166-092, 1998-166-094, 1998-166-098, 1998-166-102, 1998-166-107, 1998-166-109, 1998-166-123; DMNH 210249, 210254, 210256, 210263, 210273, 210335, 210336; FMNH 224774, 224816, 224864, 224872, 224875, 224893, 227055, 227056.

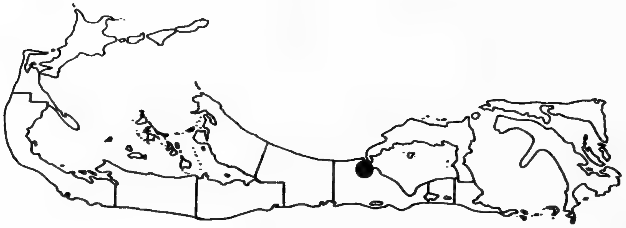
Note: *Accidentally Introduced* - A very widely distributed slug, *Deroceras laeve* is found throughout much of the Northern Hemisphere. Found in gardens or along foundations it is most commonly seen in rainy weather or at night. *Deroceras laeve* was first collected in Bermuda by the British 'Challenger' expedition in 1873.

LIMACIDAE

Limacus flavus (Linné, 1758)

(Map 31, Fig. 32)

Figure 32. *Limacus flavus.* – after Moquin-Tandon, 1855: pl. 3, fig. 3; body length = 75 to 100 mm.



Map 31. *Limacus flavus.*

Limax flavus Linné, 1758: 652 (Europe).

Limax flavus, - Pilsbry, 1900: 501; Verrill, 1902: 734, fig. 83; Peile, 1926: 90; Hughes 1968: 1;
Limacus flavus (Linné, 1758), - Falkner in Fechter & Falkner, 1990: 190 [European distribution and placement in *Limacus*].

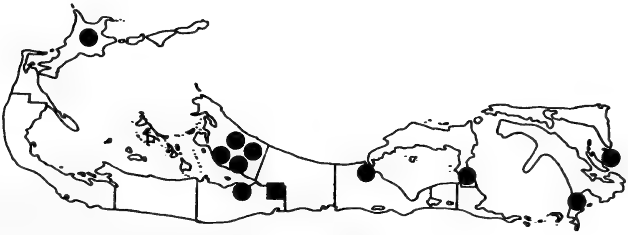
Bermuda Material Studied: FMNH 198685.

Note: *Accidentally Introduced* - Found in urban areas around the world, this native of Europe was first collected on Bermuda by Verrill in 1898. Incomplete locality data on most Bermudan specimens obscures the distribution of this species on Bermuda. This very large slug can be found at night, especially on stone fences and in gardens. Dissection of FMNH 198685 confirmed the specific identity of this slug, which is often confused with *Limacus maculatus* (Kaleniczenko, 1851).

MILACIDAE
Milax gagates (Draparnaud, 1801)
(Map 32, Fig. 33)

Limax gagates Draparnaud, 1801: 100 (France).

Figure 33. *Milax gagates*. - after Moquin-Tandon, 1855: pl. 2, fig. 1; body length = 50 to 60 mm.



Map 32. *Milax gagates*.

Limax gagates, – E. A. Smith, 1884: 276;
Amalia gagates, – Bland, 1895: 271; Pilsbry, 1900: 501; Verrill, 1902: 734;
Milax sowerbyi (Férussac, 1823), var., – Vanatta, 1911: 665-668 [*non Limax sowerbii* [*sic*] Férussac, 1823];
Milax sowerbyi, – Peile, 1926: 90;
Milax gagates, – Vanatta, 1911: 665-667; Peile, 1926: 90; Hughes, 1968: 1.

Bermuda Material Studied: FMNH 224759.

Note: *Accidentally Introduced - Milax gagates* was first collected on Bermuda by the British 'Challenger' expedition in 1873 (E. A. Smith, 1884). A native of Europe, it burrows in soil and feeds on plant roots. Introduced around the world in potted plants (Karlin & Naegele, 1966), it has become so ubiquitous in greenhouses it has earned the common name "The Greenhouse Slug" (Pilsbry, 1948). It is placed in genus *Tandonia* by some authors.

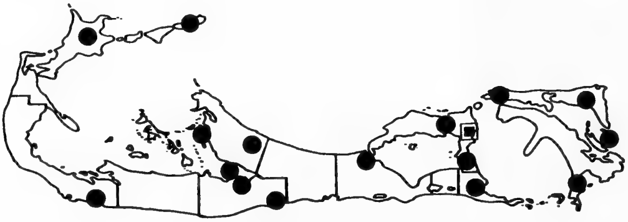
ZONITIDAE

Hawaiia minuscula (Binney, 1841)

(Map 33, Fig. 34)

Helix minuscula Binney, 1841: 435-436 pl. 22, fig. 4 (Ohio).

Zonitoides minusculus, – Pilsbry, 1900: 501, pl.62, fig.17; Verrill, 1902: 729, fig. 71; Gulick, 1904: 421 (Recent and "fossil"); Verrill, 1906: 168, figs. 52a, b (after Binney); Peile, 1926: 89; Hughes, post 1969: 1; Gould, 1970b: 491;
Zonitoides minuscula, – Vanatta, 1911: 665-668; Vanatta, 1923: 33; Vanatta, 1924: 7;
Hawaiia minuscula, – Riedel, 1980: 28-29.



Map 33. *Hawaiia minuscula*.

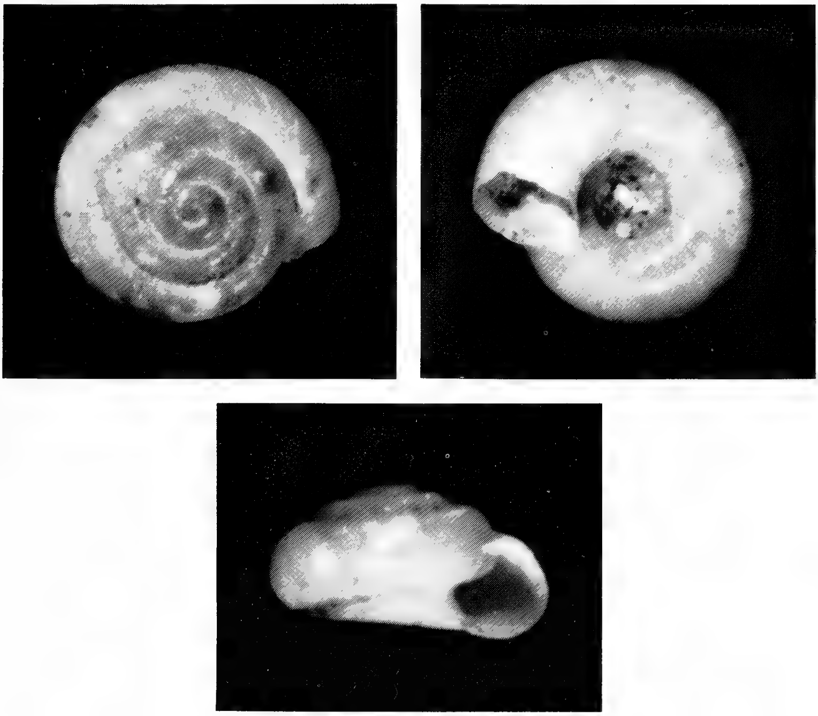


Figure 34. *Hawaiia minuscula.* - FMNH 227046, Hamilton Parish, Bermuda; diameter = 2.1 mm.

Bermuda Material Studied: BAMZ 1995-132-014; FMNH 30204, 30205, 41019, 227035, 227046.

Note: *Accidentally Introduced* - Commerce has transported this native of North America around the world, as attested by the generic name, which is based on specimens mistakenly thought native to Hawaii. *Hawaiia minuscula* is usually found on bare ground in yards, fields and other open areas. Gould (1970b) questioned the fossil record by Gulick (1904); Gulick (1904: 421) himself expressed surprise at this singular occurrence and absence at all other sites studied by him. The later references to Bermuda fossils of this species by Verrill (1906) and Hughes (post 1969) are based on Gulick's single record. Gulick's collecting site was probably contaminated with Recent material.

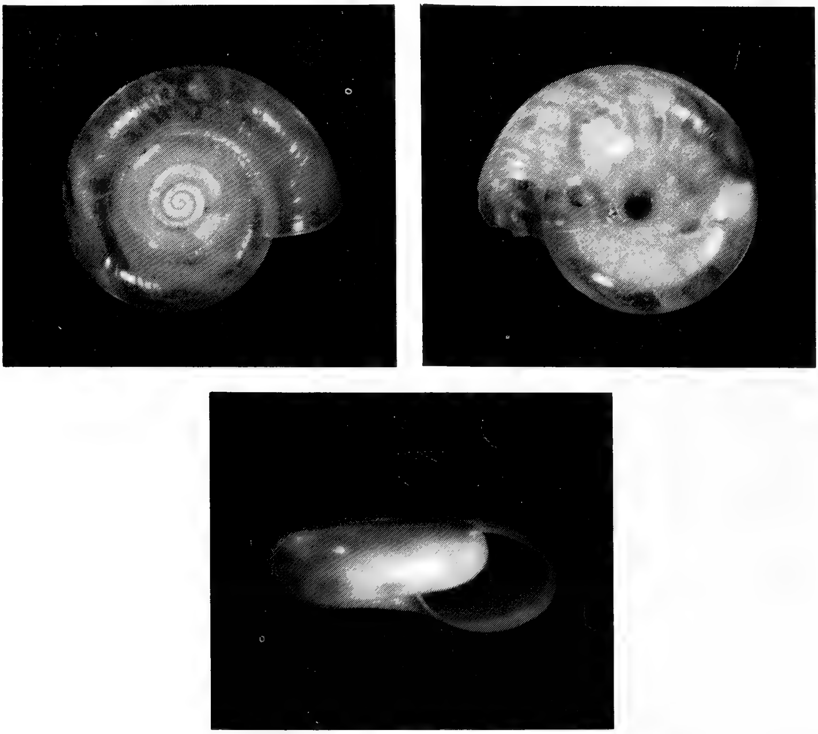
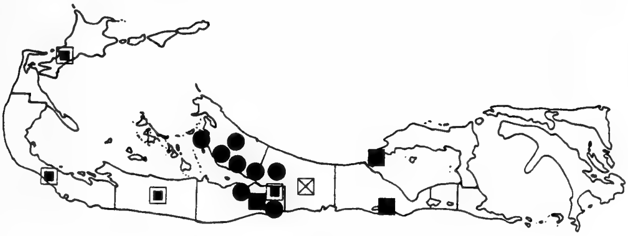


Figure 35. *Oxychilus draparnaudi.* – FMNH 13547, Paget's Parish, Bermuda; diameter = 10.9 mm.

Oxychilus draparnaudi **(Beck, 1837)**
(Map 34, Fig. 35)

Helix (Helicella) Draparnaldi [*sic*] Beck, 1837: 6 [new name for *Helix nitida* Draparnaud, 1805, *non* Müller, 1774]; *non Helix draparnaldi* Cuvier, 1816, *nec Helix draparnaudi* Sheppard, 1823 [see Manganelli & Giusti, 1997: 149-150].

Helix cellaria Müller, 1774 – Prime, 1853: 77 [*non Helix cellaria* Müller, 1774];
Hyalina lucida (Draparnaud, 1801), - Verrill, 1902: 733, fig. 81a, b; Davis, 1904: 126; [described as *Helix lucida* Draparnaud, 1801; *non Helix lucida* Pulteney, 1799];
Vitrea cellaria Müller, 1774, - Davis, 1904: 126 [*non Vitrea cellaria* Müller, 1774];



Map 34. *Oxychilus draparnaudi.*

Vitrea lucida (Draparnaud, 1801), - Bryant, 1905: 131; Vanatta, 1911: 666-667;

Helicella draparnaldi [*sic*], - Peile, 1926: 89;

Helicella draparnaldi, - Ellis, 1951: 126 [petition to place on Official List of Names];

Helicella draparnaudi, - ICZN, 1955: 81, 87, 99 [placement of the emended specific name on the Official List of Specific Names in Zoology; with erroneous "original" generic combination];

Oxychilus draparnaudi, - Manganelli & Giusti, 1997: 148 ff. [proposed conservation of specific name *Oxychilus draparnaudi* (Beck, 1837), based on *Helix draparnaldi*].

Bermuda Material Studied: BAMZ 1998-166-038, 1998-166-041, 1998-166-117, 1998-166-118; DMNH 210260, 210261, 210288; FMNH 13503, 13558, 13577, 13680, 13684, 224757, 224767, 224799, 224823, 224848, 224886, 224898, 224906, 227006, 227007.

Note: *Accidentally Introduced* - This species was first collected on Bermuda in 1852 and reported as the similar species "*Helix*" *cellaria* by Prime (1853). Museum records (all prior to 1950) and localized reports (Verrill, 1902; Vanatta, 1911) show this species limited to the vicinity of the city of Hamilton, the likely point of its introduction. The current survey finds O. *draparnaudi* common throughout the western two thirds of Bermuda. A native of Europe, western Asia and northern Africa, this species has been introduced to cities throughout North America. *Oxychilus draparnaudi* is often found in gardens and vacant lots.

***Poecilozonites bermudensis* (Pfeiffer, 1845)**
(Map 35, Fig. 36)

***Helix Bermudensis* Pfeiffer, 1845: 67 (Bermuda).**

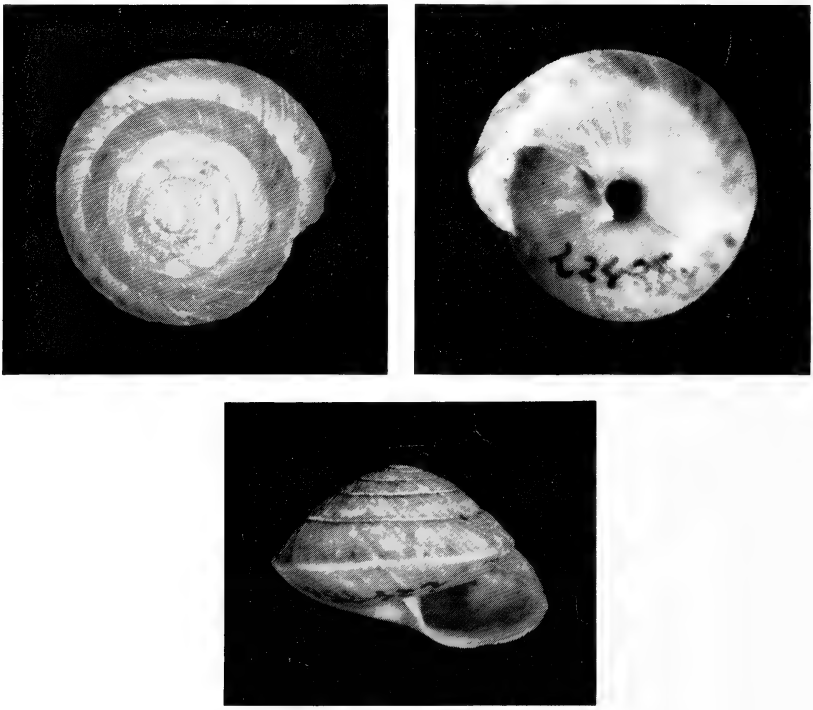


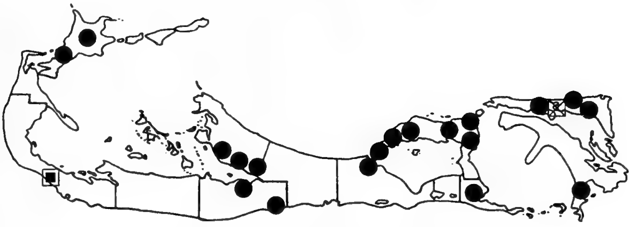
Figure 36. *Poecilozonites bermudensis.* – FMNH 224886, Southampton Parish, Bermuda; diameter = 17.1 mm (apical view); diameter = 15.4 mm (basal and apertural views).

? *Helix ochroleuca*, – Pfeiffer, 1847: 80-81; Reeve, 1854: *Helix* pl. 177, no. 1212; Bland, 1861: 351;

Helix (*Trochomorpha*) *bermudensis*, – Albers, 1850: 116;

? *Helix* (*Trochomorpha*) *ochroleuca* Férussac, – Albers, 1850: 116 [non *Helix* (*Helicostyla*) *ochroleuca* Férussac, 1821: 46 ("Les Grandes Indes?," subsequently changed to "Habite l'île Bermude (Menke)" by Férussac [in Férussac & Deshayes], 1819-1851: 183); *H. ochroleuca* Férussac was later interpreted as a senior synonym of *Pachystyla rufozonata* H. Adams, from Mauritius, by Pilsbry 1900: 499];

Helix bermudensis, – Prime, 1853: 55; Reeve, 1851: *Helix* pl. 57, no. 275; Jones, 1859: 106; Bland, 1861: 351; Tristram, 1861: 405; Rein, 1867: 77; Bland & Binney, 1873: 221; Mörch, 1878: 3; Bartram, 1878: 108; Kobelt, 1880: 258; E. A. Smith, 1884: 277; Martens, 1889: 201; Lane, 1891: 1;



Map 35. *Poecilozonites bermudensis.*

? *Nanina (Trochomorpha) ochroleuca,* – Martens in Albers, 1860: 60-61 (expressing doubt about the presence of this species on Bermuda because it was not listed by Jones in 1859);

Helix (Caracolus) bermudensis, – Martens in Albers, 1860: 156;

Hyalina bermudensis, – Bland, 1875: 77; Jones, 1876: 138; Bland, 1881: 256;

Hyalina ochroleuca, – Jones, 1876: 138;

Zonites (?) *bermudensis,* – Binney, 1876: 183; Binney, 1884: 86, 87;

? *Hyalina ochrolenca* [*sic*], – Jones, 1876: 138;

Hyalina [*sic*] *bermudensis,* – Jones, 1876: 138; Bartram, 1878: 108;

Hyalinia ? Bermudensis Clessin in Pfeiffer, 1879: 69;

Hyalinia bermudensis, – Kobelt, 1880: 286;

? *Carocolla ochroleuca,* – Kobelt, 1880: 286;

Zonites bermudensis, – E. A. Smith, 1884: 31;

Poecilozonites bermudensis, – O. Boettger, 1884: 139 [introduction of genus-group name *Poecilozonites*, 2 species originally included]; Pilsbry, 1888: 289-290, pl. 17, fig. E, C; Heilprin, 1889: 182; Pilsbry, 1889: pl. 17, figs. N, O; Pilsbry, 1889: 85; Bland, 1895: 270; Pilsbry, 1900: 499; Verrill, 1902: 782; Gulick, 1904: 418; Verrill, 1906: 159 ff.; Vanatta, 1911: 665-668; Vanatta, 1923: 33; Vanatta, 1924: 7; Peile, 1926: 89; Kutchka, 1934: 296; Gould, 1969: 507, pl. 3, figs. 6-7 (Recent), pl. 4, fig. 6 (fossil), fig. 7 (Recent); Gould, 1970b: 502 ff. (fossil); Gould, 1971a: 88 (fossil); Abbott, 1989: 126, fig; Gould, 1991: 12;

Helix (group *Patula,* section *Trochomorpha,* subsection *Poecilozonites) bermudensis,* – Tryon, 1887: 95, 96, pl. 19 figs. 7-10 [*H. bermudensis* indicated as type species of *Poecilozonites* Sandberger [*sic*, error for O. Boettger], 1884];

Bermudia bermudensis, – Ancey, 1887: 53 [introduction of genus-group name *Bermudia, with H. bermudensis* as type species by monotypy];

Juno bermudensis, – Mazÿck, 1889: 210-211 [introduction of genus-group name *Juno*, with *H. bermudensis* as type species by original designation];

Poecilozonites bermudensis bermudensis, – Gould, 1966: 1135; Gould, 1968: 81 ff., pl. 10, fig. 6 (fossil), fig. 7 (Recent); Hughes, post 1968: 1; Hughes, post 1969: 1; Eldredge & Gould, 1972: 99 ff.;
Poecilozonites (*Poecilozonites*) *bermudensis*, – Thiele, 1931: 595; Zilch, 1959: 263, fig. 933; Riedel, 1980: 23.

Bermuda Material Studied: BAMZ 1994-118-009, 1998-166-025, 1998-166-053 (fossil); 1998-166-055, 1998-166-060; DMNH 210287, 210304, 210327 (fossil); FMNH 3633, 8833, 8858, 13482, 13492, 13502, 13506, 13507, 13524, 13532, 13580, 16455, 16456 (fossil), 29787 (fossil), 29788 (fossil), 29799, 45243 (fossil), 45244, 45245, 45246, 71536, 82048, 93871, 100125, 100184, 103063, 106932, 115118, 127348, 127430 (fossil), 147304, 216369, 224859, 224886, 224910 (fossil), 227059.

Note: *Endemic* - The closest relatives of the genus *Poecilozonites* are the members of the southeastern United States genera *Gastrodonta* and *Ventridens* (Pilsbry, 1900). Once extremely common on Bermuda, *Poecilozonites bermudensis* specimens were collected by the bucket-full and destroyed by burning in the middle part of this century (Gould, 1969). Jones (1864: 8) referred to this species as "Quite as common as the Garden Snail (*H. aspersa*) is in England." After the introduction of several predatory snails, populations of *Poecilozonites bermudensis* rapidly declined (Gould, 1969, 1991) and recently this species was feared extinct (Gould, 1991). In 1988, this survey located fresh-dead specimens of this species (FMNH 224886) at one locale, giving hope to future efforts to protect this species.

This is the type species of *Poecilozonites* O. Boettger (1884: 139) and its two objective synonyms *Bermudia* Ancey (1887: 53), and *Juno* Mazÿck (1889: 211).

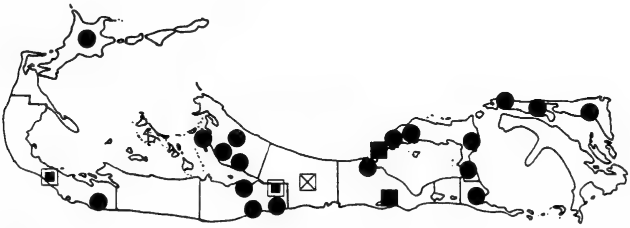
Poecilozonites circumfirmatus (Redfield, 1853)
(Map 36, Fig. 37)

Helix circumfirmata Redfield, 1853: 16, 17 (Bermuda).

Helix ptychoides Prime, 1852: 55 [*nomen nudum*]; Jones, 1859: 106 [*nomen nudum*; based on Prime's list]; Bartram, 1878: 108 [*nomen nudum*; erroneously referring to "Rein"];
Helix circumfirmata, – Shuttleworth, 1853: 123; Bland, 1861: 351; Pfeiffer, 1863: 2; Rein, 1867: 77; Bland & Binney, 1873: 221; E. A. Smith, 1884: 277; Mörch, 1878: 3; Bartram, 1878: 108; E. A. Smith, 1884: 31;
Helix circumfirmatus, – Tristram, 1861: 405;
Helix discrepans Pfeiffer, 1863: 1-2 (Bermuda); Rein, 1867: 77;

Figure 37. *Poecilozonites circumfirmatus*. - FMNH 29786, St. George's Parish, Bermuda; diameter = 8.6 mm (apical and basal views); diameter = 7.8 mm (apertural view).

Hyalina discrepans, - Pfeiffer, 1868: 216; Jones, 1876: 138; Bland, 1881: 256;
Hyalina circumfirmata, - Jones, 1876: 138; Bland, 1881: 256;
Hyalosagda discrepans, - Kobelt, 1880: 286;
Hyalosagda circumfirmata, - Kobelt, 1880: 286;
Helix (group *Sagda*, section *Hyalosagda) circumfirmata*, - Tryon, 1887: 9, pl. 1,



Map 36. *Poecilozonites circumfirmatus*.

fig. 30;

Helix (group *Sagda*, section *Hyalosagda) discrepans*, - Tryon, 1887: 9;

Poecilozonites circumfirmatus variety Pilsbry, 1888: 291, pl. 17, fig. 11;

Poecilozonites circumfirmatus, - Pilsbry, 1888: 291, pl. 17, figs. A, B, F; Heilprin, 1889: 182; Pilsbry, 1900: 500, pl. 62, fig. 9, 9a; Verrill, 1902: 728, figs. 67a, b; Gulick, 1904: 420; Verrill, 1906: 166, figs. 48a, b; Vanatta, 1911: 665-668; Peile, 1924: 18-19; Vanatta, 1924: 7; Gould, 1966: 1135; Hughes, post 1968: 1; Hughes, post 1969: 1; Gould, 1966: 1135; Gould, 1971a: 88 (fossil);

Helix (Hyalosagda) discrepans, - Heilprin, 1889: 182;

Poecilozonites circumfirmatus var. corneus Pilsbry, 1890a: 95;

? Hyalnia [*sic*] ---, - Lane, 1891: 3;

Poecilozonites circumfirmatas [*sic*], - Bland, 1895: 270;

Poecilozonites discrepans, - Bland, 1895: 270; Peile, 1925: 257; Peile, 1926: 89;

Poecilozonites (Gastrelasmus) circumfirmatus, - Pilsbry, 1924: 2 [introduction of genus-group name *Gastrelasmus* with *H. circumfirmata* as type species by original designation];

Poecilozonites (Gastrelasmus) circumfirmatus discrepans, - Pilsbry, 1924: 3, fig. 2, a, b;

Poecilozonites circumfirmatus var. caliban Peile, 1924: 19;

Poecilozonites circumfirmatus mut. corneus, - Pilsbry, 1924: 2, fig. 1;

Poecilozonites peilei Vanatta, 1925: 423, figs. 1, 2;

Poecilozonites circumfirmatus var. corneus, - Peile, 1925: 257; Peile, 1926:89;

Poecilozonites circumfirmatus var. caliban, - Peile, 1926: 89;

Poecilozonites circumfirmatus peilei, - Peile, 1926: 89;

Poecilozonites (Gastrelasmus) circumfirmatus, - Peile, 1926: 89; Thiele, 1931: 595; Zilch, 1959: 263, fig. 934;

Poecilozonites (Poecilozonites?) peilei, - Riedel, 1980: 23;

Poecilozonites (Gastrelasmus) circumfirmatus, - Riedel, 1980: 23.

Bermuda Material Studied: BAMZ 1994-118-008, 1998-166-012, 1998-166-032, 1998-166-056; CAS 54685; DMNH 210281, 210303, 210318; FMNH 11429, 13489, 13494, 13512, 13553, 13565, 13581, 16457, 16458, 29803 (fossil), 41763, 45247 (fossil), 45248, 45249 (fossil), 70863, 71537, 92868, 93813, 100080, 100186, 102848, 114991, 129496, 147327, 217552, 224786, 224813, 224825, 224838, 224850, 224887.

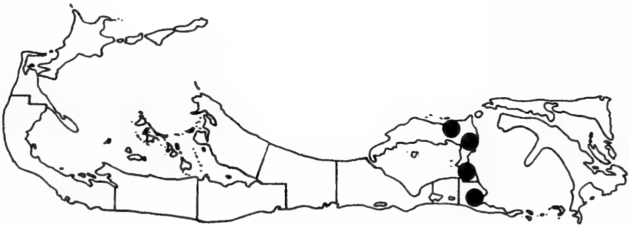
Note: *Endemic* - Once very common and widespread on the larger islands of Bermuda, this is the only member of the genus to be found alive in this latest survey. Most records appear to be associated with leaf litter under herbaceous cover. Some individuals have weak or no lamellae, leading to the varietal name *corneus*. The nominal species *Helix discrepans* was introduced by Pfeiffer (1863) for a depressed specimen collected by Rein. Gould (1991: 12) was probably referring to this species when he stated he found the "smallest and most cryptic" species of *Poecilozonites* alive in 1990.

This is the type species of *Gastrelasmus* Pilsbry (1924: 2).

Poecilozonites reinianus (Pfeiffer, 1863)
(Map 37, Fig. 38)

Helix reiniana Pfeiffer, 1863: 1 (Bermuda).

Helix Reinii [*sic*] Pfeiffer, - Rein, 1867: 77;
Helix Reiniana, - Pfeiffer, 1868: 172;
Hyalina Reiniana, - Jones, 1876: 138;
Patula reiniana, - Kobelt, 1880: 258, 286; Bland, 1881: 256;
Helix (group *Patula*, section *Discus*) *Reiniana*, - Tryon, 1887: 27;
Patula (Discus) reiniana, - Clessin in Pfeiffer, 1879: 91;
Poecilozonites reinianus var. *goodei* Pilsbry, 1889: 85, pl. 3, figs. 12, 13;
? Rotundatus, - Lane, 1891: 3 [*non Helix rotundatus* Müller, 1774];
Poecilozonites goodei, - Vanatta, 1911: 665; Peile, 1924: 18;
Poecilozonites reinianus, - Pilsbry, 1888: 290-291, pl. 17, fig I; Heilprin, 1889: 182; Bland, 1895: 270; Pilsbry, 1900: 500; Verrill, 1902: 728; Verrill, 1906: 164-165; Vanatta, 1911: 666; Vanatta, 1924: 7; Kutchka, 1934: 296; Hughes, post 1968: 1; Hughes, post 1969: 1;
Poecilozonites (Discozonites) reinianus, - Peile, 1924: 4, fig. 3 a-d; Peile, 1925: 258; Peile, 1926: 90; Riedel, 1980: 23;
Poecilozonites blandi Pilsbry, 1924: 2, 7-8, fig. 5 [introduction of genus-group name *Discozonites* with *P. blandi* as type species by original designation] (Bermuda), **new synonymy**;



Map 37. *Poecilozonites reinianus*.

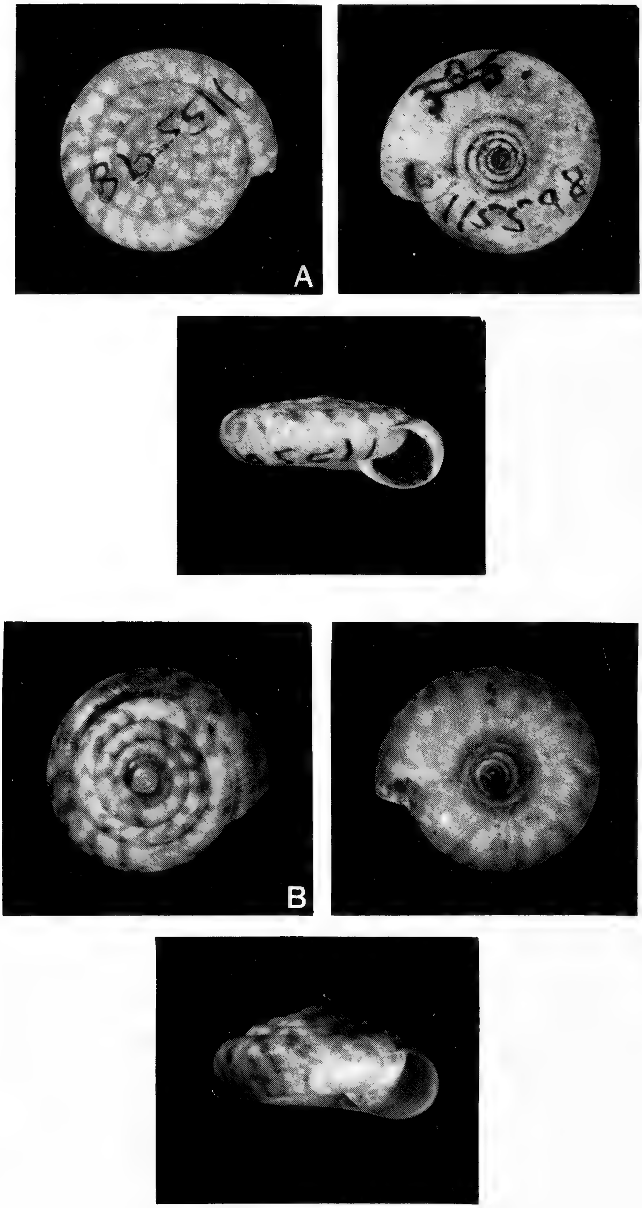


Figure 38. *Poecilozonites reinianus*. – 38a: FMNH 115598, Bermuda; diameter = 10.0 mm (apical view); diameter = 10.2 mm (basal view); diameter = 9.4 mm (apertural view). *Poecilozonites reinianus* "form blandi" – 38b: FMNH 45251, Bermuda; diameter = 8.9 mm.

Poecilozonites (Discozonites) blandi, – Peile, 1925: 258; Peile, 1926: 90; Thiele, 1931: 595; Zilch, 1959: 263, fig. 935 [after Pilsbry, 1924]; Riedel, 1980: 23.

Bermuda Material Studied: FMNH 16454, 45238, 45250 (fossil), 45251, 45252 (fossil), 45253 (fossil), 45254 (fossil), 71538, 115598.

Note: *Endemic* - Historically much less common and more restricted in range than *Poecilozonites bermudensis* and *P. circumfirmatus*, *P. reinianus* has only been collected on the eastern side of the main island of Bermuda. The varietal name *goodei* was introduced by Pilsbry (1889) for widely umbilicate and flattened shells that he wished to distinguish from narrowly umbilicate forms identified as *reinianus* in ANSP's collections. He mistakenly believed his narrowly umbilicate forms to be typical *reinianus* (Pilsbry, 1924). Pilsbry (1924) then synonymized *goodei* with *reinianus* and described *Poecilozonites blandi* for the narrowly umbilicate forms previously identified as *reinianus*. Umbilical width and the spire height of *P. reinianus* are surprisingly variable, as variable as in species of *Polygyra*. Separation of these two forms based on spire height and umbilical width alone is not possible as the full range of morphologies from tall narrowly umbilicate "*P. blandi*" to widely umbilicate "*P. reinianus*" *and* "*P. goodei*" exist in museum collections (FMNH 16454, 45238, 45251, 71538 and 115598). *Poecilozonites blandi*, the type species of *Discozonites* Pilsbry, 1924, is here synonymized with *Poecilozonites reinianus*.

This species was last reported alive by Peile (1926). Gould was unable to locate *P. reinianus* in 1973 (Gould, 1991: 12), as was this survey in 1988.

Striatura meridionalis (Pilsbry & Ferriss, 1906)
(Map 38, Fig. 39)

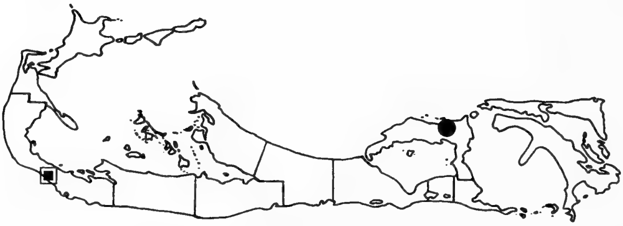
Vitrea (Striatura) milium meridionalis Pilsbry & Ferriss, 1906: 152-153 (Texas, New Mexico, Arizona).

Striatura milium meridionalis, – Vanatta, 1912: 12 (fossil);
Striatura milium v[ar]. *meridionalis*, – Peile, 1926: 89 (fossil);
Striatura meridionalis, – Pilsbry, 1946: 493-495 (fossil);
species A, – Gould, 1970b: 491;
Striatura (Pseudohyalina?) meridionalis, – Riedel, 1980: 23.

Bermuda Material Studied: ANSP 105793; FMNH 227041; MCZ Gould Station 4 (fossil), Gould Station 48 (fossil), Gould Station 63 (fossil).

Figure 39. *Striatura meridionalis.* - ANSP 105793, Hamilton Parish, Bermuda; diameter = 1.68 mm.

Note: *Native Non-Endemic* - The paucity of live records of this species on Bermuda reflects its small size. Vanatta (1912) was the first to recognize this species from Bermuda. *Striatura meridionalis* is found in the southeastern United States (Maryland to Texas), in Mexico, and the Greater Antilles (van der Schalie, 1948). It lives in moist leaf litter.



Map 38. *Striatura meridionalis.*

Zonitoides arboreus (Say, 1816)
(Map 39, Fig. 40)

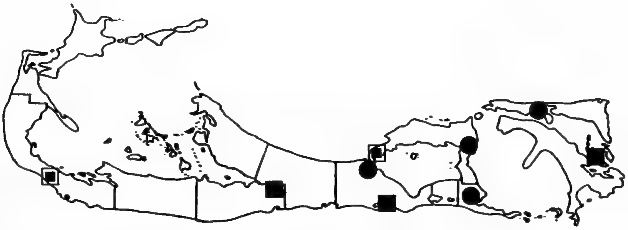
Helix arboreus [Say, 1816]: species no. 2, pl. 4, fig. 4 (North America).

Zonitoides arboreus, – Bryant, 1905: 130;
Zonitoides bermudensis Pilsbry & Vanatta, 1909: 63-64, fig. 1 a-d, **new synonymy**;
Zonitoides bermudensis, – Vanatta, 1924: 7; Vanatta, 1911: 665-667; Peile, 1926: 89.

Bermuda Material Studied: ANSP 91152, 100760, 99100, 131601, 85500, 110690, 113129, 85562; BAMZ 1998-166-081, 1998-166-114; DMNH 210277, 210258; FMNH 45024, 227050, 227051, 227052, 227053, 227054.

Note: *Accidentally Introduced* - The first record of *Zonitoides* on Bermuda came from a single lot collected by Stewerdson Brown in 1905. These specimens were used by Pilsbry & Vanatta (1909) to describe *Zonitoides bermudensis*, which is here synonymized with *Zonitoides arboreus* (Say, 1816).

In their description, Pilsbry & Vanatta cite the wide umbilicus of *Zonitoides bermudensis* as the main feature distinguishing it from *Z. arboreus*. However, Pilsbry (1946: 481) later demonstrated the variability of this character in *Zonitoides arboreus*, stating the "umbilicus [is] contained about 4 ½ to 5 times in the diameter." On the same page, measurements are given of a specimen from Williams County, Colorado, which is even more widely umbilicate (the umbilicus width fitting only four times in the shell diameter). Examination of the holotype and paratypes of *Zonitoides bermudensis* (ANSP 91152) collected by Brown reveals the holotype to be quite widely umbilicate. In fact, the holotype is among the most widely umbilicate of the hundreds of specimens collected by Brown, having a ratio of umbilical width to shell diameter of 0.338. A random sample of 50 of



Map 39. *Zonitoides arboreus*.

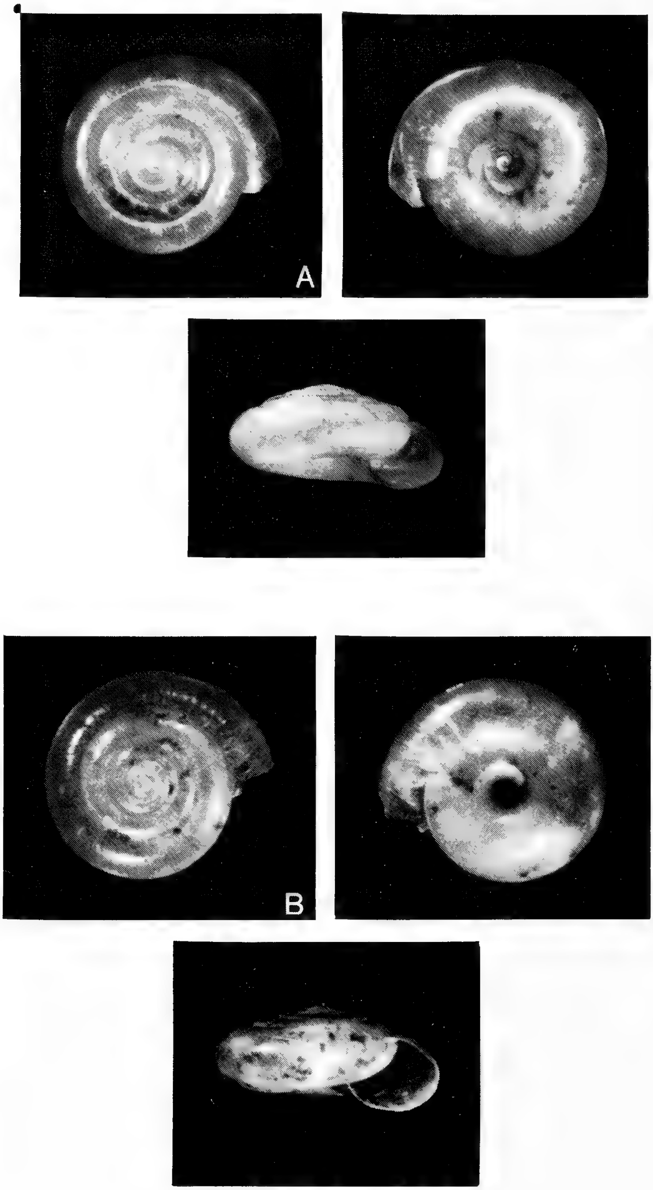


Figure 40. *Zonitoides arboreus*. – 40a: ANSP 91152, Holotype of *Zonitoides bermudensis* Pilsbry & Vanatta; diameter = 5.7 mm (body whorl damaged). – 40b: ANSP 91152, one of numerous paratypes of *Zonitoides bermudensis* Pilsbry & Vanatta; diameter = 4.6 mm.

the other specimens collected by Brown average only 0.265 umbilical width/diameter and can not be differentiated from widely umbilicate populations of *Zonitoides arboreus* from Missouri (FMNH 250319), New York (FMNH 250356), Tennessee (FMNH 250607, 250621), and Texas (FMNH 250638, 250640). Most of these widely umbilicate populations appear to occur in highly calcareous areas. The most widely umbilicate lot (FMNH 250621), like the lot collected by Brown from Bermuda, came from the vicinity of a cave. Other specimens collected from Bermuda (ANSP 85500, 110690, 113129; FMNH 227050, 227051, 227052, 227053, 227054) have the more "typical" morphology of *Zonitoides arboreus*.

Zonitoides arboreus is a native of North America and is found over most of the continent. It is also well known as an adventive species and has been recorded from South Africa, Hawaii, Japan and Australia (Pilsbry, 1946) and can often be found in potted plants. *Zonitoides* species are not found in Bermuda's abundant Pleistocene deposits. *Z. arboreus* is found under almost any type of cover and often is associated with rotting wood.

POLYGYROIDEA

POLYGYRIDAE

Patera appressa (Say, 1821)

(Map 40, Fig. 41)

Helix appressa Say, 1821: 151 ("banks of the Ohio and Missouri"; restricted to Ohio, Pilsbry, 1940: 751).

Helix Sancta Georgiensis Prime, 1853: 55 [*nomen nudum*];
Helix Sancta Georgiensis Jones, 1859: 107 [*nomen nudum*; based on Prime's list, but erroneously indicated as "n.s."];
Helix appressa, – Jones, 1876: 138; Bland, 1881: 256; Heilprin, 1889: 182 ; Lane, 1891: 2; Bland, 1895: 270;
Hex [*sic*] *appressa*, – Bartram, 1878: 108;
Triodopsis appressa, – Aldrich, 1889: 9;
Helix Sancta Georgiensis 'Bartram' – Lane, 1891: 2 [introduced in synonymy of *Helix appressa*];
Polygyra appressa, – Pilsbry, 1900: 496; Verrill, 1902: 730, 732, fig. 75d-f [with *H. sancta-georgiensis* in synonymy]; Pilsbry & Vanatta, 1924: 7;
Polygyra appressa sculptior Chadwick, 1899 [originally described as variety from Virginia], – Pilsbry, 1900: 496; Vanatta, 1911: 665; Peile, 1926;
Polygyra appressa var. *sanctaegeorgiensis* "(Prime), P. & V.", – Peile, 1926: 90;
Polygyra appressa var. *sculptior*, – Peile, 1926: 90;
Mesodon (*Patera*) *appressus* f. *sanctigeorgiensis* [*sic*] – Pilsbry, 1940: 751, fig. 452c;

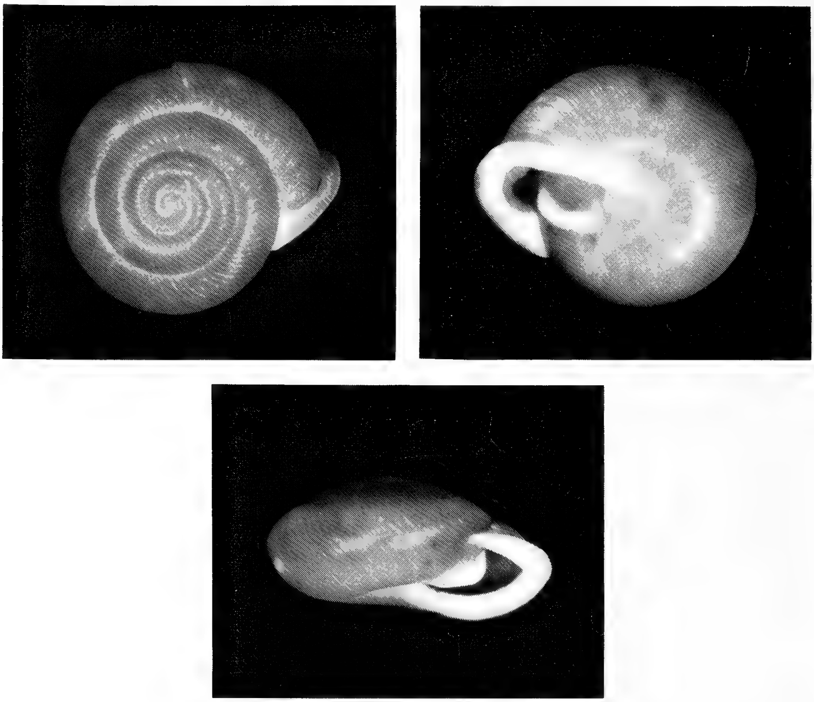
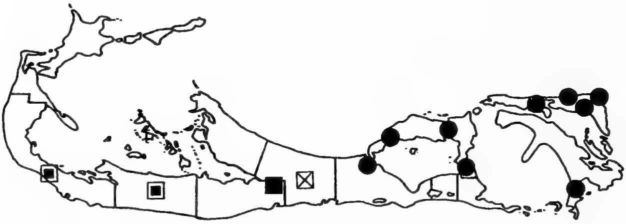


Figure 41. *Patera appressa*. – FMNH 29789, St. George's Parish, Bermuda; diameter = 13.3 (apical view); diameter = 13.0 mm (basal and apertural views).

Mesodon (*Patera*) *appressus* form *sanctageorgiensis* "'Prime' Verrill", – Pilsbry, 1940: 752.

Bermuda Material Studied: BAMZ 1998-166-001, 1998-166-008, 1998-166-016, 1998-166-029, 1998-166-042, 1998-166-047, 1998-166-115; DMNH 210241, 210250, 210280, 210312, 210320; FMNH 3639, 13484, 13525, 13533, 13539, 13583, 13592, 16460, 16461, 45850, 100191, 124505, 157504, 216047, 224768,



Map 40. *Patera appressa*.

224788, 224824, 224837, 224849, 224858, 224885, 224899.

Note: *Accidentally Introduced* - Native to the southeastern United States, from eastern Tennessee to eastern Virginia, this species was introduced to Bermuda before the first faunal survey of the islands. For many years it was restricted to the area around St. George, but it is now widespread on the larger islands of Bermuda. *Patera appressa* is often found in leaf litter in rocky areas and under cover in urban areas.

Polygyra plana (Dunker, 1843)
(Map 41, Fig. 42)

Helix plana Dunker in Philippi, 1843: 51-52, pl. 3, fig. 11 ("Indiae occidentales?").

Helix microdonta Deshayes [in Férussac & Deshayes], 1839, - Redfield, 1853: 17; Jones, 1859: 107; Bland, 1860: 93, 94; Tristram, 1861: 405; Bland, 1861: table 2, p. 351; Jones, 1864: 9; Bland, 1866: 360; Rein, 1867: 77; Jones, 1876: 138; Mörch, 1878: 3; Bland, 1881: 256; E. A. Smith, 1884: 277; Bland, 1895: 270 [*non Helix microdonta* Deshayes, 1832, teste Vanatta, 1911: 664];

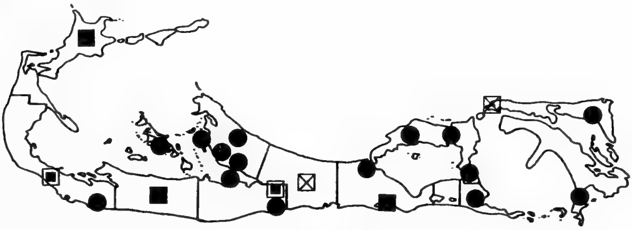
Helix cheilodon "Say MS." Bland, 1860: 94 [introduced as synonym of *H. microdonta sensu* Bland, from Bermuda);

Polygyra microdonta, - Kobelt, 1880: 258, 286; Pilsbry, 1900: 496, pl. 62, fig. 3; Verrill, 1902: 729, fig. 72; Gulick, 1904: 413; Hughes, post 1968: 1; Hughes, post 1969: 1;

Helix Ringens Lane 1891: 2, pl. 1, fig. 3 [plate not seen] (Bermuda) [*non Helix ringens* Linné, 1758: 769];

Helix (Polygyra) microdonta, - Heilprin, 1889: 182;

Polygyra plana, - Vanatta, 1911: 665-668 [citing Thiele *in litt.*; with *H. microdonta* Deshayes, 1839 in synonymy]; Honigmann, 1914: 375;



Map 41. *Polygyra plana*.

Figure 42. *Polygyra plana*. - FMNH 224888, Southampton Parish, Bermuda; diameter = 8.2 mm (apical and apertural views); diameter = 8.2 mm (basal view; different specimen).

Vanatta, 1923: 33; Peile, 1926: 90; Abbott, 1989: 134, fig.

Bermuda Material Studied: BAMZ 1998-166-003, 1998-166-010, 1998-166-027, 1998-166-074, 1998-166-096, 1998-166-100; DMNH 210262, 210272, 210284, 210306, 210314, 210322; FMNH 3640, 8834, 13517, 13535, 13545, 13551, 13564, 13573, 13593, 16459, 41023, 45687, 45778, 100168, 115647, 125209, 153255, 224781, 224800, 224801, 224851, 224867, 224873, 224888, 224894.

Note: *Accidentally Introduced* - A native of the Bahamas, this species arrived before the first faunal survey and is one of the few introduced species commonly found on the smaller island of Bermuda. It is very tolerant of salt spray and is found on dunes and in other open areas under cover.

Figure 43. *Lacteoluna selenina.* – FMNH 224881, Southampton Parish, Bermuda; diameter = 5.2 mm (apical and apertural views); diameter = 4.8 mm (basal view).

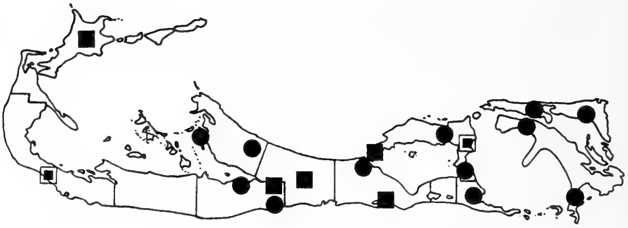
SAGDIDAE

Lacteoluna selenina (Gould, 1848)

(Map 42, Fig. 43)

Helix selenina Gould, 1848: 38 (Florida).

Helix selenina, – Prime, 1853: 55; Jones, 1859: 106;
Helix vortex Pfeiffer, 1839: 351 [*non Helix vortex* Linné, 1758] (Cuba);
Helix vortex, – Bland, 1861: table 2, p. 351; Rein, 1867: 77; Jones, 1876: 138; Bland, 1881: 256; E. A. Smith, 1884: 227;
Microphysa vortex, – Kobelt, 1880: 257, 286;
Helix (group *Patula*, section *Microphysa*) *vortex*, – Tryon, 1887: 98, pl. 19, figs. 25-28;
Helix (*Microphysa*) *vortex*, – Heilprin, 1889: 182;



Map 42. *Lacteoluna selenina.*

Patula vortex, – Bartram, 1878: 108; Bland, 1895: 270;
Thysanophora vortex, – Pilsbry, 1900: 495, pl. 62, fig. 1a, 1b; Verrill, 1902: 728, 229, fig. 70a, b; Gulick, 1904: 413; Peile, 1926: 90; Hughes, post 1969: 1;
Thysanophora selenina, – Vanatta, 1911: 665-668; Vanatta, 1923: 33;
Lacteoluna selenina, – Pilsbry, 1940: 981, 982.

Bermuda Material Studied: BAMZ 1998-166-017, 1998-166-022, 1998-166-043, 1998-166-084, 1998-166-111, 1998-166-122; DMNH 210279, 210329, 210332, 210334; FMNH 3638, 7607, 13486, 13515, 13529, 13540, 13561, 29784, 30198, 30199, 41017, 41018, 45560, 59080, 107033, 224765, 224784, 224807, 224808, 224821, 224834, 224842, 224845, 224856, 224881, 227022, 227031.

Note: *Accidentally Introduced* - One of the earliest introductions, *Lacteoluna selenina* was recorded by Prime (1853) as collected in 1852, and was reported from most surveys since, partly under its synonym *Helix vortex*, a preoccupied name. Hughes (post 1969; citing Gulick, 1904, and Gould, 1969) erroneously included this species in a listing of fossil species of Bermuda. This calciphile native of southern Florida and the West Indies is commonly found under stones and debris in woodlands.

THYSANOPHORIDAE

"Hojeda" hypolepta (Shuttleworth, 1854)

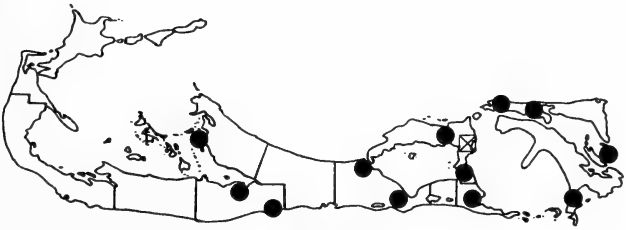
(Map 43, Fig. 44)

Helix hypolepta **Shuttleworth, 1854: 129 (Bermuda).**

Helix hypolepta**, – Jones, 1876: 138;**
?Helix hypolepta**, – Heilprin, 1889: 182;**
Patula hypolepta**, – Bland, 1881: 256;**

Figure 44. "*Hojeda*" *hypolepta*. – ANSP 100756, Paget Parish, Bermuda; diameter = 2.4 mm.

Helix (Microphysa) hypolepta, – Pilsbry, 1889: 82, pl. 3, figs. 6-8;
Patula (Thysanophora) hypolepta, – Bland, 1895: 270;
Lacteoluna hypolepta, – Haas, 1952: 104;
Thysanophora hypolepta, – Pilsbry, 1900: 496, pl. 62, fig. 2a, 2b; Verrill, 1902: 728, fig. 68a, b; Gulick, 1904: 413; Verrill, 1906: 169, fig. 52a; Vanatta, 1911: 666-667; Vanatta, 1912: 12; Vanatta, 1923: 33; Peile, 1926: 90; Hughes, post 1968: 1; Hughes, post 1969: 1; Gould, 1970b: 491, fig. 1a (fossil); Gould, 1970a: 572 (fossil); Gould, 1971a: 88;



Map 43. "*Hojeda*" *hypolepta*.

Hojeda hypolepta, – Richardson, 1986: 6.

Bermuda Material Studied: ANSP 100756; BAMZ 1995-132-021; FMNH 227021; MCZ Gould Station 1 (fossil), Gould Station 4 (fossil), Gould Station 11 (fossil), Gould Station 21 (fossil), Gould Station 21b (fossil), Gould Station 30 (fossil), Gould Station 41 east (fossil), Gould Station 48 (fossil), Gould Station 63 lower (fossil), Gould Station 73 (fossil).

Note: *Endemic* - The young of this species are very similar to *Hawaiia minuscula* and the two species were often confused in early surveys (Pilsbry, 1900). The anatomy of this species is unknown and shell characters cannot place it in any known genus. Its traditional familial placement within the Sagdidae or Thysanophoridae is also suspect. Based on shell characters alone this species might be equally well placed within the Helicodiscidae or Zonitidae. Pending anatomical studies, it is here provisionally placed in *Hojeda* Baker, 1926, following Richardson (1986). This species is found under rocks in open areas.

HELICOIDEA

BRADYBAENIDAE

Bradybaena similaris **(Rang, 1831)**

(Map 44, Fig. 45)

Helix similaris "Férussac" Rang, 1831: 15 (numerous localities).

Helix (Helicella) similaris Férussac, 1821: 43 [or p. 47, depending on issue] [*nomen nudum*];
Helix (Fruticicola) similaris, – Aldrich, 1889: 9;
Helix hortensis, – Lane, 1891: 2 [*non Helix hortensis* Müller, 1774: 52];
Eulota simularis [*sic*], – Olmsted, 1917: 225;
Eulota similaris, – Pilsbry, 1900: 495; Verrill, 1902: 734, fig. 82a-c; Vanatta, 1911: 665-668; Vanatta, 1923: 33;
Eulota (Eulota) similaris, – Honigmann, 1914: 376;
Eulota similis [*sic*], – Peile, 1926: 90.

Bermuda Material Studied: BAMZ 1998-166-009, 1998-166-030, 1998-166-048, 1998-166-050, 1998-166-059, 1998-166-070, 1998-166-075, 1998-166-093, 1998-166-119, 1998-166-121, 1998-166-124; DMNH 210243, 210244, 210248, 210253, 210291, 210296, 210299, 210321, 210325; FMNH 3635, 13488, 13491, 13505, 13514, 13522, 13534, 13546, 13562, 13590, 13678, 13685, 13688, 16468, 16469, 16470, 16471, 29792, 56551, 66154, 92867, 147322, 217509,

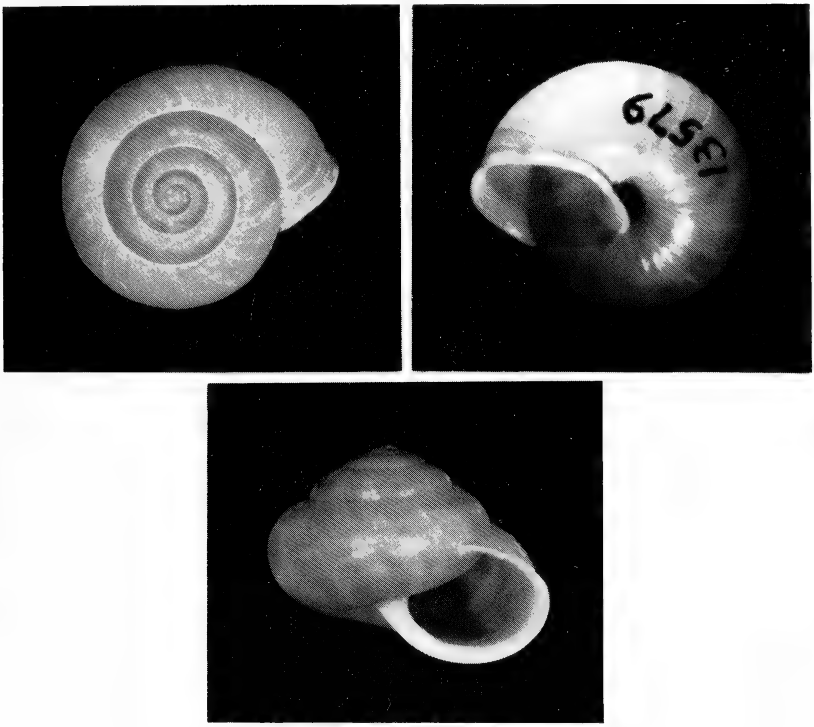
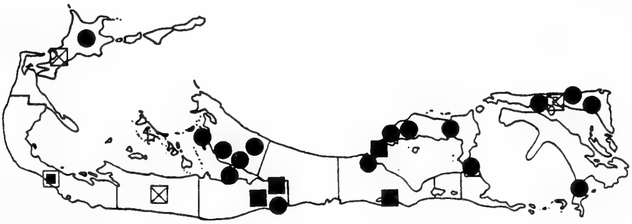


Figure 45. *Bradybaena similaris*. – FMNH 13579, Smith's Parish, Bermuda; diameter = 14.8 mm (apical view); diameter = 15.4 mm (basal and apertural views).

224758, 224769, 224782, 224802, 224818, 224829, 224877, 224895, 224904, 224915, 224916, 224917.

Note: *Accidentally Introduced* – First reported in 1889 by Aldrich, this species is one of the most common snails on Bermuda. Native to southeastern Asia, it is



Map 44. *Bradybaena similaris*.

widely introduced to subtropical and tropical regions including the southeastern United States (Dundee, 1970), the Caribbean, and southern Brazil.

COCHLICELLIDAE
Prietocella barbara **(Linné, 1758)**
(Map 45, Fig. 46)

Helix barbara Linné, 1758: 773 (North Africa).

Bulimus ventrosus (Férussac, 1821), – Prime, 1853: 55; Redfield, 1853: 17; Jones, 1859: 107; Bland, 1861: table 2; Jones, 1864: 9; Rein, 1867: 77; Jones, 1876: 139; Mörch, 1878: 3; E. A. Smith, 1884: 277; Frith, 1891: 15;

Bulimus ventricosus Draparnaud, 1801, – Tristram, 1861: 405 [*non Bulimus ventricosus* Bruguière, 1792];

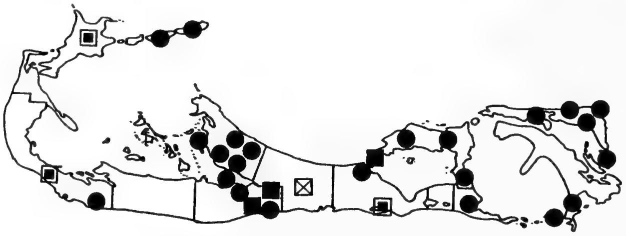
Bullimus [*sic*] *ventrosus*, – Bartram, 1878: 108;

Helix ventricosa, – Jones, 1876: 138; Bland, 1881: 256; Bland, 1895: 271;

Cochlicella ventrosa, – Kobelt, 1880: 257, 286;

Helix (*Cochlicella*) *ventricosa*, – Heilprin, 1889: 182;

Figure 46. *Prietocella barbara*. – FMNH 16472, St. George's Parish, Bermuda; height = 6.6 mm.



Map 45. *Prietocella barbara*.

Helicella (Cochlicella) ventricosa, – Pilsbry, 1900: 494;

Helicella ventricosa, – Verrill, 1902: 732, 733, fig. 79a-d; Vanatta, 1911: 665-668; Vanatta, 1923: 33;

Cochlicella barbara, – Glaubrecht, 1990: 218;

Prietocella barbara, – Schileyko & Menkhorst, 1997: 54 [for placement in *Prietocella*].

Bermuda Material Studied: BAMZ 1998-166-033, 1998-166-036, 1998-166-044, 1998-166-079, 1998-166-095, 1998-166-097, 1998-166-101; DMNH 210245, 210266, 210301, 210307, 210317; FMNH 3636, 3637, 4034, 13487, 13498, 13508, 13513, 13523, 13536, 13543, 13554, 13566, 13570, 13682, 16472, 29789, 41021, 102461, 124907, 125197, 217430, 224756, 224765, 224779, 224797, 224819, 224830, 224871, 224878, 224918, 224919, 227058.

Note: *Accidentally Introduced* - Recorded in the first survey of Bermuda, and in nearly every other survey, this snail is very common on Bermuda. *Prietocella barbara* is native to the Mediterranean region and has been introduced into North America to California and the Carolinas. It is often found in large numbers on bushes and on bark at the base of trees.

HELICIDAE

Otala lactea (Müller, 1774)

(Map 46, Fig. 47)

Helix lactea Müller, 1774: 19-20 (Europe).

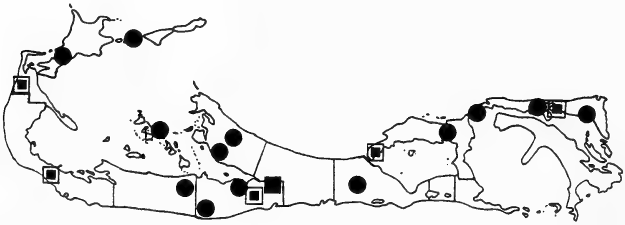
Otala lactea, – Bennett & Hughes, 1959: 432; Hughes, 1962; Hughes, 1963; Simmonds & Hughes, 1963: 219-221; Hughes (post 1968): 1; Gould, 1969: 419; Monkman, 1982a: 1; Monkman, 1982b: 71; Bennett et al., 1985: 138; Cock, 1985: 138; Abbott, 1989: 191, fig.; Glaubrecht, 1990: 220, fig. 10.

Bermuda Material Studied: BAMZ 1994-118-002, 1995-133-001, 1998-166-035, 1998-166-054, 1998-166-064, 1998-166-069, 1998-166-106; DMNH 210246, 210289, 210292, 210295, 210315; FMNH 224763, 224775, 224791, 224836, 224867, 224883, 224912, 227002, 227003, 227004, 227005.

Note: *Accidentally Introduced* - This native of southern Spain and northern Africa is a common food snail in markets around the world and has also been introduced

Figure 47. *Otala lactea*. – FMNH 224775, Paget Parish, Bermuda; diameter = 33.8 mm (apical view); diameter = 33.9 mm (apertural view).

to North America. In 1928, *Otala lactea* was introduced to Fairylands, Bermuda, reportedly by crawling out of a bag purchased from the New York Fulton Fish Market for food (Gould, 1969: 419, citing personal communication with Hughes). By the 1950s, it was widespread and considered a horticultural pest by the Bermuda Department of Agriculture. *Otala lactea* was the primary impetus for the release of several predatory snails on Bermuda (Bennett & Hughes, 1959). Initial very optimistic reports of successful control by the predatory species (Simmonds & Hughes, 1963; Hughes, post 1968; mirrored by Godan, 1983: 325, who called it a "great success") were followed by surveys showing little or no control of *Otala* populations (Monkman, 1982a). The current survey finds *Otala lactea* to be one of the most common species of snails on Bermuda, easily found aestivating in bushes throughout the larger islands of Bermuda.



Map 46. *Otala lactea*.

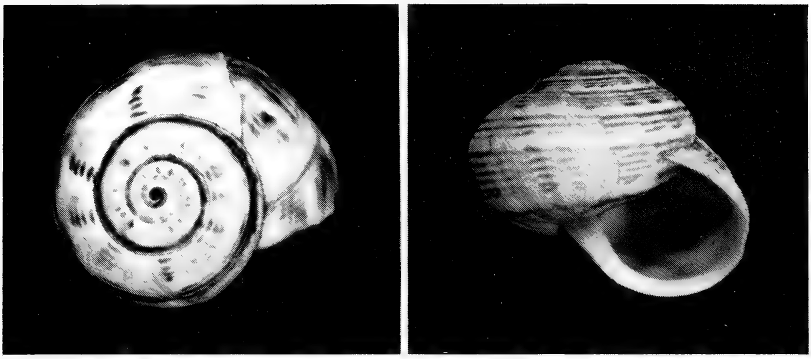


Figure 48. *Theba pisana*. - BAMZ 1995-133-005, St. George's Parish, Bermuda; diameter = 22.2 mm (apical view); diameter = 22.8 mm (apertural view).

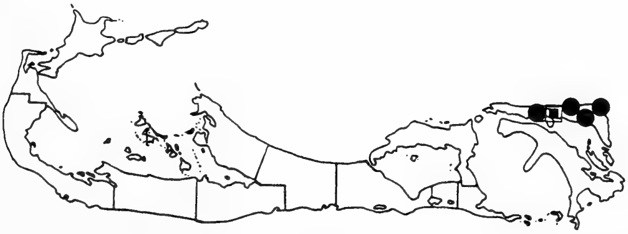
Theba pisana (Müller, 1774)
(Map 47, Fig. 48)

Helix pisana Müller, 1774: 60-61 (Europe).

Helix pisana, - Davis, 1904: 126; Vanatta, 1911: 665;
Euparypha pisana, - Peile, 1926: 90.

Bermuda Material Studied: BAMZ 1995-133-005, 1998-166-063; DMNH 210293; FMNH 16467, 29790, 29791, 227018.

Note: *Accidentally Introduced* - This common Mediterranean species was first recorded around the city of St. George by Davis (1904) who attributed his record to the Verrill party of 1898. *Theba pisana* has also been introduced to Australia, South Africa and western North America. On Bermuda it is one of the few introduced species that have a restricted range. To date it has only been found



Map 47. *Theba pisana*.

within a few miles of the city of St. George on St. George's Island. Live individuals can be found aestivating on the stems of bushes.

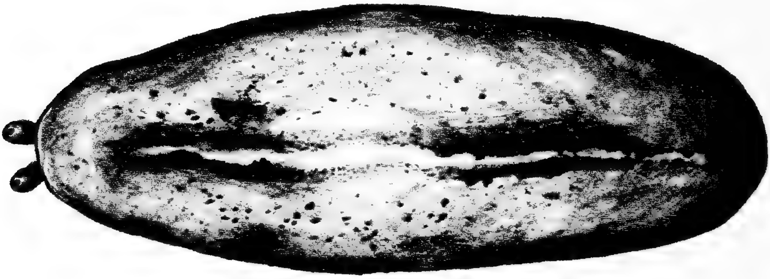


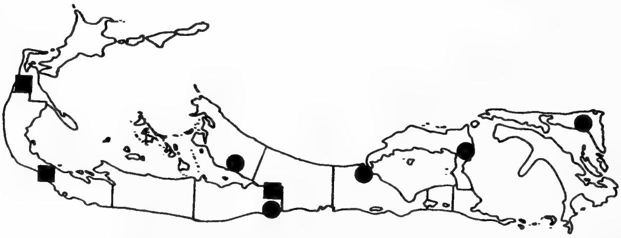
Figure 49. *Leidyula sloanii.* - FMNH 224876, Southampton Parish, Bermuda; dorsal view; body length = 29 mm.

SYSTELLOMMATOPHORA: RATHOUISOIDEA
VERONICELLIDAE
Leidyula sloanii (Cuvier, 1816)
(Map 48, Fig. 49)

Onchidium Sloanii Cuvier, 1816: 411 (Jamaica).

Vaginulus sp., - Pilsbry 1888: 288;
Vaginulus schivelyae Pilsbry, 1890b: 297, pl. 5, figs. 6-8 (Bermuda);
Vaginulus schivelyae, - Pilsbry, 1891: 39, pl. 2, figs. 6-8;
Veronicella schivelyae, - Pilsbry, 1900: 502; Verrill, 1902: 728, 735, figs. 84, 1a-c; Peile, 1926: 90; Hughes, post 1968: 1;
Veronicella schivelyoe [*sic*], - Olmsted, 1917: 224;
Veronicella sloanii schivelyae, - H. B. Baker, 1925: 160-163, pl. 3, figs. 1-4.

Bermuda Material Studied: BAMZ 1998-166-116; FMNH 3642, 13668, 30211,



Map 48. *Leidyula sloanii.*

30212, 59481, 224760, 224868, 224876.

Note: *Accidentally Introduced* - This species was first recorded from specimens collected "in the Public Garden at St. George" by the Heilprin party in 1888 (Pilsbry, 1888; 1890b: 298). It is commonly found at night, crawling on walls and garden fences.

Bermuda specimens were described as *Vaginulus schivelyae* Pilsbry, 1890, and thought endemic to Bermuda until compared to specimens of Jamaican *Leidyula sloanii* by Baker (1925). Hoffmann (1927: 215) argued in contrast that, pending further anatomical observations, Pilsbry's *V. schivelyae* could be conspecific with *Leidyula floridana* (Leidy, 1851), *L. moreleti* (Crosse & Fischer, 1872), or *L. olivacea* Stearns, 1871. The group needs additional study and is here listed under the earliest name of the complex.

Several singular or doubtful records exist:

Achatina fulica Bowdich, 1822: A snail collected in May of 1971 from Dock Hill, Devonshire Parish, was identified by staff of the Department of Agriculture as *Achatina fulica* from a photograph published in a local newspaper (Hughes, 1971). However, the snail apparently was not preserved. Specimens of *Achatina* were not located in collections at the Bermuda Department of Agriculture or in the Natural History Museum, Bermuda, and no further specimens have been reported.

Mesodon zaletus (Binney, 1837): A single series of three specimens of this eastern North American species were found in the collections of the Natural History Museum, Bermuda (BAMZ 1995-132-024). However, this large-shelled species was not found during this survey and no locality information was associated with the museum material.

Cerion spp.: ***Cerion maritimum*** (Pfeiffer, 1839) was listed by Prime (1853: 77, as *Pupa*). Jones (1864: 9) referred to Bermuda material "found by Mr. Marrett on the Port Royal Hills" as "***Pupa chrysalis*?**" (apparently based on *Cerion mumia* var. *chrysalis* Férussac, from Cuba, Guadeloupe and Martinique). One specimen of ***Cerion variabile*** Dall, 1905, was collected by Louis Mowbry in 1926 from beach drift and reported by Gray (1942). No other specimens of this genus, live or dead, have been recorded, and no *Cerion* population seems to be established on the islands.

Limax maximus Linné, 1758 - Recorded by Hughes (post 1968a), this large slug does not appear in the collections of either the Bermuda Department of

Agriculture or the Natural History Museum, Bermuda. This record is probably a misidentification of *Limacus flavus.*

Cepaea nemoralis (Linné, 1758) - The European Garden Snail was reported for Bermuda by Lane (1891, Essay 1; as *Helix nemoralis*), but has not been found since. Verrill (1902: 734) suggested this record to be an error for *Poecilozonites bermudensis*, whereas Vanatta (1911: 665) and we interpreted it as an error for *Bradybaena similaris.*

Succinea putris*, *Pupa troquilla pyrenaearia [*sic*], and ***Pachystyla mauritiana* var.** were listed for Bermuda by Bartram (1878: 108). Bartram misidentified his material by direct comparison with Chenu's illustrations of European specimens in the 'Manuel Conchyliologie.' Bartram was probably referring to *Succinea bermudensis*, *Gastrocopta pellucida*, and *Poecilozonites bermudensis.*

Unavailable names mentioned in the Bermuda literature:

"*Helix somersetii*"

Helix Somersetii Prime, 1853: 55 [*nomen nudum*];
"*H[elix] Somersetii* (n.s.)" Jones, 1859: 106-107 [based on Prime's list; *nomen nudum*].

"*Bulimus bermudensis*"

Bulimus Bermudensis Prime, 1853: 55 [*nomen nudum*];
"*B[ulimus] Bermudensis* (n.s.)" Jones, 1859: 107 [based on Prime's list; *nomen nudum*].

Neither name was validly introduced and neither can be unequivocally assigned to any one species.

DISCUSSION

Bermuda's fauna, with few terrestrial animals, has long been considered depauperate and disharmonious (Verrill, 1902). However, the 17 species of terrestrial mollusks native to Bermuda (see Table 1) are slightly more than might be expected from an island group of such limited size (54 km^2 or 19.5 mi^2) and low elevation (75 m or 245 ft). Pacific islands of similar size and elevation, for example, average only 12.5 species (Solem, 1990: table 5). As was pointed out before, land snail diversity does not seem to be well predicted by island size and counter-intuitively rises with distance from a colonization source (Solem, 1974). The high levels of species diversity observed on isolated islands are largely due to extensive species radiations of rarely successful colonists, as can be seen in the Achatinellidae of Hawaii or *Poecilozonites* of Bermuda. However, many of Bermuda's native land snails, 6 of 17, are native non-endemics and the abundance of these is perplexing when Bermuda's isolation and traditional views of the low dispersal ability of snails are taken into consideration. Several plausible scenarios have been proposed to explain such dispersal ability of snails, including wind dispersal (Peake, 1981: 250), rafting (Pilsbry, 1900), and dispersal on migratory birds (Dundee *et al.*, 1967). Small snails would be more likely to be transported by these means than larger snails. It is no surprise then, that Gould (1970b: 490) doubted "that any other factor beyond size is required to explain why the pulmonate fauna of Bermuda, an assemblage of chance immigrants, includes such a preponderance of small forms." However, size may not be the only factor determining the unusual species composition of Bermuda's land snail fauna: Many of Bermuda's native genera of land snails are known to contain species having the ability to produce young uniparentally, for example *Carychium* (Bulman, 1990) and *Vertigo* (Pokryszko, 1987), or have anatomy suggestive of self-fertilization as in *Poecilozonites* (Pilsbry, 1889: 85).

All eleven species endemic to Bermuda share their closest affinities with species of eastern North America (see notes under each species), with the possible exception of "*Hojeda*" *hypolepta* whose relationship with other species is unknown. Antillean affinities reported by Pilsbry (1900) are based in part on several species now known to have been introduced accidentally. The six native non-endemic species all have widespread distributions that are remarkably similar and include the extreme southeast coast of North America, and in most cases the Greater Antilles as well.

The majority of Bermuda's terrestrial mollusks are very widely distributed, are closely associated with human activities, and do not have a fossil history on Bermuda, leading to the generalized conclusion they are accidentally introduced through commerce. In fact, at least eleven of these species have also been accidentally introduced to the Hawaiian Islands (Cowie, 1997) and 21 are known traveling species often encountered by the Animal and Plant Health Inspection Service of the United States Department of Agriculture (Robinson, 1999). The high proportion of synanthropic mollusks on Bermuda (28 of 49 species) mirrors the high proportions in some of Bermuda's other terrestrial animal groups, such as Coleoptera ("nearly all the beetles have been introduced accidentally by human activity"; Hilburn & Gordon, 1989: 674) and spiders (53 of 59 species; Sierwald, 1988). Of the 28 introduced snail species, nine or ten are native to Europe and North Africa, ten are native to Tropical America, four or five are native to North America, two to Asia, one to Africa, and one to the Pacific Ocean Basin. Because

Table 1. Terrestrial mollusk species occurrences on Bermuda by date of survey.

Key to Symbols:
□ Recent
■ Recent Live-Collected
● Fossil
See notes in species listings for additional information about dates of introduction.

Endemic Species																
Carychium bermudense	●	-	-	-	-	-	-	-	-	-	-	□	■	■	-	■
"Euconulus" turbinatus	●	-	-	-	-	-	-	-	-	-	-	■	-	■		
"Hojeda" hypolepta	●	-	-	-	-	-	-	□	□	-	-	□	□	■	-	□
Poecilozonites bermudensis	●	□	□	□	□	□	□	□	■	-	□	□	□	■	■	□
Poecilozonites circumfirmatus	●	□	□	□	□	□	□	□	■	-	□	□	□	■	■	■
Poecilozonites reinianus	●	-	-	-	□	-	-	□	■	-	□	□	□	■		
Punctum bristoli	●	-	-	-	-	-	-	-	-	-	-	-	■	■	-	■
Succinea bermudensis	●	□	□	□	□	□	□	□	□	-	□	□	□	□	■	■
Vertigo bermudensis	●	-	-	-	-	-	-	-	-	-	-	□	-	□		
Vertigo marki	●	-	-	-	-	-	-	-	-	-	-	□	-	■		
Vertigo numellata	●	-	-	-	-	-	-	-	-	-	-	□	□	■	-	■
Date of survey*	fossil	1852	1859	1861	1867	1873	1878	1881	1888	1895	1898	1910	1922	1926	1950	1988

Native Non-Endemic Species																
Gastrocopta pellucida	●	-	□	□	□	-	-	□	□	□	□	■	□	□	■	■
Gastrocopta rupicola	●	-	-	-	-	-	-	-	□	-	□	■	□	□	■	■
Pupisoma macneilli	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	■
Pupoides albilabris	●	-	□	□	□	-	□	□	□	□	□	□	-	□		
Striatura meridionalis	●	-	-	-	-	-	-	-	-	-	-	-	-	■	-	■
Strobilops hubbardi	●	-	-	-	-	-	-	-	-	-	-	□	□	■	-	□
Date of survey*	fossil	1852	1859	1861	1867	1873	1878	1881	1888	1895	1898	1910	1922	1926	1950	1988

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*Key to Survey Dates, Collectors and Sources:
Fossil collected by A. Gulick and S. J. Gould (Gulick, 1904; Gould 1970b)
1852 collected by T. Prime (Prime, 1853; Pilsbry 1900)
1859 (pre-1860) collected by T. Prime and J. M. Jones (Jones, 1859)
1861 (pre-1862) collected by Governor F. Murray (Tristram, 1861)
1867 (pre-1868) collected by J. J. Rein and Governor C. B. Ord's sons (Rein, 1867)
1873 collected by the Challenger Expedition (Smith, 1884; Pilsbry, 1900)
1878 (pre-1879) collected by J. T. Bartram and an un-named gentleman from Hamilton (Bartram, 1878)

Table 1. (continued)

Accidentally Introduced Species

Opeas hannense															■
+Streptostele musaecola															■
Tornatellides sp.															■
Otala lactea													1928	-	■
Helicodiscus singleyanus													☐	-	■
Allopeas gracile											☐	-	☐	-	■
Allopeas micrum											☐	-	☐	-	■
Theba pisana											☐	-	☐	■	■
Zonitoides arboreus											■	-	☐	-	■
Gastrocopta servilis										☐	☐	-	☐	☐	
Limacus flavus										■	-	-	☐		
Bradybaena similaris								1889	-	■	☐	☐	☐	■	■
Gulella bicolor								☐							
Leidyula sloanii								☐	☐	■	-	-	☐	■	■
Obeliscus swiftianus								☐	-	☐	-	☐	☐	■	■
Rumina decollata						☐	-	■	☐	☐	☐	☐	☐	■	■
Deroceras laeve					☐	-	-	-	☐	-	☐	-	☐	-	■
Milax gagates					☐	-	-	-	☐	■	■	-	☐	-	■
Oxychilus draparnaudi				☐	-	-	-	-	-	-	■	-	☐	-	■
Subulina octona				☐	-	-	☐	☐	☐	☐	☐	-	☐	■	■
Ceciliodes acicula			☐	-	-	☐	☐	-	☐	☐	☐	-	☐	-	☐
Polygyra plana	1852	☐	☐	☐	☐	-	☐	☐	-	■	■	☐	☐	■	■
Prietocella barbara	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	■	☐	-	■	■
Hawaiia miniscula	☐	-	-	-	-	-	-	-	-	☐	■	☐	☐	■	■
Lacteoluna selenina	☐	☐	☐	☐	☐	☐	☐	☐	-	☐	■	☐	☐	■	■
Oligyra convexa	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	■	☐	☐	■	■
Patera appressa	☐	☐	-	-	-	☐	☐	☐	-	■	■	-	☐	■	■
Vallonia pulchella	☐	☐	☐	☐	-	-	☐	-	☐	-	☐	-	☐		
Date of survey*	1852	1859	1861	1867	1873	1878	1881	1888	1895	1898	1910	1922	1926	1950	1988

1881 (pre-1882) collected by C. B. Adams, T. Prime, R. Swift, T. Bland (Bland, 1881)
1888 collected by the Heilprin Expedition (Heilprin, 1889; Pilsbry 1900)
1895 (pre-1896) collected by C. B. Adams, T. Prime, R. Swift, T. Bland (Bland, 1895)
1898 collected by the Verrill Expedition (Pilsbry, 1900)
1910 (1905-1910) collected by S. Brown, E. E. and E. G Vanatta (Vanatta, 1911)
1922 collected by H. Hoyt (Vanatta, 1924; Vanatta, 1924)
1926 (pre-1927) collected by A. J. Peile & A. Haycock (Peile, 1926)
1950 collected by F. Haas (FMNH collections; Haas 1952)
1988 (1983 & 1988) collected by R. Bieler *et al.*
+An additional record from the Fahy Collection, 1992.

human activities have carried these species throughout the world, tracing a single point-of-origin for Bermuda's populations of each species (if only one exists) is probably impossible. Three of these species are recorded here for the first time (*Streptostele musaecola*, *Opeas hannense* and *Tornatellides* sp.). Such species introductions, although nearly tripling the number of land snail species on Bermuda, have not lead to saturation and subsequent species turnover. Solem's (1990: 112) assertion that, given time and appropriate conditions, land snail species can accumulate sympatrically to a level of more than 60 species (postulated for natural colonization of Pacific islands) might soon be proved true also for the in part "artificial" colonization of Bermuda.

Unfortunately, the similarities between Bermuda and the Pacific Islands have continued with the deliberate introduction of four predatory snail species for biological control. The earliest reports of declines in abundance in *Poecilozonites* came in the late 1960's (Gould 1969). Subsequent authors (e.g., Glaubrecht 1990) attributed the reduction in *Poecilozonites* to competition with the introduced species *Otala lactea* and *Rumina decollata*. However, *Rumina* had been introduced nearly a century earlier and *Otala* more than 40 years before, and noticeable reductions in population numbers were not observed until the period between 1963 and 1969. It is more likely that the introduction of the predatory species *Euglandina rosea* in late 1958 was responsible (see Table 1). *Euglandina* is now widespread on the larger islands of Bermuda, with the possible exception of the southeastern portion of the main island. *Gonaxis quadrilateralis* is just beginning to spread beyond its original release sites, and *Otala* and *Rumina* are among the most common and widespread snails on Bermuda, with little evidence of control by *Euglandina*. *Poecilozonites*, on the other hand, has become quite uncommon and appears to be threatened by extinction. Only two of the three extant species of this endemic genus were found during this survey and neither of these is common: *P. circumfirmatus* was found alive in two localities and fresh-dead specimens of *P. bermudensis* were found in another. Several endemic and native non-endemic species including *Poecilozonites reinianus*, *Vertigo marki*, *Vertigo bermudensis* and *Strobilops hubbardi* appear to be restricted to the southeastern portion of the main island near caves and remnant stands of native vegetation.

It is hoped that this work represents another stepping stone in the informal series investigating the history of Bermuda's mollusk fauna, and – most importantly – that it provides the necessary baseline data for continued monitoring of a rapidly changing faunal composition.

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