PROCEEDINGS

of the

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BIOLOGICAL SOCIETY OF WASHINGTON PROCEEDINGS

1046th Meeting—13 March 1974

NINETY-FIFTH ANNUAL MEETING

The meeting was called to order by Vice President Thomas E. Bowman in the absence of President Victor Springer at 2:10 p.m. in Room 43 of the National Museum of Natural History.

Reading of the minutes of the previous annual meeting was dispensed with, since they were printed in the Biological Society of Washington Proceedings.

Treasurer Oliver Flint read the Financial Report. He thanked Maureen Downey for serving as Acting Treasurer for the past 6 months and for developing figures for the report. In answer to a question as to why an endowment fund repayment had not been made during the past year, Treasurer Flint said that it was an oversight and that $1700 is to be repaid in 1974.

Clayton Ray asked the Treasurer what percent of page-charges for papers published in the *Proceedings* came from the Smithsonian Institution. Treasurer Flint said that about one-half, but that some payments of the previous year were not yet paid. In answer to a question from Stanwyn Shetler, Treasurer Flint said that page-charges were requested from all authors, but that payment was not a condition for publication.

Daniel Cohen, Chairman of the Financial Committee, stated that the Financial Report had been audited and found to be correct. A motion made to accept the report was seconded and passed. He then presented the budget for 1974.

Austin Williams, Chairman of the Editorial Committee, presented a report stating, Volume 86 of the *Proceedings* for 1973 consisted of 45 papers totalling 524 pages. The first issue of Volume 87, consisting of 14 papers, is now in galley proof. Ten of these are paid papers. Twelve papers for the second issue have been received and are under review. He also said that instructions entitled, "Information for Contributors," will be included in Volume 87. George Watson suggested that the instructions not be republished every year, but that enough reprints should be printed to last about 5 years.

Secretary Louis Kornicker gave results of the election for Officers and Council members for 1974: President, Thomas E. Bowman; Vice President, Clyde J. Jones; Secretary, Louis S. Kornicker; Treasurer, Oliver S. Flint; Members of the Council, Richard C. Banks, Isabel C. Canet, Fenner A. Chace, Clayton E. Ray, and Paul J. Spangler.

Secretary Louis Kornicker gave a report on membership (see Appendix in Treasurer's Report). Daniel Cohen asked how a new life member could have been elected since that category had been eliminated by the council some years back. He suggested that the Secretary check minutes of old meetings to ascertain whether the category of Life Member was still extant.

Vice President Bowman reported that the Council had 3 meetings during the past year and that a proposed Bicentennial Symposium had been cancelled because of being unable to obtain someone willing to organize it, and because of general lack of interest by possible participants approached. The subject of the symposium was to have been concerned with biological, geological and ecological changes that have taken place in the Washington area since 1776. He also announced that "The Panamic Biota" volume is being reprinted because of demand and should be available shortly. A policy statement concerning a proposed Sea-level Canal in Panama was distributed to other societies and was published in *Science.* A letter concerning this statement was received from the President of the Panama Canal Company and is available to interested members.

Marian Pettibone made a motion thanking Officers and Council members for their efforts on behalf of the Society during the past year, and also Paul Spangler, who had served as Editor of the *Proceedings* until it was taken over by Austin Williams in the fall. The motion was seconded and passed.

Vice President Bowman then turned the meeting over to incoming President Bowman.

A motion to adjourn was seconded and passed.

Louis S. Kornicker
Secretary

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INFORMATION FOR CONTRIBUTORS

1. *Content.* The Proceedings of the Biological Society of Washington contains papers bearing on systematics in the biological sciences (both botany and zoology, including paleontology), and notices of business transacted at meetings of the Society. Except at the direction of the Council, only manuscripts by Society members will be accepted. Papers will be published in English, except for Latin diagnosis/description of plant taxa which should not be duplicated by an English translation.

2. *Submission of manuscripts.* Manuscripts should be sent to the Editor, Proceedings of the Biological Society of Washington, U. S. National Museum of Natural History, Washington, D. C. 20560.

3. *Review.* One of the Society's aims is to give its members an opportunity for prompt publication of their shorter contributions. The Proceedings are issued in "occasional paper" style approximately three times a year. Manuscripts will be reviewed in order of receipt by a board of associate editors and appropriate referees.

4. *Presentation.* Clarity of presentation and requirements of taxonomic and nomenclatural procedures necessitate reasonable consistency in the organization of papers. Authors are urged to follow recent issues of the Proceedings as models. Telegraphic style is recommended as the most economical of space for descriptions. Synonymy of abbreviated style (author, date, page) with full citations only in Literature Cited is also recommended.

The establishment of new taxa must conform with the requirements of the appropriate international codes of nomenclature. Authors are expected to be familiar with these codes and to comply with them. New species-group accounts must designate a type-specimen deposited in an institutional collection.

(a) The sequence of material should be: Title, Text, Literature Cited, Appendix, Tables (each table numbered with an arabic numeral and heading provided), List of Figures (entire figure legends), Figures (each numbered and identified).

(b) *Webster's Third New International Dictionary of the English Language Unabridged, the AIBS Council of Biology Editors Style Manual, United States Government Printing Office Style Manual*, and the *BIOSIS List of Serials with Title Abbreviations* are useful guides for style, spelling, abbreviations, and other technical matters.

(c) Type manuscripts double-spaced throughout (including tables, legends, and footnotes) on one side of paper measuring approximately 8½ × 11 inches, leaving margins of at least one inch all around. Submit a facsimile with the original and retain an author's copy. Number pages consecutively at the top. One manuscript page = approximately ⅔ of a printed page.

(d) Underline singly scientific names of genera and lower categories; leave other indications to the editors. Use all capitals only in the title.

(e) Do not use periods after standard abbreviations such as measurements or compass points unless confusion might result from their omission: e.g.—mm, cm, m, C (Celsius), N, NW, ESE, but no. = number(s), Fig(s). = figure(s), mi. = mile(s).

(f) Figures and tables, with their legends and headings, should usually be self explanatory, not requiring reference to the text. Indicate their approximate placement by a pencil mark in the margin of the manuscript.

(g) Illustrations should be planned in proportions that will efficiently use space on the type bed of the Proceedings (9.7 × 16.8 cm). Legends require 4 mm of column length per line.

5. *Charges.* The high costs of publication make it necessary for the Society to solicit partial or complete payment of publication cost from authors who have funds available for this purpose through their grants or sponsoring institutions. Authors without access to publication funds should indicate this; cost of their publication will be borne by the Society's funds. Acceptance of a paper is in no way dependent on payment of publication costs, with the following exceptions: all authors are required to pay a handling charge for figures and to pay charges for all pages in excess of 16 that they publish in a single volume of the Proceedings.

6. *Proofs.* Galley proof will be submitted to authors for correction and approval. Changes other than printer's or editor's errors may be charged to authors. Reprint orders will be taken with returned proof.

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REDESCRIPTION OF THE CARDINAL FISH *APOGON ENDEKATAENIA* BLEEKER (APOGONIDAE), WITH COMMENTS ON PREVIOUS USAGE OF THE NAME

By Thomas H. Fraser[1]
J. L. B. Smith Institute of Ichthyology,
Rhodes University, Grahamstown, South Africa

In 1852 Pieter Bleeker described *Apogon endekataenia* from a single specimen (57 mm total length) taken at Banka in Indonesia. Subsequently, fifteen other specimens were added to the jar containing the type. According to the Auction Catalogue (Hubrecht, 1879) in which Bleeker's fish collection was offered for sale, ten specimens of *A. endekataenia* were in the A series, two specimens each in the B, C and D series and none in the E series. Whitehead *et al.* (1966: 7–14) indicate some basic procedures involved in attempting to determine which specimens are type material in the Bleeker collections. In the case of *A. endekataenia* the criteria utilized were total length and the remains of faded color pattern. Fortunately, only one specimen (55 mm total length) was close to the 57 mm length given by Bleeker. The others were of various sizes, the nearest three 45, 63 and 64 mm total length. (I cannot account for the presence of two additional specimens in the jar unless a counting or typographic error was made by Hubrecht.) The 55 mm specimen is considered to represent Bleeker's original specimen from Banka. This agrees with the opinion of M. Boeseman cited in Smith (1961).

The identification of the putative holotype fundamentally changes the concept of *Apogon endekataenia*; most past records are considered to be erroneous or doubtful identifications. The specimens subsequently added to the type jar were of

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[1] Present address: Division of Fishes, National Museum of Natural History, Washington, D. C. 20560 U.S.A.

two species and may have been the source of some errors. Descriptions in all major faunal reviews examined indicate other species, or are composites of two or more species (Bleeker, 1874, 1873–76; Weber and de Beaufort, 1929; Fowler and Bean, 1930; Smith, 1961). Lachner (1953) did not reach a decision concerning the identity of *Apogon endekataenia* but he noted that none of the specimens available to him conformed to the figure in Bleeker's Atlas (1873–76). A redescription of the species is necessary and will contribute to the eventual resolution of the dark-striped complex of species in *Apogon*.

I thank M. Boeseman, Rijksmuseum van Natuurlijke Historie (RMNH) for permission to examine Bleeker's material and for his co-operation and valuable help during my stay at Leiden. A. C. Wheeler made possible the loan of specimens at the British Museum (Natural History) (BMNH). E. A. Lachner and M. M. Smith critically read a draft of the manuscript. Funds for the taxonomic study of fishes and attending aspects were provided by the South African Council for Industrial and Scientific Research and by Rhodes University.

Counts and measurements were made according to Hubbs and Lagler (1958) except that the body depth was taken from the dorsal-fin origin to the pelvic-fin base. Measurements were made with dial calipers. The last dorsal ray and last anal ray, each split to its base, was counted as one element. The gillraker at the angle was included in the count for the lower arch.

Apogon endekataenia Bleeker, 1852

Figure 1

Description: For general body shape see Figure 1. Range of proportions (as percentages of standard lengths, putative holotype values in parentheses): body depth (33) 33–36; head length (36) 35–38; eye length (12) 11–12; snout length (8) 7–9; bony interorbital width (7) 6–7; upper jaw length (18) 17–18; caudal peduncle depth (14) 14–16; caudal peduncle length (25) 22–26; first dorsal spine length (4) 1–4; second dorsal spine length (12) 9–12; third dorsal spine length 19–23; fourth dorsal spine length 16–20; last dorsal spine length (17) 15–17; first anal spine length (2) 2; second anal spine length (13) 12–13; pectoral fin length (24) 23–25; pelvic fin length (21) 20–22.

Meristic counts and ranges for nine specimens examined: dorsal fin

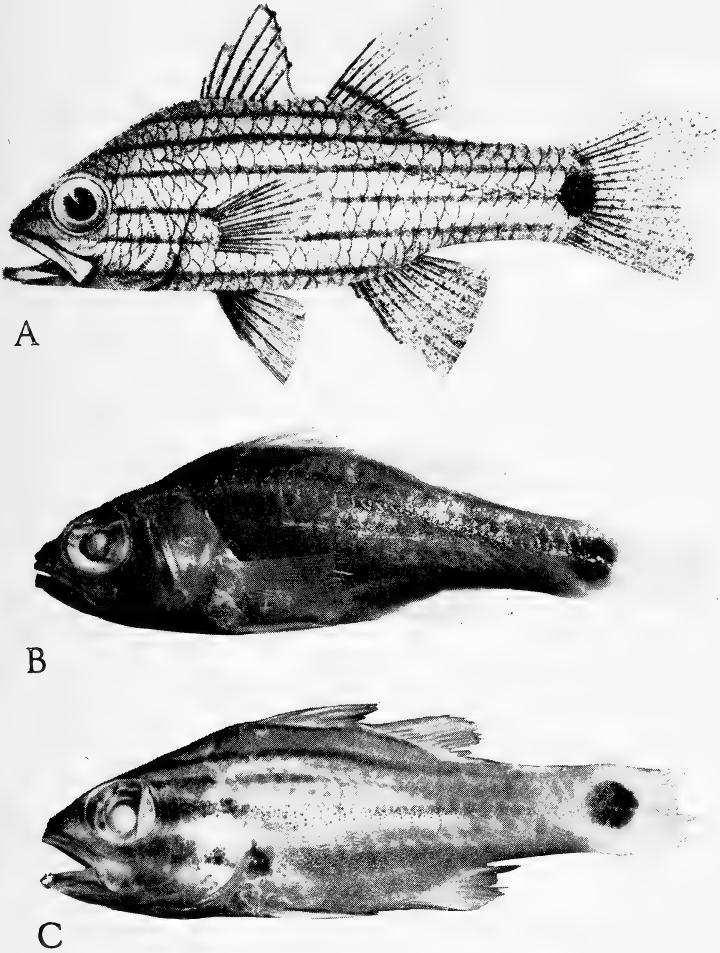

Fig. 1. A. *Apogon endekataenia*, illustration from Bleeker 1873–1876. B. *Apogon endekataenia*, putative holotype, RMNH 5593 (43.9 mm SL). C. *Apogon endekataenia*, BMNH 1892.9.2.18–20, one of three.

VII-I, 9; anal fin II, 8; pectoral fin 14; pelvic fin I, 5; well-developed gillrakers 13–15 (2–3 + 11–12), usually 13–14, including rudiments 18–21 (2–4 + 2–3; 11–12 + 2–4), putative holotype 3 + 3–12 + 3; pored lateral-line scales (25) 24–25; longitudinal scale rows above lateral line (25) 24–25; transverse scale rows above lateral line 2; transverse scale rows below lateral line (6) 6–7; median predorsal scales (3) 3–4; circumpeduncular scale rows 12 (5 + 2 + 5).

Teeth in villiform bands on premaxilla and dentary; one or two rows on vomer and palatine; none on ectopterygoid, endopterygoid or basihyal.

Vertebrae 10 + 14. Five free hypurals, one pair of slender uroneurals, three epurals, a free parhypural. Three predorsals, two spines on first dorsal pterygiophore. Seven branchiostegal rays. Basisphenoid present. Supramaxilla absent.

Life colors unknown. In 70% ethanol six dark, longitudinal stripes present from dorsal-fin base to abdomen; large round basicaudal spot slightly off center (dorsally) of lateral line (Figure 1): 1. median stripe on head splitting at dorsal fin and extending along dorsum at base of fins, fading on caudal peduncle; 2. stripe extending from snout along occiput and nape paralleling above the lateral line and reaching nearly to basicaudal spot; 3. post-ocular stripe from upper part of eye and just below lateral line extending onto caudal peduncle; 4. median stripe extending from eye above pectoral fin along side nearly to basicaudal spot; 5. stripe extending from lower part of eye and head through pectoral fin along side nearly to basicaudal spot; 6. stripe extending from lower jaw below pectoral fin along abdomen and onto last several anal-fin rays. Complete dark stripe present in basal portion of soft dorsal fin but no counterpart in soft anal fin. Peritoneum silvery, intestine black.

Distribution: Discounting the doubtful and erroneous reports, *Apogon endekataenia* is known from Borneo and Banka Island, near Sumatra, and recently I have seen material from Thailand at the California Academy of Sciences. Fowler (1937: 232–234, Fig. 23) identified two specimens from Bangkok as *Apogon robustus* (Smith and Radcliffe, 1911); however, the illustration appears similar to *A. endekataenia* but with extra stripes. It has not been reliably reported in the western Indian or central Pacific Oceans.

Material examined: Putative holotype. RMNH 5593, 43.9 mm SL, 55 mm total length, Banka Island. Other material. BMNH 1892.9.2.18–20. (3 specimens, 52.1–62.1 mm SL), Borneo, X-ray. RMNH 23966 (5, 51.5–67.6 mm SL), East Indies.

Remarks: *Apogon endekataenia* differs from other dark-striped *Apogon* (*Nectamia*) in possessing the following combination of characters: a large, round, basicaudal spot, no dark stripe in the anterior part of the anal fin, and a long post-ocular stripe. Smith (1961: 400) believed that Bleeker's illustration (1873–76: Pl. 32, fig. 2) was inaccurate. The illustration and putative holotype (Figs. 1A and B) agree better than figures by other authors of specimens purported to be *A. endekataenia*. The putative holotype also agrees with Bleeker's original description.

Of the 18 specimens examined in the Bleeker collections, five specimens in RMNH 23966 are conspecific with the putative holotype and one other specimen in RMNH 23966 was unidentifiable; two specimens in RMNH 23968 may be conspecific with the type but are too poorly preserved to be certain; and all nine in RMNH 23967 are a different species, probably *Apogon cookii* Macleay, 1881.

Smith (1961) experienced difficulty in separating closely related spe-

TABLE 1. Comparison of selected characters for three species of dark-striped *Apogon*.

Character	*A. endekataenia*[1]	*A. cookii*[2]	*A. taeniophorus*[3]
Stripe in anal fin	Absent	Present	Present
Post-ocular stripe	Present (Long)	Present (Short)	Absent
Upper and lower main stripes	Not on caudal fin	Extend onto caudal fin	Extend onto caudal fin
Midbody stripe	Not confluent with caudal spot	Confluent with caudal spot	Widens slightly at caudal base and intensified
Caudal spot	Large, slightly off center of lateral line	Small, centered on lateral line	Indistinct
Total number of gillrakers[4]	18–21	18–19	16–19
Well-developed gillrakers[4]	13–15	11–13	11–13
Pectoral rays	14	15	14
Body depth (% SL)	33–36	35–40	32–37
Interorbital width (% SL)	6–7	7–8	7–8

[1] Based on 9 specimens, 44–68 mm SL.
[2] Based on 19 specimens, 43–80 mm SL.
[3] Based on 20 specimens, 54–85 mm SL.
[4] Includes upper and lower gillrakers of first arch.

cies in the dark-striped complex of *Apogon* and believed that he was dealing with a polychromic species. He did not see the putative holotype but did see two specimens (out of five) which are here considered conspecific with the holotype. Nevertheless, he believed these specimens were identical with his relatively fresh material. None of the material so identified at the J. L. B. Smith Institute is Bleeker's species but rather *Apogon cookii* and *Apogon taeniophorus* Regan, 1908, common species in the western Indian Ocean (see Table 1 for comparisons). The illustrations in Smith (1961) are of *A. cookii.* Both of these species also appear to be widespread in the eastern Indian and western Pacific Oceans, but have been misidentified or given junior synonyms, a problem that will be discussed elsewhere.

Weber and de Beaufort (1929) probably based their description on the collection of mixed species at RMNH although it is not so stated. Their description is insufficient to determine whether more than one species was included.

Fowler and Bean (1930) examined only the type of *A. wilsoni* (Fowler, 1918), a different species.

Some of the dark-striped, seven-spined species of *Apogon* have received varied treatment: consideration as polychromic forms of the same species (Jordan and Seale, 1906; Smith, 1961), as subspecies (McCulloch, 1915), and as different species (Radcliffe, 1911; Lachner, 1953). McCulloch's treatment would seem to be least acceptable on practical and theoretical grounds because several of these supposed subspecies are sympatric over a wide geographic range. The ideas of either a single variable species or several different species are more useful hypotheses to test at this stage. Radcliffe (1911) pointed out the changes in number of stripes in *Apogon multilineatus* (Bleeker, 1865) with growth, and it appears that stripes and the basicaudal spot may be altered with growth in other species. These changes are not described for other striped species and must be investigated.

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PROCEEDINGS
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A NEW SPECIES OF *TYPHLOPS* (SERPENTES: TYPHLOPIDAE) FROM HISPANIOLA

By Richard Thomas
Museum of Zoology, Louisiana State University,
Baton Rouge, Louisiana 70803

Since the description (Thomas, 1965) of *Typhlops syntherus*, it has become evident to me that the Hispaniolan *Typhlops*, then regarded as *T. lumbricalis* Linnaeus, actually comprises two species. One of these, known from only a few localities in eastern Hispaniola but better represented from the Cul de Sac Plain of Haiti, differs in no major morphological feature, other than size, from the Cuban and Bahamian populations known as *Typhlops lumbricalis.* The other species, undescribed, appears to be restricted to the southwestern quadrant of Hispaniola.

Aside from three old specimens, the hypodigm of this undescribed species was obtained through the sponsorship and efforts of Albert Schwartz (ASFS designates the Albert Schwartz Field Series) and of Ernest E. Williams of the Museum of Comparative Zoology (MCZ). To Albert Schwartz I am greatly indebted for his support of my own efforts in the field and laboratory leading to the discovery of this new form. I also thank Lewis D. Ober, who generously provided some crucial specimens of *T. lumbricalis* (LDO designates the Lewis D. Ober private collection) and Douglas A. Rossman for his careful critical reading of the manuscript. For the loan of specimens used in this study I wish to thank Richard G. Zweifel and George R. Foley of the American Museum of Natural History (AMNH), Edmond G. Malnate of the Academy of Natural Sciences of Philadelphia (ANSP), Alice G. C. Grandison of the British Museum (Natural History) (BMNH), Neil D. Richmond and Clarence J. McCoy of the Carnegie

Museum (CM), Ernest E. Williams of the Museum of Comparative Zoology (MCZ), and the late James A. Peters and George R. Zug of the National Museum of Natural History (USNM). Without the capable field work of Robert K. Bobilin, Patricia A. Adams, Ronald F. Klinikowski, Mark D. Lavrich, and David C. Leber so extensive a series of the new species would not have been collected. Material obtained from 1968 through 1971 was collected under National Science Foundation Grants GB 7977 and B-023603 to Albert Schwartz.

The undescribed species is the sixth known species of *Typhlops* from Hispaniola; in reference to this fact I propose the name:

Typhlops hectus new species

Holotype: MCZ 81149, taken at Martineau, ca. 9 km (airline) W Jérémie, Dépt. du Sud, Haiti, 12 March 1966 by Richard Thomas. Original number ASFS V9145.

Paratypes: HAITI. DÉPT. DU SUD: ASFS V9276–77, ca. 10 km WSW Moron, 475 m, 13 March 1966, R. Thomas; MCZ 74907–14, Marfranc near Jérémie, 27 December 1966, D. Hill and F. Vuilleumier; MCZ 64779, Carrefour Sanon near Jérémie, 14 December 1960, Luc and George Whiteman; ASFS V9147, Jérémie, 12 March 1966, native; ASFS V9495, Jérémie, 19 March 1966, native; ASFS V9601–12, Jérémie, 21 March 1966, natives; ASFS V25284, beach area within 1 km E Jérémie, 1 July 1971, Elie Joseph; ASFS V9389, 2 km SE Jérémie, 15 March 1966, native; MCZ 64773–78, *Place Nègre near Jérémie, 14–15 December 1960, Luc and George Whiteman; MCZ 70044, *La Source near Jérémie, December 1962, George Whiteman; MCZ 64780, *Laye near Jérémie, 14–15 December 1960, Luc and George Whiteman; MCZ 70045, Tosia near (about 33 km SW) Jérémie, December 1962; ASFS V9348, ca. 5 km (airline) SE Marché Léon, 670 m, 15 March 1966, R. Thomas; ASFS V9514–16, ca. 7.5 km (airline) SSE Roseaux, est. 2 km W La Bastille, 20 March 1966, R. Thomas; ASFS V9519, ca. 3 km (airline) SW Corail, 20 March 1966, R. Thomas; MCZ 25552, Ile Grande Cayemite; ASFS V26459, Ile Grande Cayemite, vicinity of Anse à Macon, 6 August 1971, native; ASFS X3070, Camp Perrin, 26 July 1962, native; USNM 157928–29, ASFS X3141–52, Camp Perrin, 29 July 1962, native; MCZ R-123873–74, Marceline; ASFS V26251–53, Fond des Nègres, 1 August 1971, R. Thomas; ASFS V26223, Paillant, 548 m, 31 July 1971, R. Thomas; MCZ 66323–24, CM 37953, *Butête near Miragoâne, 16 August 1961, Luc Whiteman; MCZ 66325, *Mingrette near Miragoâne, August 1961, Luc Whiteman; MCZ 66326–28, CM 37921–22, *Pemel near Miragoâne, 14 August 1961, Luc Whiteman. DEPT. DE L'OUEST: ASFS V9821, ca. 2.4 km S Trouin, 243 m, 29 March 1966, R. Thomas; ASFS V8370–71, ca.

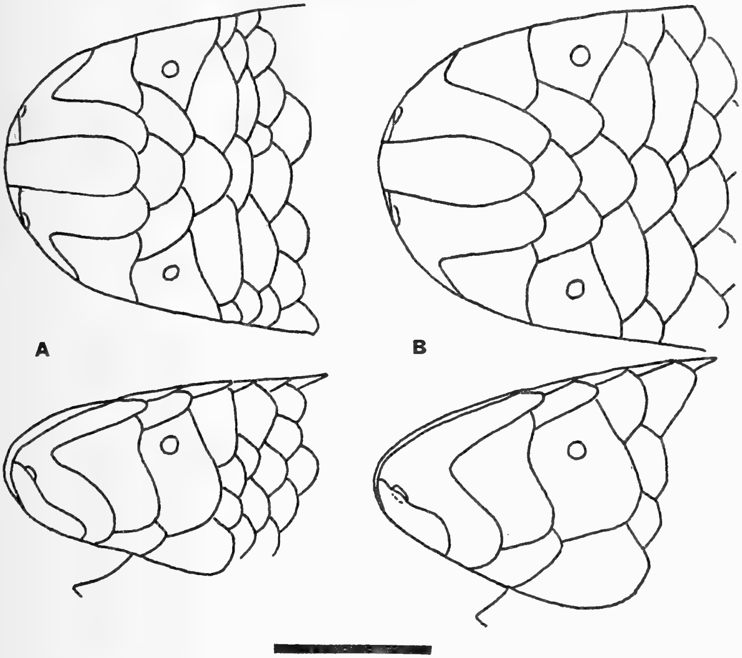

Fig. 1. A, dorsal and lateral views of the head of ASFS V9604 (*T. hectus*); B, dorsal and lateral views of the head of ASFS V8395 (*T. lumbricalis*). Bar equals one mm.

7 km (airline) W Pétionville, N versant Morne l'Hôpital, ca. 609 m, 1 March 1966, R. Thomas; ASFS V8375, 9.6 km (road) W Pétionville, N versant Morne l'Hôpital, 822 m, 1 March 1966, native.

Non-paratypic specimens: HAITI. Dépt. de l'Ouest: ASFS V8295–96, ca. 7 km SE Mirebalais; ASFS V26542–48, V26577, 3.5 km SW Lascahobas, 274 m, 15 August 1971, native. REPÚBLICA DOMINICANA. Prov. San Juan: ASFS V512–15, Río Arriba del Norte; ASFS V21567, 4 km N Sabaneta; ASFS V396–98, 7 km W Vallejuelo, 792 m. Prov. San Rafael: ASFS V21570–71, 1 km E Hondo Valle. Prov. Independencia: ASFS V20924, 15 km W Puerto Escondido; AMNH 41265–66, Duverge. Prov. Barahona: ASFS V30493, El Iguito, 2.6 km NE Fondo Negro; ASFS V35641, El Iguito, 3.1 km NE Fondo Negro; AMNH 51496, above Delmonte's Finca (near Barahona).

Localities indicated with an asterisk are not mapped; it is not certain whether the unmapped localities reckoned from Miragoâne are in the Dépt. du Sud or the Dépt. de l'Ouest.

Definition: A species of *Typhlops* having the preocular in contact with upper labial three (as opposed to contacting upper labials two and three), two postoculars, a primary scale row number of 20 with reduction to 18 rows absent or occurring far posteriorly, and high mid-dorsal scale counts (284–328). Further distinguished by a clavate rostral shape (narrow, posteriorly expanded and blunt); the posterior nasals being roughly parallel sided, not divergent in dorsal aspect; and the preocular being sharply pointed anteriorly (Fig. 1).

Distribution (Fig. 2): Southwestern Hispaniola south of the Cul de Sac-Valle de Neiba Plain (except for the Barahona Peninsula) and the southwestern part of the north island (that portion of Hispaniola north of the Cul de Sac-Valle de Neiba Plain). One certain record for the Cul de Sac-Valle de Neiba Plain (extreme eastern part).

Description of holotype: Total length 192 mm, tail length 4.6 mm; 307 mid-dorsal scales between rostral and caudal spine, 295 midventral scales posterior to mental and including last scale of anal flap; 20 scale rows anteriorly, reducing to 19 rows at ventral scale 277 and to 18 at ventral scale 279 (with some redividing and re-fusing of scale rows before final fusion); 2 postoculars and one parietal on each side. Coloration pale gray dorsally, fading out on lower sides to become unpigmented ventrally.

Variation: The paratypes vary in total length from 95 to 230 mm and in mid-dorsal scale counts from 284 to 324. The modal primary scale row number is 20 reducing to 18 at the level of midventral scale 194 to 288; 46 specimens (60 percent) have no reduction. A number of specimens show reduction abnormalities shortly anterior to the vent: the first reduction step (20 to 19 rows) may be made without the final (19 to 18 rows), or irregular fusion and dividing of the median and paramedian ventral rows may occur. Three specimens have 22 scale rows initially with reduction to 20 rows occurring from 35 to 131 ventrals posterior to the mental. A few have short regions of 22 scale rows anteriorly due to irregular division and fusion, and a few others have 21 scale rows for a short distance in the neck region. There are from 5 to 15 (mode 8–10) fewer ventrals than middorsals. Postoculars are 2/2 (66 specimens), 2/3 or 3/2 (2), or 3/3 (1); parietals are 1/1 (16), 1/2 or 2/1 (20), or 2/2 (25). Coloration is pale gray to tan but varies somewhat in intensity of pigmentation. The coloration may be bicolor with the transition from the pigmented dorsum to the unpigmented venter occurring in a narrow mid-lateral zone of one or two scale rows; or the pigmentation may extend well onto the venter, occasional individuals having almost entirely pigmented venters with irregular non-pigmented areas occurring along the midventral region. In the more extensively pigmented individuals the intensity of pigmentation gradually decreases ventrally. Some bicolor specimens have an indistinct collar of dark pigment across the throat.

Twenty-four specimens from several scattered localities north of the Cul de Sac-Valle de Neiba Plain plus six from the eastern portion of the south island and the Valle de Neiba agree with *Typhlops hectus* in the configuration of the rostral-nasal complex, in having pointed preoculars, high longitudinal scale counts, and in having the reduction from 20 to 18

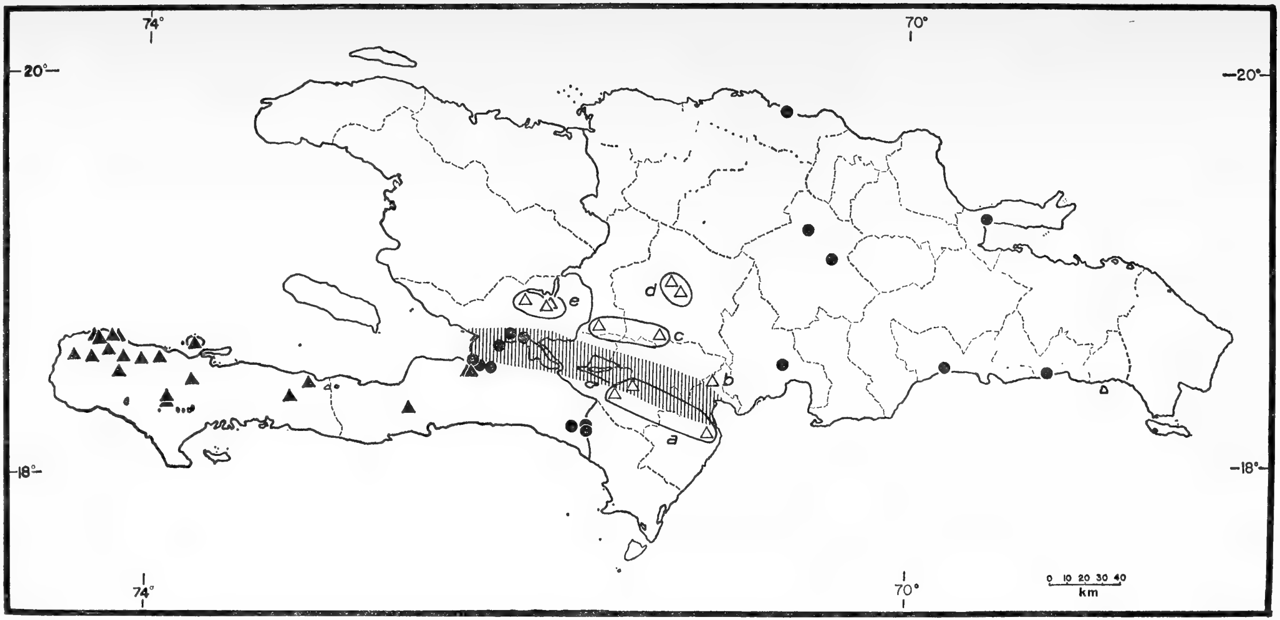

FIG. 2. Map showing known distribution of *T. lumbricalis* (solid circles) in Hispaniola and *T. hectus*. Solid triangles indicate localities for paratypic *hectus*; hollow triangles, localities for non-paratypic *hectus*; letters a–e, samples of non-paratypic *hectus* graphed in Fig. 3. The vertical hatching indicates the approximate limits of the Cul de Sac-Valle de Neiba Plain.

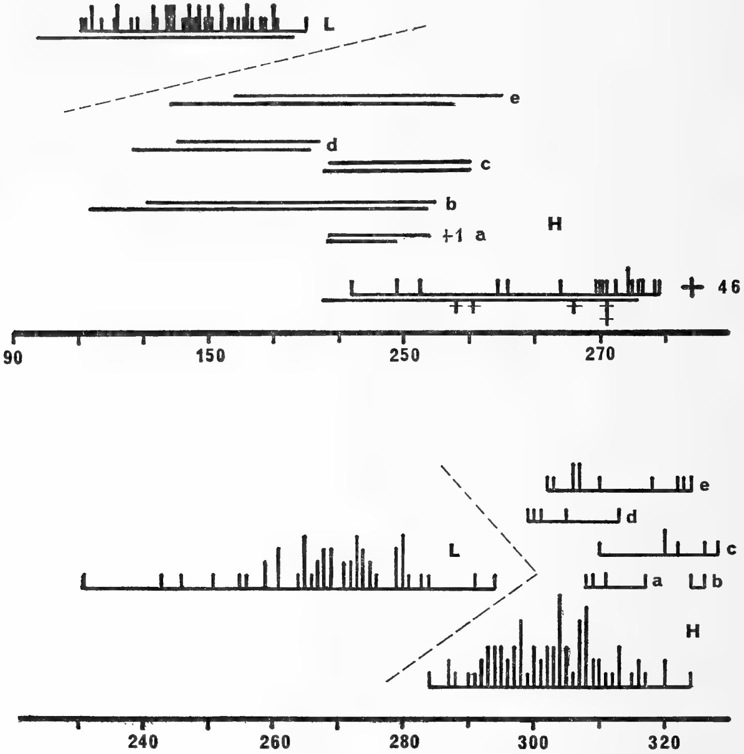

FIG. 3. Upper graph: Variation in reduction level (ventral scales posterior to mental). Range only is shown for samples of non-paratypic *hectus* (a–e); line histograms (smallest vertical unit represents one individual) are given for *lumbricalis* (L) and paratypic *hectus*. The uppermost horizontal line of a pair indicates range in level of final reduction step (19 to 18 scale rows); the lowermost line of a pair indicates the range in initial reduction step (18 to 19 rows). Crosses on lower range line for paratypic *hectus* indicate specimens that reduce to 19 but not to 18 scale rows; + 46 and + 1 indicate specimens that do not reduce from 20 scale rows. Lower graph: Line histograms showing variation in mid-dorsal scale counts of *T. lumbricalis* (L) and *T. hectus* (H); the smallest vertical unit represents one individual. Histograms a–e show counts for geographic samples of non-paratypic *hectus* indicated in Fig. 2. The dashed line in both upper and lower parts separates graphs for *lumbricalis* and *hectus*.

TABLE 1. Meristic and color variation among the Hispaniolan species of *Typhlops.*

	Pre-ocular number	Post-ocular number	Scale rows	Middorsal scales	Coloration
lumbricalis	1	1–2	20–18	231–294	bicolor
hectus	1	2	20–20 20–18	284–328	bicolor to unicolor
pusillus	2	2	20–18	252–315	bicolor to unicolor
syntherus	1	2	22–22	304–353	bicolor
sulcatus	1	1	20–20	400–452	bicolor
capitulatus	1	2	20–20	358–418	unicolor

scale rows situated relatively far posteriorly. Despite an average far posterior reduction level, these specimens are somewhat heterogeneous in this respect (Fig. 3). The four from the eastern south island are most like paratypic *hectus* in reducing far posteriorly (one does not reduce). Of those from the north island, the specimens from the northern Valle de San Juan reduce to 18 rows farther anteriorly than those in any other sample and are therefore least like paratypic *hectus* in this respect. The sample from the vicinity of Lascahobas broadly overlaps the other samples of both paratypic and non-paratypic *hectus* in reduction level, and the three specimens from the Hondo Valle and Vallejuelo region are intermediate. One of the two specimens from El Iguito in the eastern Valle de Neiba reduces far anteriorly and the other far posteriorly. Some of the samples of non-paratypic *hectus* are more heavily pigmented than paratypic *hectus,* and all have higher average mid-dorsal counts (Fig. 3). Two specimens of non-paratypic *T. hectus* have divided preoculars unilaterally (AMNH 41266 from Duvergé and ASFS V398 from 7 km NW Vallejuelo); AMNH 41265 from Duvergé has an incompletely divided preocular on one side; ASFS V396 and V398 (Vallejuelo) and V513 (Río Arriba) have indications of a groove on one preocular. Divided preoculars characterize *Typhlops pusillus* Barbour, a widespread Hispaniolan species. The significance of divided preoculars in specimens of *T. hectus* will be discussed in a comprehensive study of Antillean *Typhlops.*

Because of the isolation, heterogeneity in reduction level, and divergence of these eastern and northern samples from the balance of the specimens of *T. hectus,* I have not designated them as paratypes. It is hoped that the variation in these populations will be elucidated by more comprehensive sampling.

Comparisons: Typhlops hectus is readily distinguishable from four of the other Hispaniolan species on rather gross morphological features

(Table 1). From *lumbricalis*, however, *hectus* cannot be absolutely distinguished on the basis of meristic features. There is a small amount of overlap between the two species in mid-dorsal counts (Fig. 3). In reduction level *lumbricalis* and paratypic *hectus* are almost completely separable; the non-paratypic samples are intermediate. The differences in head scale shape are subtle; some specimens are difficult to distinguish on head scale shape alone. In *hectus* the rostral is narrow in dorsal view, almost parallel sided but with a slight terminal expansion; in *lumbricalis* it may be narrow but is usually broader than in *hectus*, and the widest point is near the middle (Fig. 1). The preocular in *hectus* is more sharply pointed (the anterior edges form a smaller angle) than that of *lumbricalis*. A correlate of the low preocular angle in *hectus* is that the lateral edges of the postnasals are more nearly parallel with one another and with the lateral edges of the rostral, whereas they are divergent in *lumbricalis* (Fig. 1). In addition, the Cul de Sac *lumbricalis* typically have four parietals (32 of 37); only 25 of 61 paratypic *hectus* have four parietals. Ten of 11 of the eastern Hispaniolan *lumbricalis* have the first parietal (only two specimens have paired parietals and these only unilaterally) greatly elongated and fused with the upper postocular, a condition not found either in *hectus* or other *lumbricalis*. *T. lumbricalis* also is a larger, stouter species than *T. hectus*.

Although *lumbricalis* and *hectus* have partially overlapping geographic ranges, their microsympatry is not established. At no time have the two been taken together, despite the collection of fair numbers of *lumbricalis* (and three other species) from the Cul de Sac. Microsympatry between *lumbricalis* and *hectus* will probably be most easily demonstrated in the area between the Cul de Sac and Pétionville.

Comparative material: *Typhlops lumbricalis*.—HAITI, DÉPT. DE L'OUEST: MCZ 62637, 81150, CM 38886, ASFS V8185–86, Manneville; USNM 117270–72, 117275, ASFS V24346, Trou Caiman; BM 1948. 1.6.63–64 (2), Pont Beudet; USNM 75893, 123792, MCZ 51426, 62631–33, Port au Prince; MCZ 65812, near Port au Prince; ASFS V8394–97, Château Blond, 6.4 km NE Pétionville, 160 m; ASFS V22440–44, LDO 7-6464–69, 4.8 km N Pétionville; ASFS V24346, 1.6 km NW Pétionville; MCZ 68571, Colombier near (22 km E) Saltrou. REPÚBLICA DOMINICANA, PROV. PEDERNALES: ASFS V2604, 11 km SW Los Arroyos, 443 m; ASFS V2708, 21 km N Pedernales, 243 m. PROV. AZUA: ASFS X8047, 2.9 km W, thence 16.4 km N, Azua. PROV. SAN PEDRO DE MACORIS: AMNH 13630, San Pedro de Macoris. PROV. LA VEGA: ASFS V35897–900, V35904–05, 1 km W Jayaco, 274 m; ASFS V14143, 4 km S La Vega. PROV. SAMANÁ: USNM 55298, Sanchez. PROV. PUERTO PLATA: USNM 10276, Puerto Plata.

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ALLACTAEA LITHOSTROTA, A NEW GENUS AND SPECIES OF CRAB (DECAPODA: XANTHIDAE) FROM NORTH CAROLINA, U.S.A.

By Austin B. Williams
National Marine Fisheries Service Systematics
Laboratory, Washington, D. C. 20560

In 1963 an unusual female crab of the family Xanthidae was brought to my attention in a collection of invertebrates made during a survey of benthic fauna off North Carolina, U.S.A., by M. J. Cerame-Vivas, then at Duke University Marine Laboratory. Description was delayed until males could be found and studied to allow more complete analysis of the species.

Genus **Allactaea**, new genus

Areoles of carapace prominent, indicated by large and small lobules often arranged in triads, tending to proliferate with increasing age. Mouth frame roughly quadrate, widest anteriorly. Third maxillipeds separated; merus wider than long, with anteroexternal corner produced, anterior margin sinuous, internal corner notched for insertion of palp. Lacinia of first maxillipeds moderate in size. Fused basal antennal segment extending into inner orbital hiatus. First gonopods of male terminating in a more or less flat and moderately developed lobe preceded by a tuft of long hairs in a nearly single file.

Type-species: *Allactaea lithostrota.*

Etymology: From the Greek "allos" other, and "actaea." The gender is feminine.

Allactaea lithostrota, new species

Figures 1–3

Holotypic male: Carapace xanthoid (Fig. 1B), wider than long, arched anteroposteriorly, regions prominently indicated by smooth raised lobules arranged in a radiating pattern eminating laterally and anteriorly from urogastric region. Smooth tracts between lobules almost completely

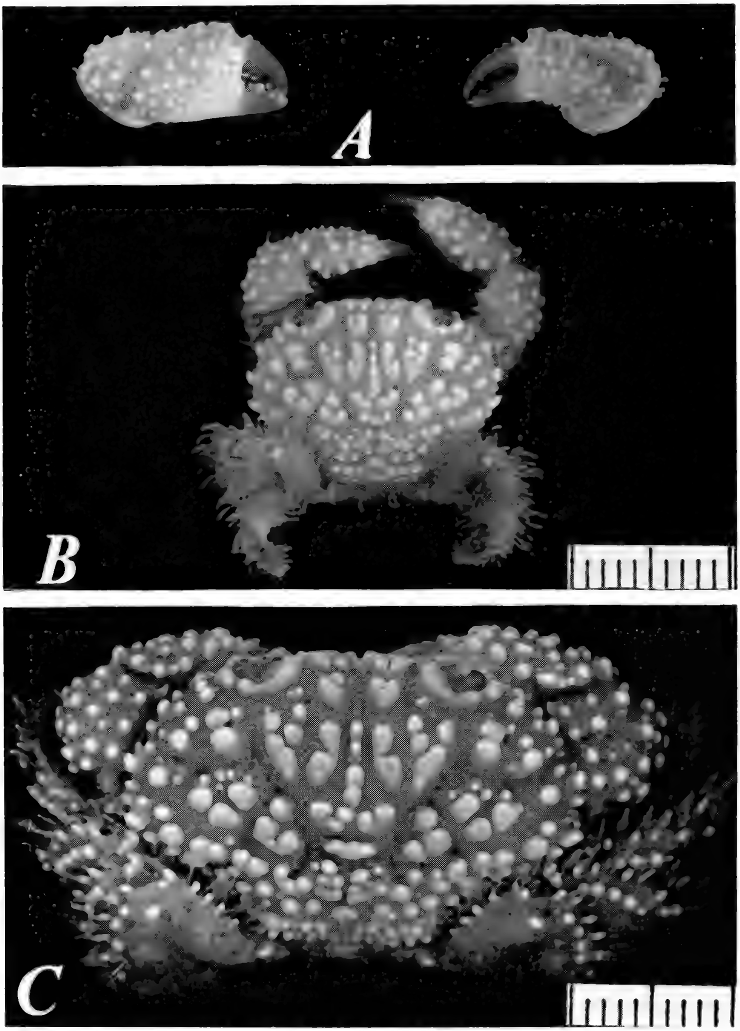

Fig. 1. *A*, right and left chelae of holotype ♂, frontal view; *B*, holotype ♂, dorsal view; *C*, allotype ♀, dorsal view; mm scales (upper, *A–B*; lower, *C*).

obscured by feltlike covering of clavate hairs anterior to urogastric region; hairy covering much thinner posteriorly.

Front fairly prominent and somewhat produced at each side of median, narrowly U-shaped notch; a dorsal, submarginal row of about 8 coalesced lobules on each side extending from antennal notch to near midline giving front a transversely doubled appearance (Fig. 2). Lobules, exclusive of margin, arranged as follows (Fig. 1B): 2 F (see Rathbun, 1930, Fig. 3), 2 well separated laterally; 1 M, 3 completely coalesced posteriorly, less so anteriorly; 2 M, evidence of 8 or 9 clumped in two groups, a longitudinally oriented and fused group of 3 near midline having a deep lateral cleft, and a more loosely clumped group of 3 and rudimentary fourth along lateral margin of region with 2 associated lobules in intermediate space; 3 M, a row of 6 in midline, 4 in transverse basal row, each series more or less fused; 4 M, 3 separated in crescentic transverse row; 1 L, solitary and small near anterolateral border; 2 L, 2 closely approximated and among largest individual lobules; 3 L, 2 approximately size of 1 L and not coalesced on right side, but coalesced into single large lobule on left side; 4 L, solitary and small near fourth and fifth anterolateral teeth; 5 L, a complex of 2 groups of 3 nearly coalesced, among largest on carapace; finally, a complex composed of 1 P, 2 P, 1 R and 3 R arranged in irregular, transverse, lunate rows with fairly symmetrical fusion of lobules within rows. Orbital margin thickened, raised and smooth dorsally with fissures closed but evident as depressons; outer orbital hiatus a broadly open notch; obtuse suborbital tooth followed laterally by irregularly increasing suborbital rim. Eyestalks with a tuft of clavate hairs in corneal emargination preceded by 2 spiniform tubercles and a number of much smaller tubercles at base of cornea. Four prominent anterolateral teeth exclusive of outer orbital widely separated and reduced to anteriorly directed mammillary lobules; on margin a bit below these a row of smaller slender intercalary teeth; hepatic and subbranchial region lightly tuberculate. Posterolateral border bearing a row of lobules.

Epistome with 2 tubercles on lower border of each antennular socket, mesial one largest. Mouth frame roughly quadrate (Fig. 2), widest anteriorly, anterior margin smoothly and sharply cristate and shaped into a low angular arch on each side. Third maxillipeds separated, divergent anteriorly; ischium with a shallow, smooth, longitudinal, ventral depression; merus broader than long with slightly sinuous anterior margin, notched for reception of strong palp and produced anterolaterally, tubercles clustered on ventral surface along mesial border and emargination for palp but scattered elsewhere centrally and near anterior margin. Lacinia of first maxillipeds moderate in size covering roughly 40 percent of endostomial surface. Inner orbital hiatus filled by a club-shaped extension of fused basal antennal segment and first movable antennal segment.

Sternal plastron relatively smooth, bearing scattered clavate hairs. Abdomen with telson wider than long, tip rounded, segments 3–5 fused.

Chelipeds (Fig. 1A) dissimilar, right larger than left. Palm and carpus of each ornamented on outer surfaces with well separated distally directed lobules varying from sharpest along dorsal crest of carpus and palm to flared at top with narrower bases on external surface of carpus and

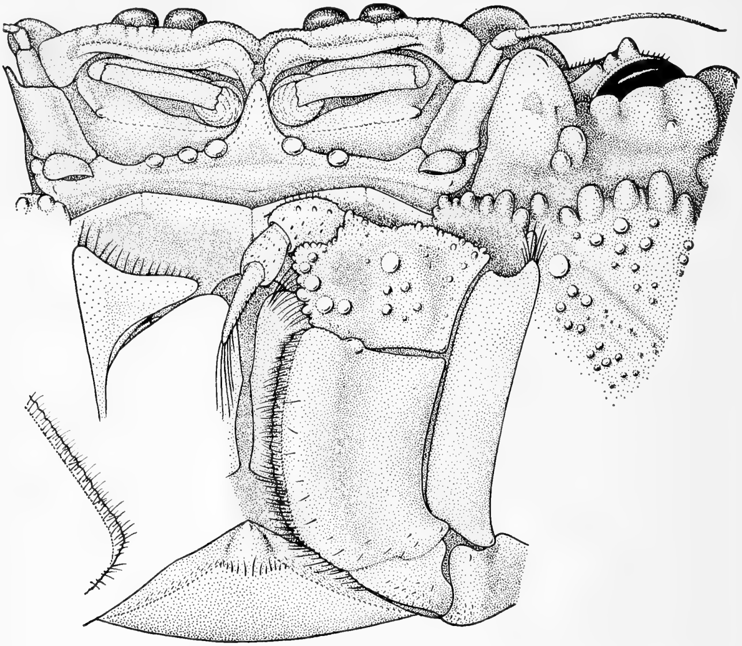

FIG. 2. Portion of frontal, suborbital and mouth field regions of allotype ♀ showing edge of front, antennules, left antenna and eye, epistome, left third maxilliped, lacinia of right first maxilliped in situ with overlying mouthparts turned aside, and outline of mandibles in situ.

dorsal portion of palm, becoming smaller, sharper and tending to alignment in longitudinal rows on outer surface of palm. Carpus with a spiniform lobule at inner angle and another below it; anterior border with a few small teeth hidden in hairs. Dorsal and outer surfaces of chela, carpus and merus with spaces between lobules and tubercles covered with dense coating of clavate hairs, inner surfaces smooth. Fingers dark colored, a crest of tubercles at base of each dactyl; teeth distinct but forming a continuous row on occlusal surface of each finger, proximal teeth of major chela somewhat molariform. Merus of each cheliped with a dorsal crest of sharp forward-curved spines flanked laterally by a few tubercles.

Second and fifth pereopods with external surfaces covered by a dense ragged coat of clavate hairs (third and fourth pairs of pereopods missing). Dorsal crest of merus, carpus and propodus of each leg armed with erect, well separated, distally trending spines; a secondary lateral row of spiniform tubercles nearly hidden in hairs on carpus and propodus.

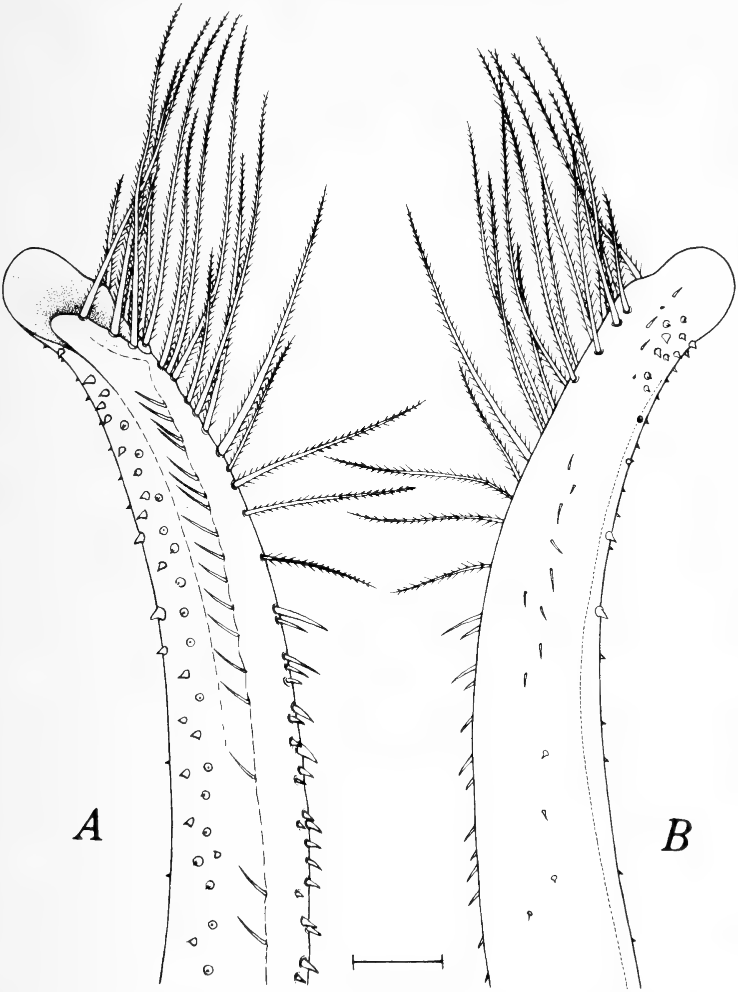

FIG. 3. First right gonopod of paratype ♂ (USNM 143774), terminal portion; *A*, mesial view, *B*, lateral view; scale = 0.1 mm.

Dactyl of second legs densely hairy on all surfaces, of fifth legs nearly naked on inner surface, both with darkened corneous tip.

First gonopod of male (Fig. 3) rather stout, approximated along middle part but tips diverging ventrolaterally, terminating in a membranous rounded lobe. An irregular row of articulated retrogressive spines along sternal edge near tip grading from scattered and smallest proximally to denser, longer and more slender distally, and merging finally into an irregular subterminal file of elongate hairs; a broader tract of similar scattered spines on mesioventral surface and a lateral cluster at base of terminal lobe. In addition, a row of slender short spinules on mesial surface following course of sperm duct.

Measurements in mm: Holotypic male: greatest width of carapace at level of fourth anterolateral tooth, 16.2, length in midline, 11.6; telson width, 1.8, length, 1.6.

Allotypic female: Lobular pattern (Fig. 1C) basically same as in holotype but specimen larger and more ornate suggesting greater age. Coalescence of lobules varying in minor details from that in holotype with introduction of additional small solitary lobules at edge of and between areoles, especially behind orbits, on branchial regions and anterolateral borders. Lunate arrangement or rows of lobules behind urogastric region in 1 P, 2 P, 1 R, 2 R and 3 R not so evident as in holotype.

Epistome with tendency to formation of a row of tubercles on lower border (Fig. 2) of antennular socket, 3 on right side, 2 on left. Lobulation at corners of buccal frame and subhepatic region much bolder and merus of third maxillipeds with ventral tubercles stronger than in holotype. Sternal plastron lightly punctate and hairy on exposed parts becoming ornamented with obsolescent granules along anterior and anterolateral borders at base of third maxillipeds and chelipeds.

Abdomen ovate, densely edged with long hairs; segments lightly covered externally with clavate hairs except on worn raised portions. Telson broadly rounded, broader than long.

Chelipeds with disparity in size and shape more pronounced than in holotype. Lobules not pointed but many with tips rounded, flattened and flared forming knobs. Anterior edge of carpus with a row of spines, a strong spine at inner angle followed by a second almost equal below it. Proximal teeth of major chela more molariform than in holotype.

Remaining pereopods essentially as in holotype, each with crest of distally trending spiniform lobules, many of them club shaped, along upper border of merus, carpus and propodus; crest most pronounced in coalesced ornate lobules on superodistal angle of merus. Each leg with an external flanking row of lobules on carpus and propodus, and a scattering of lobules on merus of fifth leg. Lower edges of each merus with ornamentation grading from proximal granules to attenuated distal lobules. Legs clothed in dense growth of clavate hairs, longest and most ragged along crests.

Measurements in mm: Allotypic female: greatest width of carapace at level of fourth anterolateral tooth, 28.1, length in midline, 18.1; telson width, 4.9, length, 4.0. Ovigerous female paratype: greatest width of carapace at fourth and fifth anterolateral teeth, 17.2, length in midline, 12.1.

Type locality: Approximately SE Cape Lookout, N. C., 33°43′ N, 76°40′ W, 90 m–33°42.7′ N, 76°40.2′ W, 110 m, *Eastward* Sta. 1087.

Material studied: Specimens studied are confined to the type series deposited in collections of the National Museum of Natural History (USNM), Washington, D. C., and University of North Carolina Institute of Marine Sciences (UNC-IMS), Morehead City, N. C.

USNM 143770 ♂ holotype; USNM 143772 ♂ juv. paratype, *Eastward* Sta. 1087, 27 Apr. 1965, L. R. McCloskey, col. USNM 143771 off Cape Lookout, N. C., 91 m, Oct. 1963, ♀ allotype, M. Cerame-Vivas, col. USNM 143773 32°39′ N, 78°32′ W, 91–95 m, 28 July 1960, ♀ (ov) paratype, R/V *Silver Bay* Sta. 2266, clam dredge. USNM 143774 33°25.7′ N, 77°01′ W, 60–70 m, 17 Mar. 1969, ♂ paratype (frags.), *Eastward* Sta. 11552, dredge, N. Chamberlain, col. UNC-IMS 2299, 34°11′ N, 76°10′ W, 60 m, 4 May 1969, ♀ paratype, *Eastward* Sta. 11943, F. J. Vernberg, col. UNC-IMS 2366, about 34°08′ N, 76°10′ W, 50 m, 27–30 Apr. 1966, ♀ juv. (dry) paratype, *Eastward*, C. E. Jenner and class, col.

Name: The name is from the Greek "lithostrotos" meaning inlaid with stones, a term descriptive of the symmetrical lobate ornamentation.

Remarks: *Allactaea lithostrota* is unusual among numerous species of the actaeid group in that lobules of the carapace are large, smooth, and either clustered or solitary in each area. Tending to be rather sharply pointed in juveniles, the lobules become progressively blunter as they increase in size, many of them finally becoming flattened knoblike expansions on somewhat constricted bases. In addition, new small lobules proliferate with increasing size. Clusters on frontal and medial areas tend to be tripartite with an opening in the cluster directed forward and outward. All lobulations of the carapace tend to be peripherally directed away from the urogastric area.

Surface ornamentation indicates close relationship to none of the American actaeas, but characters of the mouth field and orbito-antennal region are similar to *Actaea* de Haan 1833 (emend.) and those of the first male gonopod resemble *Paractaea* Guinot, 1969 (Guinot, 1967; 1969; 1971). On the basis of these comparisons, the mouth field of *Allactaea lithostrota* has a remote resemblance to that of Indo-Pacific *Actaea calculosa* (H. Milne Edwards, 1834) and *A. glandifera* Rathbun, 1914 (Guinot, 1969), and the pleopods to those of western Atlantic *Paractaea rufopunctata nodsa* (Stimpson, 1860) (Guinot, 1969).

Allactaea lithostrota may be confined to the *Lithothamnion* reeflike structure described by Menzies, Pilkey, Blackwelder, Dexter, Huling and McCloskey (1966), and Menzies, George and Rowe (1973) in warm water near the edge of the continental shelf off North Carolina.

I am indebted to M. J. Cerame-Vivas, N. A. Chamberlain, C. E. Jenner, L. R. McCloskey and F. J. Vernberg for gifts of specimens, H. B. Roberts for counsel, F. A. Chace, Jr., B. B. Collette and I. Pérez Farfante for criticism of the manuscript, and M. Diéguez for drawings and assembly of figures. The type, allotype and two paratypes have been transferred to USNM from UNC-IMS lots 2365, 1899 and 2374.

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MICROGNATHUS ERUGATUS, A NEW MARINE PIPEFISH FROM BRAZIL (PISCES: SYNGNATHIDAE)

By E. S. Herald[1] and C. E. Dawson
Steinhart Aquarium, California Academy of Sciences,
San Francisco, California 94118, and
Gulf Coast Research Laboratory Museum
Ocean Springs, Mississippi 39564

In the course of recent fieldwork by the junior author in Central and South America, we have been fortunate to obtain a single specimen of an unusual marine pipefish. Characters of this new species are so distinctive that we do not believe it necessary to delay its description until more specimens are available.

The holotype has been deposited in the Museum de Zoologia da Universidade de São Paulo (MZUSP), Brazil. Measurements are in millimeters (mm).

Appreciation is expressed to Dr. Naercio A. Menezes (MZUSP) for making this specimen available for study. The entire J. L. Almeida family of Salvador, Brazil is thanked for their hospitality and active participation in the field. This work was supported in part by National Science Foundation Grant GB 31053X.

Micrognathus erugatus, new species

Figure 1

Holotype: MZUSP 9408 (64 mm SL, female); Brazil, Bahia, rock tidepool about 1 km S of Arembepe, approx. 12°45′ S, 38°10′ W, 0–1.3 m, chemical ichthyocide; 26 August 1972, C. E. Dawson and party.

Diagnosis: Dorsal-fin rays 19, located on 0.5 trunk rings and 4.5 tail rings; trunk rings 20; tail rings 36; pectoral-fin rays 13 (2); anal-fin rays 2; caudal-fin rays 10; head length 5.9; snout length 1.9; length of

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[1] Deceased.

Fig. 1. Head and anterior body of *Micrognathus erugatus* MZUSP 9408; holotype; 64 mm SL.

dorsal-fin base 4.9; caudal-fin length 2.0; body ridges smooth, poorly developed.

Description: Head ridges indistinct, only snout, supraorbital and opercular ridges visible. Opercle with 20 or more rows of minute pocklike depressions radiating from the indistinct median ridge. Excurrent gill openings extend to top of head. Body ridge pattern typical of *Micrognathus*, i.e., lateral trunk ridge deflected ventrad at anal ring thence continuous with inferior tail ridge; superior tail ridge deflected at dorsal fin to become lateral tail ridge, ending free near middle of last trunk ring. Body ridges rounded, indistinct; intermedial scutellar plates on trunk and anterior portion of tail equal about half width of individual rings. Pectoral cover plate without ridges but with a few pocklike depressions; pectoral-fin length equals about 1.75 trunk rings. Head-in-SL 10.8; snout-in-head 3.1; dorsal-fin base-in-head 1.2.

Color in alcohol mainly dark brown with indications of 5 darker bands on upper sides and dorsum of trunk and 10 on tail; tip of upper jaw white; narrow white cross bar below angle of gape; white surrounds nares and continues as narrow, irregular bar across snout; streaks of white radiate from eye and one streak extends posteriad as narrow blotch on opercle; pectoral-fin base and top of head mottled with white; pale blotches bisect dark trunk and tail rings. Dorsal-fin rays streaked with brown near bases, fin otherwise pale; caudal fin mainly brown, but uppermost ray and distal margin white.

Etymology: *erugatus*, from the Latin *e*, not, + *rugatus*, wrinkled, in allusion to the almost smooth head and body.

Discussion: The genus *Micrognathus* now includes the subgenera *Micrognathus*, *Anarchopterus* and *Minyichthys* (Herald and Randall, 1972). Counts of 13–17 trunk rings occur in all but the two known species of the Pacific *Minyichthys*, which is characterized by 19–21 trunk rings and well-developed head and body ridges. The 20 trunk rings of *M. erugatus* suggest a close relationship with *Minyichthys*, but its smooth head and poorly developed ridges are atypical of *Minyichthys*. In the latter characters, *Micrognathus erugatus* is similar to the smooth-bodied Atlantic American *Anarchopterus*, but the anal fin is absent in this subgenus.

The unique holotype of *Micrognathus erugatus* was collected with eight specimens of the wide-ranging (Florida–Brazil) *M. vittatus* (Kaup). This is the only Atlantic representative of the subgenus *Micrognathus*, although seven of its nine Pacific congeners fall in this characteristically sharp-ridged subgenus. The western Atlantic species *Micrognathus dawsoni* (Herald, 1969) was originally placed in the subgenus *Micrognathus*, but its body ridges are not sharp edged and it is the only long-snouted species in a genus otherwise noted for short-snouted forms.

The Atlantic *Micrognathus* group presents somewhat of an enigma in that there are now five species, representing four intrageneric trends, and two species (*M. dawsoni* and *M. erugatus*) do not fall within described subgeneric limits. These two species are known only from unique female holotypes and additional study material will hopefully help clarify relationships within the genus.

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PROCEEDINGS
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POTAMORRHAPHIS PETERSI, A NEW SPECIES OF FRESHWATER NEEDLEFISH (BELONIDAE) FROM THE UPPER ORINOCO AND RIO NEGRO

By Bruce B. Collette
National Marine Fisheries Service Systematics Laboratory
National Museum of Natural History,
Washington, D. C. 20560

While reviewing the South American freshwater needlefish genus *Potamorrhaphis*, an undescribed species was found from the upper tributaries of the Orinoco in Venezuela and Colombia and the upper Rio Negro in Brazil. Because completion of the generic review has been delayed, I have decided to describe the new species separately. It is herein named in honor of the late Dr. James A. Peters, who was best known as an authority on Neotropical amphibians and reptiles. He directly aided my studies of the South American freshwater needlefishes *Potamorrhaphis* and *Pseudotylosurus*, and I take great pleasure in naming this species after him.

Study materials are in the collections of the Academy of Natural Sciences, Philadelphia (ANSP); the American Museum of Natural History (AMNH); California Academy of Sciences, San Francisco (CAS and SU); Muséum National d'Histoire Naturelle, Paris (MNHN); INDERENA, Bogotá; Museo de Biología, Universidad Central de Venezuela, Caracas (MBUCV); and the National Museum of Natural History (USNM). This paper is one in a series on the systematics of the Synentognathi; see Collette (1966) on *Belonion* and Collette (in press) on *Pseudotylosurus* for studies on the other two genera of South American freshwater needlefishes.

Discovery of a second species of *Potamorrhaphis* and sepa-

TABLE 1. Vertebral and fin-ray counts of *Potamorrhaphis petersi* and three populations of *P. guianensis.*

	Total vertebrae																			
	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	x̄	N
P. petersi																				
Upper Orinoco													2	1	–	–	2	1	82.3	6
Upper R. Negro-Casiquiare													1	1					80.5	2
Río Tomo										1									77	1
Total										1	–	–	3	2	–	–	2	1	81.3	9
P. guianensis																				
Lower Orinoco				5	7	7	2	1											72.4	22
Guianas		2	5	9	19	22	4	2											72.2	63
Lower Amazon	1	1	4	7	5	5	6	1	4	1									72.5	35
Total	1	3	9	21	31	34	12	4	4	1									72.3	120

	Caudal vertebrae																
	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	x̄	N
P. petersi																	
Upper Orinoco											3	–	–	1	2	41.8	6
Upper R. Negro-Casiquiare											1	–	1			41.0	2
Río Tomo									1							38	1
Total									1	–	4	–	1	1	2	41.2	9
P. guianensis																	
Lower Orinoco			6	10	5	1										33.0	22
Guianas		3	4	20	27	7	2									33.6	63
Lower Amazon	1	1	2	10	9	6	2	4								34.0	35
Total	1	4	12	40	41	14	4	4								33.6	120

TABLE 1. Continued.

								Dorsal-fin rays								
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	x̄	N
P. petersi																	
Upper Orinoco										1	2	–	1	1	1	40.3	6
Upper R. Negro-Casiquiare										2						38.0	2
Río Tomo									1							37	1
Total									1	3	2	–	1	1	1	39.4	9
P. guianensis																	
Lower Orinoco		4	4	14	2											31.6	24
Guianas		1	13	48	31	22	4									32.6	119
Lower Amazon	1	7	8	26	17	9	9									32.5	77
Total	1	12	25	88	50	31	13									32.5	220

								Anal-fin rays								
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	x̄	N
P. petersi																	
Upper Orinoco										2	1	–	–	2	1	36.3	6
Upper R. Negro-Casiquiare										2						34.0	2
Río Tomo								1								32	1
Total								1	–	4	1	–	–	2	1	35.3	9
P. guianensis																	
Lower Orinoco		2	5	14	2	1	1									27.8	25
Guianas		1	22	56	27	11	1									28.2	118
Lower Amazon	2	8	19	31	9	7	1									27.8	77
Total	2	11	46	101	38	19	3									28.1	220

TABLE 2. Measurements (as percent of body length) of *Potamorrhaphis guianensis* from the lower Orinoco and *P. petersi.*

	P. guianensis				*P. petersi*			
Character	Range		x̄	N	Range		x̄	N
Body length (mm)	87.8	119	101.9	23	92.7	162	120.9	9
Head length	55.2	59.2	56.91	11	47.8	55.9	51.18	4
Snout length	37.7	42.0	40.52	11	33.9	41.2	37.18	4
Postorbit length	10.7	12.5	11.37	23	9.4	11.1	10.07	9
Preopercle length	5.5	6.9	6.17	23	5.2	5.9	5.47	9
Orbit length	4.2	5.1	4.75	23	3.9	4.6	4.24	9
Interorbit width	4.8	5.6	5.17	23	4.2	4.9	4.52	9
Head depth	5.3	6.7	6.25	23	4.9	6.0	5.54	9
Head width	5.1	5.9	5.45	23	4.7	6.3	5.40	9
Pectoral-fin length	10.3	13.2	11.86	18	9.7	11.8	10.61	9
Pelvic-fin length	6.1	7.9	7.20	23	6.2	7.3	6.78	9
Pectoral fin to pelvin fin	47.4	52.0	49.44	23	43.5	46.8	44.94	9
Pelvic fin to caudal-fin base	46.0	51.4	48.97	23	51.6	54.2	53.18	9

ration (Collette, in press) of *Pseudotylosurus microps* (Günther) from *Ps. angusticeps* (Günther) raises the total number of species of freshwater synentognaths known from South America east of the Andes to seven. As previously noted (Collette, 1966), the other three include two neotenic needlefishes *Belonion dibranchodon* Collette (described from the same Río Atabapo locality as three paratypes of *P. petersi*) and *B. apodion* Collette plus the halfbeak *Hyporhamphus brederi* (Fernández-Yépez).

Potamorrhaphis petersi, new species

Figures 1–3

Diagnosis: A species of the genus *Potamorrhaphis* that differs from the other nominal species of the genus, *P. guianensis* (Schomburgk) and *P. eigenmanni* Miranda Ribeiro, primarily in having the posterior portion of the body greatly elongated. This is best reflected in the higher counts (Table 1): greater total number of vertebrae (77–85 vs. 64–77); caudal vertebrae (38–44 vs. 28–37); dorsal-fin rays (37–43 vs. 27–36); and anal-fin rays (32–39 vs. 24–31). Predorsal scales are more numerous than in the Orinoco population of *P. guianensis* (110–141, x̄ 128 vs. 97–112, x̄ 102).

Morphometrically (Table 2), this difference is shown by the distance

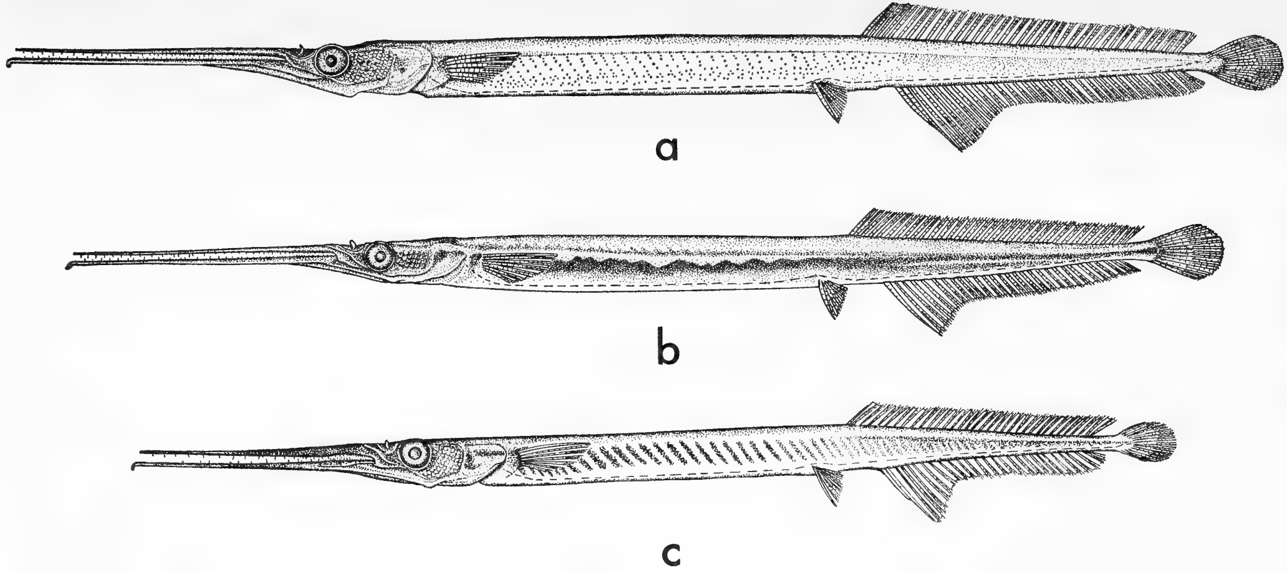

FIG. 1. a. *Potamorrhaphis petersi*, paratype, AMNH 9619, 134 mm body length, near Mt. Duida, upper Orinoco, Venezuela. b. *P. guianensis*, ANSP 116533, 119 mm, Río Meta, Colombia. c. *P. guianensis*, USNM 179527, 108 mm, Rio Urubu, Lower Amazon, Brazil.

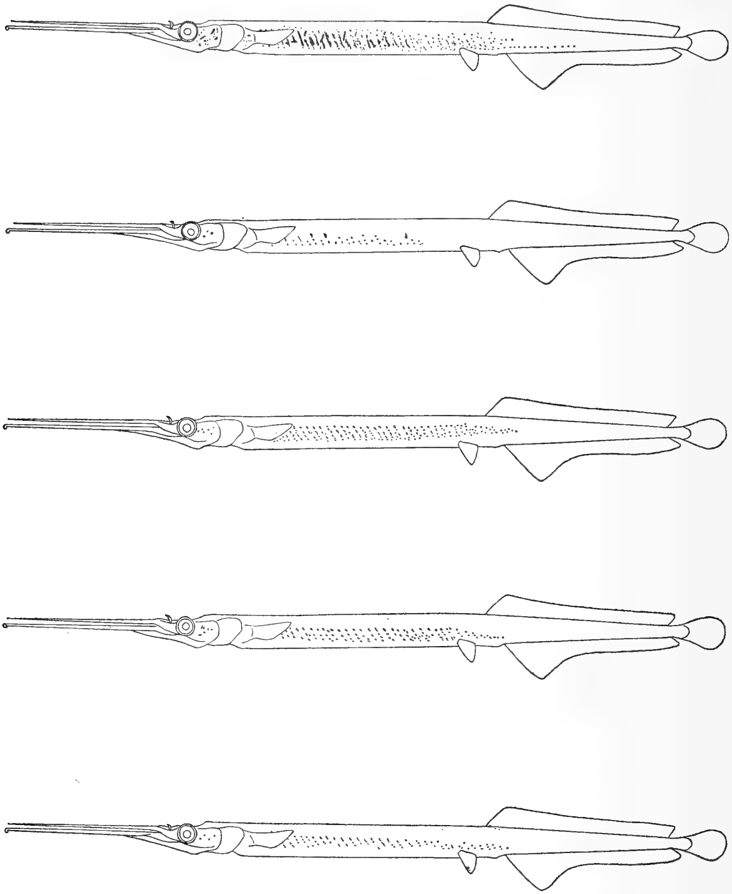

FIG. 2. Diagrammatic representation of pigment patterns of five specimens of *Potamorrhaphis petersi.* From top to bottom: USNM 210546, holotype, 162 mm BL, junction Río Guaviare and R. Inírida; USNM 210547, paratype, 137 mm, same data; AMNH 9619, paratype, 133 mm, upper Orinoco; MBUCV-V-6132, paratype, 124 mm, Río Casiquiare; and INDERENA G.A-P-0066, 111 mm BL, Río Tomo.

from the pelvic-fin origin to the caudal-fin base (P_2–C) being much greater than the distance from the pectoral-fin origin to the pelvic-fin origin (P_1–P_2) in *P. petersi* (P_2–C 51.6–54.2% vs. P_1–P_2 43.5–46.8% body length). These distances are about equal in *P. guianensis* from the lower Orinoco (P_2–C 46.0–51.4% vs. P_1–P_2 47.4–52.0% body length). Increasing the P_2–C distance in *P. petersi* also increases the body length

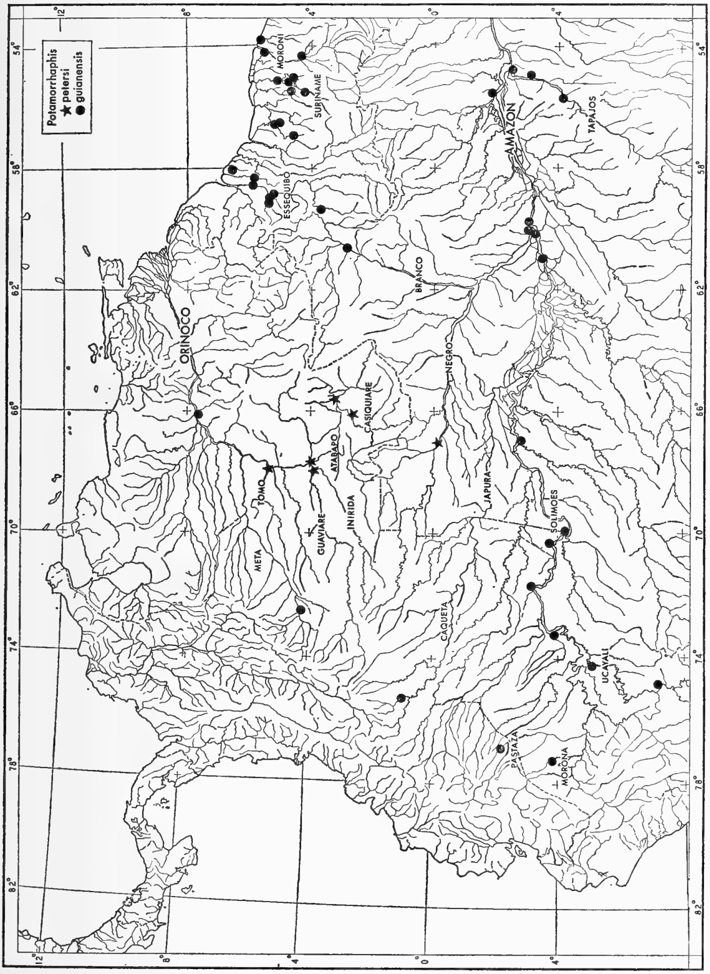

FIG. 3. Distribution of *Potamorrhaphis petersi* (stars) and northern populations of *P. guianensis* (dots).

thereby decreasing other body proportions. The type-series of *P. petersi* is completely separated from the Orinoco population of *P. guianensis* by having a smaller P_1–P_2 distance and is nearly completely separated in having a narrower interorbital distance and a shorter head (Table 2). Other proportions are also smaller but overlap with the Orinoco population of *P. guianensis.*

Potamorrhaphis petersi is also distinct in its pigment pattern. The deeper lying brown pigment that forms bars (Fig. 1c) or a continuous lateral band (Fig. 1b) in *P. guianensis* is absent and replaced by scattered large black melanophores that appear to be more superficial. These melanophores vary in number, size and position from specimen to specimen (Fig. 2) and from side to side in a single specimen.

Types: Holotype—USNM 210546, 162 mm body length, Colombia, Laguna Coco northeast of Puerto Inírida, pool near junction of Río Guaviare and Río Inírida, 17 January 1972, P. Cala. Paratypes: USNM 210547 (1: 137), same data as holotype. AMNH 9619 (1: 133), Venezuela, Caño Pescado, about 8 km north of Esmeralda near Mt. Duida, 9 March 1929, G. H. Tate. MNHN 87-655-6 (2: 97.5–123), and USNM 210861 (1: 108), Venezuela, Amazonas, Río Atabapo at San Fernando de Atabapo, October 1886; J. Chaffanjon. MBUCV-V-6132 (1: 124), Venezuela, Amazonas, Caño Beripamoni, tributary of Río Casiquiare, 29 January 1969, F. Mago L., J. Moscó, A. Machado. CAS 27587 (1: 92.7), Brazil, Rio Negro, São Gabriel rapids, above Camanaos, 1 February 1925, C. Ternetz.

Other specimen examined: INDERENA G.A-P-0066 (1: 111), Colombia, Río Tomo near entrance into Orinoco.

Comparative material: Only the data on Orinoco *Potamorrhaphis guianensis* is presented here; extensive material from the other parts of the range will be reported on in a subsequent generic review. Seven series containing a total of 24 specimens (62.7–113 mm body length) were taken in the lower Orinoco in Caño Quiribana at Caicara by C. Ternetz in April and May, 1925: SU 52684, SU 52683, CAS 28322, SU 52686, CAS 28323, SU 58818, USNM 209303. One specimen was recently collected in a western tributary of the Orinoco: ANSP 116533; 119 mm; Río Meta, Caño Emma at Finca El Viente south of Matuzal; 4°08′ N, 72°39′ W, 18 March 1973, J. E. Böhlke, W. Saul, and W. Smith-Vaniz.

Discussion: Discovery of *P. petersi* adds another species to the list of fishes common to the upper Orinoco, upper Rio Negro, and the connecting Río Casiquiare (Mago Leccia, 1971). *Potamorrhaphis* is probably derived from an inshore marine needlefish similar to *Strongylura* and has secondarily developed a larger number of caudal vertebrae and dorsal- and anal-fin rays (Collette, 1966: 21). In its even higher counts, *P. petersi* seems to be a specialized derivative of the wide-spread *P. guianensis.* Additional collecting is needed in the upper Orinoco, Río Tomo to the Río Meta and in the upper Rio Negro to ascertain the distributional limits of *P. petersi* and to determine if it is sympatric with *P. guianensis* in the Orinoco or Amazon.

The INDERENA specimen from the Río Tomo has the lowest counts of vertebrae and dorsal- and anal-fin rays of the small series of *P. petersi.* It also has traces of the usual *P. guianensis* pigment pattern underlying the large scattered melanophores characteristic of *P. petersi.* This specimen is, therefore, not designated a paratype because of these hints of possible intergradation with downstream populations of *P. guianensis.* However, the recently collected ANSP specimen of *P. guianensis* from the Río Meta agrees well with the 24 specimens from Caicara on the lower Orinoco.

Additional information about four collections of *P. petersi* is available from the following references: Chaffanjon (1889), for the Río Atabapo specimens; La Monte (1929), for the AMNH specimen from near Mt. Duida; Böhlke (1953), for Ternetz material from the upper Orinoco and Rio Negro; and Mago Leccia (1971), for the Casiquiare specimen.

Acknowledgments: Museum material and information on localities was kindly provided by: Drs. Donn E. Rosen and Gareth J. Nelson and Miss Avis Rumney (AMNH); Dr. James E. Böhlke and Messrs. William Saul and William Smith-Vaniz (ANSP); Drs. William N. Eschmeyer, Warren C. Freihofer, and Tomio Iwamoto and Miss Pearl Sonoda (CAS); and Sr. Francisco Mago Leccia (MBUCV). Dr. Neal R. Foster (ANSP) put me in contact with Dr. Plutarco Cala (Universidad Nacional de Colombia, Bogotá) who lent me the INDERENA specimen and graciously donated two important specimens of *P. petersi* to the USNM collections. Mrs. Keiko Hiratsuka Moore drew the figures except for Fig. 1c which was drawn by Mrs. Mildred Carrington; Mr. George Clipper made most of the radiographs and counted vertebrae; and Drs. Daniel M. Cohen, Victor G. Springer, and Stanley H. Weitzman commented on the manuscript.

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PROCEEDINGS
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A NEW HEART-URCHIN, *ARAEOLAMPAS ATLANTICA*, NEW GENUS, NEW SPECIES, FROM THE NORTH ATLANTIC AND NOTES ON THE CLOSELY RELATED *HOMOLAMPAS*

By D. Keith Serafy[1]

New York Ocean Science Laboratory
Drawer EE, Montauk, New York 11954

Introduction

In the summer of 1971 two lots of an undescribed species of *Homolampas* were discovered in the collections of the National Museum of Natural History, Smithsonian Institution (USNM). Unfortunately, both specimens were badly broken. An attempt was made to reconstruct the specimens, but in neither case was a complete specimen obtained. A similarly incomplete lot was found in the Museum of Comparative Zoology at Harvard University (MCZ). During 1972 three more lots of fragments were discovered in the unidentified echinoid collections of the University of Miami, School of Marine and Atmospheric Sciences (UMML). A description of this new species has been withheld for three years in the unfulfilled hope of finding a complete specimen. A complete specimen may be very difficult to obtain since the species occurs in deep water and has a very fragile test.

A review of *Homolampas* revealed two distinct species groups. One group, including *H. fragilis* and *H. lovenioides*, has a small test (less than 35 mm TL), no peripetalous fasciole, deeply sunken areoles that form internal pouches, globiferous pedicellariae, non-crenulate primary tubercles

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[1] The first part of this work was done in the Department of Zoology, University of Maine at Orono.

which do not occur on interambulacrum 5 and three (rarely four) genital pores. The other group, including *H. fulva*, *H. glauca*, *H. hastata*, *H. rostrata* and the new species, has a large test (up to 110 mm TL, except for *H. hastata* which is less than 35 mm TL), peripetalous fasciole, slightly sunken areoles that form slight internal bulges, no globiferous pedicellariae, crenulate primary tubercles extending on to interambulacrum 5 and four genital pores. On the basis of the peripetalous fasciole alone, Mortensen (1950: 265) believed that *Homolampas* may include two distinct genera, but as the species were poorly known, he retained the single genus. The presence of the peripetalous fasciole and the other characters mentioned above are believed to merit generic distinction. Since the type-species is *Homolampas fragilis* (A. Agassiz, 1869) the group including *H. fragilis* and *H. lovenioides* is included in *Homolampas*, strict sense. The other group including the five remaining species comprise the new genus described herein. A key to the species of *Homolampas* s.s. and *Araeolampas* n. gen. is given below.

KEY TO THE SPECIES OF *Homolampas* S.S. AND **Araeolampas** N. GEN.

1. No peripetalous fasciole; no primary tubercles on interambulacrum 5; deeply sunken areoles forming internal pouches; 3 (rarely 4) genital pores; globiferous pedicellariae present; primary tubercles non-crenulate; small forms generally less than 35 mm TL ---------- *Homolampas s.s.* 2

1′ Peripetalous fasciole present; primary tubercles on interambulacrum 5; areoles not forming internal pouches; 4 genital pores; no globiferous pedicellariae; primary tubercles crenulate; generally large forms up to 110 mm TL (except *A. hastata*, which is less than 35 mm TL) ---------- *Araeolampas* n. gen. 3

2. Posterior prolongation of labrum not reaching beyond second pair of adjoining ambulacral plates (tropical western Atlantic) ---------- *Homolampas fragilis* (A. Agassiz, 1869)

2′ Posterior prolongation of labrum reaching middle of third pair of adjoining ambulacral plates (Malay Region) ---------- *Homolampas lovenioides* Mortensen, 1948

3. Posterior end of test forming a rostrum surrounded by subanal fasciole; periproct visible from above (Indonesia) ---------- *Araeolampas rostrata* (de Meijere, 1902)

3′ Posterior end of test not forming a rostrum; periproct not visible from above ---------- 4

4. Only a single primary tubercle in each series of interambulacra 1, 4 and 5; small forms less than 35 mm TL (tropical eastern Pacific) .... *Araeolampas hastata* (A. Agassiz, 1898)

4′ Several primary tubercles in each series of interambulacra 1, 4 and 5; large forms up to 110 mm TL 5

5. Frontal notch shallow (about 2 percent TL) (Indian Ocean) .... *Araeolampas glauca* (Wood-Mason & Alcocks, 1891)

5′ Frontal notch deep (about 5 percent TL) 6

6. Tridentate pedicellariae with very narrow blade (Figure 1d and e); periproct small (width plus height about 15 percent TL); pores of ambulacra double adapically (central and eastern Pacific) .... *Araeolampas fulva* (A. Agassiz, 1879)

6′ Tridentate pedicellariae with wide blade (Figure 1c); periproct large (width plus height 19 to 24 percent TL); pores of ambulacra single adapically (North Atlantic) .... *Araeolampas atlantica* n. sp.

Homolampas, s.s.

Diagnosis: Small forms up to 35 mm TL; test fragile with a distinct frontal notch; ambulacral plates flush with interambulacral plates, not sunken to form petals; ambulacral pores double, placed obliquely near inner edge of plates; primary tubercles perforate, non-crenulate and present on interambulacra 1–4; primary tubercles with deeply sunken areoles that form internal pouches, as in *Lovenia*; primary spines long, curved, uniformly dentate; subanal fasciole present; apical system with 3 (rarely 4) genital pores; peristome anterior; labrum with long posterior prolongation reaching to second or third pair of adjoining ambulacral plates; anterior portion of sternum naked of primary spines; globiferous, tridentate, ophicephalous and triphyllous pedicellariae present; sphaeridia not placed in pits.

Type-species: *Lissonotus fragilis* A. Agassiz, 1869.

Araeolampas, new genus

Diagnosis: Small to large forms up to 110 mm TL; test fragile with distinct frontal notch; ambulacral plates flush with interambulacral plates, not sunken to form petals; ambulacral pores single or double, placed obliquely near inner edge of plates; primary tubercles perforate, crenulate, present on interambulacra 1–5; primary tubercles with slightly sunken areoles forming slight internal bulges; primary spines long, curved, unilaterally dentate; peripetalous and subanal fasciole present; apical system with 4 well-developed genital pores; peristome anterior; labrum with long posterior prolongation; anterior portion of sternum naked of primary spines; tridentate, rostrate and triphyllous pedicellariae present; sphaeridia not placed in pits.

Type-species: *Homolampas fulva* A. Agassiz, 1879.

Etymology: The generic name is derived from the Greek *araeo*, thin, and the Greek *lampas*, f., lamp. Gender, feminine.

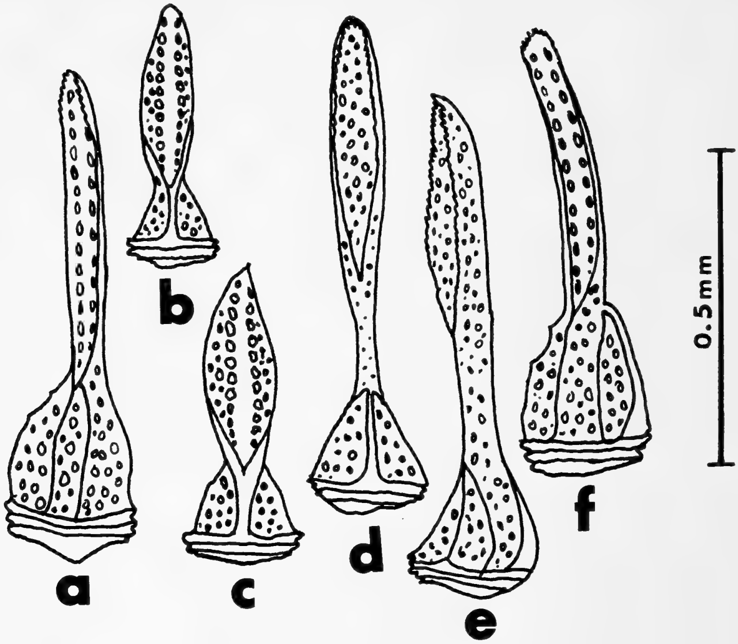

FIG. 1. Pedicellariae. a–c, *Araeolampas atlantica* n. sp., 92 mm TL, USNM 24598, holotype; d–f, *A. fulva*, 108 mm TL, USNM E889. a, rostrate pedicellaria; b, small tridentate pedicellaria; c, large tridentate pedicellaria; d, large tridentate pedicellaria; e, large tridentate pedicellaria (side view of 1d); f, rostrate pedicellaria.

Araeolampas atlantica, new species

Figures 1a–c, 2a and b

Material Examined: 1 specimen (Holotype), 92 mm TL; off Virginia, *Albatross* station 2105, 37°50′ N, 73°03.8′ W; 2575 m; 6 November 1883; USNM 24598. — fragments of 1 specimen; off the Azores, *Atlantis* station 20, 37°50.5′ N, 26°00′ W; 2585 m; 18 August 1948; USNM E7948. — fragments of 1 specimen; west of Dry Tortugas, Gulf of Mexico; 3545 m; MCZ 2910. — 1 specimen, 82 mm TL and fragments of 2 specimens; west of Georgia, *Pillsbury* station P-120, 31°48′ N, 76°38′ W; 1920 m; USNM E13095. — fragments of 1 specimen; west of Gabon, Gulf of Guinea, *Pillsbury* station P-292, 0°12′ N, 5°11′ E; 3595 m; 23 May 1965; USNM E13096. — fragments of 1 specimen; north of Haiti, *Pillsbury* station P-1429, 21°19.2′ N, 73°45.5′ W; 2532 m; USNM E13097.

Description: Test large (up to 92 mm TL), fragile; aboral aspect heart-shaped (test width about 86 percent TL and test height about 37 percent

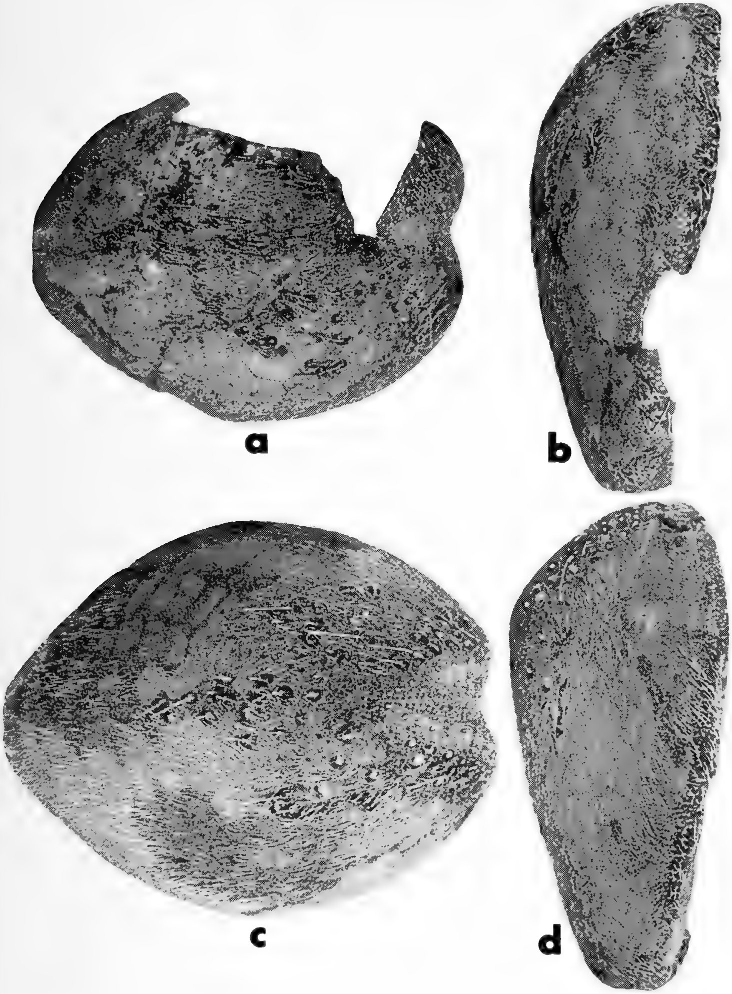

FIG. 2. a, aboral aspect of *Araeolampas atlantica* n. sp., 92 mm TL, USNM 24598, holotype; b, lateral aspect of *A. atlantica* n. sp. (holotype); c, aboral aspect of *A. fulva*, 108 mm TL, USNM E889; d, lateral aspect of *A. fulva*.

TL); periproct large (width plus height 19 to 24 percent TL), not visible from above; slight indentation above periproct at ambitus; posterior part of test truncate vertically; frontal notch deep (5 percent TL); apical system anterior (32 percent TL from anterior ambitus) with 4

TABLE 1. Morphometric characters of *Araeolampas atlantica* and *A. fulva*.*

Species	Test length	Test width	Test height	Distance apex to anterior ambitus	Periproct width	Periproct height	Depth frontal notch
A. atlantica	91.9	86.0	37.0	31.9	12.4	11.6	4.9
	81.5			33.0	7.6	11.0	4.7
A. fulva	107.9	80.2	39.9	30.7	8.4	6.9	4.8

* Test length in mm; all other measurements expressed as percent TL.

well developed genital pores; peripetalous fasciole present; primary spines restricted to interambulacral areas and to within the peripetalous fasciole except for interambulacrum 5 (Loven's system) where they occur outside the peripetalous fasciole; areoles of primary tubercles about 2.8 percent TL: posterior part of areoles of primary tubercles about 2.8 percent TL; posterior part of areole deeply sunken, anterior part slightly sunken; areoles produce slight internal bulges, but not deep internal pouches as in *Homolampas*; primary tubercles perforate and crenulate; subanal fasciole present; tridentate pedicellariae with wide valves (Figure 1b and c); rostrate and triphyllous pedicellariae the same as in *A. fulva*; pores of ambulacra near apical system single; oral surface unknown.

Etymology: The specific name refers to occurrence in the Atlantic Ocean.

Distribution: In the western North Atlantic *A. atlantica* occurs from off Virginia to north of Haiti, and in the eastern North Atlantic from the Azores to off Gabon. It is known from 1920 to 3595 m.

Taxonomic Affinities: The closest relative of *A. atlantica* (Figure 2a and b) is *A. fulva* (Figure 2c and d) from the Pacific. *A. fulva* differs from the new species by having tridentate pedicellariae with narrow blades (Figure 1d and e), a smaller periproct and double ambulacral pores adapically. The morphometric characters of these two species are shown in Table 1. The Indian Ocean species *A. glauca* can be distinguished from *A. atlantica* by its shallow frontal notch.

DISCUSSION

Agassiz (1881) considered many of the generic differences discussed above for *Homolampas s.s.* and *Araeolampas* n. gen. to be due to age. He assumed that large specimens of *H. fragilis* would acquire a peripetalous fasciole and four genital pores. Although some specimens of *H. fragilis* do have four genital pores, these specimens are not necessarily the largest specimens. No remnants of a peripetalous fasciole have ever been observed on *H. fragilis* while small specimens of *A. fulva* and *A. atlantica* n. sp. have both a distinct peripetalous fasciole and four well-developed genital pores. The peripetalous fasciole is one of the more conservative fascioles. No instance has ever been cited where this fasciole was lost during ontogeny, as has been the case for some other fascioles (e.g. subanal and lateroanal). All other generic characters mentioned above are also present on small *A. fulva* and *A. atlantica* n. sp.

The large specimen identified by H. L. Clark (1941) as *H. fragilis* (MCZ 2910) is really *A. atlantica.*

ACKNOWLEDGMENTS

I thank R. H. Chesher of the Marine Research Foundation for discovering the first specimen of the new species and encouraging me to describe it. H. B. Fell (MCZ), D. L. Pawson (USNM) and G. L. Voss (UMML) provided me with specimens. F. J. Fell and D. L. Pawson critically read the manuscript. Partial support was provided by NSF grant GB-3532 to H. B. Fell and a Sigma Xi Grant-in-Aid of Research to D. K. Serafy.

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PROCEEDINGS
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IDENTIFICATION OF *MYOTIS CALIFORNICUS* AND *M. LEIBII* IN SOUTHWESTERN NORTH AMERICA

By Michael A. Bogan
Bird and Mammal Laboratories
National Museum of Natural History
Washington, D. C. 20560

Within temperate North America there are, perhaps, no two bats more similar than *Myotis californicus* (Audubon and Bachman) and *Myotis leibii* (Audubon and Bachman). Over much of their respective ranges they are allopatric, and specimens may be identified on strictly geographic grounds. However in the southwestern United States and Mexico where their ranges overlap broadly and where *californicus* is known to be highly variable, problems of identification arise. Most students of southwestern bats agree that the two kinds are closely related but nonetheless distinct. For example, Findley (1972) includes the two species in the "Leibii group" of the subgenus *Selysius* within *Myotis*.

Most problems with the allocation of specimens appear to center in the southwestern portion of New Mexico and adjacent Arizona, Texas and Mexico (Barbour and Davis, 1969; Anderson, 1972; Findley et al., in manuscript), probably due to the increased variability of *californicus* in this area (Bogan, 1973). The collection of good series of both kinds of bats from Hidalgo County, New Mexico, by J. D. Druecker and others from the University of New Mexico offered the chance to ascertain the status of the two bats in this area and, hopefully, to establish reliable quantitative procedures for identifying these bats, both in the field and in the museum.

METHODS AND MATERIALS

Thirty-four *M. leibii* and 50 *M. californicus*, all adults, from various localities in Hidalgo County, New Mexico, were examined. Sexes were

TABLE 1. Traditional characters used to separate *Myotis californicus* and *M. leibii.*

Character	*californicus*	*leibii*
Facial coloration	Brown	Black
Ear color	Brown	Black
Dorsal pelage	Dull-tipped, not burnished or glossy	Shiny-tipped, glossy or burnished
Third metacarpal	As long as forearm (over 30.5 mm)	Shorter than forearm (less than 30.3 mm)
Braincase	Rounded	Flattened
Forehead profile	Rises abruptly	Rises gradually
Skull size	Smaller	Larger

combined for this analysis, as I have found that sexual dimorphism is not marked in these two species. The fourteen characters utilized, measured as described in Bogan (1973), are: total length, tail length, hindfoot length, ear length, forearm length, tibia length, condyle-premaxillary length, condylocanine length, maxillary toothrow length, cranial breadth, cranial depth, least interorbital breadth, rostral breadth, rostral length.

The specimens were initially identified using only published characters (Table 1). The crania were examined closely to determine additional characters for identification. Bats were grouped into samples for statistical analysis in two ways: first, using just two samples, Hidalgo County *californicus* and Hidalgo County *leibii*; and second, by subdividing the two species into samples from eastern, central and western Hidalgo County. These samples correspond to the three major mountain ranges in Hidalgo County and likewise to most of the productive collecting localities in the county (Findley and Traut, 1970).

Frequency distributions for each variable were prepared to examine normality of distributions and degree of overlap between *californicus* and *leibii*. Means and variances were then calculated for the two species. Additionally, bivariate scattergrams were prepared for most pairs of variables.

The data matrix was subjected to a two-group discriminant analysis (BMD04M) which gives a discriminant function as well as the discriminant coefficients for each variable enabling the identification of new specimens. Next, a stepwise discriminant analysis (BMD07M) yielding five canonical variates and a classification matrix based on the posterior probabilities and generalized distance values was performed, allowing an estimate of the degree of phenetic overlap. Additionally, the data were subjected to a principal component analysis (BMD01M) and to a numerical taxonomic analysis (NTSYS, developed by F. James

TABLE 2. Basic statistics for 14 variables of *Myotis californicus* and *M. leibii* from Hidalgo County, New Mexico. The mean plus or minus one standard deviation and the range (in parentheses) are shown for each sample.

Character	*M. californicus* (N = 50)	*M. leibii* (N = 34)
Total length	84.52 ± 4.69 (73.0–94.0)	89.06 ± 4.16 (80.0–99.0)
Tail length	39.00 ± 3.03 (32.0–45.0)	41.50 ± 2.71 (37.0–49.0)
Hindfoot length	6.82 ± 0.92 (5.0–8.5)	7.71 ± 0.62 (6.0–9.0)
Ear length	13.72 ± 1.03 (11.0–15.0)	14.70 ± 0.97 (12.0–16.0)
Forearm length	32.52 ± 1.07 (30.45–35.22)	33.49 ± 0.93 (31.28–35.77)
Tibia length	13.98 ± 0.83 (12.30–15.75)	13.88 ± 0.60 (13.11–15.34)
Condyle-premaxillary length	12.69 ± 0.27 (12.10–13.33)	13.33 ± 0.27 (12.73–13.88)
Condylocanine length	11.98 ± 0.26 (11.50–12.60)	12.60 ± 0.26 (11.99–13.07)
Maxillary toothrow length	4.99 ± 0.13 (4.64–5.25)	5.26 ± 0.13 (5.02–5.57)
Cranial breadth	6.27 ± 0.17 (5.95–6.65)	6.49 ± 0.13 (6.24–6.79)
Cranial depth	4.58 ± 0.17 (4.19–4.95)	4.42 ± 0.13 (4.13–4.80)
Interorbital breadth	3.09 ± 0.09 (2.90–3.28)	3.25 ± 0.14 (2.91–3.52)
Rostral breadth	4.81 ± 0.13 (4.51–5.10)	5.33 ± 0.13 (5.00–5.63)
Rostral length	5.33 ± 0.28 (4.32–6.00)	5.56 ± 0.26 (5.02–6.30)

Rohlf and associates). These last two analyses supported the discriminant analyses and therefore are not reported herein.

RESULTS AND DISCUSSION

An impressive array of investigators (Hall and Kelson, 1959; Cockrum, 1960; Barbour and Davis, 1969; Anderson, 1972; Armstrong, 1972; Findley et al., in manuscript) have used the same basic set of characters [first presented by Miller and Allen (1928)] to separate *Myotis californicus* and *M. leibii* (Table 1). In the Southwest, however, no single

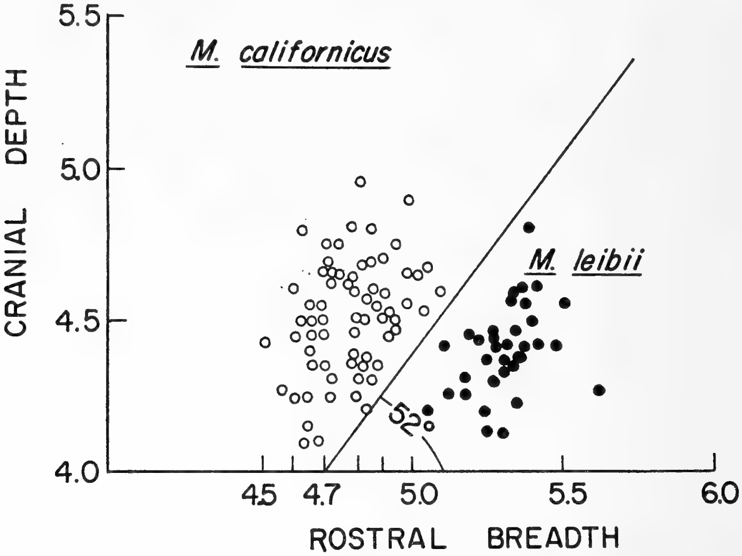

FIG. 1. Relationships of two cranial measurements in *Myotis californicus* and *M. leibii.* Measurements are in millimeters.

TABLE 3. Discriminant coefficients for original variables to be used in computing discriminant scores for unknowns. See text for details.

Variable	Coefficient
Total length	0.00508
Tail length	0.00019
Hindfoot length	–0.02895
Ear length	–0.01790
Forearm length	0.01046
Tibia length	0.02176
Condyle-premaxillary length	–0.18182
Condylocanine length	0.02349
Maxillary toothrow length	–0.06011
Cranial breadth	–0.00339
Cranial depth	0.30601
Interorbital breadth	0.14769
Rostral breadth	–0.43839
Rostral length	0.07154

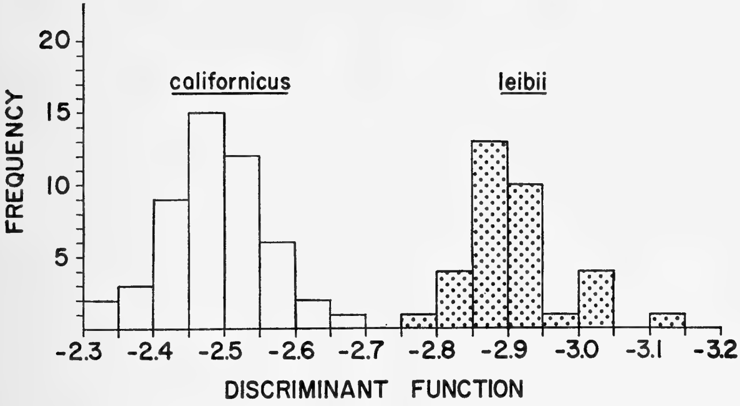

FIG. 2. Frequency distribution of Hidalgo County samples of *Myotis californicus* and *M. leibii* on the discriminant function computed by the two-group discriminant analysis.

qualitative character provides certain identification. Rather, all such characters must be considered simultaneously in a typically time-consuming operation. The quantitative character most often cited, that of third metacarpal length, was so variable within *californicus* that it was not further considered as an effective means to distinguish *californicus* from *leibii.* The basic statistics and amount of character overlap between the two species in Hidalgo County are shown in Table 2. The character showing the least amount of overlap in my analysis is rostral breadth as measured at the junction of M_1–M_2; 96% of *californicus* not exceeding 5.0 mm, and 92% of *leibii* equalling or exceeding 5.2 mm.

Most of the bivariate scattergrams were useless for separating the two species. The exceptions were rostral breadth plotted against other skull parameters; the most discriminating being rostral breadth against cranial depth (Figure 1). This useful combination is a reflection of *Myotis leibii* having a flattened skull, and *M. californicus* possessing a more globose skull. I have subsequently plotted rostral breadth against cranial depth for numerous specimens of both species from elsewhere in the southwestern U. S. and Mexico with equally good separation. Only rarely do specimens overlap the 52° line separating the clusters of *leibii* and *californicus.*

The results of the bivariate scattergram of Figure 1 were extended by performing a discriminant analysis to maximize the separation of the two species of bats. The results of this analysis are presented in Figure 2, and show a clear separation between the two groups. This analysis yielded the discriminant coefficients listed in Table 3 which can be used in determining identification of unknowns. The procedure, described in

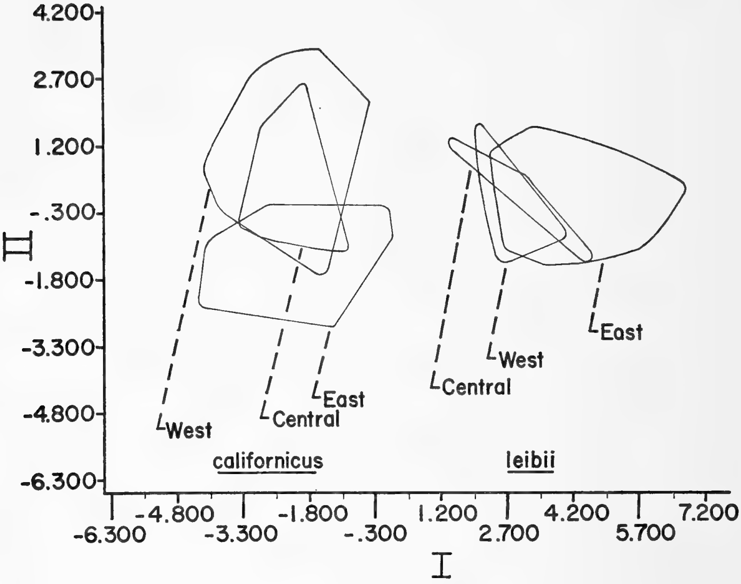

FIG. 3. Distribution of *Myotis californicus* and *M. leibii* on the first two canonical variates computed by the stepwise discriminant analysis. Each species is represented by three samples from western, central and eastern Hidalgo County. Lines enclose all bats within a sample.

Choate (1973) and elsewhere, is to multiply the value for each character by the discriminant coefficient, sum these values, and then plot the value on the discriminant function as shown in Figure 2. As Choate (1973) points out, the importance of extreme care in taking the measurements cannot be overstressed.

The multiple stepwise discriminant analysis using six groups (three *californicus* and three *leibii* samples) is of interest for at least two reasons. First, since the variables are entered in a stepwise fashion, the analysis enables the investigator to determine which variables possess the greatest discriminating power; and second, since the samples are subdivided it is possible to define a five-dimensional space within which the bats are dispersed. As seen in Table 4 the variable possessing the greatest discriminatory power among the 14 original variables is rostral breadth. Figure 3 is a plot of the six samples on the first two canonical variates and clearly shows that the two species do not overlap. The first two canonical variates account for 84% and 8% of the variance, respectively, and the first four variates account for 98.7% of the total variance.

These analyses demonstrate the distinct nature of the two taxa, and thus support the opinions of other investigators, and they enable the

TABLE 4. Rank order of variables as determined by the stepwise discriminant analysis. Those variables at the top of the column possess the greatest discriminatory power.

Rank	Variable
1	Rostral breadth
2	Hindfoot length
3	Cranial depth
4	Ear length
5	Maxillary toothrow length
6	Total length
7	Cranial breadth
8	Tibia length
9	Rostral length
10	Condyle-premaxillary length
11	Condylocanine length
12	Interorbital breadth
13	Forearm length
14	Tail length

rapid allocation of specimens of unknown identity. Proper identification, however, requires the presence of a clean, intact skull. It is disappointing that this study did not reveal any completely reliable character facilitating positive identification of these species in the field. Field identification still requires the utilization of traditional characters coupled with considerable experience. The most important feature is that *leibii* is usually darker in color than *californicus.* The exceptions are found in populations of dark-colored *californicus* occurring at higher elevations in the southwestern U. S. and Mexico. Furthermore, *californicus* usually appears to be distinctly smaller and more aggressive than *leibii.*

Having demonstrated that the two taxa are distinctive the intriguing question is, how are they partitioning the environment in areas of sympatry? Black (1972), based on his study of bat food habits, suggests that one member of the pair might be a "beetle strategist" while the other may prey more heavily on moths. Husar (1973) has recently described such a situation in *Myotis evotis* and *M. auriculus*, two very similar bats with rather narrow regions of overlap in the southwest. Geluso (1972) has shown that *californicus* and *leibii* are physiologically different in urine concentrating abilities and in kidney morphology. These investigations suggest that *californicus* and *leibii* are at least as different ecologically and physiologically as they are morphologically and they may be minimizing competition through differences in diet, roosting or foraging sites, or foraging times. Such partitioning should be demonstrable through observable differences in dietary, behavioral, or physiological parameters.

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Several people and institutions were instrumental in bringing this report to completion. The University of New Mexico and the Smithsonian Institution provided computer time. James S. Findley generously assisted in initial stages of identification of bats. Alfred L. Gardner, Charles O. Handley, Jr., Clyde Jones, Richard W. Thorington, Jr., and Don E. Wilson all read and commented on the manuscript. To all the above I am grateful.

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PROCEEDINGS
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AN EMENDATION OF THE GENUS *TRIANNULATA* GOODNIGHT, 1940, WITH THE ASSIGNMENT OF *TRIANNULATA MONTANA* TO *CAMBARINCOLA* ELLIS 1912 (CLITELLATA: BRANCHIOBDELLIDA)

By Perry C. Holt
Department of Biology and
Center for Systematic Collections
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

The nominal genus *Triannulata* Goodnight, 1940, is composed of two species, *T. magna* Goodnight, 1940, the type-species, and *T. montana* Goodnight, 1940. Superficially, these large worms resemble members of the genus *Cambarincola* Ellis, 1912, and I thought they were species of the latter when I began this study. But *magna* is a representative of a distinctive, and as of now, monotypic, genus, while *montana* is indeed a member of the genus *Cambarincola.* The following redefinition of the genus *Triannulata,* a redescription of *T. magna* and the reassignment and emended description of *montana* are offered as a part of my ongoing effort to describe and classify the North American branchiobdellid fauna.

Other than the original treatment of these species (Goodnight, 1940:56–58), their possible inclusion in such compendia as Pennak (1953:300) and brief statements in Hoffman (1963:281, 295), Liang (1963:570) and Holt (1969:195), nothing else, to my knowledge, has been written about them. In former works (Holt, 1965; 1968a; 1969), I ignored *Triannulata,* believing its species to belong to *Cambarincola.*

The illustrations herein are so oriented that the anterior of all animals, or parts thereof, is to the reader's right. Measurements given are approximations, roughly correct to the nearest

0.1 mm. The animals are large and the details shown in the illustrations are essentially free-hand sketches, based upon proportions established with the camera lucida. Further, the drawings are conventionalized (as in all my works on the branchiobdellids): stippling indicates glandular cells or structures; line hatching, muscular structures or investments. The initials "PCH" indicate collection numbers of branchiobdellids in the collections of the VPI&SU Center for Systematic Collections.

I am grateful to Mrs. Virgie F. Holt, my wife and constant field companion, for helping in the collecting of topotypical material and other specimens treated herein; to Dr. Marian H. Pettibone, Curator, Division of Worms, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, for allowing me to examine the holotypes of *Triannulata magna* and *Cambarincola montanus*; to Dr. Horton H. Hobbs, Jr., for supplying the identifications of the host animals and for a critical reading of the manuscript; to the National Science Foundation (grant GB-372) for financial support of my field work.

Goodnight (1940:56) presented the following diagnosis of the genus *Triannulata*: "With the characteristics of the subfamily; spermatheca not bifid; no accessory sperm tube; body cylindrical, not flattened; head roughly triangular in shape with protruding lips; major annuli of most segments redivided to give the appearance of three annuli per segment; this is especially evident in the median segments and moderately contracted specimens; anterior nephridia opening to the outside through separate pores in the dorsal half of segment III."

When this diagnosis is examined in the light of our knowledge of the branchiobdellids as it now exists, it is found to be inadequate.

"With the characteristics of the subfamily" means that the worms produce spermatozoa in both segments V and VI (Goodnight, 1940:27), instead of possessing testes and male funnels only in segment V. The latter is true of species of the Eurasian genus *Branchiobdella* Odier, 1823, but is not known for any North American genus (Holt, 1967:8). In including the statement, "no accessory sperm tube" in his diagnosis, Goodnight was referring to what is now known as the prostate (Holt, 1960:63). *Triannulata magna* clearly does not possess a prostate; *montana* is characterized by a very large and distinctive one. The only known genus with a bifid spermatheca is the monotypic, North American *Bdellodrilus* Moore, 1895. Members of the American genera *Xironodrilus* Ellis, 1918, and *Xironogiton* Ellis, 1919, are flattened, rather than terete, and are not at all closely related; the remaining 15 genera of the order, including *Triannulata*, are composed of animals with cylindrical bodies. The "triangular" shape of the head ("cone-shaped" would be more descriptive) with protruding lips are minor features, worthy of mention only as specific characters, and cannot be taken seriously as distinctive of a genus, since many intrageneric variations of this type are known among the branchiobdellids (*cf.* Hoffman's 1963 treatment of *Cambarincola*). The same objection applies to the use of "redivided" major annuli as a generic character. Not all of the segments of members of the two species that Goodnight placed in *Triannulata* present a tripartite appearance; in those that do, the redivision takes the form, mainly ventrally, of a rather minute diminution of the diameter of the anterior annulus immediately anterior to the usual distinct sulcus that sets off the minor (posterior and shorter) annulus of a segment. This tripartite appearance of some segments may simply be a consequence of the large size of the worms and is also characteristic of the anterior segments of the likewise large *Cambarincola ingens* Hoffman, 1963, and *Stephanodrilus* (= *Cirrodrilus*) *truncatus* Liang, 1963. [See Holt (1967:2–3) for a discussion of the synonymy of *Cirrodrilus* Pierantoni, 1905, and *Stephanodrilus* Pierantoni, 1906].

Goodnight's belief that *Triannulata* is characterized by separate nephridiopores on the dorsum of segment III must be considered carefully; the manner of opening of the anterior nephridia is a recognized generic character. *T. magna* is generically distinct on the basis of features of the reproductive systems, but Goodnight appears to be mistaken in his statement that the dorsum of segment III bears two nephridiopores. The holotype is mounted with the dorsal side uppermost on the slide and I cannot find two nephridiopores; rather, middorsally, there appears to be a single pore, but the nephridia are very difficult to see in this specimen and impossible to trace unmistakably to their opening. Immature specimens from the type locality, that I am confident on the basis of body shape and the structure of the jaws are conspecific with the type, have only one nephridiopore. In all branchiobdellids, the nephridiopores are frequently difficult to locate unambiguously in specimens mounted entire. Often, not always, their position can only be determined in mature specimens by means of serial sections. Though Goodnight (1940:8–9) mentioned the use of serial sections, nowhere does he refer to their use in the discussion of any species in his monograph or present any drawings or photographs of sections. This is noticeably true of his treatment of *T. magna.* Unfortunately, I was able to take only a few specimens of *T. magna* in the limited time I could devote to collecting in Washington and Oregon. Of these, I chose to dissect for a study of the reproductive systems all but one which is mounted entire. Yet for the reasons cited, I am convinced that *Triannulata* is partly characterized by a common opening of the anterior nephridia. The point is important for any consideration of the phylogenetic relations of the genus.

Part of these conclusions were anticipated by Liang (1963: 570) on the basis of an anlysis of Goodnight's descriptions. That is, Liang was unable to distinguish between Goodnight's description of *Triannulata* and *Stephanodrilus* (= *Cirrodrilus*) and placed both *Triannulata* and *Stephanodrilus* (= *Magmatodrilus* Holt, 1967) *obscurus* (Goodnight, 1940) together in the invalid genus *Stephanodrilus.* Liang adequately described and illustrated the reproductive systems of his Chinese worms, accepting my earlier contentions that only detailed study of the reproductive systems furnish an adequate basis for the classification of the branchiobdellids (Holt, 1949, *et seq.*; Hoffman, 1963.

Triannulata Goodnight, 1940

Triannulata Goodnight, 1940:56–58.—Pennak, 1953:300.—Hoffman, 1963:281, 295.—Holt, 1969:195.

Stephanodrilus.—Liang, 1963:570 [in part].

Type-species: *Triannulata magna* Goodnight, 1940:56–57, by original designation.

Diagnosis: Moderately large branchiobdellids (about 4.5 mm in average length); 2 pairs of testes; unpaired nephridiopore on dorsum of segment III; body terete, without peristomal tentacles or dorsal projections, head large, lips (peristomium) prominent; some, mostly III–V, segments superficially triannulate; spermiducal gland large, subspherical to subcubical, vasa deferentia entering entally, with small deferent lobes, without prostate or prostatic protuberance; no ejaculatory duct; bursa with large ectal spherical atrium, long muscular eversible penial sheath; spermatheca with thick outer muscular wall, internally essentially filled with tall columnar epithelial cells, lumen reduced.

Distribution and affinities: With the removal of *montana* from the genus, *Triannulata* becomes monotypic. Goodnight (1940:57) records *T. magna* from two localities in Washington and three in Oregon. I have material from the type-locality and one other locality in Washington. The species is probably widespread in the Cascade and Coastal Ranges of the Pacific Northwest.

The affinities of the genus must be sought among a group of presumably primitive branchiobdellids among the *Sathodrilus*—lineage whose relationships have been discussed (Holt, 1969:195–198; 1973:35): *Sathodrilus* Holt, 1968b; *Ceratodrilus* Hall, 1914; *Magmatodrilus*. In addition, the Asiatic genus *Caridinophila* Liang, 1963, must be included as a possible relative of these genera.

On the assumption that an eversible penis and the ental entry of the vasa deferentia into the spermiducal gland are primitive features, *Sathodrilus* has been placed near the beginning of a lineage that culminates in such genera as *Pterodrilus* and *Cambarincola* with single anterior nephridiopores, well defined ejaculatory ducts, prostates always present, ental points of entry of the vasa deferentia into the spermiducal gland and protrusible, cone-shaped muscular penes.

The species of *Sathodrilus* have single anterior nephidiopores, ejaculatory ducts that usually are short and relatively thick, prostates or prostatic protuberances may or may not be present, the vasa deferentia always enter the ental end of the spermiducal gland and the penes are eversible, though their finer structure differs among the species that are included in the genus. *Sathodrilus* ranges from northwestern South Carolina to southern Mexico (Holt, 1973a; 1973b).

Ceratodrilus is composed of two allopatric species from the Great Salt Lake and Snake River drainages. The anterior nephridiopore is single. A well defined, but relatively short though prominent ejaculatory duct, a prostatic protuberance, ental entry into the spermiducal gland of the vasa deferentia and an eversible penis are shared with other members of the *Sathodrilus* lineage. The genus is distinguished by long peristomal and dorsal tentacles and appendages (Holt, 1960).

Magmatodrilus, a monotypic genus from northern California, is similar to *Ceratodrilus* in the above respects, except that the places of

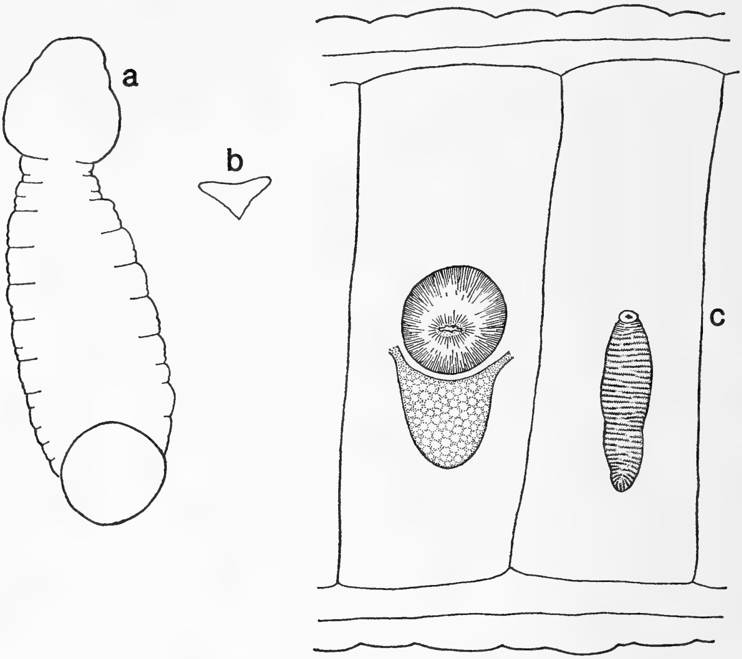


FIG. 1. *Triannulata magna.* *a*, holotype, ventral view; *b*, same, outline of ventral jaw; *c*, same, ventral view of reproductive systems.

entry of the vasa deferentia into the spermiducal gland are widely separated, the latter is long and slender without any indications of a prostatic protuberance, the penial sheath enclosing the eversible [not protrusible, *contra* Holt, 1967] penis is much shorter, tentacles and dorsal projections are absent (Fig. 4).

The Chinese genus *Cardinophila* has no spermatheca, the spermiducal gland is small and there are no vasa deferentia (the vasa efferentia enter the spermiducal gland at four separate places) and an ejaculatory duct is present (Liang, 1963: 569). Nothing is known of the penis of *C. unidens.*

The condensed account just given of the major features of these genera constitute convincing evidence of their close phylogenetic relationships. Their generic distinctiveness is attested by the differences mentioned in addition to those in the overall facies of the jaws, the presence (in *Ceratodrilus*) or absence of peristomial and dorsal body appendages and striking, but difficult to describe succinctly (see Liang, 1963, and Holt, 1960; 1967; 1968a; 1969) variations in the minor features of the reproductive systems.

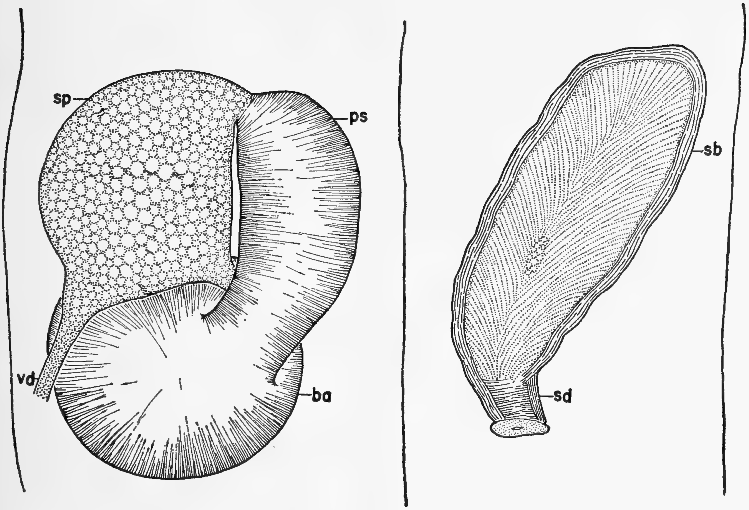


FIG. 2. *Triannulata magna.* Latero-dorsal view of reproductive systems from a dissection: *ba,* bursal atrium; *ps,* penial sheath; *sb,* spermathecal bulb; *sd,* spermathecal duct; *sq,* spermiducal gland; *vd,* vas deferens.

It is obvious that *Triannulata* is related to this group of genera. The absence of an ejaculatory duct in *Triannulata* immediately separates it from the others. Or, if one wishes to consider what I have called the penial sheath of *Triannulata* an ejaculatory duct, the eversibility of the ejaculatory duct does so. But until more study is devoted to these structures of the male reproductive system of the branchiobdellids, I cannot more precisely place the genus in the *Sathodrilus* lineage. I can only say that these four genera are closely related, that they appear to be phylogenetic relics and that guesses as to which is nearer in structure to the postulated ancestor of branchiobdellids with a single anterior nephridiopore are futile.

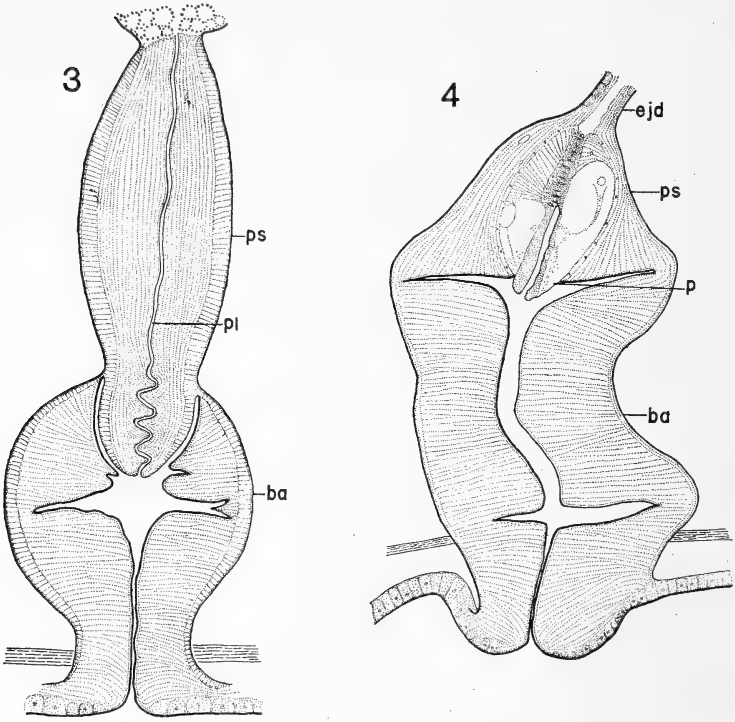
Triannulata magna Goodnight, 1940

Figures 1–3

Type-specimens: Holotype, USNM 20567 from Naches, Washington, on *Pacifastacus* sp.

Diagnosis: As for the genus.

Description: The worms are large, the holotype, the only mature specimen I have seen from the type-locality, has the following dimensions: total length, 3.8 mm; greatest diameter, segment VII, 1.2 mm; head length, 0.9 mm; head diameter, 0.9 mm; diameter, segment I, 0.6 mm;



Figs. 3–4. Longitudinal section of male copulatory apparatus. Fig. 3. *Triannulata magna.* Fig. 4. *Magmatodrilus obscurus*: *ba,* bursal atrium; *ejd,* ejaculatory duct; *p,* penis; *pl,* lumen of penis; *ps,* penial sheath.

diameter, sucker, 0.8 mm. A specimen from Cowlitz County, Washington, is somewhat larger with the following dimensions: total length, 4.9 mm; greatest diameter, 1.2 mm; head length, 1.1 mm; head diameter, 1.0 mm; diameter, segment I, 0.7 mm; diameter, sucker, 0.9 mm. The other two mature specimens from Cowlitz County that I have examined were dissected for a study of the jaws and reproductive systems, but were of comparable size.

The peristomium is divided by lateral indentations into upper and lower lips that lack emarginations or lobes, but that noticeably protrude and are less in diameter than the head. There are no detectable oral papillae. The head, execpt for the region of lessening diameter of the peristomium, has no external sulci and internally there is only one, though prominent, pharyngeal sulcus.

The anterior annuli of the trunk segments are only very slightly greater in diameter than the posterior ones, hence there are no noticeable dorsal ridges. The anterior annuli of segments I–V are subdivided, a subdivision that appears rather superficial and does not involve the longitudinal muscles. The anterior nephridiopore has been mentioned above.

The jaws are subequal in size, triangular in *en face* view, without lateral teeth, therefore, a 1/1 dental formula. They are dark brown.

The following description of the reproductive system is based upon dissected material and it is difficult or impossible to present the relative size of its components in comparison to the diameter of the animals.

The spermiducal gland is large, subspherical, almost subcubical in shape. Its ventral border is at the level of the dorsal border of the bursa and the vasa deferentia enter it at opposite angles of its ventral (ental) side. There are small, indistinct deferent lobes that are not at all prominent. A prostrate is totally absent.

The penis of the branchiobdellids is the ectal end of the ejaculatory duct. For these traditionally separately described organs in *Triannulata magna*, two interpretations are immediately suggested by the bursal-penial complex: (1) the ejaculatory duct is absent and the penial sheath is long and in its totality eversible as the penis; or (2) the ejaculatory duct is itself a heavily muscular, eversible organ with only its ectal portion representing the penis. In actuality, neither interpretation is satisfying. I have chosen to interpret the eversible, presumably intromittent portion of the male copulatory apparatus of *T. magna* as the penis and deny the animal an ejaculatory duct. At a deeper level of interpretation the problem is probably semantic. It is most likely that in the ancestors of the branchiobdellids a muscular tube, undifferentiated into penial sheath, penial and ejaculatory duct portions, was everted as the intromittent organ through a somewhat heavier muscular, but small, bursal atrium. *T. magna*, with an increase in the muscularity of this intromittent organ, has, then retained this postulated ancestral arrangement.

In any case, adopting the first of the interpretations above for the sake of simplicity of description, the eversible penis, comprised of what in other members of the order would be known as the ejaculatory duct plus the penis, is composed of, other than the investing peritoneum, a prominent outer layer of encircling muscles and a much thicker layer of longitudinal (in reference to the organ itself) ones. The lumen is distinct throughout and convoluted, particularly ectally.

The bursa is spherical, with a rather short outlet duct, and is composed almost entirely of the atrial portion: the penis projects outward only a short distance into what in other branchiobdellids is the penial sheath. The organ is, nonetheless, relatively large.

The spermatheca has a comparatively short ectal duct; most of the organ consists of a clavate bulb with a thick muscular investment and very tall columnar glandular cells which almost obliterate the lumen, leaving only a minute space near the median portion for the storage of spermatozoa.

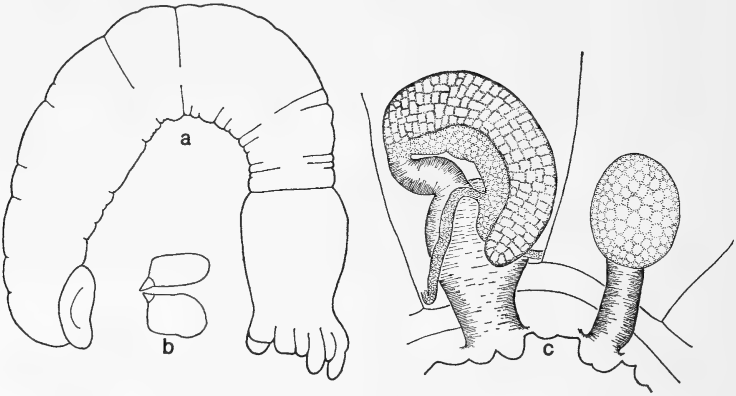


FIG. 5. *Cambarincola montanus.* *a,* lateral view of animal from Douglas County, Oregon; *b,* same, lateral view of jaws; *c,* same, lateral view of reproductive systems.

Variation: In the limited material at my disposal, no significant variations are detectable. Segment VI may be sometimes triannulate, but on the other hand it may always be so and the extra "annulus" is obscured in the holotype and other specimens I have seen.

Affinities: Discussed above as those of the genus.

Distribution: As discussed above for the genus.

Hosts: *Pacifastacus l. leniusculus* (Dana, 1852) and *P. l. klamathensis* (Stimpson, 1857).

Material examined: The holotype, several immature topotypical specimens (PCH 1811) taken on *Pacifastacus leniusculus klamathensis* from the Naches River just above its confluence with the Tieton River, Yakima County, Washington, 13 August 1964, by Perry C. and Virgie F. Holt.—4 specimens (PCH 1814) taken from the Kalami River on *P. l. leniusculus* about 8 miles south of Kelso, Cowlitz County, Washington, 15 August 1964, by Perry C. and Virgie F. Holt.

Cambarincola Ellis, 1912

Astacobdella Leidy, 1851:206.
Branchiobdella.—Moore, 1894:427 [in part].
Bdellodrilus.—Pierantoni, 1912:24 [in part].
Cambarincola.—Ellis, 1912:481; 1919:263.—Hall, 1914:190.—Stephenson, 1930:801.—Yamaguchi, 1932:454; 1934:189.—Goodnight, 1940: 30.—Holt and Hoffman, 1959:97.—Hoffman, 1963:271.—Hobbs, Holt and Walton, 1967:52.—Holt, 1969:197; 1973a:84; 1973b:9.

Diagnosis (modified from Hobbs, Holt and Walton, 1967:52): Body terete without specialized projections other than peristomial tentacles in some species; anterior nephridia opening through common pore on dorsum of segment III; deferent ducts entering ental end of spermiducal gland; prostate and ejaculatory duct both present; penis non-eversible; bursa subpyriform to obcordate; spermatheca present, never bifid.

Type-species: *Cambarincola macrodonta* Ellis, 1912, by original designation.

Cambarincola montanus (Goodnight, 1940), new comb.

Figure 5

Triannulata montana Goodnight, 1940:57.—Pennak, 1953:300.—Hoffman, 1963:281, 295.—Liang, 1963:570.—Holt, 1969:195.

Type-specimens: Holotype, USNM 2056, from the Kalami River, Washington, on *Pacifastacus* sp.

Description: Goodnight's description of *Triannulata magna* is confined almost entirely to features of the body and jaws and omits any diagnostic reference to the reproductive systems. In the following emended description of *Cambaricola montanus*, I shall quote all of Goodnight's relevant statements while adhering to my previously developed format for species descriptions.

Specimens of *Cambarincola montanus* are large worms. Averages of 5 mature individuals from Polk County, Oregon, selected at random, have the following dimensions (ranges in parentheses): total length, 5.8 mm (4.8–6.3 mm); greatest diameter, 0.8 mm (0.6–1.0 mm); head length, 1.0 mm (0.9–1.4 mm); head diameter, 0.7 mm (0.5–0.8 mm); diameter segment I, 0.6 mm (0.4–0.7 mm); diameter, sucker, 0.6 mm (0.5–0.8 mm). These measurements are concordant with Goodnight's description (1940:57) of a worm 5.0 mm long.

The peristomium (lips) are provided with 4 dorsal tentacles, 2 lateral lobes on each side and 4 ventral lobes, which accords with Goodnight's (1940:57) statement "peristomium divided into twelve lobes . . . which may be extended into tentacular appendages, dorsal longer than ventral or lateral." Experience with a variety of species, e.g., those of *Ceratodrilus* (Holt, 1960) and *Cambarincola fallax* Hoffman, 1963, enables one to distinguish between lobes and tentacles of the lips. No oral papillae are detectable. The peristomium, lateral indentations of which form the lips of the branchiobdellids, is set off from the remainder of the head by a marked narrowing in diameter, often with about 3 annular indentations. There are no other external sulci of the head and only one prominent internal (pharyngeal) sulcus. The marked narrowing of the peristomium and the relatively large diameter of the head in contrast to the lesser diameter of trunk segment I confer a distinct cone-shaped appearance to the head.

The anterior (major) annuli of the trunk segments are not noticeably greater in diameter than the posterior ones, there are, therefore, no dorsal ridges, but in segments III to V the major annuli are subdivided ventrally to give a triannulate appearance to these segments. The anterior nephridiopore is not prominent, but *contra* Goodnight (1940:57) it is a single pore located in the usual position on the dorsum of the major annulus of segment III.

The jaws are massive in appearance, but not disproportionately large, and dark brown. They are triangular in shape in *en face* view and subretangular to rounded triangular in lateral view. The usual dental formula is 1/1 with prominent blunt teeth. Younger, though large, specimens from the Kalami River, the type-locality, have a dental formula of 5/5, but the lateral teeth are obscure and probably wear away with age, so I cannot dispute Goodnight's statement that the dental formula is 7/5. There may well be this much variation with age in the number of lateral teeth.

Goodnight (1940:57) has nothing further to say of any diagnostic value, remarking merely that the reproductive organs are in their normal position in segments V and VI. The male reproductive system of *Cambarincola montanus* furnishes, however, one of the most distinctive features of the species. In its totality it is of normal proportional size for the genus, but the worms are large and its components are often compressed underneath the gut.

The spermiducal gland, though, is relatively small, in length, about 1/3 the diameter of segment VI, usually flexed and partially obscured in whole mounts by the prostate. The vasa deferentia enter the gland at widely separated regions, that is, there is a prominent anterior deferent lobe. Otherwise, it is not unusual.

The prostate is the truly remarkable feature of the male system. Proportionately huge, it exceeds somewhat the spermiducal gland in length and is at least 1½ times the diameter of the latter. Yet it is composed of only the usual single layer of columnar glandular cells which are highly vacuolated, that is, differentiated. There is no ental bulb of the prostate.

The ejaculatory duct is relatively short and thick. The bursa is somewhat more than ⅓ the diameter of its segment, a little more than ½ its length in breadth and subpyriform in shape. Internally, its structure is typical of that of other species of the genus, a short penial sheath enclosing a cone-shaped protrusible penis, a rather short atrial portion and relatively long bursal "outlet canal."

The spermatheca is composed of a long ectal duct and a globose bulb. Because of the bending of the ectal duct, the total length of the spermatheca is difficult to estimate, but it is about ½ the diameter of segment V.

Variation: There is considerable variation in the size of mature animals, but all are larger than those of most members of the genus. The reproductive systems may appear to differ from one worm to another, because of the differing positions in which they lie with reference to the gut. The peristomial tentacles may vary in degree of extension, which is of no consequence; they are always distinctly tentaculate and borne on the dorsal lobes of the upper lip. More significantly, the jaws of most specimens appear to bear only one tooth each, with undulations along the normally tooth-bearing margins, but as remarked, this is probably a function of wear and the dental formula in young animals is either 7/5 or 5/5, possibly varying between these two.

Affinities: At this stage of our knowledge of the genus *Cambarincola*, it is futile to speculate as to which of its species is closest to *C. montanus*. The differentiated prostate, the peristomal tentacles, and almost surely the large total size mark it as an advanced member of the genus. The lack of a prostatic bulb removes it from the *philadelphicus* section (Hoffman, 1963), yet in overall facies *C. montanus* is closest to members of this no longer valid section (Holt, 1973a, b) of the genus. Of the much better known eastern species of the genus, *C. ingens* Hoffman, 1963, rivals or exceeds *C. montanus* in size, but the prostate is much longer than the spermiducal gland, less in diameter, and possesses an ental bulb in the former. *C. fallax* Hoffman, 1963, has four dorsal peristomial tentacles and a 5/5 dental formula, but otherwise is a much smaller worm without the discordance in size of the prostate (which also has an ental bulb) and the spermiducal gland. Further comments must await a detailed study of the genus in western North America. For the present, the size of the total animal, the prominence of the tentacles of the upper lip and the size and nature of the prostate readily separate *C. montanus* from all of its known congeners.

Hosts: *Pacifastacus leniusculus leniusculus* (Dana, 1852), *P. l. klamathensis* (Stimpson, 1857), *P. l. trowbridgii* (Stimpson, 1857).

Distribution: Streams of the Coastal and Cascade Ranges of the Pacific drainage in western North America from Santa Barbara County, California, to northern Washington.

Material examined (all collected by Perry C. and Virgie F. Holt): 5 specimens (PCH 1110) taken on *Pacifastacus leniusculus klamathensis* from Myrtle Creek, 8.3 miles south of Tiller, on state highway 42, Douglas County, Oregon, 11 July 1960.—7 specimens (PCH 1113) taken on *P. l. klamathensis* from stream tributary to the Umpqua River, 12.6 miles south of junction of state highway 23 and U. S. highway 99 on U. S. 99, Douglas County, Oregon, 11 July 1960.—2 specimens (PCH 1116) taken on *P. l. leniusculus* from Mary's River at Philomath, Benton County, Oregon, 12 July 1960.—2 specimens (PCH 1119) taken on *P. l. klamathensis* from a small tributary to the Yaquina River, 14.4 miles east of Toledo, Lincoln County, Oregon, 12 July 1960.—5 specimens (PCH 1124) taken on *P. l. klamathensis* from South Yamhill River, 1.6 miles west of Valley Junction, Polk County, Oregon, 13 July 1960.—5 specimens (PCH 1127) taken on *P. l. klamathensis* from Butte Creek, on state highway 213 at Marion-Clackamas County line, Oregon, 13 July 1960.—5 specimens (PCH 1130) taken on *P. l. klamathensis* from Gray's River on U. S. Highway 830, Wahkiakum County, Washington, 14 July 1960.—One specimen (PCH 1133) taken on *P. l. klamathensis* from Humptulips River at Humptulips, Gray's Harbor County, Washington, 16 July 1960.—2 specimens (PCH 1137) taken on *P. l. trowbridgii* from Mill Creek, 0.9 miles south of Forks on U. S. Highway 101, Clallam

County, Washington, 16 July 1960.—3 specimens (PCH 1813) taken on *P. l. trowbridgii* from the Chehalis River at Adna, Lewis County, Washington, 15 August 1964.—4 specimens (PCH 1814) taken on *P. l. leniusculus* from the Kalami River about 8 miles south of Kelso, Cowlitz County, Washington, 15 August 1964.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

EUXESTA MAZORCA, NEW SPECIES, ASSOCIATED WITH EARS OF MAIZE IN SOUTH AMERICA (DIPTERA, OTITIDAE)

By George C. Steyskal
Systematic Entomology Laboratory, Agr. Res. Serv.,
U. S. Department of Agriculture, Washington, D. C.[1]

Specimens of a species of *Euxesta* have been received on a few occasions from Colombia, Ecuador, and Peru accompanied with the notation that they were in some manner associated with ears of corn (maize, *Zea mays* Linnaeus), although exact data concerning their relations with the plant are not available. A few specimens of the species have been in the United States National Museum collection for many years determined as *Euxesta obliquestriata* Hendel, which was described from Brazil, Paraguay, and Bolivia. The species herein described, however, differs in several ways from Hendel's description and figure.

Euxesta mazorca, new species

Figures 1–2

Male and female. Length of wing 4–0—4.83 mm. Agrees with *E. obliquestriata* Hendel in basic pattern of wing, interantennal space of same color as lower parts of face (not dull black), wholly dark metallic blue-green abdomen, and largely black legs.

Head as in Fig. 2; largely yellowish, metallic greenish on frontal triangle, parafrontal plates, vertex, and occiput; middle of face and sides of clypeus infuscated to variable extent; antenna usually wholly orange, but 3rd segment sometimes a little infuscated above; front largely almost polished, narrow orbits silvery tomentose.

Thorax wholly metallic greenish, mesoscutum lightly pale grayish tomentose with indistinct more blackish arcuate postsutural transverse band, especially evident above wing bases; scutellum blackish. Angle

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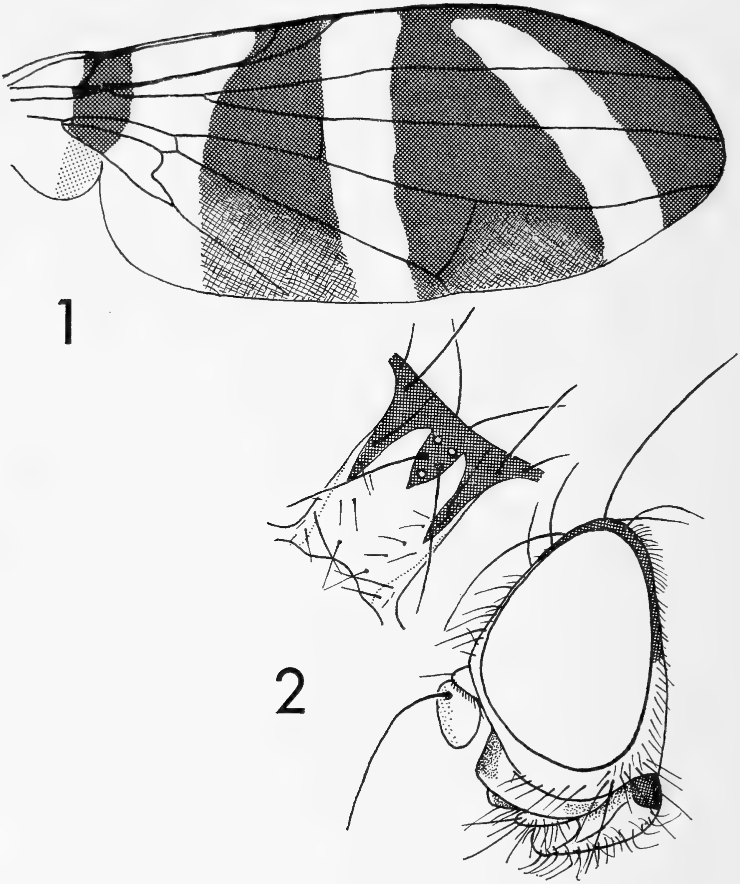
[1] Mail address: c/o U. S. National Museum, Washington, D. C. 20560.



FIGS. 1–2, *Euxesta mazorca*, new species: 1. wing; 2. lateral view, head of holotype, with anterodorsal view of front.

between line connecting posterior dorsocentrals bristles and each acrostichal bristle 45°.

Legs largely metallic greenish; forecoxa (except basilateral oval dark spot), most of inner face of forefemur, fore- and midbasitarsi, hindbasitarsus (except more or less of tip), and distal end of forefemur tawny.

Wing as in Fig. 1; medial hyaline band attaining costa in nearly full width, impinging on only small apical part of 1st vein (R_1); preapical hyaline band somewhat narrower than apical brown band; section of 4th vein crossing preapical hyaline band about equal in length to apical section in brown area; length of apical brown area in discal cell less than half as great on 5th vein as on 4th vein; brown area in base of 2nd costal cell squarish, not extended along costa; extension of tip of anal cell about as long as greatest width of cell.

Abdomen wholly metallic bluish green, very lightly pale tomentose.

Holotype ♀, allotype, and 1 ♀ and 3 ♂ paratypes, ECUADOR: Quito, Estación Experimental Santa Cataline, August, 1966, feeding on corn ear (V. Vazquez), No. 72830 in United States National Museum. Also examined: ECUADOR: 1 ♀, 1 sex ? (head and abdomen missing), Azogues; 3 ♀, 1 ♂, Paute [Cañar Province, near Azogues], 18 June 1959, in corn buds (G. Merino); COLOMBIA: 1 ♀, 3 ♂, Obonuco, 16 January 1973, mazorca choclo [= green ear of corn] (B. Yanguatin); 1 ♂, Sonson, Antioquia, 16 November 1955, 2500 meters, Solanum andigenum (L. Posada); PERU: 1 sex ? (abdomen missing), Ajipampa, Cajamarca, El Chota mountain, 1800 meters, 29 January 1968, trap with hydrolyzed protein (B. G. Casanova C.); 1 ♀, Huadquiña, Cuzco [at base of Cerro Macchupicchu], 5000 meters, 30 July 1911. All specimens are in the United States National Museum collection.

The species-name is an American Spanish word for "ear of maize," treated as Latin and used as a noun in apposition.

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A NEW SPECIES OF *TRICHODECTES* (MALLOPHAGA: TRICHODECTIDAE) FROM THE YELLOW-THROATED MARTEN (*MARTES FLAVIGULA*)

By K. C. Emerson and Roger D. Price
2704 North Kensington Street, Arlington, Virginia 22207,
and Department of Entomology, Fisheries, and Wildlife,
University of Minnesota, St. Paul, Minnesota 55101

Dr. Howard B. Emery and his colleagues of the Arun Valley Wildlife Expedition recently collected a series of Mallophaga in Nepal on the Yellow-throated Marten. We believe that these lice represent an undescribed species and herewith describe and illustrate it.

Trichodectes emeryi, new species

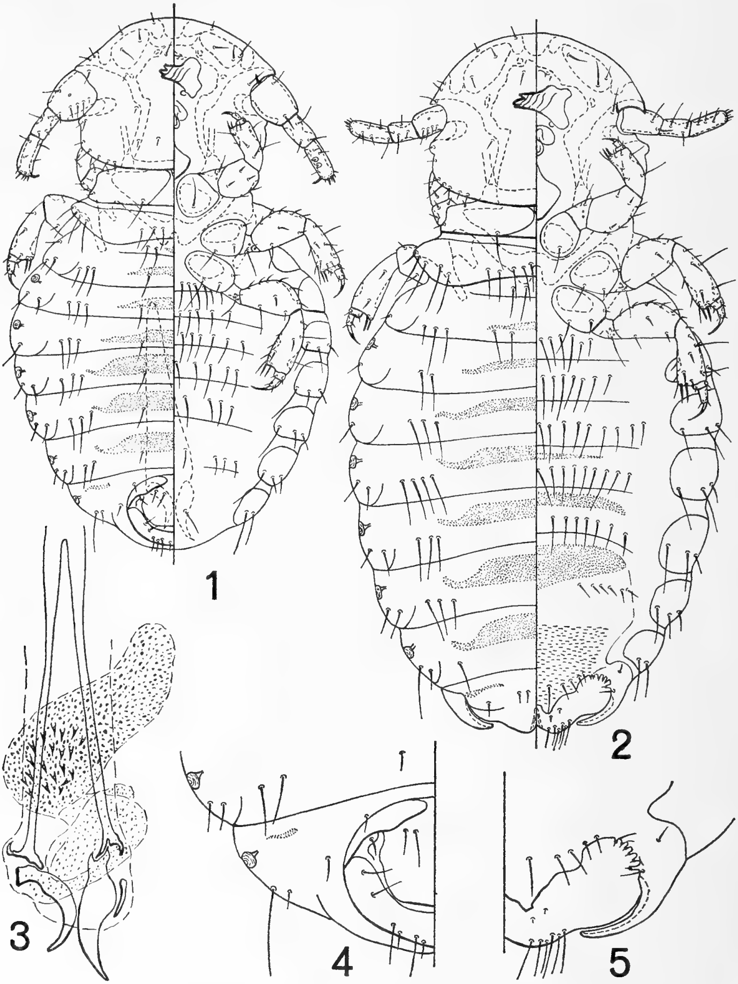
Figures 1–5

Holotype male: Total length, 1.28 mm. External morphology and chaetotaxy as shown in Figure 1. Anal region as shown in Figure 4. Genitalia as in Figure 3; genital sac large, with prominent spines; parameres unmatched in size and form, each curved outwardly.

Allotype: Total length, 1.64 mm. Female paratypes varying in length from 1.41 to 1.64 mm, reflecting differences in mounting. External morphology and chaetotaxy as shown in Figure 2, with ventral terminalia as in Figure 5.

Discussion: *Trichodectes emeryi* does not cloesly resemble any known species, although it does have a number of characters in common with certain other species. The head, in both sexes, resembles in shape that of *T. octomaculatus* Paine, 1912, found on the Raccoon, and *T. pinguis* Burmeister, 1838, found on the European Brown Bear. The chaetotaxy of *T. emeryi* consists of smaller setae on the dorsum and lateral margins of the head than *T. pinguis*, and the forehead is somewhat more rounded than that of *T. octomaculatus*. Setae on the posterior margin of the pterothorax are more prominent and numerous than *T. pinguis* and *T. octomaculatus*.

Dorsal abdominal chaetotaxy is of the type found on *T. octomaculatus* and *T. fallax* Werneck, 1948, taken from the Crab-eating Raccoon; how-



FIGS. 1–5. *Trichodectes emeryi*, new species. 1, dorsal-ventral view of male. 2, dorsal-ventral view of female. 3, male genitalia. 4, dorsal terminalia of male. 5, ventral terminalia of female.

ever, both sexes of *T. emeryi* usually have three prominent setae (less often two or four) on the posterolateral margins of segments II–VI, instead of two, and the female lacks any medial tergal setae on III–VIII, instead of having the single seta on each side as the other two species or the male of *T. emeryi*. Ventral abdominal chaetotaxy of segments II–VI is heavier and more numerous than that of *T. octomaculatus* and *T. fallax.*

The female genital region is distinctive, as shown in Figure 5. Male genitalia have uniquely structured parameres and sac. *T. zorillae* Stobbe, 1913, found on the Libyan Striped Weasel, is the only previously known species with dissimilar parameres and an armed genital sac. However, the parameres of *T. emeryi* are short, stout, and curved outwardly, whereas the parameres of *T. zorillae* are long, slender, and curved inwardly at the distal tip.

Type-host: *Martes flavigula* (Boddaert, 1785).

Type-material: Holotype male, allotype, and 22 paratypes collected off the type-host at Sankhuwa Sabha, Nepal, on 8 February 1973. The holotype and allotype will be deposited in the National Museum of Natural History, Smithsonian Institution.

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PROCEEDINGS
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VANZOLINIUS, A NEW GENUS PROPOSED FOR *LEPTODACTYLUS DISCODACTYLUS* (AMPHIBIA, LEPTODACTYLIDAE)

By W. Ronald Heyer
Division of Amphibians and Reptiles, National Museum
of Natural History, Smithsonian Institution,
Washington, D. C. 20560

The relationships of *Leptodactylus discodactylus* Boulenger have been obscure. In the first analysis of the relationships of *discodactylus* since Boulenger's description, I (1970) placed this species in the Melanonotus group of the genus *Leptodactylus*, based primarily on external morphology. This relationship was questioned when certain life history data were gathered (Heyer and Bellin, 1973). In a recent analysis of the relationships of the genus *Adenomera* within the subfamily Leptodactylinae (Heyer, 1974), I concluded that *discodactylus* was most closely related to *Lithodytes lineatus*, and with a certain amount of hesitation redefined *Lithodytes* to include *discodactylus*. Since then, the karyotype has been determined for *discodactylus* (Heyer and Diment, in prep.) and I have been able to examine more material of *Lithodytes lineatus*, which has resulted in a change of one character state. With this additional information, I believe that there is now sufficient evidence to firmly establish the generic identity of *discodactylus*.

Previously (Heyer, 1974), primitive and derived states were defined for 50 taxonomic characters, and polarities of character states were inferred for members of the subfamily Leptodactylinae. Alternate phylogenies were constructed based on shared derived character states. One phylogeny was chosen that was thought to best represent the actual relationships within the subfamily. The analysis showed that *Adenomera, Leptodactylus, Lithodytes lineatus,* and *discodactylus* constitute a tight taxonomic cluster. It is the relationships among these taxa that need to be reevaluated; this study, therefore, is limited to examining the relationships among these four taxa.

METHODS AND MATERIALS

The same methods and data are used as in Heyer (1974) with the following modifications: 1) If all four taxa share the same character state, that character is not used; 2) If a derived state is unique to one taxon, it is not used as it gives no information on common ancestry; 3) The units of comparison are different, necessitating a redescription of the character states (see below). In the previous study, the unit used in the analysis was the species. In this study, as generic relationships are the focus, the unit of comparison is the genus; 4) Four characters (pterygoid-parasphenoid overlap; iliacus externus muscle; adductor longus muscle; gluteus muscle), were shown to be suspect in the original determination of direction of change of states (Heyer, 1974), and as no additional evidence has been accumulated to resolve these characters, they are omitted in the present study.

Character state descriptions: External vocal sacs—Primitive state: No external vocal sac. State 1: No external vocal sac or indications of lateral vocal folds. State 2: No external vocal sac, indications of vocal folds, or well-developed lateral vocal sacs. The direction of change of character states is: P→1→2.

Male thumb—Primitive state: Nuptial adspersities present in form of pad. State 3: No nuptial adspersities. State 4: Either spines on thumb, or in case of Fuscus group, no adspersities (see Heyer, 1974). The directions of change of character states are: 3←P→4.

Body glands—Primitive state: No well-defined glands. State 5: No glands and/or dorsolateral folds.

Toe disks—The dorsal toe disks of *Lithodytes lineatus* have dorsal scutes, similar to those of *Hylodes* and distinct from the longitudinal grooves in the disks of *discodactylus.* Primitive state: No disks. State 6: No disks and/or disks lacking dorsal grooves or scutes. State 7: Toe disks with scutes on dorsal surface. State 8: Toe disks with longitudinal grooves on dorsal surface. The directions of change of character states are:

$$\begin{tikzcd} P \arrow[r] & 6 \arrow[r] \arrow[dr] & 7. \\ & & 8 \end{tikzcd}$$

Toe web—Primitive state: Toes fringed. State 9: Toes fringed or free. State 10: Toes free. The direction of change of character states is: P→9→10.

Egg pigment—Primitive state: Melanocytes present or absent. State 11: No melanocytes.

Geniohyoideus lateralis muscle—Primitive state: No lateral flare or slip. State 12: Lateral flare or slip present.

Sternohyoideus muscle origin—Primitive state: Single or double slip from sternum. State 13: Double slip from sternum.

Sternohyoideus muscle insertion—Primitive state: Lateral edge of hyoid plate. State 14: Some fibers near midline of hyoid plate.

Gracilis minor—Primitive state: Broad. State 15: Rudimentary.

Frontoparietal fontanelle—Primitive state: None. State 16: Small fontanelle present or absent.

Anterior articulation of vomer—Primitive state: Vomer articulating with maxilla or premaxilla or neither. State 17: Vomer articulating with maxilla or premaxilla.

Sphenethmoid-optic foramen relationship—Primitive state: Posterior extent of sphenethmoid far from optic foramen. State 18: Posterior extent of sphenethmoid far from to bordering optic foramen.

Anterior extent of sphenethmoid—Primitive state: To mid-vomer. State 19: To mid-vomer or more anteriad.

Terminal phalanges—Primitive state: Knobbed. State 20: T-shaped.

Karyotypes—Heyer and Diment (in prep.) argued that two aspects of karyotypes yield phylogenetic information on the genera *Adenomera* and *Leptodactylus*: diploid number and presence or absence of acrocentric chromosomes. The primitive karyotype was argued to have a diploid number of 26 with acrocentric chromosomes.

Diploid number—Primitive state: $2N = 26$ or 24. State 21:

2N = 22. State 22: 2N = 18. The direction of change of states is: P→21→22.

Acrocentric chromosomes—Primitive state: Present. State 23: Present or absent. State 24: Absent. The direction of change of character states is: P→23→24.

RELATIONSHIPS

The four taxa have the following advanced states: *Adenomera*—1, 3, 6, 10, 11, 12, 14, 15, 16, 18, 19, 20; *Leptodactylus*—2, 4, 5, 9, 12, 16, 18, 19, 21, 23; *lineatus*—3, 5, 7, 10, 11, 13, 14, 17, 20, 22, 24; *discodactylus*—3, 8, 11, 13, 15, 17, 20, 21.

Two taxa pairs share the most derived character states (7): *Adenomera–lineatus* and *lineatus–discodactylus*. As *Leptodactylus* and *discodactylus* only share one derived state, the best phylogeny using the *Adenomera–lineatus* pair cluster is that shown in Fig. 1, A. Two alternate phylogenies are possible using the *lineatus–discodactylus* cluster (Fig. 1, B, C). *Adenomera* shares 6 states with *Leptodactylus* (Fig. 1, C) and 5 states with *discodactylus* (Fig. 1, C, D). The phylogenies figured (A–E) are all of the reasonable possibilities.

In evaluating which phylogenies are likely to give a truer reflection of the actual relationships among these taxa, three criteria may be applied to the phylogenies. The first criterion was used in constructing the phylogenies—maximizing the number of shared character states, or in Hennig's terms, seeking sister-groups. Using this criterion, the phylogenies of Fig. 1, A, B, C are preferred over those of Fig. 1, C and D. A second criterion is the number of convergences of character states required by each phylogeny. The fewer the number, the more likely that the phylogeny is correct. The number of convergences in each of the phylogenies pictured are: Fig. 1, A and B, 13 convergences; Fig. 1, C, 11 convergences; Fig. 1, D and E, 15 convergences. A third criterion is to evaluate the ancestral clusters in terms of non-convergent character states. That is, if a character state is already convergent in

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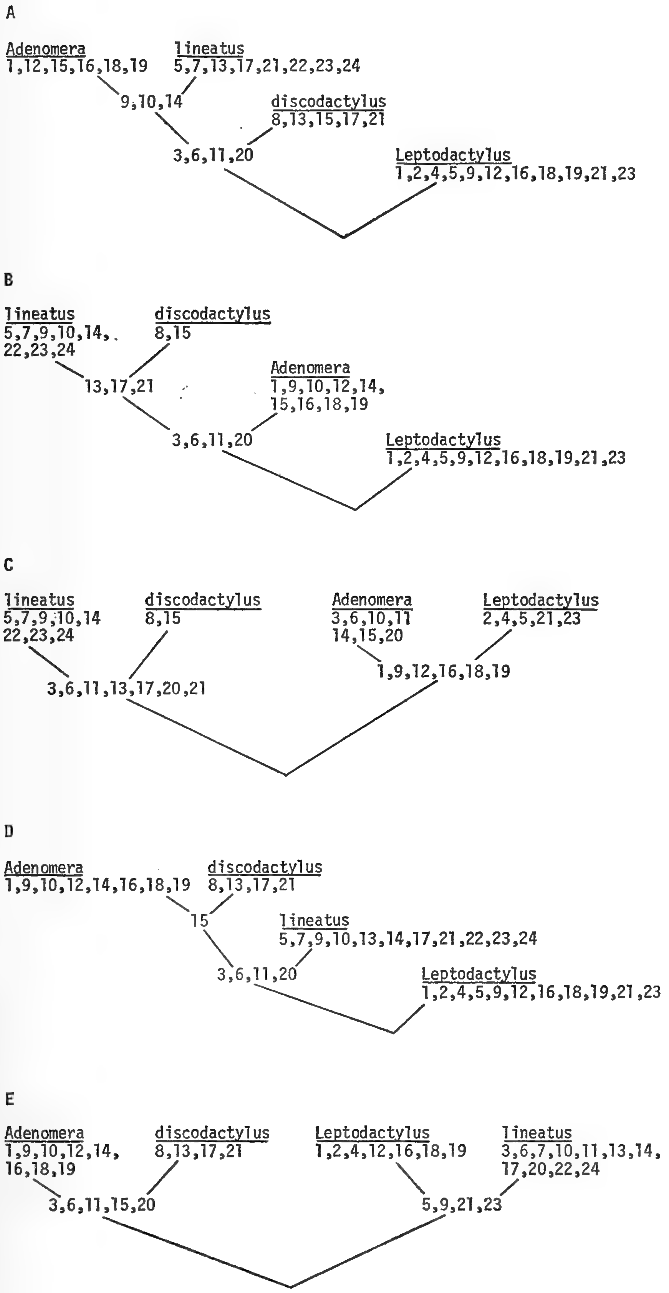
FIG. 1. Five possible phylogenies for *Adenomera*, *Leptodactylus*, *Lithodytes lineatus*, and *discodactylus*.


A
Adenomera
1,12,15,16,18,19
lineatus
5,7,13,17,21,22,23,24
9,10,14
discodactylus
8,13,15,17,21
3,6,11,20
Leptodactylus
1,2,4,5,9,12,16,18,19,21,23
B
lineatus
5,7,9,10,14,
22,23,24
discodactylus
8,15
13,17,21
Adenomera
1,9,10,12,14,
15,16,18,19
3,6,11,20
Leptodactylus
1,2,4,5,9,12,16,18,19,21,23
C
lineatus
5,7,9,10,14
22,23,24
discodactylus
8,15
Adenomera
3,6,10,11
14,15,20
Leptodactylus
2,4,5,21,23
1,9,12,16,18,19
3,6,11,13,17,20,21
D
Adenomera
1,9,10,12,14,16,18,19
discodactylus
8,13,17,21
15
lineatus
5,7,9,10,13,14,17,21,22,23,24
3,6,11,20
Leptodactylus
1,2,4,5,9,12,16,18,19,21,23
E
Adenomera
1,9,10,12,14,
16,18,19
discodactylus
8,13,17,21
Leptodactylus
1,2,4,12,16,18,19
lineatus
3,6,7,10,11,13,14,
17,20,22,24
3,6,11,15,20
5,9,21,23

a given phylogeny, its phylogenetic information content is not as great as non-convergent character states. A set of four shared derived character states that are not convergent in the phylogeny is more robust than a set of four derived states that are convergent within the total phylogeny. The phylogenies of Fig. 1, A and B are strong, with six non-convergent states ancestral to either *Adenomera* and *lineatus* (Fig. 1, A) or *lineatus* and *discodactylus* (Fig. 1, B) and four non-convergent states ancestral to *Adenomera*, *lineatus*, and *discodactylus*. The phylogeny of Fig. 1, C is almost as strong as *Adenomera* and *Leptodactylus* share five non-convergent states; however, *lineatus* and *discodactylus* share but two non-convergent states. The phylogeny of Fig. 1, D has the same non-convergent states ancestral to *Adenomera*, *discodactylus*, and *lineatus* that are found in the phylogenies of Fig. 1, A and B. Within the cluster of these three taxa, the phylogeny of Fig. 1, D is weakest, as *Adenomera* and *discodactylus* only share one non-convergent state while each of these taxa shares two non-convergent states with *lineatus* (Fig. 1, A, B). The phylogeny of Fig. 1, E is weak, *Adenomera* and *discodactylus* sharing only one non-convergent state and *lineatus* and *Leptodactylus* sharing two non-convergent states.

The phylogenies of Fig. 1, A, B, and C are the most robust. All three have the maximum number of shared derived states for a species pair. The phylogenies of Fig. 1, A and B have the most shared non-convergent ancestral states, while that of Fig. 1, C has the least number of convergent states. The phylogenies of Fig. 1, D and E are much weaker in comparison and are not further considered.

It is necessary at this point to reiterate my concept of a genus: it should 1) be monophyletic, 2) be reasonable in size (number of species), and 3) represent a distinct adaptive complex if possible. Criterion 2 does not apply here, as *Adenomera*, *Leptodactylus* and *Lithodytes* combined have about 40 species. As developed elsewhere (Heyer, 1973, 1974), *Adenomera* is a wet forest genus, *Leptodactylus* is a savanna genus and each has evolved in response to the very different selective pressures associated with the two environments. The resolution of how many genera are represented among *Adenomera*, *Leptodactylus*, *discodactylus*, and *lineatus* thus hinges on adaptive complexes, which information is not complete for *discodactylus* and *lineatus*. The available evidence is sufficient to determine the broad adaptive relationships of *lineatus* and *discodactylus*, however. No egg clutches have been found for either form, so it is not known whether either has a foam nest. In both, the eggs are non-pigmented (determined from advanced ovarian eggs), which strongly suggests that the eggs are hidden in some fashion. In the case of *lineatus*, the eggs are large and of the same size found in *Eleutherodactylus*, which has direct development. The eggs are small in *discodactylus* and are probably laid at the male calling sites, which are at the edge of seepage areas in naturally occurring enclosures formed by tree roots and leaves (Heyer and Bellin, 1973). The calling sites of *lineatus* are not known, but collections indicate that they are terrestrial and/or standing water breeders. With what is known, *discodactylus* can be categorized as having adaptive complexes distinct from both *Adenomera* and *Leptodactylus*. Briefly, *discodactylus* is adapted to the slow moving stream way of life, *Adenomera* is adapted to the terrestrial, wet-forest way of life, and *Leptodactylus* is adapted to xeric environments.

Combining this information with the phylogenies of Fig. 1, A, B, C, the following nomenclatural decisions are possible. If *Adenomera*, *Leptodactylus*, and *discodactylus* are generically distinct, then *lineatus* would have to be a distinct genus according to the phylogeny of Fig. 1, A, or it could be combined with *discodactylus* in a common genus in the phylogenies of Fig. 1, B and C. *Lithodytes lineatus* has a number of derived states in addition to those shared with *discodactylus*, however, including dorsolateral folds, free toes, and a derived karyotype. These unshared derived states, together with the probability that *lineatus* and *discodactylus* differ in mode and habitat of egg and larval development convince me that *lineatus* and *discodactylus* are generically distinct.

A comment might be helpful in explaining why I think this decision is the proper one to make. In the previous study (Heyer, 1974), the evidence then available dictated that *discodactylus* was certainly not a *Leptodactylus.* To remove *discodactylus* from the genus *Leptodactylus*, a decision had to be made to include the species in the genus *Lithodytes* or to name a new genus for it. I chose the former course because it was nomenclaturally conservative and I hoped that more information on life history and karyotypes would resolve the matter. Combining *lineatus* and *discodactylus* in a common genus was believed to be an unsatisfactory solution, however, as the two species appear very dissimilar. The karyotypic evidence further supports the generic differentiation of these two species. The relationships of *discodactylus* have been of concern because externally *discodactylus* looks like members of the Melanonotus group of the genus *Leptodactylus*, or if the toe fringe were removed, like members of the genus *Adenomera.* It is apparent that the similarities of *discodactylus* to certain species of *Leptodactylus* and *Adenomera* are based on shared primitive character states, however. The analysis of derived shared character states clearly demonstrates the divergent evolutionary pathways of these three taxonomic units.

TAXONOMIC CONCLUSIONS

Four genera are recognized in the *Leptodactylus*-complex: *Adenomera*, which contains five species, *Leptodactylus*, which contains about 35 species, *Lithodytes*, which contains one species, and a genus for *discodactylus.* Definitions of *Adenomera* and *Leptodactylus* may be found in Heyer (1974); a definition of *Lithodytes* may be found in Lynch (1971). As no generic name has been proposed for *discodactylus*, a new genus is described as follows:

Vanzolinius, new genus

Type species: *Leptodactylus discodactylus* Boulenger, 1883.

Diagnosis: *Vanzolinius* is unique among leptodactylid frogs in possessing a bony mesosternum and expanded toe disks with longitudinal grooves on the dorsal surfaces. All other genera with a bony mesosternum either do not have toe disks or, if disks are present, either do not have any dorsal modifications or have dermal scutes.

Definition: Pupil horizontal; tympanum distinct; vocal sac internal; male thumb without nuptial adspersities; body without well defined glands; toes disked with dorsal surfaces with 3–5 longitudinal grooves;

tarsal fold present; metatarsal tubercles neither pronounced nor cornified; toes with lateral fringes; eggs lacking melanophores; large clutch size (> 1000 eggs); depressor mandibulae condition DFsq (large slip originating from dorsal fascia, small slip originating from squamosal area); geniohyoideus medialis continuous medially; geniohyoideus lateralis without lateral flare or slip; anterior petrohyoideus insertion on edge of hyoid; sternohyoideus origin with distinct slips from anterior mesosternum and another from posterior meso, and/or xiphisternum; sternohyoideus insertion near lateral edge of hyoid; omohyoideus insertion on hyoid plate and fascia between posterolateral and posteromedial processes of hyoid; tendon of semitendinosus confluent with posterior portion of sartorius insertion on knee and tendons of gracilis minor and major passing dorsad to tendon of semitendinosus; iliacus externus extending from ¾ to full length of iliac bone; tensor fasciae latae insertion posterior to iliacus externus on iliac bone; gracilis minor narrow; interior and exterior portions of the semitendinosus uniting in common tendon distally, exterior portion larger or equal to interior (smaller) portion; sartorius moderately developed; accessory head of adductor magnus without distinct tendon; adductor longus well developed; gluteus insertion on cruralis and knee; quadratojugal well developed, contacting maxilla; maxillary teeth present; nasals widely separated; no frontoparietal fontanelle; zygomatic ramus of squamosal just longer than, just shorter than, or equal to otic ramus; vomerine teeth present; vomers not in medial contact; vomer articulation with premaxilla and/or maxilla; posterior extent of sphenethmoid widely separated from optic foramen; sphenethmoid extending anteriorly to middle of vomers; occipital condyles widely separated; no anterior processes of hyale; alary process of hyoid somewhat narrow and stalked; posterolateral process of hyoid present; ilium with well developed dorsal crest; terminal phalanges T-shaped, expanded; mesosternum a bony style; xiphisternum entire, single; diploid chromosome number 22, one pair of acrocentric chromosomes.

Etymology: The genus, masculine in gender, is named for Dr. Paulo E. Vanzolini, in recognition of his work on the South American herpetofauna.

Content: Monotypic. For further details of morphology and distribution, see Heyer (1970).

ACKNOWLEDGMENT

George R. Zug, National Museum of Natural History, Smithsonian Institution, critically read the manuscript.

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ADDITIONAL NOTES ON THE GENUS *GLARESIS* (COLEOPTERA: SCARABAEIDAE)

By Robert D. Gordon
Systematic Entomology Laboratory,
Agricultural Research Service, USDA[1]

Since the genus *Glaresis* was revised for the U. S. and Canada (Gordon, 1970), specimens have been examined that extend the known ranges of some species. The most interesting record is of a specimen of *G. ecostata* Fall collected by H. Howden at Angostura Dam, Hot Springs, South Dakota in July 1968, along with specimens of *G. canadensis* Brown and *G. inducta* Horn. The latter two species would be expected at that locality, but *ecostata* had previously been recorded only from California, Arizona and New Mexico. I collected another specimen of *ecostata* at Angostura Dam in August 1973. Specimens of *G. phoenicis* Fall have been examined from Mesquite, Nevada, and White Sands, New Mexico. *G. confusa* Brown was previously known only from the unique type (Gordon, 1970), but specimens from two additional localities have since been observed. The data on these specimens is as follows: Bull Creek, 5000′, 15 mi. S Hanksville, Utah, VII-6-1968, A. T. Howden; Cochise Co., Arizona, 5 mi. N Benson, VII-26-1969, A. R. Hardy, F. G. Andrews, J. W. Smith. Of 15 *Glaresis* specimens from Benton, Mono Co., California, sent to me by Alan Hardy, 13 proved to be *G. medialis* Gordon, a species previously known only from Utah (Logan and Richfield) and Washington (Toppenish). The other two specimens are *G. clypeata* Van Dyke and *G. mendica* Horn. Hardy also sent four *Glaresis* specimens from another locality, these being the type material of the new species described below.

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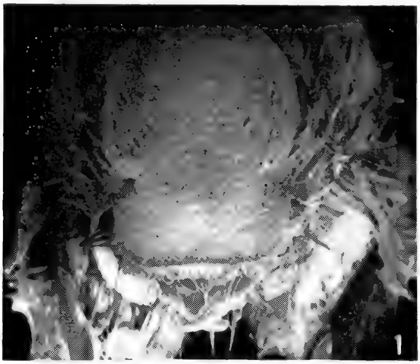
[1] Mail address: c/o U. S. National Museum, Washington, D. C. 20560.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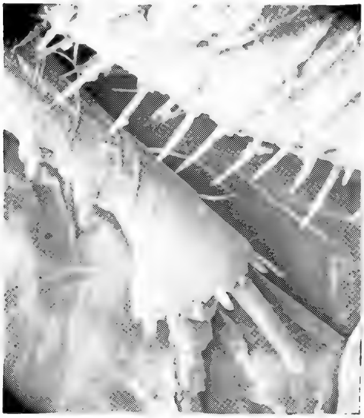

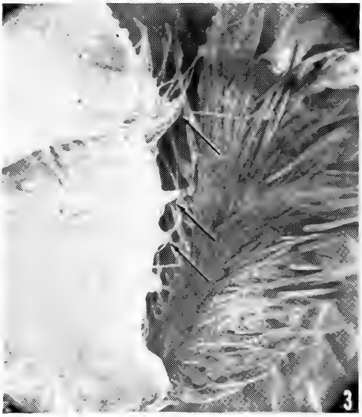
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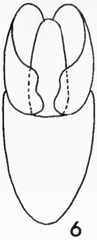

Fig. 6. *Glaresis arenata*, new species (holotype), ventral view of male genitalia.

The antenna of species of *Glaresis* has been recorded in the literature as having nine segments. In my 1970 paper I accepted this without examining the antenna myself. I am indebted to Paul Ritcher, Oregon State University, for calling my attention to the fact that *Glaresis* has ten-segmented antennae. I have personally confirmed this by examining the antenna of five species of *Glaresis*.

In addition to Dr. Ritcher, I wish to thank Alan Hardy, California Department of Agriculture, for the loan of specimens; Henry Howden, Carleton University, Ottawa, and E. C. Becker, CNC, Ottawa, for data obtained from specimens in their care.

The Scanning Electron Microscope time for this paper was supported in part by the University of Maryland Center of Material Research, Department of Mechanical Engineering and Electron Microscope Central Facility, College Park, Maryland.

Glaresis arenata, new species

Male: Length 3.80 mm, greatest width 2.05 mm. Form elongate, widest posterior to middle of elytra. Color pale brownish yellow, head and pronotum slightly darker than elytron, reddish brown. Head smooth, extremely feebly tuberculate; anterior clypeal margin straight, distinctly

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Figs. 1–5, *Glaresis arenata*, new species (paratype): 1, head; 2, apex of mesotibia; 3, teeth on posterosuperior margins of hind trochanter and femora; 4, enlarged view of teeth on posterosuperior margin of hind femora; 5, hind tibia.

margined with traces of tubercles, anterior angle angulate, not toothed (Fig. 1); mandible slender, sinuate. Pronotum slightly more than half as long as wide; short, longitudinal carinae present except in impressions; surface nearly smooth, impressions feeble; lateral and posterior margins with fringe of coarse setae; a distinct fovea medially near lateral margin and a feeble, longitudinal, median impression present. Elytron smooth; interval nearly without costa, flat with tiny, widely interrupted remains of a costa present; sparsely pubescent. Mesotibia sinuate on outer margin, five spines present on outer margin from middle nearly to apex, projecting at apex (Fig. 2). Posterosuperior margin of hind trochanter with a single, large tooth near femur (Fig. 3); posterosuperior margin of hind femur with two small teeth (Figs. 3, 4). Hind tibia broadly triangular, a strong projection on outer margin medially, elongate tubercles irregularly scattered over surface, inner margin strongly pubescent (Fig. 5). Genitalia with apex of aedeagus rounded in ventral view (Fig. 6), curved upward in lateral view.

Female: Length 3.56 mm, greatest width 2.00 mm. Similar to male in external appearance.

Type-material: Holotype, male, sand dunes, 7 mi. SW Kelso, San Bernardino Co., California, IV-20-21-1969, fluorescent black light, M. S. Wasbauer and R. R. Pinger (USNM). Paratypes, three, same data as for holotype except one collected IV-16-17-1969 and one collected beating *Larrea divaricata*. Paratypes in collections of USNM, California Academy of Sciences and the collection of Alan Hardy, Sacramento, Calif.

Variation: Length 3.25 to 3.80 mm, greatest width 1.78 to 2.05 mm. The number of spines on the outer margin of the mesotibia varies from four to five, and one specimen of the type series had a feeble second tooth present on the posterosuperior margin of the trochanter.

Remarks: This species goes to couplet ten in the key to species (Gordon, 1970) and would key to *cartwrighti* Gordon. *G. arenata* differs from *cartwrighti* in having the apex of the aedeagus broadly rounded, the elytral intervals not distinctly costate, the teeth on posterosuperior margin of hind femur widely separated, the outer margin of hind tibia strongly projecting medially and the outer margin of middle tibia with spines present, distinctly projecting apically. The lack of distinct elytral costae is unusual, and in this respect *arenata* resembles *medialis* Gordon and, to a lesser degree, *ecostata* Fall, but these two species do not resemble *arenata* in any other characteristics.

LITERATURE CITED

GORDON, R. D. 1970. A review of the genus *Glaresis* in the United States and Canada (Coleoptera: Scarabaeidae). Trans. Amer. Entomol. Soc. 96:499–517.

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PROCEEDINGS
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BIOLOGICAL SOCIETY OF WASHINGTON

A REVISION OF THE GENUS *BOCOA* (CAESALPINIOIDEAE-SWARTZIEAE)

By Richard S. Cowan
Smithsonian Institution, Washington, D. C. 20560

Introduction

Aublet (1775) described the genus *Bocoa*, with a single species, *B. prouacensis*, in a supplemental section of his classic work on the plants of French Guiana. When Schreber (1789–1791) and Willdenow (1800) considered the species of what now is *Swartzia*, no mention was made of *Bocoa*, and, except for the confusion with *Inocarpus* and *Etaballia* discussed below, the genus was ignored thereafter. In fact, taxa congeneric with *B. prouacensis* were described subsequently as species of *Swartzia* by Bentham (1840) and others. Tulasne (1843) even redescribed the genus under a new name, *Trischidium*, based on a species published by Bentham three years earlier. It remained for Amshoff (1939) to recognize the affinities of *Bocoa*, although she considered it a synonym of *Swartzia*. My earlier study of this subtribe convinced me of the distinctness of the two genera and in my monograph of the species of *Swartzia* (Cowan, 1968), I excluded several as taxa belonging to *Bocoa*; the new combinations were not made, pending further study of specific characteristics.

If one consults Index Kewensis, *Bocoa* will be found listed as a synonym of *Inocarpus* Forster, an Old World genus of which one species is widely cultivated on islands of the Pacific Basin. Another synonym that appears under this genus is *Etaballia* Bentham. Although the three genera were maintained by Bentham as separate taxa in the beginning, he was less than convinced in his 1862 paper on the subject and later in the Genera Plantarum he synonymized his genus under

Inocarpus. Comparison of herbarium material of the species of *Etaballia* and *Inocarpus* does raise considerable doubt concerning their separateness and, in fact, they have been considered to be congeneric by some later workers. Most recently, Rudd (1970) concluded they should be treated as separate genera, pending further detailed studies.

Whether or not two genera are involved, the species of *Etaballia* and *Inocarpus* are clearly papilionate legumes and have little similarity to the caesalpinioid genus *Bocoa*, except for the unifoliolate leaves of many of the taxa in question. The flowers of *B. prouacensis*, the only species Bentham accepted in the genus, are quite distinctive in being apetalous, other species of the genus having a single obovate petal; in contrast, flowers of *Inocarpus* and *Etaballia* have five, strap-like petals and a very different androecium. The latter genera have indehiscent fruits while those of *Bocoa* are dehiscent in two valves along both sutures.

The characteristics separating *Bocoa* and *Swartzia* can be set out clearly in a key:

Anthers oval or oblate to oblong, dorsifixed; stamens usually many and dimorphic, the filaments several times the length of the anthers; seeds arillate; herbage not foetid; leaflets rarely alternate .... *Swartzia*

Anthers linear to narrowly oblong, basifixed; stamens 7–30, the filaments and anthers of similar length; seeds usually exarillate; herbage often foetid in fresh state; leaflets often alternate to subopposite .... *Bocoa*

There is greater similarity morphologically between these genera than there is between *Swartzia* and other genera of this complx. One is tempted to think of *Bocoa* as a phylogenetic derivative of *Swartzia*, derived from such species as *S. arborescens* (Aublet) Pittier and *S. auriculata* Poeppig, both of which have monomorphic stamens. However, I doubt that the situation is anything so simple and I have no "hard" evidence on which even to speculate profitably with respect to the true relationship of these genera. Similarly, the order of the species in the following treatment is largely arbitrary, but generally, evolutionary loss of flower parts is viewed as derived and connation of parts more advanced than totally free members of a series.

POLLEN MORPHOLOGY

In my monograph of *Swartzia*, I described pollen shapes (Cowan, 1968:6) as "globose . . . to oval, elliptic, deltoid-globose, or deltoid." These forms were from observations of pollen in lacto-phenol aniline-blue on slides prepared by an inexperienced technician (the author). I am now convinced that deltoid-globose or deltoid grains do not occur in the genus or its near-relatives. This conclusion is based on study of the pollen of fourteen species of *Swartzia*, representing all the major subgeneric groupings, four species of *Bocoa*, two of *Aldina*, and one each of *Zollernia*, *Lecointea*, *Candolleodendron*, and *Holocalyx*. I am greatly indebted to Joan Nowicke, Julianne Piraino, and Dieter Wasshausen for the preparation of the pollen samples for study by both scanning electron and light microscopy, as well as for their consultative assistance in my analysis of the data.

I undertook this preliminary review of the pollen of the Swartzieae because of my long held suspicion that this collection of genera is an unnatural assemblage which has two characters in common but whose members are not otherwise closely related—an entire calyx and an indefinite number of stamens. It seemed possible that palynology might be helpful in sorting out the several taxa. However, this has not proven to be the case and this fact, in addition to greater familiarity with the constituent genera, leads me to believe now that there may indeed be considerable evolutionary relationship among them. Certainly pollen morphology does not refute this viewpoint, for the similarities palynologically are great.

To document this conclusion and to provide a brief summary of the diversity observed among the pollens of the limited sampling of species enumerated below, the following account and illustrations are offered. It is not intended to be a comprehensive, analytical description of pollen morphlogy in *Bocoa* or of any of its relatives. Rather, it is hoped that this presentation, however incomplete, will stimulate further, more detailed palynological investigations of the caesalpinioid legumes.

All species examined had pollen grains which were: monads with the longest axis ca. 18–30 μm, spheroidal to subprolate or prolate, 3-colporate, the colpi short, elongate, or syncolpate, the os mostly circular and frequently prominent, sometimes bridged by the ektexine, ektexine more or less psilate, punctate, finely or coarsely rugose, or striato-reticulate.

Based on a combination of colpus length and ektexine pattern, five pollen types can be recognized. Unfortunately, these groupings, appear to correlate with nothing else and certainly provide no new insights into the phylogeny of the Swartzieae. Also, it should be emphasized that these pollen types are not well separated and that palynological investigation of additional species of either *Bocoa* or *Swartzia* may reduce the already limited distinctions among these groupings:

- Group I: Colpi short or elongate but not syncolpate.
  - Type I-A: Ektexine rugose.
  - Type I-B: Ektexine striato-reticulate, sometimes very finely so.
  - Type I-C: Ektexine punctate.
- Group II: Colpi syncolpate.
  - Type II-A: Ektexine rugose.
  - Type II-B: Ektexine punctate.

Following is a listing of the species examined in each pollen-type, the number of the illustration in parentheses just after each name, any special notes about the morphology, citation of the voucher collection, and the source herbarium for the sheet sampled:

	Comments	Voucher
Species of Type I-A:		
Bocoa alterna (Fig. 1)		Ducke 24203 (US)
B. mollis (Fig. 2)		Blanchet 2774 (G)
B. prouacensis		Stahel 69 (G)
B. racemulosa (Fig. 3)		Snethlage 10058 (G)
Swartzia apetala	Thick-walled grains	Santos et al. 24166 (US)
S. aptera	Many grains abnormal	Maguire et al. 47056 (US)
S. brachyrachis	Some grains syncolpate, others not	Ducke 17038 (US)
S. flaemingii (Fig. 4)	Finely rugose	Froes 11753 (US)
S. guianensis (Fig. 5)	Very coarsely rugose and thick-walled	Boyan 67 (US)

	Comments	Voucher
Species of Type I-B:		
S. amplifolia	Very finely striato-reticulate	Klug 3122 (US)
S. panacoco (Fig. 6)	Finely reticulate	Cardona 1142 (US)
S. cuspidata (Fig. 7)	Os prominent	Maguire et al. 60409 (US)
S. jorori (Fig. 8)		Cardenas 5211 (US)
S. arborescens (Fig. 9)	Very finely reticulate, appearing psilate by light microscopy	Lizot s.n. (US)
S. leptopetala	Finely striato-reticulate	Wurdack et al. 41367 (US)
Species of Type I-C:		
Aldina latifolia (Fig. 10)		Maguire/Wurdack 35595 (US)
A. macrophylla		Wurdack/Adderley 43431 (US)
Zollernia vogelii (Fig. 11)		Handro 45344 (US)
Cyathostegia matthewsii (Fig. 12)		Ferreyra 8911a (US)
Species of Type II-A:		
Swartzia benthamiana (Fig. 13)	Thick-walled with os prominent	Irwin 57641 (US)
Species of Type II-B:		
Swartzia panamensis (Fig. 14)	Punctate	Standley 55317 (US)
S. grandifolia	Coarsely punctate	Holt/Blake 673 (US)

It is interesting to note that all the species of *Bocoa* have the same pollen-type, in common with several *Swartzia* species representing disparate phylogenetic groupings into which the genus is divided. Also the species of *Aldina*, *Cyathostegia*, and *Zollernia* have similar pollen morphology which apparently is slightly different from that of all other species examined. (*Cyathostegia* is now considered a separate genus but was earlier viewed as a part of *Swartzia*.)

The pollens of the three other genera in this complex do not fit into the "classification" above. The pollens of *Lecointea* (Ducke 1702-US) and *Holocalyx* (Pedersen 1422a-US) are more similar to each other than to those of any of the other taxa studied: under light microscopy the grains appear thin walled, more or less psilate, 3-colporate, the colpi not continuous at the poles. On the other hand, the pollen of *Candolleodendron* (Froes 32364-US) is intermediate in several respects, just as is the gross morphology of other parts of the plant: the grains are prolate and rugose but some are syncolpate while others (fewer) are not.

The following figures are arranged by pollen-type to facilitate review of the observations made. The arrangement represents, then, an attempt to organize the data for reporting purposes, rather than to suggest phylogenetic relationships of the taxa in each grouping or between groupings.

SYSTEMATIC TREATMENT

Bocoa Aublet

Bocoa Aublet, Pl. Guiane Fr. Suppl. 38, t. 391. Jun. 1775.
Trischidium Tulasne, Ann. Sci. Nat. (Ser. 2) 20:141, t. 4. Sep. 1843.

Shrub or small to large tree up to 30 m tall and 25 cm in diameter, the wood and leaves foetid, the branchlets glabrous or strigulose to tomentulose and glabrescent, the stipules minute and more or less triangular or lanceolate and up to 5 mm long; leaves 1- to 9-foliolate, imparipinnate, the petioles and rachis terete or occasionally flat or canaliculate on the upper surface, leaflets alternate to opposite, the blades glabrous to tomentulose, oval, elliptic, rounded, sometimes ovate-elliptic or lanceolate-elliptic, the base rounded to acute, the apex acute to acuminate or obtuse and retuse to emarginate; inflorescences racemose, infrequently compound racemes, ramuligerous just below the leaves of the current season, or occasionally axillary, sometimes very short but up to 10 cm long, the axis glabrous, puberulous, strigulose, or tomentulose, the pedicel scars strongly raised, the bracts caducous to persistent, triangular to semicircular, about 1 mm long and wide; bracteoles absent; pedicels 0.5–8 mm long at anthesis, becoming nearly twice as long with mature fruits, pubescent like the inflorescence axis; buds ellipsoid to oblong-ellipsoid, more or less pubescent externally, glabrous within, opening into 3 or 4 segments, free or remaining united in basal half, reflexed to strongly revolute after anthesis; petal present or lacking, white and usually glabrous, caducous to persistent, the claw 2–6 mm long, the blade round to oblate, 4–8 mm long and 3–7 mm wide; stamens 7–30, uniform, the filaments glabrous, sometimes shortly united basally, 2–6 mm long, the anthers oblong, basifixed, 1.5–4 mm long, 0.5–0.9 mm wide, glabrous; gynoecium glabrous to densely strigulose, the stigma truncate to capitellate, sometimes obliquely so, the style about as long as the elliptic ovary, the ovules 10–14, in two rows but only the one nearest the style maturing, the gynophore basicentric, to 2 mm long; fruit oval, inflated, one-seeded, the surface usually reticulate-veined, glabrous to densely strigulose, 1–3 cm long, the seed yellow brown, tan, or black, oval, arillate in two species but usually exarillate, the funicle elongate (to 3 m) in the type species.

Type-Species: *Bocoa prouacensis* Aublet, Pl. Guiane Fr. (Suppl.) 38, t. 391. 1775.

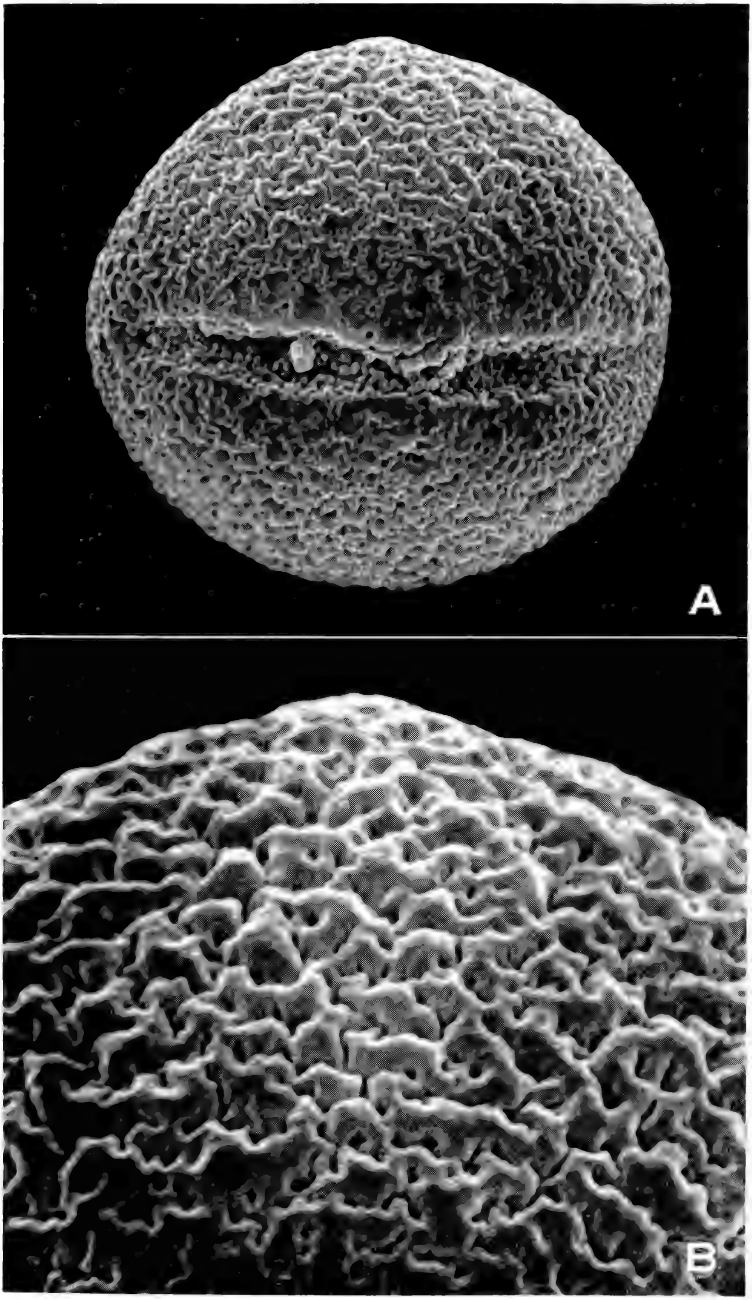

Fig. 1. *Bocoa alterna*—Type I-A. a. Equatorial view. × 3500. b. Portion of surface. × 10,000.

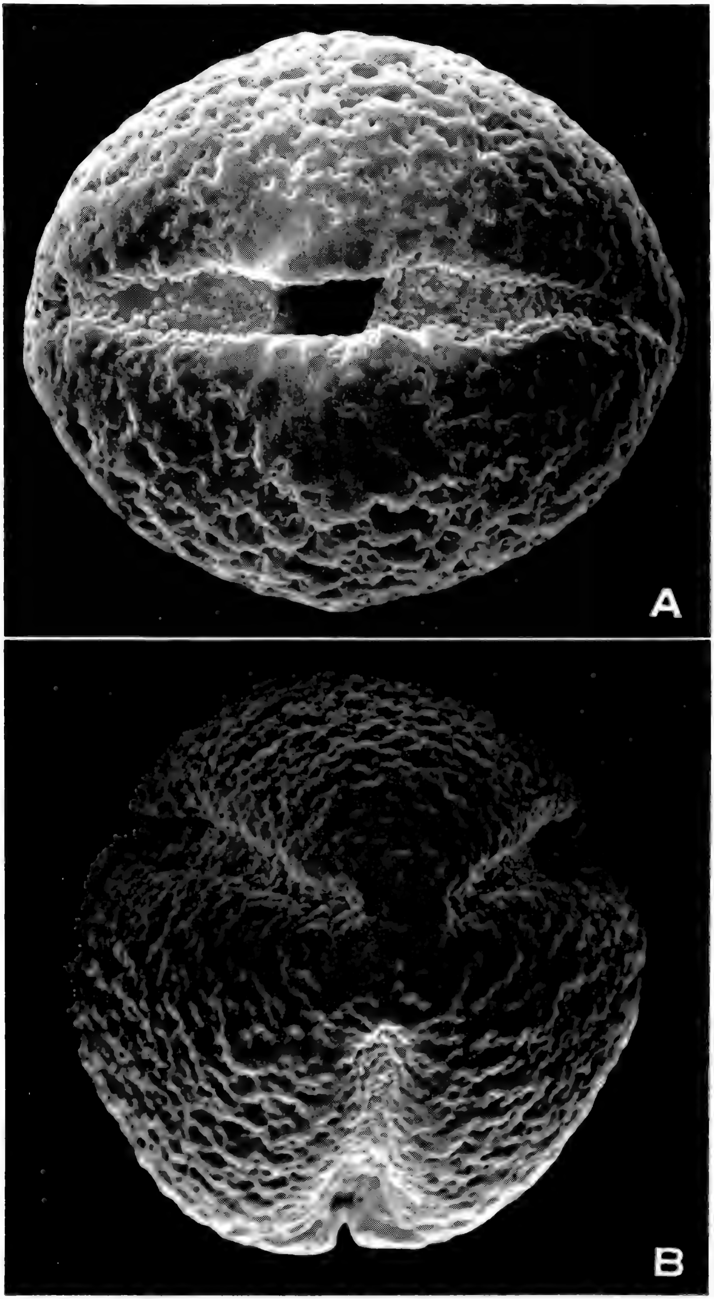

FIG. 2. *Bocoa mollis*—Type I-A. a. Equatorial view, showing prominent os. × 3900. b. Polar view. × 3900.

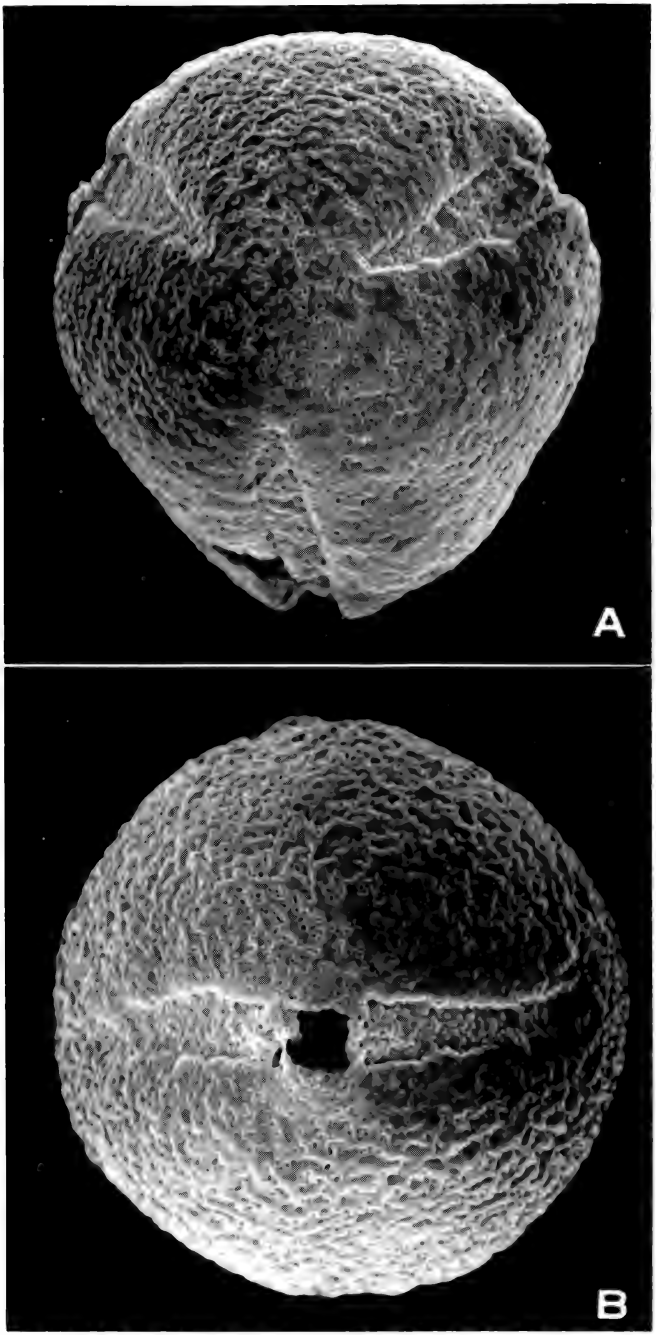

FIG. 3. *Bocoa racemulosa*—Type I-A. a. Polar view, showing short colpi. × 3700. b. Equatorial view. × 3700.

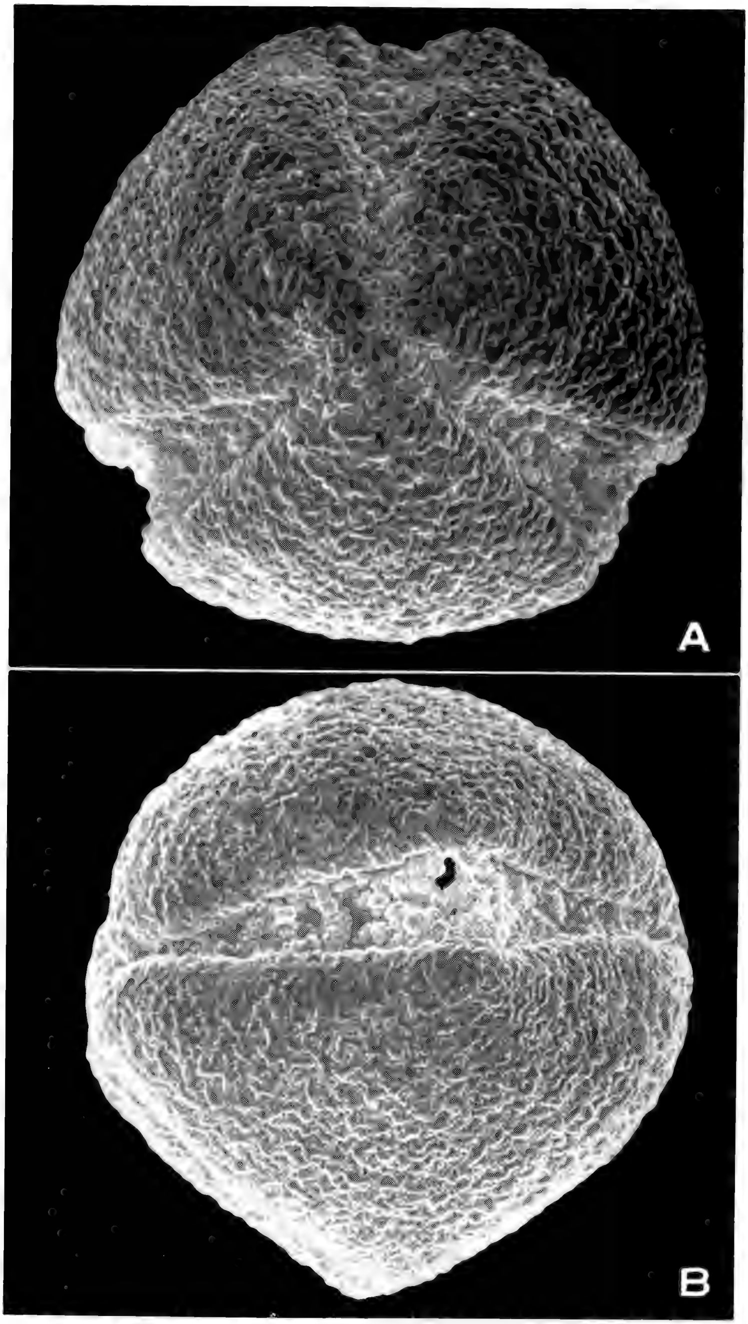

FIG. 4. *Swartzia flaemingii* var. *psilonema*—Type I-A. a. Polar view. × 3000. b. Equatorial view. × 3000.

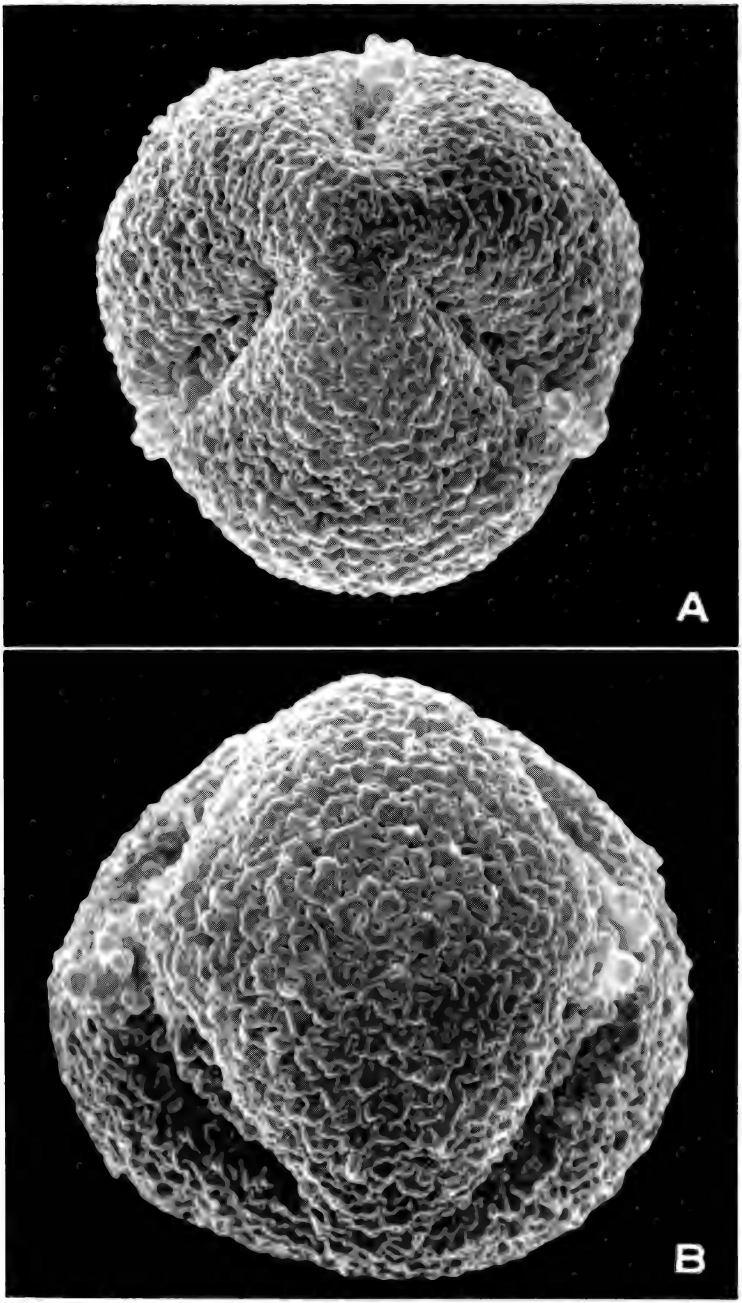

FIG. 5. *Swartzia guianensis*—Type I-A. a. Polar view. × 3000. b. Slightly oblique equatorial view, showing very coarsely rugose ektexine. × 3000.

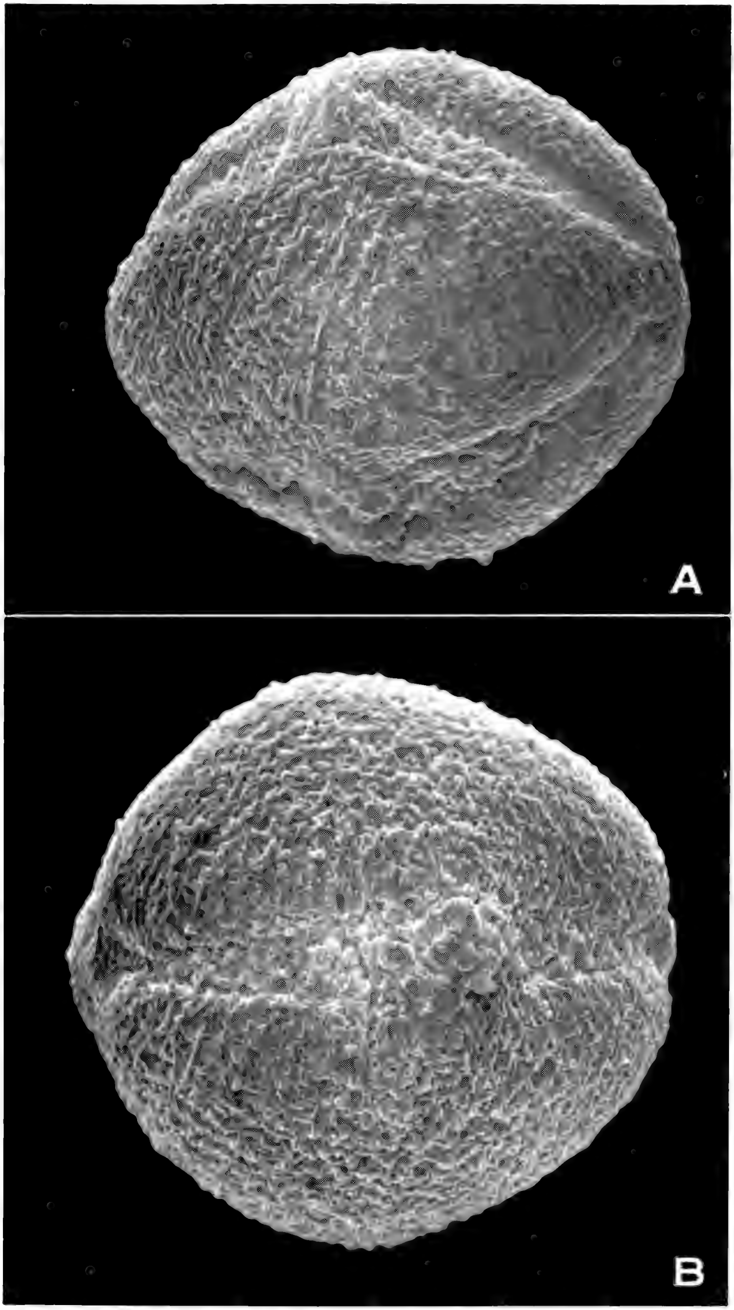

FIG. 6. *Swartzia panacoco* var. *cardonae*—Type I-B. a/b. Equatorial views. × 3000.

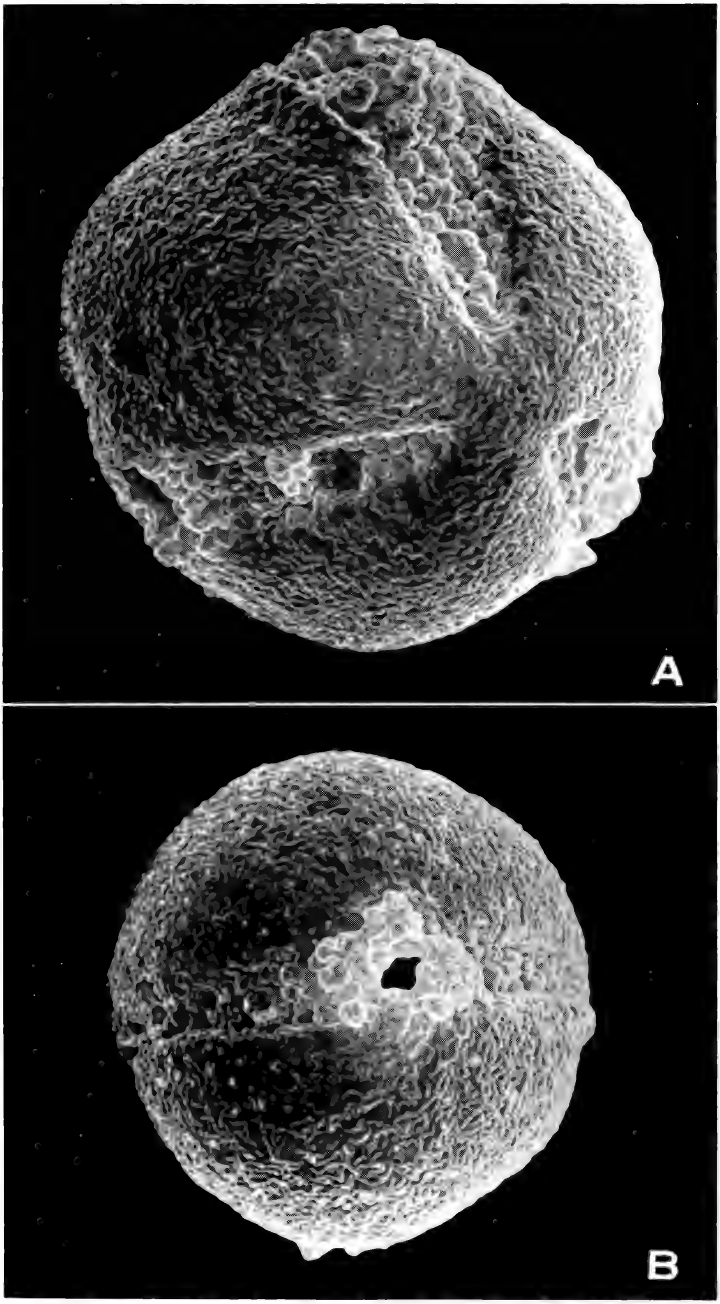

FIG. 7. *Swartzia cuspidata*—Type I-B. a. Oblique polar view, showing striato-reticulate ektexine. × 3000. b. Equatorial view. × 3000.

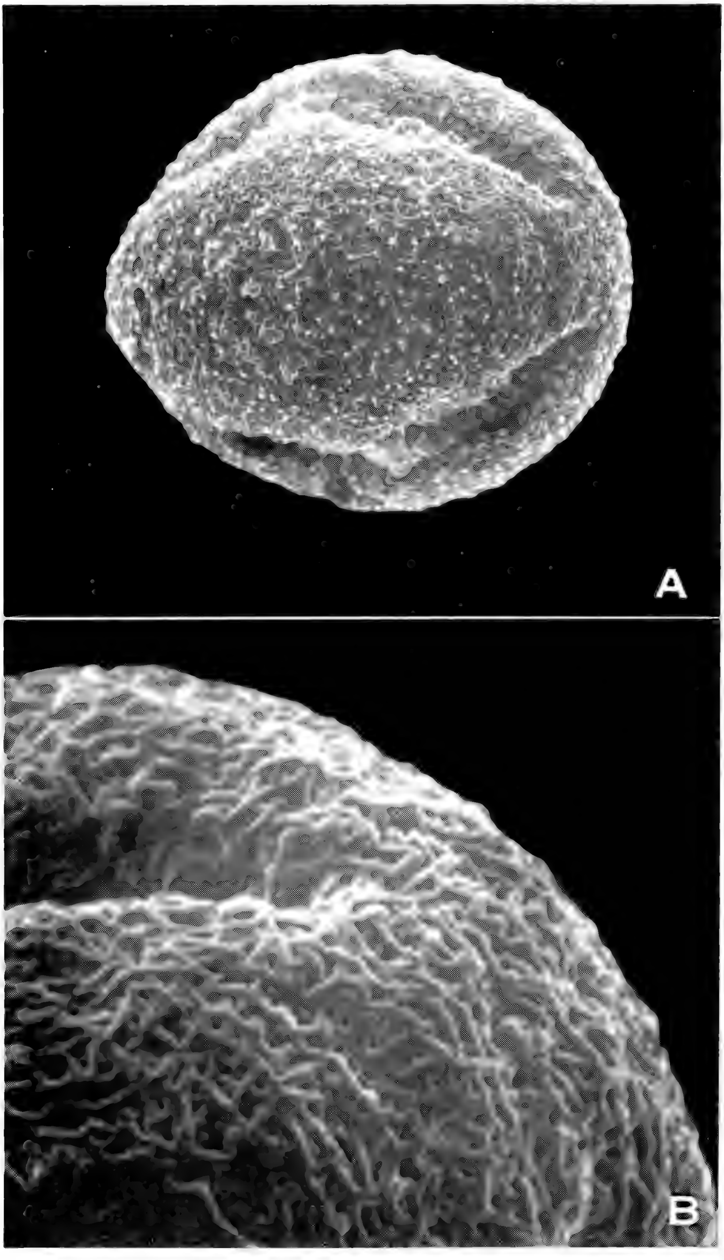

FIG. 8. *Swartzia jorori*—Type I-B. a. Oblique equatorial view. × 3000. b. Portion of surface of ektexine, showing relatively narrow, interwoven muri. × 10,000.

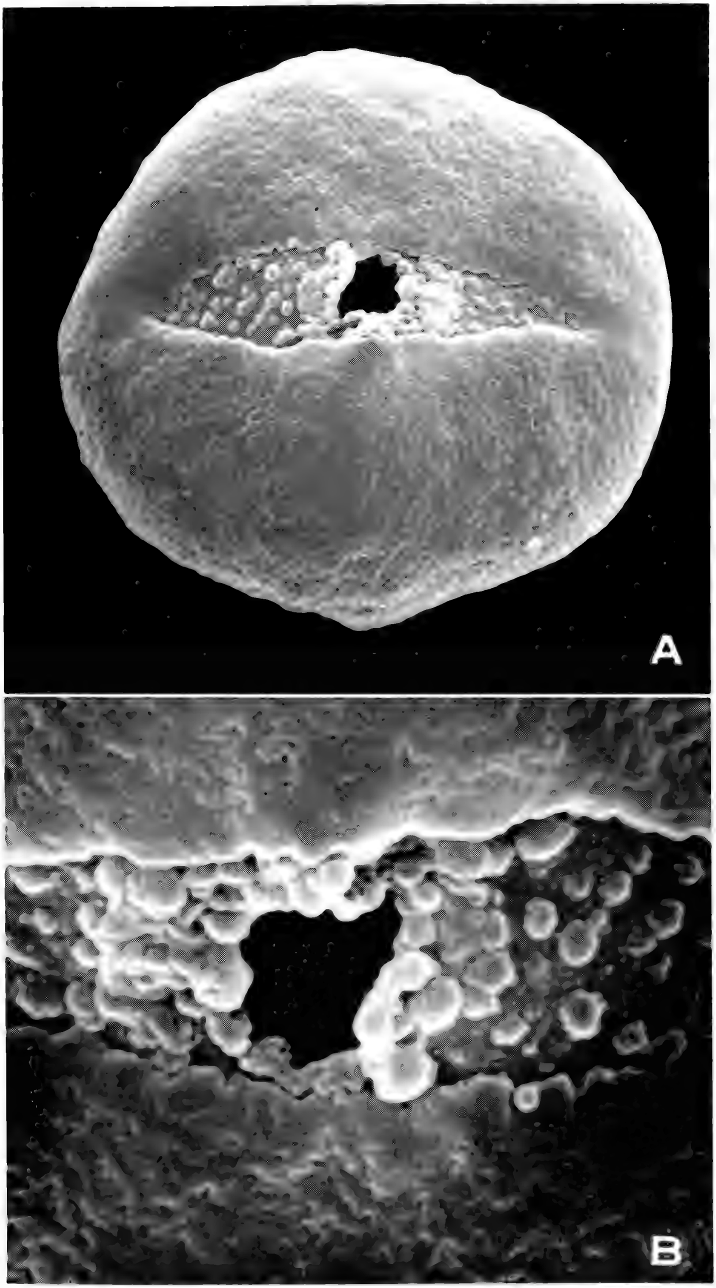

Fig. 9. *Swartzia arborescens*—Type I-B. a. Equatorial view, showing prominent os and discrete orbicules. × 3600. b. Enlargement of mid-section of colpus. × ca. 10,000.

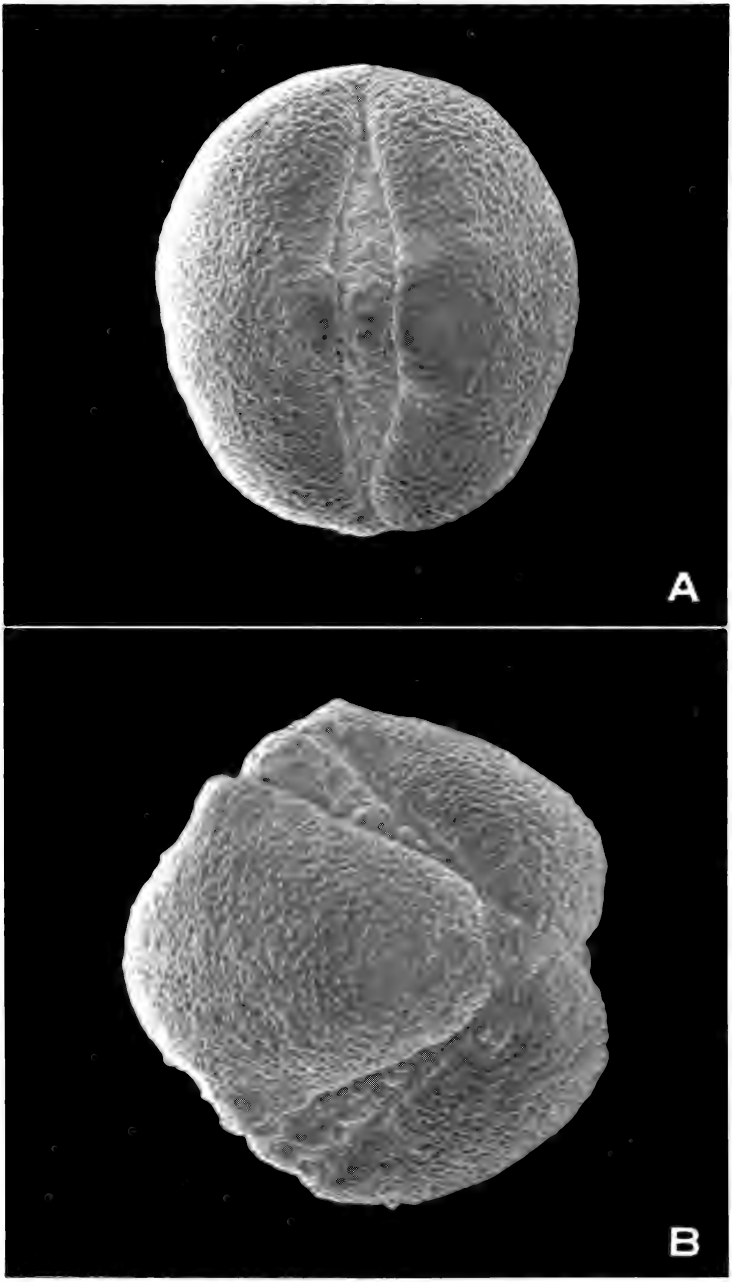

FIG. 10. *Aldina latifolia*—Type I-C. a. Equatorial view. × 3000. b. Oblique polar view. × 3000.

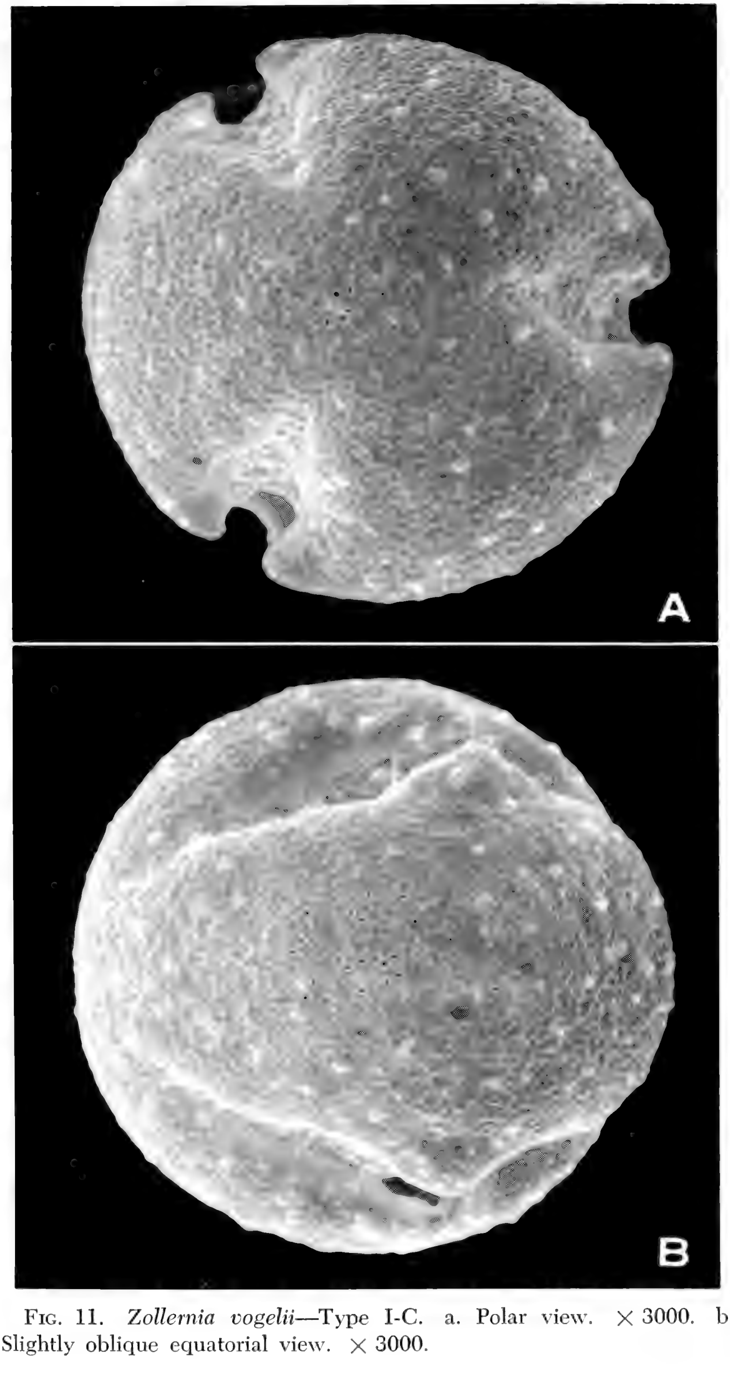

FIG. 11. *Zollernia vogelii*—Type I-C. a. Polar view. × 3000. b. Slightly oblique equatorial view. × 3000.

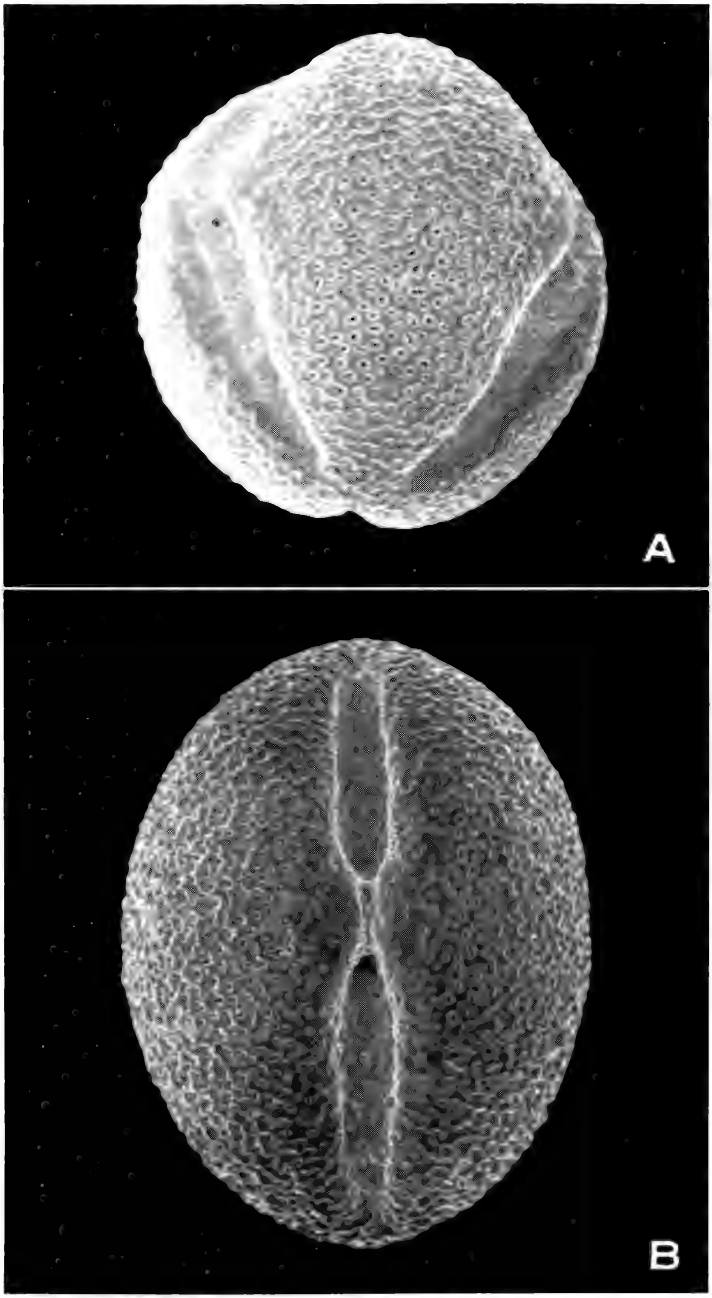

FIG. 12. *Cyathostegia matthewsii*—Type I-C. a. Slightly oblique equatorial view. × 3000. b. Equatorial view. × 3000.

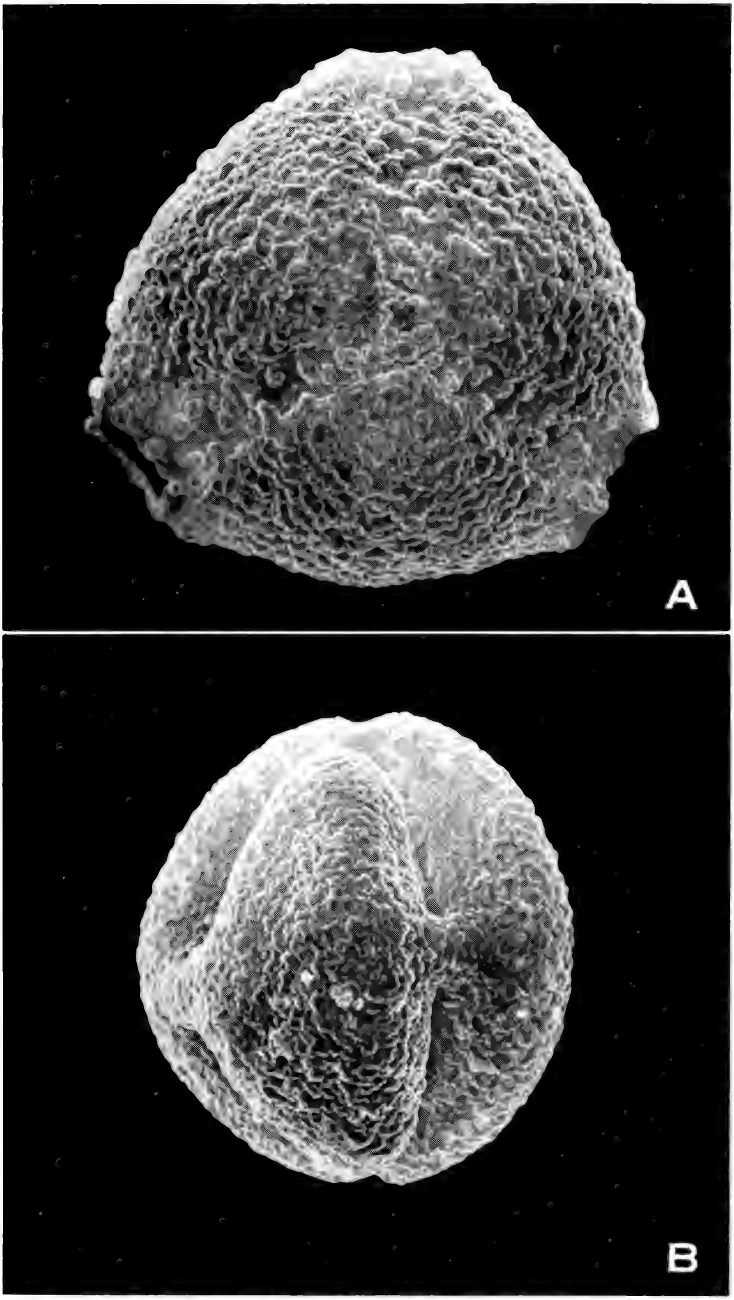

FIG. 13. *Swartzia benthamiana*—Type II-A. a. Polar view, showing syncolpate condition. × 3000. b. Equatorial view. × 3000.

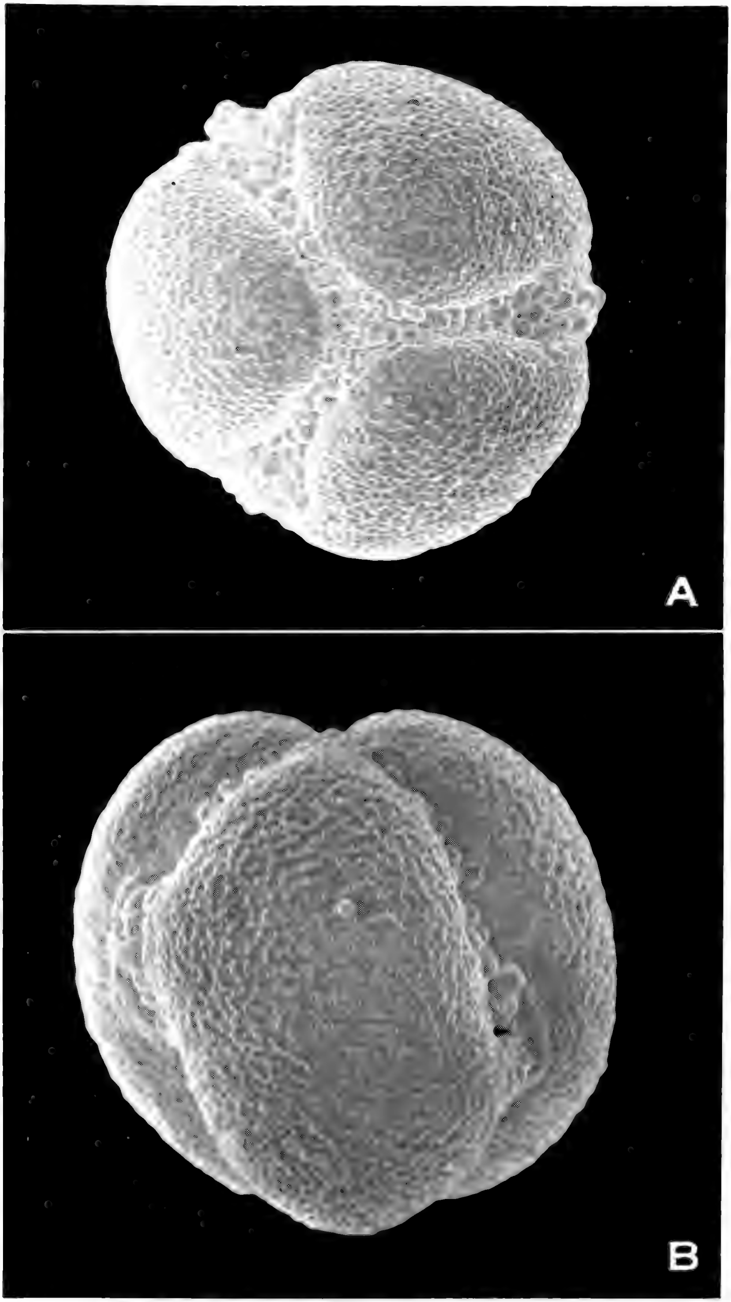

FIG. 14. *Swartzia panamensis*—Type II-B. a. Polar view, showing syncolpate condition. × 3000. b. Oblique equatorial view. × 3000.

Key to the Species

1. Leaves unifoliolate or trifoliolate 2
   Leaves with more than 1–3 leaflets 4
2. Flowers lacking a petal; leaf rachis and petioles about equal in length or leaves unifoliolate; seeds obviously arillate; large trees 14 m or more tall 3
   Flowers with a petal; leaf rachis several times as long as the petioles; seeds exarillate; shrub or small tree .... 3. *B. racemulosa*
3. Leaves trifoliolate, the stipules deciduous, lanceolate, 3–4.5 mm long; inflorescence tomentulose; stamens 25–30; funicle not elongated .... 4. *B. viridiflora*
   Leaves unifoliolate, the stipules persistent, broadly triangular, 1.5 mm or less in length; inflorescence glabrous; stamens 7–10; funicle 1.5–3 m long .... 5. *B. prouacensis*
4. Leaflets alternate, the apices acute to acuminate, about 7–13 cm long 5
   Leaflets opposite to subopposite, the apices obtuse to rounded, usually at least some emarginate or retuse, 0.5–5 cm long 6
5. Petal deciduous or caducous; stamens 13–15; stigma obliquely capitellate; inflorescence 30–50 mm long; calyx segments free throughout their length .... 1. *B. alterna*
   Petal persistent even with old flowers; stamens 6–11; stigma truncate; inflorescences 3–10 mm long; calyx segments not separating in basal ¼ of length .... 2. *B. limae*
6. Branchlets, lower surface of leaflets, and inflorescence axes puberulous to tomentulose; leaflets 35–55 mm long, the lower ones oval to elliptic; inflorescence axes 9–20 mm long; calyx segments becoming strongly revolute; ovary and fruit glabrous .... 6. *B. mollis*
   Branchlets, lower surface of leaflets, and inflorescence axes minutely strigulose, glabrous or glabrescent; leaflets 3–22 mm long, the lower ones round; inflorescence axes 2–2.5 mm long; calyx segments reflexed; ovary and fruit strigulose .... 7. *B. decipiens*

1. *Bocoa alterna* (Bentham) Cowan, comb. nov.

Swartzia alterna Bentham, Hook. Jour. Bot. 2:89. 1840.

Description: Shrub or small tree 3–8 m tall, the trunk slender, to 10 cm in diameter, the bark when bruised with a foetid odor, the branchlets puberulous to strigulose, sometimes glabrescent, the stipules usually persistent, more or less triangular 0.3–0.4 mm long, strigulose externally; petioles terete to subterete, (5–)12–18(–25) mm long, more or less puberulous, sometimes glabrescent, the rachis (3–)6–8(–11.5) cm long, terete to subterete, more or less puberulous; leaflets (3–)5–7, subopposite to alternate, always with one terminal on the rachis, the petiolules (1–)2–4(–6) mm long, usually sparingly puberulous, the blades mostly elliptic to ovate-elliptic, sometimes narrowly elliptic, lanceolate-elliptic, or ovate (4.5–)7–12(–20.5) cm long, (2.8–)3.5–6(–7.5) cm wide, the base cuneate and acute or rounded but finally acute, the apex acute to acuminate with the tip acute to obtuse, usually glabrous except puberulous on the costa above, occasionally soft-puberulous on the undersurfaces generally, often somewhat lucid on one or both surfaces, the venation prominulous on both surfaces or subobscure above, the costa impressed on the upper surface, salient beneath; inflorescences (1–)3–5 (–8) cm long, racemose or sparsely branched panicles of racemes, usually several arising together at the same node below the leaves of the current season but sometimes also axillary, the axis strigulose or puberulous, the flower scars prominently raised, the bracts about triangular and 1 mm long and wide, persistent or tardily deciduous, the pedicels 4–7 mm long in flower, 6–13 mm long in fruit, sparingly strigulose or puberulous, the buds 5–6 mm long, 3 mm in diameter, ellipsoid, sparsely strigulose except for the tufted apex; calyx segments 3 or rarely 4, free to the base, revolute tightly at anthesis, glabrous on the inner surfaces; petal one, white, glabrous, obovate to oblanceolate, the claw (1–)3–6 mm long, the blade 5–8 mm long, 3–5 mm wide; stamens (12–)13–15(–18), the filaments filiform, 3.5–5 mm long, usually free but sometimes shortly joined basally, the anthers narrowly oblong, 3–4 mm long, 0.7–0.8 mm wide; gynoecium glabrous or occasionally with a few hairs on the ovary and rarely puberulous, the stigma obliquely capitellate, the style 3–5.5 mm long, the ovary oblong, 1.5–4.5 mm long, 1–2.5 mm wide, the gynophore 0.8–2 mm long, ovules 14–16 in each ovary but only one (usually nearest the style) maturing; fruits dehiscent, usually glabrous, rarely puberulous, more or less reticulate-veined on the surface, oval to round in outline, 1–2 cm long, 1–1.5 cm wide, the seed black, oval to oblong-oval, 8–10 mm long, 5–5.5 mm in diameter, exarillate.

Type-Collection: L. Riedel 1 (holotype K), "Barra do Rio Negro in Brasilia." The specimens cited below as "Riedel s.n." are from the type locality and may be isotypes.

Distribution: Guyana, Amazonian Brazil, and western Peru in dense primary or open, dry secondary forest on sandy or clay soils above annual flooding by the rivers in the lowlands and up to 800 m elevation.

Discussion: Since there are small local morphological differences among the collections representing the species *sensu lato*, the following are cited under each of several unnamed "phases" I have distinguished. They are not worthy of formal recognition but should not be passed over without notice.

KEY TO PHASES OF *B. ALTERNA*

1\. Leaflets soft-pubescent on the lower surfaces .... "Pubescent Leaflet Phase"
Leaflets glabrous or minutely puberulous on costa 2
2\. Fruits pubescent .... "Pubescent Fruit Phase"
Fruits glabrous 3
3\. Fruits about 10 mm long on pedicels 4–5 mm long .... "Small Fruit Phase"
Fruits 15–20 mm long on pedicels 6–12 mm long 4

4\. Leaflets long-acuminate, narrowly elliptic .... "Acuminate Leaflet Phase"
Leaflets acute to acuminate, elliptic, ovate-elliptic, or lanceolate-elliptic .... "Glabrous Phase"

(1) The "Glabrous Phase" is glabrous in most parts, particularly the leaflets and the gynoecium. Collections representing this phase are: GUYANA: basin of Essequibo R., near mouth of Blackwater Creek, December 1937, A. C. Smith 2828 (A, K, NY); Wawitau, Kanuku Mtns., September 1948, Wilson-Browne 176 (Record No. 5669 (K, NY). PERU: Depto. Junin, Puerto Bermudez, July 1929, Killip & Smith 26502 (US). BRAZIL-AMAZONAS-vicinity of Manaus: Igarapé do Bindá, April 1956, Coelho (INPA No.) 3740 (US); Barcelos, September 1962, Duarte 6978 (US); Flores, January 1941, Ducke 371 (MADw); Cachoeira Grande, April 1937, Ducke 454 (A,F,IAN,MG,MO,NY,US); Cachoeira below Tarumá, 21 September 1956, Francisco & Luiz 4188 (IAN); Estrada do Mundú, February 1945, Froes 20465 (IAN,K,NY,US); Pai Raimundo, Rio Demeni, Froes & Addison 29016 (IAN); Rio Tarumá, Aug. 1949, Froes 24946 (IAN); Flores, March 1924, Kuhlmann 96 (P, U) and 1607 (RB,US); Cachoeira baixa de Tarumá, September 1956, Mello & Coelho (INPA No.) 4188 (US); Kms 65–70 da Rodovia, Manaus-Itacoatiára, 22 Oct. 1963, Oliviera 2742 (IAN); Estrada do Aleixo, March 1947, Pires 213 (US); Road Igarapé Leaõ 25 km north of Manaus, November 1966, Prance et al. 3137 (U,US); estrada Manaus-Itacoatiara km 70, October 1960, Rodrigues & Coelho 1877 (US); Estrada do Tarumá, January 1962, Rodrigues & Chagas 4112 (US); Igarapé do Buião, November 1962, Rodrigues & Chagas 4723 (US); Km 22 da estrada Manaus-Caracaroí, November 1962, Rodrigues et al. 4811 (US); Manaus, Schwacke 3942 (RB); between Santarem and Barra do Rio Negro along the Amazon River, October 1850, Spruce s.n. (BM,G,K,NY,RB); Paruná-mirí dos Ramos, Oct. 1850, Spruce 1106 (K,P). PERNAMBUCO: Recife, Dois Irmãos, Feb. 1948, Ducke 2116 (IAN).

(2) The "Pubescent Leaflet Phase" has leaflets that are softly pubescent on the undersurfaces, but like the typical phase in other respects. All the collections are from BRAZIL-AMAZONAS-Manaus: B.A.M., BR 17, Km 9, December 1955, Dionisio 3076 (MG); Flores, October 1936, Ducke 296 (A,F,IAN,K,MG,MO,NY,US); between the city and Flores, July 1929, Ducke (HJBR No.) 23342 (G,K,RB,US); near the city, August 1931, Ducke (HJBR No.) 24203 (G,K,P,RB,U,US); road to Aleixo, August 1936, Krukoff 7944 (A,BM,G,K,MO,P,U,US); Margem do Igarapé do Buião, July 1956, Luis 13979 (IAN); Sept. 1945, Pires & Black 930 (IAN); Barra do Rio Negro, Riedel s.n. (A,G,K,P); Igarapé do Santa Maria, June 1962, Rodriguez and Chagas 4473 (US), cultivated at Rio de Janeiro, Dec. 1878, Glaziou 9767 (K,P,U).

(3) The "Acuminate Leaflet Phase" differs in having relatively narrower leaflets that have long-acuminate apices and it occurs in the Kanuku Mountains of Southwestern Guyana: March–April 1938, A. C. Smith 3147 (F,IAN,K,NY,P,U,US) and 3575 (G,F,IAN,K,MADw,MO,

NY,U,US). One additional Guyana collection without locality should be assigned here: Robt. Schomburgk 293 (Rich. Schomburgk 585) (K,P).

(4) The "Pubescent Fruit Phase" is separable only by the puberulous fruits and is represented by a single collection from Guyana: basin of Essequibo River near mouth of Onoro Creek, December 1937, A. C. Smith 2772 (A,F,G,K,MADw,MO,NY,U,US).

(5) The "Small Fruit Phase" has noticeably smaller fruits, somewhat shorter pedicels, and longer inflorescences: Serra do Navío, Terr. do Amapá, Rio Amaparí, Brazil, November 1954, Cowan 38157 (F,NY).

(6) The "Unifoliolate Phase" is identical with the "typical phase" except that the leaves are uniformly unifoliolate. The only two collections are from the Brazil-Guyana boundary in the Akarai Mountains, at 600–800 m elevation between the drainages of the Rio Mapuera and Shodikar Creek: A. C. Smith 2991 (A,F,G,K,MADw,MO,NY,U,US) and 2996 (A,F,G,K,MO,NY,P,U,US).

The closest relationship of *B. alterna* is with *B. limae*, which shows once again a familiar distributional pattern (in the legumes at least)—a wide-ranging species with a disjunct, very similar, related species in the coastal forest of southeastern Brazil. The two taxa differ in the length of the inflorescence, persistence of the petal, and the post-anthesis union of the calyx-segments.

2. **Bocoa limae** Cowan, sp. nov.

Description: Frutex 1.5–2 m altus, trunco ca. 3 cm diametro, ramulis strigulosis, stipulis caducis, non visis; petioli 3–4(–6) mm longi, sparse strigulosi, subteretes, rhachibus 4.5–8 cm longis, sparse strigulosis, subteretibus; foliola 4–7, alterna, imparipinnata, petiolulis 1–2 mm longis, laminis superioribus amplioribus, 6–20 cm longis, 2.5–7.5 cm latis, laminis inferioribus minoribus, 3–5.5 cm longis, 1.5–3 cm latis, laminis omnibus ellipticis, ad basim angustatis acutis vel tandem obtusis, ad apicem argute vel obtuse acutis, sparse strigulosis infra sed mox glabrescentibus, lucidis, manifeste venulosis in ambobus paginis; inflorescentiae ramuligerae vel axillares, axe 3–5(–10) mm longo, striguloso, bracteis deciduis, triangularibus, strigulosis extus; pedicelli 4–5.5 mm longi, strigulosi, alabastris oblongis, sparse strigulosis; calycis segmenta 3 vel 4, revoluta, ad basim incomplete fissa; petalum unum, album, persistens, glabrum, unguiculo 3.5–4 mm longo, lamina rotundata sed attenuata ad basim, 5–7 mm diametro; stamina 6–11, filamentis 3–5 mm longis, antheris anguste oblongis, ca. 4 mm longis et 1 mm latis; gynoecium glabrum, stigmate truncato, stylo ca. 5 mm longo, ovario elliptico, ca. 3.5 mm longis et 1.8 mm latis, gynophoro ca. 1 mm longo; fructus ovalis, glaber, reticulatus, ca. 18 mm longus et 12 mm latus, rostellatus, semine uno, nigro, exarillato, ovali ca. 10 mm longo et 7 mm lato.

Type-Collection: A. Lima 65-4270 (holotype US, sheet no. 2639742, isotype IPA), "Bahia. Salvador. Areias em torno da Lagôa do Abaeté," Brazil, 26 January 1965.

Distribution: Coastal brush-forest from Pernambuco to Bahia, Brazil, on sandy soils. BRAZIL-PERNAMBUCO: Recife, woods near Dois Irmãos, 29 October 1949, Lima 49-369 (IPA); along road to Aldeia, 17 March 1952, Lima 52-1007 (IPA, US); mata de Dois Irmãos, 2 June 1966, Soares 2185 (US).

Vernacular Name: "Feijao brabo" (Soares 2185).

Discussion and Etymology: There is a great resemblance of *B. limae* (named for the collector of most of the known material of the new taxon) to *B. alterna* but close examination reveals a number of differences in addition to the obvious geographic disjunction. Unlike its nearest relative, the new species has a very short inflorescence, at times the flowers almost seeming to arise from the branchlets directly; the calyx segments do not open completely, remaining partially united basally; the petal is persistent, even with quite old flowers; the stamens are fewer, and the stigma is truncate; vegetatively, the leaflets are obviously venulose and the costa is salient on both surfaces.

3. *Bocoa racemulosa* (Huber) Cowan, comb. nov.

Swartzia racemulosa Huber, Bol. Mus. Goeldi 5:395. 1909.

Description: Shrub or small tree, the branchlets sparingly strigulose minutely, glabrescent, the stipules not seen, the petioles 2–10 mm long, sparingly strigulose but glabrescent soon, rachis 2.5–6 cm long, glabrous, subterete; leaflets 1–3, the lateral ones smaller (6–11 cm long, 3–7 cm wide) ovate, with petiolules 1–3 mm long, the terminal leaflet 12–23.5 cm long, 5–12 cm wide, the petiolules 3–4 mm long, base of leaflets rounded-obtuse (some lateral ones) to rounded and acute, or simply acute, the apex sharply to bluntly acute, sometimes emarginate, glabrous, venation prominulous; inflorescences 2.5–3 cm long, ramuligerous, racemose, minutely strigulose, the bracts persistent, ovate-triangular, about 1 mm long, minutely strigulose externally; pedicels about 2.5 mm long in flower and 4 mm long with fruit, minutely strigulose sparingly, the calyx minutely strigulose externally, opening only about half of length in 2–4 segments, ca. 3.5–4 mm long, segments erect or somewhat reflexed, the calyx usually falling in one piece; petal white, glabrous, obovate, 7 mm long (fide Huber), cuneate-unguiculate; stamens 12–14, the filaments 2–3 mm long, the anthers oblong, 2.5–2.8 mm long, 0.5 mm wide; gynoecium glabrous, the stigma capitellate, the style 3.5 mm long, the ovary elliptic, ca. 2 mm long and 0.8 mm wide, the gynophore ca. 1 mm long; fruit ca. oval in outline and 1.5 cm long, 1 cm wide, reticulate-veined on surface, glabrous, the seed exarillate, black, oval-oblong.

Type-Collection: A. Ducke 7870 (holotype presumably in Brazil but not at Museu Goeldi in Belém (fide the curator), isotypes F,G), "in silvis flumenis Trombetas ad vicum Oriximiná, Pará," Brazil, 8 December 1906.

Distribution: Lowland forest of Pará in east-central Brazil, near the junction of the Amazon and the Rio Trombetas: São Jorge, Municipio de Faro, November 1950, Black & Ledoux 50-10669 (IAN,US); Oriximiná, 23 November 1907, Ducke 8865 (BM,G,MG); Rio Tapajoz, Mangabal, February 1917, Ducke 11184 (HAMP No. 16755) (BM,G, MG,P,RB,U,US); S. Luiz do Rio Tapajoz, December 1915, Ducke 11185 (HAMP No. 15856) (BM,MG,RB); Obidos, November 1919 (fl.), June 1926 (frt.), Ducke 11186 (G,K,P,RB,U,US); Rio Tapajoz, Villa Braga, November 1908, Snethlage 10058 (BM,G,MG).

Discussion: While clearly related to *B. alterna*, this species is easily distinguished by its dimorphic leaflets. The pair of lateral ones is ovate and about half the length of the elliptic terminal one. In addition, the calyx segments in *B. racemulosa* only separate about halfway and they are more or less reflexed, in contrast to the totally free, retrorsely revolute segments in *B. alterna.*

4. *Bocoa viridiflora* (Ducke) Cowan, comb. nov.

Swartzia viridiflora Ducke, Arch. Inst. Biol. Veg. 2:44. 1935.

Description: Tree to 30 m tall and 43 cm diameter, with glabrescent, lucid branchlets, strigulose at very early stages, the stipules deciduous, lanceolate, 3–4.5 mm long, 1–1.5 mm wide, strigulose externally at first but soon glabrescent; leaves glabrous, trifoliolate (unijugate and imparipinnate), the petioles 1–4 cm long, terete, the rachis 2–4.3 cm long, terete; lateral leaflets opposite, occasionally subopposite, petiolules 3–6 mm long, transversely rugose, the blades subcoriaceous, lucid, 7–15 cm long, 3–6.5 cm wide (the terminal leaflet larger), elliptic, the base acute, the apex acuminate to bluntly acute, costa and 3–5 pairs of primary veins more or less salient on both surfaces; inflorescences 5–9 cm long, to 20 cm long in fruit, ramuligerous, axes albo-tomentulose, the peduncle 3–4 mm long, the bracts persistent, darker colored, semicircular, cucullate, about 1 mm long and broad, puberulous externally; flowers greenish, fragrant, the pedicels tomentulose, about 1 mm long; calyx segments deciduous, sparingly tomentulose externally, glabrous on inner surfaces; petal absent; stamens equal, 25–30, the filaments 6 mm long, the anthers basifixed, oblong ca. 1.5 mm long and 0.5 mm wide, gynoecium glabrous, the stigma capitellate, the style 3–4 mm long, the ovary oblong, 3 mm long 1.5 mm wide, the gynophore 1.5–2 mm long; fruits oval in outline, ca. 3 cm long and 1.5 cm in diameter, the surface tessellate-scaly, the "scales" darker, the seed oval, only slightly smaller than the fruits, the aril small.

Lectotype-Collection: A. Ducke (H.J.B.R. No.) 24219 (flowering portion). (Lectotype RB, isolectotypes F,G,K,MADw,NY,P,U,US), "circa Manáos (civ. Amazonas) in silvis loco alto ultra Flores," Brazil, 29 November 1932.

Distribution: Vicinity of Manaus, Brazil, southern Guyana and Suriname, in riverine lowland forest. BRAZIL-AMAZONAS: Vicinity of Manaus above Flores, 18 April 1933, Ducke (H.J.B.R. No.) 24219 (fruiting portion) (F,G,MADw,NY,P,US) and 1 March 1946, Ducke 1923 (A,F,IAN,K,MG,NY,US). BRAZIL-PARÁ: Tinguelim km 21, 30

March 1970, Silva 3024 (IAN). GUYANA: "Plot 3, hill top 1000 feet high, 7 miles E. of Onoro mouth, Upper Essequibo," 30 September 1952, Guppy 304 (Record No. 7280) (NY). SURINAME: Fallawatra, 8 Nov. 1971, Jimenéz-Saa 1568 (K).

Choice of a lectotype is required in this instance because Ducke included two collections under one number, probably from the same tree but this is not at all certain; both parts of the type collection are cited here.

The collection from Guyana is sterile but it almost certainly represents this species.

Vernacular Names: "Gombeira amarela" (Silva 3024).

Discussion: This is one of the two species of the genus which are characterized by apetalous flowers and arillate seeds. It is distinct from its near relative, *B. prouacensis*, by the number of leaflets, stipule size, and number of stamens. Like *B. racemulosa*, although less pronounced, *B. viridiflora* has trifoliolate leaves with the terminal one the largest. This species has the largest stipules, the longest inflorescences, and the largest number of stamens.

5. *Bocoa prouacensis* Aublet, Pl. Guiane Fr. Suppl. 38, t. 391. 1775.

Swartzia prouacensis (Aublet) Amshoff, Meded. Bot. Mus. & Herb. Rijks. Univ. Utrecht 52:40. 1939.
Swartzia minutiflora Kleinhoonte, Rec. Trav. Bot. Neerl. 22:408. 1925.

Description: Tree 14–30 m tall, the trunk 19–25 cm diameter, straight and cylindrical, the bark brownish-grey with small rectanglar scales, the branchlets glabrous, the stipules persistent, rigid, 0.7–1.3 mm long and wide, broadly triangular-ovate, acute, glabrous; leaves glabrous, unifoliolate, the petiole subterete, non-alate, 6–16 mm long or occasionally totally suppressed, petiolules 4–7 mm long, transversely corrugate, the blades coriaceous, 9–18(–21) cm long, 4.5–8(–10) cm wide, mostly elliptic but sometimes elliptic-ovate or broadly ovate, sometimes asymmetric, the base rounded and obtuse to subobtuse, infrequently acute, the apex bluntly acute, infrequently acuminate, the costa and its primary branches more or less salient on both sides of the leaflet-blade; inflorescences 2–5 cm long, ramuligerous, axes glabrous, the bracts persistent, cucullate, broadly ovate, about 0.6–0.8 mm long and 1 mm wide, glabrous except for ciliolate margin, bracteoles lacking; pedicels 0.3–0.6 mm long, rarely to 2 mm long, glabrous, the calyx opening nearly to the base in three, more or less equal segments which often fall in one piece; petal absent; stamens 7–10, uniform, the filaments 4.5 mm long, the anthers oblong, 1.3–1.5 mm long, ca. 0.5 mm wide; gynoecium glabrous, the stigma capitellate, the style filiform, 1.7–2 mm long, the ovary 1.8–2 mm long, 0.8–1 mm broad, oblong, the gynophore 1–1.5 mm long; fruit oval in outline, 2.5–3 cm long, 1.5–2.5 cm wide, dehiscent, the seed yellow or light brown (fide Amshoff) 1–2 cm long, the aril white, laciniate, the funicle filiform, 1.5–3 m long.

Type-Collection: J. B. C. F. Aublet s.n. (BM), "Habitat in sylvis Caux," French Guiana.

Distribution: Suriname and French Guiana in lowland forest. SURINAME: Marechalskreek, 9 July 1921, BW 5441 (U) and 21 Jan. 1922, BW 5769 (U); Brokopondo District, 8 km ESE of Brownsweg Village, 26 Mar. 1965, van Donselaar 2273 (U); Tapanahoni River, 11 Nov. 1918, Gonggrypp 4175 (IAN,U); Nassau Mts., 9 Mar. 1949, Lanjouw & Lindeman 2545 (U); Boven Coesewijne, ca. 20 km SW of Poika, Schulz 7926 (U); Sectie "O," 23 Apr. 1915, Suriname Forestry Department 342 (K,MO,U),—23 Oct. 1915, 1191 (U) (type of *Swartzia minutiflora* Kleinhoonte),—27 Oct. 1915, 1198 (K,MO, U),—Nov. 1915, 1434 (U),—22 Nov. 1915, 1560 (U),—26 Feb. 1916, 1660 (U),—22 Dec. 1916, 2552 (U),—5 Mar. 1917, 2743 (U,US),—22 Aug. 1918, 3974 (U),—2 Sept. 1918 3984 (NY,U,US),—4 Sept. 1918, 3986 (IAN,U),—9 Dec. 1918, 4185 (U),—30 May 1919, 4326 (U),—28 Nov. 1919, 4455 (MO,U),—28 Nov. 1919, 4477 (U),—21 Jan. 1920, 4521 (U),—6 Mar. 1920, 4569 (IAN,K,U,US),—3 Nov. 1920, 4781 (U),—12 Nov. 1921, 5556 (U),—17 May 1922, 5839 (K,NY,U),—16 Mar. 1923, 6084 (IAN,U); Brownsberg Forest Reserve, Suriname Forestry Department 6130 (NY,U); Sectie "O," Dec. 1942, Suriname Woodherbarium (Stahel) 69 (A,IAN,K,MADw,NY,U); Brownsberg Forest Reserve, 10 Oct. 1969, Tawjoeran 12581 (U). FRENCH GUIANA: St. Laurent, Feb. 1956, BAFOG 339M (U), 7236 (U), and 7249 (P,U), 7 Feb. 1956, Bena 1117 (U); Placeau no. 2—Carreau no. 56—Route de Mana," 3 Jan. 1956, French Guiana Forestry Department 7126 (NY,P,U), 26 Mar. 1956, 7415 (U); Sinnamary River, Crique Grégoire, 28 Apr. 1968, Oldeman B-1614 (P); Camopi River, 1 km downstream from Saut Ouasseye, 11 Dec. 1967, Oldeman 2625 (P); Karouany, 1859, Sagot 1210 (BM,K,P); without locality or date, Wachenheim s.n. (BM,K,P,US).

Vernacular Names: "Bois bobo," "caux bois boco" (Aublet s.n.); "boko" (Oldeman B-1614); "aie oudou" (F. G. For. Dept. 7126); "itikiboroballi hohorodikoro," "ijzerhart" (Sur. Woodherb. 69); "yzerhart" (Sur. For. Dept. 4326).

Discussion: *Bocoa prouacensis* is one of the two most frequently collected species in the genus and certainly one of the most distinctive. One characteristic alone separates it from all its relatives; the single seed in each fruit at the time it dehisces is suspended on a thread up to three meters long. (An interesting description of this phenomenon is given by Stahel in the Journal of the New York Botanical Garden, vol. 45:265–268. 1944). This attribute plus an obvious, fleshy aril is surely of some adaptive significance, probably for dispersal by animals. The aril in this species, and in the preceding, links the genus to *Swartzia*, most of whose species have arillate seeds. The unifoliolate leaves of *B. prouacensis* serve to separate it from all its near-relatives, the closest of which is probably *B. alterna*.

6. *Bocoa mollis* (Bentham), Cowan, comb. nov.

Swartzia mollis Bentham, Hook. Journ. Bot. 2:89. 1840.

Trischidium vestitum Tulasne, Ann. Sci. Nat. (Ser. 2) 20:141, t. 4. Sept. 1843.

Swartzia cearensis Ducke, Anais da Academia Brasileira de Ciencias 31: 295. 30 June 1959.

Description: Shrub or small tree 2–4 m tall, foetid in fresh state, the young branchlets tomentulose densely; stipules early caducous, minute, ca. 0.5 m long, densely strigulose; petioles 6–11 mm long, tomentulose, terete, the rachis 25–50 mm long, tomentulose, terete; leaves imparipinnate, the leaflets 5–9, 3.5–5.5 cm long, 1.5–3 cm wide, subopposite or rarely opposite, the petiolules 0.7–1.5 mm long, tomentulose, the blades oval to elliptic or ovate to lanceolate, the base rounded, obtuse or slightly cordate, the apex obtuse, retuse, to sub-emarginate, puberulous to tomentulose beneath, rarely only on costa, puberulous to strigulose above, the venation subobscure to barely prominulous, plane except the costa salient on lower surface; inflorescences ramuligerous, racemose, the axes 9–20 mm long, densely tomentulose-pilosulose, the bracts early deciduous, broadly triangular-ovate or semicircular in outline, about 1 mm long and wide, densely strigulose externally, glabrous within, the pedicels 4–12 mm long at anthesis, 7–15 mm long with mature fruits, pilosulose; buds elliptic in outline, subappressed-tomentulose, ca. 5 mm long and 3.5 mm diameter, the calyx opening only about half-way into 3 or 4 segments; petal one, deciduous to caducous, white, the claw 2–6 mm long, sparingly villosulose externally or glabrous, the blade glabrous, oblate, 4–7 mm long and 5–7 mm wide; stamens (12–)20–22, the filaments 4–7 mm long, slightly joined basally, the anthers narrowly oblong, 2–3 mm long, 0.7–0.9 mm wide; gynoecium glabrous except sometimes a few long hairs on ovary, the stigma capitellate, sometimes obliquely so, the style 2–3.5 mm long, the ovary elliptic, ca. 3.5 mm long and 2 mm wide, the gynophore ca. 1 mm long; fruit obliquely ellipsoid, beaked with the 1–2 mm long remnant of style, 10–15 mm long, 8–10 mm diameter, reticulate, the carpophore about 1–4 mm long; the seed tan to black, exarillate, 5.5–7 mm long, 4.5–5 mm diameter, shiny, ellipsoid to subrotund.

Type-Collection: J. S. Blanchet 2774 (holotype K, isotypes F (frag.), G,K,P) (also the type collection of *Trischidium vestitum* Tulasne). "In Brasilia prope Utinga, Fazenda in Certao de San Francisco," Bahia, 1839.

Distribution: Near-interior of Ceara and Rio Grande do Norte to Bahia, Brazil, on sandy soils in scrub forest. BRAZIL-CEARA: Baturité, 11 Apr. 1909, Ducke 1980 (BM,G,US); Itaitinga, Pé do Serrote da Pedreira, 11 August and 23 December, 1955, Ducke 2467 (IAN,INPA,K,MG,NY,US) (type of *Swartzia cearensis* Ducke) and Ducke 2582 (IAN,K,NY,RB,US); along the road from Morada Nova to Bixobá, 14 February 1960, Lima 60-3443 (IPA,US); no specific locality, Dias da Rocha (HJBR No.) 11183 (RB); without locality or date, Allemão & Cysneiros 497 (P). Rio Grande do Norte: Açu, along the margin of the left bank of the Rio Açu, Lima 60-3505 (IPA). Pernambuco: Margem da estrada Ibimirim-Joazeiro dos Candidos, Lima 50-700 (IPA); Maniçobal, Fazenda Contenda, 20 June 1952, Lima & Magalhães 52-1050 (IPA). Bahia: Antonio B. de Oliviera (HJBR No.) 68404 (RB); Raxo da Catarina, Labouriou 912 (F, RB,US). Minas Gerais: 4 km N of Vasante de San Francisco, Municip. Januaria, 29 Sept. 1953, Magalhães 6082 (IAN,RB).

Vernacular Names: "Brinquinho" (Oliveira 68404).

Discussion: This species and *B. decipiens* form a small subgeneric grouping that may represent a separate phylogenetic offshoot of the genus. Both have several pairs of emarginate leaflets and small fruits, and both apparently are shrubs to small scrubby trees in the arid parts of southeastern Brazil. The smaller, glabrous or glabrescent leaflets, longer inflorescence, strongly revolute calyx segments, and larger number of stamens amply separate *B. mollis* from its closest relative.

7. **Bocoa decipiens** Cowan, sp. nov.

Swartzia decipiens Holmes, Pharm. Journ., ser. 4, 3:2. 4 July 1896. (Provisional Name)

Diagnosis: Frutex foliorum foliolis basalibus rotundatis 3–9 mm longis, 5–5.5 mm latis; gynoecium sicut fructus strigulosum.

Description: Shrub with the branchlets minutely strigulose, the stipules minute; petioles 1–2 mm long, lightly canaliculate on upper surface, minutely strigulose, the rachis 9–28 mm long, minutely strigulose, obviously canaliculate-marginate on the upper surface; leaflets 5–7, imparipinnate, the laterals subopposite, the petiolules 0.2–0.5 mm, glabrous, the blades glabrous, smaller and rounded near the base of the leaves but progressively larger and more elliptic toward the leaf apex, the basal ones 3–9 mm long, 5–5.5 mm wide, the upper ones and the terminal one 14–22 mm long, 6–10 mm wide, the base acute except the basal ones rounded-obtuse, the apex rounded, emarginate, glabrous or sparingly puberulous minutely on the costa, the venation subobscure, the costa salient on both surfaces; inflorescences axillary, racemose, few-flowered, the axis 2–5 mm long, strigulose, the bracts persistent, ca. 0.5 mm long, the fruiting pedicels 8–10 mm long, glabrous; calyx segments 3 or 4, glabrous, separating to the base, about 4.5 mm long, reflexed; stamens 8–10, glabrous, the filaments 2.5–3 mm long; gynoecium densely strigulose; fruit more or less strigulose, the basal 1–2 mm of the style persistent as a beak, the body of the fruit 8–9 mm long and wide, broadly oval in outline, the surface more or less reticulate, gynophore and carpophore densely strigulose, 0.5–1 mm long; seed black, exarillate, oval in outline, 5 mm long, 3.5–4 mm wide.

Type-Collection: A. Lima & M. Magalhães 52-1075 (holotype US, sheet no. 2639739, isotype IPA), "Nos campos da Serra Araripe, prox. Est. Exp. Araripina," Pernambuco, Brazil, 24 June 1952.

Distribution: Known certainly only from the type collection but circumstantial evidence in the following discussion indicates a broader range.

Discussion: In the latter part of the 19th Century, Europe was importing for medicinal purposes large quantities of one species of *Pilocarpus* (Rutaceae). As demand exceeded supply, another species of the same genus gradually came into commerce, as well as other unrelated adulterant plants. In his discussion of one of these, E. M. Holmes, who for 50 years was Curator of the Materia Medica Museum of the Pharmaceutical Society in London, noted in the paper referred to above, "Some of the more recent importations of these leaves (*Pilocarpus microphyllus*) have contained a few bales of leaves almost indistinguishable from them to the eye of the casual observer, . . . attention has probably been directed to them by their not yielding pilocarpine." He was encouraged by W. B. Hemsley at Kew to look among the legumes for the indentity of the plant parts in the "few bales" and it is very much to Holmes's credit that he correctly related his scraps to *Swartzia*, three species in particular—S. *mollis*, S. *pilulifera*, and S. *matthewsii*. He concluded that his material "probably" represented an undescribed species which he characterized quite adequately, considering the quality of his material. However, the last sentence leaves considerable doubt with respect to the validity of the publication of the new species: "Until further specimens are procurable from which it might be determined if only one petal and five stamens are present, the plant might be provisionally named Swartzia decipiens." Article 34 of the Code states (in part), "A name is not validly published . . . (2) when it is merely proposed in anticipation of the future acceptance of the group concerned . . ." Having concluded that Holmes's description is invalid, I have supplied a Latin diagnosis and as full an English description as possible to make the same specific epithet available in *Bocoa* where the species properly belongs. Its very small leaflets and pubescent fruits serve to distinguish it readily from all the other species in the genus.

The choice of type collection indicated above requires some explanation, for ordinarily I would probably have used the older material on which Holmes had based his description. However, this was not practical in this instance. I have seen no material certainly studied by Holmes and used by him in drawing up his description, although there are two sheets at Kew which have been viewed as "type material." One is a small packet with a label bearing the following notation: "Swartzia decipiens Holmes / fruits picked out of the leaves in commerce. March 1897 / Comm E. M. Holmes / See Ph. Journ. July 4.96. p. 2." If one were to accept his description as validly published, this fragment would have to be viewed as the type. In addition, there is at Kew a "type" sheet bearing several small packets and a note "with 2 samples (A & B) of 'genuine Paraguay Jaborandi leaves' / comm. by J. W. Drysdale & Co. / recd. 21.3.01." On the note there are sketches in pencil of calyx segments, a gynoecium, a flower with pedicel, calyx segments, and ten antherless filaments (the anthers, petal, and gynoecium are omitted from the flower sketch); there is also a representation of a partly opened ovary with ten ovules. The Berlin Herbarium likewise had one or more sheets of fragments obtained from the same source, the drug importing firms of Western Europe; copies of the photograph made by Macbride of the Berlin sheet are in several world herbaria but only the one at the Field Museum has a packet of the fragments from the original source. All these materials I have seen certainly represent the new species.

The small leaflets, fewer stamens, and smaller strigulose fruits serve to separate this poorly known taxon from *B. mollis*, with which it shares numerous characteristics. In fact, one can speculate, apparently rather safely, that *B. decipiens* is an evolutionary derivative of *B. mollis*.

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List of Exsiccatae

The figures in parentheses refer to the number assigned to each taxon.

Allemão & Cysneiros
497 (6)
Aublet, K. B. C. F.
s.n. (5)
BAFOG
339M (5); 7236 (5); 7249 (5)
Bena, P.
1117 (5)
Black, G. A. & Ledoux, P.
50-10669 (3)
Blanchet, J. S.
2774 (6)

Coelho, D.
3740 (1)
Cowan, R. S.
38157 (1)
van Donselaar, J.
2273 (5)
Dias da Rocha
11183 (6)
Dionisio
3076 (1)
Duarte, A. P.
6978 (1)
Ducke, A.
296 (1); 371 (1); 454 (1); 1923 (4); 1980 (6); 2116 (1); 2467 (6); 2582 (6); 7870 (3); 8865 (3); 11184 (3); 11185 (3); 11186 (3); 15856 (3); 16755 (3); 23342 (1); 24203 (1); 24219 (4)
Francisco & Luis
4188 (1)
French Guiana Forestry Department
7126 (5); 7415 (5)
Froes, R. L.
20465 (1); 24946 (1)
Froes, R. L. & Addison
29016 (1)
Glaziou, A. F. M.
9767 (1)
Gonggrijp, J. W.
4175 (5)
Guppy, N. G. L.
304 (4)
Jiménez-Saa, H.
1568 (4)
Killip, E. P. & Smith, A. C.
26502 (1)
Krukoff, B. A.
7944 (1)
Kuhlmann, J. G.
96 (1); 1607 (1)
Labouriau, L.
912 (6)
Lanjouw, J. & Lindeman, J. C.
2545 (5)
Lima, A.
49-369 (2); 50-700 (6); 52-1007 (2); 60-3443 (6); 60-3505 (6); 65-4270 (2)
Lima, A. & Magalhães, M.
52-1050 (6); 52-1075 (7)
Luis
13979 (1)
Magalhães, M.
6082 (6)
Melo, F. & Coelho, L.
4188 (1)
Oliveira, A. B.
68404 (6)
Oliviera, E.
2742 (1)
Oldeman, R. A. A.
B-1614 (5); 2625 (5)
Pires, J. M.
213 (1)
Pires, J. M. & Black, G. A.
930 (1)
Prance, G. T. et al.
3137 (1)
Riedel, L.
1 (1); s.n. (1)
Rodrigues, W. et al.
1877 (1); 4112 (1); 4473 (1); 4723 (1); 4811 (1)
Sagot, P.A.
1210 (5)
Schwacke, C. A.
3942 (1)
Schomburgk, Rich.
585 (1)
Schomburgk, Robt.
293 (1)
Schulz, J. P.
7926 (5)
Silva, N.T.
3024 (4)
Smith, A. C.
2772 (1); 2828 (1); 2991 (1); 2996 (1); 3147 (1); 3575 (1)
Snethlage
10058 (3)

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PROCEEDINGS
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THE "SEA FLEA" *DOLOBROTUS MARDENI* N. GEN., N. SP., A DEEP-WATER AMERICAN LOBSTER BAIT SCAVENGER (AMPHIPODA: EUSIRIDAE)

By Thomas E. Bowman
Smithsonian Institution, Washington, D. C. 20560

Amphipod crustaceans called "sea fleas" or "sand flies" are well known to American and Canadian lobstermen. These amphipods frequently scavenge the bait placed in lobster pots; they will also attack and devour trapped lobsters that have been wounded, but apparently do not molest uninjured lobsters.

Fishermen have been catching American lobsters in baited traps for well over a century, and we may suppose that amphipod scavengers have been feeding on the bait and have been noticed by fishermen for about the same length of time. Yet the voluminous literature on the delectable *Homarus americanus* contains no references to "sea fleas" until the appearance in recent decades of a few notes on these bait scavengers (Templeman, 1954, 1958; Scarratt, 1965; Shave, 1966). Thus far 2 species of "sea fleas" have been identified: *Anonyx sarsi* Steele & Brunel and *Orchomenella pinguis* (Boeck). Both are members of the family Lysianassidae, notorious for its scavengers in the cooler waters of the world oceans (references in Vader, 1972; see also Hessler, Isaacs and Mills, 1972; Bowman and Manning, 1972; Paul, 1973). Two additional amphipod species were collected recently from baited lobster pots by Luis Marden, Chief, Foreign Editoral Staff, National Geographic Magazine, while collecting information for an article about the American lobster (Marden, 1973). Mr. Marden kindly sent his specimens to me, and later forwarded other samples taken from lobster pots by William

Dion, Chief Engineer of the lobster trawler *Mars*. One of Mr. Marden's samples, collected near Petit Manan light, Maine (about 44°22′N), at a depth of about 20 m, contained numerous specimens of *Pontogeneia inermis* (Krøyer) and a single specimen of *Calliopius laeviusculus* (Krøyer). The other samples, collected from lobster pots set at greater depths at the edge of the continental shelf in the vicinity of Atlantis Canyon, south of Nantucket Island, Massachusetts, and almost due east of Philadelphia, Pennsylvania, contained specimens of the new genus and species described below.

EUSIRIDAE (SENSU BARNARD, 1972)

Dolobrotus, new genus

Antenna 1: slightly shorter than antenna 2, with small, apparently unarticulated accessory flagellum. Labium: without inner lobes. Mandible: 3rd segment of palp not widening distally, about ¾ length of 2nd segment. Maxilla 1: inner lobe with fully setose inner margin. Maxilla 2: inner lobe with oblique row of setae. Pereopods 1 and 2 (gnathopods): subchelate; propus sublinear, elongate, especially in pereopod 1; carpus not lobate, sublinear, elongate but shorter than propus; coxa of pereopod 1 slightly narrowing distally. Pereopods 5–7: basis and propus subequal in length. Uropod 3: rami subequal. Telson: cleft to midlength.

Type-species: *Dolobrotus mardeni*, new species.

Etymology: From the Greek "dolos" (= "bait") and "brotos" (= "eating"). Gender, masculine.

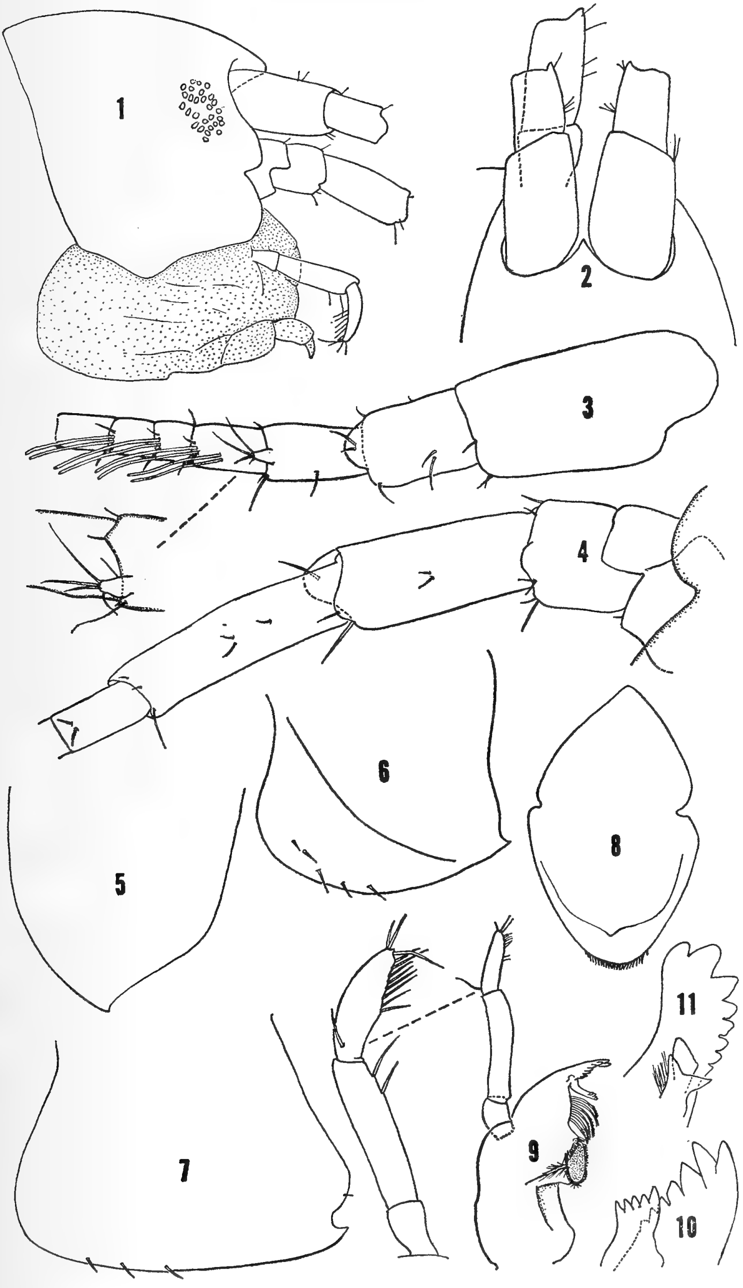
Dolobrotus mardeni, new species

Figures 1–27

Material examined (all from lobster pots set in the vicinity of Atlantis Canyon):—Holotype, 7.0 mm ovigerous ♀, (USNM 149127) and several hundred paratypes (149216), 2–4 miles W of Atlantis Canyon, 39°52′N, 70°12′W, depth 170–256 m, received 16 February 1973. 10 paratypes from this collection have been deposited in the National Museum of Natural Sciences, Ottawa, Canada.—25 paratypes (USNM 142192), vicinity of Atlantis Canyon, exact locality unknown, depth 90 m, received 22 August 1972.—Several hundred paratypes (USNM

→

FIGS. 1–11. *Dolobrotus mardeni*. 1, head, lateral; 2, head, dorsal; 3, antenna 1, medial; 4, antenna 2; 5–7, epimera of pleonites 1–3; 8, labrum; 9, left mandible; 10, incisor and lacinia of left mandible; 11, incisor of right mandible.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149217), northern edges of Atlantis Canyon, depth 75–165 m, received 4 May 1973.

Etymology: Named for Luis Marden, who first collected these amphipods and brought them to my attention.

Diagnosis: With the characters of the genus.

Additional description: Length of largest adult 8.5 mm. Eyes: difficult to discern in preserved specimens, without dark pigment; roughly oval in shape, with regular scattered ommatidia. Head: rostrum short, triangular in dorsal view, rounded in lateral view; lateral lobe with sloping dorsal margin and truncate vertical margin; anteroventral corner smoothly rounded. Pereon: smooth dorsal profile. Pereonites 1 and 2 with anterior part of dorsum elevated above posterior part. Pleon: epimera with posteroventral corners pointed; posterior margin above point with shallow concavity in pleonite 2, with deeper concavity in pleonite 3; pleonites 2 and 3 each with 3 spines along ventral margin, pleonite 2 with 2 additional spines anterior and slightly dorsal to marginal spines.

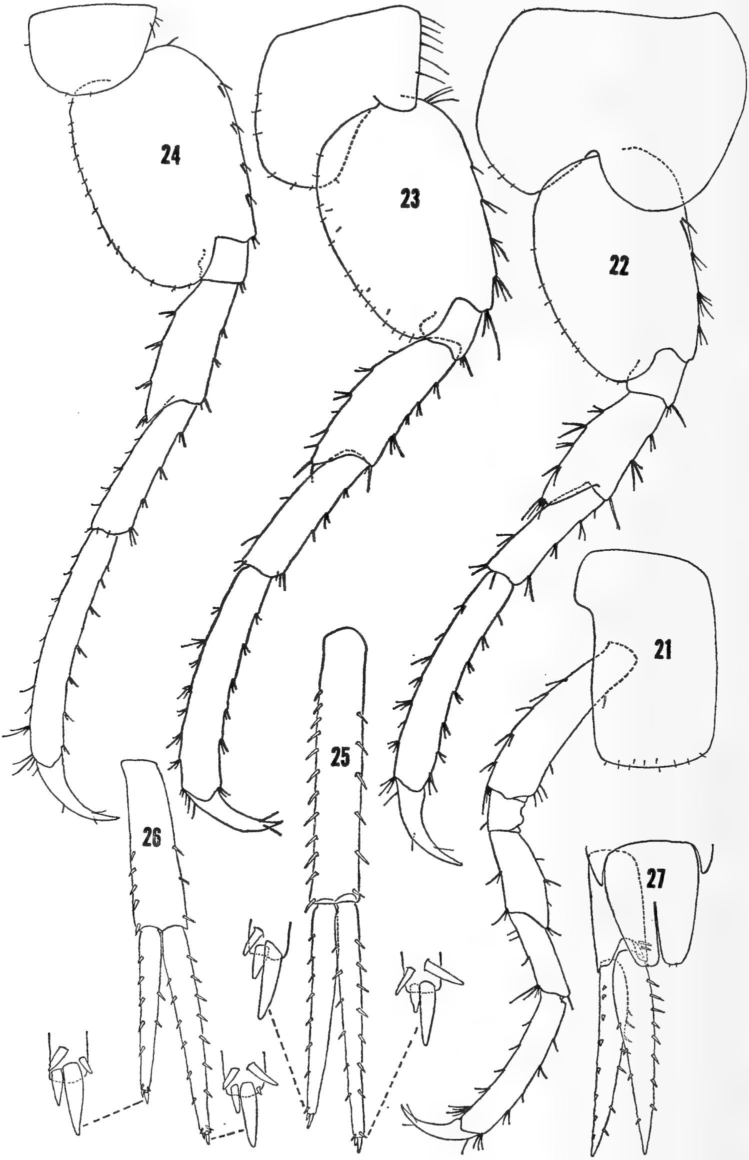
Antenna 1: slightly shorter than antenna 2; 2nd peduncular segment about half as long as 1st, distal margin produced medially into rounded lobe; 3rd peduncular segment subequal in length to 2nd, but narrower; accessory flagellum somewhat less than twice as long as wide, without basal suture separating it from 3rd peduncular segment, bearing 4 apical setae; flagellum with 19–26 segments. Antenna 2: about as long as head and pereon combined; 4th peduncular segment produced into rounded medial lobe; 5th peduncular segment subequal in length to 4th; flagellum with about 22 segments.

Epistome: pointed above, rounded anteriorly, separated from labrum by lateral notches. Labrum: rounded anteriorly; posterior margin evenly rounded, armed with close-set spinules.

Left mandible: incisor with 7–8 teeth; lacinia with 5 teeth; spine row with 6–7 spines. Right mandible: incisor with 8 teeth; spine row with about 8 spines, 2 spines adjacent to incisor broad, truncate, resembling noncuspidate lacinia. Labium: outer lobes densely setose; mandibular processes rather narrow, sublinear. Maxilla 1: inner lobe with about 17 setae along medial margin and a much longer terminal seta; outer lobe with 11 strongly pectinate terminal spines; palp with 11 terminal spines. Maxilla 2: inner lobe with 3 robust apical spines; outer lobe with about 9 stout spines along medial margin; palp with moderately broad 2nd segment and acutely produced distolateral corner of 3rd segment.

Pereopod 1: slender, subchelate, resembling that of *Leptamphopus*; coxa slightly narrowing distally, with rounded distal margin; carpus about ¾ as long as propus, both with densely setose posterior margins, their combined length subequal to that of basis. Pereopod 2: slender, subchelate; basis about ¼ longer than propus, widening distally; carpus about ⅘ as long as propus and slightly broader, both with densely setose posterior margins. Pereopods 3–4: basis slightly longer than propus, nearly linear; dactyl with inner and outer facial setae distally.

FIGS. 12–20. *Dolobrotus mardeni.* 12, labium; 13–15, maxilla 1: 13, inner lobe; 14, apex of outer lobe; 15, apex of palp; 16, maxilla 2, inner lobe (setae omitted except those in oblique row); 17, maxilliped; 18, pereopod 1; 19, pereopod 2; 20, palm and dactyl of pereopod 2 (most setae omitted).



FIGS. 21–27. *Dolobrotus mardeni.* 21–24, pereopods 4–7; 25, uropod 1; 26, uropod 2; 27, uropod 3 and telson.

TABLE 1. Comparison of some genera of Eusiridae.

	Dolobrotus	*Bouvierella*	*Djerboa*	*Leptamphopus*	*Oradarea*	*Schraderia*
Longer antenna	A2	A1	A1	A1	A2	A1
Accessory flagellum	short	absent	long, 1-seg.	absent	short	present
Labium, inner lobes	absent	absent	absent	absent	present	absent
Md palp segments 2 & 3	3 shorter	3 shorter	3 shorter	3 = 2	3 shorter	3 shorter
Mx 1 inner lobe	fully setose	setae reduced	fully setose	fully setose	fully setose	fully setose
Mx 2 inner lobe, oblique setae row?	Yes	?	Yes	Yes	Yes	Yes
P1–2, carpus & propus	elongate	slightly elongate	elongate	elongate	elongate	elongate
P3–7 subchelate?	No	Yes	No	No	No	No
Up 3 rami	subequal	subequal	exopod longer	endopod longer	endopod longer	subequal
Telson	cleft to midlength	Emarginate	cleft 4/5	notched	minute notch	cleft 4/5

Pereopods 5–7: P7 > P6 > P5; basis broadly expanded, slightly shorter than propus; dactyls with inner and outer facial setae distally.

Uropod 1: reaching distal end of uropod 3 and slightly beyond distal end of uropod 2; protopod slightly longer than exopod, both margins armed with spines, more numerous on lateral margin; endopod sublinear, slightly longer than exopod, both margins armed with spines, apex bearing 2 spines, lateral half as long as medial. Uropod 2: exopod similar to uropod 1, but protopod subequal in length to exopod, only ¾ length of endopod; exopod with 2 spines on medial margin. Uropod 3: rami lanceolate, with spines on both margins but not at apex. Telson: about ⅓ longer than wide; incised to midlength; each half of apex with minute indentation bearing spinule.

Relationships: *Dolobrotus* belongs to the family Eusiridae sensu Barnard (1972). Barnard (1964) had previously expanded the Eusiridae to incorporate the Pontogeneiidae. The addition of the Calliopiidae in 1972 was anticipated by his statement (1964:57), "The Calliopiidae are simply a mixture of eusirid and pontogeneiid types having the telsonic lobes completely fused." Bousfield (1973), however, did not accept Barnard's combining the Pontogeneiidae with the Eusiridae [Barnard's (1972) addition of the Calliopiidae appeared after Bousfield's book was in press]. My limited experience in gammaridean taxonomy deters me from taking part in the argument; I will only point out that those amphipod genera that appear to be closest to *Dolobrotus* include both Calliopiidae (*Bouvierella*, *Leptamphopus*, *Oradarea*) and Pontogeneiidae (*Djerboa*, *Schraderia*). A comparison of the principal features of all these genera is given in Table 1.

Distribution of lobster bait scavengers: The 2 species of Lysianassidae are panarctic species that occur also in Atlantic boreal waters. *Orchomenella pinguis* ranges south to North Carolina, but *Anonyx sarsi* only reaches Rhode Island (Steele and Brunel, 1968; Bousfield, 1973). Both are found on sandy bottoms, *O. pinguis* to depths of more than 100 m and *A. sarsi* down to about 50 m. Two of the reported attacks on trapped lobsters took place in Seal Cove, Grand Manan, New Brunswick, and the depths were shallow. Templeman's (1954) reported attacks by an amphipod later identified as *Orchomenella pinguis* (Templeman, 1958) took place at 3 fathoms (5.5 m), and the predation by *Anonyx sarsi* reported by Scarratt (1965) was on live lobsters that had been loaded into crates and left floating overnight. Shave (1966) did not give depths for his "sand fleas," identified by Roland Wigley as *Orchomenella* and *Anonyx*.

Pontogeneia inermis is an Arctic boreal species that ranges south in the western Atlantic to Long Island Sound. Bousfield (1973) characterized it as "An essentially pelagic cold-water species; clings to submerged plants and algae, from lower intertidal levels to more than 10 m." I am not aware of any previous reports of its having been attached to bait.

Dolobrotus mardeni appears to inhabit greater depths than the other known amphipod bait scavengers and probably has not been a pest to lobstermen until the recent development of setting pots at depths of about 100 to 350 m. Thus far it is known only from the vicinity of Atlantis Canyon (about 40°N, 70°10′W). A rather similar amphipod, *Leptamphopus sarsii* Vanhöffen, was recently taken in baited traps near Bergen, Norway, at 450 m, together with several species of Lysianassidae (Vader, 1972).

Predation on lobsters by amphipod bait scavengers: "Sea fleas" are a problem to lobster fishermen not only because they devour the bait in lobster pots, but also because in some circumstances they will attack trapped lobsters. Templeman (1954) noted that the shells of trapped lobsters that had been eaten by amphipods always had a new appearance and were not hard. He believed that these recently molted lobsters had been wounded by hard-shelled lobsters in the same pot, and that amphipods had been attracted to the wounds. Scarrett (1965) observed a lobster placed in an aquarium with a number of *Anonyx*. After 6 hours the lobster had not been attacked, but had eaten about a dozen amphipods. Scarrett concluded that healthy lobsters can resist attack except when their movements are restricted. Lobster fishermen also report that only wounded lobsters are attacked.

ACKNOWLEDGMENTS

I am grateful to Luis Marden and William Dion for collecting the specimens used in this study, to J. L. Barnard for discussions on the relationships of *Dolobrotus mardeni*, and to E. L. Bousfield for information on published accounts of amphipod bait scavengers.

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PROCEEDINGS
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EIGHT NEW *ASHMUNELLAS* FROM THE SOUTHWESTERN UNITED STATES (PULMONATA : POLYGYRIDAE)

By Joseph Vagvolgyi
Staten Island Community College,
Staten Island, New York 10301

Introduction

During the summers of 1967 and 1968 a search was made for *Ashmunellas* in the low mountains of Arizona, New Mexico and Texas. These mountains had been studied previously by very few malacologists, presumably because their barren appearance discouraged potential collectors. The mountains are deceptive, however, for many sustain land snail communities in protected canyons, rock slides or near the peak areas. Among the many species of land snails found, 8 forms of the genus *Ashmunella* proved to be new to science. Description of these forms and a critical reexamination of the taxonomy of several related *Ashmunella* species follows.

Acknowledgments

I am very grateful to Miss Cathy Corrigan, Messrs. Joe Jarvis and László Simon who accompanied me on the field trips; Dr. Joseph Rosewater, who made the collection of the United States National Museum of Natural History (USNM) available for comparative studies; Dr. Robert Robertson, who allowed me to use the collection of the Academy of Natural Sciences of Philadelphia (ANSP); Mrs. Morgan C. Rulon, who helped me to obtain Pilsbry's field notes; Dr. Kenneth J. Boss, who sent specimens of *Ashmunella bequaerti* for comparison. I am also very grateful to Messrs. J. M. Cox, Jack Hayter, Lotto Turner, Deryl York and many other ranchers who allowed collecting on their property, and the Headquarters of the Army, the Fort Bliss Military Reservation and the White Sand Missile Range who gave access to restricted areas. Special thanks are due to the rangers who escorted us in these areas and whose fabulous knowledge of the terrain helped our work considerably. The work was supported by Grant-in-Aid #89-2-B from the research foundation of the State University of New York; Grant #4838, Penrose Fund, from the American Philosophical Society.

TERMINOLOGY

The measurements and symbols used in this paper are explained in Fig. 1.

DESCRIPTIONS

The descriptions start with that of the nominal subspecies of *Ashmunella kochi.* Its description is necessary to provide a comparative basis for the descriptions of three new subspecies of *A. kochi* which follow, and to allow a more meaningful discussion of their relationships.

Ashmunella kochi Clapp
Ashmunella kochi kochi Clapp

Plate I, Figures 1, 1a; Figure 4a

Ashmunella kochii Clapp, 1908: 77, pl. 8, figs. 1–3. Black Mountains, San Andres Range, Doña Ana County, New Mexico. W. E. Koch. This locality appears erroneous, see discussion of distribution below.

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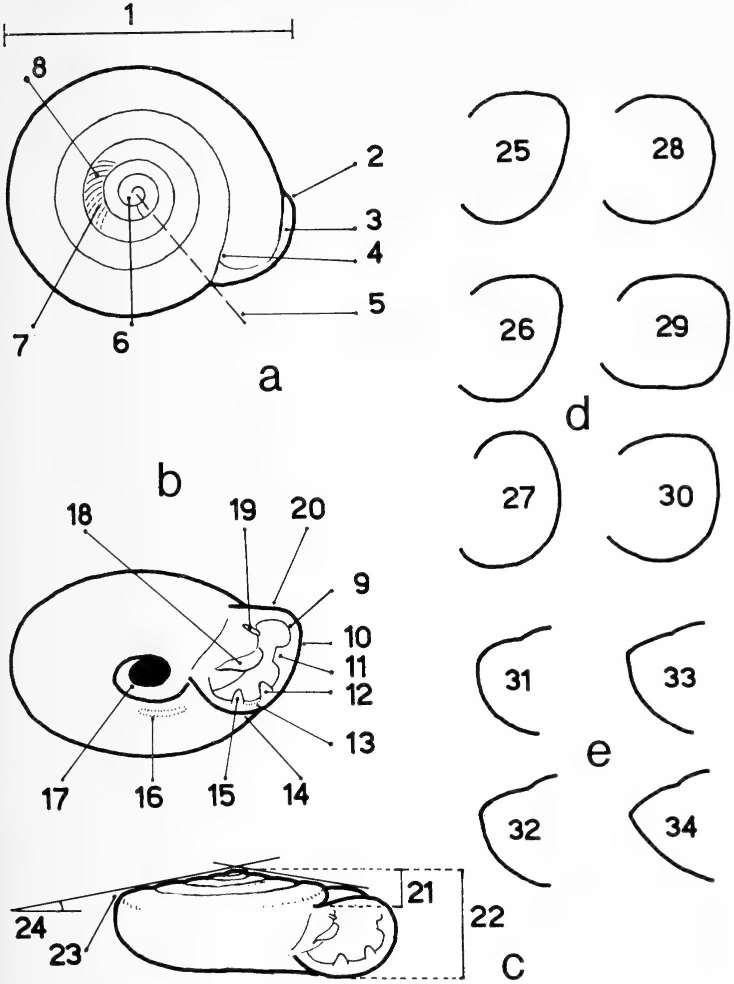
FIG. 1. Terms and standards of description. a, Shell in top view. 1, width; 2, reflected lip; 3, constriction or furrow behind lip; 4, ascending portion of last whorl; 5, whorl number; measured under dissecting microscope, using circular scale divided into 10 parts, apex of the shell pointing upward and being held in the center of scale; shell shown has 5.4 whorls; 6, embryonic shell; shell shown has 1.5 embryonic whorls; 7, granules, arranged in regressing radial rows; 8, striae, regressing radial in direction. b, Frontal view, shell tilted. 9, lip swelling; 10, outer lip; 11, outer lip tooth; 12, outer lamella of lower lip; 13, spout between outer and inner lower lip lamellae; 14, lower lip; 15, inner lamella of lower lip; 16, fulcrum or inner lamella, inside of shell; 17, umbilicus; 18, lower parietal lamella; 19, upper parietal lamella; shell shown has medium



thick lip swelling, wide and medium high outer lip tooth, medium large lower lip lamellae, long fulcrum, medium large lower parietal lamella and small upper parietal lamella; 20, upper lip. c, Frontal view, shell held horizontally. 21, spire; 22, height of shell; 23, left shoulder of last whorl; angularity of last whorl measured here, shell shown is rounded; 24, elevation of spire; (shell shown has 10° angle = flat) 7.5°–22.4° = flat, 22.5°–37.4° = moderately elevated; d, Aperture shape. 25, triangular; 26, auricular; 27, standing oval; 28, round; 29, rectangular; 30, angular; all but 29 round below. e, Angularity of last whorl, measured at left shoulder. 31, rounded; 32, slightly angular; 33, angular; 34, keeled.

George H. Clapp Collection, Pittsburgh, Pa. Lot labelled "Topotype, original lot [probably paratype]," ANSP 97640, 2 specimens, examined.

Ashmunella kochi Clapp.—Pilsbry, 1940: 976, figs. 566a–c.

Ashmunella kochi amblya Pilsbry, 1940: 977, fig. 566d. Pine Spring Canyon, Guadalupe Mountains, Culberson County, Texas. Type ANSP 164659, 1 specimen, examined.

Definition: *Ashmunella k. kochi* as defined here includes the current *A. k. kochi* and those populations of the current *A. k. amblya* which live in the Guadalupe Mountains, but excludes those living in the San Andres Range. The latter are considered a separate subspecies, *A. k. sanandresensis*; see below.

Material examined: 7 samples, 1–30 specimens each, 77 specimens altogether, from the ANSP and my own collection.

Description of shell: *Size and Shape*: Width 15.9–21.5 mm; spire flat and only very slightly convex or plane in contour; apex sometimes so depressed that it is level with right shoulder of last whorl when shell is held horizontally; height of shell 5.6–7.9 mm, height–width ratio, 0.30–0.40; last whorl slightly angular or angular on left shoulder, slightly or not at all ascending and then briefly but abruptly descending before aperture, constricted by a deep furrow behind outer and lower lips.

Growth pattern: The 4.9–5.7 whorls first increase gradually, but last whorl expands suddenly, particularly in larger specimens (Fig. 2b); coiling usually looser than average, whorl–width ratio, .25–.34; embryonic shell has 1.4–1.6 whorls.

Umbilicus: Narrow at beginning but becoming suddenly wider in last half of last whorl, diameter here reaching 4.0–7.1 mm; umbilicus–width ratio varies from .24 to .34.

Aperture: Angular to triangular—auricular above, round below; its plane slanted down and backward, somewhat concave when viewed from side; outer and lower lips reflected; lip swelling medium thick to thick, receded in upper lip, marginal in outer and lower, thus upper lip appears sharp, outer and lower, round.

Armature: Consists of 6 elements as follows: outer lip tooth, outer and inner lower lip lamella, upper and lower parietal lamella, and fulcrum (lamella deep inside of last whorl near umbilicus). Outer lip tooth medium high and variable in width, moderately or deeply receded and slanted down and inward; 2 lower lip lamellae medium large or large, outer one usually larger than inner one, lip swelling usually protruding between them to form a little spout; upper parietal lamella present in traces or completely absent, lower large and long; fulcrum moderately to well developed, ⅕ to ¼ of a whorl in length.

Sculpture: First whorl of embryonic shell smooth except near suture where it bears short radial striae; rest of embryonic shell covered with fine striae, some of which break up into rows of fine granules; this pattern persists for 1 or 2 more whorls, after that granules gradually disappear and striae become more widely and irregularly spaced.

Reproductive anatomy: As characteristic of *Ashmunella*, the spermatheca is long, cylindrical, without a terminal widening; the epiphallus is long, and the flagellum, vestigial (Fig. 4a). Three internal ridges run through the entire length of the epiphallus (see cross sections). All is in essential agreement with Pilsbry's drawing of the genitalia of *A. k. amblya* (1940: 916, from Pine Spring Canyon, Guadalupe Mountains, Texas). However, in my specimen the penial retractor is only attached to the penis and that region of the epiphallus next to it, whereas in Pilsbry's it is also attached to a point farther above on the epiphallus. The difference may be due to individual variation.

Taxonomy: *Ashmunella k. amblya* of Pilsbry is combined with *A. k. kochi* because their types are inseparable in shell features such as width, height, umbilicus, whorl number, apertural characteristics, etc. (Figs. 2a, 2b).

Distribution and ecology: *Ashmunella k. kochi* is restricted to the Guadalupe Mountains of Texas (Fig. 3). We found it in a very narrow and deep branch of Pine Spring Canyon, on the northern slope of Guadalupe Peak (8,751 ft.), at about 6,800–7,000 ft. of elevation, about 3 mi. west of Pine Spring. There was a nice stand of oak in the canyon. In spite of the heavy rains that fell prior to our visit, we only could find 20 live adult specimens in 4–5 hours of search. The snails were hiding under rocks and logs. Pilsbry described some of the localities he collected at in the area as "dry, stony hills," "terraced butte on dry canyon," etc.

The type-locality of *Ashmunella k. kochi* reportedly lies in the Black Mountains, San Andres Range, New Mexico. This locality appears erroneous for the following reasons. First, the type-specimens of *A. k. kochi* most closely match the types of *A. k amblya*, reportedly collected in Pine Spring Canyon, Guadalupe Mountains, which appear authentic because they match other populations collected in that same mountain range. Second, populations of *A. k. kochi* other than the types do not occur in the San Andres Range; they seem only to occur in the Guadalupe Mountains. Third, in the San Andres Range, of which Black Mountains are a part, another subspecies of *A. k. kochi* occurs, *A. k. sanandresensis*; this subspecies differs significantly from the types of *A. k. kochi.* Fourth, another subspecies, *A. k. cornudasensis* occurs in the Cornudas Mountains, which lie halfway between the areas of the two subspecies in question (Fig. 3), which fact makes it unlikely that *A. k. kochi* could occur in identical forms at both ends of the range. All these considerations seem to indicate to me that the types of *A. k. kochi* do, in fact, come from the Guadalupe Mountains, not from the San Andres Range as accepted today. But until further studies I leave the status quo unchanged.

Ashmunella kochi cornudasensis, new subspecies
Plate I, Figures 2–2a; Figure 4b

Holotype USNM 701251, deposited in the United States National Museum of Natural History, Washington, D.C. Paratypes in the collection of the author. Type-locality: Wind Mountain, Cornudas Mountains, Otero County, New Mexico.

Material examined: 1 sample, 3 specimens altogether, from my own collection.

Description of shell: *Size and shape*: Width of shell 17.9–18.2 mm; spire flat or moderately elevated, very slightly convex or plane in outline; height 7.4–8.1 mm, height—width ratio 0.41–0.45; last whorl angular at left shoulder, descending briefly before aperture, constricted by a deep furrow behind outer and lower lips.

Growth pattern: The 5.3–5.4 whorls widen gradually; coiling is loose, whorl—width ratio varies from 0.29 to 0.30; embryonic shell has 1.4–1.5 whorls.

Umbilicus: Very narrow at beginning, almost point-like, widening suddenly in last part of last whorl; umbilical diameter here is 3.8–4.2 mm, umbilicus—width ratio, 0.21–0.23.

Aperture: Auricular or angular above, round below, its plane concave and strongly slanting down and backward in side view; outer and lower lips reflected; lip swelling medium thick, receded from edge of lip above outer lip tooth, marginal below it, therefore former region appears sharp, the latter, round.

Armature: Consists of same elements as in nominal subspecies; outer lip tooth medium large, wide, receded and slanted down and inward; 2 lamellae on lower lip medium large, outer usually stronger than inner; lip swelling forms a spout between them; lower parietal lamella medium high and long, upper, very weak and short; they converge inward but do not fuse at their inner end; fulcrum moderately large.

Sculpture: Embryonic whorls smooth except below suture where very fine, short striae are visible; postembryonic whorls bear a fine striation.

Reproductive anatomy: Reproductive organs essentially as in *Ashmunella k. kochi* (Fig. 4b) except that spermatheca is somewhat shorter and penial retractor is attached to epiphallus both near penis and at a point farther above; when the retractor contracts, it throws the lowest section of the epiphallus into a loop. Also, a minor ridge is noticeable in cross sections of the middle epiphallus beside the 3 major ridges, and the penis has much thicker walls and smaller ridges than in nominal subspecies.

Similarities and differential diagnosis: *Ashmunella k. cornudasensis* closely resembles *A. k. kochi* in apertural features and armature. Its higher spire, narrower umbilicus and angular last whorl clearly differentiate it, however, from that subspecies (Table 1). In the angularity of the last whorl it resembles *A. b. mudgei*; this appears to be a superficial parallelism, however, because the growth pattern and the apertural features are very different in the two forms.

Name: The name *cornudasensis* refers to the Cornudas Mountains where the subspecies was found.

Distribution and ecology: *Ashmunella k. cornudasensis* is a geographic isolate of *A. kochi* (Fig. 3). It is only known from Wind Mountain, Cornudas Mountains, New Mexico, about 18 mi. north of Cornudas, Hudspeth County, Texas. We collected on the northwestern slope, in a small, very steep canyon, some hundred feet below the peak (the elevation of which is 7,280 ft.). The vegetation was rather sparse in the habitat, and so were the snails. In several hours of search we found only 3 live specimens; one was crawling on the underside of a boulder we turned over, 2 others were copulating under another big rock. The ground was still moist from storms a few days before, and we expected to find more snails. It is possible that additional specimens would have been found at slightly higher elevations.

Ashmunella kochi sanandresensis, new subspecies

Plate I, Figures 3–3a; Figure 4c

Holotype USNM 701252, deposited in the collection of the United States National Museum of Natural History, Washington, D.C. Paratypes in the collection of the author. Type-locality: Western slope of San Andres Peak, San Andres Range, Doña Ana County, New Mexico.

Definition: *Ashmunella k. sanandresensis* includes those populations of the former *A. k. amblya* which live in the San Andres Range, but excludes those which live in the Guadalupe Mountains. The latter is synonymized here with *A. k. kochi.* The reason for this procedure is that the San Andres populations differ so much from the Guadalupe populations (Fig. 2a; Table 1) that they have to be treated as a separate taxonomic unit.

Material examined: 2 samples, 8–23 specimens each, 31 specimens altogether, from the collection of the Academy of Natural Sciences of Philadelphia and my own collection.

Description of shell: *Size and shape*: Width of shell 14.5–18.4 mm; spire flat or sometimes moderately elevated, very slightly convex or plane in contour; height 5.2–6.7 mm, height-width ratio, 0.34–0.42; last whorl slightly angular at left shoulder, gently ascending and then briefly but abruptly descending before aperture, constricted behind outer and lower lips.

Growth pattern: The 5.1–5.7 whorls increase gradually; coiling average in tightness, whorl-width ratio varies from 0.31–0.36; embryonic shell consists of 1.5–1.6 whorls.

Umbilicus: Narrows at beginning but suddenly expanding in last part of last whorl, reaching a diameter of 5.7–6.5 mm and an umbilicus-width ratio of .30–.38; however sudden this expansion may appear, it is less sudden than in the related species *A. auriculata.* This is shown by the fact that the first part of the umbilical diameter (U1, Fig. 2c) is nearly equal to the second part (U2), values for U1 being 2.2–3.4 mm and U2, 2.4–3.4, whereas in *A. auriculata* U2 values are definitely greater than U1 values.

Aperture: Rounded auricular or rounded angular above, round below, its plane concave and slanting down and backward when viewed from side; outer and lower lips reflected; lip swelling medium thick, receded in region above outer lip tooth, marginal below it, hence former region is sharp, latter, round.

TABLE 1. Comparison of some shell features of *Ashmunella auriculata* and 4 subspecies of *Ashmunella kochi.* Good distinguishing features are marked with an asterisk (*); weak ones with a dagger (†). Differences between *A. auriculata* and *A. kochi* ssp. are numerous and great, whereas among latter, relatively slight. Height/width and umbilicus/width ratios for *A. k. cornudasensis* are rated as weak distinguishing characters even though they do overlap comparable values of other taxa and thus appear as very good ones; sample of *A. k. cornudasensis* is composed of only 3 specimens and it is presumable that were sample larger, variation would be greater and there would be some overlap with other taxa.

Character	*A. k. kochi*	*A. k. cornudasensis*	*A. k. sanandresensis*	*A. k. caballoensis*	*A. auriculata*
Width in mm	15.9–21.5	17.9–18.2	14.5–18.4	15.3–20.5	11.5–12.9*
Height/width ratio	.30–.40	.41–.45†	.34–.42	.34	.35–.40
Growth pattern	last whorl suddenly widens (Fig. 2b)†	whorls gradually increasing			
Whorl/width ratio	.25–.34	.29–.30	.31–.36	.28–.34	.40–.42*
Umbilicus	rapidly expands in last part of last whorl				very rapidly expands in last part of last whorl*
Umbil./width ratio	.24–.34	.21–.23†	.30–.38	.26–.34	.30–.35
Left shoulder	slightly angular	angular*	slightly angular		
Aperture shape	angular to triangular-auricular†	angular to auricular†	rounded angular to rounded auricular	round, round-angular to round-auricular	round-auricular to standing oval-auricular†

Table 1. Continued.

Character	*A. k. kochi*	*A. k. cornudasensis*	*A. k. sanandresensis*	*A. k. caballoensis*	*A. auriculata*
Outer lip tooth	medium large, variable in width	medium large, wide	medium large, rather narrow†	medium large, medium wide to wide	large, medium wide†
Constriction behind lips	behind outer and lower lips only				behind upper, outer and lower lips*
Fulcrum	medium to large	medium		large to totally absent	absent*
Upper parietal lamella	usually absent, barely visible when present†	very weak and short		very weak and short, sometimes only in traces	short and small†
Ascension of last whorl	very slight				pronounced*

Armature: Consists of same elements as in *Ashmunella k. kochi*; outer lip tooth medium large, rather narrow, receded from margin of aperture, slanted down and inward; lower lip lamellae medium large although outer lamella usually slightly larger than inner; both protrude slightly from aperture, and there is often a spout between them formed by a protrusion of lower lip swelling; upper parietal lamella very weak and very short, sometimes only in traces, while lower one is moderate or strong and long; both converge inward but remain separate; fulcrum medium large.

Sculpture: Embryonic whorls covered from suture to suture with closely packed, fine striae many of which are broken up into long, transverse granules; exception is apex of shell which is smooth; on postembryonic whorls both striae and granules become more widely spaced, and on last whorls the granules gradually disappear.

Reproductive anatomy: *Ashmunella k. sanandresensis* is like *A. k. cornudasensis* in all features except that the lower section of the epiphallus is wider and has a much wider lumen with 4 ridges (Fig. 4c). This is remarkable since in shell features, especially in the height and the angularity of the last whorl the subspecies is closer to the nominal subspecies than to *A. k. cornudasensis.* It may be that the penis is contracted to a different degree in the dissected specimens, and this makes the difference.

Differential diagnosis: The distinguishing characteristics of the subspecies are summarized in Table 1.

Name: The name *sanandresensis* refers to San Andres Range where the subspecies occurs.

Distribution and ecology: *Ashmunella k. sanandresensis* is a geographic isolate of *A. kochi* (Fig. 3). It is known from 2 localities in the San Andres Range, both on the western slope of San Andres Peak (8,239 ft.), near Ropes Spring, 28 mi. northeast of Las Cruces, Doña Ana County, New Mexico. Pilsbry and Ferriss first found the snails in 1922; they collected in a ravine southeast of the spring, rather deep under stones; elevation was not given. I found the snails for the second time in 1967 at a locality far above the spring, at the foot of a low, north facing cliff, under small rocks, deep in the dirt, under brush oak; elevation was about 7,000 ft. The terrain generally was rocky, with sparse vegetation. Despite the heavy storm of a few days before, I found very few live specimens.

The specimens that Pilsbry and Ferriss collected are noticeably larger than the ones I found (16.5 versus 15.2 mm mean sample width). The reason for the size difference is not known.

Ashmunella kochi caballoensis, new subspecies

Plate I, Figures 4–4a; Figure 4d

Holotype and one paratype deposited in the collection on the United States National Museum of Natural History, Washington, D.C., USNM

701253 and 706822, respectively. Other paratypes in the collection of the author. Type-locality: Brushy Mountain, Caballo Mountains, Sierra County, New Mexico.

Material examined: 1 sample, 30 specimens, from my collection.

Description of shell: *Size and shape*: Shell width 15.3–20.5 mm; spire moderately elevated or flat, sometimes so flat that right shoulder of last whorl is level with apex of shell when held horizontally; shell height 6.0–8.2 mm, height-width ratio, 0.34–0.46; last whorl round or slightly angular at left shoulder, at the most (as in the flattest specimens) slightly ascending and then briefly but abruptly descending before aperture, constricted by deep furrow behind outer and lower lips.

Growth pattern: The 5.2–5.7 whorls are evenly although fairly rapidly expanding; whorl-width ratio 0.28–0.34, coiling looser than average; embryonic whorls number 1.5–1.7.

Umbilicus: Narrow at beginning, but expanding suddenly in last part of last whorl reaching diameter of 4.0–7.0 mm; umbilicus-width ratio varies from 0.26 to 0.34.

Aperture: Round, rounded-angular or rounded-auricular above, round below; plane of aperture concave to varying degrees and slanting down and backward when viewed from side; outer and lower lips reflected; lip swelling medium thick or thick, receded in region above outer lip tooth while marginal below it, thus lips appear sharp in former region, round in latter.

Armature: Consists of 6 elements as usual in species; outer lip tooth medium large, moderately wide or wide, receded and often slanted down and inward; lower lip lamellae both large or very large with outer being usually larger than inner lamella; lip swelling often forms a spout between them; lower parietal lamella medium large or large and long, upper, small or very small and short, sometimes only present in traces; the two parietal lamellae converge inward but fuse only exceptionally; fulcrum may be large, small or totally absent.

Sculpture: Embryonic whorls smooth except below the suture where they bear very fine, regularly arranged striae; rest of shell with a somewhat coarser and more irregular striation.

Reproductive anatomy: Agrees in all essential features with *Ashmunella k. cornudasensis* (Fig. 4d); the differences are that one of the 3 internal ridges is slightly subdivided in the lower region of the epiphallus, and that the penis has very thick walls and 6–7 small ridges.

Differential diagnosis: The distinguishing features of the subspecies are summarized in Table 1.

Name: The name *caballoensis* refers to Caballo Mountains, the type-locality of the taxon.

Distribution and ecology: *Ashmunella k. caballoensis* is a geographic isolate of its species (Fig. 3). It occurs only on Brushy Mountain, Caballo Mountains, New Mexico. We collected it on the north face just below the peak, at an elevation of about 7,200–7,300 ft. The snails live under the small, loose rocks and dirt that accumulated at the foot of the huge cliffs forming the peak. The vegetation was sparse with juniper, brush oak, creosote, yucca, etc. being the more conspicuous elements. The soil was still wet from the rains that fell a few days before our visit, yet we only could find 18 live, adult specimens, most of them deep underground. Empty shells were abundant.

Taxonomy of Ashmunella kochi: The species as defined here consists of 4 subspecies, 3 of which are newly described, while the remaining one, the nominal subspecies, is the result of the synonymization of 2 previously recognized taxa. Considering that the 4 taxa recognized as valid in this paper are but geographic isolates of the same entity, each with some morphological distinction, some investigators may wish to rank them as separate full species. My reasons for treating them as conspecific subspecies are 2. First, the 4 taxa in shell features differ from one another less than any one of them does from other, related forms, e.g. *A. auriculata*. Second, the differences in reproductive anatomy between them are minute.

Ashmunella auriculata, new species

Plate I, Figures 5–5a

Holotype USNM 701254, deposited in the collection of the United States National Museum of Natural History, Washington, D.C. Paratypes in the collection of the author. Type-locality: Boulder Canyon, Organ Mountains, Doña Ana County, New Mexico.

Material examined: 1 sample, 13 specimens, from my own collection.

Description of shell: *Size and shape*: Width of shell 11.5–12.9 mm; spire flat, sometimes so much so that ascending portion of last whorl may be higher than apex when shell is held horizontally; spire very slightly convex or plane in outline; height of shell 4.3–5.0 mm, height-width ratio 0.35–0.40; last whorl slightly angular at left shoulder, ascending decidedly and then descending abruptly before aperture, constricted from suture to suture behind lips.

Growth pattern: The 4.8–5.3 whorls increase slowly, gradually; coiling moderately tight; whorl-width ratio ranges from 0.40 to 0.42; embryonic shell consists of 1.5–1.6 whorls.

Umbilicus: Narrow at beginning but suddenly very greatly expanding in last part of last whorl which renders it oval shaped, and makes diameter of last part of umbilicus greater than that of first part (Fig. 2c, U2 and U1 values); umbilical diameter 3.5–4.4 mm, U1 values 1.3–1.9 mm, U2, 2.1–2.6 mm; umbilicus-width ratio 0.30–0.35

Aperture: Rounded-auricular or standing oval-auricular above, round below, its plane concave in side view and slanted down and backward; lips reflected all around; lip swelling medium thick, marginal or slightly receded above outer lip tooth, marginal or protruding below it, hence lips are sharp in former region, round or bulging in latter.

Armature: Composed of 5 elements: outer lip tooth, moderately wide and high, sometimes bicuspid, slightly or deeply receded and slanted down and inward; outer and inner lamellae on lower lip, medium large, or large, sharp blade protruding from aperture; often a spout between them formed by protrusion of lower lip swelling; upper parietal lamella short and weak, lower parietal lamella very strong and long; they converge inward but do not fuse at their inner end. The fulcrum which forms the sixth element in the armature of the related species *A. kochi* is missing.

Reproductive anatomy: Unknown. There are no live specimens available for study.

Similarities and differential diagnosis: *Ashmunella auriculata* closely resembles *A. kochi* in apertural features. However, the high whorl-width ratio, the pronounced ascension of the last whorl upon the penultimate one, the suture-to-suture constriction behind the completely reflected lips, the oval umbilicus, the standing oval-auricular aperture and the absence of the fulcrum are more than enough to distinguish this species from any of the 4 subspecies of *A. kochi* (Table 1).

Taxonomy: Considering that in apertural features *Ashmunella auriculata* is similar to *A. kochi*, and that it is isolated but occurs near the area of one of the subspecies of *A. kochi*, *A. k. sanandresensis*, some malacologists may wish to consider it just another subspecies of that species. As the great number of distinguishing features listed above indicates, however, *A. auriculata* is more different from any subspecies of *A. kochi* than the latter are from each other. Therefore, it seems best to rank it as a full species. While the facts that the ascension of the last whorl, the shape of the umbilicus and that of the aperture may be correlated characters (and a slight ascension also is noticeable in some specimens of *A. kochi*) weaken this conclusion somewhat, they do not seem to invalidate it.

Name: The name *auriculata* refers to the shape of the aperture, which is more auricular than in related species.

Distribution and ecology: *Ashmunella auriculata* is a geographic isolate of the *A. kochi* group. To date it has been found only in Boulder Canyon, in the southern part of Organ Mountains, about 14 mi. east of Las Cruces, Doña Ana County, New Mexico (Fig. 3). The snails were found in the narrow upper part of the canyon, at about 6,500–6,800 ft. of elevation, under dirt and small rocks that accumulated at the foot of the precipitous eastern wall of the canyon. The cliffs provided some shelter, but otherwise the canyon was exposed to the scorching sun and was very dry and barren.

The discovery of *Ashmunella auriculata* in Organ Mountains was surprising since another species of *Ashmunella*, namely *A. organensis* of Pilsbry, was already reported from there, and only a small area is involved. I first assumed that some error was made in labelling the localities, and checked both my collection and Pilsbry's field book. I have found some discrepancies and some data are missing from the latter; nevertheless, the localities appear correct. Thus it seems that 2 species of *Ashmunella* occur in Organ Mountains.

Ashmunella macromphala, new species

Plate I, Figure 7; Figure 5a

Holotype and 1 paratype deposited in the collection of the United States National Museum of Natural History, Washington, D.C., USNM 701256 and 706823, respectively. Other paratypes in the collection of the author. Type-locality: Cooks Peak, Luna County, New Mexico.

Material examined: 1 sample, 30 specimens, from my collection.

Description of shell: *Size and shape*: Width of shell 12.5–14.9 mm; spire flat or sometimes moderately elevated, plane or slightly convex in outlines; height of shell 5.4–6.5 mm, height-width ratio 0.40–0.51; last whorl slightly angular or angular on left shoulder, briefly descending before aperture, constricted by deep furrow behind lips in region of outer lip tooth and below it.

Growth pattern: The 5.0–5.4 whorls are evenly expanding and moderately tightly coiled; remarkably, the whorl number varies independently of the width of the shell (Fig. 2a), whereas usually the two characters are positively correlated: It is possible, however, that correlation would become evident if more samples were studied; whorl-width ratio 0.35–0.43; embryonic shell has 1.5–1.6 whorls.

Umbilicus: Wide from very beginning so that one can see underside of first whorls; in last part of last whorl umbilicus widens even more, reaching a diameter of 2.7–4.3 mm, and an umbilicus-width ratio of 0.21–0.29.

Aperture: Round, rounded-angular or rounded-auricular above, round below; its plane slanted down and backward, concave in side view, sometimes pronouncedly so; lips reflected in region of outer lip tooth and below it, thus paralleling extent of constriction behind lips; lip swelling medium thick at most, receded above outer lip tooth, marginal below it, therefore lip appears sharp in former region while round in latter.

Armature: Consists of 5 elements: outer lip tooth, medium large and medium wide or wide, receded and slanted down and inward; outer and inner lower lip lamellae both medium large although outer usually somewhat larger than inner; lower lip often bears a spout-like protuberance between these two lamellae; fourth and fifth elements are 2 parietal lamellae which converge inward although remaining separate along their entire length; upper parietal lamella very short and small, sometimes only in traces; lower parietal lamella medium large and long.

Sculpture: Embryonic whorls completely covered with fine, closely packed striae which sometimes break up into long transverse granules; post embryonic whorls bear a similar sculpture except that striae are somewhat coarser and more widely spaced.

Reproductive anatomy: The long epiphallus, the vestigial flagellum and the long, cylindrical spermatheca are typical ashmunelloid features (Fig. 5a). The inner structure of the epiphallus is characterized by 3 longitudinal ridges which run through its entire length. The distinguishing features are: the hermaphroditic gland is not subdivided; the penial retractor is attached to a long section of the epiphallus above the penis, thus contraction of the retractor muscle forces the epiphallus into at least 2 loops; the penis sac is quite large in comparison to the vagina, its wall is relatively thin and its lumen wide, with 2 major and 7 or 8 minor internal ridges; the atrium is small.

Similarities and differential diagnosis: In regard to the aperture and the armature, *Ashmunella macromphala* is very similar to *A. kochi*. Its main distinguishing feature is the umbilicus which is wide throughout whereas in the *A. kochi* group it is narrow at the beginning and wide only in the last part of the last whorl. In the structure of the epiphallus, too, an agreement exists between the 2 species. The large penis clearly distinguishes *A. macromphala* from the *A. kochi* group. In fact, the shape and structure of the penis somewhat resembles that of *A. mogollonensis* (Pilsbry 1940, Fig. 524:3).

Taxonomy: *Ashmunella macromphala* is considered a full species because of the distinguishing features in its shell and in its reproductive anatomy, and because of its isolated distribution. Its nearest relatives appear to be the members of the *A. kochi* group, with which it shares apertural features and epiphallic structure, and possibly *A. mogollonensis*, with which it agrees in some features of the penis.

Name: The name *macromphala* refers to the most distinguishing feature of the species, the large umbilicus.

Distribution and ecology: *Ashmunella macromphala* is only known from Cooks Peak, New Mexico (Fig. 3). We collected the snails on the very steep northern slope of the peak, at about 6,900–7,000 ft. of elevation, at the edge of 2 huge rock slides, from under the rocks and the debris accumulated between them. Groups of oak bordered the rock slides, providing food and shelter for the snails. The debris was dry, it did not rain for weeks prior to our visit; yet we found 80–90 live adult snails at one of the rock slides. At the other, which was located merely a quarter of a mile to the east, we only found 20–30 empty shells.

Ashmunella animasensis, new species

Plate I, Figure 8

Holotype USNM 701282, deposited in the collection of the United States National Museum of Natural History, Washington, D.C. Paratype in the collection of the author. Type-locality: Animas Peak, Hidalgo County, New Mexico.

Material examined: 1 sample, 2 specimens, from my own collection.

Description of shell: *Size and shape*: Width of shell 11.9–12.0 mm; spire moderately elevated and slightly convex in contours; height of shell 5.4–6.0 mm, height-width ratio 0.45–0.50; last whorl slightly angular on left shoulder, very slightly descending before aperture, constricted by a deep furrow behind lips below right shoulder.

Growth pattern: The 6.1–6.2 whorls increase very slowly, gradually, coiling very tight, whorl-width ratio in both shells 0.51; embryonic shell consists of 1.4 whorls.

Umbilicus: Narrow at beginning but suddenly expanding in last part of last whorl, its diameter here reaches 2.3–2.4 mm; umbilicus-width ratio 0.19–0.20.

Aperture: Rectangular or auricular-rectangular, its plane slanted down and backward and hardly concave in side view; outer and lower lips reflected; lip swelling medium thick, receded in upper lip, nearly marginal in outer, and slightly protruding in lower; therefore upper lip is sharp, the outer and lower, round.

Armature: Consists of 1 tooth in outer lip, 2 in lower, and 1 lamella on parietal wall; outer lip tooth low but very wide, sometimes bifid, slightly receded and slanted down and inward; outer lip tooth of lower lip medium sized, inner lip tooth a small structure, both situated near middle of lower lip; lip swelling protrudes between them like a spout; parietal lamella moderately or strongly developed, straight; it corresponds in position to lower parietal lamella of the *Ashmunella kochi* group.

Sculpture: The 2 shells available for description are somewhat worn and therefore fine details of the sculpture are difficult to discern; but apparently the sculpture solely consists of fine striae both on the embryonic and postembryonic whorls.

Reproductive anatomy: Not known.

Relationships and differential diagnosis: *Ashmunella animasensis* is most similar to *A. proxima* of the Chiricahuas in size and coiling pattern, but to *A. pilsbryana* of the Mogollons, in apertural features. The true relations are probably to the Chiricahua species, because that range lies only 25 mi. from Animas Peak, whereas the Mogollons are about 120 mi. away.

Ashmunella animasensis is not identical with *A. tetrodon animorum* of Pilsbry and Ferriss, 1917.

Name: The name *animasensis* refers to Animas Peak, where the species was discovered.

Distribution and ecology: *Ashmunella animasensis* is restricted to Animas Peak, New Mexico (Fig. 3). It is a geographic isolate, presumably of *A. proxima* which lives in the nearby Chiricahua Mountains. The collecting site was on the western side of Animas Peak (8,519 ft.), somewhat below the summit, at an estimated elevation of 7,500–8,000 ft. Pine, oak and juniper grew in abundance on the slope, indicating a fair amount of precipitation. At the time of our visit, however, everything was dry. We had to dig about 2 ft. in loose dirt and rock before we found a couple of live adult specimens and a few empty shells.

Ashmunella salinasensis, new species

Plate I, Figure 9; Figure 5b

Holotype USNM 701257, deposited in the collection of the United States National Museum of Natural History, Washington, D.C. Paratypes in the collection of the author. Type-locality: Salinas Peak, Socorro County, New Mexico.

Material examined: 1 sample, 20 specimens, from my collection.

Description of shell: *Size and shape*: Width of shell 12.9–14.6 mm; spire flat or moderately elevated, its contours plane or very slightly convex; height of shell 6.0–7.3 mm, height-width ratio 0.44–0.51; last whorl slightly angular on left shoulder, very slightly descending before aperture, constricted behind lips; constriction very shallow near origin of upper lip (where latter fuses with parietal wall), considerably deeper elsewhere.

Growth pattern: The shell is formed by 4.8–5.2 gradually to rather rapidly expanding whorls; coiling moderately tight, whorl-width ratio 0.35–0.38; embryonic shell has 1.3–1.6 whorls.

Umbilicus: Narrow at beginning but suddenly expands in last part of last whorl where its diameter is 2.8–3.8 mm; umbilicus–width ratio varies between 0.22 and 0.28.

Aperture: Round, rounded-rectangular or rounded-auricular above, round below, its plane slanted down and backward, exceptionally with slight concavity in region of outer lip tooth when viewed from side; upper lip slightly, the outer and lower, very much reflected; lip swelling medium thick or thick, running near edge of lips except near origin of upper lip where receded, hence lips swollen except in latter region where sharp.

Armature: Consists of 3 elements: outer and lower lip teeth and parietal lamella; outer lip tooth has degenerated into a barely recognizable thickening of lip swelling or completely disappeared; lower lip tooth is a minuscle protuberance or again may be completely absent; parietal lamella, corresponding to lower parietal lamella of *A. kochi*, may be very short and low, may be present in traces or may be completely absent; about ⅔ of specimens have no armature at all.

Sculpture: Embryonic whorls ornamented with fine striation except on smooth apex; some striae may break up into rows of long, transverse granules; this pattern persists for first 2 or 3 postembryonic whorls; thereafter moderately strong ribs replace striae, numbering 33–39 on last whorl.

Reproductive anatomy: Spermatheca long, cylindrical, without a terminal sac, epiphallus long, and flagellum vestigial, as usual in *Ashmunella* (Fig. 5b). Upper epiphallus characterized internally by 3 longitudinal ridges and several minute wrinkles, which features occur in many congeners. However, spermatheca is unusually swollen (had the specimen just mated?) and middle region of epiphallus has a section about 3.7 mm long inflated to about 1½ times normal diameter with walls and 3 internal ridges being stretched out thin; particularly, this latter feature is distinctive. Penis has 3 major, subdivided ridges and 4–6 minor ones.

Similarities and differential diagnosis: *Ashmunella salinasensis* is very similar in shell features to the *A. rhyssa* group. It is distinguishable from the latter by its smaller and flatter shell and much wider umbilicus. Anatomically it is difficult to relate to any group; the inflation of the middle epiphallus is a unique feature. It is fair to say that nothing in the anatomy contradicts the conclusion concerning its relationships reached on conchological grounds.

Taxonomy: On the basis of its isolated distribution and moderate degree of distinction in shell morphology, *A. salinasensis* could be ranked either as a subspecies of *A. rhyssa* or as a separate species. Its uniqueness in anatomical features lends support to the latter alternative.

Name: The name *"salinasensis"* refers to Salinas Peak where the species was found.

Distribution and ecology: *Ashmunella salinasensis* is a geographic isolate of the *A. rhyssa* group (Fig. 3). It occurs solely on Salinas Peak (8,958 ft.), New Mexico, while the *A. rhyssa* group is widespread in the Sierra Blanca Mountains, about 35 mi. to the east. The collecting site was on the northern slope of the peak, near the summit, at about 8,500–8,800 ft. elevation. The road leading to the summit was met here by the upper end of a huge rock slide. Several groups of oak trees occurred at the edge and inside the rock slide, forming small green islands on the otherwise barren mountainside. We found many live snails in these patches, under rocks in the dirt and litter. We also collected at another rock slide further down along the road, at about 7,200–7,800 ft. elevation on the northwestern slope, but there found only *Sonorella.*

Ashmunella pasonis polygyroidea, new subspecies

Plate I, Figure 10

Holotype USNM 701225, deposited in the collection of the United States National Museum of Natural History, Washington, D.C. Paratypes in the collection of the author. Type-locality: Franklin Mountain, El Paso County, Texas.

Material examined: 1 sample, 3 specimens, from my collection.

Description of the shell: *Size and shape*: Width of shell 14.1–14.8 mm; spire nearly or completely flat, plane or very slightly convex in outline; height of shell varies from 4.9 to 5.1 mm, height-width ratio 0.34–0.35; last whorl angular at left shoulder, ascending and then briefly but very abruptly descending before aperture, with deep constriction behind outer and lower lips, with a shallow constriction or none behind upper lip.

Growth pattern: The 5.0–5.1 whorls expand slowly, gradually; coiling moderately tight, whorl-width ratio 0.34–0.36; embryonic shell consists of 1.4–1.5 whorls.

Umbilicus: Very narrow at beginning, but expands rapidly in last part of last whorl, reaching diameter of 4.3–4.6 mm; umbilicus-width ratio varies from 0.30–0.32.

Aperture: Round or rounded-auricular above, round below, its plane slanted down and backward, deeply concave in region of outer lip tooth; upper lip moderately reflected, outer and lower ones more so; lip swelling moderately thick or thick, receded above outer lip tooth, marginal below.

Armature: Unique in that dentition resembles that of *Ashmunella kochi*, while parietal features resemble those of *A. pasonis*. Thus, upper lip toothless, outer lip bears a tooth, and lower lip bears 2 lamellae; outer lip tooth medium large, medium wide, situated near right upper corner of aperture, slightly receded and slanted down and inward; outer lamella of lower lip medium large or large, inner lamella small or medium large; both rather short, in 1 specimen so much so that they resemble teeth (i.e. tubercles) more than lamellae (i.e. folds perpendicular to the peristome); both situated far away from origin of lower lip (where lip joins parietal wall), thus outer lamella is quite close to outer lip tooth; parietal wall features a callus, roughly triangular in shape, slightly raised at its frontal edge; lower boundary of callus formed by a very large lamella which runs in a straight line from near origin of lower lip across parietal wall towards outer lip tooth; upper boundary formed by a slight thickening which fuses with lower lamella at its inner end; a short fulcrum situated about 0.2 whorls behind aperture inside last whorl. It must be emphasized here that a parietal callus is characteristic of the related genus *Polygyra*, but it is extraordinary in *Ashmunella*.

Sculpture: The embryonic shells are worn in all specimens hence their sculpture cannot be described with certainty; they appear to be smooth with short striae near the sutures; the rest of the shell bears fine striation; no granules or scales are discernible.

Reproductive anatomy: Not known.

Similarities and differential diagnosis: *Ashmunella pasonis polygyroidea* resembles *A. k. sanandresensis* in size, shape, growth pattern, sculpture and dentition, and *A. p. pasonis* (Plate I, Fig. 11) in parietal features. This combination is unique and it distinguishes the subspecies from any other form of *Ashmunella*.

Evolution and taxonomy: The newly recognized form presumably originated by hybridization between *A. p. pasonis* and *A. k. sanandresensis*, or some other subspecies of *A. kochi*. The former of the putative parents lives in Franklin Mountain, the latter, in the San Andres Range, near enough to allow hybridization. The assumption that hybridization occurred is based on the fact that the new subspecies combines features from each of its putative parents. This contention has not been substantiated by statistical analysis or breeding experiments. The small number of shells available for study prevents a statistical treatment; the breeding experiments so far undertaken have not yielded any results since neither inter- nor intraspecific matings were observed (4 experiments, each involving 19–32 specimens). Alternative explanations also are possible.

Whether or not the newly described form originated through hybridization, it is best to classify it as a subspecies of *A. pasonis*. The latter is the only other form of *Ashmunella*, beside the taxon under discussion, which has a polygyroid parietal lamella, and the conspecific status would bring out this fact. Furthermore, both of the *Ashmunella pasonis* subspecies occur in the same mountain, separated by

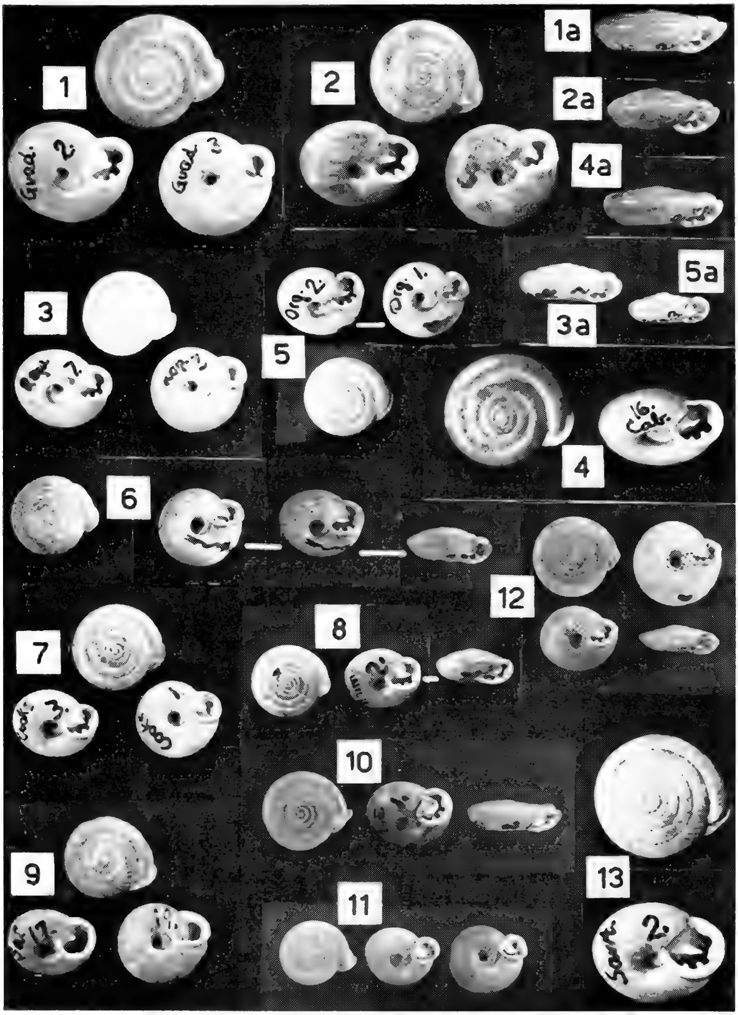


PLATE I. 1–1a, *Ashmunella k. kochi*, Guadalupe Mountains, Texas, × .82; 2–2a, *Ashmunella k. cornudasensis*, Cornudas Mountains, New Mexico, × .82; 3–3a, *Ashmunella k. sanandresensis*, San Andres Range, New Mexico, 3, × .82, 3a, × .88; 4–4a, *Ashmunella k. caballoensis*, Caballo Mountains, New Mexico, 4, × .88, 4a, × .82; 5–5a, *Ashmunella auriculata*, Organ Mountains, New Mexico, 5, × .93, 5a, ×.88; 6, Undescribed *Ashmunella* from Chisos Mountains, Texas, × .82; 7, *Ashmunella macromphala*, Cooks Peak, New Mexico, × .88; 8, *Ashmunella animasensis*, holotype and paratype, Animas Peak, New Mexico, × .88;

only a few miles from one another, and it appears most unlikely that 2 forms of *Ashmunella* could acquire a polygyroid parietal callus and occur near one another without being related to one another. It seems less logical to consider the new subspecies conspecific with the other putative parent, *A. k. sanandresensis*, because it is more isolated geographically from the latter form. In light of the above arguments, it also appears illogical to rank it as a full species. Still another possibility is to leave the subspecies, a presumed hybrid, without any taxonomic recognition. However, the taxon does deserve some recognition because it has some geographic isolation and thus an evolutionary potential with already acquired morphological distinction.

The occurrence of a parietal callus in both *Ashmunella pasonis polygyroidea* and the analogous *A. p. pasonis* poses another evolutionary problem. As it has been pointed out earlier, a parietal callus is not known in any other form of *Ashmunella* while it is characteristic of the related genus *Polygyra*. It may be that intergeneric hybridization is involved, or that independent evolution brought about this phenomenon; this problem is not solved at the present time. It may be added that *A. p. pasonis* resembles *Polygyra* in the location of the lip teeth and the development of the whole peristome region as well, which facts may lend some more credence to the assumption of intergeneric hybridization.

Name: The name *polygyroidea* has been chosen to express the similarity of the subspecies to the genus *Polygyra* in apertural features, especially in regard to the parietal callus.

Distribution and ecology: *Ashmunella pasonis polygyroidea* is only known from Franklin Mountain, just north of El Paso, Texas (Fig. 3). We collected in a large canyon on the east side of the mountain, above Cottonwood Spring, at an elevation of about 6,000 ft., under the rocks of a rock slide on the north-facing slopes; the vegetation was very sparse. We only found a few empty shells.

Reproductive anatomy of Ashmunella bequaerti, mudgei and A. p. pasonis: These taxa are not new to science. Cheatum described the former in 1971 as a full species, *A. mudgei*; Drake described the latter in 1951 also as a full species, *Polygyra pasonis*. Neither author described the anatomy of the reproductive organs, however.

Reproductive anatomy of Ashmunella b. mudgei: The spermatheca is cylindrical, the flagellum very small, attached, and the epiphallus, long as usual in *Ashmunella* (Fig. 5c). The upper portion of the epiphallus has 1 major and 7–9 minor ridges, which pattern is rather unusual. The

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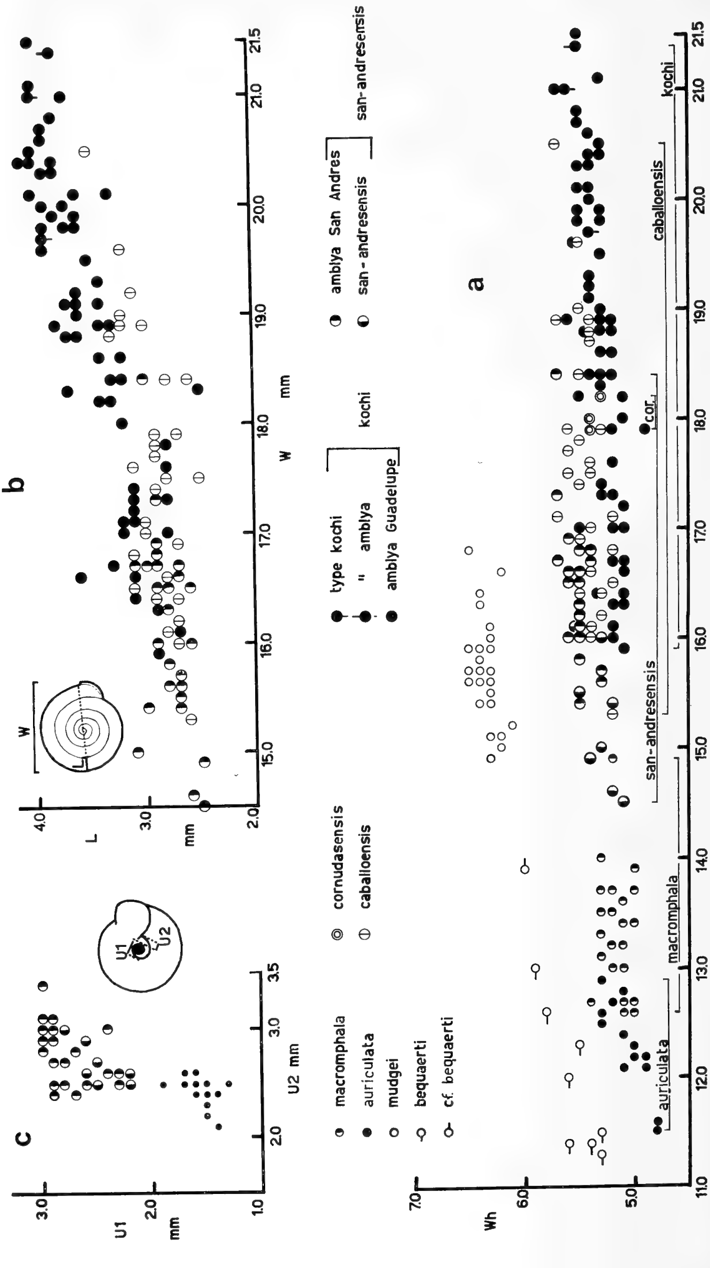
9, *Ashmunella salinasensis*, Salinas Peak, New Mexico, × .88; 10, *Ashmunella pasonis polygyroidea*, Franklin Mountain, Texas, × .82; 11, *Ashmunella p. pasonis*, Franklin Mountain, Texas, × .82; 12, *Ashmunella b. bequaerti*, Davis Mountains, Texas, × .93; 13, *Ashmunella b. mudgei*, Davis Mountains, Texas, × 1.1.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caballoensis
kochi

middle epiphallus has 3 thin, large ridges and 6–8 small ones; the penis has 1 very large ridge, 1 intermediate in size and about 10 very small ones.

Reproductive anatomy of Ashmunella p. pasonis: This taxon was originally described as a *Polygyra*, based on shell features, which indeed are very much more those of a *Polygyra* than an *Ashmunella* (Drake, 1951). Soon after its description, the taxon was transferred to the genus *Ashmunella* by Drake (1952) who cited Wendell O. Gregg's observation that anatomically the taxon belongs to *Ashmunella*. Gregg's observations have not been published, however, thus the position of the taxon has remained somewhat uncertain. As the description below will show, the taxon indeed belongs to *Ashmunella*.

The spermatheca, the flagellum and the epiphallus are as characteristic in *Ashmunella* (Fig. 5d). The upper epiphallus shows 3 major ridges and several wrinkles in cross section, which is also a common feature in the genus. The middle epiphallus has, however, 2 of the major ridges subdivided and has in addition a small ridge. The penis is very large, blunt, and horseshoe-shaped.

The conspecificity of Ashmunella bequaerti and A. mudgei: The two forms in question were originally described as separate species (Clench and Miller, 1966; Cheatum and Fullington, 1971). Considering the great degree of morphological difference between them, their at least

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FIG. 2. Variation of width, whorl number, umbilicus and width of last whorl in 4 species of *Ashmunella*. a, Scatter diagram of variation in width (W) *vs.* whorl number (Wh) in *Ashmunella kochi*, *A. auriculata*, *A. macromphala* and *A. bequaerti*. Symbols as explained in diagram; horizontal lines indicate range of variation; one dot may represent more than one specimen. Note how close the type of *A. k. amblya* is to those of *A. k. kochi*; this is the reason for synonymizing it with the latter. Also note the lack of correlation between width and whorl number in *A. macromphala*. b, Scatter diagram of variation in width of last whorl (L) *vs.* width of shell (W) in *A. k. kochi*, *A. k. sanandresensis* and *A. k. caballoensis*. Symbols as above, except that a common sign is used for specimens of *A. k. sanandresensis*. Note that while there is an overlap between the smaller specimens of the nominal subspecies and specimens of the other 2 taxa, the larger specimens of *A. k. kochi* have a relatively wider last whorl (i.e. the regression curve of *A. k. kochi* is steeper than that of the 2 other taxa). The great size of these specimens is due to the disproportionately wide last whorl not to more whorls (cf. Fig. 2a). c, Scatter diagram of variation in diameter of first and last part of umbilicus (U1 *vs.* U2) in *A. k. sanandresensis* and *A. auriculata*. Measurements as explained on the diagram; symbols as explained above. The more the umbilicus expands in the last part of the last whorl, the greater the U2 value becomes relative to U1, as in *A. auriculata*.

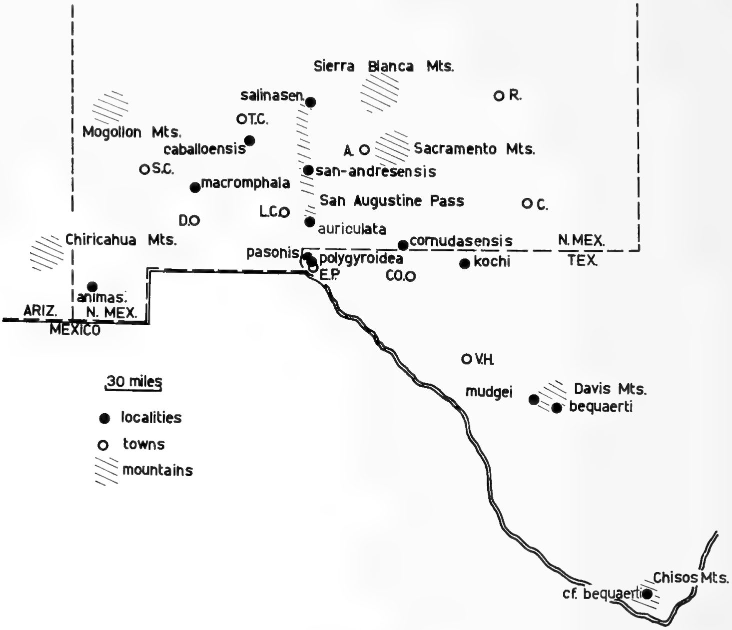

FIG. 3. Distribution of *Ashmunellas* described or discussed in text. Symbols as shown in figure. Abbreviations: A., Alamogordo; C., Carlsbad; CO., Cornudas; D., Deming; E.P., El Paso; L.C., Las Cruces; R., Roswell; S.C., Silver City; T.C., Truth or Consequences; V.H., Van Horn; other abbreviations are of states. Note: not all mountain ranges are shown in area.

partial geographic isolation, and the lack of evidence for interbreeding, this procedure was logical. The discovery of a shell in the USNM collection (USNM 251921) has, however, changed this picture. This shell (Plate I, Fig. 6) contains a mixture of the characteristics of the two forms under discussion thus bridging the gap between them. Because of practical reasons, formal taxonomic recognition is not extended to this shell (or to the taxon of which it is a sample); but a somewhat shortened description of the properties of this shell is presented here.

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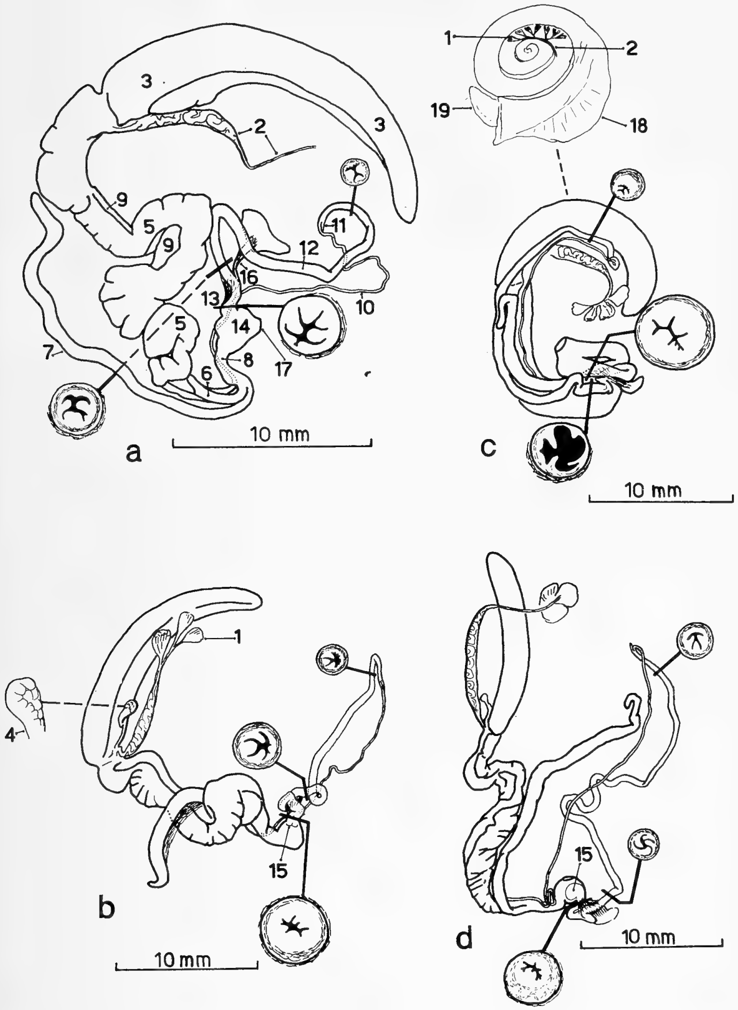
FIG. 4. Anatomy of reproductive organs of *Ashmunellas* described or discussed in text. a, *Ashmunella k. kochi*, Guadalupe Mountains, Texas; b, *Ashmunella k. cornudasensis*, Cornudas Mountains, New Mexico; c, *Ashmunella k. sanandresensis*, San Andres Range, New Mexico; d, *Ashmunella k. caballoensis*, Caballo Mountains, New Mexico. Insets



show sections of the epiphallus and penis sac made where indicated by heavy lines; additional inset to Fig. 4b shows enlargement of the talon, to Fig. 4c, location of the hermaphroditic gland *in situ.* 1, hermaphroditic gland; 2, hermaphroditic duct; 3, albumen gland; 4, talon; 5, uterus; 6, oviduct; 7, spermatheca; 8, vagina; 9, prostate; 10, vas deferens; 11, flagellum; 12, epiphallus; 13, penis sac; 14, atrium; 15, penis; 16, penis retractor; 17, genital orifice; 18, mantle; 19, foot; 20, eye. Note: the insets were drawn under 20 × magnification; their dimensions are proportionate in relation to one another, but not to the rest of the diagrams.

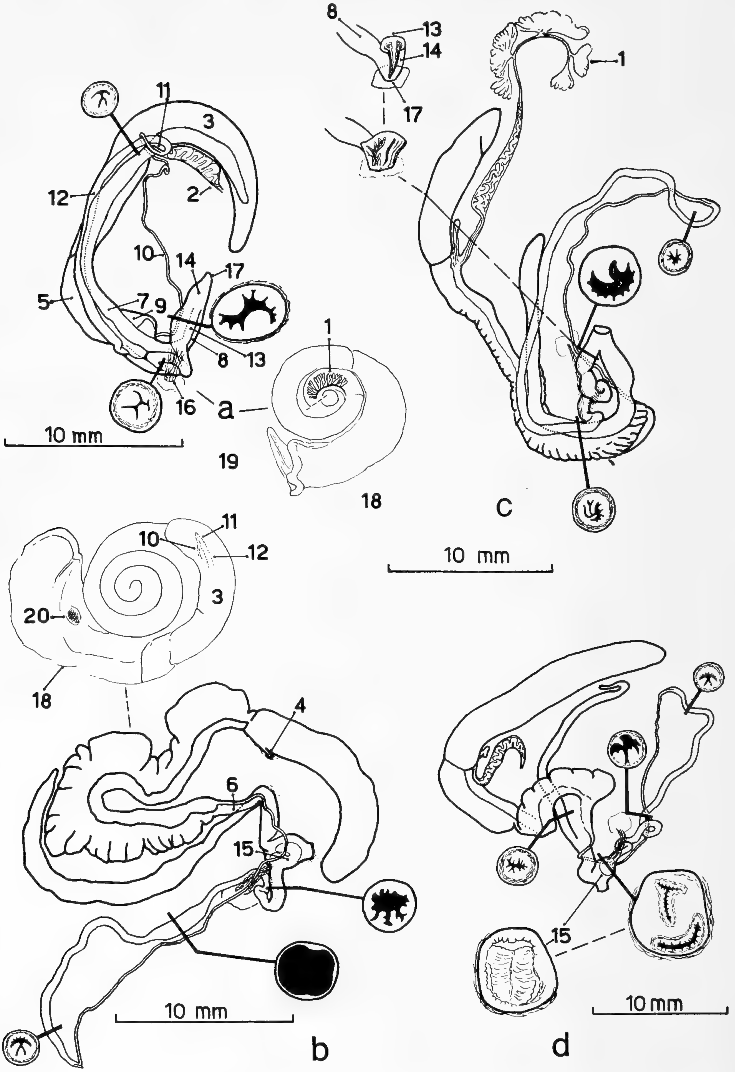


Fig. 5. Anatomy of reproductive organs of *Ashmunellas* described or discussed in text. a, *Ashmunella macromphala*, Cooks Peak, New Mexico; b, *Ashmunella salinasensis*, Salinas Peak, New Mexico; c, *Ashmunella b. mudgei*, Sawtooth Mountain, Davis Mountains, Texas; d, *Ashmunella p. pasonis*, western side of Franklin Mountain, Texas. Insets show sections of the epiphallus, penis sac and penis made where indicated by heavy lines. Additional inset to Fig. 5a shows the soft body,

Width of shell 13.9 mm; spire flat and convex in outline; height 5.7 mm; last whorl keeled on left shoulder; whorl number 6.0, coiling tight. Umbilicus wide at beginning so that underside of first whorls can be seen from below; umbilical diameter in last whorl 3.4 mm.

Aperture angular above, round below; upper lip slightly, outer and lower, widely reflected; lip swelling moderately thick; outer lip tooth high and very wide, outer lamella of lower lip large, inner lamella, medium large; upper parietal lamella very thin and long, lower lamella strong and long.

The sculpture can only be tentatively described because the shell of the only available specimen is somewhat worn; the embryonic whorls seem to have only granules, packed tightly, the first postembryonic whorls bear both granules and striae, and the last whorl, only striae.

As can be seen from the foregoing description, the shell in question is similar to A. *mudgei* (Plate I, Fig. 13) in shape, sculpture and growth pattern (Fig. 2a). It does not have, however, the exceedingly heavy lip swelling and lower parietal lamella characteristic of that form, its umbilicus is wide at the beginning whereas that of A. *mudgei* is narrow, and it is somewhat smaller than the latter. At the same time, this shell in question agrees with A. *bequaerti* (Plate I, Fig. 12) in the formation of the umbilicus, but lacks the more compressed, carinated shape, more angular aperture, very widely separated parietal lamellae and predominantly granular sculpture of that form.

As to the locality of the shell in question, the museum label reads: "Chisos Mts., Texas, V. Bailey." This certainly is possible but it has to be pointed out that Chisos Mountains lie outside the known area of distribution of the genus and that several collectors who worked in the Chisos Range have failed to find any *Ashmunella* there. Thus this locality report may be in error. It is possible though that future collecting will disclose the species in the Chisos Range. This range is sizeable and it provides a variety of habitats some of which appear suitable for *Ashmunella.* (The range lies in the Big Bend National Park, Brewster County, Texas; highest point is Emory Peak, 7,777 ft.)

Whether this shell in question comes from Chisos Range or from Davis Mountains, where both A. *bequaerti* and A. *mudgei* occur, its significance is in the fact that it provides a mixture of the morphological characters of these two species and thereby it indicates their conspecificity.

←

with the shell broken away and the apical 2½ whorls removed to expose the hermaphroditic gland *in situ*; to Fig. 5b, the intact soft body with the shell broken away, and the position of the albumen gland and the tip of the epiphallus with the flagellum *in situ*; to Fig. 5c, the atrium, partially and completely opened; and to Fig. 5d, the tip of the penis as seen from the genital orifice.

Therefore, I propose that their taxonomic rank be changed from species to subspecies, and their names be *A. b. bequaerti* and *A. b. mudgei.*

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PROCEEDINGS
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A NEW TRICOLOR *LEPTOTYPHLOPS* (REPTILIA: SERPENTES) FROM PERU

By Braulio R. Orejas-Miranda and George R. Zug
Division of Reptiles and Amphibians, National Museum of Natural History, Washington, D.C. 20560

Two Peruvian species of *Leptotyphlops* possess color patterns of red, yellowish white, and black. *L. rubrolineatus* (Werner, 1901:6) has a body pattern of alternating red and black longitudinal stripes; yellow pigment is confined to the rostrum, chin and throat, and tail. *L. teaguei* (Orejas-Miranda, 1964:4) has a body pattern of red, black, and yellow longitudinal stripes. Black stripes predominate with a thin middorsal black stripe flanked on each side by an equally thin black stripe. These three stripes lie on a red field bordered by dorsolateral black stripes and yellow lateral stripes; ventrolaterally and ventrally the body is black. Recently one of us (B.O-M.) discovered in the Museo de Historia Natural "Javier Prado" (MHNJP) three *Leptotyphlops* specimens with a tricolor pattern similar to that of *L. teaguei.* Scutellation differences indicate that these specimens represent a distinct species.

Leptotyphlops tricolor, new species

Holotype: MHNJP 0669, Peru: Ancash Department, Huaylas Province, Huaylas District: Yunca Pampa, (2700 m), collected by Acacio Ramos on 24 February 1966.

Paratypes: MHNJP 0670 and USNM 195853, same data as holotype.

Diagnosis: A *Leptotyphlops* of the *tesselatus* species group (Orejas-Miranda, 1964:4) characterized by broad contact between supraoculars and first pair of labials, differing from other members of the group except *L. teaguei* by its tricolor pattern of brick red, black, and cream longitudinal stripes, and differing from *L. teaguei* by absence of three narrow middorsal black stripes, presence of a cream colored mental region bisected by black stripe, and a higher number of dorsal scales (more than 300).

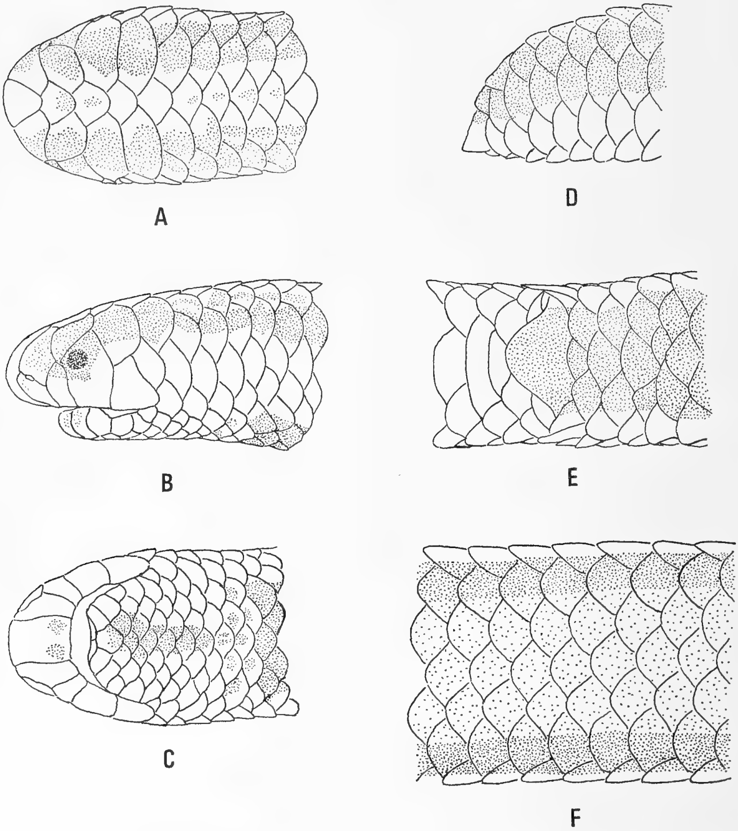

Fig. 1. *Leptotyphlops tricolor* (MHNJP 0669). A, B, C, dorsal, lateral, and ventral views of head, respectively; D, lateral view of tail; E, ventral view of cloacal region; F, dorsal view at midbody. Heavy stippling, black; light stippling, brick red; no stippling, cream white.

Description of the holotype: An adult male with total length of 295 mm and tail length of 14 mm; total body length/midbody diameter 60; head slightly depressed with snout projecting a third of entire head length beyond lower jaw; body subcylindrical, slightly tapered cranially and caudally; tail tip with spine mucronate. Body tricolor, a broad, dorsal, red stripe, a pair of narrow dorsolateral black stripes, a pair of lateral cream stripes, and a black venter (Figure 1).

Rostral triangular, dorsal apex not extending to transverse line between anterior border of eyes; nasal completely divided with naris in center of suture, supranasal longer than infranasal (approximately two times);

supralabial border formed by rostral, infranasal, anterior labial, ocular and posterior labial; rostral, ocular and posterior labial of subequal width at supralabial border; infranasal and anterior labial subequal, their width at least half that of former three scales; anterior labial single, two and a half times as high as wide, in contact dorsally at level of eye with supraocular; ocular one and a half times as high as wide; eye at level of maximum width of ocular and in anterodorsal half of ocular without reaching nasal border; posterior labial trapezoidal, widest at supralabial border; prefrontal, frontal, interparietal and interoccipital subequal and slightly smaller than more posterior middorsal scales; large supranasal and supraocular subequal and three quarters the size of the subequal parietal and occipital; eye in contact with supraocular-ocular suture; mental followed by four sublabials on each side; first pair of sublabials separated by a postmental.

Middorsal scales 303 plus rostal and caudal spine; body covered with 14 scale rows, reducing to 12 rows at anal plate and to 10 rows at the level of third subcaudals; anal plate enlarged and triangular with apex free posteriorly, anteriorly bordered by five rows of scales; 19 subcaudal scales.

Color pattern in alcohol: The body pattern consists of six longitudinal stripes. The middorsal brick red stripe occupies four scale rows, the middle three rows and half of each the two adjacent scale rows. The dorsolateral black stripes cover the halves of each scale on two adjacent rows. The lateral cream stripes lie on half of one scale row and entirely on the next adjacent ventral row. The ventral black stripe covers the five ventralmost scale rows.

The stripes lose their regularity on the head and tail. The wide ventral stripe ends abruptly on the neck; the throat has a few black spots, and a narrow black stripe extends from these spots to the mental. The mental is cream, although the dorsal halves of the first two pairs of sublabials are black. The dorsolateral stripes gradually angle dorsally as they approach the head, so that by the tenth scale row they lie over a single scale row rather than two halves. Also at this level, the dorsolateral stripe begins to widen medially, first as a few scattered black spots and cranially as solid black scales. On the head, this dorsolateral black stripe covers most of the occipital, parietal, and supraocular scales, dips ventrally onto the ocular to enclose the eye, and extends anteriorly across the dorsal tip of anterior supralabial onto the ventral half of the supranasal. The cream-colored rostral is immaculate except for a faint black mustache at the labial border. The prefrontal and frontal bear medial smudgelike black spots. The dorsal stripe begins to change from cream to red at the fifth middorsal scale, and the change is complete by the tenth middorsal scale.

Caudally, the ventral black stripe ends abruptly on the enlarged preanal scale; thus the ventral half of the tail including the caudal spine is cream colored. The dorsolateral black stripes converge and fuse dorsally above the spine. Black pigment has invaded the dorsal red

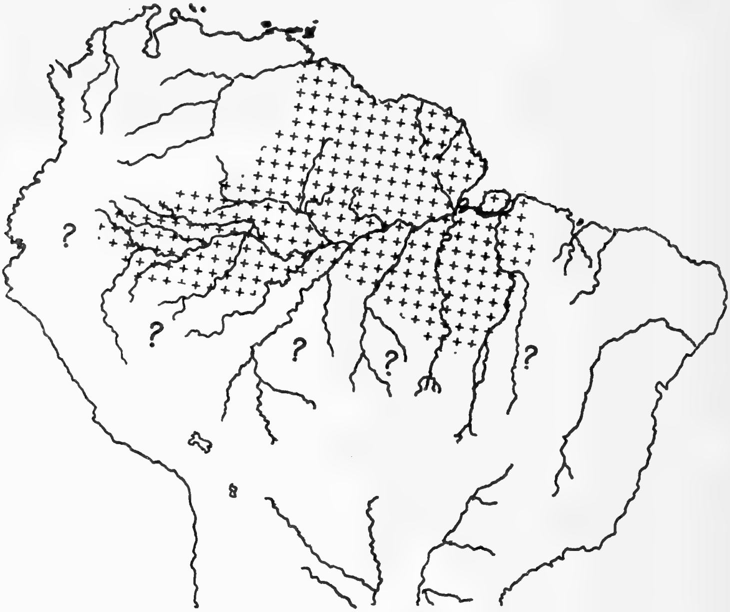

FIG. 2. Distribution of *Leptotyphlops tenellus.*

stripe to produce three faint black stripes that fade out as they approach the base of the tail.

Variation: Both paratypes are smaller than the holotype, a total length of 269 mm and 222 mm, tail length of 12 mm and 11 mm for the MHNJP and USNM specimens, respectively. The midbody diameter into total body length is 89 and 71, respectively. They possess 302 and 310 middorsal scales plus rostral and spine, and 18 and 21 subcaudals, respectively. The number of scale rows around body and tail is the same for all three specimens. Similarly the shape, position, and number of head scales is constant for all specimens. The only deviation occurs in the USNM specimen in which the postmental is enlarged to the right so that the second sublabial touches it.

The color patterns of the paratypes are similar to that of the holotype; differences are discernible only by close examination. The MHNJP specimen was preparing to shed when it was preserved, so color brightness is dulled; however the three narrow black stripes in the middorsal red field appear more prominently on the tail than on the body and also appear for a short distance in the neck region. On both of the paratypes the black pigment of the venter extends across the vent as a midventral stripe on the first one or two subcaudals. The black chin and throat stripe are continuous with the ventral body stripe and tend to

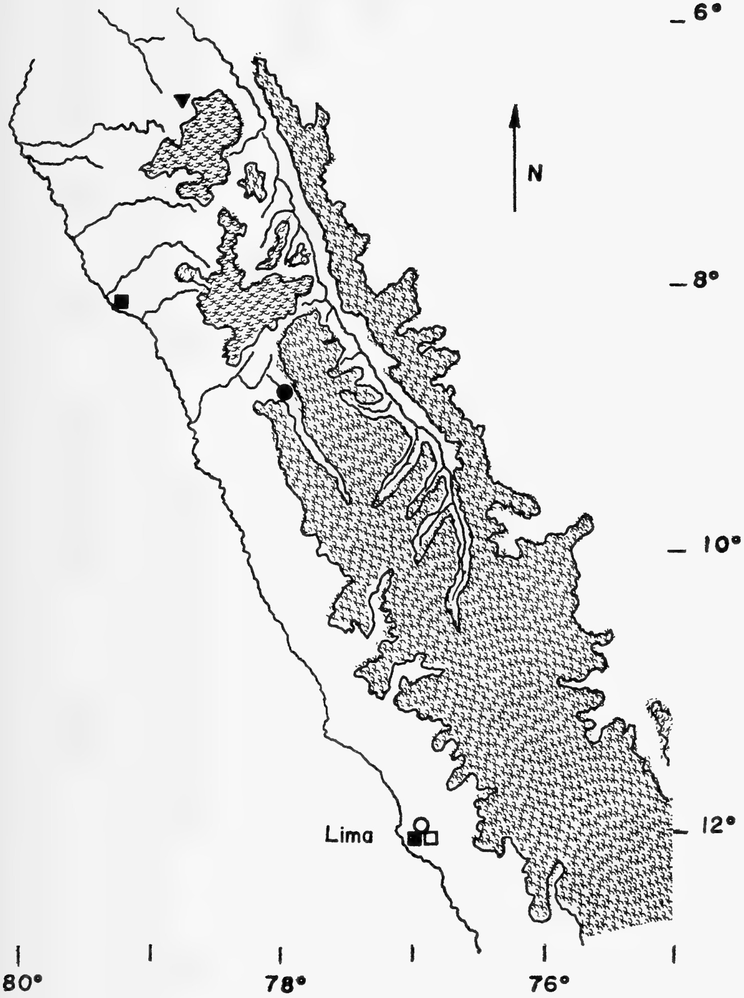

FIG. 3. Distribution of Peruvian members of *tesselatus* species group. *L. rufidorsus* is intermediate between this group and *albifrons* group. Open circle, *rubrolineatus*; solid circle, *tricolor*; open square, *tesselatus*; solid square, *rufidorsus*; triangle, *teaguei*; shaded area, altitude greater than 2500 m.

be wider. The black rostral mustache of the USNM paratype is proportionately larger than that of the holotype and continuous across the infranasal with the dorsolateral stripe.

Discussion: Members of the *tesselatus* species group share: a supralabial border of rostral, infranasal, anterior supralabial, ocular and posterior supralabial, an enlarged supraocular in broad contact with the anterior supralabial thereby preventing ocular-nasal contact, and ten scale rows around the middle of the tail. Currently five species comprise this group: *L. rubrolineatus*, *L. teaguei*, *L. tenellus*, *L. tesselatus*, and *L. tricolor*. *L. tenellus* is widespread in northern South America (Figure 2), whereas the other four are confined to western Peru (Figure 3) and generally to the immediate vicinity of their type localities.

L. rufidorsus (Taylor, 1940:532) is not included in the *tesselatus* group because the holotype has an asymmetry of left and right supraoculars, and the second known specimen (Schmidt and Walker, 1943) possesses ocular-nasal contact, albeit narrow (Orejas-Miranda, 1964). However, the enlargement of the supraocular reduces the amount of ocular-nasal contact in *rufidorsus* and suggests that *rufidorsus* is intermediate between the *albifrons* and *tesselatus* groups. These two groups are similar in most characteristics but differ primarily by the broad ocular-nasal contact of the *albifrons* group.

L. rufidorsus and three of the *tesselatus* group species (*rubrolineatus*, *teaguei* and *tricolor*) share a striped pattern with a red dorsal stripe. The reddish stripe occurs only in these Peruvian species. Because the four species are related, their sharing of a similar color pattern is not unexpected. But why is the dorsum red, when red does not appear in any other leptotyphlopid groups, and why is this color pattern restricted to western Peru? The three colors, red, cream and black, occur either together or in combinations of two in many fossorial snakes; however, these colors are usually in transverse bands or blotches and are considered to be aposematic or mimetic patterns. The pattern of these leptotyphlopids is possibly mimetic. R. Thomas (*in litt.*) suggested that some *Leptotyphlops* bear a strong resemblance to small millipeds; therefore mimicry is a possibility.

If the *tesselatus* members prove to be polymorphic, *teaguei* may be the red-striped morph of *tenellus*. In spite of the strong similarity in color pattern to *teaguei*, *tricolor* has approximately 60 to 70 more middorsal scales, a number which does not support a close relationship. Likewise *tricolor* has 40 to 50 more middorsals than either *rufidorsus* or *tesselatus* and is probably not closely related to them. *L. tricolor* is a distinctive new leptotyphlopid in the Peruvian fauna.

KEY TO SPECIES OF THE *TESSELATUS* GROUP

1. A bicolor pattern of cream white and dark brown; dorsal and ventral coloration pattern identical 2
   A tricolor pattern of cream white, brick red and black; dorsal and ventral coloration dissimilar 3
2. Middorsal scales more than 250; generally small, body diameter 55 times or more into total body length .... *tesselatus*
   Middorsal scales less than 250; generally large, body diameter less than 49 times into total body length .... *tenellus*

3. Body bicolor, a black venter bordered above by a red dorsum; cream white areas confined to head and tail .... *rubrolineatus*
   Body tricolor, a black venter separated from a red dorsum by a cream white lateral, and a black dorsolateral stripe on each side .. 4
4. Middorsal scales less than 250; five black dorsal stripes, the middle three thin and enclosed within dorsal red stripe; throat completely black .... *teaguei*
   Middorsal scales more than 300; dorsal red stripe bordered by dorsolateral black stripe, three middle stripes absent; throat cream white with a midventral black stripe .... *tricolor*

ACKNOWLEDGMENTS

We wish to thank Dr. Ramon Ferreyra and Ms. Nelly Carrillo de Espinoza for allowing us to examine these specimens from the Museo de Historia Natural "Javier Prado" (MHNJP), Lima Peru, and for permitting us to retain one of the types in the National Museum of Natural History (USNM). Dr. Albert Schwartz and Mr. Richard Thomas provided critical reviews of the manuscript. Mr. George Steyskal informed us of the zoological nomenclature committee's decision to consider all generic names ending in *-ops* as masculine (1972, Bull. Zool. Nomencl. 29(4):177).

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PROCEEDINGS
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OCCURRENCE OF THE ATLANTIC MALDANID *ASYCHIS ELONGATA* (ANNELIDA, POLYCHAETA) IN SAN FRANCISCO BAY, WITH COMMENTS ON ITS SYNONYMY

By William J. Light
California State University, San Francisco, San Francisco,
California 94132, and Department of Invertebrate Zoology,
California Academy of Sciences, San Francisco,
California 94118

A maldanid polychaete of the genus *Asychis* Kinberg, commonly found in San Francisco Bay, California, has previously been misidentified in the literature (Berkeley and Berkeley, 1960 and Hartman, 1969). Based on numerous, recently collected specimens, and by comparison with extensive material on loan from the National Museum of Natural History, the specimens can now be correctly identified as *Asychis elongata* (Verrill), previously known only from the Atlantic coast of the United States. The synonymy is discussed below. *Asychis elongata* may have been introduced into San Francisco Bay through shipments of the Virginia oyster, *Crassostrea virginica* (Gmelin). It is now a conspicuous element of the benthos throughout the bay.

I wish to thank Dr. Curtis Newcombe, San Francisco Bay Marine Research Center (MRC), and Dr. David Liu, Department of Toxicology, Stanford Research Institute (SRI), for making specimens available to me. Dr. Liu also provided extensive field data. Drs. Robert Beeman and Claude Alexander, California State University, San Francisco, gave much helpful advice. I am especially grateful to Dr. Marian H. Pettibone for the generous loan of material from the National Museum of Natural History (USNM), for a xeroxed copy of part of an unpublished manuscript by J. Percy Moore, and for

the immense encouragement, help and advice she has offered me. The manuscript has benefited from the critical reading of James T. Carlton, California Academy of Sciences. The material from San Francisco Bay is deposited in the California Academy of Sciences, the National Museum of Natural History, the Allan Hancock Foundation and the Zoological Institute, Academy of Sciences of the USSR, Leningrad.

Maldanidae

Asychis elongata (Verrill)

Figures 1, 2

Maldane elongata Verrill, 1873:343, 365, 371, 377, 609.—Webster, 1879: 259; 1880:124.—Verrill, 1881:302, 318, 322, pl. 9: fig. 1.—Andrews, 1892:294.—Hartman, 1944:355, pl. 58: figs. 6, 6a.
Maldanopsis elongata.—Verrill, 1900:659.—Pettibone, 1963:183.
Asychis elongata.—Arwidsson, 1907:262.
Branchioasychis colmani Monro, 1939:352–354, fig. 283.
Branchioasychis americana Hartman, 1945:40–42, pl. 9: figs. 1–4; 1951: 105.—Day, 1973:104.
Asychis amphiglypta.—Berkeley and Berkeley, 1960:360.—Hartman, 1969:421, figs. 1–5 (part). [Not *Maldane amphiglypta* Ehlers, 1897.]

Material examined: California: San Francisco Bay, 11–17 m, in fine sands with silt-clay component through equal parts silt-clay to almost pure silt, salinities varying from 7–23‰, sediment temperature 11.3–13.8°C., March 1973, SRI Sta. 5a, 5c (Redwood City Harbor), 5b, 5d (South Bay, south of San Mateo Bridge), 4 (Hunter's Point), 3 (Oakland Inner Harbor), 2b (Carquinez Strait), 20 September 1973, HP-6 (Hunter's Point); MRC Sta. 18.3, 18 November 1971 (Hunter's Point) and 18.1, 22 August 1973 (Hunter's Point)—many specimens. South San Francisco Bay, 3–6 m, W. A. Newman, M. Leberman, collectors, 11 specimens (USNM 40864-5; as *A. amphiglypta* by the Berkeleys). Maine: Morgan's Bay, L. N. Taxiarchis, collector, 2 specimens (USNM 49275). Rhode Island: Off Newport, 20 m, dark, soft, fetid mud, bottom temperature 21.7°C. (see Smith and Rathbun, 1886:919), *Fish Hawk* Sta. 834, 27 August 1880, 2 specimens (USNM 11854; identified by A. E. Verrill). Massachusetts: Woods Hole, wharf dredgings, August 1883, 10 specimens (USNM 10122; identified by A. E. Verrill). Hadley Harbor, M. H. Pettibone, collector, 22 August 1953, 3 specimens (USNM 44138). Delaware: E of Millsboro, Sussex County, channel

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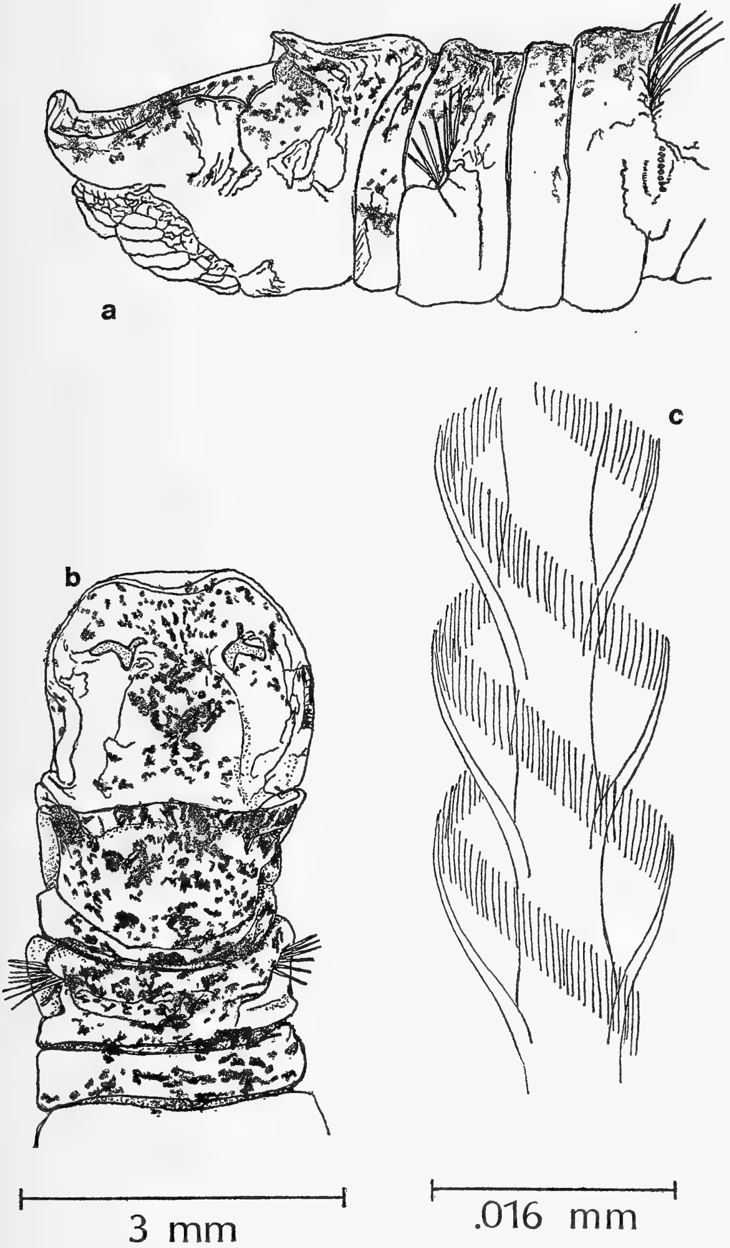
Fig. 1. *Asychis elongata*. a, anterior end, left lateral view; b, anterior end, dorsal view; c, distal portion of spirally fringed capillary.


a
b
c
3 mm
.016 mm

marker no. 34, R. D. Jones, collector, 16 February 1972, 1 specimen (USNM 49200). VIRGINIA: H. E. Webster, collector, 8 specimens (USNM 539). NORTH CAROLINA: Beaufort, E. A. Andrews, collector, 1885, 4 specimens (USNM 4883). FLORIDA: Alligator Harbor, A. J. Kohn, collector, 21 February 1959, 1 specimen (USNM 34240). Tampa Bay, J. L. Taylor, collector, 1963, 5 specimens (USNM 45665). Key West, near bridge of U.S. Naval Hospital, M. L. Jones, collector, 3 May 1964, 2 specimens (USNM 34260). MISSISSIPPI: Between Biloxi and Ship Island, 4.6 and 6.8 m (15 and 22 ft), R. L. Caylor, collector, 27 July 1949, 2 specimens (USNM 22094; as *B. americana* by O. Hartman).

Description (*San Francisco Bay specimens*): 22 somites, including fused prostomium and peristomium, first achaetous somite, 19 setigers and pygidium, no achaetous pre-anal somites. Overall length to 215 mm by 3 mm wide; most specimens considerably smaller, averaging 62–90 mm long by 1.5 mm wide. Lateral cephalic lobes set off from posterior cephalic lobe by deep lateral notches, former confluent with and indistinguishable from anterior margin of prostomium; margin of cephalic plate otherwise entire, smooth, with thin, sharply defined lip (Fig. 1a, b). Prostomium forming upturned prow in lateral view (Fig. 1a) and, together with lateral cephalic lobes, defining unbroken semicircle in dorsal aspect (Fig. 1b). Paired nuchal organs completely separated from margins of cephalic plate (unlike most *Asychis*), forming small crescentic or V-shaped glandular depressions. First setiger rolled into thick, complete collar projecting anteriorly around posterior portion of first, achaetous somite. Achaetous somite and first 3 setigers completely biannulate, next 3–4 somites incompletely biannulate, heavily glandularized laterally and ventrally, dorsum smooth and blister-like, occasionally somewhat transparent; parapodial tori greatly expanded and glandular over this region. Somites to this point from 1–3 times as long as broad, thereafter gradually lengthening posteriorly in most individuals up to and including setiger 17, reaching length-width ratios of 13:1, with some variation depending upon state of contraction of specimen. Usually 3 longitudinal rows, 1 dorsal and 2 lateral, of rounded, biscuit-like tubercles and papillae (Fig. 2b), commencing as early as setiger 6 in some specimens; these rows of papillae occasionally obscured, exhibiting more diffuse pattern. From setigers 6–14 dorsal transverse folds of tissue forming epaulettes between notopodial postsetal lamellae at segmental nodes; epaulettes sometimes faint or absent. Pygidium well developed, trumpet-shaped, dorsal lobe flared, petaloid, separated from ventral lobe by deep, V-shaped lateral notches; margins of both lobes completely smooth or very faintly crenulate (Fig. 2a), margins forming thin lips. Anus situated on posterior tip of long, rectangular dorsal mound (Fig. 2b).

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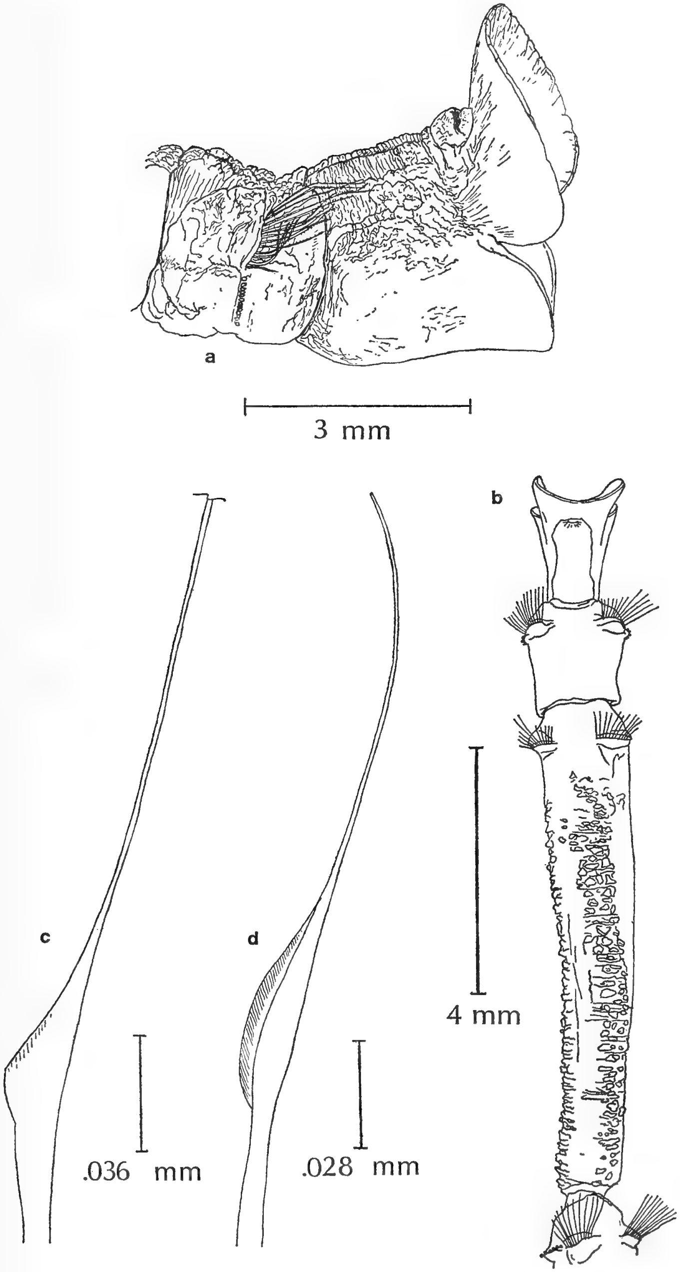
FIG. 2. *Asychis elongata.* a, posterior end, left lateral view; b, posterior end, dorsal view; c, spatulate companion seta, showing lateral keel; d, limbate companion seta.


a
3 mm
b
4 mm
c
d
.036 mm
.028 mm

Notosetae of 3 types: (1) simple, eccentrically sheathed capillaries, appearing unilimbate upon first inspection, occurring on setigers 1 to 7 or 8; (2) spirally fringed capillaries becoming gradually elongated on more posterior somites, with sheaths splitting into fimbriae and forming well expanded, double spiral at distal ends (Fig. 1c), these spirally fringed capillaries occurring in setigers 8–19, becoming extremely long posteriorly; (3) long, whiplike, capillary companion setae with greatly expanded, flattened, spatulate bases, usually with winglike keel lateral to spatulate portion (Fig. 2c), occasionally limbate (Fig. 2d), or without keel, being evenly expanded proximally; found between above two types throughout length of worm. Uncini of typical configuration for *Asychis*, in neuropodia of setigers 2–19, up to 30–40 per ramus.

Color in alcohol: pale white, generally with iridescent blue-black or greyish-purple mottlings and blotches on cephalic plate and dorsum of anterior segments, pigmentation sometimes quite extensive; individuals occasionally unmarked; specimens collected from Hunter's Point (20 September 1973) dark grey-brown, completely opaque. Tubes long, thick, of black mud and clay, often collected without animals.

Remarks: The animals from San Francisco Bay conform in every respect to *Asychis elongata* from the eastern coast of North America, although the latter tend toward a much larger size. A complete individual from Hadley Harbor, Massachusetts (USNM 44138) measures 365 mm in length, and Moore (MS: 870) commented that specimens may range up to more than 450 mm, although 150–300 mm is most common. Atlantic specimens are generally much darker, at least in the northern part of their range (North Carolina to Maine) and vary from light flesh-brown, red- and yellow-brown, dark red-brown and dark chocolate-brown to light grey. Four specimens from San Francisco Bay (SRI Sta. HP-6) are indistinguishable both in color and form from Atlantic examples. The anterior mottled pigmentation is generally reddish-brown to purple-grey or blue-black and the anterior segments are nearly always strongly iridescent. Specimens previously identified as *Branchioasychis americana* from North Carolina south through Florida and into the Gulf of Mexico are lighter in color, ranging from yellow-brown, yellow-ochre and flesh to cream-white; the anterior mottled pigmentation tends to be much reduced, and is usually blue- to sepia-black. A cream-white specimen from Alligator Harbor, Florida (USNM 34240) was apparently dark red in life, as indicated by the collector, A. J. Kohn.

Branchioasychis americana Hartman was described from specimens from North Carolina and southern Florida and included the record of *Maldane elongata* by Andrews from Beaufort (see below). Specimens from these localities, including some identified as *B. americana* by Hartman (Mississippi, USNM 22094, and the specimens recorded by Andrews, USNM 4883) were carefully examined. They conform closely in every respect to *Asychis elongata* with the exception of the presence of "gills." The dense gill-like diverticula, found on the dorsal and lateral surafces of setigers 6 to 10 or 11, are arranged in a more or less distinct pattern (although this is somewhat obscured by their density) of parallel lines running postero-anteriorly from the middorsal line at an angle of 45° from the longitudinal axis of the worm. The pattern exhibited on one side is a mirror image of that seen on the other. It is not clear whether these dorsal outgrowths represent branchiae or some other type of structure; they appear in some individuals and not in others. Of 8 specimens collected by H. E. Webster from Virginia (USNM 539), one specimen exhibits the dense feltlike dorsal outgrowths characteristic of *Branchioasychis.* Andrews (1892:294) remarked that a fragment in his collection of *Maldane elongata* exhibited these "slender papillae" over several somites. Of the 4 specimens collected by Andrews (USNM 4883), 2 of these bear dense dorsolateral outgrowths. *Branchioasychis* Monro, 1939, with type-species *B. colmani* Monro, 1939, from British Honduras, was separated from *Asychis* Kinberg, 1867, on the basis of these so-called branchiae. Monro (1939:354) mentions Andrews' specimens as possibly synonymous with *B. colmani. Branchioasychis colmani* is herein synonymized with *Asychis elongata,* since there are no significant differences between Monro's excellent description (1939:352–354, Fig. 283) and the characters seen in *A. elongata.* It seems clear that *Branchioasychis* Monro is a junior synonym of *Asychis* Kinberg.

The presence of these dorsal outgrowths, found in some specimens and not in others throughout its range and within single samples from the same locality, may be due to an expression of developmental phenotypic flexibility. It is curious that the species tends towards greater plasticity and a greater development of the dorsal diverticula in the southern part of its range.

Moore (MS: 869) included *Maldane elongata* Verrill in the synonymy of *Maldane urceolata* (Leidy) [= *Clymene urceolatus* Leidy, 1855]. Hartman (1959:450, 455) refers Leidy's species to *Asychis*; however, *C. urceolatus* possessed 26 segments according to Leidy (1855:145), whereas the genus *Asychis* is not known to have more than 19 setigers. I have been advised by Dr. Robert Robertson, The Academy of Natural Sciences of Philadelphia, that a thorough search failed to turn up the holotype of *Clymene urceolatus* Leidy and that it must be presumed lost. Because of the inadequacy of the original description and the lack of figures, this taxon is in substantial doubt, and, in concurrence with a suggestion by Dr. Marian Pettibone (personal communication), *Clymene urceolatus* Leidy is herein declared a *nomen dubium.*

Distribution: Maine to Florida, Gulf of Mexico, British Honduras. San Francisco Bay, California (new record). In clay, silt and sandy mud, intertidal to 37 meters.

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PROCEEDINGS
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A REVIEW OF THE CORAL TOADFISHES OF THE GENUS *SANOPUS* WITH DESCRIPTIONS OF TWO NEW SPECIES FROM COZUMEL ISLAND, MEXICO

By Bruce B. Collette

National Marine Fisheries Service Systematics Laboratory, National Museum of Natural History, Washington, D.C. 20560

Two species of western Atlantic toadfishes have been known only from their original descriptions: *Opsanus barbatus* Meek and Hildebrand, 1928, based on the holotype from Colon, Panamá, and *Opsanus astrifer* Robins and Starck, 1965, based on five specimens from the Turneffe Islands, Belize (British Honduras). Smith (1952) named the genus *Sanopus* for *O. barbatus* because of its higher number of dorsal fin rays (24–27 in *Opsanus* vs. more than 30 in *Sanopus*). *O. astrifer* was transferred to *Sanopus* based on its agreement with *O. barbatus* in high number of fin rays and absence of distinct pectoral fin glands (Collette, 1966). New material of *S. barbatus* and *S. astrifer* collected by George C. Miller and David W. Greenfield, respectively, stimulated Collette to write a short paper diagnosing *Sanopus* and its two species. At about the same time, Walter A. Starck II was planning to describe two new species of toadfishes that he had collected around Cozumel Island, México. Independently, Craig Phillips obtained specimens of one of these species and planned to describe it. In the interests of having a complete review of the genus, we have combined forces with Collette writing the review and Starck and Phillips participating in the description of the two new species. A total of 26 specimens of *Sanopus* is now available: 12 *S. barbatus*, 7 *S. astrifer*, 6 *S. splendidus* n.sp. Collette, Starck, and Phillips and 1 *S. johnsoni* n.sp. Collette and Starck.

METHODS AND MATERIALS

At the subfamily level, important characters in the Batrachoididae include presence or absence of photophores and of hollow spines connected to venom glands (Smith, 1952; Collette, 1966). At the generic level, characters such as the presence or absence of scales and the nature of the glands around the pectoral fin region (Collette, 1966) are important. Other useful characters include number of vertebrae (precaudal and caudal), number of fin rays (dorsal, anal, and pectoral), number and shape of teeth, shape of anterior nostril tube (Roux, 1971), number of lateral lines, number of opercular and subopercular spines, and number and shape of barbels, flaps, and cirri on the head and body. Within *Sanopus*, the most important species characters are the relative branching of barbels on the chin and head and the color pattern. Numbers of fin rays and vertebrae are more valuable than morphometric characters.

Counts of vertebrae and dorsal and anal fin rays were made with the aid of radiographs. All dorsal and anal elements were counted. Vertebral counts include the two hypural vertebrae. Two factors cause difficulties in counting teeth. Teeth are frequently broken or missing, leading to low counts when estimating the number of empty sockets. High counts result from counting extra replacement teeth. To arrive at the best estimate for the number of teeth on the premaxillary, palatine, and dentary bones, counts for left and right sides were averaged and rounded off to the nearer higher whole number. These averaged numbers are used in the species descriptions (except for the vomer, for which total counts are given). Papillae were counted along the dorsal lateral line from above the opercular spine to the caudal base and along the ventral lateral line from between the pectoral and pelvic fin origins to the caudal base. Standard length was measured from the tip of the upper jaw to the caudal base. Head length extends

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PLATE I. *Sanopus splendidus* Collette, Starck and Phillips, n.sp., Cozumel I., México. Photograph by Hans Flaskamp.

to the most posterior part of the opercular flap. Head width was measured at its maximum point. Orbit length is the maximum length of the clear part of the orbit. Interorbital width is the least distance between the clear parts of the two eyes. Snout to second dorsal and snout to anal are straight line distances to the origins of these fins. Pectoral fin length is measured from the upper base of the fin to the tip of the longest ray; pelvic fin length from the outer base to the tip of the longest ray.

Material examined is in the following collections: ANSP (Academy of Natural Sciences, Philadelphia); CAS (California Academy of Sciences, San Francisco); FMNH (Field Museum of Natural History, Chicago); MCZ (Museum of Comparative Zoology, Harvard University); SIO (Scripps Institution of Oceanography, La Jolla, California); UCR (University of Costa Rica, San Jose); UMML (University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami); UP (Departamento de Biología Marina, Universidad de Panamá); and USNM (U.S. National Museum of Natural History, Washington).

Sanopus Smith

Sanopus Smith, 1952:314 (type-species, by original designation, *Opsanus barbatus* Meek and Hildebrand).

Diagnosis: A genus of the subfamily Batrachoidinae (lacks hollow dorsal and opercular spines connected to venom glands and lacks photophores). Closest to *Opsanus*, which it resembles in six characters: body scaleless; three solid spines in first dorsal fin; an axillary pore (leading to a group of glands) present behind pectoral fin; anterior nostrils at the ends of narrow tubes arising from flaps projecting beyond upper jaw; two opercular and one subopercular spines; second dorsal rays 24 or more. Differs from *Opsanus* in several important characters as summarized in Table 1. No discrete glands on the posterior surface of the pectoral fin between bases of the upper fin rays. Only one fin ray supported by the last dorsal and anal pterygiophore (usually two in *Opsanus*). The species of *Sanopus* are longer-bodied than the species of *Opsanus* as reflected in the higher numbers of vertebrae; dorsal and anal fin rays; papillae along the dorsal and ventral lateral lines. Correlated with the larger size of *Sanopus*, adults develop more teeth: premaxillary 29–44 vs. 20–28; dentary 21–32 vs. 13–21; palatine 12–22 vs. 9–15; and total vomerine teeth 7–15 vs. 5–10.

TABLE 1. Diagnostic characters of *Opsanus* and *Sanopus*.

Character	*Opsanus*	*Sanopus*
Pectoral fin glands	6–16 well-developed glands between upper rays on posterior surface of fin	absent
Number of rays on last dorsal and anal pterygiophores	usually 2	always 1
Precaudal vertebrae	9 or 10	11, occasionally 12
Caudal vertebrae	23–25	26–29
Total vertebrae	31–36	37–41
Dorsal fin rays	23–27	29–34
Anal fin rays	19–23	24–28
Upper lateral line papillae	24–30	30–41
Lower lateral line papillae	21–26	27–36
Premaxillary teeth (one side)	20–28	29–44
Dentary teeth (one side)	13–21	21–32

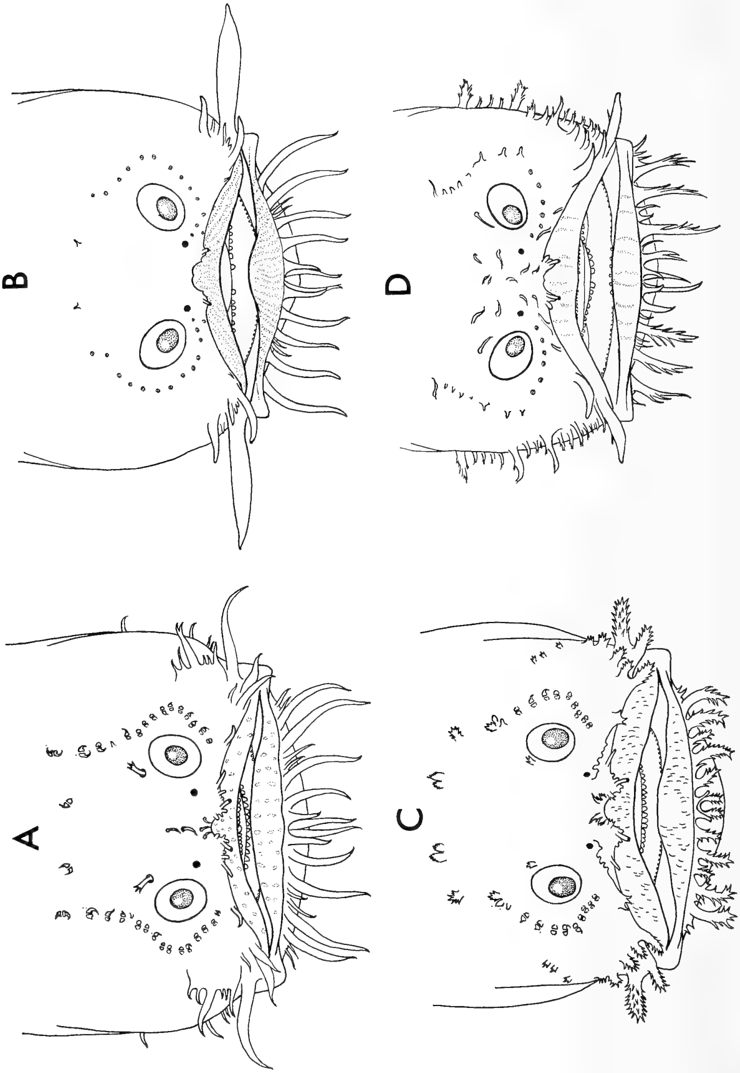
Sanopus barbatus (Meek and Hildebrand)
Figs. 2 and 3

Opsanus barbatus Meek and Hildebrand, 1928:917–918 (original description; Colon, Panamá; USNM 81009; pl. 91).—Walters and Robins, 1961:13 (comparison with other species of *Opsanus*).—Robins and Starck, 1965:249–250 (comparison with *O. astrifer*).

Sanopus barbatus.—Smith, 1952:314 (type-species of *Sanopus* Smith). Collette, 1966:848 (genus recognized as valid).—Randall, 1968:285 (listed).

Diagnosis: S. *barbatus* is similar to S. *johnsoni* and different from S. *astrifer* and S. *splendidus* in having branched chin barbels, brown dorsum with mottled belly, and generally higher counts. It differs from S. *johnsoni* primarily in the nature of the branching of the barbels. The main barbels are shorter and thicker in S. *barbatus* and the branches are also short and thick (compare Figs. 1c and 1d). The papillae along the lateral line are much shorter and wider in S. *barbatus* than in S. *johnsoni* (compare Fig. 5c with 5d). No cirri are present on the interorbital region of S. *barbatus* as they are on S. *johnsoni*. Pectoral fin shorter than in S. *johnsoni* (157–166 vs. 175 thousandths of SL, Table 2).

Frequency distributions of counts (except teeth) presented in Table 3. Dorsal fin rays III, 31–34, usually III, 33; anal fin rays 25–28; pectoral fin rays 20–22, usually 20–21; vertebrae (11–12) + (28–29) = 39–41,


B
D
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C

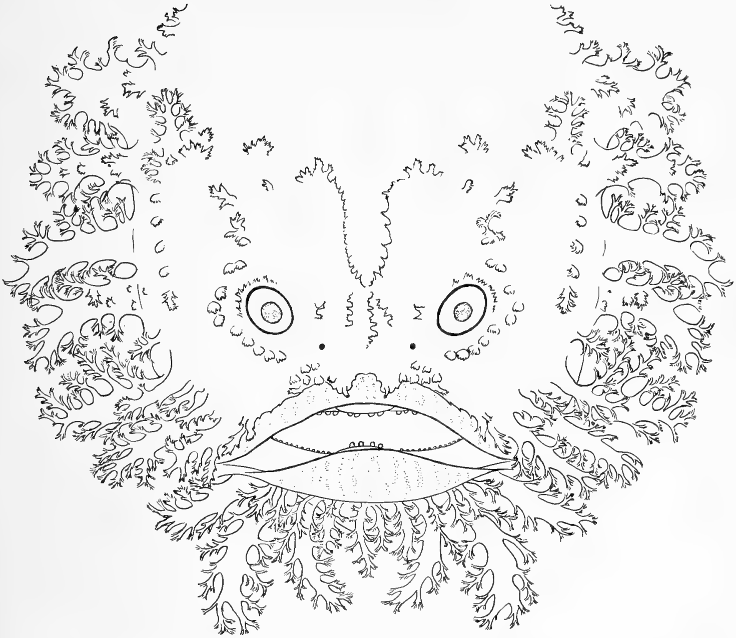

FIG. 2. Anterodorsal view of head of *Sanopus barbatus* (UCR 442-2, 370 mm SL, Uvita I., Costa Rica).

usually 40; upper lateral line papillae 32–38; lower lateral line papillae 27–34; dentary teeth 21–32 ($\bar{x}$ 25.4); palatine teeth 12–22 ($\bar{x}$ 16.4); premaxillary teeth 29–39 ($\bar{x}$ 34.3); and total vomerine teeth 8–15 ($\bar{x}$ 9.0).

Changes with growth: Comparisons can be made between seven large specimens (213–370 mm SL) and five juveniles (two, 92.1–97.4 mm, and three 28.7–36.0 mm). Juveniles have larger eyes, longer pectoral and pelvic fins, narrower heads and interorbital distances and shorter snout to second dorsal and snout to anal origin distances (Table 2). Meristically, counts of fin rays, vertebrae, and lateral line papillae do not change with size. The number of teeth on all four toothed bones

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FIG. 1. Diagrammatic anterodorsal views of heads of four species of *Sanopus*. A. *S. astrifer* (USNM 209720, 245 mm SL, Glovers Reef, Belize). B. *S. splendidus* n.sp. (holotype, USNM 205944, 245 mm SL, Cozumel I., México). C. *S. barbatus* (USNM 211322, 250 mm SL, Bonacca, Honduras). D. *S. johnsoni* n.sp. (holotype, USNM 205945, 253 mm SL, Cozumel I., México).

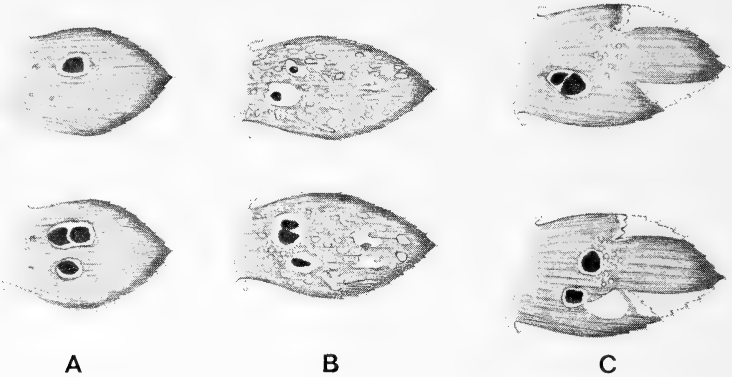

Fig. 3. Diagrammatic views of left and right sides of caudal fin of three large *Sanopus barbatus* to show caudal ocelli. A. USNM 81009, 329 mm SL, Panamá, holotype B. UP 736, 355 mm SL, Panamá. C. UCR 442-2, 370 mm SL, Costa Rica.

increases with size: dentary from 15–18 to 21–32; palatine from 10–13 to 12–22; vomer from 5–9 to 8–15; and premaxillary from 15–21 in the three smallest specimens (and also the 97.4 mm specimen) to 29–39 in the seven adults (and also the 92.1 mm specimen).

The papillae along the lateral line are all simple in the four smallest specimens (28.7–92.1 mm), the anteriormost few are branched in the 97.4 mm specimen, most are branched in the 213 and 215 mm specimens, and they are branched the length of the lateral line in the five largest specimens (306–370 mm). The branching of the barbels on the head becomes increasingly complex with age (compare Fig. 1c of the head of a 250 mm SL specimen with Fig. 2 of a 370 mm specimen). Specimens smaller than 250 mm have reduced branching. Caudal ocelli (Fig. 3) are present on the tails of the three largest specimens (329, 355, and 370 mm) but not on the nine smaller specimens (28.7–306 mm).

Range: Central American coast of Caribbean Sea. Originally described from a specimen from Colon Reef, Panamá, and now also known from Costa Rica and Honduras, as well as several additional Panamanian localities.

Material Examined: Panamá: USNM 81009 (329); Colon Reef; S. E. Meek and S. F. Hildebrand; 6 May 1912; holotype. UP 736 (355); María Chiquita, about 17 km NE of Colon; 5 May 1973. MCZ 44549 (28.7); Canal Zone, Ft. Sherman; I. Rubinoff; 16 June 1964. MCZ 44550 (36.0); Canal Zone, Ft. Sherman; I. Rubinoff; 26 July 1964. SIO 67–45 (2, 29.5–92.1); Toro Point; R. Rosenblatt, I. and R. Rubinoff; 23 March 1967. UMML 22522 (97.4); Canal Zone; Pulpit Point, W Shore Limón Bay; R/V Pillsbury 319; 4 July 1966.

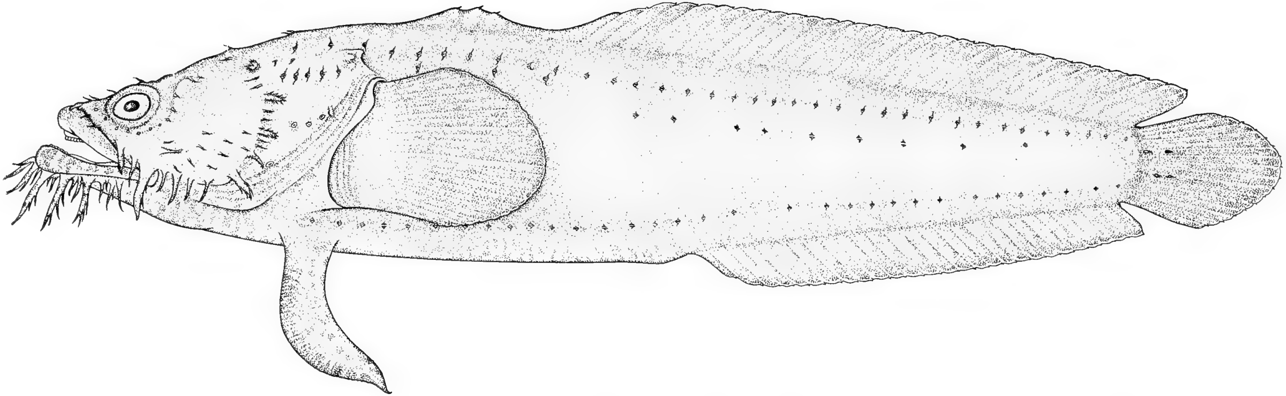

FIG. 4. *Sanopus johnsoni* Collette and Starck, n.sp. (holotype, USNM 205945, 253 mm SL, Cozumel I., México). Drawn by Keiko Hiratsuka Moore.

Costa Rica: UCR 442-2 (370); Limón Prov.; Isla Uvita off Puerto Limón; W. and M. Bussing and R. Nishimoto; 4 October 1970.

Honduras: UMML 31257 (306); The Town, Guanaja (Bonacca); G. C. Miller; 5 May 1967. USNM 211322 (3, 213–306); The Town, Guanaja (Bonacca); G. C. Miller, 6 May 1967.

Sanopus johnsoni Collette and Starck, new species

Fig. 4

Diagnosis: *S. johnsoni* is most similar to *S. barbatus* in general color pattern (uniform brown with reticulated belly), counts of fin rays and vertebrae, measurements, and in having branched chin barbels. The chin barbels are longer and thinner in *S. johnsoni* than in *S. barbatus* and the branches are longer, thinner, and fewer in number (compare Fig. 1d and 1c). The papillae along the lateral line are longer and thinner in *S. johnsoni* than in any of the other species of the genus (compare Fig. 5a-c with 5d). There are a number of long, thin cirri on the interorbital region in *S. johnsoni* that are absent in *S. barbatus*. They are also absent in *S. splendidus* and only a few are present in *S. astrifer*. The pectoral fin is longer than in *S. barbatus* (175 vs. 157–166 thousandths of SL, Table 2).

Dorsal fin rays III, 32; anal fin rays 25; pectoral fin rays 22; vertebrae $11 + 28 = 39$; upper lateral line papillae 37; lower lateral line papillae 32; dentary teeth 20–21; palatine teeth 14–15; and total vomerine teeth 10. Premaxillary teeth more numerous (R-38, L-48) than the range in *S. barbatus* (29–37).

Etymology: Named in honor of Mr. J. Seward Johnson in recognition of his generous and extensive patronage of marine science.

Habitat: The holotype was speared at night as it rested part way out of a small cave under a coral head. Another individual was seen among the rock and coral on top of the reef near the same location on another night dive. It retreated into a crevice after a few seconds exposure in the beam of the diving light. The stomach of the holotype was empty but the intestine was greatly distended, chiefly with parts of the spines and test of a small specimen of sea urchin, *Diadema antillarum*.

Holotype: USNM 205945 (253); México; Quintana Roo; Cozumel I., Palancar Reef near S end of island, just inside drop-off at 8 m; Walter A. Starck, II; 30 September 1968.

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Fig. 5. Anterior portion of lateral line in four species of *Sanopus* showing differences in shape of papillae that protect the neuromast dorsally and ventrally. A. *S. astrifer* (USNM 209720). B. *S. splendidus* n.sp. (USNM 205944). C. *S. barbatus* (USNM 211322). D. *S. johnsoni* n.sp. (USNM 205945).

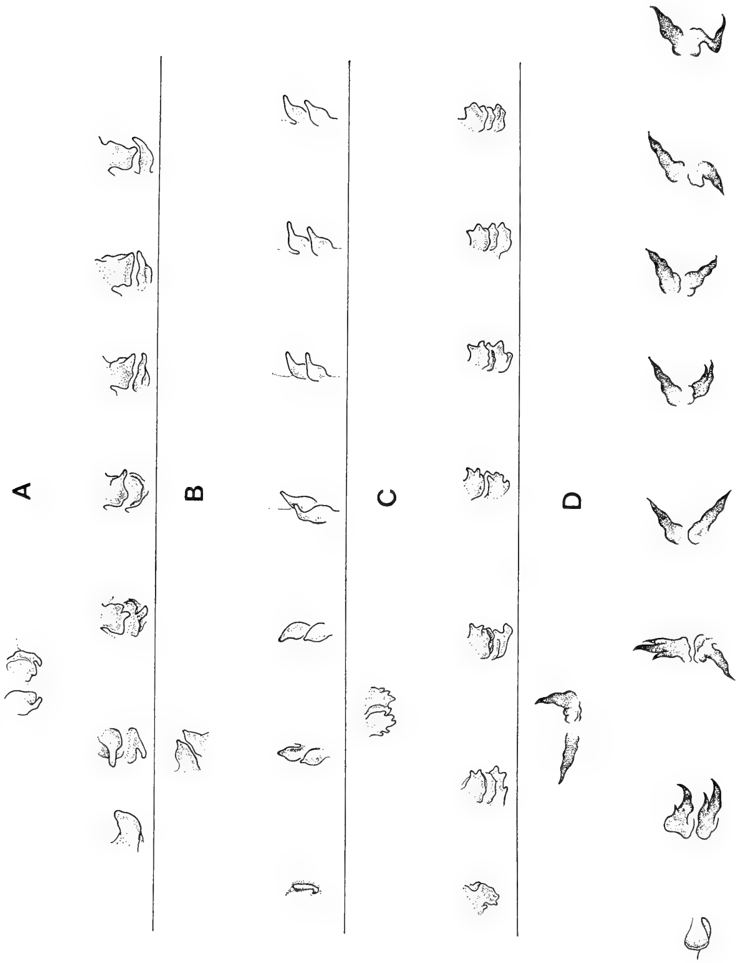
A
B
C
D

TABLE 2. Morphometric comparison (in thousandths of standard length) between the four species of *Sanopus* and two size classes of *S. barbatus* and *S. astrifer.*

	Adults										Juveniles					
	S. barbatus (N = 7)			*S. astrifer* (N = 3)			*S. splendidus* (N = 6)				*S. barbatus* (N = 5)			*S. astrifer* (N = 4)		
Character	Range		$\bar{x}$	Range		$\bar{x}$	Range		$\bar{x}$	*S. johnsoni*	Range		$\bar{x}$	Range		$\bar{x}$
SL (mm)	213	370	304.1	233	245	238.0	217	252	237.0	253	28.7	97.4	56.7	24.7	72.9	41.4
Head length	341	397	370.6	354	368	362.7	338	356	345.8	352	349	373	360.2	370	383	376.3
Head width	295	316	309.9	323	333	328.3	290	314	299.5	295	247	259	250.6	268	293	278.0
Orbital	34	47	42.7	44	50	47.7	40	52	46.2	42	62	92	79.0	64	81	72.2
Interorbital	85	95	89.7	84	94	88.0	69	77	73.5	89	64	84	69.8	81	93	89.0
Snout-second dorsal fin origin	427	451	439.6	420	487	451.0	423	439	432.5	439	417	431	421.8	439	463	447.8
Snout-anal fin origin	572	635	594.6	579	597	590.7	583	604	594.0	581	533	573	557.0	530	551	540.8
Pectoral fin length	157	166	162.4	193	219	208.0	158	203	178.6	175	187	223	205.0	213	247	227.3
Pelvic fin length	131	158	147.6	144	180	164.3	154	203	170.0	153	183	216	201.6	172	226	204.8

TABLE 3. Numbers of fin rays, vertebrae, and lateral line papillae in the four species of *Sanopus*. (* = counts for holotype of each species).

	Dorsal fin rays								Anal fin rays							Pectoral fin rays					
Species	29	30	31	32	33	34	N	x̄	24	25	26	27	28	N	x̄	20	21	22	23	N	x̄
astrifer		4	3*				7	30.4	3	4*				7	24.6		1	6*		7	21.9
splendidus	1*	5					6	29.8		6*				6	25.0		2	3*	1	6	21.8
barbatus			1	3	7*	1	12	32.7		4	4	3*	1	12	26.1	4	6*	2		12	20.8
johnsoni				1*			1	32.		1*				1	25.			1*		1	22.

	Vertebrae												
	Precaudal		Caudal				Total						
Species	11	12	26	27	28	29	37	38	39	40	41	N	x̄
astrifer	6*	1	3	3	1*		2	4	1*			7	37.9
splendidus	6*		6*				6*					6	37.0
barbatus	9*	3			5	7*			3	8*	1	12	39.8
johnsoni	1*				1*				1*			1	39.

	Upper lateral line papillae														Lower lateral line papillae											
Species	30	31	32	33	34	35	36	37	38	39	40	41	N	x̄	27	28	29	30	31	32	33	34	35	36	N	x̄
astrifer								1	1	1	2*	2	7	39.4							2	2*	1	1	6	34.2
splendidus	1*	2	1	1	1								6	31.8		1*	1	4							6	29.5
barbatus			1*	2	2	–	3	2	1				11	35.1	1	1*	–	–	2	2	3	1			10	31.4
johnsoni								1*					1	37.						1*					1	32.

Sanopus astrifer (Robins and Starck)
Fig. 6

Opsanus astrifer Robins and Starck, 1965:247–250 (original description; Turneffe Is., British Honduras; USNM 259421-F1; fig. 1, table 1). Greenfield and Greenfield, 1973:564 (reported from Glovers Reef, Belize).

Sanopus astrifer.—Collette, 1966:848 (transferred to *Sanopus*).—Randall, 1968:285 (listed).

Diagnosis: Differs from the other three known species of *Sanopus* in having the dorsum dark with prominent white spots. Most similar to *S. splendidus* in having unbranched chin barbels and generally lower counts. The barbel at the corner of the mouth is about the same size as those on the chin, not wider and longer as in *S. splendidus* (compare Figs. 1a and 1b). *S. astrifer* has the broadest head of the four species (323–333 vs. 290–316 thousandths of SL) but is similar to the other species in most other measurements (Table 2).

Frequency distributions of counts (except teeth) are presented in Table 3. Dorsal fin rays III, 30–31; anal fin rays 24–25; pectoral fin rays 21–22, usually 22; vertebrae 11 (rarely 12) + (26–28) = 37–39, usually 37–38; upper lateral line papillae 37–41; lower lateral line papillae 33–36; dentary teeth 23–24 ($\bar{x}$ 23.7); palatine teeth 13–16 ($\bar{x}$ 14.8); premaxillary teeth 33–44 ($\bar{x}$ 39.0); and total vomerine teeth 10–11 ($\bar{x}$ 10.7).

Changes with growth: The three largest specimens (233–245 mm SL) were compared with the four smallest (one 72.9 mm, three 24.7–37.6 mm). Morphometrically (Table 2), the four smallest specimens had longer heads, orbits, pectoral fins, and pelvic fins and smaller head width and snout to anal distances. Meristically, counts of fin rays, vertebrae, and lateral line papillae do not change within this size range. The number of teeth increases on the vomer (8–9 vs. 10–11), dentary (18–19 vs. 23–24), and premaxillary (32–34 teeth in the 72.9 mm specimen vs. 36–44), but not on the palatine (14–16 vs. 13–16).

Habitat: The types and three specimens recently collected by Dr. Greenfield all came from caves or hollows underneath *Montastrea* coral heads, *M. annularis* in the case of the Greenfield specimens. Most specimens were taken over sand but one was resting on coral (Robins and Starck, 1965; D. W. Greenfield, pers. comm.). The individual taken on the coral "produced loud grunts and thumps" when speared by Dr. Greenfield.

Range: Caribbean, Belize (British Honduras). Described from Turneffe Is., and now also known from Glovers Reef (Greenfield and Greenfield, 1973).

Material Examined: Belize (British Honduras). USNM 259421-F1 (holotype, 236); UMML 9415 (paratype, 73); and ANSP 102736 (3 paratypes, 25–38); Turneffe Is., 200 yards ESE of Cay Bokel in a coral cave at 5 m; W. A. Starck II and E. N. Belcher III; 30 June 1961.

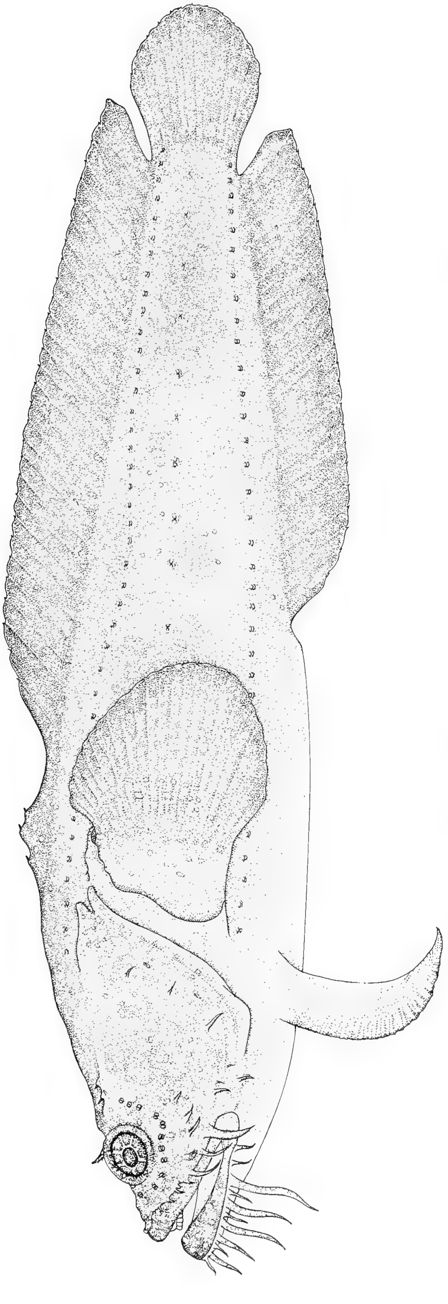

FIG. 6. *Sanopus astrifer* (holotype, USNM 259421-F1, 236 mm SL, Belize). Drawn by Keiko Hiratsuka Moore.

FMNH 71318 (1, 233); Glovers Reef, Southwest Cay outside of lagoon; D. W. and T. Greenfield 71–66; 18 August 1971. USNM 209720 (1, 245); Glovers Reef, patch reef inside of lagoon off Long Cay at 3 m; D. W. Greenfield 70–128; 22 December 1970.

Sanopus splendidus Collette, Starck and Phillips, new species

Plate 1 and Fig. 7

Opsanus superbus Korthaus, 1973:240 (Cozumel; color photograph, *nomen nudum*).

Diagnosis: The most brightly colored species of *Sanopus.* Differs from the other three known species in having all the fins, except the first dorsal, broadly bordered with bright orange-yellow in life (white in preservative). Body ground color dark bluish-gray with numerous alternating narrow and wider dark-bordered crossbars on head and body posterior to the second dorsal fin origin (Pl. 1 and Fig. 7). The barbel at the corner of the mouth is much wider and longer than in the other species of *Sanopus* (Fig. 1). Similar to *S. astrifer* in having conical, unbranched chin barbels and in lower average counts of second dorsal rays and caudal and total vertebrae (Table 3). Interorbital width narrower (69–77 thousandths of SL compared to 84–95 in the other three species, Table 2).

Dorsal fin rays III, 29–30; anal fin rays 25; pectoral fin rays 21–23, modally 22; vertebrae $11 + 26 = 37$; upper lateral line papillae 30–34; lower lateral line papillae 28–30; dentary teeth 23–32 ($\bar{x}$ 27.7); palatine teeth 13–19 ($\bar{x}$ 16.5); premaxillary teeth 35–42 ($\bar{x}$ 39.2); and total vomerine teeth 7–13 ($\bar{x}$ 10.8).

Habitat: The three specimens collected by the Starcks, plus another individual seen in the field, were all at depths of 10–15 m on the narrow shelf of shoal water along the western side of Cozumel Island. None were seen by the Starcks at greater depths during numerous dives along the outer edge of the shelf. Each was in a small cave under a coral head, facing outwards with its head just inside the entrance. An individual observed at night rested partly outside of its cave. The stomachs of these three specimens were empty but the intestines of two contained small fish bones, small gastropods, and bristles that may be setae of polychaete worms. Hans Flaskamp (pers. comm.) reported that the species was common in sand-floored caves under rocks or corals at depths of 10–25 m.

Range: Known only from Cozumel Island, Quintana Roo, México. None were seen by the Starcks in several days diving along the mainland coast of Yucatan.

Holotype: USNM 205944 (245); Cozumel Is., about 200 m offshore of middle of W coast of island at 10 m; Jo D. Starck; 28 September 1968.

Paratypes: ANSP 117316 (225); Palancar Reef near S end of island, just inside drop-off at 15 m; Jo D. Starck; 26 July 1970. UMML 29141 (217); same locality at 8 m; Walter A. Starck II; 1 October 1968. USNM

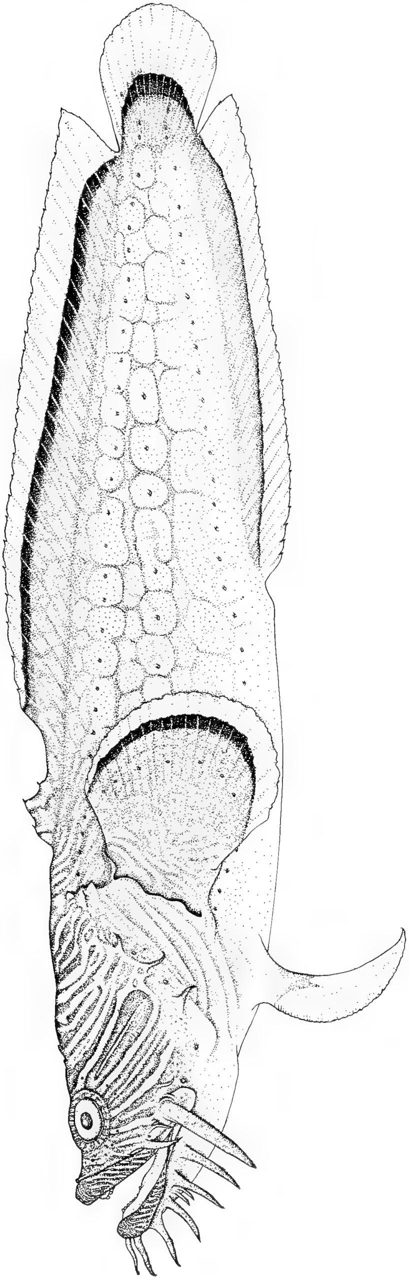

FIG. 7. *Sanopus splendidus* Collette, Starck and Phillips, n.sp. (holotype, USNM 205944, 245 mm SL, Cozumel I., México). Drawn by Keiko Hiratsuka Moore.

205606 (♀, 252); Cozumel Is., 12 m from shore off seaward coast at 3.5–4.0 m; N. Neilson; 6 January 1970. USNM 205607 (♀, 246); same locality; N. Neilson; August 1970. CAS 29110 (250); Cozumel Is.; N. Neilson; 1971.

DISCUSSION

The lack of pectoral fin glands is the primary reason that *Sanopus* is recognized as distinct from *Opsanus*. As previously shown (Collette, 1966:848), the presence or absence of pectoral fin glands and of the axillary gland is a useful character at the generic level in the Batrachoididae. A suite of other characters (Table 1) shows the four species of *Sanopus* to be much more closely related to each other than to any of the four known species of *Opsanus*: *beta* Günther in Goode and Bean, *pardus* Goode and Bean, *phobetron* Walters and Robins, and *tau* (Linnaeus). Furthermore, the two genera occupy different habitats and are almost completely separated geographically: *Sanopus* lives on coral reefs along the Caribbean coast of Central America; *Opsanus* is found in the Gulf of Mexico to Yucatan (plus one record of *O. beta* from Belize, Greenfield and Greenfield, 1973), the Bahamas, and along the east coast of the United States over a variety of bottom types other than coral reefs.

Sanopus can be divided into two species groups. 1. *S. barbatus* and *S. johnsoni* are sombre-colored brown toadfishes, frequently with mottled bellies. Both species have branched chin barbels and higher average numbers of second dorsal rays, caudal vertebrae and total vertebrae. 2. *S. astrifer* and *S. splendidus* are strikingly patterned and have conical, unbranched barbels and lower average numbers of dorsal rays, caudal vertebrae and total vertebrae. The only case of sympatry in *Sanopus* is of *S. splendidus* and *S. johnsoni* at Cozumel; however, the ranges of *S. astrifer* and *S. barbatus* almost overlap. *S. barbatus* extends from Panamá to Honduras and *S. astrifer* occurs in Belize.

COMPARATIVE MATERIAL EXAMINED

Opsanus beta. FLORIDA: USNM 158548 (1, 186); Clearwater. USNM 21477 (lectotype of *O. beta*, 200); Pensacola. USNM 23541 (paralectotype of *O. beta*, 185); Punta Rassa. ANSP 68629 (1, 175); Sand Key; holotype of *O. vandeuseni* Fowler. TEXAS: USNM 746 (2 paralectotypes of *O. beta*, 104–145); Indianola. MÉXICO: USNM 192217 (1, 101); Yucatan, Ascension Bay. USNM 199218 (1, 73); Yucatan, Ascension Bay. USNM 192354 (2, 44–58); Quintana Roo, Mujeres Is.

Opsanus pardus. FLORIDA: USNM 22317 (2 syntypes of *O. pardus*, 314–324); Pensacola. USNM 73173 (1, 116); Anclote. USNM 142837 (1, 76); Pepperfish Keys. UMML 189 (1, 182); Dry Tortugas. UMML 4220 (1, 200); Ft. Myers.

Opsanus phobetron. BAHAMA Is.; Bimini: 5 paratypes of *O. phobetron*. USNM 170961 (1, 127). USNM 170962 (1, 87). ANSP 79480 (1,

119). ANSP 79481 (1, 114). UMML 498 (1, 114). Also: UMML 27128 (1, 129); Bimini. MCZ 34708 (1, 25); Eleuthera. CUBA: MCZ 12751-4 (4, 56–154).

Opsanus tau. NEW YORK: USNM 48976 (1, 131); Peconic Bay. MARYLAND: USNM 45460 (1, 143); Cornfield Harbor. VIRGINIA: USNM 91202 (2, 74–83); Lewisetta. GEORGIA: USNM 258056-F10 (1, 118); Sapelo Is. FLORIDA: USNM uncat. (1, 125); Cape Canaveral. USNM 18034 (1, 161); Matanzas R. Inlet.

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PROCEEDINGS
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A NEW EASTERN PACIFIC LABRID (PISCES), *DECODON MELASMA*, A GEMINATE SPECIES OF THE WESTERN ATLANTIC *D. PUELLARIS*[1]

By Martin F. Gomon
*Smithsonian Institution, Washington, D.C. 20560, and
Rosenstiel School of Marine and Atmospheric Sciences,
University of Miami, Miami, Florida 33149*

The genus *Decodon* was erected by Günther (1861) for *Cossyphus puellaris* Poey 1860, a species differing from other members of the genus *Cossyphus* (= *Bodianus*) primarily in lacking scales on the membrane of the soft dorsal fin. For over a hundred years *Decodon* was thought to be monotypic with a distribution restricted to the deeper shelf waters of the Western Atlantic between North Carolina and Brazil. Recent collections from along the Pacific Coast of Central and northern South America in depths similar to those in which *D. puellaris* is often taken in the Atlantic, however, have yielded a second, geminate species. As in many other closely related labrids, differences between the two species are largely in color pattern while counts and measurements are nearly identical. Furthermore, two species from the Indo-West Pacific presently placed in allied genera are referable to *Decodon*, though not treated here.

Methods

Terminology follows that of Hubbs and Lagler (1958) except: caudal-ray count includes dorsal unsegmented rays + dorsal segmented, unbranched rays + segmented, branched rays + ventral segmented, unbranched rays + ventral unsegmented rays; pectoral-fin rays are indicated with unbranched

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[1] Contribution No. 1701 from the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami.

rays in lower case Roman numerals and branched, segmented rays in Arabic (the dorsalmost pectoral ray in labrids is typically short, unsegmented and unbranched; the second ray is typically long, segmented and unbranched); first lateral-line scale is the anteriormost free, pored scale not attached to upper end of posterior opercular membrane; scales below lateral line are counted diagonally forward and upward from the first moderately sized body scale laterally adjacent the first anal-fin spine to but not including the lateral line (small scales in vicinity of anus and first anal-fin spine are ignored for standardization of counts); gill-raker counts include rudiments; orbital length is a horizontal measurement. Figures enclosed by parentheses following meristic counts indicate number of specimens or structures (e.g., pectoral fins) exhibiting count. Measurements were made with needlepoint dial calipers and recorded in millimeters; morphometric dimensions are given as ranges in percent of standard length; all body length measurements are expressed as the standard length (SL) in mm. Color descriptions of the new species are based on photographs and color notes supplied by Lloyd T. Findley and transparencies loaned by Richard H. Rosenblatt; comparative color transparencies of *D. puellaris* were made available by Patrick L. Colin.

Type specimens and study material are deposited in the following institutions: Academy of Natural Sciences of Philadelphia (ANSP); California Academy of Sciences (CAS); Los Angeles County Museum (LACM); Museum of Comparative Zoology, Harvard University (MCZ); Scripps Institution of Oceanography, University of California (SIO); University of Arizona (UA); University of Costa Rica (UCR), also temporarily housing Searcher specimens; School of Marine and Atmospheric Sciences, University of Miami (UMML); U.S. National Museum of Natural History, Smithsonian Institution (USNM); University of California at Los Angeles (W).

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Decodon Günther

Günther 1861, p. 384. Type-species by monotypy, *Cossyphus puellaris* Poey 1860.

Decodon puellaris, the new species and two species from the Indo-West Pacific form a natural group within the bodianine labrids (e.g., *Bodianus, Choerodon, Pimelometopon*), here recognized at the generic level. A treatment of the species occurring in the Indo-West Pacific, together with an examination of the general systematic status of *Decodon*, is deferred until a study of the bodianine labrids by the author is complete. A combination of the following characters separates *Decodon* from other closely related genera of bodianines: absence of scales on basal portion of dorsal and anal-fin membranes; dorsal-fin rays XI, 9–10; anal-fin rays III, 10; pored lateral-line scales 26–30; trunk scales deciduous; predorsal area scaled from dorsal-fin origin to anterior nostrils; preoperculum completely scaled.

Decodon melasma, new species

(Figure 1)

Holotype: USNM 210859 (139.6), Mexico, Gulf of California, Baja California Sur, 3 miles (4.8 km) off Buena Vista, small reef surrounded by sand, depth 55 fathoms (100 m), collected by Ray Cannon and Boyd W. Walker, 15–16 March 1961, field station no. W61-33, hook and line.

Paratypes: USNM 210860 (4, 56.2–106.9), Mexico, Gulf of California, Baja California Sur, Bahia Santa Inex, 26° 56.9′ to 58.3′N, 111° 51.9′ to 53.5′W and 26° 59.2′ to 57.7′N, 111° 51.5′ to 51.0′W, water depth 40–45 fathoms (82 m), 40′ otter trawl, collected by W. Baldwin and party, field station no. RR 65-51, 14 July 1965, 1410–1510 and 1535–1615 hours; CAS 28809 (4, 52.2–150.1), LACM 33722-1 (4, 59.7–149.3) and SIO 65-305 (50, 37.8–200.0), same data as USNM 210860.

Other material: Gulf of California, SIO 65-250 (6, 78.6–128.9), 65-257-50 (1, 87.7), 65-294 (1, 118.8), 65-304 (4, 69.6–147.8), 65-313

(1, 79.3), 68-67 (1, 91.1), 68-71 (1, 27.6), 68-75 (4, 44.1–99.3), UA 67-59-4 (2, 68.7–86.2), 70-21-5 (4, 128.3–136.1), 70-41-2 (4, 83.0–126.8), W61-79 (1, 132.8), W63-148 (2, 129.2–129.5); Costa Rica, UCR 139-23 (1, 141.5), 339-1 (1, 135.5), 353-1 (2, 104.4–167.3), 510-5 (1, 116.7), Searcher 484 (1, 61.6), 485 (4, 36.8–88.7); Isla del Coco, Searcher 521 (4, 100–139), 522 (1, 169), 539 (1, 55.2); Gulf of Panama, UMML 26461 (1, 104.3), 26462 (1, 94.5), USNM 210711 (1, 48.2), 210712 (1, 48.7), 210713 (1, 126.4); Ecuador, USNM 210710 (2, 122.4–128.4).

Diagnosis: Pectoral-fin rays ii, 15, rarely ii, 16; lateral-line scales 28; adults with vertically elongate dark spot below seventh dorsal-fin spine extending from just above lateral line (eighth pored lateral-line scale) to midside; juveniles with up to 6 vertical dusky bars on side of body, usually confined to dorsal half.

Description: Dorsal-fin rays XI, 10 (72), XII, 9 (1); anal-fin rays III, 10 (72), III, 9 (1); caudal-fin rays 9 (42), 10 (20) + 2 (61), 1 (1) + 12 (61), 13 (1) + 2 (47), 3 (15) + 8 (10), 9 (40), 10 (12); pectoral-fin rays ii, 15 (133), ii, 16 (9), ii, 12 (1), ii, 14 (1); pelvic-fin rays I, 5; vertebrae 11 + 17 = 28 (61), 11 + 18 = 29 (1); lateral-line scales 28; scales above lateral line 2½; scales below lateral line 8; caudal peduncular scales 16; predorsal scales approximately 20; gill rakers 5 (3), 6 (16), 7 (6) + 9 (3), 10 (15), 11 (6), 12 (1).

Body compressed, elongate, greatest depth in large specimens at about level of dorsal-fin origin, body depth 20.3–31.6, increasing with increase in SL; caudal peduncle 11.6–14.8, increasing with increase in SL. Scales on trunk large, cycloid, deciduous; scales not extending onto bases of dorsal and anal fins; lateral line smoothly curved, uninterrupted; lateral-line scales posteriorly notched, possessing unbranched medial canal with single posterior pore.

Head blunt, length 32.2–38.0; forehead gently curved, curve more pronounced in large specimens; snout 6.1–11.8, increasing with increase in size; eye 6.9–10.6, decreasing with increase in SL. Head almost totally scaled; scales on nape and forehead small, reaching anteriorly to just in front of anterior nostrils; underside of head and chest with small scales reaching anteriorly to symphysis of jaw; small scales covering cheeks and infraorbital area forward to angle of mouth; preopercle scaled to edge; preopercular edge finely serrate; operculum mostly covered by large deciduous scales; opercular membrane naked posteriorly. Opercular membranes united and free from isthmus; ventral end of gill opening reaching anteriorly to below posterior part of eye. Pseudobranch present; diagonal series of 5 or 6 fleshy, gill raker-like appendages present on inner surface of operculum opposing ventral gill rakers of first arch; gill rakers on first gill arch moderately long, narrow, usually simple; dorsalmost gill raker on lower limb of arch occasionally bifurcate. Lower lip narrow, not differentiated from chin at tip of jaw; upper lip broad, smooth, not fleshy, covering lower lip completely when mouth closed. Teeth in jaws caniniform, more or less uniserial (Figure 2). Upper jaw

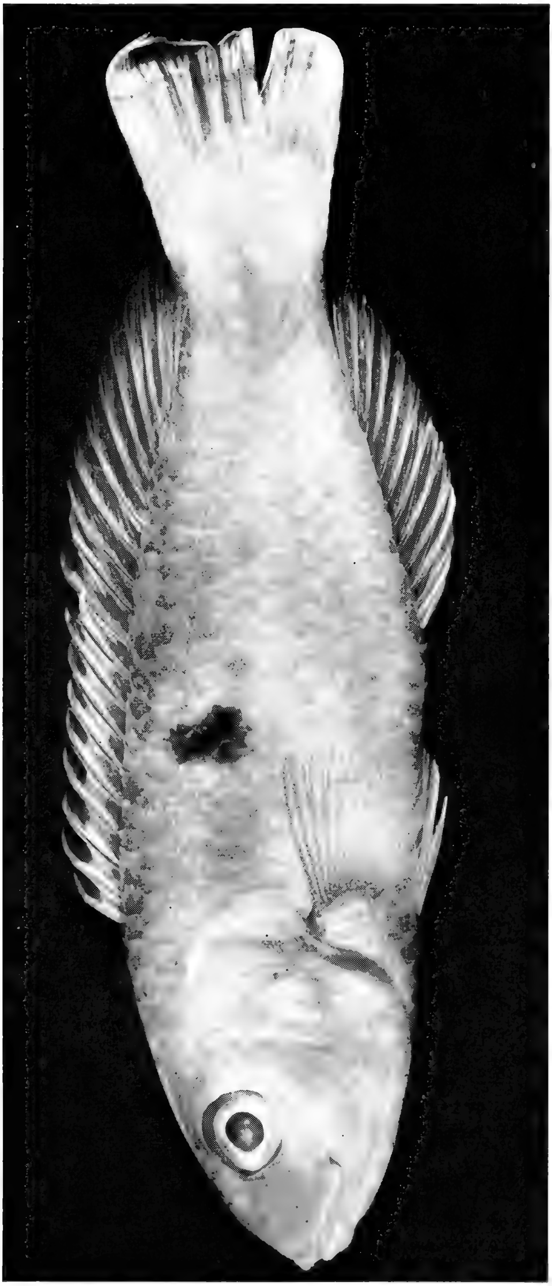


Fig. 1. *Decodon melasma*, USNM 210859, holotype, 139.6 mm SL.

with two widely spaced, large, curved canines on either side of symphysis at anterior outer margin of premaxillary, followed posteriorly by row of approximately 5 to 8 equally short canines arising from narrow bony ridge on ventral edge of premaxillary; ridge prominent anteriorly, forming relatively tall cutting edge along mesial side of bases of anterior canines, becoming less distinct posteriorly; several small teeth often present along mesial side of bony ridge; usually one or two (0–3) anteriorly curved canines present at posterior end of upper jaw. Lower jaw with two large curved canines on each side of symphysis at anterior outer margin of dentary; first canine directed anteriorly next to symphysis; second canine widely spaced and larger than first, angled slightly laterally; large canines followed by row of 3 to 5 short posteriorly longer canines arising from narrow bony ridge similar to that in upper jaw, and in turn, followed by second row of shorter canines of equal length; second series of short canines based on separate bony ridge immediately posterior to first ridge, also forming cutting edge with short blunt teeth in large specimens.

Dorsal fin low, continuous, origin slightly anterior to posterior extent of opercular margin; first dorsal-fin spine shortest, subsequent spines slightly longer and nearly equal in length; 11th dorsal-fin spine 10.5–12.6; each spine with filamentous membrane at tip; dorsal fin pointed posteriorly, not reaching base of caudal fin. Anal fin low; spines progressively longer posteriorly, 3rd anal-fin spine 8.6–11.7, fin pointed posteriorly, not reaching base of caudal fin. Caudal fin rounded to truncate in small specimens, truncate with dorsal and ventral rays produced in large specimens. Depressed pectoral-fin tip reaching perpendicularly below 7th or 8th dorsal-fin spine; length of pectoral fin 17.2–21.3. Pelvic-fin tip reaching slightly more than half way from pelvic-fin origin to anus; pelvic-fin length 12.0–18.0, increasing with increase in SL.

A comparatively small species of bodianine; largest specimen examined 200.0 mm SL.

Reproduction: Adults appear to be synchronous hermaphrodites in practically all but very large individuals. Six of seven small adult paratypes (98.3–106.9) examined have a large, well developed ovary with advanced oocytes on each side of the body and a lobe of testicular tissue about one-fourth or one-fifth the size of each ovary present next to the ovary of the left side, no testis on the right. The seventh specimen has a single testis approximately the same size as the testicular lobe in each of the other specimens and two strands of connective tissue which appear to represent spent ovaries. Smaller adult specimens consistently have two distinct ovarian lobes and a single testicular lobe. The ovary does not appear to degenerate at any particular adult size as further exemplified by two paratypes, 149.3 and 150.1 mm SL, with well-developed ovaries, and the holotype, 138.3 mm SL, with only a single narrow testis on the right side and no vestige of ovarian development. The largest specimen examined, a paratype (200.0), has testicular tissue proportionate in size to that of other paratypes and no sign of functional

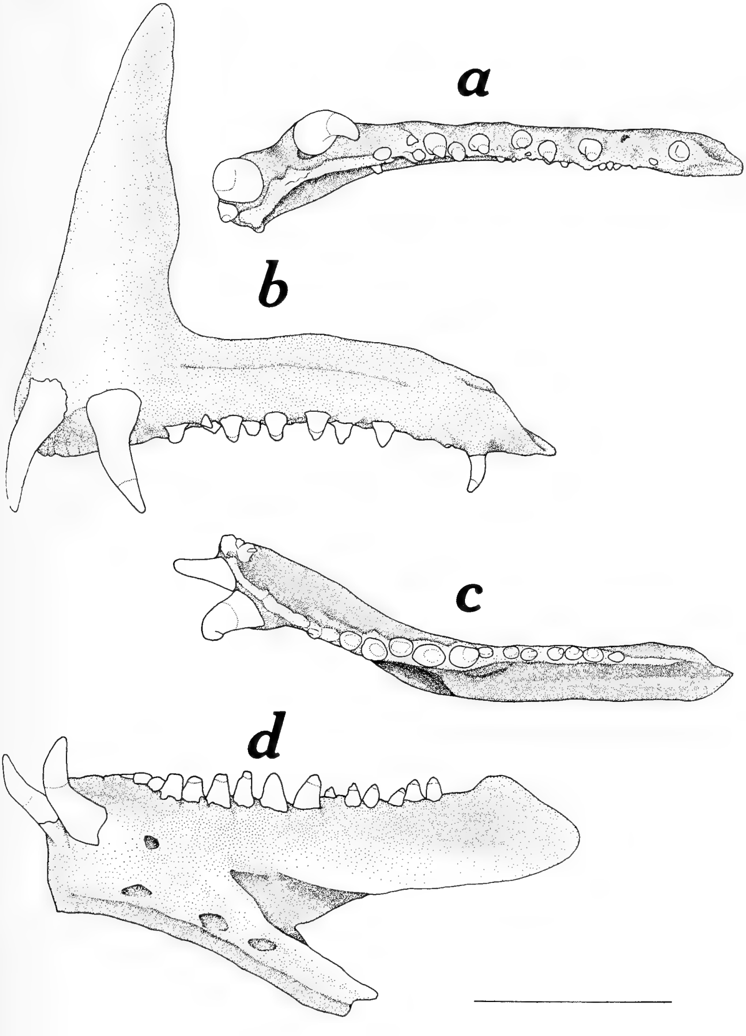


FIG. 2. Dentition in upper and lower jaws of *D. melasma.* Premaxillary: (a) ventral view, (b) lateral view. Dentary: (c) dorsal view, (d) lateral view. USNM 210713, 126.4 mm SL. Line indicates 5 mm.

ovaries. The highly convoluted appearance of the testis in this specimen, however, suggests that development of testicular tissue may also have taken place in the walls of the spent ovaries.

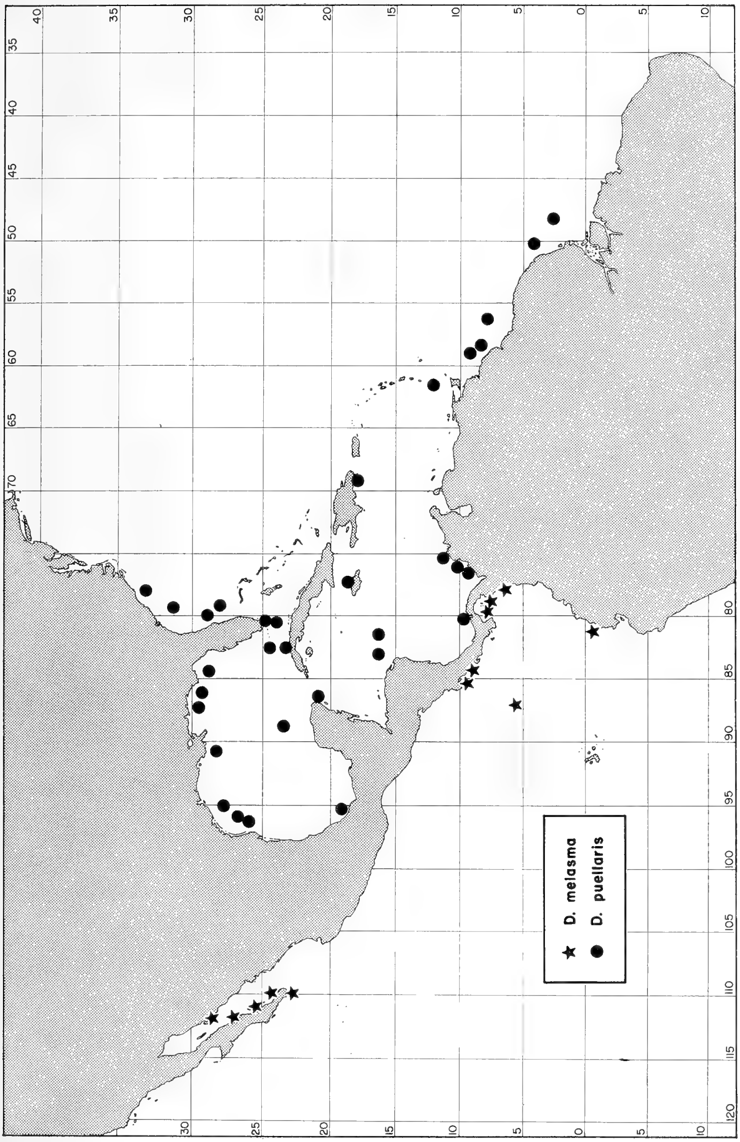
Color in alcohol: (Specimens larger than about 130 mm) Head and body pale; underside of head, throat and chest with underlying white pigmented layer visible; moderately large, often faint, diffuse, dusky spot present on dorsal midline of nape just anterior to dorsal fin origin; vertically elongate dark spot dorsolaterally on body below seventh dorsal-fin spine, extending from just above lateral line almost to midside. Fins transparent.

(Specimens smaller than about 130 mm) Markings better developed in smaller specimens, fainter in larger ones. Head and body pale; large dusky spot present on nape anterior to dorsal-fin origin; as many as six, usually faint, broad, dusky, vertical bands present on dorsal half of body; bands reaching or nearly reaching dorsal body contour dorsally and usually extending to or just below lateral midline ventrally; very small specimens with bands reaching ventral body contour; anteriormost band positioned below second dorsal-fin spine, second band below seventh dorsal-fin spine, third band below ninth or tenth dorsal-fin spine, fourth band below fifth segmented dorsal-fin ray, fifth band on caudal peduncle just posterior to dorsal fin, fourth and fifth bands often very faint or absent. Small, dusky spot present middorsally on caudal peduncle just anterior to caudal fin, remnant of sixth band on basal edge of caudal fin in very small specimens. Anal, caudal, pectoral and pelvic fins transparent; dorsal fin transparent in specimens larger than about 45 mm, smaller specimens with large dark spot in center of dorsal fin usually extending from first to third segmented rays.

Color in life: Head and body pinkish red above, white below. Head pinkish red on snout and top of head, becoming pinkish white below level of eye and white below level of mouth. Three curved, moderately broad, chrome yellow stripes on head; dorsalmost stripe originating on dorsal margin of orbit, encircling orbital margin dorsoposteriorly, then curving posteriorly across preopercle and opercle to opercular margin at upper level of pectoral base where it turns ventrally and forms short, broad, yellow posterior margin on gill flap; second stripe anteriorly confluent with corresponding stripe of opposite side across snout from anterior edge of orbit, encircles orbital margin ventrally and is directed ventroposteriorly from ventroposterior edge of orbit across cheek to ventroposterior angle of gill flap; third stripe forms narrow margin on free edge of upper lip (confluent with that of opposite side anteriorly) and is directed posteroventrally from angle of mouth, becoming broader ventrally and terminating just below ventral edge of preopercle. Chrome yellow blotch on nape at anterior end of lateral line. Faint purplish blue area on opercle above upper level of pectoral-fin base. Trunk pinkish red above level of posterior lateral line, becoming pinkish white ventrolaterally and white ventrally. Large, vertically elongate, black spot on body below seventh dorsal-fin spine extending from just above

→

FIG. 3. Distribution of *D. melasma* and *D. puellaris.*


★ D. melasma
● D. puellaris

lateral line (eighth pored lateral-line scale) almost to midside (approximately 2 to 2½ scale rows high).

Pectoral fin pinkish red. Pelvic fin dusky white; bases of membranes between inner rays chrome yellow. Dorsal fin pinkish red on spinous portion, pinkish white on anterior segmented ray portion with chrome yellow highlights to rays and whitish posteriorly. Anal fin white with narrow, horizontal, chrome yellow stripe parallel with ventral body contour near base of fin. Caudal fin pinkish red with some chrome yellow on bases of outer rays.

Distribution: Present only in the Eastern Pacific from the northern Gulf of California to off Ecuador (Fig. 3). The absence of specimens from the central portion of this range (Fig. 3) is probably related to poor collecting efforts. This species is rather common in shrimp-trawl hauls made in depths of 40 to 160 m. Areas of capture usually have flat sandy to slightly soft bottoms often with some rocky rubble or patch reefs, very similar to those areas in the Western Atlantic inhabited by *D. puellaris.*

Etymology: *melasma*, a Greek noun meaning black spot, in reference to the characteristic single black mark on each side of the body in large specimens. *Melasma* is here used as a noun in apposition.

Relationships: *D. melasma* and *D. puellaris* differ in counts only in the number of pectoral-fin rays, ii, 14 (ii, 15 in 2 of 50 counts) in *D. puellaris* versus ii, 15 (ii, 16 in 9 of 142 counts) in *D. melasma,* and number of lateral-line scales, 28 in *D. melasma* versus 27 in *D. puellaris.* Proportional measurements in specimens of the two species show no significant differences.

Preserved specimens of *D. melasma* and *D. puellaris* are virtually identical in appearance with the exception of the presence of a single, dark, lateral body mark in large specimens and several vertical, diffuse, dark bands on the sides of smaller individuals of *D. melasma,* in contrast to the virtual absence of dark pigment in all specimens of *D. puellaris* (both *D. melasma* and *D. puellaris* possess a dark spot on the anterior branched, segmented-ray portion of the dorsal fin in specimens smaller than about 45 mm). Life colors of both are basically pinkish red dorsally grading to white ventrally with distinct chrome yellow markings on the head, body and fins. Specimens of *D. puellaris* possess a number of chrome yellow spots on the operculum and apparently on most of the lateral body scales. These spots are not present in specimens of *D. melasma.* Specimens of *D. puellaris* also have a basal row of yellow spots on the anal fin rather than the basal stripe of *D. melasma,* and possess a narrow yellow line along the distal margin of the fin as well as a number of yellow spots scattered on the midportion of the fin. The two species also appear to differ in dorsal-fin coloration, although available photos are not sufficiently clear to evaluate this aspect adequately. Both species, however, possess an identical pattern of yellow stripes radiating from the eye and have a distinctive chrome yellow upper lip.

Both appear to inhabit the same ecological niche in the same depth range (a relatively unique ecological distribution for bodianines, as most species are shallow water reef forms or are associated with sheer rocky conditions) and are distributed almost identically along their respective coasts of North, Central and South America in continental shelf conditions.

Adults of both species have an identical blunt head profile in contrast to the more typically pointed, *Bodianus*-like head of their two congeners occurring in the Indo-West Pacific. This fact suggests a closer and more recent ancestry of the new world species than of either with the Indo-West Pacific species. The greatest similarities in structure, appearance and ecology of the two probably point to their recent evolution, thus affording a good example of a geminate species pair of the tropical Western Atlantic and Eastern Pacific faunas as envisioned by Jordan (1905) and discussed by Robins (1972). An interesting aspect concerning the two species lies in their rather deep vertical distribution, making them the first documented consistently deep water geminate pair; all other Central American geminates occur in shallow marine or estuarine habitats (Jordan, 1905).

Comparative Material

Comparative material of *Decodon puellaris* includes: South Carolina, USNM 151868 (1, 97); Georgia, USNM 156600 (1, 63); northeast Florida, UMML 29567 (1, 164); eastern Florida, UMML 1236 (1, 73); Florida Keys, UMML 10206 (2, 41–43); Tortugas, UMML 20527 (3, 33–89), USNM 116960 (5, 45–135); northwest Florida, UMML 4925 (5, 74–115), USNM 156599 (1, 62), 158826 (2, 112–143), 210636 (1, 145), 210638 (2, 114–117); Louisiana, USNM 185304 (1, 138); Texas, USNM 156616 (1, 58), 185441 (1, 179), 210634 (4, 132–171), 210637 (2, 116–143); Mexico, USNM 210644 (2, 108–116); Yucatan, UMML 28613 (4, 36–73); Honduras, UMML 2712 (1, 93), USNM 185045 (1, 71), 185260 (15, 52–103); Panama, USNM 210645 (2, 64–101), 210646 (1, 91); Colombia, UMML 16295 (2, 96–112), 22290 (4, 39–62), USNM 210640 (3, 109–116), 210641 (1, 92), 210643 (1, 92); Venezuela, USNM 185297 (1, 122); Guyana, USNM 210635 (1, 133), 210639 (1, 105), 210642 (1, 122); Surinam, UMML 4974 (1, 142); Brazil, USNM 185031 (2, 80–86), 185052 (1, 83), 185065 (1, 91), 185192 (2, 67–70); Cay Sal Bank, UMML 9968 (3, 51–79); Cuba, ANSP 90775 (1, 148), MCZ 14339 (2, 140.0–151.5, types), USNM 4753 (1, 135), 12564 (1, 122), 24941 (1, 183); Jamaica, UMML 29888 (1, 157); Dominican Republic, UMML 29564 (2, 40–89); Grenada, USNM 178125 (1, 122).

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

BRANDTIKA ASIATICA NEW GENUS, NEW SPECIES, FROM SOUTHEASTERN ASIA AND A REDESCRIPTION OF *MONROIKA AFRICANA* (MONRO) (POLYCHAETA: SABELLIDAE)

By Meredith L. Jones
Smithsonian Institution, Washington, D.C. 20560

In 1939, Monro reported on a collection of polychaetes from near the mouth of the Congo River in West Africa. Among these were specimens of a small sabellid from Matadi, approximately 130 km upstream from the Congo River mouth, in what is now the Democratic Republic of the Congo. Monro considered these to be a new species of *Manayunkia*, *M. africana*, in spite of the presence of true spatulate thoracic setae (on the basis of there being a trend from mere limbation toward a spatulate condition among various described species of *Manayunkia*) and in spite of the presence of two (rather than three) abdominal setigers. Further, he noted that specimens of *M. africana* constructed incrusting, ". . . intertwining sandy tubules" (Monro, 1939:220) on the shells of the freshwater gastropod, *Hydrobia plena*, that the worms were found in areas of swift current, that they were not confined to snail shells, but also found on rocks, and that additional dried tubes of the worms were collected in the M'Pozo River, further upriver from Matadi.

No additional collections of *M. africana* have been reported in the literature. Hartman (1951:389), in connection with a study of the sabellid polychaetes of the Fabriciinae, considered the presence of a palmate membrane on the branchial crown to be sufficient grounds to separate *M. africana* from *Manayunkia* and established the new genus *Monroika*, based on Monro's description.

During an extensive study of southeast Asian specimens of the polychaete genus *Caobangia* and the molluscs associated with it (Jones, 1969, 1974), curious incrusting sandy tubes were observed on the surface of the shells of the viviparid snail, *Mekongia jullieni* (Deshayes), and on the valves of the unionid bivalve, *Hyriopsis delaportei* (Crosse and Fischer), both collected by Dr. R. A. M. Brandt from the Mekong River in southern Laos. Perusal of the southeast Asian freshwater snails in the collections of the Division of Molluscs, National Museum of Natural History, Smithsonian Institution, yielded other snails with similar incrusting tubes, i.e., *Brotia* cf. *baccata* (Gould) and the paratype of *Melania pagodula* Gould [= *Brotia pagodula* (Gould)] both from the Salween River drainage.

The sandy tubes found associated with the four molluscan species mentioned above contained the dried remains of a sabellid similar to *Monroika* and were in from fair to very poor condition. Drying notwithstanding, it was possible to observe a number of similarities and differences relative to Monro's description of *Manayunkia africana* and it was felt necessary to re-examine Monro's material deposited in the British Museum (Natural History) and, subsequently, to redescribe the type-species of *Monroika*, as well as to establish a new genus, *Brandtika*, for the Asian specimens.

It is with great pleasure that I thank Dr. R. A. M. Brandt, School of Tropical Medicine, Bangkok, Thailand, for the Laotian molluscs which bore the tubes of *Brandtika*, Dr. J. David George, British Museum (Natural History) (BMNH) for arranging the loan of Monro's types of *Manayunkia africana*, and Dr. Marian H. Pettibone, National Museum of Natural History (USNM), my colleague and ever ready and ever willing manuscript reader.

FAMILY SABELLIDAE

SUBFAMILY FABRICIINAE

Monroika Hartman, 1951; emended

Type-species: *Manayunkia africana* Monro, 1939, by original designation. Gender: feminine.

Diagnosis: Fabriciine sabellids with 8 thoracic and 2 abdominal setigers; with long limbate capillary setae on all 10 setigers, with short limbate capillary setae on setigers 1, 2, 6–8, with spatulate setae on setigers 2–5, with neuropodial long-handled hooks on setigers 2–8, and with notopodial long-necked uncini on setigers 9–10; branchial crown of simple radioles united by high palmar membrane (?).

Remarks: Examination of Monro's syntypes and other material from the original collection of *M. africana* have allowed the recognition of two kinds of limbate capillary setae, and the emendation herein reported results from this. The presence of ". . . fairly numerous, possibly about a dozen [simple filamentous radioles] . . . and . . . a high palmar membrane" (Monro, 1939:220) could not be confirmed, for, as Monro stated, ". . . the state of preservation is poor and the more delicate parts such as the gills are partly disintegrated" (Monro, 1939:220).

In contrast to Hartman's judgment, I feel that the crucial generic differences between *Monroika* and *Manayunkia* lie in the type and distribution of setae and the number of thoracic and abdominal setigers, rather than in having ". . . a weblike membrane in the crown" (Hartman, 1951: 389), which has not been unequivocally demonstrated.

Monroika africana (Monro)

Figures 1, 2

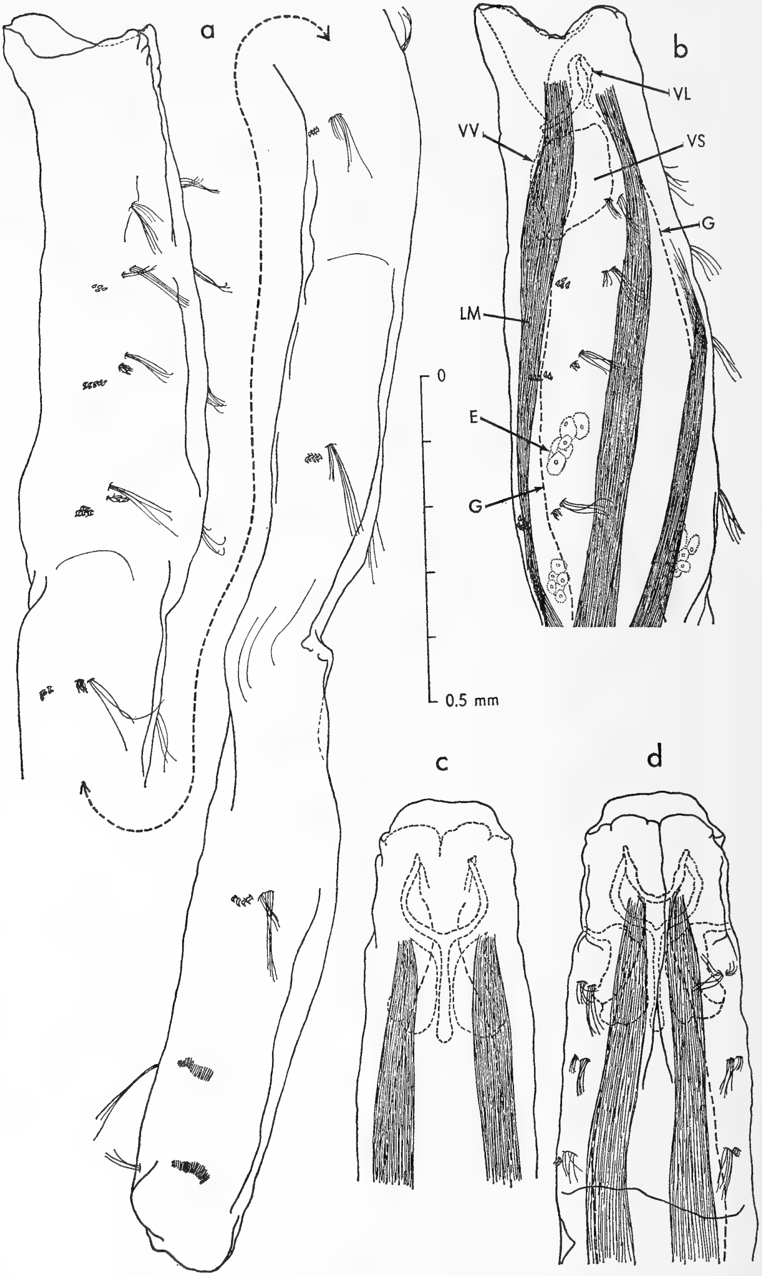
Manayunkia africana Monro, 1939:220–223.—Wesenberg-Lund, 1958:29 [list of fresh- and brackish-water polychaetes].
Monroika africana.—Hartman, 1951:389–390.

Material examined: Democratic Republic of the Congo, the Congo River at Matadi (05°49′S, 13°27′E) E. Dartevelle, collector; syntype mounted on microscope slide (BMNH 1939.7.17.1); three syntypes mounted on microscope slide (BMNH 1939.7.17.2); additional specimens, (USNM 50913) dissected from sandy tubes on snails labelled as follows: "*Manayunkia africana*—[BMNH] 1939.7.17.12 *Holotype* [sic] —Matadi, Congo River."

Type-material: Syntypes are from 2 to 3 mm in length and from 0.2 to 0.3 mm in width at their widest part. Little detail of the branchial crown can be discerned. One of the syntypes (BMNH 1939.7.17.2) is in two pieces. None of the syntypes appears to be the specimen figured by Monro (1936: Fig. 1).

Description: The body is small, having 10 setigerous segments, 8 thoracic, with notopodial setae and neuropodial hooks, and 2 abdominal, with notopodial hooks and neuropodial setae; the anterior end is provided with a branchial crown (Fig. 1). There is a collar which bears what appear to be shallow dorsolateral incisions (Fig. 1c, d), as well as a mid-dorsal notch and groove (Fig. 1d).

The first setiger is provided only with unilimbate capillary notosetae of 2 types, 3–5 longer ones (Fig. 2a) and 2–4 shorter ones (Fig. 2b; Tables 1, 2). The following 7 thoracic setigers all bear longer limbate capillary notosetae (Fig. 2f, i, m, r); the 2 abdominal setigers bear long capillary notosetae (Fig. 1a) which may be smooth or provided with extremely fine limbations. There are from 1–4 short limbate capillary


a
b
VL
VV
VS
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LM
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G
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0.5 mm
c
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notosetae on setiger 2 and from 1–3 or 4 on setigers 6–8 (Fig. 1n, p, s). Spatulate notosetae occur on setigers 2–5 (Fig. 2d, g, k). Occasional short limbate capillary notosetae were found on setigers 3 and 5 (Fig. 2j). Limbations tend to become progressively less well-developed toward the posterior end.

There are 2–5 long-handled avicular notopodial hooks on setigers 2–8. These have a stout, sinuous manubrium surmounted by a large central fang topped by series of small denticles, becoming smaller, more distal to the central fang (Fig. 2c, e, h, l, o, q, t). When viewed *en face* it is apparent that there is some asymmetry in the placement of the denticles above the central fang (Fig. 2l). The more posterior thoracic hooks apparently have fewer small denticles. Notopodial hooks of the abdominal region disposed in what might be called "uncinigerous" rows, from 14–41 per row, dorsal to the long capillary neurosetae (Fig. 1a). The hooks are provided with rather broad long necks (Fig. 2u). Each abdominal hook bears a single proximal, relatively large, central tooth surmounted distally by many small teeth, in about 10–11 rows, with about 5 in each row.

Remarks: The buff-colored sand tubes of *M. africana* are found at the apical ends of the associated snails (*Hydrobia plena*). There is a suggestion of a dorsal transverse groove between setigers 3 and 4 (Fig. 1d), and, in the case of 2 of the syntypes, there appears to be an internal septum between setigers 5 and 6. Eggs were noted in one specimen and these were restricted to the anterior end, extending between setigers 3–6 (Fig. 1b). Striated muscles were found associated with the rows of abdominal hooks. There appears to be a single medial ventral blood vessel in the region of the first setiger; this is formed by the union of the lower ends of a vascular loop which seems to be closed dorsally (Fig. 1b, d). There are 2 pairs of brown granular structures, also in the region of the first setiger, which may prove to be "ventral sacs" functioning in tube formation. Spatulate setae may appear to be "spatulate" due to their usual orientation and, when differently disposed, may appear to be limbate (cf. Fig. 2d, g, k, and Fig. 3p).

Brandtika new genus

Type-species: *Brandtika asiatica* new species. Gender: feminine.

Diagnosis: Fabriciine sabellids with 8 thoracic and 2 abdominal

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FIG. 1. *Monroika africana* (USNM 50913): a, Left lateral view of entire specimen, branchial crown lacking (figure split between setigers 5 and 6 to fit page); b, left lateral view of second specimen showing some internal structures (slightly twisted); c, ventral view of same (setae omitted); d, dorsal view of same (VL = vascular loop, VV = ventral vessel, VS = ventral sac (?), LM = longitudinal muscle bundle, E = eggs, G = gut).

TABLE 1. Numbers and distribution of types of setae observed in specimens of *Monroika africana* (A = long limbate capillary notosetae; B = short limbate capillary notosetae; C = spatulate notosetae; D = thoracic avicular neuropodial hooks; E = abdominal notopodial hooks; X = obscured; ? = uncountable). Entries for setigers 9 and 10, column 4, derived from a fifth specimen.

Setiger number	BMNH 1939.7.17.1 (1 syntype)	BMNH 1939.7.17.1 (3 syntypes)			Non-syntypes (5 specimens)			
		1	2	3	1	2	3	4
Th 1	4a, 3B	5A, 2B	3A, 2B	4A, 3B	4A, 4B	3A, 4B	4A, 4B	4A, 5B
Th 2	4A, 4D	5A, 4B, 4D	4A, 2B, 2C, 3D	5A, 1B, 3C, 3D	5A, 4C, 4D	4A, 3C, 4D	4A, 1B, 4C, 5D	5A, 4C, 4D
Th 3	4A, 1B, 4C, 3D	5A, 4C, 4D	4A, 4C, 4D	4A, 3C, 3D	5A, 5C, 5D	4A, 3C, 5D	5A, 3C, 5D	5A, 3C, 5D
Th 4	5A, 3C, 3D	4A, 3C, 3D	4A, 4C, 4D	5A, 2C, 3D	5A, 5C, 5D	4A, 4C, 5D	5A, 3C, 4D	4A, 4C, 5D
Th 5	3A, 3C, 3D	3A, 4C, 3D	3A, 2C, 3D	4A, 2D	5A, 6C, 4D	3A, 4C, 4D	4A, 1B, 3C, 3D	?
Th 6	?	3A, 1B, 3D	2A, 2B, 2D	2A, 1B, 2D	3A, 4B, 3D	4A, 3B, 3D	3A, 1B, 2D	?
Th 7	?	2A, 2B, 2D	3A, 1B, 3D	3A, 2B, 2D	3A, 2B, 4D	3A, 3B, 4D	?	?
Th 8	?	2A, 3B, 4D	3A, 2B, 3D	2A, 2B, 3D	4A, 3B, 5D	4A, 3B, 5D	?	?
Abd 1	?	4A, 26E	3A, 18E	2A, 18E	2A, 1B, 32E	3A, 29E	?	3A, 41E
Abd 2	?	3A, ?E	2A, 14+E	2A, 17E	3A, 21E	3A, 20+E	?	3A, 21E

TABLE 2. Comparison of summarized numbers and distribution of types of setae observed in specimens of (a) *Monroika africana,* (b) *Brandtika asiatica,* and (c) *Brandtika* sp. (A = long limbate capillary notosetae; B = short limbate capillary notosetae; C = spatulate notosetae; D = thoracic avicular neuropodial avicular hooks; E = abdominal notopodial hooks; F = pilose neurosetae).

Setiger	*Monroika africana*	*Brandtika asiatica*	*Brandtika* sp.
Th 1	3–5A, 2–4B	4A, 3B	?
Th 2	4–5A, 1–4B, 2–4C, 3–5D	4–5A, 2C, 4–5D	?
Th 3	4–5A, (1B), 3–5C, 3–5D	4–5A, 2C, 5D	?
Th 4	4–5A, 2–5C, 3–5D	4–5A, 2–3C, 4D	6A, 2C, 7D
Th 5	3–5A, (1B), 2–6C, 2–4D	5–6A, 2–3C, 3–4D	5A, 2C, 6D
Th 6	2–4A, 1–4B, 2–3D	3–4A, 2–3C, 2F	3A, 1C, 2F
Th 7	2–3A, 1–3B, 2–4D	2–4A, 2C, 1–2F	?
Th 8	2–4A, 2–3B, 3–5D	2–4A, 2–4C, 1–2F	5A, 4C, 4F
Abd 1	2–4A, (1B), 18–41E	3A, 17–20E	3A, 34E
Abd 2	2–3A, 14+–21E	2A, 14–15E	3A, 24E

setigers; with long limbate capillary setae on all 10 setigers, with short limbate capillary setae only on setiger 1, with spatulate setae on setigers 2–8, with neuropodial long-handled hooks on setigers 2–5 and short, abruptly geniculate, pilose neurosetae on setigers 6–8, and with notopodial long-necked uncini on setigers 9–10.

Etymology: It is with pleasure that I name this genus in honor of Dr. R. A. M. Brandt, School of Tropical Medicine, Bangkok, Thailand, in appreciation for the collecting of the numerous snails from Thailand and Laos which provided me with these sabellids, as well as specimens of *Caobangia.*

Remarks: *Brandtika* appears to be closely related to *Monroika,* as regards the presence of similar thoracic notopodial and abdominal neuropodial hooks and the presence of thoracic spatulate setae. *Brandtika* differs, however, in that spatulate notosetae are not replaced by short limbate capillaries in the posterior thoracic region, whereas long-handled avicular neuropodial hooks are replaced by short pilose neurosetae in the posterior 3 thoracic setigers.

Brandtika asiatica, new species

Figure 3

Monroika sp. Jones, 1974: Fig. 5*a.*

Material examined: Laos: Mekong River at Ban Don Det, south of Khong Island, Sithandone (14°07′N, 105°48′E), associated with the

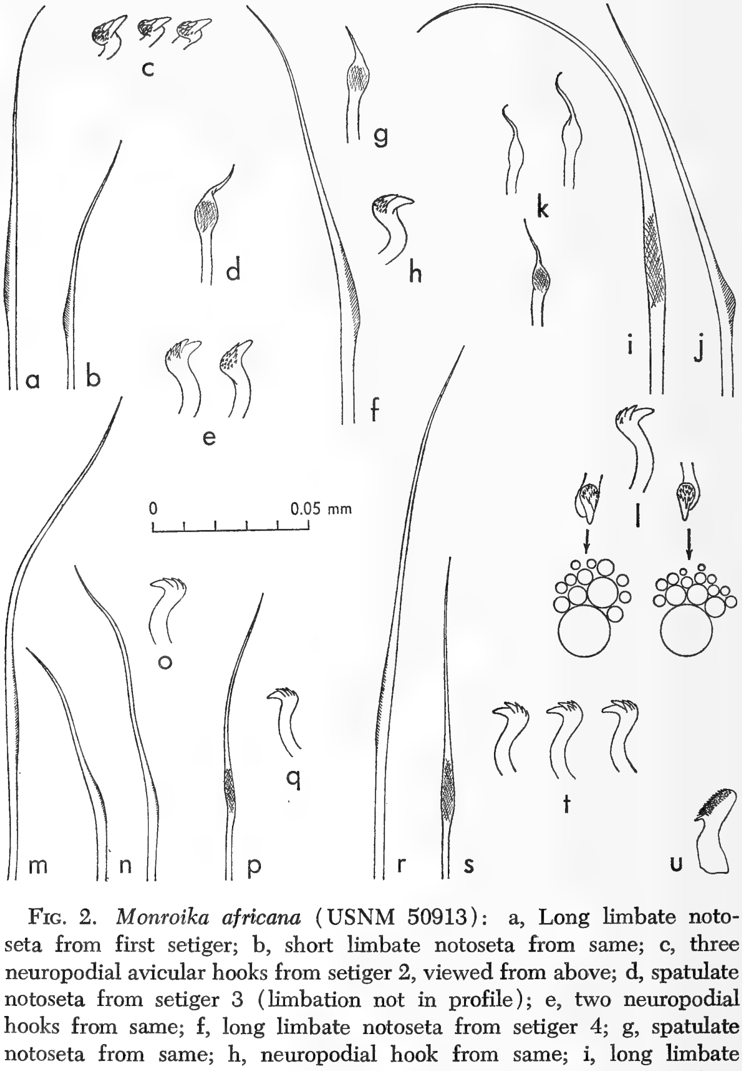

FIG. 2. *Monroika africana* (USNM 50913): a, Long limbate notoseta from first setiger; b, short limbate notoseta from same; c, three neuropodial avicular hooks from setiger 2, viewed from above; d, spatulate notoseta from setiger 3 (limbation not in profile); e, two neuropodial hooks from same; f, long limbate notoseta from setiger 4; g, spatulate notoseta from same; h, neuropodial hook from same; i, long limbate notoseta from setiger 5 (limbation not in profile); j, short (?) limbate notoseta from same; k, three spatulate notosetae from same; l, three hooks from same (diagrams below right and left hooks show disposition of denticles); m, long limbate notoseta from setiger 6; n, two short limbate notosetae from same; o, neuropodial hook from same; p, short limbate notoseta from setiger 7; q, neuropodial hook from same; r, long limbate notoseta from setiger 8; s, short limbate notoseta from

viviparid gastropod *Mekongia jullieni* (Deshayes) (USNM [Molluscs] 704235), R. A. M. Brandt, collector, 13 March 1968—holotype (USNM 50914), paratypes (USNM 50915), dried specimens; Mekong River at Ban Seo, south of Khong Island, Sithandone (14°06′N, 105°51′E), associated with the unionid bivalve *Hyriopsis delaportei* (Crosse and Fischer) (USNM [Molluscs] 704236), R. A. M. Brandt, collector, 6 March 1968—paratypes (USNM 50916), dried specimens.

Type-material: The holotype is 1.75 mm long, excluding the branchial crown, and 0.13 mm wide at its widest part; the branchial crown is totally dried. Paratypes are from 1.50–3.10 mm long, excluding the branchial crown, and 0.14–0.27 mm wide; branchial crowns are 0.15–0.18 mm.

Description: The body is small, with 10 setigerous segments, 8 thoracic and 2 abdominal (Fig. 3a). The anterior end has a branchial crown whose details can not be determined, due to the dried condition of the specimens. A collar is present, and its margin is entire except for a deep mid-dorsal cleft which is continuous with a dorsal groove extending to about the level of setiger 2 (Fig. 3a).

The first setiger is provided only with unilimbate capillary notosetae of 2 types, about 4 long ones (Fig. 3b) and 3 short ones (Fig. 3c; Table 2). The following 7 thoracic setigers all bear 2–6 long limbate capillary notosetae (Fig. 3f, i, l, o); the 2 abdominal setigers bear long geniculate limbate capillary neurosetae (Fig. 3r, t). Only the first setiger bears short limbate capillary setae; on setigers 2–8, these are replaced by 2–4 spatulate notosetae (Fig. 3g, j, m, p).

There are 3–5 long-handled avicular neuropodial hooks on setigers 2–5. Each of these has a stout, sinuous manubrium with a large, single, central fang surmounted by a series of smaller denticles (Fig. 3d, e, h, u). An *en face* view reveals that there is a pronounced asymmetry in the placement of the denticles above the central fang (Fig. 3d, e, u). Notopodial hooks of the abdominal region are in "uncinigerous" rows, from 14–20 per row, dorsal to the long geniculate capillary neurosetae. The hooks are provided with long necks (Fig. 3s). Each abdominal hook is provided with a single, proximal, relatively large, central tooth surmounted distally by many small teeth in about 10 rows; the number of denticles per row decreases distally from about 3 proximally (just above the single tooth) to about 7–8 distally.

Unique pilose neurosetae appear on setigers 6–8, where they replace the neuropodial avicular hooks of the more anterior thoracic segments. They are short and sharply bent to nearly right angles, relative to the slightly curved shaft; their distal ends present a pilose appearance (Fig. 3k).

Remarks: Tubes of *B. asiatica* were present over several of the apical

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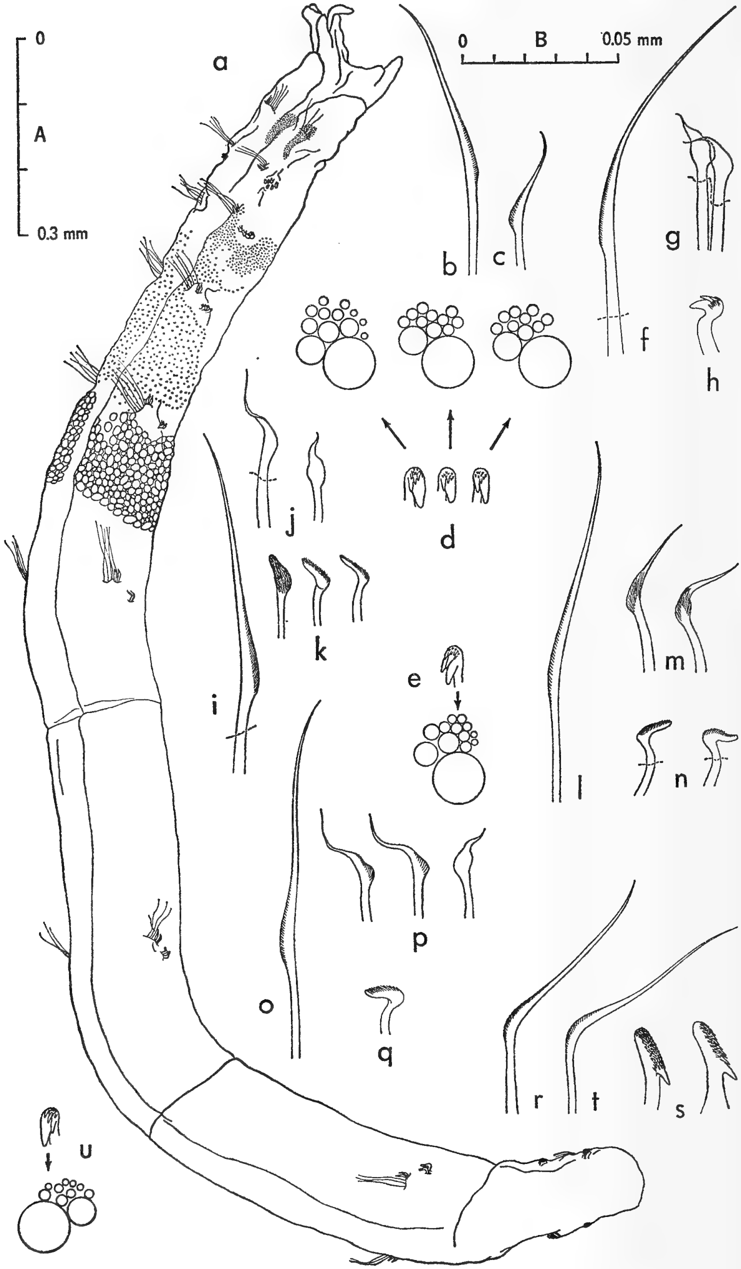
same; t, three neuropodial hooks from same; u, abdominal notopodial hook.


0
A
0.3 mm
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B
0.05 mm
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whorls of *Mekongia* and formed extensive incrustations on the valves of *Hyriopsis*; in both cases, they were associated with the aberrant sabelliform polychaete *Caobangia brandti* (Jones, in press). Two types of granular dermal inclusions are present in the anterior thoracic region of some specimens of *B. asiatica.*

Brandtika sp.

Figure 4

Material examined: Thailand: Salween River at Ban Chao Noi, Mae Hong Son Province (approximately 18°26′N, 97°35′E), associated with *Brotia* cf. *baccata* (Gould) (USNM [Molluscs] 420480b), H. M. Smith, collector, 14 January 1933 (USNM 50917). Burma: Thoungyin River [a tributary of the Salween], associated with paratype of *Melania pagodula* Gould [= *Brotia pagodula* (Gould)] (USNM [Molluscs] 611238) (USNM 50918).

Fragments of from 1 to 3 setigers each were obtained from tubes similar to those of *B. asiatica.* In only a few instances was it possible to determine which setigers were being examined and then, only by making the assumption that the types of setae and their linear distribution along the body of these worms was the same as for *B. asiatica.* Thus, because a posterior end consisted of 3 setigers, the terminal 2 of which had rows of hooks and the other had short pilose setae, it was possible to decide that these were setigers 8–10. Similarly, it was possible to determine that another series of 3 setigers consisted of the setigers 4–6, because of the shift from neuropodial avicular hooks to pilose setae between setigers 5 and 6. Unfortunately, not all of the setae encountered were oriented so that they could be illustrated. However, no setae were found which were radically different from those found in specimens of *B. asiatica.*

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FIG. 3. *Brandtika asiatica* new genus, new species (a–t, USNM 50915; u, USNM 50916): a, Right dorsolateral view of entire specimen; b, long limbate notoseta from first setiger; c, short limbate notoseta from same; d, three neuropodial avicular hooks from setiger 2 (diagrams show disposition of denticles); e, same, from setiger 3; f, long limbate notoseta from setiger 5; g, two adjacent spatulate notosetae from same; h, neuropodial hook from same; i, long limbate notoseta from setiger 6; j, two spatulate notosetae from same; k, three pilose neurosetae from same; l, long limbate notoseta from setiger 7; m, two adjacent spatulate notosetae from same; n, two pilose neurosetae from same; o, long limbate notoseta from setiger 8; p, three spatulate notosetae from same; q, pilose neuroseta from same; r, slightly geniculate, long limbate seta from setiger 9; s, two notopodial abdominal hooks from same; t, geniculate long limbate neuroseta from setiger 10; u, thoracic avicular hook. Scale A, a; scale B, b–u.

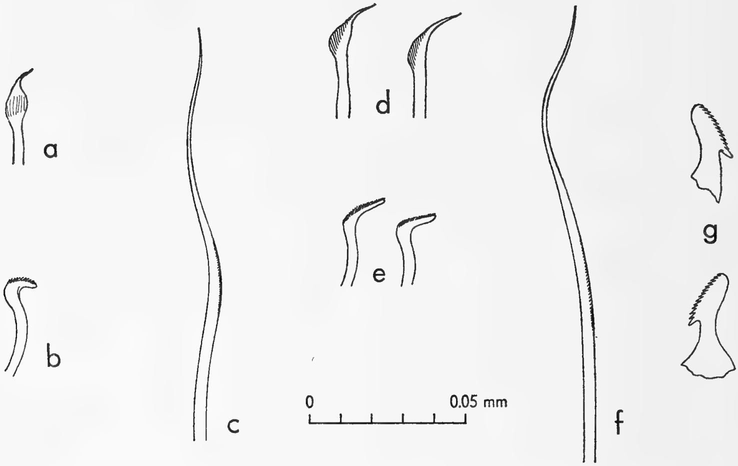

FIG. 4. *Brandtika* sp. (USNM 50917): a, Spatulate notoseta from setiger 4; b, pilose neuroseta from setiger 6; c, long limbate notoseta from setiger 8; d, two spatulate notosetae from same; e, two pilose neurosetae from same; f, long limbate neuroseta from abdominal setigers 9 or 10; g, two notopodial abdominal hooks from same.

Due to the lack of even one whole specimen, I do not feel that these specimens should be considered to be conspecific with *B. asiatica* or necessarily a different species from *B. asiatica*, even though they occur in a quite different drainage system than *B. asiatica*. It should be noted that the two different species of *Caobangia* occur in these same two drainages, i.e., *C. brandti* in the Mekong, as well as the Chao Phraya of Thailand, and *C. smithi* in the Salween (Jones, 1974). Thus, I offer the following merely to add to our present knowledge of the genus *Brandtika*.

Preliminary description: A fourth setiger included 6 long limbate capillary notosetae, 2 spatulate notosetae (Fig. 4a), and 6 neuropodial avicular hooks, all similar to their counterparts in *B. asiatica*. The adjacent setiger 5 bore 5 long capillary notosetae, 2 spatulate notosetae, and 6 neuropodial hooks; setiger 6 had 3 long capillary notosetae, 1 spatulate notoseta, and 2 pilose neurosetae (Fig. 4b). In the posterior section mentioned above, setiger 8 had 5 long capillary notosetae (Fig. 4c), 4 spatulate notosetae (Fig. 4d), and 4 pilose neurosetae (Fig. 4e); setiger 9 carried 3 long, slightly sinuous, limbate capillary neurosetae (Fig. 4f) and about 34 long-necked notopodial hooks (Fig. 4g); setiger 10 was provided with 3 nearly straight capillary neurosetae and about 20 notopodial hooks.

Potential specific differences between these specimens and *B. asiatica*

(Table 2) may lie in the number of neuropodial avicular hooks in the anterior thorax, i.e., 6–7 hooks in setigers 4–5 in *Brandtika* sp. compared with 3–4 hooks in the same setigers in *B. asiatica*, and in the number of abdominal hooks on setigers 9 and 10, i.e., 24–24 in *Brandtika* sp. vs. 15–20 in *B. asiatica*, as well as in the shape of the abdominal capillary setae (cf. Fig. 4f vs. Fig. 3r, t) and of the abdominal notopodial hooks (cf. Fig. 4g vs. Fig. 3s). Confirmation or refutation of this possibility must await the collection of better preserved material.

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PROCEEDINGS
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CAUDAL SCALATION OF CENTRAL AMERICAN *CROCODYLUS*

Charles A. Ross and Franklin D. Ross
Bird and Mammal Laboratories, Bureau of Sport Fisheries and Wildlife, National Museum of Natural History, Washington, D.C. 20560, and Goldfarb Library, Brandeis University, 415 South Street, Waltham, Massachusetts 02154

Two species of Central American crocodiles, *Crocodylus acutus* Cuvier, 1807, and *C. moreletii* Duméril, 1851, have been confused owing to variation in their presumed diagnostic characters. The examination of a large number of live and preserved individuals shows that these species can be differentiated on the basis of their caudal scalation. Specimens of *C. acutus* were examined from Belice, Guatemala, Honduras, Mexico, and Nicaragua; *C. moreletii* was examined from throughout its range—Belice, Guatemala, and Mexico.

The presence of caudal irregularities in *C. moreletii* was used by King and Brazaitis (1971) to aid in the identification of commercial crocodilian skins. However, they failed specifically to note that caudal irregularities occur on some *C. acutus*. In both species, one or more scales have been noted between the caudal whorls in the proximal half of the tail (Fig. 1). No more than three proximal irregularities occur in *C. acutus*, as determined from the examination of 63 specimens; each irregularity may consist of from one to three scales. Furthermore, these irregularities are restricted to the lateral surface of the tail (Table 1). *Crocodylus moreletii* also exhibits proximal caudal irregularities; however, these are always on, but not limited to, the ventral surface. These ventral surface irregularities are variable. They may be either a single scale, or two or more scales arranged laterally. Extensive,

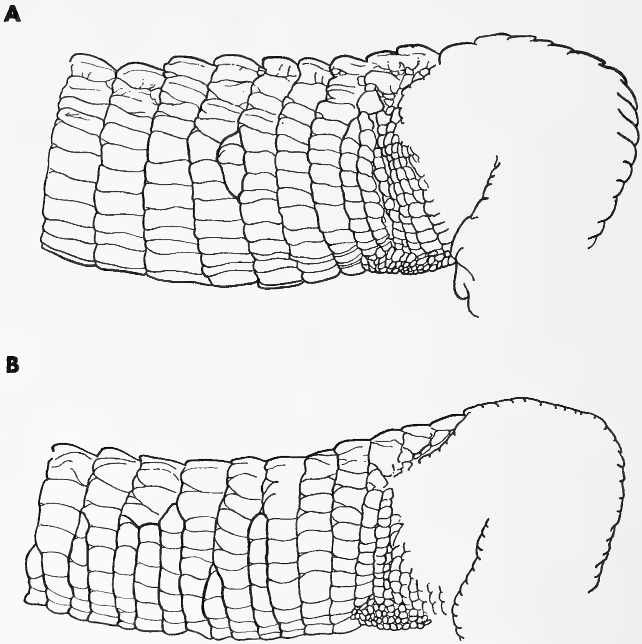

FIG. 1. Ventro-latero views of anterior caudal scalation of *C. acutus* (A), and *C. moreletti* (B), showing caudal irregularities. Anterior is to the right of the figure.

complex ventral irregularities have been noted in which the normal number of proximal ventral whorls was nearly doubled. Some specimens of *C. moreletii* exhibit lateral caudal irregularities similar to those of *C. acutus*, but these are always accompanied by ventral irregularities.

No mention of proximal caudal irregularities was made in the type descriptions of *C. moreletii* (Duméril and Duméril, 1851; A. Duméril, 1852). The second description (1852) was accompanied by a plate which shows ventral proximal caudal irregularities extending laterally. King and Brazaitis (1971) state that *C. moreletii* exhibits a caudal irregularity 66 per cent of the time. All the specimens we examined possessed ventral proximal caudal irregularities and 87 per cent exhibited irregularities extending laterally (Table 1). This condition is visible in animals of all ages.

TABLE 1. Numbers of Central American crocodiles exhibiting caudal scalation irregularities.

	Sample size	None	Lateral	Ventral	Ventral extending laterally
Crocodylus acutus	63	56	7	0	0
Crocodylus moreletii	111	0	many*	111	97

* Number not noted, however, always occurring in conjunction with ventral irregularities.

As determined by our sample, *C. acutus* exhibits regular caudal scalation 89 per cent of the time. Eleven per cent exhibit proximal lateral caudal irregularities (Table 1), but no ventral caudal irregularities have ever been noted.

ACKNOWLEDGMENTS

We wish to acknowledge the financial support of Robert L. Whiston, Queensland, Australia; Dr. G. F. De Witte for the loan of the co-types of *Alligator lacordairei* Preudhomme de Borre (= *C. acutus*) housed in the Académie Royal de Belgique, Professor Miguel Alvarez del Toro for permitting the examination of live specimens in his charge at the Instituto de Historia Natural, Tuxtla Gutierrez, Chiapas, Mexico. Special gratitude is due the Division of Amphibians and Reptiles of the National Museum of Natural History for providing research space and encouragement. We would like to thank Dr. George R. Zug for his critical reading of the manuscript and advice.

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PROCEEDINGS
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A REDESCRIPTION OF *HERMILIUS PYRIVENTRIS* HELLER (COPEPODA: CALIGOIDA) WITH THE FIRST DESCRIPTION OF THE MALE

By Roger F. Cressey
Smithsonian Institution, Washington, D.C. 20560

The genus *Hermilius* was described by Heller in 1868 to accommodate a new species of caligid copepod collected from the catfish *Arius acutus* in Java. Since then 3 additional species have been described; *H. longicornis* Bassett-Smith 1898, *H. armatus* Capart 1959, and *H. youngi* Kabata 1964. Kabata suggested that *H. armatus* might be synonymous with *H. pyriventris.* Examination of the material described below and its comparison with Capart's description of *H. armatus* has led me to this conclusion also.

Several specimens of *Hermilius pyriventris* Heller were sent to me by Dr. I. Paperna of the Hebrew University of Jerusalem. Additional specimens were collected by the author from the gills of catfish from India and the Philippines contained in the fish collections of the Smithsonian Institution.

A review of the literature concerned with the genus *Hermilius* revealed that no adequate description of the type-species exists. Pillai (1961) described a collection containing material which he identified as *H. pyriformis* but which Kirtisinghe (1964) showed to be *H. longicornis* Bassett-Smith.

All drawings were made with the aid of a Wild Drawing Tube.

All material has been deposited in the collections of the Smithsonian Institution.

The illustrations were made by Hillary Boyle.

Hermilius pyriventris Heller

Figures 1–21

Hermilius pyriventris Heller, 1868, p. 186.—Bassett-Smith, 1899, p. 445. —Brian, 1924, p. 393.—Capart, 1959, p. 91.

Hermilius armatus Capart, 1959, p. 90 non *H. pyriventris*.—Pillai, 1961 (= *H. longicornis* Bassett-Smith).

Material studied: 6 females from the gills of *Netuma macrocephalus* and 11 females from the gills of *N. thalassinus*, both hosts collected off the coast of Kenya. 16 females and 2 males from the gills of *Arius* sp. collected at Vizakhapatnam, India. 11 females from the gills of *Tachysurus* sp. (USNM 160551) from the Philippines.

Description: Female.—Body form as in Figures 1 and 2. Measurements (in mm) for total body length and width as below.

	No. of specimens	Avg. length	Avg. width	Range of length
N. thalassinus Vipingno, Kenya	5	2.05	0.56	1.84–2.38
N. thalassinus Diani, Kenya	3	5.40	1.33	5.03–5.77
N. macrocephalus Vipingno, Kenya	3	3.94	1.11	3.57–4.48
Trachysurus sp. Philippines	9	3.78	1.05	3.33–4.16
Arius sp. India	11	3.86	1.14	3.44–4.24

The specimens in the two collections from Kenya varied *significantly* in size but no morphological differences could be found between them —hence they are considered to be of the same species here. Measurements below are from a specimen in the Vipingno collection.

Cephalon about one-half of total body length, folding laterally to envelope that part of gill to which it is attached. (This modification is not uncommon to parasitic copepods which attach to gill filaments, *Lernanthropus*, *Metataeniacanthus*, and *Alicaligus* for example). Cephalon supported by several heavily sclerotized rods making it rather rigidly folded laterally and difficult to flatten for study. Genital segment (Fig. 3) longer than wide ($968\mu \times 679\mu$), widest anteriorly. Abdomen (Fig. 4) 2-segmented, segments 136μ and 124μ in length

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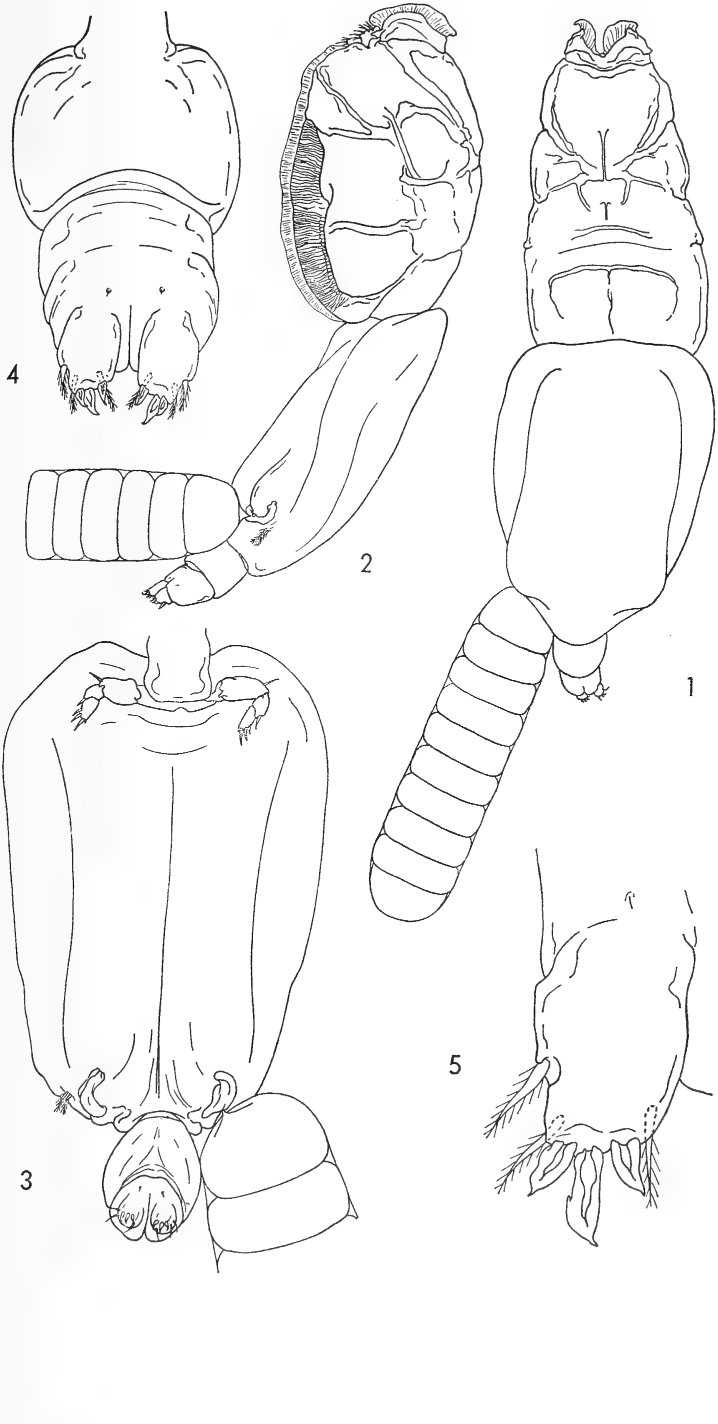
Figs. 1–5. *Hermilius pyriventris* Heller, female: 1, dorsal; 2, lateral; 3, genital segment and abdomen, ventral; 4, abdomen, ventral; 5, caudal ramus, ventral.

Figs. 6–12. *Hermilius pyriventris* Heller, female, cont: 6, first antenna; 7, second antenna; 8, mandible; 9, first maxilla; 10, second maxilla; 11, maxilliped; 12, sternal furca.

Figs. 13–16. *Hermilius pyriventris* Heller, female, cont: 13, leg 1; 14, leg 2; 15, leg 3; 16, leg 4.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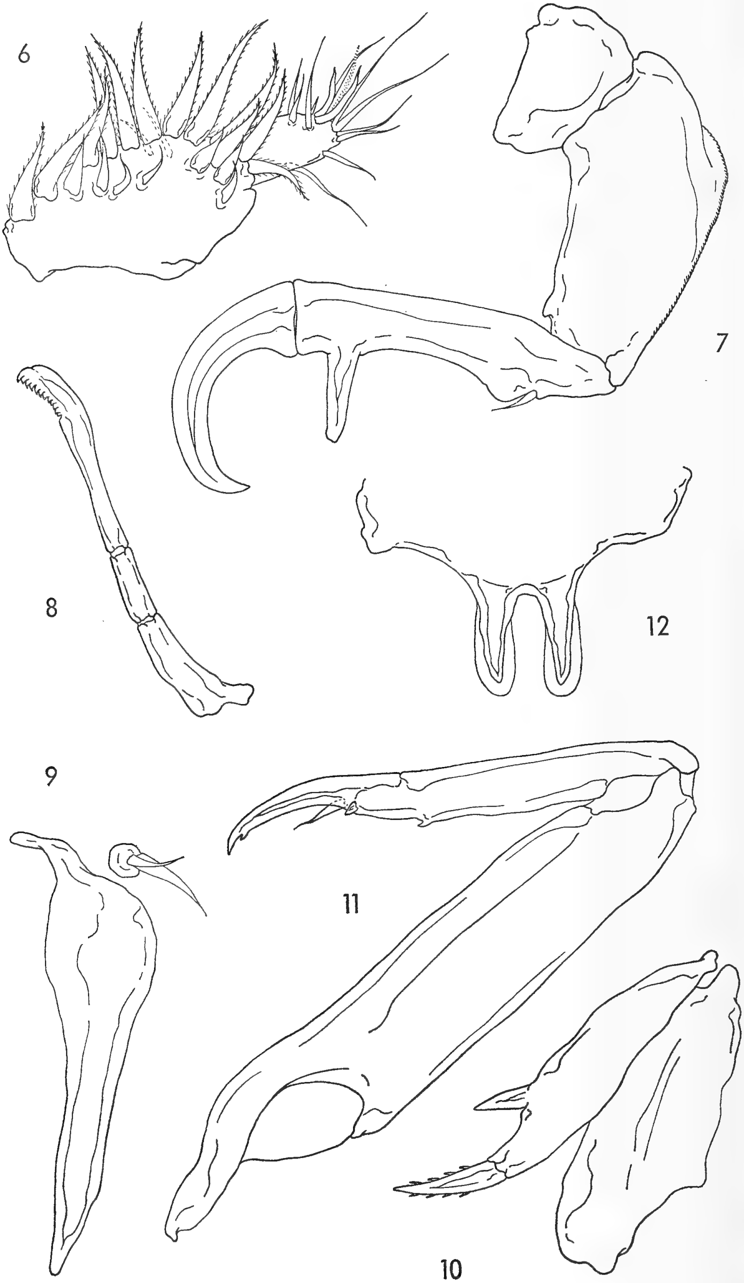
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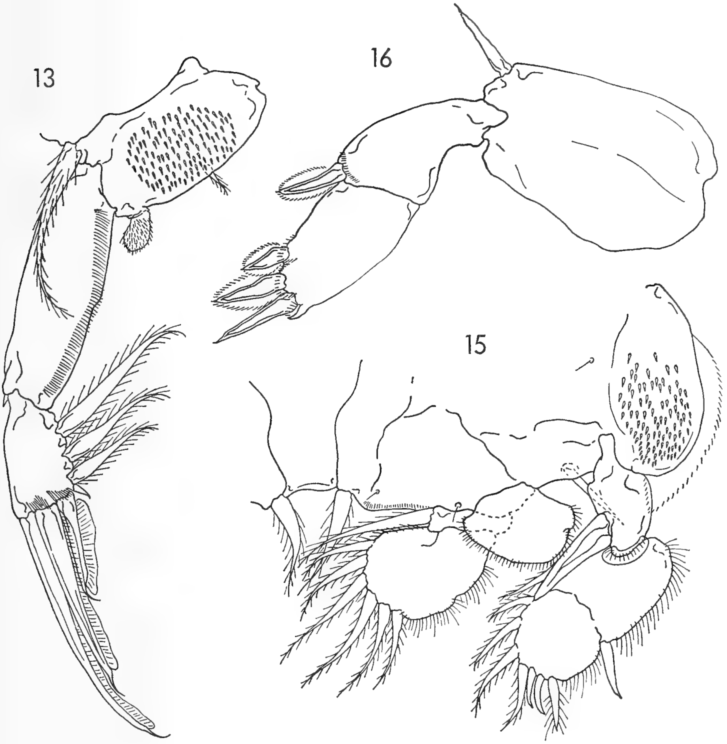
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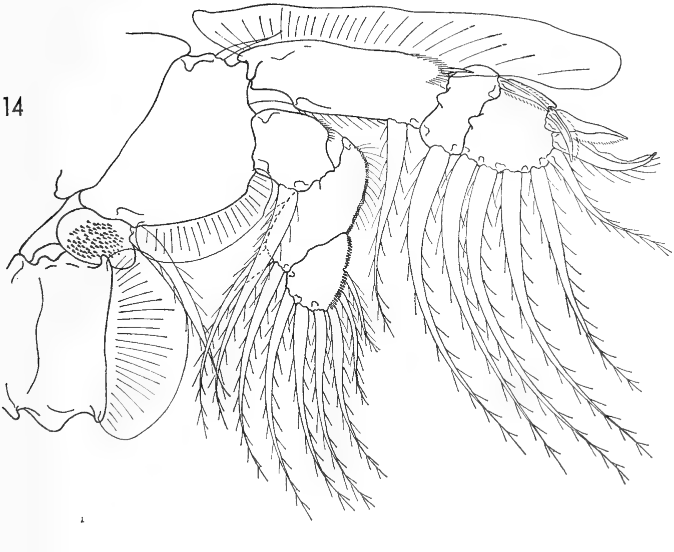
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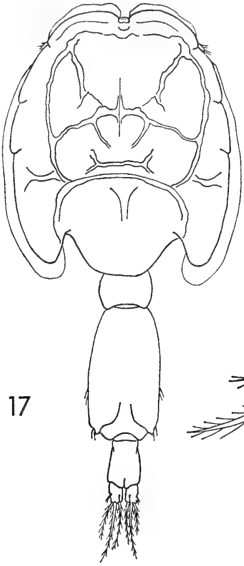

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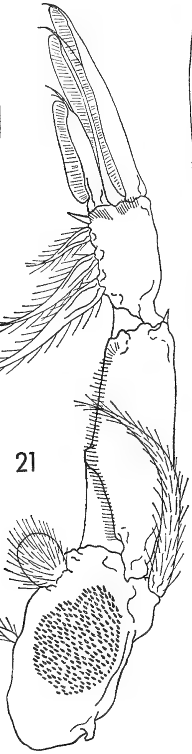

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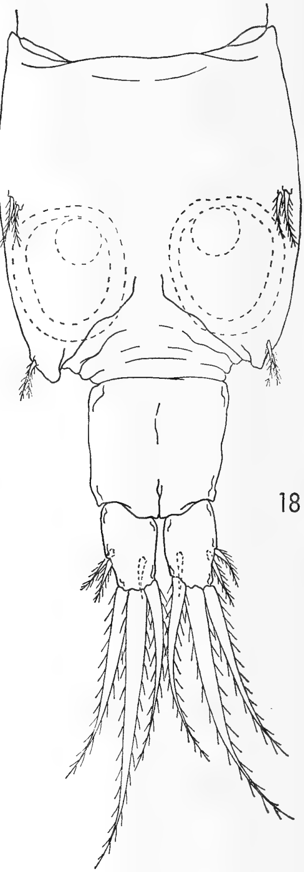

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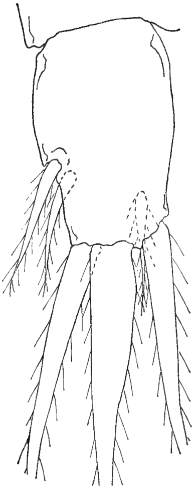

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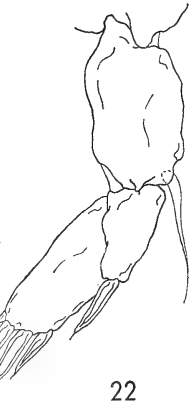

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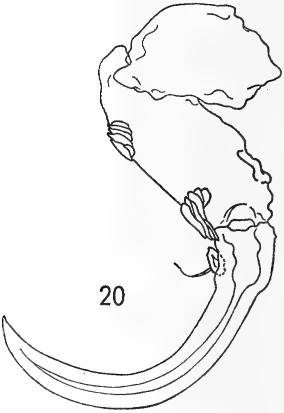

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respectively, each considerably wider than long. Caudal rami (Fig. 5) longer than wide ($59\mu \times 47\mu$); each with 6 setae; terminal 3 short and pyriform; lateral and subterminal setae plumose, of about equal length.

First antenna (Fig. 6) 2-segmented; basal segment 94μ in length, bearing many stout finely plumose setae; terminal segment bearing 12 slender naked setae and one aesthete. Second antenna (Fig. 7) 4-segmented; segments measure 89μ, 295μ, 260μ and 183μ long respectively. Second segment with fine striations along inner edge. Terminal claw of 2 segments; first with short seta near base and accessory process near inner distal corner, second recurved to complete claw. Mandible (Fig. 8) of typical caligid type with 13 teeth. First maxilla (Fig. 9) a long sclerotized, posteriorly directed, process with 2 short setae near base; process situated lateral to and nearly as long as mouth tube. Second maxilla (Fig. 10) small, 2-segmented; terminal segment with short spinelike process near inner distal corner and terminal, finely serrate, spine. Maxilliped (Fig. 11) slender, 3-segmented, not heavily sclerotized; second segment with short barblike process on inner margin and short stout spine on inner distal corner, terminal segment slightly recurved bearing basal seta and short accessory barb near tip. Sternal furca (Fig. 12) weakly developed, tines spatulate.

Leg 1 (Fig. 13) basipod with patch of spinules and 2 plumose setae, one inner and one on outer distal corner; exopod 2-segmented, first segment with short spine on outer distal corner, second segment with 3 inner plumose setae and 3 terminal setae, each with inner hyaline membrane; endopod reduced to short spinulose process. Leg 2 (Fig. 14) exopod 3-segmented, first segment with inner seta and short outer distal spine, second segment with inner seta and longer outer distal spine, third segment with 5 terminal to inner setae and 3 terminal spines, outermost directed inwardly across other 2; endopod 3-segmented, first segment with inner seta, second segment with 2 inner setae, third segment with 6 setae, outer edges of last 2 segments with short blunt spinules. Leg 3 (Fig. 15) exopod 3-segmented, first segment with heavily sclerotized inwardly directed spine, second segment with short inner seta and outer distal spine, third segment with 7 short setae, second and third outer shorter and naked; endopod 3-segmented, first segment lobate, covering part of second and third segments, second segment short with inner seta, third segment with 6 setae. Leg 4 (Fig. 16) basipod with outer short seta; exopod 2-segmented, first segment with outer distal spine, second segment with 3 terminal

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FIGS. 17–22. *Hermilius pyriventris* Heller, male: 17, dorsal; 18, genital segment and abdomen; 19, caudal ramus, ventral; 20, second antenna; 21, leg 1; 22, leg 4.

spines, innermost naked. Leg 5 absent. Leg 6 represented by 2 short plumose setae lateral to area of egg string attachment.

Egg strings of usual caligoid form.

Male.—Body form as in Figure 17. Total length and greatest width 1.53 × 0.68 mm. Cephalon about one-half of total body length. Cephalon folded laterally as in female to envelope gill filaments. Genital segment (Fig. 18) longer than wide ($401\mu \times 212\mu$), spermatophores easily visible within. Abdomen 1-segmented, longer than wide ($124\mu \times 100\mu$). Caudal ramus (Fig. 19) bearing 6 plumose setae, 2 lateral, 1 subterminal, and 3 terminal (longest seta 472μ long); each ramus longer than wide ($59\mu \times 47\mu$).

Cephalic appendages as in female except second antenna. Second antenna (Fig. 20) 3-segmented (4 in female), without accessory process on claw.

Leg 1 (Fig. 21) similar to female except endopod relatively larger and 3 terminal exopod spines relatively shorter. Legs 2 and 3 as in female. Leg 4 (Fig. 22) similar to female except terminal spines of male relatively longer and without fringes. Leg 5 represented by 2 setae near midlateral margin of genital segment. Leg 6 represented by 2 setae at posterior corners of genital segment.

Remarks: *H. pyriventris* females can be easily separated from *H. longicornis* and *H. youngi* by the nature of the second antenna (4-segmented in *pyriventris* and 3-segmented in the other 2). The pyriform terminal setae of the caudal rami of *pyriventris* further separates them from females of *longicornis* and *youngi*. So far the genus has only been reported from species of marine catfish (Arridae) and has not been collected from waters adjacent to North and South America. I have examined many catfish from the Gulf of Mexico without finding *Hermilius*.

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PROCEEDINGS
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A NEW SPECIES OF HERMIT CRAB OF THE GENUS *NEMATOPAGURUS* (CRUSTACEA: DECAPODA: PAGURIDAE) FROM HAWAII

By Patsy A. McLaughlin and Julie H. Brock
Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida 33149, and Department of Zoology, University of Hawaii, Honolulu, Hawaii 96822

The genus *Nematopagurus* was established by A. Milne-Edwards and Bouvier (1892) for *Nematopagurus longicornis* A. Milne-Edwards and Bouvier from the western Mediterranean and eastern Atlantic from Spain to Cape Verde (A. Milne-Edwards and Bouvier, 1892; 1899, 1900). Subsequently, Alcock (1905) assigned *Catapagurus muricatus* Henderson, 1896 from Ceylon to *Nematopagurus* and described four additional species from several localities in the northern Indian Ocean. De Saint Laurent (1968) proposed, without discussion, that Melin's (1939) *Eupagurus* (*Catapagurus*) *vallatus* from Japan also should be assigned to *Nematopagurus.* Recently, Lewinsohn (1969) reported *N. muricatus* and *N. squamichelis* Alcock from the Gulf of Aqaba, Red Sea, and described another new species, *Nematopagurus diadema* Lewinsohn from the same area. The discovery of a new species of this genus from Hawaii is the first record of *Nematopagurus* in this easternmost part of the Indo-west-Pacific Ocean.

This species, *Nematopagurus spinulosensoris* n. sp., described herein, is particularly noteworthy, not only as indicative of the considerable extension of the range of *Nemato-*

pagurus, but because, as its name implies, it possesses certain unique sensory structures, unknown in other pagurids.

The holotype and certain paratypes are deposited in the National Museum of Natural History, Smithsonian Institution (USNM). Additional paratypes are deposited as follows: Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii; Allan Hancock Foundation (AHF), University of Southern California; and Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands (RMNH). A single measurement, the shield length (SL) has been made for each specimen.

The authors are indebted to Dr. Paul J. Struhsaker, National Marine Fisheries Center, Honolulu, Hawaii, for providing specimens from the collections of the National Marine Fisheries Service; to Dr. Chanan Lewinsohn, Tel-Aviv University, Tel-Aviv, Israel, for providing comparative specimens of *Nematopagurus muricatus* (Henderson); and particularly to Dr. Robin M. Overstreet, Gulf Coast Research Laboratory, Ocean Springs, Mississippi, for his serial sections and preliminary interpretation of the sensory structures of this species. This research has been supported, in part, by Research Grant GB 40062 from the National Science Foundation and by a Hawaii Biomedical Support Grant 1970/1971.

Nematopagurus spinulosensoris new species

Figures 1–3

Holotype: ♂ (SL = 8.6 mm), NOAA station TC-33-15, 21°02′N, 156°46′W, 31 October 1967, 241–254 m, USNM 149299.

Paratypes: 1♂ (SL = 5.2 mm), off Oahu, 23 September 1971, 382 m, RMNH; 6♂, (SW = 5.1–7.4 mm), 2♀, 1 ovigerous (SL = 5.2, 6.5 mm), NOAA station TC-33-15, 21°02′N, 156°46′W, 31 October 1967, 241–254 m, USNM, BPBM, AHF, RMNH.

Type-Locality: Off Molokai, Hawaii, 21°02′N, 156°46′W.

Diagnosis: Chelae and carpi of both chelipeds, each with sensory-modified spines on dorsal surface. Right chela with several irregular rows of spines on dorsal surface. Carpi of ambulatory legs each with row of strong spines dorsally.

Description: Shield (Fig. 1a) longer than broad; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections concave; posterior margin truncate or roundly truncate; dorsal surface with numerous tufts of stiff setae; anterolateral angle produced, subacute or acute. Rostrum usually obtusely rounded,

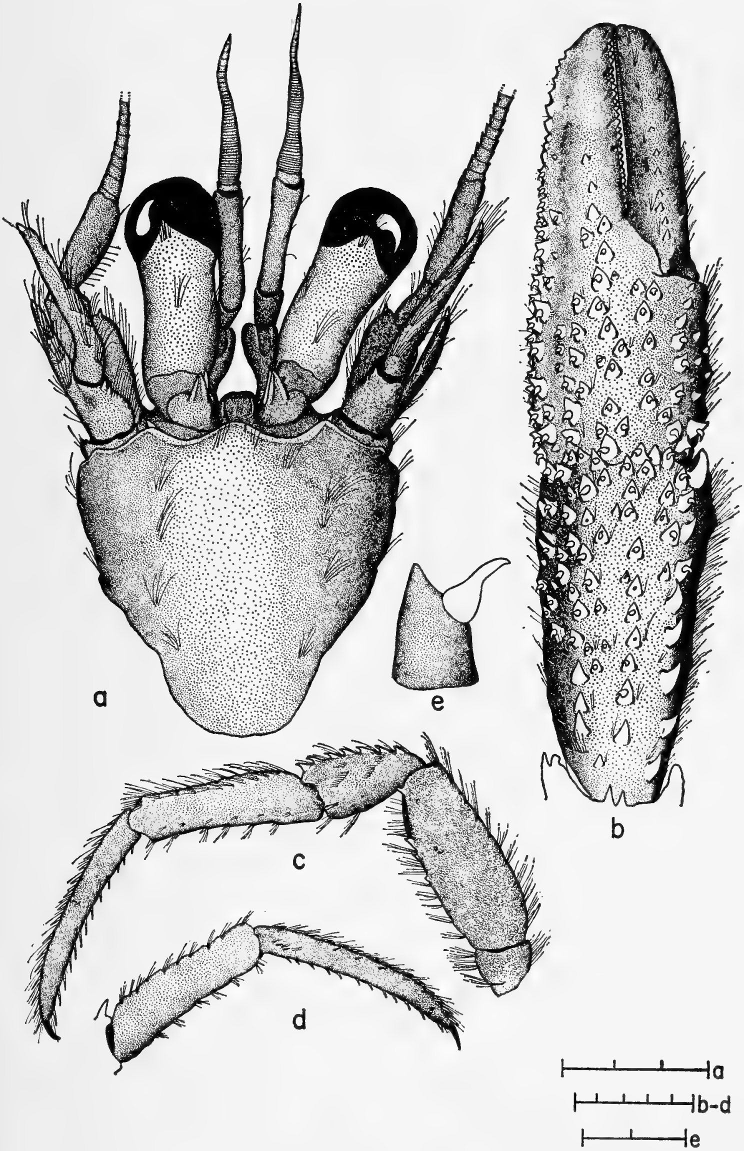

FIG. 1. *Nematopagurus spinulosensoris* n. sp., ♂ paratype: a, shield; b, left chela and carpus (dorsal view); c, 2nd left pereiopod (lateral view); d, 2nd left dactyl and propodus (mesial view); e, spine of chela with sensory process. Scales equal 3 mm (a), 5 mm (b–d) and 0.5 mm (e).

occasionally obtusely triangular; often not exceeding lateral projections, occasionally slightly exceeding lateral projections; usually with few moderately long setae. Lateral projections prominent, obtusely triangular, each with prominent submarginal spine.

Ocular peduncles moderately short, two-thirds to three-fourths length of shield; dorsal and dorsomesial surfaces frequently with few tufts of setae; corneae usually strongly dilated. Ocular acicles acutely triangular, moderately slender, with prominent longitudinal furrow; terminating acutely or subacutely, and with very strong submarginal spine; separated basally by three-fourths to entire basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by one-half to two-thirds length of ultimate segment; ultimate segment with longitudinal row of setae on dorsal surface in distal half, occasionally on distal two-thirds to four-fifths; penultimate segment with few scattered setae; basal segment with small spine or spinule at ventrodistal margin, partially obscured by tuft of long stiff setae, lateral face proximally, with very strong, slender, acute spine.

Antennal peduncles moderately short, exceeding ocular peduncles by one-fifth to one-half length of ultimate segment; with supernumerary segmentation (c.f. McLaughlin, 1974). Fifth and fourth segments with numerous tufts of moderately long setae. Third segment with small to moderately strong spine at ventrodistal angle, partially obscured by tuft of very long stiff setae. Second segment with dorsolateral distal angle produced, terminating in strong simple or bifid spine, lateral margin occasionally with small spine distally, mesial face with tufts of long stiff setae and occasionally also with 1 or 2 small spines; dorsomesial distal angle with 1, occasionally 2, small to moderately strong spines, mesial face with long stiff setae. First segment with small to moderately strong spine on lateral face distally; ventrodistal margin with 1–5 small to moderately strong spines. Antennal acicle moderately long, usually reaching beyond proximal half of ultimate peduncular segment; terminating in acute or blunt spine; mesial margin with tufts of long stiff setae and occasionally with 1 or 2 small spines. Antennal flagella long, overreaching tip of right cheliped; occasionally few articles each with 1 or 2 very short setae or bristles.

Mandible without distinguishing characters. Maxillule (Fig. 3a) with proximal endite subquadrate; endopodite with 1 moderately long

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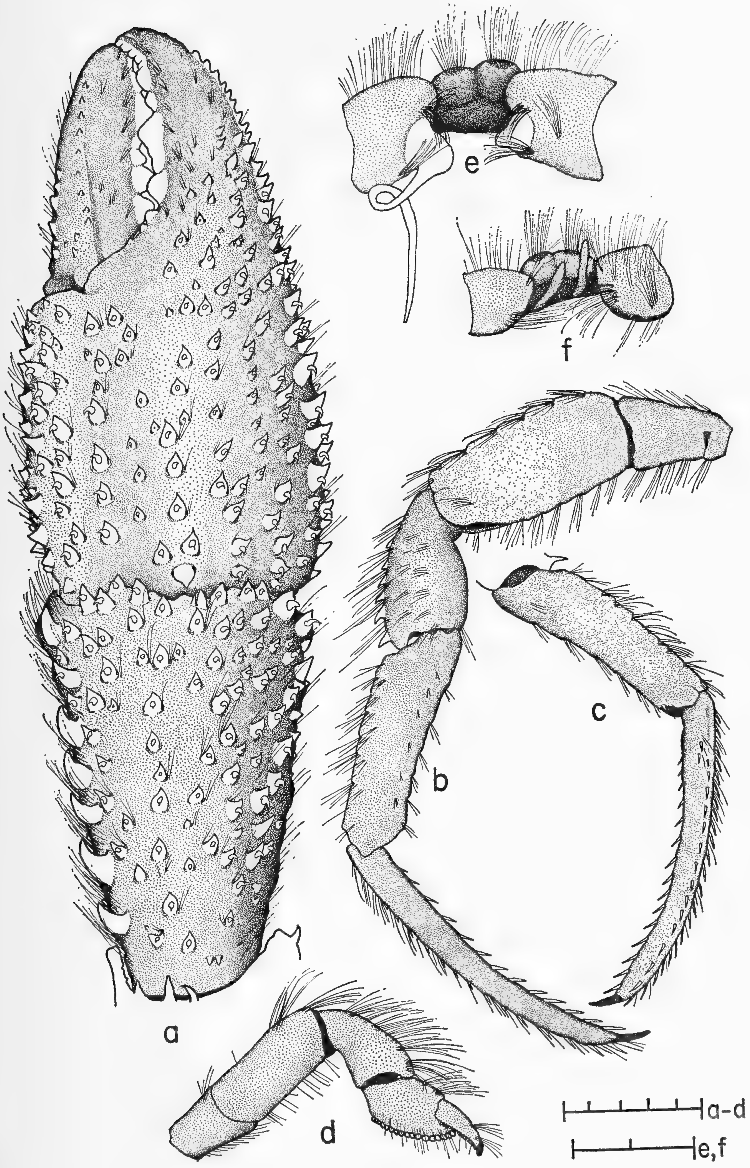
FIG. 2. *Nematopagurus spinulosensoris* n. sp., a–e, ♂ paratype: a, right chela and carpus (dorsal view); b, 3rd left pereiopod (lateral view); c, 3rd left dactyl and propodus (mesial view); d, 4th right pereiopod (lateral view); e, coxae of 5th pereiopods with sexual



tubes (ventral view). f, ♀ paratype, coxae of 5th pereiopods and paired gonopods of 1st abdominal segment (ventral view). Scales equal 5 mm (a–d) and 1 mm (e, f).

bristle on well developed internal lobe, external lobe vestigial or absent. Maxilla (Fig. 3b) with moderately broad endopodite usually equalling scaphognathite in distal extension. First maxilla (Fig. 3c) with basal segment of exopodite very slender. Second maxilliped (Fig. 3d) with basis-ischium fusion complete. Third maxilliped (Fig. 3e) with basis-ischium incomplete; basis usually unarmed; ischium with crista dentata well developed, with accessory tooth; merus with strong spine on dorsodistal margin, ventrodistal angle with cluster of denticulate bristles. Sternite of third maxillipeds unarmed, sparsely setose.

Chelipeds subequal, right usually somewhat larger than left; chelae and carpi of both chelipeds with numerous sensory-modified spines (Figs. 1b, e, 2a) on dorsal surfaces. Right cheliped (Fig. 2a) elongate, moderately slender. Dactyl moderately short, slightly shorter than or equalling length of palm; cutting edge with row of calcareous teeth and usually with few corneous teeth distally, terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface generally flattened, with few tufts of setae, dorsomesial margin, or dorsal surface mesially, usually slightly elevated and with irregular longitudinal row of unmodified small spines or tubercles, frequently becoming obsolete distally; mesial face with scattered tubercles or spines on proximal third and scattered tufts of setae; ventral surface usually with 3 or 4 rows of tufts of stiff bristles. Palm slender, moderately long, two-thirds to four-fifths length of carpus; dorsomesial margin with irregular single or double row of usually unmodified moderately strong spines, and tufts of long stiff setae; dorsal surface with several irregular rows of usually modified spines, extending onto fixed finger proximally, and scattered tufts of setae; dorsolateral margin with single or double row of moderately strong, usually modified spines, extending onto fixed finger as single row of blunt unmodified spines or tubercles, decreasing in size distally; lateral face frequently weakly tuberculate and with scattered tufts of long stiff setae; ventral surface usually tuberculate, particularly mesially, with scattered tufts of long stiff setae; mesial face with 1 or 2 irregular rows of small tubercles or unmodified spines dorsally and tufts of stiff setae. Carpus moderately long, usually equalling or slightly exceeding length of merus; dorsomesial margin with row of very strong, slender, often curved or hooked, unmodified spines and tufts of long setae; dorsal surface with very irregular rows of moderately strong, usually modified spines, more numerous distally, and scattered tufts of long stiff setae; dorsolateral margin not noticeably delimited, lateral face often with low protuberances and tufts of long stiff setae dorsally and distally, occasionally with moderately strong spines, laterodistal margin with acute spine; ventral surface usually somewhat tuberculate and with numerous tufts of long stiff setae; mesial face with numerous low tubercles or ridges and tufts of stiff setae. Merus subtriangular; dorsal margin with irregular row of transverse ridges, often becoming somewhat spinulose distally, and with tufts of long stiff setae, distal margin usually with 2 or 3 strong acute spines; lateral face with scattered tufts of long stiff setae, ventrolateral margin with row of strong, acute, often curved or hooked spines; mesial face usually setose, distal margin and ventromesial face distally with few, small, usually acute spines; ventral surface usually with low tubercles or ridges and tufts of long stiff setae, occasionally with few moderately strong spines. Ischium with strong acute spine at ventrolateral distal angle; ventral, lateral and mesial surfaces setose, ventromesial margin often with few small spines. Coxa with clump of long stiff setae at ventromesial distal angle, 1–3 small tubercles or spinules on ventroproximal angle, ventrolateral margin occasionally with few small spines or spinules, ventrolateral distal angle usually with 1 or 2 acute spines.

Left cheliped (Fig. 1b) moderately long, usually reaching beyond proximal half of dactyl of right; moderately slender, fingers arched or somewhat depressed distally. Dactyl moderately long, one and one-half to twice length of palm; cutting edge with row of small corneous teeth, terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface somewhat convex, with short row of small unmodified spines or spinulose tubercles usually in midline or occasionally on dorsomesial margin proximally and with 2 or 3 rows of tufts of long stiff setae; mesial face slightly spinulose or tuberculate proximally and with tufts of long stiff setae ventrally and distally; ventral surface with 2 or 3 rows of stiff settae. Palm moderately long, one-third to one-half length of carpus; dorsomesial margin with single or double row of moderately small, frequently modified, acute spines; dorsal surface somewhat convex, midline with 2 or 3 irregular rows of moderately strong, usually modified spines extending onto fixed finger as single row proximally, usually with 1 or 2 irregular rows of modified spines laterally and mesially, occasionally only with scattered spines; dorsolateral margin with double or triple row of small modified spines proximally becoming single row of small unmodified spines or spinulose or blunt tubercles on fixed finger distally, and with long stiff setae; lateral, mesial and ventral surfaces usually somewhat tuberculate and with tufts of long stiff setae. Carpus long, equalling or exceeding length of merus; dorsomesial margin with row of strong, slender, often curved, usually unmodified spines; dorsal surface with 2 or 3 irregular rows of moderately strong modified spines proximally, tending to cluster distally, distal margin occasionally with 1 or 2 spines; dorsolateral margin with single or double row usually modified spines and tufts of long stiff setae; lateral face with scattered modified spines in dorsal half, tufts of long stiff setae ventrally, distal margin ventrally with moderately strong acute spine; mesial and ventral surfaces frequently with low

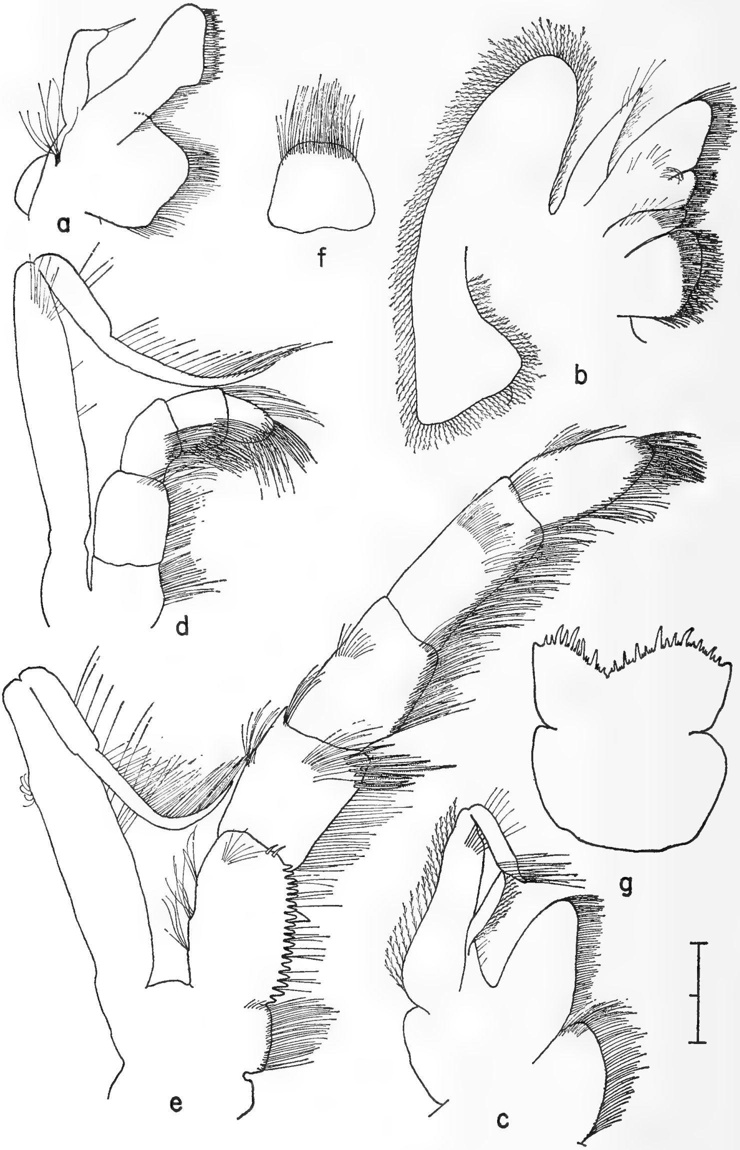


FIG. 3. *Nematopagurus spinulosensoris* n. sp., ♂ paratype, a–e, mouthparts (left, internal view): a, maxillule; b, maxilla; c, 1st maxilliped; d, 2nd maxilliped; e, 3rd maxilliped. f, sternite of 3rd pereiopods; g, telson. Scale equals 1 mm.

protuberances or ridges and tufts of long stiff setae. Merus moderately long, subtriangular; dorsal surface with low transverse ridges, often becoming spinulose distally, and tufts of stiff setae, distal margin with 1–3 acute spines; lateral and mesial faces with low transverse ridges and tufts of long stiff setae; ventromesial and ventrolateral margins each with row of strong, acute, sometimes curved spines. Ischium with row of small spines and tufts of long setae on ventromesial margin, ventrolateral distal angle with acute spine and tuft of long setae. Coxa with clump of long stiff setae at ventromesial distal angle and often 1 or 2 acute spines at ventrolateral distal angle.

Second (Fig. 1c, d) and third (Fig. 2b, c) pereiopods usually overreaching right cheliped, right slightly longer than left, generally similar in structure and armature. Dactyls long, slender, one and one-fourth to one and one-half length of propodi; in lateral view, slightly curved ventrally; in dorsal view, somewhat twisted; each terminating in strong corneous claw; dorsal surfaces each with row of strong corneous spines, increasing in size distally, and tufts of long stiff setae; mesial faces each with faint longitudinal sulcus proximally flanked by 1 or 2 rows of corneous spinules above and few corneous spinules below; lateral faces each sometimes with faint longitudinal sulcus proximally and usually with 1 or 2 rows of tufts of setae; ventral surfaces each with row of strong corneous spines increasing in size distally. Propodi moderately long, one-third to twice length of carpi; dorsal surfaces each with irregular row of transverse ridges and tufts of long stiff setae; mesial and lateral faces usually with 1 or 2 rows of tufts of setae; ventral surfaces each with 1 or 2 rows of tufts of long stiff setae (P_2) or row of small corneous spinules and tufts of long setae (P_3). Carpi two-thirds to three-fourths length of meri; dorsal surfaces each with row of strong spines; mesial and ventral surfaces each with few scattered tufts of long setae; lateral faces each with 1 or 2 rows of stiff setae. Meri laterally compressed; dorsal surfaces each with row of transverse protuberances or ridges and long stiff setae; lateral and mesial faces usually with few tufts of setae, lateral distal margin (P_2) usually with strong acute spine ventrally; ventral surface usually with 1 to several small to moderately strong spines and tufts of setae (P_2) or row of transverse ridges and tufts of long setae (P_3). Ischia each usually with row of long setae on ventral margin and row of small spines (P_2 left). Coxae each with row of tufts of long setae on ventromesial and ventrolateral margins, ventral surface distally also with long setae. Sternite of third pereiopods (Fig. 3f) semisubcircular, anterior margin with long stiff setae.

Fourth pereiopods (Fig. 2d) subchelate; without apparent preungual process; propodal rasp of single row of corneous scales or teeth.

Fifth pereiopods weakly chelate.

Males with well developed, elongate, filiform sexual tube on right coxa of fifth pereiopods (Fig. 2e) left with vas deferens usually slightly protruded. Pleopods unpaired, pl_3–pl_5 with exopodites well developed; endopodites moderately well developed, smallest on pl_5.

Females with paired gonopores; first pleopods (Fig. 2f) paired, pl_2–pl_4, unpaired, with exopodite moderately well developed, endopodite reduced.

Telson (Fig. 3g) with posterior lobes usually somewhat asymmetrical, left usually slightly larger than right, subtriangular or subquadrate; separated by very shallow median cleft; terminal and usually also lateral margins weakly calcified, terminal margins somewhat oblique, each with numerous small calcareous spines marginally and several stronger calcareous acute or blunt spines submarginally; lateral margins unarmed or occasionally each with row of small calcareous spines or spinules. Anterior lobes unarmed.

Color: In life: Chelipeds and ambulatory legs generally vivid salmon-pink, bordering on iridescent; antennal flagella bright yellow. In preservative: Shield pale orange or straw-colored; ocular peduncles light orange with dark orange ring proximally. Chelipeds very pale orange with white spines; carpi with darker red-orange proximally and ventrally. Ambulatory legs pale orange with lighter longitudinal stripes on dactyls and propodi; carpi pale orange with darker red-orange proximally; meri pale orange and white. Color fading in time to straw-color.

Distribution: Known only from the Hawaiian Islands, 180–250 meters.

Etymology: The specific name, *spinulosensoris*, is derived from the diminutive of the Latin, *spina*, meaning spine, and *sensor*, meaning pertaining to sense, and depicts the sensory-modified spines of the chelipeds.

Remarks: As previously indicated, *N. spinulosensoris* is particularly distinctive in the development of sensory structures on the majority of the spines on the dorsal surfaces of the chelae and carpi of the chelipeds. Although presumed sensory structures are known from several pagurid genera (cf. De Saint Laurent, 1970; McLaughlin, 1974) none of these structures have been asssociated with modifications of the spines. In this species these structures appear as chitinous "tear-drop" like processes, generally on the proximal faces of the spines. Preliminary serial sections have confirmed the sensory character of these processes; however, their fine structure is still under study and will be described in a subsequent report.

N. spinulosensoris can be distinguished from all other species of the genus particularly by the presence of sensory-modified spines on the dorsal surfaces of the chelae and carpi of the chelipeds. In addition, the presence of several irregular rows of spines on the dorsal surface of the right chela distinguishes this species from all others except *N. muricatus*; however, the presence of a row of spines on the dorsal surface of the carpus of each ambulatory leg immediately distinguishes *N. spinulosensoris* from the latter species.

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PROCEEDINGS
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WHAT IS *ALLOPERLA IMBECILLA* (SAY)? DESIGNATION OF A NEOTYPE, AND A NEW *ALLOPERLA* FROM EASTERN NORTH AMERICA (PLECOPTERA: CHLOROPERLIDAE)

By Richard W. Baumann
Smithsonian Institution, Washington, D.C. 20560

Alloperla imbecilla (Say) is the type-species of the genus *Alloperla* Banks (1906). It was described by Thomas Say from the Ohio River at Cincinnati but the description is very brief and does not include anything about the genitalia. Needham and Claassen (1925) redescribed what they thought was this species using specimens from New York because no type-specimen was available. Their description and figures of male and female genitalia served to fix the concept of *A. imbecilla* until now.

Recently while studying *Alloperla* specimens at the National Museum of Natural History it became apparent that two species were included under the name *Alloperla imbecilla* (Say). Since no type-specimen was known, as complete a study as possible was undertaken using most existing specimens. The results obtained indicate that a type-specimen does not exist and that the true *A. imbecilla* is restricted to the Ohio River drainage and nearby localities along the Allegheny Front. A second, previously undescribed species, is distributed all along the eastern portion of North America from Canada to the southeastern United States.

I am indebted to the following people for helping me with this study: Dr. Edwin F. Cook, University of Minnesota (UM); Dr. Paul H. Freytag, University of Kentucky (UK);

Dr. Arden R. Gaufin, University of Utah (UU); Dr. Peter P. Harper, University of Montreal (UMC); Dr. Robert L. Jeanne, Boston University (BU); Mr. J. E. H. Martin, Canadian National Collection (CNC); Dr. Charles H. Nelson, University of Tennessee, Chattanooga (CHN); Dr. L. L. Pechuman, Cornell University (CU); Dr. Selwyn S. Roback, Academy of Natural Sciences, Philadelphia (ANSP); Mr. Martin A. Tkac, Kent State University; Dr. F. Christian Thompson, American Museum of Natural History (AMNH); Dr. Charles A. Triplehorn, Ohio State University (OSU); Dr. George E. Wallace, Carnegie Museum (CM); Mr. Donald W. Webb, Illinois Natural History Survey (INHS); Ms. Janice C. White, Museum of Comparative Zoology (MCZ); Dr. Glenn B. Wiggins, Royal Ontario Museum (ROM). Special thanks are given to Dr. Freytag and Dr. Triplehorn for allowing the type-specimens to be deposited at the National Museum of Natural History (USNM).

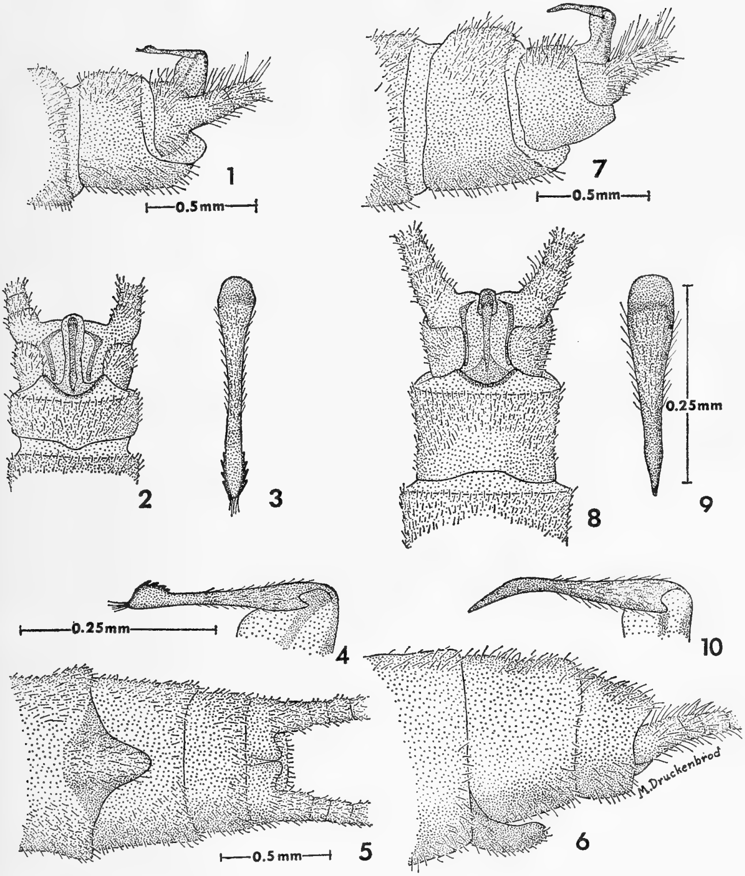
Alloperla imbecilla (Say)

Figures 1–6

Sialis imbecilla Say, 1823:165.
Perla imbecilla, Hagen, 1861:31.
Alloperla imbecilla, Banks, 1906:175; 1907:13 (in part).—Claassen, 1940:186 (in part).—Walker, 1947:135.—Gaufin, 1956:323; 1964:40 (in part).—Illies, 1966:432 (in part).

Male: Macropterous. Length of forewings 7.5–8.5 mm; length of body 7–8 mm. General color light pale green (dirty white in alcohol); legs yellow; antennae brown; cerci yellow; head and pronotum yellow brown, eyes and ocelli prominent chestnut brown. Head as wide as prothorax; ocellar triangle equilateral; posterior ocelli slightly closer to eyes than to each other. Pronotum wider than long, with very faint rugose markings. Abdomen without dark dorsal markings; abdominal segments covered by dense hairs. Epiproct long slender and lightly sclerotized, basal ⅔ covered with hairs; dorsal aspect broadest at base and apex, narrowest at midline, lateral margins of apex serrated and heavily sclerotized, tip bearing numerous stout hairs which appear as a single spine under low magnification (Figs. 2 & 3); lateral aspect broad at base, tapering gradually toward apex, apical portion enlarged, bearing sclerotized serrations on dorsal margin, stout hairs plainly visible at tip (Figs. 1 & 4).

Female: Macropterous. Length of forewings 8.5–9.5 mm; length of body 8–9 mm. Color and general morphology similar to male.



FIGS. 1–6. *Alloperla imbecilla* (Say): 1, male terminalia, lateral; 2, male terminalia, dorsal; 3, epiproct, dorsal; 4, epiproct, lateral; 5, female terminalia, ventral; 6, female terminalia, lateral. FIGS. 7–10. *Alloperla atlantica* sp. nov.: 7, male terminalia, lateral; 8, male terminalia, dorsal; 9, epiproct, dorsal; 10, epiproct, lateral.

Subgenital plate formed from posterior median portion of seventh sternum, base broad, ⅓ width of sternum 8, tapering abruptly to narrowly rounded apex, extending over sternum 8 beyond midline (Fig. 5); lateral aspect slightly broader at base, width nearly constant to rounded tip, appearing as stout fingerlike projection (Fig. 6).

Material: Neotype, male, Ohio, Adams Co., Lower Twin Creek, Vastine Run, 10-V-1963, F. J. Moore, USNM #73053). Additional confirmed records: New York: Tompkins Co., Newfield, 5-VI-1923, ?, 1♂ (CU). Ohio: Adams Co., same data as neotype, 2♂♂ (OSU) (UK); Geauga Co., Stebbins Gulch, 20 to 27-V-1972, M. A. Tkac, 12♂♂, 11♀♀ (USNM). Virginia: Bath Co., Blowing Spring Cmpg., 8 miles W. Warm Springs, 18 to 20-V-1963, Flint & Field, 1♂, 1♀ (USNM). West Virginia: Summers Co., Bluestone State Park, near Hinton, 21 to 22-V-1963, Flint & Field, 1♂, 4♀♀ (USNM).

Alloperla atlantica, new species

Figures 7–10

Alloperla imbecilla, Banks, 1907:13 (in part); 1908:150.—Needham and Claassen, 1925:125.—Procter, 1938:53.—Claassen, 1940:186. —Harden, 1942:319.—Procter, 1946:54.—Sprules, 1948:74.—Ricker, 1948:411.—Harden and Mickel, 1952:59.—Brinck, 1958:56.—Gaufin, 1964:40 (in part).—Illies, 1966:432 (in part).—Hitchcock, 1968:43. —Ricker, et al. 1968:1116.

Male: Macropterous. Length of forewings 7.5–8.5 mm; length of body 6–8 mm. General color and morphology similar to *A. imbecilla*. Epiproct long slender and lightly sclerotized, basal ⅔ covered with hairs; dorsal aspect broadest at base, tapering gradually to pointed apex, tip rounded and naked (Figs. 8 & 9); lateral aspect tapering from broad base to pointed tip, apical ⅓ naked and often slightly bent downward (Figs. 7 & 10).

Female: Macropterous. Length of forewings 8–9 mm; length of body 8–9.5 mm. Color and general morphology similar to male. Subgenital plate formed from posterior median portion of seventh sternum, base broad, ⅓ width of sternum 8, tapering abruptly to narrowly rounded apex, extending over sternum 8 nearly to posterior margin; lateral aspect slightly broader at base, width nearly constant to narrowly rounded tip, appearing as stout fingerlike projection with slightly pointed tip.

Material: Holotype, male and allotype, Maryland, Frederick Co., Fishing Creek, Mountaindale, 4-VI-1958, P. H. Freytag (USNM # 73054). Paratypes: CANADA: New Brunswick: York Co., Fredericton, 12-VI-1933, J. L. McDunnough, 4 ♂♂, 6♀♀ (CNC). Nova Scotia: Cape Breton Co., Baddeck, 23-VI-1936, J. L. McDunnough, 1♂ (CNC); Baddeck Forks, Cape Breton Island, 30-VI-1936, J. L. McDunnough, 1♀ (CNC). Queens Co., White Point Beach, 23-VII-1934, J. L. McDunnough, 1♀ (CNC). Ontario: Nipissing Dist., Costello Lake, Algonquin Provincial Park, 7 to 10-VI-1939, W. M. Sprules, 2♂♂, 6♀♀ (INHS). Parry Sound Dist., Kearney, 22-VI-1926, F. P. Ide, 1♀ (CNC). Quebec: Brome Co., Knowlton, 20-VI-1927, G. S. Walley, 1♂ (CNC); 4-VI-1936, 1♂ (CNC); 12-VI-1928, G. H. Fisk, 1♀ (CNC). Gatineau Co., Masham Hills, 5-VI to 1-VIII-1935, F. P. Ide, 3♂♂, 5♀♀ (ROM); 27-VI to 8-VIII-

1935, G. E. Bucher, 11♂♂, 6♀♀ (ROM). Huntingdon Co., Covey Hill, 15 to 25-VI-1924, G. S. Walley, 3♂♂, 2♀♀ (CNC). Montmorency Co., Montmorency River, 14-VII-1958, R. Malouin, 1♀ (CNC); Barriere Brook, Laval, 28-VII-1958, 1♀ (CNC); Goudreault River, Laval, 14-VII-1958, R. Malouin, 1♂, 1♀ (CNC); Dauphine River, Orleans Island, 13-VI-1957, R. Malouin, 1♀ (CNC); La Fleur River, Orleans Island, 10-VII-1958, R. Malouin, 1♀ (CNC); Moulin River, Orleans Island, 6-VII-1958, R. Malouin, 2♂♂ (CNC); St. Patrick Brook, Orleans Island, 26-VI-1957, R. Malouin, 1♂, 2♀♀ (CNC); 24-VI to 4 VIII-1958, 15♂♂, 10♀♀ (CNC); 4-VI to 10-VII-1959, 33♂♂, 15♀♀ (CNC); 28-VI-1960, 2♀♀ (CNC). Saguenay Co., Nabisipi River, 4-VII-1962, G. Shooner, 3♂♂, 5♀♀ (UMC). Terrebonne Co., du Diable River, Mont Tremblant Provincial Park, 28-V to 4-VIII-1959, A. Robert, 9♂♂, 36♀♀ (UMC); 25-VI-1960, 1♀ (CNC); Mont Tremblant Provincial Park, 3 to 18-VI-1958, A. Robert, 15♂♂, 23♀♀ (UMC); 1960?, 11♂♂, 11♀♀ (UMC). Ungava, Great Whale River, 7 to 20-VII-1949, V. R. Vockeroth, 2♂♂, 5♀♀ (CNC). UNITED STATES: GEORGIA: Rabun Co., Burton, 21-V-1911, J. C. Bradley, 1♂, 1♀ (CU). ? Co., S. Georgia, ?-V-1931, P. W. Fattig, 1♂ (CU). MAINE: Hancock Co., Bar Harbor, Mt. Desert Island, 13 & 14-VI-?, C. W. Johnson, 3♂♂, 1♀ (BU). MARYLAND: Baltimore Co., Baltimore, 16-V-1938, E. G. Fisher, 2♂♂, 1♀ (ANSP). Frederick Co., Fishing Creek, Mountaindale, 4-VI to 1-VII-1958, P. H. Freytag, 6♀♀ (UK); Little Hunting Creek, 25-V-1958, P. H. Freytag, 1♂ (UK). MASSACHUSETTS: Franklin Co., Johnsons Brook, Colrain, 16-VI-1968, C. H. Nelson, 1♂ (CHN). Hampshire Co., Westfield River, Rt. 9, Cummington, 17-VI-1965, F. R. Holbrook, 1♂, 1♀ (CHN). MICHIGAN: Marguette Co., Marguette, 25-VII-?, Hubbard & Schwarz, 1♂ (USNM). MINNESOTA: Cook Co., ?, 5-VIII-1939, H. T. Peters, 1♂, 3♀♀ (UM); Kimball Creek, 22-VII-1948, P. H. Harden, 2♂♂, 2♀♀ (UM); Temperance River, 6 miles from Lake Superior, 22-VII-1948, P. H. Harden, 3♂♂, 3♀♀ (UM); Kadunce Creek, Grand Marais (dead in spider web), 8-VIII-1929, C. T. Schmidt, 3♂♂, 4♀♀ (UM) (INHS); Devil's Track River, Grand Marais (dead in spider web), 7-VIII-1935, C. T. Schmidt, 6♂♂, 3♀♀ (UM) (INHS); Devil's Track River, Gunflint Trail, 11-VI-1969, H. Bell, 1♂, 4♀♀ (USNM); Little Devil's Track Creek, Grand Marais, C. T. Schmidt, 15♀♀ (UM) (INHS). Lake Co., Stewart River, Boy Scout Camp, N. Two Harbors, 9-VI-1966, H. Bell, 1♂, 1♀ (USNM); 20-VI-1966, 1♂, 4♀♀ (USNM). St. Louis Co., French River, 22-VII-1948, P. H. Hardin, 2♀♀ (UM). NEW HAMPSHIRE: Coos Co., Imp Creek, Pinkham Notch, near Mt. Washington, 23-VI-1941, Frison & Ross, 1♀ (INHS); Gorham, 23-VI-1941, Frison & Ross, 1♂, 1♀ (INHS). Grafton Co., Franconia, ?, A. T. Slosson, 1♀ (AMNH); Bog Brook, North Woodstock, 21-VI-1941, Frison & Ross, 1♀ (INHS); Whitcherville Brook, near Benton, 21-VI-1941, Frison & Ross, 2♀♀ (INHS). Merrimack Co., Ragged Mountain Brook, East Andover, 16-VI-1973, D. N. Alstad, 3♂♂, 3♀♀ (USNM). New York: Albany Co., Catskill Creek, Rt. 145, near Cooksburg, 16-VI-1964, Nelson & Root, 1♂ (CHN). Essex Co., Alcohol Brook, Adirondacks Lodge, 1-VII-1923, ?, 1♂ (CU); trib. Au Sable River, Keene, 20-VI-1941, Frison & Ross, 1♂ (INHS); Tahawus, 20-VI-1941, Frison & Ross, 1♂ (INHS). Fulton Co., Trammel Brook, near Stratford, 18-VII-1935, ?, 1♂ (CU). Greene Co., Ashland, Rt. 23, 19-VI-1964, Nelson & Root, 2♂♂, 1♀ (CHN). Hamilton Co., Sacandaga River, Sport Island, 14-VI-1910, Alexander, 1♂, 1♀ (MCZ); Bear Brook, near Blue Mt. Lake, Adirondack State Park, 19-VI-1941, Frison & Ross, 3♂♂, 1♀ (INHS). Tompkins Co., Ithaca, 1 to 7-VII-?, N. Banks, 1♀ (MCZ); 9-VII-1924, ?, 1♂, 5♀♀ (CU). Ulster Co., Chichester, Rt. 214, 16-VI-1964, Nelson & Root, 2♂♂, 1♀ (CHN). North Carolina: Swain Co., Smokemont Cmpg., 11-V-1944, Frison & Ross, 8♂♂, 1♀ (INHS). Transylvania Co., Whitewater River, Rt. 171, 18-V-1970, O. S. Flint, Jr., 2♂♂, 1♀ (USNM). Pennsylvania: Sullivan Co., Little Loyalsock Creek, Dushore, ?, 1♂ (UU). South Carolina: Pickens Co., Six Mile Creek, Hwy. S-160, 1-V-1968, P. H. Carlson, 1♀ (USNM). Oconee Co., Chattooga River, Rt. 28, 8-V-1969, J. C. Morse, 1♂ (USNM). Tennessee: Monroe Co., Tellico River, 21 miles SE, Tellico Plains, 18-VI-1969, W. L. Peters, 4♂♂, 1♀ (UU) (USNM). Polk Co., 12.8 miles N. jct. Rt. 30/64 on Rt. 30, Cherokee National Forest, 9-V-1970, C. H. Nelson, 1♂ (CHN); .6 mile N. Parksville Lake Cmpg., Rt. 30, Cherokee National Forest, 11-VI-1970, C. H. Nelson, 2♂♂ (CHN). Sevier Co., Elkmont Cmpg., 12-VI-1935, H. H. Ross, 1♂ (INHS); LeConte Creek, Gatlinburg, 14-V-1939, Frison & Ross, 4♂♂ (INHS); Fighting Creek Gap, Gatlinburg, 27-V-1934, T. H. Frison, 1♀ (INHS); 15-V-1939, Frison & Ross, 1♂ (INHS); Fork of Little Pigeon River, Gatlinburg, 27-V-1934, T. H. Frison, 6♂♂, 9♀♀ (INHS); Little Pigeon River, Gatlinburg, 29-V-1934, T. H. Frison, 2♂♂, 1♀ (UU); 12-VI-1935, H. H. Ross, 5♀♀ (INHS); Gatlinburg, 14-V-1939, Frison & Ross, 1♂, 1♀ (INHS); 13-VI-1940, T. H. Frison, 1♂, 1♀ (INHS); 11-V-1944, Frison & Ross, 1♂ (INHS). Vermont: Orange Co., Waits River, West Topsham, 21-VI-1941, Frison & Ross, 1♂ (INHS). Windham Co., Townshend, 16-VII-1934, H. Kahl, 1♀ (CM).

There are also literature records (as *A. imbecilla*) from Newfoundland (Labrador) Brinck (1958) and Connecticut Hitchcock (1968), which likely represent *A. atlantica* but were not confirmed in this study.

Diagnosis: *Alloperla atlantica* may be separated from *A. imbecilla* in the male adult stage by the detailed structure of the epiproct. The epiproct of *A. atlantica* has a naked apex (Figs. 9 & 10), while the epiproct of *A. imbecilla* has darkly sclerotized serrations on the dorsolateral margins of the apex (Figs. 3 & 4). The female adults are very similar and cannot always be separated with certainty. However, the subgenital plate of *A. atlantica* tends to be slightly longer and thinner with a more pointed apex as shown in Needham and Claassen (1925).

The female of *Alloperla usa* Ricker has a subgenital plate of similar shape but can be distinguished because of its larger size and the more flattened appearance of the projecting subgenital plate in lateral view. Ricker (1952) gives the length of *A. usa* females as 8.5–9.5 mm but most specimens are larger attaining up to 12 mm.

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PROCEEDINGS
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THE ISOPOD CRUSTACEAN GENUS *MUNNOGONIUM* GEORGE AND STRÖMBERG, 1968 (MUNNIDAE, ASELLOTA)

BY THOMAS E. BOWMAN AND GEORGE A. SCHULTZ
Smithsonian Institution, Washington, D.C. 20560,
and 15 Smith St., Hampton, N. J. 08827

The genus *Munnogonium* was established by George and Strömberg (1968) for their new species of Munnidae, *Munnogonium waldronense*, from the San Juan Islands, Washington. The generic name was based on the belief that the new genus was intermediate between *Munna* and *Pleurogonium*, or at least . . . "combines a number of characters of both . . .". The genus actually appears to be closest to *Austrosignum* Hodgson (1910). If the diagnosis of *Austrosignum* by Nordenstam (1933; repeated by Menzies and Barnard, 1959) is compared to that of *Munnogonium* by George and Strömberg (1968), only 3 differences of possible generic value can be found. 1. Coxae visible dorsally on pereonites 2–7 in *Munnogonium*, but only on pereonites 5–7 in *Austrosignum*. 2. Ocular processes slender in *Austrosignum*, short and partly hidden in dorsal view by base of antenna 1 in *Munnogonium*. 3. Mandible with 3-segmented palp in *Austrosignum*, without palp in *Munnogonium*. A brief discussion of these differences follows.

As shown in Figures 1–2, coxae in *Munnogonium* are visible dorsally on pereonites 2–7 in the male and on pereonites 5–7 in the female. In the latter, the anterior pereonites expand laterally in conjunction with development of the marsupium, with the result that the coxae come to lie beneath the pleura where they are not visible in dorsal view. Validity of the first difference seems questionable.

Length and slenderness of the ocular processes vary among the known species of *Austrosignum*, and in *A. falklandicum* Nordenstam (1933) these processes are short and partly covered by the base of antenna 1 as in *Munnogonium*. We doubt the significance of this character.

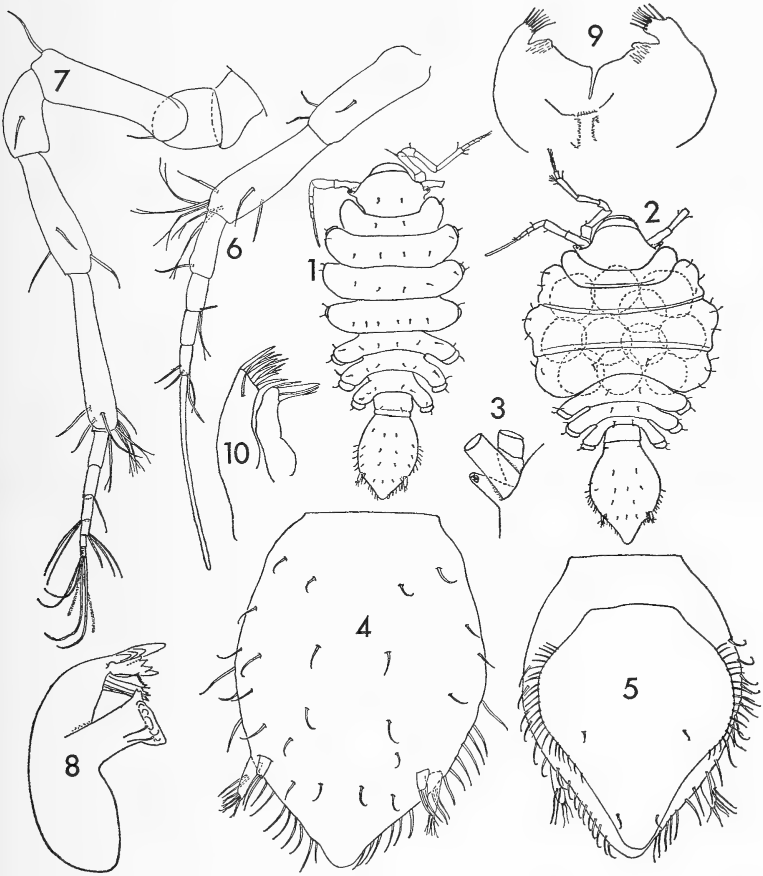
We are left with the presence or absence of a mandibular palp as the only difference between species of *Austrosignum* and *Munnogonium*, and this seems to us to be a character of generic value. Species of *Austrosignum* which lack a mandibular palp and should therefore be transferred to *Munnogonium* are the following: *A. grande* Hodgson, 1910; *A. tillerae* Menzies and Barnard, 1959; *A. globifrons* Menzies, 1962; *A. erratum* Schultz, 1964; and *A. maltinii* Schiecke and Fresi, 1972. Hodgson (1910, p. 72) considered *Austrimunna incisa* Richardson (1908) "most closely allied to" if not identical with his species *A. grande*. In his list of species of *Austrosignum*, Menzies (1962, p. 50) included *A. incisa* (Richardson) and *Paramunna dubia* Hale (1937), but gave no reasons for transferring them to *Austrosignum*. It was not definitely stated in the original descriptions whether either has or does not have a mandibular palp.

George and Strömberg (1968) pointed out the possibility that *Austrosignum tillerae* Menzies and Barnard might be a *Munnogonium*, but because of the brevity of the description and the fact that the type-series was temporarily unavailable to them, they did not make the transfer. We have examined the 5 paratypes of *Austrosignum tillerae* (the holotype could not be found) and find that not only is this species a *Munnogonium*, but it is conspecific with *M. waldronse*. In support of this finding we give below some descriptive notes, based on specimens from Puget Sound (Figs. 1–20) and on paratypes from southern California (Figs. 21–31).

Munnogonium tillerae (Menzies and Barnard)
Figures 1–31

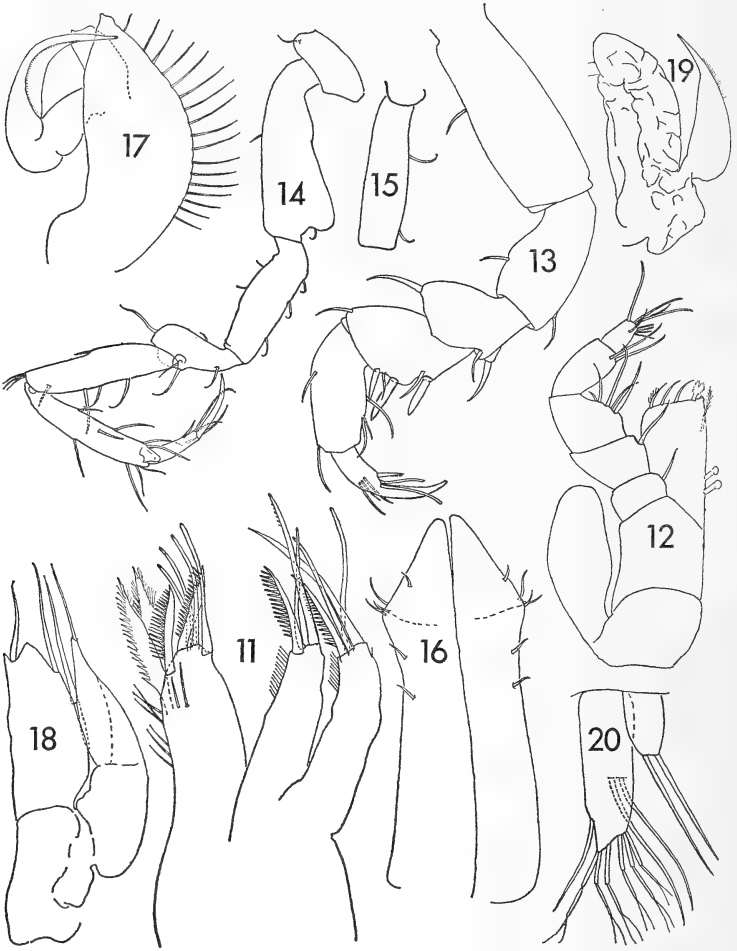
Austrosignum tillerae Menzies and Barnard, 1959, pp. 8–9. fig. 1 A–C.
Munnogonium waldronense George and Strömberg, 1968, pp. 226–230, figs. 1–2.

Material examined: Paratypes of *Austrosignum tillerae* (4♀♀ 1♂), from southern California (Figs. 21–31). More than 50 specimens of



FIGS. 1–10. *Munnogonium tillerae.* 1, Male, dorsal (1.45 mm). 2, Female, dorsal (1.42 mm). 3, Eye and bases of antennae 1 and 2, dorsal. 4, Male telson, dorsal. 5, Female (1.2 mm) operculum and telson, ventral. 6, Left male antenna 1, dorsal. 7, Left male antenna 2, dorsal. 8, Left mandible, male. 9, Labium, mandibular surface. 10, Maxilla 1, male.

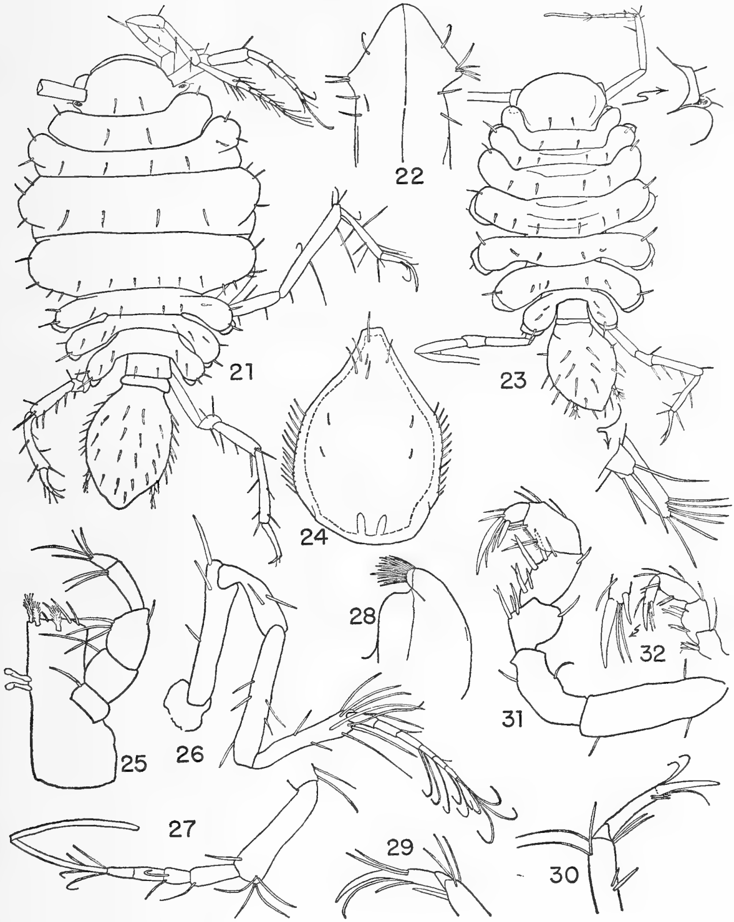
M. tillerae collected by William Shapeero in Puget Sound, about 1350 m NW of West Point, Seattle, Washington, November 1965 (Figs. 1–20). Depth about 6 m; bottom of fine to muddy sand with many seapens (*Leioptilus quadrangularis*) present. Ten specimens (5♂♂, 5♀♀) from a sandy mud bottom at about 6 m depth in Shilshole Bay, off Seattle, Washington, collected in the summer of 1970



FIGS. 11–20. *Munnogonium tillerae.* 11, Maxilla 2, male. 12, Maxilliped, male. 13, Pereopod 1, male. 14, Pereopod 2, male. 15, Pereopod 2, female, basis. 16–19, Pleopods 1–4, male. 20, Right uropod, dorsal.

by William Shapeero. The longest male was 1.3 mm and longest female 1.6 mm long.

Supplemental description of specimens from Puget Sound: Length of *A. tillerae* paratypes, ♀ 1.0–1.5 mm, ♂ 1.2 mm; Puget Sound specimens 0.8–1.8 mm. Ocular processes longer and more slender



Figs. 21–32. *Munnogonium tillerae.* 21, Female paratype (1.5 mm). 22, Pleopod 1, male. 23, Paratype male (1.2 mm). 24, Female operculate pleopod. 25, Maxilliped. 26, Antenna 2. 27, Antenna 1. 28, Labium. 29, Dactylus pereopod 7, male. 30, Dactylus pereopod 2, male. 31, Pereopod 1, male. 32, *Munnogonium erratum.* Pereopod 1, holotype, male.

then shown by Menzies and Barnard, partly to almost completely concealed in dorsal view by proximal segments of antenna 1. Pereonites 5–7, lateral expansions separated by distinct gaps except in holotype ♀ of *A. tillerae.* Coxae visible in dorsal view on pereonites 2–7, except in some ovigerous ♀♀ in which they are not visible in pereonites 2–4. Dorsal surface of pereon with scattered setae (not shown by previous authors). Antenna 1 with 4-segmented flagellum (3-segmented in holotype of *A. tillerae*). Antenna 2 with 6-segmented flagellum (5-segmented in holotype of *A. tillerae*). Incisor of mandible with 4 teeth (3 teeth in allotype of *M. waldronense*). Lower lip with distal setose lobe on either side, separated by notch from small blunt lobe covered with fine setules. Other mouthparts agree with those described by George and Strömberg, with slight differences in numbers of setae. Pereopod 2 sexually dimorphic; posterior margin of basis produced into flange ending distally in rounded lobe in male; flange absent in female. Female operculum with scattered setae on ventral surface and row of setae on convex proximal part of each lateral margin. Male pleopods 2–4, not previously illustrated, as in Figures 17–19. Endopod of pleopod 3, 1.5 times as wide as exopod; apex with seta inserted in notch; lateral margin with 2 setae on distal half. Exopod of pleopod 3 narrowly pyriform, with terminal seta. Endopod of pleopod 4 much wrinkled; exopod with convex lateral margin, concave medial margin, and slender pointed apex.

Munnogonium erratum (Schultz)

Figure 32

Austrosignum erratum Schultz, 1964, pp. 307–310, figs. 1–11.
Munnogonium erratum (Schultz).—George and Strömberg, 1968, p. 230.

The holotype, thus far the only specimen discovered, was reexamined, and found to be a *Munnogonium*, distinct from the other Pacific coast species, *M. tillerae*. The most obvious difference is the much greater separation of the lateral parts of the pereonites in *M. erratum*, especially those of pereonites 4–7. The absence of a mandibular palp is confirmed. Antenna 1 is broken at the fourth flagellar segment, giving this segment the flattened appearance shown by Schultz (1964, fig. 8). Pereopod 1 resembles that of *M. tillerae* (compare figs. 31 and 32).

Acknowledgements

We are grateful to William Shapeero, Department of Fisheries and Wildlife, Oregon State University, for the fine collection of *Munnogonium tillerae* from Puget Sound.

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A REVIEW OF THE COPEPOD *SCOTTOCALANUS SECURIFRONS* (T. SCOTT) AND A NOTE ON ITS SYNONYM *SCOLECITHRIX CUNEIFRONS* WILLEY (CALANOIDA: SCOLECITHRICIDAE)

By T. C. Gopalakrishnan
Regional Centre of National Institute of Oceanography
(C. S. I. R.) Cochin, India

Abstract

Scottocalanus securifrons from the International Indian Ocean Expedition Collections is described and compared with that of T. Scott 1893, A. Scott 1909, Tanaka 1961, *Lophothrix securifrons* Wolfenden 1904 and *Scolecithrix cuneifrons* Willey 1918. A thorough examination of the descriptions of *securifrons* and *cuneifrons* and the examination of ♀ syntypes of S. *securifrons* from the British Museum revealed a doubtful existence of *Scolecithrix cuneifrons* as a distinct species. Hence it is considered as a synonym of S. *securifrons* in agreement with Vervoort (1965).

Introduction

While studying the scolecithricid copepods collected during the International Indian Ocean Expedition 1960–65 (IIOE) I encountered a number of specimens of both sexes belonging to the genus *Scottocalanus* Sars. Upon comparing the IIOE specimens with published descriptions of species of *Scottocalanus*, I found good agreement with S. *securifrons* (T. Scott, 1893) and also with S. *cuneifrons* (Willey, 1918). The IIOE specimens are assigned to the older S. *securifrons* and described below.

Scottocalanus securifrons (T. Scott)

(Figure 1 a–g, Figure 2 a–c, Figure 3 a–h)

Scolecithrix securifrons T. Scott, 1893, p. 47, pl. 4, figs. 40–56, pl. 5, fig. 1 [♀ only, ♂ = *Scottocalanus helenae* (Lubbock)].—Giesbrecht and Schmeil, 1898, p. 49.—van Breemen, 1908, p. 76, fig. 88 [♀ only].—Canu, 1896, p. 425.—Thompson, 1903, p. 20.—Norman 1903, p. 137.—Cleve, 1904, p. 197.—Cons. Explor. Mer, 1909, p. 99.—Jespersen, 1940, p. 36.

Lophothrix securifrons Wolfenden, 1904, p. 120, pl. 9, figs. 12–15.

Lophothrix securifrons (T. Scott).—Wolfenden, 1911, p. 268.

Scottocalanus acutus Sars, 1905, p. 7.

Scolecithrix cuneifrons Willey, 1918, p. 194, figs. 17–24.

Scottocalanus securifrons (T. Scott).—Sars, 1905, p. 7 [by implication]; 1912, p. 654; 1924–1925, p. 160–162, pl. 45 figs. 1–8.—Pearson, 1906, p. 19.—Farran, 1908, p. 57; 1920, pp. 18, 21; 1926, p. 267; 1929, p. 251.—Paulsen, 1909, p. 137.—A. Scott, 1909, p. 104, pl. 25 figs. 1–9, pl. 28 figs. 1–9.—Stebbing, 1910, p. 529.—With, 1915, p. 220, pl. 8 fig. 13, text figs. 71–73.—Cons. Explor. Mer, 1916, p. 57.—Lysholm and Nordgaard, 1921, p. 21.—Rose, 1929, p. 26; 1933, p. 144, fig. 144; 1942, p. 148.—Wilson, 1936, p. 91; 1950, p. 340.—Tanaka, 1937, p. 259, figs. 9a–c; 1953, p. 132; 1961, p. 141–143, fig. 106; 1969, p. 275.—Leavitt, 1938, p. 384.—Lysholm, Nordgaard and Wiborg, 1945, p. 26.—Sewell, 1947, p. 143.—Fraser and Saville, 1949a, pp. 61, 63.—Brodsky, 1950, p. 242, fig. 152.—Wiborg, 1955, p. 51.—Hida and King, 1955, p. 11.—Marques, 1956, p. 15; 1958, p. 225; 1959, p. 211.—Heinrich, 1958b, p. 1029.—Vinogradov, 1960, p. 502.—Grice, 1962, p. 213, pl. 19 figs. 12–15.—Grice and Hart, 1962, appendix, tab.—Owre, 1962, p. 492.—Vervoort, 1965, p. 36.—Fleminger, 1967, p. 194.—Owre and Foyo, 1967, p. 63, figs. 98, 400–403, 409, 410.—Park, 1970, p. 476.—Bowman, 1971, p. 34.

Description of the specimens: Female. Length 4.2 mm. Head and first thoracic segment, 4th and 5th thoracic segments fused. Head with high median crest (Fig. 1c). Last thoracic segment produced posteriorly into triangular expansion terminating in sharp pointed spine on either side. Rostrum bifid at tip (Fig. 2 a). Abdomen 4-segmented. Genital segment swollen ventrally at mid-length; its ventral posterior margin overlapping the following segment (Fig. 1 d). Posterolateral margins of genital segment furnished with spines which are absent on dorsal and ventral side (Fig. 1 e). A. Scott (1909) shows spines on the posterior margin of the genital segment present on the dorsal as well as lateral surfaces. Posterior margins of 2nd and 3rd abdominal segments with a hyaline fringe (Fig. 1 e). Anal segment very short. Caudal rami almost as wide as long, each with 4 setae.

First antenna with 23 separate segments, when the partly separated 8th and 9th segments are counted as one (Fig. 1 a). First maxilla with

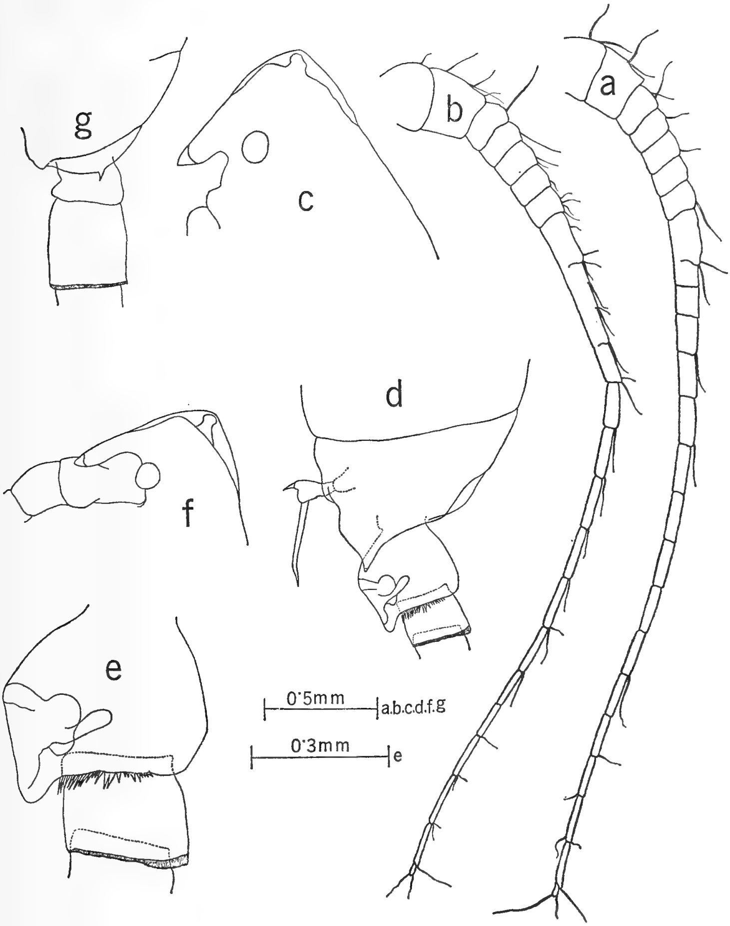

FIG. 1. *Scottocalanus securifrons.* a, 1st antenna ♀; b, 1st antenna ♂; c, frontal profile ♀; d, last thoracic segment and genital segment ♀; e, genital segment ♀, enlarged; f, frontal profile ♂; g, last thoracic segment ♂.

numbers of setae on different lobes as follows (Fig. 2 b): Inner lobe 1 with 12 setae of which 3 are on posterior surface; inner lobe 2 with 2 setae; inner lobe 3 with 3 setae; basipod 2 with 5 setae; endopod segment 1 with 3 setae; endopod segments 2 and 3 together with 4 setae; exopod with 8 setae; outer lobe with 9 setae. Exopod segment with fine surface hairs at distal end. Second maxilla endopod with 4 bud-like and

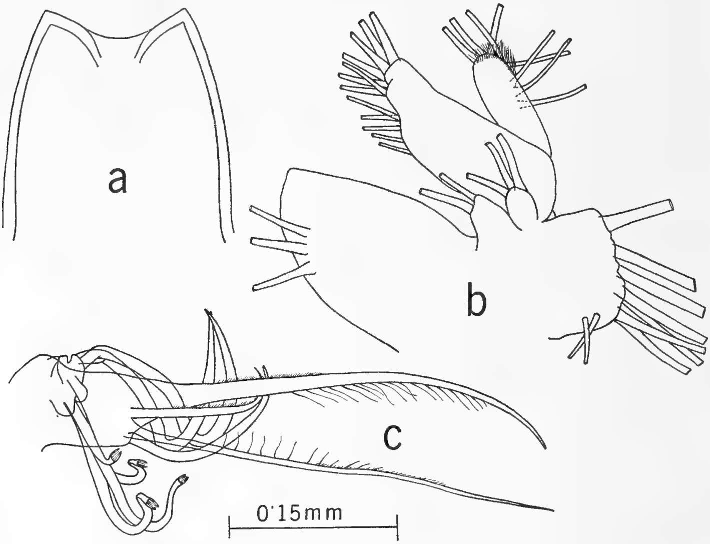

FIG. 2. *Scottocalanus securifrons.* a, rostrum ♀; b, 1st maxilla ♀; c, distal portion of 2nd maxilla ♀.

3 vermiform filaments (Fig. 2 c). Swimming legs 1–4 as shown in figures (Figs. 3 a–d).

Fifth pair of legs asymmetrical; subapical spine of left leg thicker than that of right leg. Subapical spines with two rows of teeth (Fig. 3 e).

Male. Length 4.57 mm. General appearance similar to that of female. Head with high median crest (Fig. 1 f). Last thoracic segment terminating in small spine on either side (Fig. 1 g). Abdomen 5—segmented. Posterior margin of 2nd to 4th abdominal segments with hyaline fringe (Fig. 1 g). First antenna with 20 segments when fused 8th to 12th segments, partly divided by 2 incomplete sutures between segments 8 and 9 and 11 and 12, are counted as one (Fig. 1 b). 5th leg as illustrated (Fig. 3 f–h). The small teeth on the inner margin of the proximal joint of the endopod of the left leg figured by A. Scott are not present in Tanaka's specimens, Willey's specimens or in the IIOE specimens.

DISCUSSION

The IIOE specimens agree well with descriptions of *S. securifrons* by T. Scott (1893, ♀ only), A. Scott (1909), Wolfenden (1904), and Tanaka (1961). They also appear to conform to Willey's (1918) description of *S. cuneifrons.* Willey was aware of the similarity of his *S. cuneifrons* to *S. securifrons*, and stated that he was at first inclined to identify his specimens as *S. securifrons*, but decided to establish a

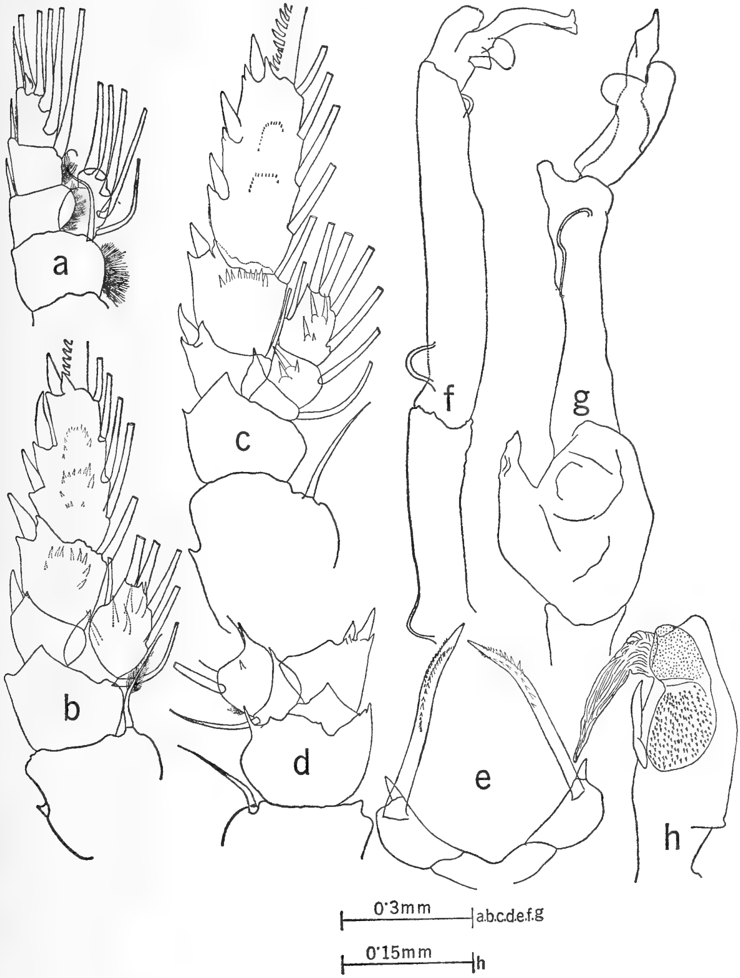

FIG. 3. *Scottocalanus securifrons.* a, 1st leg ♀; b, 2nd leg ♀; c, 3rd leg ♀; d, proximal portion of 4th leg ♀; e, 5th leg ♀; f, left 5th leg ♂; g, right 5th leg ♂; h, left 5th leg ♂, 2nd joint of Re, enlarged.

new species for them because the male fifth legs of his specimens differed from those of S. *securifrons.* Apparently he was referring to T. Scott's male, which is now believed to belong to a different species, *Scottocalanus helenae* (Lubbock), and not to the male described by A. Scott which had a fifth leg very similar to that of S. *cuneifrons.* Curiously, Willey did not cite either T. Scott (1893) or A. Scott (1909) in his bibliography.

In order to be certain about the identity of T. Scott's specimens, I requested a loan of them from The British Museum (Natural History). Although Scott (1893) reported S. *securifrons* from 5 "Buccaneer" stations, Dr. Roger J. Lincoln reported that the British Museum had only 2 females, the male being missing. Upon examining these 2 females, I found that one of them is not S. *securifrons* but another species of *Scottocalanus*, possibly S. *australis* Farran (1936). The remaining female is herewith designated as the lectotype of *Scolecithrix securifrons* T. Scott in order to obviate further confusion.

Distribution: The species has a fairly wide distribution, and has been recorded from the Atlantic, Pacific and Indian Oceans. It has been recorded from the central and southern part of the Arabian Sea (Sewell, 1947), from the Indian Ocean off Port Shepstone, South Africa (Cleve, 1904a), from many localities in the eastern part of the Malay Archipelago (A. Scott, 1909, and Snellius Expedition), from the Philippine Islands region (Wilson, 1950), from the central equatorial Pacific, 00°03′N, 157°00′E (Grice, 1962), from the California Current region (Fleminger, 1967), from Sagami and Suruga Bays, Izu region, Japan (Tanaka, 1937, 1961) from surface waters off Three Kings Islands, New Zealand (Farran, 1929), from many localities in the West-Pacific ranging from off Peru to the Galapagos Islands region (Wilson, 1950) and from the Far Eastern and Polar Seas of the U.S.S.R. (Brodsky, 1950). The specimens described in this paper are from around the central part of the equatorial Indian Ocean (03°29′N, 77°54′E).

In the Atlantic S. *securifrons* is widely distributed over large areas, penetrating at least as far north at the Atlantic slope off Cabot Strait, 42°31′N, 63°31.5′W (Willey, 1918) and 43°18′N, 60°11′W (Rose, 1929). Also known from 47°47′–63°08′N, 8°00′–26°20′W (With, 1915; Lysholm and Nordgaard, 1921); the South coast of Iceland, 63°08′N, 21°30′W; 62°47′N, 15°03′W (Paulsen, 1909; Jespersen, 1940); the Faroe Channel, ± 60°N, 7°W (Norman, 1903; Wolfenden, 1904); 28°–58°N, 7°–50°5′W (Lysholm, Nordgaard and Wiborg, 1945); NNW of Achill Head, Ireland (Norman, 1903); 52°06′–54°33′N, 10°30′–15°53.9′W (Thompson, 1903; Farran, 1908); off the south-west coast of Ireland (Farran, 1920); 27°43′–47°43′N, 8°06′–42°40.5′W (Sars, 1925); Bermuda (Wilson, 1936); 30°08′N, 31°19′W (Sars, 1912); Florida current (Owre, 1962); between Bermuda and New York (Grice and Hart, 1962); Bay of Biscay ± 47°N, 8°W (Farran, 1926); 44°17′N, 4°38′W (Canu, 1896); 20°41′N, 31°53′W; 17°28′N, 29°42′W; 16°24′N, 28°53′W (Wolfenden, 1911); Gulf of Guinea (T. Scott, 1894); off Angola (Marques, 1956, 1958, 1959); 26°59′S, 17°06′W and 35°10′S, 2°33′W (Wolfenden, 1911). It has been captured in the northern part of the North Sea during the periodical plankton investigations, 1902–1908 (Cons. Explor. Mer 1909, Scottish area). It has been recorded from the southeastern United States between Cape Hatteras and Southern Florida (Bowman, 1971).

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I am grateful to Dr. N. K. Panikkar, former Director, National Institute of Oceanography, India for allowing me to take the material to the U. S. National Museum and for his interest in the progress of this study. My sincere thanks are due to Dr. Janet M. Bradford for her encouragement and to Dr. T. E. Bowman for his valuable suggestions and helpful criticism during the preparation of this paper. Thanks are also due to the U. S. National Muesum for providing all facilities to pursue this work.

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PROCEEDINGS
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BIOSYSTEMATICS OF CENTRAL AMERICAN SPECIES OF *CTENOCOLUM*, A NEW GENUS OF SEED BEETLES (COLEOPTERA: BRUCHIDAE)

By John M. Kingsolver[1] and Donald R. Whitehead[2]
National Museum of Natural History, Washington, D. C. 20560

Introduction

This paper is the third in a series concerned with a group of related seed beetle genera predatory on leguminous plants in the New World tropics; see Kingsolver and Whitehead (in press) for a review of *Caryedes*, and Whitehead and Kingsolver (in press) for a review of *Gibbobruchus*. As in those papers, the major purpose is to make known the fauna of Central America in general and of Costa Rica in particular, in conjunction with ecological studies of the beetles and their host plants being conducted by D. H. Janzen.

In this paper, we treat only the species of *Ctenocolum* known from Mexico and Central America, an area including the northernmost part of the range of the genus. Two species groups are distinguished, each represented in this area by four species. Our respective contributions are as in our *Caryedes* paper, but with some nongenital drawings contributed by K. Conway and L. Heath.

Materials and methods: We studied about 250 specimens, most of which are deposited in the United States National Museum of Natural History, Washington (USNM). All American specimens of the host plant subtribe Lonchocarpinae (tribe Dalbergiae, family Fabaceae) in the United States National Herbarium were examined for additional data. Methods are as described previously (Kingsolver and Whitehead,

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[1] Systematic Entomology Laboratory, IIBII, Agr. Res. Serv., USDA.
[2] Organization for Tropical Studies.

in press; Whitehead and Kingsolver, in press). Distribution records are mapped for each species. Holotypes of the five species described as new in this paper are deposited in the USNM.

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Type material of previously described species belonging to *Ctenocolum* is housed in the British Museum (Natural History), London; Naturhistoriska Riksmuseum, Stockholm; and Zoological Museum, Moscow State University, Moscow. We thank the curators of these collections for allowing us to study their material.

Additional material was loaned by the following individuals and institutions: D. E. Bright, Canadian National Collection, Ottawa (CNC); H. R. Burke, Texas A&M University, College Station (TAMC); H. F. Howden, Carleton University, Ottawa (HFHo); C. D. Johnson, Northern Arizona University, Flagstaff (NAUF); H. Reichardt, Museu de Zoologia da Universidade, São Paulo (MZSP); and G. E. Wallace, Carnegie Museum, Pittsburgh (CarP).

TAXONOMY

Ctenocolum, new genus

Type-species: *Pachymerus tuberculatus* Motschoulsky 1874.

Derivation of name: The name *Ctenocolum* is derived from Greek: *Ktenos* = comb, + *Kolon* = leg, in reference to the comb-shaped pecten characteristic particularly of the type-species and its relatives.

Diagnostic combination and relationships: *Ctenocolum* is one of the American genera of Bruchinae with pronotum campaniform and gibbous, hind tibia arcuate, and external carina of hind femur obsolete or represented by row of teeth. We previously placed this genus (as the "*Caryedes*" *tuberculatus* group) in the "*Caryedes*" assemblage (Kingsolver and Whitehead, in press) in which the abdomen and pygidium lack glabrous polished areas and the antennal scrobe of the gena is as long as or longer than the width of the antennal fossa. Of the three genera placed in the "*Caryedes*" assemblage, *Meibomeus* and *Caryedes* differ from *Ctenocolum* by having the synapomorphous condition of lateral lobes of male genitalia not deeply divided. Conversely, an increased number of teeth of the hind femoral pecten is synapomorphous for members of the genus *Ctenocolum*; either 6–10 teeth with second and following forming a crescentic profile or 8–16 teeth with second and following forming a linear profile. The hind tibial mucro is short, but is neither as short as in *Meibomeus* nor longer than apical width of tibia as in most *Caryedes*.

Description: Body robust; length from pronotum to pygidium 2.0–4.6 mm, about 1.5 times greater than maximum width; width across elytra 1.4–3.6 mm, nearly equal to maximum length of elytron. Head moderately elongate, strongly constricted behind eye, postocular lobe short. Eye prominent, larger in male than in female or not, interocular ratio about 0.12–0.24 in male, 0.15–0.24 in female; ocular sinus deep, 4–10 rows of facets behind sinus. Frons with median carina prominent, alutaceous, extended forward onto base of clypeus, triangularly expanded basally. Frontoclypeal region broad, pentagonal; sides parallel behind, convergent in front; distance from apex of clypeus to apex of superior lobe of eye not or slightly greater than length of eye from apex of superior lobe to base. Gena between base of mandible and antennal fossa about as long as width of antennal fossa, glabrous. Antenna of male extended to or beyond elytral humerus, outer articles transverse to elongate, eccentric to serrate or subflabellate; antenna of female extended to about elytral humerus, outer articles transverse to slightly elongate, moderately eccentric to serrate. Pronotum campaniform, sides shallowly and irregularly concave; median and lateral basal gibbosities low to moderately elevated, median sulcus shallow to moderately deep; median anterior gibbosities low, not or shallowly sulcate between; median basal lobe shallowly emarginate; lateral carina obsolete to distinct. Scutellum about square, bidentate or truncate. Intercoxal process of prosternum narrow, acute. Metasternum shallow, broadly rounded in profile. Mesosternal lobe broad, flat, apex rounded or truncate. Elytra together subquadrate; striae deep, punctate; striae three and four strongly deflected laterad before base, abbreviated basally by high bidentate gibbosity; striae four and five abbreviated apically, coalescent or not; striae seven, eight, and nine limited basally by humeral gibbosity; interval nine flat to moderately convex apically, not carinate; disc convex. Front and middle legs slender, not sex-dimorphic, front coxae contiguous apically, middle coxae widely separated. Hind coxa densely punctate, middle third glabrous. Hind femur strongly swollen, external ventral margin finely dentate to coarsely dentate-carinate to base; ventral sulcus developed to or nearly to base, deep in apical half; internal ventral margin with two or more small teeth before pecten; pecten raised, either with 7–9 apical teeth separated from basal tooth by distinct gap, or with 12–16 evenly spaced teeth. Hind tibia strongly carinate, arcuate, flanged ventrally from near middle to mucro; mucro shorter than apical width of tibia; external apical margin oblique or not, lateral coronal tooth sharply developed or not; hind basitarsus longer than four outer tarsal articles together. Abdominal sterna telescoped in male, last sternum emarginate, abdomen not otherwise sex-dimorphic; sterna without polished lateral areas. Pygidium various, without speculum, dimorphic or not in pattern. Male genitalia with median lobe broad, not fractured before apex, not strongly arcuate; internal sac various, with or without distinctive sclerites; lateral lobes broadly divided; median lobe with strap- or blade-like hinge sclerites; basal strut of tegmen narrow, with median keel; median lobe with characteristic patch of setae above apical orifice; basal hood of median lobe broad.

Distribution: *Ctenocolum* is restricted to tropical America including the West Indies, and is most diverse in species in Central America and northern South America. Eight species are known from Mexico and Central America; there probably are several additional species from this area. We recognize two species groups, each of which includes four of the Central American species.

Remarks: So far as known, larval *Ctenocolum* attack seeds of members only of the subtribe Lonchocarpinae (tribe Dalbergiae, family Fabaceae). No other bruchid genera are known to attack this group of plants. The only known host genera for species from Mexico and Central America are *Lonchocarpus* and *Piscidia*, but South American species occur in *Bergeronia* and *Muellera* also. Pods of all of these plants are indehiscent, and beetles emerge through circular exits cut through the seed and pod walls.

Key To Species of *Ctenocolum* from Mexico and Central America

1. Pecten with 8–16 teeth, second and following linear in profile; hind tibial apex oblique or nearly so, lateral coronal tooth not distinguished from mucro by deep notch; internal sac of male genitalia with large distinctive sclerites (Tuberculatum Group) .... 2.

1′ Pecten with 6–10 teeth, second and following crescentic in profile; hind tibial apex with strong lateral coronal tooth distinguished from mucro by deep notch; internal sac of male genitalia without large sclerite (Crotonae Group) .... 5.

2 (1). Eye with about 10 rows of facets behind sinus; external ventral denticles of hind femur greatly reduced; vestiture of pronotum and hind femur largely bright orange .... 1. *Ctenocolum acapulcensis* n. sp.

2′ Eye with about 3–6 rows of facets behind sinus; external ventral denticles of hind femur strongly developed; vestiture of pronotum and hind femur yellowish or whitish .... 3.

3 (2′). Eye with about 3 rows of facets behind sinus; vesiture of elytral intervals two and three uniform from behind scutellum to midlength, in most specimens dark; female pygidium with

contrasting longitudinal pattern .... 4. *Ctenocolum tuberculatum* (Motschoulsky).

3′ Eye with about 6 rows of facets behind sinus; vestiture of elytral intervals two and three variegated behind scutellum; female pygidium without distinctive pattern .... 4.

4 (3′). Dorsoapical angles of antennal articles 8–10 dark; sclerite of male endophallus not produced, with lateral hooks .... 3. *Ctenocolum salvini* (Sharp).

4′ Antennal articles 8–10 uniformly colored externally, dark in most specimens; sclerite of male endophallus produced, without lateral hooks .... 2. *Ctenocolum janzeni* n. sp.

5 (1′). Elytron (Fig. 5) with extensive whitish sutural maculation .... 5. *Ctenocolum colburni* n. sp.

5′ Elytron (Fig. 6–8) without extensive whitish sutural maculation .... 6.

6 (5′). Apex of outer tooth of basal elytral gibbosity nearer to elytral base than to apex of inner tooth .... 6. *Ctenocolum biolleyi* n. sp.

6′ Apex of outer tooth of basal elytral gibbosity nearer to apex of inner tooth than to elytral base .... 7.

7 (6′). Base of notch between teeth of basal elytral gibbosity equidistant between elytral base and apex of inner tooth .... 7. *Ctenocolum martiale* n. sp.

7′ Base of notch between teeth of basal elytral gibbosity nearer apex of inner tooth than elytral base .... 8. *Ctenocolum crotonae* (Fåhraeus).

THE TUBERCULATUM GROUP

Diagnostic combination: The Tuberculatum Group is sharply distinguished from the Crotonae Group by the following characters of the hind leg and the male genitalia. Hind femur: pecten with 8–16 evenly spaced teeth, all teeth except first regular in profile. Hind tibia: lateral coronal tooth not sharply developed, not set off from mucro by deep emargination, apex oblique. Male median lobe: internal sac with large complex sclerite; ventral valve acute, sides not or barely sinuate.

Additional characteristics of the Tuberculatum Group are the following: eye of male enlarged in some species; ocular sinus shallow to deep, 3–10 rows of facets behind sinus; antenna of male flabellate in some species; lateral subbasal tubercles of pronotum moderate to strong; placement of outer tooth of basal elytral gibbosity not or slightly basad of inner tooth; and hind femur with external ventral series of denticles reduced in some species.

Distribution: Northern Mexico to northern South America. Four species are known from Mexico and Central America and are treated in this paper. We have examined specimens of three additional species from Colombia and Venezuela; all three are undescribed.

Taxonomic notes: This group is quite poorly known, as none of the species are represented by adequate numbers and samples. However, there are no evident taxonomic problems, as all the species are readily separable by characteristics of the male genitalia, especially by the form of the sclerite of the internal sac.

Remarks: Larvae of members of the Tuberculatum Group develop in seeds of *Lonchocarpus* and *Piscidia.* We suspect that the range of hosts for each species is limited. Only one species is known from more than one host species, and it is known from three closely related host species.

Little is known of flight activity. Specimens of two South American species were taken at black lights in Feburary, and another specimen of one of them was collected in July.

1. **Ctenocolum acapulcensis**, new species

Description of holotype male: *Ctenocolum*, Tuberculatum Group. Length 4.6 mm. Width 3.2 mm. Integument largely dark rufous or rufopiceous, elytra largely piceous with rufopiceous variegation; antennal articles 3–10 infuscated, article 11 pale; front and middle legs and hind tarsus rufotestaceous. Vestiture variegated; pattern of dorsum (Fig. 1); bright orange on base of head, pronotum, mesepisternum, metepisternum, dorsal surfaces of all femora, and elytral intervals one and two; sparse and dark on most of elytra and hind tibia; pale or nearly white on most of pygidium, abdomen, and lower surface of hind femur. Head (Fig. 9); antenna flabellate (Fig. 16); eye large, interocular ratio about 0.15; ocular sinus shallow, 10 rows of facets behind sinus. Pronotum and elytra (Fig. 1); lateral subbasal gibbosities strongly developed. Hind leg (Fig. 24); pecten with about 12 teeth, first tooth not much larger than second; external ventral series of denticles much reduced. Pygidium (Fig. 31). Male genitalia (Fig. 43–44).

Type material: Holotype male, "Bot. N°226.", "Acapulco. Mex.", "Chittenden Collection", "MEX. Guerrero. Acapulco vic. X.1894-III.1895 E. Palmer #226", "Lonchocarpus eriocarinalis Micheli USNM Herb."; in United States National Museum of Natural History, Washington, type no. 72797.

Paratype, Costa Rica (Fig. 58), 1; in USNM. COSTA RICA. Guanacaste: 6 km. n. Bagaces, 3.XI.1970, D. H. Janzen #268, reared *ex Lonchocarpus eriocarinalis* Micheli, live adult extracted from seed 9.III.1971.

Remarks: *Ctenocolum acapulcensis* is named for the type locality. The only other bruchid species known from this host species is *C. martiale*, one specimen of which was found in the same herbarium specimen with the holotype of *C. acapulcensis.*

Ctenocolum acapulcensis is the only Central American member of the genus with male antenna flabellate and with external ventral denticles of hind femur nearly obsolete. An undescribed South American species is closely related but differs conspicuously by having only about 8 teeth in the femoral pecten and by having whitish rather than bright orange dorsal vestiture.

2. **Ctenocolum janzeni**, new species

Description: *Ctenocolum*, Tuberculatum Group. Length 3.3–3.8 mm. Width 2.1–2.4 mm. Integument largely rufopiceous, elytra largely piceous with rufopiceous variegation; antenna rufotestaceous, outer surfaces of articles 8–10 infuscated; base of head with bilobate piceous mark; front and middle femora mottled, front and middle legs otherwise rufotestaceous; hind tarsus rufous. Vestiture variegated; pattern of dorsum (Fig. 2); nearly white on most of pygidium and abdomen; light tan on mesepisternum, metepisternum, dorsal surface of hind femur; dark tan or orange brown on much of pronotum and in elytral variegation. Head (Fig. 11); antenna not flabellate (Fig. 17); eyes large, sexdimorphic, interocular ratio about 0.17 in male and 0.23 in female; ocular sinus deep, 6 rows of facets behind sinus. Pronotum and elytra (Fig. 2); lateral subbasal gibbosities moderately developed. Hind leg (Fig. 26); pecten with 13–16 teeth, first tooth much larger than second and following; external ventral denticles of hind femur strongly developed. Pygidium (Fig. 34). Male genitalia (Fig. 45–47).

Type material: Holotype male, "C.R. Puntarenas Prov., 4 mi. n. jct. to Puntarenas 6.III.1972 DHJanzen", "reared ex Piscidia fruits, em. by 20.VI.1972 CODE: VI-20-1972-X"; in United States National Museum of Natural History, Washington, type no. 72798.

Paratypes, Mexico to Costa Rica (Fig. 57); 8; in CarP, CNC, USNM. MEXICO. Jalisco: Guadalajara, McConnell. Oaxaca: Carrizal, 25.XII. 1940, F. Miranda #1043 (MEXU), *ex* herbarium specimen of *Piscidia grandifolia* (Donn. Sm.) I. Johnst. San Luis Potosi: El Salto de Agua, 28-30.VII.1960, H. Howden. Sinaloa: no locality specified, M. Narvaez M. & A. E. Salazar #3129 (US), *ex* herbarium specimen of *Piscidia mollis* Rose. SONORA: Ciudad Obregón, 29.IX.1933, H. S. Gentry #305M (US), *ex* herbarium specimen of *Piscidia mollis* Rose; Torres, 10.II.1903, F. V. Coville #1659 (US), *ex herbarium* specimen of *Piscidia mollis* Rose. Tamaulipas: 20 mi. n. Nuevo Morelos, 3.VII.1954, D. G. Kissinger. COSTA RICA. Puntarenas: 4 mi. n. jct. to Puntarenas, 6.III.1972, D. H. Janzen #VI-20-1972-X, reared *ex Piscidia carthagenesis* Jacq., emerged by 20.VI.1972.

Remarks: *Ctenocolum janzeni* is named for D. H. Janzen, collector of the holotype.

We report *C. janzeni* from three species of *Piscidia* and suspect that it also attacks seeds of the other Mexican and Central American *Piscidia* species. Various other *Ctenocolum* attack *Piscidia* in South America and the West Indies, and Janzen reared *C. crotonae* from the same plant that produced the holotype and a paratype of *C. janzeni* in Costa Rica.

3. *Ctenocolum salvini* (Sharp), new combination

Bruchus salvini Sharp 1885:446. Type-locality: Capetillo, Sacapetequez, Guatemala. Type-depository: British Museum (Natural History), London.
Pseudopachymerus salvini: Pic 1913:12.
Caryedes salvini: Blackwelder 1946:758.

Remarks: We have no host records for this species. Only the type specimens from Capetillo (Fig. 58) are known and we are unable to give a full redescription. The bright coppery vestiture (see Sharp 1885, pl. 26, Fig. 5) is distinctive. Head: bilobate dark mark at base as in *C. janzeni*; antenna (Fig. 18) not flabellate, articles 8–10 infuscated only at apical angles; eye large and ocular sinus deep, not or slightly sex-dimorphic, ocular ratio about 0.18–0.20; ocular sinus deep, 6 rows of facets behind sinus. Hind leg: pecten with about 12 teeth as in *C. tuberculatum*, first tooth much larger than second and following; external ventral denticles of femur strong. Pygidium: pattern not sex-dimorphic. Male genitalia (Fig. 39–42). The pattern of elytral vestiture is strongly variegated as in *C. janzeni*, but differs from the pattern of both *C. janzeni* and female *C. tuberculatum* in that the post-scutellar dark macula is widely broken by the pale vestiture of intervals one and two.

4. *Ctenocolum tuberculatum* (Motschoulsky), new combination

Pachymerus tuberculatus Motschoulsky 1874:244; Sharp 1885:440 (as synonym of *B. longicollis* Fåhraeus but ". . . will prove to be one of the varieties of this species"). Type-locality: Panama. Type-depository: Zoological Museum, Moscow State University, Moscow.
Pseudopachymerus longicollis var. *tuberculatus*: Pic 1913:11.
Caryedes longicollis var. *tuberculata*: Blackwelder 1946:758.
Bruchus serratissimus Sharp 1885:443. Type-locality: Paso Antonio, Escuintla, Guatemala. Type-depository: British Museum (Natural History), London. New synonymy.
Pseudopachymerus serratissimus: Pic 1913:12.
Caryedes serratissima: Blackwelder 1946:758.

Description: *Ctenocolum*, Tuberculatum Group. Length 2.5–3.9 mm. Width 1.7–2.3 mm. Integument largely dark rufous or rufopiceous, dorsum with some piceous variegation; antennal articles 8–10 strongly infuscated externally, articles 4–7 slightly infuscated; front and middle femora faintly banded, front and middle legs and hind tarsus rufotestaceous. Vestiture of dorsum (Fig. 3–4) and pygidium (Fig. 32–33) sex-dimorphic, pattern more strongly developed in female; black brown dorsally in median maculations of pronotum, elytra, and pygidium of female, paler in male; tan or orange brown most of rest of dorsum; whitish ventrally. Head (Fig. 10); antenna (Fig. 19–20) not flabellate; eyes large, not sex-dimorphic, interocular ratio 0.21–0.24; ocular sinus deep, 3 rows of facets behind sinus. Pronotum and elytra (Fig. 3–4); lateral subbasal gibbosities moderately developed. Hind leg (Fig. 25); pecten with about 12 teeth, first tooth much longer than second and following; external ventral denticles of hind femur strongly developed. Pygidium (Fig. 32–33). Male genitalia (Fig. 48–50).

Material examined: Mexico to Costa Rica (Fig. 59) and Venezuela, 110. MEXICO. Jalisco: 34 mi. nw. Barra de Navidad, 9.III.1973, C. D. Johnson #438-73, reared *ex ?Lonchocarpus*, emerged by 22.III-13.VI. 1973. Yucatán: Mérida, 24.VII.1944, N. Souza, through G. N. Wolcott 44-19729, *ex Lonchocarpus longistylus* Pittier. COSTA RICA. Guanacaste: Cañas area, 2.II.1969, D. H. Janzen, reared *ex Lonchocarpus*: 7 km. n. Cañas, 6.II.1970, D. H. Janzen reared *ex Lonchocarpus*; La Pacifica, 7 km. n. Cañas, 2.III.1972, D. H. Janzen #VI-20-1972-XXV, reared *ex Lonchocarpus*, emerged by 20.VI.1972; 1.3 mi. e. Playa Coco, 3.XII.1970, D. H. Janzen #307, reared *ex Lonchocarpus costaricensis* Donn. Sm.; Santa Rosa, 15.III.1972, D. H. Janzen #VI-19-1972-XXVIII, reared *ex Lonchocarpus*, emerged by 19.VI.1972. VENEZUELA. Aragua: 45 km. e. Sombrero, 30.I.1964, W. H. Cross, "cultivated cotton."

Remarks: Specimens of *Ctenocolum tuberculatum* are readily distinguished from specimens of *C. acapulcensis, C. janzeni,* and *C. salvini* by having only 3 facet rows behind the ocular sinus rather than 6 or more. We have examined specimens of two closely related species from Colombia and Venezuela which agree in eye structure but differ in structure of the sclerite of the internal sac of the male genitalia and, in at least one of these two species, lack of dark median stripe on female pygidium.

The Crotonae Group

Diagnostic combination: The Crotonae Group is well distinguished from the Tuberculatum Group by each of the following characteristics. Hind femur: pecten with 6–10 teeth, teeth from second of series to last gradually increased in size to middle then decreased to apex. Hind tibia: lateral coronal tooth sharply developed, set off from mucro by deep emargination. Male median lobe: internal sac without large complex sclerite; ventral valve truncate, sides strongly sinuate.

Further characteristics of the Crotonae Group include the following: eyes not sex-dimorphic; ocular sinus deep, 4–5 rows of facets behind sinus; antenna not sex-dimorphic, or male antenna elongate; lateral subbasal gibbosities of pronotum weak to moderate; placement of outer tooth of basal elytral gibbosity well basad of inner tooth; and hind femur with external ventral series of denticles strong in all species.

Distribution: Northern Mexico to southern South America, and West Indies. Four species are known from Mexico and Central America and are treated in this paper. At least two Central American species extend to South America. Several additional species occur in South America and the West Indies.

Taxonomic notes: Though this group is less poorly known than the

Tuberculatum Group, various taxonomic problems are evident. The four known Central American species are separable from one another without difficulty, but southern limits for one of them, *C. crotonae* are uncertain. The name *Bruchus podagricus* Fabricius (1801) pertains, we think, to a closely related West Indian form; type material of this form (in Copenhagen) needs to be studied further. Several other South American forms are also closely related, and indeed may not be distinct from *C. crotonae*.

Remarks: Larvae of species of the Crotonae Group devour seeds of *Bergeronia, Lonchocarpus, Muellera,* and *Piscidia.* The host ranges for at least some of the species are rather broad. Three of the known Central American species are known from two or more species of *Lonchocarpus,* and one of them is known also from *Piscidia.*

We know little about adult activity. One specimen of a Brazilian form was taken at a light trap in January. Other specimens of South American and West Indian forms were collected at various times throughout the year.

5. **Ctenocolum colburni**, new species

Description: *Ctenocolum,* Crotonae Group. Length 2.5–2.8 mm. Width 1.6–1.9 mm. Integument largely rufous; dorsum of head, anterior median portion of pronotal disc, and outer two-thirds of elytron piceous; hind tibia rufopiceous; antennal articles 1–5 partly and articles 6–11 wholly infuscated externally; front and middle legs testaceous. Vestiture mixed black and white, variegated in density; black only on dorsal surface as shown, characteristic (Fig. 5). Head (Fig. 13); antennal form as in *C. crotonae* (Fig. 21–22); eyes large, interocular ratio about 0.18–0.19; ocular sinus deep, 5–6 rows of facets behind sinus. Pronotum and elytra (Fig. 5); lateral subbasal gibbosities of pronotum nearly obsolete; basal elytral gibbosities displaced far behind base, paired teeth of each relatively small and proximate. Hind leg (Fig. 27); pecten with about 6 teeth, wide gap between first and second. Pygidium (Fig. 36). Male genitalia (Fig. 51–52).

Type material: Holotype male, "HOND. Cuyamel 17.VIII.1924 MACarleton," "Lonchocarpus pentaphyllus (Poir.) D. C. USNM herb."; in United States National Museum of Natural History, Washington, type no. 72800.

Paratypes, Mexico to Costa Rica (Fig. 62), 8; in USNM. MEXICO. Veracruz: Coyame, Lake Catemaco, 14.VII.1971, Clark *et al.* GUATEMALA. Chimaltenango: road between Chimaltenango and San Martín Jilotepeque 1500–1900′, along stream, 25.XI.1938, P. C. Standley #57907 (NY), *ex* herbarium specimen of *Lonchocarpus purpureus* Pittier. HONDURAS. Colón: Cuyamel, 17.VIII.1924, M. A. Carleton #634 (US), *ex* herbarium specimen of *Lonchocarpus pentaphyllus* (Poir.) DC. COSTA RICA. Heredia: San Miguel, 20.III.1971, D. H. Janzen #656, reared *ex Lonchocarpus velutina* Benth.

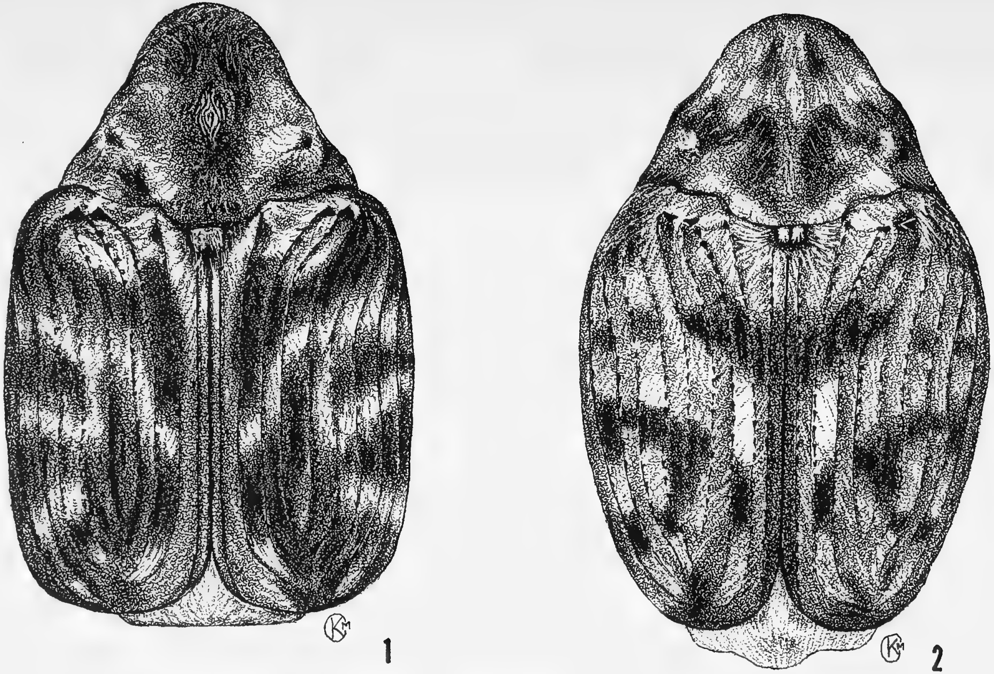


PLATE 1. FIG. 1–2, *Ctenocolum* spp., habitus. 1, *C. acapulcensis*; 2, *C. janzeni*.

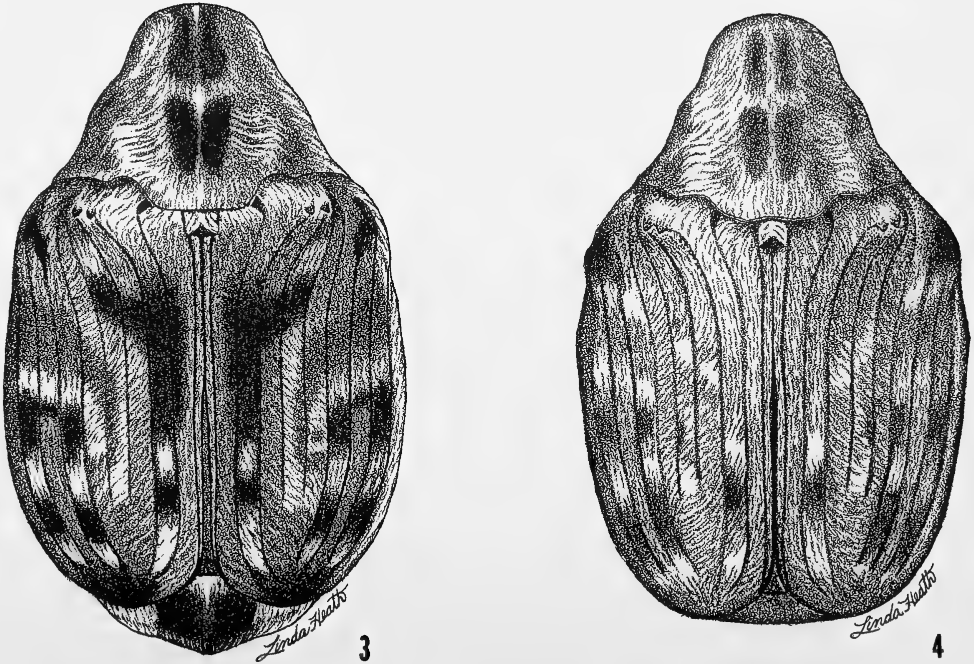


PLATE 2. FIG. 3–4, *Ctenocolum tuberculatum,* habitus: 3, female; 4, male.

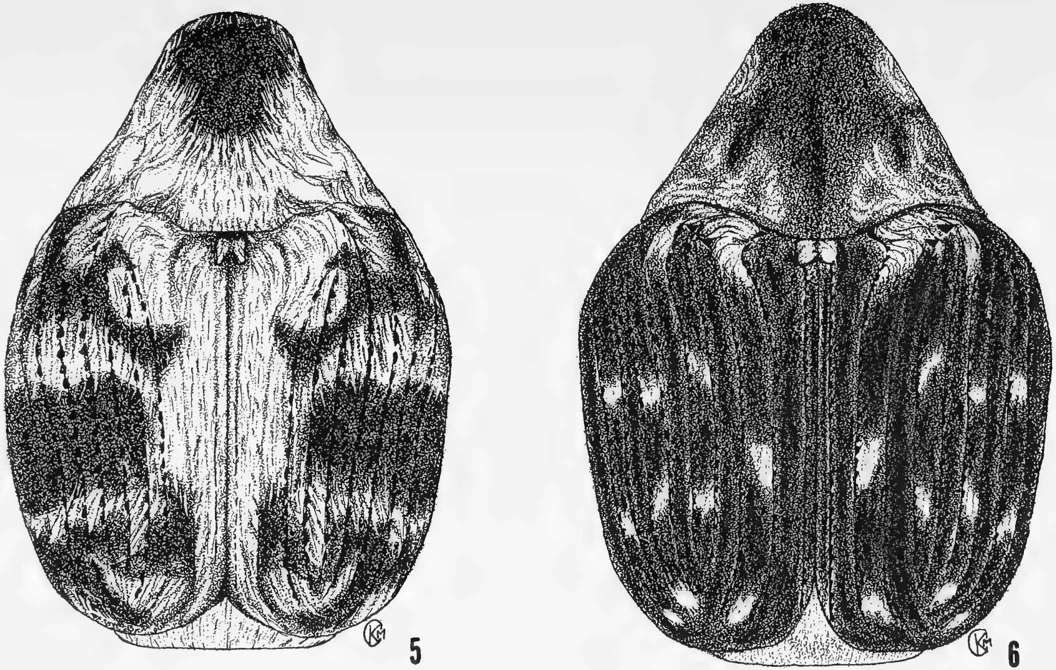


PLATE 3. FIG. 5–6, *Ctenocolum* spp., habitus: 5, *C. colburni*; 6, *C. martiale*.

PLATE 4. FIG. 7–8, *Ctenocolum* spp., habitus: 7, *C. biolleyi*; 8, *C. crotonae.*

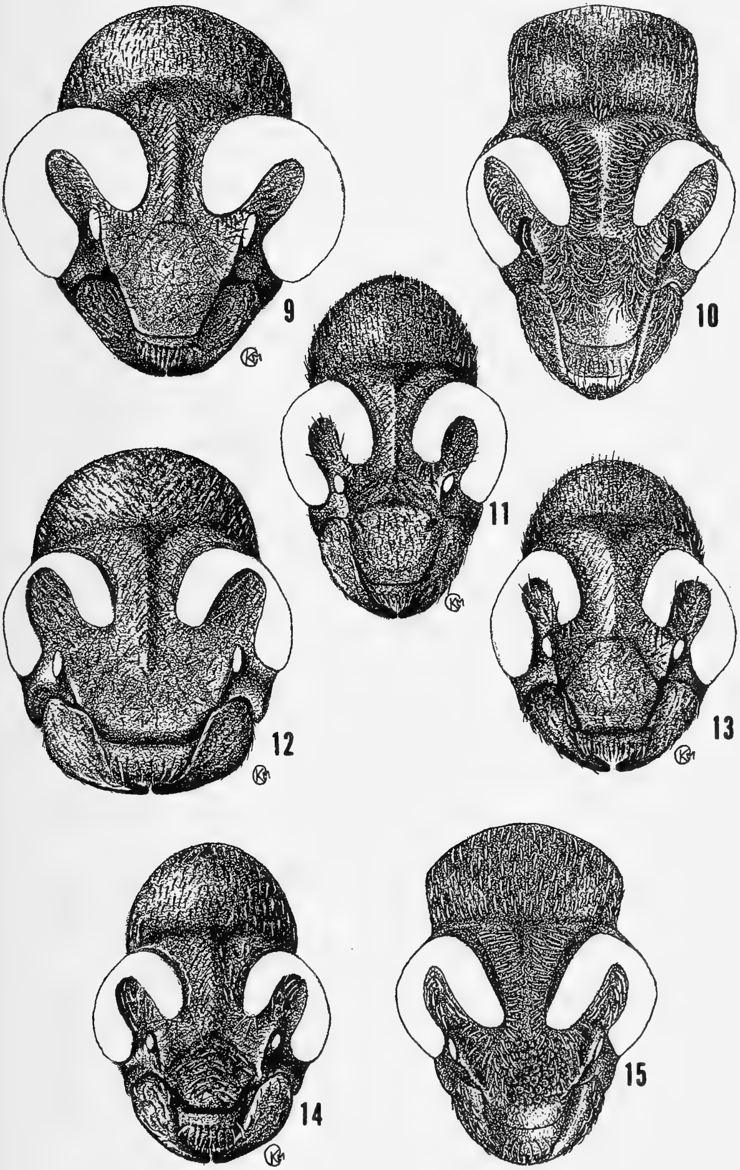


PLATE 5. FIG. 9–15, *Ctenocolum* spp., head: 9, *C. acapulcensis*; 10, *C. tuberculatum*; 11, *C. janzeni*; 12, *C. martiale*; 13, *C. colburni*; 14, *C. biolleyi*; 15, *C. crotonae*.

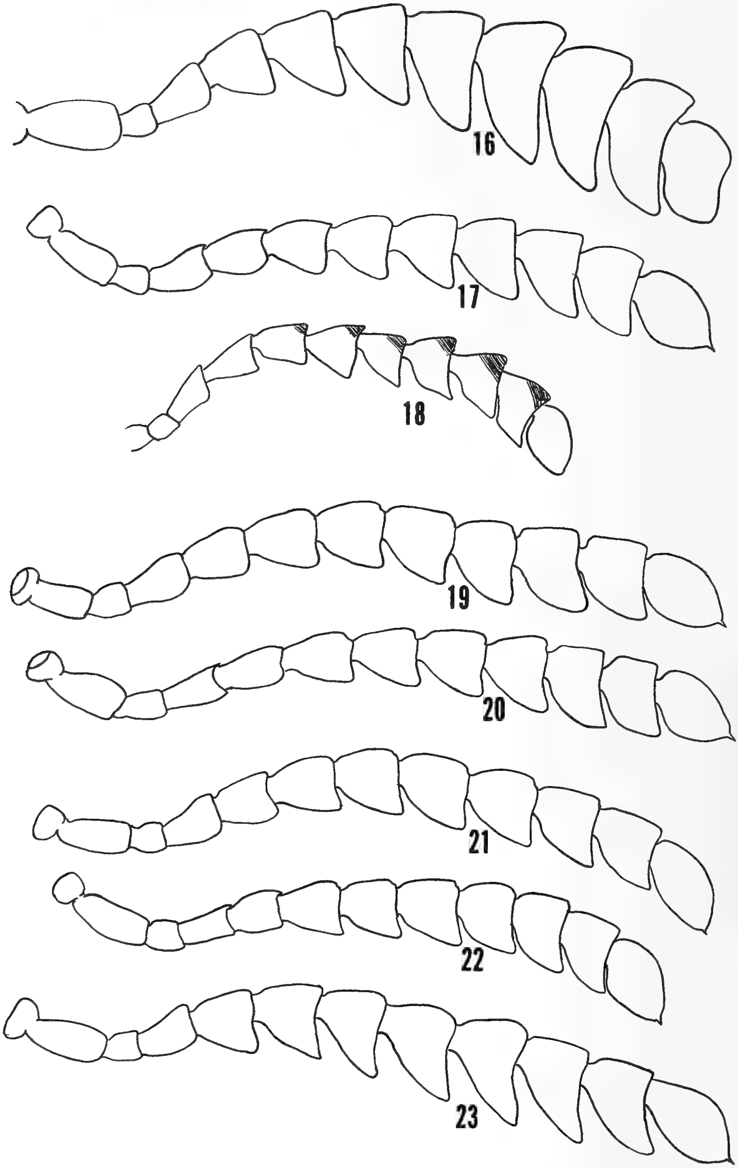


PLATE 6. FIG. 16–23, *Ctenocolum* spp., antenna: 16, *C. acapulcensis*, male; 17, *C. janzeni*, male; 18, *C. salvini*, male; 19, *C. tuberculatum*, male; 20, same, female; 21, *C. crotonae*, male; 22, same, female; 23, *C. martiale*, male.

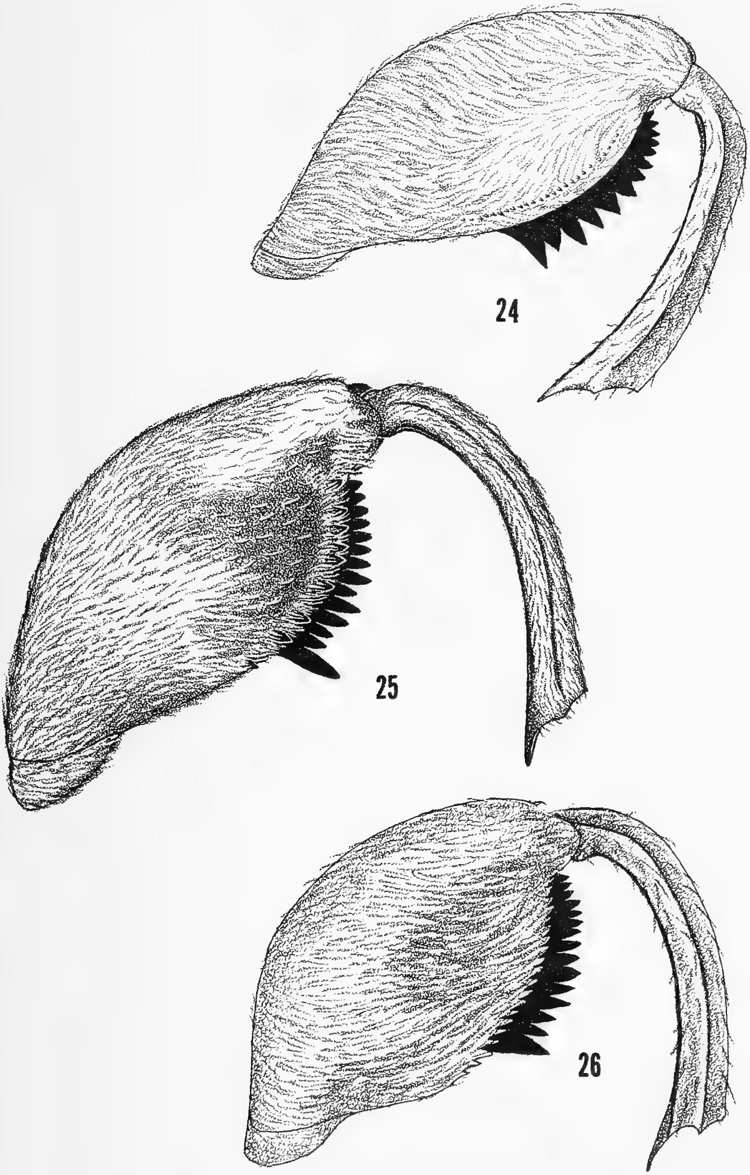


Plate 7. Fig. 24–26, *Ctenocolum* spp., hind leg: 24, *C. acapulcensis*; 25, *C. tuberculatum*; 26, *C. janzeni*.

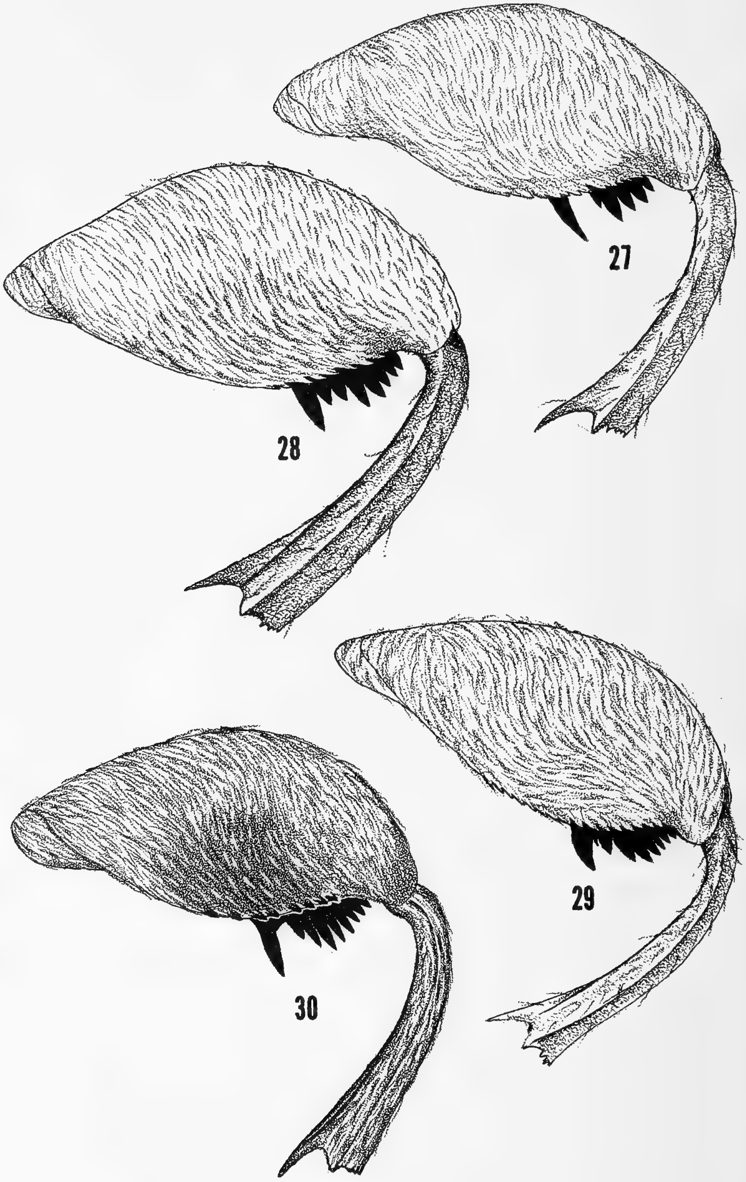


PLATE 8. FIG. 27–30, *Ctenocolum* spp., hind leg: 27, *C. colburni*; 28, *C. martiale*; 29, *C. biolleyi*; 30, *C. crotonae*.

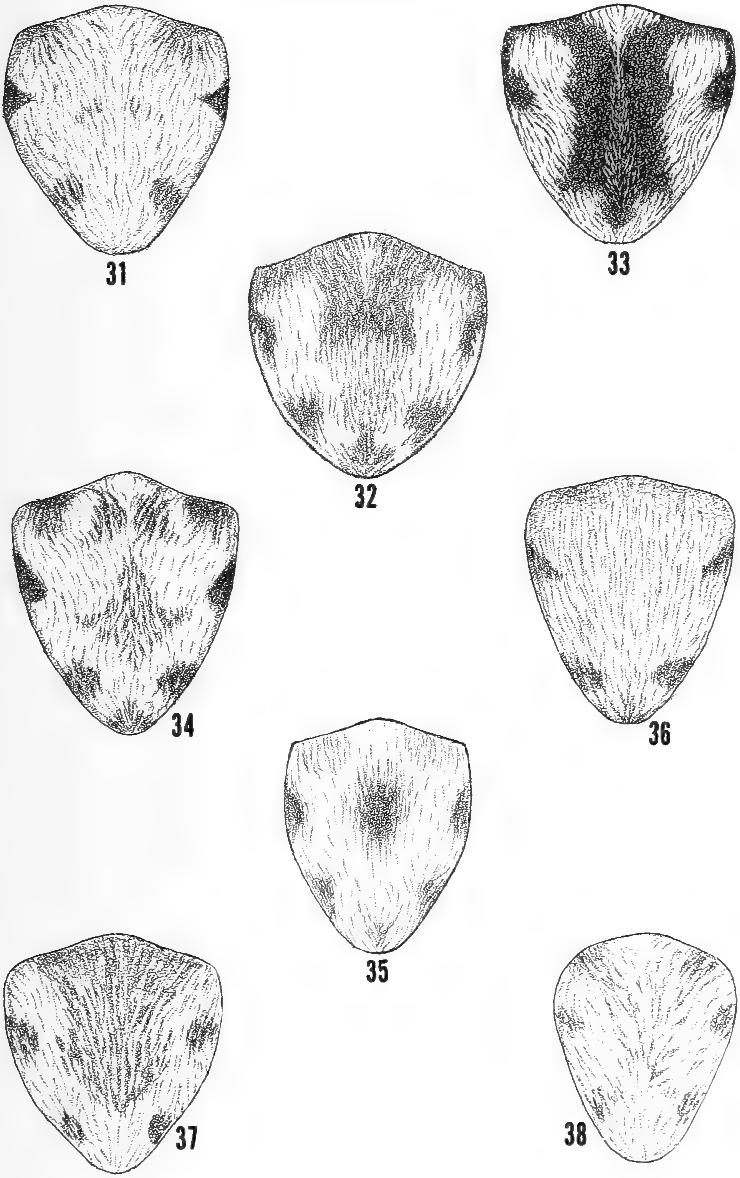
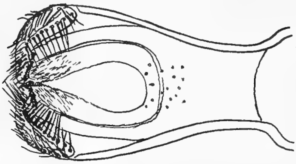


PLATE 9. FIG. 31–38, *Ctenocolum* spp., pygidium: 31, *C. acapulcensis*; 32, *C. tuberculatum*, male; 33, same, female; 34, *C. janzeni*; 35, *C. crotonae*; 36, *C. colburni*; 37, *C. martiale*; 38, *C. biolleyi*.



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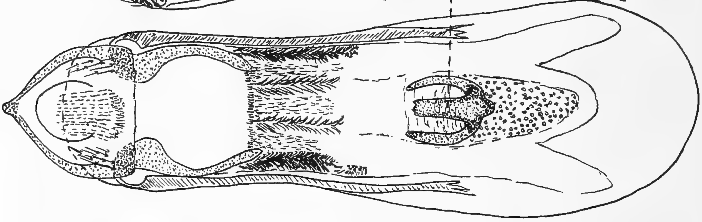

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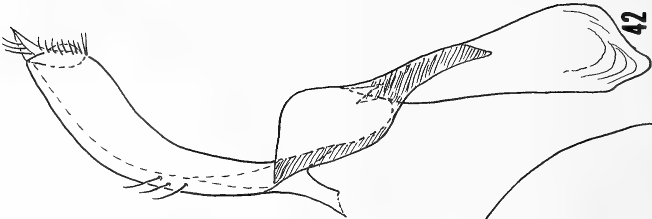

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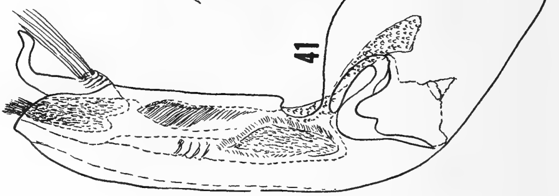

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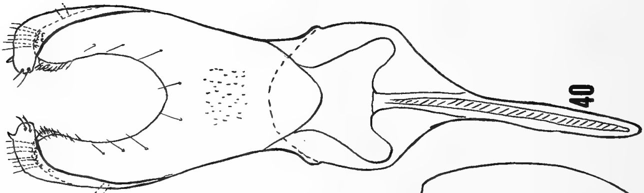

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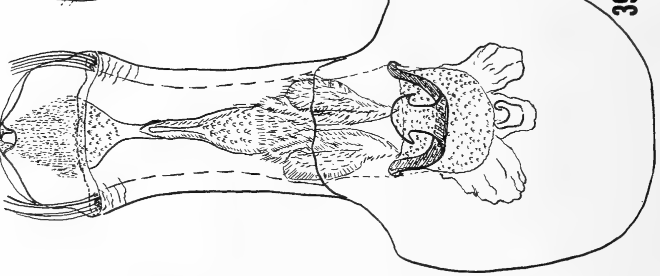

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Remarks: *Ctenocolum colburni* is named to honor John Colburn Bridwell's outstanding contributions to knowledge of the Bruchidae.

This particularly handsome species is immediately distinguishable from all other members of the genus by the color pattern. No other Central American species is closely related. An undescribed South American species has similar elytral and pronotal gibbosities, femoral pecten, and male genitalia but lacks a dark spot on the pronotum and has a more diffuse elytral pattern. This undescribed species is represented in USNM material by a long series from Guyana labelled as from *Muellera* seeds; this host record needs confirmation.

6. **Ctenocolum biolleyi**, new species

Description of female: *Ctenocolum*, Crotonae Group. Length 4.4 mm. Width 2.8 mm. Integument largely dark rufous, pronotum and elytra with piceous maculation; (antennal color not known); front and middle legs rufotestaceous. Vestiture variegated; mostly pale tan on venter, pleura, and pygidium; elytra and central part of pronotal disc variegated mostly with brown orange and black (Fig. 7). Head (Fig. 14); (antennal form not known); eyes large, interocular ratio about 0.23; ocular sinus deep, 5 rows of facets behind sinus. Pronotum and elytra (Fig. 7); lateral subbasal gibbosities of pronotum moderate; basal elytral gibbosities not displaced far behind base, paired teeth of each large, outer tooth much nearer to base than to inner tooth. Hind leg (Fig. 29); pecten with about 10 teeth, no gap between first and second but second minute. Pygidium (Fig. 38).

The male of this species is unknown.

Type material: Holotype female, "San Jose Costa Rica," "P. Biolley Collector," "Buchus? Teosite (*Rheana luxurians*"; [sic], "Chittenden Collection"; in United States National Museum of Natural History, Washington, type no. 72801.

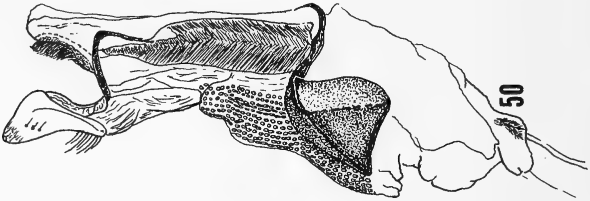
Paratype, Costa Rica (Fig. 58), 1; in USNM. COSTA RICA. San Jose: San Jose, P. Biolley.

The holotype lacks the head, and the paratype lacks the elytra. Measures of length and width are based on the holotype and of interocular ratio on the paratype.

Remarks: *Ctenocolum biolleyi* is named for Paul Biolley, whose turn-of-the-century collections contributed greatly to knowledge of Costa Rican invertebrates. This species, the largest of the Crotonae Group, is related to *C. crotonae* and *C. martiale* but differs markedly from both by the peculiar positioning of the teeth of the basal elytral gibbosities.

←

PLATE 10. FIG. 39–44, *Ctenocolum* spp., male genitalia: 39, *C. salvini*, median lobe; 40, same, lateral lobes; 41, same, median lobe, lateral aspect; 42, same, lateral lobes, lateral aspect; 43, *C. acapulcensis*, median lobe; 44, same, lateral lobes.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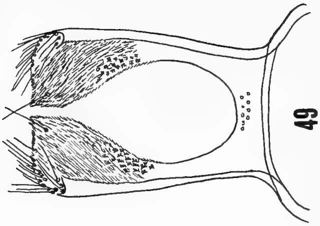
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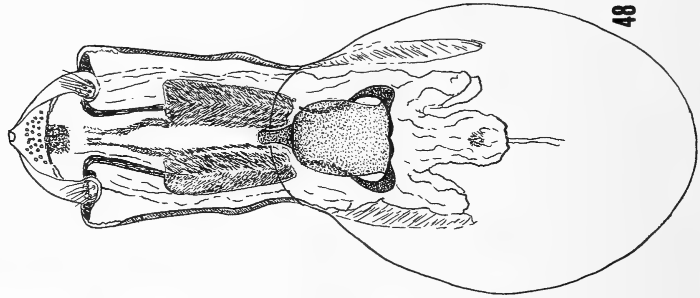
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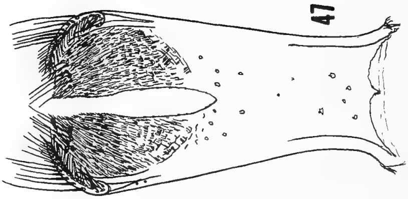
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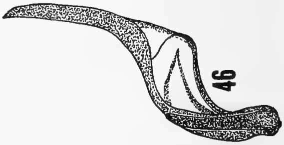
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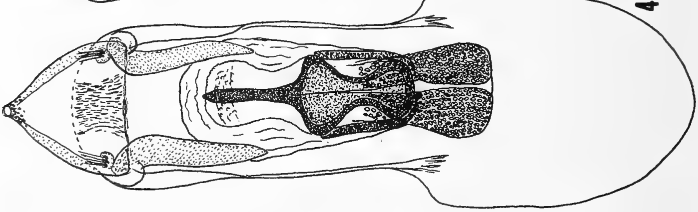
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7. **Ctenocolum martiale**, new species

Description: *Ctenocolum*, Crotonae Group. Length 2.6–4.4 mm. Width 2.0–2.6 mm. Integument largely piceous above, dark rufous or rufopiceous below; antenna externally with articles 4–10 piceous and other articles infuscated in male, and with articles 4–10 but slightly infuscated in female; front and middle legs and hind tarsus rufous in male and with front and middle femora and tibiae extensively infuscated, much paler in female. Vestiture sex-dimorphic, variegated; dorsum (Fig. 6) with orange brown and black pattern on pronotum, and with elytra almost wholly black except for orange brown in scutellar region and small white areas (male) or with extensive orange brown and white variegation (female); pygidium light orange brown basally, light tan apically; mesepisternum, metepisternum, and dorsum of hind femur light orange brown; venter white, sparse. Head (Fig. 12); antenna (Fig. 23) serrate, extended to about elytral humerus in female and to about elytral basal third in male; eyes large, interocular ratio 0.21–0.23; ocular sinus deep, 4–5 rows of facets behind sinus. Pronotum and elytra (Fig. 6); lateral subbasal gibbosities of pronotum moderate; basal elytral gibbosities not displaced far behind base, paired teeth of each large, outer tooth about as close to base as to inner tooth. Hind leg (Fig. 28); pecten with about 8 teeth, no gap between first and second but second much smaller. Pygidium (Fig. 37). Male genitalia (Fig. 53–54).

Type material: Holotype male, "ex Lonchocarpus cruentus Lundell M. Sousa #3353," "MEX. Ver. Laguna del Majahual, Los Tuxtlas, 100 m. 30 Nov. 1967"; in United States National Museum of Natural History, Washington, type no. 72799.

Paratypes, Mexico (Fig. 61) and Trinidad, 13; in CNC, USNM. MEXICO. Guerrero: Acapulco, X.1894-III.1895, E. Palmer #589 (US), *ex* herbarium specimen of *Lonchocarpus constrictus* Pittier; Acapulco, X.1894-III.1895, E. Palmer #226 (US), *ex* herbarium specimen of *Lonchocarpus eriocarinalis* Micheli. Oaxaca: Loma del Chivo, 50 m., Chiltepec, Tuxtepec, 9.V.1968, M. Sousa #3664, *ex* herbarium specimen of *Lonchocarpus cruentus* Lundell. Veracruz: Laguna del Majahual, 100 m., Los Tuxtlas, 30.XI.1967, M. Sousa #3353, *ex* herbarium specimen of *Lonchocarpus cruentus* Lundell. TRINIDAD. 3 mi. w. Mayaro, 14.VIII.1969, H. & A. Howden.

Remarks: We name this species, which destroys seeds of *Lonchocarpus*, after Mars, the Roman god of war: from Latin, "*Martialis*" =

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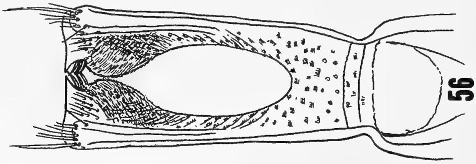
PLATE 11. FIG. 45–50, *Ctenocolum* spp., male genitalia: 45, *C. janzeni*, median lobe; 46, same, sclerite of endophallus, lateral aspect; 47, same, lateral lobes; 48, *C. tuberculatum*, median lobe; 49, same, lateral lobes; 50, same, endophallus, lateral aspect.



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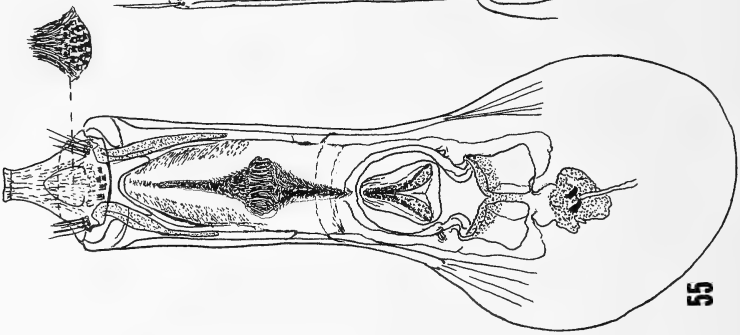

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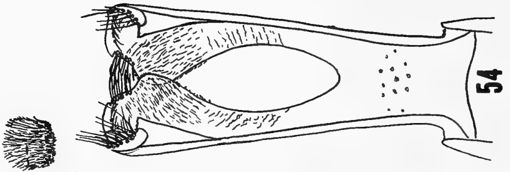

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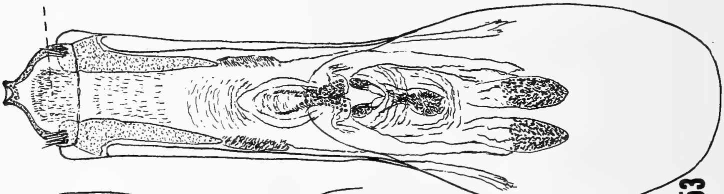

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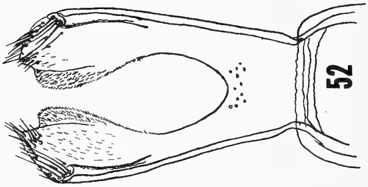

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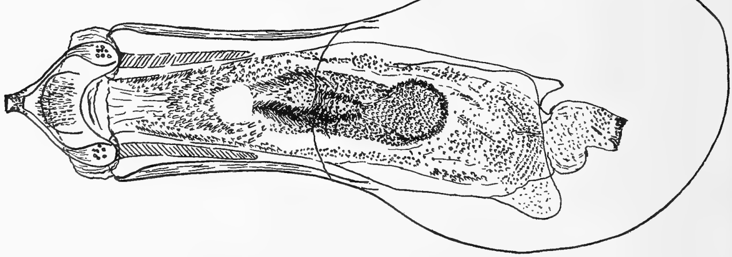

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"of Mars." We dedicate *Ctenocolum martiale* to Mario Sousa, who in the course of studies of *Lonchocarpus* provided us with important material of this and other species of *Ctenocolum*.

8. *Ctenocolum crotonae* (Fåhraeus), new combination

Bruchus crotonae Fåhraeus 1839:123. Type-locality: Brazil. Type-depository: Naturhistoriska Riksmuseum, Stockholm.
Pseudopachymerus crotonae: Pic 1913:10.
Caryedes crotonae: Blackwelder 1946:758.
Bruchus pictifemur Sharp 1885:446. Type-locality: Jalapa, Veracruz, Mexico. Type-depository: British Museum (Natural History), London. New synonymy.
Pseudopachymerus pictifemur: Pic 1913:11.
Caryedes pictifemur: Blackwelder 1946:758.

Description: *Ctenocolum*, Crotonae Group. Length 2.0–3.4 mm. Width 1.4–2.0 mm. Integument and vestiture color and variegation much as in *C. martiale* except that sex-dimorphism is much less developed (most strongly in South America); integument of males and females varied from largely rufous to largely piceous; antennae in most specimens not strongly infuscated; pygidium in some specimens with vestiture orange brown nearly to apex. Head (Fig. 15); antenna (Fig. 21–22) serrate, extended to about elytral humerus in female and to about basal third of elytron in male; eyes large, interocular ratio 0.17–0.20; ocular sinus deep, 4–5 rows of facets behind sinus. Pronotum and elytra (Fig. 8); lateral subbasal gibbosities of pronotum moderate; basal elytral gibbosities not displaced far behind base, paired teeth of each large, outer tooth closer to inner tooth than to base. Hind leg (Fig. 30); pecten with 7–9 teeth, no gap between first and second but second much smaller. Pygidium (Fig. 35). Male genitalia (Fig. 55–56).

Ctenocolum crotonae is distinguished from the related *C. martiale* by the male genitalia, with conspicuous differences in form of ventral valve, form of lateral lobe apices, and armature of internal sac; by larger eye size and smaller interocular ratio; and by positioning of the teeth of the basal elytral gibbosities. Several South American forms are much less distinct and perhaps are conspecific but are here distinguished from *C. crotonae* by having more reduced pronotal markings rather than a nearly continuous central macula.

Material examined: Mexico to Costa Rica (Fig. 60) and northern South America, 100. MEXICO. Campeche: head of Río Candelaria,

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PLATE 12. FIG. 51–56, *Ctenocolum* spp., male genitalia: 51, *C. colburni*, median lobe; 52, same, lateral lobes; 53, *C. martiale*, median lobe; 54, same, lateral lobes; 55, *C. crotonae*, median lobe; 56, same, lateral lobes.

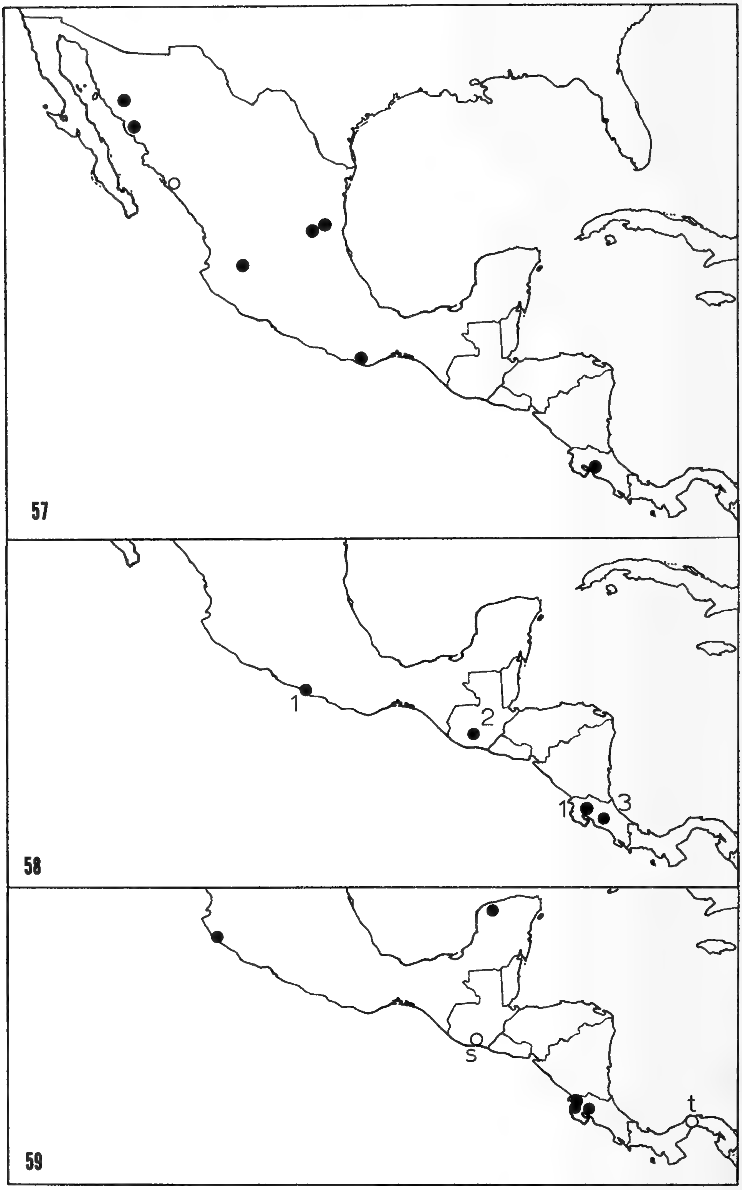

PLATE 13. FIG. 57–59, *Ctenocolum* spp., distribution records in Central America: 57, *C. janzeni* (open symbol = state record); 58, *C. acapulcensis* (1), *C. salvini* (2), *C. biolleyi* (3); 59, *C. tuberculatum* (s = type locality of *serratissimus*, t = type locality of *tuberculatum*).

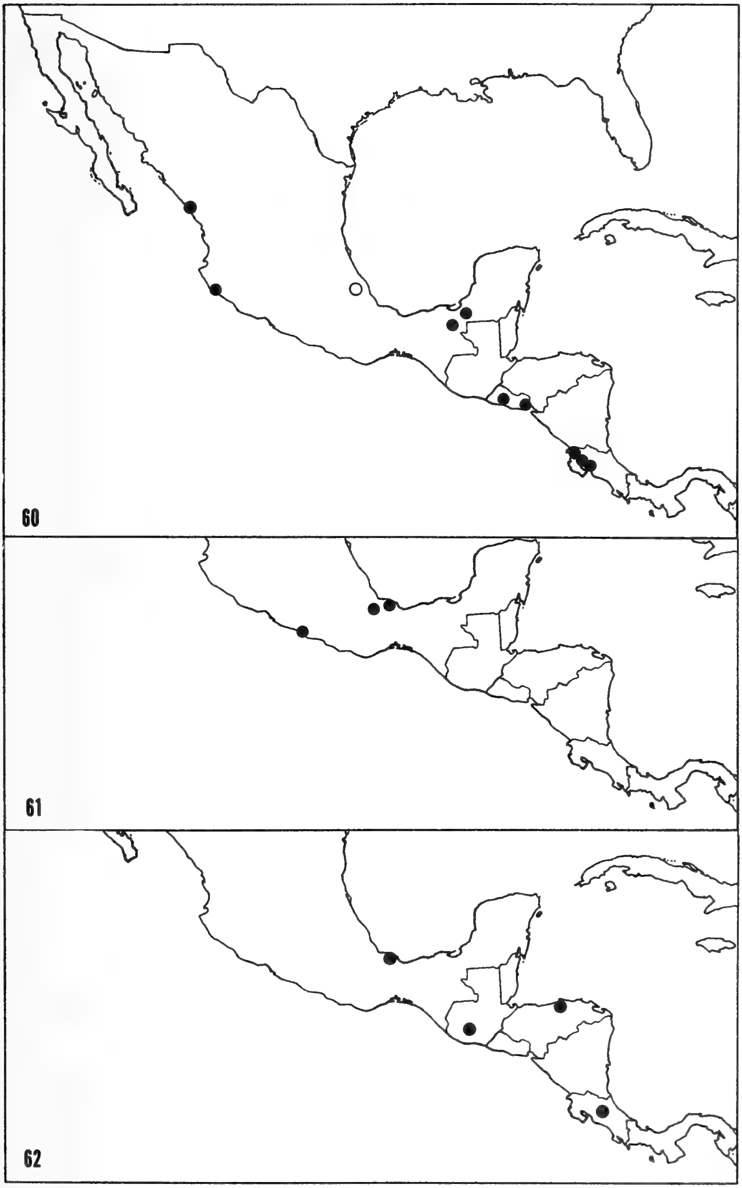

PLATE 14. FIG. 60–62, *Ctenocolum* spp., distribution records in Central America: 60, *C. crotonea* (open symbol = type locality of *pictifemur*); 61, *C. martiale*; 62, *C. colburni*.

Rancho San José, Río San Pedro, 27.VI.1957, O. G. Enriquez #B48 (US), *ex* herbarium specimen of *Lonchocarpus hondurensis* Benth. Chiapas: Ejido Morelos, La Libertad 60 m., 20.III.1968, M. Sousa #3657 (US), *ex* herbarium specimen of *Lonchocarpus rugosus* Benth. Jalisco: 34 mi. nw. Barra de Navidad, 9.III.1973, C. D. Johnson #438-73, reared *ex Lonchocarpus nitidus* (Vog.) Benth., emerged by 12.IV-23.VI.1973. Sinaloa: Mazatlan, 14.VIII.1965, H. Burke & J. Meyer. EL SALVADOR. La Unión: Volcan Conchagua, 27-29.V.1958, L. J. Bottimer #101u, reared *ex Lonchocarpus*. San Salvador: San Salvador, 650–850 m., 20.XXI.1921-4.I.1922, P. C. Standley #19254 (US), *ex* herbarium specimen of *Lonchocarpus rugosus* Benth. COSTA RICA. Guanacaste: La Pacifica, 7 km. n. Cañas, 2.III.1972, D. H. Janzen #VI-20-1972-XXV, reared *ex Lonchocarpus*, emerged by 20.VI.1972; Santa Rosa, 15.III.1972, D. H. Janzen #VI-19-1972-XXVIII, reared *ex Lonchocarpus*, emerged by 19.VI.1972; Santa Rosa, ½ km. from highway, 15.III.1972, D. H. Janzen #VI-19-1972-XXIV, reared *ex Lonchocarpus*, emerged by 19.VI.1972. Puntarenas: 4 km. n. Puntarenas junction, 6.III.1972, D. H. Janzen #VI-20-1972-X, reared *ex Piscidia carthagenesis* Jacq., emerged by 20.VI.1972. VENEZUELA. Distrito Federal: Caracas, 22.XII.1944, interception #EQ#087748 *ex Lonchocarpus margaritensis* Pittier. TOBAGO. Interception #PQ#022305 (Washington) *ex* "seeds of black manoe," 17.VIII.1933. GUYANA. Interception #EQ#A33506 *ex* "seeds of *Peltophorum dosyrachis*," 20.XII.1935; interception (from botanic garden) #EQ#A33506 *ex Lonchocarpus pentaphyllus* (Poir.) DC., 20.X.1935; interception (from botanic garden) #BPQ#030932. BRAZIL. Mato Grosso: Borda da Mato Sertaozinho, 12.I.1960, Medeiros & Pereira. ECUADOR. Intercepted at Honolulu *ex* "tree seeds."

The specimen from "*Peltophorum dosyrachis*" is doubtless mislabelled, as it bears the same quarantine interception numbers as a series from *Lonchocarpus pentaphyllus*.

Remarks: There appear to be several closely related forms in the West Indies and South America. The male genitalia of these probably different species differ from the genitalia of *C. crotonae* particularly in structures of the internal sac. Also, dark markings of the pronotum are reduced to a pair of broken longitudinal vittae, rather than confluent or nearly so as in *C. crotonae*.

Ctenocolum crotonae is known from more species of host plants than is any other member of the genus, and it is the only species of *Ctenocolum* so far known from more than one host genus. The records of *Lonchocarpus margaritensis* and *L. pentaphyllus* are based on quarantine inspections and need confirmation. Several collections of reared material from undetermined species of *Lonchocarpus* include both *C. crotonae* and *C. tuberculatum*, and one rearing from *Piscidia carthagenensis* included *C. janzeni* as well as *C. crotonae*.

DISCUSSION

Since several of the Central American species of *Ctenocolum* are known from only one or two localities each, several additional species are likely to be found. Much remains to be learned about the natural history of the genus. We can confidently state only that the genus is restricted to various members of the subtribe Lonchocarpinae (tribe Dalbergiae, family Fabaceae), and that no other New World bruchids are known to use these plants as hosts. We can draw no useful conclusions about geographic relationships, save that the greatest evolutionary activity for both species groups seems to be in Central America and northwestern South America. Similarly, distributional data are of no help in a phylogenetic reconstruction of the relationships of the species.

We recognize two apparently natural species groups, but relationships of their included species are unclear and perhaps cannot be adequately worked out until South American species are studied. The Tuberculatum Group may be defined as monophyletic by having as an apomorphous characteristic a large, complex, symmetric sclerite in the male endophallus. The Crotonae Group may similarly be defined by having the ventral valve of the male median lobe truncate and by having the pecten of the hind femur crescentic in outline.

Within the Tuberculatum Group, *C. tuberculatum* is distinguished by having the eye not sex-dimorphic, the male interocular ratio over 0.20, and the male lateral lobes divided to near the base (probably all plesiomorphous states); and by the ocular sinus deep, with 3 facet rows behind the sinus, and by the male lateral lobes not rolled over at the tips (probably apomorphous states). Perhaps the form of the ocular sinus (deep in *C. tuberculatum*, moderate in *C. janzeni* and *C. salvini*, and shallow in *C. acapulcensis*) is a true morphocline, with the deep sinus a plesiomorphous condition. Among the other three species in Central America, *C. acapulcensis* stands out by having the male antenna flabellate, the ocular sinus shallow and with about 10 facet rows behind the sinus, and the external ventral denticles of the hind femur obsolete. All of these conditions, however, are apomorphous, and the possession of plesiomorphous states of these characters does not indicate an unequivocal relationship between *C. janzeni* and *C. salvini*. The sclerite of the male endophallus is relatively simplified in *C. acapulcensis* and *C. salvini*, perhaps as a synapomorphous condition. Similarly, the eyes are strongly sex-dimorphic in *C. acapulcensis* and *C. janzeni*, an equally plausible synapomorphy.

Among Central American members of the Crotonae Group, *C. colburni* is certainly the most distinctive species and perhaps therefore is the least related, but we have discovered no convincing synapomorphous conditions to relate the other three species. A clue to relationships among *C. crotonae, C. martiale,* and *C. biolleyi* lies in the probable morphocline of increasing basal displacement of the outer tooth of the basal elytral gibbosity. Thus, *C. martiale* and *C. biolleyi*, in which this displacement is greatest, are probably the most closely related species of the Crotonae Group.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

UCA PANACEA, A NEW SPECIES OF FIDDLER CRAB FROM THE GULF COAST OF THE UNITED STATES

BY ALLEN NOVAK AND MICHAEL SALMON
*Department of Zoology, University of Illinois,
Urbana, Illinois 61801*

This paper documents the presence of a new species of fiddler crab, *Uca panacea*, on the Gulf Coast of the United States. A morphological description of the larval and adult specimens is given here, with special reference to those characters which distinguish the new form from *U. pugilator*, with which it has been confused.

Most of the North American fiddler crabs (Genus *Uca*) are found along the Atlantic and Gulf Coasts of the United States. Rathbun (1918) first attempted to list all of these species and describe them. She listed 9 species, including *Uca pugilator* (Bosc), the most common form, which is found from Cape Cod, Mass., to Florida and along the Gulf Coast to Texas.

Since her initial study, some new species have been described. Tashian and Vernberg (1958) designated *U. pugnax* and *U. rapax* (considered by Rathbun to be subspecies) as distinct species. Salmon and Atsaides (1968) described two new species, *U. longisignalis* and *U. virens*, as distinct from the Atlantic populations of *U. pugnax* with which they had previously been confused. Subsequently, these findings were confirmed by Selander, Johnson and Avise (1971) employing as their measure electrophoretic analyses of variation in muscle proteins.

Rao and Fingerman (1968) described two variants in coloration pattern among "*U. pugilator*" from the Panacea area. Each variant exhibited different chromatophoric response to black and white backgrounds. The study by Selander, et al. (1971) led to the discovery that Gulf Coast specimens, thought to be *U. pugilator*, could be placed in two distinct groups. That finding led to this morphological study. In another paper (in preparation), behavioral differences between the two forms are considered. The results indicate that *U. panacea* new species exists sympatrically but distinct from *U. pugilator* on the Gulf Coast of the United States.

METHODS

Uca panacea new species was found and studied within a ten-mile radius of the Florida State University Marine Laboratory, Carrabelle, Florida. Several large populations were found on the beach areas of Saint Mark's wildlife preserve, just east of Panacea, Florida. Animals from this location were used in this study.

About 150 individuals were collected and brought back alive to the University of Illinois, Urbana. The sample consisted of males and females from 1.1 to 1.8 cm in carapace width. The crabs were maintained in a large, 400 liter aquarium, 1.9 m long by 58 cm wide), provided with a bank of sand. These crabs, which were observed for behavioral studies, were also measured.

Characters measured with vernier calipers (accurate to 0.01 mm) were the following: width of front; width of carapace at its greatest dorsolateral extension; on large chela—length of propodus (from tip of finger to proximal edge), dactyl length (from tip to upper point of articulation with propodus), and dactyl width from ventral tooth ridge to dorsal margin midway from tip to point of articulation with propodus. Regressions for these measures were established for each species. The figures were then subjected to statistical analysis by comparison of regression slopes. In other cases, means of certain measurements were compared, using a *t*-test. The 0.05 level was chosen to reject the null hypothesis of no significant difference between the samples.

The number, distribution, and form of the spoon-tipped hairs on the merus of the second maxilliped were examined. Samples of 14 maxillipeds from 10 males and 4 females from

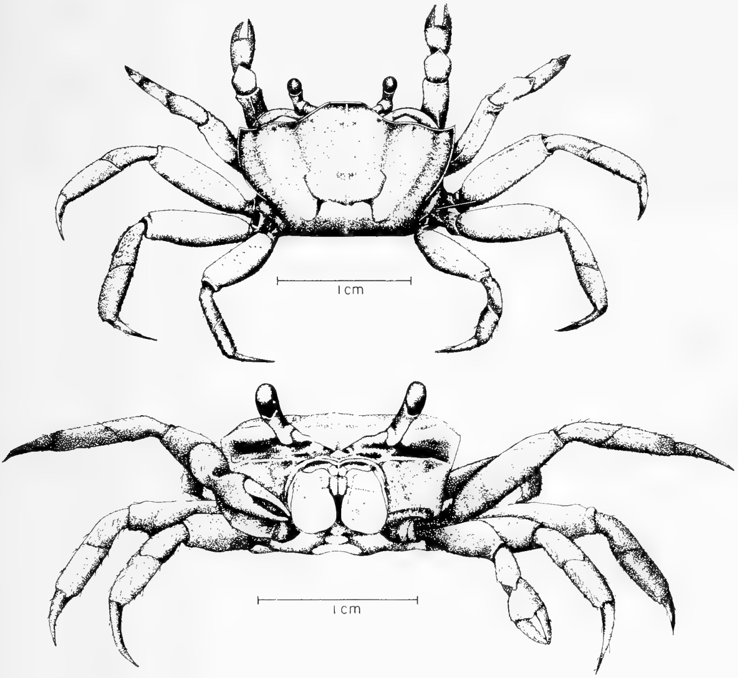

FIG. 1. *Uca panacea*, new species, allotype female. Top, dorsal view; bottom, frontal view.

U. panacea new species were photographed and compared to 4 maxillipeds from *U. pugilator*, as well as previous descriptions of the latter (Miller, 1961). The hair tips for both species were photographed under a scanning electron microscope (magnification 450–900 ×). Hairs used for electron microscopy were taken from fresh maxillipeds that had been placed in 95% ethyl alcohol for at least 72 hours. The hairs were mounted on pedestals and gold-palladium coated in a vacuum chamber before being photographed.

Five egg-bearing females were sent to the Duke University Marine Laboratory, Beaufort, North Carolina. The larvae were reared to the second crab stage at a temperature of 25 degrees C, salinity of 35 ppt, and photoperiod 12 L: 12 D, using established techniques (Costlow and Bookhout, 1962). A few (10–20) larvae at each stage were preserved in a solu-

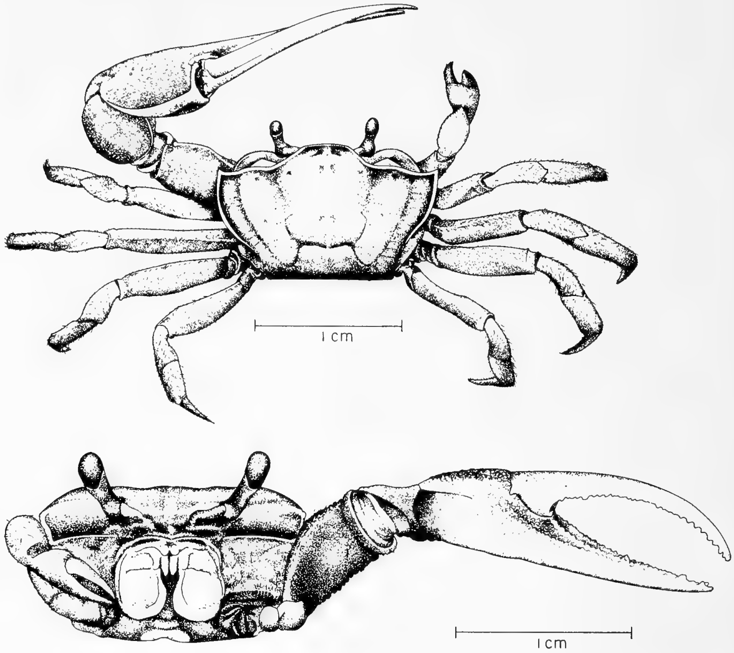

Fig. 2. *Uca panacea*, new species, holotype male. Top, dorsal view; bottom, frontal view.

tion of 4% formalin buffered to pH 7 with hexamethylenamine. Larval description is based primarily upon preserved specimens, although details were often checked against the morphology of living larvae.

Uca panacea, new species

Etymology: Panacea, alluding to the location where this animal was first discovered.

Distribution: Specimens of *U. panacea* described here were collected from Saint Mark's Wildlife Preserve just east of Panacea, Florida. They are known to occur west to Texas (Selander, personal communication).

Types: Deposited in the Smithsonian Institution. Holotype, male, USNM 150096; allotype, female, USNM 150097; paratypes, 50 males, 50 females, USNM 150098.

Sample size: 250 preserved and 150 live animals of various sex and size combinations were used for this study.

Morphological description: (Figs. 1 and 2) Carapace moderately

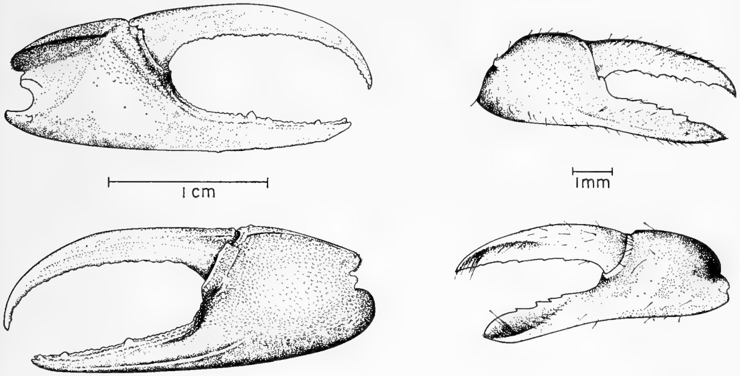

FIG. 3. *Uca panacea*, new species. Left, major cheliped: top, interior view; bottom, exterior view. Right, minor cheliped: top, exterior view; bottom, interior view.

arched, widest at anterolateral margins. Lateral margins parallel. Frontal margin transverse, angulate, forming obtuse angle on either side of protruding front. Surface of carapace smooth. H-form cardiac depression moderately outlined. Anterolateral margins distinct but blending into smooth surface of carapace posterior to middle of cardiac region. A ridge above last 2 paris of walking legs on oblique lateral wall of carapace. Oblique and anterolateral margins converging anteriorly to form less than right angle. Carapace about 2.8 times wider than front but these proportions vary with size.

Minor cheliped (Fig. 3) slightly serrated along inner margin of lower finger except near flattened spoon tip. Distinct gap present when fingers are closed. Scattered row of hairs extending along margins of both fingers.

Outer surface of major cheliped (Fig. 3) smooth but covered with many small flat tubercles. Propodus about 1.30 times as long as dactylus but proportions vary with size. Dactyl 8.25 times as long as wide but proportions vary with size and maturity. Submarginal ridge on palm not developed and lacking distinct tubercles. Teeth of both fingers well developed. Inner row of teeth continuing along palm usually extending close to lateral margin of carpal cavity.

Carpus with oblique ridge on inner surface continuing proximally along upper margin of carpus with slightly developed tubercles to point of articulation with merus. Lower margin having distinct ridge containing tubercles extending proximally to point of articulation with merus.

Supplementary specific characteristics: (Figs. 4 and 5) Spoon-tipped hairs of second maxilliped totaling about 160, projecting beyond inner margin of merus with many more non-projecting shorter hairs. Hairs confined to wide zone on median and distal inner edge of merus. Spoon-

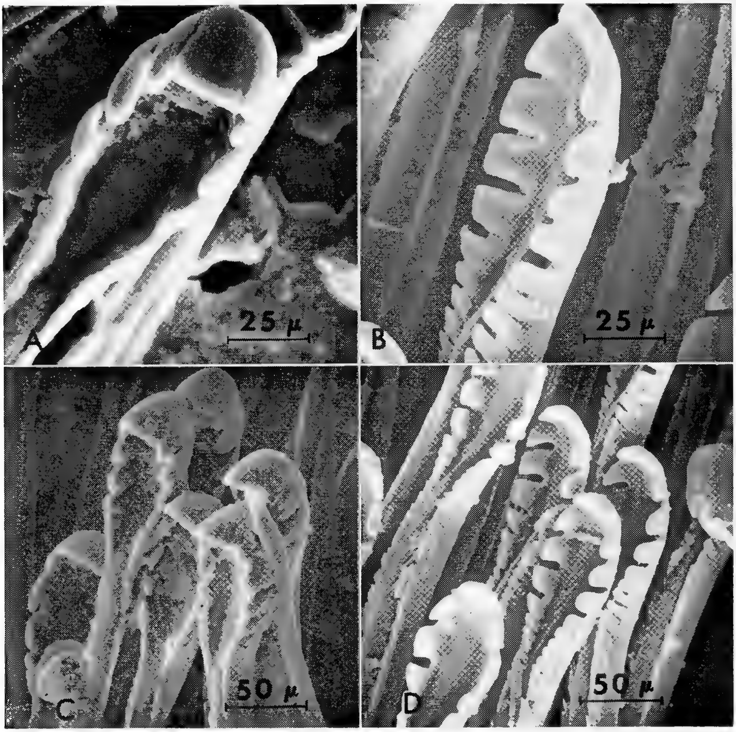

FIG. 4. Electron micrographs of spoon-tipped hairs from the second maxilliped. Left (A and C), *Uca pugilator*; right (B and D), *U. panacea*, new species. Note that tips are cup-shaped in the former, but more spatulate in the latter.

tipped process bearing 8–9 enlarged lateral lobes which continue as smaller lobes and extend down the shaft of the hair (Fig. 4).

Abdominal appendage with well developed arm. Curvature of tip continuing to follow that of shaft of appendage (Fig. 5).

Color: Carapace light grey-brown to uniformly creamy olive brown, being slightly darker posteriorly and laterally; the cardiac H-form depression is uniformly rust-red. Major cheliped of males white at fingers. Outside propodus orange to purple, palm usually being slightly lighter. Inner surface of carpus deep orange to red. Ambulatories white and speckled or uniform light red. Females with same color pattern. Color pattern of all animals altered with environmental conditions. Often carapace is considerably darker. When carapace is light colored, a pair of small grey spots can occasionally be seen slightly anterior to H-form depression.

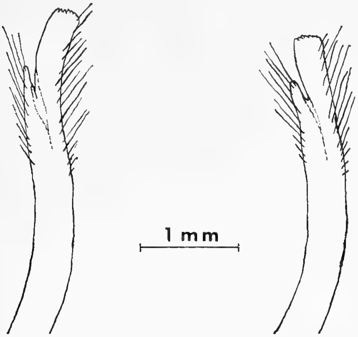

FIG. 5. Right abdominal appendage, seen from an anterior view. Right, *Uca panacea,* new species; left, *U. pugilator.*

Morphology of larvae: First zoea (Fig. 6-I); carapace dorsoventrally elongated, bearing dorsal and rostral spines. Rostral spine longer than dorsal. No lateral spines present. Carapace smooth with no sharp depressions or protuberances. Abdomen composed of 5 segments, 5th segment coalesced with telson. First abdominal segment predominantly covered by carapace. First and second segments show blunt lateral spines. Posterolateral margins of abdominal segments 2–5 overlap following segment with short blunt points, posterodorsal margin of each segment bears short hairs. Exopodite of maxilliped bears 4 natatory setae. Eyes sessile.

Second zoea (Fig. 6-II); carapace primarily unchanged with exception of slight protuberance just posterior to dorsal spine. Growth and expansion have occurred in carapace. Dorsal surface of first abdominal segment bears single setae centrally. Posterolateral edges of abdominal segments longer than in 1st stage and more heavily constructed. Exopodite of maxilliped bears 6 plumose setae. Eyes are now stalked.

Third zoea (Fig. 6-III); carapace enlarged with no apparent lengthening of dorsal and rostral spines over 2nd stage. Expansion of carapace gives dorsal spine stout appearance. Rostral spine still longer than dorsal. Carapace maintains smooth surface. Three setae appear in posteroventral margin of carapace; 3 setae are borne by, and are equally spaced along dorsal margin of first abdominal segment. First abdominal segment partially covered by carapace. Abdomen now composed of 6 segments, 6th bearing telson. Segments 3–5 have posterolateral projections which appear as short spines. Exopodite of maxilliped typically bears 8 plumose setae.

Fourth zoea (Fig. 6-IV); carapace remains smooth. Rostral and dorsal spines maintain previous size as carapace and abdomen continue to grow. First abdominal segment (hidden under carapace) bears 6

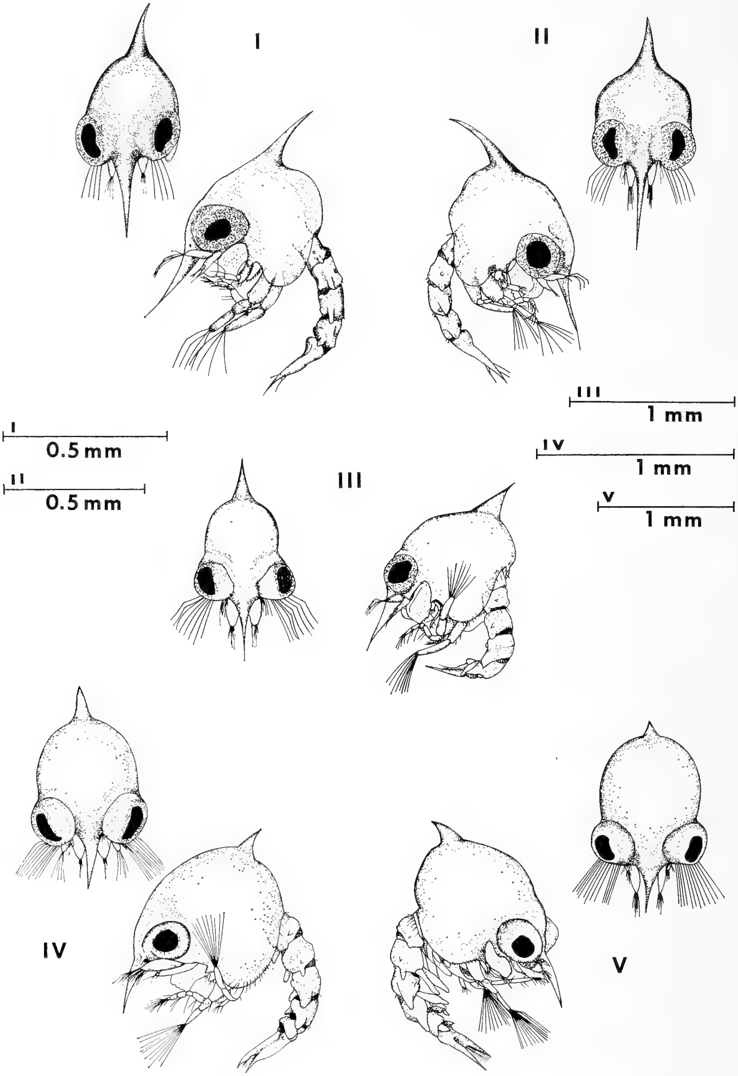

FIG. 6. *Uca panacea*, new species. Frontal and lateral views of the five zoeal stages.

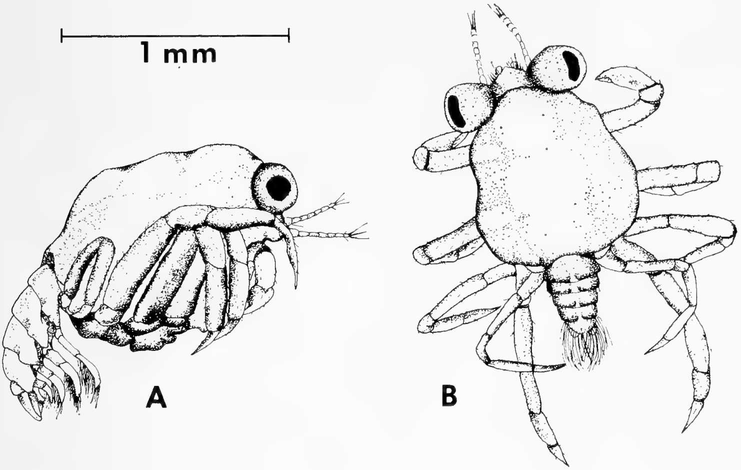

FIG. 7. *Uca panacea,* new species. Lateral (A) and dorsal (B) view of megalopa.

setae equally spaced along entire dorsal margin. Pleopod buds appear on abdominal segments 2–5. Spiny posterolateral projections on segments 3–5 are maintained. Maxilliped typically bears 10 plumose setae.

Fifth zoea (Fig. 6-V); carapace remains smooth. Eyes large, stalked. First abdominal segment (under carapace) bears 11 setae equally spaced along dorsal margin. Pleopods are more developed and occur on segments 2–5. Posterolateral margins of abdominal segments 3–5 have short spines which overlap following segment. Exopodite of maxilliped typically has 12 plumose setae.

Gross morphology of megalopa (Fig. 7); carapace oval when viewed from above, rounded on dorsal surface by 3 protuberances running from anterior to posterior surface. Chelipeds formed but small. Abdomen consists of 6 segments (1st segment hidden by carapace) plus telson. Segments 2–6 have bisegmented pleopods. Pleopods typically bear 15 setae each segment.

Gross morphology of first crab: (Fig. 8-A) Carapace round when viewed from above, extension of carapace between stalked eyes has formed. Depressions and protuberances slight and not well defined. Chelipeds are developed but small and equal in size. Abdomen (not visible in figure) carried under body where it fits into midventral depression.

Gross morphology of second crab: (Fig. 8-B) Carapace round when viewed from above, with grooves for horizontal reception of eyestalks. Extension of carapace between eyestalks now fully developed. "U"-

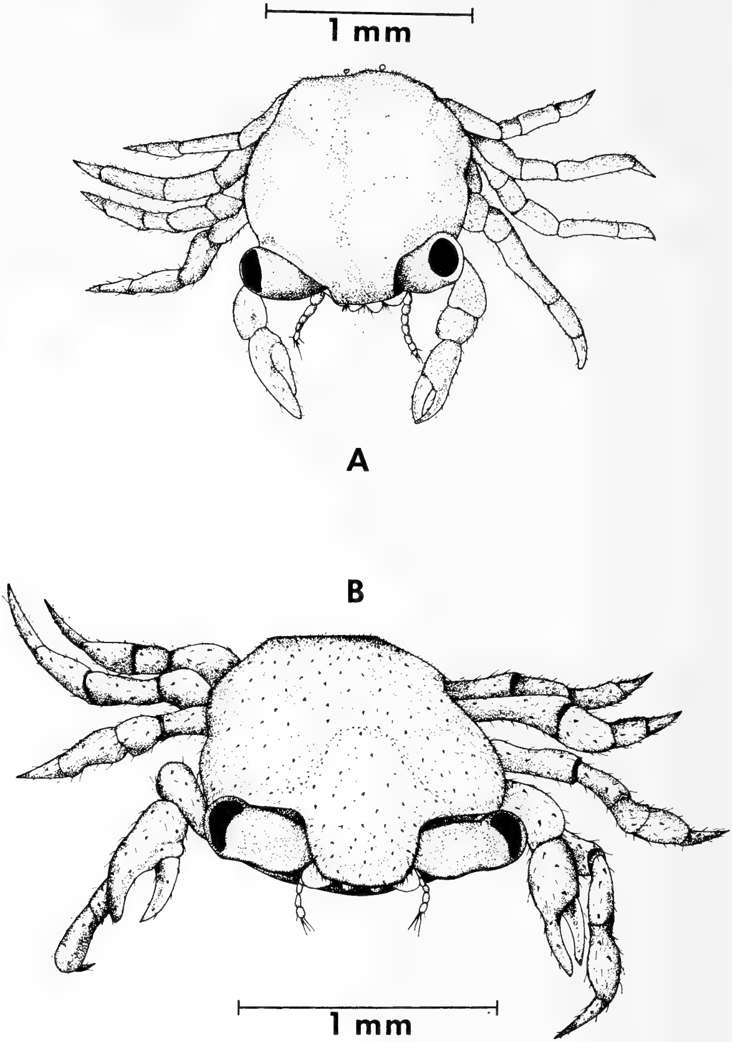

FIG. 8. *Uca panacea*, new species. A, dorsal view of first crab stage; B, anterodorsal view of second crab stage.

shaped slight depression sometimes apparent on dorsal surface of carapace, beginning posterior to eyestalks and arching posteriorly where arcs meet middorsally. Abdomen remains folded under ventral portion of body where it is retained in a depression.

COMPARISON WITH *UCA PUGILATOR*

While *U. pugilator* in the Carrabelle-Panacea area of Florida commonly reach a size greater than that of the largest *U. panacea*, the typical size of an adult *U. panacea* is in keeping with that of most mature *U. pugilator*. A typical carapace width for *U. panacea* in Carrabelle, Florida, is 1.6 cm, while *U. pugilator* commonly attains a width of 2.0 cm and occasionally larger. From a random sample of 500 animals collected, the greatest carapace width of *U. pugilator* was 1.91 cm while that of *U. panacea* was 1.63 cm.

Regressions were established using carapace width as a function of width of front. A random sample (20 of each sex for each species) was drawn and the regressions compared using F-test to establish whether the two regressions could be drawn from the same population. In both sexes the statistical analysis indicated that the slopes of the regressions of *U. panacea* ($b = 3.1088$, ♀♀, and 1.9254, ♂♂) and those of *U. pugilator* ($b = 2.3674$, ♀♀, and 2.822, ♂♂) were different (comparison of females: $F_{[1,36]} = 5.7771$, $p \leq .025$; comparison of males: $F_{[1,36]} = 7.2547$, $p \leq .01$).

Unfortunately, carapace pigmentation is variable within the two species. However, distinctive characteristics do exist in the form of the cardiac H-form depression, carpal pigmentation, the spots on the carapace and overall carapace color, especially when the animals are in a lightened state. A most distinctive characteristic is the rust-red cardiac depression on the back of *U. panacea*. This differs from *U. pugilator*, which typically has a dark grey-brown cardiac depression, and is maintained even when the animals assume the dark coloration.

Occasionally *U. panacea* is seen with a pair of small grey spots slightly anterior to the H-form depression. This marking is common in *U. pugilator* also, but two additional zones of purple pigmentation are located just anterior and lateral to the grey spots.

When animals assume light carapace pigmentation, differentiation becomes simple. *Uca panacea* appears creamy olive-brown compared to *U. pugilator* (creamy powder blue-grey carapace with deep purple spots). The difference in cardiac H-form is at a maximum then, with *U. panacea* bright rust-red compared to the greyish-brown of *U. pugilator*.

The broad flat inner margin of the carpus is orange to deep red in *U. panacea* and distinct from the rest of the appendage segments. The carpus of *Uca pugilator*, while having some red pigmentation, does not present as bright a color as in *U. panacea*.

The major cheliped of male *U. panacea* appears more slender than that of *U. pugilator*. Measurements confirmed this. Mean dactyl widths were compared between 15 crabs of each of the two forms, using a sample in which dactyl length was held between 1.55 and 1.59 cm. The mean ± s was 0.189 ± 0.007 cm for *U. panacea*, and 0.221 ± 0.006 cm for *U. pugilator* ($t = 191.3$, $p < .005$). Mean dactyl lengths were also compared, again using 15 crabs/sample, and holding carapace width between 1.43 and 1.49 cm. For *U. panacea*, the mean was 1.51 ± 0.06 cm; for *U. pugilator*, 1.32 ± 0.14 cm. These values were also significantly different ($t = 131.4$, $p < .005$). Thus, in the major cheliped of *U. panacea*, the dactyl is more slender and longer than in *U. pugilator*. Of the 30 animals measured, the range and mean of the dactyl length: width proportion was 7.75–8.78, 8.25 for *U. panacea*; and 6.80–7.48, 7.09 for *U. pugilator*.

The overall proportion of dactyl length to propodus length is only slightly different between the two species. Regressions were established using dactyl length as a function of propodus length. With a random sample of 30 for each species, the comparison of slopes (*U. panacea*, $b = 0.864$, *U. pugilator*, $b = 0.800$) was not significant ($F_{[1,56]} = 2.3132$, $p < .10$). The tooth midway along the finger of the propodus is in most cases smaller in *U. panacea* than it is for *U. pugilator*.

Spoon-tipped hairs of both species are equal in abundance and distribution on the second maxilliped. In five *U. panacea* examined, 148–162 spoon-tipped hairs were counted extending beyond the inner margin of the merus. Crane (1943) describes *U. pugilator* as having 150–200 spoon-tipped hairs extending beyond the inner margin of the merus. Photographs under the scanning electron microscope however, indicate different morphology for the two species (Fig. 4). The spoon-tipped hairs of *U. panacea* are broader and shallower than those of *U. pugilator*. Lateral lobes of the former extend down the shaft of the hair, while in the latter, none are seen along the shaft.

Abdominal appendages of adult males are similar, but a difference is apparent in the angles and ridges at the tip of the appendage (Fig. 5). Six males of both species were compared. The appendage of *U. panacea* continues to follow the curvature of the shaft to the tip of the appendage, while in *U. pugilator*, it diverts away from the arm. This causes the tip of *U. pugilator* to form a concave arch on the side opposite the arm.

Discussion

The larval as well as adult descriptions given here form a base of reference for species identification. The only previous description of larval development in *Uca* was done by Hyman (1922) for *U. pugilator*. Crane (1940) primarily refers to Hyman's description when comparing the Genus *Ocypode* to *Uca*. But Hyman did not rear his animals in the laboratory. Hence, his data are suspect, both in terms of uncontrolled environmental (salinity, temperature, nutrition) influences as well as species identification.

The distinct differences in the form of the spoon-tipped hair is of prime importance. According to Crane (1941), and Miller (1961), this character is correlated with feeding adaptations to different substrates. Thus the differences found here are indicative of niche specialization between the two forms.

Another important character, again indicative of species distinctiveness, is the difference in shape of the abdominal appendages. This slight difference in form may, in conjunction with other adaptations, prevent interbreeding. No intermediate forms, which could indicate hybridization, were found in the field.

Color pattern is a distinctive characteristic differentiating the two species, and it is now known that fiddler crabs have color vision (Hyatt, 1973). Characteristics such as the bright color of the carpus on the major chela may coordinate vitally with the mating display of the male.

The description presented above indicates that *U. panacea* and *U. pugilator* are closely related and have probably diverged only recently. There is little doubt, based upon the combined evidence from this description and the biochemical study of Selander et al. (1971), that isolation is complete. The courtship displays of both species are also distinct and will be described in a separate paper. From an evolutionary viewpoint, this behavioral evidence must be considered the most conclusive for speciation (Crane, 1943; Cain, 1954; Mayr, 1966).

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THE KARYOTYPE OF *VANZOLINIUS DISCODACTYLUS* AND COMMENTS ON USEFULNESS OF KARYOTYPES IN DETERMINING RELATIONSHIPS IN THE *LEPTODACTYLUS*-COMPLEX (AMPHIBIA, LEPTODACTYLIDAE)

By W. Ronald Heyer and M. Judith Diment
Division of Amphibians and Reptiles, National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560, and
Biology Department, Pacific Lutheran University, Tacoma, Washington 98447

Information on karyotypes of several species of the frog genera *Adenomera* and *Leptodactylus* recently has become available. Bogart (In press) described and figured the karyotypes of 16 species of *Leptodactylus* and 3 species of *Adenomera* (reported as the *marmoratus* group members of the genus *Leptodactylus*). We have obtained information on the karyotypes of 9 species of *Leptodactylus* and *Vanzolinius discodactylus.* The purpose of this paper is to describe the karyotype for the previously unreported *V. discodactylus* and offer alternatives to the relationships among the *Leptodactylus*-complex to those proposed by Bogart (In press). It should be pointed out that the genera *Adenomera, Leptodactylus,* and *Vanzolinius* have been considered to all belong to the genus *Leptodactylus* until recently.

Methods and Materials

The technique and terminology used in preparation and description of the karyotypes follows Patton (1967). Approximately 50 cells were examined from marrow, spleen, or testis tissue of the specimens. The material was examined

Fig. 1. Karyotype of *Vanzolinius discodactylus*, specimen WRH 464. Chromosome pair number 3 with overlap.

using a phase contrast microscope and the better metaphase figures were photographed. The chromosomal spreads used in the analysis were those with few or no overlapping chromosomes in the condensed state. Each arm of every chromosome was measured and the chromosomes were grouped in pairs according to their size and arm ratio. Our preparations did not allow the location of secondary constrictions.

The specimens were taken from the following localities: *Leptodactylus bolivianus, melanonotus*—Costa Rica. *Leptodactylus bufonius, chaquensis, fuscus, latinasus*—Argentina: Salta; Embarcacion. *Leptodactylus mystaceus, pentadactylus, wagneri, Vanzolinius discodactylus*—Ecuador: Napo; Limoncocha. Specimens and slides will be deposited at the Natural History Museum, Los Angeles County.

The Karyotype of *Vanzolinius discodactylus*

The karyotype of *Vanzolinius discodactylus* is characterized as follows: diploid number = 22; three pair of metacentrics (Fig. 1, chromosome pair numbers 5, 8, 9); four pair of submetacentrics (Fig. 1, chromosome pair numbers 1, 2, 6, 10); three pair of subtelocentrics (Fig. 1, chromosome pair numbers 3, 4, 7); one pair of acrocentrics (Fig. 1, chromosome pair number 11); fundamental number = 42.

Fig. 2. Karyotype of *Leptodactylus chaquensis*, specimen WRH 1402.

KARYOTYPIC COMPARISONS OF *Leptodactylus* SPECIES

The karyotypes of the species of *Leptodactylus* we examined agree with previously published accounts in that all species have a diploid number of 22.

Although Barbieri (1950) reported the diploid number of *L. chaquensis* as 2n = 22, he did not include a metaphase figure of the karyotype. We include a metaphase figure (Fig. 2) of this species for comparative purposes. There are four pair of metacentrics (Fig. 2, chromosome pair numbers 1, 6, 8, 11); five pair of submetacentrics (Fig. 2, chromosome pair numbers 2, 5, 7, 9, 10); and two pair of subtelocentrics (Fig. 2, chromosome pair numbers 3, 4).

Our analysis of chromosome morphology based on centrometric position differs considerably from previously published accounts (Table 1). These differences could be accounted for in three different ways. First, the different karyotypes could be the result of different techniques. Bogart (In press) used the corneal squash technique while we have used the marrow and spleen cell suspension technique. Second, the differences could be due to geographic variation within species. Third, the differences might be due to different interpretations of morphology and of which pairs are ho-

TABLE 1. Comparison of karyotypes for species of *Leptodactylus*.

Source	Species	Metacentrics	Submetacentrics	Subtelocentrics	Acrocentrics
Bogart[1]	*bolivianus*[2]	8	2	1	0
Present Study	"	4	5	2	0
Bogart	*bufonius*	7	2	2	0
Present Study	"	6	2	3	0
Bogart	*fuscus*	7	3	1	0
Present Study	"	5	3	3	0
Bogart	*melanonotus*	6	3	2	0
Present Study	"	4	4	3	0
Bogart	*mystaceus*	5	3	3	0
Present Study	"	4	4	3	0
Bogart	*pentadactylus*	7	3	1	0
Denaro[3]	"	4	3	4	0
Present Study	"	2	6	3	0
Bogart	*wagneri*	2	4	1	4
Present Study	"	2	2	3	4

[1] Bogart (In press).
[2] Reported as *insularum*.
[3] Denaro (1972).

mologous. We think that the third explanation could very well account for many of the differences noted in the karyotypes of Table 1. Until homologues can be determined objectively, we think that the karyotype data must be interpreted extremely conservatively.

RELATIONSHIPS

There are two aspects of the karyotypes that appear to be conservative in the sense that they are not influenced by interpretations by different workers and also appear to provide information of possible use in predicting relationships. These aspects are the diploid number and the presence or absence of acrocentric chromosomes. Character states of these two karyotypic characters are assigned as follows:

Diploid number of chromosomes: Character state a = diploid number of 26. This is the primitive state of the family (Lynch, 1971, p. 37). State A = diploid number of 24 and is

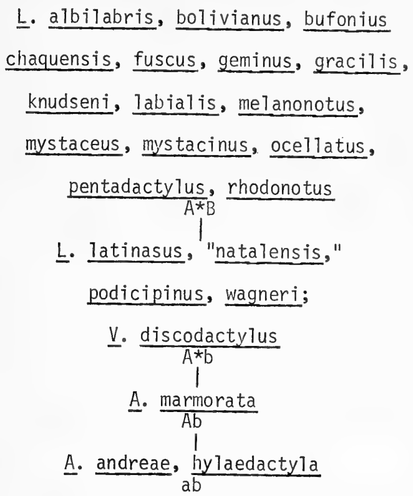

FIG. 3. Proposed relationships based on karyotypes. Lower case letters indicate primitive states, capital letters indicate derived states, asterisks indicate secondarily derived states. Character a is the diploid number, character b is presence or absence of acrocentric chromosomes. Also see text. Based on data from Barrio (1973), Bogart (In press), Denaro (1972), Heyer (1972), and present study.

derived. State A* = diploid number of 22 and is secondarily derived.

Acrocentric chromosomes: Character state b = acrocentric chromosomes present. This is the primitive state, generally recognized by chromosome workers, although there is no information to support this from the primitive members of the family Leptodactylidae. Character state B = acrocentric chromosomes absent and is derived.

A phylogeny based on these two characters is presented (Fig. 3). Certain comparisons of this phylogeny with previously proposed species groupings (Heyer, 1968) are of interest. As only two characters are used, the clusterings of species at certain steps of the phylogeny are large, particularly for the last. The most advanced cluster contains all of the members of the *ocellatus* (*L. bolivianus, chaquensis, ocellatus*) and *pentadactylus* (*knudseni, pentadactylus, rhodonotus*) species groups examined. All species examined of the *fuscus* group (*L. albilabris, bufonius, fuscus, geminus, gracilis, labialis, mystaceus, mystacinus*) except *L. latinasus* are in this group, and one member of the *melanonotus* group (*L. melanonotus*) is also represented in the most advanced group. The rest of the *melanonotus* group members (*"natalensis," podicipinus, wagneri*) are in an ancestral grouping. This generally corresponds to the scheme previously proposed (Heyer, 1969), in which the *melanonotus* species group is among the most primitive species groups in the genus. The two exceptions to this agreement of phylogenetic schemes are *L. melanonotus* and *L. latinasus*. In the case of *L. melanonotus*, the advanced state of the karyotype may indicate that *L. melanonotus* has diverged from *podicipinus* and *wagneri* to a greater degree than expected on the basis of standard morphological analysis. This explanation makes biogeographic sense as *L. melanonotus* has a Middle American distribution pattern, while *podicipinus* and *wagneri* are South American species.

We think that the karyotype evidence gives greater insight to the relationships among the species of the *melanonotus* group, but that the karyotypes should not be emphasized more than standard morphological evidence. For example, *L. melanonotus* should not be removed from its group members *podicipinus* and *wagneri* because it has a more derived karyotype. We are also hesitant in recognizing species within the *melanonotus* group based only on karyotypic evidence. Bogart (In press) and Denaro (1972) found different numbers of acrocentric chromosome pairs in the two geographic samples of *L. podicipinus* they examined. We prefer to give a conservative explanation to this karyotypic variation and consider the two karyotypes to represent the same species. Similarly, until more evidence is gathered, we prefer to consider the karyotype Bogart (In press) reported as *"natalensis"* to be a geographic variant of *wagneri*, differing in acrocentric number. Because *L. podicipinus* and *wagneri* show geographic differences in the number of acrocentrics, both species would appear to be ideal systems for detailed population study by the use of karyotypes to determine evolutionary patterns within the species, as has been successfully used in some species of small mammals (e.g. Patton, 1972) and *Sceloporus* (e.g. Cole, 1972).

Members of the genus *Adenomera* apparently have the most primitive karyotypes of the *Leptodactylus*-complex. The karyotype of *Vanzolinius* is comparable to the more primitive karyotypes of *Leptodactylus* species. Karyotypic information is limited in delineating relationships at the generic level within the *Leptodactylus*-complex.

Bogart (In press), using chromosome morphology based upon centromere position, postulated relationships that crossed many of the species groups lines that were based on other morphological evidence (Heyer, 1968). We think that his analysis is overextended as he is basing homologies on measurements. As Pathak, Hsu, Shirley, and Helm (1973) demonstrated, homologies based on karyotype measurements can be incorrect (in this case banding indicated the errors based on measurements). Atchley (1972) has also demonstrated the pitfalls of predicting relationships from karyotypes when the homologues are not known with certainty. The conservative use of karyotype information as used herein is more consistent with relationships of the taxa based on other data sets.

Bogart (In press) postulated that because *Adenomera* had a primitive karyotype, terrestriality (no free swimming, feeding larva) is primitive within the *Leptodactylus*-complex. We disagree with this hypothesis for two reasons. First, the homologous chromosomes are not known. It may be that the karyotype of members of the genus *Adenomera* is actually derived. Second, there is no reason why a group of frogs cannot retain a primitive karyotype while having a derived life history pattern. The morphological evidence (Heyer, 1969, 1972, 1974) is quite conclusive that terrestriality is a derived condition in the *Leptodactylus*-complex; we see no reason to overthrow this evidence in light of the supposedly primitive karyotypes of *Adenomera* species.

We conclude that until homologous pairs of chromosomes can be determined accurately (banding probably will give this information), 1) the information content of karyotypes in elucidating relationships among *Leptodactylus* species and genera of the *Leptodactylus*-complex is limited, and 2) the karyotype evidence must be interpreted within the framework of other morphological and ecological evidence and can not profitably be used as an entirely independent set of information in elucidating relationships.

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A NEW CUBAN SPECIES OF *SPHAERODACTYLUS* (GEKKONIDAE) OF THE *NIGROPUNCTATUS* COMPLEX

By Albert Schwartz and Orlando H. Garrido
Miami-Dade Community College, Miami, Florida 33167, and Academia de Ciencias de Cuba, Instituto de Zoología, La Habana, Cuba

The *nigropunctatus* complex of the gekkonid genus *Sphaerodactylus* occurs in the Bahama Islands (*S. nigropunctatus* Gray), Hispaniola (*S. stejnegeri* Cochran), and Cuba (*S. nigropunctatus, S. torrei* Barbour, *S. alayoi* Grant, *S. intermedius* Barbour and Ramsden, and *S. ruibali* Grant). The last revision of the group is that of Thomas and Schwartz (1966); they, however, used the name "*decoratus* complex" for this group of species. Later Thomas and Schwartz (in press), after examination of the long-neglected holotype of *S. nigropunctatus*, showed that this name, which has priority over *S. decoratus* Garman, should be applied to the species which formerly was called *S. decoratus* and which occurs in both the Bahamas and Cuba. Thomas and Schwartz (1966:25) also suggested that perhaps *S. cinereus* Wagler should be included within this complex, but neither they nor others have studied that species in detail.

In Cuba, the center of *Sphaerodactylus* diversity is in the eastern portion of the island, in Camagüey and Oriente Provinces. This is true not only for the genus but also for the *nigropunctatus* complex. Of the five Cuban species of this complex, all occur in Oriente, and *ruibali, torrei,* and *alayoi* are restricted to that province. *S. intermedius* has a peculiarly disjunct distribution, occurring in extreme southwestern Oriente Province (vicinity of Cabo Cruz) and in northern Habana and Matanzas Provinces far to the northwest. The systematic status of S. *alayoi* remains in doubt; no further specimens of this taxon have been collected since the Thomas and Schwartz review. Those authors commented that S. *alayoi* was a distinct form, but whether it should be regarded as a separate species or as a subspecies of S. *nigropunctatus* would depend in part upon learning details of distribution of both forms in Oriente.

Gradually, additional material from the southern Oriente coast has reached collections in the Instituto de Zoología, Academia de Ciencias de Cuba. Previously, S. *ruibali* has been known only from the United States Naval Base, both east and west of Bahía de Guantánamo. More recent specimens taken by the junior author and Jorge de la Cruz have extended the range of this species to the east as far as Baitiquirí (two specimens) and Loma de Macambo between Imías and San Antonio del Sur (one specimen). These newly collected specimens agree in most details with long series of topotypes from the east side of Bahía de Guantánamo on the United States Naval Base; but specimens, taken primarily by Peter J. Tolson, from the west side of Bahía de Guantánamo differ in several respects from topotypical material and likely represent a new subspecies of S. *ruibali.*

A series of six specimens of *Sphaerodactylus* was taken by Luis de Armas in 1973 at Cabo Maisí, Cuba's extreme eastern point. This locality is about 60 kilometers northeast of the nearest locality for any other member of the *nigropunctatus* complex (*ruibali,* at Loma de Macambo). At first, we considered that this series of geckos was a well marked subspecies of S. *ruibali.* Further comparisons, however, suggest that they are more closely related to S. *intermedius* but are separated from the nearest locality for that species (Río Puerco) not only by about 330 kilometers but also by the intervening distributions of S. *torrei,* S. *alayoi,* S. *nigropunctatus,* and S. *ruibali.* Although we are reluctant to add still another named population to this complex of geckos on the southern Oriente coast, the Cabo Maisí specimens are so distinctive that we cannot associate them nomenclaturally with any other named species. To complicate matters even further, the Oriente specimens of S. *intermedius* number only two and are old and faded;

additionally, they may not be identical with the Habana-Matanzas segment of the species (the type-locality of *S. intermedius*). Since much of this xeric coastal area of Oriente is still difficult of access, remote from most populous areas, and collecting there is difficult, we feel justified in naming the Cabo Maisí series as a distinct species, despite the presently insoluble uncertainties involved with *Sphaerodactylus* from this entire area. Accordingly, we name the Cabo Maisí lizards in honor of Sr. de Armas who collected the type-series.

Sphaerodactylus armasi, new species

Holotype: Instituto de Zoología (IZ), Academia de Ciencias de Cuba, 4089, an adult female, from Cabo Maisí, Baracoa, Oriente Province, Cuba, taken 6 October 1973 by Luis de Armas.

Paratypes: IZ 4093-94, ASFS (Albert Schwartz Field Series) V28442–43, and NMC (National Museum of Canada) 15849, same data as holotype.

Definition: A moderate size species of *Sphaerodactylus* (males to 26 mm, females to 30 mm snout-vent length), characterized by the combination of: a short blunt snout; dorsal scales small and granular, 45 to 60 between axilla and groin; ventral scales smooth and imbricate, 31 to 41 between axilla and groin; 74 to 89 scales around body at midbody; usually 4 enlarged supralabials to eye center; 1 internasal scale. Head pattern in females diffuse grays and white without a distinct pattern (even in female-patterned juveniles) except for a dark gray to black postocular line and a dark loreal line which in fully adult females may expand to give a solid dark loreal region; dorsum strongly crossbanded pale and dark, with five pale (whitish in preserved specimens) crossbands, at times composed of transverse series of isolated pale elongate dots, bordered by black bands on either side, the most anterior black bands and their included pale band forming a collar immediately posterior to the ear opening; a pair of large pale ocelli on the base of the tail, followed by two additional tail bands of two fused ocelli (no tail is complete). Males dull grayish brown dorsally, more or less vaguely spotted with dark gray, the upper surface of the head at times with scattered black irregular spots, extending onto the lores and snout, and onto the sides of the throat.

Variation: The series of *S. armasi* consists of three adult females, two adult males, and one juvenile. The largest male (ASFS V28443) has a snout-vent length of 26 mm, the largest female (ASFS V28442) 30 mm, and the juvenile 20 mm. Dorsals between axilla and groin are 45 to 60, ventrals between axilla and groin 31 to 41, scales around body at midbody 74 to 89, fourth toe lamellae 7 to 11, almost always 4 enlarged supralabials to eye center (one specimen with 3 enlarged supralabials bilaterally), internasal scale usually 1 (one specimen with 2), escutcheon in two males 3 to 10 × 6 to 15. All ventral scales smooth, including gular and pectoral scales; dorsal scales small and granular, showing very slight keeling dorsolaterally.

The two males are generally undistinguished. The dorsal color (as preserved) is dark tan to grayish, with vague to moderately prominent dark blotches densely appressed and almost lepoard-like. One male (IZ 4093) has the upper surface of the head heavily marked with black spots, these extending laterally and ventrally onto the sides of the throat, whereas the other male has the head and throat unmarked. The heavily spotted male also has a tiny pair of pale ocelli, outlined with dark gray, on the neck, and both males have a pair of almost-fused postsacral ocelli, the tails showing vague further indications of more distal transverse bands.

The three females and the female-patterned juvenile are very distinctive. Basically, the pattern consists of a series of five pale transverse bands, at times showing their origin from a series of elongate (anterior to posterior) pale spots which fuse with each other laterally to give a continuous pale band. Each pale band is bordered both anteriorly and posteriorly by dark gray to black edging, which may be irregular or scalloped due to the nature of the pale crossbands (*i.e.*, that they represent fused rows of pale spots). Of the five pale bands, one is nuchal, one is more or less scapular, and three are on the body. The anterior dark border of the first pale band lies just behind the auricular opening. There is a prominent pair of large pale, but dark-bordered, ocelli postsacrally, and the unregenerated portions of the tails likewise have at least two prominent irregular pale crossbands which represent pairs of fuse docelli. The juvenile is like the females in dorsal pattern, but the pale transverse body bands are less prominent than in adults. The head in females is mottled with shades of gray and white dorsally and has no clear-cut pattern except for the presence of a dark postocular line, and in the juvenile a dark loreal line. The latter line, in adult females, is so expanded that the entire loreal region is black. The holotype has some large pale areas on the temporal region, and the dark postocular line is much obscured. The venter (including the chin and throat) are immaculate, but there may be some uniform dark stippling (ASFS V28442) on the throat.

Comparison: S. *armasi* requires comparsion primarily with S. *ruibali*, that species of the complex which is closest geographically. In S. *ruibali*, dorsals between axilla and groin are 42 to 60, ventrals between axilla and groin 30 to 43, scales around midbody 69 to 80, fourth toe lamellae 6 to 12, supralabials to eye center usually 4 (occasionally 3 or 5), 1 internasal, and escutcheon 5 to 10 × 19 to 28. None of these counts is strikingly different between the two species; however, S. *armasi* has a higher number of scales around the body at midbody (74 to 89) than does S. *ruibali* (69 to 80); there is, however, considerable overlap.

It is in pattern that S. *armasi* differs most strongly from topotypical and eastern S. *ruibali*. In the S. *ruibali* populations east of Bahía de Guantánamo, males are finely stippled dorsally and lack any sort of head pattern; there is no tendency for these males to have spotting on the body. In females from the same region, there is a nuchal pattern of three fine dark transverse bands not including a pale ocellar band, and occasionally there is a fourth dark band across the back at the axilla. The female head pattern in S. *ruibali* consists of a clearly delineated dark canthal line which continues as a distinct postocular line; the loreal region is never generally black. The top of the head is vaguely patterned with pale dots or merely variegated smudges of grays. Both sexes of S. *ruibali* are shown in Thomas and Schwartz, 1966, fig. 19. In addition, S. *ruibali* lack ocellate tails, although there may be (rarely) a pair of faint ocelli in the sacral region in males.

Referring to Thomas and Schwartz, 1966, fig. 18, which shows two female S. *intermedius* from northern Habana and Matanzas Provinces, one can see the similarities between that species and S. *armasi*. The dorsal pattern in the Habana specimen shows a diagrammatically transversely banded lizard, with five pale crossbands (which do not show indications of a fused ocellar origin) and with distinct and sharp-edged black borders; there is a postsacral pair of ocelli. The Matanzas specimen illustrated shows the same sort of pattern but only the axillary pale band is clearly shown. However, the head pattern of S. *intermedius* is sharply delineated, and consists mainly of a complete or incomplete black U-shaped figure, along with additional dark cephalic lines including a loreal and a postocular line. As far as scale counts are concerned, S. *intermedius* has 49 to 62 dorsals between axilla and groin, 31 to 44 ventrals between axilla and groin, 65 to 77 scales around midbody, internasals usually 1 (0 to 2), and enlarged supralabials 4 (mode) or 5. S. *armasi* is comparable in scale counts to S. *intermedius*, but the midbody counts are higher in S. *armasi* (74 to 89) than in S. *intermedius* (65 to 77) with less overlap than between S. *armasi* and S. *ruibali*. In addition, S. *intermedius* reaches a greater snout-vent length (35 mm) than does S. *armasi*. It should be recalled that the major portion of the known distribution of S. *intermedius* lies far to the northwest along the northern coast of Habana and Matanzas Provinces, but that there are two old and faded specimens from the Cabo Cruz region which Thomas and Schwartz assigned to S. *intermedius*.

The three other species of the *nigropunctatus* complex which occur in southern Oriente Province are S. *nigropunctatus*, S. *alayoi*, and S. *torrei*. Females of all these species are vividly crossbanded and also have distinct dark head patterns, a feature which is absent in S. *armasi*. All species are quite comparable in scale counts; for instance, all (including S. *armasi*) regularly have 1 internasal scale and 4 enlarged supralabials to eye center as the modal conditions. Dorsal scales are less in S. *t. torrei* (45 to 49), the subspecies closest geographically to

S. *armasi*, and these two species are distinguishable by this feature as well as in details of pattern. S. *alayoi* (whose status as a distinct species remains questionable) differs from S. *armasi* in its vividly marked crossbanded dorsum (three dark but uniformly hollowed crossbands), head pattern, and slightly larger size (32 mm in S. *alayoi*). From S. *n. strategus* (the subspecies of S. *nigropunctatus* closest geographically to S. *armasi*), S. *armasi* differes in smaller size (S. *n. strategus* to 40 mm snout-vent length), quite different dorsal and head patterns in females, and lesser number of dorsal scales between axilla and groin (45 to 60 versus 50 to 67). In addition, none of the species with which S. *armasi* might be confused locally is distinctly short-snouted; this is especially true of S. *ruibali*, which is a long-headed and attenuate-snouted species.

Remarks: Very much yet remains to be learned concerning the distributions and variation of the southern Oriente *Sphaerodactylus*. In those species about which we have some ecological information, S. *torrei* and S. *nigropunctatus* are mesophilic or at least inhabitants of shaded situations. S. *ruibali* on the other hand inhabits open and more xeric areas. S. *intermedius* (along its northern Habana-Matanzas distribution) likewise is mesophilic and most closely associated with rock rubble; it appears to some extent to be saxicolous. The series of S. *armasi* was secured in xeric situations associated with a species of *Agave*. Also secured syntopically with S. *armasi* was S. *notatus atactus* Schwartz; this species is tolerant of a wide variety of ecological situations, from semi-mesic coastal woods to open and exposed beaches. S. *notatus* is widespread in Cuba (where it is less common in the western and central portions of the island), Isla de Pinos, throughout many of the Bahama Islands, and the Swan Islands; it also occurs on the continental mainland in extreme southeastern Florida and the Florida Keys. Its broad geographical distribution is due at least in part to its ecologcial tolerances in contrast to other species of *Sphaerodactylus* which are often more rigidly restricted ecologically.

One further comment is pertinent. Specimens of S. *ruibali* from west of Bahía de Guantánamo (an area where the species has not previously been recorded) show strong differences in dorsal and cephalic pattern from specimens taken east of the bay. It is likely that these S. *ruibali* are subspecifically different from their eastern relatives. However, they do not approach S. *armasi* in complexity of dorsal pattern and are typically long-snouted S. *ruibali*. They show no trends toward the very few Cabo Cruz S. *intermedius*, and indeed the hiatus between the two species in this area is about 220 kilometers. Thomas and Schwartz (1966:24) suggested that S. *ruibali* and S. *intermedius* are related (S. *armasi* seems to be close to this species-pair), but there is as yet no unequivocal evidence that S. *ruibali* should be regarded as a subspecies of S. *intermedius*. Certainly, the southern Oriente coast of Cuba and its adjacent lower montane slopes well merit intensive collecting for the *nigropunctatus* complex of *Sphaerodactylus*.

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A NEW POLYDESMID MILLIPED FROM THE SOUTHERN APPALACHIANS, WITH REMARKS ON THE STATUS OF *DIXIDESMUS* AND A PROPOSED TERMINOLOGY FOR POLYDESMID GONOPODS

By Richard L. Hoffman
Radford College, Radford, Virginia 24141

The diplopod generic name *Dixidesmus*, presently comprehending some eleven named taxa endemic to eastern United States, was established by R. V. Chamberlin in 1943. The genus was defined as being very similar to *Pseudopolydesmus* in gonopod structure, ". . . but differing in having a spine or spine-like process in the angle above the papillose cushion and in having on outer side, at or distad of the level of the cushion, a retrorse tooth or barb with a spur on or near its base, the latter rarely abortive or absent." *Dixidesmus* has subsequently come into general use by American diplopodologists despite its foundation upon a single character (the second cited by Chamberlin admitted to be variable).

Since 1951 I have had material of an undescribed species which completely negates the supposed difference between the two "genera" mentioned and, in my view, requires the abolition of *Dixidesmus*. Publication of this species has been repeatedly deferred in the hope it might be included in a revision of the American forms, but as the completion of that revision still seems remote, I wish to place the new taxon on record in order to justify combination of *Dixidesmus* with *Pseudopolydesmus* in a general classification of Diplopoda now in preparation.

Genus *Pseudopolydesmus* Attems

Polydesmus (nec Latreille 1802) American authors prior to 1943.
Pseudopolydesmus Attens, 1898, Denk. Akad., Wien, 67: 270, 479.—

Brolemann, 1916, Ann. soc. ent. France, 84: 569.—Verhoeff, 1931, Zool. Anz., 94: 305.—Attems, 1940, Tierreich, 70: 139.—Carl, 1941, Zool. Anz. 133: 291.—Chamberlin, 1943, Bull. Univ. Utah, biol. ser., 8(2): 17. Type species, *Polydesmus canadensis* Newport, 1844 (? = *serratus* Say, 1821).

Dixidesmus Chamberlin, 1943, Bull. Univ. Utah, biol, ser., 8(2): 18.—Chamberlin & Hoffman, 1958, U. S. Nat. Mus. Bull. 212:65. Type species, *Dixidesmus tallulanus* Chamberlin, by original designation. [New synonymy.]

Diagnosis: Gonopod large, falcate in general shape, with prominent endomerite subtended by small dentiform process (*m 1*) on median side; prostatic groove running distad from median to lateral side, debouching not into a small fossa within endomerite but into a deeply invaginated groove ("*Samenslauch*," Carl) which extends proximad to base of femoral region, and is then reflexed distad to open on distad side of endomerite. Apex of telopodite with a linear series of flattened setae, and, usually, a small cluster of spiniform setae from base of distalmost process on the median side (*m 4*).

Species: Approximately ten, all endemic to North America east of the Great Plains, concentrations of species in the southern Appalachians and in the Ozark region.

Remarks: The combination of the names *Dixidesmus* and *Pseudopolydesmus* is suggested here because of the discovery of a species which in some ways resembles "*D.*" *branneri* (e.g. fusion of lateral telopodite processes *e 2* and *e 3*) but which has the proximal lateral process (*e 1*) reduced to a small point or in many specimens, absent entirely. As this process was the criterion upon which *Dixidesmus* rested, and as the examination of numerous species of American polydesmids has revealed no other basis for making generic distinctions, there seems no justification for continued recognition of *Dixidesmus*.

This merger will bring the following names into combination with *Pseudopolydesmus* for the first time: *branneri* Bollman, 1887; *catskillus* Chamberlin, 1947; *christianus* Chamberlin, 1946; *echinogon* Chamberlin, 1942; *erasus* Loomis, 1943; *gausodicrorhachus* Johnson, 1954; *humilidens* Chamberlin, 1943; *nitidus* Bollman, 1887; *penicillus* Chamberlin, 1943; *phanus* Chamberlin, 1951; *sylvicolens* Chamberlin, 1943; and *tallulanus* Chamberlin, 1943. The great majority of these names are either subspecific in rank or are strict synonyms, and will be accounted in a forthcoming paper. Bibliographic reference to all of these names is to be found in the "Checklist of the Millipeds of North America" (Chamberlin & Hoffman, 1958).

Pseudopolydesmus collinus, new species

Figures 1, 2

Diagnosis: A medium-sized species of the genus (length to 23 mm), with the following diagnostic gonopod characters: process *m 1*, *m 2*, and *m 4* present; *e 1* vestigial, sometimes wanting; *e 2* and *e 3* basally fused and stipate; *e 4* present.

Type-material: Male holotype, ♂ and ♀ topoparatypes from "Pinnacles of Dan," ± 4 miles southwest of Vesta, Patrick County, Virginia; 22 April 1972, R. L. Hoffman & L. S. Knight, leg. (Hoffman collection).

Holotype: Adult male, 22.0 mm in length, 3.8 mm in maximum width, W/L ratio 17.3%. Segmental widths across paranota as follows:

Segment 1–2.3 mm
2–2.6
4–3.2
6–3.8
8–3.8

Segment 10–3.7 mm
12–3.5
14–3.4
16–3.2
18–2.0

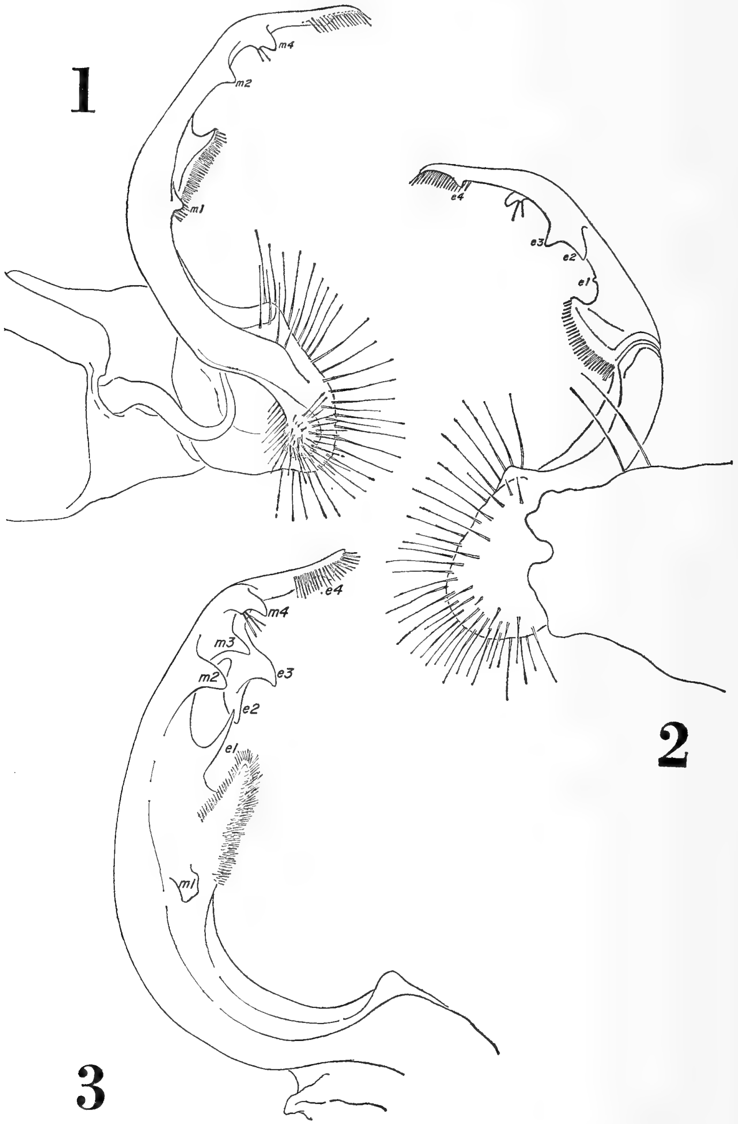
Color in life dorsally uniform light brown, legs and sterna lighter, no suffusion of reddish pigmentation on paranota.

Segmental sculpture typical for the family. Most metaterga with three transverse series of convex areas middorsally: a large area occupying the anterior half of the tergum between stricture and transverse sulcus, four smaller pentagonal areas immediately behind the sulcus, and six smaller areas along the posterior edge of the segment. On the posteriormost segments these latter areas project slightly caudad, producing a subserrate edge between the paranota. Latter moderately broad, the anterior and lateral edges forming a continuous curvature with four minute lateral denticles; peritreme broad, convex, the pore small and located in a dorsolateral depression behind middle of peritrematic length. Dorsum of paranota with an almost circular prominent convexity.

Sterna bicruciately impressed, each quadrant moderately setose; sterna between legs 3, 4, 5, 6, 9, 11, and 13 produced into two prominent conical paramedian lobes, the lobes anterior to gonopods profusely setose; sterna between legs 7 and 10 produced into subhemispherical subcoxal swellings a little further apart than the other lobes. Prefemora and femora of most legs somewhat enlarged, ventral sides of tibiae and tarsi with a row of moderate-sized sphaerotrichomes, preceded on the anterior side by a series of much smaller but similar setae.

Coxae of gonopods large, mostly exserted, directed caudal parallel to each other and to median axis of body, with the usual concavity on the ventral side for retraction of telopodites, lateral ventral edge with two macrosetae. Telopodite of normal polydesmid form, arcuate caudally, the prefemur densely setose but without processes, acropodite slender, with a terminal series of macrosetae and endomerite at midlength, medial side with three marginal processes (*m 3* apparently absent) and lateral with four (*e 1* vestigial or absent, *e 2* and *e 3* fused and carried on a common stalk, *e 4* of normal form and position, see Figs 1 and 2).

Remarks: An account of female genitalia is deferred for the planned revision of the genus. Externally the female is similar to the male in size, color, and peripheral characteristics.



FIGS. 1–2. *Pseudopolydesmus collinus,* n. sp.: 1, left gonopod of male topoparatype, mesal aspect; 2, the same gonopod, lateral aspect.

FIG. 3. *Pseudopolydesmus branneri* (Bollman): left gonopod of specimen from Roan Mountain, Tennessee, slightly oblique caudo-mesal aspect, to show complete series of telopodite processes.

This species has been taken in association with both *Pseudopolydesmus serratus* and *P. branneri* in western Virginia, as well as in biotopes in which those two species were absent. *P. collinus* is easy to recognize in the field, being about 3–5 mm shorter than *serratus* which it otherwise resembles, and 2–4 mm smaller than *branneri* which is characterized by having a black middorsum and reddish paranota. No observations suggest any difference in the phenology of the three, nor, overtly, in habitat preferences.

The specific name reflects the fact that although the species occurs in the southern Appalachians it clearly prefers moderate elevations and has not been found so far above 3600 ft.

Distribution: The species is known to me from the following counties (detailed citations deferred for a later account): Kentucky: Carter Co.; West Virginia: McDowell Co.; Virginia: Alleghany, Floyd, Franklin, Henry, Montgomery, Patrick, and Pittsylvania counties. It seems to be most abundant in central southwestern Virginia on and just east of the Blue Ridge, but occurs on river bluffs well out into the Piedmont, and extends westward to easternmost Kentucky.

GONOPOD TERMINOLOGY

The characterization of polydesmid gonopods has long been impeded by the lack of standardized names for the various spines, branches, or processes which adorn the posterior face of the telopodite. Although some names have been used for European species, they are usually vernacular in origin and often not easily translatable, in any case often long and cumbersome.

It has long seemed possible to me to devise a somewhat different approach which I venture to present here in a brief outline. First of all, the invention of meaningful names of classical origin is not only difficult but perhaps at the present time a little premature, so that one alternative is to develop a numerical system of designation reflecting the actual location of the processes as well as providing an indication of serial homologies between species.

The telopodite of the gonopod in polydesmids, as seen in a caudal or obliquely caudal aspect (Fig. 3) is fairly broad at its base and gradually tapers to a much thinner distal end, although even there it retains the dimension of breadth, and may be correctly stated to have two distinct sides: *ectal* and *mesal.* Except for the large setiferous endomerite, which occupies a median position on the gonopod, the various smaller processes all originate on one side or the other and this fact provides an initial dichotomy in their classification: a given process is either mesal or ectal in its place on the telopodite and may be indicated by the prefix *m* or *e*.

Arbitrarily taking as a standard that species which is most complex in terms of number of processes, such as *P. branneri,* we can apply a numerical designation to those on each side starting with the most proximal. On each side there appear to be no more than four processes, although in some forms one or more may be suppressed, or two may be coalesced and carried by a common pedicle. Thus, in *P. branneri*, the processes on the mesal side are *m 1*, *m 2*, *m 3*, and *m 4*, on the ectal side *e 1*, *e 2+3*, and *e 4*, by which it is indicated that 2 and 3 are joined at the base. In the American species, process *m 1* is generally present near the base of the endomerite, and *e 4* is usually present beside the terminal row of setae. *M 4* usually carries several setae at its base and is easy to recognize as a result. The greatest variation thus appears to occur with processes 2 and 3 on each side.

Using the above terminology, the original generic diagnosis for *Dixidesmus* quoted above could be rewritten as follows: "Gonopod with process *e 1* present, spiniform or acicular; process *e 2* present, usually with a smaller *e 3* at its base."

It is generally necessary to examine a gonopod from both sides, as frequently it is impossible to see all of the processes due to concealment of a small process by juxtaposition of a larger one; this is shown very clearly in Figs. 1 and 2.

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PELAGIC OSTRACODS COLLECTED ON HUDSON 70 BETWEEN THE EQUATOR AND 55°S IN THE ATLANTIC

By Georgiana B. Deevey
Florida State Museum, University of Florida,
Gainesville, Florida 32611

Zooplankton samples were collected in the South Atlantic on the first two legs of the CSS HUDSON 70 Expedition. Between the equator and 55°S, samples were obtained routinely along the 30°W Longitude parallel (Fig. 1). The first leg of the expedition left Halifax in mid-November 1969 and arrived at Rio de Janeiro in mid-December. The second leg left Rio on December 20th, proceeded down the 30°W Longitude parallel to 55°S, then passed northeast of South Georgia and up the 40°W Longitude parallel to 47°S, crossed the Argentine Basin to the Rio Plata and arrived in Buenos Aires in mid-January, 1970. Between the equator and 25°S, zooplankton samples were collected for the micropaleontology program by vertical tows, 200–0 m, with a ½ meter net of No. 8 mesh. South of 27°30′S, hauls were made with ¾ m nets of No. 6 mesh to varying depths with up to 4,000 m of cable out, and the 200–0 m vertical tows were also obtained.

Some 70 species of pelagic ostracods were recorded, of which two belong to the family Cypridinidae and the rest to the family Halocyprididae. Since many species of ostracods are bathypelagic, only 33 species were found in the 200–0 m tows collected between the equator and 25°S. Eight species (*Conchoecia acuminata, C. allotherium, C. atlantica, C. concentrica, C. echinata, C. inermis, C. incisa* and *C. stigmatica*) were not noted south of 16°S. Six more species (*C. ctenophora, C. echinulata, C. microprocera, C. macrocheira, C. parthenoda*

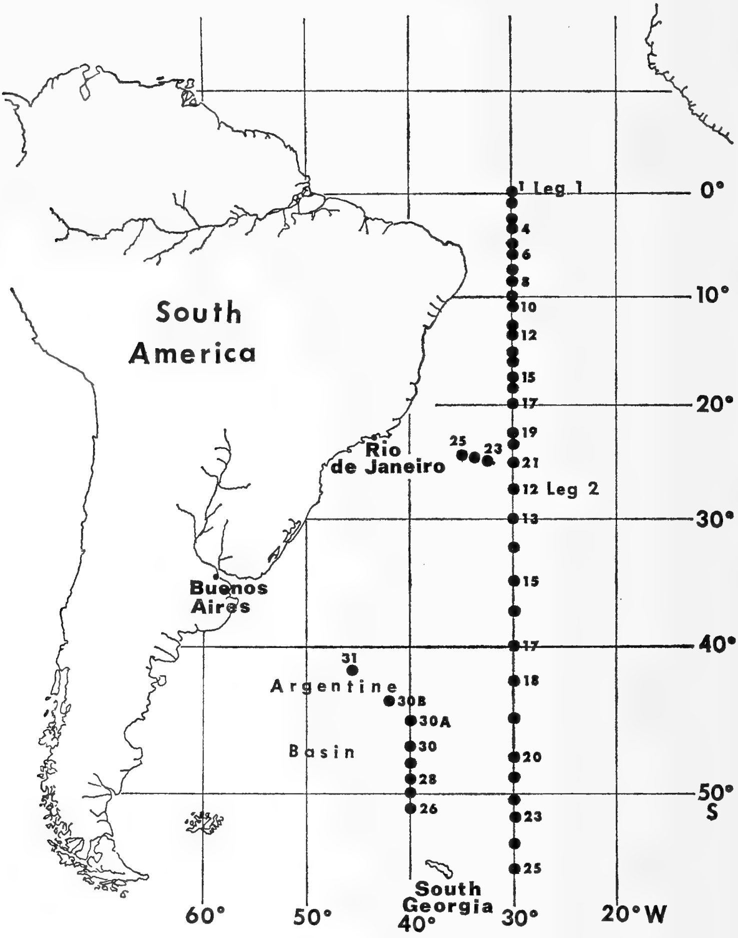

FIG. 1. Map of zooplankton station locations for Legs 1 and 2 of HUDSON 70.

and *C. pseudoparthenoda*) did not occur south of 30°S. Between 30°S and 40°S, 42 species were recorded, half of which were not noted south of the subtropical convergence. Between the subtropical and subantartic convergences, around 42°S–49°S, 27 species were present in the samples, although 9 of these were not found south of 45°S. South of the subantarctic convergence 18 species occurred between 50°S and 55°S. Two

TABLE 1. Station data, Leg 1, Halifax to Rio de Janeiro. 200–0 m vertical tows.

Station	Date	Latitude	Longitude	Time of day	No. species
1	XI/30/69	0°02′N	29°58.3′W	10.40 AM	12
2	XI/30	0°51′S	30°W	9.00 PM	21
3	XII/1	2°29′S	30°W	10.20 AM	18
4	XII/1	3°32′S	30°07′W	10.00 PM	16
5	XII/2	4°55′S	30°W	10.20 AM	16
6	XII/2	6°04′S	30°W	10.15 PM	18
7	XII/3	7°27′S	30°03′W	10.20 AM	14
8	XII/3	8°30.8′S	30°W	10.20 PM	14
9	XII/4	9°59′S	30°W	10.30 AM	11
10	XII/4	10°59′S	29°59′W	10.00 PM	16
11	XII/5	12°26′S	30°07′W	10.00 AM	10
12	XII/5	13°29′S	30°W	10.30 PM	16
13	XII/6	14°55′S	30°07′W	10.30 AM	7
14	XII/6	15°47′S	29°59′W	10.15 PM	13
15	XII/7	17°32′S	30°W	1.30 PM	8
16	XII/7	18°19.5′S	30°04′W	10.50 PM	11
17	XII/8	20°S	30°W	8.15 AM	10
18	XII/8	20°02.6′S	30°31.3′W	Midnight	17
19	XII/9	22°30.2′S	29°58′W	2.15 PM	9
20	XII/9	23°21′S	29°55′W	9.45 PM	19
21	XII/10	25°S	30°W	8.30 AM	14
22	XII/10	24°52.5′S	30°08′W	8.15 PM	15
23	XII/11	24°37′S	32°30.6′W	8.15 AM	12
24	XII/11	24°17.3′S	32°44′W	9.00 PM	16
25	XII/12	24°13.4′S	35°W	7.15 AM	15

species, *C. isocheira* and *C. belgicae,* were found only south of the subantarctic convergence. The total number of species recorded therefore decreased markedly between the subtropical and subantarctic convergences. HUDSON 70 specimens extend the southward ranges in the Atlantic for 27 species, some by only a few degrees. The northward range was extended for two species, *C. belgicae* and *C. major* (= *C. plactolycos major*). *C. plactolycos* (= *C. plactolycos plactolycos*), described from the Indian Ocean, is now known from the Atlantic. A few species, such as *C. elegans* and *C. skogsbergi,* increased in size farther south. Larger forms began

TABLE 2. Station data, Leg 2, Rio de Janeiro to Buenos Aires.

Station	Date	Latitude	Longitude	Total M of cable	No. species
12	XII/23/69	27°31.6′S	30°07′W	450	18
13	XII/24	30°00′S	29°59′W	1400	32
14	XII/25	30°25.05′S	30°10.5′W	1500	30
15	XII/26	35°00′S	30°04.7′W	1800	36
16	XII/27	37°28′S	29°59.2′W	2500	30
17	XII/28	39°55′S	29°53′W	2500	30
18	XII/29	42°30′S	29°57.5′W	2500	24
19	XII/30	45°07.3′S	29°59′W	2500	15
20	XII/31	47°35′S	29°53.4′W	2500	9
21	I/1/70	49°03.4′S	29°48.7′W	2500	14
22	I/2	50°33.3′S	29°35.4′W	2500	12
23	I/3	52°04′S	30°04′W	2500	7
24	I/4	53°27′S	29°59.5′W	2500	6
25	I/5	54°55′S	29°23′W	2500	11
26	I/8	51°28′S	39°57′W	3000	14
27	I/8	49°59′S	39°58′W	1000	9
28	I/9	48°59′S	39°52.4′W	500	6
29	I/10	47°59′S	39°59.6′W	400	7
30	I/10	47°03′S	40°04.6′W	3000	13
30A	I/11	45°10.6′S	41°10.8′W	4000	16
30B	I/12	44°12.4′S	42°46′W	4000	25
31	I/13	41°46.5′S	46°26.4′W	2500	31

to appear in the region of the subtropical convergence, but the increase in size was gradual; two distinct size ranges for a species were not noted.

The station data for Legs 1 and 2 are given in Tables 1 and 2. Table 2 shows the decrease in numbers of species/station south of the subtropical convergence, and the increase in numbers of species as the ship proceeded north over the Argentine Basin. Table 3 lists the species of ostracods, together with the stations from which they were recorded and their overall latitudinal distribution. All specimens have been deposited in the Florida State Museum.

I am indebted to Gordon Riley, Director of the Institute of Oceanography at Dalhousie University, for arranging for my travel between Halifax and South America, to C. R. Mann

TABLE 3. The species of ostracods, their station records and latitudinal distribution.

Species	Stations	Latitudinal distribution
Gigantocypris mülleri	Leg 2: 16, 18, 19, 22, 24, 30A	37°28′S–53°27′S
Macrocypridina castanea	Leg 2: 13, 15	30°S–35°S
Fellia cornuta dispar	Leg 2: 13–19, 30B	30°S–45°S
Halocypria globosa	Leg 1: 18, 20–25; Leg 2: 12–16, 18, 30A, 31	20°S–45°S
Halocypris brevirostris	Leg 1: 2–25; Leg 2: 12–19, 21, 31	0°–49°S
Archiconchoecia cucullata	Leg 2: 13–17, 22, 30B	30°S–50°33′S
A. striata	Leg 1: 2–4, 6–8, 10–25; Leg 2: 12–16, 31	0°–41°45′S
Conchoecia acuminata	Leg 1: 3–6	2°26′S–6°S
C. acuticosta	Leg 2: 14–19, 30B, 31	32°25′S–45°S
C. aequiseta	Leg 2: 13–16, 31	30°S–42°S
C. allotherium	Leg 1: 2–14	0°′51′S–15°42′S
C. amblypostha	Leg 2: 13–17, 30, 31	30°S–47°S
C. ametra	Leg 2: 13–17, 30B, 31	30°S–44°S
C. atlantica	Leg 1: 2, 3, 5–7	0°51′S–7°27′S
C. belgicae	Leg 2: 25, 26	51°28′S–55°S
C. bispinosa	Leg 1: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 25; Leg 2: 12–17, 31	0°–42°S
C. borealis antipoda	Leg 2: 15, 17–28, 30–31	35°S–55°S
C. brachyaskos	Leg 2: 16–18, 21–23, 25–27, 30A–31	37°28′S–55°S
C. chuni	Leg 2: 14–22, 25, 27–31	32°25′S–55°S
C. concentrica	Leg 1: 2	0°51′S
C. ctenophora	Leg 2: 13	30°S
C. curta	Leg 1: 1–12, 14, 16–18, 20, 21, 23–25; Leg 2: 12–15	0°–35°S

TABLE 3. Continued.

Species	Stations	Latitudinal distribution
C. daphnoides	Leg 1: 5, 20; Leg 2: 12–17, 31	5°S–42°S
C. dichotoma	Leg 2: 18	42°30′S
C. echinata	Leg 1: 1–6, 10, 18	0°–20°S
C. echinulata	Leg 1: 10, 14, 20, 22, 24, 25; Leg 2: 12, 13	11°S–30°S
C. edentata	Leg 1: 20; Leg 2: 17, 18, 25	23°19′S–55°S
C. elegans	Leg 1: 1–9, 15, 17, 20–25; Leg 2: 13–23, 25–31	0°–55°S
C. gaussae	Leg 2: 14, 26	32°25′S–51°28′S
C. glandulosa	Leg 2: 30B	44°S
C. haddoni	Leg 2: 15–19, 21, 26, 30–31	35°S–51°28′S
C. hettacra	Leg 2: 21–30B	49°S–55°S
C. hirsuta	Leg 2: 15, 30B, 31	35°S–44°S
C. hyalophyllum	Leg 1: 6; Leg 2: 12–18, 31	6°S–42°30′S
C. imbricata	Leg 1: 16, 24; Leg 2: 12–17	18°S–40°S
C. incisa	Leg 1: 4	3°40′S
C. inermis	Leg 1: 12	13°30′S
C. isocheira	Leg 2: 21, 22, 24–26	49°S–55°S
C. kyrtophora	Leg 2: 17	40°S
C. lophura	Leg 2: 13–17, 19, 30B, 31	30°S–45°S
C. loricata loricata	Leg 2: 15	35°S
C. macrocheira	Leg 1: 2; Leg 2: 12	0°–27°32′S
C. macromma	Leg 2: 30B	44°S
C. magna	Leg 1: 1–14, 16–18, 20–25; Leg 2: 12–18, 31	0°–42°S
C. major (= *C. plactolycos major*)	Leg 2: 21, 23–26, 30, 30B	44°S–55°S

Table 3. Continued.

Species	Stations	Latitudinal distribution
C. mamillata	Leg 2: 13–16, 30B, 31	30°S–44°S
C. microprocera	Leg 1: 2, 3, 9, 10, 12, 15, 17, 18, 20–25	0°–25°S
C. nasotuberculata	Leg 1: 2–4, 6, 8, 10, 14, 24; Leg 2: 13, 14, 17, 18, 31	0°–42°30′S
C. oblonga	Leg 1: 1–14, 16–25; Leg 2: 12–16, 31	0°–42°S
C. obtusata antarctica	Leg 2: 7–22, 26–31	40°S–51°28′S
C. parthenoda	Leg 1: 1–3, 9–15, 17, 19–25; Leg 2: 12, 13	0°–30°S
C. parvidentata	Leg 2: 15–20, 29–31	35°S–48°S
C. plactolycos	Leg 2: 30B, 31	42°S–44°S
C. plinthina	Leg 2: 18	42°30′S
C. porrecta	Leg 1: 1–6, 8, 10–25; Leg 2: 12, 13, 15, 16	0°–37°28′S
C. procera	Leg 1: 1–14, 16, 18–25; Leg 2: 12–15, 17	0°–40°S
C. pseudoparthenoda	Leg : 1–3, 5–7, 10; Leg 2: 12, 13	0°–30°S
C. rotundata	Leg 1: 2–9, 12, 15, 17–25; Leg 2: 12–15	0°–35°S
C. secernenda	Leg 1: 8, 12; Leg 2: 12	8°31′S–27°30′S
C. serrulata	Leg 2: 17–22, 26–31	40°S–51°30′S
C. skogsbergi	Leg 2: 13–27, 30–31	30°S–55°S
C. spinifera	Leg 1: 2, 12, 18, 20, 22; Leg 2: 13–17, 31	0°–42°S
C. spinirostris	Leg 1: 1–25; Leg 2: 12–17, 31	0°–42°S
C. stigmatica	Leg 1: 1, 3, 5, 7–9	0°–10°S
C. subarcuata	Leg 1: 8, 10, 12, 14, 18, 25; Leg 2: 13–16	8°31′S–37°28′S
C. symmetrica	Leg 2: 15–23, 25–27, 30–31	35°S–55°S
C. teretivalvata	Leg 1: 5; Leg 2: 13–21, 29–31	5°S–49°S
C. valdivae	Leg 2: 14, 15, 17, 18, 30A–31	32°25′S–45°S

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THE SPECIES OF OSTRACODS

Suborder CYPRIDINIFORMES Skogsberg

Family Cypridinidae Dana

Gigantocypris muelleri Skogsberg. One gravid female, 19.9 mm long, and 7 juvenile specimens were taken in hauls with 2,500 m of cable out, between 37°30′S and 53°30′S.

Distribution: 63°38′N–62°S in the Atlantic.

Macrocypridina castanea (Brady) s. str. One female 5.9 mm long and a female 6.2 mm long were found at 30°S and 35°S. Poulsen (1962) designated the Indo-Pacific form as *M. castanea rotunda.*

Distribution: 56°N–35°S in the Atlantic.

Suborder HALOCYPRIFORMES Skogsberg

Family Halocyprididae Dana

Subfamily Archiconchoecinae Poulsen

Archiconchoecia cucullata (Brady). A number of specimens were taken in tows with 750–4000 m of cable out, between 30°S and 50°30′S.

Distribution: 52°N–50°30′S in the Atlantic; Indian Ocean. These specimens extend the southward range.

A. striata Müller. This tiny species was common in the 200–0 m hauls taken between the equator and 25°S and was present to 37°30′S, 30°W and at about 42°S in the Argentine Basin; it did not occur south of the subtropical convergence.

Distribution: 36°N–42°S in Atlantic; Indian and Pacific Oceans and Mediterranean. These specimens extend the southward range.

Subfamily Halocyprinae Poulsen

Halocypria globosa Claus. *H. globosa* occurred from 20°S–42°S, 30°W, and in the Argentine Basin between 42°S and 45°S. Females were caught at shallow depths, but males (Fig. 2h) were taken only in samples collected with 750–2500 m of cable out.

Distribution: 64°N–37°S in the Atlantic; Pacific and Indian Oceans. These specimens extend the range south to 45°S.

Halocypris brevirostris (Dana). This species was present in all 200–0 m tows obtained between the equator and 25°S, and was found down to 49°S, extending the southward range in the Atlantic. Between the equator and 32°30′S, adult specimens were 1.15–1.25 mm long. Females up to 1.45 mm long appeared at 35°S; between 37°30′S and 42°30′S females were 1.5–1.6 mm long.

Distribution: 60°N–49°S in the Atlantic; Pacific and Indian Oceans.

Fellia cornuta dispar (Müller). Müller (1906a) described two subspecies of *F. cornuta*, the typical form, *F. cornuta typica* (1906a) = *F. cornuta cornuta* (1912), which has a sharp horn on each side of the shoulder vaults (Fig. 2a), and *F. cornuta dispar* for some southern hemisphere males which lacked these projections and had rounded shoulder vaults. Both Müller and Poulsen (1969a) recorded only males as lacking the sharp horns. Müller's specimens were found south of 29°S in the Atlantic and Indian Oceans, and Poulsen's south of 30°S in the Pacific off New Zealand. The typical horned form has been recorded from around 20°N–38°S in the Atlantic, around the equator in the Indian Ocean and Indo-Pacific regions, and from around 30°N–45°S in the Pacific. Both males and females, lacking the sharp lateral processes, were found between 30°S and 45°S, in hauls with 1100–2500 m of cable out; no typical forms were taken. Juvenile specimens 1.30–1.45 mm long (Fig. 2f) had small lateral points on the shoulder vaults, not as large and curved as in the typical form (Fig. 2a). Specimens 2.0–2.1 mm long had either no points or very tiny points (Fig. 2g). Mature males 2.9–3.1 mm long (Fig. 2d, e) and females 3.00–3.35 mm long (Fig. 2b, c) had completely rounded shoulder vaults. This subspecies can therefore be distinguished from the typical form in the juvenile stages.

Distribution: 29°S–45°S in the Atlantic; south of 29°S in Pacific and Indian Oceans.

Subfamily CONCHOECINAE Poulsen

Most Halocyprids belong to the genus *Conchoecia*, for which over 90 species have been described. Müller's (1906a) system of grouping species together into more or less natural groups of related forms will be followed here.

Spinifera Group Müller

C. spinifera Müller. This species was recorded from the equator to 40°S, 30°W and at about 42°S in the Argentine Basin, extending the recorded southward range. It did not occur south of the subtropical convergence.

Distribution: 52°N–42°S in the Atlantic; Indian and Pacific Oceans.

C. oblonga (Claus). Müller (1906a) distinguished two forms of this species, Form A in which the right asymmetrical gland opens at the postero-ventral corner, and Form B in which the gland opens just anterior to this location. In the Canary Island region Angel (1969) found Form A at shallower depths than Form B. The two forms were not distinguished in the HUDSON 70 material. *C. oblonga* was found from the equator to 37°S and at about 42°S in the Argentine Basin, extending its southward range.

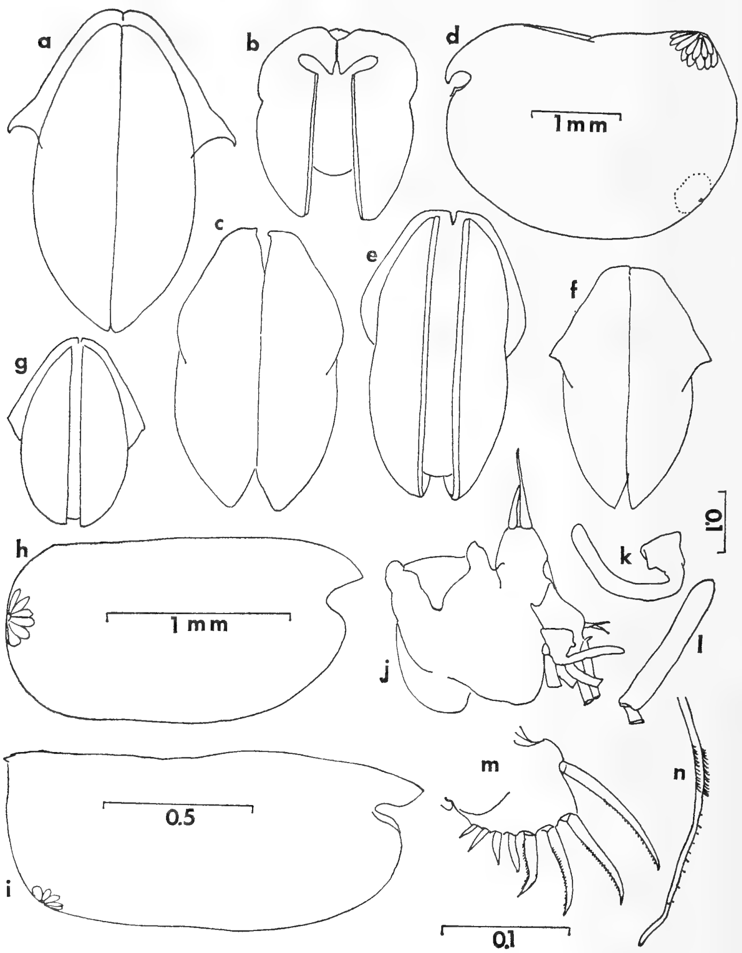

FIG. 2. a, Ventral view of female *Fellia cornuta cornuta* from the Caribbean Sea; b and c, Anterior and dorsal views of female *F. cornuta dispar*; d and e, Lateral and ventral views of male *F. cornuta dispar*; f, Dorsal view of 1.3 mm juvenile; g, Ventral view of 2.0 mm juvenile; h, Lateral view of *Halocypria globosa* male; i, Lateral view of *Conchoecia allotherium* male; j, Endopodite of left second antenna of *C. allotherium* male; k, Right clasper; l, Capitulum of frontal organ; m, Furca; n, Distal part of proximal secondary seta of male first antenna. Scale on b for a–e and g, on h for f and h, on i for i, on right margin for l and m, at bottom for j, k, and n. Scales in mm.

Distribution: 48°N–42°S in Atlantic; Indian and Pacific Oceans.

C. allotherium Müller. Males of this species were taken in two of the 200–0 m tows from 0°51′S and 15°42′S. This species is similar in size and shape to *C. oblonga* Form A (Fig. 2i); also the 4th claw on the furca is curved as in *C. oblonga* (Fig. 2m), and Müller was unable to differentiate the females of the two species. The male is distinguished by a double row of spinules near the tip of the proximal secondary seta (Fig. 2n) of the first antenna, and the frontal organ is bare of spinules (Fig. 2l).

Distribution: 18°N–35°S in Atlantic; 10°N–10°S in Indian Ocean.

C. aequiseta Müller and *C. hirsuta* Müller. Females of these two species are indistinguishable, and males are differentiated only on the basis of long hairs on the distal bristle of the first endopodite joint of the second antenna in *C. hirsuta.* This bristle is bare in *C. aequiseta* males and in females and juveniles of both species. Females and juveniles identified as *C. aequiseta* were found between 30°S and 37°30′S, 30°W; a *C. aequiseta* male was taken at 42°S in the Argentine Basin. *C. hirsuta* males were present in samples from 35°S, 30°W and from 42°S–44°S in the Argentine Basin, so both forms occur south to the region of the subtropical convergence.

Distribution: For *C. aequiseta* 32°N–31°S and for *C. hirsuta* 29°N–35°S in the Atlantic; Indian Ocean. The HUDSON 70 males extend the southward range to 42°S and 44°S, respectively.

C. echinata Müller. This species occurred from the equator to 20°S.

Distribution: 37°N–29°S in Atlantic; Pacific and Indian Oceans.

C. inermis Müller. A single specimen was taken at 13°30′S in a 200–0 m night haul, extending slightly the known southward range.

Distribution: 43°N–13°30′S in Atlantic; Indian Ocean.

C. mamillata Müller. This species was taken in hauls with 1100–4000 m of cable out from 30°S–37°30′S, 30°W, and from 42°S–44°S in the Argentine Basin.

Distribution: 48°N–56°S in the Atlantic; Indian and Pacific Oceans.

Elegans Group Müller

C. elegans Sars. This was one of the commonest species, and occurred from the equator to 55°S. Between the equator and 25°S, males and females were 1.2–1.3 mm long; between 30°S and 40°S larger specimens up to 1.60–1.65 mm long were found; south of 45°S females were 1.5–1.8 mm long and males 1.75–1.85 mm in length.

Distribution: 80°N–55°S in Atlantic; Indian and Pacific Oceans.

Procera Group Müller

C. microprocera Angel. *C. microprocera* was taken at 14 stations between the equator and 25°S in the 200–0 m vertical tows.

Distribution: 32°N–25°S in Atlantic.

C. procera Müller. This species occurred from the equator to 40°S and was not found south of the subtropical convergence.

Distribution: 32°N–40°S in the Atlantic; Mediterranean and Indian Ocean.

C. brachyaskos Müller. *C. brachyaskos* was recorded from 37°30′S to 55°S, 30°W and from 42°S–45°S in the Argentine Basin, from hauls with 1000–4000 m of cable out. Females (Fig. 3a) were 1.5–1.6 mm and males (Fig. 3b) 1.4–1.5 mm long. Although larger than the specimens recorded from the Sargasso Sea (Deevey, 1968), the frontal organs (Fig. 3c, d) and male claspers (Fig. 3f, g) were similar. Also the armature (Fig. 3e) of the male first antenna had no more teeth or spinules than that of the smaller males.

Distribution: 32°N–56°30′S in the Atlantic; Indian and Pacific Oceans.

Acuminata Group Müller

C. acuminata (Claus). This species was taken in only 4 of the 200–0 m tows collected between 2°26′S and 6°S.

Distribution: 46°N–37°S in the Atlantic; Pacific and Indian Oceans.

Obtusata Group Müller

C. obtusata Sars var. *antarctica* Müller. *C. obtusata* is a bipolar species. *C. obtusata antarctica* was found from 40°S to 50°30′S, 30°W and from 42°S to 51°30′S in the Argentine Basin, in hauls with 100–200 m of cable out, as well as the deeper tows. The length range for males (Fig. 3j) was 1.25–1.35 mm and for females (Fig. 3i) 1.65–1.85 mm. The antarctic form differs from the arctic form primarily in the shape of the frontal organs (Fig. 3n, o) and the right male clasper (Fig. 3m) and usually in the shape of the posterior end of the shell. The capitulum of the frontal organs of both males and females is sharply pointed, and the right male clasper is bent at a more acute angle than in the arctic forms. The armature of the principal seta of the male first antenna (Fig. 3p) is apparently similar.

Distribution: 23°S–68°S in Atlantic; 26°S–68°S in the Pacific. *C. obtusata obtusata* occurs chiefly north of 60°N in the Atlantic and Arctic Ocean and at 58°N in the Skager Rak and Cattegat.

Rotundata Group Müller

This group is greatly in need of taxonomic revision. Müller originally included 7 species in this group, which differs from all others in the position of the asymmetrical glands: *C. macromma, C. pusilla major, C. pusilla minor, C. glandulosa, C. kyrtophora, C. nasotuberculata, C. rotundata* and *C. isocheira*. *C. rotundata* has since been separated into 3 species (Iles, 1953): *C. rotundata, C. skogsbergi* Iles and *C. teretivalvata* Iles, and Rudyakov (1962) has described *C. abyssalis* from the Pacific. Eleven species were found in the HUDSON 70 samples, in-

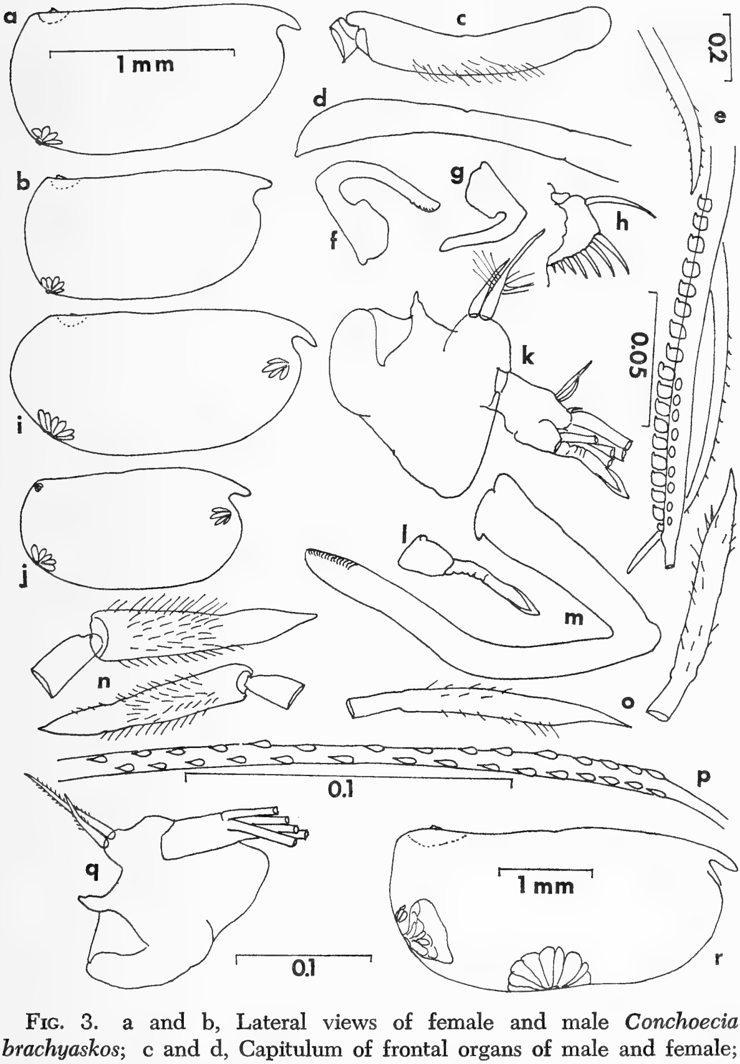

FIG. 3. a and b, Lateral views of female and male *Conchoecia brachyaskos*; c and d, Capitulum of frontal organs of male and female; e, Armature of male first antenna; f and g, Right and left male claspers; h, Female furca; i and j, Lateral views of female and male *C. obtusata antarctica*; k, Endopodite of male left second antenna; l and m, Left and right male claspers; n, Capitulum of frontal organs of two males; o, Capitulum of frontal organs of two females; p, Armature of principal seta of male first antenna; q, Endopodite of female second antenna; r, Lateral view of female *C. gaussae*. Scale on a for a, b, i and j, at upper right for h, beside e for e, below p for p, at bottom center for c, d, f, g, k–o and q, on r for r. Scales in mm.

cluding two new forms, which, due to insufficient material, will not be described in this report. Of the known species, only *C. abyssalis* and *C. pusilla* were not recorded.

C. teretivalvata Iles (Figure 4). This species was recorded from 5°S in the 200–0 m tows and from 30°S–49°S, 30°W and from 42°S–48°S in the Argentine Basin. As in the case of *C. skogsbergi,* smaller and larger forms were present, and the larger forms may eventually prove to be a different species, but males of both sizes had the large penis (Fig. 4l) shaped as figured by Müller (1894, Pl. 6, Fig. 20). Females and males, 0.85–0.90 mm long (Fig. 4b, g, h), occurred down to 42°30′S and at 42°S in the Argentine Basin. Larger specimens 1.0–1.1 mm long (Fig. 4a, j) were found from 40°S–49°S, between the subtropical and subantarctic convergences. Smaller males had 9–10 pairs of teeth on the principal seta of the first antenna, and larger males 10–11 pairs of teeth (Fig. 4e). Larger and smaller males had claspers of similar shape (Fig. 4c, d, i).

Distribution: Mediterranean; warmer Atlantic to 29°S in Benguela Current. These specimens extend the range southward.

C. rotundata Müller. This species, as described from the Sargasso Sea (Deevey, 1968), occurred from the equator to 35°S. The length range for females was 0.87–0.95 mm and for males 0.80–0.85 mm (Fig. 5h).

Distribution: 32°N–35°S in Atlantic; tropical Pacific.

C. skogsbergi Iles. *C. skogsbergi* was recorded from 30°S–55°S, 30°W and from 42°S–47°S in the Argentine Basin, from all stations where samples were collected with 1000 or more meters of cable out. Smaller specimens, females 1.10–1.25 mm long and males 1.05–1.20 mm long, such as those described from the Sargasso Sea (Deevey, 1968) were found from 30°S–35°S where larger specimens 1.35–1.50 mm long were also present. South of 35°S females were 1.4–1.7 mm long and males 1.35–1.75 mm long (Fig. 5b). Males 1.7 mm long had 14 pairs of teeth on the principal seta of the first antenna, whereas males 1.25 mm long had 13 pairs of teeth.

Distribution: 32°N–65°S in the Atlantic.

C. nasotuberculata Müller. This species (Fig. 5a) was found from the equator to 42°30′S, just south of the subtropical convergence.

Distribution: 18°N–40°S; Indian Ocean and Mediterranean. These specimens extend the range slightly south.

C. kyrtophora Müller. This is not the species described (Deevey, 1968) as *C. kyrtophora* from the Sargasso Sea. One female 0.93 mm long (Fig. 5g) and one male 0.95 mm long were collected at 40°S in a haul with 2500 m of cable out. This species is closely related to *C. nasotuberculata,* but the female is distinguished by lacking the lateral bumps on the shell that are characteristic of female *C. nasotuberculata.*

Distribution: 14°N–35°S in Atlantic; Indian Ocean. These specimens extend the range 5° south.

C. macromma Müller. Two females 1.40 (Fig. 5c, d) and 1.27 mm long and one male 1.50 mm long were collected at 44°12.4′S, 42°46′W

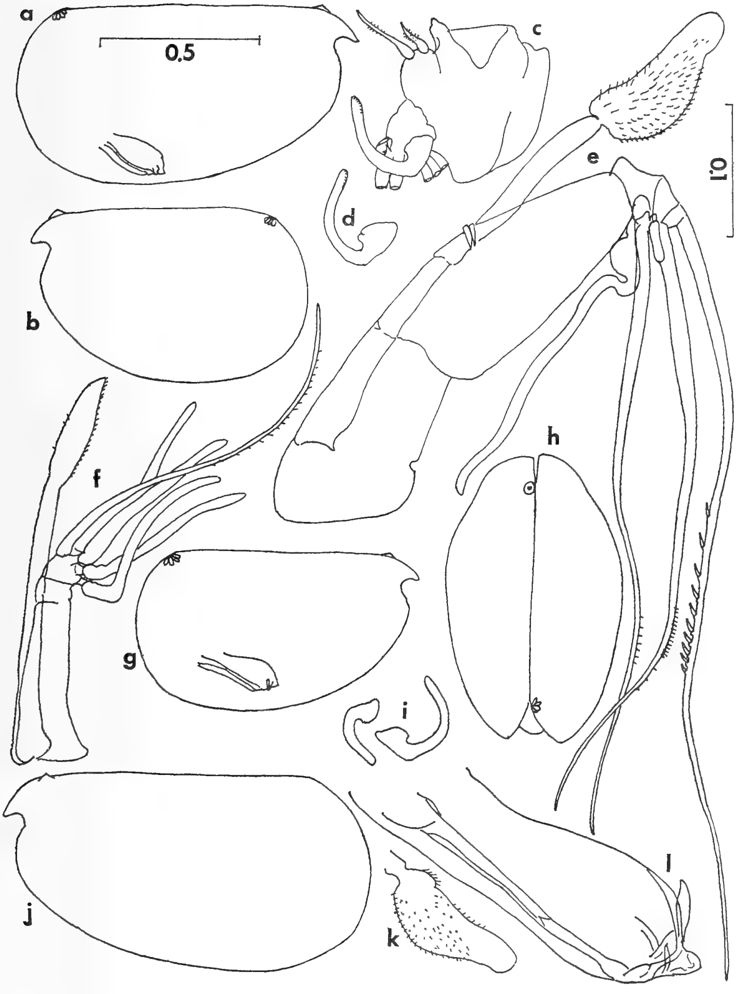

FIG. 4. *Conchoecia teretivalvata.* a, A 1.10 mm male; b, 0.92 mm female; c, Endopodite of right second antenna of 1.07 mm male; d, Right clasper of 1.05 mm male; e, Frontal organ and first antenna of 1.05 mm male; f, Frontal organ and first antenna of 0.92 mm female; g and h, Lateral and dorsal views of 0.85 mm male; i, Left and right claspers of 0.9 mm male; j, 1.1 mm female; k, Capitulum of frontal organ of 0.9 mm male; l, Penis of 1.0 mm male. Scale on a for a, b, g, h and j, at upper right for c–f, i, k and l. Scales in mm.

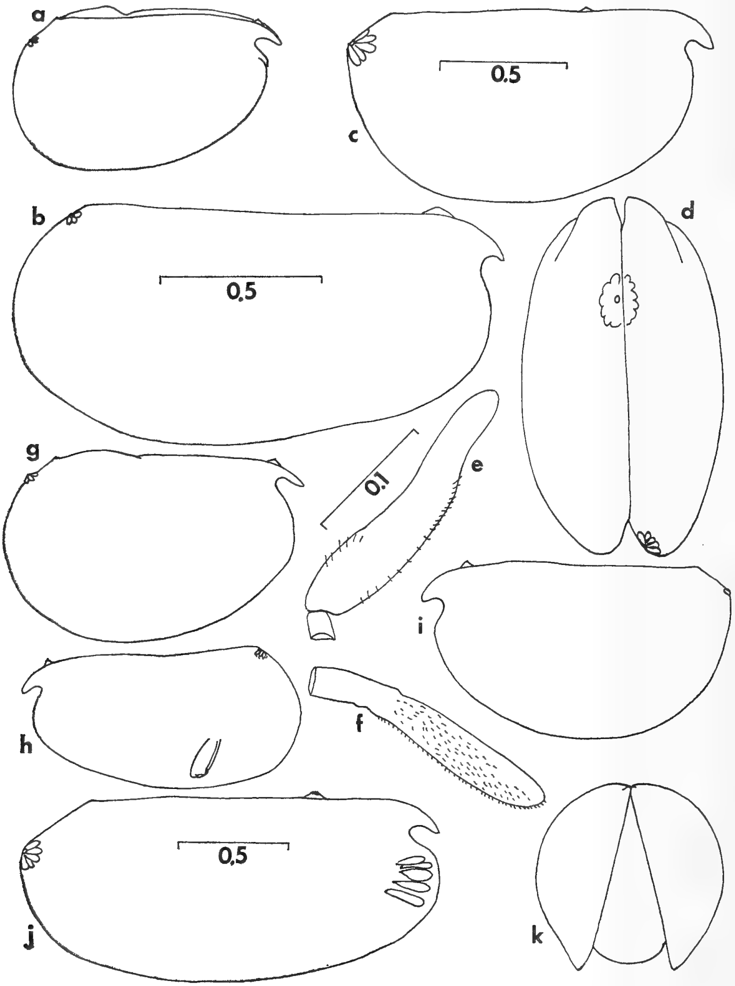

FIG. 5. a, Lateral view of 0.85 mm female *Conchoecia nasotuberculata*; b, 1.6 mm male *C. skogsbergi*; c and d, Lateral and dorsal views of 1.4 mm female *C. macromma*; e and f, Capitulum of frontal organs of male and female *C. macromma*; g, Lateral view of 0.93 mm female *C. kyrtophora;* h, 0.85 mm male *C. rotundata*; i, 0.93 mm female *C. isocheira*; j and k, Lateral and posterior views of 1.95 mm female *C. glandulosa.* Scale on b for a, b, g–i, on c for c and d, in center for e and f, on j for j and k. Scales in mm.

in a haul with 4000 m of cable out. Although these specimens are larger than those described by Müller from 24°N–3°S in the Atlantic, the position of the asymmetrical glands, the frontal organs (Fig. 5e, f), and the structure of the first and second antennae agree with his figures. Iles (1953) listed one female from a 750–1000 m haul at 25°S in the Benguela Current, but did not give its size or any corroboratory data.

Distribution: 24°N–25°S in the Atlantic; Indian Ocean. These specimens extend the range to 44°S.

C. *glandulosa* Müller. One female 1.95 mm long (Fig. 5j, k) was caught at 44°S in the Argentine Basin in a haul with 4000 m of cable out.

Distribution: 32°N–64°S in the Atlantic; Pacific and Indian Oceans.

C. *isocheira* Müller. C. *isocheira* (Fig. 5i) occurred from 49°S–55°S, in hauls with a minimum of 500 m of cable out. The length range for females was 0.95–1.05 mm and for males 0.84–1.00 mm.

Distribution: 53°S–71°S in the Atlantic, Indian and Pacific Antarctic. The HUDSON 70 specimens extend the range a few degrees to the north.

Curta Group Müller

C. *curta* Lubbock. This species was found from the equator to 35°S, and did not occur south of the subtropical convergence.

Distribution: 48°N–37°S in the Atlantic; Indian and Pacific Oceans and Mediteranean.

C. *echinulata* (Claus). C. *echinulata* was present from 11°S–30°S.

Distribution: 34°N–37°S in Atlantic; Indian Ocean.

C. *stigmatica* Müller. Juvenile specimens of this species were noted from the equator to 10°S in the 200–0 m tows.

Distribution: 0°39′N–31°S in Atlantic; Indian and Pacific Oceans.

C. *acuticosta* Müller. This species occurred from 32°30′S–45°S, 30°W and from 42°S–44°S in the Argentine Basin, primarily in hauls with 1000–4000 m of cable out.

Distribution: 27°N–36°S in the Atlantic; Indian and Pacific Oceans. These specimens extend the range to 45°S.

Bispinosa Group Müller

C. *haddoni* Brady and Norman. C. *haddoni* was present from 35°S to 51°30′S, 30°W, and from 42°S–47°S in the Argentine Basin, in hauls with 1000–4000 m of cable out. The length range noted for females was 2.8–3.1 mm and for males 2.30–2.55 mm. Müller noted that the southern forms were larger than those from the North Atlantic, where Angel (1970) recorded length ranges of 2.15–2.53 mm for females and 1.75–2.00 mm for males.

Distribution: 60°N–51°30′S in Atlantic; Indian Ocean.

C. *bispinosa* Claus. C. *bispinosa* was found from the equator to 40°S, 30°W and at 42°S in the Argentine Basin. Ramirez and Moguilevsky (1971) identified all their specimens, collected between 36° and 38°S, as C. *secernenda*, but their smaller males around 2.1 mm long were evidently *C. bispinosa,* since they noted 29 pairs of teeth on the principal seta of the male first antenna. Apparently, as in the case of *C. haddoni,* specimens of *C. bispinosa* are larger in the South Atlantic than in the North. HUDSON 70 females were 1.85–2.20 mm long and males 1.90–2.00 mm long. Angel (1970) recorded length ranges of 1.8–2.1 mm for females and 1.65–1.88 mm for males from around 29°N–33°N in the eastern North Atlantic. Females from the Sargasso Sea were 1.80–1.95 mm long and males 1.65–1.80 mm long (Deevey, 1968).

Distribution: 43°N–42°S in the Atlantic.

C. secernenda Vavra. This species was caught only in several 200–0 m tows between 8°30′S and 27°30′S, 30°W, and apparently is not as abundant in the South Atlantic as in the North. Judging by their large size (females 2.6 mm and males 2.3 mm mean length) Poulsen's (1969b) specimens identified as *C. bispinosa* from the Gulf of Guinea are presumably *C. secernenda;* he did not state the number of teeth on the principal seta of the male first antenna, but believes *C. secernenda* and *C. bispinosa* to be synonymous.

Distribution: 37°N–38°S in the Atlantic.

C. atlantica (Lubbock). *C. atlantica* was found only between 0°51′S and 7°27′S, 30°W.

Distribution: 40°N–37°S in the Atlantic; Indian and Pacific Oceans.

Gaussae Group Skogsberg

Skogsberg (1920) included *C. gaussae* and *C. incisa* in this group, both of which Müller (1906a) had put in the *Bispinosa* Group. In this report *C. edentata,* which Müller assigned to the *Acuminata* Group, is also included. These three species differ from all others in having large compound glands on the mid-ventral margin of both shells, as well as the usual asymmetrical glands. Poulsen (1969b) has provisionally included *C. congolensis* Poulsen in this group, although it lacks the glands on the ventral margin.

C. edentata Müller. Three females, 1.65, 1.73, 1.73 mm long, and two juvenile specimens 1.40 and 1.45 mm long were collected between 23°S and 55°S. Müller described this species from a 1.7 mm male and an immature female. Barney (1921) recorded 4 specimens from a 0–1000 m haul at about 72°S in the Pacific Antarctic, and Iles (1953) a single female from a 250–500 m tow at 23°S in the Benguela Current. Rudyakov (1962) gave a supplementary description of a 1.83 mm female and 2 males, 1.43–1.45 mm long.

Distribution: 0°39′N–56°S in the Atlantic; 55°S–62°S in the Indian Ocean; 72°S and 44°N–50°N in the Pacific.

C. incisa Müller. A single female, 2.37 mm long, was caught in a 200–0 m tow at 3°40′S, 30°W. Müller (1906a) described this species from a 2.15 mm male and a 2.5 mm female from the Indian Ocean. Poulsen (1969b) has since recorded 3 females, 2.5–2.6 mm long, from a station near the equator in the Gulf of Guinea. Angel (1969) noted this species from the Canary Island region.

Distribution: 29°N–3°40′S in the Atlantic; 2°S–26°S in the Indian Ocean.

C. gaussae Müller. One female, 3.45 mm long, was caught at 32°30′S in a haul with 750 m of cable out, and another female, 3.85 mm long (Fig. 3r), was taken at 51°30′S in a tow with 3000 m of cable out. Müller (1908) described the species from a single male, 3.1 mm long, from 35°11′S, 2°43′E. Skogsberg (1920) described the female from a 3.6 mm specimen from 50°S in the Atlantic. A subspecies, *C. gaussae curilensis*, has been described from the Kuril Kamchatka region from two females 4.08–4.18 mm long (Rudyakov, 1962). The only other recorded specimens are two 4.0 mm females and a 3.3 mm male from 2°S–6°35′S in the Gulf of Guinea (Poulsen, 1969b).

Distribution: 2°S–51°30′S in the Atlantic; 46°31′N, 154°22′E in the Pacific

Loricata Group Müller

C. loricata loricata (Claus). A single male, 1.8 mm long, was found at 35°S in a haul with 1800 m of cable out.

Distribution: 46°N–37°S in the Atlantic; Indian Ocean and Mediterranean.

C. ctenophora Müller. One female, 2.7 mm long, was taken at 30°S in a haul with 1400 m of cable out.

Distribution: 18°N–35°S in the Atlantic; near equator in Indian and Pacific Oceans.

Serrulata Group Skogsberg

C. concentrica Müller. A single female, 1.55 mm long, was found at 0°51′S.

Distribution: 38°N–3°S in the Atlantic; Malay Archipelago and Indian Ocean.

C. serrulata Claus. This species occurred from 40°S–51°30′S, in hauls with 100 or more meters of cable out. It was most numerous between 47°S and 49°S, over the convergence in subantarctic waters in the Argentine Basin. The length range for females was 1.40–1.65 mm and for males 1.25–1.35 mm.

Distribution: 10°S–58°S in the Atlantic; to 59°S in the Indian Ocean and to 68°S in the Pacific.

Magna Group Müller

C. magna Claus. *C. magna* occurred from the equator to 42°30′S, and was present in almost all 200–0 m tows. Females had a length range of 1.7–2.0 mm and males of 1.6–1.9 mm.

Distribution: 52°N–55°S in the Atlantic; Indian and Pacific Oceans and Mediterranean.

C. lophura Müller. This species, easily recognized by the large group of gland cells on the ventral margin at the postero-ventral corner of the shell, was found from 30°S–45°S, in hauls with 750–2500 m of cable out.

Distribution: 46°N–48°S in the Atlantic; Pacific and Indian Oceans and Mediterranean.

C. parvidentata Müller. *C. parvidentata* occurred from 35°S–48°S, to the region of the subantarctic convergence. Females had a length range of 2.55–2.85 mm and males of 2.15–2.50 mm.

Distribution: 31°N–48°S in Atlantic; Indian Ocean.

C. hyalophyllum Claus. This species was recorded from 6°S in a 200–0 m tow and from 27°30′S–42°30′S. Females were 1.65–1.80 mm long and males 1.55–1.70 mm long.

Distribution: 52°N–48°S in the Atlantic; Indian Ocean.

C. macrocheira Müller. *C. macrocheira* was noted on only two occasions, at 0°51′S and at 27°30′S, in hauls with 200–450 m of cable out.

Distribution: 60°N–34°S in the Atlantic; Indian and Pacific Oceans.

C. subarcuata Claus. This species was recorded from 8°31′S–37°30′S, and did not occur south of the subtropical convergence.

Distribution: 59°N–56°S in the Atlantic; Indian and Pacific Oceans.

C. parthenoda Müller. *C. parthenoda* was found from the equator to 30°S. The two specimens described as *C. parthenoda* by Ramirez and Moguilevsky (1971, p. 657, Pls. 12–13) may represent *C. magna*; at least in the case of the male the size is too great and the left asymmetrical gland is not placed far enough forward on the dorsal margin.

Distribution: 37°N–30°S in the Atlantic; Indian and Pacific Oceans.

C. pseudoparthenoda Angel. This species occurred from the equator to 30°S in 200–0 m tows. The male specimen figured as *C. parthenoda* from Barbados (Deevey, 1970) is now recognized as *C. pseudoparthenoda.* Also, in all probability Poulsen's (1969b) description and figures of his male *C. parthenoda* represent *C. pseudoparthenoda.*

Distribution: 14°N–30°S in the Atlantic.

C. spinirostris Claus. *C. spinirostris* was recorded from the equator to 40°S, 30°W and to 42°S in the Argentine Basin, and was not found south of the subtropical convergence.

Distribution: 45°N–24°S in the Atlantic; Pacific and Mediterranean. These specimens extend the range to 42°S.

C. porrecta Claus. This species was found from the equator to 37°30′S, and also did not occur south of the subtropical convergence. Because of their size, the specimens identified by Poulsen (1969b) as *C. spinirostris* must be *C. porrecta*; Poulsen does not separate these two species.

Distribution: 41°N–2°N in the Atlantic; Mediterranean. These specimens extend the range to 37°30′S.

Mollis Group Müller

C. amblypostha Müller (Figure 6). This species occurred from 30°S–40°S, 30°W and from 42°S–47°S in the Argentine Basin, in hauls with 1100–3000 m of cable out. Poulsen (1969b) recorded this species from 1°S–17°S in the Gulf of Guinea, from 670–800 m depths. Müller (1906a)

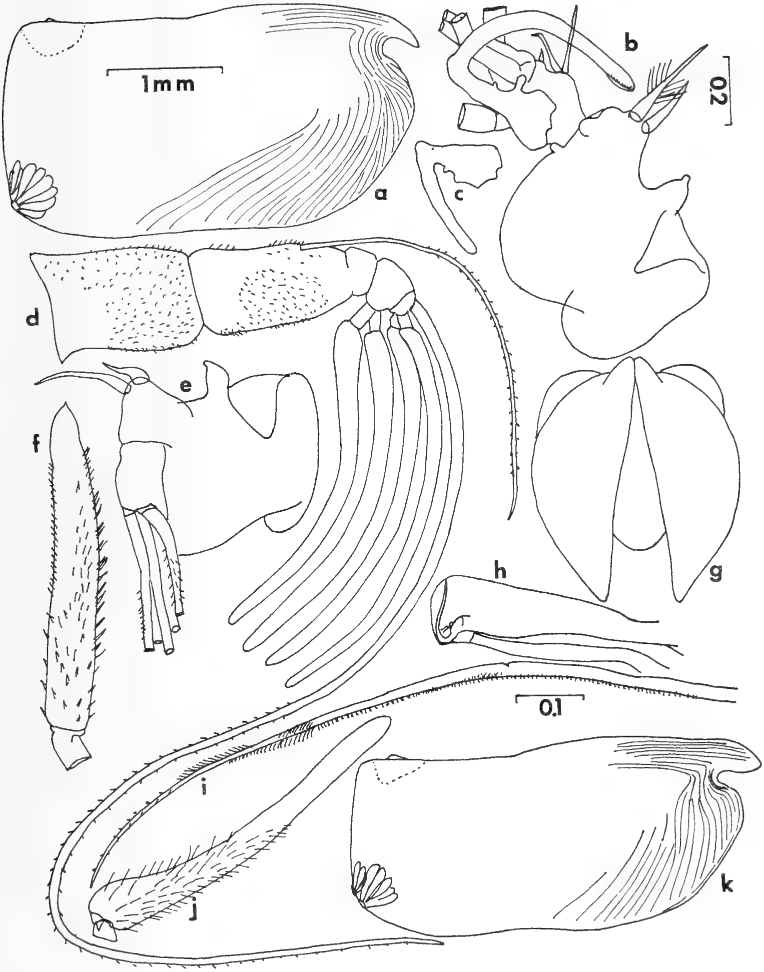

FIG. 6. *Conchoecia amblypostha.* a, Lateral view of female; b, Endopodite of male right second antenna; c, Left clasper; d, Female first antenna; e, Endopodite of female second antenna; f, Capitulum of female frontal organ; g, Posterior view of female; h, Male penis; i, Armature of distal secondary seta of male first antenna; j, Capitulum of male frontal organ; k, Lateral view of male. Scale on a for a, g, k, below i for b–f, i, j, at upper right for h. Scales in mm.

was unable to differentiate the females (Fig. 6a, g) from those of *C. mollis*, but males are distinguished by the armature of the first antenna, particularly the distal secondary seta (Fig. 6i) and the shape of the penis (Fig. 6h). No *C. mollis* males were noted. Females had a length range of 3.30–3.75 mm and males of 3.2–3.5 mm. The female frontal organ (Fig. 6f), first and second antennae (Fig. 6d, e) are indeed similar in structure and spination to those of female *C. mollis*. The male claspers (Fig. 6b, c) are also similar in the two species, but the male *C. mollis* lacks the long hairs on the "b" bristle of the endopodite of the second antenna that are present in male *C. amblypostha*.

Distribution: 1°S–37°31′S in the Atlantic; Indian Ocean. These specimens extend the range to 47°S.

C. dichotoma Müller. A single immature female, 2.04 mm long, was taken at 42°30′S in a haul with 2500 m of cable out. Poulsen (1969b) recorded 3 specimens from 0°50′S.

Distribution: 0°50′S–35°S in the Atlantic. This specimen extends the range to 42°30′S.

C. plactolycos Müller (Figure 7). Müller described two subspecies of *C. plactolycos*: *C. plactolycos typica* (1906a) = *C. plactolycos plactolycos* (1912) and *C. plactolycos major* (1906a, 1908). Specimens of both of these forms were collected in the HUDSON 70 samples and are easily distinguishable, so that each form should be raised to the rank of species. According to rule, *C. plactolycos plactolycos* thus becomes *C. plactolycos* Müller and *C. plactolycos major* is named *C. major* Müller. Müller described *C. plactolycos* from a single male 2.3 mm long from 29°S in the Indian Ocean. One male, 2.5 mm long, was taken at 44°12.4′S, 42°46′W in a haul with 4000 m of cable out. This specimen (Fig. 7c, d, g–k) agrees with Müller's description in the shape of the shell, location of the glands, shape of the frontal organ and clasping organs and the armature of the first antenna (Müller, 1906a, p. 114, Pl. 25, Figs. 14–20). *C. plactolycos* is closely similar to *C. major*, but is smaller in size and the sculpturing of the shell is difficult to discern. The principal seta of the male first antenna has 33 pairs of short fat teeth (Fig. 7i) as against 43 pairs for the *C. major* male (Fig. 8i) and the distal secondary seta is not armed (Fig. 7d) as in the larger form. The medial glands on the posterior margin are much more visible in the *C. plactolycos* male (Fig. 7k). A single female, 2.7 mm long (Fig. 7a, b), taken at 41°44.6′S, 46°33′W, resembles the male in shape and sculpturing. The female differs from that of *C. major* in having fewer spinules on the basal segments of the first antenna (Figs. 7f and 8d) and in lacking spinules on the anterior side of the principal seta. Unfortunately, the distal part of the capitulum of the frontal organ was broken off (Fig. 7e).

Distribution: 42°S–44°S in the Atlantic; 29°S in the Indian Ocean.

C. major (= *C. plactolycos major*) Müller (Figure 8). *C. major* was recorded from 49°S–55°S, 30°W and from 44°S–47°S in the Argentine

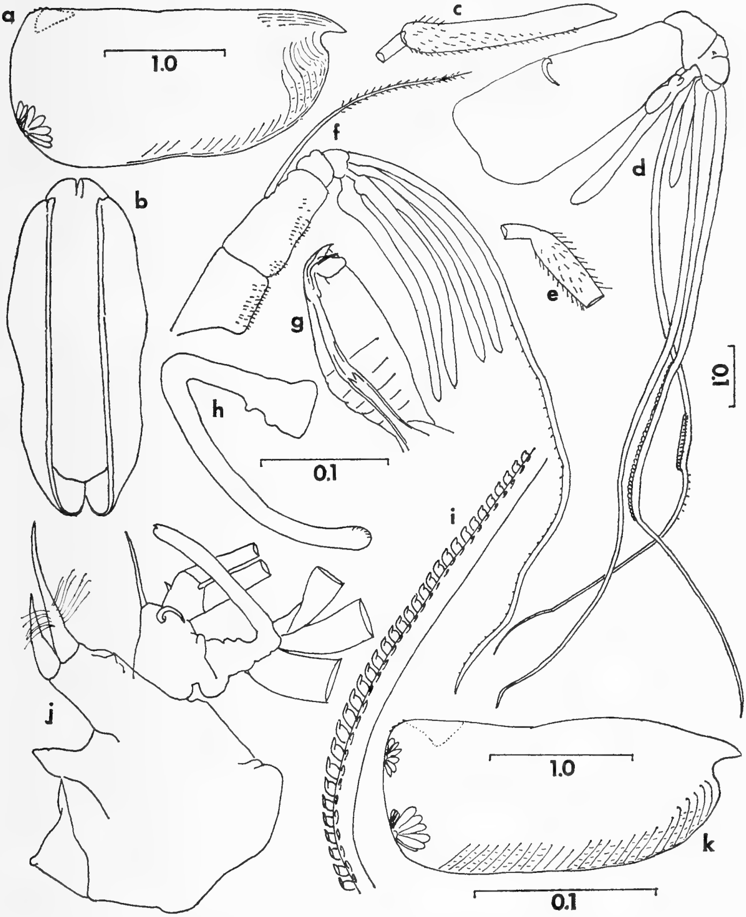

FIG. 7. *Conchoecia plactolycos* (= *C. plactolycos plactolycos*). a and b, Lateral and ventral view of female; c, Capitulum of male frontal organ; d, Male first antenna; e, Proximal part of capitulum of female frontal organ; f, Female first antenna; g, Male penis; h, Male right clasper; i, Armature of principal seta of male first antenna; j, Endopodite of male left second antenna; k, lateral view of male. Scale on a for a and b, on k for k, in center for j and h, at bottom right for i, on right margin for c–g. Scales in mm.

Basin in hauls with 2500–4000 m of cable out. The length range for females was 3.1–3.6 mm and for males 2.97–3.30 mm. Apparently this is the first record of this species since Müller (1906a, 1908) described it from 56°S in the Atlantic and 62°S–65°S in the Indian Ocean. The

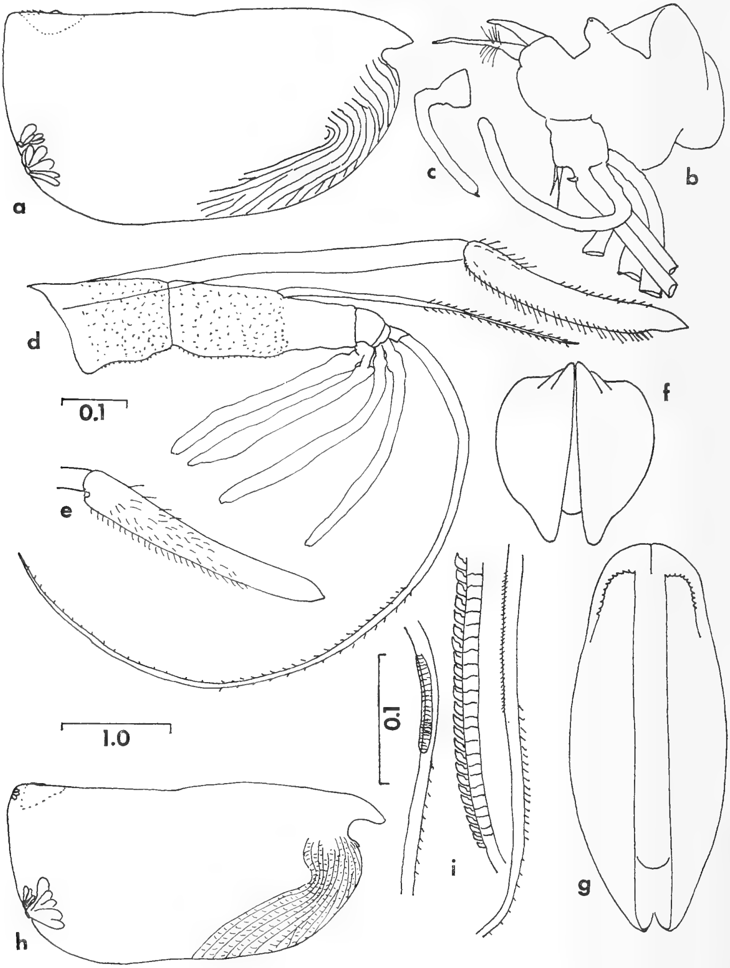

FIG. 8. *Conchoecia major* (= *C. plactolycos major*). a, Lateral view of female; b, Endopodite of male right second antenna; c, Male left clasper; d, Frontal organ and first antenna of female; e, Capitulum of male frontal organ; f, g and h, Posterior, ventral and lateral views of male; i, Armature of male first antenna. Scale above h for a, f–h, beside i for i, at left center for b–e. Scales in mm.

sculpturing on the shell (indicated in Fig. 8a, h) is much more definite than in *C. plactolycos*; other differences have been noted above.

Distribution: 56°S in Atlantic; Indian Ocean. These specimens extend the range north to 44°S.

C. borealis Sars var. *antipoda* Müller. *C. borealis antipoda* occurred from 35°S–55°S, 30°W and from 42°S–51°28′S in the Argentine Basin, in hauls with 1000–4000 m of cable out. The length range for males was 2.80–3.05 mm and for females 3.05–3.35 mm. The antarctic form is larger than the arctic form for which Skogsberg (1920) gave measurements of 2.1–2.3 mm for males and 2.4–2.9 mm for females. The female has more sharp-edged shoulder vaults (Fig. 9a, b) than the male (Fig. 9c, h). The male appears to differ from male *C. borealis* Sars, as figured by Skogsberg (1920, Fig. 135-4), in having fewer teeth on the principal seta (Fig. 9e); 40–45 pairs of teeth were noted, whereas Skogsberg described 50–55 pairs of teeth on the principal seta of males from Lofoten. The clasping organs and frontal organ (Fig. 9d, f, g) are similar to those of the arctic form.

Distribution: 1°S–65°S in the Atlantic and Antarctic Oceans.

Imbricata Group Müller

C. imbricata (Brady). This species was recorded at 18°S, 24°S and from 27°30′S–40°S, and was not found south of the subtropical convergence.

Distribution: 63°N–55°S in the Atlantic; Pacific and Indian Oceans.

C. ametra Müller. *C. ametra* was taken from 30°S–40°S, 30°W and from 42°S–44°S in the Argentine Basin, in hauls with 1100–4000 m of cable out. A length range of 3.75–4.10 mm was noted for males and of 4.5–4.8 mm for females.

Distribution: 60°N–37°S in the Atlantic; Indian and Pacific Oceans. These specimens extend the range south to 44°S.

C. plinthina Müller. A single juvenile specimen, 4.1 mm long, was found at 42°30′S in a haul with 2500 m of cable out. This is the largest species of this group.

Distribution: 48°N–31°S in the Atlantic; Indian and Pacific Oceans. This specimen extends the range to 42°30′S.

C. symmetrica Müller. *C. symmetrica* occurred from 35°S–55°S, 30°W and from 42°S–47°S in the Argentine Basin, in hauls with 1000–4000 m of cable out. The length range for females was 4.1–4.5 mm and for males 3.7–4.0 mm.

Distribution: 0–55°S in the Atlantic; Indian Ocean and Pacific Antarctic.

Alata Group Müller

C. hettacra Müller. *C. hettacra* (Fig. 9i–k) occurred from 49°S–55°S, 30°W and from 42°S–51°30′S in the Argentine Basin, at shallow depths, since it was taken in the 200 and 100 m tows. The length range for females was 2.25–2.45 mm and for males 1.80–1.95 mm.

Distribution: 47°S–57°S in the Atlantic, so these specimens extend the range north to 42°S; 43°S–70°S in the Indian Ocean.

C. valdiviae Müller. This species occurred from 32°30′S–42°30′S,

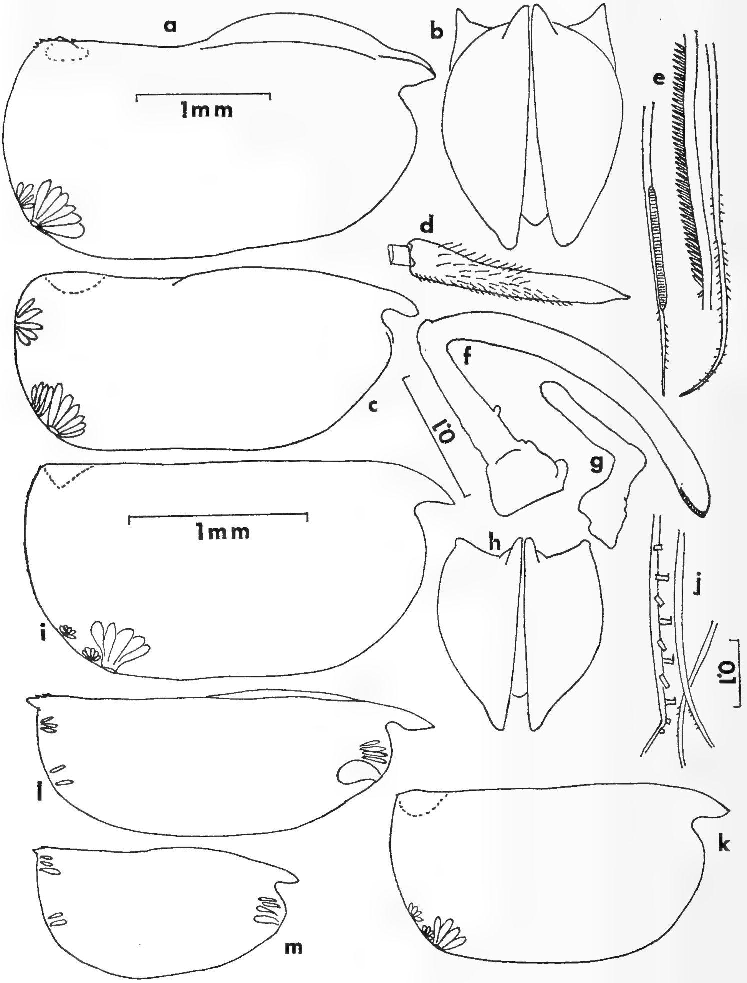

FIG. 9. a and b, Lateral and posterior views of female *Conchoecia borealis antipoda*; c, Lateral view of male; d, Capitulum of male frontal organ; e, Armature of male first antenna; f and g, Right and left male claspers; h, Posterior view of male; i, Lateral view of female *C. hettacra*; j, Armature of *C. hettacra* male first antenna; k, Lateral view of male; l and m, Lateral views of female and male *C. chuni*. Scale on a for a–c and h, beside f for f and g, on lower right margin for d, e, and j, on i for i, k–m. Scales in mm.

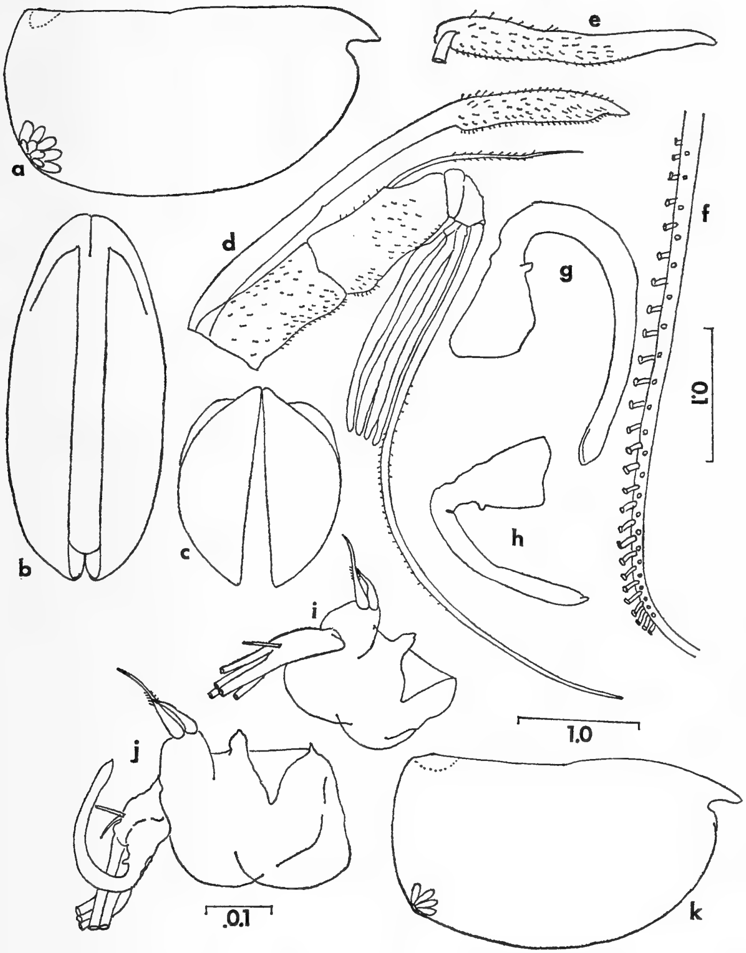

FIG. 10. *Conchoecia belgicae.* a, b and c, Lateral, ventral and posterior views of female; d, Female frontal organ and first antenna; e, Capitulum of male frontal organ; f, Armature of principal seta of male first antenna; g and h, Right and left male claspers; i, Endopodite of female second antenna; j, Endopodite of male right second antenna; k, Lateral view of male. Scale above k for a–c and k, at bottom for d, e, i, j, on right margin for f–h. Scales in mm.

30°W and from 42°S–45°S in the Argentine Basin. *C. valdiviae* is exceptionally large and bulky, deep red in color when alive. Most specimens were immature, but one female was 5.35 mm long and one male 5.0 mm in length.

Distribution: 28°N in the Gulf of Mexico (Kornicker, 1968) to 47°S in the Atlantic; to 58°S in the Indian Ocean.

C. belgicae Müller (Figure 10). One 2.8 mm male was obtained at 51°30′S, 40°W, in a haul with 600 m of cable out, and one female 2.9 mm long was taken at 55°S in a haul with 1100 m of cable out. These specimens agree with Müller's (1906b) and Skogsberg's (1920) descriptions and figures. Müller's "Belgica" females were 2.4–2.7 mm long and his males 2.4–2.6 mm long, but speciemns from the Gausstation (66°2.9′S, 89°38′E) were larger: females 2.6–3.0 mm long and males 2.6–2.8 mm in length. Figure 10 illustrates the shape of the male and female shells and the structure of the first and second antennae. According to Skogsberg, the male first antenna has 27–30 pairs of teeth, similar in shape to those of the *C. hettacra* male (Fig. 9j). The HUDSON 70 specimen had 26 teeth in lateral view, the two rows unevenly paired (Fig. 10f).

Distribution: Müller described this species from 70°S–71°S in the Pacific Antarctic, and obtained it later from 65°S–66°S in the Indian Antarctic. Skogsberg's specimens were from about 66°S in the Atlantic. Barney (1921) reported it abundant at a number of stations in the Ross Sea and McMurdo Sound and also at two stations north of New Zealand. The HUDSON 70 specimens extend the range in the Atlantic north to 51°30′S.

Daphnoides Group Müller

C. daphnoides (Claus). *C. daphnoides* was recorded from about 5°S and 23°S to 40°S, 30°W, and at 42°S in the Argentine Basin, and therefore was not found south of the subtropical convergence. Males ranged in length from 2.8–3.1 mm and females from 4.8–5.6 mm.

Distribution: 60°N–37°S in the Atlantic; Indian and Pacific Oceans. These specimens extend the range to 42°S.

C. chuni Müller. *C. chuni* (Fig. 9l, m) was taken from 32°30′S–55°S, 30°W, and from 42°S–50°S in the Argentine Basin, in shallow as well as deeper hauls. The length range for males was 1.40–1.55 mm and for females 2.0–2.4 mm.

Distribution: 26°S–53°S in the Atlantic; 2°S–44°S in the Indian Ocean, and to 64°S in the Pacific. These specimens extend the range slightly to 55°S.

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PROCEEDINGS
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A NEW SPECIES OF *ELEUTHERODACTYLUS* (AMPHIBIA: LEPTODACTYLIDAE) FROM THE PACIFIC LOWLANDS OF ECUADOR

By John D. Lynch

School of Life Sciences, The University of Nebraska, Lincoln

Soon after my description of *Eleutherodactylus croceoinguinis* (Lynch, 1968) from Provincia Napo, Ecuador, Dr. Charles F. Walker called my attention to a series of a diminutive eleutherodactyline frog that he had collected in 1962 in the vicinity of Santo Domingo de los Colorados, Prov. Pichincha, Ecuador. His frogs were superficially similar to *E. croceoinguinis* in size (less than 25 mm SVL) and color pattern (presence of bright color patches on the concealed surfaces of the limbs). At that time I had not done field work in western Ecuador but had seen two examples of this frog collected along the Rio Baba. Field work in 1968 and 1970 provided me the opportunity to collect additional material at Santo Domingo de los Colorados as well as at several other localities in western Ecuador and to make ecological observations of this frog which is here named

Eleutherodactylus walkeri, new species

Holotype: The University of Kansas Museum of Natural History (KU) 131652, an adult male collected at Las Palmas (junction of highways 28 and 30), Prov. Pichincha, Ecuador, 920 m, 8 August 1970 by J. D. Lynch.

Paratypes: KU 131653-63, California Academy of Sciences 134064-66, collected syntopically with holotype; University of Michigan Museum of Zoology 131675 (10 specimens), Hacienda Delta, ca. 8 km SE Santo Domingo de los Colorados, Prov. Pichincha, Ecuador.

Diagnosis: (1) skin of dorsum finely shagreened, no dorsolateral folds, that of venter coarsely areolate, discoidal folds prominent; (2)

tympanum visible externally, its length one-third eye length; (3) snout subacuminate in dorsal view, rounded in lateral profile; (4) upper eyelid slightly narrower than interorbital distance (IOD); no cranial crests; (5) prevomerine odontophores oval, bearing teeth; (6) males with vocal slits and median subgular vocal sac; (7) first finger shorter than second, digits bearing discs on large, non-emarginate pads, discs wider than long; subarticular tubercles simple; (8) fingers bearing weak, keel-like lateral fringes; (9) ulnar tubercles obscure or lacking; (10) inner tarsal tubercle minute, outer edge of tarsus with faint tubercles; no heel tubercles; (11) inner metatarsal tubercle oval, length 2–3 times width, 5–6 times size of conical outer metatarsal tubercle; plantar surfaces bearing 0–3 supernumerary tubercles; (12) toes bearing weakly defined lateral fringes, not basally webbed; digits bearing discs and pads, pads slightly smaller than those of fingers; (13) color pattern polymorphic; most common pattern is: dorsum gray to brown with dark brown markings; limbs barred; venter cream with brown flecking; posterior surface of thighs pale to medium brown, sometimes with black patches enclosing cream spots; groin black with large cream (yellow in life) spots; (14) adults small, males 15.3–17.9 mm, females 20.8–25.3 mm SVL.

E. walkeri is the only small South American eleutherodactyline frog now known having visible tympana and yellow spotting on a black or dark brown field in the groin. *E. carvalhoi* Lutz and *E. croceoinguinis* are superficially similar frogs but have concealed tympana.

Description: Statements listed in the diagnosis are not repeated below unless additional information is provided. Head about as wide as body or slightly wider than body; head longer than wide; head width 33.7–37.6 percent SVL ($\bar{x} = 35.6$); tip of snout extending beyond lower jaw; snout short, eye-nostril distance slightly less than eye length; canthus rostralis moderately sharp, slightly concave or straight; loreal region concave, sloping abruptly to lip; lips not flared; nostrils directed laterally, protuberant; interorbital space flat; frontoparietals complete, not produced laterally into crests; upper eyelid width 74.5–100.0 percent IOD ($\bar{x} = 87.2$); tympanum visible, its upper third usually concealed by supratympanic fold; tympanum round, its length 24.1–34.7 percent eye length ($\bar{x} = 31.3$), not sexually dimorphic in size or shape, separated from eye by distance equal to tympanic diameter; tongue large, longer than wide, weakly notched or entire along posterior border, posterior two-fifths to one-third not adherent to floor of mouth; choanae large, round, not concealed by palatal shelf of maxillae; prevomerine teeth present on small (one-third size of a choana), low, odontophores lying medial and posterior to choanae; 2–3 teeth per odontophore, arranged in a row (or clump) across posterior edge of odontophore.

Skin of dorsum, upper flanks, and limbs smooth to finely shagreened, that of lower flanks and venter coarsely areolate; shank of males 52.1–

54.4 percent SVL ($\bar{x} = 53.1$), of females 44.9–57.0 percent ($\bar{x} = 49.7$); forearm lacking prominent ulnar fringe or tubercles, no antebrachial tubercle; palmar tubercle bifid, larger than oval thenar tubercle; palm bearing a few supernumerary tubercles; subarticular tubercles subconical, round; all fingers bearing discs on simple pads; pad of thumb only slightly wider than digit, pads on fingers 2–4 nearly twice width of digit below pad.

Heel lacking tubercles in most individuals; when heel tubercles present, small and non-conical; most individuals have a minute inner tarsal tubercle and a series of small outer tarsal tubercles but a few individuals lack tarsal tubercles (possibly due to preservative); toe pads wider than long but less than twice width of digit below pad; pads of toes 3–5 largest; all toe pads smaller than finger pads (2–4) but larger than thumb pad.

Preserved color pattern: Gray to brown dorsally, pale cream (with indefinite infuscation on throat) to dark gray ventrally; labial bars, canthal and supratympanic stripes, interorbital bar, scapular and sacral chevrons, and lumbar bar dark brown (Fig. 1); limbs with oblique dark brown bars separated by broader, paler interspaces; anal triangle dark brown to black, contiguous with dark brown posterior surfaces of thighs; posterior surfaces of thighs with or without black-ringed cream spots (spots occur in 5 percent of specimens from Las Palmas and vicinity of Santo Domingo de los Colorados, Prov. Pichincha, and in 65 percent of specimens from Balzapamba, Prov. Bolivar); groin and anterior surfaces of thighs dark brown to black with colorless spots; concealed shank brown with cream spots.

E. walkeri exhibits pattern polymorphism (Fig. 2). Three pattern morphs are clearly evident (A–C), whereas a fourth (D) may not be distinct from the most common morph (A). The morphs are as follows:

Morph A. Pattern of interorbital bar, scapular and sacral chevrons, and lumbar bar; flanks and side of head not darker than dorsum and top of head. (Fig. 1).

Morph B. Flanks and side of head much darker than dorsum and top of head; dark vertebral stripe from tip of snout to vent bordered by paravertebral dark stripes. No chevrons or bars present.

Morph C. As in A except for fine, cream, dark-brown-edged vertebral stripe passing through chevrons and bars.

Morph D. As in A except for broad, pale cream, dorsolateral stripes; chevrons and bars occur between dorsolateral stripes.

At three localities, samples are adequate to compute frequencies of the morphs. Morph A is the most common at each locality (Santo Domingo de los Colorados and vicinity—86.4%; Las Palmas—93.3%; and Balzapamba—76.9%). The frequencies at the three localities are as follows (data given as numbers of A:B:C:D): Santo Domingo de los Colorados

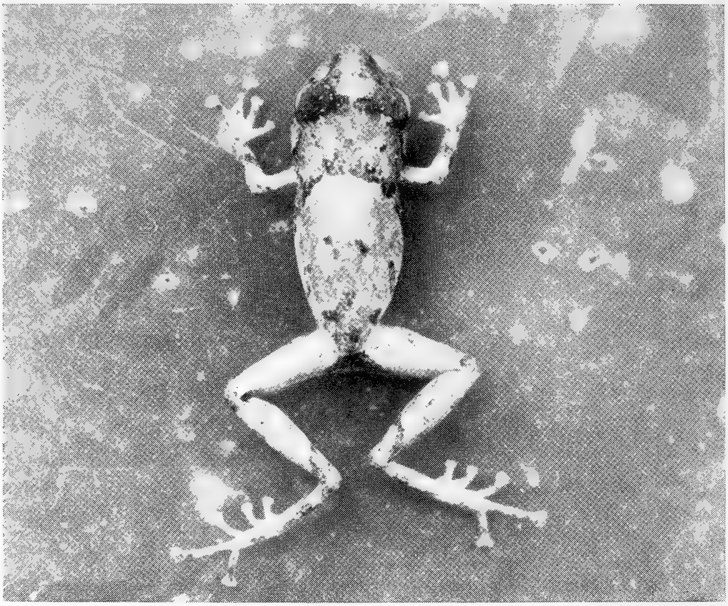

FIG. 1. *Eleutherodactylus walkeri* new species (KU 120230).

and vicinity—19:0:1:2; Las Palmas—14:1:0:0; and Balzapamba—30:5:3:1.

Color in life: Gray, brown, rusty-brown, or black with black or dark brown markings; dorsal surfaces irregularly flecked with cream; venter dark gray to dull black with pale gray flecking; groin and anterior and posterior surfaces of thighs (latter variable with respect to spotting) dark brown to black with lemon yellow spots; iris chocolate-brown reticulated with black or gray-bronze above, brown below; dark brown horizontal streak through eye.

Natural history: All specimens collected were found in forested or forest-analogue habitats. Perhaps due to its small size, *E. walkeri* has not been found on the forest floor but has been found on herbs 10–30 cm above the ground. One individual was taken at night about 2.5 m above the forest floor on an elephant-ear plant. The specimens from Las Palmas were found on sticks and ferns in the spray zone of a small waterfall (ca. 6–7 m in height) where the vegetation was constantly buffeted by wind and spray. At Balzapamba, all but two individuals were collected by day in the cut-off stumps of banana plants. Walker found males calling both by day and night and described the call as "a weak, single-syllabled 'tink', quite *Acris*-like in quality."

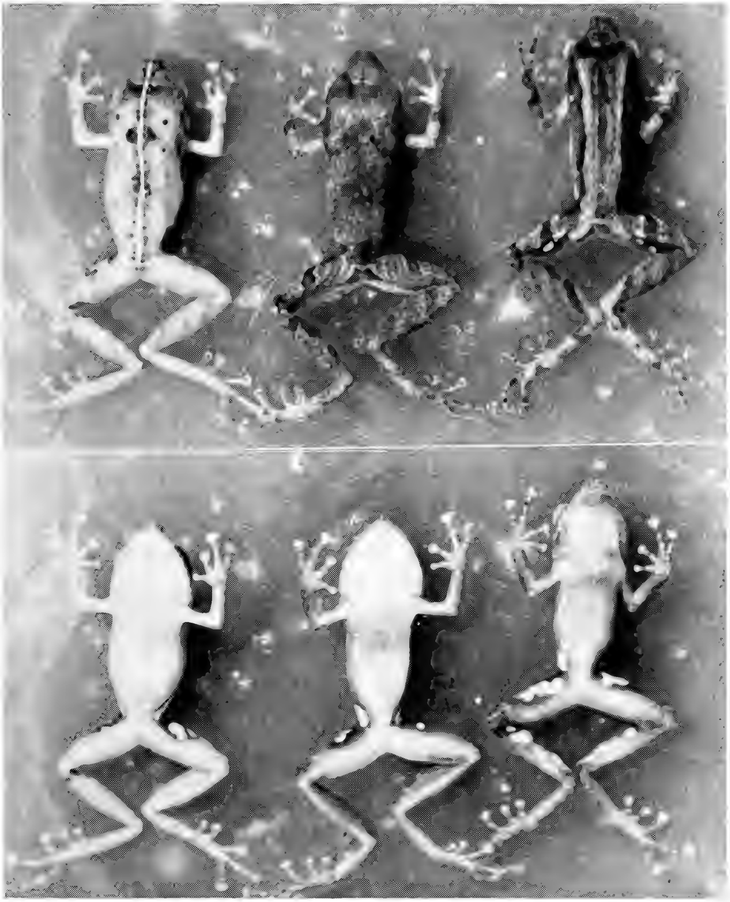

FIG. 2. Color pattern morphs of *Eleutherodactylus walkeri* new species. Top row, left to right, KU 120221 (morph C), 120215 (morph A), and 131628 (morph B). Lower row, left to right, KU 120221, 120215, 131628.

The only evidences of breeding were calling males (11 August 1962; 4 August 1968) at Hacienda Delta and Santo Domingo de los Colorados and an amplectic pair (KU 131652-53) at the type-locality (8 August 1970). The female of the pair (KU 131653) is the largest specimen examined (25.3 mm SVL) and has large, yellow ovarian eggs.

The known altitudinal range for *E. walkeri* is 220 m (Estacion Biologica Rio Palenque) to 1270 m (ESE of Balzapamba). Collections made on the Pacific slopes of the Andes at Tandapi, Prov. Pichincha

(1450 m), Apuela, Prov. Imbabura (1650 m), Guaranda, Prov. Bolivar (2500 m), and La Esperanza, Prov. Cotopaxi (1500 m), include several eleutherodactyline species but not *E. walkeri*; these localities are possibly too high for *E. walkeri.* The leptodactylid sympatrants of *E. walkeri* include two largely terrestrial species, *Barycholos pulcher* (diurnal) and *E. achatinus* (nocturnal), and several arboreal species (all nocturnal) including *E. areolatus, E. latidiscus,* and *E. ornatissimus* among the named forms. Of these, only *E. achatinus* occurs at elevations above 1270 m (found at Tandapi).

Measurements of the holotype in mm: SVL 17.9; tibia 9.4; head width 6.4; head length 6.6; upper eyelid width 1.6; IOD 2.1; tympanum length 0.8; eye length 2.5.

Etymology: Named for Charles F. Walker.

Other specimens examined: In addition to the type-material, the following have been examined. ECUADOR, *Prov. Bolivar*: Balzapamba, 800 m, KU 131613-51; 6 km ESE Balzapamba, 1270 m, KU 142039-40. *Prov. Cotopaxi*: 20.3 km W Pilalo, 830 m, KU 142034-38. *Prov. El Oro*: 32.6 km SSE Portovelo, 990 m, KU 142041. *Prov. Los Rios*: Estacion Biologica Rio Palenque, 56 km N Quevedo, 220 m, KU 147567-68. *Prov. Pichincha*: 3 km E Dos Rios, 1050 m, KU 142033; 3.7 km E Dos Rios, 1190 m, KU 142031-32; Rio Baba, 4 km E, 10 km S Santo Domingo de los Colorados, Univ. Illinois Mus. Nat. History 93560-61; Santo Domingo de los Colorados (vicinity of Hotel Zaracay), 660 m, KU 120215-21, 120227-31.

Remarks: Few species of Cochran and Goin's (1970) Group II (skin of venter areolate, first finger shorter than second) are as small as *E. walkeri.* Of the Group II species, only *E. carvalhoi* (northwestern Brazil and adjacent Colombia) and *E. croceoinguinis* (eastern Ecuador and adjacent Peru) are likely to be confused with *E. walkeri.* These three species have bright color patches in the groin (yellow in *carvalhoi* and *walkeri*, orange in *croceoinguinis*). The bright spots are irregular in shape and number in *walkeri* (Fig. 2), two are found on each side in *croceoinguinis* (one on the flank and one on the anterior thigh—both round), and one on the flank (round) in *carvalhoi.* The tympana are concealed in *carvalhoi* and *croceoinguinis* and neither species exhibits pattern polymorphism as in *walkeri.*

E. trachyblepharis (Boulenger) resembles *E. walkeri* in having visible tympana but lacks bright color patches on the concealed surfaces and does not exhibit pattern polymorphism. *E. trachyblepharis* has narrower digital pads and is slightly smaller than *E. walkeri*; *E. trachyblepharis* is currently known only from the Pastaza valley on the Amazonian versant of the Ecuadorian Andes. *E. martiae* Lynch, from the Amazon basin in Ecuador, resembles *E. walkeri* in size, structure of the hands and feet, and in exhibiting a similar pattern polymorphism. Unlike *E. walkeri, E. martiae* has a short, rounded snout, lacks color patches in the groin, does not have visible prevomerine odontophores, and has a concealed tympanum. The several other dwarf *Eleutherodactylus* known from northwestern South America will not be confused with *E. walkeri*. *E. acuminatus* Shreve has a protruding snout and concealed tympana; *E. diastema* (Cope) and *E. moro* Savage have short, fringed digits; *E. gularis* (Boulenger) has short, fringed digits and papillae at the tips of the digits (as in *E. areolatus*, see Lynch, 1971); *E. paululus* Lynch has a protruding snout and is much smaller; and *E. pseudoacuminatus* Shreve has a truncate snout and concealed prevomerine odontophores. None of these species has yellow spotting in the groin or on the concealed limbs and none is polymorphic in color pattern.

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PROCEEDINGS
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A NEW SPECIES OF *PSEUDOPOLYDORA* (POLYCHAETA, SPIONIDAE) FROM THE SOLOMON ISLANDS

By William J. Light

Department of Invertebrate Zoology
California Academy of Sciences
San Francisco, California 94118

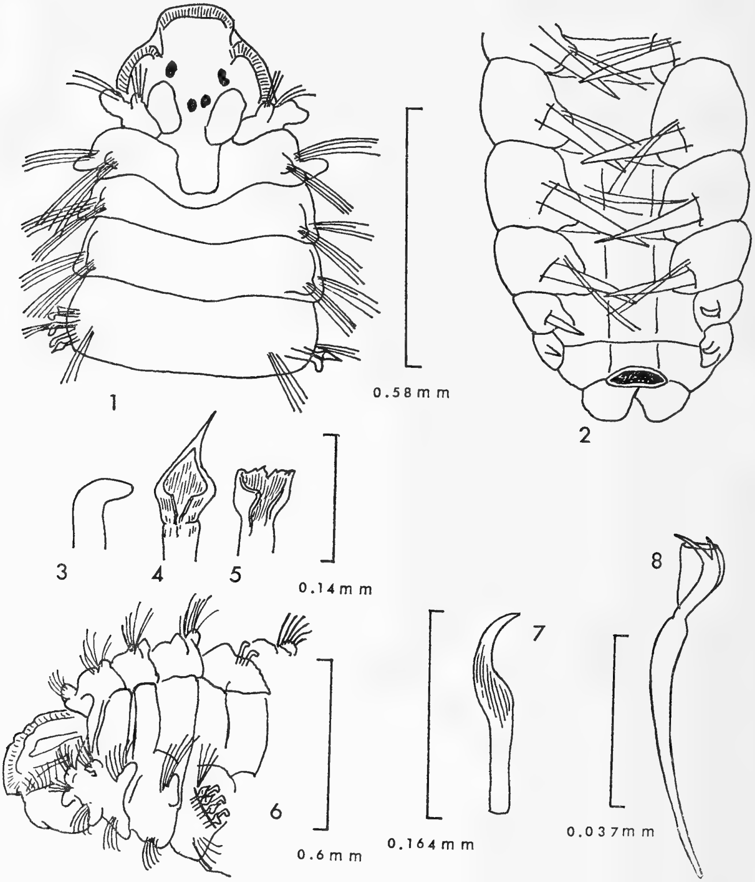
A new spionid polychaete of the genus *Pseudopolydora* Czerniavsky was collected in large numbers from the north coast of Guadalcanal Island in a lagoon at the mouth of the Lunga River by Peter E. Gibbs during the Royal Scientific Expedition to the Solomon Islands in 1965. The animals were taken from the interstices of a sponge growing around submerged tree roots, in association with the cosmopolitan serpulid, *Mercierella enigmatica* Fauvel. The new species was found in water of very low salinity (5.6 ‰). A more complete account of the ecology and faunal associations of this worm may be found in a monograph on the polychaetes of the Solomon Islands (Gibbs, 1971). I wish to thank Dr. Gibbs who kindly provided the specimens upon which this paper is based and in whose honor the species is named.

Pseudopolydora gibbsi, new species

Figures 1–8

Pseudopolydora sp., Gibbs, 1971: 173–174.

Diagnosis: Prostomium anteriorly entire, no occipital or nuchal cirrus; all notosetae, except posterior hooks, smooth simple capillaries, first present on setiger 1; stout, curved, notopodial hooks in posterior 15–17 segments; neuropodial crotchets from setiger 8, 6–8 per ramus; setiger 5 with 2 types of modified spines: (1) anterior row of stout spathe-like setae, with hollow ends bearing acuminate tips, and (2) posterior row of heavy, curved falcigers; modified spines of setiger 5 not ar-



FIGS. 1–8. *Pseudopolydora gibbsi*, new species. 1, anterior end, dorsal view, palpi removed; 2, posterior end, dorsal view; 3, major spine from posterior row of setiger 5; 4, major spine from anterior row of setiger 5; 5, major spine from anterior row of setiger 5, broken example; 6, anterior end, dorso-lateral view, showing arrangement of modified spines of setiger 5; 7, posterior notopodial hook; 8, neuropodial hooded crotchet.

ranged in double U-shaped row; branchiae from setiger 6, 10–14 pairs; pygidium much reduced, consisting of pair of small, ventral lappets.

Description: Largest specimen (holotype) 9 mm long by 0.5 mm wide at broadest point (setiger 5), but most examples only half this size.

Prostomium wide, anteriorly entire, with 2 pairs of eyes arranged trapezoidally, anterior pair twice as far apart as posterior pair; caruncle extending to middle of setiger 2, occasionally reaching anterior border of setiger 3 (Fig. 1). No trace of occipital or nuchal cirri. First setiger completely suppressed dorsally and ventrally by prostomial caruncle and peristomium, respectively. Well developed, extrusible proboscis present.

Body attenuated over anterior and posterior regions, attaining greatest width over median somites, beginning approximately with setiger 5. Notopodial postsetal lamellae of typical configuration, well formed over first 2–4 setigers, or may be much reduced. Neuropodial postsetal lamellae prominent on setigers 1 and 2, often reduced on 3 and absent on 4. Minute notosetal fascicle present on setiger 1. All setae, except modified spines of setiger 5, neuropodial crotchets and specialized posterior notopodial hooks, consisting of simple, alimbate, smooth, long capillaries numbering about 6 per fascicle.

Setiger 5 with 2 rows of modified major spines forming gentle arc (Fig. 6); anterior (ventral) row consisting of 5–6 stout, spathe-like, distally acuminate setae (Fig. 4), these spines often broken or worn (Fig. 5); posterior (dorsal) row consisting of 3–4 heavy falcigers with tip at right angles to main axis of shaft (Fig. 3). Both dorsal and ventral fascicles of capillary setae also present.

Hooded neuropodial crotchets commencing on setiger 8, 6–8 per ramus, with well developed manubrium (Fig. 8). Posterior 15–17 notopodia bearing 1 or 2 stout, sickle-shaped hooks on each side, together with 2–3 long capillaries (Figs. 2, 7).

Branchiae beginning on setiger 6, generally fully developed from that segment, typically 10–14 pairs, this arrangement not always symmetrical, there often being more on one side than other. Pygidium quite reduced, consisting merely of pair of ventral lappets (Fig. 2).

Color in alcohol: Fleshy white, occasionally with few very faint flecks of dark pigment on dorsum of anterior segments.

Type material: Holotype (ZB. 1970.880) and 26 paratypes are deposited in Porifera-Polychaeta Section of British Museum (Natural History).

Type-locality: Mouth of Lunga River, Guadalcanal Island (9° 24′ 30″ S, 160° 01′ 30″ E), from interstices of sponge, in association with *Mercierella enigmatica.*

Remarks: *Pseudopolydora gibbsi* resembles *P. antennata* (Claparède, 1870) in the configuration of the anterior modified setae on setiger 5. It also resembles *P. reishi* Woodwick, 1964, in that the modified major spine series does not form a U- or J-shaped double row, as generally seen in species of *Pseudopolydora. P. gibbsi* may be differentiated from *P. antennata* by the absence of an occipital cirrus and in exhibiting an entire prostomium. It is distinguished from *P. reishi* and *P. antennata* in the absence of a pygidial funnel. *P. pigmentata* Woodwick, 1964, also lacks an occipital cirrus, but there is only one pair of eyes, no notosetae on setiger 1 and the anterior row of modified setae on setiger 5 consists of limbate capillaries.

The hooded neuropodial crotchets exhibit an overall configuration intermediate between that of *Pseudopolydora* and the genus *Polydora* Bosc; the apical tooth is less closely imbricated over the main fang than in most species of *Pseudopolydora* but more so than in most species of *Polydora*, with both forming an angle of 90° with the main shaft. Their commencement on setiger 8 is consistent with *Pseudopolydora.* The presence of only a few simple capillaries differs from the dense, 3-tiered fascicles of heteromorphic setae generally seen in species of *Pseudopolydora,* such as *P. kempi* (Southern, 1921) and *P. paucibranchiata* (Okuda, 1937; 232, 234, Fig. 12b; see also Imajima and Hartman, 1964: 287; Light, 1969: 544).

The posterior notopodial hooks are unique for species of this genus. Their close resemblance to similar hooks in *Boccardia hamata* (Webster), Blake, 1966, as well as to those of the *Polydora hoplura-colonia* complex (see Light, 1969: 540), indicates that such specialization of the posterior notosetae must be incipient in the entire polydorid line, having developed independently several times. Similarly, the tendency towards reduction of the pygidium into small lappets is also seen in all three genera.

Pseudopolydora gibbsi appears to be quite specialized by virtue of the development of the major spines in the anterior row of setiger 5, the reduced number of crotchets in each ramus, the absence of an occipital cirrus and the presence of highly modified posterior notopodial hooks. The only other species of *Pseudopolydora* known to possess modified posterior notosetae is *P. corallicola* Woodwick, 1964, from Eniwetok Island. In this form the posterior notosetae are awl-shaped and grouped together in conical bundles, a condition very similar to that seen in the *Polydora armata-caulleryi* complex (see Light, 1969: 542).

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COMMENTS ON THE TAXONOMY OF THE WEST AFRICAN *TATERILLUS* (RODENTIA: CRICETIDAE) WITH THE DESCRIPTION OF A NEW SPECIES

By C. Brian Robbins

Division of Mammals, National Museum of Natural History, Washington, D.C. 20560

The taxonomy of West African rodents of the genus *Taterillus* is confused. Allen (1939) and Ellerman (1941) listed four taxa: *T. gracilis gracilis* (Thomas, 1892), *T. g. angelus* Thomas and Hinton, 1920, *T. nigeriae* Thomas, 1911, and *T. lacustris* (Thomas and Wroughton, 1907). Rosevear (1969) recognized two species, *T. gracilis* and *T. nigeriae*, allocating *T. lacustris* as a subspecies of *T. gracilis. Taterillus pygargus* (F. Cuvier, 1838), long considered a species of *Gerbillus* occuring in Egypt and the Sudan, has been shown by Petter (1952) to be a species of *Taterillus.* The holotype of *T. pygargus* is from Senegal. This taxon was overlooked by Rosevear (1969).

Even though Ellerman (1941) and Rosevear (1969) recognized more than one species of *Taterillus*, they suggested that the West African forms could be a single polymorphic species. Cytogenetic data and additional study specimens demonstrate the presence of at least four distinct species. Near topotypes of *T. gracilis* from Senegal have a karyotype of $2N = 36/37$, $FN = 44$ (Matthey and Jotterand, 1972; Petter *et al.*, 1972). Chromosomal information is also known on *Taterillus* from Upper Volta (Matthey and Petter, 1970; Matthey and Jotterand, 1972), Ivory Coast (Petter, pers. comm.), and Ghana (Robbins unpublished data). These specimens have a karyotype of $2N = 36/37$, $FN = 42$, and have been identified as

T. gracilis. Chromosomal information has been reported from near topotypes of *T. pygargus* (2N = 22/23, FN = 37–40) from Senegal (Matthey and Jotterand, 1972; Petter *et al.*, 1972). Specimens from the Cameroon with a karyotype of 2N = 28, FN = 44 have been referred to *T. lacustris* (Tranier *et al.*, 1974). A *Taterillus* with a karyotype of 2N = 30, FN = 36, reported as *T. nigeriae* has been found in Mauritania (Matthey, 1969).

Petter (1972) revised all of the species and subspecies of *Taterillus* utilizing chromosomal information. Based on a greater number of specimens and additional karyotypic information, I have come to different conclusions regarding the taxonomy of West African *Taterillus*. The large number of West African specimens of *Taterillus* now available are a result of the Smithsonian Institutions' African Mammal Project under the direction of Dr. H. W. Setzer. Among these are 115 specimens from Mauritania where *Taterillus* was previously known only by the single specimen reported by Matthey (1969) and Petter (1970). The purpose of this report is to clarify the identities of the West African *Taterillus*.

MATERIALS AND METHODS

The specimens used in this study, except for a single individual from the Museum National d'Histoire Naturelle, Paris (MNHP), which was reported as a 2N = 30 karotype by Matthey (1969), are housed in the National Museum of Natural History, Division of Mammals (USNM), and were all prepared as conventional museum study skins. Twenty-four measurements as applied to *Taterillus* by Robbins (1973), were made of various dimensions of the skull. Measurements are in millimeters, weights in grams, and capitalized color terms are those of Ridgway (1912).

Computer analyses were performed through the Information Systems Division, Smithsonian Institution. The Smithsonian-developed DSTAT univariate analysis program yielded standard statistics (mean, standard error, standard deviation, variance, coefficient of variation, and range), as well as Student's "t" test, F-test for homogeneity of variance, and one-way analysis of variance. The BMDO7M (Dixon, 1973) multivariate program performed the step-wise discriminant function analysis. Results from multivariate analysis are shown in Table 1. A scattergram of the first two canonical variates and character vectors are presented in Figure 2. Vectors were determined by multiplying the pooled within-groups standard deviation by the coefficients for canonical variates one and two for the most useful characters (Power and Tamsitt, 1973).

An analysis of the West African *Taterillus*, which includes a reexamination of the Mauritanian specimen discussed by Matthey (1969) and Petter (1970), reveals the presence of a heretofore undescribed species that may be known as:

Taterillus arenarius, new species

Holotype: Adult male, skin and skull, USNM 401919, from Tiguent, Trarza Region, Mauritania; obtained 9 April, 1967, by C. B. Robbins, original number 799.

Etymology: The name *arenarius* refers to the sandy substrate characterizing the areas where the species occurs.

Distribution: Mauritania, Niger, and presumably Mali (Fig. 1).

Definition: Interauricular, interorbital, and rostral areas same color as dorsum and varying from Sayal Brown to Snuff Brown; circumorbital region, postauricular patches, mystacial and pectoral areas, fore and hind limbs, and entire underparts white; cheeks and sides Cinnamon-Buff; dorsal hairs plumbeous basally, the brown pigmented portion only 2 to 3 mm in length, and some hairs finely tipped with dark brown; fore and hind limbs have five digits with claws, plantar surfaces naked except for a narrow band of white hairs; pinna of ear long and almost naked, color almost the same as the dorsum, and anterior margin with short buff colored hairs; vibrissae long and composed of both white and dark brown hairs; tail long and uniformly Cinnamon-Buff basally with the dorsal hairs interspersed with darker brown hairs grading to a terminal Mummy Brown pencil; ventrally, the Cinnamon-Buff color grades to white in the region of the pencil.

Skull relatively large for the genus and moderately robust; zygomata heavy; lachrymals large; molariform teeth medium-sized; auditory bullae large and inflated; parapterygoid fossae large and deep but not markedly flared; rostrum relatively long and slightly expanded anterior to the infraorbital shield; nasals relatively broad and long; braincase flattened.

Measurements: Measurements of the holotype (age class 5; see Robbins, 1973) followed by averages and extremes of eight adults (age class 4) from the type-locality are, respectively: total length 289, 279 (269–300); head and body length 128, 117 (111–124); length of tail 161, 163 (158–176); length of hind foot 33, 33 (32–34); length of ear from

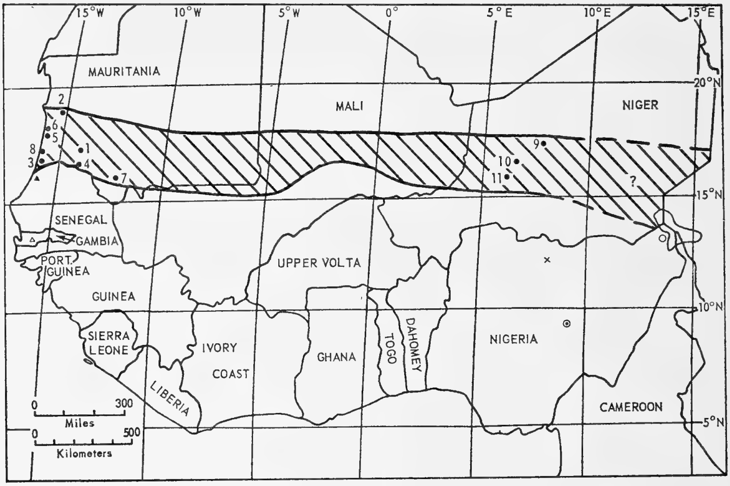

FIG. 1. Distribution of *T. arenarius* with known localities shown by closed circles. Type-localities for the other species and subspecies of West African *Taterillus* are: *T. pygargus,* closed triangle; *T. g. gracilis,* open triangle; *T. g. angelus,* ×; *T. g. nigeriae,* open circle with dot enclosed; *T. lacustris,* open circle.

notch 22, 21 (19–22); weight 59, 46 (42–52); greatest length of skull (GLS) 36.9, 35.6 (34.9–36.3); occipitonasal length 35.7, 34.3 (33.4–35.3); basilar length 26.9, 25.7 (25.2–26.5); zygomatic breadth 18.2, 17.6 (17.4–17.8); condylobasilar length 28.8, 27.5 (27.1–28.2); cranial breadth 14.6, 14.4 (13.6–14.7); least interorbital constriction 6.0, 6.1 (5.8–6.6); breadth of rostrum 4.5, 4.6 (4.4–4.8); greatest breadth across bullae (GBAB) 13.9, 13.4 (12.8–13.8); greatest width across upper molars 7.3, 7.1 (6.7–7.3); length of diastema 9.0, 8.9 (8.6–9.6); palatilar length 15.3, 15.0 (14.6–15.3); postpalatal length (PPAL) 11.3, 10.6 (10.0–11.0); length of anterior palatine foramina 6.2, 5.9 (5.5–6.5); length of palatal bridge 7.4, 7.3 (7.0–7.7); length of auditory bulla (LAB) 10.1, 9.4 (9.0–9.7); breadth of auditory bulla (BAB) 6.2, 5.8 (5.6–6.1); length of nasals 15.0, 14.8 (14.1–15.3); length of rostrum 13.4, 12.9 (12.7–13.6); frontonasal length 28.2, 27.2 (26.4–28.3); depth of cranium 13.7, 13.6 (13.0–13.8); length of posterior palatine foramina (LPPF) 3.8, 3.7 (3.2–4.2); alveolar length of first molar (ALM1) 2.8, 2.7 (2.4–3.1); alveolar length of maxillary toothrow 5.1, 5.1 (5.0–5.4).

Comparisons: *Taterillus arenarius* can be distinguished from *T. pygargus,* where the two occur together, by its markedly longer and more robust skull; flatter, less rounded braincase; broader rostrum and slightly larger incisors; more bulbous bullae; slightly smaller cheek teeth; parapterygoid fossae larger (deeper) but not so widely flaring; and paler dorsal coloration. At Garak, Mauritania, where *T. arenarius* is sympatric with *T. pygargus*, the latter are darker dorsally and laterally—Snuff Brown and Tawny-Olive, respectively.

Taterillus arenarius differs from *T. gracilis* by its broader, more robust skull although the skulls are similar in length. The bullae of *T. arenarius* are more inflated anteriorly, antero-laterally, and ventrally. The pelage color of *T. arenarius* is conspicuously paler.

Taterillus arenarius closely resembles *T. lacustris*, from which it can be distinguished by its somewhat narrower nasals, flatter braincase, and more inflated bullae. The pelage color is similar.

Remarks: A specimen of *Taterillus* from Bou Rjeimat, Mauritania, has a reported karyotype of 2N = 30, FN = 36 (Matthey, 1969) and was identified by Matthey (1969), Petter (1970), and Petter (1972) as *T. nigeriae*. Inasmuch as the karyotype of *T. nigeriae* was not known, and since its geographic range is closer to Mauritania than any other known species of *Taterillus*, this allocation was made. However, an examination of available specimens of *T. nigeriae*, including the holotype, demonstrates that *T. arenarius* is distinct. *Taterillus nigeriae* is darker in dorsal coloration and occupies a different habitat.

Taterillus arenarius is restricted in distribution to the vegetated sandy habitats of the northern Sahel Savanna and Sub-Desert of West Africa. It is replaced southward by either *T. pygargus* or *T. gracilis*. Where sympatric with *T. pygargus*, this species occupies the sandier habitats while *T. pygargus* is found in areas with a harder substrate vegetated with tall grasses. Eastward, *T. arenarius* is replaced by *T. lacustris*.

Other rodents occurring with *T. arenarius* are: *Gerbillus* (*Gerbillus*) *gerbillus*, *G.* (*G.*) *pyramidum*, *G.* (*G.*) *nigeriae*, *G.* (*Hendecapleura*) *mauritaniae*, *G.* (*H.*) *amoenus*, *Tatera guineae*, *T. kempi*, *T. gambiana*, *T. wellmani*, *Desmodilliscus braueri*, *Jaculus jaculus*, *J. deserti*, *Arvicanthis niloticus*, and *Euxerus erythropus*.

Specimens examined: Mauritania (97). Inchiri Region: Bou Rjeimat, 1 (MNHP 247); Trarza Region: 11 km N Nouakchott, 5 (USNM 411120–411124); 6 km E Nouakchott, 3 (USNM 401117–401119); Tiguent, 48 (USNM 401893–401939); Garak, 10 (USNM 401940; 401941; 401950–401956; 401958); Brakna Region: 3 km S Aleg, 14 (USNM 401960–401973); Gorgol Region: Kaedi, 10 (USNM 401974–401983); Guidimaka Region: Passe de Soufa, 6 (USNM 401989; 401994–401996; 401998; 401999). Niger (15). Agadez Region: 5 km NE Agadez, 7 (USNM 482626–482632); 30 km S In-Gall, 3 (USNM 482633–482635); Tahoua Region: 120 km S In-Gall, 5 (USNM 482636–482640).

Gazetteer: (Localities plotted in Figure 1)

1.	Aleg, 3 km S	17°02′N., 13°55′W.
2.	Bou Rjeimat	19°04′N., 15°08′W.
3.	Garak	16°33′N., 15°46′W.

TABLE 1. Discriminant coefficients for characters most useful in separating three West African species of *Taterillus*. For explanation of abbreviations see text and Fig. 2

Character	A vs. P	A vs. G	P vs. G
BAB	9.287	11.552	2.265
GBAB	– 6.197	– 0.334	5.863
PPAL	–11.921	–20.116	– 8.195
GLS	4.758	– 7.975	–12.715
ALM1	14.857	22.794	8.237
LAB	– 6.624	– 2.408	4.216
LPPF	–14.407	–13.813	0.594

4.	Kaedi	16°09′N., 13°30′W.
5.	Nouakchott, 6 km E	18°09′N., 15°58′W.
6.	Nouakchott, 11 km N	18°13′N., 16°01′W.
7.	Passe de Soufa	15°56′N., 12°00′W.
8.	Tiguent	17°16′N., 16°01′W.
9.	Agadez, 5 km NE	17°02′N., 08°02′E.
10.	In-Gall, 30 km S	16°33′N., 06°52′E.
11.	In-Gall, 120 km S	15°45′N., 06°36′E.

Analysis of Variation and Diagnostic characteristics of the Species: Table 1 and Figure 2 show the results of the discriminant analysis on three species of *Taterillus*. The specimens of *T. gracilis* and *T. pygargus* were age class 4 animals (see Robbins, 1973) of known karyotype representing several localities in Senegal. The specimens of *T. arenarius* were also age class 4 from several Mauritania localities, but most were from the type-locality.

The mean and standard error for seven cranial characters in their order of inclusion in the discriminant analysis are shown in Table 2. These seven cranial characters were selected as the minimum necessary for discriminating the three species because of sample size. In addition, by step seven, the F-matrix in the discriminant analysis showed significant differences between the three groups at the 95 per cent level.

It should be noted that three of the cranial characters in the discriminant analysis reflect auditory bulla dimensions. *Taterillus arenarius* and *T. pygargus* have bullar shapes which are more similar to each other than either are to *T. gracilis*. In areas where *T. arenarius* and *T. gracilis* are sympatric (as well as areas where *T. pygargus* and *T. gracilis* occur together), comparisons of bullar shape and size are the most reliable method of distinguishing between the species. The length and direction of the cranial character vectors (Fig. 2) show the relative importance of each variable in discriminating between the three species. When a clean, intact skull is available, specimens of unknown identity can be correctly allocated.

TABLE 2. Means and standard error for seven cranial characters in their order of inclusion in the discriminant analysis. For explanation of abbreviations see text.

	T. arenarius (n = 15)		*T. pygargus* (n = 9)		*T. gracilis* (n = 7)	
Character	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
1. BAB	5.70	0.084	5.50	0.087	5.30	0.117
2. GBAB	13.40	0.109	13.80	0.137	13.30	0.157
3. PPAL	10.50	0.149	10.50	0.070	10.90	0.146
4. GLS	35.40	0.190	35.00	0.102	35.30	0.261
5. ALM1	2.66	0.081	2.83	0.041	2.77	0.047
6. LAB	9.40	0.082	9.30	0.087	9.40	0.084
7. LPPF	3.60	0.121	3.60	0.095	3.50	0.094

The chromosomes of *T. arenarius* are only known from the female reported under the name *T. nigeriae* by Matthey (1969). Its karyotype (as reported by Matthey, 1969) consists of one pair of large subtelocentrics, three pairs of medium-sized to small metacentrics, and ten pairs of medium-sized acrocentric autosomes. The X-chromosomes are large submetacentrics. The Y-chromosome is unknown.

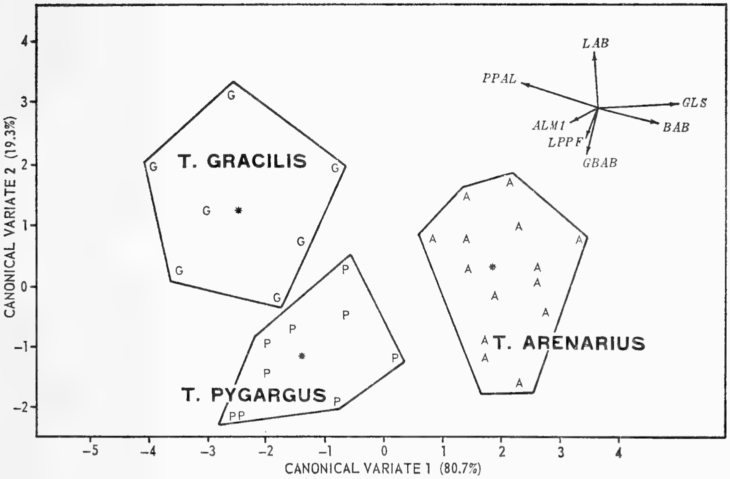

FIG. 2. Projection of the first two canonical variates for three species of West African *Taterillus*. Vectors show relative contributions of the characters in the discriminant analysis. For explanation of abbreviations see text.

On gross morphology, the four West African species of *Taterillus* appear to be closely related. However, their different karyotypes do not affirm a common derivation. The $2N = 28$, $FN = 44$ karyotype of *T. lacustris* could have been easily derived from the $2N = 36$, $FN = 44$ karyotype of *T. gracilis* through four fusions. However, serum protein analysis (Tranier *et al.*, 1974) shows that *T. lacustris* is more closely related to *T. pygargus* than to *T. gracilis.* The $2N = 30$, $FN = 36$ karyotype of *T. arenarius* and the $2N = 22$, $FN = 40$ karyotype of *T. pygargus* could also have been derived from the *T. gracilis* karyotype, but would have required a complex series of translocations and inversions. The $2N = 22$, $FN = 40$ karyotype of *T. pygargus* could have been derived from the $2N = 30$, $FN = 36$ karyotype of *T. arenarius* through two inversions and four fusions. Speculation on the relationships of these four species based on their karyotypes is premature at this time, and should await additional information from banding pattern analysis.

ACKNOWLEDGMENTS

Special thanks must go to Henry W. Setzer for allowing me to study the *Taterillus* collection at the Smithsonian, for the opportunity to collect in West Africa, for computer time, and for commenting on the manuscript. Francis Petter (MNHP) kindly provided specimens and karyotype information. Dan Piecesi and Charles Roberts of the Smithsonian Information Systems Division helped with the computer programs. Don E. Wilson and Michael A. Bogan tutored me on multivariate statistics and read the manuscript. Alfred L. Gardner critically reviewed the manuscript and offered numerous helpful suggestions. My wife Norrie provided the illustrations. This paper is based on specimens collected under the U.S. Army Medical Research and Development Command Contract No. DA-49-193-MD-2738, and the research was partially funded by National Science Foundation Grant GB 35143 to the author.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

PSEUDOPHALLUS BRASILIENSIS (PISCES: SYNGNATHIDAE), A NEW FRESHWATER PIPEFISH FROM BRAZIL

By C. E. Dawson

Gulf Coast Research Laboratory Museum
Ocean Springs, Mississippi 39564

I recently received eight specimens of an undescribed syngnathine tailpouch pipefish of the genus *Pseudophallus* Herald (1940) from the Rio Tocantins, a major tributary of the lower Rio Amazonas, Brazil. Although the genus is treated in a manuscript being prepared for the Sears Foundation series "Fishes of the Western North Atlantic," there will be considerable delay in completion of that work. Description of the new species is, therefore, given at this time in order to make the name available.

Type-material has been deposited in collections of the Museu de Zoologia da Universidade de São Paulo (MZUSP), National Museum of Natural History, Smithsonian Institution (USNM) and Gulf Coast Research Laboratory Museum (GCRL). Measurements (mm) or proportions referred to standard length (SL) or head length (HL) are given for the holotype followed, in parentheses, by the range for the remainder of the type-series; counts from the holotype are marked with an asterisk (*). Coloration is described from alcohol preserved specimens. Data used in species comparisons are from my observations on almost all specimens of *Pseudophallus* now available in Central and North American collections. Lists of these examined materials are omitted here, but will be included in the forthcoming general treatment of the genus mentioned above.

I thank the curators of the various institutions that have loaned comparative material. Special acknowledgment is due Dr. Naércio A. Menezes (MZUSP) for providing the specimens of the new species which were obtained by the MZUSP Expedição Permanente da Amazônia. Drawings are by Anne Langenfeld (GCRL). This work was in part supported by National Science Foundation Grant GB-31053X.

Pseudophallus brasiliensis, new species

Figure 1

Holotype: MZUSP 10278 (85 mm SL, male); Brazil, Pará, Rio Tocantins, Igarapé Inó, Faro de Panaquera; 01°52′S, 49°10′W; 1 Sept. 1970.

Allotype: USNM 212058 (70, female); taken with holotype.

Paratypes: MZUSP 10627 (1 specimen, 43 mm SL); taken with holotype. MZUSP 10279 (2, 60–63), GCRL 12755 (2, 56–66); Brazil, Pará, Rio Tocantins, Igarapé Mapará, Parana, Samuuma; 02°05′S, 49°20′W; 5 Sept. 1970. MZUSP 10280 (1, 54); Brazil, Pará, Rio Tocantins, Igarapé Acicurá at Cameta; 02°15′S, 49°30′W; 7 Sept. 1970.

Diagnosis: Dorsal fin rays 28 to 31, located on 6.75 to 7.25 tail rings; trunk rings 13; tail rings 31 to 32; median head ridges, opercular and pectoral cover plate ridges, trunk and tail ridges somewhat elevated, distinct; length of dorsal fin in head 0.9 to 1.0; snout without a longitudinal brownish stripe.

Counts and measurements: Dorsal fin rays 28(in 1), 29*(5), 30(1), 31(1); pectoral fin rays 13(4), 14*(8), 15(4); caudal fin rays 10(8), trunk rings 13(8); tail rings 31(3), 32*(5); trunk rings covered by dorsal fin 0(8); tail rings covered by dorsal fin 6.75*(3), 7.0(3), 7.25 (2). Head length 9.5 (5.8–8.1); snout length 3.4 (2.3–3.1); least breadth of snout 0.9 (0.6–0.9); pectoral fin length 1.8 (1.0–1.3); caudal fin length 3.5 (2.3–2.9); length of dorsal fin base 10.1 (5.8–9.1). Head length in SL 8.9 (7.4–8.6); snout length in HL 2.8 (2.5–2.7); dorsal fin base in HL 0.9 (0.9–1.0).

Description: Median snout ridge smooth, somewhat elevated, extends from rear of articulation of upper jaw to about anterior third of interorbital (Fig. 2); supraorbital, frontal, nuchal and prenuchal ridges low but distinctly elevated and prominent in all specimens; opercular ridge prominent, complete in 6 specimens (extends across ¾ of opercle in remainder) margined above and below by radiating striae; pectoral cover plate with a distinct anteroventrally directed ridge margined by radiating striae; trunk and tail ridges well defined, their edges distinctly granular or scalloped under 30× magnification; width of intermedial scutellar plates on trunk and anterior portion of tail equals about a third the distance between proximal margins of adjacent scutellae. Body

FIG. 1. Head and anterior part of body of *Pseudophallus brasiliensis*; USNM 212058, allotype female, 70 mm SL.

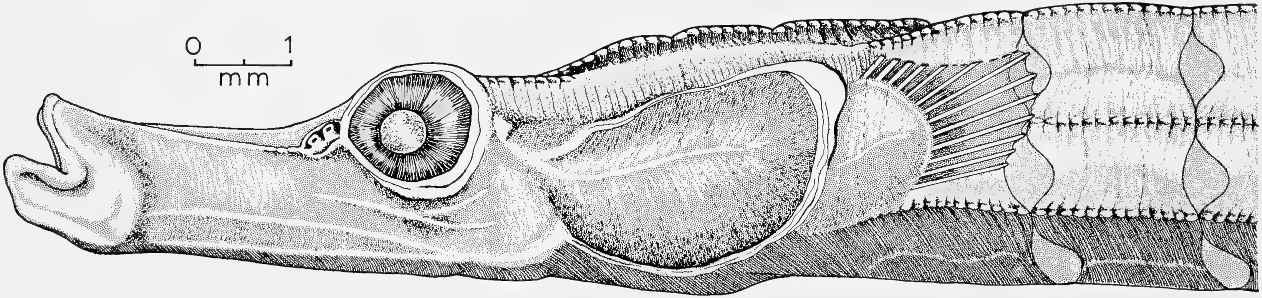

FIG. 2. Delineation of head and anterior trunk rings of *Pseudophallus brasiliensis*; MZUSP 10278, holotype.

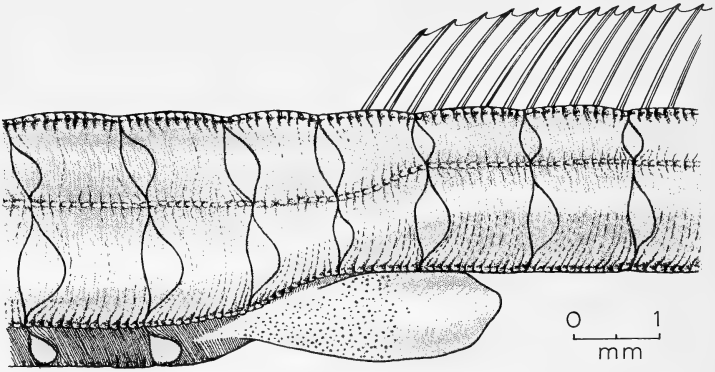

FIG. 3. Delineation of posterior trunk and anterior tail rings of *Pseudophallus brasiliensis*, illustrating ridge pattern, dorsal fin location and anal papilla of USNM 212058; allotype.

ridge pattern typical of *Pseudophallus*, i.e., lateral trunk ridge continuous across anal ring, uniting with superior tail ridge near right angle from posterior end of dorsal fin, usually with some irregular degree of deflection at or near anal ring (Fig. 3). Lateral line neuromasts indistinct. Dorsal fin originates at middle of first tail ring; anal fin absent; abdomen somewhat V-shaped in both sexes. Anal papilla of mature females much enlarged (Fig. 3), apparently smooth over its distal third, the middle portion distinctly papillose under 30× magnification; anal papilla measured 1.9 mm (from posterior basal angle to tip) in allotype, 2.4 mm in 66 mm fish (GCRL 12755). Brood pouch of holotype covers 13 tail rings and contains eggs through 12 rings; maximum diameter of 5 measured eggs with eyed larvae was 1.1 mm.

Ground color tan to brown, markings brown to near black, generally darkest on venter. Markings highly variable, generally distinctly blotched and mottled with brown (Fig. 1), most frequently with up to 13 irregularly spaced, narrow, pale bands on trunk and tail; head irregularly blotched, snout without a lateral stripe; iris crossed by up to 10 brown bars somewhat narrower than interspaces; dorsal and pectoral fin rays irregularly edged with brown melanophores; caudal fin dark brown with narrow pale margin. Proximal half of anal papilla of mature females heavily pigmented with brown melanophores, distal portion pale to nearly white with few flecks of brown.

Etymology: Named *brasiliensis*, in reference to the Brazilian type-locality.

Comparisons: Principal features differentiating *Pseudophallus brasiliensis* are given in the key below.

Discussion: The amphi-American genus *Pseudophallus* now includes four closely related forms that appear to be largely restricted to fluvial

TABLE 1. Frequency distributions of dorsal fin rays in species of *Pseudophallus*.

Species	N	Dorsal fin rays																			x̄
		27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
starksi	325											5	46	89	79	75	27	3	1		39.8
mindii	31							4	5	6	2	8	2	3		1					36.1
elcapitanensis	60				1	5	25	18	8	3											32.6
brasiliensis	8		1	5*	1	1															29.2

* holotype.

TABLE 2. Frequency distributions of total body rings (trunk rings + tail rings) in species of *Pseudophallus*.

Species	N	Total body rings												x̄
		43	44	45	46	47	48	49	50	51	52	53	54	
starksi	324								31	179	106	8		51.3
mindii	30				3	10	8	4	4	1				48.0
elcapitanensis	60						4	36	19	1				49.3
brasiliensis	8		3	5*										44.6

* holotype.

habitats. All exhibit considerable overlap in meristic or morphometric characters but they appear to represent distinct taxa. Meristic features, such as frequencies of dorsal fin rays or total body rings (Table 1 and 2), alone do not permit identification of single specimens, but little difficulty is encountered when multicharacter comparisons are employed.

The late Earl S. Herald (unfinished Ms.) treated the Atlantic *P. mindii* as a subspecies of the Pacific *P. starksi* and retained species rank for the other Pacific form, *P. elcapitanensis.* He was, however, unaware of the new Brazilian form and had not seen much of the material examined by me. My data indicate a modal shift from 40 to 39 dorsal fin rays between Mexican and Costa Rican-Panamanian populations of *P. starksi*, but there is no evidence of clinal variation in the other species. The Pacific forms are sympatric in Costa Rica and Panamá and sympatric populations of *P. mindii* and *P. brasiliensis* may occur in Brazil. Pending collection of more extensive series from Atlantic drainages, I retain species rank for each of the four nominal forms of *Pseudophallus.*

Provisional key to the genus *Pseudophallus*

1. Trunk rings modally 14 (99%); Pacific species 2
   Trunk rings modally 13 (78%); Atlantic species 3
2. Dorsal fin rays 37 to 44 ($\bar{x} = 40$); dorsal fin covers 9.0 to 11.0 ($\bar{x} = 9.7$) rings; trunk rings 13 to 15 ($\bar{x} = 14$); usually with a distinct, broad, brown stripe on snout and short ventrally directed brown bar or blotch behind eye; Baja California Sur, México to Ecuador .... *P. starksi* (Jordan and Culver)
   Dorsal fin rays 30 to 35 ($\bar{x} = 33$); dorsal fin covers 6.75 to 7.50 ($\bar{x} = 7.1$) rings; trunk rings 14; without postorbital bar or stripe on snout; Costa Rica and Panamá .... *P. elcapitanensis* (Meek and Hildebrand)
3. Dorsal fin rays 33 to 41 ($\bar{x} = 36$); dorsal fin covers 7.50 to 10.25 ($\bar{x} = 8.7$) rings; length of dorsal fin base in head 0.6 to 1.0 ($\bar{x} = 0.7$); rings total 46 to 51 ($\bar{x} = 48$); head ridges usually indistinct or obsolete in adults; usually with postorbital blotch and stripe on snout; Cuba, Jamaica, Guatemala to Panamá, Venezuela and Brazil .... *P. mindii* (Meek and Hildebrand)
   Dorsal fin rays 28 to 31 ($\bar{x} = 29$); dorsal fin covers 6.75 to 7.25 ($\bar{x} = 7.0$) rings; length of dorsal fin base in head 0.9 to 1.0 ($\bar{x} = 1.0$); rings total 44 to 45 ($\bar{x} = 45$); head ridges prominent in adults; without postorbital bar or stripe on snout; Rio Tocantins, Brazil .... *P. brasiliensis* new species

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PROCEEDINGS
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BIOLOGICAL SOCIETY OF WASHINGTON

CYCLOPOID COPEPODS (LICHOMOLGIDAE) FROM GORGONACEANS IN MADAGASCAR

By Arthur G. Humes

Boston University Marine Program,
Marine Biological Laboratory,
Woods Hole, Massachusetts 02543

Lichomolgid copepods associated with Gorgonacea have been reported from the West Indies (Humes and Stock, 1973), Bermuda (Humes, 1973a), and the Mediterranean coast of France and Spain (Stock and Kleeton, 1963). In addition three lichomolgid copepods are known to be associated with Gorgonacea in Madagascar. These are *Acanthomolgus astrictus* Humes and Stock, 1973, from *Acanthogorgia aspera* Pourtalès, *Acanthomolgus hales* Humes and Stock, 1973, from *Solenocaulon tortuosum* Gray, and *Metaxymolgus cinctus* Humes and Stock, 1973, from *Psammogorgia ramosa* Kükenthal.

This paper includes the descriptions of three new species of *Acanthomolgus* and one new species of *Paramolgus*, along with new records for certain species of *Acanthomolgus*, *Metaxymolgus*, and *Telestacicola*. All these were collected by the author from shallow-water gorgonaceans in the vicinity of Nosy Bé in northwestern Madagascar. The specimens were recovered from the sediment obtained after washing the hosts in approximately 5 per cent ethyl alcohol in sea water.

The field work in 1963–64 was carried out while the author was chief scientist in Madagascar for the U. S. Program in Biology of the International Indian Ocean Expedition. The work in 1967 was supported by a grant (GB-5838) from the National Science Foundation. The study of the material has been aided by another grant (GB-8381X) also from the Na-

tional Science Foundation. I wish to acknowledge with many thanks the generous assistance given by the staff of the Centre O.R.S.T.O.M. de Nosy Bé, where the field work was done.

I am greatly indebted to Dr. J. Vervoort, Rijksmuseum van Natuurlijke Historie, Leiden, for the identification of the gorgonacean hosts.

The observations and measurements were made on specimens cleared in lactic acid. Measurements are in microns unless otherwise specified. The dimensions of the body are based on ten specimens and the body length does not include the setae on the caudal rami. The lengths of the segments of the first antennae are taken along their posterior nonsetiferous margins. All figures have been drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn.

Acanthomolgus Humes and Stock, 1972

Acanthomolgus mopsellae, new species

Figures 1–17

Type-material: 285 ♀♀, 470 ♂♂, and 311 copepodids from one colony of the gorgonacean *Mopsella rubeola* Wright and Studer, in 3 m, Pte. Lokobe, Nosy Bé, Madagascar, 3 June 1967. Holotype ♀, allotype, and 567 paratypes (201 ♀♀, 366 ♂♂) deposited in the National Museum of Natural History (USNM), Washington; 90 paratypes (40 ♀♀, 50 ♂♂) in the Zoölogisch Museum, Amsterdam; the remaining paratypes in the collection of the author.

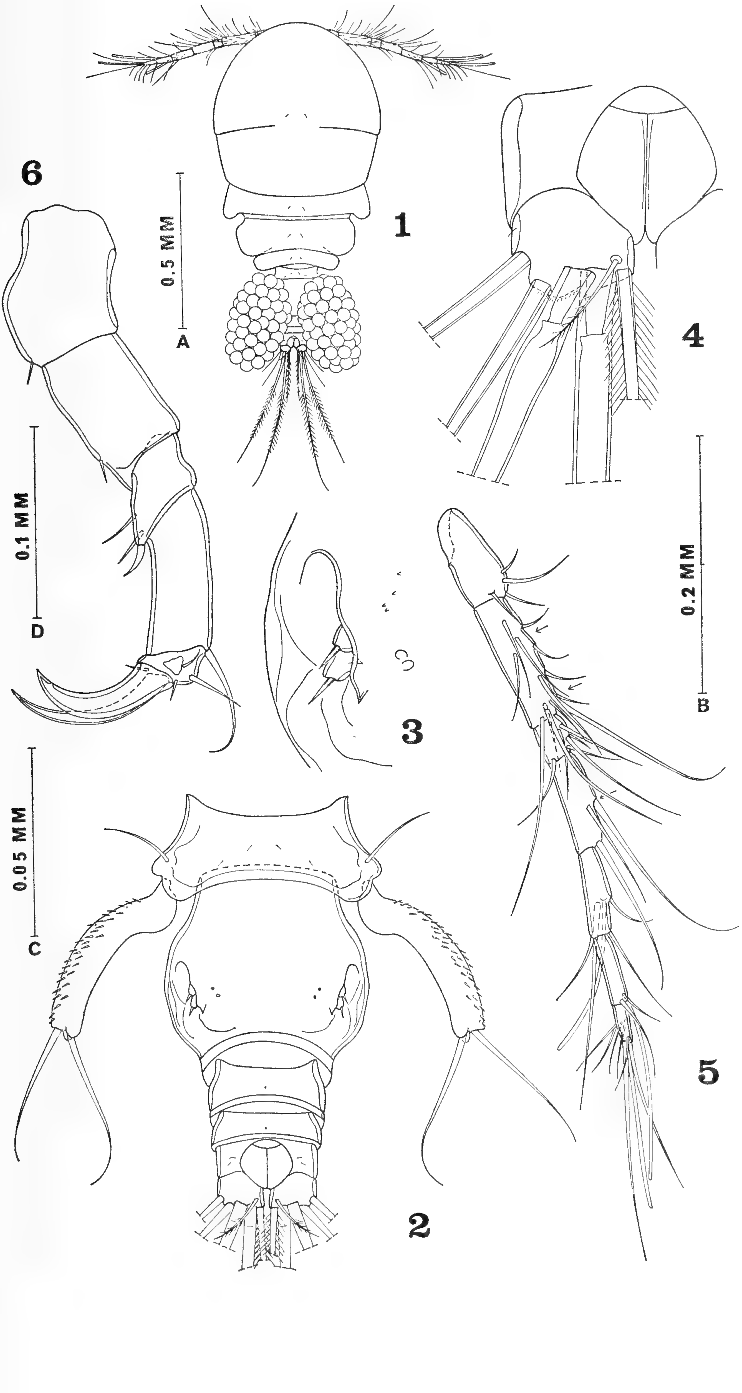
In the following description those features not mentioned may be assumed to be essentially like those of *Acanthomolgus hians* (Humes and Ho, 1968a).

Female: Body (Fig. 1) with a moderately slender prosome. Length 0.98 mm (0.89–1.02 mm) and the greatest width 0.49 mm (0.46–0.56 mm). Ratio of the length to the width of the prosome 1.45:1. Ratio of the length of the prosome to that of the urosome 2.91:1.

Segment of leg 5 (Fig. 2) 73 × 156. Between this segment and the genital segment no ventral intersegmental sclerite. Genital segment 143

→

FIGS. 1–6. *Acanthomolgus mopsellae*, new species, female: 1, dorsal (A); 2, urosome, dorsal (B); 3, genital area, dorsal (C); 4, caudal ramus, dorsal (C); 5, first antenna, with arrows indicating positions of three aesthetes added in the male, dorsal (B); 6, second antenna, anterior (inner) (D).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× 143. Genital areas located dorsolaterally (more laterally than in *A. hians*). Each area (Fig. 3) bearing two naked setae about 9 long; spiniform process small instead of prominent and unguiform as in *A. hians*. Three postgenital segments from anterior to posterior 42 ×88, 31 × 83, and 34 × 75. Posteroventral border of the anal segment smooth.

Caudal ramus (Fig. 4) 27 × 31, wider than long. Outer lateral seta 143 and naked, the dorsal seta 30 and delicately haired, the outermost terminal seta 198 and naked, the innermost terminal seta 275 with lateral spinules, and the two long median terminal setae 495 (outer) and 583 (inner), both with strong spinules along their midregions.

Egg sacs (Fig. 1) variable in size. Those in the figure approximately 320 × 175, but in another female about 495 × 250. Each of the many eggs about 47 in diameter.

Rostrum resembling that in *A. hians*. First antenna (Fig. 5) 425, with the armature as in *A. hians*. Lengths of the seven segments: 34 (77 along the anterior margin), 100, 29, 67, 69, 48, and 35 respectively. Second segment 100 × 28.5, shorter and broader than in *A. hians*, where it is 130 × 22.

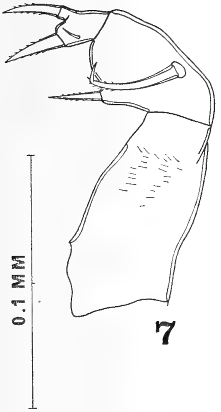
Second antenna (Fig. 6) with the formula 1, 1, 3, and II + 5, lacking minute spinules on the first and second segments. Fourth segment 99 along its outer side, 66 along its inner side, and 31 wide. Stouter claw 73 along its axis, the more slender claw 83.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of *A. hians*. Two setae on the second segment of the maxilliped (Fig. 7) 22 and 43 (in *A. hians* 28 and 66), the longer seta sharply bent distally. Two terminal elements on the third segment less divergent than in *A. hians*.

Legs 1 and 2 like those of *A. hians*. Leg 3 also resembling that species except for the relative lengths of the three spines on the third segment of the endopod (Fig. 8), which are 38, 35, and 45 from outer to inner (31, 24, and 36 in *A. hians*). Leg 4, with the formula for the exopod I-0; I-1; II, I, 5, like that in *A. hians* except for details of the endopod (Fig. 9). First endopod segment 48 × 36 (including the spiniform processes) and the inner distal spine 30. Second endopod segment 93 long (including the spiniform processes), 32 in greatest width and 23 in least width, with the two terminal spines 31 (outer) and 72 (inner).

→

Figs. 7–10. *Acanthomolgus mopsellae*, new species, female: 7, maxilliped, postero-inner (E); 8, third segment of endopod of leg 3, anterior (D); 9, endopod of leg 4, anterior (D); 10, leg 5, dorsal (D). Figs. 11–17. *Acanthomolgus mopsellae*, new species, male: 11, dorsal (F); 12, maxilliped, outer (D); 13, third segment of endopod of leg 1, anterior (E); 14, third segment of endopod of leg 2, anterior (E); 15, endopod of leg 4, anterior (D); 16, leg 5, dorsal (E); 17, spermatophores, attached to female, lateral (F).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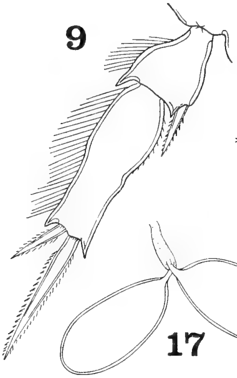
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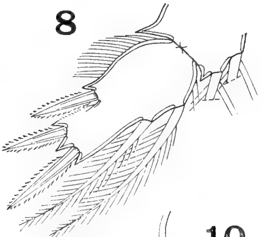
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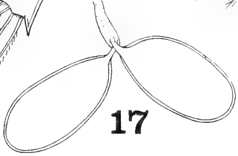
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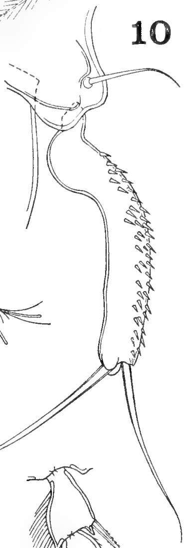
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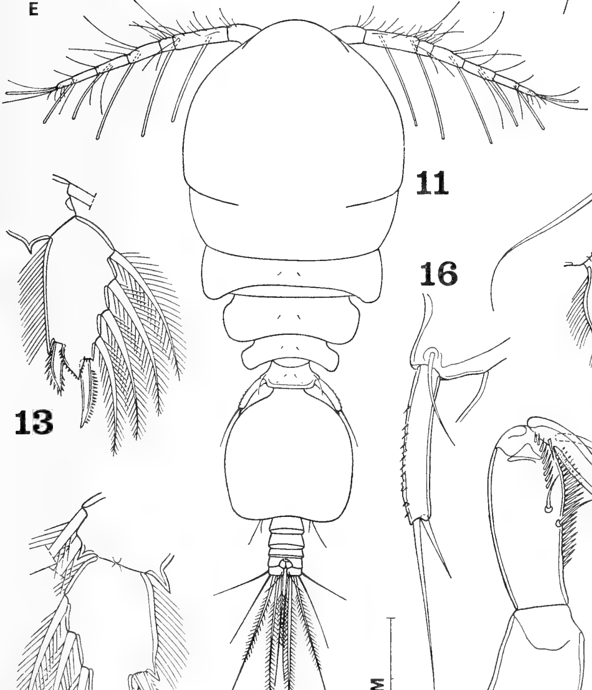
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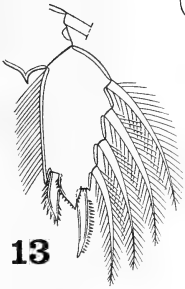
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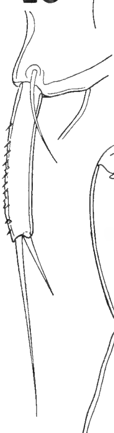
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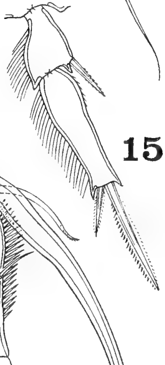
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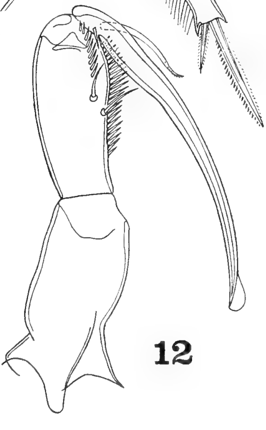
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Leg 5 (Fig. 10) with a slender free segment 140 long, 28 wide proximally, and 22 wide distally. Two terminal setae 130 and 122. Seta on the body adjacent to the free segment 47. Spines on the free segment a little more slender and less scalelike than in *A. hians.*

Living specimens in transmitted light opaque, the intestine brown, the eye red, the egg sacs gray.

Male: Body (Fig. 11) with a moderately slender prosome as in the female. Length 0.86 mm (0.83–0.89 mm) and the greatest width 0.36 mm (0.32–0.39 mm). Ratio of the length to the width of the prosome 1.52:1. Ratio of the length of the prosome to that of the prosome 1.58:1.

Genital segment 230 × 210. Caudal ramus 20 × 25.

Rostrum like that of the female. First antenna similar to that of the female, but three aesthetes added as in *A. hians.* Second antenna resembling that of the female, but the fourth segment a little more slender, 105 along its outer side, 74 along its inner side, and 25 wide.

Labrum, mandible, paragnath, first maxilla and second maxilla like those of the female. Maxilliped (Fig. 12) resembling closely that of *A. hians.* Claw 180 along its axis including the terminal lamella.

Leg 1 like that of the female except for the third segment of the endopod (Fig. 13) which has the formula I, I, 4 instead of I, 5. Inner spine with a row of spinules along the inner side but the outer side smooth, thus differing from *A. hians* where both margins are barbed. Leg 2 like that of the female, with the third segment of the endopod (Fig. 14) not showing an enlarged outer terminal process as in the male of *A. hians.* Leg 3 like that of the female. Leg 4 resembling that of the female except for dimensions of the endopod (Fig. 15). First segment 37 × 24 (including the spiniform processes) and its inner distal spine 26. Second segment 70 long (including the processes), 21 in greatest width, and 15 in least width, with the two terminal spines 25 (outer) and 64 (inner).

Leg 5 (Fig. 16) with a long slender free segment 57 × 10.5 bearing a few minute spines. Two terminal elements 81 × 23 and the seta on the body adjacent to the free segment approximately 30.

Leg 6 like that of *A. hians.*

Spermatophore (Fig. 17) oval, 200 × 100, not including the neck.

Living specimens colored as in the female.

Etymology: The specific name *mopsellae* is the genitive form of the generic name of the host.

Comparison with other species in the genus: In the keys published by Humes (1973a) to both sexes of the 17 known species of the genus *Acanthomolgus*, the new species from *Mopsella* falls in the same position as *A. hians*, a species from the alcyonacean *Siphonogorgia pichoni* Verseveldt at Nosy Bé, Madagascar (for the correct name of the host see Humes and Stock, 1973). Although the two species have certain similarities, careful study shows that there are many consistent significant differences. The more important and easily recognized of these are summarized in Table 1.

TABLE 1. Comparison of distinguishing characters of *Acanthomolgus mopsellae* and *Acanthomolgus hians.*

	A. mopsellae	*A. hians*
FEMALE		
genital areas	situated far apart, each with a small pointed process	closer together, each with a prominent unguiform process
length of second segment of first antenna	relatively short, ratio 3.5:1	more elongate, ratio 5.9:1
free segment of leg 5	slender, with 2 terminal setae nearly equal in length	stouter, with 2 terminal setae very unequal
MALE		
length of claw on maxilliped	180 microns	159 microns
inner of 2 spines on third segment of endopod of leg 1	with barbs along inner side only	with barbs along both sides
outer terminal process on third segment of endopod of leg 2	small	enlarged
ratio of length to width of free segment of leg 5	5.4:1	4.4:1

Acanthomolgus combinatus, new species

Figures 18–41

Type-material: 114 ♀♀, 278 ♂♂, and many copepodids from one colony of *Echinogorgia sasappo* (Esper), in 10 m, Pte. Lokobe, Nosy Bé, Madagascar, 18 July 1967. Holotype ♀, allotype, and 384 paratypes (110 ♀♀, 274 ♂♂), deposited in the National Museum of Natural History (USNM), Washington; the remaining paratypes (dissected) in the collection of the author.

Other specimens (all from *Echinogorgia sasappo*): 3 ♀♀, 10 ♂♂, and a few copepodids from one colony, in 10 m, Nosy N'Tangam, near Nosy Bé, 1 January 1964; 4 ♀♀, 18 ♂♂, and a few copepodids from one colony, in 25 m, Tany Kely, a small island to the south of Nosy Bé, 14 August 1964; 55 ♀♀, 57 ♂♂, and a few copepodids from one colony, in 25 m, Tany Kely, 14 August 1964; 1 ♀, 2 ♂♂, and a few copepodids from one colony, in 13 m, opposite Antsiabe, Nosy Komba, near Nosy Bé, 2 September 1967.

Female: Body (Fig. 18) resembling in general form that of *A. mopsellae*. Length 1.10 mm (1.02–1.19 mm) and the greatest width 0.60 mm (0.58–0.62 mm). Ratio of the length to the width of the prosome 1.47:1. Ratio of the length of the prosome to that of the urosome 3.06:1.

Segment of leg 5 (Fig. 19) 86 × 174. Between this segment and the genital segment no ventral intersegmental sclerite. Genital segment 143 × 169, in dorsal view broadest in its midregion, posterior to which the lateral margins are obliquely truncated, then abruptly constricted near the end of the segment. Genital areas located dorsolaterally along the truncated margins. Each area (Fig. 20) bearing two short naked setae 11 and 20 and a small spiniform process. Adjacent to the area two spiniform papillate processes, one larger than the other. Three postgential segments from anterior to posterior 22 × 91, 23 × 86, and 34 × 84. Posteroventral border of the anal segment bearing a row of minute spinules on each side.

Caudal ramus (Fig. 19) quadrate, 34 × 34. Outer lateral seta 112 and the dorsal seta 39, both naked. Outermost terminal seta 230 and naked, the innermost terminal seta 350 with spinules along the inner side. Two long median terminal setae 570 and 690, both with strong lateral spinules along their midregions. A minute setule on the proximal outer side of the ramus.

Body surface bearing only a few small hairs (sensilla) as in Fig. 18.

Egg sac (Fig. 21) 550–600 × 240, reaching nearly to the ends of the longest setae on the caudal ramus, and containing many eggs about 50 in diameter.

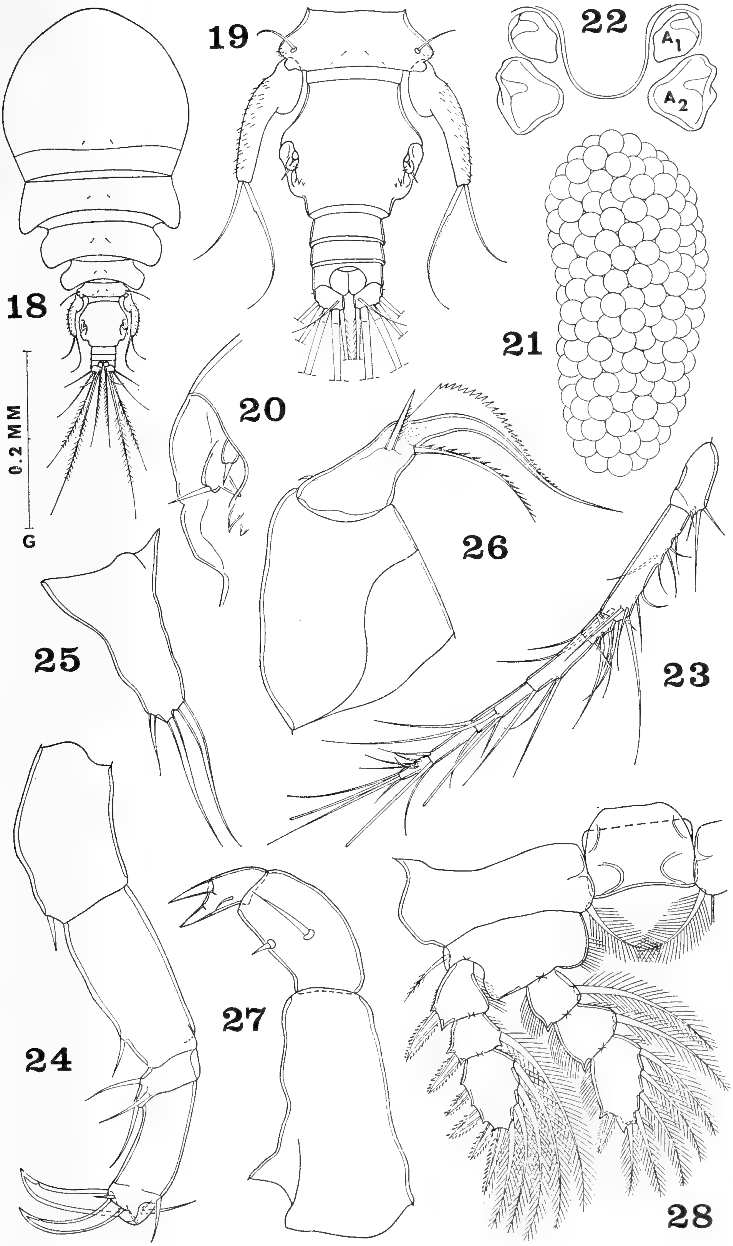
Rostrum (Fig. 22) in ventral view broadly rounded posteroventrally.

First antenna (Fig. 23) 492 long. Lengths of the seven segments: 36 (75 along the posterior margin), 135, 31, 78, 76, 62, and 35 respectively. Formula for the armature the same as in other species of the genus: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All the setae naked.

Second antenna (Fig. 24) 4-segmented with the formula 1, 1, 3, and II + 5. All the setae naked. Fourth segment 86 along its outer edge,

→

FIGS. 18–28. *Acanthomolgus combinatus*, new species, female: 18, dorsal (A); 19, urosome, dorsal (G); 20, genital area, dorsal (E); 21, egg sac, dorsal (F); 22, rostrum, ventral (B); 23, first antenna, ventral (G); 24, second antenna, posterior (outer) (D); 25, first maxilla, posterior (C); 26, second maxilla, posterior (E); 27, maxilliped, posterior (E); 28, leg 1 and intercoxal plate, anterior (B).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50 along its inner edge, and 27 wide. More slender terminal claw 55 and the stouter claw 57. First and second segments lacking fine ornamentation.

Labrum like that in *A. hians* and *A. verseveldti* (Humes and Ho, 1968a). Mandible similar to that in *A. telestophilus* (Humes and Ho, 1968a). Paragnath resembling that of *A. verseveldti.* First maxilla (Fig. 25) with three elements. Second maxilla (Fig. 26) 2-segmented. First segment unarmed. Second segment with a small setule on its proximal outer (ventral) surface, a surficial posterior seta finely barbed along one edge, a long inner (dorsal) distal setiform spine with spinules along one edge; the terminal lash with a broad hyaline lamella fringed with small teeth. Maxilliped (Fig. 27) lacking ornamentation on the first segment. Two naked setae on the second segment 6.5 and 28.5. Small third segment with a small naked seta and two nearly equal terminal spinelike elements.

Ventral area between the maxillipeds and the first pair of legs like that in *A. verseveldti.*

Legs 1–4 (Figs. 28, 30, 31, and 32) segmented and armed as in other species in the genus. Outer spines on the exopod of leg 1 having conspicuous lateral barbs (Fig. 29). Inner coxal element of leg 4 a short naked seta 10 long; inner margin of the basis of this leg smooth. Exopod 196. First segment of the endopod 53 × 35 (including the spiniform processes) and the inner distal spine 31 and very finely barbed. Second segment 107 × 32 (greatest width and including the spiniform processes). Outer terminal spine 27.5 and finely barbed; inner terminal spine 68 and more coarsely barbed, the barbs along the outer margin being larger than those on the inner margin. (In another female these spines 33 and 72.)

Leg 5 (Fig. 33) with a long slender free segment having a rounded proximal inner expansion. Segment 143 long, 47 in greatest width at the expansion and 18 in least width distally. Two terminal setae 169 (with a narrow outer lamella) and 135. Seta on the body near the insertion of the segment about 44 and apparently naked. Near this seta a patch of small spines. Free segment ornamented on its outer dorsal surface with short spines.

Leg 6 represented by the two setae and the spiniform process on the genital area.

→

FIGS. 29–33. *Acanthomolgus combinatus*, new species, female: 29, spines on exopod of leg 1, anterior (E); 30, leg 2, anterior (B); 31, third segment of endopod of leg 3, anterior (B); 32, leg 4 and intercoxal plate, anterior (B); 33, leg 5, dorsal (D). FIGS. 34–36. *Acanthomolgus combinatus*, new species, male: 34, dorsal (F); 35, urosome, dorsal (G), 36, second antenna, posterior (outer) (D).

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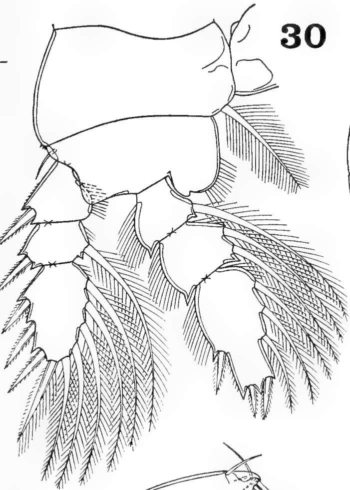

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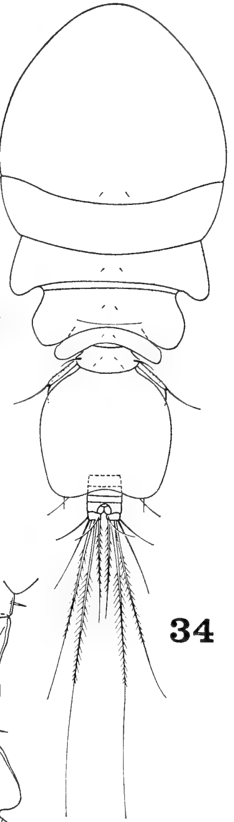

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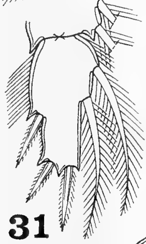

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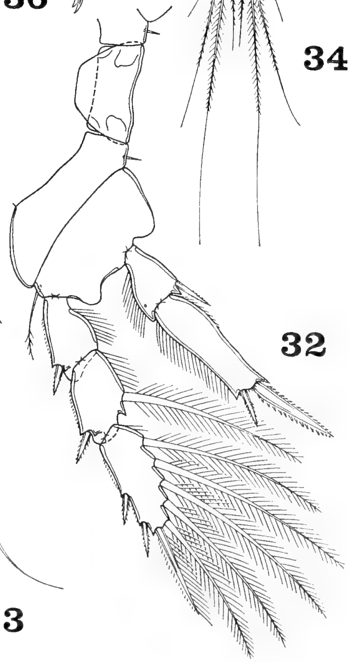

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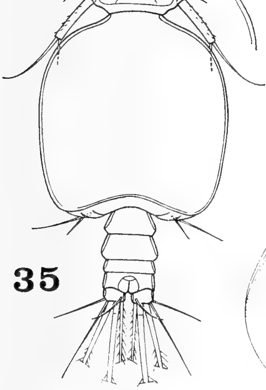

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Living specimens in transmitted light opaque and slightly reddish, the eye red, the egg sacs dark gray.

Male: Body (Fig. 34) resembling that of *A. mopsellae.* Length 0.93 mm (0.83–0.99 mm) and the greatest width 0.37 mm (0.34–0.39 mm). Ratio of the length to the width of the prosome 1.50:1. Ratio of the length of the prosome to that of the urosome (in the specimen drawn) 1.94:1. In another male the postgenital segments less contracted (as in Fig. 35) and the ratio 1.70:1.

Segment of leg 5 (Fig. 35) 47 × 109. No ventral intersegmental sclerite. Genital segment 224 × 213. Four postgenital segments from anterior to posterior 29 × 57, 21 × 62, 15.5 × 60, and 23.5 × 60.

Caudal ramus 22 × 24, and armed as in the female.

Fine ornamentation of the body resembling that of the female.

Rostrum like that of the female. First antenna resembling that of the female, but three aesthetes added as in the male of *A. mopsellae.* Second antenna (Fig. 36) similar to that of the female, but slight sexual dimorphism indicated by the minute spinules along the inner surface of the second segment and by the more slender proportions of the fourth segment (79 along the outer side, 53 along the inner side, and 47 wide). Terminal claws 55 and 53.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those in the female. Maxilliped (Fig. 37) slender and 4-segmented (assuming that that proximal half of the claw represents a fourth segment). First segment unarmed. Second segment with two rows of spines and two naked setae, one with a minutely trifurcated tip (Fig. 38). Small third segment unarmed. Claw 168 including the small terminal lamella, and bearing proximally two unequal setae.

Ventral area between the maxillipeds and the first pair of legs like that of the female.

Legs 1–4 like those of the female, except for the third segment of the endopod of leg 1 (Fig. 39) which has the formula I, I, 4, the two spines being coarsely barbed. On the second segment of the endopod of leg 4 (Fig. 40) the two terminal spines 27.5 and 55. (In another male these spines 25 and 52.)

Leg 5 (Fig. 41) with a long slender free segment 65 × 8, ornamented with a few small spines. Inner terminal seta 28 and barbed along its outer side, the outer seta 70 and naked.

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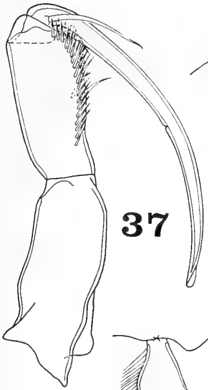
FIGS. 37–41. *Acanthomolgus combinatus*, new species, male: 37, maxilliped, inner (D); 38, seta on second segment of maxilliped, outer (H); 39, endopod of leg 1, anterior (D); 40, endopod of leg 4, anterior (D); 41, leg 5, dorsal (E). FIGS. 42–46. *Acanthomolgus arctatipes*, new species, female: 42, dorsal (F); 43, urosome, dorsal (D); 44, genital area, dorsal (H); 45, caudal ramus, dorsal (I); 46, first antenna, dorsal (D).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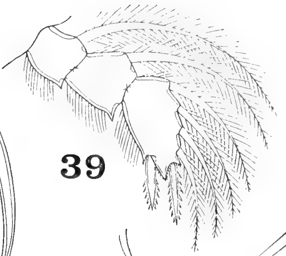
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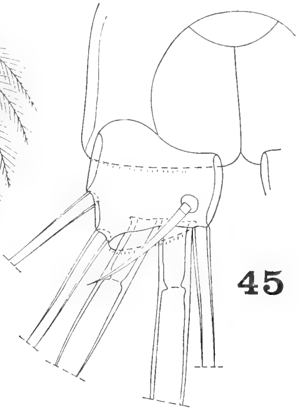
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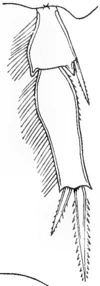
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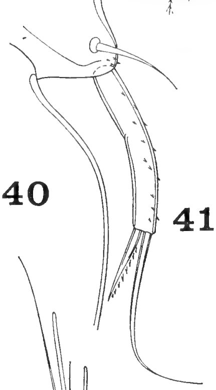
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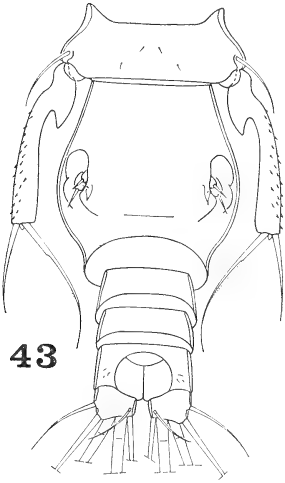
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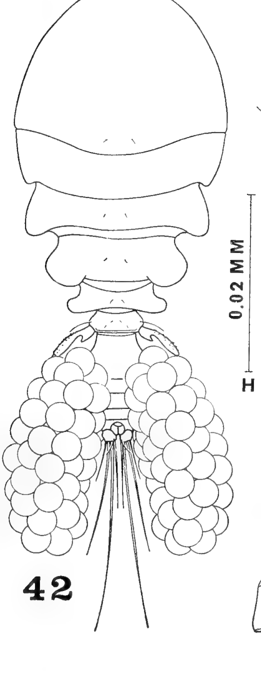
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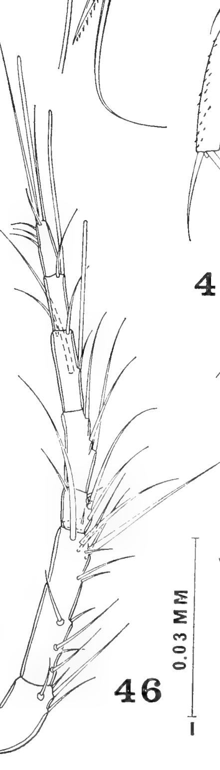
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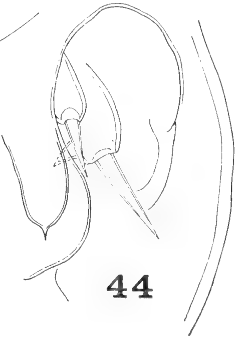
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Leg 6 resembling that in *A. telestophilus.* Two setae 65 and 39.

Spermatophore not observed.

Living specimens having a color similar to that of females.

Etymology: The specific name *combinatus,* Latin = combined or united, refers to the incorporation in this species of several characters found in related forms.

Comparison with other members of the genus: The new species bears many similarities with *A. telestophilus,* a species from the telestacean *Telesto arborea* Wright and Studer at Nosy Bé, Madagascar. In fact, in the keys of Humes (1973a) it falls with *A. telestophilus.* There are, however, several ways in which *A. combinatus* differs significantly from that species. These are summarized in Table 2.

Acanthomolgus arctatipes, new species

Figures 42–63

Type-material: 99 ♀♀, 57 ♂♂, and many copepodids from one colony of *Echinogorgia sasappo* (Esper), in 10 m, Pte. Lokobe, Nosy Bé, Madagascar, 18 July 1967. Holotype ♀, allotype, and 149 paratypes (95 ♀♀, 54 ♂♂) deposited in the National Museum of Natural History (USNM), Washington; the remaining paratypes (dissected) in the collection of the author.

Other specimens (all from *Echinogorgia sasappo*): 16 ♀♀ and a few copepodids from one colony, in 10 m, Nosy N'Tangam, near Nosy Bé, 1 January 1964; 49 ♀♀, 13 ♂♂, and a few copepodids from one colony, in 25 m, Tany Kely, a small island to the south of Nosy Bé, 14 August 1964; 33 ♀♀, 1 ♂ from one colony in 25 m, Tany Kely, 14 August 1964; 6 ♀♀, 1 ♂ from one colony, in 13 m, opposite Antsiabe, Nosy Komba, near Nosy Bé, 2 September 1967.

Female: Body (Fig. 42) resembling in general form that of *A. astrictus* Humes and Stock, 1973. Length 0.74 mm (0.66–0.80 mm) and the greatest width 0.34 mm (0.29–0.37 mm). Ratio of the length to the width of the prosome 1.52:1. Ratio of the length of the prosome to that of the urosome 2.05:1.

Segment of leg 5 (Fig. 43) 47 × 93. Between this segment and the genital segment no ventral intersegmental sclerite. Genital segment 99 × 90, in dorsal view with gently rounded sides. Genital areas located dorsolaterally at the middle of the segment. Each area (Fig. 44) bearing two naked setae 7 and 11 and a small spiniform process. Medial to the genital area an elongated lobe with a mucronate tip. Three postgenital segments from anterior to posterior 29 × 54, 23 × 52, and 24 × 52. Posteroventral border of the anal segment bearing a row of small spinules on each side.

Caudal ramus (Fig. 45) quadrate, 21 × 21. Outer lateral seta 52, the dorsal seta 17, the outermost terminal seta 70, the innermost terminal seta 130, and the two long median terminal setae 247 (outer) and 380 (inner), both inserted between dorsal (with a smooth margin)

TABLE 2. Comparison of distinguishing characters of *Acanthomolgus combinatus* and *Acanthomolgus telestophilus*.

	A. combinatus	*A. telestophilus*
FEMALE		
length of body	1.10 mm (1.02–1.19 mm)	0.91 mm (0.85–0.95 mm)
genital segment	sides obliquely truncated posterior to middle	sides rounded rather than truncated
outermost terminal seta on caudal ramus	naked	with lateral spinules
second antenna	inner surfaces of all 4 segments smooth; all three setae on third segment straight	minute inner spinules on all 4 segments; one of setae on third segment angularly bent
first maxilla	with 3 elements	with 4 elements
second maxilla	lash having hyaline lamella with small marginal teeth	lash with graduated teeth; no lamella
longer of 2 setae on second segment of maxilliped	smooth	with spinules
MALE		
length of body	0.93 mm (0.83–0.99 mm)	0.75 mm (0.72–0.79 mm)
second antenna	with inner spinules on second segment only	with inner spinules on all 4 segments
setae on second segment of maxilliped	one with trifurcated tip, other attenuated	both attenuated
dimensions of free segment of leg 5	65 × 8 microns	38 × 8.5 microns

and ventral (with a marginal row of spinules) flanges. All the setae naked.

Body surface bearing only a very few small hairs (sensilla) as in Fig. 42.

Egg sac (Fig. 42) 350 × 145, reaching to more than half the length of the longest ramal setae, and containing numerous eggs 45–47 in diameter.

Rostrum like that in *A. astrictus.*

First antenna (Fig. 46) 285 long. Lengths of the seven segments: 21 (44 along the anterior edge), 81, 21, 36, 44, 34, and 25 respectively. Formula for the armature like that in *A. combinatus.* All the setae naked.

Second antenna (Fig. 47) segmented and armed as in the previous two species. One of the three setae on the third segment characteristically bent. Fourth segment 62 along the outer side, 43 along the inner side, and 14 wide. Stouter claw 42 along its axis, the more slender claw 38. All the setae naked.

Labrum (Fig. 48) with two broad posteroventral lobes.

Mandible (Fig. 49) basically similar to that of *A. astrictus,* but the convex side of the base having an expanded hyaline area without spinules followed by a minutely serrated portion. Paragnath (Fig. 48) a small hairy lobe. First maxilla (Fig. 50) with four elements, one of them with small spinules. Second maxilla (Fig. 51) resembling in general structure that of *A. astrictus,* but the lash having along its convex side an expanded hyaline lamella with a finely dentate margin. Maxilliped (Fig. 52) also resembling that of *A. astrictus* but the first segment lacking spinules and the two setae on the second segment more unequal, 7.5 and 22, with a ratio of approximately 1:3.

Ventral area between the maxillipeds and the first pair of legs like that in *A. astrictus.*

Legs 1–4 segmented and armed as in *A. astrictus* with only minor differences in details. In the endopod of leg 1 (Fig. 53) the terminal process on the third segment having a slightly different form than in that species. In leg 4 (Fig. 54) the inner coxal seta only 2 long. Exopod 112. First segment of the endopod 28.5 × 22 (including the terminal spiniform processes) and its inner distal spine (extremely finely barbed) 13. Second segment 55 × 17.5 (greatest width and the length including the terminal spiniform processes). Two terminal spines unequal, the outer 21 and slender with very small barbs, the inner 42 and stouter with more prominent barbs along the outer side than the inner side.

Leg 5 (Fig. 55) with an elongated free segment 86 long. At the

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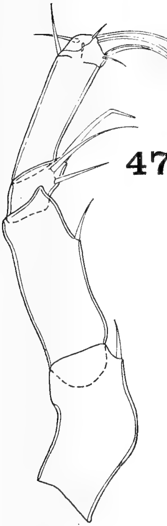
FIGS. 47–54. *Acanthomolgus arctatipes,* new species, female: 47, second antenna, posterior (E); 48, labrum, with paragnaths indicated by broken lines, ventral (C); 49, mandible, anterior (I); 50, first maxilla, anterior (C); 51, second maxilla, posterior (I); 52, maxilliped, posterior (I); 53, endopod of leg 1, anterior (E); 54, leg 4, anterior (D).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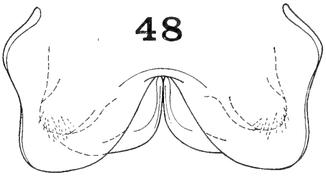
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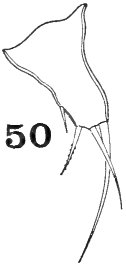
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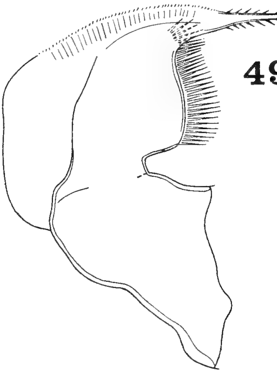
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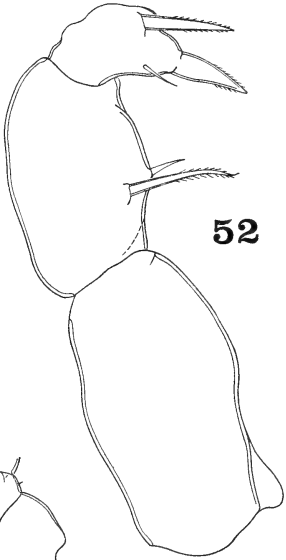
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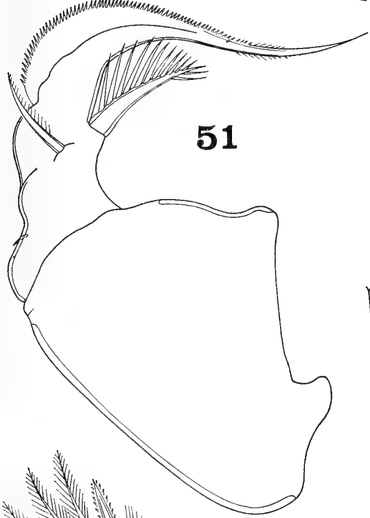
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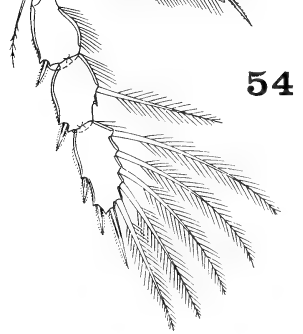
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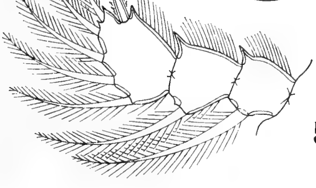
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proximal beaklike inner expansion the width 15.5. At the slender neck the width only 6.5. Width increasing distally to the widest point of 15.5. Two terminal setae 44 and smooth and 78 with a narrow lamella. Segment ornamented outwardly with small spines. Adjacent seta on the body, held erect and difficult to measure, about 35 and naked.

Leg 6 represented by the two setae and the spiniform process on the genital area.

Living specimens in transmitted light opaque, the eye red, the egg sacs gray.

Male: Body (Fig. 56) slender. Length 0.61 mm (0.57–0.65 mm) and the greatest width 0.21 mm (0.19–0.23 mm). Ratio of the length to the width of the prosome 1.77:1. Ratio of the length of the urosome to that of the prosome 1.60:1.

Genital segment (Fig. 57) 24 × 56. No ventral intersegmental sclerite. Genital segment 110 × 107. Four postgenital segments from anterior to posterior 19 × 38.5, 19 × 36, 11 × 35.5, and 14 × 36.

Caudal ramus resembling that of the female but smaller, 17 × 17.

Fine ornamentation on the body like that of the female.

Rostrum like that of the female. First antenna similar to that of the female, but three aesthetes added as in the males of *A. mopsellae* and *A. combinatus*. Second antenna (Fig. 58) resembling that of the female, but sexually dimorphic in having minute spinules on the inner margins of the first, second, and fourth segments.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of the female. Maxilliped (Fig. 59) resembling that of *A. astrictus*, but both setae on the second segment naked. Claw 117 along its axis.

Ventral area between the maxillipeds and the first pair of legs like that in the female.

Legs 1–4 segmented and armed as in the female, except for the last segment of the endopod of leg 1 (Fig. 60) where the formula is I, I, 4 instead of I, 5 as in the opposite sex. Two terminal spines on the endopod of leg 4 (Fig. 61) having proportions different from those in the female, the outer being 13, the inner 34 long.

Leg 5 (Fig. 62) with a rectangular free segment 25 × 6.5 ornamented with a few small spinules. Two terminal elements 32 and smooth, and 15.5 with barbs along the outer edge.

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FIG. 55. *Acanthomolgus arctatipes*, new species, female: 55, leg 5, dorsal (C). FIGS. 56–63. *Acanthomolgus arctatipes*, new species, male: 56, dorsal (F); 57, urosome, dorsal (D); 58, second antenna, posterior (E); 59, maxilliped, outer (E); 60, endopod of leg 1, anterior (C); 61, endopod of leg 4, anterior (E); 62, leg 5, dorsal (I); 63, leg 6, ventral (E). FIG. 64. *Paramolgus ellisellae*, new species, female: 64, dorsal (F).


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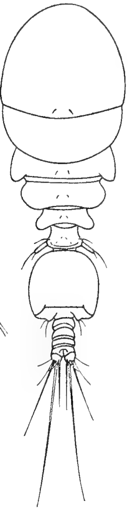
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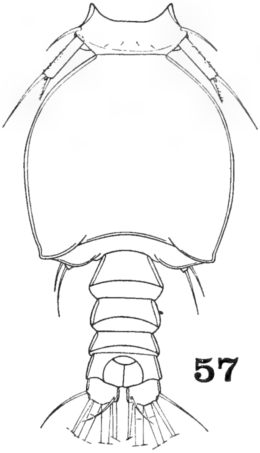
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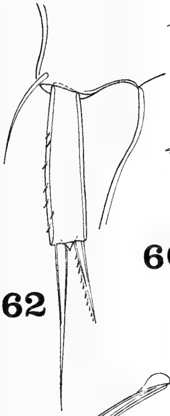
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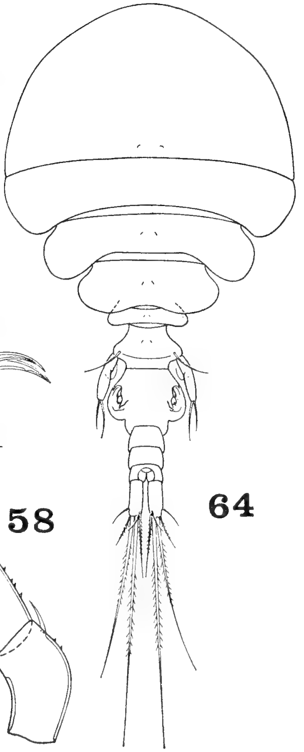
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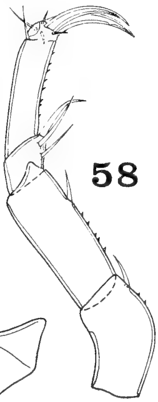
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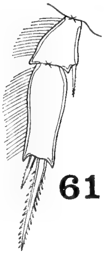
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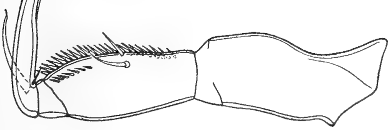
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Leg 6 (Fig. 63) consisting of the usual posteroventral flap on the genital segment bearing two naked setae 17 and 41.

Spermatophore not observed.

Living specimens colored as in the female.

Etymology: The specific name *arctatipes*, Latin *arctatus* = constricted and *pes* = foot, alludes to the constricted leg 5 in the female.

Comparison with other members of the genus: Only three species of *Acanthomolgus* have on the free segment of leg 5 in the female an inner proximal distally directed process separated sharply from the more distal margin of the segment. These are *A. astrictus* from the gorgonacean *Acanthogorgia aspera* Pourtalès, *A. cuneipes* (Humes and Ho, 1968b) from the alcyonaceans *Stereonephthya acaulis* Verseveldt and *Dendronephthya mucronata* (Pütter), and *A. longispinifer* (Humes and Ho, 1968a) from the alcyonacean *Siphonogorgia pichoni* Verseveldt, all in Madagascar. The new species differs from these, however, in many features. It seems to be closest to *A. astrictus*, but is easily separated from that species which has lateral spinules on the two long median setae on the caudal rami.

The expanded hyaline area without spinules on the convex side of the mandible and the hyaline finely dentate lamella on the lash of the second maxilla distinguish *A. arctatipes* from the other three species just mentioned. These species lack a similar hyaline expansion on the mandible and have large teeth but no lamella on the lash of the second maxilla. In addition, *A. longispinifer* has lateral spinules on the two long median setae of the caudal rami and the outer spine on the first segment of the exopod of leg 1 is unusually long. *A. cuneipes* has a relatively shorter fourth segment in the second antenna and the free segment of leg 5 in the female has a different form, without a constricted neck as in *A. arctatipes*.

Acanthomolgus astrictus Humes and Stock, 1973

Specimens collected: From the gorgonacean *Acanthogorgia aspera* Pourtalès: 15 ♀♀, 16 ♂♂, and 7 copepodids from one colony, in 4 m, Pte. Lokobe, Nosy Bé, 24 December 1963; 28 ♀♀, 17 ♂♂, and 7 copepodids from one colony, in 40 m, Banc de Cinq Mètres, near Nosy Bé, 19 August 1964; 56 ♀♀, 22 ♂♂, and 4 copepodids from one colony, in 8 m, Nosy Ovy, Isles Radama, south of Nosy Bè, 13°59′S, 47°46.5′E,

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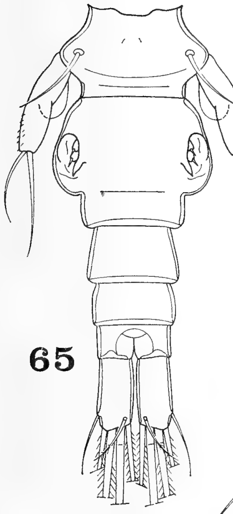
FIGS. 65–73. *Paramolgus ellisellae*, new species, female: 65, urosome, dorsal (B); 66, genital area, dorsal (I); 67, caudal ramus, dorsal (E); 68, rostrum, ventral (B); 69, first antenna, with arrows indicating positions of aesthetes added in the male, dorsal (D); 70, second antenna, posterior (E); 71, labrum, with paragnaths indicated by broken lines, ventral (E); 72, mandible, posterior (I); 73, first maxilla, anterior (I).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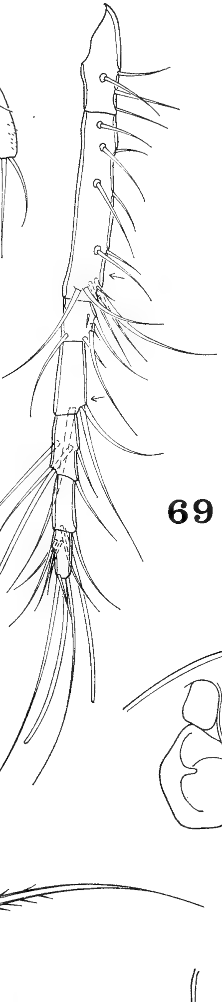
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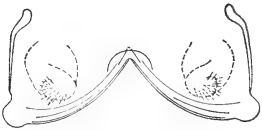
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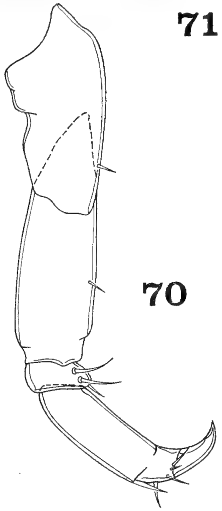
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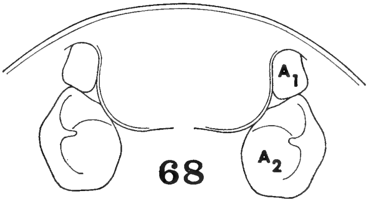

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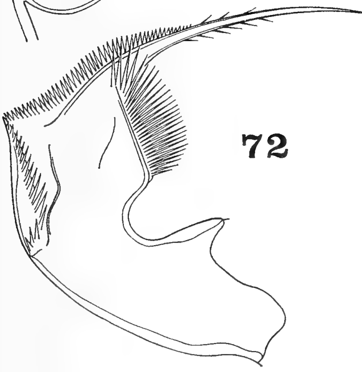
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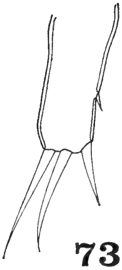
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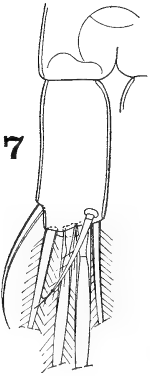
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30 September 1964. From the gorgonacean *Muricella rubra robusta* Thomson and Simpson: 77 ♀♀, 44 ♂♂, and 4 copepodids from one colony, in 15 m, Tany Kely, near Nosy Bé, 30 August 1964; 3 ♀♀, 1 ♂ from one colony, in 10 m, Nosy N'Tangam, near Nosy Bé, 1 June 1964. *Muricella rubra robusta* is a new host for this species.

Acanthomolgus hales Humes and Stock, 1973

Specimens collected: 157 ♀♀, 190 ♂♂, and 103 copepodids from one colony of the gorgonacean *Solenocaulon tortuosum* Gray, in 18 m, on sand in the pass at Pte. Lokobe, Nosy Bé, 14 July 1967.

Metaxymolgus cinctus Humes and Stock, 1973

Specimens collected (all from the gorgonacean *Psammogorgia ramosa* Kükenthal): 17 ♀♀, 43 ♂♂, and 99 copepodids from one colony, in 2 m, northern end of Nosy Sakatia, near Nosy Bé, 19 August 1963; 22 ♀♀, 73 ♂♂, and 206 copepodids from one colony, in 2 m, east of Ambariotelo, near Nosy Bé, 20 July 1967; 4 ♀♀, 60 ♂♂, and 132 copepodids from two colonies, in 15 m, Nosy Iranja, southwest of Nosy Bé, 9 August 1967.

Paramolgus Humes and Stock, 1972

Paramolgus ellisellae, new species

Figures 64–90

Type-material: 30 ♀♀, 38 ♂♂, and 63 copepodids from one colony of the gorgonacean *Ellisella ramosa* (Simpson), in 24 m, Banc des Frères, Isles Mitsio, northeast of Nosy Bé, Madagascar, 12°58′S, 48°28′E, 17 August 1967. Holotype ♀, allotype, and 60 paratypes (26 ♀♀, 34 ♂♂) deposited in the National Museum of Natural History (USNM), Washington; the remaining paratypes (dissected) in the collection of the author.

Other specimens: 30 ♀♀, 23 ♂♂, and 22 copepodids from one colony of *Ellisella ramosa*, in 25 m, north of Ankazoberavina, near Nosy Bé, 13°27.6′S, 47°58.2′E, 24 August 1967.

Female: Body (Fig. 64) with a broad flattened prosome. Length 0.81 mm (0.75–0.86 mm) and the greatest width 0.43 mm (0.37–0.46 mm). Epimeral areas of the segments of legs 1–4 rounded. Ratio of the length to the width of the prosome 1.09:1. Ratio of the length of the prosome to that of the urosome 1.65:1.

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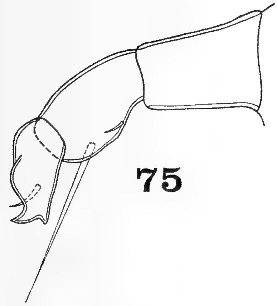
FIGS. 74–79. *Paramolgus ellisellae*, new species, female: 74, second maxilla, anterior (C); 75, maxilliped, anterior (C); 76, area between maxillipeds and first pair of legs, ventral (D); 77, leg 1 and intercoxal plate, anterior (E); 78, leg 2, anterior (E); 79, third segment of endopod of leg 3, anterior (E).



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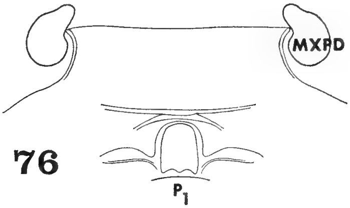

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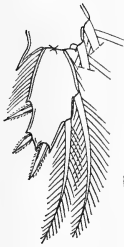

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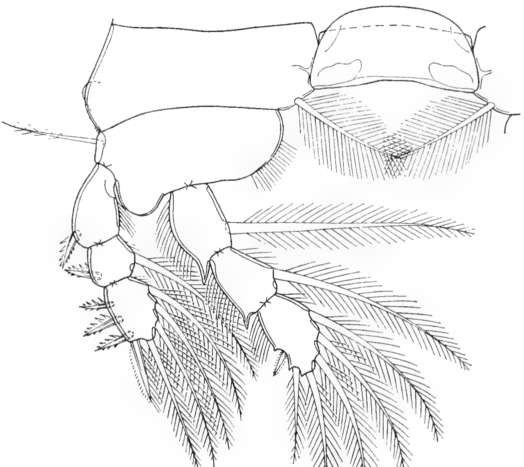

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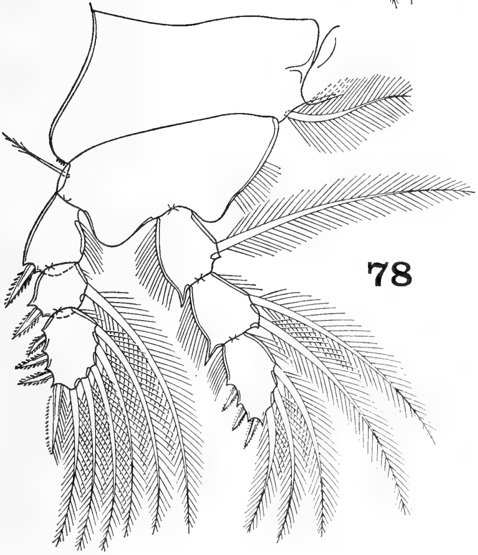

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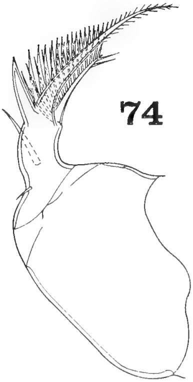

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Segment of leg 5 (Fig. 65) 73 × 112. Between this segment and the genital segment no ventral intersegmental sclerite. Genital segment 96 long, in dorsal view moderately widened in its anterior three-fourths (greatest width 122) and abruptly narrowed in its posterior fourth (width 74). Genital areas situated dorsolaterally. Each area (Fig. 66) bearing two naked setae about 8 long and a small blunt spiniform process. Nearby a large pointed bladelike process. Three postgenital segments from anterior to posterior 42 × 68, 31 × 65, and 26 × 57. Posteroventral border of the anal segment smooth.

Caudal ramus (Fig. 67) elongated, 60 × 26, with the ratio being about 2.3:1. Outer lateral seta 47 and naked. Dorsal seta 38 and sparsely feathered. Outermost terminal seta 88, the innermost terminal seta 115, and the two long median terminal setae 210 (outer) and 400 (inner), both inserted between smooth dorsal and ventral flanges. All four terminal setae having lateral spinules.

Body surface with only a very few small hairs (sensilla) as in Fig. 64. Egg sac not observed.

Rostrum (Fig. 68) broad and weakly delimited posteroventrally.

First antenna (Fig. 69) 7-segmented, with the formula 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Lengths of the segments: 24 (49 along the anterior margin), 104, 24, 38, 34, 27, and 24 respectively. All the setae naked.

Second antenna (Fig. 70) 180 long and 4-segmented with the formula 1, 1, 3, and I + 5. Fourth segment 60 along the outer side, 45 along the inner side, and 17 wide. Claw 23 along its axis. All the setae naked.

Labrum (Fig. 71) with two divergent posteroventral lobes, each with a small rounded terminal hyaline process.

Mandible (Fig. 72) having on the convex side of the base a scalelike area with a row of spinules followed by a deeply insected dentate fringe, and on the concave side a row of long spinules. Lash long with only a few spinules proximally. Paragnath (Fig. 71) a small hairy lobe. First maxilla (Fig. 73) with four elements. Second maxilla (Fig. 74) 2-segmented. First segment unarmed. Second segment bearing a small proximal inner setule, a naked surficial posterior seta, and an outer distal spine with long spinules along the distal edge and a few on the proximal edge. Segment produced distally to form a lash with graduated teeth

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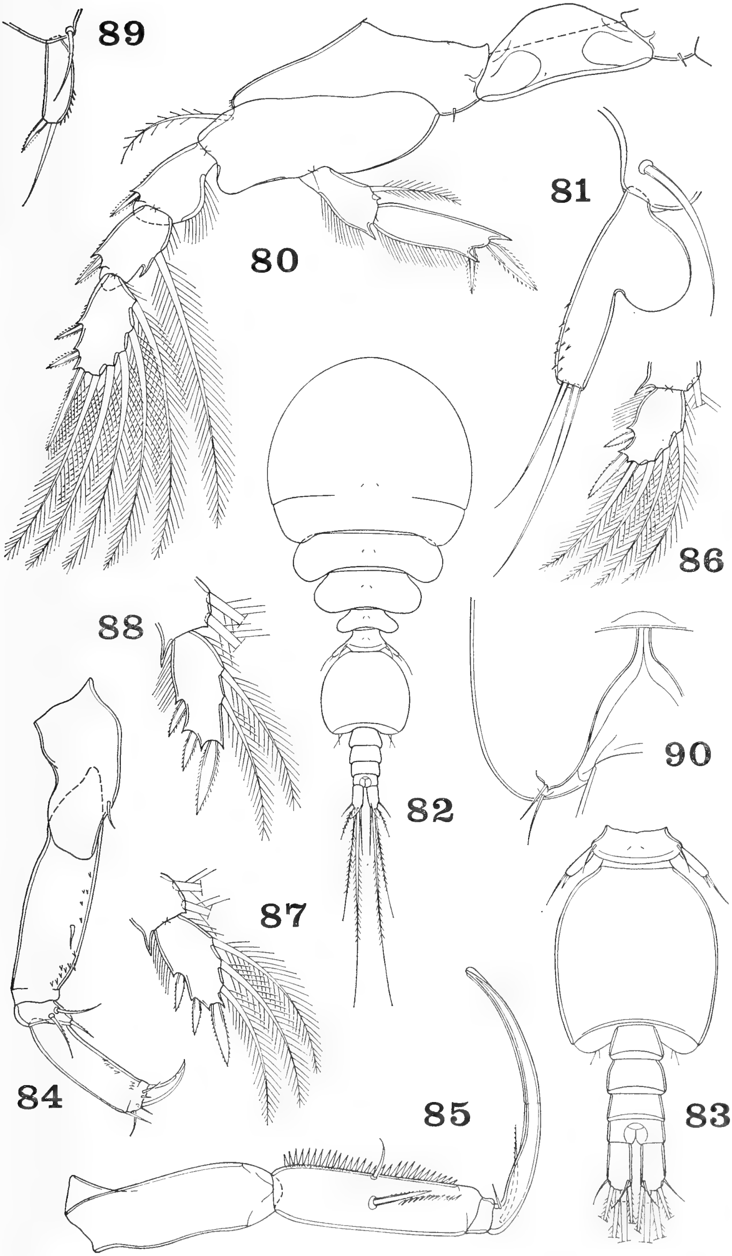
Figs. 80–81. *Paramolgus ellisellae*, new species, female: 80, leg 4 and intercoxal plate, anterior (E); 81, leg 5, dorsal, but free segment dorsoventral (E). Figs. 82–90. *Paramolgus ellisellae*, new species, male: 82, dorsal (F); 83, urosome, dorsal (B); 84, second antenna, posterior (E); 85, maxilliped, outer (D); 86, third segment of endopod of leg 1, anterior (E); 87, third segment of endopod of leg 2, anterior (E); 88, third segment of endopod of leg 3, anterior (E); 89, leg 5, dorsal, but free segment dorsoventral (E); 90, leg 6, ventral (E).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along the distal edge and with bilateral spinules distally. First tooth on the lash much larger than the others. Maxilliped (Fig. 75) 3-segmented. First segment unarmed. Second segment bearing two naked setae 5 and 50. Third segment bearing a seta 14 and terminating in two unequal spiniform processes.

Ventral area between the maxillipeds and the first pair of legs (Fig. 76) not protuberant.

Legs 1–4 (Figs. 77, 78, 79, and 80) segmented and armed as in other species of the genus, for example, *Paramolgus politus* (Humes and Ho, 1967). In leg 1 (Fig. 77) the coxa having a small outer posterior protrusion and the outer spines on the exopod being prominently barbed. In leg 2 (Fig. 78) the three spines on the third segment of the endopod 10, 9, and 11 from proximal to distal; in leg 3 these spines 10, 9, and 12 (Fig. 79). In leg 4 (Fig. 80) the exopod 95 long. Inner element on the coxa reduced to a minute setule 5 long. Inner margin of the basis smooth instead of haired as in the preceding legs. First segment of the endopod 30 long (including the spiniform processes) and 16 wide, with its inner distal feathered seta 33. Second segment 54 long (including the spiniform processes) and 13 wide. Two terminal barbed spines 15.5 (outer) and 27.5 (inner).

Leg 5 (Fig. 81) having a free segment 80 long, 39 wide at the large rounded proximal inner expansion, and 18 wide distally. Two terminal setae 57 and 81. Adjacent seta on the body 57. All the setae naked. Outer distal surface of the free segment bearing a few small spines.

Leg 6 represented by the two setae and spiniform process on the genital area.

Living specimens in transmitted light opaque, the eye red.

Male: Body (Fig. 82) with the prosome less expanded than in the female. Length 0.71 mm (0.67–0.73 mm) and the greatest width 0.30 mm (0.28–0.32 mm). Ratio of the length to the width of the prosome 1.30:1. Ratio of the length of the prosome to that of the urosome 1.49:1.

Segment of leg 5 (Fig. 83) 29 × 64. No ventral intersegmental sclerite. Genital segment 143 × 122. Four postgenital segments from anterior to posterior 26 × 47, 29 × 47, 21 × 43, and 18 × 42.

Caudal ramus resembling that of the female, but shorter, 42 × 21, with the ratio 2:1.

Fine ornamentation of the body like that of the female.

Rostrum similar to that of the female. First antenna resembling that of the female but two aesthetes added so that the formula is 4, 13 + 1 aesthete, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete.

Second antenna (Fig. 84) showing sexual dimorphism in having a few spinules along the inner surfaces of the second and fourth segments and in the three setae on the third segment being finely barbed along one edge.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of the female. Maxilliped (Fig. 85) slender and 4-segmented (assuming that the proximal part of the claw represents the fourth segment). First and third segments unarmed. Second segment bearing a naked seta, a spiniform seta finely barbed along one side, and two rows of spines. Claw 142 along its axis (including the small terminal lamella), showing a weak subdivision about midway, and bearing proximally two very unequal setae, the longer seta with short barbules distally.

Ventral area between the maxillipeds and the first pair of legs like that of the female.

Legs 1–4 segmented and armed as in the female, except for the third segment of the endopod of leg 1 (Fig. 86) where the formula is I, I, 4 instead of I, 5 as in the opposite sex. These two spines 13 and 22 respectively. Slight sexual dimorphism in leg 2 where the three spines on the third endopod segment (Fig. 87) are 14, 14, and 23 and in leg 3 where these spines (Fig. 88) are 15.5, 15.5, and 28.5 respectively.

Leg 5 (Fig. 89) with a small free segment 33 × 11, armed terminally with a short spiniform finely barbed seta 15 with a narrow inner lamella, and a longer naked seta 34.

Leg 6 (Fig. 90) consisting of the usual posteroventral flap on the genital segment bearing two naked setae 24 and 28.

Spermatophore not observed.

Living specimens colored as in the female.

Etymology: The specific name *ellisellae* is the genitive form of the generic name of the host.

Comparison with other species in the genus: Humes and Stock (1973) listed seven described species in the genus *Paramolgus*, but one of these, *P. anomalus* (A. Scott, 1909) was included with reservations. Two additional species have recently been described (Humes, 1973b).

The large rounded proximal expansion on the free segment of leg 5 in the female distinguishes *Paramolgus ellisellae* from all other species in the genus. Both sexes may be separated from all other species by the proximalmost tooth on the lash of the second maxilla being greatly enlarged. In other *Paramolgus* this tooth is not conspicuously enlarged and forms part of a graduated series with the succeeding teeth.

Although species of *Paramolgus* are known from various cnidarians (actiniarians, alcyonaceans, and antipatharians), *P. ellisellae* is the first record from gorgonaceans.

Telestacicola angoti Humes and Stock, 1973

Specimens collected: From *Suberogorgia reticulata* (Ellis and Solander): 14 ♀♀, 6 ♂♂ from one colony, in 8 m, Pte. Lokobe, Nosy Bé, 25 July 1967. From *Suberogorgia suberosa* (Pallas): 1 ♀ from one colony, in 17 m, near the black buoy north of Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, 5 August 1967.

These two gorgonaceans are new hosts for *T. angoti.*

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A NEW SPECIES OF *NESOTROCHIS* FROM HISPANIOLA, WITH NOTES ON OTHER FOSSIL RAILS FROM THE WEST INDIES (AVES: RALLIDAE)

By Storrs L. Olson

Smithsonian Institution, Washington, D. C. 20560

In the National Museum of Natural History (USNM) are extensive collections of vertebrate remains from cave and midden deposits in the Greater Antilles. Most of these were obtained in the 1920's under the auspices of Gerrit S. Miller. A few papers concerning some of these remains were published by Miller and Alexander Wetmore, after which the collections were set aside by Miller. Subsequently they have been largely neglected. I have recently attempted some rough sorting of the avian material in these collections which has resulted in several significant discoveries of fossil birds. Because much yet remains to be done, the present report is preliminary, the main purpose being to put on record a new species of the distinctive ralline genus *Nesotrochis*. There appear to be other undescribed rails and new birds in the collections, but analysis of these will have to await completion of the sorting of specimens and associating them with their often scanty and scattered data.

A Review of the Genus *Nesotrochis* Wetmore

Nesotrochis debooyi Wetmore

This large flightless rail was first described by Wetmore (1918) from aboriginal kitchen middens in the Virgin Islands. It was later found in middens and cave deposits in Puerto Rico. The following list gives the locality, references and location of specimens for each of the known occurrences of the species (key to abbreviations in acknowledgments).

Puerto Rico

Cueva Clara near Morovís	Wetmore, 1922a	AMNH
Cueva San Miguel near Morovís	Wetmore, 1922a	AMNH
Cueva Toraño near Utuado	Wetmore, 1922a	AMNH
Hacienda Jobo near Utuado	Wetmore, 1922a	AMNH
Midden at Barrio Canas, ca. 2.4 km E of Ponce	Wetmore, 1938	YPM, USNM
Río Piedras	Specimens examined by Olson	MCZ
Cave at Ciales	Specimens examined by Olson	MCZ
Shell heap at Aguirre	Specimens examined by Olson	MCZ

Virgin Islands

St. Thomas; midden at Magen's Bay (type-locality)	Wetmore, 1918; Brodkorb, 1974	USNM and UF
St. Croix; midden at mouth of Salt River	Wetmore, 1918	USNM
St. Croix; midden ca. 2.4 km E of SW Cape	Wetmore, 1937	USNM
St. Croix; midden near Christiansted	Wetmore, 1927	USNM
St. John; midden at Francis Bay	Brodkorb, 1974	UF
?Virgin Gorda (based on hearsay)	Nichols, 1943	———

The skeletal elements known for this species include the femur, tibiotarsus, tarsometatarsus, humerus and fragments of pelvis. It has been suggested that the Puerto Rican birds may have been larger than those of the Virgin Islands (Wetmore, 1938; Brodkorb, 1974), but there is not sufficient material to confirm this, especially since there appears to be marked sexual dimorphism in size. The not unlikely possibility that West Indian aborigines may have transported this species from one island to another must also be entertained.

N. debooyi apparently was an important food item of the aborigines of Puerto Rico and the Virgin Islands, and it probably persisted there at least until late in the last century. Wetmore (1927) attributed to this species legends of a bird called the "carrao" which hunters in Puerto Rico prior to 1912 used to run down with dogs. The name "carrao" is now applied to the Limpkin (*Aramus guaruana*), a wary bird of strong flight that is unlikely to have been captured by dogs. To Wetmore's account may be added the report of Nichols (1943), who was told by the natives of Virgin Gorda that in the past "flightless waterhens" had been common and many had been killed with sticks.

Table 1. Measurements (mm) of limb bones of the three species of *Nesotrochis*. Those of *N. picapicensis* from Fischer and Stephan (1971).

	N. debooyi			*N. picapicensis*		*N. steganinos*		
	n	range	mean	n	range	n	range	mean
Length tarsometatarsus	6	71.4– 75.5	73.2	2	62.0–63.2	1	———	59.5
Length tibiotarsus	13	104.6–124.0	117.5	2	88.0–96.2	———		
Distal width tibiotarsus	11	11.4– 13.2	12.3	6	9.3–10.0	3	8.4– 9.7	9.2
Length femur	8	72.3– 80.3	76.7	2	58.5–68.3	———		
Length humerus	3	58.3– 63.7	61.2	4	49.0–50.0	4	43.2–49.2	46.9
Length ulna	———			———		1	———	33.8

Nesotrochis picapicensis (Fischer and Stephan)

Fischer and Stephan (1971) described three new species of birds, including two rails, in Pleistocene deposits from Pío Domingo cave, near Sumidero, Pinar del Río, Cuba. Their paper fails to compare or even discuss many of the Antillean taxa with possible affinity to their fossil species. Consequently, their generic assignments are incorrect.

The flightless rail that Fischer and Stephan named *Fulica picapicensis* was based on femora, tibiotarsi, tarsometatarsi, humeri, pelves, a few vertebrae, a proximal end of an ulna[1] and a partial cranium. A humerus was designated as the holotype. I have had only their illustrations, description and tables for comparison, but these indicate clearly that *picapicensis* shows no more than a familial resemblance to the coots (*Fulica*). Furthermore, the broad distal end of the tarsometatarsus, with widely flared trochleae, particularly the inner one, is a feature peculiar among rails to *Nesotrochis* and indicates, along with the other skeletal elements illustrated, that *picapicensis* certainly belongs in *Nesotrochis* rather than in *Fulica*. *Nesotrochis picapicensis* differs from *N. debooyi* in its much smaller size (Table 1), more pointed intercotylar knob and in the heavier and straighter shaft of the humerus. No doubt more differences could be discerned upon comparison of actual specimens of *N. picapicensis*.

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[1] This is not from a rail and is possibly columbid.

Nesotrochis steganinos, new species

Figures 1, 2

Holotype: Complete right tarsometatarsus USNM 205609 (Fig. 1). Collected in Pleistocene cave deposits (Cave I in Miller's notes) near St. Michel de L'Atalaye, Département de L'Artibonite, Haiti, Hispaniola, in 1925 by G. S. Miller.

Measurements of holotype: Overall length 59.5 mm, proximal width 9.9, proximal depth 10.1, least width of shaft 4.3, least depth of shaft 2.7, width through trochleae 10.3, depth through trochleae 6.7.

Paratypes: Incomplete left tarsometatarsus (USNM 205610), three left humeri (205676, 205687, 205691), two proximal ends of left humeri (205689, 205690), two distal ends of right humeri (205684, 205677), left ulna (205688), two distal ends of left tibiotarsi (205678, 205685), two distal ends of right tibiotarsi (205679, 205680), right femur lacking distal end (205681), incomplete left femur (205682), shaft of right femur of juvenile (205683). These came from the same group of caves as the holotype, details of which are discussed by Miller (1922, 1929). A left humerus (205686) of this species was found in a tray of specimens with no data. It is almost certainly from one of the Haitian collections. Matrix adhering to it is similar to that on specimens labelled "San Raphael"—a locality about ten miles north of St. Michel.

Etymology: Gr. *steganos*, through a covered passage or tube + *inos*, sinew—in reference to the closed hypotarsal canals.

Diagnosis and description: Clearly referable to the genus *Nesotrochis* on the basis of the expanded distal end of the tarsometatarsus with widely flaring trochleae and particularly the more anterior and distal placement of the inner trochlea. Much smaller than *N. debooyi* and averaging somewhat smaller than *N. picapicensis* (Table 1).

Tarsometatarsus with ossified ring below internal cotyla as typical of most rails. Distinctive in having a sheet of bone completely enclosing both of the tendinal canals on the internal side of the hypotarsus (Fig. 1c, e), whereas in all other known rails, except *Paraortygometra porzanoides* from the Miocene of France, the posterior canal is open. In medial view (Fig. 1c) the area anterior to the hypotarsus is more deeply excavated, with the result that the ridge descending along the shaft from the external cotyla is much narrower and more distinct than in *N. debooyi*. In proximal view (Fig. 1e) the internal cotyla is deeper and much more distinctly set off from the hypotarsus than in *N. debooyi*, and the intercotylar knob and the depression posterior to it are both better developed. In anterior view the tarsometatarsus differs from *N. debooyi* and *N. picapicensis* in that the internal cotyla and the proximomedial part of the shaft below it do not project as abruptly medially beyond the line of the shaft, and the distal foramen is relatively smaller.

The tendinal bridge of the tibiotarsus is not higher on the internal side in *N. steganinos* as it is in *N. debooyi*, and the opening distal to

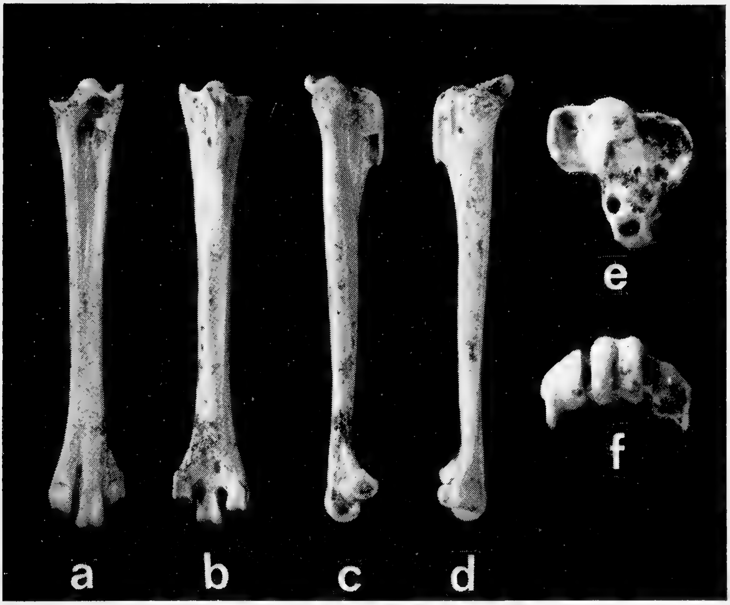

FIG. 1. *Nesotrochis steganinos*, new species, holotype tarsometatarsus, USNM 205609: a, anterior view; b, posterior view; c, medial view; d, lateral view; e, proximal view; f, distal view; a–d natural size; e and f, twice natural size.

the bridge is not slanted (Fig. 2d). Both of these species differ from *N. picapicensis* in having this opening smaller and more constricted. The few tibiotarsi of *N. steganinos* differ considerably in size.

Conformation of the humerus in *N. steganinos* shows clearly that the species was flightless. The humerus is shorter and heavier than in *N. debooyi* and more similar to that of *N. picapicensis*, but differs from both of these species in having the entepicondyle produced much farther distally and internally. There appear to be two distinct types of humeri in *N. steganinos*—larger ones with a shallow elongated brachial depression (Fig. 2a) and smaller ones with a very deep, rounded brachial depression (Fig. 2b). These at first seemed so disparate that I took them to be from entirely different species. However, they are alike in all but these two respects and one of the specimens (205691) is somewhat intermediate. It seems best, therefore, to refer all of these humeri to *N. steganinos*, since there is no other indication of the presence of two species of *Nesotrochis* in the deposits. The size differences are in accord with observed size differences in the hindlimb, while differences in the brachial depression are possibly indicative of a sexual dimorphism that involved more than size.

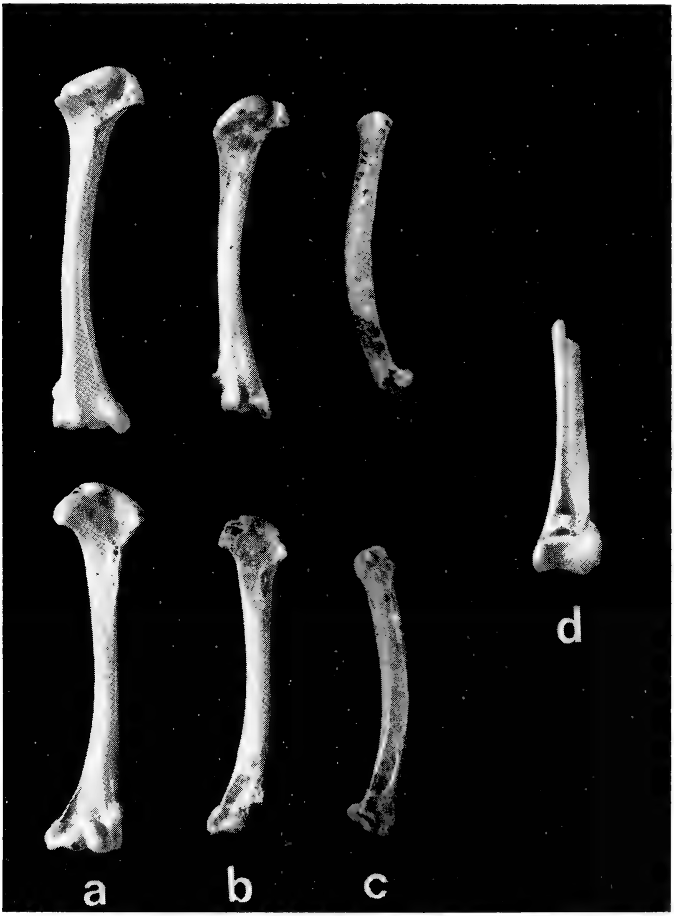

Fig. 2. *Nesotrochis steganinos*, new species, paratypes: a–c, wing elements (upper row, anconal view; lower row, palmar view); a, humerus, USNM 205676; b, humerus, USNM 205687; c, ulna, USNM 205688; d, distal end of tibiotarsus, USNM 205678. All figures natural size.

The ulna referred to *N. steganinos* (Fig. 2c) appears to be the only specimen of that element of *Nesotrochis* yet recognized. It is short and markedly curved, with a much reduced olecranon and a distinctly flattened internal surface of the shaft.

The remains of *N. steganinos* were found in deposits containing great quantities of bones of large extinct rodents and other mammals. These accumulations of bones are attributed to predations of the gigantic extinct barn owl, *Tyto ostologa* Wetmore (1922b), bones of which occur in the same deposits. The owl must also have taken the flightless rails from time to time.

On the basis of the elements so far known, particularly the tarsometatarsus, the genus *Nesotrochis* appears to be quite distinct from other genera of rails. Its affinities are uncertain. Wetmore (1922a) at first considered *Nesotrochis* to be an offshoot of the primitive South American wood-rails of the genus *Aramides*, but later he felt it to be closer to the gallinules (1937). I fully concur that *Nesotrochis* is not related to *Aramides,* while a gallinule-like ancestor is a possibility. The discovery of a complete skull of any of the species of *Nesotrochis* would probably shed much light on the affinities and adaptations of the genus.

Other Fossil Rails from the West Indies

Cyanolimnas cerverai Barbour and Peters

The rail *Cyanolimnas cerverai* was first described from skins obtained in the Zapata Swamp of Cuba (Barbour and Peters, 1927) and all subsequent non-fossil specimens have come from this same vicinity. I have elsewhere discussed the relationships of the genus (Olson, 1973). The species has generally been regarded as flightless (e.g. Ridgway and Friedmann, 1941), although Bond (1942) reported that he saw one flutter about ten feet across a canal, and that another observer had also seen a bird fly for short distances. On morphological grounds *Cyanolimnas cerverai* would be classed as a flightless species, since the pectoral girdle and wing are as reduced as in other species of rails that are considered to be flightless (Fig. 3).

In addition to describing "*Fulica*" (=*Nesotrochis*) *picapicensis*, Fischer and Stephan (1971) named another, smaller rail represented in the fossil material from Pío Domingo cave in Pinar del Río as *Rallus sumiderensis.* They had a very large series of this species and the morphology of the wing and pectoral girdle indicated to them that it was flightless. If they were aware of the existence of *Cyanolimnas cerverai,* they gave no indication of it in their paper.

In the USNM is a collection of bones from a cave deposit in the Caballos Mountains on the Isle of Pines that contains a large series (at least 40 individuals) of a rather small rail

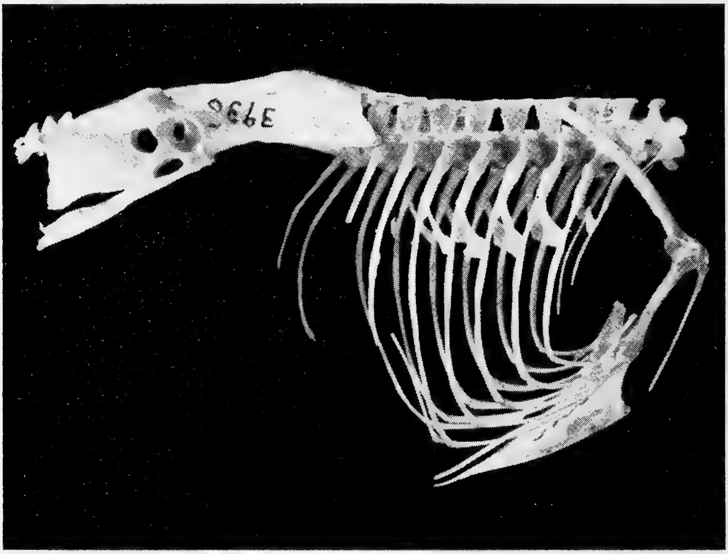

FIG. 3. Body skeleton of *Cyanolimnas cerverai*, AMNH 3930. Note the reduced pectoral girdle and carina, and the obtuse coraco-scapular angle typical of flightless rails.

with similarly reduced wings and pectoral girdle. The various elements agree well with illustrations of "*Rallus sumiderensis*" in Fischer and Stephan (1971). In Table 2 these specimens are compared with "*Rallus sumiderensis*" and with the scanty comparable material of *Cyanolimnas* from the Zapata Swamp (tarsal measurements from skins and a single body skeleton). There is close agreement between the three groups except in the tarsal measurements. Published measurements of tarsus length in "*Rallus sumiderensis*" do seem to be somewhat smaller than in the Zapata Swamp specimens but there is overlap with the Isle of Pines material.

The single available femur of *Cyanolimnas cerverai* from the Zapata Swamp is generally similar to specimens from the Isle of Pines but is somewhat more slender and curved, with a heavier, more rounded head that is not as markedly undercut on the anteroventral side. This is not a large enough sample to establish that there were differences between the pop-

TABLE 2. Lengths of limb bones (mm) of three samples of *Cyanolimnas cerverai.*

	Pinar del Rio*		Isle of Pines			Zapata Swamp		
	n	range	n	range	mean	n	range	mean
Tarsometatarsus	39	32.0–38.3	17	35.4–42.6	39.1	8	39.5–46.7	42.2[1]
Femur	2	41.5–44.2	15	42.1–50.6	46.6	1	———	48.1[2]
Coracoid	1	—— 19.3	2	17.7–19.6	18.7	1	———	19.6[2]
Humerus	26	32.4–36.7	18	32.7–38.1	35.2	———		
Ulna	1	—— 26.4	15	22.8–29.6	26.1	———		
Carpometacarpus	1	—— 17.5	2	18.0–18.2	18.1	———		

* *"Rallus sumiderensis"* from Fischer and Stephan (1971).
[1] Measured from skins.
[2] From body skeleton AMNH 3930.

ulations of the Zapata Swamp and the Isle of Pines. While recognizing that further study may disclose temporal or geographic variation within the species, I feel that it is best to consider the Isle of Pines specimens and *"Rallus sumiderensis"* as belonging to *Cyanolimnas cerverai*, until better material becomes available.

Barbour (1928) was of the opinion that *Cyanolimnas cerverai* originated in the Zapata Swamp. It is now evident that this was not the case. Two other distinctive birds, the finch *Torreornis inexpectata* and the wren *Ferminia cerverai*, were also originally described from the Zapata Swamp. Later, a well-marked new race of *Torreornis* was discovered on the arid coast of extreme southeastern Cuba (Spence and Smith, 1961). It thus seems fairly certain that all three of these species were formerly more widely distributed in Cuba and that the present populations are relicts.

Fulica podagrica Brodkorb

The species described by Brodkorb (1965) as *Fulica podagrica* from the Pleistocene of Barbados requires further study; after a perfunctory examination of the type material, I believe that it is probably a composite. The holotype humerus is clearly that of a coot and seems to differ from available specimens of *Fulica americana* and *F. caribaea* only in its slightly heavier shaft and the slightly more proximal position of the ectepicondyle. Historical specimens of coots taken on Barbados were mentioned by Brodkorb (1965) as possibly belonging to *F. podagrica*, but he was unable to locate them. They were later discovered by Phillips (1967) who identified them as *Fulica caribaea*, thus establishing that this species once occurred on the island.

Most, if not all, of the leg elements assigned to *F. podagrica*, upon which most of the diagnosis of that species was based, appear to be from a wholly different rail that was larger and heavier than indicated by the type humerus of *F. podagrica*. The distal part of a tarsometatarsus (UF 7468), for example, has a wider shaft, narrower trochleae, smaller and more proximally located distal foramen, and a longer and deeper scar for the hallux than does *Fulica*, and it evidently does not pertain to that genus.

Through an unfortunate mixup, the specimen Brodkorb (1965) gives as "*Fulica leucoptera*" is actually *Gallinula chloropus garmani*. Since much of the original characterization of *F. podagrica* rested on comparisons with this specimen, there is further cause to reappraise *F. podagrica*.

ACKNOWLEDGMENTS

This paper is dedicated to Alexander Wetmore, the father of Antillean paleornithology, who called to my attention much of the type material of *Nesotrochis steganinos*. For loan of specimens and for information concerning them I am indebted to Pierce Brodkorb and S. David Webb, University of Florida (UF); Malcolm C. McKenna and Dean Amadon, American Museum of Natural History (AMNH); Raymond A. Paynter, Jr., Museum of Comparative Zoology (MCZ); and Fred C. Sibley, Yale Peabody Museum (YPM). I thank William B. Robertson for directing me to the Nichols reference. The manuscript was criticized by Pierce Brodkorb, Robert J. Emry, John Farrand, Jr., Clayton E. Ray, and Alexander Wetmore. The photographs are by Victor E. Krantz.

RESUMEN

Se hacen breves consideraciones acerca de la especie extinta de rálido no volador *Nesotrochis debooyi*, de Puerto Rico y las Islas Vírgenes, y se añaden nuevas localidades a su distribución. *Fulica picapicensis* Fischer y Stephan, hallada en cuevas pleistocénicas del oeste de Cuba, se asigna al género *Nesotrochis*. Se describe una nueva especie, *Nesotrochis steganinos*, encontrada en depósitos cavernícolas de la Española. La especie fósil *Rallus sumiderensis* Fischer y Stephan, descrita en base de restos procedentes de cuevas del oeste de Cuba, es la especie viviente *Cyanolimnas cerverai*, y otros fósiles hallados en la Isla de Pinos, Cuba, se asignan también a esta misma especie que hasta ahora se conocía sólo de la Ciénaga de Zapata, Cuba. El material tipo de *Fulica podagrica* Brodkorb, del Pleistoceno de Barbados, parece que incluye dos especies y, por tanto, debe estudiarse con más detalle.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

TWO NEW AXIIDS (CRUSTACEA: DECAPODA: THALASSINIDEA: *CALOCARIS*) FROM NORTH CAROLINA AND THE STRAITS OF FLORIDA

By Austin B. Williams

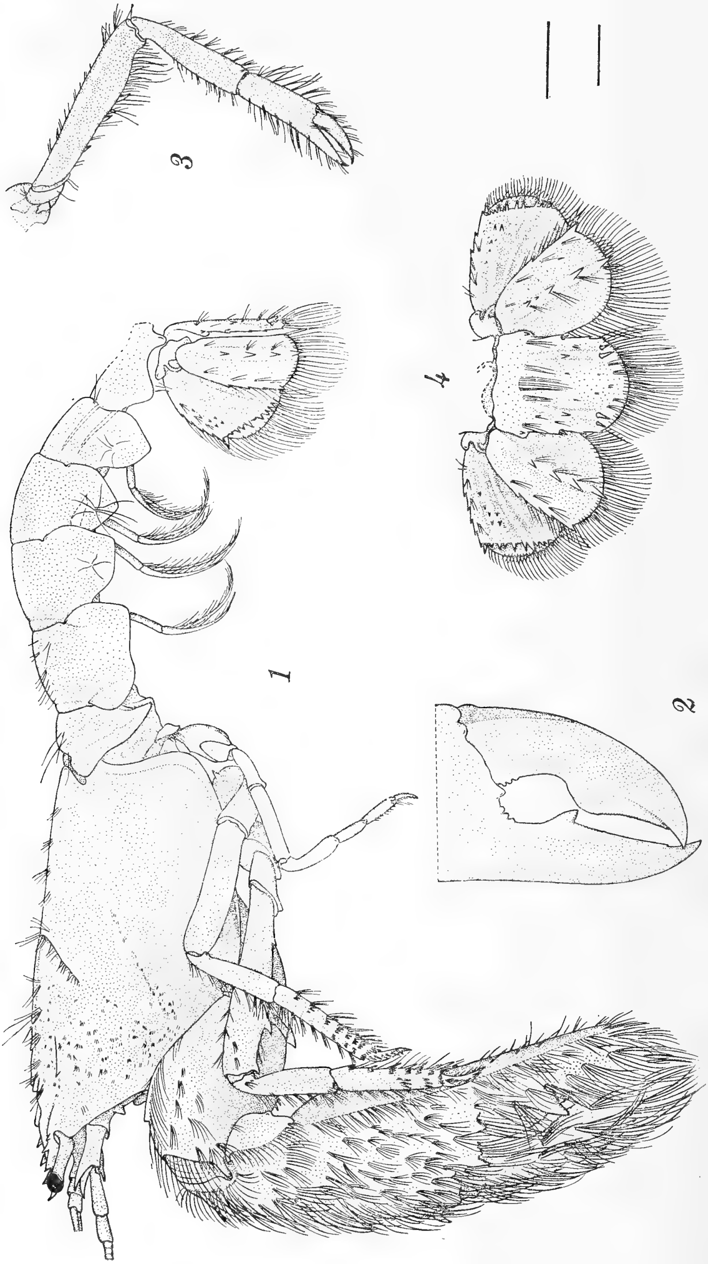
National Marine Fisheries Service Systematics Laboratory,
National Museum of Natural History, Washington, D.C. 20560

Benthic biological sampling near the edge of the continental shelf off Cape Lookout, North Carolina, during cruises of the Duke University, NSF-sponsored, R/V *Eastward* has produced a few specimens of a new species of axiid "lobster" belonging to the genus *Calocaris.* A second new species, represented by a single specimen from the western edge of the Bahama Bank, was taken during deep-water shrimp exploration with a 40-foot flat trawl in the Straits of Florida by the then U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries vessel *Combat.* These species added to the four North Atlantic Axiidae discussed by Boesch and Smalley (1972) reinforce their conclusion that the genus *Calocaris* as now constituted represents more than one group.

Calocaris (Calastacus) jenneri, new species
Figures 1–10

Holotype male: Integument microscopically granulate. Carapace compressed; nearly smooth, scattered rugosities anteroventrally on branchiostegite and cephalic part; almost straight along middorsal line in lateral view except gradually deflexed from gastric region to tip of rostrum; midline narrowly rounded and elevated posteriorly but not keellike; cephalic groove obsolete ventrolaterally; branchial groove inconspicuous; branchiostegite emarginate ventrally and posteriorly; scattered setae overall but tufts anterior to branchial region, densest on gastric region.

Rostrum slightly exceeding eyes, tip upturned but no larger than any of 3 asymmetrically spaced marginal spines on each side; with low



FIGS. 1–4. *Calocaris* (*Calastacus*) *jenneri*, holotype male: 1, lateral view; 2, fingers of minor chela with setae removed, inner view; 3, second leg; 4, tail fan. Scales = 2 mm: upper, 1, 3, 4; lower, 2.

median dorsal, interrupted keel reaching from level of midlength of eyestalks to cephalic groove; ventrally with fairly deep median keel; notched laterally at base where rostrum merges with gastric region (orbit) for reception of eyestalks in erect position.

Gastric region with 2 dorsal carinae on each side of middorsal keel more or less interrupted by spines and gaps; lateral pair interrupted at about midlength by blunt spine, but continued to near base of rostrum, ending in low ridge on left but a broken spine on right at base of rostrum; row of scattered tubercles between middorsal keel and submesial carinae.

Abdomen and telson together about 1.5 times length of carapace (parts of segments 4–6 broken). Segments smooth and almost uniformly arched transversely (but with low lateral carina most prominent and oblique on first segment, becoming obsolescent posteriorly), bearing scattered clumps of long, fine setae; first segment short, fitted for articulation with carapace, with pleuron drawn posteroventrally to acute tip; pleura of second to fifth segments with anteroventral margins broadly rounded, ventral margin of second and third nearly straight, posterior corners of 2–5 nearly rectangular; sixth with broadly rounded pleuron.

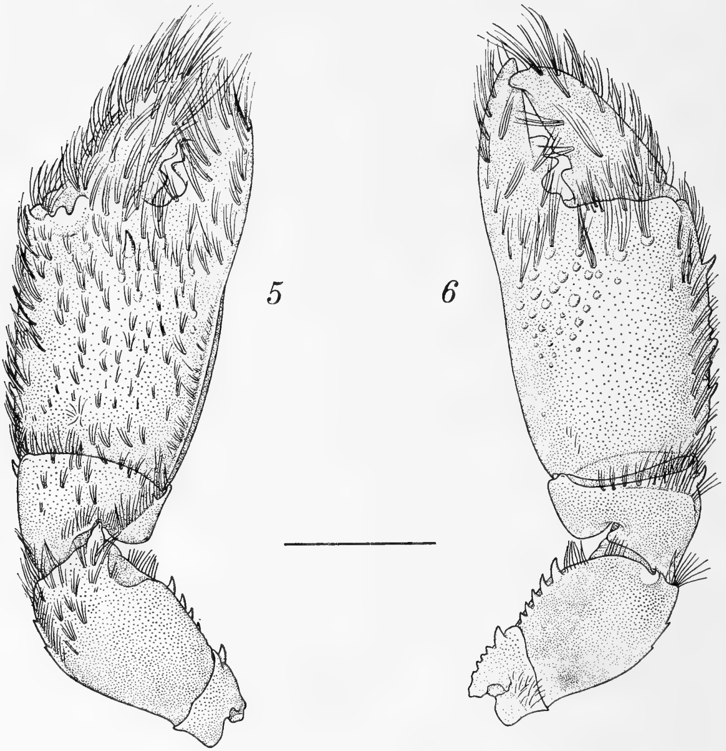
Eyestalks almost cylindrical, slightly flattened mesiodorsally, cornea well developed.

Antennular peduncle with second article almost reaching tip of rostrum.

Antennal peduncle with penultimate article extending beyond antennular peducle; first (coxal) article with a short ventral spine; strong dorsolateral spine of second article reaching proximal border of cornea; antennal thorn (acicle) slender, curved, exceeding cornea and reaching distal border of penultimate article of antennular peduncle; third article with slender mesioventral spine reaching about ¼ length of fourth article; terminal article about ⅗ length of fourth article; flagellum reaching beyond chelipeds, but broken.

Endopods of third maxillipeds pediform, densely setiferous ventrally and mesially; distal article unarmed; merus with 3 ventral spines progressively larger and more acute distad; ischium with 2 small spines on ventral margin proximally, and along mesial margin a prominent crest of about 17 strong spines terminating in distally advanced spine curved mesad; coxa with ventral spine.

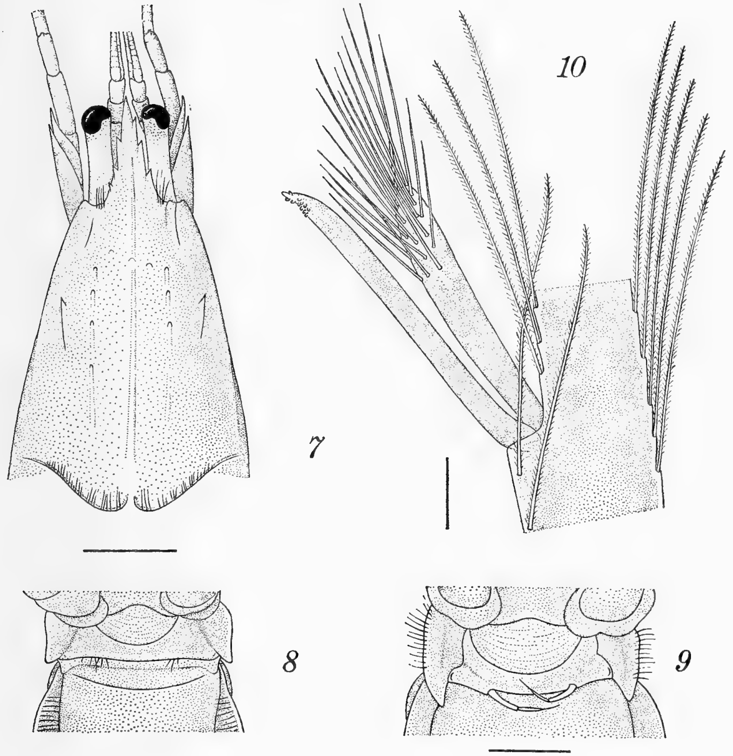
First legs strong, chelate, asymmetrical; with numerous tufts of conspicuous, silky, plumose setae obscuring fingers on both inner and outer surfaces, becoming progressively shorter to crest of merus on outer surface but leaving inner proximal part of hand bare; submarginal row of setae on inner face of carpus and ventral border of merus. Right chela strongest, fingers stout; fixed finger nearly straight, crushing edge with small proximal tooth and larger bilobed tooth distally; dactyl curved, tip closing inside fixed finger, strong tooth opposing bilobed tooth of fixed finger and a stronger tooth proximal to it; crest of propodus with few spines and tubercles, inner face with patch of strong tubercles near base of fixed finger; carpus with sharp dorsal spine at articulation with hand;



Figs. 5–6. *Calocaris* (*Calastacus*) *jenneri*, major (right) chela of holotype male: 5, external view; 6, internal view. Scale = 5 mm.

merus with upper margin keeled, low tooth near crest and row of 5 spines on proximoventral margin. Left chela similar except more slender and shaped as cutter; fingers agape proximally, distal half with opposed edges straight and finely serrate; prominent triangular tooth at middle of fixed finger diverging outward from cutting edge, opposite it an internal shoulder on dactyl; low rounded teeth on both fingers near articulation of dactyl; externally, and nearly concealed in pubescence, a prominent row of coalesced tubercles and spines parallel to proximal margin of fixed finger near articulation of dactyl; tubercles at bases of setal tufts on inner palm proximal to fixed finger.

Second legs chelate (left missing), flattened, merus with 3 unequal ventral spines; fingers corneous-tipped, cutting edges with fine spinules most dense distally, arranged full length of fixed finger, only on distal half of dactyl; dense tufts of setae on fingers and longer tufts of setae on margins elsewhere.



FIGS. 7–10. *Calocaris* (*Calastacus*) *jenneri*: 7, anterior carapace in dorsal view, holotype male; 8, sternite of first abdominal segment and adjacent parts, holotype; 9, sternite of first abdominal segment, allotype female; 10, appendices interna and masculina with part of second pleopod, paratype male (UNC-IMS 2484). Scales: horizontal, 7, 8, 9 = 2 mm; vertical, 10 = 0.2 mm.

Third and fourth legs similar, flattened; dactyls slightly curved, a comb of corneous spinules laterally, 3rd with 5 on left, 6 on right, 4th with 6, tips corneous; propodus with combs of corneous spinules ventrolaterally, 3rd with 7, 4th with 8 on left, 9 on right, and 3 or 4 smaller accessory combs laterally; scattered setae on all articles.

Fifth legs smaller in diameter as well as length, cylindrical; dactyl curved, corneous-tipped, with spinules laterally and on propodus distally; scattered setae longest and densest distally.

Biramous, setose pleopods on abdominal segments 2–5, lacking on first segment; endopod of each with appendix interna equipped with hooked setules at tip; second pleopod with an appendix masculina bearing long non-plumose setae on distal third (appendix missing from left side).

Tail fan with dense, long, plumose setae on caudal margin and tufts elsewhere. Telson longer than broad, with submesial pair of thickened longitudinal ribs; caudal margin evenly rounded, lateral margins with proximal lobate process articulating with mesial branch of uropod and interrupted distally by 3 progressively more closely spaced spines; submarginal spine each on marginal process, at base of first marginal spine (movable), mesial to it on submesial rib (fixed), and an unequal pair near distolateral corners (movable). Uropods as long as telson. Mesial branch with thickened longitudinal ribs bearing 4–5 spines, lateral margins with 2–4 spines progressively longer distally. Lateral branch with transverse distal suture bordered by row of strong, fixed spines; submarginal movable spine at distolateral corner; 2 thickened longitudinal ribs, lateral one broadest and bearing scattered small spines; lateral margins with 2–4 spines and slight unevenness distally.

Allotype female: Much as holotype in general appearance but differing as follows: Rostrum with asymmetrical marginal spines, 2 on left, 1 plus rudiment on right. Ridging and tuberculation of gastric area less pronounced. Both chelae somewhat less setose and less tuberculate. Major chela with dactyl closing completely inside fixed finger, tips crossing; fixed finger with a prominent tooth near midlength and 3 low ones proximally, shearing edge distally with 1 low broad tooth; dactyl with broad, low proximal tooth, a notch distal to it followed by smooth shearing edge. Minor chela with fingers separated by narrower proximal diastema, distal shearing edges of fingers faintly serrate; single sharp spine on external surface of palm proximal to articulation of dactyl. Small uniramous pair of pleopods on sternite of first abdominal segment; pleura of 4th and 5th segments more acutely tipped.

Measurements in mm: Holotype ♂. Carapace: length including rostrum, 12.4; width, 6.3; height, 6.3. Length articles of legs, L = left, R = right:

	1R	2R	3L	4L	5L
dactyl	6.9	1.9	1.5	1.4	1.1
propodus	14.4	4.3	3.8	4.1	3.8
carpus	4.4	4.3	3.6	3.3	2.6
merus	6.5	7.0	6.9	5.0	3.5
total	32.2	17.5	15.8	13.8	11.0

Allotype ♀. Carapace: length including rostrum, 10.5; width, 4.4; height, 4.6. Right chela: length dactyl, 4.0; propodus, 7.9.

Type-locality: E Cape Lookout, N. C., 34°18′N, 76°01.2′W–34°17.1′N, 76°01.3′W, 100–85 m, *Eastward* Stn. 12885, Cape Town dredge, 3 October, 1969, C. E. Jenner and class.

Material studied: Specimens studied are confined to the type series deposited in collections of the National Museum of Natural History (USNM), Washington, D.C., and University of North Carolina Institute of Marine Sciences (UNC-IMS), Morehead City, N. C.

USNM 150472 holotype ♂; USNM 150474 allotype ♀, paratype ♂ (cl 7.5 mm [est., rostrum broken], cl 8.4 mm), SW Cape Lookout, N. C., 33°43.1′N, 76°40.7′W–33°43.4′N, 76°40.3′W, 100 m, *Eastward* Stn. 1089, small biological trawl, 27 April, 1965, Menzies. UNC-IMS 2484 paratype ♂ and ♀ (cl each 11.3 mm), E Cape Lookout, N. C., 34°43′N, 76°40′W–33°42.7′N, 76°40.2′W, 90–110 m, *Eastward* Stn. 1087, small biological trawl, 27 April, 1965, Menzies. USNM 150473 paratype ♂ (cl 9.6 mm), SSW Cape Lookout, N. C., 33°43.3′N, 76°42′W–33°44′N, 76°41′W, 91–98 m, *Eastward* Stn. 10789, Cape Town dredge, 4 November, 1968, J. and W. Vernberg.

Variation: Ornamentation (setae, tubercles, spines) increases in size and complexity with increasing body length. In one male (USNM 150473) the proximal tooth of the major propodal finger is fairly well developed, but other teeth are rudimentary. The diastema on fingers of the minor chela is also well developed in this specimen, but it is not pronounced in smaller specimens examined. The hands of this male are reversed, the left stronger, but there is no evidence of alteration in the minor chela to indicate regeneration. The rostrum may be symmetrically or asymmetrically toothed.

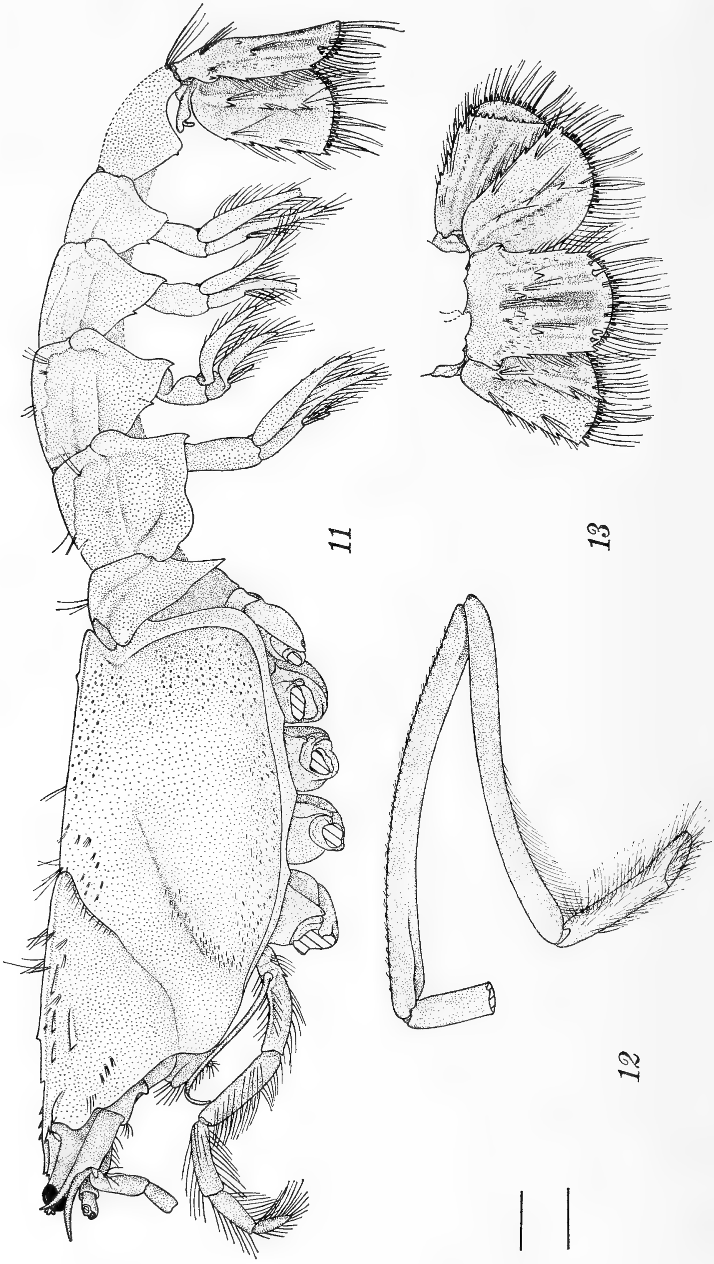
Color in life: Ground color "flesh" to off-white (pinkish white) with longitudinal trending, cross-banded spots of orange-red. Most dense orange-red color on posterior part of carapace where red is also deepest in intensity. Abdomen with first segment pale, others progressively darker caudad; lightest areas at articulations dorsally, deepest colors at bases of pleura. Basal articles of antennules and antennae with bands of color equal in intensity to darker parts of abdomen. Color on legs more washed out. Pubescence light greenish tan. (From holotype.)

Name: This species is named in honor of Professor Charles E. Jenner, Department of Zoology, University of North Carolina, Chapel Hill, who has contributed much to knowledge of marine invertebrates of the Carolinas and who with one of his classes collected the holotype.

Calocaris (Calastacus) oxypleura, new species

Figures 11–18

Holotype male: Integument microscopically granulate. Carapace compressed; bearing a sparse, short pubescence in tufts originating from rather evenly scattered, nearly obsolescent tubercles, longer setae on gastric region and in grooves; almost straight along middorsal line in lateral view except rostrum very slightly deflexed; most broadly rounded dorsally in gastric region, narrowing posteriorly; midline slightly raised, almost keellike in short section near posterior margin but interrupted at cervical groove, posterior part of gastric region and middle of posterior carapace; cephalic groove deepest dorsally but evident throughout length; branchial groove obsolescent but forming broad, shallow depression.



FIGS. 11–13. ***Calocaris* (*Calastacus*) *oxypleura*,** holotype male: 11, lateral view; 12, second leg; 13, tail fan. Scales: upper, 11, 13 = 2 mm; lower, 12 = 1 mm.

Rostrum slightly exceeding eyestalks, tapered and narrow; edges upturned; tip slightly damaged but apparently ending in an upturned spine approximately equal to pair of adjacent marginal spines, behind these a pair of slightly larger spines at midlength, and at broadening base a still larger pair; marginal notch (orbit) at base for reception of eyestalks in erect position where rostrum merges with gastric region.

Gastric region with 2 interrupted carinae on each side of raised midline; midline with moderate anterior spine followed by obsolescent spine; each lateral carina originating in diverging rostral base and armed with 3 buttressed spines, 1 above ocular notch, 1 behind notch, and 1 remote posterior spine; each submesial carina consisting of 3 remote buttressed spines in nearly straight line; area between carinae smooth except for scattered tufts of setae.

Abdomen and telson together about 1.5 times length of carapace (parts of abdominal segments 2–6 badly broken); segments smooth and uniformly arched dorsally, first short, fitted for articulation with carapace; low discontinuous longitudinal carina laterally between segmental articulations; pleura of segments 1–5 drawn posteroventrally to acuminate tips and with uniform margins except as follows: anterior margin of first segment slightly sinuous, of long second segment quite sinuous, of segments 3–5 with single spine in middle; sixth segment with pleuron subrectangularly produced, a tiny blunt spine anterior to tip of pleural lobe.

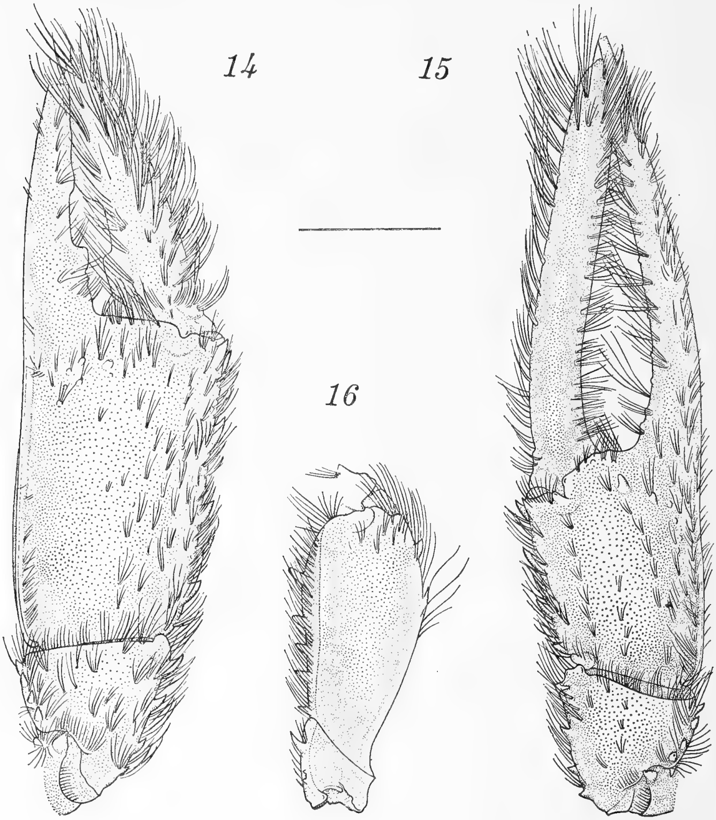
Eyestalks slightly flattened mesiodorsally, left slightly longer than right; cornea dilated.

Antennular peduncle with second article reaching anteriorly to same level as tip of rostrum (estimated rostral length).

Antennal peduncle with penultimate article extending beyond antennular peduncle; first (coxal) article with short, slender, terminal ventral spine; strong dorsolateral spine of second article reaching beyond distal margin of cornea; antennal thorn (acicle) slender (bent unnaturally) exceeding antennular peduncle; third article with small, distal, mesioventral spine; terminal article ½ length of penultimate fourth article; flagellum missing.

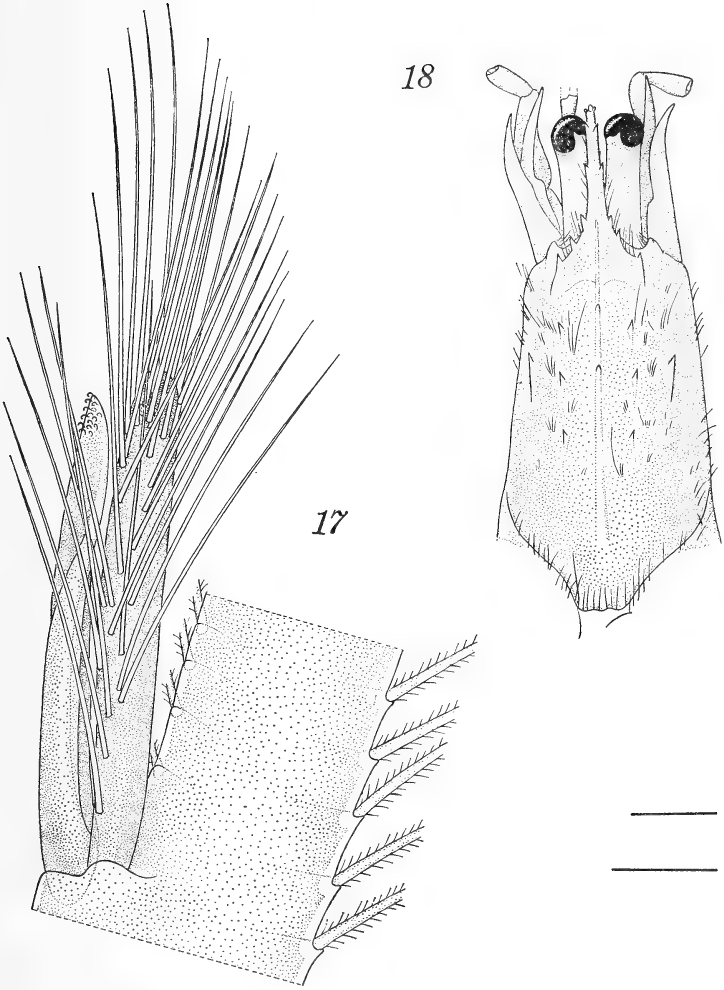
Endopods of third maxillipeds pediform, densely setiferous ventrally and mesially, a few long setae on carpus and merus laterally; distal articles unarmed; carpus with small distoventral spine laterally; merus with 3 ventral spines progressively larger and more acute distad; ischium with 2 small spines on ventral margin, and along mesial margin a prominent crest of about 16 spines terminating in an enlarged distal spine curved mesad; coxa with ventral spine.

First legs strong and asymmetrical, chelae elongate. Each rather thinly clothed with tracts of conspicuous, tufted, long setae, thickest on dactyls (but nearly as thick on fixed finger of right chela), dorsal aspect of palms, external surface of carpus and distal exposed part of merus; sparser but equally long tufts on inner surface of palms (except central inflated part), in row along groove on ventrolateral margin of



Figs. 14–16. *Calocaris* (*Calastacus*) *oxypleura*, chelae of holotype male in external view: 14, left; 15, right; 16, right merus. Scale = 5 mm.

hands, and on ventral edge of merus; tufts more evenly distributed on right than on left chela. Each hand with: row of 4 nearly equidistant spines on dorsal margin of palm and laterally displaced one near articulation of dactyl; tracts of irregularly sized tubercles on both inner and outer surfaces of palms, distally near base of fixed finger (one spiniform tubercle on each surface of right chela much larger and sharper than remainder) and trailing posteroventrally, especially on inner surface; low but sharp ridge along ventrolateral margin, sharpest proximally but diminishing to obsolescence near tip of fixed finger. Right chela slender, fingers agape nearly throughout length but tips broken; dactyl stouter than fixed finger, its prehensile edge with fine but uneven serrations most dense distally; fixed finger with prominent triangular tooth at ⅔



FIGS. 17–18. *Calocaris* (*Calastacus*) *oxypleura,* holotype male: 17, appendices interna and masculina with part of second pleopod; 18, anterior carapace in dorsal view. Scales: upper, 18 = 2 mm; lower, 17 = 0.25 mm.

length diverging outward from prehensile edge, proximal to it a row of widely spaced, fairly evenly distributed tuberculiform teeth, and distal to it a row of fine, irregular but much more closely spaced teeth. Left chela stouter, palm moderately inflated; dactyl stouter than fixed finger;

opposed edges of fingers with central diastema, proximal ¼ of fingers armed with irregularly elongate sectorial teeth and weak molar complex on fixed finger, distal half of both with shearlike edges, tips broken. Carpus of each cheliped with 4 strong dorsal and 4 ventrolateral spines. Merus of right cheliped with 5 spines on inner crest and 1 laterally near articulation with carpus, left merus with 4 spines on inner crest; both meri with 2 spines on external crest (left proximal one broken). Each ischium with single curved spine on inner crest.

Remaining legs missing except for disarticulated, chelate left second; chela nearly bare on inner surface but clothed with long, dense setae elsewhere, most prominent on dactyl and along ventrolateral aspect; fingers bent ventrally at slight angle to palm, opposed edges spooned; dactyl about ⅓ length of palm; both carpus and merus slightly bent to fit curve of carapace, prismatic in cross section; distal third of carpus with long setae ventrally; external surface of merus covered with ciliated, transverse rugosities.

Biramous, setose pleopods on abdominal segments 2–5, lacking on first segment; endopod of each with appendix interna equipped with hooked setules at tip; second pleopod with an appendix masculina bearing long nonplumose setae along entire length, most dense distally.

Tail fan with dense, long, plumose setae on caudal margin (many broken) and scattered tufts elsewhere. Telson about ¼ longer than wide, evenly rounded caudally; lateral margins with proximal lobate process articulating with uropodal endopods and armed with 4 spines, 1 surmounting lobate process, 2 well deparated on middle reaches, and 1 at posterolateral corner; mesial to latter an unequal pair of movable spines; median longitudinal sulcus fairly broad; suggestion of a pair of submesial thickened longitudinal ribs in proximal half and on these a small submesial pair of proximal spines, larger spine near center on each side. Uropods as long as telson. Mesial branch with thickened longitudinal ribs, central rib bearing 4 nearly equidistant spines, caudalmost one nearly on terminal margin; lateral marginal rib with 4 spines progressively longer distally and strong spine at caudolateral angle (spine twinned and broken on right side). Lateral branch with transverse distal suture bordered by row of small spines; 2 thickened longitudinal ribs centrally; lateral margin with 4 unevenly spaced spines, distalmost flanked mesially by submarginal movable spine.

Measurements in mm: Carapace: length including rostrum, 18.8; width, 6.1; height, 7.0. Length abdomen and telson (estimate), 23. Length articles of first legs: right propodus, 21; right dactyl, 14.4; left propodus, 19.8; left dactyl, 10.0—of second leg: dactyl, 0.94; propodus, 2.94; carpus, 6.25; merus, 7.31.

Type-locality: [Straits of Florida W of Riding Rocks] 25°15′N, 79°13′W, 365 m, *Combat* Stn. 445, 23 July, 1957 (USNM 101651 holotype ♂).

Name: The name is from the Greek "oxys" acute, and "pleura" side, for the abdominal pleura with prominent acuminate tips.

Remarks: I have described this species with some hesitation because the imperfect holotype is the only specimen, but the characters are so distinctive that there seems little likelihood that it could be confused with another species. Specimens of most axiids are rare in collections, and knowledge of the group seems benefitted by any evidence available.

The specimen is well preserved but damaged mechanically. The rostral tip and tip of each antennal thorn have seemingly been jammed and pushed to the right. A number of spines on the carapace and appendages are broken, as are many setae. The legs present are disarticulated from the body and tips of the chelipeds broken off. The abdomen has been crushed and twisted, most damage inflicted on segments 4–6, splitting the terga and cracking some pleura. The lateral branch of the left uropod is missing.

The large chelae, though apparently worn, are distinctive in shape. The left chela is the major, and the right the slender, forcepslike minor. No other minor chela resembles this one among published illustrations of Axiidae or specimens available for study. The hand may be regenerated, but there is no evidence for or against this.

Discussion: In the western Atlantic, 3 species of *Calocaris* belonging to the subgenus *Calastacus* are now known from waters off the southeastern United States, the 2 described here and *C. hirsutimana* Boesch and Smalley, 1972, known also from Guyana. All have conspicuously bearded chelae. Boesch and Smalley (1972) found the gills of *C. hirsutimana* as listed for *Calocaris* by Gurney (1942: 149) except with "podobranch and arthrobranch on second maxilliped well developed and epipod of second pereiopod lacking a podobranch." The large male specimen of *C. hirsutimana* listed below agrees with Gurney's gill formula except that legs 3 and 4 have epipods and that of 3 has a small podobranch. *Calocaris jenneri* has the same gill formula as *C. hirsutimana*; danger of breakage prevented examination of gills in *C. oxypleura*.

Calocaris jenneri is much less spinose on the lower palm of the chelae and along the edges of the pleura than *C. hirsutimana*, and it lacks the elongate antennal thorn and median spine on the telson; but *C. jenneri* does have much more prominently armed tooth rows and accessory spines on the chelae in both males and females (females of *C. hirsutimana* are unknown). While the long antennal thorn and somewhat setose carapace link *C. oxypleura* to *C. hirsutimana*, the acuminate tips on the pleura, open forcepslike chelae, and lack of a median spine on the telson clearly separate it from the latter. Boesch and Smalley (1972) drew parallels between *Axiopsis* and *Calastacus*, pointing out that irregularities in the middorsal keel make it a poor generic character, and related *C. hirsutimana* to 2 Indo-Pacific species of *Axiopsis*, implying thereby some importance in the long antennal thorn. *Calocaris jenneri* has a short antennal thorn yet shares other features with *C. hirsutimana*. It is clear that present generic definitions are inadequate.

New locality record: USNM 150475 *Calocaris* (*Calastacus*) *hirsut-*

imana, 1 ♂ (mature, broken), Tortugas shrimp grounds [Florida], fisherman, April, 1964, to D. Tabb, to A. J. Provenzano.

Acknowledgments: I am indebted to D. M. Dexter, C. E. Jenner, R. J. Menzies, and J. and W. Vernberg for gifts of specimens, to Fenner A. Chace, Jr., and Isabel Pérez Farfante for critical reading of the manuscript, and to Maria M. Diéguez for preparing the llustrations. The holotype, allotype and a series of paratypes of *Calocaris jenneri* were transferred to USNM from UNC-IMS lots 2376, 2564 and 2579.

Addendum: After this paper was in press a second male specimen was found in material from the then U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries R/V *Oregon*, Stn. 6460, 14°12′N, 81°57.5′W [Quita Sueño Bank off Nicaragua], 146 m, 2 December 1967, 66-foot trawl, by Michelle de Saint Laurent. The specimen agrees well with the holotype, is considered a paratype (USNM 151211), and differs in minor details as follows: Chelipeds and left fifth leg attached, remainder of legs missing. Carapace length 18.5 mm, extreme tip of rostrum broken, spines of rostrum asymmetrically arranged. Abdominal pleura with a few small submarginal tubercles laterally. Chelae with tracts of spines and/or spiniform tubercles on both inner and outer surfaces of palms in same position as tracts of tubercles in holotype; left (major) chela with tips of fingers each tapered to a point and curved toward each other, crossing when closed; right (minor) chela with similar tip on dactyl, tip of fixed finger broken; left carpus with 3, right with 4 ventrolateral spines; meri each with 5 spines on inner crest. Fifth leg slender; brush of long setae on dactyl; propodus with a few long, mesial setae on distal end, a dense patch of short setae terminally on lower margin, and an elongate patch of longer ones distolaterally; length of dactyl 1.3, propodus 4.1, carpus 3.2, merus 4.4, ischium 2.5 mm. Tail fan with dense fringe of long, plumose setae largely intact, minor differences from holotype in spination.

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CICHLASOMA REGANI, A NEW SPECIES OF CICHLID FISH FROM THE RIO COATZACOALCOS BASIN, MEXICO

By Robert Rush Miller

Museum of Zoology, The University of Michigan,
Ann Arbor, Michigan 48104

In 1957 and 1959, collections were made in the upper part of the Río Coatzacoalcos basin near the crest of the Isthmus of Tehuantepec, Oaxaca, México. One paper on cichlid fishes collected there (Miller and Nelson, 1961) gave the specific traits of a seemingly localized endemic of the *Thorichthys* group, *Cichlasoma callolepis* (Regan). The present paper describes another localized endemic, this time of the *Theraps* group, which I am pleased to name for the late British ichthyologist, C. Tate Regan, in recognition of his classic studies on American cichlids.

Study materials are in the collections of the Museum of Zoology of The University of Michigan (UMMZ), the National Museum of Natural History (USNM), and the Museum of Natural History of The University of Kansas (KU). The lateral-series scale count begins with the first scale in the upper lateral line, goes to the last one in that line, then continues with the scale on the lower lateral line that is next behind the transverse row that extends downward and forward from the last pored scale of the upper lateral line. The last scale recorded is at the end of the lower lateral line, where it meets the base of the caudal fin (this is not necessarily the last pored scale, since pored scales often extend onto the caudal fin). This method is equivalent to Regan's "longitudinal series," as redefined by Trewavas (1935: 72), and is employed to make use of his extensive scale-count data on American cichlids (Regan, 1905a–c, 1906a–b). The transverse-series scales are counted, as described by Regan, from the base of the first dorsal spine downward and backward to, but not including, the scale row on the midline of the abdomen. Fin-ray counts and measurements are made according to the methods prescribed by Hubbs and Lagler (1958).

Cichlasoma regani, new species

Figure 1

Cichlasoma sp. Miller (1966: 793), upper part of Río Coatzacoalcos basin, Atlantic slope of Isthmus of Tehuantepec, México.

Diagnosis: A moderately small, rather slender-bodied, large-scaled species of the *Theraps* group of Regan (1906–08: 17), distinguished from other members of this group by lacking both clearcut vertical bars and a horizontal stripe on the side of the adult, with 32 (31–33) scales in lateral series, typically XVII,13 elements in dorsal and VI,9 in anal fins, 3 + 8 or 9 gill rakers, rather somber life colors, and the adult with 2 or 3 blotches along upper side below dorsal fin and a prominent dark spot at caudal base.

Holotype: UMMZ 184756 (adult female, 80.5 mm S. L.), from Río Almoloya where crossed by the Trans-Isthmian Highway about 33 km north of southern terminus of that road, at 95° 01′ W Long., 16° 45′ N Lat., Oaxaca, México, taken 25 February 1959 by R. R. Miller and R. J. Schultz; elevation approximately 250 meters.

Paratypes: UMMZ 184757 (11, 36–67 mm), same data as holotype. UMMZ 178529 (male, 37 mm), same locality as holotype, 27 March 1957, R. R. and M. Miller. USNM 102255 (male, 95 mm), from Río Malotengo, upper tributary Río Coatzacoalcos, 6.4 km southeast of Matías Romero, Oaxaca, 21 December 1935, T. MacDougall. KU 1573-1574 (2 females, 116 and 145 mm), from 60 km southwest of Jesús Carranza (Río Jaltepec drainage), Oaxaca, 26–30 March 1948, W. W. Dalquest; elevation, 150 meters.

Description: Form and color pattern are shown in Figure 1 and meristic data are given below. Proportional measurements appear in Table 1.

Dorsal spines, XVI (1), XVII (15); dorsal soft rays, 12 (1), 13 (12), 14 (3); anal spines, V (1), VI (15); anal soft rays, 9 (16); pectoral rays in both fins (splint along uppermost ray excluded), 15 (11), 16 (21). Lateral scales, 31 (2), 32 (13), 33 (1); scales in upper lateral line, 20 (1), 21 (5), 22 (6), 23 (4), and in lower lateral line, 9 (1), 10 (3), 11 (5), 12 (5), 13 (2); scale-row overlap of the upper lateral line on the lower, 2 (2), 3 (3), 4 (5), 5 (4), 6 (2); transverse scales, 18 (1), 19 (3), 20 (7), 21 (5); lateral line to soft dorsal origin

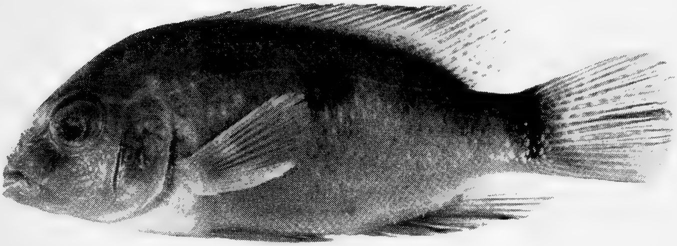

FIG. 1. *Cichlasoma regani*, holotype, UMMZ 184756, female, 80.5 mm standard length, from Río Almoloya, Oaxaca, México.

(not including scales on scaly sheath along fin base), 2½ (6), 3 (7), 3½ (3); lateral line to origin of anal fin, 8 (4), 9 (10), 10 (2); scale rows between bases of pectoral and pelvic fins, 5 (7), 6 (8), 7 (1); scales around caudal peduncle, 8 + 9 = 19 (8), 9 + 9 = 20 (6); scale rows on cheek, 4 (7), 5 (9). Gill rakers on first arch, upper limb, 3 (14), 4 (2); lower limb, 8 (6), 9 (10); total, 11 (5), 12 (10), 13 (1). Vertebrae, 13 (1), 14 (14), 15 (1) precaudal; 16 (3), 17 (12), 18 (1) caudal; and 30 (2), 31 (14) total.

Body slender, elongate, becoming deeper with age, predorsal contour strongly arched in marked contrast to the gently sloping (concave) preventral contour. Highest point along back at or near origin of dorsal fin. Base of dorsal fin increasing in length with age. Mouth horizontal, low (well below level of ventral rim of orbit), lower lip thicker than upper (from about half to slightly greater than half diameter of pupil). Upper jaw extends to vertical from a point between nostril and anterior rim of orbit; jaws equal anteriorly or lower slightly included. Fold of lower lip not continuous, but frenum narrow. Dorsal origin above insertion of pectoral fin, spines increasing in length rapidly to about fifth to eighth, then more gradually to last (longest) which varies from slightly less than half (in juveniles) to half (in adults) head length; soft part of fin when laid back extending from anterior fourth to half of caudal fin. Pectoral shorter than head, extending from middle of to well beyond midlateral spot or to between anus and anal-fin origin; pelvic extending from anus to slightly beyond base of second anal spine. Caudal fin rounded to slightly emarginate. Caudal peduncle deeper than long. Depth of preorbital varying from about one-half

TABLE 1. Proportional measurements in per mille of standard length of the type-series of *Cichlasoma regani.* Juveniles are from UMMZ 178529 and 184757; adults include KU 1573–74, USNM 102255, the holotype, and 2 from UMMZ 184757; half-grown are from UMMZ 184757. Figures in parentheses are means.

Measurement	Juveniles (2)	Half-grown (4)	Adults (6)	Holotype
Standard length	35.9,37.1	44.4–53.1(48.0)	63.4–145.5(94.5)	80.5
Predorsal length	435,437	431–449(437)	419–435(427)	435
Body depth	404,410	410–421(414)	402–448(421)	404
Head length,	371,372	367–377(372)	337–356(348)	356
depth	342,345	328–358(347)	335–362(350)	353
Postorbital length	123,129	113–121(119)	107–128(115)	108
Snout length	123,127	135–145(141)	142–161(151)	154
Preorbital depth	56,62	65–72(68)	74–102(89)	89
Interorbital bony width	95,100	100–101(101)	101–117(110)	113
Orbit diameter	121,123	109–116(112)	80–111(95)	102
Cheek depth	100,105	105–110(108)	109–138(120)	122
Mandible length	140,148	132–146(141)	125–139(131)	127
Upper jaw length	95,102	99–105(102)	93–111(102)	104
Caudal peduncle length,	137,143	131–137(133)	134–149(142)	140
least depth	151,156	154–161(158)	148–154(152)	154
Dorsal-base length	555,568	576–585(581)	574–637(599)	574
Longest (= last) dorsal spine length	156,173	155–169(161)	166–204(181)	175
Anal-base length	270,275	266–275(270)	252–274(264)	252
Pectoral length	291,298	266–277(271)	273–303(282)	278
Pelvic length	279,286	241–275(260)	245–281(266)	251

diameter of orbit in juveniles to greater than orbit in large adults. Premaxillary process extending backward between a point on posterior part of snout to above middle of pupil. Along base of caudal rays one supplementary lateral line, lying either above or below principal lateral line, occurs in 6 juvenile-to-adults, and two supplementary lateral lines occur in 2 half-grown, holotype, and 2 largest specimens; the other types lack this feature.

Teeth: Jaw teeth conic, without a posterior cusp (present in *Herichthys*), bluntly pointed (sometimes peg-like). Teeth of outer series in upper jaw number 7 to 9 on each side, increasing rather regularly in size anteriorly; in lower jaw anterior 4 outer teeth enlarged, subequal, and sharply differentiated from smaller lateral ones. Occlusal surface of lower pharyngeal bone of a 67-mm specimen with dentigerous portion about 1.3 times broader than long, the teeth arranged in about 24 rows; those teeth in the two median rows, especially posteriorly, heavy and rounded (molariform) but most of them bear remnants of a central cusp, and those on rows on each side of these specialized (crushing) teeth also enlarged.

Color pattern: Up to seven vertical bars (mostly rather obscure) in young, four in juveniles, the broadest only about half diameter of eye, the third broadest and darkest dorsally extending from below dorsal fin nearly to venter or to anal fin, decreasing in number with age (4 in juveniles, 2–3 in small adults, 1–2 in large adults) and represented in larger specimens chiefly by prominent dark spots or blotches, 2 or 3 in number, along upper lateral line (Fig. 1), the largest blotch below 10th to 14th dorsal spines and above tip of extended pectoral fin; the upper lateral line runs through this blotch. Interradial membranes of soft dorsal and caudal fins with rows of prominent dark spots, weakly developed on soft anal fin. A prominent ovate to nearly round black spot occurs on base of caudal fin and adjacent part of caudal peduncle, extending over most of side of latter. Top of head with two prominent, dark brown, curved saddles, anterior one across snout to anterodorsal part of orbit and posterior one largely between eyes; anterior saddle widest at its midpoint, about two-thirds diameter of pupil, whereas posterior one narrowest there, about one-fourth to one-third diameter of pupil.

Color in life: At time of capture, no bright colors were noted on body or fins. Dorsal, caudal, and anal fins had rusty orange spots. Horizontal rows of spots along side following scale rows were black, each scale with a spot at or near its base, the rows becoming less prominent toward abdomen. Body greyish olive to greenish to golden yellow (on sides). Sexes not distinguished in field.

Habitat and Associates: The Río Almoloya is a clear winding stream of moderate gradient, about 6 meters wide on the average, with pools attaining a maximum depth of 3 meters. At the time of our visits late in the dry season it consisted of swift, rocky riffles alternating with long pools and some sluice-like sections. Nearly a fourth of the stream was shaded with marginal vegetation along the steep banks. The bottom included much sand and silt in the pools, alternating with rocks and boulders on the riffles. There was also some bedrock. A green alga and localized growths of *Nasturtium* were the only aquatic plants noted. A fairly rich fish fauna was secured at this locality, including 18 species in 8 families: Characidae (*Astyanax fasciatus*), Pimelodontidae (*Rhamdia guatemalensis*), Belonidae (*Strongylura hubbsi* Collette, 1974), Poeciliidae (*Poecilia mexicana* and *P. sphenops, Heterandria bimaculata, Poeciliopsis fasciata* and *P. gracilis*), Atherinidae (*Archomenidia bolivari* and *Xenatherina schultzi*), Mugilidae (*Agonostomus monticola*), Cichlidae (*Cichlasoma aureum auct., C. callolepis, C. bulleri, C. zonatum, C. salvini*), and Eleotridae (*Gobiomorus dormitor*).

Distribution: *Cichlasoma regani* is known from the Ríos Almoloya, Malotengo, and Jaltepec, upper tributaries of the Río Coatzacoalcos on the Atlantic slope of the Isthmus of Tehuantepec.

Acknowledgments: I am grateful to the staff of the National Museum of Natural History for facilities and working space, the John Simon Guggenheim Memorial Foundation for support as a Guggenheim Fellow while preparing the manuscript, the U. S. National Science Foundation (Grant GB-4854) for field support, and Louis P. Martonyi for the photograph. Mexican officials kindly gave permission to collect fishes in their country.

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STUDIES OF NEOTROPICAL CADDISFLIES, XIX: THE GENUS *CAILLOMA* (TRICHOPTERA: RHYACOPHILIDAE)

By Oliver S. Flint, Jr.
Smithsonian Institution, Washington, D.C., 20560

All of the 17 recognized Neotropical genera of Rhyacophilidae belong to the subfamily Hydrobiosinae, a subfamily which also occurs in southern and eastern Asia, Fiji, Australia, Solomon Islands, New Caledonia, and New Zealand. The larvae of all species are free-living, and, as far as is known, predaceous and rheophilic.

One genus, *Atopsyche*, is known from the southwestern United States, south throughout Central and South America, including the Greater Antilles, and as far south as the Province of Catamarca in Argentina. Yet this genus has not been collected, and probably does not occur, in Chile or southern Argentina. Conversely, 14 of the 16 remaining genera are strictly limited to these southernmost regions of Chile and Argentina. Of the remaining 2 genera, *Iguazu* is known from outside Chile by only 1 specimen labelled Misiones, Argentina, that may be mislabelled. This genus, then, is most likely limited also to the Chilean Subregion. The other genus, *Cailloma*, actually has a distribution that broadly overlaps the two Neotropical subregions. Examples of this genus have been collected near the eastern tip of Isla de los Estados (Staten Island) off the tip of Tierra del Fuego, and north along the Andes at least into Ecuador. Why *Atopsyche*, whose larvae may occur on the same rock as those of *Cailloma* in northern Argentina, has not been able to accomplish the same bridging of the two Subregions, remains unanswered.

I have frequently collected adults and immatures of this genus in my travels in Chile, especially during my most recent visit in Argentina in 1973. In fact, a special trip was taken to Mendoza for the primary purpose of collecting additional material of the unrecognizable *Cailloma lucidula* (Ulmer), the results of which are summarized in the discussion under this species. As a result I now possess larvae and pupae, males and females, of all 3 known species of this genus. This paper, then, brings together illustrations, keys, distributions, and new synonymies in the genus *Cailloma*.

I wish to thank Prof. Dr. H. Weidner for the loan of the type of *Cailloma lucidula* (Ulm.), and Dr. J. Unzicker for the loan of the type of *C. brunosa* Ross & King. Mr. L. M. Druckenbrod prepared the excellent illustrations of the larval heads and pronota.

Genus *Cailloma* Ross & King

Cailloma Ross & King, 1951, p. 507.—Ross, 1951, p. 112; 1953, p. 154; 1956, p. 125.—Flint, 1971, p. 12.—Fischer, 1971, p. 149.

Genus A Flint, 1963, p. 463; 1971, p. 12.

Type species: *Cailloma brunosa* Ross & King (= *lucidula* Ulmer).

Adult: Spurs 2,4,4. Venation nearly identical in both sexes, except that the discal cell in the forewing of the female is typically longer than in the male. Forewing with R_{2+3} branched well beyond s, R_{4+5} branched at s; M_{1+2} and M_{3+4} both branched about midway to wing margin. Hindwing with R_{2+3} apparently arising from R_4 with cell Cu_{1b} considerably inflated. Abdomen without lateral processes; seventh sternum of both sexes with a small wart bearing enlarged setae. Male genitalia with cercus small, filicercus elongate, paracercus short; clasper one-segmented; aedeagus short, simple, with a single internal spine. Female genitalia not produced into an elongate ovipositor.

Larva: Mandibles with a single tooth on dorsal carina, ventral carina lacking on right mandible, a simple ridge on left. Head ¾ as wide as long. Prosternum with sclerite small, ¼ to ⅕ as wide as distance between legs. Foreleg with apicoventral process of femur short and slender; tibia and tarsus fused. Mid and hindlegs similar in size and structure; claw with basal seta short, broad, and curved. Lateral sclerite of anal proleg 1½ times as long as broad; claw without ventral teeth, but with basoventral seta broad and curved.

Pupa: Mandibles curved; inner margin serrate with larger teeth at midlength. Hook plates anteriorly on segment 2 to 6 or 7, not raised above body surface, each with many small teeth; posterior plates on segments 4 and 5, each broader than long, low, and with many small teeth.

Recognition: The adults of the genus are easily recognized by their venation, especially the short apical forks of R_{2+3}, M_{1+2}, and M_{3+4} in the forewing and the apparent origin of R_{2+3} from R_4 in the hindwing. The other genera that may be confused with *Cailloma* on the basis of venation are *Parachorema*, *Stenochorema*, and *Nolganema*. The males of the first 2 genera possess a narrow reflexed costal cell and lack all vestiges of crossveins in the forewing. In addition, the claspers in the males of *Parachorema* are clearly 2-segmented and in *Stenochorema* possess a basal complex. The genus *Nolganema* Navas is not fully recognizable from the original description, but clearly falls into this complex of genera. Navas does state however, that the type possesses sternal processes, which are lacking in *Cailloma* but present in some degree in the other genera.

The larvae of few Neotropical Hydrobiosines have been described, but based on undescribed material in the collection here, the following characteristics will probably serve for recognition of the larvae of *Cailloma*: presence of a single dorsal tooth and reduction of ventral cutting edges of mandibles; shape and structure of forelegs, especially fusion of tibia and tarsus; very small size of prosternal sclerite; modification of basal setae of mid and hind legs; and short lateral plate of anal prolegs, whose claw lacks ventral teeth and possesses a modified basal seta.

The larvae described as genus A from Ecuador in 1963 are clearly those of a species of *Cailloma*. They are in an early instar, at which time the pronotal halves are fused and the head spots discrete. Early instar larvae in any collection that I examined have the appearance of these from Ecuador, thus they cannot be identified to species at this time.

In general, characteristics of the mandibles, hook plates, and apical lobe offer the best characteristics for recognition of the pupae whenever recognition has been possible.

Biology: Immatures of the species in this genus are commonly found on and under the rocks in cold, rather small streams in the Andes. *C. lucidula* (Ulm.) is a dominant, and at times exclusive, inhabitant of small, tumbling, brooks of the puna grassland areas of Tucuman and Mendoza, Argentina (and probably similar areas in the other northwestern provinces). Dr. Spangler informs me that the stream near Cochabamba, Bolivia, was 1 to 2 meters wide, with riffles but at a rather low gradient and also in the puna. According to Dr. Hodges, the two Ecuadorian localities where small larvae were taken were also of similar nature and in the paramo, a similar low-type vegetation zone of high elevations.

However, many of the collection sites in southern Chile and Argentina are in the *Nothofagus* forest, which characteristic is especially true for

C. rotunda Flint. Two sites in southern Chile near Punta Arenas are most instructive in this connection. One site, collected on Jan. 10, 1965 was at an elevation where the forest was well developed with the small stream, slightly over a half meter wide, flowing in and alongside the forest. The site collected on Feb. 26, 1966 was at a slightly lower elevation, in open grassland. At the first site only *C. rotunda* Flint was taken, at the second only *C. pumida* Ross. Yet, one night in central Chile at the fish hatchery at Río Blanco males of all three species came to the light. There are, however, many springs and streams up to several meters in width in the vicinity, some of which are shaded by trees planted at the fish hatchery, others in the more open, natural scrub-type vegetation. It is thus still possible for some degree of ecological difference in the breeding sites at this one locality.

KEY TO SPECIES, ADULTS

1. With claspers and aedeagus (males) 2
   Without these structures (females) 4
2. Clasper broadest subapically, apex nearly round .... *rotunda* Flint
   Clasper narrowing apicad, apex bluntly pointed 3
3. Apicoventral lip of aedeagus produced into a long narrow point .... *lucidula* (Ulmer)
   Apicoventral lip of aedeagus broad and bluntly bifid .... *pumida* Ross
4. Midventral membranous process of ninth sternum greatly surpassing apex of ninth tergum .... *rotunda* Flint
   Midventral process only attaining apex of ninth tergum .... *lucidula* (Ulmer) & *pumida* Ross

KEY TO SPECIES, LARVAE

1. Head with frontoclypeus unmarked anteriorly .... *rotunda* Flint
   Head with frontoclypeus bearing a dark transverse bar or with dark lateral spots anteriorly .... *lucidula* (Ulmer) & *pumida* Ross

KEY TO SPECIES, PUPAE

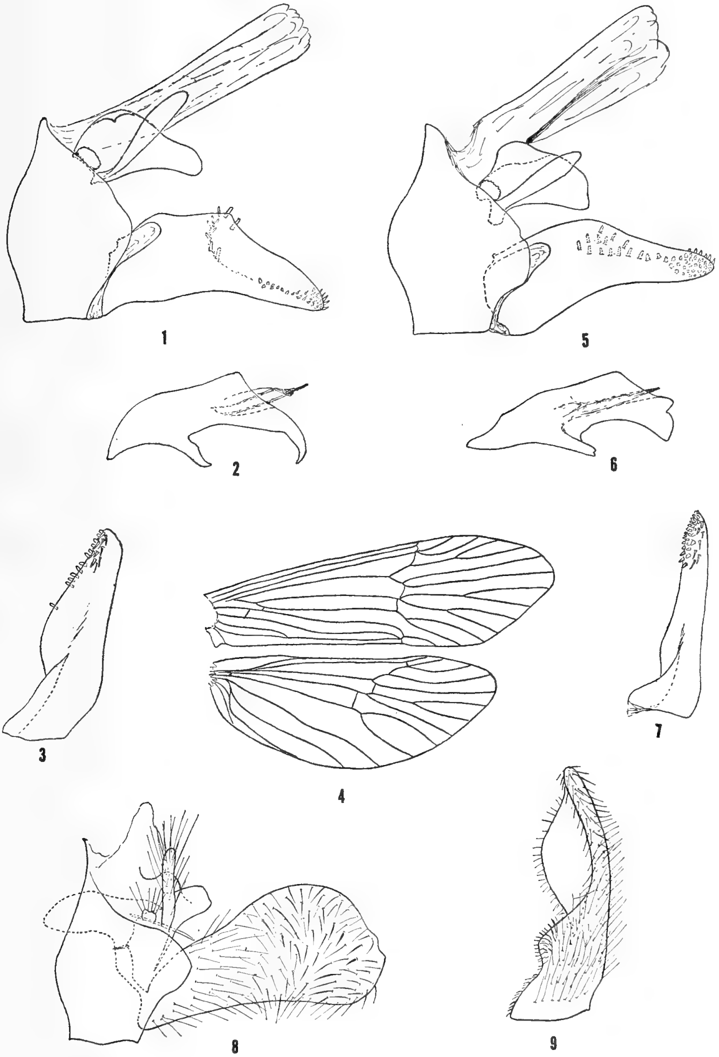
1. Hook plate 6A about twice as wide as long; without 3 large apicolateral setae on apical lobe .... *rotunda* Flint
   Hook plate 6A about as wide as long; apical lobe with 3 large setae apicolaterally .... *lucidula* (Ulmer) & *pumida* Ross

Cailloma lucidula (Ulmer)

Figures 1–4, 12–17, 19, 21–26

Atopsyche lucidula Ulmer, 1909, p. 73; 1913, p. 404.—Jörgensen, 1919, p. 392.—Fischer, 1960, p. 161.

Cailloma lucidula (Ulm.).—Ross & King, 1951, p. 507.—Ross, 1956, p. 125.—Fischer, 1971, p. 149.



Figs. 1–9. *Cailloma lucidula* (Ulmer): 1, male genitalia, lateral; 2, aedeagus, lateral; 3, clasper, ventral; 4, wings. *C. pumida* Ross: 5, male genitalia, lateral; 6, aedeagus, lateral; 7, clasper, ventral. *C. rotunda* Flint: 8, male genitalia, lateral; 9, clasper, ventral.

Cailloma brunosa Ross & King, 1951, p. 507.—Ross, 1956, p. 125.—Fischer, 1971, p. 149. [NEW SYNONYMY].

Cailloma angustipennis Schmid, 1955, p. 122.—Fischer, 1971, p. 149.—Knutson & Flint, 1971, p. 315. [NEW SYNONYMY].

Through the kindness of Prof. Dr. Weidner, I have been able to clear and study the type female of *A. lucidula* Ulmer. It is absolutely typical of the complex containing this species and *C. pumida* Ross, the females of which I am unable to tell apart. I visited the type locality of Potrerillos, Mendoza, Argentina within a few days of the day of the year of the collection of the type in the hope of collecting additional material which would permit the resolution of this problem. I found larvae and pupae commonly in the small streams above Potrerillos, and obtained adults at the light on several nights. All the male metamorphotypes and adult males, save one, pertain to the species previously known as either *C. brunosa* Ross & King or *C. angustipennis* Schmid. There is one adult male of *C. pumida* Ross in the collection. Therefore, on the overwhelming preponderance of this species at the type locality near the date of collection of the type, I identify the type of *A. lucidula* with the species here treated.

I have studied the type of *C. brunosa* Ross & King, loaned by the Illinois Natural History Survey and returned to the Field Museum of Natural History (FMNH), and *C. angustipennis* Schmid, located at the National Museum of Natural History (USNM). They are clearly conspecific with *C. lucidula*, which shows little variation over its extensive range.

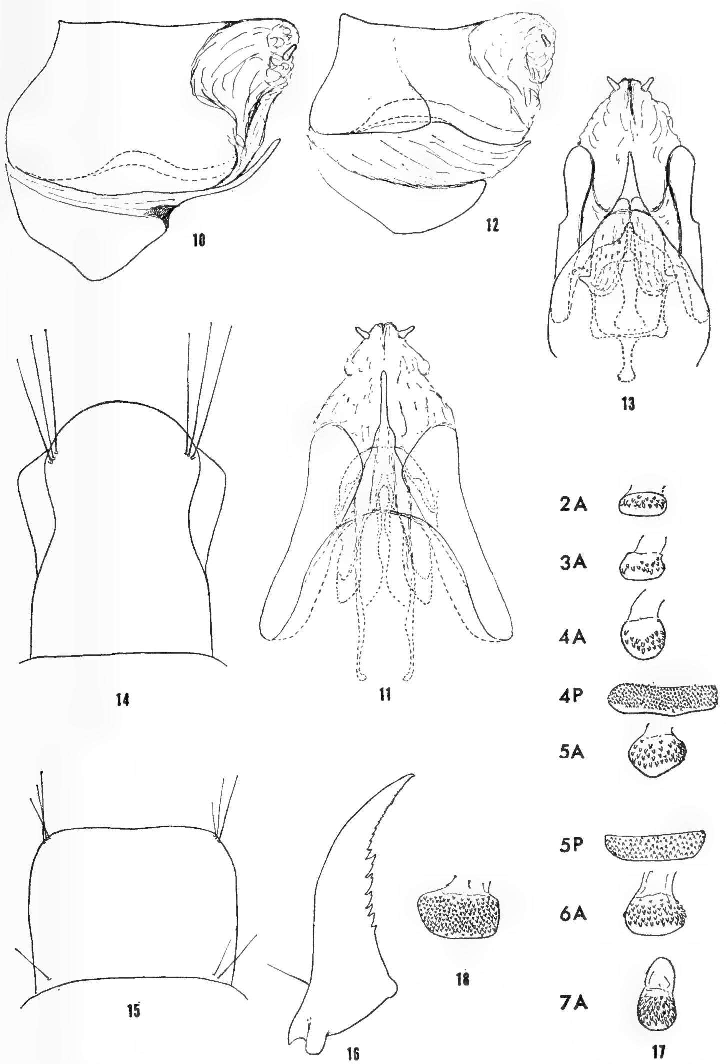
This species and the following, *C. pumida* Ross, are separable with certainty only in the male sex; the females, larvae, and pupae seem to be identical in the two species. The aedeagus, which offers the surest means of recognition, has its apicoventral lip drawn out into a long slender point in *C. lucidula*, but in *C. pumida* the lip is broader and bluntly bifid. In addition the clasper is broader apically and in dorsal aspect bears a smooth, slightly cupped dorsomesal area in *C. lucidula*.

Material: PERU: San Ignacio, Cailloma, 1 Sept. 1939, K. P. Schmidt, ♂ holotype of *C. brunosa* Ross & King (FMNH).

BOLIVIA: COCHABAMBA; 48 km north of Cochabamba, 8490′ (2570 m), 10 May 1969, P. & P. Spangler, 45 larvae, 4 prepupae, 7 pupae, 1♂ 2♀ metamorphotypes.

ARGENTINA: TUCUMAN; Rt. 307, La Angostura, 1850 m, 11 Oct. 1973, O. S. Flint, Jr., 1♂ 2♀, 1 larva. Rt. 307, km 76, west of Tafi del Valle, 2600 m, 11 Oct. 1973, O. S. Flint, Jr., 1 larva, 5 prepupae, 6 pupae, 1♂ metamorphotype. Rt. 307, Abra de Infiernillo, 2970 m, 11 Oct. 1973, O. S. Flint, Jr., 17 larvae. Camino a Amaichá (Rt. 307) km 92, 31 Oct. 1964, Teran, 1♀ (Inst. Lillo). Rt. 307, km 97.5, Los Cardones, 2700 m, 11 Oct. 1973, O. S. Flint, Jr., 1 prepupa, 5 pupae, 2♂ 1♀ metamorhpotypes.

MENDOZA; Potrerillos, 26 Dec. 1907, P. Jörgensen, ♀ holotype of *A. lucidula* Ulmer (Hamburg Mus.). 4 km south of Potrerillos, 1450 m, 18 Dec. 1973, C. M. & O. S. Flint, Jr., 20 larvae, 2 prepupae, 7 pupae, 2♂ 1♀ metamorphotypes. Río Blanco, 10 km south of Potrerillos, about 1500 m, 18 Dec. 1973, C. M. & O. S. Flint, Jr., 9 larvae, 6 prepupae,



FIGS. 10–18. *Cailloma rotunda* Flint: 10, female genitalia, lateral; 11, female genitalia, ventral. *C. lucidula* (Ulmer): 12, female genitalia, lateral; 13, female genitalia, ventral; 14, apical lobe of male pupa, dorsal; 15, apical lobe of female pupa, dorsal; 16, pupal mandible, dorsal; 17, pupal hook plates, dorsal. *C. rotunda* Flint: 18, pupal hook plate 6A, dorsal. (A = anterior, P = posterior, 2-7 = segment number).

16 pupae, 6♂ 5♀ metamorphotypes. Above El Salto, southwest of Potrerillos, about 1600, m, 20 Dec. 1973, C. M. & O. S. Flint, Jr., 21♂ 4♀, 10 larvae, 16 prepupae, 25 pupae, 3♂ 4♀ metamorphotypes.

CHILE: Coquimbo; Las Hedionditas, 10 Jan. 1966, L. E. Pena G., 1♂ 2♀. Aconcagua; Río Blanco, 10 Mar. 1968, Flint & Pena, 3♂. Santiago; El Alfalfal, 29 Feb. 1968, Flint & Pena, 1♂. El Manzano, 26 Oct. 1951, L. E. Pena G., ♂ holotype *C. angustipennis* Schmid (USNM).

Cailloma pumida Ross
Figures 5–7, 27

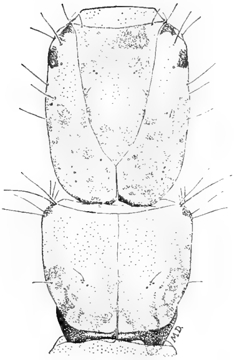
Cailloma pumida Ross, 1956, p. 125.—Schmid, 1958, p. 190.—Flint, 1967, p. 45.—Knutson & Flint, 1971, p. 315.—Fischer, 1971, p. 149.

Cailloma erinaceus Schmid, 1957, p. 382; 1958, p. 190.—Fischer, 1971, p. 149.

Cailloma pumida Ross is very similar to *C. lucidula* (Ulm.); indeed, I am able to tell only the males apart. However, I have collected males of both these as well as *C. rotunda* Flint together, indicating an absolute sympatry and validity of the species. The characters differentiating males of the former two species are discussed under *C. lucidula.*

Material: ARGENTINA: Mendoza; Río Blanco, 8 km south of Potrerillos, 18 Dec. 1973, C. M. & O. S. Flint, Jr., 1♂. Neuquen; Río Quilquihué, at Quilquihué, 26 Jan. 1974, O. S. Flint, Jr., 5♂ 2♀. Río Quilquihué, at Lago Lolog, 22–23 Jan. 1974, O. S. Flint, Jr., 2 prepupae. Arroyo Cordoba Grande, at Caleufu, 3 Feb. 1974, O. S. Flint, Jr., 1 larva, 1 prepupa. Río Negro; Arroyo Nireco, near San Carlos de Bariloche, 5 Mar. 1957, J. Illies, 4♂; same, but 31 Dec. 1957, 3♂; same, but 3 May 1958, L. E. Pena G., 5♂ 2♀; same, but 26 May 1958, 1♂; same, but 17 June 1958, 1♂; same, but 15 Oct. 1958, 1♂. Lago Nahuel Huapi, near Arroyo Nireco, San Carlos de Bariloche, 25 Sept. 1957, J. Illies, 1♂, 1♂ metamorphotype. Río Nirihuau, at Estacion Nirihuau, 11 Feb. 1974, O. S. Flint, Jr., 1♂ 1♀. Brook 5 km south of Río Villegas, 7 Feb. 1974, O. S. Flint, Jr., 5 larvae, 1♂ 1♀ metamorphotypes. Cascada Mallin Ahogado, near El Bolsón, 9 Feb. 1974, O. S. Flint, Jr., 2♂, 3♀, 2 larvae. Chubut; Río Epuyen, near Hoyo de Epuyen, 10 Feb. 1974, O. S. Flint, Jr., 1♀, 4 larvae, 2 prepupae.

CHILE: Coquimbo; Los Molles, 1 Oct. 1967, L. E. Pena G., 1♂ 1♀. Canela Baja, 23–24 Oct. 1961, L. E. Pena G., 1♂. Rivadavia, 16 May 1952, L. E. Pena G., 1♂. Aconcagua; Los Andes, 12 Nov. 1957, J. Illies, 1♂. Río Blanco, 10 Mar. 1968, Flint & Pena, 1♂. Santiago; El Alfalfal, 29 Feb. 1968, Flint & Pena, 2♂. O'Higgins; La Leonera, 26–28 Dec. 1954, L. E. Pena G., 2♂ 5♀ including ♂ holotype ♀ allotype of *C. erinaceus* Schmid (USNM). Nuble; Las Trancas, 10–11 Feb. 1956, L. E. Pena G., 1♂. Chiloe; Ancud, 6 Jan. 1952, L. E. Pena G., 1♂. Magallanes; Tributary to Río de las Minas, at water supply in-



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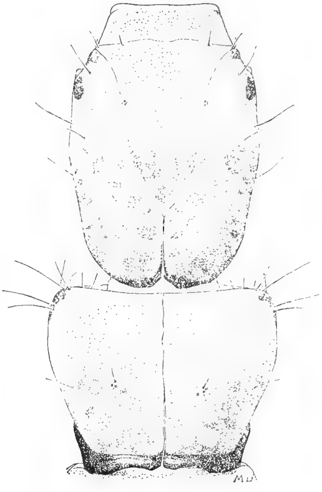

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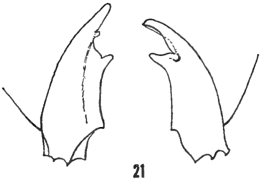

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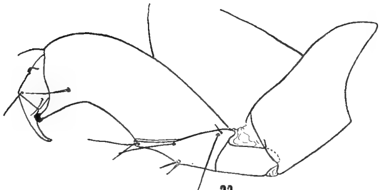

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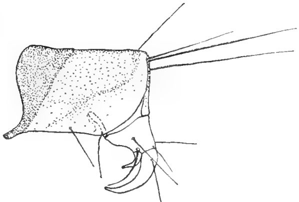

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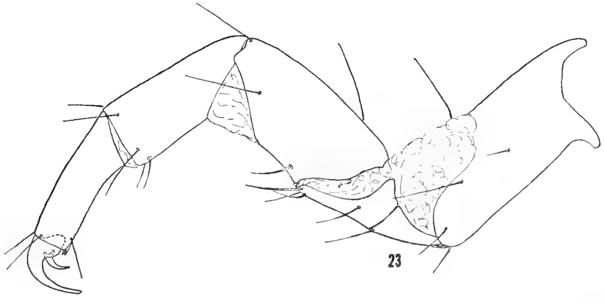

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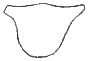

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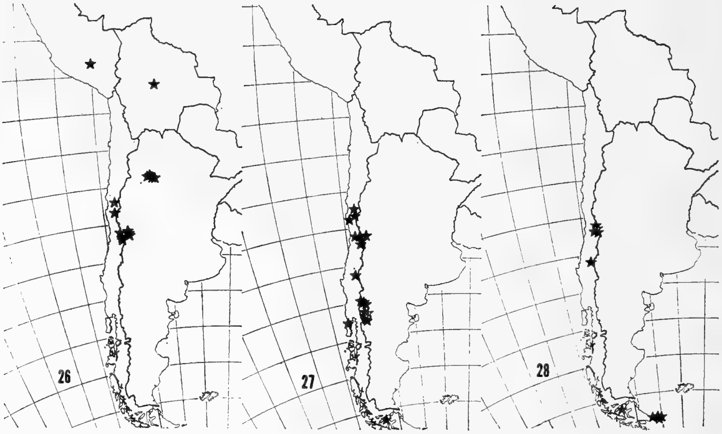
FIGS. 19–25. *Cailloma lucidula* (Ulmer): 19, larval head and pronotum, dorsal. *C. rotunda* Flint: 20, larval head and pronotum, dorsal. *C. lucidula* (Ulmer): 21, larval mandibles, dorsal; 22, larval foreleg, posterior; 23, larval hindleg, posterior; 24, larval anal proleg, lateral; 25, larval prosternite, ventral.



FIGS. 26–28. Recorded distribution of: 26, *Cailloma lucidula* (Ulmer); 27, *C. pumida* Ross; 28, *C. rotunda* Flint.

take above Punta Arenas, 26 Feb. 1966, O. S. Flint, Jr., 1 larva, 9 prepupae, 66 pupae, 3♂ metamorphotypes.

Cailloma rotunda Flint

Figures 8–11, 18, 20, 28

Cailloma rotunda Flint, 1967, p. 46.—Knutson & Flint, 1971, p. 315.

This recently described species is only distantly related to the other two species of *Cailloma.* The male is easily recognized by the very broad and rounded claspers and the differently shaped paracercus and aedeagus. The female genitalia also are diagnostic, especially the much longer mesal process from the ninth sternum and the general shape and structure of the vagina and associated supports. The larva is less certainly determined, but lacks all dark marks anteriorly on the frontoclypeus, which marks appear to be present in some degree on the other species. The pupa of *rotunda* is easily recognized by the reduction or loss of the hook-plate on 7A and the general increase in size of the other plates, as well as the loss of the 3 pairs of long setae on the apical lobe.

Material: ARGENTINA: TIERRA DEL FUEGO; Bahia Buen Suceso, 23–26 April 1971, Flint & Hevel, 1♂ 2♀. Isla de los Estados, Bahia Crossley, 26–30 April 1971, Flint & Hevel, 2 prepupae, 17 pupae, 1♂ 1♀ metamorphotypes. Isla de los Estados, Bahia Capitan Canepa, 1–3 May 1971, Flint & Hevel, 5 larvae, 1 prepupae, 1♂ 1♀ metamorphotypes. Isla de los Estados, Bahia Blossom, 10 May 1971, Flint & Hevel, 1 prepupa. Isla de los Estados, Puerto Ano Nuevo, 19 May 1971, Flint & Hevel, 1 larva, 5 pupae, 1♂ metamorphotype.

CHILE: Aconcagua; Río Blanco, 10 Mar. 1968, Flint & Pena, 1♂. Santiago; El Alfalfal, 29 Feb. 1968, Flint & Pena, 1♂; same, but 12–13 Oct. 1969, Flint & Barria, 1♀. Near Los Valdes, 4000 m, 25 Mar. 1958, J. Illies, ♂ holotype (USNM). Near Banos Morales, 2000 m, 25 Mar. 1958, J. Illies, 1♂. Los Valdes, tributary to Río Volcan, 7 Mar. 1958, J. Illies, 4 larvae. Nuble; 2.7 km north of Las Trancas, 27 Jan. 1967, Irwin & Stange, 2♂. Magallanes; Tributary to Río de las Minas, 14 km north of Punta Arenas, 10 Jan. 1966, Flint & Cekalovic, 13 larvae, 8 prepupae, 13 pupae, 3♂ 3♀ metamorphotypes.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF *HYPSOPHRYS* (DECAPODA: HOMOLIDAE) FROM THE STRAITS OF FLORIDA, WITH NOTES ON RELATED CRABS

By Austin B. Williams
National Marine Fisheries Service, Systematics Laboratory, National Museum of Natural History, Washington, D.C. 20560

A crab taken in a 40-foot trawl during exploratory drags for royal red shrimp, *Hymenopenaeus robustus* Smith, by the then U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, R/V *Silver Bay* SW of Dry Tortugas, Fla., on 8 June, 1959, belongs to an undescribed species and is the first specimen of the genus *Hypsophrys* Wood-Mason, 1891, to be reported from the Atlantic. The two other known species in the genus, *H. superciliosa* Wood-Mason, 1891, and *H. longipes* Alcock and Anderson, 1899, are confined to the Indo-Pacific region (Alcock, 1900; Serene and Lohavanijaya, 1973). The well-preserved animal shows an external feature on the chelipeds that is also evident in the previously known species, represented by faded specimens preserved for over ¾ of a century. The terminology of Ihle (1913), revised by Serene and Lohavanijaya (1973), is followed in describing features on the carapace.

Genus *Hypsophrys* Wood-Mason, 1891

To Alcock's (1900) definition of *Hypsophrys* the following should be added: palm of each cheliped with smooth, oval spot on inner and outer surface at base of fixed finger.

Hypsophrys noar, new species

Figures 1–12

Holotype male: Carapace ovate-oblong, tending toward quadrangular in dorsal aspect, flattened and deep; distinctly subdivided into regions;

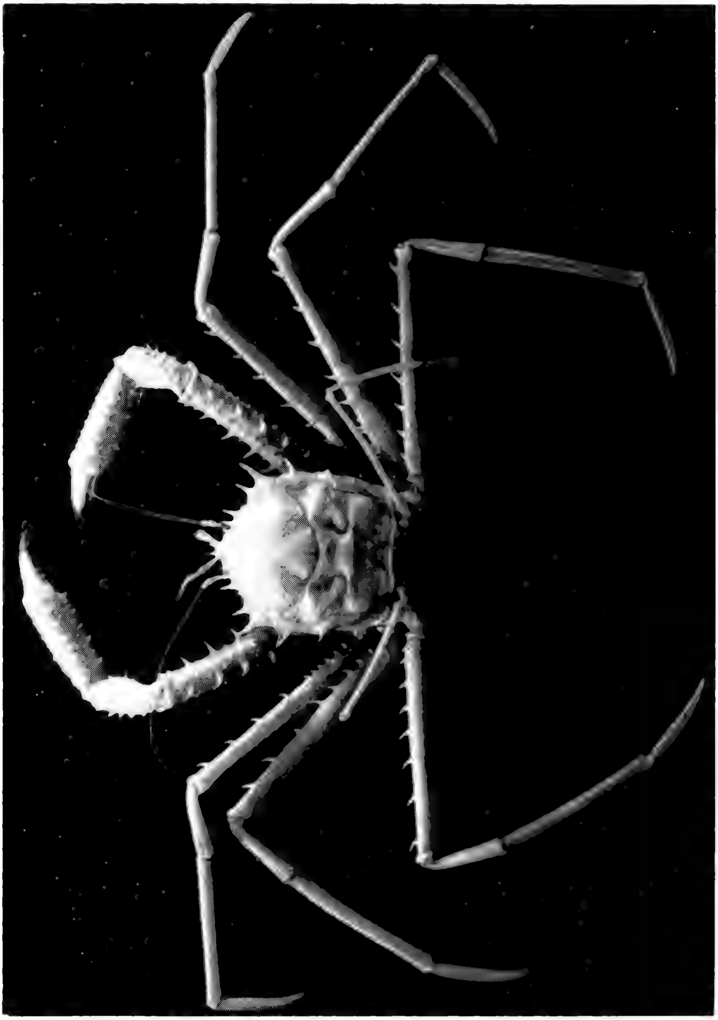


FIG. 1. *Hypsophrys noar*, dorsal view. × 0.5.

median raised regions glabrous; remainder of body clothed with rather stiff pubescence of variable length and density.

Rostrum narrow, decurved, exceeding eyes, distinctly bifurcated, each short tip continuous with raised margin in turn continuing on carapace as raised orbital margin; reinforced ventrally by median keel fused with interantennular septum, but distinguished from it by suture line.

Orbital margins each interrupted by prominent intermediate spine and stronger supraorbital spine, and ending ventrally near still larger antennal spine.

Gastric region humped and prominent; obscurely subdivided into central subregion flanked by larger lateral subregions; pair of epigastric spines at each side diagonally in line with supraorbital spine, a low tubercle anterolateral to each; an eminence behind and to each side of rostral base surmounted by prominent tubercle with scattered smaller tubercles on slopes.

Lineae homolica originating near edge of orbit above antennal spine, passing around gastric region and continuing sinuously to disappear near posterior margin of carapace. Deeply inscribed cephalic groove separating gastric region from posterior carapace and, ventral to *linea homolica* on each side, separating hepatic region bearing 3 strong spines from more posterior somewhat triangular region bearing strong dorsolateral spine and 2 tubercles in line below it. Post-cervical groove separating triangular from branchial region bearing strong posterolateral spine (broken on right) and smaller spines and tubercles behind it (more on right than left).

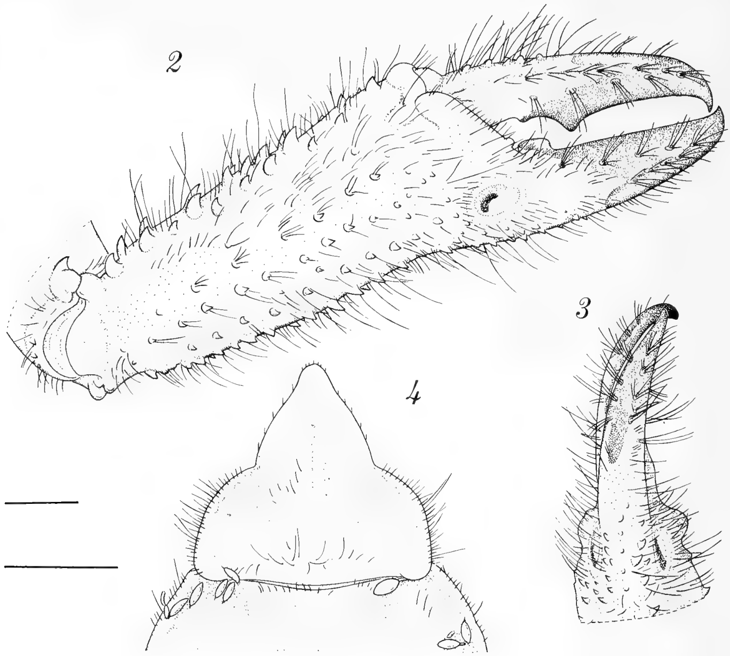
Eyes well developed.

Antennular peduncles with proximal article greatly inflated, much more slender distal articles nearly cylindrical, terminal article shortest.

Antennae longer than carapace; antennal peduncle with proximal article greatest in diameter, with spine at anterolateral corner; middle article longer but more slender and terminal article less than half length of middle one.

Pediform third maxillipeds lacking spines, setose, especially on prehensile surfaces.

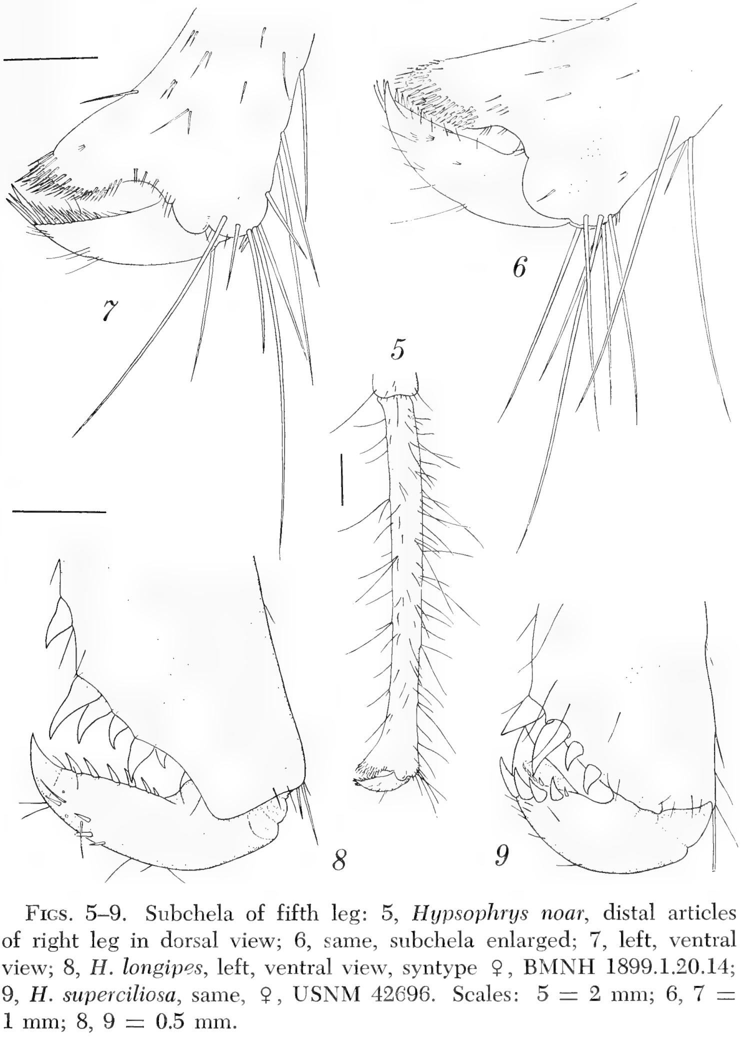
Chelipeds subequal, right slightly larger, elongate and spiny. Carpus and chela about equal in length to merus-ischium. Palm irregularly spiny, spines tending to be arranged in rows, lower border of palm with fixed finger offset obliquely at angle of about 5–8°; an ocellated, hairless, smooth, oval spot at base of fixed finger on both inner and outer surfaces (right chela, outer 3.50 × 4.25—inner 2.63 × 4.13 mm) having central partially darkened portion surrounded by lighter, irregular hyaline ring, and that in turn by wider white border. Fingers dark colored along opposed edges and portion of other surfaces; curving inward from origins to tips; opposed edges thin, sharp, and closely fitted with toothless shearlike edges distally but with alternately meshing teeth proximally. Fixed (propodal) finger with prominent, dark tooth near base and smaller light colored tooth proximal to it on distal edge of palm; dactyl longer than fixed finger and closing inside it, with subconical dark tooth closing distal to large propodal tooth, and proximally an inconspicuous tooth meshing between propodal teeth. Carpus irregularly spiny on upper surface; merus-ischium subcylindrical, with numerous short and sparser long spines tending to alternate in longitudinal rows.



FIGS. 2–4. *Hypsophrys noar*: 2–3, right chela, 2, external view, 3, ventral view of fingers showing paired spots at base; 4, telson and part of sixth abdominal segment with attached barnacles. Scales = 5 mm: upper, 2, 3; lower, 4.

Second, third and fourth legs similar to each other, longer than chelipeds, proximal articles oval in cross section, distal ones flattened; fourth leg having shorter coxal and basal articles than preceding legs; each merus bearing dorsal row of well separated, strong, acute, curved spines; propodi with pair of movable spines mesiodistally at articulation with dactyls; each dactyl slightly curved, with row of slender corneous spines along prehensile margin, ending in an acute corneous tip.

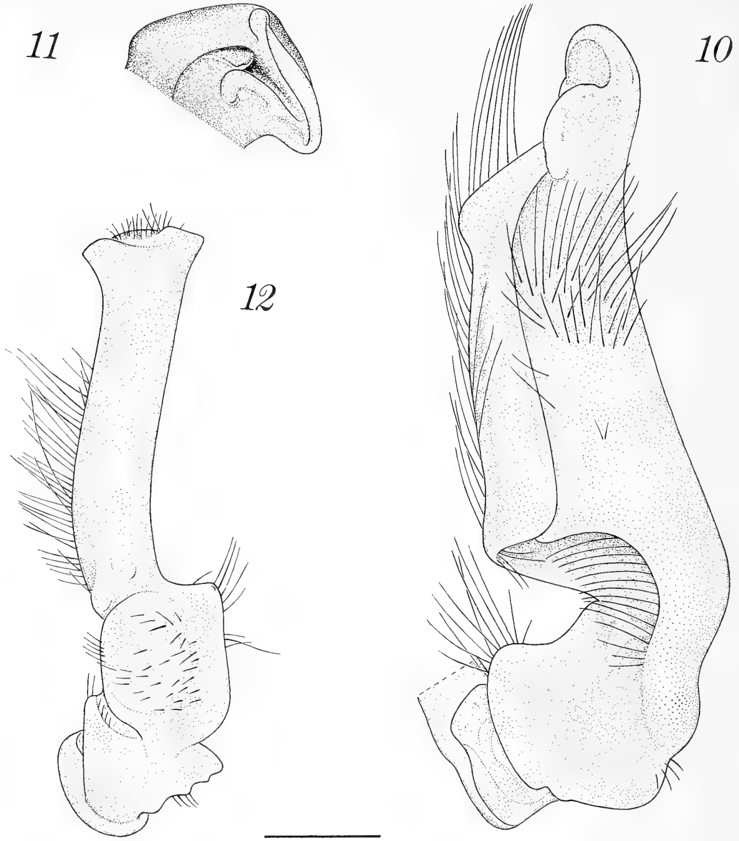
Fifth legs dorsal in position, much more slender and shorter than preceding legs; carpus and propodus about equal in length and together about as long as merus; propodus branching into shallow, asymmetrical Y-shape terminally, one branch bearing dactylar condyle, other terminating in densely spined, setose, spooned pad forming stationary member of subchela opposing extremely short, curved, clasping dactyl; dactyl closing at about 90° to axis of leg, length twice width of propodus (left detached), bearing row of closely arranged, strong, curved, corneous spines on ventral edge and tip.



FIGS. 5–9. Subchela of fifth leg: 5, *Hypsophrys noar*, distal articles of right leg in dorsal view; 6, same, subchela enlarged; 7, left, ventral view; 8, *H. longipes*, left, ventral view, syntype ♀, BMNH 1899.1.20.14; 9, *H. superciliosa*, same, ♀, USNM 42696. Scales: 5 = 2 mm; 6, 7 = 1 mm; 8, 9 = 0.5 mm.

Abdomen large, ovate in outline, composed of 6 free segments; first segment dorsal and quite narrow; fifth segment broadest and longest. Telson large, essentially triangular, but almost trilobate with slightly mucronate naked terminal lobe and rounded proximolateral lobes having setose margins.

First and second pairs of gonopods large and conspicuous. First gonopods diverging tangentially distolaterad from articulation as stout, flat-



Figs. 10–12. *Hypsophrys noar*, male gonopods: 10, first, caudal view; 11, same, terminal aspect of tip; 12, second, cephalic view. Scale = 2 mm.

tened plate, but becoming aligned with central axis of body and rolled into tube progressively flattened distally and drawn into low, shoulder-like, somewhat corneous distomesial ridge angling distolaterally into prominent and more membranous distolateral lobe; secondary lobular shoulder on distocaudal aspect, and (concealed from view caudally but visible terminally) a small central triangular lobe folded in from cephalic surface and nestled among other terminal foliations; suture line on caudal surface marking edge of rolled tube; short, dense setae on lip of broadly open proximal aperture, and longer setae distally.

Second gonopods shorter and more compact than first pair, bent tangentially mesad from flattened basal portion and formed into thick nearly cylindrical plunger terminating in asymmetrical, flared, truncate head tilted mesially; central concavity of head membranous and furred with short, soft setae; longitudinal mesial tuft of longer setae on cylindrical distal portion.

Measurements in mm: Carapace: length from rostral notch to posterior margin, 39.7; width excluding spines, 37.7; height, 20.4; maximum height of body, 24.3. Length of right hand, 42.2; left, 40.9. Average length of articles in legs 2–4: merus, 50; carpus, 19; propodus, 40; dactyl, 25.

Type-locality: SW of Dry Tortugas, Fla., 24°11′N, 83°21.5′W, 400 fm (732 m), *Silver Bay* Stn. 1196.

Material studied: The holotype deposited in the U.S. National Museum of Natural History (150816) is the only known specimen of this species. It was compared with specimens of *H. superciliosa* and *H. longipes.*

Name: The name is a noun in apposition from the Greek "noar" meaning phantom or specter, referring to the fancied appearance of the crab (Liddell and Scott, 1940, p. 1177).

Remarks: *Hypsophrys noar* is larger than reported specimens of *superciliosa* (ov ♀, cl 19 mm) but about the same size as *H. longipes* (ov ♀, cl 38 mm) (Alcock, 1900). In both *H. longipes* and *H. noar* the rostrum is bifid, and the carapace conspicuously spined; *H. superciliosa* has a simple rostrum, and the body is somewhat less spiny. *Hypsophrys longipes* has spines on the third maxillipeds but the other species lack these. The body in *H. superciliosa* is smooth and nearly devoid of setae except for a few long ones; *H. longipes* has a sparse covering of very short setae in addition to a larger number of longer ones, and *H. noar* has a dense coat of short setae and still more numerous longer ones. The oval spots on the chelae are concave in *H. longipes* and *H. superciliosa* but flat in *H. noar.* Superficial structure suggests that these spots may be photophores.

The specialized subchela on each fifth leg is distinct in the 3 species (Figs. 6–9). Unlike that in *H. noar*, the propodus is not Y-shaped distally in either *H. superciliosa* or *H. longipes*, but its mesial edge is angled so that the dactyl must swing through an arc of nearly 135° to close. In both, the propodus has strong spines bordering the surface against which the dactyl closes. In *H. superciliosa* the dactyl bears a few curved corneous spines ventrally on the occlusal surface, as well as some opposed fringing setae on the propodus, but in *H. longipes* the dactyl has only a strong corneous tip and row of weak spines on the edge of the occlusal surface. In specimens of *H. longipes* and *H. superciliosa* examined, the *linea homolica* extends nearly to the posterior edge of the carapace.

The species of *Hypsophrys* can be distinguished by the following key:

1. Rostrum simply pointed .... *superciliosa.*
   Rostrum bifid 2

2. Propodus of last legs as long as carpus; third maxillipeds without spines .... *noar.*
   Propodus of last legs much shorter than carpus; third maxillipeds with spines on ischium and merus .... *longipes.*

Fastened to setae on the abdomen and left cheliped of the holotype of *H. noar* are a number of small pedunculate barnacles, *Poecilasma inaequilaterale* Pilsbry.

ACKNOWLEDGMENTS

I am indebted to Henry B. Roberts who first recognized *H. noar* as a probably undescribed species, provided the photograph for Fig. 1, and helped with other details of study. R. W. Ingle, British Museum (Natural History) (BMNH), and V. K. Prem Kumar and K. K. Tiwari, Zoological Survey of India, loaned specimens from their institutional collections for comparative study, and William A. Newman identified the commensal barnacle. Fenner A. Chace, Jr., and Isabel Pérez Farfante critically read the manuscript, and María M. Diéguez prepared the drawings.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

HEDGPETHIUS TRIDENTATUS, A NEW GENUS AND NEW SPECIES, AND OTHER PYCNOGONIDA FROM KEY WEST, FLORIDA, U. S. A.

By C. Allan Child
Smithsonian Institution, Washington, D. C. 20560

The following specimens were collected during repeated surveys for marine annelids by Dr. Meredith L. Jones, of the Smithsonian Institution, on the islands of Key West, Florida. They include five species, two of which are new. This is rather surprising, because the area 60 miles west of Key West was intensively collected for marine organisms for many years during the time the Carnegie Institute Marine Laboratory was located in the Dry Tortugas Islands. These collections were reported on by Hedgpeth (1948), and hardly any new species have come to light from southern Florida since that time. That the present collection contains 40 percent new species attests to the careful hand collecting techniques used by Dr. Jones.

I wish to thank Dr. Jones for making the specimens available for study. They are deposited in the collections of the U. S. National Museum of Natural History (USNM).

Ammotheidae Dohrn, 1881

Hedgpethius, new genus

Diagnosis: Ammotheidae: *Ascorhynchus*-like with minutely papillose body surface, without trunk or lateral process tubercles. Anterior trunk segment longer than combined length of posterior 3 segments. Ocular tubercle near extreme anterior of first segment; first lateral processes at extreme posterior of first segment, imparting "long necked" appearance. First 2 trunk segments articulated, last segment only faintly articulated. Proboscis with large ventrodistal mouth opening and 3 anterior pointing tubercles arranged laterally and ventrally around its largest circumference. Scape 1-segmented, very short; chela vestigial, ovoid, without fingers. Palp 6-segmented. Oviger (female) rudimentary, 3-segmented. Propodus with large auxiliary claws more than twice length of very reduced main claw.

Type-species: *H. tridentatus*, n. sp.

Etymology: Named for Joel W. Hedgpeth in recognition of his enduring contributions to the phylogeny and systematics of the Pycnogonida. Gender, masculine.

Relationships: This genus is closely related to *Ascorhynchus*, but has the following peculiarities which immediately remove it from the many described species of that genus: It has 6 rather than 9 palp segments, and peculiarly degenerate ovigers which are alike on both specimens examined. The proboscis tubercles are not found on any *Ascorhynchus* species and may be similar in nature to the female sexual (?) alar processes of *Anoplodactylus portus* and *A. digitatus*. Perhaps they exist only on females of the new genus. The presence of dominant auxiliary claws flanking a reduced main claw is not found in any species of *Ascorhynchus*, a genus without auxiliary claws. The genus *Ammothella* has 1 species, *A. biunguiculata*, in which this claw configuration exists, but here the main claw is reduced to a tiny tubercle which does not appear to have articulation. There is no further resemblance between *Hedgpethius* and *Ammothella*. The extremely long first trunk segment is similar to some species of *Ascorhynchus*, although with *Hedgpethius* it is longer in relation to the other trunk segments than with any *Ascorhynchus* species.

The genus *Hedgpethius* is placed tentatively in the Ammotheidae because, although the presence or absence of complete male ovigers is unknown, it conforms with all other definitions of this heterogeneous group of genera.

Hedgpethius tridentatus, new species

Figure 1

Material examined: Holotype, USNM 149797, ovigerous female; Paratype, USNM 149798, female: Key West, just west of bridge to Fleming Key, south shore among intertidal and subtidal rocks, 24 March 1968, Sta. KW-5.

Description: With the characters of the genus. First body segment 0.3 longer than combined length of posterior 3 segments. Lateral processes short, less than half trunk diameter, separated by their own diameter, all but posterior pair armed with single dorsodistal seta. Ocular tubercle a low truncate cone near anterior of ocular segment. Eyes large, unpigmented in alcohol. Abdomen short, slightly bulbous distally, not extending beyond fourth lateral processes, armed with 2–3 short dorsodistal setae.

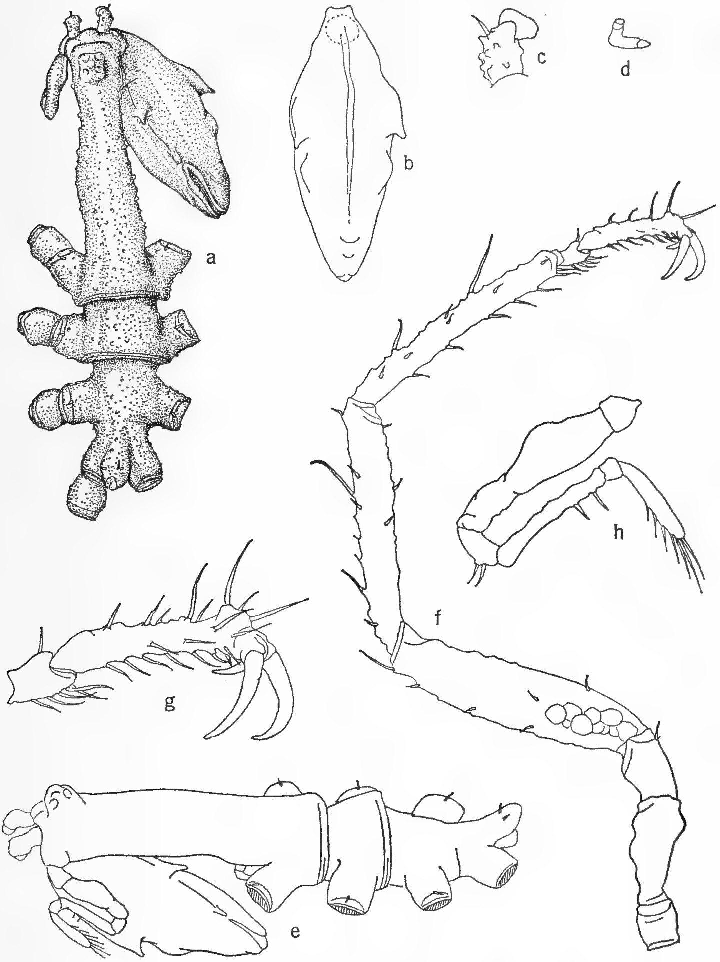

FIG. 1. *Hedgpethius tridentatus*, new genus, new species: a, dorsal view of trunk; b, dorsal proboscis; c, chelifore; d, oviger; e, oblique view of trunk; f, third leg; g, terminal segments of third leg; h, palp.

Proboscis large, ovoid, without constrictions, carried pointing posteriorly as in *Ascorhynchus*. Two dorsolateral and 1 ventral anterior-pointing tubercles surmount widest diameter of proboscis at ⅓ its length. Anterior to dorsolateral tubercles are 2 bulges in same longitudinal axes. Mouth at anterior tip, extending ventrally for ⅕ length of proboscis; lips flat, distinct.

Scape 1-segmented, short, heavily papillose, armed with single dorsodistal seta. Chela vestigial, carried anaxially, ovoid, without trace of fingers.

Palp 6-segmented. First segment no longer than wide; second longest, inflated toward proximal end, with hint of suture line towards distal end; third twice as long as wide, armed with 2 ectal setae as long as segment diameter. Fourth segment thin, ⅚ length of second, armed with 2 stout ectal setae or spines distally. Fifth as wide as long, unarmed; sixth 6 times its diameter, armed distally and ectally with 7–8 setae. Distal setae longer than 3 times diameter of segment.

Oviger (female) rudimentary, 3-segmented, arising on ventral surface of ocular segment just anterior to first lateral processes. First and third segments subequal; second 3 times as long, L-shaped. All segments extremely small.

Third leg of moderate length, femur swollen with eggs. Femur subequal in length to tibiae, tibiae equal, armed with several short dorsal setae and 1–2 setae longer than segment diameter, several lateral and ventral setae shorter than segment diameter. Propodus thin, without heel or large sole spines, armed with long dorsal setae arising from tubercles and several lateral and distal setae. Main claw tiny, curved ventrally under propodus. Auxiliaries large, over twice main claw length, strongly curved. Propodal sole armed with single row of 7–8 setae equal to segment diameter.

Measurements (holotype) in mm:

Ocular segment length			0.50
Total trunk length (anterior tip to tip of 4th lateral processes)			.84
Trunk width (across 2nd lateral processes)			.31
Proboscis length			.40
Abdomen length			.10
Third leg:		Tibia 1	.42
Coxa 1	0.07	Tibia 2	.42
Coxa 2	.19	Tarsus	.05
Coxa 3	.13	Propodus	.19
Femur	.44	Auxiliary claw	.08

Distribution: Known only from the type-locality, Key West, Florida.

Etymology: The specific name refers to the three tooth-like tubercles on the proboscis.

Remarks: This species first appeared to be an aberrant *Ascorhynchus* undergoing regeneration, but the second specimen with the same set of characters did not support this view. The peculiar tuberculate proboscis is unlike that of any other pycnogonid, to my knowledge, and may or may not be confined to the female. The ovigers appear as they would on most juvenile pycnogonids, but present an enigma on a mature female with eggs. Perhaps both specimens have damaged ovigers that are undergoing regeneration. Only further collecting of male and female adults can solve these perplexing problems.

Achelia sawayai Marcus

Achelia (*Pigrolavatus*) *sawayai.*—Fry and Hedgpeth, 1969: 104 [literature].

Material examined: One female, just west of bridge to Fleming Key, south shore among intertidal and subtidal rocks, 24 March 1968, Sta. KW-3. Eight males, 6 females, 2 juveniles, scrapings of culvert wall carrying water from Cow Key Channel to ponds west of Airport, 0.3–0.6 meter, 14 May 1967, Sta. KW-5. Two males, 2 females, on rocks in above culvert, Sta. KW-6. One male, 1 female, 1 juvenile, Aero Palms Club at base of Trumbo Point, subtidal under rocks, 30 March 1968, Sta. KW-6. Two females, east side of Fleming Key near boat dock, with *Thalassia* and *Halimeda*, subtidal, 20 May 1967, Sta. KW-9.

Remarks: These specimens are typical and inseparable from their neighbors in the Dry Tortugas.

Ammothella appendiculata (Dohrn)

Ammothella appendiculata.—Stock, 1955: 250 (literature).

Material examined: One subadult, just west of bridge to Fleming Key, south shore among intertidal and subtidal rocks, 24 March 1968, Sta. KW-5. One male, 2 females, 3 juveniles, scrapings of culvert wall carrying water from Cow Key Channel to ponds west of Airport, 0.3–0.6 meter, 14 May 1967, Sta. KW-5.

Remarks: These specimens appear to be the more slender stage II described by Stock (1955: 251–2).

Ammothella sp.

Material examined: One juvenile, near bridge to U. S. Naval Hospital, associated with black ascidians on subtidal rock, 3 May 1964.

Remarks: This is unidentifiable, but probably is *A. appendiculata.*

PHOXICHILIDIIDAE Sars, 1891

Anoplodactylus jonesi, new species

Figure 2

Material examined: Holotype, USNM 150619, ovigerous hermaphrodite (?): Key West, southwest tip, off Fort Taylor, intertidal and subtidal, 24°32′55″N, 81°48′37″W, 21 June 1963, Sta. 2.

Description: Body unsegmented, but with marked indentations suggesting segmentation. Lateral processes glabrous, separated by their own diameter. Ocular tubercle low truncated cone pointing anteriorly.

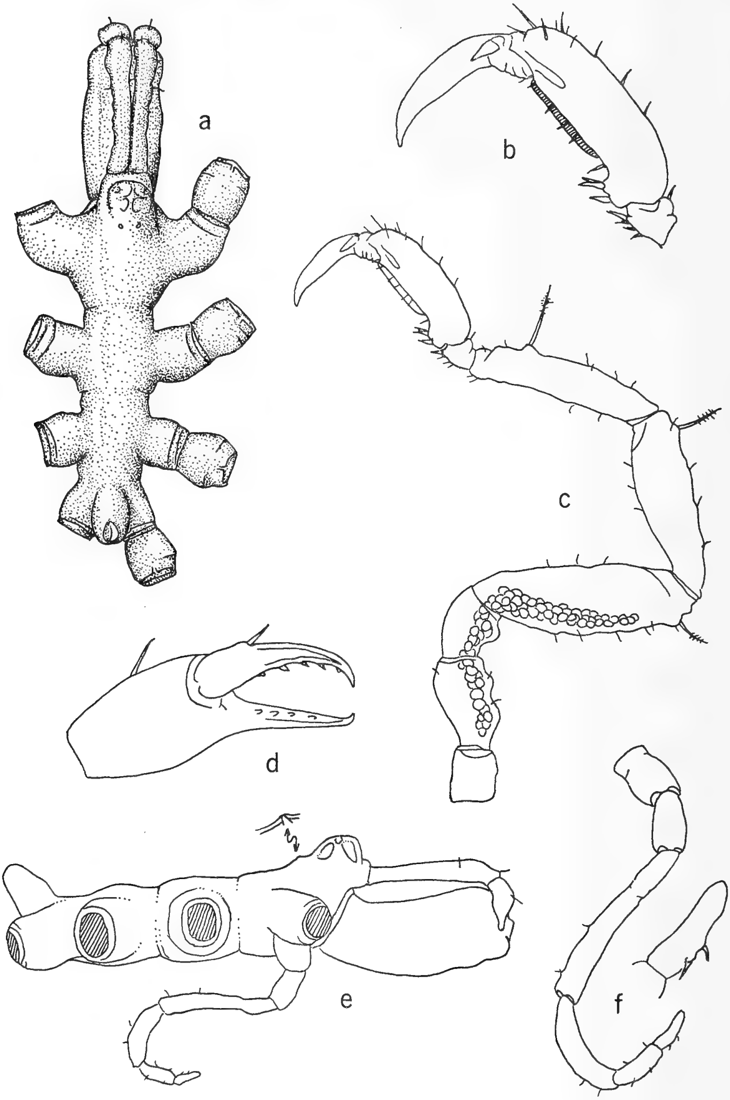

FIG. 2. *Anoplodactylus jonesi,* new species: a, dorsal view of trunk; b, terminal segments of third leg; c, third leg; d, chela; e, lateral view of trunk, with enlargement of dorsal pore; f, oviger with enlargement of terminal segment.

Eyes large, unpigmented. Two (sensory?) papillae on dorsolateral crown of ocular tubercle. Abdomen slightly longer than fourth lateral processes, erect, without setae.

Proboscis cylindrical, slightly constricted anteriorly.

Chelifore as long as proboscis, thin. Scape armed with 2 lateral setae and 1 dorsodistal seta. Chela small, fingers curved, tips overlap when closed, armed with 2–3 setae on hand and movable finger and 4–5 minute teeth on each finger.

Oviger segments 1 and 2 subequal; segment 3 longest, with proximal constriction and 2 distal setae. Terminal segments increasingly shorter, armed with 2–4 setae. Ultimate segment slightly shorter than segment 2, armed with 2 recurved setae.

Legs robust, tibiae subequal, femur slightly longer, each armed with few dorsal and ventral setae and single long dorsodistal feathered seta on tubercle. Propodus straight with small heel bearing 3 spines. Sole with lamina over almost entire length, armed with few setae. Claw slightly curved. Auxiliary claws robust, short.

Hermaphrodite characters: Ovigers of male, but lacking femoral cement glands. Female genital pores on coxa 2 of all four legs and mass of eggs in swollen femora. Two swollen pores immediately behind ocular tubercle may or may not have some sexual function. No evidence of glands seen beneath cuticle under pores.

Measurements in mm:

Trunk length (chelifore insertion to tip 4th lateral processes)			0.90
Trunk width (across 1st lateral processes)			.52
Proboscis length (ventral)			.50
Third leg:		Tibia 1	.48
Coxa 1	0.13	Tibia 2	.49
Coxa 2	.22	Tarsus	.07
Coxa 3	.20	Propodus	.33
Femur	.53	Claw	.24

Distribution: Known only from its type-locality, Key West, Florida.

Etymology: Named for its collector, Meredith L. Jones.

Remarks: There is nothing adherent on the ovigers which could prove them functional, and without the usual femoral cement glands of males in this genus I hesitate to call this specimen a true hermaphrodite. This single pycnogonid has all of the normal female characters, including eggs, and it is possible the ovigers are just the result of early embryonic misdetermination. There is nothing I could find in the leg that takes the form of a testis, such as that figured by Marcus (1952, p. 30, fig. 9) for *Ascorhynchus corderoi.* If subsequent collecting proves this to be a functional hermaphrodite, then *Anoplodactylus jonesi* will only mark the second record of this phenomenon in an otherwise dioecious group.

Besides the evident bisexual characters of this specimen, there is no other outstanding character that separates it from many others of this large, cumbersome genus. Its two closest geographical associates on the American coast are *Anoplodactylus parvus* and *A. petiolatus,* and although it compares favorably in size to these two, chelifore and oviger length ratio differences separate it from *A. parvus.*

Propodus shape, ocular tubercle size, segment length ratios, and the presence of lateral process tubercles on *A. petiolatus* serve to separate *A. jonesi* from that species.

Anoplodactylus pectinus Hedgpeth

Anoplodactylus pectinus Hedgpeth, 1948: 234–236, fig. 34.—Stock, 1955: 235, fig. 11.—Arnaud, 1973: 955–957.

Material examined: Two females, Fleming Key, on east side near boat dock, with *Thalassia* and *Halimeda,* subtidal, 20 May 1967, Sta. KW-9.

Remarks: This is an easily recognized species and these specimens are typical of Hedgpeth's Tortugas males and Stock's Virgin Island females. Why these should turn up in the Indian Ocean at Madagascar (Arnaud, 1973) only serves to emphasize our extreme lack of knowledge concerning transport and zoogeography of the majority of pycnogonid species. So many species have appeared to be endemic to some areas, but later turn up in widely disparate places, sometimes as if to confound our various efforts to compartmentalize, that the value of distribution maps becomes questionable.

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INDEX TO NEW TAXA

VOLUME ~~86~~ i.e. 87

(New taxa indicated in **boldface**; n. c. = new combination)

CHORDATA