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EDITOR

PAUL J. SPANGLER

CLASSICAL LANGUAGE EDITOR

George C. Steyskal

All correspondence should be addressed to the
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TABLE OF CONTENTS

Volume 86

BIOLOGICAL SOCIETY OF WASHINGTON PROCEEDINGS

1045th Meeting—14 March 1973

NINETY-FOURTH ANNUAL MEETING

The meeting was called to order by President Roger Cressey at 2:05 p.m. in Room 43 of the National Museum of Natural History. Thirty members were present.

The minutes of the previous annual meeting were read by the Secretary. President Cressey asked that they be corrected to include the name of Dr. Isabel Canet, whom he inadvertently did not thank for her previous services as Secretary of the Society at the 93rd Annual Meeting. A Motion to accept the report was seconded and carried.

Dr. Cressey announced the names of the newly elected Officers and Council.

Treasurer Oliver Flint read the Financial Report. A Motion to accept the report was seconded and carried.

The Secretary reported on membership changes during the past year as received from Treasurer Flint. Twenty-four new members and 11 new subscribers were added, 3 members died, 43 members discontinued membership, and 5 subscriptions were canceled. Dr. Thomas Bowman asked why members had discontinued their membership. Treasurer Flint said that the large number for this year was mainly due to bringing the rolls up to date, and that many resignations should have been included in the reports of prior years.

Editor Paul Spangler reported that Volume 85 of the Proceedings consisted of 578 pages in 49 papers. A motion to accept the report was seconded and passed. Dr. Cressey announced that Editor Spangler had requested that he be replaced, and that an *Ad Hoc* Editorial Practices Committee has been appointed at Council meeting to review procedures and seek a replacement. The Committee members are Meredith E. Jones (Chairman), Bruce Collette, Oliver Flint, and Paul Spangler. Chairman Jones reported that it was decided that the new Editor should have 3 Associate Editors, one in Invertebrates, one in Vertebrates, and one in Insects, and that the following individuals have accepted editorial assignments: Editor—Austin Williams (commencing October), Associate Editor for Invertebrates—Thomas Bowman, Associate Editor for Vertebrates—Victor Springer, Associate Editor for Insects—Robert Gordon. Manuscripts received by the Editor are to be forwarded to the pertinent Associate Editor, who will see to the reviewing and correspondence with the author. The Editor will collate the manuscripts and arrange for publication with the Allen Press, and will also consult with the Society Treasurer.

Dr. Cressey reported that one Council Meeting had been held during the year. (This is in addition to Council Meeting held prior to the Annual Meeting.) During that meeting a request from a Microfilm Service to microfilm the Publication for a 15% commission was deemed undesirable by the Council. Dr. Bowman asked why it was turned down. Treasurer Flint stated that it was mainly because it might hinder our selling back issues.

Dr. Cressey reported that the Smithsonian Archives had asked for the Archives of the Society, and that the Council had agreed to their request. Arrangements to transfer archival materials are to be made between Dr. Springer and Mr. William Deiss, Archivist.

A question was raised about whether the Society was planning any new symposia. Dr. Cressey answered in the negative, and said that if any members had an interest in having another symposium they should contact the new President. A general discussion followed with mention being made that possibly a symposium could be organized to go along with the 1976 Centennial Celebration. A topic suggested was the "Natural History of Washington." No members expressed a desire to serve on a Symposium Committee.

Dr. Cressey presented Mr. John H. Miles with a letter stating that because of his outstanding service to the Society he had been appointed by the Council, "Custodian of Publications," and that this title would appear on the fly-leaf of the Proceedings. The letter also told of a gift subscription for 2 volumes of a book-series on mammals.

Dr. Cressey then turned the meeting over to incoming President Springer, who thanked the officers, council members and others who worked for the Society during 1972, and asked for a motion to adjourn. The motion was made, seconded and passed.

The Meeting was adjourned at 2:31 p.m.

Louis S. Kornicker
Secretary

Vol. 86, No. 1, pp. 1–8 31 May 1973

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW EURYHALINE SPECIES OF *PARAPLEUSTES* (AMPHIPODA) FROM THE EAST COAST OF NORTH AMERICA

By Les Watling and Don Maurer
College of Marine Studies, University of Delaware,
Lewes, Delaware 19958

From mid 1968 to the present we have been engaged in a survey of the benthic fauna of the Delaware Bay region. In Delaware Bay we have been concerned chiefly with the oyster community (Maurer et al., 1971, Maurer and Watling, in press) while in the smaller Indian River and Rehoboth bays along Delaware's ocean coast, the total benthic community is being studied. Thus far we have described the amphipod and hydroid faunas (Watling and Maurer, 1972a, 1972b) and have discussed factors influencing the distribution of the associated oyster fauna (Maurer and Watling, in press).

During these investigations an amphipod belonging to the genus *Parapleustes* was found, sometimes in very great abundance. We were advised by E. L. Bousfield (National Museums of Canada) that this was an undescribed species and that Feeley and Wass (1971, as *Parapleustes* sp.) and R. L. Cory (1967, as Amphipod species A) had encountered this species in the Patuxent River, Maryland, and that R. Heard had found this species in Georgia. The present paper is a description of this new amphipod.

Parapleustes aestuarius, new species

Figures 1–4

Diagnosis: Body without dorsal processes; antenna 1 at least as long as first 5 pereonites; interantennal lobe bluntly rounded; fifth article of gnathopods with posterior lobe; 3 clusters of spines delimit the palms of the gnathopods; coxae 1–3 with 3 or 4 posteroventral notches.

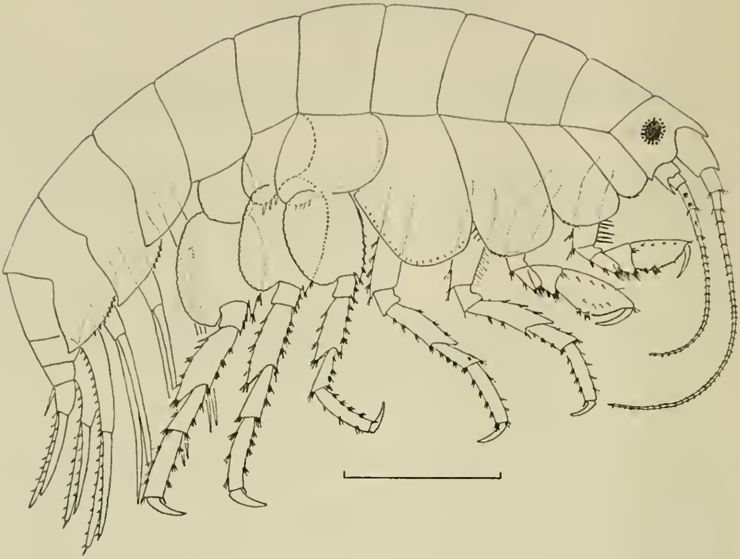

FIG. 1. *Parapleustes aestuarius*, new species, female. Scale equals 1.0 mm.

Description: Female; 3.5–6.0 mm: Interantennal lobe bluntly rounded; rostrum short, extending along ¼ of antenna 1 peduncle article 1; eye circular, black.

Antenna 1 at least as long as first 5 pereonites, generally as long as entire pereon; peduncle article 3 shorter than article 2, article 1 wider at base than at distal end. Antenna 2 shorter than antenna 1; peduncle article 2 with gland cone projecting beyond article 3; peduncle articles 4 and 5 subequal.

Mouthparts as illustrated. Mandible molar a small, smooth protuberance; inner side of mandible palp article 3 with many fine sharply pointed setae, lower margin with 9 strong serrated spines. Maxilliped palp article 3 not distally produced.

Gnathopod 2 slightly larger than gnathopod 1. Article 5 on both pairs of gnathopods with distally directed posterior lobe; sixth articles with palm delimited by cluster of short, strong spines; palms with short setae, and often with single, bluntly rounded, minute tooth midway along its length; this tooth more frequently absent from gnathopod 2 than gnathopod 1.

Coxal plates 1–3 of ovigerous females each with 3–4 distinct notches on posteroventral corners. Pereopods 1 and 2 with clusters of strong spines on posterior margins, and clusters of setae on anterior margins of articles 4–6. Pereopods 3–5 with spine clusters on anterior margins

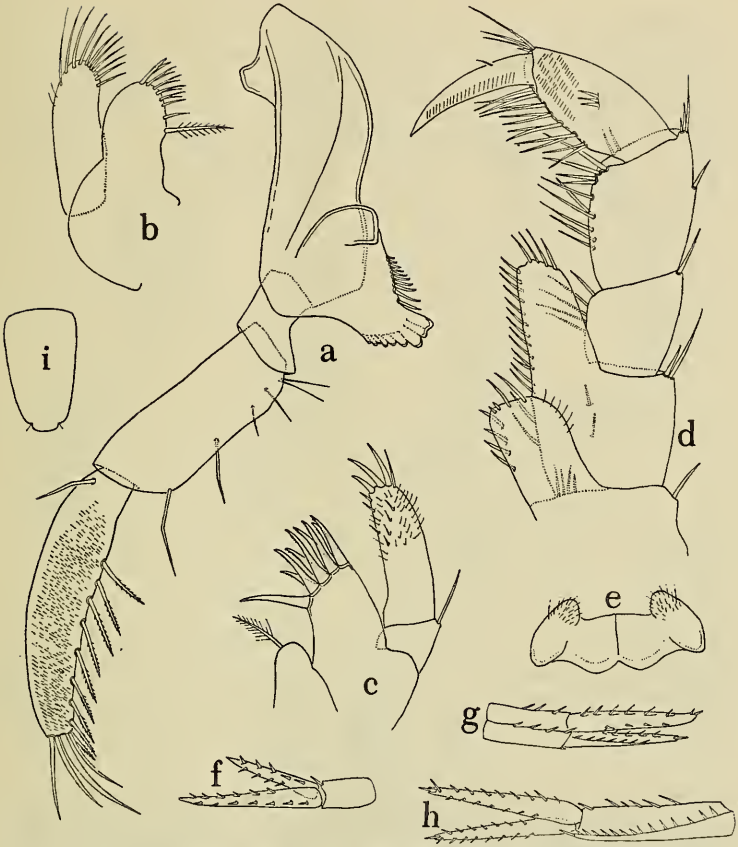

FIG. 2. *Parapleustes aestuarius*, new species: a, mandible; b, maxilla 2; c, maxilla 1; d, maxilliped; e, lower lip; f, uropod 3; g, uropod 2; h, uropod 1; i, telson.

and setal clusters on posterior margins of articles 4–6. All pereopods with a small, plumose seta on ventroproximal corner of article 7.

Pleon side plate 3 posterior margin slightly sinuous, ventrally acuminate; anterior part of ventral margin with 7 setae. Pleon side plate 2 with 4 setae. Uropods 1–3 outer ramus distinctly shorter than inner. Uropod 3 peduncle without dorsal spines; uropods 1 and 2 with 2 dorsal rows of spines on peduncle; uropod 1 peduncle nearly as long as rami. Telson entire, with a pair of subapical setae.

Male; 3–4 mm: Almost indistinguishable from female; body not so robust. Gnathopod 1 with much stronger tooth and fewer setae on

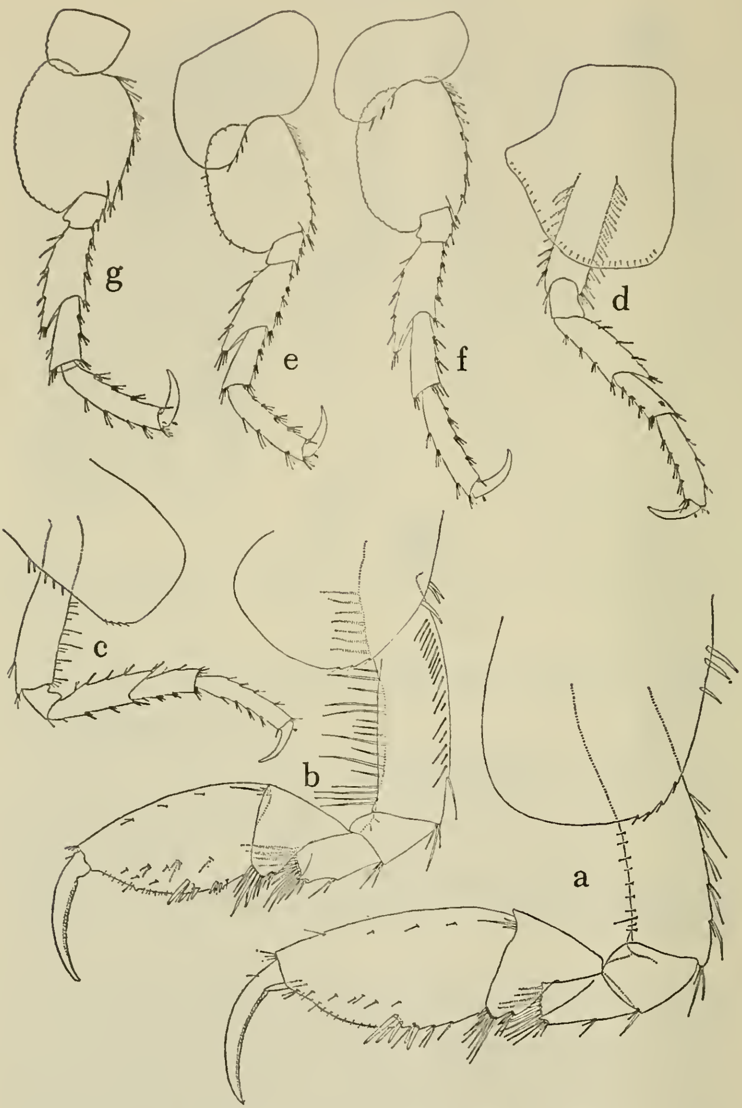

FIG. 3. *Parapleustes aestuarius*, new species: a, gnathopod 2; b, gnathopod 1; c, pereopod 1; d, pereopod 2; e, pereopod 3; f, pereopod 4; g, pereopod 5.

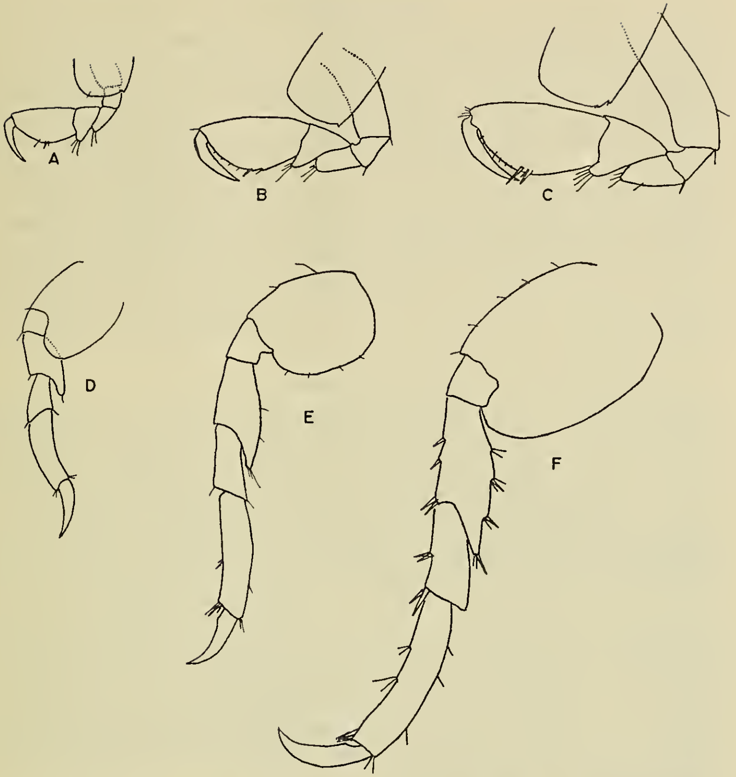

FIG. 4. *Parapleustes aestuarius*, new species: a–c, second gnathopods from 1.2 mm, 2.0 mm, and 2.5 mm specimens respectively; d–f, fifth pereopods from the same specimens; all appendages drawn at the same magnification.

palm; article 5 with distally directed posterior lobe more pronounced, without penultimate setal cluster on posterior margin. Gnathopod 2 also with stronger tooth and fewer setae on palm; article 5 with distally directed posterior lobe more pronounced; article 4 without setae on posterior margin. Pleon side plate 3 with 4 setae on ventral margin.

Holotype: USNM No. 140942; female, ovigerous.

Paratypes: USNM No. 139522; female, dissected, from the Broadkill River, Delaware; USNM No. 139523 from the Broadkill River, Delaware, about 25 individuals; USNM No. 139524, collected by R. Heard from Sapelo Island, Georgia, about 25 individuals.

Type-locality: Broadkill River, Delaware, latitude 38° 30′ 00″ N., longitude 75° 12′ 00″ W.; recorded salinity range 10 ‰ to 33 ‰; recorded temperature range –1.8°C to 28.9°C; recorded dissolved oxygen range 0.7 mg./l.–9.5 mg./l.; depth 3–5 m; specimens collected from the bases of hydroids attached to oysters.

Distribution: No other species of *Parapleustes* has thus far been described from the east coast of North America south of Cape Cod. This new species has been found from Delaware Bay, Delaware, the Patuxent River, Maryland (George Abbe, Benedict Estuarine Laboratory, personal communication; R. L. Cory (1967) and Nauman and Cory (1969)), the York River, Virginia (Feeley and Wass, 1971) and from Sapelo Island, Georgia (Richard Heard, personal communication). Feeley and Wass (1971) found this species to be rare in the York River, but Cory (1967) found it to be abundant on his fouling plates in the Patuxent River. It has been found in large numbers in our samples and in the samples sent to us by R. Heard.

Relationships: The presence of the small, non-triturative mandibular molar, article 3 of the maxillipedal palp not being distally produced, and subchelate gnathopods are characteristic of the genus *Parapleustes* as defined by Barnard (1969). This new species possesses all these features. Within the genus its closest affinities appear to be with the type-species, *Parapleustes gracilis* Bucholz. *Parapleustes aestuarius* is distinguished from *P. gracilis* by the following characters: interantennal angle bluntly rounded rather than acute as in the latter species; there are 3 spines delimiting the palm of the gnathopods whereas in *P. gracilis* there are only 2 spine clusters; all appendages possess a larger number of spine clusters; the distally directed lobe on gnathopod article 5 more pronounced in females of *P. gracilis* than in female of *P. aestuarius*; antenna 1 is longer than the first four body segments; there is no accessory flagellum on antenna 1, though a minute (12 microns in length) scale is visible at high magnification. Sexton (1909) illustrated an accessory flagellum from Bucholz's specimens.

In figure 4 the second gnathopod and pereopod 5 have been illustrated from 3 specimens of undetermined sex measuring 1.2, 2.0, and 2.5 mm, respectively. The study of these and other specimens of different sizes illustrate the variability of some morphological features. While all diagnostic characters are present by the time the animal is sexually mature, some appear before others. As well, almost all features appear gradually on a cumulative basis. For example, the four teeth on the posteroventral corner of coxae 1–3 appear one at a time (Figure 4A–C) as do the spine clusters between the corners of the appendage articles. Laboratory reared specimens of other amphipods (Sexton, 1924, and Myers, 1971), and our own field-collected specimens demonstrate the gradual addition of flagellar articles to the antennae. Some characters, however, are present from the youngest stages. These are: 1) the spines which will become spine clusters on the corners of the pereopod articles; 2) the distalmost spine delimiting the palm of the gnathopod; and 3) a minute plumose seta (not included in the figures) near the proximal-posterior corner of the dactyl of all pereopods.

ACKNOWLEDGMENTS

The authors thank Dr. E. L. Bousfield of the National Museum of Canada who has aided in all of our amphipod studies. We also express our appreciation to Dr. Richard Heard of the University of Georgia and Mr. George Abbe of the Benedict Estuarine Laboratory in Maryland who sent specimens to us. We appreciate also the time spent by Dr. Scott Gray and Dr. J. L. Barnard who reviewed the manuscript.

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This study is contribution number 79 from the University of Delaware, College of Marine Studies.

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Vol. 86, No. 2, pp. 9–24 31 May 1973

PROCEEDINGS
OF THE
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HARPACTICOID COPEPODS (CRUSTACEA) OF THE FAMILY TETRAGONICIPITIDAE LANG: A REVIEW AND REVISION, WITH KEYS TO THE GENERA AND SPECIES

By Bruce C. Coull
Department of Biology, Clark University,
Worcester, Massachusetts 01610

In recent years there have been many new species and two new genera described in the Tetragonicipitidae. Most of these new forms are from tropical and semitropical areas (Por, 1964; Wells, 1967; Geddes, 1968a; Coull, 1969, 1970, 1971), which appears to be the evolutionary center for this family. Por (1964) has previously commented on the confused systematics of this family, the need for its revision, and on the increasing numbers of known taxa, particularly from tropical areas.

In this paper I include a revision (where necessary) to the genera in the family and provide keys to the known species. Some genera are little changed since the last complete review (Lang, 1948), while others (*Phyllopodopsyllus*, for example) have changed so much that even Lang's recent (1965) key to the genus is outdated. Except where publication lag misses new species, this review is complete (to my knowledge) and includes every species described up through October 1972.

This review is based entirely on the literature. I have tried to borrow and examine one of two species considered incerta sedis in this paper, i.e., *Phyllopodopsyllus pirgos* Apostolov 1969. However, I have met with no success in my attempts to borrow this species and am, therefore, unable to redescribe it as originally planned. The second incerta sedis species, *Phyllopodopsyllus tristanensis* Wiborg 1964 is lost (see Wiborg 1964, p. 34) and must await rediscovery before inclusion in any revision.

Each measurement used in this paper was recalculated by measuring the figures given in the original text. In caudal rami length/width ratios the width was measured at the widest portion of the ramus. The term caudal rami, not furca, is used after Bowman (1971). These measurements then, are not necessarily the same as listed by the authors or by those who cite the author, but are consistent throughout. The terminology used throughout is adopted from Lang (1948, 1965).

FAMILY TETRACONICIPITIDAE LANG 1948, Char. emend.

Tetragonicepsidae Lang 1948

Since Lang's (1948) familial diagnosis, several changes have been made, thus necessitating the following new diagnosis: Body elongate, more or less cylindrical. Female genital somite undivided dorsally. Caudal rami aberrant. Rostrum variable, from large and pointed to round and small to absent. Labrum very large. A_1 ♀ 5–9 segmented. A_2 with basis. Exp. A_2 1 segmented, with 1–3 setae. Md. well developed with 2–3 setae on coxa-basis and separate Exp., Enp. fused or distinct. Mx. with 4–5 endites. Mxp. well developed, prehensile. P_1 with 2–3 segmented Exp., when 3 segmented middle segment without inner seta; terminal segment with 3–5 setae. Enp. P_1 2–3 segmented, prehensile, 1st segment nearly as long as entire Exp. P_2–P_4 with 3 segmented Exp., 1–2 segmented Enp. Setation of P_2–P_4 variable. P_5 ♀ distinct or confluent. Single ovary. A_1 ♂ haplocer. P_2 or P_3 or P_4 or caudal rami may be dimorphic, or any combination of the above. ♂ P_5 always dimorphic. Benp. P_5 ♂ fused, Exp. and Benp. confluent or distinct.

KEY TO THE GENERA OF TETRAGONICIPITIDAE

1. Cephalothorax with 2 pointed posterolateral processes .... *Laophontella* Thompson & A. Scott 1903
   Cephalothorax without posterolateral processes 2
2. Exp. A_2 dwarfed, represented by a single seta .... *Pteropsyllus* T. Scott 1906
   Exp. A_2 well developed with 2 or 3 setae 3
3. First segment A_1 with dentiform projection; Exp. P_5 ♂ 2-segmented 4
   First segment A_1 without dentiform projection; Exp. P_5 ♂ 1-segmented 5
4. Dentiform projection A_1 at posterior distal corner pointing laterally .... *Tetragoniceps* Brady 1880
   Dentiform projection A_1 in middle of segment pointing medially .... *Fearia* Coull 1971
5. First segment A_1 shorter than second .... *Diagoniceps* Willey 1930
   First segment A_1 longer than second 6

6\. Rostrum short, rounded; Benp. and Exp. P_5 ♀ confluent, foliaceous; Benp. P_5 ♂ with 3 setae .... *Phyllopodopsyllus* T. Scott 1906
Rostrum as long as first 2 segments A_1, and pointed at tip; Benp. and Exp. P_5 ♀ distinct; Benp. P_5 ♂ with 2 setae .... *Protogoniceps* Por 1964

Laophontella Thompson & A. Scott 1903

Type-species: *Laophontella typica* Thompson & A. Scott 1903

Phyllopodopsyllus armatus Willey 1935.—*Willeyella* Por 1964

Remarks: This genus, with its three species, has been extremely problematical in any attempts to elucidate Tetragonicipitidae systematics (see Willey, 1935; Sewell, 1940; Lang, 1948, 1965; Por, 1964; Bodin, 1967; Geddes, 1968a; Coull, 1969). I suspect that the description of the type of the genus (Thompson & Scott, 1903) is based on an immature female (e.g., bi-articulate P_5; uni-articulate P_4 endopod, short-stout antennae). The unifying feature of the three species is the pointed-cephalo-thoracic processes, a distinctive generic character. I, therefore, refer the reader to Por's (1964) generic designation of *Willeyella* (a junior synonym for *Laophontella*) for the diagnosis, keeping in mind that *L. typica* officially exists as the generic type, but that the original diagnosis may not be accurate.

Geddes (1968a) has further suggested that the description of *L. armata* var. *indica* Sewell may also be based on an immature form.

Generic diagnosis: See Por (1964, p. 105 for *Willeyella*)

KEY TO THE FEMALES OF *Laophontella*

1\. A_1 5 segmented 2
A_1 8 segmented, 1st segment prolonged with dentiform projection mid-way pointing medially; furca elliptical with spiniform projections laterally .... *L. horrida* (Por)
2\. P_5 foliaceous, comprised of single plate; 1st segment A_1 greatly elongated and slender so that it is as long as 4 succeeding segments combined: Enp. P_4 2 segmented .... *L. armata* (Willey)
P_5 with distinct baseoendopodite and exopod, 1st segment A_1 broad, 2 times as long as 2nd segment, with small outer and inner projections; Enp. P_4 1 segmented .... *L. typica* Thompson & A. Scott

Pteropsyllus T. Scott 1906, Char. emend.

Type-species: *Tetragoniceps consimilis* T. Scott 1894

Tetragoniceps T. Scott 1894

Remarks: Wells (1967) has recently reviewed this genus and suggests that it is monotypic, with *P. consimilis* (T. Scott, 1894) the only valid species. He asserts that *P. plebius plebius* Monard 1935, *P. plebius furcatus* Kunz 1938 and *P.* sp. Wells 1961 are all junior synonyms of

P. consimilis due to the continuous variations which exist. I see no need to alter Wells' (1967) conclusions and concur that the genus is indeed monotypic. No key is given as the generic key serves to distinguish the species.

Alteration to generic diagnosis: Lang's (1948, p. 890) generic diagnosis should be altered to state that P_6 ♂ is variable and may have confluent or distinct exopodite and baseoendopodite (after Wells 1967).

Tetragoniceps Brady 1880, Char. emend.

Type-species: *Tetragoniceps malleolatus* Brady 1880

Remarks: There are currently 10 valid species in this genus. Since the last review (Lang, 1948), the following species have been added: *T. truncata* and *T. longicaudata* Nicholls (1939), *T. arenicolous* Krishnaswamy (1957), *T. bergensis* Por (1965), *T. brownei* Wells (1967) and *T. bookhouti* Coull (1971). Table I summarizes the data on the known species. Male characteristics are not included as the males are known in only 4 of the 10 species. A key to the 10 known species is given below.

Alteration to generic diagnosis: Many species described subsequent to Lang's (1948) monograph do not fit his generic diagnosis, hence I present a new generic diagnosis: Caudal rami variable, ranging from as wide as long to 10 times longer than wide. Rostrum small or absent. A_1 ♀ 8–9 segmented, first segment elongate with dentiform projection at posterior distal corner pointing laterally. Exp. A_2 well developed, with 2 or 3 setae. Enp. Mxl. well developed. Mx. with 4 or 5 endites. Enp. P_1 2 segmented. Setal formulae variable (see Table I). P_5 ♀ confluent or distinct. Setation on P_5 ♀ variable. P_5 ♂ distinct in all known species. Sexual dimorphism in P_2 or P_2 and P_3, or caudal rami. A_1 ♂ with or without dentiform projection.

KEY TO THE FEMALES OF *Tetragoniceps*

1. P_5 fused into single plate each side 2
   P_5 not fused into single plate each side 4
2. Exp. A_2 with 3 setae 3
   Exp. A_2 with 2 setae .... *T. bookhouti* Coull
3. Exp. portion P_5 with only 1 well-developed seta .. *T. malleolatus* Brady
   Exp. portion P_5 with 4 well-developed setae ....
   .... *T. dubius* Thompson & A. Scott
4. *C.R. 3 times as long as wide 5
   *C.R. at most 2 times as long as wide 7
   *C.R. 10 times as long as wide; cephalothorax with dorsal dentiform projection .... *T. bergensis* Por
5. Middle segment Exp. P_3–P_4 with inner seta 6
   Middle segment Exp. P_3–P_4 without inner seta ....
   .... *T. longicaudata* Nicholls

TABLE 1. Genus *Tetragoniceps*—Summary of salient female morphological characters

	A_1	No. setae		No. setae P_5		Caudal rami	Setal formulae					
							P_2		P_3		P_4	
Species	No. seg.	Exp. A_2	P_5—Benp. & Exp.	Benp.	Exp.	length/ width	Exp.	Enp.	Exp.	Enp.	Exp.	Enp.
malleolatus Brady	8	3	confluent	4(5)	1	?	unknown		0.1.022	?.121	0.1.221	1.120
dubius Thompson & A. Scott	8	3	confluent	5	4	1:1	unknown		unknown		1.1.322	1.020
bookhouti Coull*	8	2	confluent	4(5)	4	4:1	0.1.122	1.120	0.1.122	1.120	0.1.122	1.120
brevicauda T. Scott	9	3	distinct	5	6	1.5:1	unknown					
scotti Sars*	9	3	distinct	4	6	3:1	unknown		1.1.122	1.120	1.1.123	1.120
truncata Nicholls	9	3	distinct	4(5)	6	1:1 (truncate)	1.0.023	1.120	1.0.023	1.120	1.1.223	1.120
longicaudata Nicholls	9	3	distinct	3	5	3:1	1.0.023	1.120	1.0.023	1.120	1.1.123	1.020
arenicolous Krishnaswamy	8	2	distinct	4	3	3:1	1.1.023	1.020	? 1.023	unknown	1.1.123	1.121
bergensis Por*	9	3	distinct	4	5	10:1	0.1.222	1.120	0.1.221	1.120	0.1.223	1.120
brownei Wells*	8	3	distinct	5	4	2:1	1.0.022	1.020	1.0.221	1.020	1.0.221	1.020

* Designates species in which the male is known.

6. Exp. P_5 with 3 setae; last segment Exp. P_3 with 3 outer setae;
   Exp. A_2 with 2 setae .... *T. arenicolous* Krishnaswamy
   Exp. P_5 with 6 setae; last segment Exp. P_3 with 2 outer setae;
   Exp. A_2 with 3 setae .... *T. scotti* Sars
7. Exp. P_5 with 6 setae 8
   Exp. P_5 with 4 setae; Fu. with prominent dorsal keel; dentiform
   projection A_1 small .... *T. brownei* Wells
8. *C.R. truncate, broad at somitic attachment, rapidly compressed
   .... *T. truncata* Nicholls
   *C.R. normal, gradually tapering .... *T. brevicauda* T. Scott

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* C.R. refers to caudal rami

* Fearia* Coull 1971

Type-species: *Fearia prima* Coull 1971

Remarks: This monotypic genus is characterized by the medially pointing dentiform projection on the first segment of the female and male A_1. There is but one species in the genus, *F. prima*. The generic diagnosis must still be considered preliminary as it is based solely on the type-species (Coull, 1971). Except for the antennule spine, *Fearia* is very close to *Tetragoniceps*.

Diagoniceps Willey 1930, Char. emend.

Type-species: *Diagoniceps laevis* Willey 1930

Remarks: Since Lang's (1948) review of this genus, two species have been added, *D. monodi* Chappuis and Kunz (1955) and *D. menaiensis* Geddes (1968b), bringing to four the number of known species. Geddes (1968b) has discussed his unique species and compared it with the others in the genus. The 3-segmented P_1 makes *D. menaiensis* an enigma. For the time being, however, I agree with Geddes (1968b) and prefer to leave the species in *Diagoniceps* rather than create a new genus for it.

Alteration to generic diagnosis: With the addition of *D. monodi* and *D. menaiensis*, Willey's (1930, p. 94–95) and Lang's (1948, p. 894) generic diagnosis must be changed as follows: P_1 of 2 or 3 segments; Exp. P_5 ♀ with 5 or 6 setae.

KEY TO THE FEMALES OF *Diagoniceps*

1. Enp. P_1 2 segmented 2
   Enp. P_1 3 segmented .... *D. menaiensis* Geddes
2. Inner edge of *C.R. with small rounded projection: terminal
   segment exopod P_4 with 2 inner setae .... *D. laevis* Willey
   Inner edge of *C.R. straight, terminal segment exopod P_4 with
   3 inner setae 3
3. Terminal segments exp. P_2–P_4 with 3 outer setae .... *D. bocki* Lang
   Terminal segments exp. P_2–P_4 with 2 outer setae ....
   .... *D. monodi* Chappuis & Kunz

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* C.R. refers to caudal rami

Phyllopodopsyllus T. Scott 1906, Char. emend.

Type-species: *Tetragoniceps bradyi* T. Scott 1892
Tetragoniceps T. Scott 1892
Paraphyllopodopsyllus Lang 1948

Remarks: Since Lang's (1965) revision and key, the following species have been added. *P. danielae* Bodin (1964); *P. tristanensis* Wiborg (1964); *P. biarticulatus* Wells (1967); *P. ponticus* Apostolov (1968); *P. bahamensis* Geddes, *P. opististoceratus* Geddes; *P. parafurciger* Geddes (1968a), *P. pirgos* Apostolov (1969), *P. hermani* Coull (1969), *P. chavei* Coull, *P. paraxenus* Coull (1970), *P. parafurciger carolinensis* Coull (1971). The female of *P. longicaudatus* A. Scott has been described by Vervoort (1964) and Marinov (1971) has redescribed the females of *P. briani* Petkovski and *P. thiebauldi* Petkovski. Challis (1969) mentions *Phyllopodopsyllus* sp. from the Solomon Islands, but there is no description available to date.

Lang (1965) has recently discussed the genus and divided it into three groups: (1) with a strong unguiform projection on the second segment of A_1; (2) with a small, but not unguiform projection on segment 2 of A_1; and (3) with no projection on segment 2 of A_1. This third group had previously been designated a separate genus, *Paraphyllopodopsyllus*, but Lang (1965) asserts that the 2 genera cannot be kept apart, especially when one considers the many intermediate forms, and concluded that *Paraphyllopodopsyllus* must be withdrawn. This is the format that will be followed here; i.e., one genus with three groupings within the genus.

Table 2 lists the salient features for all the known species. Two recently described species (*P. tristanensis* and *P. pirgos*) deserve further evaluation. *P. tristanensis* is a taxonomic nightmare because the critical swimming legs are not included and the characters listed by Wiborg (1964) are of little taxonomic value. The description of *P. pirgos*, I suspect, is based on an immature (5th copepodite) male. This is particularly evident in Apostolov's (1969) figures of the swimming legs (the segments of which appear too broad and indistinct for the adult and show no sexual dimorphism) and the P_5 which is still in the fused state. Nowhere else in the genus does a fused P_5 occur although I have observed a similar morphology in stage 5 copepodites of my *P. hermani*. Furthermore, Apostolov (1969) does not figure or refer to the antennule (especially the critical unguiform process) except to mention that it is eight segmented. He then goes on to distinguish his *P. pirgos* from *P. briani* and *P. thiebauldi* on the number of antennule segments. However, he has compared the A_1 of his male specimens to the A_1 of Petkovski's (1955) female specimens. Apostolov's species (*P. pirgos*) must therefore be considered incerta and await redescription. Since Wiborg's species (*P. tristanensis*) is known only from his incomplete drawings and the types are lost, it too must be considered incerta sedis. Neither of

TABLE 2. Genus *Phyllopodopsyllus*—Summary of salient morphological characters. + or – in column listed C.R. dorsal keel, refers to the presence (+) or absence (–) of a dorsal keel.

	Female										Male			
					Seta formulae						No. setae			
	No. seg. A_1	C.R. L/W ratio	C.R. 1° terminal seta	C.R. dorsal keel	P_2		P_3		P_4		P_5			
Species					Exp.	End.	Exp.	End.	Exp.	End.	Benp.	Exp.	C.R. ratio	C.R. dorsal keel
Process A_1 large														
bermudae Lang	8	7.1	bulbous	—	1.0.122	0.3	1.0.222	0.3	1.1.322	1.3	3	5	8.5	—
bradyi (T. Scott)	9	1.4	bulbous	—	1.0.122	0.3	1.0.222	1.3	1.1.321	1.3	3	5	5.5	—
parabradyi Lang	9	1.4	bulbous	—	1.0.122	1.3	1.0.122	1.2	1.1.222	1.3	3	5	5.2	—
minutus Lang	8	5.6	non-bulbous	—	1.0.122	0.3	1.0.222	0.3	1.1.222	1.2	3	5	?	?[1]
furciger Sars	8	3.3	bulbous	+	1.0.122	0.3	1.0.222	1.3	1.1.322	1.3[2]	3	5	5.5	—[2]
aff. *furciger* Por	8[3]	3.0	bulbous	+	1.0.122	0.3	1.0.222	0.3	1.1.221	1.3	unknown			
borutzkyi Lang	9	2.0	bulbous	—	1.0.022	0.3	1.0.022	1.3	1.0.222	1.3	3	5	3.9	—
pauli Crisafi	8	1.6	bulbous (modified)	—	1.0.022	1.3	1.0.022	1.3	1.1.222	1.3	3	5	4.4	—
medius Por	8[4]	2.0	bulbous	—	1.0.022	0.3	1.0.022	0.3	1.0.221	1.3	3	5	3.5	—
laticauda Por	8[4]	1.4	bulbous	—	1.0.022	0.3	1.0.022	0.3	1.1.221	1.3	unknown			
minor (Thompson & A. Scott)	8	3.8	non-bulbous	—	"Legs much the same as *bradyi*"						unknown[5]			
danielae Bodin	8	2.0	bulbous (modified)	—	1.0.022	1.3	1.0.022	1.3	1.0.322	1.3	3	5	2.8	—
chavei Coull	8	3.0	bulbous	—	1.0.122	1.3	1.0.222	1.3	1.1.222	1.3	3	5	unknown	
hermani Coull	9	3.1	non-bulbous	—	1.0.022	0.2	1.0.022	1.2	1.0.221	1.1	3	5	4.5	—
bahamensis Geddes	9	2.0	bulbous	+	1.0.022	0.3	1.0.022	0.3	1.0.222	1.2	unknown			
opistoceratus Geddes	9	3.2	non-bulbous	—	1.0.022	0.3	1.0.022	0.3	1.0.222	3	3	5	5.9	—
longicaudatus A. Scott	9	5.1	bulbous	—	1.0.122	0.3	1.0.222	1.3	1.1.222	1.3	3	5	8.0	—[6]

[1] Willey (1935) does not mention or figure the male caudal rami.

[2] Setal formula, male information from Bodin (1964).

[3] Por (1964) does not mention the A_1, but I assume it's the same as *furciger*.

[4] Por (1964) does not mention A_1 in text; information from Por (pers. comm.).

[5] Lang (1965) lists the male of *minor* as known; however, I cannot find the male description anywhere in the literature.

[6] Male information from Vervoort (1964).

TABLE 2. *Continued.*

	Female										Male			
					Setal formulae						No. setae P_5			
					P_2		P_3		P_4					
Species	No. seg. A_1	C.R. L/W ratio	C.R. 1° terminal seta	C.R. dorsal keel	Exp.	End.	Exp.	End.	Exp.	End.	Benp.	Exp.	C.R. ratio	C.R. dorsal keel
parafurciger parafurciger Geddes	8	2.2	bulbous	—	1.0.122	0.3	1.0.222	1.3	1.1.322	1.3	3	5	7.3	—[7]
parafurciger carolinensis Coull	8	2.1	bulbous	—	1.0.122	0.3	1.0.222	1.3	1.1.322	1.3	3	5	7.3	—[7]
Small process A_1														
briani Petkovski[8]	9	4.0	non-bulbous	+	1.0.122	1.3	1.0.222	1.3	1.1.322	1.3	3	5	4.0[9]	+?[9]
hardingi (Roe)	9	2.7	non-bulbous	—	1.0.022	1.3	1.0.022	1.3	1.0.321	1.3	3	5	?[10]	—?[10]
No process A_1														
aegypticus Nicholls	9	1.6	non-bulbous	—	1.0.122	0.3	1.0.222	0.3	1.1.321	1.3	unknown			
thiebauldi Petkovski	9	1.6	non-bulbous	+	1.0.122	1.3	1.0.122	1.3	1.1.3–222	1.3	3	5	3.2	—
mossmani T. Scott	9	2.5	bulbous	+	1.0.022	1.3	1.0.122	1.3	1.0.322	1.3	3	5	2.2	—
paramossmani Lang	9	2.0	non-bulbous	?	1.0.022	1.3	1.0.022	1.3	1.0.222	1.3	3	5	?[11]	?[11]
berrieri Monard	9	3.3	non-bulbous	—	1.0.022	1.3	1.0.022	1.3	1.0.223?	1.3	3	5	4.7	—[12]
hibernicus (Roe)	9	1.3	non-bulbous	+	1.0.022	1.3	1.0.022	1.3	1.0.322	1.3	unknown			
xenus (Kunz)	9	2.1	non-bulbous	—	1.0.022	0.2	1.0.022	0.2	1.0.321	0.3	unknown			
paraxenus Coull	8	1.6	bulbous	+	1.0.022	0.2	1.0.022	0.2	1.0.321	0.2	3	5	2.0	—
ponticus Apostolov	9	2.0	non-bulbous	—	1.0.022	1.3	1.0.022	1.3	1.0.122	1.3	3	5	5.0	—
longipalpatus (Chappuis)	8	1.5	non-bulbous	—	1.0.022	0.2	1.0.022	0.2	? ? 321	1.2	3	4	3.1	—
biarticulatus Wells[13]	8	1.4	non-bulbous	+	1.0.022	0.2	1.0.022	0.2	1.0.222	0.2	3	4	2.2	+[13]
tristanensis Wiborg[14]	9	2.5	non-bulbous	?			unknown				3	5	3.1	—

[7] These 2 subspecies are separated on presence or absence of protuberance on inner margin of the caudal rami.

[8] Marinov (1971) does not figure the small process on the second antennal segment.

[9] Petkovski (1955) says the caudal rami the same as the female.

[10] Roe (1955) states caudal rami same as female, but smaller.

[11] Lang (1934) gives no figures, but states male caudal rami same as female.

[12] Male information from Pesta (1959).

[13] Wells' (1967) species is distinguished from all the others in the genus by a 2-segmented P_1 Exopodite and a small dorsal keel on the male caudal rami.

[14] This species is considered incertae sedis (see text).

these species is included in the key, although *P. tristanensis* is included in Table 2.

Since several males are unknown or very poorly described, the following key to the valid species is based on the females.

Alteration to generic diagnosis: Since Lang (1965) combined *Paraphyllopodopsyllus* with *Phyllopodopsyllus*, a new generic diagnosis has not been made and is required.

Generic diagnosis: Caudal rami aberrant, generally longer than wide. Rostrum small, separated from body. A_1 ♀ 8–9 segmented, 1st segment longer than second. 2nd segment with or without dentiform projection. Exp. A_2 well developed with 3 setae. Mxl. with separate Exp. and Enp. Mx. with 5 endites. Enp. P_1 2-segments; Exp. P_1, 2–3 segments. Exp. P_2–P_4, 3 segments, Enp. P_2–P_3, 2 segments; Enp. P_4, 1–2 segments. P_5 ♀ large, foliaceous, Benp. and Exp. fused into single leaf-shaped plate. P_5 ♂ with distinct Benp. and Exp., Benp. with 3 setae, Exp. with 4–5 setae. P_2 or P_2 and P_3 dimorphic. ♂ caudal rami aberrant, may or may not be different than ♀, always longer than wide.

KEY TO THE FEMALES OF *Phyllopodopsyllus*

1.	Second segment A_1 with a conspicuous unguiform process	2
	Second segment A_1 with a small not unguiform process	20
	Second segment A_1 without any process	21
2.	A_1 of 9 segments	3
	A_1 of 8 segments	9
3.	*C.R. with a large conspicuous lamellar expansion inside near base	4
	C.R. with no or very slight lamellar expansion inside near base	5
4.	1st segment Enp. P_2 without seta, last segment Enp. P_3 with 3 setae; last segment Exp. P_3 with 6 setae	*P. bradyi* (T. Scott)
	1st segment Enp. P_2 with seta, last segment Enp. P_3 with 2 setae; last segment Exp. P_3 with 5 setae	*P. parabradyi* Lang
5.	Principal terminal seta *C.R. not bulbous at base.	6
	Principal terminal seta *C.R. bulbous at base	7
6.	Enp. P_4 1-segmented with 3 setae	*P. opistoceratus* Geddes
	Enp. P_4 2-segmented; last segment with one seta	*P. hermani* Coull
7.	*C.R. about 2 times as long as wide; last segment Exp. P_2–P_3 with 4 setae	8
	*C.R. 5 times as long as wide; last segment Exp. P_2–P_3 with 5 and 6 setae respectively	*P. longicaudatus* A. Scott
8.	*C.R. without dorsal keel; 1st segment Enp. P_3 with inner seta; last segment P_4 with 3 setae	*P. borutzkyi* Lang
	*C.R. with dorsal keel; 1st segment Enp. P_3 without inner seta; last segment Enp. P_4 with 2 setae	*P. bahamensis* Geddes
9.	Principal terminal seta *C.R. not bulbiform at base	10
	Principal terminal seta *C.R. bulbiform at base	11
10.	*C.R. 5.6 times as long as wide; inner edge *C.R. straight and hairy	*P. minutus* Lang

*C.R. 3.8 times as long as wide; inner edge *C.R. slightly convex and not haired .... *P. minor* (Thompson & A. Scott)

11\. 1st segment Enp. P$_2$ with inner seta 12

1st segment Enp. P$_2$ without inner seta 14

12\. Last segment Exp. P$_2$–P$_3$ with 4 setae; principal terminal seta C.R. short and modified as bulb 13

Last segment Exp. P$_2$–P$_3$ with 5 and 6 setae respectively; principal terminal seta C.R. also bulbous but with long slender spine protruding distally .... *P. chavei* Coull

13\. Last segment Exp. P$_4$ with 7 setae; middle segment Exp. P$_4$ without inner seta .... *P. danielae* Bodin

Last segment Exp. P$_4$ with 6 setae; middle segment Exp. P$_4$ with inner seta .... *P. pauli* Crisafi

14\. *C.R. at most 3–4 times as long as wide 15

*C.R. 7–8 times as long as wide .... *P. bermudae* Lang

15\. Last segment Exp. P$_2$–P$_3$ with 4 setae 16

Last segment Exp. P$_2$–P$_3$ with 5 and 6 setae respectively 17

16\. Middle segment Exp. P$_4$ with inner seta; total body length $>$ 1 mm .... *P. laticauda* Por

Middle segment Exp. P$_4$ without inner seta; total body length 0.6–0.85 mm .... *P. medius* Por

17\. *C.R. without dorsal keel—*P. parafurciger* 18

*C.R. with dorsal keel—*P. furciger* 19

18\. *C.R. with pointed knob like inner protrusion at ½ the length .... *P. parafurciger parafurciger* Geddes

*C.R. convex along inner margin with no distinctive knob like protrusion .... *P. parafurciger carolinensis* Coull

19\. Last segment Exp. P$_4$ with 5 setae and spines in all .... *P.* aff. *furciger* Por

Last segment Exp. P$_4$ with 7 setae and spines in all (according to Bodin 1964) .... *P. furciger* Sars

20\. *C.R. 4 times as long as wide with dorsal hairy keel; last segment Exp. P$_3$–P$_4$ with 6 and 7 setae respectively .... *P. briani* Petkovski

*C.R. 2.5–3 times as long as wide; no dorsal keel; last segment Exp. P$_3$–P$_4$ with 4 and 6 setae respectively .... *P. hardingi* (Roe)

21\. A$_1$ of 8 segments, Exp. P$_5$ (♂) with 4 setae 22

A$_1$ of 9 segments, Exp. P$_5$ (♂) with 5 setae 23

22\. Exp. P$_1$ 3 segmented, last segment with 4 setae .... *P. longipalpatus* (Chappuis)

Exp. P$_1$ 2 segmented, last segment with 5 setae .... *P. biarticulatus* Wells

23\. Principal terminal seta of *C.R. bulbous at base 24

Principal terminal setae of *C.R. not bulbous at base 25

24\. Last segment Enp. P$_2$–P$_4$ with 2 setae; C.R. with no inner expansion in proximal half, *C.R. 1.5 times as long as wide .... *P. paraxenus* Coull

Last segment Enp. P_2–P_4 with 3 setae; C.R. with inner expansion in proximal half; *C.R. 2.5 times as long as wide .... *P. mossmani* T. Scott
25. 1st segment Enp. P_2–P_3 without inner seta 26
1st segment Enp. P_2–P_3 with inner seta 27
26. Last segment Enp. P_2–P_3 with 3 setae .... *P. aegypticus* Nicholls
Last segment Enp. P_2–P_3 with 2 setae .... *P. xenus* (Kunz)
27. *C.R. with inner and outer lamellar expansions at base .... *P. thiebauldi* Petkovski
*C.R. without expansions at base 28
28. Last segment Exp. P_4 with 7 setae 29
Last segment Exp. P_4 with 6 setae .... *P. paramossmani* Lang
Last segment Exp. P_4 with 5 setae .... *P. ponticus* Apostolov
29. *C.R. 3.3 times as long as wide, distal inner edge slightly concave, *C.R. without dorsal keel .... *P. berrieri* Monard
*C.R. 1.3 times as long as wide, analoperculum hairy on distal edge, *C.R. with dorsal keel .... *P. hibernicus* (Roe)

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* C.R. refers to caudal rami

Protogoniceps Por 1964

Remarks: Since Por's (1964) creation of the genus, no new species have been added. It is very difficult to ascertain the validity and/or the primary characteristics of the genus from Por's original description since his text and figures contradict each other. Lang (1965, p. 386) has already pointed out the discrepancy between the number of setae on the last exopodite segment of P_1 (i.e., Por's text says 5 setae, yet he illustrates 4). Furthermore, Por (1964) states that "the endopodite of P_1 is formed of 2 segments," yet his Plate 19, Figure 211 shows the P_1 endopodite as 3 segmented.

Recently, Dr. Por sent his original figures (Por, pers. comm., 30 May, 1972) and it is obvious that mistakes were made in drafting and typing. The terminal segment of the P_1 exopodite has 4 setae and the P_1 endopodite is composed of 2 segments, thus clarifying the published discrepancies.

Por relates some features of *Protogoniceps* to *Pteropsyllus*, some to *Tetragoniceps* and some to *Phyllopodopsyllus*. With the descriptions of several new species and familial revisions (Lang, 1965; Wells, 1967), these relationships are no longer valid. For example, the 9-segmented A_1 and "primitive" P_6 (♀ or ♂?) does not necessarily relate *Protogoniceps* to *Tetragoniceps* as one-half the known *Tetragoniceps* have 8-segmented antennules and 3 of the known species have a confluent, not distinct ("primitive") ♀ P_6. *Pteropsyllus* is known to harbor much variation within its single species (Wells, 1967) and setal formulae affinities between it and *Protogoniceps* may well be within the range of specific variation and lends no support to the relationship of these two genera.

Por (1964) states that *Protogoniceps* and *Phyllopodopsyllus* are related by the presence of the spur on second antennular segment. Lang (1965) has refuted the spur as a generic characteristic, and many known *Phyllopodopsyllus* completely lack the spur or have it in a greatly reduced condition (Table 2). It is, therefore, impossible to relate *Protogoniceps* to any of the known Tetragonicipitidae, but hopefully with continued collection more specimens will be collected and the intergeneric relationships elucidated.

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PROCEEDINGS
OF THE
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THE IDENTITY OF *BRADYPUS VARIEGATUS* SCHINZ (MAMMALIA, EDENTATA)

By Ralph M. Wetzel and Dieter Kock
*Biological Sciences Group, University of Connecticut,
Storrs, Connecticut 06268*
and
*Natur-Museum & Forschungsinstitut Senckenberg,
Frankfurt am Main, Germany*

A brown-throated, three-toed sloth from Brazil, in the Frankfurt Museum, was described by Schinz (1825:510) as "*Brad. variegatus*," the "Gefleckter Faulthier." *B. variegatus* is an earlier name for the brown-throated sloth than *B. infuscatus* Wagler, 1831:611, currently used for that species.

Schinz's specimen, a former museum exhibit mount plus skull, is still in the collection of the Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main. The skin and skull, SMF 4313 (old catalogue No. VIII.A.1.a), have been examined by both authors. The specimen was acquired in 1822 from the collector Freireiss who was sponsored by Baron Rothschild to obtain Brazilian specimens for the Senckenberg Museum. Labels on the skin indicate that it is the type of *B. variegatus* Schinz, and that it was compared (by Rüppell, 1842b) with Prince Maximilian Wied-Neuwied's illustration of *B. tridactylus* L. and believed to be a synonym of that species.

The coloration and pattern of the skin of SMF 4313 fit Schinz's description. Apparently this actually is the specimen that he described.

Because of the good quality of preservation, the skin and skull of SMF 4313 retain the necessary features for specific identification. Both represent the same species. The specimen is not of the maned sloth, *Bradypus torquatus* Illiger of

Espírito Santo and eastern Bahia, Brazil, for the skin lacks the distinctive long black tufts of posterior nuchal hair, the black neck and head, and the unique dorsal pelage of *B. torquatus*, and the skull does not have the expanded pterygoid sinuses characteristic of that species. On the other hand, it also is not of *B. tridactylus* L. of coastal Guiana, the Guyana Highlands, and the adjoining northern Amazon basin. The throat and sides of the forehead are brown as in *B. infuscatus*, not light yellow or buff as in *B. tridactylus*, and the skull lacks the foramina of the anterodorsal nasopharynx seen in *B. tridactylus*. In all respects, both skin and skull agree with *Bradypus infuscatus* Wagler whose holotype has been examined by the senior author.

The history of the name *B. variegatus* Schinz has been an unfortunate one. Gray (1843:192) placed it in synonymy with *B. torquatus*, as did later authors such as Fitzinger (1871: 391) and Cabrera (1958:210). This was done despite the evidence that Schinz (1821:328 and 1825:432) recognized *B. torquatus* as a distinct species. Wied-Neuwied (1823, 1826) recognized only two species, *B. torquatus* and what he called *B. tridactylus*. It is probable that he was not familiar with the actual *tridactylus* as he used the specific name but illustrated (1823) the brown-throated species later known as *B. infuscatus* (shown here to be *variegatus*). Because of the usually high quality of Wied-Neuwied's observations, it seems unlikely that he had seen both species and lumped them together as *B. tridactylus*.

Rüppell (1842b:178), working with the Frankfurt collection, continued the use of the name *B. tridactylus* L. for the *variegatus* (= *infuscatus*) species. Although he did not cite *variegatus* Schinz, he included the type-specimen of *variegatus* (specimen VIII.A.1.a) under *tridactylus*, as he found the specimen similar to that figured by Wied-Neuwied (1823). As Frankfurt had, by this time, a three-toed sloth from "die Wälder von Guiana," Rüppell (1842a:138) recognized the difference between the two species by erecting a new name, *B. gularis*, which is a junior synonym of *B. tridactylus* L. A syntype (labeled "cotype") for *B. gularis* Rüppell is SMF 4312, skin and skull, which Mertens (1925:23) considered to be the type.

His decision, therefore, should be accepted as a selection of a lectotype.

Bradypus variegatus Schinz is a valid name because of priority. On the basis of repeal of "the fifty year rule," Article 23 (b), and the expiration, in December, 1970, of the substitute article (Declaration 43, Bull. Zool. Nomencl., 27 (3/4):135, Dec. 1970), *Bradypus infuscatus* Wagler is a junior synonym. An incomplete synonymy, restricted to names from Venezuela and Colombia east of the Andes, the greater Amazon basin and the remainder of Brazil, follows. Although by inference the name *B. variegatus* will replace *B. infuscatus* elsewhere in its range, a broader geographic list of synonymies will be deferred until the senior author has completed his study of the three-toed sloths. Holotypes examined by the senior author are cited with the following abbreviations indicating their repositories: BMNH = British Museum (Natural History), London; NRMS = Naturhistoriska Riksmuseet, Stockholm; SMF = Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main; and ZSM = Zoologische Sammlung des Bayerischen Staates, Munich.

Bradypus variegatus Schinz

Brad. [*ypus*] *variegatus* Schinz, 1825:510.

Bradypus tridactylus.—of authors, not of Linné, 1758:34: Schreber, 1775:197 & 279 in part, and Pl. 64; Wied-Neuwied [1823, plate and description], 1826:482; Wagler, 1830:7; Blainville, 1839:762–764; Rüppell [1842b:178]; Gray, 1847:xvi, 74; Cornalia, 1850:303, in part; Ihering, 1894:16; Mertens, 1925:23; Tate, 1939:173 in part, 1947:66; Sanderson, 1949:783, in part; Méndez, 1951:211; Vieira, 1953:210, 218, 1955:401 in part.

Bradypus Ai Wagler, 1831:605, 610; Thomas, 1917:354. Type-locality: Rio Matheus, Espírito Santo (Thomas, ibid.).

Bradypus infuscatus Wagler, 1831:605, 611; Wagner, 1844:vii, 148, 149; Schinz, 1845:543; Fitzinger, 1871:338 & 363, in part; Thomas, 1880: 402, 1917:354; Pelzeln, 1883:98; Ihering, 1904:424; Vieira, 1949: 241, 270; Sanderson, 1949:783; Cabrera, 1958:209. Type-locality: "Brazil versus Peru" on label of holotype, restricted to confluence of Rio Iça and Rio Solimões, Amazonas, by Cabrera (1958:209). Holotype: ZSM 1162.

Bradypus tridactylus Brasiliensis Blainville [1840:64, Pls. 3, 4]; Cornalia, 1850:311; Vieira, 1950:335, 1955:401. Type-locality: Rio de Janeiro.

Acheus ustus Lesson, 1840:271. Type-locality: Rio de Janeiro.

Bradypus torquatus.—of some authors, in part; not of Illiger, 1811:109 nor of Desmarest, 1816:327: Gray, 1843:192; Fitzinger, 1871:390; Cabrera, 1958:210.

Bradypus pallidus Wagner, 1844:vii, 143, 1855:170; Schinz, 1845:543; Fitzinger, 1871:338 & 350, in part; Pelzeln, 1883:97; Thomas, 1917: 354. Type-locality: Ipanema, São Paulo (Pelzeln, ibid.; Vieira, 1955: 401).

Arctopithecus marmoratus Gray, 1849:71, 1862:291, 1869:364, 1871:439, 443, 1873:5; Turner, 1851:208. Type-locality: restricted to "Pará" by Cabrera (1958:210). Holotype: BMNH skin 42.4.29.20, skull 49.4.13.2.

Arctopithecus problematicus Gray, 1849:73, Pl. 11, Fig. 5, 1862:290, 1869:365, 1871:439; Thomas, 1917:354. Type-locality: "Pərá" (Gray, 1849:73). Holotype: BMNH 44.10.9.34.

Bradypus trivittatus Cornalia, 1850:303, 310, 311. Type-locality: Rio Amazonas to Rio Napo.

Arctopithecus blainvillii.—Gray, in part: ?1862:291, 1869:365, 1871: 439, 441–442, 1873:4; not of Gray, 1849:71 and holotype BMNH 49.5.5.1.

Arctopithecus flaccidus.—Gray, in part: 1871:439, 448, 1873:5; not of Gray, 1849:72, Var. 1 and 2, nor 1869:365, Var. 1 *Dysoni* (holotype: BMNH skin 47.7.18.3, skull 49.4.13.3) and Var. 2 *Smithii* (holotype: BMNH skin 45.3.11.5, skull 49.5.5.2).

Bradypus brachydactylus Wagner, 1855:173; Fitzinger, 1871:372 in part; Pelzeln, 1883:97; Thomas, 1917:354. Type-locality: Borba, Rio Madeira, Amazonas (Pelzeln, ibid.; Vieira, 1955:402).

Bradypus dorsalis Fitzinger, 1871:355, in part; Thomas, 1917:354. Type-locality: Pernambuco (Thomas, ibid.).

Bradypus marmoratus.—Fitzinger, 1871:367, in part; Pelzeln, 1883:98; Goeldi and Hagmann, 1904:90; Hagmann, 1908:27; Thomas, 1917: 354; Lönnberg, 1942:13, in part; Sanderson, 1949:783.

Bradypus unicolor Fitzinger, 1871:362, in part; Thomas, 1917:354. Type-locality: Pará to Rio Grande do Norte; restricted to "Pará" by Vieira (1955:402).

Bradypus speculiger Fitzinger, 1871:372 as synonym of *B. brachydactylus*; Thomas, 1917:354.

Bradypus ustus.—Liais, 1872:341.

Bradypus brasiliensis.—Thomas, 1917:354; Cabrera, 1917:59; Sanderson, 1949:783.

Bradypus smithii.—Thomas, 1917:354; not of Gray, 1869:365.

Bradypus blainvillei.—Thomas, 1917:354; Krumbiegel, 1941:53, 55; not of Gray, 1849:71.

Bradypus macrodon Thomas, 1917:356; Krumbiegel, 1941:53, 55. Type-locality: Sarayacu, Pastaza, Ecuador. Holotype: BMNH 80.5.6.56.

Bradypus tridactylus flaccidus.—Pittier and Tate, 1932:254, in part; not of Gray, 1849:72.

Bradypus flaccidus.—Krumbiegel, 1941:53, 55; Sanderson, 1949:783 as *B. flaccions*; not of Gray, 1849:72.

Bradypus tocantinus Lönnberg, 1942:5. Type-locality: Cametá, Rio Tocantins, Pará. Holotype: NRMS 501.

Bradypus miritibae Lönnberg, 1942:8. Type-locality: Miritiba, Maranhão. Holotype: NRMS 9.

Bradypus marmoratus codajazensis Lönnberg, 1942:15. Type-locality: Codajáz, Amazonas. Holotype: NRMS 1054.

Bradypus infuscatus subjuruanus Lönnberg, 1942:21. Type-locality: Lago Grande, Rio Juruá, Amazonas. Holotype: NRMS 2474.

Bradypus tridactylus infuscatus.—Vieira, 1955:401.

Bradypus tridactylus miritibae.—Vieira, 1955:402.

Bradypus tridactylus tocantinus.—Vieira, 1955:402.

Bradypus infuscatus brasiliensis.—Cabrera, 1958:208.

Bradypus infuscatus flaccidus.—Cabrera, 1958:209 in part; Ojasti and Mondolfi, 1968:447, Fig. 30; not of Gray, 1849:72.

Bradypus infuscatus marmoratus.—Cabrera, 1958:210.

Holotype: SMF 4313, male, museum exhibit mount and separated skull.

Type-locality: Brazil, possibly Bahia (Mertens, 1925:23).

Range: All suitable habitats in Venezuela east of the Andes except for the Guyana Highlands (state of Bolívar and highland portion of T. F. Amazonas) and the delta of the Río Orinoco (T. F. Amacuro), continuing through the forests east of the Andes in Colombia and Ecuador, to eastern and southern Brazil and the province of Misiones, Argentina. The northern limits of the species in Brazil are the islands of Mexiana and Marajó in the east, westerly along the Rio Amazonas (occasionally also on the north bank of the Amazonas to the Rio Negro), where it overlaps with *B. tridactylus* to Manaus, and throughout the forests of northern Brazil west of the Rio Negro. A statement of the distribution of the three-toed sloths in Bolivia and northwestern Argentina (*Bradypus boliviensis* Gray) or those west of the Andes from Venezuela to Central America will not be attempted until the relationship of those sloths with *B. variegatus* is clarified.

Comments: *Bradypus variegatus* Schinz has a continuous brown pelage on the shoulders, neck, throat, and sides of the face. This is in distinct contrast to that of *B. tridactylus* L. whose throat is light or yellowish buff, continuous with the light color of the forehead. Both species have brown shoulders and legs and show considerable variation in the pattern of spots or splotches of lighter color on the back. The presence of foramina in the anterodorsal nasopharynx of *B. tridactylus* and their absence in the much larger skull of *B. variegatus* have been mentioned above. (See also Thomas, 1917:353.)

The reasons for restriction of the name *B. tridactylus* L. have been pointed out by Thomas: The first reference by Linné (1758:34) was to his sixth edition of *Systema Naturae*, which in turn used Seba's thesaurus as first reference. Thomas (1911:132) therefore suggested that Surinam should be the type-locality for *B. tridactylus* L. In addition, the senior author has examined the skull (BMNH 67.4.12.579) of the specimen determined by Thomas (1892:314) to be that figured by Seba and thus the holotype of *B. tridactylus* L. The skull is similar to those of all other specimens of three-toed sloths from the Guyana Highlands and delta of the Orinoco of Venezuela, all of Guyana, Surinam, French Guiana, and adjoining northeastern Brazil.

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A THIRD SPECIES OF THE HISPANIOLAN *SHREVEI* GROUP OF *SPHAERODACTYLUS* (SAURIA, GEKKONIDAE)

By Albert Schwartz
Miami-Dade Junior College, Miami, Florida 33167

The West Indian island of Hispaniola has revealed an increasing and intriguing number of geckos of the genus *Sphaerodactylus.* Of these small geckos, one group is composed of two known species: *shrevei* Lazell 1961 and *rhabdotus* Schwartz 1970. The former species is known from only one specimen from the Presqu'île du Nord Ouest in extreme northwestern Haiti; the holotype has apparently been lost. The second species was named from a series of 15 specimens from near La Florida, República Dominicana. *S. shrevei* and *S. rhabdotus* together form a distinctive pair of Hispaniolan (and indeed Antillean) sphaerodactyls which differ in several characteristics from all other Hispaniolan species. The distributions of these two species are very poorly known: *shrevei* is a north island (*sensu* Williams, 1961) species which occurs in the remote northwest of Haiti, whereas *rhabdotus* is known only from the type-locality on the northern edge of the south island, bordering the Valle de Neiba which, with the Cul de Sac Plain in Haiti is the paleostrait between the Hispaniolan north and south islands. The localities for the two species are separated by about 250 kilometers, but both species occur in similar xeric situations (Schwartz, 1970).

Under National Science Foundation grant B-023603, I visited the type-locality of *S. rhabdotus* in the autumn of 1971, in the company of Danny C. Fowler, Bruce R. Sheplan, and Jeffrey R. Buffett. We were unsuccessful in securing more specimens of *S. rhabdotus*, since the palm-thatch pile wherein the sole specimens of the species had been collected in 1969 had long ago disintegrated, and those very special circumstances which allowed the collection of the species at that locality no longer exist.

While in the Barahona area in the República Dominicana, we emphasized visiting areas which had previously been bypassed; the Valle de Neiba and its margins in this region have been shown to be especially productive as far as new taxa of both amphibians and reptiles are concerned. It seemed quite likely that S. *rhabdotus* has a much broader distribution in the Valle de Neiba-Llanos de Azua, and it was our hope that we would encounter another locality for the species. On 3 September 1971 we stopped at the village of El Iguito northeast of Fondo Negro in the extreme eastern Valle de Neiba. The region is excessively arid desert, with cacti and *Acacia* forming a relatively sparse cover over the rocky to sandy soils. Adjacent to the highway was an unoccupied and roofless house, the interior floor filled to a depth of about 1 meter with the apparently untouched and very dry roof thatch and boards. Overturning the mass of thatch and boards revealed *Aristelliger lar* Cope and four specimens of a new *Sphaerodactylus*, which, in allusion to the series of white "stars" in its dorsolateral brown stripes may be called

Sphaerodactylus leucaster, new species

Holotype: United States National Museum 189234, an adult male, from El Iguito, 1.6 mi. (2.6 km) NE Fondo Negro, Barahona Province, República Dominicana, on 3 September 1971, one of a series collected by Danny C. Fowler and Bruce R. Sheplan. Original number ASFS (Albert Schwartz Field Series) V30523.

Paratypes: ASFS V30524–26, same data as holotype.

Distribution: Known only from the type-locality.

Diagnosis: A species of *Sphaerodactylus* characterized by moderate size (males to 26 mm, female to 30 mm snout–vent length); throat, chest, and ventral scales smooth; dorsal scales keeled and only slightly imbricate, 23 to 26 between axilla and groin, and without a middorsal zone of granules or smaller scales; ventral scales cycloid and subimbricate, 29 to 32 between axilla and groin; scales around midbody between 35 and 41; supralabials 4 to beneath center of eye; internasal scales 2; escutcheon in males moderate (5 to 7 scales) and broad (up to 24 scales); dorsal scales with from 3 to 8 "hair"-bearing organs (usually 2, occasionally 1, short "hairs" per organ) along the free posterior margin of scales; no sexual dichromatism, dorsal pattern of 2 dark

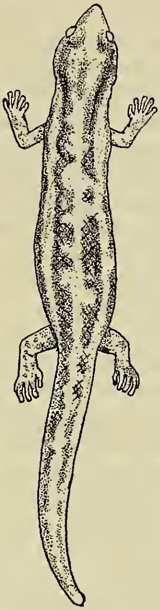

FIG. 1. *Sphaerodactylus leucaster* (United States National Museum 189234, holotype), dorsal view.

brown dorsolateral and 2 broken ventrolateral stripes on a lavender ground, the dorsolateral stripes with from 4 to 7 discrete white spots per stripe, males with a median dark brown nuchal line (Fig. 1), female with a dark brown cephalic-nuchal Y; heads and throats bright orange and tails yellow in males; a vertically elliptical pupil; and a distinctly convex snout.

Description of the holotype: An adult male with a snout–vent length of 26 mm, tail 24 mm (almost completely regenerated); dorsal scales keeled, only slightly imbricate, without a middorsal band of granules or of small and large irregularly placed scales (although there are a few scattered smaller scales above and just posterior to the axilla), 23 between axilla and groin; throat, chest, and ventral scales smooth and imbricating, 31 between axilla and groin; scales around body at midbody 39; internasals 2; fourth toe lamellae 11; escutcheon moderately well developed, 5 scales long and 8 scales broad, not extending to level of knee; 4 enlarged supralabials on each side to center of eye; snout, head, and dorsal neck scales small and granular, grading fairly abruptly above the axilla into the large keeled dorsal scales; throat scales granular, grading gradually into the large smooth ventral scales posteriorly, and anteriorly into somewhat enlarged scales bordering the sublabials; superior caudals small and keeled, subcaudals smooth.

Coloration of holotype: Dorsum (in life) lavender, head and throat bright orange; a pair of dorsolateral dark brown lines beginning behind the eye and extending to the regenerated portion of the tail, with a series of white starlike spots along their lengths; a median brown nuchal line; a pair of dark brown ventrolateral lines, one on each side, from just above the forelimb insertion onto the base of the tail; tail bright yellow with vague dark brownish dorsolateral stripes which appear to be the continuations (in a diluted form) of the dorsolateral brown stripes onto the regenerated portion of the tail; venter pink; iris greenish gold.

Variation: Data for four S. *leucaster* (the holotype, two male and one female paratypes) are: dorsal scales between axilla and groin 23–26; ventral scales between axilla and groin 29–32; scales around body at midbody 35–41; supralabials to center of eye 4; internasals 2; fourth toe lamella 8–11; escutcheon 5–7 × 8–24; largest males (holotype, ASFS V30524) with snout–vent lengths of 26 mm; female (ASFS V30526) with snout–vent length of 30 mm.

The two paratypic males are colored and patterned like the holotype; the ventrolateral dark stripe may be somewhat fragmented but it is always apparent. The median nuchal line has an indicated branching leading to the ocular region (thereby giving a vague Y) in one paratype (ASFS V30525). The number of white starlike punctae in each dorsolateral dark line varies between 4 and 7 and these spots are a bold and conspicuous feature in life. The greater length of the escutcheon in the two paratypic males in contrast to that in the holotype is due to the extension of the escutcheon along the ventral surface of the thigh; such an extension is not clearly defined in the holotype.

The single female was patterned much like the males in life, but there is a well-defined dark brown occipital Y-shaped figure which includes (as the stem) the median brown nuchal line. In the female, the venter is pink as in males, but the throat and head are not orange; the upper surface of the head is lavender with some random dark brown snout stippling, and the throat is white with vague brown scribbling.

The scale organs are "hair"-bearing, with from 3 to 8 organs along the free posterior margins of each dorsal scale. Counts of organs on five scales are 3, 5, 6, 6, and 8. Usually there are two "hairs" per organ, but occasional organs have only one "hair."

Comparisons: S. *leucaster* differs from both S. *shrevei* and S. *rhabdotus* in dorsal pattern. Although *rhabdotus* is longitudinally lined dorsally (see Schwartz, 1970; fig. 1), the species lacks white spots in the dorsolateral lines. Additionally, the ventrolateral dark brown lines are absent or only at best very tentatively indicated. The occipital Y or the median nuchal dark line are consistent features in *rhabdotus*, with the former condition the more prevalent. Male *rhabdotus* have the head and throat yellow rather than bright orange as in *leucaster*. The iris is greenish gold in *leucaster* and brown to gray in *rhabdotus*. The two species are comparable in all scale counts.

Lazell (1961) and Schwartz (1970) commented on the pattern and coloration of the now-lost holotype of S. *shrevei.* This species is not longitudinally lineate. All three taxa included in the *shrevei* group share a community of scale characters (4 supralabials to eye center, 2 internasals—although the only known *shrevei* has 1 internasal) as well as habitus (convex snouts) and structural features (slightly imbricate, subimbricate, or non-imbricate dorsal scales). At least *leucaster* and *rhabdotus* have vertically elliptical pupils; the pupil shape is not recorded for *shrevei.* One feature in which *shrevei* differs from both *rhabdotus* and *leucaster* is that the former has a middorsal zone of irregularly sized small and large scales which is absent (or at best only indicated by a few smaller dorsal scales in the midline above the axilla) in the latter pair.

Remarks: Since it is obvious that S. *leucaster* and S. *rhabdotus* are more closely related to each other than either is to S. *shrevei,* the matter of relationships between these two southern populations is problematical. The two localities (La Florida, El Iguito) from which each is known are separated by about 62 kilometers airline, whereas the distance between the two localities for *rhabdotus* and *shrevei* (La Florida, Môle St. Nicholas) are some 250 kilometers apart. It would seem reasonable to assume, considering the lack of scutellar differences between *rhabdotus* and *leucaster*, that these taxa are subspecifically related.

I have been swayed in my naming *leucaster* as a full species by the fact that, despite the proximity of the *rhabdotus* and *leucaster* localities, they lie on two portions of Hispaniola which have had separate histories. Hispaniola, as is by now well known, was previously composed of two islands, separated by a strait, which is now the Cul de Sac-Valle de Neiba plain, the hot and xeric lowlands, in places below sea level, which mark even today the boundary between the two old islands. The herpetofaunas of these two palaeoislands differ strikingly in many ways, most notably in species-composition. The only *rhabdotus* locality lies on or near the old northern shore of the south island (at the foot of the Sierra de Baoruco) whereas the *leucaster* locality lies near the southern shore of the north island (near the foothills of the Sierra de Neiba-Sierra Martín García).

It seems likely that these two populations represent two stocks, one derived from the other, which occupied lowland dry situations along the coasts on the north and south islands. One might well expect that, of the three *shrevei* group species, *rhabdotus* and *leucaster* would be closer than either is to *shrevei,* on the grounds of the history of this region in comparison with the history of the remainder of the north island (at whose northwestern extremity S. *shrevei* occurs).

There is at present no evidence that either *rhabdotus* or *leucaster* occurs throughout the hot and dry lowlands of the Valle de Neiba which lies between their two known localities. This intervening region harbors the small S. *brevirostratus* Shreve and an as yet unnamed even smaller species of *Sphaerodactylus.* S. *difficilis* Barbour occurs peripheral to this region but is unknown from the xeric lowlands themselves.

Considering all of the above facts, historical, ecological, and geographic, I have chosen what I consider a conservative course in naming *leucaster* as a full species. Only more intensive collecting in the region between the *leucaster* and *rhabdotus* localities may reveal the relationships of these two populations. One major drawback is that in neither case do we as yet know the natural habitat of either species; both have been secured only in man-disturbed and highly specialized situations—basically, shaded retreats in xeric regions. Intensive collecting with native assistance in a mesic *Musa* grove with much ground litter adjacent to El Iguito revealed no additional *S. leucaster*. Only *S. brevirostratus* was secured in this very mesic and extremely shaded artificial situation. I have little doubt that both *S. rhabdotus* and *S. leucaster* are typically desert-dwelling geckos, but encountering specimens in open and undisturbed desert may well prove an almost impossible task. It is remarkable that, despite considerable collecting carried on within the Valle de Neiba (and in the confluent Cul de Sac Plain in Haiti) no member of this group of *Sphaerodactylus* has been taken. The precise habitat requirements for members of the *S. shrevei* group members in natural situations remain to be determined.

The illustration is from the competent pen of David C. Leber to whom I am very grateful.

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A NEW CRAYFISH FROM THE CUMBERLAND RIVER SYSTEM WITH NOTES ON *CAMBARUS CAROLINUS* (ERICHSON)

By Horton H. Hobbs, Jr.,
and Raymond W. Bouchard
Smithsonian Institution, Washington, D.C. 20560,
and University of Tennessee, Knoxville, 37916

The two species treated here have been so often confused with other crayfishes that to aid in avoiding further errors, we offer descriptions together with all information available to us concerning them, including as complete synonymies as possible. While their relationships to other allied members of the complexes to which they belong are not adequately understood, we hope that the descriptions and information presented here will be helpful to future investigators.

The existence of *Cambarus* (*Puncticambarus*) *cumberlandensis*, new species, has been known since 1905 when Ortmann identified crayfish from the Rockcastle River in Kentucky as *Cambarus extraneus* Hagen, 1870. All subsequent authors treating this crayfish, which frequents the Cumberland and upper Green drainage systems, have utilized his determination, largely because of a lack of knowledge as to the identity of *Cambarus extraneus,* which, insofar as we know, is confined to one tributary, South Chickamauga Creek, of the Tennessee River in southeastern Tennessee and northwestern Georgia. That portion of the Tennessee drainage system lying between the ranges of *C. cumberlandensis* and *C. extraneus* is occupied by another species of the subgenus *Puncticambarus* that is being described by one of us (Bouchard, see Relationships).

Our knowledge of *Cambarus carolinus* Erichson, 1846, has been in a state of chaos since this crayfish was first described.

The type, which has been lost, was deposited in the Berlin Museum, and the only students of crayfishes who are known to have seen it were Erichson and Hagen. It is unfortunate that the latter did not examine it until after he had prepared his monograph (1870) of the North American crayfishes. Both Faxon and Hay had access to a photograph of the type and drawings of the chela and first pleopod, but the whereabouts of the photograph and the sketches is not known. The only specimens considered here to be typical of *C. carolinus* are those collected near the type-locality. With the exception of the lost type, specimens from southwestern North Carolina, and those cited here, all specimens, to which references have been made in other contributions, belong either to *Cambarus dubius* Faxon, 1884, or to one or more species cited below. Because of inadequate series of these difficult-to-capture burrowers, descriptions of those believed to be new are being delayed until additional specimens can be acquired. Less than half of the references to *C. carolinus* actually refer to that species; hence, to avoid possible misinterpretations of our analysis of the synonymy presented, we are appending all remaining citations to *C. carolinus* that we believe applicable to other species.

Acknowledgments: We are most grateful to all of those persons cited herein who assisted us in collecting, or who donated to us, specimens of the species treated here. Especial thanks are extended to George F. Townes and John J. Huebner for their interest and assistance in locating the type-locality of *Cambarus carolinus.* Our appreciation is also extended to Carolyn B. Gast for the illustrations, and to Fenner A. Chace, Jr., and Margaret A. Daniel for their critical review of the manuscript.

Cambarus (Puncticambarus) cumberlandensis, new species

Cambarus extraneus.—Ortmann, 1905a:310*–311*; 1905b:121*, 134; 1918:849*; 1931:97*, 99*, 102*–104*, 105.—Fleming, 1938:300*, 303*; 1939:311*.—Hobbs and Shoup, 1942:634, 636–639.—Rhoades, 1944:112, 114, 134, 136*.—Hobbs, 1956:116*, 120*.—Holt, 1968: 20, 28.

Cambarus extraneous.—Cole, 1959:81 (erroneous spelling).

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* In part.

Cambarus (*Puncticambarus*) sp. A.—Hobbs, 1969:102, 133, 134 (Fig. 7).

Diagnosis: Body and eyes with pigment. Rostrum with marginal spines or tubercles. Areola 3.5 to 5.3 times longer than broad and constituting 31.6 to 37.3 percent of total length of carapace (41.6 to 46.6 percent of postorbital length) with 6 to 9 punctations across narrowest part. Cervical spines almost always well developed; hepatic spines absent; branchiostegal spine present; suborbital angle usually acute; postorbital ridge moderately strong and terminating in spine or acute tubercle. Antennal scale approximately 2.5 times longer than broad, broadest slightly distal to midlength. Chela with 2 rows of 6 to 9 tubercles on mesial surface of palm; lateral margin strongly costate and lateral base of fixed finger strongly impressed above and below; dactyl at least twice as long as mesial margin of palm. Hook on ischium of third pereiopods of male overreaching basioischial articulation and opposed by tubercle on basis. First pleopod of first form male with central projection corneous, bladelike, bearing distinct subapical notch, recurved at angle of approximately 110 degrees, and constituting, if straightened, approximately one-fifth total length of appendage; mesial process tumescent, tapering to subacute tip, and directed caudolaterally at angle of approximately 90 degrees to shaft of appendage. Annulus ventralis symmetrical, subquadrangular, with caudal portion somewhat movable; cephalic half bearing longitudinal median trough between longitudinal ridges, and caudal half with tilted S-shaped sinus. First pleopod of female uniramous and reaching midlength of annulus when abdomen flexed.

Holotypic male, form I: Body subovate, depressed (Fig. 1*a*, *j*). Abdomen narrower than thorax (22.5 and 27.9 mm). Greatest width of carapace greater than depth at caudodorsal margin of cervical groove (27.9 and 18.5 mm). Areola 4.9 times longer than wide with 6 to 8 punctations across narrowest part; length of areola 34.3 percent of entire length of carapace (41.3 percent of postorbital length). Rostrum with weakly thickened, convergent margins bearing prominent acute, corneous tubercles at base of acumen; latter almost reaching distal end of ultimate podomere of antennular peduncle and terminating in corneous, acute, upturned tip; upper surface concave and bearing small setiferous punctations. Subrostral ridges moderately well developed and evident in dorsal aspect to marginal tubercles. Postorbital ridges moderately strong, deeply grooved dorsolaterally, and terminating cephalically in acute, corneous tubercles. Suborbital angle strong with acute corneous tip; branchiostegal spine moderately large and with similar tip. Single pair of cervical spines present; hepatic area and lateral portion of branchiostegites tuberculate; dorsal portion of carapace punctate.

Abdomen shorter than carapace (50.0 and 53.4 mm); pleura of moderate length with caudoventral extremity subangular. Cephalic section of telson with 2 spines in each caudolateral corner. Proximal podomere of uropod with small distal spine on lateral lobe and slightly

FIG. 1. *Cambarus* (*Puncticambarus*) *cumberlandensis*, new species. *a*, Lateral view of carapace of holotype; *b*, Mesial view of first pleopod of paratypic male, form I; *c*, Mesial view of first pleopod of morphotypic male; *d*, Caudal view of first pleopods of holotype; *e*, Lateral view of first pleopod of morphotypic male; *f*, Lateral view of first pleopod of paratypic male, form I; *g*, Antennal scale of holotype; *h*, Epistome of holotype; *i*, Proximal podomeres of third through fifth pereiopods of holotype; *j*, Dorsal view of carapace of holotype; *k*, Annulus ventralis and adjacent sternal area of allotype; *l*, Dorsal view of distal podomeres of cheliped of paratypic male, form I.

larger one on mesial lobe; both rami with weak longitudinal keel, that on mesial ramus with well-developed premarginal spine.

Cephalic lobe of epistome (Fig. 1*h*) subtriangular with slightly irregular, thickened cephalolateral margins and with weak rounded cephalomedian projection; ventral surface shallowly concave with scattered setiferous punctations. Basal portion of epistome with deep median fovea and pair of obliquely disposed slitlike fossae immediately cephalic and subparallel to thickened, arched epistomal zygoma (Bouchard, 1973); lateral extremities with 1 (left) or 2 (right) tubercles. Proximal segment of antennule with small spine on ventral surface at base of distal third. Antennae extending caudally to sixth abdominal tergum. Antennal scale (Fig. 1g) moderately broad, broadest slightly distal to midlength; thickened lateral portion terminating in prominent, acute, corneous-tipped spine projecting forward to about same level as tip of rostrum. Postaxial surface of third maxilliped with submarginal lateral row of short plumose setae, conspicuous submesial longitudinal band of long stiff setae, and small, widely spaced setiferous punctations between longitudinal series.

Left chela (Fig. 1*l*, illustrated in mirrored image) about 3 times longer than broad (56.9 and 21.5 mm), somewhat depressed, although inflated proximolaterally; mesial margin of palm with 2 rows of 7 or 8 tubercles and few additional ones on dorsal surface lateral to rows; distoventral surface of palm with 2 large, swollen tubercles at base of dactyl, lateral one with small, corneous, acute tip. Lateral surface of propodus strongly costate with row of punctations rendering proximolateral margin of fixed finger irregular in dorsal aspect. Fixed finger with proximolateral base deeply impressed dorsally and ventrally; dorsal and ventral surfaces with distinct submedian ridge flanked by setiferous punctations; opposable surface with row of 11 knoblike tubercles along proximal four-fifths of finger, third from base much larger than others, and those along distal three-fourths of finger decreasing in size distally; additional large tubercle present on lower level between sixth and seventh tubercle of row, and double row of minute denticles extending distally from latter-mentioned large tubercle to corneous tip of finger. Dorsal and ventral surfaces of dactyl with median longitudinal ridges, somewhat weaker than those on fixed finger, flanked by setiferous punctations; opposable margin with row of 16 tubercles which, except fourth from base, decreasing in size distally; mesial margin of dactyl tuberculate along proximal half and punctate along distal half; single row of minute denticles extending distally from fourth tubercle to fourteenth, although interrupted by tubercles, and continuing ventrally to corneous tip of finger.

Carpus longer than broad (17.1 and 11.8 mm) with deep oblique furrow dorsally; mesial surface with large procurved spine near midlength and 2 small tubercles on dorsomesial surface of proximal half; distoventral margin with median strong spiniform tubercle and smaller one proximomesial to latter; podomere otherwise punctate.

Upper surface of merus with 2 prominent spines and 1 or 2 small tubercles near distal end; mesial surface somewhat rugose; lateral surface smooth with few fine punctations; ventral surface with lateral row of 7 tubercles, irregular in size and some corneous-tipped, and mesial row of 12 corneous-tipped, acute tubercles; small corneous tubercle also present slightly proximoventral to lateral articulation with propodus. Ischium with row of 5 small tubercles on mesial margin.

Hooks on ischia of third pereiopods only (Fig. 1*i*); hooks simple, overreaching basioischial articulation and opposed by acute tubercle on basis. Coxae of fourth pereiopods with prominent caudomesial boss, those of fifth pereiopods without prominences. For measurements see Table 1.

First pleopods (Fig. 1*b*, *d*, *f*) reaching caudal portion of coxae of third pereiopods when abdomen flexed. See Diagnosis for description.

Allotypic female: Differing from holotype in following respects: acumen of rostrum reaching slightly beyond base of distal podomere of antennule; spine on antennal scale reaching short distance beyond distal podomere of antennule; cephalolateral margins of epistome more regular; more lateral row of tubercles on mesial margin of palm of right chela consisting of 9, in addition, row of 6 tubercles extending proximally from dorsal articular knob at base of dactyl; opposable margin of fixed finger of chela with row of 12 tubercles and cluster of plumose setae at mesioventral base; lateromesial and ventromesial rows of tubercles on merus consisting of 7 and 11, respectively. See Table 1.

Annulus ventralis (Fig. 1*k*) subquadrangular, broader than long, and situated rather shallowly in sternum with cephalic portion fused with sternum and caudal third hinged (slightly movable); cephalic half more pliable than caudal half and bearing median longitudinal trough flanked by subparallel longitudinal ridges; dextral ridge continuing caudally and resembling inverted "?"; sinistral ridge terminating at cephalic base of dextrally directed tongue; sinus originating slightly dextral to median line near midlength of tongue, paralleling contour of curved portion of "?," and finally turning slightly caudodextrad, ending on midcaudal wall of annulus. Sclerite immediately caudal to annulus subspindle-shaped in outline with ventral surface somewhat elevated. Uniramous first pleopods reaching midlength of annulus when abdomen flexed.

Morphotypic male, form II: Differing from holotype in following respects: cephalolateral margins of epistome with 4 asymmetrically arranged tubercles on each side; opposable margin of fixed finger of right chela with row of 10 tubercles, that of dactyl with 15; mesial surface of carpus with additional small tubercle slightly distal to base of procurved spine, and ventromesial surface with additional small tubercle ventral to small distal one on mesial surface; merus with 13 spines in ventromesial row; mesial margin of ischium of cheliped with only 3. Hooks on ischia of third pereiopods much reduced, not reaching basioischial articulation, and opposing tubercle on basis also much smaller;

boss on coxae of fourth pereiopods somewhat smaller and less sharply defined. First pleopods (Fig. 1*c*, *e*) of uniform texture and as illustrated.

Type-locality: Poplar Cove Creek (a tributary to the East Fork of the Obey River), 5.8 miles west of Jamestown, Fentress County, Tennessee, off State Route 52, just east of Helena. There this crayfish was associated with *Orconectes placidus* (Hagen, 1870), *Cambarus* (*Depressicambarus*) *striatus* Hay, 1902c, and *Cambarus* (*Erebicambarus*) *rusticiformis* Rhoades, 1944.

Disposition of types: The holotypic male, form I (no. 132989), the allotypic female (no. 132990), and the morphotypic male, form II (no. 132991) are deposited in the National Museum of Natural History, Smithsonian Institution. Paratypes consisting of 4♂I, 15♂II, 15♀, 3 juv.♂, and 5 juv.♀ are in the Smithsonian Institution, and 8♂I, 12♂II, 18♀, 6 juv.♂, 7 juv.♀, and 3 ovigerous females are in the collection of the junior author.

Range: This crayfish is a common inhabitant of the Cumberland River system from Jellico Creek (Scott County, Tennessee) downstream to and including Roaring River in Jackson County, Tennessee (Fig. 2). Nearby populations in the Green River system in Adair and Metcalf counties, Kentucky, perhaps reached this watershed through stream capture or by migrating across low divides; however, a single record from Sink Creek at Tennessee Route 56 in the Caney Fork River system in DeKalb County, Tennessee (not shown in Fig. 2), probably represents an introduction. Such a conclusion is based on the fact that in the many collections made in the Caney Fork River, this crayfish has been found in only the one locality.

Variations: Minor variations are rampant in this species; however, many of the differences noted are obviously due to regenerated appendages and abrasions of spines and tubercles of individuals in late intermolt stages. Of possible phylogenetic interest is the occasional presence of 2 pairs of cervical spines instead of the usual single pair, one or both of which rarely are reduced to tubercles. There is considerable variation in the arrangement of tubercles along the mesial margin of the palm of the chela; whereas usually there are 2 well-defined rows with a few irregularly arranged above and below them, in some individuals there are 3 somewhat distinct, although irregular, rows. Rhoades, 1944:136, pointed out that his specimens from Beaver Creek (Wayne County, Kentucky) possess only a single row of tubercles along the mesial margin of the palm. In our 6 specimens from the same stream, all have 2 rows, and we have observed no specimens from elsewhere with fewer than 2 rows.

The limited material available from the Green River drainage is indistinguishable from most of that from the Cumberland system.

Comments on Ortmann's discussion (1931:102) of the specimens from "the upper Cumberland drainage" seem hardly apropos, for *C. girardianus* is, in our opinion, a somewhat distantly related species that has been assigned to the subgenus *Hiaticambarus* (Hobbs, 1969:106).

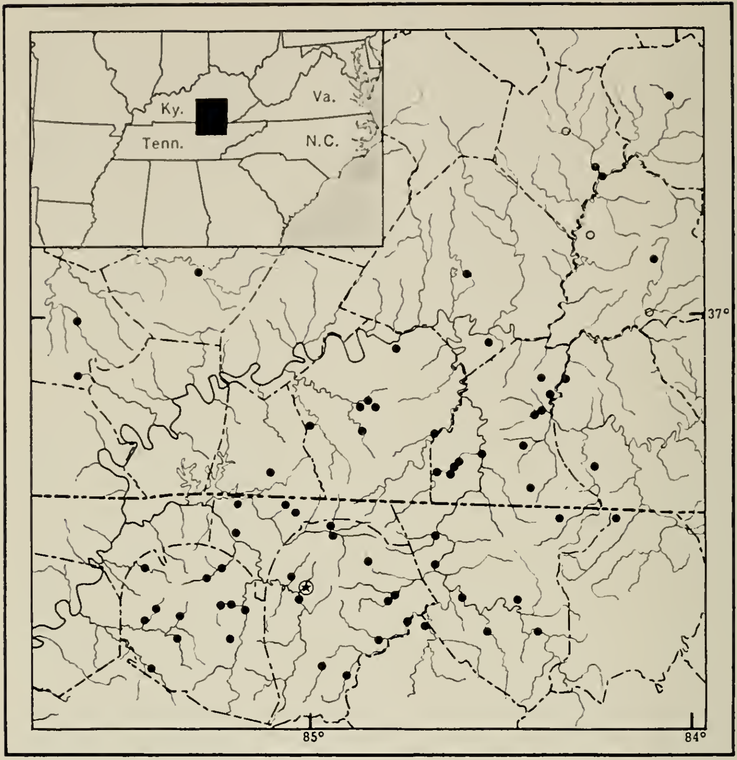

FIG. 2. Distribution of *Cambarus* (*P.*) *cumberlandensis.* One locality in the Caney Fork River drainage is not included, see "Range." Encircled star = type-locality; open circles = specimens not seen by us, records based on Rhoades, 1944.

Size: The largest specimen available is a second form male with a carapace length of 57.4 mm (postorbital length 46.6 mm). The smallest first form male has corresponding lengths of 43.6 and 33.8 mm. The largest first form male has a postorbital length of 46.0 mm (rostrum broken). The smallest female with eggs (or young) has a carapace length of 39.3 mm (postorbital length of 30.1 mm).

Color notes: Ground color of cephalothorax and abdomen ranging from blue green, green, greenish brown to brown dorsally, usually concolorous although sometimes mottled in juveniles. Dorsal dark brown band with cephalomedian emargination situated immediately anterior to cervical groove; narrower similar bands present on caudal margins of carapace and abdominal terga. Gastric area with caudolateral subelliptical patches of dark vermiculations marking attachments of mandibular muscles. Branchiostegites and hepatic region fading ventrally to cream or white, occasionally mottled; areola frequently lighter in color than adjacent portions of branchiostegites. Rostral margins and postorbital ridges varying from light brown or orange to cream; cervical spines and tubercles on carapace ranging from orange or yellow to cream. Dorsum of abdomen fading or becoming darker laterally; pleura of first abdominal segment with or without cream spot. Terga with somewhat regular dorsolateral greenish to light brown pattern consisting of circles with attached stems directed cephalically, and with conspicuous semilunar markings at bases of pleura. Ventral surface of cephalothorax and abdomen cream to white. Flagella of antennules and antennae and lateral margin of antennal scale dark green to brown; peduncles and remainder of scale mostly cream mottled with green or brown. Chelae with ground color of dorsal surface corresponding to that of cephalothorax but profusely modified by dark green to dark brown reticulations and larger spots; tubercles and lateral costa orange to cream, and both fingers fading distally to yellow, sometimes with yellow coloration extending proximally to midlength of fingers; dorsal surface of merus and carpus of cheliped colored similar to palmar area of chela but with dark brown reticulations more restricted. Remaining pereiopods with merus through propodus usually similarly colored dorsally, although hues less intense; dactyl, entire proximal podomeres, and ventral surfaces of all pereiopods cream to white.

Life history notes: Collections have been made during January and April through November. First form males were found from April to November. Ovigerous females have been observed during July, August, and September, and a female with young was collected on 15 August 1969. Rhoades (1944:136) reported a female "bearing 'eyed' eggs" collected on 15 August 1939.

Ecological notes: *Cambarus cumberlandensis* occurs under rocks and among debris in streams ranging from a few feet in width to large rivers. In broader streams, the large individuals are more common in the middle portion of the stream, and, sharing that area of the stream with members of the genus *Orconectes*, is predominant under the larger rocks. With the exception of *Cambarus rusticiformis*, other sympatric congeners are typically more abundant near shore.

Accompanying *Cambarus cumberlandensis* in at least parts of its range are *Cambarus* (*Jugicambarus*) *distans* Rhoades, 1944; *C.* (*J.*) *parvoculus* Hobbs and Shoup, 1947; *C.* (*J.*) new species Bouchard (in press); *C.* (*Depressicambarus*) *striatus* Hay, 1902c; *C.* (*D.*) *sphenoides* Hobbs, 1968a; *C.* (*Erebicambarus*) *rusticiformis* Rhoades, 1944; *C.* (*E.*) *tenebrosus* Hay, 1902b; *Orconectes placidus* (Hagen, 1870); and two additional undescribed members of the latter genus.

Relationships: *Cambarus* (*P.*) *cumberlandensis* is more closely allied to *Cambarus extraneus* Hagen, 1870, than to any other crayfish. Both share with *C. nerterius* Hobbs, 1964, *C. spicatus* Hobbs, 1956, and an undescribed species of the subgenus *Puncticambarus*, marginal spines or tubercles on the rostrum, all differing in this respect from other members of *Puncticambarus*. *Cambarus spicatus* is unique among them in that it possesses hepatic spines. *Cambarus nerterius* differs from *C. cumberlandensis* and *C. extraneus* in having only 1 row of tubercles along the mesial margin of the palm of the chela and in having 2, instead of 1, rows of tubercles along the opposable margins of the fingers. The differences that exist between *C. cumberlandensis* and *C. extraneus* include the absence of stripes in the former as compared with the conspicuous longitudinally striped cephalothorax and abdomen of the latter. In *C. cumberlandensis* the impressions at the base of the fixed finger of the chela are distinctly deep whereas in *C. extraneus* they are very shallow, that on the ventral surface forming only a shallow concavity even in the largest males. The suborbital angle of the former is typically acute or subacute whereas that of the latter is obtuse although often furnished with a small acute spine. Although the characters of the areola overlap in the 2 species, in general that of *C. extraneus* is less than 4 times longer than broad (range 3.1–4.8, average 3.4); it is more often greater than 4 times longer than broad in *C. cumberlandensis* (range 3.5–5.3, average 4.4); also in *C. extraneus* it never constitutes more than 33.4 percent of the total length of the carapace (range 31.0–33.4, average 32.3) and 42.5 percent of the postorbital length (range 41.3–42.5, average 41.7); in *C. cumberlandensis* the respective ranges are 31.6–37.3, average 34.5, and 41.6–46.1, average 43.7, percent. Measurements of juvenile specimens are not included in these percentages.

TABLE 1. Measurements (mm) of *Cambarus* (*Puncticambarus*) *cumberlandensis*

	Holotype	Allotype	Morphotype
Carapace			
Height	18.5	16.2	15.1
Width	27.9	21.4	21.8
Total length	53.4	42.1	42.7
Postorbital length	42.5	33.9	34.0
Areola			
Width	4.0	3.6	3.2
Length	19.0	15.0	15.2
Rostrum			
Width	7.9	6.0	6.4
Length	13.4	10.3	10.6
Chela			
Length of mesial margin of palm	16.4	10.4	9.6
Width of palm	21.5	13.7	13.2
Length of lateral margin	56.9	35.2	35.8
Length of dactyl	37.5	21.7	23.5

Cambarus (*Jugicambarus*) *carolinus* (Erichson)

Astacus Carolinus Erichson, 1846:87, 88.—Hagen, 1870:6.

Astacus (*Cambarus*) *Carolinus* Erichson, 1846:96–97.

Astacus (*Cambarus*) *carolinus*.—Dana, 1852:522 (by implication).—Ortmann, 1906:394.—Fowler, 1912:567.—Ortmann, 1931:147.

Cambarus carolinus.—Girard, 1852:88.—Hay, 1899:959, 962; 1902a:38*.—Harris, 1903:58, 81, 96*, 142, 154*, 158*.—Ortmann, 1905b:122*, 123*, 128*, 129*; 1905c:393*–395*, 398*, 401*; 1906:394, 451*–453*.—Fowler, 1912:567*.—Ortmann, 1913:333*(?).—Faxon, 1914:396*, 397*, 398, 399*, 425.—Ortmann, 1931:156, 157*(?).—?Creaser, 1934:364.—?Brimley, 1938:503*.—Hobbs, 1942a:335; 1942b:75, 165.—Rhoades, 1944:146.—?Griffith, 1945:269.—Pennak, 1953:456*, 464*.—Penn, 1955:73.—Hobbs, 1959:897*.—Hobbs III, 1965:163.—Hobbs, 1967:126, 130; 1968b:K-15*; 1970:168.—Hobbs & Walton, 1970:860.

Cambarus Carolinus.—Hagen, 1870:6, 8.—Faxon, 1884:140*, 141*; 1885:11, 54*, 58*, 65*, 158*, 167*, 173*.—Underwood, 1886:366, 368.

Cambarus (*Bartonius*) *carolinus*.—Ortmann, 1905b:120*; 1906:394*, 397*.

Cambarus (*Cambarus*) *carolinus*.—Fowler, 1912:341 (by implication).—Ortmann, 1931:147*, 149*–152*, 155(?).

Cambarus carolinus carolinus.—Faxon, 1914:399.—Ortmann, 1931:150*(?).

Cambarus carolinensis.—Rhoades, 1944:147 (erroneous spelling).

Cambarus (*Jugicambarus*) *carolinus*.—Hobbs, 1969:107*, 108*, 139*, 142*–144*, Figs. 9*, 19a.

This crayfish was described by Erichson (1846) who based his brief account of it on a single first form male collected "In Carolina in Nordamerika von Hrn. Cabanis aufgefunden." Among the characters mentioned, the narrow areola and a single cristiform row of tubercles on the palm of the chela can apply only to one crayfish in the region of the type-locality—the latter subsequently more precisely determined through the efforts of Hagen (see Faxon, 1885:9).

The next reference to the species was that of Girard (1852) who elevated Erichson's subgenus to generic rank, referring to the crayfish as *Cambarus carolinus*, and cited the localities, "Carolina (Erichson); Anderson, S. C." There is no explanation for his including Anderson as a locality for the species, and it has not been repeated subsequently. Although Girard included *Astacus affinis* Milne Edwards, 1837 (not Say, 1817), in his synonymy of *C. carolinus*, it is very unlikely that Milne Edwards was referring to Erichson's species.

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* In part.

In the same year, Dana (1852) refuted Girard's elevation of Erichson's subgenus *Cambarus* to generic status and, by implication, referred to this crayfish in the original combination.

Hagen (1870), in monographing the North American crayfishes, misapplied the name *C. Carolinus* to an undescribed species, later designated *Procambarus hagenianus* (Faxon, 1884), and made the further error of transposing his treatment of it together with some of the illustrations with those of *P. advena* (LeConte, 1856). Only the references on pages 6 and 8 apply to Erichson's species.

Faxon (1884) discussed the confusion in Hagen's treatment of *C. carolinus* and indicated that the latter had examined Erichson's type in 1870 and "thought that it was *C. Bartonii.*" Faxon concluded that "if it [Hagen's *C. Carolinus*] be really *C. Bartonii*, the species under consideration must receive a new name, *C. Hagenianus.*" The fact that Hagen, after examining the male type, thought it conspecific with *C. bartonii* almost certainly testifies to the conclusion that the first pleopod of Erichson's species ended in two parts recurved at approximately 90 degrees to the main shaft of the appendage, thus associating it with the currently recognized genus *Cambarus*, s.s. Moreover, Faxon's proposal of the provisional name *C. hagenianus* for Hagen's intended *C. carolinus* was obviously justified. In 1885, he enlarged upon the discussion presented in 1884, but in spite of Hagen's remark concerning the type, he was apparently uncertain as to which of his "Groups" Erichson's species should be assigned. The most important contribution was the statement (p. 9) that Dr. Cabanis informed Dr. Hagen "that all the Cambari which he collected were taken in a rivulet in the northern part of South Carolina, near Greenville, at a farm called Tiger Hall."

Underwood (1886) added nothing to our knowledge of the species and erroneously (p. 386) ascribed the description of *C. carolinus* to Hagen, 1870.

The key to the North American crayfishes by Hay (1899) failed to contribute to the recognition of the species. Laying the groundwork for further problems, Faxon (1890) cited a specimen, which he assigned to his *C. dubius* (1884), from "'Among the Cherokees,' Indian Territory" (this was corrected by him (1914:396): "it was in reality obtained in Swain or in Jackson Co., N.C., among the *Eastern* Cherokees . . ."). Inasmuch as *C. dubius* was synonymized with *C. carolinus* by Hay (1902a), Faxon's 1890 citation entered the literature of *C. carolinus* and caused further uncertainties regarding the range of the species. Ortmann's (1902) discussion of *C. carolinus* was based upon Hagen's error in applying the name to the undescribed *P. hagenianus*, and therefore augmented the existing errors.

Hay (1902a), after obtaining a photograph of Erichson's type and drawings of the first pleopod and chela, stated "They show that the species [*C. carolinus* (Erichson)] is neither *C. carolinus* Hagen nor *C. bartonii* Fabricius, but *C. dubius* Faxon." Even though in our opinion the positive portion of this statement is in error, the fact that Hay believed *C. dubius* to be synonym of *C. carolinus* assures us that Erichson's type was not a member of the currently recognized genus *Procambarus* (thus disassociating it with *P. hagenianus*), and it became clear that it belongs to the species group currently recognized as the subgenus *Jugicambarus*. Unfortunately, Hay stated that Erichson's type was collected in western North Carolina, an error that was accepted and expanded upon by Harris the following year. The West Virginia localities mentioned by Hay are referable to *C. dubius* rather than to *C. carolinus*.

Harris (1903) abetted the existing chaos surrounding the identity and range of *C. carolinus* when he compiled and made cross references to erroneous locality records from the literature; in so doing he compounded the mistakes by reporting the occurrence of this crayfish in spurious drainage systems.

Ortmann (1905b) utilized a new combination, *Cambarus* (*Bartonius*) *carolinus*, and, considering *C. dubius* a synonym, cited a range for the species that considerably exceeds the limits as determined by the localities included herein. In the same year (1905c), he recorded new locality records and observations on the habits of *C. dubius*, again designated by him as *C. carolinus*. His classical treatment of the crayfishes of Pennsylvania (1906) adds almost nothing to our knowledge of Erichson's species but is the best account available for *C. dubius*.

Fowler (1912) corrected Ortmann's subgeneric designation, *Bartonius*, and implied a new combination for this species, *Cambarus* (*Cambarus*) *carolinus*. The following year, Ortmann (1913) simply referred to this crayfish as a burrowing species.

Faxon (1914), in addition to summarizing the locality records and reviewing some of the complexities of the literature devoted to this species, introduced the combination *Cambarus carolinus carolinus*, recognizing 2 additional subspecies, *C. carolinus dubius* and *C. carolinus monongalensis* Ortmann, 1905c.

Ortmann (1931) reviewed the status and ranges of *C. carolinus* and its close relatives, considering *C. dubius* a synonym of *C. carolinus* and maintaining specific rank for his *C. monongalensis*. Except for 2 possible new localities ("Swampy ground near springs, Marion, McDowell County, North Carolina" and "Swamp, Ashville, Buncombe Co., North Carolina") which should be confirmed, he added nothing to our knowledge of the species as restricted here. All other localities cited are for *C. dubius* or undescribed relatives.

Creaser (1934) referred to the color of the burrowing *C. carolinus* as being red. Although it is typically red, this information was almost certainly gleaned from observations of previous authors on *C. dubius* who considered it a synonym of *C. carolinus*. Brimley (1938) listed the North Carolina records cited by Ortmann (1931) and included an additional one, "Judson." This locality also should be confirmed.

All except one of the citations to *Cambarus carolinus* by Fleming

(1938–1939) refer to *C. gentryi* Hobbs, 1970; the record from Cumberland Gap, Claiborne County, Tennessee, refers to *C. dubius* or a probable undescribed species.

Hobbs (1942a and b) added no new information, and Rhoades (1944) included nothing more than an indication that *C. carolinus* would probably be found in Kentucky. Griffith (1945) recorded the presence of corixid eggs on this crayfish; however, his failure to cite a locality and the general lack of understanding as to the identity of this species leave doubt as to the authenticity of the determination.

With the following exception, all of the references noted in the synonymy after 1945 include statements concerning relationships of other crayfishes to *C. carolinus* or to its serving as a host to entocytherid ostracods or branchiobdellids. Hobbs (1969) introduced the combination *Cambarus* (*Jugicambarus*) *carolinus* and presented the only illustration available of Erichson's *C. carolinus*.

The many other references to this species that are not included in the above synonymy are presented below.

To summarize our knowledge of Erichson's *C. carolinus*—until 1969, all that was known about it was that it is a member of the genus *Cambarus* closely allied to members of the species group now constituting the subgenus *Jugicambarus*, that it occurs in the vicinity of Greenville, South Carolina, and that it possesses, among the few characters mentioned by Erichson, a narrow areola and a chela bearing a single cristiform row of tubercles along the mesial margin of the palm. In view of the fact that the type has been lost, it is unfortunate that neither Hay nor Faxon published the photograph and drawings of it that were examined by both of them.

After collecting crayfishes in the vicinity of Greenville on a number of occasions between 1934 and 1968, one of us (Hobbs) became convinced that the only species occurring in the area that possesses the 2 characters just cited is that which he illustrated in his summary of the genus (1969) and which is described and more fully depicted below. Hence, except for the single figure of the first pleopod that was included in Hobbs' 1969 publication, the only unquestionable published data available on the species is that pertaining to Erichson's type.

For a number of years, Hobbs has attempted to discover the location of "Tiger Hall" farm without success. Several collecting trips in the Greenville area were made and he and companions finally secured several specimens of *C. carolinus* from a single locality in the Saluda watershed (see Specimens Examined). Not until recently, when Mr. George F. Townes of Greenville, South Carolina, became interested in the problem, was any progress made in finding the locality at which Erichson's specimen was collected. Mr. Townes communicated the following to us:

"I interpret the locality phrase 'Tiger Hall Farm,' as referring to a Hall farm on the Tyger River. This river is ordinarily spelled 'Tyger' rather than 'Tiger.' This would be analogous to 'Potomac, Smith Farm.'

"Plantations were customarily not named in upper South Carolina . . . I assume rather that the collector was interested in recording first the river, then the location on the river.

"I find that in 1804 Baylis Earle conveyed 182 acres on the South Tyger River to Joab Hall. The deed description refers to the property as being located on Wildcat Creek, waters of South Tyger River. The deed is recorded in Deed Book G, at page 153 . . .

"There are no deeds of record by Joab Hall and no record of his estate. There is nothing to show that he did not own the farm in 1846. I do not find any other deeds conveying property on the Tyger River to anyone named Hall in the early 19th Century."

With this probable identification of the type-locality, we went to Greenville, and, with the assistance of Mr. John J. Huebner of the Greenville County Planning Commission, located Wildcat Creek (labeled "Camp Creek" on a 1952 edition of the General Highway Map of Greenville County) and a farm nearby known locally as the "old Hall farm." Specimens that are surely Erichson's *Cambarus carolinus* were obtained from burrows in both localities which are less than 3 miles apart (see Specimens Examined) and on small tributaries of the South Tyger River. Inasmuch as the farm that was deeded to Joab Hall was stated to be located on Wildcat Creek, we shall consider those specimens collected by us from along this stream as topotypes of the species. Furthermore, there is every reason to believe that all of the specimens cited below are conspecific. The second form male topotypes are being maintained in aquaria in anticipation of their molting to the first form.

Diagnosis: Body and eyes with pigment; latter conspicuously small. Rostrum slightly broader than long, without marginal spines or tubercles. Areola 13.7 to 39.3 times longer than broad and constituting 37.3 to 40.7 percent of total length of carapace (42.5 to 46.0 percent of postorbital length) with 1 punctation in narrowest part. Cervical spines absent, tubercle representing it scarcely larger than others nearby; hepatic spines lacking; suborbital angle virtually obsolete; postorbital ridge strong but without spine or tubercle cephalically; branchiostegal spine low and tuberculiform. Antennal scale approximately 2.5 times longer than broad, margins subparallel proximal and distal to midlength. Chela with single cristiform row of 6 to 8 tubercles on mesial surface of palm, lateral margin weakly costate, particularly proximally; dactyl less than twice length of mesial margin of palm. Hook on ischium of third pereiopod overreaching basioischial articulation and not opposed by tubercle on basis. First pleopod of first form male with central projection corneous, bladelike, lacking subapical notch, recurved at angle of approximately 110 degrees, and constituting, if straightened, almost one-fourth total length of appendage; mesial process tumescent basally with cephalodistal surface tapering strongly to subacute tip of process and directed caudolaterally at angle of 90 degrees to main axis of appendage. Annulus ventralis strongly asymmetrical, broader than long;

FIG. 3. *Cambarus* (*Jugicambarus*) *carolinus* (Erichson), male, form I. (USNM no. 116930). Right chela in specimen is regenerated, that figured is mirrored image of left chela.

cephalic half bearing median longitudinal trough flanked by caudally diverging longitudinal ridges which, near midlength of annulus, joining arched transverse ridges; dextral fused ridge continuing caudosinistrally across median line and forking into subtransverse tongue disappearing under sinistral wall and sinuous dextral wall of sinus; sinistral fused ridge heavier than dextral and forming high J-shaped sinistrocaudal wall of annulus; sinus in form of almost inverted S. First pleopods of female moderately well developed, reaching midlength of annulus when abdomen flexed.

Male, form I (U.S.N.M. no. 116930): Body subcylindrical (Figs. 3, 4*a*). Abdomen narrower than thorax (13.6 and 17.3 mm). Greatest width of carapace greater than depth at caudodorsal margin of cervical groove (17.3 and 14.0 mm). Areola 18.3 times longer than wide with 1 or 2 punctations in narrowest part; length of areola approximately 40.0 percent of entire length of carapace (46.0 percent of postorbital length). Rostrum broken but with only slightly thickened convergent margins lacking spines or tubercles; surface concave with widely spaced punctations, somewhat concentrated at caudomesial bases of margins. Subrostral ridges weakly developed. Postorbital ridges rather depressed with deep longitudinal dorsolateral furrows and merging almost imperceptibly with carapace cephalically. Suborbital angle very weakly indicated, almost obsolete; branchiostegal spine reduced to small angular tubercle. Cervical spine represented by tubercle subequal in size to others in vicinity; hepatic area and lateral portion of branchiostegites tuberculate; gastric area polished with very few small tubercles in cephalomedian and cephalolateral areas, remainder of dorsum punctate.

Abdomen shorter than carapace (26.5 and 36.0 mm); pleura moderately short and rounded ventrally. Cephalic section of telson with single spine in each caudolateral corner. Proximal podomere of uropod with mesial lobe bearing minute acute tubercle, lateral lobe unarmed; mesial ramus with moderately strong submedian keel terminating in premarginal spine.

Cephalic lobe of epistome (Fig. 4*i*) subhemispherical in outline with cephalomedian projection and 2 cephalolateral pairs of low subtriangular projections, its ventral surface with pair of anterior tubercles and paired horizontal rows of punctations; basal portion with well-developed fovea and arched epistomal zygoma; lateral extremities without tuberosities. Proximal segment of antennule with small spine at base of distal third. Antennae extending caudally to first abdominal tergum. Antennal scale (Fig. 4*d*) short and moderately broad, with mesial and lateral margins subparallel for some distance proximal and distal to midlength; thickened lateral portion terminating in prominent, somewhat distolaterally directed, corneous-tipped spine projecting forward to base of ultimate podomere of antennule. Postaxial surface of third maxilliped with submarginal lateral row of short plumose setae and clusters of simple, erect setae arranged in 2 submedian longitudinal rows, most tufts with few plumose setae.

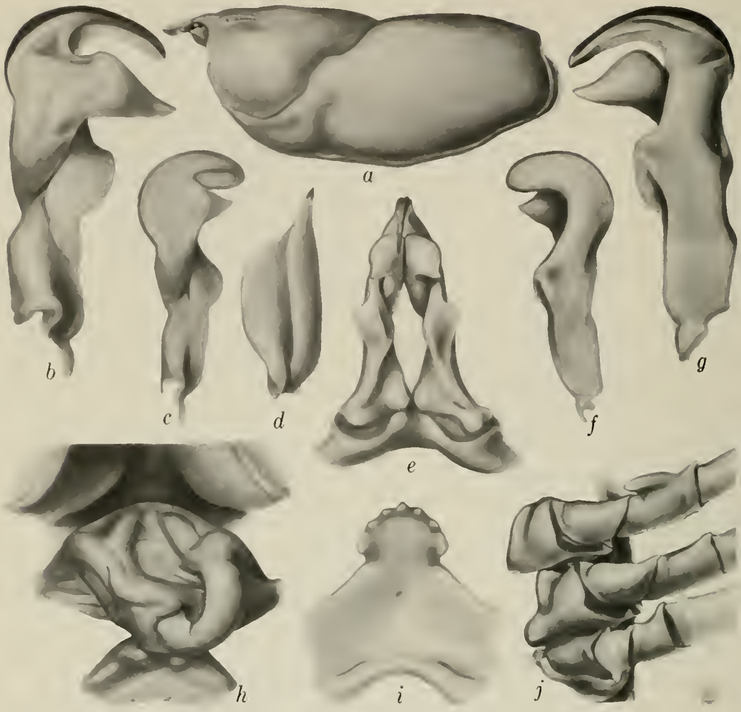

Fig. 4. *Cambarus* (*Jugicambarus*) *carolinus* (Erichson). *a*, Lateral view of carapace of male, form I; *b*, Mesial view of first pleopod of same; *c*, Mesial view of first pleopod of male, form II; *d*, Antennal scale of male, form I; *e*, Caudal view of first pleopods of male, form I; *f*, Lateral view of first pleopod of male, form II; *g*, Lateral view of first pleopod of male, form I; *h*, Annulus ventralis and adjacent sternal area of female; *i*, Epistome of male, form I; *j*, Proximal podomeres of third through fifth pereiopods of male, form I.

Left chela (Fig. 3) about 2 times longer than broad (26.4 and 12.8 mm), rather depressed, and with gaping fingers; mesial margin of palm with single cristiform row of 7 tubercles (counting that on distal border); dorsal surface of palm punctate with conspicuous row of deep punctations extending proximally from articular notch at base of dactyl; lateral margin of palm with longitudinal series of punctations and weakly costate distally; ventral surface of palm with small shallow punctations mesially, large deep ones on lateral half, and 3 prominent tubercles: one on distal margin near mesial base of dactyl, another proximomesial to first, and third proximal to distal ridge and slightly lateral to latter tubercle.

Fixed finger with prominent submedian longitudinal ridge dorsally and slightly weaker more mesial ridge, both flanked by setiferous punctations; lateral margin slightly costate with single row of similar punctations; ventral surface with single longitudinal ridge displaced somewhat mesially; opposable surface with 2 prominent tubercles in proximal third, another on lower level at base of distal fourth, and single row of minute denticles extending distally from second basal tubercle to corneous tip of finger, row broken only by distalmost tubercle. Dorsal and ventral surfaces of dactyl similar to those of fixed finger except ventral ridge submedian. Mesial surface with 2 rounded tubercles at base and single longitudinal row of setiferous punctations extending to corneous tip of finger; opposable margin with row of 6 tubercles along proximal four-fifths of finger and single row of minute denticles extending distally from fourth tubercle to corneous tip of finger.

Carpus longer than broad (11.2 and 9.0 mm) with prominent oblique furrow dorsally; mesial surface with large, spikelike, procurved tubercle, smaller but similar one proximally, and much smaller one dorsal to level of 2 large tubercles; ventral surface with mesial arc of 3 tubercles and small one at base of second; ventral laterodistal angle with tuberculiform swelling on articular boss; podomere otherwise punctate.

Dorsal surface of merus with 3 subdistal rounded tubercles and row of very low ones extending proximally from lateralmost of subdistal group; lateral and mesial surfaces sparsely punctate; ventral surface with lateral row of 3 subacute tubercles and mesial one of 7. Mesial margin of ischium with 4 very small, irregularly arranged tubercles.

Hooks on ischia of third pereiopods only (Fig. 4*j*); hooks simple, overreaching basioischial articulation but not opposed by tubercle on basis. Mesial surface of coxa of second, third, and fourth pereiopods with prominent flange, particularly conspicuous on coxae of third and fourth; coxa of fourth pereiopod with rather large caudomesial boss, that of fifth with only slight caudomesial swelling at caudoventral base of penis papilla.

First pleopods (Fig. 4*b*, *e*, *g*) reaching caudal portion of coxae of third pereiopods when abdomen flexed. See Diagnosis for description.

Female (USNM no. 114096): Rostrum broader than long, extending anteriorly to midlength of penultimate podomere of antennular peduncle, shallowly excavate dorsally, with convergent margins and corneous upturned tip; acumen not delimited basally. Otherwise differing from male, form I, in following respects: cephalolateral margins of epistome evenly rounded, fovea represented by broad shallow depression; ventrolateral surface of fixed finger of right chela with row of long stiff setae; opposable margin of fixed finger with row of 4 tubercles on proximal half, third from base largest, and that of dactyl with 8 along proximal five-sixths; mesial surface of carpus with small dorsal tubercle lacking, and ventral surface without small tubercle at base of second tubercle of arc; dorsal surface of merus with only 1 well defined subdistal tubercle, others vestigial; neither coxae nor ischia of third through fifth pereiopods modified. Annulus ventralis (Fig. 4*h*) deeply imbedded in V-shaped sternum and as described in Diagnosis. Sternite immediately caudal to annulus concavo-convex (concave caudally), elevated ventrally with median cleft.

Male, form II (USNM no. 133056): Differing from first form male in following respects: epistome with cephalolateral margins rounded; cephalic section of telson with 2 spines in each caudolateral corner, mesial members movable; ventral surface of palm of right chela with 1 additional tubercle proximal to major tubercle on distal margin at base of dactyl; all punctations on chela with better developed setae, those flanking tubercles on opposable margins of fingers proportionately much more conspicuous, and those on ventrolateral surface of fixed finger and on ventromesial surface of dactyl quite long and stiff; however, those on dactyl not so long as those on fixed finger; mesial surface of carpus with only 2 spiniform tubercles, smaller ones lacking; ventromesial surface with small tubercle ventral to major spine on mesial surface, and ventral surface without small tubercle at base of second member of arc; ventral surface of merus with lateral and mesial rows of 4 and 6 tubercles, respectively; mesial margin of ischium with only 3 small tubercles. First pleopod (Fig. 4*c, f*) of uniform texture; mesial process lacking arch at distal base, shorter and more nearly conical; central projection lobiform and directed at right angle to principal axis of appendage. Remaining secondary sexual characters, except flanges on coxae of second through fourth pereiopods, much reduced in size and less sharply defined.

Specimens Examined: The specimens described and illustrated here were collected from burrows along a small tributary to the Saluda River in a wooded area northwest of Greenville, about 0.5 mile north of State Route 183 on Route 462, Greenville County, South Carolina. The burrows are complex, winding among roots and debris, with several openings to the surface. The deepest passages are not more than 2.0 feet deep. Situated along the low banks of the small brook, where the water table is almost at the surface, the entire burrows are water-filled, and, at the times this locality was visited, none of the openings was marked by well-formed chimneys. Only 4 specimens were collected at this locality: 1♂II, VI/12/52, H. H. H., coll.; 1 ovigerous ♀, IV/14/62, J. F. Fitzpatrick, Jr., and H. H. H.; 1♂I, 1♀, IV/16/66, J. F. Payne, J. F. F. and H. H. H.

Collections from burrows at 2 additional localities in the Tyger River drainage in Greenville County are also available. Along Wildcat Creek, 8.8 miles north of the junction of U.S. Hwy. 29 and State Route 101, on latter, 3♂II, 1♀, and 1♀ with young, VI/13/72, D. J. Peters, J. E. Pugh, F. E. Oakberg, C. F. Saylor, R. W. B. and H. H. H. On the same day, these collectors obtained 1♂II, and 4♀ along a small creek on County Route 113, 0.5 mile northeast of its intersection with County Route 92, on the Hall farm.

A small female was dug from a burrow along Georges Creek, at the junction of State Routes 135 and 183 in Pickens County, South Carolina, on 24 April 1967, by Rudolph Prins, Torgny Unestam, and H. H. H.

To our knowledge, the 15 crayfish just cited represent the only extant specimens of the species.

Color notes: Carapace mostly brick red dorsally, with gastric area bearing 2 broad, transverse, irregular but symmetrical, darker reddish brown bands fading on hepatic region; lateral portion of branchiostegites fading ventrally to pinkish cream. Cephalic part of first abdominal tergum almost black, its caudal part and remaining terga reddish brown dorsally, fading to pale brick red on pleura; dorsal surface of telson and uropods brownish red, fading toward caudal and distal extremities, respectively. Antennules and antennae mostly dilute brick red, flagellum of latter dark reddish brown. All pereiopods with podomeres distal to ischium red dorsally, fading ventrally; with exception of cheliped, distal portion of merus and dorsum of carpus of each darker than remaining podomeres; proximal portion of merus fading to pinkish cream, matching color of 3 basal podomeres. Cheliped similar to other pereiopods except dorsal surface of palmar area of propodus darker than most of carpus, and ridge flanking dorsal base of dactyl almost black; tubercles on cheliped, as well as elsewhere, distinctly lighter than remaining surfaces, some with almost cream tips. Ventral region of body varying from pinkish cream to cream.

Variations: While none of the variations noted has been correlated with a particular locality, there exist conspicuous differences among the available specimens. One of the most noticeable is in the shape of the rostrum which varies from that illustrated to one in which distinct angles exist at the base of a broad, short acumen. The areola exhibits variations in its relation to the postorbital length and in its relative width; variations in its length are reflected in the ratio, areola length/postorbital length that ranges from 42.5 to 46.0 percent, and in its width by the ratio, areola length/areola width that ranges from 13.7 to 39.3 percent. The cephalic lobe of the epistome usually lacks all of the cephalolateral prominences that are illustrated in Fig. 4*i*. The cephalic section of the telson bears 1 or 2 spines in each caudolateral corner. The number of tubercles on the mesial margin of the palm of the chela ranges from 6 to 8 (as few as 5 in a regenerated chela). Usually, the mesial surface of the carpus of the cheliped has fewer tubercles than that of the first form male: there is a major spine slightly distal to midlength and a less prominent tubercle proximally, and occasionally there is a smaller tubercle at the base of the latter. The number of tubercles on the ventral surface of the merus of the cheliped ranges from 5 to 8 in the mesial row and 3 to 6 in the lateral one, and those on the mesial margin of the ischium from 0 to 4. Mirrored images of the annulus ventralis also exist, and, as usual, in young females the sculpture is not so well developed although the conspicuous cephalomedian depression is always obvious.

TABLE 2. Measurement (mm) of *Cambarus* (*Jugicambarus*) *carolinus*

	Male, Form I	Male, Form II	Female
Carapace			
Height	14.0	15.0	7.3
Width	17.3	19.1	10.0
Total length	36.0*	38.0	20.5
Postorbital length	31.7	33.8	18.0
Areola			
Width	0.8	1.1	0.6
Length	14.6	15.4	8.2
Rostrum			
Width	5.7	6.1	3.3
Length	—*	5.4	3.0
Chela			
Length of mesial margin of palm	9.0	9.2	3.8
Width of palm	12.8	13.4	6.0
Length of lateral margin	26.4	27.1	12.0
Length of dactyl	16.7	17.1	7.4

* Rostrum broken—total length estimated.

Misapplications of the name, Cambarus carolinus: The following synonymies are not complete; instead, they include only the original citation to the species and misidentifications of them as *Cambarus carolinus.*

Cambarus (*Jugicambarus*) *dubius* Faxon

Cambarus dubius Faxon, 1884:114.

Cambarus carolinus.—Hay, 1902a:38*.—Harris, 1903:58*, 59, 81*, 82, 96*, 137*, 146*, 148, 154*, 155, 158*.—Ortmann, 1905b:122*, 123*, 128*, 129*, 136; 1905c:388, 389, 393*, 394*, 395*, 396, 398*, 399, 400, 401*; 1906:346, 349, 351, 401, 403, 404, 414, 416–420, 451*, 452*, 453*, 454, 464–466, 489, 491, 492, 495–497, 500–503, 510–512. —Williamson, 1907:759, 760.—Adams, 1907:897.—Ortmann, 1907: 713–716; 1913:333*(?).—Newcombe, 1929:280–282, 284, 287.—Ortmann, 1931:157*.—Creaser, 1934:364(?).—Pennak, 1953:456*, 464*. —Hobbs, 1959:897*.—Meredith & Schwartz, 1959:2; 1960:21, 24, 28–30, Fig. 12.—Schwartz & Meredith, 1960:42, 54; 1962:260, 261, 271.—Hobbs & Walton, 1962:42, 44.—Hobbs & Hart, 1966:36*, 38*, 39, 40(?), 43, 46.—Hobbs, Holt, & Walton, 1967:5–8, 12, 16, 17, 22–25, 36, 38, 41, 51, 54, 58, 61, 64–70, 72, 74, 75, 78, Fig. 3.—Browning, 1968:3.—Hobbs, 1968b:K-15*.—Momot and Gall, 1971: 363.—Smiley and Miller, 1971:221.

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* In part.

Cambarus (*Bartonius*) *carolinus*.—Ortmann, 1905b:120*; 1906:394*, 395, 396, 397*, 398.

Cambarus carolinensis.—Adams, 1907:898, 899 (erroneous spelling).

Cambarus carolinus carolinus.—Newcombe, 1929:277, 280, 282, Fig. 1.

Cambarus (*Cambarus*) *carolinus*.—Fowler, 1912:567 (by implication). —Ortmann, 1931:148, 149.

Cambarus (*Jugicambarus*) *carolinus*.—Hobbs, 1969:107*, 108*, 139*, 142*, 143*, 144*, Fig. 9*.

Procambarus (*Hagenides*) *advena* (LeConte)

Astacus advena LeConte, 1856:402.

Cambarus Carolinus.—Hagen, 1870:87, 88*, Figs. 51–54, 165.

Procambarus (*Girardiella*) *hagenianus* (Faxon)

Cambarus Hagenianus Faxon, 1884:141.

Cambarus Carolinus.—Hagen, 1870:31, 32, 53, 74, 75, 88*.—Brocchi, 1875:27.—Faxon, 1884:140*, 141*; 1885:8, 9, 48, 54*, 55, 56, 58*, 65*, 158*, 167*, 173*.

Cambarus carolinus.—Ortmann, 1902:277, 279.—Faxon, 1914:366.—Hobbs & Villalobos, 1964:321, 322.

Cambarus (*Jugicambarus*) *gentryi* Hobbs

Cambarus (*Jugicambarus*) *gentryi* Hobbs, 1970:163.

Cambarus carolinus.—Faxon, 1914:397*.—Ortmann, 1931:149*.—Fleming, 1938:301–303.—?Pennak, 1953:456*, 464*.

Cambarus (*Cambarus*) *carolinus*.—Ortmann, 1931:149*.

Cambarus carolinus carolinus.—Fleming, 1939:312, 318–320, Plate 21.

Cambarus (*Jugicambarus*) sp., near *C. carolinus*

Cambarus carolinus.—Harris, 1903:58*, 81*, 96*, 137*, 145, 146*, 152, 154*, 158*.—Ortmann, 1905b:121, 122*, 123*, 128*, 129*, 135; 1905c:394*, 395*, 398*, 401*; 1906:451*, 452*, 453*.—Faxon, 1914: 396*, 397*, 399*.—Fleming, 1938:300.—Pennak, 1953:456*, 464*. —Hobbs, 1955:330, 332; 1959:897*.—Hobbs III, 1965:159, 162.—Holt, 1965:12.—Hobbs & Hart, 1966:36*, 38*, 41, 47, 48, 50.—Holt, 1968:32.—Hobbs, 1968b:K-15*.—Dowell & Winier, 1970:489.

Cambarus (*Bartonius*) *carolinus*.—Ortmann, 1905b:120*; 1906:397*.

Cambarus (*Cambarus*) *carolinus*.—Ortmann, 1931:147*–152*.

Cambarus (*Jugicambarus*) *carolinus*.—Hobbs, 1969:107*, 108*, 139*, 142*, 143*, 144*, Fig. 9*.

"Undescribed crayfish closely allied to *C. carolinus*."—Hobbs & Walton, 1970:860.

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* In part.

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PROCEEDINGS
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A NEW GENUS OF POECILOCHAETIDAE (POLYCHAETOUS ANNELIDS) IN THE MEDITERRANEAN: *ELICODASIA MIRABILIS*[1]

By Lucien Laubier and Jeanete Ramos
Centre Océanologique de Bretagne, B.P. 337, Brest-29273
and Laboratoire Arago, Banyuls-sur-Mer-66650

In the framework of a general study of the benthic communities located on the continental shelf in the Bay of Rosas (on the Spanish Catalonian coast of the Mediterranean), several specimens of a new genus belonging to the small family Poecilochaetidae Hannerz, 1956 were recovered. The object of this study is to describe and classify this unusual organism in relation to the one genus already known in this family.

Genus **Elicodasia,** new genus

Diagnosis: Body long and slender, with numerous segments. Prostomium reduced with median antenna and pair of deciduous lateral palps; without eyes or nuchal organ. Tentacular segment with pair of tentacular cirri, without setae. First setigerous segment reduced, biramous, without dorsal and ventral cirri. Following segments all of same type, with biramous parapodia and dorsal and ventral cirri. Lateral sensory organs between rami. No branchiae. Notopodia with capillary setae and one or two pectinate setae. Neuropodia with capillary setae, large curved acicular setae (continue to posterior end) and one or two pectinate setae. Pygidium with ventral anus and three anal cirri —one mediodorsal and lateral pair. Smooth integument, with exception of head and pygidial regions; cirri and antenna furnished with cylindroconical or hemispherical papillae. Proboscis well developed, unarmed.

Type-species: *Elicodasia mirabilis*, new species.

Etymology: *Elicodasia*, feminine gender, from the Greek *ελισ*, *ικοσ*, rolled in a spiral, and *δασυ*, *εια*, bushy, shaggy: an allusion to the

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[1] Contribution no. 125 of the Scientific Department of the Centre Océanologique de Bretagne.

pectinate setae and to the general distribution of the setae on the parapodia.

Elicodasia mirabilis, new species

Material examined: All the specimens were recovered from the western Mediterranean in the Bay of Rosas on the Spanish Catalonian coast, between 50 and 185 meters depth: Sta. BR 40, 42° 13′ 07″N, 3° 21′ 05″E, 115 meters—anterior fragment of 44 segments, middle fragment of 35 segments; Sta. BV 149, 42° 03′N, 3° 15′ 20″E, 145 meters—two anterior fragments of 28 and 41 segments, middle fragment of 15 segments; Sta. BR 61, 42° 04′ 03″N, 3° 14′ 02″E, 82 meters—anterior fragment of 25 segments; Sta. BR 82, 42° 21′ 02″N, 3° 12′ 02″E, 50 meters—posterior fragment of 37 segments, three middle fragments of 11, 12 and 14 segments; Sta. BR 37, 42° 10′ 08″N, 3° 07′ 08″E, 50 meters—posterior fragment of 36 segments; Sta. BR 60, 42° 04′ 04″N, 3° 15′ 05″E, 60 meters—middle fragment of 11 segments.

The anterior fragment of 41 segments from station BV 149 was chosen as the holotype and deposited in the collection of the Smithsonian Institution, Washington (U.S.A.) (USNM no. 49228). Other fragments are deposited in the authors collections.

Description: The longest anterior fragment was 11 mm long for 44 segments and 0.8 mm wide without cirri. Pigmentation is lacking. The segments are short and wide, with well-developed ventral and dorsal cirri. The integument of the body is smooth, with the exception of the tentacular segment, the prostomial antenna, the cirri, and the pygidial area, all of which have hemispherical papillae. The papillae have a subconical extension and are similar to the papillae of the Polynoidae or the Pilargidae, for instance.

The prostomium is small, hemispherical, with a well-developed median antenna inserted dorsally on the anterior part; the paired palps are missing but their position is indicated by scars between the prostomium and the inner borders of the tentacular segment (Fig. 1A, B). No trace of nuchal organ on the posterior part of the prostomium was observed. Lateral to the prostomium, the tentacular segment is formed of achaetous lobes covered with subconical papillae; each lobe bears a single tentacular cirrus, which is slightly longer than the median antenna (probably corresponds to the ventral tentacular cirrus of *Poecilochaetus* Claparède). The mouth is located ventrally in an oblique transverse plane, with the posterior lip located at the level of the fourth setigerous segment.

The first setigerous segment is small, biramous, with 0–1 notoseta and 1–3 neurosetae; dorsal and ventral cirri are lacking (Fig. 1A, B). The setae are all capillary. Beginning with the second setigerous segment, papillate spindle-shaped dorsal and ventral cirri are found (Fig. 2A, B). The parapodia are clearly biramous, both the noto- and neuropodia having numerous setae nearly encircling the bases of the dorsal and ventral cirri, their number increasing slightly towards the middle region of the body.

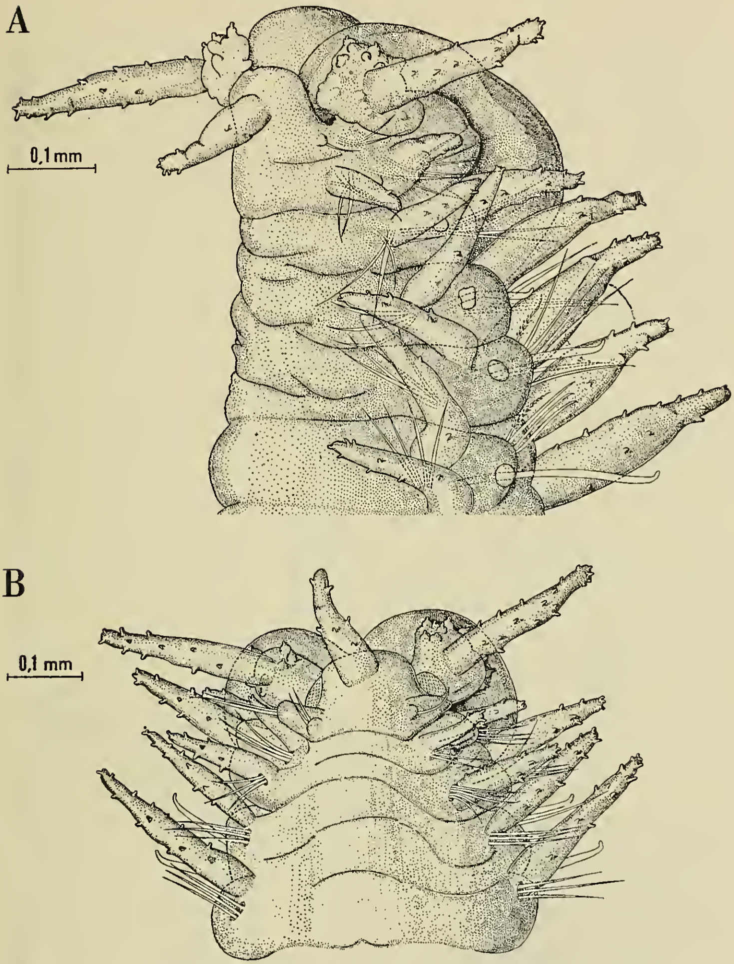


FIG. 1. *Elicodasia mirabilis*: A, anterior region, lateral view; B, same, dorsal view.

Internal acicula were not observed. On all segments, with the exception of the first setiger, there is a small globular papilla between the rami, similar to the lateral sense-organs of *Poecilochaetus*.

The notosetae include three types. Capillary notosetae, of variable thickness, are usually covered by thin spines, which are longer at the tips than at the bases of the setae; their tips are sharply tapered (Figs. 2A, 3B). There are 3–12, usually 6, capillary notosetae per ramus. The

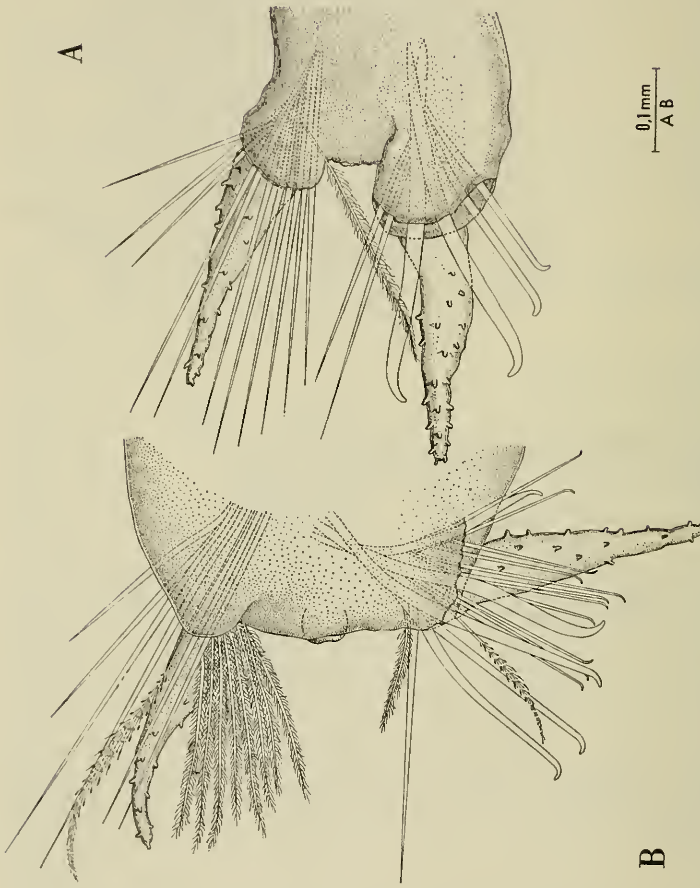


FIG. 2. *Elicodasia mirabilis:* A, parapodium from 35th setigerous segment; B, parapodium from middle region.

second type of notosetae appears on setiger 10 and continues posteriorly to the end of the body, 0–2 per ramus. These pectinate setae consist of a spirally rolled strip drawn out along the spiral axis, giving the illusion of a series of nested cones, with the outside edge of the strip furnished with thin spines (Figs. 2B, 3A). The entire seta is translucent and fairly difficult to see. The shape of the setae varies considerably according to where it is observed: there may exist a thick axial stem having the spines attached at its base and distributed in a fairly loose spiral, or the axial stem may be totally lacking. The existence of intermediate forms allows the conclusion that the setae in question are indeed of one unique type. The third type consists of fine capillary notosetae with very slender secondary filaments extending along their entire length (Fig. 3D). On the holotype, these plumose notosetae first appear on setiger 35; they continue to the posterior segments where they become more abundant (Fig. 2B).

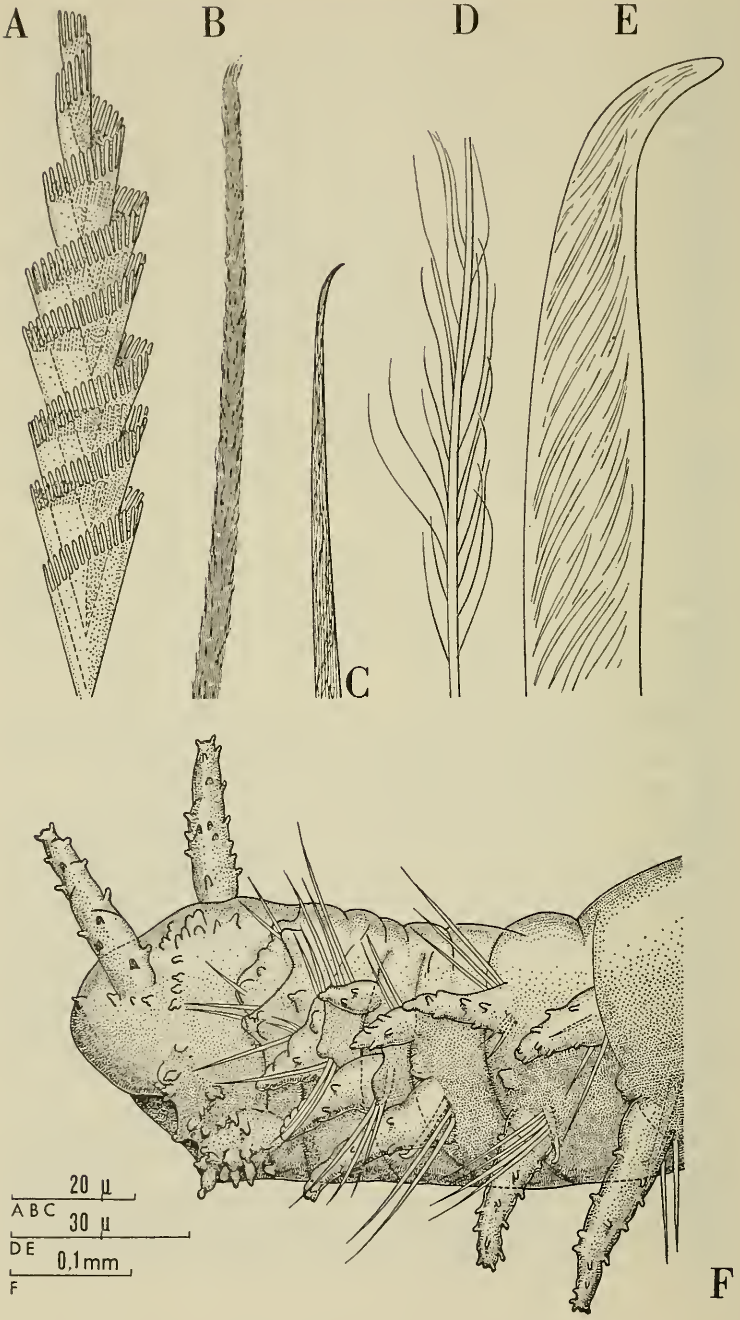
The neurosetae include the same three types as the notosetae, as well as two other kinds. Smooth acicular neurosetae with curved tips begin on setiger 3–4 and continue posteriorly (Figs. 2A, B; 3E). Smooth, very fine capillary neurosetae, terminating in short, slightly curved tips, are present on most of the segments.

It is difficult to verify the regularity of distribution of setae on the different segments; the pectinate setae are often missing, but their absence is not systematic but probably due to their extreme fragility. As in the case of the lateral sensory organ, the fact that we do not possess complete specimens will not permit us to affirm whether or not other types of setae may exist.

Branchiae are lacking, at least on the incomplete specimens examined. The posterior segments of the body are reduced and the pygidium has three anal cirri—two laterodorsal and one mediodorsal (Fig. 3F). The anus opens obliquely on the ventral side.

Discussion: The family position of *Elicodasia* has been particularly difficult to determine precisely. In reality, only the objective comparison of the parapod and of the diverse types of setae possessed by the organism with those of *Poecilochaetus* have permitted the parallel to be drawn between these two genera so that *Elicodasia* could be placed in the family Poecilochaetidae, up to now comprising the single genus *Poecilochaetus*. Among the most significant morphological criteria, we consider the lateral sensory organ, the pectinate setae, the filamentous capillary setae, and the neuropodial acicular setae. To our knowledge, these four structures are not found united in any other family of polychaetous annelids.

This conclusion reinforces the validity of the arguments used by Hannerz (1956) in justifying the creation of a particular family for *Poecilochaetus*. However, it now becomes necessary to modify the original family diagnosis. In reality, neither Hannerz nor the authors who have subsequently considered the family Poecilochaetidae and admitted its validity (Pettibone, 1963:308; Orrhage, 1964:389; Hart-


A
B
D
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C
20 µ
A B C
30 µ
D E
0,1mm
F
F

mann-Schröder, 1971:107) have furnished an actual family diagnosis except to infer that the diagnosis of Poecilochaetidae is synonymous with that of *Poecilochaetus*, the one known genus up to now.

The principal differences between the two genera are the following:

	Elicodasia new genus	*Poecilochaetus* Claparède
Prostomium:		
median antenna	Present	With frontal tentacle
nuchal organ	Absent	Well developed
Tentacular segment	Achaetous	With series of long setae extending anteriorly and forming a kind of cephalic cage
First setigerous segment	Reduced, without dorsal and ventral cirri	Well developed, similar to following segments, with dorsal and ventral cirri
Neuropodial acicular setae	Present in most of body (begin on segment 4 and continue posteriorly)	Confined to few anterior segments
Anus	Ventral	Dorsal

The genus *Poecilochaetus* is presently made up of 11 species and one subspecies. They are listed below, along with their type-localities:

P. fulgoris Claparède, 1875. Northeastern Atlantic, in 1326 meters.
P. serpens Allen, 1904. England, on the continental shelf.
P. tropicus Okuda, 1935. Palau, South Seas Islands.
P. johnsoni Hartman, 1939. Southern California.
P. vitjazi Levenstein, 1962. Tonga Trench, Abyssal Pacific, in more than 10,000 meters.
P. australis Nonato, 1963. Brazil.
P. bermudensis Hartman, 1965. Off Bermuda, in 1000 meters.
P. modestus Rullier, 1965. West Africa, in 82 meters.
P. japonicus Kitamori, 1965. Iyo Nada, Japan, in 5 to 20 meters.
P. paratropicus Gallardo, 1968. South Vietnam, in 9 to 42 meters.
P. vietnamita Gallardo, 1968. South Vietnam, in 19 meters.
P. serpens honiarae Gibbs, 1971. Solomon Islands.

←

FIG. 3. *Elicodasia mirabilis*: A, pectinate seta; B, capillary seta; C, capillary neuroseta with curved tip; D, seta with secondary filaments; E, acicular neuroseta; F, posterior region and pygidium, lateral view.

The genus is remarkably homogeneous, but it should be emphasized that a number of these species are incompletely known, since their descriptions were based on fragmentary specimens. On the other hand, it is interesting to note that our knowledge of the group has increased rapidly during the last decade, the number of species having trebled. The majority of the species have been recovered in tropical or subtropical areas and in intertidal or relatively shallow depths. Three of them, however, are known from deep to abyssal depths (*P. fulgoris*, *P. bermudensis*, and *P. vitjazi*).

In the present state of our knowledge, the discovery of *Elicodasia* brings no new data regarding the position and phylogenetic relationships of the Poecilochaetidae. It also seems premature to attempt to establish the basis of a true family diagnosis from a comparison between the two genera. However, it is now possible to recall several characteristics which seem to belong to the family:

Preliminary emended diagnosis of Poecilochaetidae Hannerz, 1956.

Polychaetes having long and slender body formed by numerous segments. Prostomium small, subglobular, with median antenna or frontal tentacle and pair of long spioniform palps (easily deciduous). Peristomium or tentacular segment surrounding prostomium, with 1–2 pairs of tentacular cirri, with or without well-developed setae. Parapodia biramous, with lateral sense-organs between rami. Setae simple, of various kinds, including capillary, pectinate, plumose, and acicular. Dorsal and ventral cirri spindle-shaped or bottle-shaped. With or without branchiae. Pygidium with 3–4 anal cirri.

Acknowledgments

We thank Dr. M. H. Pettibone, who carefully read the manuscript and offered many valuable suggestions for its improvement.

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PROCEEDINGS
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EPIGEAN BRANCHIOBDELLIDS (ANNELIDA: CLITELLATA) FROM FLORIDA

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

In the early Pleistocene, most of Florida was covered by marine waters (Cooke, 1945:275) which reduced the peninsula to a few small islands. The distribution of the salt intolerant branchiobdellids of the state should present interesting zoogeographical problems. But, though confined to their crustacean hosts and, hence, able to go only where their hosts take them, they have evolved at a slower rate than the crayfishes (their principal hosts) (Holt, in press), they are not host specific and the paucity of species in the state as opposed to the richness of the crayfish fauna, make the solution of such problems difficult. Nonetheless, some tentative conclusions can be reached. In any case, little is known of the branchiobdellids of Florida, and as a part of efforts the objectives of which are to describe, classify and speculate on the evolution of the North American members of the order, the following is offered as a contribution towards these goals. The troglobitic branchiobdellids of Florida will be treated in another paper which is in preparation.

Much is known of the crayfishes of the state through the work of Hobbs, but I know of only three references to any branchiobdellids of the state. Goodnight (1940:34) recorded the presence of *Cambarincola philadelphicus*[1] in Punta Gorda,

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[1] By direction of the International Code of Zoological Nomenclature, London, 1961, Article 30 (a) (i) (2), the gender of the generic name *Cambarincola* is masculine and it is so treated herein. A list of the required changes in species names is included in another paper (Holt, in press).

Florida: there is no reason to accept this record. Later, utilizing some 75 collections taken by Hobbs, Goodnight (1941) reported the occurrence of four species in the state. Most of his Florida records of *Cambarincola vitreus* Ellis (= *C. osceolai* Hoffman) and his species, *C. floridanus*, are accepted; but his report of *C. philadelphicus* (Leidy) and *C. chirocephalus* Ellis has not been confirmed and their occurrence in this area is not consonant with the known distribution of the two (Hoffman, 1963:349) and I have found specimens of only one Floridian species that even resembles these two closely related ones.

Hoffman (1963) extracted from *C. vitreus* a group of populations of the southern Coastal Plain, extending from the "panhandle" of Florida to "tidewater" Virginia, to which he gave the name *osceola*. This designation is accepted herein, though there are reasons for doubting its validity (see below under *C. osceolai*).

The taxonomic characteristics of the branchiobdellids and methods of handling the material have been discussed several times (cf. Hoffman, 1963, for those of the genus *Cambarincola*; Hobbs et al., 1967; other works of Holt). There is, therefore, little need for further comments herein on these topics except to note that I shall accept Hoffman's (1963:287) view that an undifferentiated prostate is a primitive feature, that in all figures the animals, or separately illustrated parts of them, are so oriented that the anterior portions are to the reader's right and that all measurements, made with an ocular micrometer, are to be regarded as approximations. For the measurements presented, the numbers within parentheses represent the ranges of the measurements on which the preceding average is based and the greatest diameter is always, unless otherwise indicated, that of segment VII.

Much of the material on which this paper is based is deposited in the National Museum of Natural History, Smithsonian Institution, including all holotypes, and such material is identified by the initials "USNM" preceding the catalogue numbers. In all cases, my catalogue numbers are given, identified by the initials "PCH," and material not in the collections of the Smithsonian Institution are housed, under my care, at Virginia Polytechnic Institute and State University.

I am grateful to Mr. and Mrs. Chester A. Mann for the hospitality they extended to me and my wife during our collecting trips in Florida and to Mr. Mann for additional collections; to Mr. and Mrs. John E. Cooper for furnishing me with some valuable collections; to my wife whose aid makes my own collecting possible; and to the other collectors whose names appear in the "Material examined" sections below. To Dr. Horton H. Hobbs, Jr., I owe a triple debt for supplying specimens and furnishing or confirming host identifications and reading the manuscript. My travel for the purpose of collecting branchiobdellids was supported by NSF grants G-4439, G-9828 and GB-372.

ORIGINS OF THE BRANCHIOBDELLIDS OF FLORIDA

In general, the greatest diversity of Amercian branchiobdellids occurs in upland regions: the southern Appalachians, the Ozarks and the mountainous streams of the Pacific drainage. The plains of North America are inhabited, in contrast to their crustacean hosts, by relatively few species of the worms. Florida has over 30 species of crayfishes (Hobbs, 1942; 1958; and other papers), close to a third of which are troglobites; many of which are endemics. On the other hand, seven species of branchiobdellids from Florida are treated herein and a few others, cave dwelling ones, are known (their treatment is reserved for a paper in preparation on branchiobdellids that have been found in caves). Of these, none is known with certainty to be endemic, though it is highly likely that the cavernicolous species and *Cambarincola floridanus*, *C. manni* and *C. goodnighti*, the latter two newly described below, are endemics. The two new species of *Sathodrilus* described herein may be endemics, but since they are from the northern portion of the western panhandle of the state, it is doubtful if they are.

Hobbs (1942; 1958; and elsewhere) has cogently, and in convincing detail, discussed the evolution and history of the crayfishes of Florida. The few known species and the fact that the worms can move readily from one crayfish host to another, precludes any such discussion of the origins of the branchiobdellids of the state. Yet a few tentative conclusions can be proposed.

The ranges and affinities of the species discussed herein are presented below with the treatment of each species. Briefly, these data may be summarized as follows.

Cambarincola manni, although it is related to the wide ranging *C. mesochoreus* Hoffman, has as its closest relative a primitive Mesoamerican species (Holt, in press). Yet it is the most common and wide ranging of Floridian branchiobdellids. One can only assume that its progenitors reached Florida in pre-Pleistocene times, perhaps as early as the Miocene, and survived subsequent inundations of the peninsula (Cooke, 1945:197, 275, 283, 288, 298) on islands or a greatly reduced peninsular area near the present central part of the state (utilizing the ancestral *Procambarus alleni*, a crayfish that according to Hobbs (1967) also has Mesoamerican affinities). After the post-Pleistocene lowering of sea level, it has migrated outward to occupy almost all of peninsular Florida, a territory that is only slightly breached by other species (Fig. 1).

C. goodnighti is another primitive species known only from a region that may have been on or near a body of land that persisted as such throughout the Pleistocene (Cooke, 1945: 275, 283, 288, 293, 298). Possibly, its progenitors survived farther to the northwest, or on one of the possible islands along "Trail Ridge." One cannot know.

The type-locality of *C. floridanus* in Taylor County probably was covered one or more times by interglacial Pleistocene seas, but the other known record of the species from Liberty County is on or near land that probably escaped the fluctuations of the late Cenozoic waters. It is a close relative of *C. philadelphicus* and most likely represents a somewhat modified invader of the *philadelphicus* stock into the Coastal Plain during a Pleistocene glacial advance.

Two species of *Cambarincola* are clearly not endemics. *C. osceolai* ranges widely over the southern Coastal Plain and its presence along the northern border of the "panhandle" of Florida may antedate the Pleistocene and go back to the

Pliocene (Cooke, 1945:112). Its presence in Levy County, however, is indubitably a post-Pleistocene extension of range.

The surprising find of *C. heterognathus* Hoffman in Leon and Calhoun Counties can only confirm the speculations as to the origins of *C. floridanus* and represents relics of a Pleistocene invasion of the Coastal Plain by a species now confined to the uplands of the southern Appalachians.

The two newly discovered species of the genus *Sathodrilus* are closely related and possibly sympatric. Their closest relative is *S. veracruzicus* from northern Veracruz, Mexico, which may have been carried there by the ancestors of the Mexicanus group of the genus *Procambarus*, i.e., by relatives of the postulated hosts of the ancestors of *C. manni* (Hobbs, 1967; Holt, in press). The members of the genus range from South Carolina to southern Mexico and all appear to be primitive. The presence of *S. hortoni* and *S. okaloosae* in the western "panhandle" can tell us little about the history of the genus, but suggests the survival there, and perhaps in southern Mississippi, of members of a genus that originated somewhere in the southern Appalachians or associated uplands and reached southern Mexico before mid-Miocene times (Holt, in press).

The branchiobdellid fauna of Florida is composed of descendants of several waves of invasion. It is dominated by members of the largest genus, and one of the most advanced, of the order. The primitiveness of the most widespread of these species in the state, and the presence of members of the primitive genus *Sathodrilus*, attest to an early invasion of Florida by branchiobdellids and confirm the earlier proposed hypothesis of the antiquity of the genera of the order (Holt, in press). The primitive species of *Cambarincola* survived on islands during the Pleistocene; the more advanced *C. heterognathus* and perhaps *C. floridanus* arrived in the northern parts of the state that were not covered by the interglacial seas during the Pleistocene as refugees from the north; *C. osceolai* may be a post-Pleistocene invader; and *S. hortoni* and *S. okaloosae* are relics persisting near or in their present range since much earlier, perhaps pre-Miocene, times. More one cannot say; there is little need at this time to attempt to correlate these speculations with Hobbs' hypotheses explaining the origins of the crayfish fauna of Florida: the notorious absence of host specificity among these epizoötic worms makes such an effort entirely too complicated for anything beyond the meager speculations that there are parallel relationships between Floridian branchiobdellids and their hosts and those of Mesoamerica discussed above.

Genus *Cambarincola* Ellis, 1912

Astcobdella Leidy, 1851:206.

Branchiobdella.—Moore, 1894:427 (in part).

Bdellodrilus.—Pierantoni, 1912:24 (in part).

Cambarincola Ellis, 1912:481; 1918:51; 1919:25.—Hall, 1914:190.—Stephenson, 1930:801.—Yamaguchi, 1932:454; 1933:191; 1934:189.—Goodnight, 1940:30.—Holt and Hoffman, 1959:97.—Hoffman, 1963:271.—Hobbs et al., 1967:52.—Holt, 1969:197; in press.

Diagnosis: "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 noneversible; bursa subpyriform to obcordate; spermatheca never bifid." (Hobbs et al., 1967:52).

Remarks: Members of the genus *Cambarincola* constitute the dominant portion of the North American branchiobdellid fuana: they are found wherever other branchiobdellids occur on the continent (with the exception of the Great Salt Lake drainage and a few streams of the Coastal and Cascade Ranges of the Pacific drainage). In much of the Central and Coastal Plains they appear to be the only representatives of the order.

KEY TO THE FLORIDIAN SPECIES OF THE GENUS *CAMBARINCOLA*

1	Prostate undifferentiated	4
1′	Prostate differentiated	2
2(1′)	Spermiducal gland reflexed; jaws subequal in size	*Cambarincola osceolai*
2′	Spermiducal gland not reflexed, jaws variable in size	3
3(2′)	Prostate subequal in length to spermiducal gland; jaws subequal in size	*Cambarincola floridanus*
3′	Prostate very short, about one-fourth length of spermiducal gland; upper jaw much larger than lower	*Cambarincola heterognathus*
4(1)	Spermiducal gland reflexed; prostate about one-half length of latter; ental end of prostate composed of nonglandular cells	*Cambarincola goodnighti*
4′	Spermiducal gland not reflexed; prostate subequal in length to latter; ental end of prostate with prostatic bulb	*Cambarincola manni*

Cambarincola manni, new species
Figures 1, 2

Type-specimens: Holotype, nine paratypes, USNM 48700 on *Procambarus fallax* (Hagen) taken from Lake Martha, at 612 E. Lake Martha Drive, Winter Haven, Polk County, by Chester A. Mann, 12 January 1964 (PCH 1793); one paratype, USNM 48701 on *Procambarus fallax* (Hagen) taken from canal between Lake Buckeye and Lake Fanny, Winter Haven, Polk County, by Chester A. Mann and Perry C. Holt, 20 April 1963 (PCH 1663); one paratype, PCH 1670, on *Procambarus fallax* (Hagen) taken from Lake Martha, Winter Haven, Polk County, by Chester A. Mann and Perry C. Holt, 20 April 1963; ten paratypes, PCH 1793, from the type-locality; five paratypes, PCH 1673, on *Procambarus paeninsulanus* (Faxon) taken from slough, 13 miles northwest of Inglis, Levy County, by Perry C. and Virgie F. Holt, 25 April 1963.

Diagnosis: Small branchiobdellids (average length approximately 2.0 mm); anterior segmental annuli of trunk segments not noticeably greater in diameter than posterior ones, though weak supernumerary muscles occur in anterior segments; jaws small, length about 1/15 that of head, dental formula 5/4; bursa pyriform, about 1/3 body diameter in length, penial sheath and bursal atrium subequal in length; ejaculatory duct short; spermiducal gland slender, length approximately 6/7 that of bursa, its diameter about 1/6 its total length, without obvious deferent lobes; prostate undifferentiated, subequal to spermiducal gland in length and diameter, with small clear ental bulb; length of ectal duct of spermatheca slightly greater than 1/2 body diameter, spermathecal bulb globose without ental process.

Etymology: It is a pleasure to dedicate this species to its codiscoverer and my friend, Chester A. Mann, whose enthusiasm for natural history remains undiminished after a life time of its study.

Description: Specimens of *Cambarincola manni* are smaller than those of most of its congeners. The holotype has the following dimensions: total length, 2.1 mm; greatest diameter, 0.3 mm; head length, 0.3 mm; head diameter, 0.2 mm; diameter, segment I, 0.2 mm; diameter, sucker, 0.2 mm. The average dimensions of the holotype and four specimens selected from the type-series at random are as follows: total length, 2.1 mm (1.8–2.3 mm); greatest diameter, 0.3 mm (0.3–0.3 mm); head length, 0.3 mm (0.3–0.4 mm); head diameter, 0.3 mm (0.2–0.3 mm); diameter, segment I, 0.2 mm (0.2–0.3 mm); diameter, sucker, 0.2 mm (0.2–0.2 mm). The animals are, therefore, rather uniform in size and relatively slender.

The lips are entire, without indentations other than the usual lateral ones and there are no detectable oral papillae. My material is well preserved and if these structures were present, they should be readily seen. The peristomial sulcus is not unusually prominent. The head is marked by one other very shallow annular indentation or sulcus and there is only one pharyngeal sulcus.

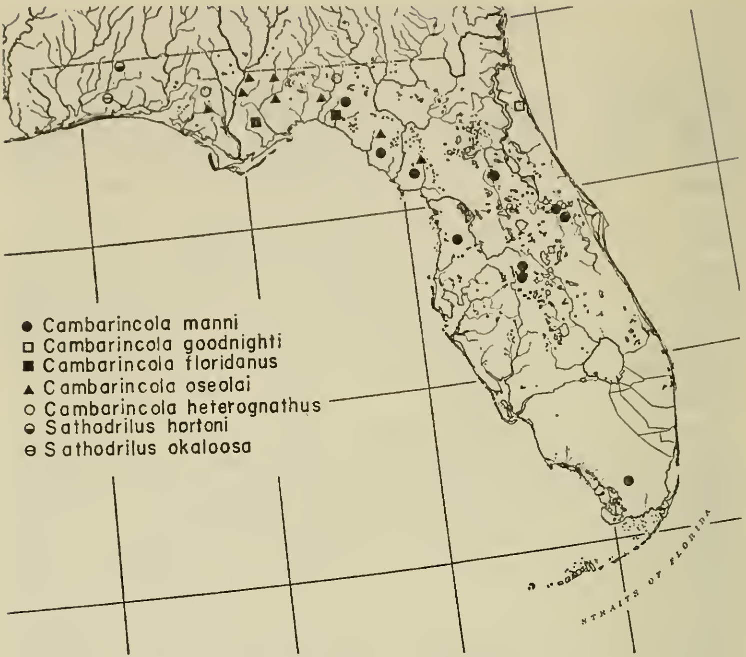

FIG. 1. Known distribution, excepting the doubtful records from Goodnight (1941) (see text, page 80), of the branchiobdellids of Florida.

The body outline is generally smooth, though rather weak or rudimentary supernumerary muscles of the anterior segmental annuli are present in at least the anterior segments and the intersegmental furrows are prominent in some specimens.

The jaws, although somewhat small, are similar to those of other members of the genus that are of overall small body size and possess a 5/4 dental formula. The basal portions are light brown; the sharp pointed and widely spaced teeth are almost colorless.

The size and proportions of the spermiducal gland and prostate are distinctive. The spermiducal gland is unusually slender, though of usual histological appearance. The prostate is subequal in length and diameter to the spermiducal gland, and similar (undifferentiated) to it histologically. A small, clear ental bulb of the prostate is present.

The bursa is proportionately larger than other structures of the male efferent apparatus, is pyriform in shape, with the bursal atrium composing about ½ of its total length, and there is a suggestion in the appearance of the retracted penis (no specimens with the penis protruded have been seen) that it may be of disproportionate length when

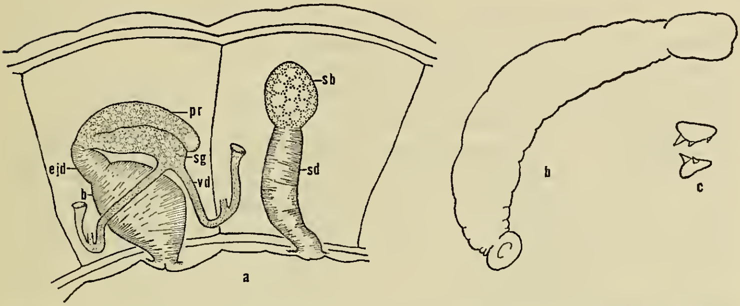

FIG. 2. *Cambarincola manni*, n. sp. *a*, reproductive organs of holotype; *b*, same, lateral view; *c*, same, lateral view of jaws. Abbreviations: *b*, bursa; *ejd*, ejaculatory duct; *pr*, prostate; *sb*, spermathecal bulb; *sd*, spermathecal ectal duct; *sg*, spermiducal gland; *vd*, vas deferens.

protruded, but none that it is eversible. The ejaculatory duct is short, subequal in its length and diameter.

The spermatheca possesses a long ectal duct, its length approximately ⅔ the diameter of segment V. It terminates entally in a relatively small, thin-walled bulb without any evidence of an ental process.

Variation: None, other than in size and the aforementioned prominence of the intersegmental furrows (probably a result of the effect of different fluids used in the collection and preservation of specimens).

Affinities: The relationships of *C. manni* lie with a group of species that have been designated the Mesochoreus section which are characterized by an undifferentiated prostate (which was originally thought to be without an ental bulb [Hoffman, 1963:320]). Among these species only two need to be mentioned. *Cambarincola mesochoreus*, with a rather wide range in the United States (from the Canadian border to southern Louisiana), is a larger worm (2.8–4.2 mm in length) with a much more prominent spermiducal gland and prostate than *C. manni.* It also possesses a "slender, elongate, subfusiform [spermatheca, which] curving dorsolateral around the gut, [expands] laterally, and [is] attenuated to a blunt ental process near the middorsal portion of the segment" (Hoffman, 1963:307–308), as opposed to the globose spermathecal bulb without an ental process in *C. manni.*

A second species which resembles *C. manni* and, indeed, may be its closest relative, is known from Rio Tapalapa and Lake Catemaco in southern Veracruz, Mexico, and Lake Nicaragua in Nicaragua (Holt, in press). This species differs from *C. manni* in the total absence of dorsal ridges, the occurrence of a smaller bursa, a spermiducal gland with a peculiar heavily granulated ental portion, in possessing a prostate which arises farther entad to its junction with the spermiducal gland and in a spermatheca with a shorter ectal duct and an ental process. This would seem to be a formidable list of differences, but in size and overall appearance the two species resemble each other quite closely and the differences are small and subtle, except for the peculiar spermiducal gland of the Mexican–Nicaraguan species.

Hosts: *Procambarus acherontis* (Lönnberg), *P. alleni* (Faxon), *P. fallax* (Hagen), *P. paeninsulanus* (Faxon).

Distribution: *Cambarincola manni* ranges from the Everglades (Monroe County) to the upper part of peninsular Florida (Taylor County) and is probably widespread throughout the peninsula. It is not known from the "panhandle," from which I have the largest number of collections, which suggests that it may be confined to the peninsula and that it may be a pre-Pleistocene relic that survived Pleistocene interglacial times on one of the islands that remained above salt water.

Material examined: Other than the types listed above, six specimens, USNM 48702 on *Procambarus fallax* (Hagen) and *P. paeninsulanus* (Faxon) taken from a roadside stream on U.S. Highway 98, 11.6 miles east of Enconfina River, Taylor County, by Perry C. and Virgie F. Holt, 18 April 1958, (PCH 746); one specimen, USNM 48703, on *Procambarus alleni* (Faxon) taken from Everglades drainage ditch, 2.0 miles east of intersection of State Road 94 on U.S. Highway 41, Monroe County, by Perry C. and Virgie F. Holt, 24 April 1963, (PCH 1671); six specimens, USNM 48704, host unknown, taken from slough 5.0 miles northwest of Brooksville on U.S. Highway 98, Hernando County, by Perry C. and Virgie F. Holt, 25 April 1963, (PCH 1672); four specimens, USNM 48705, host unknown, taken from a slough on U.S. Highway 98, 9.0 miles southeast of Taylor–Dixie County line, Dixie County, by Perry C. and Virgie F. Holt, 25 April 1963, (PCH 1674); twenty specimens, on *P. acherontis* (Lönnberg) taken at Palm Springs, Seminole County, by John E. and Martha R. Cooper, January 1965, (PCH 2373).

Cambarincola goodnighti, new species

Figures 1, 3

Type-specimens: Holotype, USNM 48706, one paratype, USNM 48707, and one paratype, PCH 2607, on *Procambarus fallax* (Hagen), and *P. paeninsulanus* (Faxon) taken 5.6 miles north of St. Augustine, St. John County. (Collector and date unknown.)

Diagnosis: Small branchiobdellids (about 1.7 mm in length), anterior segmental annuli slightly greater in diameter than minor ones (weak supernumerary muscles present, dorsal ridges obscure); jaws small, length less than 1/10 that of head, light brown, dental formula 5/4, lateral teeth of lower jaw small, obscure; bursa about 1/3 body diameter in length, with prominent atrial fold, penial sheath short; ejaculatory duct short, its length subequal to its diameter; spermiducal gland long, slender, bent upon itself, without deferent lobes; prostate undifferentiated, subequal in diameter to that of spermiducal gland, ending entally in thick-walled bulb at level of flexure of latter; spermatheca with very long ectal duct curving dorsally over gut, spermathecal bulb globose, lying on opposite side of gut from ectal duct.

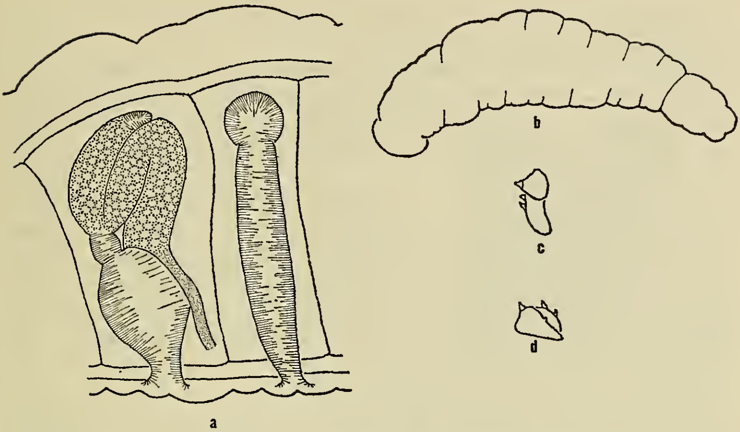

FIG. 3. *Cambarincola goodnighti*, n. sp. *a*, lateral view of reproductive organs of holotype; *b*, same, lateral view; *c*, oblique view of upper jaw; *d*, oblique view of lower jaw.

Etymology: I take pleasure in naming this worm for my friend Clarence J. Goodnight, whose studies of North American branchiobdellids furnished the stimulus for my studies of them.

Description: Specimens of *Cambarincola goodnighti* are rather small worms. The holotype has the following dimensions: total length, 1.7 mm; greatest diameter, 0.4 mm; head length, 0.3 mm; head diameter, 0.2 mm; diameter, segment I, 0.25 mm; diameter, sucker, 0.25 mm. The paratypes are of comparable size and dimensions.

The lips each have median indentations. There are no oral papillae. Two internal pharyngeal sulci are present, the posterior one the smaller. Externally, the head is marked by a prominent sulcus which corresponds in position to the anterior internal one; the peristomial sulcus is likewise prominent and the diameter of the peristomium is noticeably less than the greatest diameter of the head.

The anterior annuli of the body segments are greater in diameter than the posterior ones, but only slightly so: the animals do not present the sawtoothed appearance, in lateral view, of species with prominent dorsal ridges. The anterior nephridiopore is obscure. The clitellum is well developed on segment VII, but less so on VI.

The jaws are not large, subequal in size, distinctly brown, and the dental formula is 5/4. The teeth are not prominent and the lateral teeth of the lower jaw are small and difficult to see.

The spermiducal gland is long, extending beyond the dorsal border of the gut where it is sharply bent upon itself. Its ental end is not marked by deferent lobes and begins at the dorsal apex of the bursa. The prostate, of approximately the same diameter as the spermiducal gland, is undifferentiated and ends entally at the dorsal flexure of the latter in a narrowed and thick-walled bulb.

The bursa is of the rather usual subpyriform shape and is characterized by a prominent atrial fold and a rather short penial sheath. The ejaculatory duct is apparently subequal in diameter and length—not the usual proportions of the organ which is more often a narrower muscular tube.

The spermatheca is rather remarkable. The ectal duct is exceedingly long and in the holotype (Fig. 3b) appears to end entally in a muscular-walled slight enlargement. In reality, as seen from the opposite side and in the paratypes, the ectal duct bends dorsally over the gut and the spermatheca ends approximately mid-laterally on the opposite side in a thin-walled globose bulb that, however, abruptly narrows entally, suggesting the presence of a vestigial ental process.

Variation: None detectable in the type-series.

Affinities: *Cambarincola goodnighti* is a member of the Mesochoreus section of the genus, but differs from other members of the section in that the undifferentiated prostate possesses an ental bulb with a thick wall and an obscure lumen. The spermiducal gland is almost identical to that of *C. vitreus*, *C. osceolai* and a new species (Holt, in press) from the Rio San Juan of the Rio Grande drainage in Nuevo León, Mexico. The Mexican animal lacks an ental bulb of the prostate; *C. vitreus* and its closely allied relative, *C. osceolai*, have differentiated prostates. *C. goodnighti* differs from these species in the structure of the spermatheca: they have a shorter ectal duct and an ovoid or clavate bulb without an ental process. In addition, the prominent external sulcus of the head is absent in the closest relatives of *C. goodnighti*. *Cambarincola goodnighti* is a relatively primitive member of the Mesochoreus section.

Hosts: *Procambarus fallax* (Hagen), *P. paeninsulanus* (Faxon).

Distribution: Known only from the type-locality.

Material examined: The type-series.

Cambarincola floridanus Goodnight, 1941

Figures 1, 4

Cambarincola floridana Goodnight, 1941:73.—Hoffman, 1963:368.
Cambarincola floridanus.—Holt, in press.

Type-specimens: "From Taylor County, Florida, 6.8 miles south of Lamont; collected March 18, 1939, on *Cambarus fallax* Hagen, by H. H. Hobbs [,Jr.,]" (Goodnight, 1941:73). Holotype, USNM 20570.

Diagnosis: (Based on material from Liberty County, Florida.) Medium large branchiobdellids (approximate total length 3.0 mm); anterior annuli of body segments greater in diameter than posterior ones; jaws subequal in size, dark brown, dental formula 5/4; bursa moderately large, ⅓ or more body diameter in length, subpyriform, with prominent atrial fold; spermiducal gland with prominent posterior

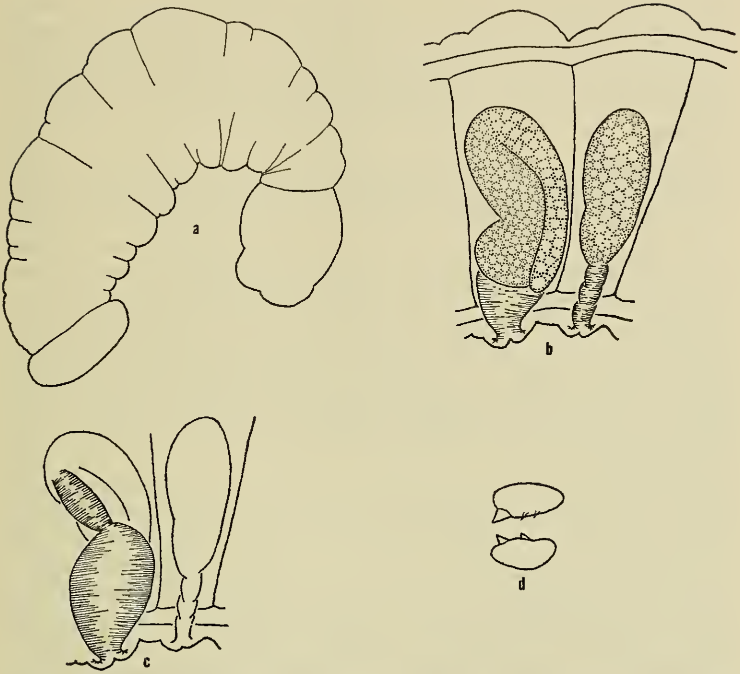

Fig. 4. *Cambarincola floridanus* Goodnight, *a*, lateral view of specimen from Liberty County, Florida; *b*, same, reproductive organs; *c*, same, mesial view of reproductive organs; *d*, same, lateral view of jaws.

deferent lobe, relatively thick, subequal to bursa in length; prostate differentiated, subequal to spermiducal gland in length, with small, obscure ental bulb; spermatheca with clavate to subovate bulb.

Description: Goodnight (1941:73) presented a rather short diagnostic description which includes nothing of value in reference to the reproductive systems, a practice current among students of the branchiobdellids at the time he wrote. Hoffman and I have examined the holotype and both of us have made free-hand sketches of it. "This specimen is mounted laterally, but the reproductive system[s] cannot be made out with certainty" (Hoffman, 1963:368). Since, because of correspondences in the structures that can be seen in it, I am convinced that my specimens are conspecific with Goodnight's holotype, it seems appropriate that I present a description based on these animals.

Specimens of *Cambarincola floridanus* are medium sized members of the genus. Averages of measurements of five mature animals from Liberty County are as follows: total length, 2.8 mm (2.4–3.2 mm) greatest diameter, 0.6 mm (0.5–0.7 mm); head length, 0.4 mm (0.3–0.5 mm); head diameter, 0.3 mm (0.3–0.4 mm); diameter, segment I, 0.3 mm (0.3–0.4 mm); diameter, sucker, 0.4 mm (0.2–0.5 mm). These measurements accord well with those given by Goodnight: "length . . . 2.5–3.0 mm . . . (greatest diameter, segment VI) 0.5 mm" (Goodnight, 1941:73).

The lips have a slight (very difficult to detect in animals mounted laterally) median emargination. There are no detectable oral papillae. The peristomial sulcus is not unusually prominent; there is no external sulcus of the head; internally, there is one prominent pharyngeal sulcus.

The anterior annuli of the trunk segments are slightly greater in diameter than the minor ones, but not so "distinctly and visibly elevated" as Goodnight (1941:73) implies, but more so than my drawing (Fig. 4a) of a somewhat extended and distorted specimen suggests (a specimen chosen for the clarity with which the reproductive systems can be seen); in other words, the supernumerary muscles are present but not strongly developed. The anterior nephridiopore is not prominent, nor is the clitellum.

The jaws, subequal in size and dark brown, are typical of most species of the genus. The dental formula, as noted by Goodnight (1941:73), is 5/4.

The spermiducal gland is subequal to the bursa in length and diameter and ectally appears to bend sharply posteriorad, but I interpret this ectal portion of the gland as a posterior deferent lobe. The organ is large and may lie almost longitudinally oriented dorsal to the gut or variously bent in a lateral position alongside the gut mesal to the bursa. The prostate is about ½ the diameter of the spermiducal gland and subequal to the latter in length. The ental bulb of the prostate is obscure and easily overlooked in most specimens.

The ejaculatory duct is relatively short. The bursa is characterized by its relatively large size, as noted by Hoffman (1963:368), and the disproportionately thick muscular wall of the penial sheath.

The spermatheca has a long, but not unusually so, ectal duct. The bulb is oblong ovate to clavate in mature animals and in some specimens there is a thickening of its ental end that is suggestive of an ental process.

Variation: The variation in size of specimens of *C. floridanus* is no more than usual among most species of the genus. The reproductive organs do show a greater amount of variation. The bursa is rather constant in proportional size and position, but the spermiducal gland appears to differ considerably in shape and position between individuals: a variation I am inclined to ascribe to the large size of the organ and the various positions in the coelom that it may assume. More disturbing is my observation that it possesses a posterior deferent lobe: the vasa deferentia are impossible to trace in my material, or essentially so, thus this lobe could, with a better series of specimens, be shown to be only an ental flexure of the gland as a whole. The spermathecal bulb, as noted above, differs in shape among my specimens; a difference I ascribe to the degree of its distenstion with seminal fluid. But the apparent presence of a rudimentary (or vestigial?) ental process of the bulb in some specimens, and apparent absence in others (which may be due, again, to the greater or lesser amount of seminal fluid present) casts doubt upon the taxonomic usefulness of this feature, if I did not know that it is always present in all specimens of other species of the genus in which it occurs, whatever the degree of sexual maturity of the specimens. Other observed variations are of no significance, since they are the usual ones attributed to differences in position and degree of contraction at death.

Affinities: Goodnight (1941:74) said that "morphologically *Cambarincola floridana* is closely related to *Cambarincola elevata* Goodnight but it differs in the elevation of the major annulations . . . However, since *C. elevata* does not occur in this area it may have evolved from *C. vitrea. C. vitrea* differs both in the structure of the jaws and the lack of any elevation of major annulations." Actually, "*C. elevata*" is not a member of the genus (Holt, unpublished data; Hoffman, 1963: 294) and need not be considered further. *C. vitreus* differs from *C. floridanus*, not only in the characters mentioned by Goodnight, but also in important features of the reproductive systems. Hoffman (1963: 368) was correct in his guess that *C. floridanus* is most closely related to his Philadelphicus section: in truth, *C. floridanus* differs from *C. philadelphicus* most noticeably in the absence of distinct lobation of the lips, the less marked dorsal ridges and in the relatively larger size of the reproductive organs. *C. floridanus* is almost surely the survivor of an early invasion of north Florida by the progenitors of the Philadelphicus section.

Hosts: *Procambarus fallax* (Hagen) [= *Cambarus fallax* (from Goodnight, 1941:73)], *Procambarus spiculifer* (LeConte).

Distribution: Known only from the type-locality and one locality in Liberty County.

Material examined: The holotype, USNM 20570; in addition, 11 specimens, USNM 48708 (PCH 665), on *Procambarus spiculifer* (LeConte) taken 1.6 miles north of Hosford, Liberty County, by H. H. Hobbs, Jr., and C. W. Hart, Jr., 5 September 1955.

Cambarincola osceolai Hoffman, 1963

Figures 1, 5

Cambarincola osceola Hoffman, 1963:330
Cambarincola osceolai.—Holt, in press.

Type-specimens: "Holotype and seven paratypes, USNM 29943, from *Procambarus paeninsulanus* and *Cambarus uhleri* collected along Dry Creek, 3.1 miles north of Iron City, Seminole County, Georgia, by Horton H. Hobbs [,Jr.,] and C. W. Hart, September 9, 1955" (Hoffman, 1963: 330).

Diagnosis: "A small species of the Vitrea group, very similar to the

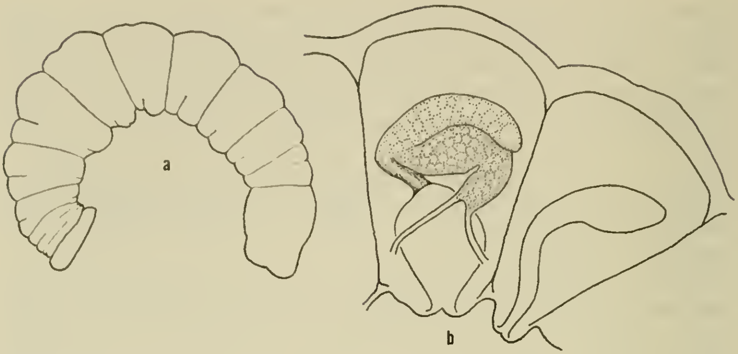

FIG. 5. *Cambarincola osceolai* Hoffman (after Hoffman, 1963). *a*, lateral view of specimen from Calhoun County, South Carolina; *b*, same, reproductive systems.

typical species and possibly a geographic race of it, but differing in the much smaller diameter of the prostate in comparison with that of the spermiducal gland, as well as by differences in the jaw sizes at least in the populations of the two that are geographically most approximate" (Hoffman, 1963:330).

Material examined: In addition to that cited by Hoffman (1963:333, Fig. 31), the following material has been examined: five specimens, USNM 48709, on *Procambarus paeninsulanus* (Faxon) taken from a cypress swamp, 6.0 miles south of Lamont on State Highway 257, Jefferson County, by Perry C. and Virgie F. Holt, 25 April 1963, (PCH 1675); five specimens, USNM 48710, on *Procambarus paeninsulanus* (Faxon) taken 2.0 miles west of Bloxham on State Highway 20, Liberty County, by Perry C. and Virgie F. Holt, 26 April 1963, (PCH 1676); five specimens, USNM 48711, on *Procambarus spiculifer* (LeConte) taken 9.0 miles west of Greensboro, Gadsden County, by Perry C. and Virgie F. Holt, 26 April 1963, (PCH 1677); five specimens, USNM 48711, on *Procambarus spiculifer* (LeConte) taken on U.S. Highway 80 at eastern edge of Quincy, Gadsden County, by Perry C. and Virgie F. Holt, 26 April 1963, (PCH 1678).

Remarks: The description of *Cambarincola osceolai* and its affinities with *C. vitreus* are thoroughly discussed by Hoffman (1963:330–332) and the only thing that needs to be added here is that I share his suspicion that *C. osceolai* is a geographical variant of *C. vitreus*. However, until such time that I can study with more thoroughness specimens from Mississippi and Alabama, I prefer to retain his name for the Florida worms. Both *C. vitreus* and *C. osceolai* are inhabitants of streams of the plains: *C. vitreus* is widespread in the Central Plains of the Mississippi Valley and the Great Lakes region; *C. osceolai* is known from Florida and Georgia to eastern Virginia (Hoffman, 1963:327, Fig. 31).

Both are members of the Philadelphicus section that differ from *C. floridanus* in the smaller and strongly reflexed spermiducal gland. Goodnight's (1941:72–73) records of *C. vitreus* in Florida may be provisionally accepted as records of *C. osceolai* for the northern part of the state, though I have not plotted them in Figure 1. I suspect strongly that many of his records of this species, particularly in the central and southern portions of the peninsula, apply to *C. manni* which is much more widespread and is superficially similar, but differs markedly in reproductive systems (see above, under *C. manni*).

Cambarincola heterognathus Hoffman, 1963

Figures 1, 6

Cambarincola heterognathus Hoffman, 1963:362
Cambarincola heterognathus.—Holt, in press.

Type-specimens: "Holotype and paratype, USNM 29947, from *Cambarus* sp. collected in a tributary to Big Wilson Creek, 4 miles south of Mouth of Wilson on Va. Hy. 16, Grayson County, Virginia, by Horton H. Hobbs, Jr., and C. W. Hart, June 14, 1950" (Hoffman, 1963:362).

Diagnosis: "Immediately recognizable by the remarkably dissimilar jaws alone. In addition, the male reproductive system is reduced in size and the prostate gland is less than half the length of the spermiducal gland" (Hoffman, 1963:362).

Material examined: In addition to that cited by Hoffman (1963: 363–364), eight specimens, USNM 48712, on *Cambarus rogersi rogersi* (Hobbs), taken at Horse Shoe Bay, Leon County, by H. H. Hobbs, Jr., 27 November 1936 (PCH 1795); one specimen, PCH 2719, on *P. rogersi campestris* taken from roadside ditch, 10.3 miles south of Jackson County line on State Highway 71, Calhoun County, by Horton H. Hobbs III, 11 August 1968.

Remarks: The discovery in my collections of a slide labelled "*Cambarincola philadelphica*" in Dr. Hobbs' handwriting that bore a specimen of *C. heterognathus* was most surprising. At my request, Dr. Hobbs searched the original collection of *Cambarus r. rogersi* and found additional specimens that undoubtedly must be assigned to *C. heterognathus*, a species that I long ago recognized as distinct and that is adequately described by my student, Hoffman. The affinities of the species lie with the Philadelphicus section and though species from Mesoamerica (Holt, in press) and the western United States are now known (Holt, unpublished data) to have equally disparate jaws, they are different from those of *C. heterognathus*, and the reproductive systems of all of these species are markedly different and none is closely related to the others.

The previously known range of *C. heterognathus* is a coherent one that is confined to the southern Appalachians (Hoffman, 1963:363, Fig. 74; Holt, 1969:206–207). There can be little doubt that the populations of the species in northern Florida are disjunct and the only plausible

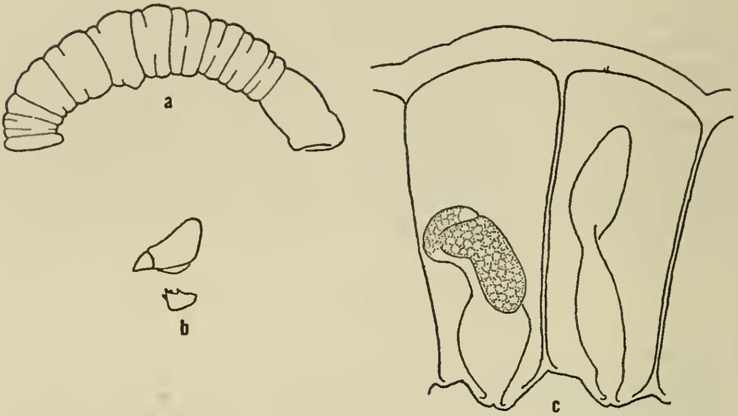

FIG. 6. *Cambarincola heterognathus* Hoffman (after Hoffman, 1963). *a*, lateral view of paratype; *b*, same, jaws in lateral view; *c*, same, reproductive organs.

explanation is that they are relics of an invasion during a Pleistocene glaciation. The two localities from which *C. heterognathus* is known lie on opposite sides of the Apalachicola bluff area. A number of other disjunct species of plants and animals of Appalachian origin are found in this region. It is possible that *C. heterognathus* is at least a facultative inhabitant of the gill chambers of its hosts and, if this is so, the fact that its Floridian host is a burrowing crayfish would aid its survival in an area now so unlike its ancestral home in the Appalachians.

Genus *Sathodrilus* Holt, 1968

Sathodrilus Holt, 1968:294.

Diagnosis: "Medium sized branchiobdellid worms (known species 1.5 to 4.6 mm in average length) with two pairs of testes; unpaired nephridiopore on dorsum of segment III; body terete, without peristomal tentacles or dorsal projections on trunk segments; spermiducal gland with vasa deferentia entering entally; prostate, if present, consisting of bulb-like prostatic protuberance on anterior or dorsal border of spermiducal gland; ejaculatory duct present; penis eversible, but attached by cytoplasmic strands to inner wall of penial sheath and without cuticular hooks; spermatheca with or without ental process" (Holt, 1968:294).

Remarks: The two new species of *Sathodrilus* described below are geographically intermediate between the previously recorded localities from which the genus is known in South Carolina, northern Georgia, and Mexico (the latter with species on both sides of the ancient, mid-Miocene, Cordillera Volcánico Transversal). They do not, however, invalidate the previous conclusion (Holt, 1968:295) that the genus is a relatively primitive one. These species and those previously described, must be considered as phylogenetic relics of a stock once much more common and widespread.

A key to the species cannot be presented herein because of the danger of creating nomina nuda, but a comparison of the following diagnoses with those in Holt (1968; in press [Mexican species]) will readily separate all the known species of the genus.

Sathodrilus hortoni, new species

Figures 1, 7

Type-specimens: Holotype, USNM 48713, two paratypes, USNM 48714, two paratypes, PCH 2716, on *Cambarus d. diogenes* Girard and *Cambarus* sp. Hobbs taken from Pond Creek 2.1 miles northeast of Laurel Hill, Okaloosa County, 10 August 1968, by H. H. Hobbs III.

Diagnosis: Medium sized branchiobdellids (holotype 2.2 mm in length); only first two and last three body segments with detectable annuli; jaws small, approximately 1⁄12 length of head, medium brown, dental formula 5/4, lateral teeth very small; bursa elongate, about 1⁄7 body diameter in length, bent posteriorad under gut; ejaculatory duct short; spermiducal gland slightly longer than bursa, its diameter about 1⁄13 its length; histologically homogeneous; prostatic protuberance absent; spermatheca with distinct spermathecal bursa; spermathecal bulb narrowed, elongated, thick walled.

Etymology: It is with pleasure that I name this species for the son of my mentor, Horton H. Hobbs III, its discoverer.

Description: *Sathodrilus hortoni* is composed of medium sized worms. The holotype has the following dimensions: total length, 2.2 mm; greatest diameter (segment VI), 0.5 mm; head length, 0.3 mm; head diameter, 0.2 mm; diameter, segment I, 0.25 mm; diameter, sucker, 0.25 mm. The average dimensions of the type-series are as follows: total length, 2.7 mm (2.2–3.4 mm); greatest diameter (segment VI), 0.5 mm; head length, 0.3 mm (0.3–0.3 mm); head diameter, 0.2 mm (0.2–0.2 mm); diameter, segment I, 0.25 mm (0.2–0.3 mm); diameter, sucker, 0.2 mm (0.2–0.25 mm).

The upper lip is divided into four very indistinct lobes that are not apparent under the lower powers of the microscopes; the lower, separated by deep but broad indentations from the upper, is entire. No oral papillae are detectable. The peristomial sulcus is shallow and there are no other external furrows of the head. Internally, other than that in which the jaws lie, there is one prominent anterior sulcus and another smaller posterior one.

The first two body segments are longitudinally compressed and only with difficulty can they be seen to be composed of two annuli each and both are filled with muscles that are attached to the gut producing an "oesophagus." Segment VIII and succeeding ones to the sucker are normal in appearance. Segments III–VII show no external or internal signs of being divided into annuli. The body cavities of these

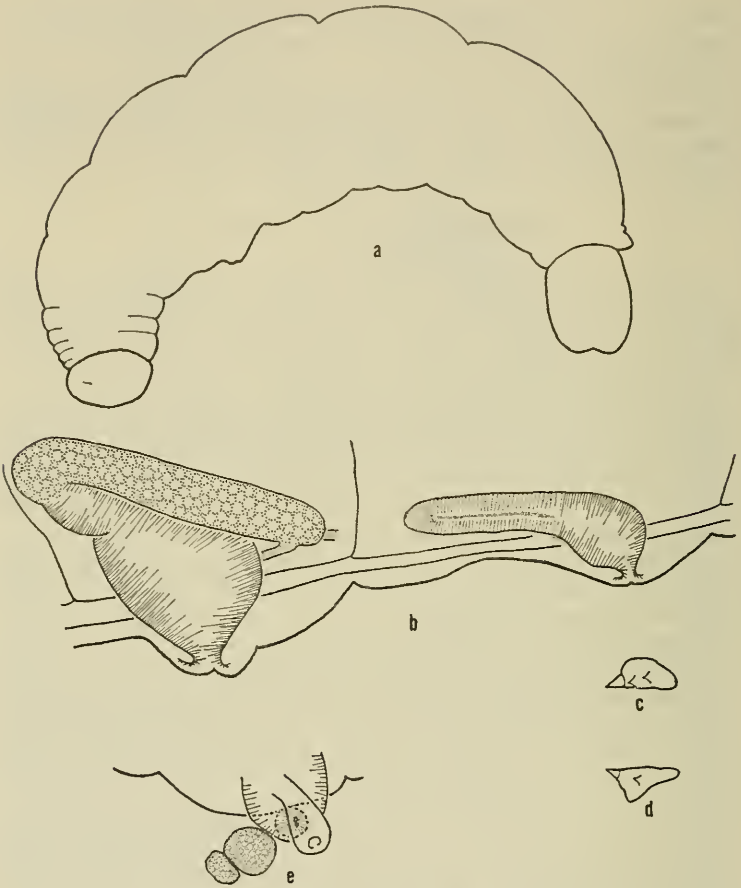

FIG. 7. *Sathodrilus hortoni*, n. sp. *a*, lateral view of holotype; *b*, same, reproductive organs; *c*, same, upper jaw; *d*, same, lower jaw; *e*, everted portions of male system (see text).

segments are distended by the gut which is filled with a yellowish material composed mostly of what appear to be globules of fat (I have never before seen material similar to this in any branchiobdellid and have no idea as to what it may be). The body wall is exceedingly thin, thinner than in any branchiobdellid known to me. The nephridiopore can be seen in its usual position, but is insignificant in size and the anterior nephridia are apparently reduced and pressed between the gut and body wall in such a way that they cannot be discerned in whole mounts of the worms.

The jaws are small, medium brown, with a dental formula of 5/4; the lateral teeth are small and indistinct.

The slender spermiducal gland lacks any detectable evidence of the presence of a prostatic protuberance or of any differentiated regions. The vasa deferentia and the male funnels cannot be seen in my material and only with difficulty can a very few clumps of spermatozoa be seen to lie in the all but obliterated space between the gut and body wall of segments V and VI.

The bursa is elongate ovoid in shape and there is little indication externally of its division into penial sheath and atrial portions. A series of zig-zag transverse folds in the penial sheath indicates that the penis is eversible. Its cuticular inner lining (when everted) appears to be attached by cytoplasmic strands to the inner wall of the penial sheath. The atrial portion of the bursa is also eversible. A specimen (Fig. 7e) from which the male reproductive system seems to have been mechanically squeezed confirms, somewhat uncertainly, these comments. The penis is an everted, cuticular tube, the bursa is also everted, but the spermiducal gland is lying, at least partially, outside the body and this cannot be the normal copulatory position of this organ. In animals with the penis retracted, both the spermiducal gland and bursa are compressed underneath the gut and hardly extend dorsad beyond the latter's ventral border.

The ejaculatory duct (Fig. 7b) is short and thick.

The spermatheca is, to my knowledge, unique among the branchiobdellids. The spermathecal pore opens immediately into a thick-walled, subglobose spermathecal bursa (Holt, 1960:64) which passes entally into a narrow, thick-walled, blindly ending tube. This tube resembles the ental process of the spermatheca of other species but it appears, however, to contain spermatozoa, which, if true, means that it is homologous to the spermathecal bulb of other branchiobdellids.

Variation: None of note.

Affinities: See below, p. 101.

Hosts: *Cambarus d. diogenes* (Girard), *C.* sp.

Distribution: Known only from the type-locality.

Material examined: The type-series.

Sathodrilus okaloosae, new species

Figures 1–8

Type-specimens: Holotype, USNM 48715, five paratypes, USNM 48716, two paratypes, PCH 2720, on *Procambarus evermani* (Faxon) and *P. versutus* (Hagen), taken 1.0 mile east of Santa Rosa County line on U.S. Highway 90, Okaloosa County, 12 August 1968, by Horton H. Hobbs III.

Diagnosis: Small branchiobdellids (average length of type-series, 1.5 mm); with dorsal ridges on major annulations; jaws dark brown, teeth reflexed posteriorad, dental formula 1/4 (?3/4); bursa about ⅔ body diameter in length, lessening in diameter towards apex, penial sheath

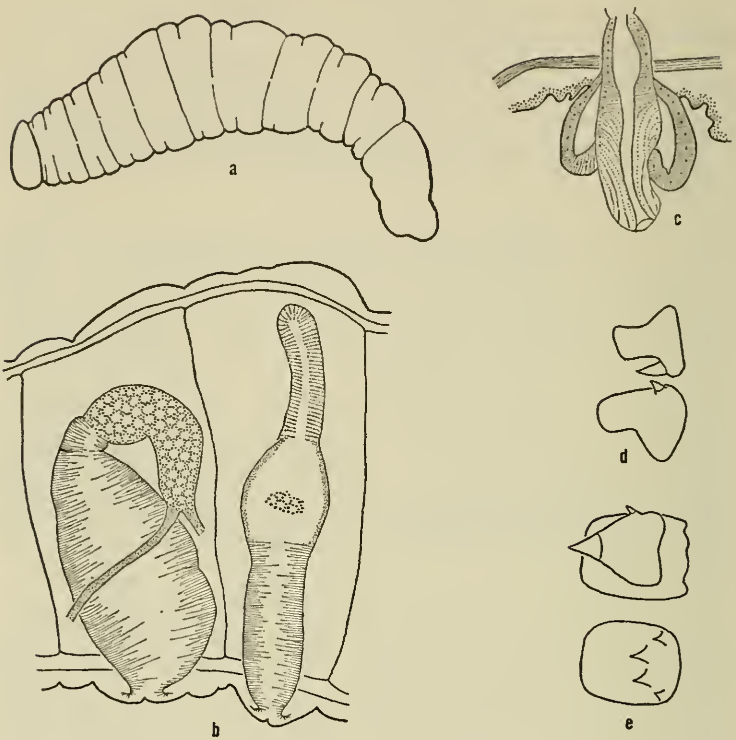

FIG. 8. *Sathodrilus okaloosae*, n. sp. *a*, lateral view of holotype; *b*, same, reproductive organs; *c*, everted penis of paratype; *d*, lateral view of jaws of holotype; *e*, *en face* view of jaws of paratype.

approximately ½ total length, atrial fold prominent; ejaculatory duct short, thick; spermiducal gland short, about ⅔ length of bursa, bent ventrad at midlength, no prostatic protuberance, no deferent lobes; spermatheca long, with ental end reaching dorsal border of segment, ectal duct long, ental process long, shorter median bulb only slightly greater in diameter than ectal duct.

Etymology: For Okaloosa County, Florida, within which is the type-locality.

Description: Specimens of *Sathodrilus okaloosae* are small worms. The holotype has the following dimensions: total length, 1.6 mm; greatest diameter (segment VI), 0.3 mm; head length, 0.3 mm; head diameter, 0.2 mm; diameter, segment I, 0.2 mm; diameter, sucker, 0.2 mm. The average dimensions of the holotype and four paratypes are as follows: total length, 1.5 mm (1.1–1.9); greatest diameter, 0.2 mm

(0.2–0.3 mm); head length, 0.3 mm (0.3–0.4 mm); head diameter, 0.2 mm (0.2–0.2 mm); diameter, segment I, 0.2 mm (0.15–0.2 mm); diameter sucker, 0.2 mm (0.15–0.2 mm).

The lips are entire, the upper distinctly longer than the lower. There are no oral papillae. Externally there is a faint, shallow sulcus which corresponds to one prominent internal one.

The trunk segments are distinct; the anterior (major) annuli bear relatively low dorsal ridges. The state of preservation is such that one can only guess at the position of the anterior nephridiopore; presumably it is in the usual middorsal position on segment III.

The jaws are peculiar and diagnostic. They consist of rather broad and thick rectangular plates that bear a raised ridge anteriorly on which the teeth are set. Most unusually, although the teeth point posteriorad in all branchiobdellids, the tooth bearing ridge and the teeth of S. *okaloosae* are bent backward in a very distinctive manner (Figs. 8d, e). The upper jaw bears one very large tooth, and in one paratype a small lateral one is present on one side; I cannot determine in my material whether the normal dental formula is 1/4 (which it appears to be) or 3/4 (which I think is more likely). The dental ridge of the lower jaw is not so highly elevated as that of the upper one, but the four teeth, subequal in size, that it bears are as sharply reflexed. Both jaws are dark brown and massive in appearance, though their anterioposterior dimension is only about 1⁄7 that of the head.

The spermiducal gland is not well preserved in the holotype, the specimen in which it is best seen, but it appears to be of usual histology, lacks any sign of a prostate, lies high in its segment, runs a short distance anteriorad from its junction with the ejaculatory duct, bends ventrad, and is formed entally by the closely placed union of the vasa deferentia at approximately the midlength of the bursa.

The bursa is elongate ovoid, with a slight constriction demarcating the penial sheath and atrium. The penial sheath composes about ⅔ of the organ and the eversibility of the penis is indicated internally by transverse folds. There is a heavily muscular atrial fold. In two of the paratypes the penis is everted (Fig. 8c) and its eversible nature is clear, with thin cytoplasmic strands connecting its inner cuticular lining to its outer wall and the ejaculatory duct. The latter is short, thick and heavily muscular.

The spermatheca is distinctive. It is composed of a long muscular ectal duct, a median thin-walled portion that contains a small quantity of spermatozoa and a long ental process that is subequal to the ectal duct in length and of indeterminate nature (muscular or glandular).

Variation: None that can be discerned in the type-series.

Affinities: The absence of a prostatic protuberance allies *Sathodrilus okaloosae* with S. *veracruzicus* and S. *hortoni* from both of which it is otherwise quite different. Only S. *megadenus* and S. *hortoni* have ental processes of the spermatheca. S. *hortoni* has a spermathecal bursa and is unique in this respect. Both S. *hortoni* and S. *okaloosae* have bursae and penes that are similar to those of *S. carolinensis.* The jaws of *S. hortoni* are similar to those of other species of the genus; those of *S. okaloosae* are distinctly different from those of any branchiobdellid known to me. The presence of ental processes of the spermatheca and the absence of a prostatic protuberance relate the two species from Florida more closely to each other than either is related to other members of the genus. Their nearest relative seems to be *S. veracruzicus.*

Hosts: *Procambarus evermanni* (Faxon), *P. versutus* (Hagen).

Distribution: Known only from the type-locality.

Material examined: The type-series.

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PROCEEDINGS
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A HUGE NEW XENOSAURID LIZARD FROM THE UPPER MIOCENE OF NEBRASKA

By J. Alan Holman
*Museum, Michigan State University,
East Lansing 48823*

A recent collection of fossils from the well-studied Norden Bridge local fauna (Upper Miocene) of Brown County, Nebraska, yielded the dorsal portion of the skull of an unexpected reptile, a very large xenosaurid lizard, *Nordenosaurus magnus*, new genus and species, with a probable snout–vent length of over 265 mm, and a probable total-length of over 530 mm. The fossil is assigned to the family Xenosauridae on the basis of a combination of characters unique to the family, including fused frontals, cranial sculpturing caused by the co-ossification of cranial osteoderms with each other and with the underlying bones, and the lack of expansion of the frontals anterior to the orbital emargination. But the fossil is not closely related to any fossil or living xenosaurid, thus it is assigned to a new subfamily, the Nordenosaurinae. It is suggested that the rarity of this strange form in the fossil record might be due to the possible arboreal habits of the lizard.

I here thank the members of the 1971 Michigan State University field party for their steadfast work in collecting fossils in Nebraska. I also thank Morris F. Skinner of the American Museum of Natural History for his aid in the field as well as for his helpful comments about the Tertiary stratigraphy of north-central Nebraska. The 1971 field work was supported in part by Grant Number 6034 of the Penrose Fund of the American Philosophical Society and in part by Grant Number 1459-71 of the Geological Society of America. Donna Rae Holman made the drawings.

THE FOSSIL SITE

Much collecting during the 1960's at the Norden Bridge local fauna (Upper Miocene) of Brown County, Nebraska, produced so many fossils representing poikilothermous vertebrates that a rash of papers appeared on fishes (Smith, 1962), amphibians (Tihen and Chantell, 1963; Chantell, 1964; Estes and Tihen, 1964; Chantell, 1966; and Meszoely, 1966), and reptiles (Estes and Tihen, 1964; Holman, 1964; and Meszoely, 1970). Thus, it might appear that the coldblooded fauna was well documented, and that continued collecting at the Norden Bridge site might produce diminishing returns. But in 1971, a small collection made at the Norden Bridge site by a Michigan State University Museum field party, yielded the remains of the startling new reptile.

The site lies in Brown County, Nebraska, near the Norden-Johnstown Road, about 300 yards south of the Norden Bridge across the Niobrara River at an elevation of 2170 feet in the SE ¼, SW ¼ of Sect. 33, T 33 N, R 23 W, Brown County, Nebraska. In July and August 1971, a collecting party from the Museum, Michigan State University led by J. A. Holman and consisting of George Cutts, Christopher King, Dan and Jane Lyons, and Robert Weigel, collected vertebrate fossils from sites which lie in what is presently known as the lower part of the Valentine Formation. The party processed 35 tons of matrix from a site designated the Egelhoff local fauna on the north side of the Norden Bridge in Keya Paha County, Nebraska, and processed a 5 ton sample of matrix from the classic Norden Bridge local fauna on the south side of the Norden Bridge in Brown County. This collecting was done mainly to document previous records, thus the party was surprised to find several noteworthy amphibians and reptiles as well as the huge xenosaurid lizard, by far the most interesting lower vertebrate thus far recorded from the fauna.

The Norden Bridge local fauna beds are presently undergoing stratigraphic revision and they represent a heretofore unnamed lithologic unit whose mammalian remains indicate Barstovian (Upper Miocene) as well as Clarendonian (Lower Pliocene) relationships (Morris F. Skinner, personal communication, November 1972). I consider the Norden Bridge

TABLE 1.—Classification and distribution of Xenosauridae (modified from McDowell and Bogert, 1954)

Family Xenosauridae	Upper Cretaceous to Recent
Subfamily Melanosaurinae	
Genus *Melanosaurus*	Lower Eocene, Wyoming
Subfamily Shinisaurinae	
Genus *Exostinus*	Upper Cretaceous to Middle Oligocene, Western North America
Genus *Necrosaurus*	Middle Eocene, Europe
Genus *Shinisaurus*	Recent, Southern China
Subfamily Nordenosaurinae	
Genus *Nordenosaurus*	Upper Miocene, Nebraska
Subfamily Xenosaurinae	
Genus *Xenosaurus*	Recent, Mexico to Guatemala

site as well as the Egelhoff site to represent Upper Miocene rather than Lower Pliocene times based on the presence of boid snakes and archaic colubrid snake genera that are absent from well-known Upper Pliocene (Clarendonian) herpetofaunas in the Great Plains (Holman, 1972, paper given at Society of Vertebrate Paleontology Meetings, Lincoln, Nebraska).

FAMILY XENOSAURIDAE

The fossil is assigned to the family Xenosauridae (Table 1) on the basis of (1) the fused frontals, (2) the co-ossification of the cranial osteoderms with each other as well as with the underlying bones producing a sculpturing that is characteristic of the Xenosauridae as compared with the Anguidae, and (3) the lack of anterior expansion of the frontals anterior to the orbital emargination.

Nordenosaurinae, new subfamily

Diagnosis: Very large lizards of the family Xenosauridae with the skull very narrow in the interorbital region; with the anterior edge of the fused frontals straight; and with a cranial sculpturing of round pits interspersed among irregular ridges.

Nordenosaurus, new genus

Diagnosis: *Nordenosaurus* may be separated from the living genera *Xenosaurus* and *Shinisaurus* on the basis of the deep rounded pits in the cranial sculpturing which are lacking in the latter two genera. Moreover, *Nordenosaurus* has the anterior edge of the fused frontals straight, whereas in *Xenosaurus* and *Shinisaurus* this edge is deeply incised.

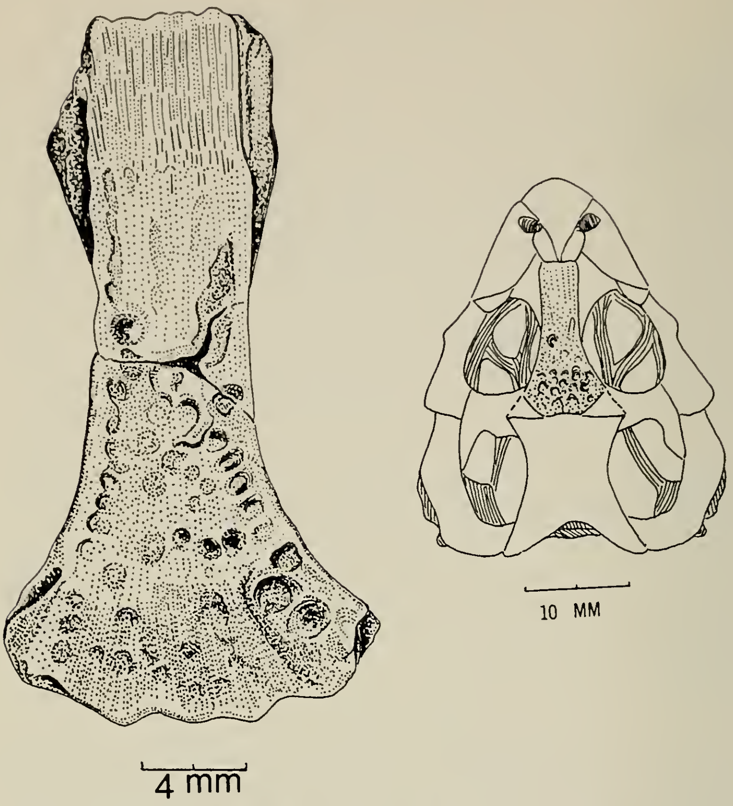

Fig. 1. Left, *Nordenosaurus magnus*, new genus and species; holotype, MSU-VP-715, dorsal portion of skull consisting of fused frontals, dorsal view. Right, reconstruction of skull of *Nordenosaurus magnus* (based on a Recent *Xenosaurus grandis* skull) to indicate the size of *N. magnus*; stippled area represents actual fossil.

Finally, *Nordenosaurus* is a much larger lizard than either *Xenosaurus* or *Shinisaurus*.

Nordenosaurus may be separated from *Exostinus* of the Upper Cretaceous, Upper Paleocene, and Middle Oligocene of western North America on the basis of the much larger size of *Nordenosaurus* and the lack of a knobbed sculpturing of the cranial bones in *Nordenosaurus*. *Nordenosaurus* may be separated from *Melanosaurus* of the Lower Eocene of Wyoming on the basis of the narrow interorbital region of the skull of *Nordenosaurus* (narrowest interorbital distance into length of frontals more than two times in *Nordenosaurus*, less than two times in

TABLE 2.—Measurements (mm) of *Nordenosaurus magnus* compared with adult *Xenosaurus grandis*

	Nordenosaurus		*Xenosaurus*	
Greatest length of fused frontals	actual	28.0	actual	12.5
Head length	estimated	66.3	actual	29.6
Head width	estimated	49.3	actual	22.0
Snout–vent length	estimated	265.2	actual	118.4
Total length	estimated	530.4	actual	236.8

Melanosaurus). Moreover, in *Nordenosaurus* the cranial sculpturing is produced by rounded pits and irregular ridges, in *Melanosaurus* the sculpturing is produced by a fine tuberculation.

Nordenosaurus magnus, new species

Holotype: Dorsal portion of a skull consisting of the fused frontal bones, Michigan State University, Museum, Vertebrate Paleontology Number 715 (Fig. 1).

Referred bones: Two fragments of skull bones, MSU-VP-716.

Type-locality: Norden Bridge local fauna (Upper Miocene) of Brown County, Nebraska. Near the Norden-Johnstown Road, about 300 yards south of the bridge across the Niobrara River in the SE ¼, SW ¼, of Sect. 33, T. 33 N, R. 23 W, Brown County, Nebraska.

Diagnosis: As for the genus.

Description of the holotype: The holotype, MSU-VP-715 represents the dorsal portion of a skull, consisting of a pair of fused frontal bones. The fossil is 28 mm long and it is 12.5 mm wide through the interorbital region. In dorsal view, the sculpturing on the posterior half of the fossil is more pronounced than it is on the anterior half where on the last few millimeters the sculpturing becomes a series of thin, anteroposteriorly directed parallel ridges or striae. The main sculpture pattern consists of rounded pits, some larger and deeper than others, with these pits being interspersed among irregular ridges. Some of the larger pits on the posterior part of the bone are over 1 mm in diameter. The fossil is widest at the posterior end where it measures 15 mm and it is narrowest in the interorbital region where it measures 12.5 mm. The width at the anterior end is 13.5 mm. The anterior edge of the fossil is straight. Along each side of about the anterior one-third of the bone the articular surfaces for the prefrontals are produced laterally beyond the dorsal rims of the orbits.

In lateral view, there is a pronounced supraorbital shelf that runs the full length of the fossil. Below the supraorbital shelf occupying about the anterior one-half of the lateral surface of the fossil is a deep groove for the insertion of the prefrontal articular processes. Below this groove are ridges and pits that produce a sculptured surface. The diameter of

FIG. 2. Photograph of living *Xenosaurus grandis* from Cuautlapan, Veracruz, Mexico, to show the cranial tuberculation that produces the sculpture pattern on the skull bones of the Xenosauridae.

the orbit appears to have been about 15 or 16 mm. The notch for the reception of the postfrontal at the posterior end of the fossil is much less excavated than the notch for the prefrontal.

In ventral view, the most obvious features are the ventrally extending ridges forming the lateral borders of the cranial cavity. At the middle of the fossil these ridges come within 3 mm of each other. It is interesting to note that the entire ventral surface of the fossil is sculptured, but not as strongly as the dorsal surface.

Estimated size of the lizard: Assuming that *Nordenosaurus* had body proportions (Table 2) somewhat like a Recent *Xenosaurus grandis* from Cuautlapan, Veracruz, Mexico, estimated measurements of the fossil lizard are as follows: head length, 66.3 mm; head width, 49.3 mm; snout to vent length, 265.2 mm; total length, 530.4 mm. The fossil was a large, powerful lizard, a veritable giant compared with living *Xenosaurus* and *Shinisaurus.*

DISCUSSION

The occurrence of a very large xenosaurid lizard as a part of the Norden Bridge herpetofaunal assemblage is quite unexpected. The amphibian fauna of the Norden Bridge site is rather drab, with many forms referred to living species and all genera being extant ones, with the exception of the large salamander *Andrias*. The previously de-

TABLE 3.—Distribution of American Fossil Xenosauridae

Age and locality	Taxon	Latest Reference
Upper Cretaceous, Lance Formation, Wyoming	*Exostinus lancensis* Gilmore	Estes, 1964
Upper Paleocene, Polecat Bench Formation, Wyoming	*Exostinus rugosus* Gilmore	Estes, 1965
Lower Eocene, "Wasatch Formation," Wyoming	*Melanosaurus maximus* Gilmore	McDowell and Bogert, 1954
Middle Oligocene, White River Series, Colorado	*Exostinus serratus* Cope	Estes, 1965
Upper Miocene, lithic unit to be named, Nebraska	*Nordenosaurus magnus* Holman	This paper

scribed reptile fauna is a little more interesting as giant tortoises, small boid snakes, and some archaic colubrid snake genera are present; but nothing as bizarre as the large xenosaurid lizard has heretofore been reported from the coldblooded fauna of the site.

Possible ecological role of Nordenosaurus: Today only two living genera, each in a monotypic subfamily, represent the family Xenosauridae; *Xenosaurus* (Fig. 2), which ranges from Mexico to Guatemala and is represented by three species, *X. grandis*, *X. newmanorum*, and *X. platyceps* (King and Thompson, 1968) and *Shinisaurus* which is known only from the mountainous Yaoshan region of eastern Kwangsi in southern China and is represented by one species, *S. crocodilurus*. *Shinisaurus* is said to live along streams and to feed partly upon tadpoles and fish, but beyond this nothing much is known about its habits. The food habits of *Xenosaurus* are not known, although King and Thompson (1968) presume they feed mainly on soft-bodied invertebrates, particularly arthropods. I kept a living *Xenosaurus grandis* from Cuautlapan, Veracruz, Mexico, in captivity for almost 2 years, and I found that when kept at a warm temperature the lizard was rather aggressive and would feed upon a variety of small animals, including large cockroaches (*Nauphoeta*) and small mice (*Mus musculus*). The jaws were very strong and the lizard could produce a painful bite that would break the skin of an adult human hand.

Therefore, considering its large size, *Nordenosaurus* must have been an important predator on small vertebrates, eating smaller lizards, snakes, small mammals, and possibly birds and their eggs.

One modern form, *Xenosaurus grandis arboreus* from the Isthmus of Tehuantepec in Mexico is arboreal and lives in tree-holes in standing trees (Lynch and Smith, 1965). If indeed *Nordenosaurus* was arboreal, this would suggest a reason why this large form is represented in the geological record by only one fossil; for it is axiomatic that arboreal forms such as birds and primates are among the rarest of vertebrate fossils.

Phylogenetic relationships: Other than the unquestionable assignment of *Nordenosaurus* to the family Xenosauridae, it is difficult to suggest its relationships to living forms or to fossil forms (Table 3). *Nordenosaurus* is about as large as *Melanosaurus* of the Lower Eocene of Wyoming, but it differs from this form in strong characters (see diagnosis). *Nordenosaurus* is much larger and differs in strong characters from the Cretaceous and early Tertiary American genus *Exostinus* and the living genera *Xenosaurus* and *Shinisaurus*. Thus I have assigned the Nebraska fossil genus to a subfamily of its own, the Nordenosaurinae, and I suggest it was a dead-end form with no living relatives.

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PROCEEDINGS
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HARPIOSQUILLA INTERMEDIA, A NEW STOMATOPOD CRUSTACEAN FROM NEW CALEDONIA

By Raymond B. Manning and Alain Michel
Smithsonian Institution, Washington, D.C. 20560,
and O.R.S.T.O.M., Centre de Noumea, New Caledonia

The stomatopod described below was collected by one of us (A.M.) in the course of field work carried out as part of a long-range study of the stomatopods of the Central Pacific Ocean. Inasmuch as our planned study of the adults will be delayed for some time, we decided to prepare a preliminary description of the new species.

We thank Lilly K. Manning for the illustrations.

Harpiosquilla intermedia, new species

Figures 1, 2*b*

Material: 2 ♂, 160–200 mm; 2 ♀, 208–209 mm; Baie de Ducos, New Caledonia; mud bottom, 6 meters; December 1970; A. Michel: ♂, 200 mm, is holotype, USNM 141791; ♀, 209 mm, is paratype, USNM 141792; other two specimens deposited at the O.R.S.T.O.M. Centre de Noumea, New Caledonia.

Description: Size large, total length of 200 mm or more. Antennular peduncle slightly shorter than carapace. Cornea (Fig. 2*b*) large, corneal indices 275 to 346 in specimens with carapace lengths of 33.0 mm to 44.3 mm, respectively. Rostral plate (Fig. 1*a*) longer than broad, apex rounded, lacking apical projection. Carapace with median carina. Dactylus of claw with 8 teeth, outer margin with obtuse prominence in males. Upper margin of propodus of claw with 1 or 2 smaller spines and several minute denticles between largest spines. Fifth thoracic somite rounded laterally (Fig. 1*b*). Posterior 3 thoracic somites with submedian and intermediate carinae, none armed. Ventral keel of eighth thoracic somite broadly rounded. All 6 abdominal somites with submedian carinae, abdominal carinae spined as follows: submedian 6, intermediate 2–6, lateral 1–6, marginal 1–5. Median carina of telson inflated in males, marginal carina of telson (Fig. 1*c*) about twice as long as

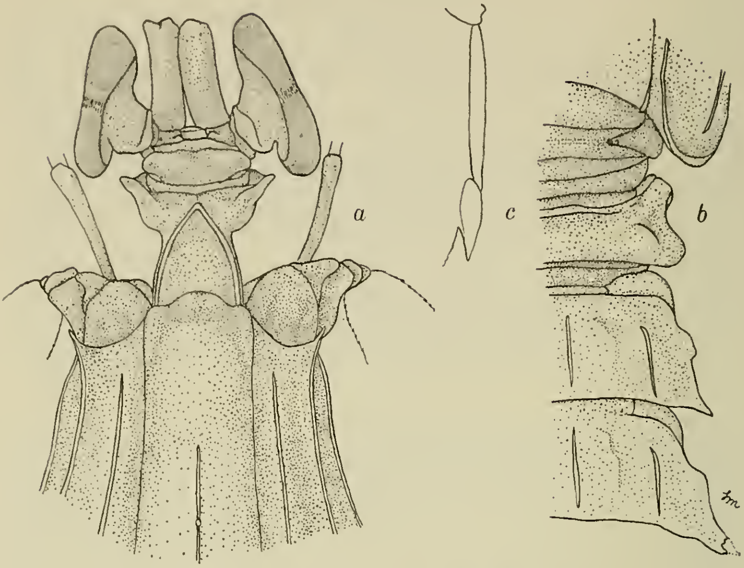

FIG. 1. *Harpiosquilla intermedia*, new species, male holotype: *a*, anterior portion of body; *b*, lateral processes of exposed thoracic somites; *c*, outline of lateral and marginal carinae of telson.

lateral carina. Postanal keel of telson extending about halfway from anus to posterior margin. Inner half of distal segment of uropodal exopod dark.

Color: Anterior margins of lateral plates, median posterior margin, and carinae and grooves of carapace lined with dark pigment. Propodus of claw with dark distal spot. Posterior 3 thoracic and all abdominal somites with dark posterior line. Submedian and intermediate carinae of carapace dark. Telson with pair of small, oval black spots anteriorly. Distal segment of uropodal exopod with inner half dark, distal half of endopod dark.

General aspect of living specimens whitish yellow. Propodus of claw with yellowish distal spot. Carinae and posterior margin of posterior 3 thoracic and all abdominal somites olive green. Telson with median, lateral, and marginal carinae olive green, with pair of oval black spots anteriorly, and with series of minute black spots posteriorly convergent on each side of median carina. Distal segment of uropodal exopod with inner half olive green and outer half light blue, distal half of basal prolongation and endopod olive green.

Measurements: Male holotype, total length 200 mm: carapace length 39.4 mm; cornea width 12.3 mm; rostral plate length 6.8 mm, width

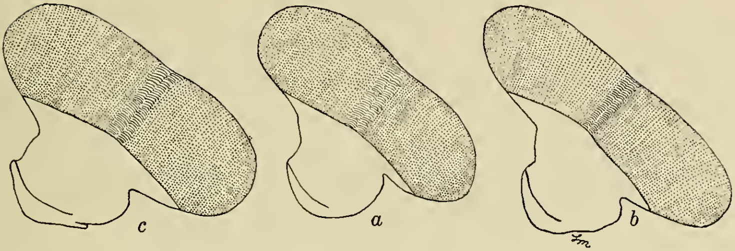

FIG. 2. Eyes of: *a*, *H. japonica* Manning, male paratype, total length 165 mm (USNM 125718); *b*, *H. intermedia*, new species, male holotype, total length 200 mm; *c*, *H. stephensoni*, male paratype, total length 272 mm (USNM 125720).

4.9 mm; raptorial propodus length 53.4 mm; telson length 34.0 mm, width 33.8 mm.

Remarks: This is the third species of *Harpiosquilla* to be recognized in which the rostral plate lacks a slender anterior projection. The two species previously described with a short rostral plate are *H. japonica* Manning, 1969, from Japan and *H. stephensoni* Manning, 1969, from Australia. The new species resembles *H. japonica* and differs from *H. stephensoni* in having 8 teeth on the dactylus of the claw, and agrees with *H. stephensoni* but differs from *H. japonica* in having a posterior spine on the intermediate carinae of the second abdominal somite. It differs from both species in three features: the rostral plate is longer than broad; the cornea is much slenderer (compare the eyes of each of the three species shown in Figure 2); and the marginal carina of the telson is comparatively longer (Fig. 1*c*), about twice as long as the carina of the lateral tooth.

Although the shape of the cornea is different in the three species, the corneal indices overlap broadly.

Etymology: The specific name is from the Latin, and alludes to the relationship of the new species to *H. japonica* and *H. stephensoni*, in terms of both morphology and geographical distribution.

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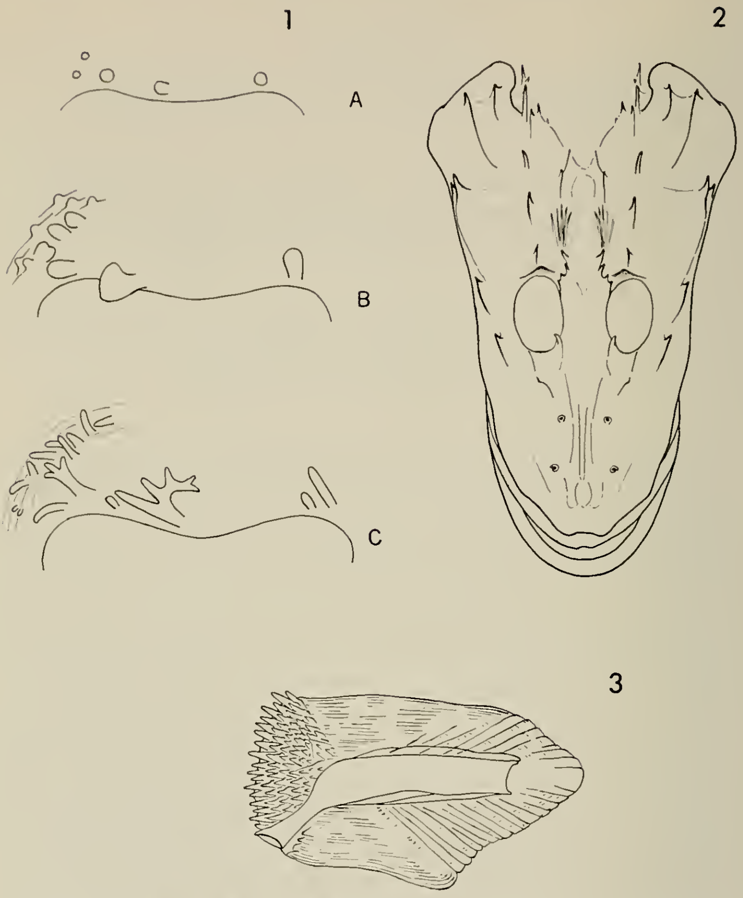
PLATYCEPHALUS BEAUFORTI, A NEW SPECIES OF FLATHEAD (PISCES, PLATYCEPHALIDAE) FROM THE WESTERN PACIFIC

By Leslie W. Knapp
*Smithsonian Oceanographic Sorting
Center, Washington, D.C. 20560*

Cuvier (1829:255) gave a brief description of *Platycephalus longiceps*, a new species from the Red Sea that he apparently based on an unpublished drawing by Ehrenberg. Rüppell (1835:103–4) noted the inadequacy of Cuvier's description and placed *P. longiceps* in synonymy (with question marks) of his new Red Sea species, *P. tentaculatus.* Klunzinger (1870:813–15) chose to use the Cuvier name but indicated his approval of Rüppell's action. Günther (1876:166) commented on the status of *P. longiceps* and *P. tentaculatus* and he described a specimen from the Pelew (Palau) Islands under the name of *P. tentaculatus.* The description was partially inadequate but it was accompanied by a particularly fine illustration. Most workers have followed Günther in applying the name *P. tentaculatus* to similar specimens from the western Pacific.

Recently, de Beaufort (1962:136) placed *P. tentaculatus* in synonymy of *P. longiceps* but questioned whether specimens from the Rea Sea represented the same species as those from the western Pacific. I recognize the western Pacific specimens as a new species of the subgenus *Cymbacephalus* Fowler. Usage of the name *P. longiceps* should be restricted to those populations in the western Indian Ocean and Red Sea characterized by a single, unbranched dermal flap over the eye, small brown punctae on back and top of head, pored lateral line scales with two canals to the exterior and lacking a pit behind the eye. *Cymbacephalus* is arbitrarily assigned sub-



FIGS. 1–3. *Platycephalus beauforti*, new species: 1. Development of dermal flaps, upper eye, at different sizes (right side is anterior). A, 74 mm SL; B, 137 mm SL; C, 248 mm SL. 2. Outline of cranial spines of holotype, CAS 15768. 3. Tenth pored scale, right side, CAS 15767.

generic status here. The subgenus is distinguished by the presence of a pit behind the eye.

A total of 41 specimens examined of *P. beauforti*, 18 specimens of *P. nematopthalamus* and one specimen of *P. parilis* were from the following sources: American Museum of Natural History (AMNH); Bernice P. Bishop Museum

(BPBM); British Museum of Natural History (BMNH); California Academy of Sciences (CAS); Museum of Comparative Zoology, Harvard (MCZ); National Museum of Natural History (USNM) and Zoological Museum, University of Copenhagen (ZMUC).

I thank the following for making material and data available: C. Lavett Smith (AMNH); John E. Randall (BPBM); G. Palmer (BMNH); Pearl Sonoda and William Eschmeyer (CAS); Tyson Roberts and Myvanwy Dick (MCZ); and Jörgen Nielsen (ZMUC).

Considerable thanks are due the Division of Fishes (USNM) for providing laboratory facilities and other assistance. Special appreciation is due Drs. Daniel M. Cohen and Bruce B. Collette, National Marine Fisheries Service Systematics Laboratory (USNM) for furnishing the services of Mrs. Keiko Moore (drawings) and Mr. George Clipper (radiographs). Dr. John E. Randall provided the photograph and Mr. Kjell Sanved prepared it for publication. The manuscript was read by Drs. Bruce B. Collette and Ernest A. Lachner.

Counts and measurements follow the procedures listed by Hubbs and Lagler (1958:19–26) with the following exceptions: diagonal scale count was taken by starting with the scale nearest second dorsal origin and proceeding downward and backward to but not including the pored lateral line scale; the interpelvic scale count was the least number of scales in a straight line between pelvic bases; diameter of orbit was measured from lower, rear margin to base of preocular spine; standard, head and snout lengths were measured from tip of mandible and not from tip of snout; and height of dorsal spine was measured from base at rear of spine to tip.

Platycephalus (Cymbacephalus) beauforti, new species

Figures 1–4

Platycephalus tentaculatus Günther (nec Rüppell), 1876:166 (pl. 107, figs. A and B); Pelew Is.—Meyer, 1885:21; Cebu I., Philippine Is.—Asano, 1936:414–20; Palao.—Abe, 1939:576; Palao Is.

Thysanophrys tentaculatus Herre, 1934:67; Culion, Jolo, Philippine Is.—Herre, 1935:165; Pelew Is.

Platycephalus longiceps de Beaufort (nec Cuvier), 1962:134–36; Singapore, Java?, Borneo, Kei Is., Pelew Is.

TABLE 1. Characters separating the species of *Platycephalus* (*Cymbacephalus*)

Characters	*P. beauforti*	*P. nematopthalamus*	*P. parilis*
Number of dermal flaps on upper surface of eye	Often 10–12 in adults	Usually 6–8	Lacking
Shape and location of major dermal flap on eye	Antler-shaped (Fig. 1C), not reaching supraorbital ridge	An elongated central stalk with many lateral flaps, reaching well above supraorbital ridge	Lacking
Inner pelvic ray	Simple	Simple	Branched
Location of posterior margin of maxilla	Well in front of eye	Behind anterior margin of eye	Behind anterior margin of eye
Number of suborbital spines	Two	One	Two
Number of oblique scale rows slanting backward above the lateral line	Closely approximates number of pored scales	More than pored scales	More than pored scales
Short brown vertical stripes on second dorsal and caudal fins	Absent	Usually present	Absent
Nasal spines	Absent	Usually present	Absent

Diagnosis: A species of the subgenus *Cymbacephalus* Fowler with a pit behind the eye; a series of fleshy dermal flaps on the upper surface of the eye; prominent interopercular flap with several broad projections; inner pelvic ray simple; posterior margin of maxilla well in front of anterior margin of eye; two suborbital spines; number of oblique scale rows slanting backward above the lateral line closely approximating the number of pored scales; nasal spines usually lacking; and short, brown, vertical stripes not present on second dorsal and caudal fins. Characters separating the three species of the subgenus *Cymbacephalus*, *Platycephalus beauforti*, *P. nematopthalamus* Günther, and *P. parilis* (McCulloch) are presented in Table 1.

Ranges are given followed by a parenthesis containing two numbers separated by a comma for most of the characters considered in the following description. The first number is the value for the holotype and the mean is the second number.

Description: Dorsal rays usually I,VIII-11(I,IX-11 in two paratypes); anal rays 11; pectoral rays 19–21(19,19.8); pelvic rays I,5; vertebrae (11–12) + (15–16) = 27(11 + 16 in holotype); interpelvic scales 27–38(28,31.9); diagonal scales 13–17(14,14.9); and pored lateral line scales 50–55(52,52.6). Interorbital width 3.2 times in diameter of orbit in smaller specimens and the ratio decreases progressively to 1.5 times in large specimens (2.2 in holotype). A similar trend is indicated by the ratio of orbit diameter into head length so it appears that the orbit is relatively larger in juvenile specimens. Orbit diameter 2.4–3.2(2.5,2.9) times into distance from orbit to tip of mandible, distance from orbit to tip of mandible 2.2–2.5(2.4,2.4) times in head length and head length 2.3–2.8(2.7,2.6) times in standard length. Height of first dorsal spine 3.2–7.3(3.9,3.9) times into second spine. Nape, preopercle, opercle, back and sides covered with ctenoid scales, abdomen and breast with cycloid scales. The first two (three in 10 paratypes) pored scales in the lateral series with spines.

The arrangement of cranial spines in the holotype appears in Figure 2. Nasal and preorbital spines lacking; a single preocular spine; interorbital space concave; supraorbital ridge entire except for a few spines posteriorly at border of pit, a series of fine ridges radiating out behind last spine; and usually two, short preopercular spines, the upper only slightly longer.

Variation in numbers of branched and unbranched pectoral rays is correlated with growth, the following approximation with some overlap, taken from 36 specimens. All rays were unbranched in juveniles below 60 mm SL; usually iii,4–8,ix–xiii at 74 to 100 mm SL; usually ii,8–11,vii–x at 100 to 200 mm SL(ii,8,ix in holotype); and usually i,11–14,vi–viii above 200 mm SL.

Pit behind eye poorly developed in juveniles. Teeth villiform, in bands in jaws and palatines and in two discrete vomerine patches. Pelvic fin rounded. Umbraculum or iris lappet cirrose. Lateral line scale pores elongate, with a single tube to the exterior that is usually directed ventrad (Fig. 3). Typically, the duct is directed upward in some of the pored scales near the hypural plate. Similar pore patterns have been noted in *Ratabulus megacephalus* (Tanaka) by Matsubara and Ochiai (1955:9) and in most flatheads with pored scales having single ducts to the exterior by the author. Interopercular flap well developed, usually broader than long and with several subdivisions. Anterior nostril with a flat, elongate, elliptical flap that tends to become slightly crenulate in large specimens.

Dermal flaps appear on the upper surface of the eye as a few "warts" in smaller specimens (Fig. 1A), increase in number and show signs of incipient branching in two flaps (Fig. 1B), and develop branches in two or three flaps in older specimens (Fig. 1C). There are usually one or two simple flaps anteriorly, a major branched flap behind the middle of the eye and numerous simple and one or two branched flaps on the upper rear surface.

Color pattern in preserved specimens: Back and top of head usually dark brown; lower sides frequently with irregular dark brown blotches; all fins mottled with combinations of small and large dark blotches which tend to form bands in some specimens, especially the pelvic and first dorsal; jaws with dark blotches, best developed on mandible and maxilla; and abdomen light but breast streaked with brown anteriorly in some.

Habitat: Specimens of *P. beauforti* included in the study were captured at depths to 25′ but were most commonly taken at from 5′ to 10′. Most reportedly came from rocks or coral with eel grass and mangroves nearby in a few cases.

Range: Of the three species of the subgenus, *P. nematopthalamus* appears to be most widely distributed and is found from Australia to Singapore and the Philippines. The range of *P. parilis* is primarily restricted to Australia and, according to Munroe (1967:528), to coastal waters of New Guinea. *Platycephalus beauforti* is known from Yap, the Palaus, the Philippines, Duke of York Island near New Britain, and the Tobriand Islands near New Guinea. The record from Java by Kner (1865:122–23) is questionable and de Beaufort (1962:136) also included Singapore although I have not seen any specimens from there.

Etymology: This species is named in honor of the late Dr. L. F. de Beaufort who, in addition to his many notable contributions to ichthyology, at the age of 88 wrote a most informative and encouraging letter to me concerning the need for a revision of the Platycephalidae.

In the following list of material, the number of specimens (when more than one) and range of standard lengths (mm) appear in parentheses after the catalog or station number. Paratypes are all from the Palau and Caroline Is.

Holotype: CAS 15768 (191): Palau Is., Urukthapel I., Garamejo region, Ngaremedin district, fringing reef on first projecting cape W of beach, 7°15′15″N, 134°26′51″E; H. A. Fehlmann and party; 31 July 1955.

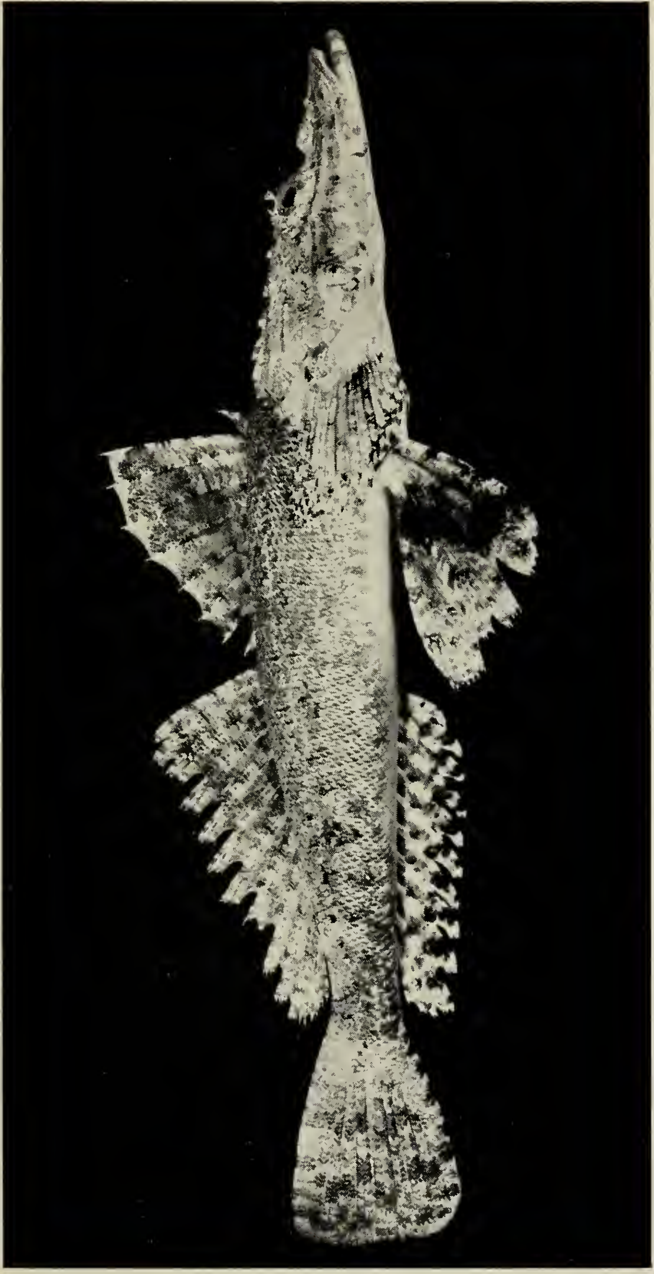


Fig. 4. Right side of paratype of *Platycephalus beauforti*, BPBM9641, Palau Is., 287 mm SL.

Paratypes: BPBM 9641 (287), Urukthapel I.; USNM 208427 (212), Urukthapel I.; BMNH 1972.12.5.3 (200), Urukthapel I.; CAS 15745 (412), Palau Is.; CAS 15746 (265), Peleliu; CAS 15747 (4,155–289), Nardueis; CAS 15748 (3,41–57), Arakabesan; CAS 15749 (2,79–104), Auluptagel; CAS 15750 (111), Auluptagel; CAS 15751 (246), Auluptagel; CAS 15765 (74), Auluptagel; CAS 15752 (2,165–204), Auluptagel; CAS 15753 (331), Kuror; CAS 15754 (2,210–224), Kuror; CAS 15755 (91), Kuror; CAS 15756 (87), Kuror; CAS 15757 (212), Kuror; CAS 15758 (254), Babelthuap; CAS 15759 (3,262–407), Babelthuap; CAS 15761 (2,372–406), Babelthuap; CAS 15764 (2,289–395), Yap; CAS 15763 (69), Yap; CAS 15760 (133), Yap; CAS 15766 (137), Yap; CAS 15767 (248), Yap.

Comparative material examined: *P. beauforti* (not paratypes): USNM 208428 (453), New Guinea, Tobriand Is., Kiriwinna I., N coast off Towai Point, B. B. Collette and party, 8 June 1970; USNM 151100 (82), Philippines, Cebu market; USNM 209158 (189), Duke of York Is., Keraward I., St. George Channel between New Britain and New Ireland, D. Cohen and W. Davis. *P. nematopthalamus*: MCZ 13804 (10,111–151), Singapore; MCZ 30513 (223), Makassar, Celebes; ZMUC Galathea Exped. 1950–52, sta. 337 (210), Singapore; AMNH S69-10 (49), Little Hope I., Australia; BMNH 1855.9.19.96 (186), Port Essington, Australia; GVF Walter Brown Philippine Exped. 1960–61, sta. A-5 (2,212–236), sta. A-14 (185), sta. A-16 (162). *P. parilis*: USNM 173885 (368), Darwin, Australia.

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STUDIES OF NEOTROPICAL CADDISFLIES, XVI: THE GENUS *AUSTROTINODES* (TRICHOPTERA: PSYCHOMYIIDAE)

By Oliver S. Flint, Jr.
Smithsonian Institution, Washington, D.C. 20560

The family Psychomyiidae (sensu Ross 1944) is represented in the Chilean subregion by two genera, *Polycentropus* and *Austrotinodes.* The former, because of its nearly worldwide distribution and diversity of species, must be analyzed in detail before the zoogeographical relationships of its various units can be understood. *Austrotinodes,* however, has heretofore seemed to be a perfect example of a Gondwanaland relict. It has been known only from the west of the Andes and south of Central Chile, and is most closely related to a genus occurring in Australia and New Zealand. This type of distribution pattern has been found in other rheophilous, cold-stenothermal aquatic insects (Brundin, 1966; Edmunds, 1972; Illies, 1965) and has been postulated to be the result of the disruption of an old continuous distribution by continental drift.

Recent field work (supported in part by NSF grant GB-2616 and the U.S. Antarctic Research Program) has produced several valuable collections of *Austrotinodes.* As a result the known distribution is now extended into northern South America, Central America, and Mexico; good evidence as to the subfamily placement of the genus is provided by the previously unknown larvae and pupae; and additional examples of Chilean species have served to fill in details of the distribution of these species. Unfortunately it is still not possible to present a complete analysis of this genus, primarily because the immature stages of related genera are unknown.

I am indebted to Mr. George Venable, staff artist of the Department of Entomology, Smithsonian Institution, for the excellent habitus view of the larva and phylogenetic diagram. Mr. M. E. Irwin and Dr. Saul Frommer of the Department of Entomology, University of California, Riverside (UCR) lent important Neotropical collections.

Genus *Austrotinodes* Schmid

Type-species: *Austrotinodes latior* Schmid (original designation). *Austrotinodes* Schmid, 1955:132; 1958:200.—Kimmins, 1957:260.—Fischer, 1972:87.

Adult: Length of forewing, 6–8 mm. Spurs, 3,4,4. Forewing with R_1 forked apically, R_{2+3} unbranched; R_{4+5}, M_{1+2}, M_{3+4}, and Cu_1 all branched. Hindwing lacking corneous point in fork of R_{4+5}; R_{4+5}, M_{1+2}, and Cu_1 all branched; discoidal cell present or absent. Male genitalia: Ninth segment deeply divided laterally. Cerci large, often elongate, usually with mesal teeth and a basomesal process. Tenth tergum apparently a simple mesal lobe. Claspers usually fused mesally, generally with a mesal rodlike process basodorsally. Aedeagus basically tubular, often with lateral processes.

Larva: Length to 11 mm, width 1 mm. Head, pronotum, and forelegs chestnut brown; meso- and metanota, and mid and hindlegs yellowish; abdomen whitish, dorsally with purplish flecks (Fig. 1).

Head considerably elongate, broadest posteriad; with a ventro-lateral carina from eyes posteriad; with only primary setae (Fig. 2). Frontoclypeus with anterior margin rounded, elongate and parallel-sided. Labrum sclerotized, without secondary setae or brushes; inner surface asymmetrically sclerotized with a row of basally directed spinelike setae (Fig. 8). Mandibles long and slender; without mesal brushes; with dorsal cutting edge overhanging ventral edge, left mandible deeply concave between cutting edges (Figs. 5, 6). Maxillae without secondary setae or brushes; palpifer and galea elongate; palpus with basal two segments very short, third greatly elongate, fourth about half length of third; labium with an elongate mesal lobe, palpus long and slender (Fig. 4).

Pronotum with few secondary setae; posterolateral angle greatly developed and meeting at midventral line. Propleuron fused to trochantin which is elongate and narrow in lateral aspect but rather broad in dorsal. Foreleg heavily sclerotized; coxa elongate, broad, apically with a stout black seta (Fig. 9). Meso- and metanota sclerotized, divided longitudinally on midline with few secondary setae (Fig. 3). Mid and hindlegs more lightly sclerotized than foreleg; coxae normal (Fig. 10). Hindleg with scattered setae on trochanter, femur, tibia, and tarsus modified into short, enlarged spines; claw slender and straight (Fig. 11).

Abdomen without lateral line setae; with only scattered primary setae. Anal proleg with basal membranous section lacking setae; sclerite with

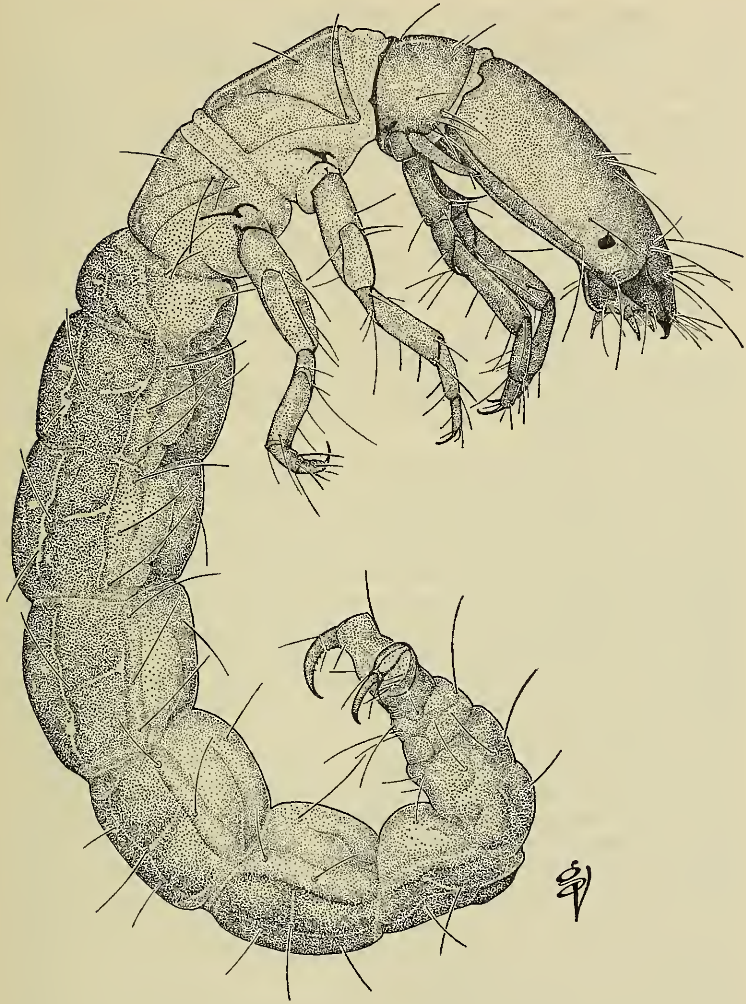

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FIG. 1. *Austrotinodes* sp: larval habitus view.

a few setae. Claw evenly curved and tapered; ventral margin with a few small teeth at midlength (Fig. 7).

Pupa: Length to 7 mm. Mandibles elongate, curved, mesal margin without serrations (Fig. 13). Labrum roughly semicircular, with a distinct basal section; a cluster of setae basolaterally on apical portion, three elongate setae laterally on each side of basal section (Fig. 12). Front with two pairs of setae mesally and a small seta near eye ventrally; with tentorial pits mesad of eye large and deep. Basal antennal segment with two stout setae; antennae barely surpassing tip of abdomen. Tarsus of metathoracic leg with a fringe of hairs. Wing pads reaching fifth abdominal segment. Hook plates anteriorly on segments 2–8, posteriorly on 5 (Fig. 15). No lateral line fringe of hairs; with one to three stout setae posterolaterally on each segment. Each segment dorsally near posterior margin with four pairs of setae which become progressively larger toward the eighth segment; each segment ventrally with three pairs of setae. Apical process a small lobe bearing a cluster of long setae (Fig. 14).

The description of the larva is based on a series taken in Chile, Prov. Llanquihue, 10 km north of Pargua, 5 June 1969, P. & P. Spangler. These larvae show no differences from the sclerites associated with a male metamorphotype of *A. recta* Schm., which is the basis for the description of the pupa.

The adults and larvae clearly substantiate the placement of *Austrotinodes* in the subfamily Ecnomiinae (as defined by Kimmins, 1957), whereas the relationship evinced by the pupae is less clearcut. The Ecnomiinae are composed of the genera *Ecnomus* McLachlan (Palearctic, Ethiopian, Oriental, and Australian Regions), *Parecnomina* Kimmins (Ethiopian Region), *Psychomyiellodes* Mosely (Ethiopian Region), *Ecnomina* (Australian Region), and *Austrotinodes* Schmid (Neotropical Region). The genus *Ecnomodellina* Ulmer (*Ecomodes* Ulmer) described from Ecuador and originally placed in the Ecnomiinae is a synonym of *Polyplectropus* Ulmer (Flint, 1968) and as such must be removed to the Polycentropodinae.

The evolutionary history (Diagram 1) of the Ecnomiinae seems to proceed from an ancestral form that possessed a rather complete venation (M_1 and M_2 present in the hindwing, R_2 and R_3 present in the forewing), and a comparatively unmodified genitalia (the claspers separate, and only one pair of processes from both the cerci and aedeagus). This ancestral form must have been found over much of Gondwanaland early in the Cretaceous. The line that remained with the African fragment retained most of these ancestral characteristics, whereas the line that developed in the Australian–New Zealand–Chilean fragment became specialized by the fusion mesally of the claspers, development of additional processes from the cerci and aedeagus, and complete fusion of R_2 and R_3 in the forewing. Of all living genera, *Parecnomina* is probably most like the ancestral form. *Ecnomus*, which is easily derived by the fusion of M_1 and M_2 in the hindwing, is the most successful of living genera, with many species scattered over Africa, Europe, southern Asia, and Australia. The genus *Psychomyiellodes* is the most specialized in this line, having a specialized spur on the male tibia, a cuplike structure laterally on the male genitalia, and a fusion of R_2 and R_3 in the forewing in some species.

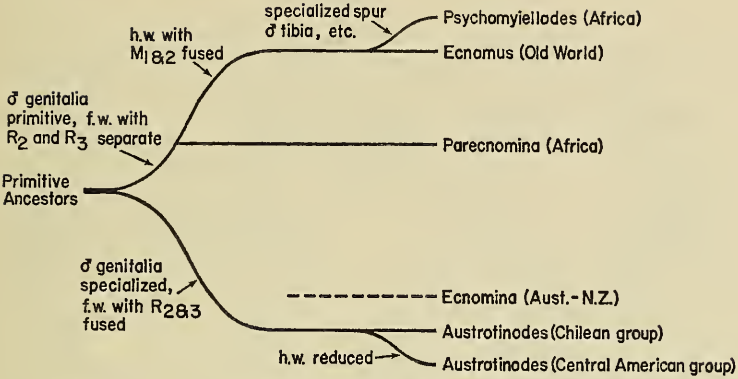


DIAGRAM 1. Phylogenetic tree of the subfamily Ecnomiinae.

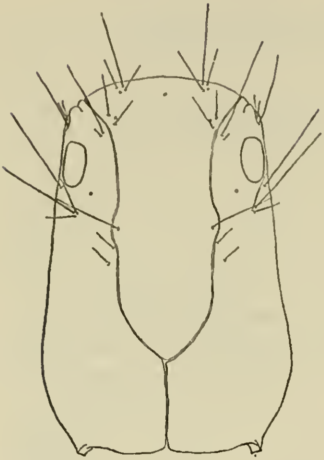
The second evolutionary line consists only of the genera *Ecnomina* and *Austrotinodes.* The descriptions of the genitalia and ventation of *Ecnomina* offer no ready means to distinguish this genus from *Austrotinodes,* and the two genera may ultimately be synonymized. However, until better descriptions of *Ecnomina* are published and its immature stages become known, it seems better to retain separate genera for the Australian–New Zealand and South American components. Within the genus *Austrotinodes,* the Central American–northern South American group of species appears to be the most specialized. In these species the hindwing is reduced in size with the consequence that one anal vein is lost and the area occupied by the radial veins is smaller.

The larvae of *Austrotinodes* agree with the larvae of *Ecnomus* (the only other genus in the subfamily in which the immature stages are known) in the following characteristics: mandibles without a mesal brush, labial palpi elongate, maxillary palpi with first two segments short and the third very long, and all thoracic nota sclerotized. It differs from *Ecnomus* in the shape of the head, structure and chaetotaxy of the legs, and lack of lateral line.

→

FIGS. 2–8. *Austrotinodes* sp.: 2, larval head, dorsal; 3, larval thoracic nota, dorsal; 4, larval maxillolabium, ventral; 5, larval right mandible, ventral; 6, larval left mandible, ventral; 7, larval anal proleg, lateral; 8, larval labrum, dorsal.

FIGS. 9–15. *Austrotinodes* sp.: 9, larval foreleg and prothorax, lateral; 10, larval midleg, lateral; 11, larval hindleg, lateral. *A. recta* Schm.: 12, pupal labrum, dorsal; 13, pupal mandible, dorsal; 14, apex of pupal abdomen, dorsal; 15, pupal hook plates, dorsal (A = anterior, P = posterior, 1–8 = segment number).



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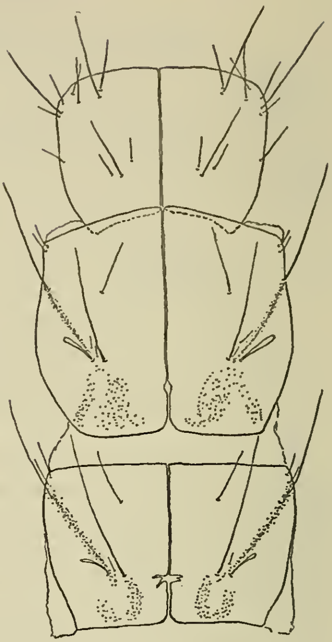

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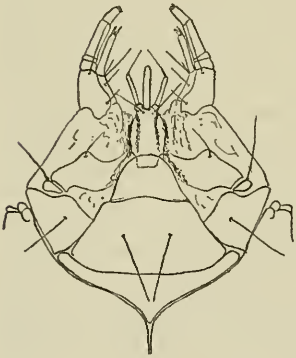

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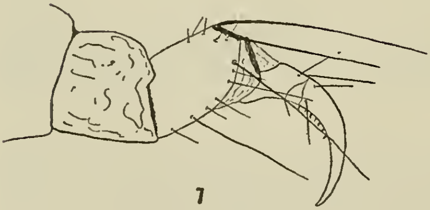

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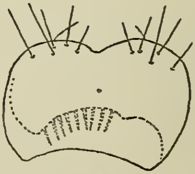

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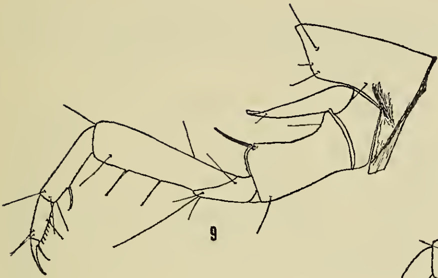

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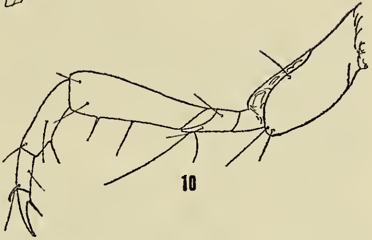

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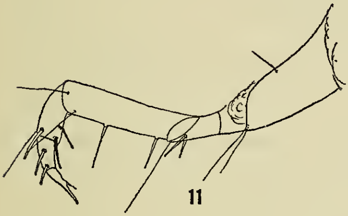

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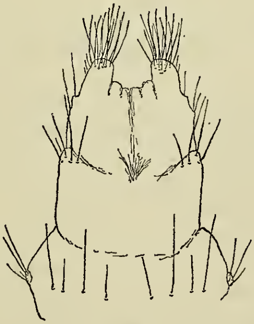

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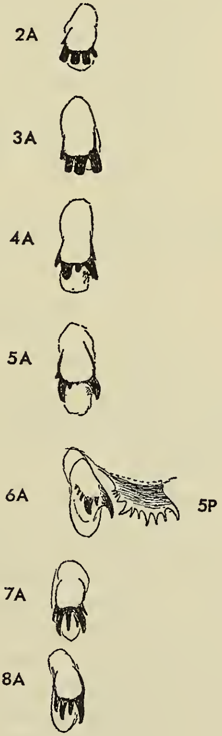

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The pupae of *Austrotinodes* and *Ecnomus* have mandibles of roughly similar shape, and the apical appendages are also very similar. However, the chaetotaxy of the labrum, number and form of the hook plates, and chaetotaxy of the abdomen are very different.

I have not collected active larvae of *Austrotinodes*, only prepupae and pupae. These latter were in elongate, rather flimsy shelters of sand and silk on the underside of rocks in riffles of small and medium sized streams. The ecological data associated with the one collection of larvae indicates only that they were picked off rocks in a sandy, rocky stream. Because of the odd structure of the legs and rather hairless appearance of the larva, I am suspicious that they may be tube-dwellers, possibly in the sand or gravel of the stream bottom or on rocks and large boulders.

The following key will separate the adult males of *Austrotinodes*. The species *A. lineata* (Navas) and *A. talcana* (Navas) are known from females only and are presently unidentifiable.

1\. Clasper three to four times longer than broad in both lateral and ventral aspects 2
Clasper not more than barely twice as long as broad in lateral aspect, and as broad as or broader than long in ventral aspect 5
2\. Clasper in lateral and ventral aspects with a distinct subapical lobe or angle laterally 3
Clasper without an apicolateral lobe in either lateral or ventral aspect 4
3\. Cercus broadly triangular, with basoventral process short and triangular in lateral aspect .... *triangularis*
Cercus narrow and elongate, with two pairs of elongate basoventral processes .... *irwini*
4\. Claspers in ventral aspect divided mesally and ending in two dark points .... *quadrispinosa*
Claspers completely united mesally, apex a narrow rectangular lobe, blackened laterally .... *recta*
5\. Clasper in lateral aspect with distinct basodorsal and apicomesal lobes 6
Clasper in lateral aspect a simple, rounded structure 7
6\. Claspers in ventral aspect with fused mesal region narrowly and distinctly produced apicad .... *cekalovici*
Claspers in ventral aspect with fused mesal region only broadly and slightly produced apicad .... *mexicanus*
7\. Mesal process between claspers forked apically .... *latior*
Mesal process not forked 8
8\. Basoventral process of cercus ending in a point or a single spine 10
Basoventral process of cercus ending in a cluster of spines 9
9\. Basoventral process of cercus much enlarged apically, and with a distinct apicomesal lobe; with two pairs of processes on the aedeagus .... *panamensis*

Basoventral process only barely enlarged at apex, without a mesal lobe; one pair of processes from aedeagus .... *sedmani*

10\. Venter of aedeagus with a pair of sclerotized, caliper-like lobes apically .... *brevis*

Venter of aedeagus without such a pair of caliper-like lobes .... *angustior*

Austrotinodes angustior Schmid

Austrotinodes angustior Schmid, 1955:133; 1958:202.—Fischer, 1972: 88.

This species is known only from the Provinces of Chiloe and Maule in Chile.

Austrotinodes brevis Schmid

Austrotinodes brevis Schmid, 1958:201.—Fischer, 1972:88.

This species was previously known only from the type from the Province of Arauco, Chile. It is now recorded from the Province of Malleco.

Material: Chile, Malleco, Rio Manzanares, 2 Jan. 1966, Flint & Cekalovic, 1 ♂.

Austrotinodes cekalovici Flint

Austrotinodes cekalovici Flint, 1969:507.

The type-material of this species came from the Provinces of Cautin and Valdivia in Chile.

Austrotinodes irwini, new species

Figures 27–29

This Chilean species is closely related to *A. recta* Schmid, differing in details of the cerci and claspers. The mesal darkened area of the cerci is further basad in *irwini*, the basal processes of the cerci are quite different especially the curved mesal one, and the claspers differ in being angulate before the apical constriction and the apex itself is produced into a single erect point on each side.

Adult: Length of forewing, 7 mm. Color in alcohol, pale yellowish. Male genitalia: Ninth segment divided laterally, produced posteriad ventrally, with posterolateral angle produced into a thin lobe. Tenth tergum a simple membranous lobe between bases of cerci. Cercus elongate, rounded apically, mesal face with a darkened expansion at near midlength; with two pairs of processes basoventrally, dorsolateral process elongate, simple, ventromesal process arising from a cuplike base, with apex gently upturned. Claspers fused mesally, very long, produced into a thin, upturned flange laterally, with a lateral subapical angle, apex produced into a darkened, erect, point on each side; with a basodorsal arched rod. Aedeagus elongate, membranous apically with a pair of long, slender spines.

Material: Holotype, male: Chile, Prov. Malleco, Parque Nacional Nahuelbuta, 4350′, 24 Jan. 1967, M. E. Irwin (UCR). Paratype: Same data, 1♂ (USNM).

Austrotinodes latior Schmid

Austrotinodes latior Schmid, 1955:132; 1958:200.—Flint, 1967:55.—Fischer, 1972:88.

The species has been recorded from the Provinces of Chiloe and Valdivia in Chile and is now recorded from Malleco, Concepcion, and Nuble.

Material: Chile, Malleco, Rio Manzanares, 2 Jan. 1966, Flint & Cekalovic, 1♂. Prov. Concepcion, Fundo Pinares, 30 Dec. 1965, Flint & Cekalovic, 3♂. Prov. Concepcion, Quebrada Honda, near Lirquen, 31 Dec. 1965, Flint & Cekalovic, 2♂; same, but 5 Feb. 1966, Cekalovic, 1♂. Prov. Nuble, Rio Pinto, east of Chillan, 24 Oct. 1969, Flint & Barria, 2♂.

Austrotinodes lineatus (Navas)

Tinodes lineata Navas, 1934:166.—Fischer, 1962:192.
Austrotinodes lineatus (Navas): Schmid, 1955:132.—Fischer, 1972:88.

This species is known only from the original description which is insufficient for identification of the species. No locality is given for the types, but presumably they came from Chile.

Austrotinodes mexicanus, new species

Figures 16–20

This species is closest to *A. sedmani*, new species, from which it is easily recognized by its bearing two pairs of processes from the aedeagus and by having the lateral lobe of the clasper clearly set off from the mesal portion.

Adult: Length of forewing, 4.5 mm. Specimens in alcohol; color now uniformly brownish. Male genitalia: Ninth segment deeply divided laterally with ventral portion prolonged posteriad. Tenth tergum consisting of a pair of elongate, membranous lobes lying dorsally between

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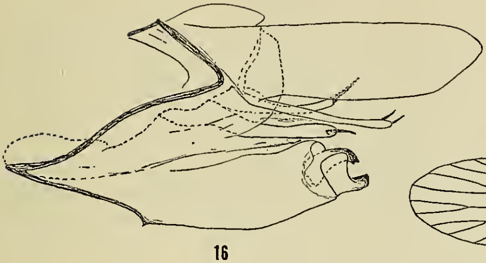
Figs. 16–24. *Austrotinodes mexicanus*, new species: 16, male genitalia, lateral; 17, cerci, aedeagus, and ninth and tenth terga, dorsal; 18, ninth sternum and claspers, ventral; 19, wings; 20, female genitalia, ventral. *A. sedmani*, new species: 21, ninth sternum and claspers, ventral; 22, cerci, aedeagus, and ninth and tenth terga, dorsal; 23, male genitalia, lateral; 24, female eighth sternum, ventral.



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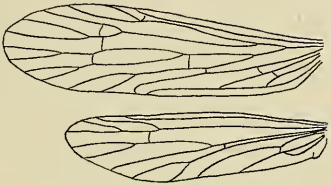

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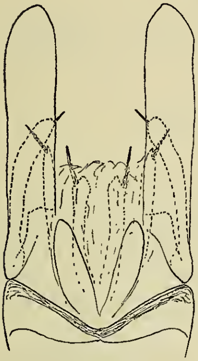

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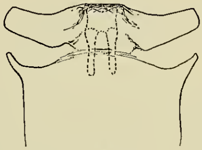

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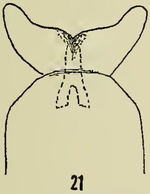

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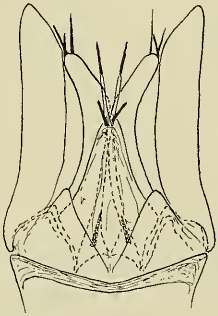

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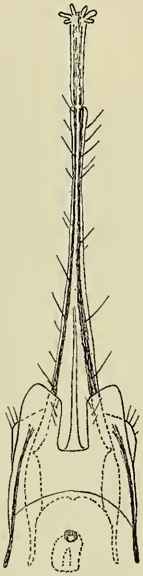

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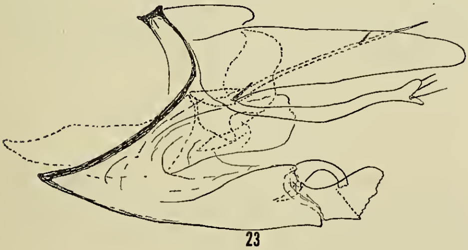

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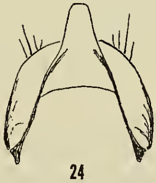

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the bases of cerci. Cercus elongate, parallel-sided, apex tapering to a blunt tip; with a long rodlike basomesal process bearing two enlarged apical setae. Claspers fused mesally, short with a thin basolateral lobe, posteromesally slightly produced and considerably darkened; with a basodorsal darkened rod, whose apex is slightly bilobate. Aedeagus with two pairs of slender, rodlike appendages, each bearing an enlarged apical seta. Female genitalia: Eighth segment with apodeme short; sternum prolonged posteriad and deeply and broadly divided mesally. Ninth segment with apodeme short; greatly prolonged and a narrow, compressed tube bearing scattered setae. Tenth segment elongate, narrow, with three pairs of apical papillae.

Material: Holotype, male: Mexico, San Luis Potosi, El Salto Falls, 23–24 June 1965, O.S. Flint, Jr. USNM Type 72478. Paratypes: Same, but 8 May 1964, Blanton, et al., 9♂, 3♀.

Austrotinodes panamensis, new species

Figures 25–26

A. panamensis, new species and *A. sedmani*, new species are very closely related, appearing to differ only in the processes of the cerci and aedeagus. In *panamensis* the basomesal process of the cercus is broader apically and bears a distinct mesal lobe, and there is a distinct, although frequently obscured, basolateral spur on the aedeagus in addition to the long dorsal pair.

Adult: Length of forewing, 4.5 mm. Color identical to that of *sedmani*. Male genitalia: Ninth segment deeply divided laterally, ventral portion greatly prolonged posteriad. Tenth tergum consisting of a pair of broadly trianguloid membranous lobes dorsally between bases of cerci. Cercus elongate, tapering on apical third to a rounded apex; basomesal process expanded apicad, apex with a distinct ventromesal lobe, and three enlarged setae. Claspers fused mesally, short, with a thin rounded lateral lobe, posteromesally darkened and slightly divided; with a basodorsal arched rod ending in a blunt tip. Aedeagus with two pairs of slender dorsal processes, mesalmost very long with an enlarged seta at midlength, more laterad pair less than half length of mesal pair. Female genitalia: Apparently identical to that of *sedmani*.

Material: Holotype, male: Panama, Cerro Campana, 11–14 July 1967, O. S. Flint, Jr. USNM Type 72479. Paratypes: Panama, Barro Colorado Island, 12 March 1967, M. E. Irwin, 3♂, 10♀ (UCR and USNM).

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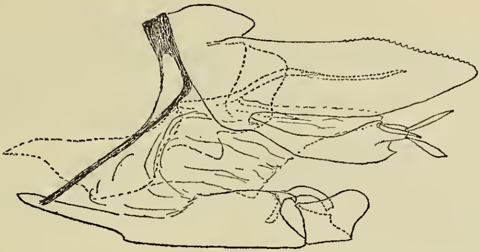
FIGS. 25–29. *Austrotinodes panamensis*, new species: 25, male genitalia, lateral; 26, cerci, aedeagus, and ninth and tenth terga, dorsal. *A. irwini*, new species: 27, ninth sternum and claspers, ventral; 28, cerci and ninth and tenth terga, dorsal; 29, male genitalia, lateral.



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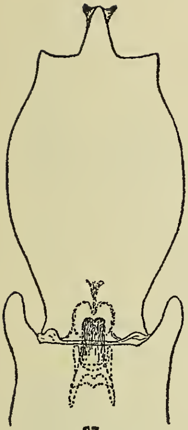

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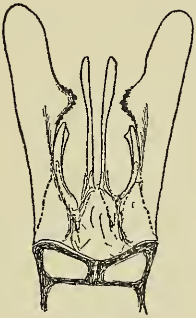

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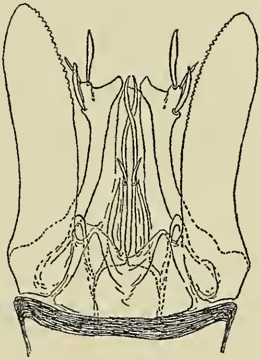

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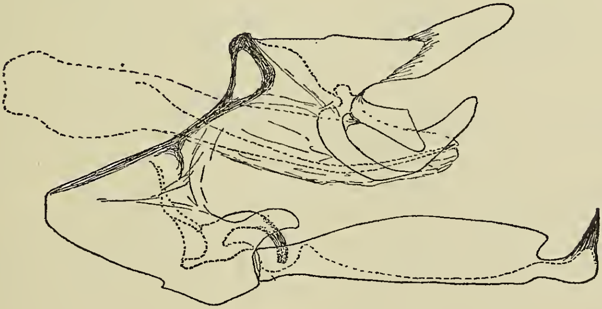

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Austrotinodes quadrispina Schmid

Austrotinodes quadrispina Schmid, 1958:200.—Fischer, 1972:88.

This species was described from a unique male collected in the Province of Arauco, Chile. I have examples taken in the adjacent provinces of Malleco and Concepcion.

Material: Chile, Malleco, Parque Nacional Contulmo, 2 Jan. 1966, Flint & Cekalovic, 1♂. Prov. Concepcion, Quebrada Honda, near Lirquen, 5 Feb. 1966, Cekalovic, 1♂.

Austrotinodes recta Schmid

Austrotinodes recta Schmid, 1964:322.

The types of the species came from the provinces of Malleco and Curico, Chile. I have taken it additionally in the provinces of Cautin and Llanquihue.

Material: Chile, Malleco, Rio Manzanares, 2 Jan. 1966, Flint & Cekalovic, 1♂. Prov. Cautin, Puente Huilquilco, 4 Jan. 1966, Flint & Cekalovic, 1♂. Cautin, near Pucon, 4 Jan. 1966, Flint & Cekalovic, 1♂, 2♀. Cautin, 30 km NE of Villarrica, 16–31 Dec. 1964, Pena, 1♀. Prov. Llanquihue, Rio Maullin, 6 Jan. 1966, Flint & Cekalovic, 3♂, 2♀. Llanquihue, Rio Gomez, 6 Jan. 1966, Flint & Cekalovic, 1♂.

Austrotinodes sedmani, new species

Figures 21–24

The male genitalia of this species is very similar to that of *A. panamensis*, new species. *A. sedmani* is easily recognized by bearing only a single pair of processes from the aedeagus, and in the shape of the basomesal process of the cercus.

I take pleasure in dedicating this species to Dr. Yale Sedman who forwarded not only the paratype of this species from British Honduras, but also much other valuable material from this poorly known area.

Adult: Length of forewing, 4 mm. Head and thorax bearing whitish hairs, antenna cream colored, forewing mostly pale brownish with most of costal margin and a few small flecks elsewhere dark brown. Male genitalia: Ninth segment deeply divided laterally, ventral portion prolonged posteriad. Tenth tergum consisting of a pair of broadly trianguloid membranous lobes lying dorsally between bases of cerci. Cercus elongate, tapering regularly from base to rounded apex; with a long, rodlike, slightly sinuate basomesal process bearing several apical setae. Claspers fused mesally, short, with a thin, rounded lateral lobe, posteromesally darkened and slightly divided; with a basodorsal, arched rod ending in a blunt tip. Aedeagus with a pair of long slender lateral arms, each bearing several short, enlarged setae. Female genitalia: Similar to that of *A. mexicanus* except for eighth sternum which is entire and narrowly produced posteriad.

Material: Holotype, male: Guatemala, Izabal, Las Escobas, near Matias de Galvez, 26–27 June 1966, Flint & Ortiz. USNM Type 72480. Paratypes: Same, but 14–16 Aug. 1965, 1 ♀. British Honduras, Cayo Dist., Mountain Pine Ridge, 27 June 1971, G. Stacell, 1 ♂.

Austrotinodes talcana (Navas)

Tinodes talcana Navas, 1934:165.—Schmid, 1949:340.—Fischer, 1962: 203.
Austrotinodes talcana (Navas): Schmid, 1955:132.—Fischer, 1972:88.

The type, a female, came from the province of Talca, Chile. Schmid figured the genitalia of this specimen in 1949, but the species is still unidentified.

Austrotinodes triangularis Schmid

Austrotinodes triangularis Schmid, 1958:202.—Fischer, 1972:88.

The species is still known only from the types from the province of Arauco, Chile.

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PROCEEDINGS
OF THE
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THE LARVA AND PUPA OF THE PREDACEOUS WATER BEETLE, *HYGROTUS SAYI* (COLEOPTERA: DYTISCIDAE)

By Paul J. Spangler and Janice M. Gillespie
Smithsonian Institution, Washington, D.C. 20560, and
Department of Entomology, University of Idaho,
Moscow, Idaho 83843

The purpose of this study is to describe the larva and pupa of *Hygrotus sayi* J. Balfour-Browne and to report some observations made on the bionomics of the species.

In 1969, the junior author collected numerous adults and larvae of aquatic beetles from a farm pond near Moscow, Latah County, Idaho. Larvae and assumed adults of a species of Dytiscidae were found abundantly in algal mats of *Mougeotia* sp. Specimens were sent to Mr. Hugh B. Leech (California Academy of Sciences) who identified the adults as *H. sayi* and suggested that the larvae probably were the immature stage of *sayi.* Establishment of the identity of the larvae was desirable because the immature stage of *H. sayi* was undescribed.

The pond (Fig. 1), on the Floyd W. Trail property, covers an area of 1½ acres and is 12 to 13 feet deep at its maximum. In 1969, *Hygrotus* larvae were numerous about 6 feet from shore in mats of a filamentous green alga, *Mougeotia* sp. These mats were about 12 inches thick and floating in water 3 feet deep. In 1970, larvae were found again in mats (Fig. 2) of *Mougeotia* intermixed with *Spirogyra* sp. and *Lemna* sp. among a stand of *Typha latifolia* Linn. These mats were located 1 to 2 feet offshore in water 3 to 12 inches deep. In both years larvae were found only in the upper 4 or 5 inches of the mats, perhaps being limited to this portion by a need for ready access to the water surface for respiration. Early

FIG. 1. Biotope, Trail's Pond, Moscow, Latah County, Idaho.

instar larvae first appeared in early June and peaked in abundance about a month later. Larvae in late instars were prevalent throughout July and peaked at midmonth. No larvae were found after mid-August.

Larvae collected for rearing were placed individually or in groups of 2 to 4 specimens in a small petri dish (35 mm) containing water which was in turn enclosed in a larger container. The space between the two containers was filled with soil which afforded a pupation site. These rearing chambers were maintained at room temperature. Specimens being reared were fed cladocerans and small amphipods daily or allowed to cannibalize weaker dytiscid larvae.

Last-instar larvae taken to the laboratory for rearing pupated from 3 to 15 days after collection. Table 1 shows the results of eight rearing attempts.

Two larvae were observed constructing pupal cells. Each specimen labored about 5 hours, moving about in its chamber and compacting the soil. Also, the larvae produced a milky yellow fluid which appeared to help cement together the soil particles. The finished cells were oval with smooth inner walls. After the pupal cell was completed, the larva remained

FIG. 2. Habitat niche, algal mat in Trail's Pond.

quiscent (but reacted actively if disturbed) for about 10 hours before transformation. The pupa freed itself from the larval exuvium by wriggling. The abdomen was freed first and then the thorax and head. The shed exuvium remained in the pupal cell. If the exuvium is retrieved promptly it may be used for descriptive purposes.

TABLE 1. Rearing data for pupation of *Hygrotus sayi*

Larva No.	Larva collected	Date pupated	Date preserved	Date eclosed	Days in pupation
1	VII-20-70	VIII- 1-70	VIII- 3-70	—	–
2	VII-27-70	VIII- 2-70	VIII- 2-70	—	–
3	VII-27-70	VIII-11-70	VIII-12-70	—	–
4	VII-29-70	VIII- 4-70	VIII- 5-70	—	–
5	VII-27-70	VIII- 2-70	—	VIII- 4-70	2–3
6	VIII- 7-70	VIII-10-70	—	VIII-15-70	5–6
7	VIII- 7-70	VIII-11-70	—	VIII-15-70	4–5
8	VIII- 7-70	VIII-13-70	—	VIII-16-70	3–4
Average days from pupation to eclosion					3½–4½

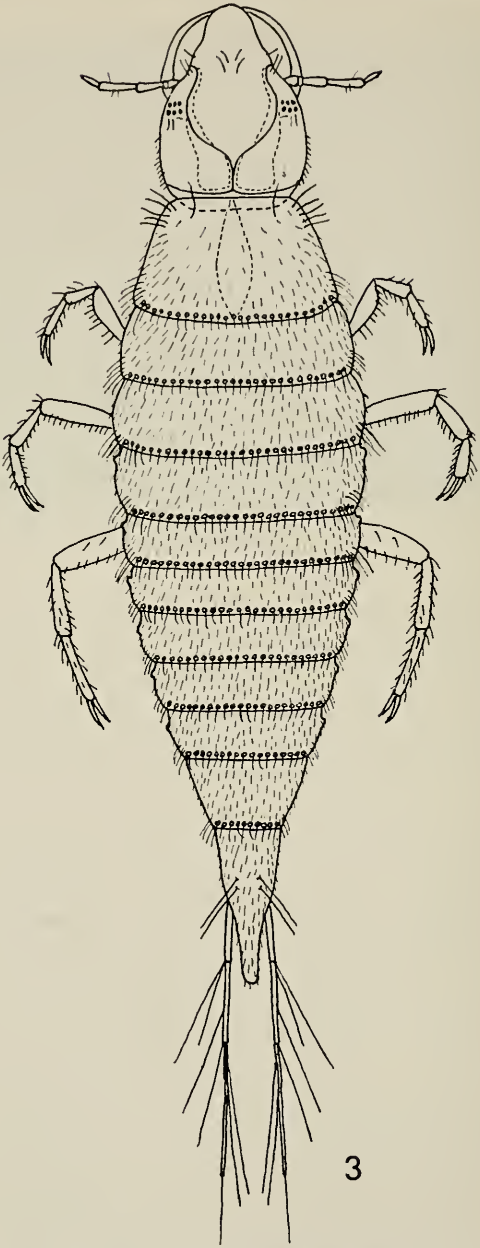


Fig. 3. *Hygrotus sayi* Balfour-Browne, last-instar larva, habitus view.

Three pupae, not included in Table 1, which died in the process of shedding the larval exuvium were preserved to illustrate this stage of ecdysis. In these specimens, the larval exuviae are split along the ecdysial cleavage line on the head, the pro-, meso-, and metathoracic segments, and the first abdominal segment.

Last-instar larva: Length (including cerci), 5.6 mm; greatest width, 1 mm. Color of dorsal surface of head and thoracic segments yellowish brown; abdominal segments reddish brown. Head with distinct darker brown maculae adjacent to base and frontal arms of ecdysial cleavage line and along posterolateral angles. Ventral surface, legs, cerci, and appendages of head creamy yellow to yellowish brown. Body subcylindrical and elongate (Fig. 3).

Head pyriform. Nasale broad, elongate; laterally notched at midlength; toothed ventrolaterally behind notch (Fig. 4); with 3 or 4 denticles in front of each notch; anteroventral margin bearing fringe of fine setae; dorsal surface smooth and bearing 2 long setae behind each notch and 1 seta in front of each notch. Ecdysial cleavage line distinct, forked a short distance in front of occipital ridge near base of head; frontal arms terminating mesad of and in front of antennae. Occipital ridge dark brown, extending transversely across head near base. Ocular area with 6 ocelli arranged in an ellipse; anterior 3 ocelli slightly closer than posterior 3; ocelli about equal in size. Temporal setae 10 to 12. Antenna (Fig. 5) cylindrical, 4 segmented; basal segment broadest, shorter than 2nd or 3rd segment; 3rd segment longest; 4th segment shortest; acicular seta on apex of 3rd segment shorter than and adjacent to 4th segment. Ventral surface of head smooth; with 5 or 6 slender setae behind base of each mandible; gula distinct, elongate; posterior tentorial pits midway between base of head and mandibular articulation. Mandible long, falciform (Fig. 6). Maxillary palpus (Fig. 7) slender, elongate, 4 segmented; basal segment shortest, second segment longest and slender; all segments glabrous. Stipes subquadrate and bearing 1 short seta on mesal surface. Labium (Fig. 8) small, rectangular, with 2 long slender setae on dorsal surface at each anterolateral angle behind insertion of labial palpus; ligula absent; labial palpus slender, 2 segmented, basal segment with 1 ventrolateral seta at midlength and 1 seta medially at apical fifth, ultimate segment with 1 medial seta near base and 1 dorsal, 1 lateral, and 1 ventral seta near apical third.

Pronotum trapezoidal, wider basally; with 4 or 5 long and several short setae near anterolateral angle, 2 or 3 long and several short setae along lateral margin, 5 or 6 long and several short setae at posterolateral angle, numerous long and short setae along basal margin, and numerous short setae scattered over surface. Mesonotum slightly wider than and about half as long as pronotum, with numerous setae along lateral and posterior margins and scattered over surface; setae at

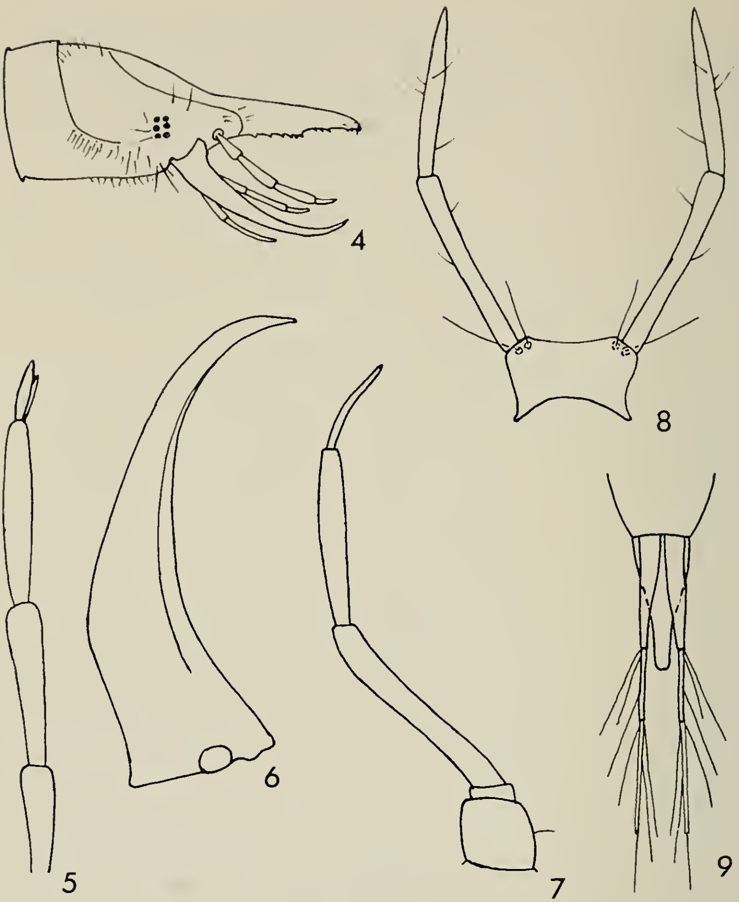
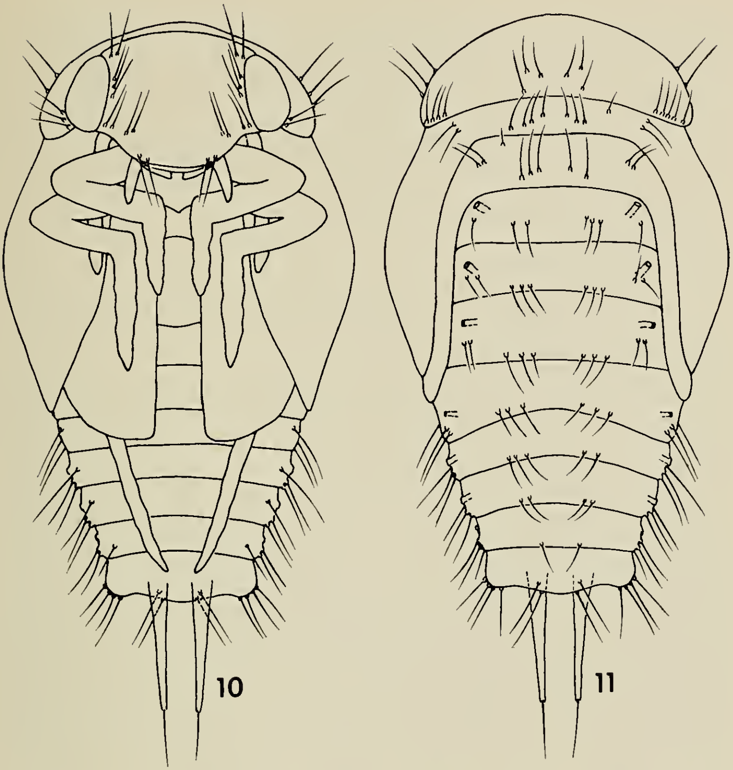


Fig. 4–9. *Hygrotus sayi* Balfour-Browne, last-instar larva: 4, head, lv; 5, antenna, dv; 6, mandible, vv; 7, maxillary palpus, vv; 8, labium, vv; 9, last abdominal segment and cerci, vv. lv = lateral view; dv = dorsal view; vv = ventral view.

posterolateral angles longest; spiracular opening in pleural region below each anterolateral angle of sclerite. Metanotum slightly wider than and about as long as mesonotum; setation similar to mesonotum.

Legs elongate, 5 segmented; coxa long; trochanter about one-third as long as coxa; femur as long as tibia and tarsus combined; tarsus with 2 elongate claws, inner claw slightly more robust and slightly longer than outer claw. Coxa with 1 short seta ventrally at base and 2 small



FIGS. 10, 11. *Hygrotus sayi* Balfour-Browne, pupa: 10, ventral view; 11, dorsal view.

setae and 1 stout long seta on ventrolateral angle and 5 or 6 long setae on dorsolateral angle. Trochanter with 3 small setae on ventral surface. Femur with 3 small setae on upper edge, 1 basal, 1 medial, and 1 apical; ventral surface with 4 long, stout setae; anteroventral angle with 8 or 9 short, stout setae; posteroventral angle with 12 or 13 small, robust setae. Tibia with 3 stout setae on upper surface; ventral surface with 5 or 6 stout setae. Tarsus with 4 stout setae on upper surface and 4 on lower surface.

Abdomen of 8 distinct segments. Segments 1 through 6 with broad, distinct terga; pleural and sternal areas not sclerotized. Segments 7 and 8 completely sclerotized, ringlike. Terga of segments 1 through 7 with setae on lateral margins, across hind margins, and scattered over surface. Segment 8 setose over surface, prolonged posteriorly as a slender cone-shaped segment beneath which are 2 slender cerci (Fig. 9). Cerci without secondary hairs; each cercus of 2 long slender articles; basal article with 3 long slender setae, 2 lateral at basal third and 1 dorsal at apical third; apical article with 3 long slender setae, 2 basoventral and 1 on apex. Lateral margins of abdominal segments 1 through 7 each with a spiracle. Mesopleural, metapleural, and pleural folds of abdominal segments 1 through 6 each with several long setae and numerous short setae. Abdominal segments with numerous short setae scattered over ventral surface.

Pupa: Length (including cerci), 2.6 mm; greatest width, 1.4 mm. Color creamy white except eyes dark reddish brown. Glabrous except for styli described below.

Head (Fig. 10) with 22 styli arranged as follows: 5 along dorsomedial margin of eye, 4 at lower anterior corner of each eye and 2 on each lateral corner of clypeus.

Pronotum (Fig. 11) with 20 styli arranged as follows: 2 on right anterolateral angle, 3 on left anterolateral angle, 5 on right posterolateral angle, 4 on left posterolateral angle and 3 on each side of median line on disc.

On the dorsum of the mesonotum, metanotum, and several of the abdominal segments, the styli are unequal in number on opposite halves of the pupa; therefore a numerical formula is used that gives the number of styli on the left and right side of the midline. The midline is indicated by a -M- between the number of styli. The styli are arranged as follows: mesonotum, 6-M-6; metanotum, 6-M-4; abdominal segment 1, 3-M-4; abdominal segments 2 through 4, 5-M-5; abdominal segment 5, 5-M-4; abdominal segment 6, 4-M-4; abdominal segment 7, 3-M-3; abdominal segment 8, 6-M-6.

Abdominal segment 9, mostly hidden by expanded 8th segment, terminates in 2 cerci longer than length of 8th segment; apex of each cercus bearing a slender elongate seta, one-third as long as cercus.

First through seventh abdominal segments each with a pair of lateral spiracles arranged as follows: segment 1 with large spiracle near anterolateral angle; segments 2, 3, and 4 each with large spiracle close to lateral margin near midlength; segments 5, 6, and 7 each with smaller spiracle in pleural area; spiracle of segment 7 very small.

Antennae directed posteriorly and lie against ventral side of wing pads of elytra. Front and middle femora extend outward at right angles from body axis and lie beneath elytral wing pads. First 2 pairs of legs with tibiae folded against femora; tarsi turned backward parallel with body axis. Hind femora and tibiae hidden between abdomen and pads of hind wings. Each hind leg with femora and tibiae not folded against each other; femora directed obliquely away from midline; tibiae directed obliquely toward midline; tarsi almost parallel with body axis.

Variation: The preceding description refers to a single plesiotype pupa. The number of styli on the four pupae varied considerably as follows: head, 20–22; pronotum, 20–30; mesonotum, 12 to 14; metanotum, 9 to 14; abdominal segment 1, 1 to 6; abdominal segment 2, 9 to 10; abdominal segment 3, 9 to 10; abdominal segment 4, 9 to 10; abdominal segment 5, 8 to 10; abdominal segment 6, 9 to 10; abdominal segment 7, 4 to 7; abdominal segment 8, 8 to 10.

Ecological notes: Other insects found in the algal mats with the adults and larvae of *H. sayi* were adults and larvae of the hydrophilid beetles, *Tropisternus lateralis nimbatus* (Say), *Enochrus californicus* Horn, *Enochrus piceus* Miller, *Helophorus lacustris* LeConte, *Helophorus brevipalpis* Bedel, *Helophorus* spp., and a ceratopogonid, *Bezzia* sp.

The predator relationships in the pond and especially in the algal mat have not been studied. However, the larvae of the hydrophilids listed above are voracious predators. In one instance, a larva of *Tropisternus lateralis nimbatus* was observed feeding on a larva of *H. sayi.*

An interesting association occurs between a peritrich protozoan *Zoothamnium* sp. and the larvae of *H. sayi.* Among 84 larvae examined, 77 or about 92 percent were infested with *Zoothamnium.* In all infestations the stalked protozoans were attached only to the ventral surface of the head of the larvae and near the base of the nasale in front of the buccal cavity. On two specimens, some of the protozoans were attached also to the bases of the maxillary palpi. It has not been established whether this is an example of commensal or mutual symbiosis or a phoretic relationship.

Taxonomic conclusions: Watts (1970) described the larvae of the following seven species of *Hygrotus*: *punctilineatus* (Fall), *tumidiventris* (Fall), *punctatus* (Say), *sellatus* (LeConte), *patruelis* (LeConte), *canadensis* (Fall), and *impressopunctatus* (Schaller). He stated that generic separation of the larvae of *Hygrotus*, *Hydroporus*, and *Deronectes* was impossible. We concur that with the very incomplete knowledge available regarding the larvae belonging to these genera, their separation is not now possible.

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PROCEEDINGS
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EUSTOMIAS CRUCIS (STOMIATOIDEI, MELANOSTOMIATIDAE). A NEW SPECIES OF DEEPSEA FISH FROM THE EASTERN SOUTH PACIFIC, AND CONTRIBUTIONS TO THE KNOWLEDGE OF *EUSTOMIAS TREWAVASAE* NORMAN

By Robert H. Gibbs, Jr. and James E. Craddock
Smithsonian Institution, Washington, D.C. 20560
and Woods Hole Oceanographic Institution,
Woods Hole, Massachusetts 02543[1]

Among the midwater fishes collected in the eastern South Pacific during cruise 13 of the R/V Anton Bruun (Craddock and Mead, 1970) were two species of the genus *Eustomias*. One of these, unfortunately represented by a single specimen, is an undescribed species. The second species is referable to *E. trewavasae* Norman. These are the only two species of *Eustomias* thus far recorded from the eastern South Pacific and the southern portion of the Peru Current. This paper describes the new species and presents new taxonomic and distributional data for *E. trewavasae*.

The cruises of the R/V Anton Bruun were supported by the National Science Foundation. We thank the officers and the crew, especially Shigeru Yano, for their part in the success of those cruises, both in the Indian and Pacific Oceans. Through the kindness of Gerhard Krefft, Gibbs was privileged to participate in the cruise of the FFS Walther Herwig, during which two Atlantic specimens of *E. trewavasae* were caught. For courtesies extended to Gibbs during and after his visits to their museums, we thank N. B. Marshall and A. C. Wheeler, (BMNH) and Jorgen Nielsen (ZMUC). Gerhard

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Krefft (ISH), Myvanwy M. Dick (MCZ), and Robert J. Lavenberg (LACM) lent specimens, and Bruce Hodess (USNM) prepared radiographs. Richard L. Haedrich, Richard H. Backus, and Richard H. Goodyear read and criticized the manuscript. The studies of which this paper is a small part have been supported by the National Science Foundation (G-18001 and GA31365X) and Smithsonian Research Foundation (3309, 3362, 3514).

Museums at which the specimens are located are indicated by the following abbreviations: BMNH, British Museum (Natural History), London; ISH, Institut für Seefischerei, Hamburg; LACM, Los Angeles County Museum; MCZ, Museum of Comparative Zoology, Harvard University; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; ZMUC, Zoologiske Museum, University of Copenhagen. Abbreviations used in the descriptions are: SL, standard length; HL, head length.

Eustomias crucis, new species

Figure 1

Holotype and only known specimen: MCZ 49062, a maturing female, 166.0 mm standard length. R/V Anton Bruun Cruise 13, collection 26, 31°16′S, 92°28′W to 30°59′S, 92°28′W, 0–380 m, 20–21 January 1966, 2014–0138 hours local time, 10 foot (3-m) Isaacs-Kidd midwater trawl.

Diagnosis: A species of *Eustomias* with two pectoral rays and the barbel stem dividing into two main branches.

Description: Dorsal rays 25; anal rays 38; pectoral rays 2; pelvic rays 7. Photophores: IP 7, PV 29, VAV 15, four over anal base, the last over anal ray 8, OV 29, VAL 15, AC 21. Premaxillary teeth on left side 12, depressible except numbers 1, 4, and 8, number 3 longest; on right side 11, depressible except numbers 1, 3, and 7, number 2 longest. Maxilla with small serrae. Mandibular teeth 12 on both sides, depressible except numbers 1, 4, and 7, number 1 longest. No teeth on vomer or palatines. Three pairs of teeth on basibranchials. No gill rakers or teeth. Branchiostegal photophores 11. Notochord U-shaped behind cranium; a neural arch but no centrum just behind cranium; an isolated, vertically oriented centrum with haemal arch on descending part of notochord; about four neural and haemal arches, but no centra, on ascending part or second, slight ventrad bend. A continuous row of 65 well-developed centra posterior to the last isolated neural arch.

Measurements, followed by percent of SL in parentheses: snout to dorsal origin 139.8 (84.2), snout to anal origin 121.7 (73.3), snout to

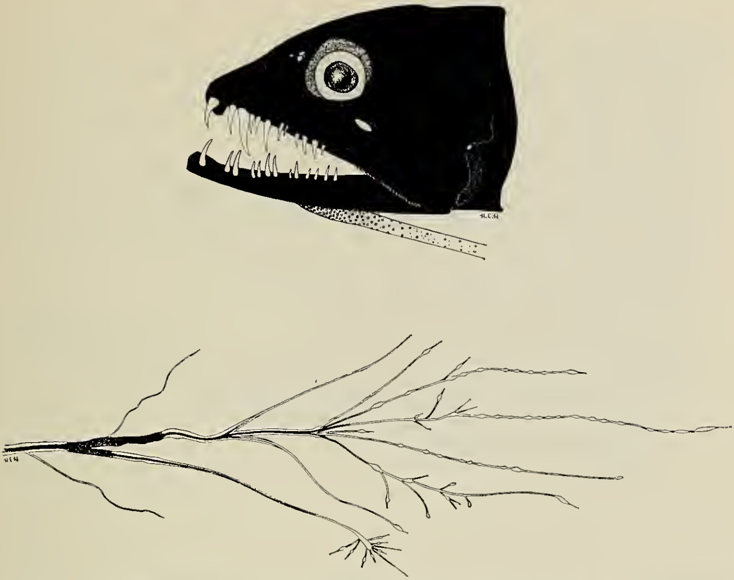

FIG. 1. *Eustomias crucis*, holotype. Head and distal end of barbel. The third mandibular tooth is actually a replacement for the second tooth and is not included in the tooth count. Drawn by Howard E. Hamman.

pelvic insertion 91.6 (55.1), depth behind head 11.0 (6.6), greatest depth 13.2 (8.0), caudal peduncle depth 2.8 (1.7), head length 18.4 (11.1), snout to fleshy orbit 5.9 (3.6, 32.1% of HL), fleshy orbit length 4.6 (2.8, 25.0% of HL), bulb of postorbital organ 1.5 (0.9, 32.6% of fleshy orbit), upper jaw length 16.4 (9.9, 89.1% of HL), longest premaxillary tooth 2.9 (15.8% of HL), longest mandibular tooth 2.1 (11.4% of HL), barbel overall length 103.8 (62.5, 564.1% of HL), barbel stem to junction of two main branches 57.0 (34.3), longer branch overall length 46.8 (28.2), shorter branch length without terminal filaments 23.8 (14.3), pectoral fins broken, the rays closely bound together, pelvic fin length 20.5 (12.3), length of dorsal fin base 21.7 (13.1), length of anal fin base 38.4 (23.1).

Barbel without prominent bulbs, its stem branching into two main distal branches; the longer branch with several smaller branches, some of which contain bulblets; the shorter branch simple until its tip, which ends in a small swelling and several filaments.

Head and body dark brown to black, without organized patches of lighter material. Pectoral fin rays very darkly pigmented; all other fin rays lightly to moderately pigmented, the interradial membranes transparent.

Comparisons: Including *E. crucis*, 15 recognized species of *Eustomias* have two pectoral rays (Morrow and Gibbs, 1964). Of these, *E. crucis* is the only one lacking relatively large bulbs in its barbel. The species in the group that includes *E. bigelowi, binghami, parvibulbus, silvescens, schmidti, fissibarbis,* and *dendriticus* have relatively short barbels with a well-developed terminal bulb and a branch or three branches arising together from the stem well proximal to the terminal bulb. In *E. brevibarbatus* and *polyaster* the barbel has two or more distal bulbs, while in *E. xenobolus, globulifer, leptobolus, macrophthalmus,* and *dubius* the barbel has a single terminal bulb; none of these seven species has prebulbar branches.

When the barbel is intact, the only species that closely resembles *E. crucis* is *E. bifilis*, which normally has three pectoral rays, one of which is slightly separated from the other two. These are the only two known species of *Eustomias* with the stem of the barbel dividing into two main branches. Gibbs has examined more than 100 specimens of *E. bifilis*, which is perhaps the most abundant species of *Eustomias* in Indian Ocean and Pacific equatorial and central waters. The barbel of *E. bifilis* varies only slightly from that illustrated in the original description (Gibbs, 1960). A large number of side branches, as are present on the longer branch of the barbel of *E. crucis*, has never been observed in *E. bifilis*, and *E. bifilis* has a small bulb at or near the distal end of both branches. Comparison of meristic and morphometric characters in these two species suffers from lack of information on variation in *E. crucis*. Nevertheless, the fully developed barbel appears to be longer in *E. crucis* (62.5% SL) than in most *E. bifilis* (23–43% SL; in one specimen of 134 mm, 72% SL). In the holotype of *E. crucis*, there are two more photophores in both the ventral and lateral series than have been observed in *E. bifilis* (72 and 65 vs. 64–70 and 58–63), largely due to high counts in the VAV, VAL, and AC portions (15, 15, and 21 vs. 12–14, 12–15, and 16–20); probably there will be overlap when *E. crucis* becomes better known.

Etymology: The name *crucis* is the genitive form of the Latin noun *Crux*, referring to the Southern Cross, the constellation that watches over the waters inhabited by this fish.

Geographic distribution: The holotype of *E. crucis* was taken at the westernmost of 42 midwater trawling stations that began just off the coast of Valparaiso, Chile (Craddock and Mead, 1970). This suggests that *E. crucis* may belong to the fauna of the South Pacific central waters, a fauna that has been sampled exceedingly poorly.

Eustomias trewavasae Norman

Figure 2

Until now, the only published information on this species has been the original description (Norman, 1930), inclusion in a key to known species of *Eustomias* (Morrow and Gibbs, 1964), and the observation,

FIG. 2. *Eustomias trewavasae,* 178.6 mm female. Head and distal end of barbel. This is one of the few specimens in which the second premaxillary tooth is longer than the first. It is also one of the few in which there are no filaments associated with either of the two proximal bulbs of the barbel. Drawn by Howard E. Hamman.

unsupported by data, that it occurs in the Subtropical Convergence of the Atlantic, Indian, and Pacific Oceans (Gibbs, 1968). We present here an extended description of the species and its geographic range.

Diagnosis: A species of *Eustomias* with three pectoral rays, a low number of serial photophores (IC 65–72, PV 29–32, AC 14–17), a low number of anal rays (31–37), and an unbranched barbel with four distal bulbs.

Description: Meristic characters based on 16 specimens, including the holotype. Dorsal rays 20–26; Anal rays 31–37; Pectoral rays 3; Pelvic rays 7; Photophores in ventral series: IP 7 (or 8), PV 29–32, VAV 14–17, five or six over anal base, the last over anal ray 10 or 11, AC 14–17, IA (series without AC) 51–56, IC (total series) 65–72; in lateral series: OV 30–32, VAL 15–17, OA (series without AC) 46–49, OC (total row including AC) 60–65. Maxilla with small serrae. Premaxillary teeth 8–13, anteriormost tooth usually longest. Mandibular teeth 10–17, second tooth usually longest. No teeth on vomer or palatines. Three pairs of teeth on basibranchials. Branchiostegal photophores 8–11. Notochord U-shaped behind cranium; a neural arch but no centrum just behind cranium; an isolated, vertically-oriented centrum with haemal arch on descending part of notochord. About six neural and haemal arches, but no centra, on ascending part and fairly long following portion, which may be straight or bent ventrad. A continuous row of 59–63 centra posterior to the last isolated neural arch.

Measurements, in percent of SL, from 13 specimens, 45.7–178.6 mm, including the holotype. Snout to dorsal origin 81.6–86.0; snout to anal origin 72.7–76.4; snout to pelvic insertion 57.6–62.5; depth behind head 4.5–7.7; greatest depth 4.5–9.1; caudal peduncle depth 1.5–2.1; head length 12.1–17.0; snout to fleshy orbit in five specimens less than 90 mm, 6.2–8.7 (46.9–51.3% HL), in six specimens longer than 125 mm, 4.2–5.3 (33.1–40.6% HL); fleshy orbit length 2.3–4.0 (17.1–21.8% HL); bulb of postorbital organ in young and females 45.7–178.6 mm, 0.2–0.7 (6.3–26.8% of fleshy orbit), in males 127.3–159.4 mm, 1.4–1.5 (52.9–53.3% of fleshy orbit); upper jaw length 10.5–14.6 (78.1–88.9% HL); longest premaxillary tooth in two specimens less than 60 mm, 2.8 (16.7% HL); in six specimens longer than 70 mm, 1.4–1.9 (11.1–14.2% HL), longest mandibular tooth in six specimens longer than 125 mm, 1.1–1.8 (8.0–14.6% HL); barbel length in two specimens less than 70 mm, 28.9–29.5 (201–237% HL), in eight specimens longer than 70 mm, 44.1–73.3 (336–536% HL); length of largest barbel bulb (usually the first or second) 0.8–1.2 (27.3–44.7% of fleshy orbit), pectoral-fin length in 3 specimens 127.3–141.3 mm, 8.0–10.2; pelvic-fin length 10.5–14.0; length of dorsal-fin base 11.5–14.2, length of anal-fin base in three specimens less than 60 mm, 19.8–22.8, in nine specimens longer than 70 mm, 23.0–24.1.

Barbel with four small distal bulbs, the proximal two (first and second) moderately separated from each other, the distal pair (third and fourth) close together and widely separated from the proximal two. Distalmost bulb commonly constricted, with a broad base and narrower apical lobe. A cluster of short to long filaments usually present at distal end of second bulb (of first bulb in one specimen); several tiny filaments observed at apex of distal bulb in one specimen; no other filaments noted.

Colors of barbel bulbs when freshly caught were observed by Gibbs in two South Atlantic specimens. In the first, the 141.3 mm female, before preservation the first (proximal) bulb was yellowish green, the second pea green, the third dark bluish green, and the fourth (distal) pea green. In the second, the 154.1 mm female that had been in formalin about 8 hours, the first two bulbs were reddish brown, the third bluish green, and the fourth yellowish green. The postorbital photophores in both were white.

Head and body dark brown to black, without organized patches of lighter material. Pectoral- and pelvic-fin rays either very lightly or not pigmented; all other fin rays and all interradial membranes with little or no pigment.

Comparisons: Twelve recognized species of *Eustomias* have three pectoral rays (Morrow and Gibbs, 1964; Johnson and Rosenblatt, 1971). Of these, *E. trewavasae* is the only one with four barbel bulbs. Three other species have two or more such bulbs: *E. bibulbosus* has two; *E. melanostigma* has two or, rarely, three; and *E. polyaster* has more than four. Only in *E. bifilis* is the barbel divided into two branches. The remaining seven species have a single terminal bulb (a few specimens of *E. obscurus* have been observed with two bulbs). When the barbel is intact, identification of *E. trewavasae* presents few difficulties.

Although meristic characters of these species with three pectoral rays are very similar, two groups of species can be separated out on the basis of counts. Four species have low numbers of serial photophores (64–72 in the total ventral series, IC): *E. enbarbatus, bifilis, simplex,* and *trewavasae*. The IC count is 72–80 in the other group of eight species: *E. obscurus, bibulbosus, melanostigma, bulbornatus, polyaster, gibbsi, patulus,* and *longibarba*. The PV portion of the ventral series appears to account for much of the difference: 26–32 in the first group, 30–36 in the second, and the difference is reflected in the anal-ray counts: 31–38 in the first group, 33–46 in the second. The AC photophore count of *E. trewavasae* is distinctly low, 14–17, compared with 16–23 in the other 11 species.

Sexual dimorphism: Sex was determined for 9 specimens: 2 males 127.3–159.4 mm and 7 females 71.2–178.6 mm. Only the largest female had well-developed gonads, with eggs about 0.5 mm in diameter. Two others, 45.7–56.8 mm could not be sexed by gross examination (4 more lacked coelomic organs, and the holotype was not sexed).

Males have a larger postorbital organ than females, about half the diameter of the fleshy orbit as opposed to one-fourth or less of the fleshy orbit diameter in females.

The only other suggested dimorphism, based on only three specimens, is in pelvic-fin length, where the fin is 8.0% of SL in one male, 9.9–10.2% in two females.

Geographic distribution, and variation: Apparently a member of the Subtropical Convergence fauna, *E. trewavasae* has been taken between 33°41′ and 40°14′S in the Atlantic, Indian, and Pacific Oceans.

Although the number of specimens is small, those from the South Pacific (New Zealand to South America) tend to have more photophores and vertebrae than those from the Atlantic and Indian oceans (Table 1). There are no obvious trends that indicate differences between Atlantic and Indian Ocean specimens. These observations suggest that the Pacific population is relatively isolated from those in the Atlantic-Indian Oceans, while the latter two populations experience considerable interchange.

TABLE 1. *Eustomias trewavasae.* Photophores and vertebrae of specimens from three oceans, showing high counts in the Pacific population. Vertebral counts include only those in the continuous series.

	Ventral Photophores (IC)							
	65	66	67	68	69	70	71	72
Atlantic			1	–	–	1	1	
Indian	1	–	–	1	1			
Pacific						3	2	1

	Vertebrae					Lateral Photophores (OC)					
	59	60	61	62	63	60	61	62	63	64	65
Atlantic	1	–	–	1			1	1	1		
Indian	3	2	1			1	1	–	1		
Pacific				4	2					2	2

Vertical distribution: Diel vertical migration is suggested, although none of the thirteen collections was made with a closing device. Maximum depths of three daytime collections were 820 m to ca. 1250 m, of six night collections 50 to 1015 m (only one was deeper than 700 m). Four collections include crepuscular (migration) periods and are not considered. During the day, *E. trewavasae* appears to live deeper than 800 m, while at night it occurs at depths shallower than 700 m.

Material examined: Atlantic Ocean (3 specimens). BMNH 1930.1. 12.531, Holotype (60.4 mm), R/V DISCOVERY sta. 79, 34°48′S, 16°36′W, 0–1000 m, 13 June 1926, 1420–1525 hrs. ISH, 1, female (141.3 mm) FFS Walther Herwig sta. 358/71-III, 39°47′S, 43°30′W, 0–1015 m, 7 March 1971, 2142–2157 hrs. ISH, 1, female (154.1 mm) FFS Walther Herwig sta. 371/71-III, 40°00′S, 30°30′W, 0–700 m, 10 March 1971, 2105–2305 hrs.

Indian Ocean (7 specimens). USNM 201037, 1 (75.7 mm), R/V ANTON BRUUN, cruise 3, trawl 23, 35°09′S, 59°57′W, 0–680 m, 9–10 September 1963, 2300–0140 hrs. USNM 201038, 2 (45.7–56.8 mm) R/V ANTON BRUUN cruise 6, trawl 352 B, 34°14′S, 64°58′E, 0–750 m, 30 June 1964, 1420–2000 hrs. USNM 201036, 1 female (164.2 mm) R/V ANTON BRUUN, cruise 6, trawl 353A, 37°59′S, 64°56′E, 0–2394 m, 2 July 1964, 1115–1925 hrs. MCZ 45992, 3 (56.3–59.7 mm), same data as USNM 200138.

Pacific Ocean (6 specimens). ZMUC P202821, 1 male (159.4 mm), R/V DANA, sta. 3651(1), 35°36′S, 171°52′E, 0–ca. 1250 m, 22 January 1929, 1530 hrs. LACM, 1 female (134.1 mm), USNS ELTANIN, cruise 24, sta. 1738, 40°14′S, 144°45′W, 0–ca. 50 m, 26 July 1966, 0040–0155 hrs. MCZ 49063, 1 female (71.2 mm), R/V ANTON BRUUN, cruise 13, coll. 24, 33°48′S, 90°19′W, 0–2900 m, 19 January 1966, 0300–

0940 hrs. MCZ 49064, 1 female (178.6 mm), R/V Anton Bruun, cruise 13, coll. 22, 33°51'S, 87°49'W, 0–375 m, 18 January 1966, 0013–0530 hrs. MCZ 49065, 1 female (88.5 mm), R/V Anton Bruun, cruise 13, coll. 17, 33°50'S, 82°06'W, 0–370 m, 14–15 January 1966, 2326–0330 hrs. MCZ 49066, 1 male (127.3 mm), R/V Anton Bruun, cruise 13, coll. 40, 33°31'S, 77°29'W, 0–820 m, 28 January 1966, 1113–1440 hrs.

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PROCEEDINGS
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NEW RODENTS (MAMMALIA: CRICETIDAE, MURIDAE) FROM IRAN AND PAKISTAN

By Duane A. Schlitter and Henry W. Setzer
Smithsonian Institution, Washington, D.C. 20560

From 1962 until 1967, collections of mammals were retained as voucher specimens as part of studies on ectoparasites and scrub typhus conducted in Pakistan and Iran. Subsequent examination of these collections of mammals reveals the existence of six undescribed subspecies of rodents which are proposed and described in this paper.

Materials and Methods

All cranial measurements were taken with dial calipers and are in millimeters, weights are in grams and capitalized color terms are from Ridgway "Color Standards and Color Nomenclature" 1912. External measurements are those of the field collector. Hind foot measurements include the claw. Total length and length of tail were taken on the dorsal surface of specimens; the latter measurement with tail held perpendicular to the body.

All specimens are deposited in the National Museum of Natural History (USNM), Smithsonian Institution. Museum catalog numbers listed in the measurements refer to this collection.

Calomyscus bailwardi grandis, new subspecies

Holotype: Adult female, skin and skull, USNM 369548, from 11 km ENE Fasham, Teheran Prov., Iran; obtained 28 June 1965, by Robert G. Tuck, Jr., original no. 1704.

Specimens examined: Twenty-six, as follows: Iran, Teheran Prov., 11 km ENE Fasham, 7; south slopes of Mount Demavend, 8500 ft., 19.

Measurements: Selected external and cranial measurements of the holotype followed by means and extremes of five adult females (341096–097, 341106–107, 341110) and six adult males (341099, 341101, 341103–105, 341112) from the south slopes of Mount Demavend, Iran, are: Total length, 187, 176.8 (173–181), 180.2 (177–183); length of tail, 92, 94.8 (90–99), 96.3 (96–97); length of hind foot, 20, 20.8 (20–21), 21.0 (20–22); length of ear, 21, 19.6 (19–20), 19.8 (19–20); occipitonasal length, 26.8, 26.6 (26.1–27.1), 26.7 (26.4–26.8); zygomatic breadth, 12.7, 12.9 (12.6–13.1), 12.9 (12.7–13.0); breadth of braincase, 12.1, 12.2 (11.9–12.4), 12.1 (11.9–12.5); least interorbital constriction, 3.9, 4.1 (3.9–4.3), 4.0 (3.9–4.1); length of nasals, 10.4, 10.1 (9.8–10.5), 10.0 (9.9–10.2); length of auditory bulla, 4.1, 4.2 (4.0–4.3), 4.4 (4.2–4.5); crown length of maxillary toothrow, 3.4, 3.3 (3.3–3.4), 3.4 (3.3–3.5); palatal length, 13.0, 12.8 (12.6–13.2), 12.6 (12.4–13.0); and length of anterior palatine foramina, 5.1, 5.3 (5.1–5.5), 5.2 (5.0–5.3).

Diagnosis: Entire upper parts Buffy Brown with an admixture of black-tipped hairs, all hairs plumbeous at base; fur soft. Hairs of belly, hands, feet, throat, circumoral region and venter of tail white to bases. Narrow (2 mm) band of Cinnamon Buff hairs dividing dorsal and ventral color of pelage. Dorsal hairs of tail matching hairs of dorsal pelage; tail tufted distally. Pinnae sparsely haired, distal external and two-thirds of internal portion of pinnae Deep Mouse Gray. Eye ring absent. Vibrissae nearly equally divided between black dorsal and white ventral hairs. Skull long and broad; rostrum long and relatively narrow; maxillary toothrow narrow and relatively short; length of palate long.

Comparisons: *Calomyscus bailwardi grandis* differs from *C. b. elburzensis* Goodwin, 1939, from northeastern Iran by having grayish pelage and larger overall external size, especially total length. The skulls can be separated by the larger size of *C. b. grandis*. In addition, the new subspecies has longer nasals, relatively shorter toothrow, longer palatal length and longer anterior palatine foramina than *C. b. elburzensis*.

Specimens of *C. b. mystax* Kashkarov, 1925, have not been examined but judging from published reports, this subspecies is near to *C. b. elburzensis*. *C. b. grandis* appears to be larger both externally and cranially and gray rather than pinkish brown in pelage color. The length of the maxillary toothrow of *C. b. mystax* would be relatively longer than those of the new subspecies.

From representatives of the nominate subspecies from southwestern Iran, *C. b. grandis* can be distinguished by its larger size and gray pelage with only a slight trace of the pinkish color characteristic of *C. b. bailwardi* Thomas, 1905. The long tail and hind feet of *C. b. grandis* separate these two subspecies. Cranially, the long, narrow skull of the new subspecies is larger in nearly all measurements taken than the nominate subspecies. The long and relatively narrow rostrum of *C. b. grandis* separates it at once from the short, broad rostrum of *C. b. bailwardi*

Examples of *C. b. hotsoni* Thomas, 1920, are small for the species, both externally and cranially, and are easily separable from *C. b. grandis* by their smaller size. In addition, the black-tipped, pale, yellow-brown pelage of *C. b. hotsoni* contrasts markedly with the gray pelage of *C. b. grandis*.

Other named subspecies of *Calomyscus bailwardi* are geographically far removed from *C. b. grandis* and need not be compared.

Remarks: Specimens of *Calomyscus bailwardi grandis* were taken in snap traps set on a rocky hillside and along the rock wall of a garden at the Fasham locality. On Mt. Demavend, individuals were caught in snap traps placed on vegetated rocky outcroppings along crests of hills radiating from the flanks of the main mountain. As with other subspecies of *Calomyscus bailwardi*, this subspecies prefers rocky habitats.

Etymology: The name *grandis* refers to the large size of this new subspecies.

Alticola roylei parvidens, new subspecies

Holotype: Adult male, skin and skull, USNM 413551, from 20.5 mi N Dir, 10,400 ft., Dir State, West Pakistan; obtained 28 September 1966, by Carlton J. Philipps, original no. 744.

Specimens examined: Twenty-six, as follows: West Pakistan: Swat State, Utror, 7600 ft., 1; 6 mi SW Utror, 7; 3 mi S Kalam, 1. Dir State, 20.5 mi N Dir, 10,400 ft., 7; 20 mi N Dir, 10,200 ft., 5; 16 mi N Dir, 5.

Measurements: Selected external and cranial measurements of the holotype followed by means and extremes of two adult males (413541, 413548) from 16 mi N Dir, two adult males (413546, 413548) from 20 mi N Dir and one adult male (413562) from 6 mi SW Utror and in turn followed by measurements of a young adult female (413553) from 20.5 mi N Dir, all from Pakistan, are: Total length, 167, 163.2 (159–169), 154; length of tail, 55, 50.8 (49–54) 50; length of hind foot, 23, 21.6 (20–23), 20; length of ear, 18, 18.4 (17–20), 17; occipitonasal length, 27.8, 27.6 (27.1–28.0), 26.7; condyloincisive length, 26.7, 26.8 (26.5–27.4), 25.9; zygomatic breadth, 14.8, 14.7 (14.4–15.3), 14.1; least interorbital breadth, 3.8, 3.8 (3.6–4.0), 3.8; postzygomatic breadth, 11.9, 11.6 (11.5–11.7), 11.7; length of nasals, 8.5, 8.1 (7.9–8.5), 8.0; oblique length of auditory bulla, 8.0, 7.9 (7.8–8.0), 7.2; crown length of maxillary toothrow, 5.9, 5.8 (5.7–6.0), 5.4; length of anterior palatine foramina, 5.4, 5.4 (5.3–5.6), 5.5; and length of palate, 13.8, 14.1 (13.7–14.5), 13.5.

Diagnosis: Entire upper parts Hair Brown with red-brown cast, bases of all hairs Slate Color; fur soft. Hairs of belly and throat tipped with Ochraceous-Buff, bases of all hairs Slate. Hairs of hands and feet white to bases. Tail bicolored; dorsally same color as dorsum of body and ventrally, hairs of mixed white and Ochraceous-Buff. Pinnae well haired, externally same color as dorsum of body; internal outer edge covered with hairs of same color as external surface. Eye ring absent.

Vibrissae nearly equally divided between black dorsal and white ventral hairs. Skull relatively short and rugged; bullae relatively large, well inflated; rostrum relatively short and broad; maxillary toothrow relatively short, posterior loop of M^3 small resulting in a narrow and short M^3.

Comparisons: From specimens of *Alticola roylei blanfordi* Scully, 1880, from northern Pakistan and northwestern Baltistan, *Alticola roylei parvidens* can be distinguished externally by buffy-tipped ventral pelage, darker more reddish-brown dorsal pelage and more bicolored tail. Cranially, this new subspecies has a shorter, more rugged skull and shorter toothrow than *A. r. blanfordi*. The posterior loop of M^3 is small thus giving *A. r. parvidens* a narrow and short third upper molar.

Alticola roylei parvidens can be separated from *A. r. glacialis* Miller, 1913, from central Baltistan by the darker, reddish-brown dorsal and buffy ventral color and bicolored tail of the former. Cranially, *A. r. parvidens* has larger, more inflated bullae than *A. r. glacialis*. The well-haired, white tail of *A. r. glacialis* will separate the two subspecies immediately.

From the holotype of *A. r. albicauda* (True, 1894) from the Braldu Valley, Baltistan, *A. r. parvidens* differs by being darker, more reddish brown rather than pale brown, having a moderately haired bicolored long tail rather than a white, well-haired short tail.

The holotype and type-series of *Alticola roylei acmaeus* Schwarz, 1939, from near Leh, Kashmir, differs from *A. r. parvidens* by having a short, white, well-haired tail; long, thick grayish dorsal pelage; and white-tipped ventral fur. The skull of *A. r. acmaeus* is smaller with small, relatively uninflated bullae.

Alticola roylei parvidens can be distinguished externally from *A. r. montosa* (True, 1894) from northeastern Pakistan and western Kashmir by a slightly more blackish cast to the reddish-brown dorsal fur, the buffy tips of the ventral pelage, and less marked bicolored tail. Cranially, *A. r. parvidens* has a shorter, broader rostrum; more parallel-sided mesopterygoid fossa; and larger, more inflated auditory bullae than *A. r. montosa*.

Remarks: Ellerman (1947:276) reported *Alticola roylei montosa* from Safed Koh, North West Frontier; this locality is near Parachinar according to Siddiqi (1961:223). Judging from the distribution of *A. r. montosa* in Pakistan, this population is doubtfully referable to this subspecies but might possibly be *A. r. parvidens*. The Safed Koh Mountains are an extension into Pakistan of mountains in Afghanistan and the *Alticola roylei* there are undoubtedly related to those found in Afghanistan. Whether the Safed Koh and the Afghanistan populations are *A. r. parvidens* or some other subspecies, perhaps undescribed, remains to be ascertained.

Alticola roylei parvidens were trapped among rocks in conifer forests.

Etymology: The name *parvidens* refers to the small teeth of this taxon.

Gerbillus cheesmani aquilus, new subspecies

Holotype: Adult male, skin and skull, USNM 354623, from 60 km W Kerman, Kerman Province, Iran; obtained 8 December 1964, by Robert G. Tuck, Jr., original no. 1222.

Specimens examined: Forty-two, as follows: Iran: Kerman Prov., 60 km W Kerman, 9; 10 km N Mahan, 22 km SE Kerman, 2; 60 km SW Iranshahr, 19; 50 km W Iranshahr, 8; 30 km SW Iranshahr, 4.

Measurements: Averages and extremes of selected external and cranial measurements of 11 (extreme followed by sample size if less than 11) adult males from 60 km W Kerman (354621, 354623, 354626–628), 22 km SE Kerman (329073), 50 km W Iranshahr (328043–044, 328047), 60 km SW Iranshahr (354614) and 30 km SW Iranshahr (354620), with the measurements of the holotype in brackets followed by nine (extreme followed by sample size if less than nine) adult females from 60 km SW Iranshahr (354609–613, 354615–618), Iran, are, respectively: Total length, 238.0 (227–254) [227] 224.8 (216–231); length of tail, 135.3 (124–151) [124] 131.9 (122–137); length of hind foot, 30.8 (30–32) [30] 29.6 (28–30); length of ear, 14.9 (14–17) [14] 13.4 (13–14); occipitonasal length, 30.8 (30.1–31.8) 9 [31.3] 28.7 (28.0–29.2) 8; zygomatic breadth, 16.6 (16.1–17.1) 10 [16.7] 15.5 (15.1–15.9) 8; breadth of braincase, 14.4 (13.9–14.9) [14.7] 13.8 (13.5–13.9) 7; least interorbital breadth, 5.7 (5.1–6.2) [6.2] 5.2 (5.0–5.3); length of nasals, 11.3 (10.6–12.1) 10 [11.3] 10.3 (10.0–10.8) 8; oblique length of audital portion of auditory bulla, 9.9 (9.6–10.2) 10 [10.1] 9.4 (9.2–9.6) 8; crown length of maxillary toothrow, 3.7 (3.4–4.0) [3.7] 3.5 (3.3–3.7); greatest crown breadth of M^3–M^3, 4.8 (4.4–5.0) [4.8] 4.6 (4.4–4.8); length of anterior palatine foramina, 4.5 (4.3–4.8) [4.7] 4.2 (4.1–4.3); length of posterior palatine foramina, 2.1 (1.9–2.5) [1.9] 2.1 (1.9–2.2); and height of skull, 12.6 (12.2–12.9) 9 [12.9] 11.9 (11.7–12.1) 5.

Diagnosis: Upper parts near Cinnamon with admixture of black-tipped hairs, becoming interspersed with white hairs on sides and pectoral areas. Postorbital areas, postauricular areas, circumoral region, entire under parts, and ventral and dorsal hairs of hands and feet white. Pinnae Cinnamon-Buff, finely covered with buffy hairs on anterior margin, margin of pinnae black. Tail indistinctly bicolored Pinkish Buff ventrally and Light Pinkish Cinnamon dorsally terminating in a distinct dorsal pencil of Mouse Gray hairs. Vibrissae long, dorsal hairs black and ventral white. Skull large in size and robust; auditory bullae inflated; zygomata heavy; basioccipital constricted anteriorly and forming distinct foramina near medial margins of auditory bullae; mastoidal portion of bullae inflated, projecting well beyond occiput; rostrum broad.

Comparisons: From specimens of *Gerbillus cheesmani cheesmani* Thomas, 1919, from 10 mi S and 14 mi S of Kuwait, Kuwait, *Gerbillus cheesmani aquilus* differs in having more inflated auditory bullae, more anteriorly constricted basioccipitals, larger foramina between the basioccipitonasal and the auditory bullae, narrower pterygoid hamulae, greater occipitonasal length, greater zygomatic breadth, greater breadth of braincase, greater interorbital breadth, greater total length and greater length of tail. The nominate subspecies is more golden in color and lacks the dusky color of the dorsum of *G. c. aquilus*. The tail of *G. c. aquilus* possesses a relatively well-developed dark pencil compared to the slightly developed one on *G. c. cheesmani*.

For comparison with *Gerbillus cheesmani subsolanus*, see the following account.

Remarks: There is a broad hiatus in the distribution of this gerbil in Iran from the locality 19 km S Shush reported by Lay (1967:173) and the one 60 km W Kerman reported here. Numerous localities were visited in the intervening area during 2 different years but only *Gerbillus nanus* was trapped in that area. The geographic relationship between the plateau populations of central and eastern Iran and the plains populations of southwestern Iran and southern Iraq is unclear. Perhaps this species occurs in suitable sandy habitats along the Persian Gulf.

Etymology: The name *aquilus* refers to the swarthy, dusky color of the dorsal pelage of this new subspecies.

Gerbillus cheesmani subsolanus, new subspecies

Holotype: Adult female, skin and skull, USNM 369335, from 56 km E Nok Kundi, Kalat Division, Pakistan; obtained 3 February 1965, by Robert G. Tuck, Jr., original no. 1283.

Specimens examined: Forty-four, as follows: Iran: Kerman Prov., 85 km N Zahedan, 13. Pakistan: Kalat Division, 56 km E Nok Kundi, 24; 10 km E Dalbandin, 4; 25 km SW Noshki, 3.

Measurements: Averages and extremes of selected external and cranial measurements of nine (extreme followed by sample size if less than nine) adult males from 56 km E Nok Kundi (369317, 369319, 369330, 369333, 369336–338) and 10 km E Dalbandin (369340, 369342), with the measurements of the type in brackets followed by seven (extreme followed by sample size if less than seven) adult females from 56 km E Nok Kundi (369318, 369320–321, 369325, 369335) and 10 km E Dalbandin (369339, 369341), Pakistan, are, respectively: Total length, 236.6 (223–248) [242] 224.9 (213–242); length of tail, 135.9 (128–143) [136] 127.1 (122–136); length of hind foot, 29.3 (26–31) [31] 28.7 (28–31); length of ear, 14.3 (13–16) [15] 14.3 (13–15); occipitonasal length, 29.8 (28.7–30.9) 8 [30.8] 29.3 (27.1–30.8); zygomatic breadth, 16.1 (15.5–16.9) 8 [16.2] 15.9 (15.2–16.4); breadth of braincase, 14.4 (13.7–14.8) [14.3] 14.2 (13.8–14.3); least interorbital breadth, 5.6 (5.3–6.0) [6.0] 5.7 (5.5–6.0); length of nasals, 10.8 (10.1–11.6) [11.9] 10.7 (9.5–11.9); oblique length of audital portion of auditory bulla, 10.1 (9.8–10.5) [10.0] 9.9 (9.6–10.3); crown length of maxillary toothrows, 3.7 (3.6–3.8) [3.7] 3.6 (3.5–3.8);

greatest crown breadth of M^3–M^3, 4.7 (4.4–5.0) [4.3] 4.7 (4.3–5.2); length of anterior palatine foramina, 4.3 (4.0–4.6) [4.0] 4.2 (3.7–4.6); length of posterior palatine foramina, 2.1 (1.5–2.5) [2.5] 2.2 (1.9–2.5); and height of skull, 12.3 (12.1–12.6) [12.5] 12.2 (11.8–12.7) 6.

Diagnosis: Upper parts near Pinkish Cinnamon with admixture of black-tipped hairs, becoming interspersed with white hairs on sides. Postorbital and postauricular areas, circumoral region, entire under parts and ventral and dorsal hairs of hands and feet white. Pinnae Cinnamon-Buff, finely covered with white and buffy hairs along anterior margin; margin of pinnae black. Tail indistinctly bicolored, Pale Pinkish Buff ventrally, and Pinkish-Buff dorsally terminating in a distinct dorsal pencil of Mouse Gray hairs. Vibrissae long, dorsal hairs black and ventral white. Skull moderately large in size and robust; auditory bullae inflated; zygomata moderately heavy; mastoidal portion of bullae weakly inflated for species, barely projecting beyond occiput; rostrum narrow; nasals narrow; anterior palatine foramina short and narrow, pointed anteriorly.

Comparison: From specimens of *Gerbillus cheesmani cheesmani* Thomas, 1919, from 10 mi S and 14 mi S Kuwait, Kuwait, *Gerbillus cheesmani subsolanus* can be distinguished by having more inflated auditory bullae, narrower pterygoid hamulae, greater breadth of braincase, greater interorbital breadth, greater total length and greater length of tail. In color, *Gerbillus cheesmani subsolanus* is darker and lacks the pure golden color characteristic of the nominate subspecies. The dark, penicillate tip of the tail in *G. c. subsolanus* is lacking in *G. c. cheesmani.*

Gerbillus cheesmani subsolanus differs from *Gerbillus gleadowi* Murray, 1886, as known from specimens 3 mi W Dera Ghazi Khan, Pakistan, by having a greater occipitonasal length, greater zygomatic breadth, greater breadth of braincase, shorter oblique length of audital portion of auditory bulla, greater ventral and dorsal inflation of the audital portion of the auditory bullae, and greater length of head and body. In color, *G. c. subsolanus* and *G. gleadowi* are similar. Both have a suffusion of black in the color of the dorsal hairs, a distinctly penicillate tail and white underparts. From above *G. gleadowi* appears slightly more streaked due to the concentration of black towards the center of the dorsum. In addition, *G. gleadowi* differs from *G. c. subsolanus* by having a distinctly bicolored tail, the color of the dorsum nearly matching the color of the dorsal hairs of the body but the venter is paler being nearly white in some individuals.

Gerbillus cheesmani subsolanus differs from *Gerbillus cheesmani aquilus* in having less inflated auditory bullae, less anteriorly constricted basioccipitals, smaller foramina between the basioccipital and the auditory bullae, broader pterygoid hamulae, slightly shorter nasals, narrower and posteriorly less rounded anterior palatine foramina, and less inflated mastoidal bullae. In color, *G. c. aquilus* is darker, more dusky dorsally, than is *G. c. subsolanus*; the dorsal color of the tail and its tip is darker in *G. c. aquilus* than in *G. c. subsolanus.*

Remarks: The specimens from 85 km N Zahedan, Iran, are paler in color than are the specimens of this subspecies from Pakistan and show less suffusion of black dorsally. However, the skulls are indistinguishable from those of specimens from Pakistan.

Even though numerous localities were visited in the south of the Baluchistan portion of Pakistan, only *Gerbillus nanus* was taken there.

Etymology: The name *subsolanus* refers to the eastern position of this subspecies in the geographic range of *Gerbillus cheesmani.*

Meriones erythrourus farsi, new subspecies

Holotype: Adult male, skin and skull, USNM 329186, from 3 km N Bariz, 50 km N Lar, Fars Province, Iran; obtained 27 March 1963, by Gary L. Ranck, original number 3911.

Specimens examined: One hundred forty-four, as follows: Iran: Fars Prov., 13 km SE Shiraz, 1; 71 km SE Shiraz, 2; 8 km W Estahbanat, 1; 11 km NW Darab, 9; 41 km S Fasa, 29; 32 km SE Jahrom, 6; 19 km S Mansorabad, 56; 3 km N Bariz, 50 km N Lar, 4; 4 km N Lar, 36.

Measurements: Selected external and cranial measurements of the holotype followed by an adult male (USNM 329187) and an adult female (USNM 329184) from the type-locality are: Total length, 289, 284, 278; length of tail, 140, 150, 140; length of hind foot, 35, 35, 32; length of ear, 19, 18, 16; occipitonasal length, 43.0, 40.3, 39.0; condyloincisive length, 39.2, 37.0, 36.1; zygomatic breadth, 23.0, 21.5, 21.3; breadth of braincase, 19.2, 19.7, 18.3; least interorbital breadth, 6.7, 6.8, 6.4; length of nasals, 16.6, 14.8, 15.4; oblique length of audital portion of auditory bulla, 15.0, 14.5, 14.8; crown length of maxillary toothrow, 5.0, 4.7, 4.7; length of anterior palatine foramina, 7.5, 7.1, 7.0; and length of posterior palatine foramina, 2.4, 1.6, 2.2.

Diagnosis: Upper parts of body pale for the species, between Light Ochraceous-Buff and Cinnamon-Buff with tips of hairs black, proximal two-thirds of hairs plumbeous; sides becoming paler with gradual transition to white on belly and throat. Postauricular areas and circumoral region white. Dorsal hairs of hind and forefeet Pinkish Buff. Hairs of external pinnae Light Ochraceous-Buff; hairs of internal surface near Pale Pinkish Buff. Tail not bicolored, Cinnamon-Buff in color with penicillate tip of mixed long white and black hairs. Vibrissae long, dorsal hairs black and ventral white. Small Cinnamon-Buff patch on each side of nose. Skull large in size and robust; zygomata heavy; auditory bullae well inflated; nasals relatively long; maxillary toothrow relatively long.

Comparisons: From specimens of *Meriones erythrourus caucasius* Brandt, 1855, from 27 km N Abadeh and 150 km N (by road) Isfahan, Iran, *Meriones erythrourus farsi* can be distinguished by its paler dorsal color, especially lacking in reddish tinge, paler tail, less development of a black pencil on the tail, large skull, heavy zygomata, large teeth and long toothrow.

Meriones erythrourus farsi differs from *M. e. irani* Goodwin, 1939, as known from numerous localities in northeastern and eastern Iran by having paler dorsal fur with less reddish color and suffusion of black in the hairs, paler colored tail, and less development of a black pencil. Cranially the two subspecies are similar, both having large skulls with large teeth and heavy zygomata.

The two subspecies compared above are the only ones bordering on the range of *Meriones erythrourus farsi. Meriones erythrourus syrius* Thomas, 1919, occurs in Iraq but is separated geographically from *M. e. farsi* by *M. e. caucasius.*

Remarks: With the present nomenclatural confusion in northeastern Africa concerning *Meriones libycus* Lichtenstein, 1823, and *Meriones shawi* (Duvernoy and Lereboullet, 1842) (Setzer, 1961:88, Ranck, 1968:161, 183), we choose to retain the oldest name available for the Asian population [*M. erythrourus* (Gray, 1842)] at this time, pending a more detailed study of North African *Meriones* and a revision of the genus.

Both Heptner (1940) and Ellerman (1948) reported the occurrence of *Meriones erythrourus* from Khuzistan province, Iran. These specimens have not been examined but probably represent either *M. e. caucasius* or *M. e. syrius.*

Of the 144 specimens of this subspecies examined, only 10 specimens were classed as adults and used in the description. Most of the individuals taken were subadults. Thus comparisons were made between comparable aged samples of subadults and young adults of each subspecies as well.

Etymology: The subspecies name *farsi* refers to the province of that name in Iran from which the specimens were obtained.

Nesokia indica chitralensis, new subspecies

Holotype: Adult male, skin and skull, USNM 354362, from 4 mi N Chitral, approx. 4800 feet, Chitral State, Pakistan; obtained 18 August 1964; by Ronald H. Pine, original no. 2496.

Specimens examined: Ten, as follows: Pakistan: Chitral State, 4 mi N Chitral, ca. 4800 ft., 6; 10 mi N Chitral, ca. 5100 ft., 1. Dir State, Dir, 4400 ft., 3.

Measurements: Selected external and cranial measurements of the holotype followed by those of an adult female (354368) from 10 mi N Chitral and an adult female (413713) from Dir, Pakistan, respectively, are: Total length, 316, 295, 295; length of tail, 117, 108, 110; length of hind foot, 42, 38, 34; length of ear from notch, 21, 21, 22; occipitonasal length, 44.8, 42.5, 42.1; condylobasal length, 46.2, 43.9, 43.5; zygomatic breadth, 29.0, 27.8, 28.2; breadth of braincase, 18.6, 18.2, 17.7; least interorbital breadth, 6.5, 6.3, 5.7; length of nasals, 15.9, 14.5, 13.6; oblique length of auditory bulla, 7.6, 6.9, 7.7; crown length of maxillary toothrow, 7.7, 7.4, 7.0; and length of anterior palatine foramina, 5.3, 4.9, 5.2.

Diagnosis: Entire upper parts brindled, between Hair Brown and Cinnamon-Drab with reddish-brown cast near midline of back and head; fur coarse and stiff. Dorsal pelage of hands and feet Mummy Brown with white hairs on phalanges. Tail unicolored, black. Belly near Hair Brown but lacking reddish-brown cast; white spot, of varying size, on chest. Pinnae sparsely haired; hairs varying from brownish to white on external surface and white hairs present on internal surface. Skin of pinnae near Blackish-Brown (2). Vibrissae divided nearly equally between black dorsal and white ventral hairs. Skull large with broad braincase; nasals long; auditory bullae relatively as well as actually small and uninflated.

Comparisons: From representatives of the nominate subspecies, *Nesokia indica chitralensis* can be distinguished by its much larger skull, small and uninflated auditory bullae, and long nasals. Skins of *N. i. chitralensis* are darker with more suffusion of black than are those of *N. i. indica* (Gray, 1830). The skins also lack the reddish-brown tint and soft pelage characteristic of the nominate subspecies.

The new subspecies differs from *N. i. huttoni* (Blyth, 1846) by having dark, coarse pelage with black-tipped guard hairs as opposed to the pale brown, soft pelage with pale tipped guard hairs of *huttoni.* The skulls can be separated by the small and uninflated auditory bulla, shorter maxillary toothrow, and broader, more rounded braincase of *N. i. chitralensis.*

Nesokia indica indica and *N. i. huttoni* are the only currently recognized subspecies near *N. i. chitralensis* that need comparison. Judging from published measurements, the Russian subspecies, *N. i. satunini* Nehring, 1899, and *N. i. boettgeri* Radde and Walter, 1889, would differ from the new subspecies in the same manner as does *N. i. huttoni.* The status of *N. i. scullyi* Wood-Mason, 1876, and *N. i. brachyura* Büchner, 1889, both from Chinese Turkestan, is uncertain at this time. It is doubtful, however, that gene flow between these latter two subspecies and *N. i. chitralensis* would exist across the higher elevations of the Himalayas, an area in which *Nesokia* is not known, nor expected, to occur.

Remarks: *Nesokia indica chitralensis* was taken in moist habitats in agricultural areas, particularly rice fields, in the vicinities of Chitral and Dir.

The southern limits of this new subspecies are not known, but it should be expected in Afghanistan along the Kunar and Kabul rivers near the Pakistan border.

Specimens from Dir have a softer, more reddish pelage than do those from north of Chitral. However, the skulls of the Dir individuals are indistinguishable from the Chitral specimens and the texture and color of the pelage of the Dir animals is nearer to *Nesokia indica chitralensis* than to *N. i. indica* or *huttoni.*

Etymology: The subspecies name *chitralensis* refers to the name of the State in Pakistan from which the type series was taken.

ACKNOWLEDGMENTS

We thank Dr. Robert W. Traub for depositing at the Smithsonian Institution the mammalian voucher specimens resulting from the work in Pakistan by personnel of the Department of Microbiology, School of Medicine, University of Maryland, and the Pakistan Medical Research Center, Lahore, and for making these specimens available to us for study. A special acknowledgment must be given to the many individuals from Iran, Pakistan, and the United States who did the field work and to the many persons who helped curate the collections at the Smithsonian Institution.

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PROCEEDINGS
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THE SYSTEMATIC STATUS OF *PEROGNATHUS MERRIAMI* ALLEN

By Don E. Wilson
Bird and Mammal Laboratories, National Museum of Natural History, Washington, D.C. 20560

In 1892, J. A. Allen named *Perognathus merriami* on the basis of 17 silky pocket mice from the vicinity of Brownsville, Texas. He compared this material with specimens of *P. flavus* from El Paso and concluded that they represented distinct species. He also figured six skulls of *P. merriami* and three of *P. flavus*.

Allen used the following characters to distinguish *P. merriami* from *P. flavus*: ". . . brighter and more yellowish in coloration, the sides being strongly yellowish or golden instead of pale cinnamon. . . . generally brighter yellowish color, particularly along the sides. . . . the skull is much larger and disproportionately broader in proportion to the length. The mastoids are shorter and less developed, leaving a much broader intermastoid area, with the interparietal much broader than long, instead of nearly square as in *P. flavus*."

W. H. Osgood (1900), in his revision of the genus *Perognathus*, named *Perognathus merriami gilvus* based on three specimens from west Texas and four from Eddy (= Carlsbad), New Mexico. Osgood recognized the difficulty of separating his specimens from *P. flavus*: "This subspecies combines to some extent the characters of *flavus* and *merriami*."

I have studied more than 250 specimens of *P. merriami* and *P. flavus*, including the types of *P. merriami*, *P. merriami gilvus*, *P. flavus bimaculatus*, *P. f. fuliginosus*, *P. f. hopiensis*, *P. f. mexicanus*, *P. f. piperi*, and *P. f. sonoriensis*. I report here the results of a discriminant function analysis which leads me to believe that *P. merriami* and *P. flavus* are conspecific.

FIG. 1. Map showing collecting localities of *Perognathus merriami* ■, *Perognathus flavus* ●, and *Perognathus merriami gilvus* ▲. Ⓐ indicates locality of supposed sympatry of *P. flavus* and *P. m. gilvus.*

METHODS

Figure 1 shows the specimen localities listed in Table 1. All specimens are study skins, skulls, or both. A total of 24 characters was used in the discriminant function analysis;

TABLE 1. Samples of *Perognathus* examined

Sample Locality	Used in Multivariate Analysis	Additional
Perognathus merriami gilvus		
Mexico, Coahuila, 15SE Langtry, Texas	1	1
New Mexico, Carlsbad	5	
New Mexico, Roswell, 40W		1
New Mexico, Tucumcari, 25W	1	1
Texas, Presidio Co.	1	
Texas, Langtry	4	4
Texas, Comstock	3	
Texas, Stanton	1	
Texas, Washburn	2	
Texas, Big Springs	1	
Texas, Fort Lancaster	4	3
Texas, Marathon, 15S		1
Texas, Marathon		1
Texas, Boquillas	1	2
Texas, Juno, 20E	1	
Texas, Rock Spring		1
Texas, Japonica, 15W		1
Texas, Howard, 5S	1	
Texas, Monahans	3	3
Texas, Comstock, 10S	1	
Texas, Van Horn	1	
Texas, Samuels	1	1
Texas, Eagle Pass		1
Texas, Mobeetie	1	1
Texas, Kermit, E	8	1
Texas, Magic City, 1N	1	
Subtotals	42	23
Perognathus merriami merriami		
Mexico, Coahuila, Monclova	2	
Mexico, Coahuila, Sabinas		3
Mexico, Coahuila, Saltillo		1
Mexico, Nuevo Leon, Linares	1	
Mexico, Nuevo Leon, Doctor Cos	1	
Mexico, Nuevo Leon, Aldama		2
Mexico, Tamaulipas, C. Victoria	4	5
Mexico, Tamaulipas, Hidalgo	5	2
Mexico, Tamaulipas, Mier	3	2
Mexico, Tamaulipas, Matamoros, 10S	2	
Mexico, Tamaulipas, Reynosa		3
Mexico, Tamaulipas, Alta Mira		1

TABLE 1. (Continued)

Sample Locality	Used in Multivariate Analysis	Additional
Mexico, Tamaulipas, Nuevo Laredo	2	3
Mexico, Tamaulipas, Camargo	1	2
Mexico, Tamaulipas, Soto La Marina	2	
Texas, Brownsville	29	2
Texas, Blocker Rancho		1
Texas, Rio Grande City		1
Texas, Padre Island	1	2
Texas, Santa Rosa	4	6
Texas, Kerrville		3
Texas, Brownsville, 20E		1
Texas, Mason		1
Subtotals	57	41
Perognathus flavus flavus		
Mexico, Chihuahua, Gallego		1
Mexico, Chihuahua, Chihuahua	2	8
Mexico, Chihuahua, Escalon	1	1
New Mexico, Deming		2
New Mexico, Chico Springs		1
New Mexico, Dog Spring		1
New Mexico, Carrizozo	4	
New Mexico, Tularosa	4	1
New Mexico, Santa Rosa	6	1
New Mexico, Ribera		1
New Mexico, Mesa Jumanes	1	
New Mexico, Manzano Mtns.	3	3
New Mexico, Grants	3	
New Mexico, Carlsbad	1	1
New Mexico, Rio Puerco		1
New Mexico, Quemado, 10SW	1	
New Mexico, Glenwood	1	
New Mexico, Laguna		2
New Mexico, Hachita		1
New Mexico, Playas Valley	1	
New Mexico, Gila National Forest, Diamond Creek	1	
New Mexico, Fairview		1
New Mexico, Reserve, 5NE		1
New Mexico, Vaughn, 5W	1	1
Texas, El Paso	1	4
Texas, Sierra Blanca		1
Texas, Valentine	1	
Texas, Alpine		1
Subtotals	32	34

TABLE 1. (Continued)

Sample Location	Used in Multivariate Analysis	Additional
Perognathus flavus medius		
Mexico, San Luis Potosi, Hacienda La Parada	1	2
Mexico, San Luis Potosi, Jesus Maria	1	2
Perognathus flavus bunkeri		
Colorado, Loveland	1	8
Perognathus flavus hopiensis (type)		
Arizona, Oraibi	1	
Perognathus flavus mexicanus (type)		
Mexico, Distrito Federal, Tlalpam		1
Perognathus flavus piperi (type)		
Wyoming, Newcastle	1	
Perognathus flavus sonoriensis (type)		
Mexico, Sonora, Costa Rica Ranch		1
Perognathus flavus fuliginosus (type)		
Arizona, San Francisco Mtn.		1
Perognathus flavus bimaculatis (type)		
Arizona, Fort Whipple		1
Subtotals	5	16
Totals	136	114

nine were skull characters measured to the nearest .05 mm with dial calipers, eight were skin measurements or scores, and seven were ratios (Table 2). The characters used were as follows:

Occipitonasal length.—Medial distance from the tip of the nasals to the posteriormost margins of the condyles.

Frontonasal length.—Medial distance from the tip of the nasals to the frontoparietal suture.

Nasal length.—Medial distance from the tip of the nasals to the nasal–frontal suture.

Least interorbital constriction.—The least distance across the skull between the orbits.

Mastoid breadth.—Greatest width of the skull across the mastoid bones.

Bullar length.—Greatest length of the auditory bulla.

Interparietal length.—Greatest length of interparietal bone.

TABLE 2. Means and standard deviations of the 24 characters used in the discriminant function analysis

	P. merriami (n = 57)		*P. m. gilvus* (n = 42)		*P. flavus* (n = 37)	
Character	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
1. Bullar length Occipitonasal length	0.354	0.010	0.359	0.012	0.388	0.017
2. Background color	4.193	0.766	3.214	0.813	2.568	0.835
3. Tail length Total length	0.490	0.029	0.488	0.026	0.452	0.035
4. Mastoid breadth	11.277	0.377	11.442	0.409	11.930	0.431
5. Nasal length	7.343	0.371	7.375	0.279	7.203	0.345
6. Frontonasal length	13.696	0.450	13.719	0.404	12.991	2.246
7. Postauricular patch	2.053	0.580	2.762	0.726	3.108	0.774
8. Lateral line	2.421	0.596	1.500	0.672	1.378	0.492
9. Interparietal width	3.532	0.368	3.323	0.390	3.053	0.267
10. Dorsal black	3.632	0.645	2.929	0.778	3.054	0.405
11. Interparietal length	2.469	0.226	2.486	0.242	2.555	0.209
12. Interparietal width Mastoid breadth	0.314	0.035	0.290	0.032	0.256	0.026

TABLE 2. (Continued)

Character	*P. merriami* (n = 57) Mean	*P. merriami* (n = 57) Standard Deviation	*P. m. gilvus* (n = 42) Mean	*P. m. gilvus* (n = 42) Standard Deviation	*P. flavus* (n = 37) Mean	*P. flavus* (n = 37) Standard Deviation
13. Maxillary toothrow length	2.986	0.136	3.056	0.137	2.953	0.165
14. Hind foot length Total length	0.141	0.010	0.143	0.007	0.145	0.009
15. Silkiness	3.561	0.501	2.786	0.645	2.784	0.584
16. Bullar length	7.123	0.271	7.318	0.261	7.846	0.386
17. Occipitonasal length	20.141	0.632	20.401	0.578	20.245	0.704
18. Nasal length Occipitonasal length	0.364	0.011	0.362	0.010	0.356	0.010
19. Mastoid breadth Occipitonasal length	0.560	0.013	0.561	0.017	0.589	0.014
20. Least interorbital constriction	4.605	0.174	4.712	0.235	4.436	0.187
21. Total length	113.930	7.198	116.429	4.467	113.270	5.635
22. Hind foot length	16.070	0.961	16.667	0.786	16.351	0.857
23. Tail length	55.772	4.375	56.833	4.060	51.243	5.035
24. Maxillary toothrow length Occipitonasal length	0.148	0.007	0.150	0.006	0.146	0.007

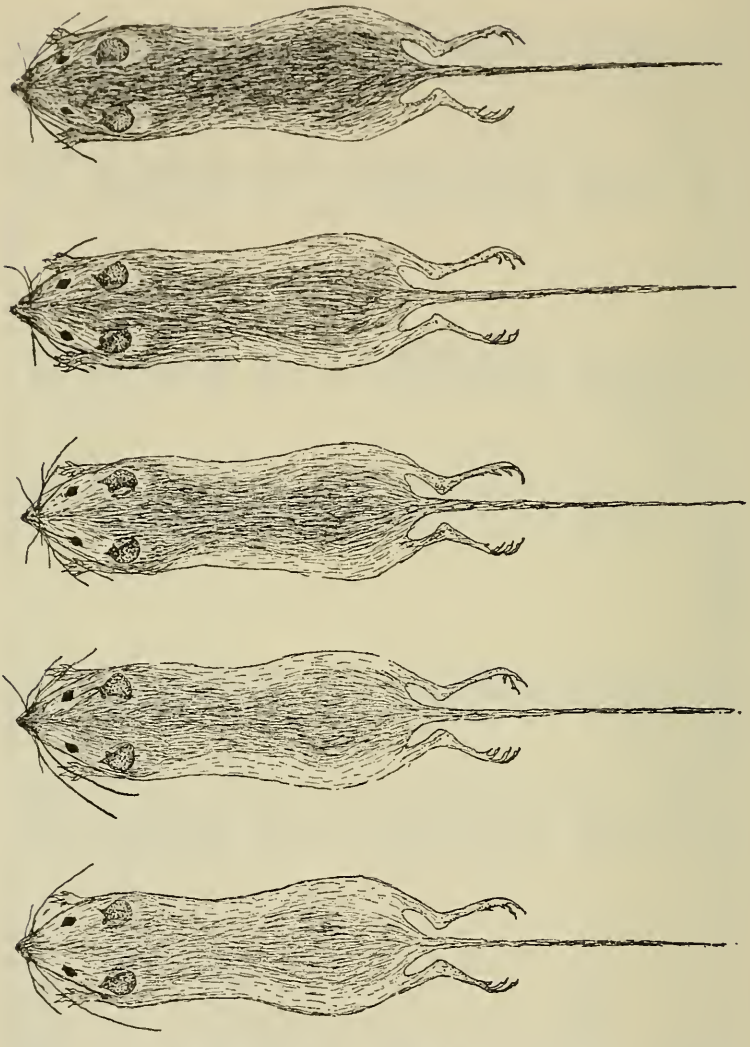


FIG. 2. Five standards used for scoring skins for amount of dorsal black and degree of development of postauricular patches.

Interparietal width.—Greatest width of interparietal bone.

Maxillary toothrow length.—Alveolar length of the upper cheek teeth.

Nasal length/Occipitonasal length

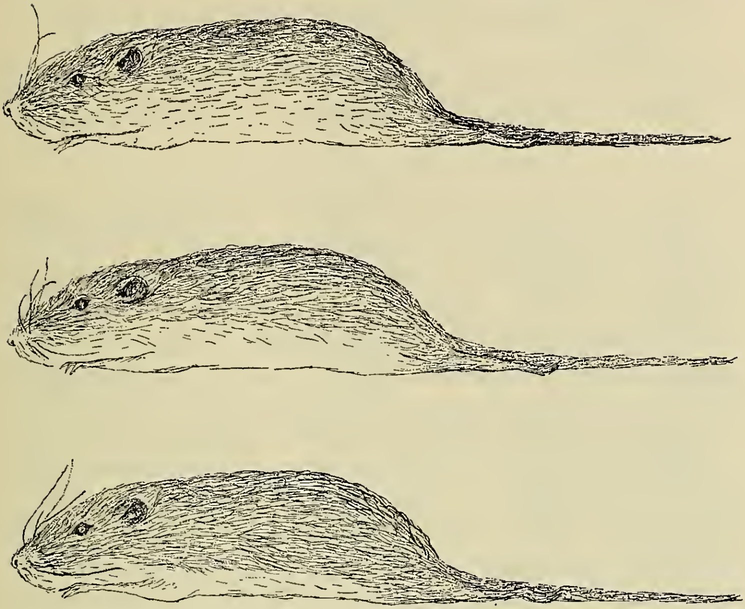


Fig. 3. Three standards used for scoring skins for degree of development of lateral line.

Mastoid breadth/Occipitonasal length

Bullar length/Occipitonasal length

Interparietal width/Mastoid breadth

Maxillary toothrow length/Occipitonasal length

Total length.—Recorded from skin tags.

Tail length.—Recorded from skin tags.

Hind foot length.—Recorded from skin tags.

Tail length/Total length

Hind foot length/Total length

Background color.—Color of the dorsal underfur scored from 1 (light pinkish) to 5 (bright yellowish orange).

Amount of dorsal black.—Color of the dorsal guard hairs scored from 1 (light) to 5 (dark). See figure 2.

Postauricular patch.—Degree of development of postauricular patches scored from 1 (none) to 5 (large). See figure 2.

Silkiness.—Softness of the pelage scored from 2 (silky) to 4 (harsh).

Lateral line.—Degree of development of lateral line scored from 1 (indistinct) to 3 (distinct). See figure 3.

STATISTICAL TECHNIQUES

After deleting specimens with missing characters, I subjected 57 *P. merriami*, 42 *P. m. gilvus*, and 37 *P. flavus* to a stepwise discriminant function analysis using a program (BMD07M) which originated at the Health Sciences Computing Facility, UCLA (Dixon, 1965). I treated the *P. merriami* and *P. flavus* as reference groups, and entered all 42 *P. m. gilvus* as unknowns. A subsequent run using all three as distinct groups yielded substantially similar results.

Explanations and examples of discriminant function analyses are available in Fisher (1936), Morrison (1967), Cooley and Lohnes (1962), and Sokal and Rohlf (1969). Basically, it is a technique for allocating unknown specimens to one of two or more previously recognized groups. It computes a new variable which is a linear function of the original *n* variables that maximizes the distance between the groups. Unknown specimens are scored for the new variable and placed in the most appropriate group.

The analysis is done in stepwise fashion, adding or deleting a single variable at each step. This allows one to determine which characters best separate the groups when used singly or in small combinations. In addition, within groups covariance and correlation matrices are generated, permitting one to determine the degree to which characters are correlated.

The end product is a canonical analysis using all variables (except those which are deleted by the computer). A number of canonical variables equal to the number of characters used in the analysis is extracted. Character coefficients, which may be multiplied by their pooled within group standard deviation to show the contribution of each of the original variables to each of the new canonical variables, are given. In addition, each specimen is assigned a number corresponding to its generalized taxonomic distance (Mahalinobis' distance)

TABLE 3. Number of individuals classified as *P. merriami* or *P. flavus* after various steps in the discriminant function analysis

	Group	*merriami*	*flavus*
Step number 1	*merriami*	53	4
Variables used 1	*flavus*	6	31
	gilvus	35	7
Step number 4	*merriami*	55	2
Variables used 1–4	*flavus*	1	36
	gilvus	33	9
Step number 8	*merriami*	56	1
Variables used 1–8	*flavus*	0	37
	gilvus	27	15
Step number 12	*merriami*	56	1
Variables used 1–12	*flavus*	0	37
	gilvus	25	17
Step number 16	*merriami*	56	1
Variables used 1–16	*flavus*	0	37
	gilvus	24	18
Step number 25	*merriami*	57	0
Variables used 1–23	*flavus*	0	37
	gilvus	27	15

from the mean of each reference group. The probability of a given specimen belonging to a given group is indicated for every specimen in all groups.

Eigenvalues, cummulative proportion of total dispersion, and canonical correlations are calculated for each canonical variable. These values allow one to determine how much of the total available variability is accounted for by each successive canonical variable.

RESULTS

To demonstrate the difficulty encountered in attempting to separate these mice using morphological characters, Figure 4 shows histograms for four of the better characters. These figures clearly show the overlap between *P. merriami* and *P. flavus*, and demonstrate the intermediate nature of *P. m. gilvus*. Table 2 is a list of the original variables in the order the computer entered them into the analysis. Table 3 shows the grouping results of the stepwise analysis at various steps. The characters contributing the most to the first canonical

TABLE 4. Standardized character coefficients and percent contributions to the first canonical variable

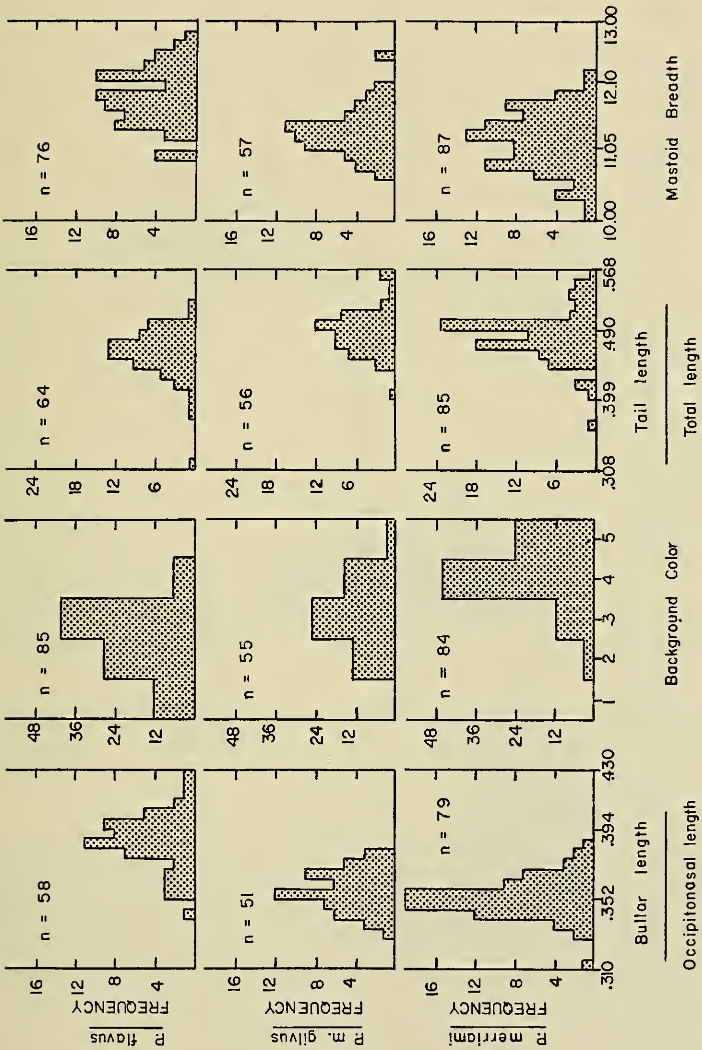
	Coefficient	Percent
Occipitonasal length	4.40	11.19
Total length	–3.83	9.74
Interparietal width/Mastoid breadth	3.62	9.21
Bullar length	–3.60	9.16
Interparietal width	–3.56	9.05
Bullar length/Occipitonasal length	3.21	8.16
Hind foot length/Total length	–3.07	7.81
Nasal length	–2.71	6.89
Hind foot length	2.50	6.36
Tail length/Total length	–2.03	5.16
Tail length	1.83	4.65
Mastoid breadth	1.28	3.26
Nasal length/Occipitonasal length	1.00	2.54
Mastoid breadth/Occipitonasal length	0.45	1.14
Lateral line	–0.42	1.07
Background color	–0.39	0.99
Postauricular patch	0.32	0.81
Dorsal black	–0.31	0.79
Interparietal length	0.26	0.66
Frontonasal length	0.24	0.61
Maxillary toothrow length	0.22	0.56
Silkiness	–0.04	0.10
Interorbital constriction	–0.03	0.08

variable are not the same as those at the top of the list. Table 4 gives the standardized coefficients and the percentage contribution of each of the original variables to the first canonical variable.

Histograms of the discriminant scores of the first canonical variable for *P. merriami*, *P. flavus*, and *P. m. gilvus* are presented in Figure 5. It can be seen that although complete separation of *P. merriami* and *P. flavus* can be achieved using multivariate techniques, once again *P. m. gilvus* bridges the gap. Figure 6 is a plot of the first and second canonical

→

FIG. 4. Histograms showing single character separation for four of the best characters. *Perognathus flavus* on top, *P. m. gilvus* in the middle, and *P. merriami* on the bottom.


P. flavus
P. m. gilvus
P. merriami
FREQUENCY
n = 58
n = 85
n = 64
n = 76
n = 51
n = 55
n = 56
n = 57
n = 79
n = 84
n = 85
n = 87
16
12
8
4
48
36
24
12
24
18
12
6
.310
.352
.394
.430
1
2
3
4
5
.308
.399
.490
.568
10.00
11.05
12.10
13.00
Bullar length
Occipitonasal length
Background Color
Tail length
Total length
Mastoid Breadth

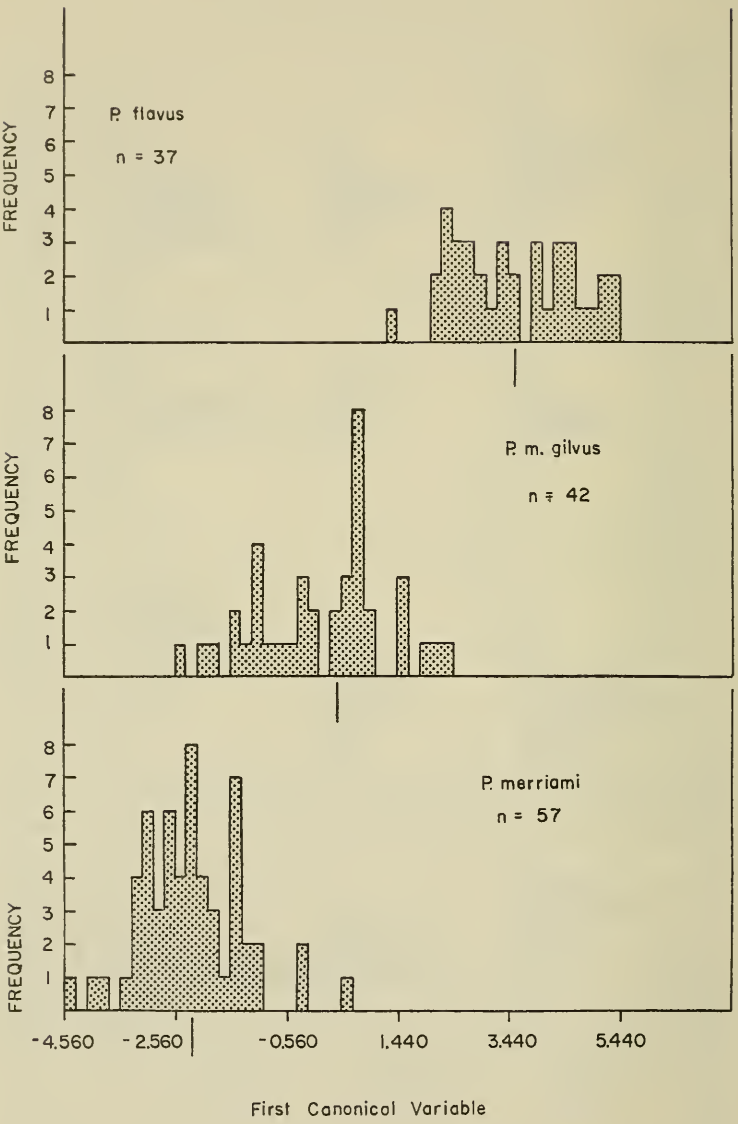


FIG. 5. Histograms showing distribution of the first canonical variable.

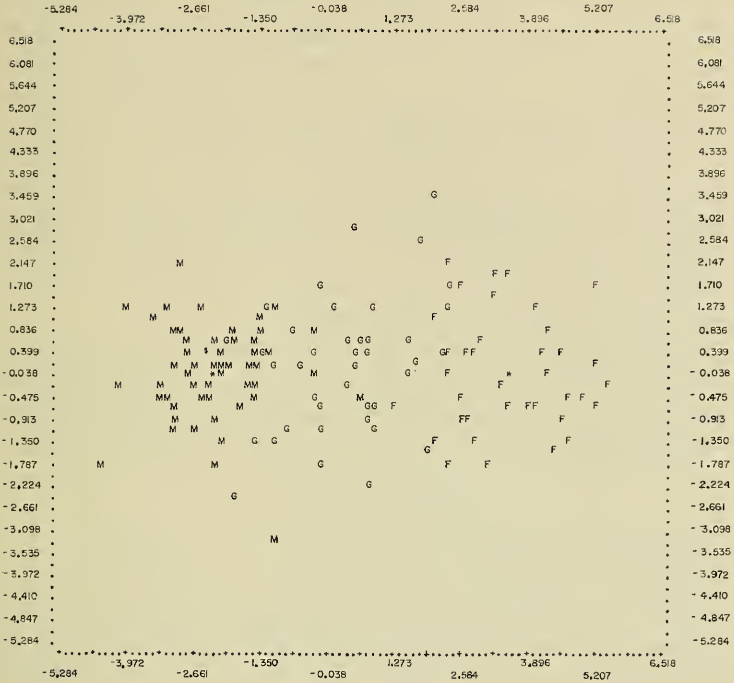


FIG. 6. Plot of the first and second canonical variables. m = *P. merriami*, g = *P. m. gilvus*, f = *P. flavus*, * = group means, $ = overlap.

variables, and includes all of the specimens used in the analyses.

DISCUSSION

Table 2 and Figure 4 both illustrate the difficulties which faced taxonomists working with these animals in the past. Although differences can be seen between certain individuals, quantifying those differences and finding characters which are useful in allocating all individuals is extremely difficult. Table 3 shows that the best single character, Bullar length/Occipito-nasal length, is not sufficient to allocate all of the individuals correctly. Using this character, four of the *P. merriami* and six of the *P. flavus* are incorrectly allocated, while 35 of the *P. m. gilvus* are allocated to *P. merriami* and seven to *P. flavus*.

Using the four characters shown in Table 2 in combination, only two *P. merriami* and one *P. flavus* are misallocated, and two additional *P. m. gilvus* are switched to *P. flavus*. All of the *P. flavus* and all but one of the *P. merriami* are correctly allocated using eight characters. At this step, 27 *P. m. gilvus* are assigned to *P. merriami* and 15 to *P. flavus*. This is the same as the final proportions for *P. m. gilvus*. At 16 and 20 characters, the proportion of *P. m. gilvus* allocated to *P. flavus* continues upward through 17 to 18. The final step correctly allocates all of the reference samples, and places 27 *P. m. gilvus* in *P. merriami* and 15 in *P. flavus*.

Of the reference *P. merriami* sample, one had a probability of 0.953 and one of 0.999 of being in the right group, and all of the rest were 1.000. For *P. flavus*, there were 2 with 0.953, 1 with 0.993, 1 with 0.998, 2 with 0.999 and the rest were 1.000. The 27 *P. m. gilvus* allocated to *P. merriami* had probabilities ranging from 0.953 to 1.000. Three *P. m. gilvus* had probabilities of 0.500 for both groups.

The three intermediate specimens included one from 25 mi. W of Tucumcari, New Mexico, one from Comstock, Texas, and one from near Kermit, Texas. Osgood (1900) considered the Comstock specimen to be an intermediate between typical *P. merriami* and *P. m. gilvus*. The type-specimen of *P. m. gilvus* was allocated to *P. flavus* with a probability of 0.731.

The cumulative proportions of total dispersion for the first two canonical variables were 0.99861 and 0.99971, respectively, and corresponding eigenvalues were 8.21030 and 0.00906. This indicates that the data illustrated in Figures 5 and 6 account for virtually all of the variability within these samples.

Figure 6 probably illustrates quite well the actual relationships between these three groups. *Perognathus m. gilvus* is a geographically intermediate population between *P. flavus* to the west and *P. merriami* to the east. I suggest that the overlap shown in Figure 6 is probably indicative of the population now known as *P. m. gilvus* interbreeding with *P. flavus* in Eastern New Mexico and Western Texas, and with *P. merriami* in south-central Texas. Data are at present insufficient to determine whether the zone of overlap between *P. flavus* and *P. m. gilvus* is a narrow one limited to Eastern

New Mexico and adjacent portions of Western Texas or whether the integradation is more broadly clinal over the whole range of *P. m. gilvus.*

Throughout this analysis, *P. m. gilvus* has been demonstrated to be closer to *P. merriami* than to *P. flavus.* This is not surprising, since the majority of the specimens are from areas that are geographically closer to *P. merriami* than to *P. flavus.* This probably also explains the early allocations of this population to *P. merriami,* rather than to *P. flavus,* even though the close relationships of all three were noted (Osgood, 1900).

In conclusion then, it seems best to regard *P. flavus* and *P. merriami* as conspecific. The three populations are certainly distinct enough to retain subspecific status with the easternmost population known as *Perognathus flavus merriami,* and the intermediate population as *Perognathus flavus gilvus.*

Acknowledgments

I am grateful to a number of people for help with this study. Robert Fisher measured specimens, Sheila Jones transferred the data to IBM cards, Mike Schum acted as my interpreter for communication with The University of New Mexico's IBM 360 computer, James Findley kindly explained the results, Neil Roth patiently tutored me in multivariate statistics, and Richard Thorington read and commented on the manuscript.

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PROCEEDINGS
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TWO FRESHWATER COPEPODS FROM BARRANCAS, VENEZUELA: *NOTODIAPTOMUS CEARENSIS* (WRIGHT) AND *N. VENEZOLANUS DEEVEYORUM*, NEW SUBSPECIES (CALANOIDA: DIAPTOMIDAE)

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

In connection with their revision (Deevey and Deevey, 1971) of American species of the Cladoceran genus *Eubosmina*, Edward S. Deevey, Jr., and Georgiana B. Deevey made several plankton collections in 1967 in the vicinity of Barrancas, Monagas State, Northeastern Venezuela. One collection, labeled "Barrancas II," was made November 26 in a wide, shallow (maximum depth less than 2 meters), meandering gully. The gully was not connected at that time with the nearby Orinoco River, but obviously would connect when the river was in flood.

The "Barrancas II" collection, kindly made available to me by Mrs. Deevey, contained specimens of two superficially similar species of diaptomid copepods, *Notodiaptomus cearensis* (Wright, 1936) and *N. venezolanus* Kiefer (1954). *N. cearensis* was 3 times as numerous as *N. venezolanus*; in 270 specimens picked at random from the sample there were 203 *N. cearensis* and 67 *N. venezolanus*. Kiefer's description is entirely adequate; some confusion as to the date of publication of the specific name *venezolanus* could arise from the fact that Kiefer (1956) published almost the same description and illustrations 2 years after the original description, with the heading "*Notodiaptomus venezolanus* n. sp." and with no indication that the original description had already been published in 1954. The Barrancas specimens exhibited minor differences from Kiefer's specimens and are considered to represent a new subspecies.

Wright's description of *N. cearensis* is quite brief and only the ♂ 5th leg is illustrated. Hence, a fairly detailed redescription of *N. cearensis* is warranted. The specimens of both diaptomid species are deposited in the Division of Crustacea, Smithsonian Institution.

Notodiaptomus cearensis (Wright)

Figures 1–21, 33–35

Diaptomus cearensis Wright, 1936, pp. 80–81, pl. 1, fig. 2.
Notodiaptomus cearensis (Wright).—Kiefer, 1956, p. 242 [by implication].

Female: Length about 1.4 mm (prosome 1.10–1.15 mm). In dorsal view body widest at 1st pedigerous segment. 4th and 5th pedigerous segments fused dorsally, separated by suture laterally. 5th pedigerous segment produced into small obliquely directed wings ending in conical spines; wings nearly symmetrical.

Urosome apparently 2 segmented, but actually 3 segmented with most or all of 2nd segment telescoped into genital segment. Genital segment about 1.5 times as long as rest of urosome combined; anterior half expanded on either side into nearly symmetrical low rounded lobe with spine at apex; right lobe slightly more strongly produced. Right posterolateral corner of genital segment produced posteriorly into rounded lobe, sometimes scarcely evident. Caudal rami symmetrical, slightly more than half as wide as long.

1st antenna reaching posterior end of caudal rami. Segment 11 with 2 setae; segments 13–21 each with 1 seta. Armature of segments shown in Figure 7.

2nd antenna and mandible with normal complement of setae. Gnathal lobe of mandible with following dentition in ventral to dorsal order (nomenclature of teeth after Fleminger, 1967): Apical tooth blunt. Subapical tooth pointed. Medial teeth 3 in number, bicuspidate; ventralmost medial tooth much larger than others, with 2 broadly rounded cusps; the 2 dorsal medial teeth each with a larger rounded dorsal cusp and a smaller obtuse ventral cusp. Basal teeth 3 in number; the 2 ventral teeth bicuspidate, with obtuse cusps; dorsal tooth slender, with dentate ventral margin.

Maxilliped with 4 lobes of 1st basipod well developed; distal seta of 2nd lobe longer than proximal seta; 4th lobe with only 3 setae.

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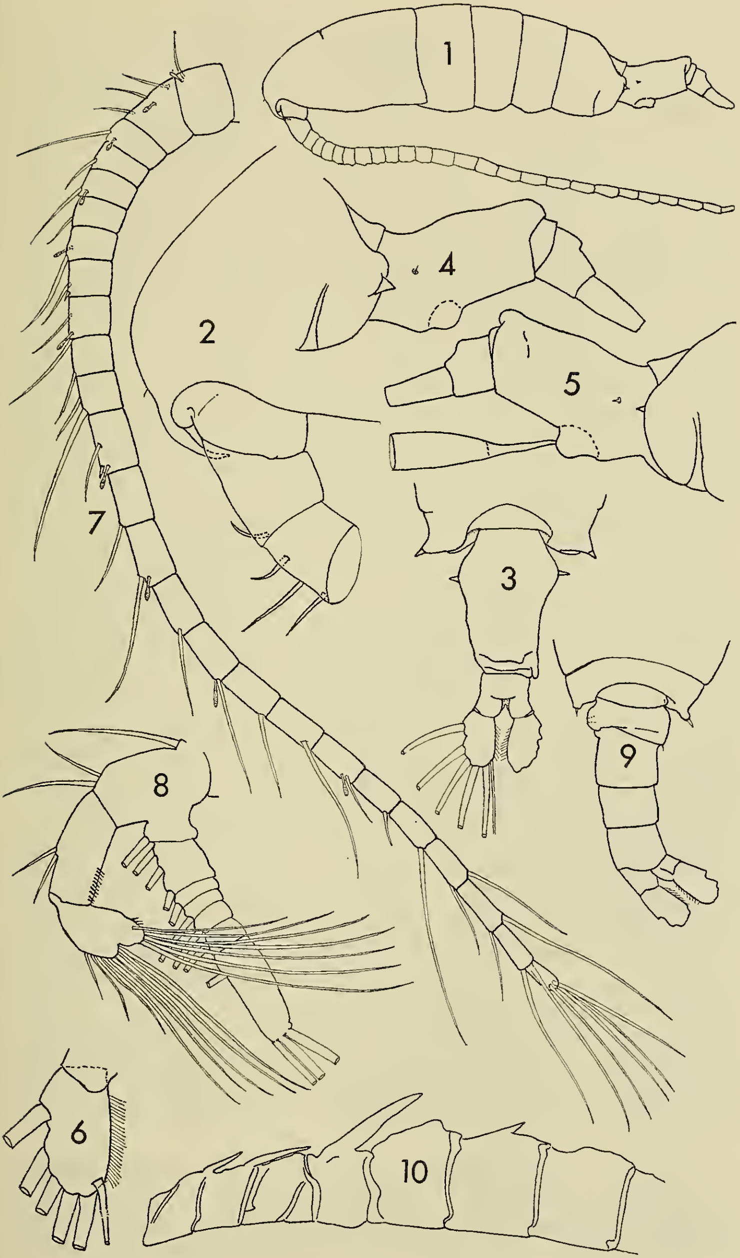
FIGS. 1–10. *Notodiaptomus cearensis*. 1–8, ♀: 1, lateral view. 2, head, lateral. 3, urosome, dorsal. 4, urosome, left side. 5, urosome, right side. 6, caudal ramus, dorsal. 7, 1st antenna. 8, 2nd antenna. 9–10, ♂: 9, urosome, dorsal. 10, right 1st antenna, segments 10–16.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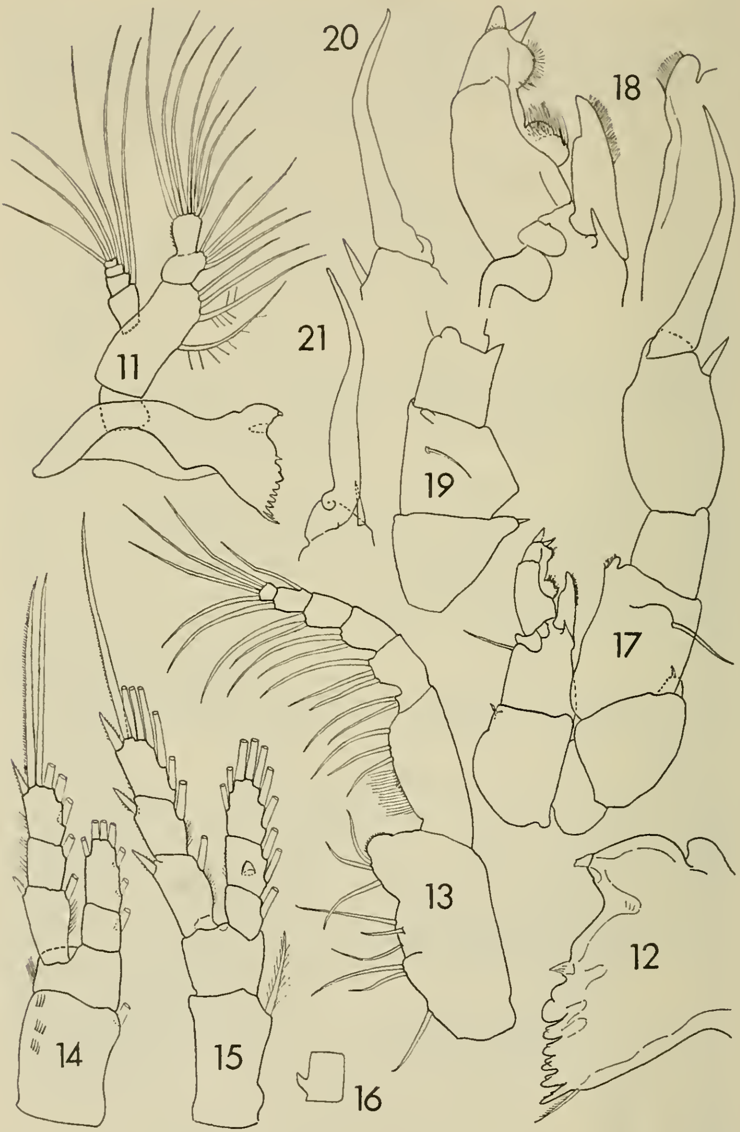

Figs. 11–21. *Notodiaptomus cearensis.* 11–16, ♀: 11, mandible. 12, mandible, gnathal lobe. 13, maxilliped. 14, leg 1, posterior. 15, leg 2, posterior. 16, leg 2, 2nd endopod segment, lateral. 17–21, ♂ leg 5: 17, anterior view. 18, left leg and endopod of right leg, enlarged.

Swimming legs with normal armature of spines and setae. Leg 1 with 3 patches of hairs on posterior surface of 1st basipod. Leg 2 with triangular cuticular lobe on posterior surface of 2nd endopod segment.

Leg 5 (Figs. 33–34), posterior surface of 1st basipod with prominent conical process ending in heavy spine. 2nd basipod with long lateral seta reaching distal ¼ of 1st exopod segment. 1st exopod segment unarmed, twice as long as wide. 2nd exopod segment without lateral setae, distolateral corner with or without short spine; claw moderately stout, armed on both margins with close-set spinules. 3rd exopod segment slightly longer than wide, armed with 2 apical setae; medial seta 3 times as long as lateral seta. Endopod 1-merous, reaching slightly beyond midlength of 1st exopod segment; distal margin oblique, bearing a close-set row of fine setae and 2 somewhat larger setae.

Male: Length about 1.25 mm (prosome 0.89–0.94 mm). Greatest width at level of 2nd pedigerous somite. Suture between 4th and 5th pedigerous somites complete dorsally, but weaker than sutures between other somites. Posterior corners of 5th somite produced into short, narrow, only slightly divergent spine-tipped lobes; right lobe slightly longer and directed slightly more laterad. Genital segment asymmetrical, bulging laterally more on left side than on right side; right posterolateral corner armed with a seta. Posterior part of urosome curved to right in preserved specimens.

Right 1st antenna with spines on segments 10, 11, 13, and 15; segment 16 without spine. Spines on segments 10 and 11 subparallel to axis of antenna, that on segment 11 much longer. Spine on segment 13 very large, with minute incision at apex. Segment 23 with very narrow hyaline fringe.

Right leg 5, 1st basal segment with strong conical process bearing sensillum on posterior surface. 2nd basal ⅓ longer than 1st; outer seta at distal ¼. Exopod (excluding claw) subequal in length to basipod; 1st segment slightly longer than wide, distolateral margin produced into rounded lobe anteriorly and triangular process posteriorly. 2nd exopod segment nearly 2½ times as long as 1st, slightly less than twice as long as wide; both margins moderately convex; lateral spine subterminal, shorter than width of segment; terminal claw slightly longer than exopod, bent at distal ⅔. Endopod short, oval; fused with 2nd basal segment; medial margin bearing row of close-set setae.

Left leg 5 slightly more slender than right, reaching beyond middle of 1st exopod segment of right leg. 1st basal segment nearly ¾ as wide as long; sensillum inconspicuous, inserted on small lobe. 2nd basal segment with margins gradually converging distally. Exopod with widely separated proximal and distal hairy pads; proximal pad incompletely divided

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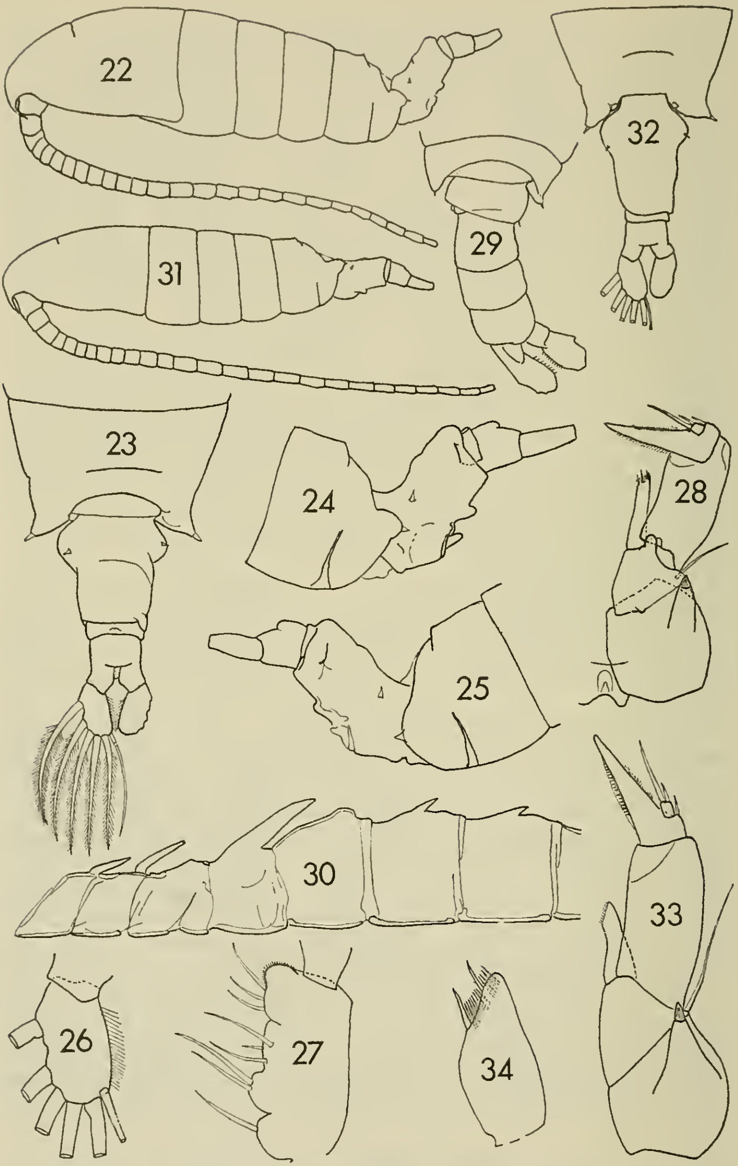
19, right leg, proximal segments in situ, lateral. 20, right leg, terminal claw in situ, dorsal. 21, same, ventral.



FIGS. 22–34. *Notodiaptomus venezolanus deeveyorum.* 22–28, ♀: 22, lateral, 23, urosome, dorsal. 24, urosome, right side. 25, urosome, left side. 26, right caudal ramus. 27, maxilliped, 1st basal. 28, leg 5.

into 2 lobes by medial sinus; distal process conical, straight; proximal process about as long as distal process but more slender.

Relationships: Kiefer (1956) lists 18 species of *Notodiaptomus*, of which seven have a relatively short lateral spine on the 2nd exopod segment of the right ♂ leg 5. Of the latter seven species, only *N. carteri* (Lowndes, 1934) is known to agree with *N. cearensis* in lacking a spine on segment 16 of the ♂ right antenna. *N. carteri* differs from *N. cearensis* in the 2-merous endopod on the ♀ leg 5 and in the evenly curved terminal claw of the ♂ right leg 5.

In two species having short lateral spines on the right ♂ leg 5, the armature of the ♂ grasping antenna is unknown, viz. *N. incompositus* (Brian, 1926), and *N. isabelae* (Wright, 1936). I have examined specimens of *N. incompositus* in the collections of the Division of Crustacea from Lago Chascomus, Argentina, collected and identified by Stillman Wright (USNM 92961) and found a small but distinct spine on segment 16. No specimens of *N. isabelae* are available to me, but Wright's illustration of the ♂ leg 5 shows that it differs from *N. cearensis* in the oval shape of the right 2nd exopod segment and in the slightly but evenly curved terminal claw.

Remarks: Because of the brevity of Wright's description the Barrancas specimens cannot be assigned to *N. cearensis* with absolute confidence. However, Wright's illustration of the ♂ 5th leg, a copy of which is given herein (Fig. 35), matches closely the 5th legs of Barrancas ♂ ♂ (Fig. 17), and there is nothing in Wright's description that excludes the Barrancas specimens. Unfortunately Wright did not deposit types or other specimens of *N. cearensis* in the Smithsonian Institution. For certain identification the Barrancas specimens should be compared with topotypes, especially in view of the distance, about 2000 km, separating Barrancas from the Brazilian localities cited by Wright (northeast Ceará, western Parahyba, and Rio Grande do Norte).

Notodiaptomus venezolanus deeveyorum, new subspecies

Figures 22–30, 36–39

Diagnosis: Closely resembling the typical subspecies, but body longer (♀ 1.5 mm, ♂ 1.35 mm) and 1st antenna relatively shorter, reaching slightly beyond posterior margin of genital segment.

Additional description. Female. Length about 1.5 mm (prosome 1.04–1.09 mm). Suture between pedigerous segments 4 and 5 present dorsally and ventrolaterally, absent dorsolaterally. Wings of 5th pedigerous segment less oblique than in *N. cearensis*, asymmetrical (most evident in lateral view, Figs. 24–25). Genital segment slightly longer

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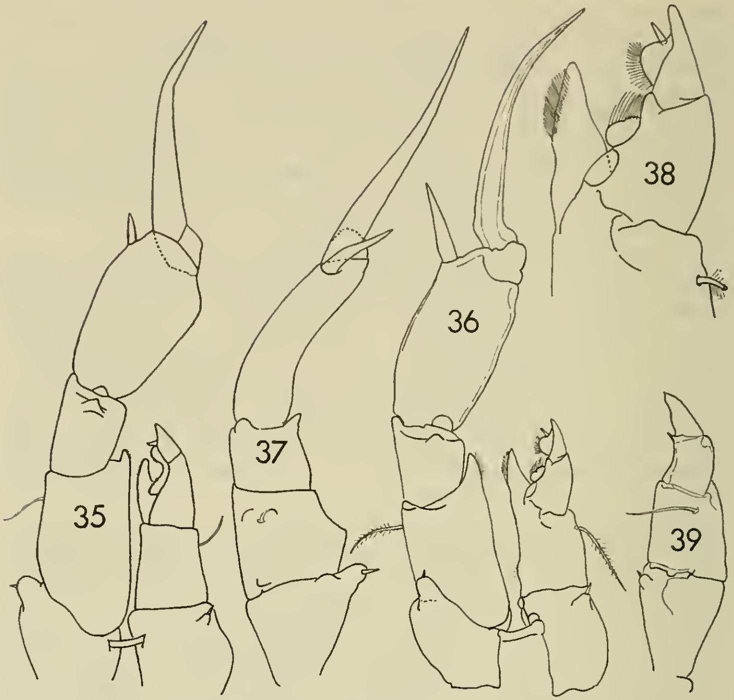
29–30, ♂: 29, urosome, dorsal. 30, right 1st antenna, segments 10–16. *Notodiaptomus venezolanus venezolnaus*, ♀: 31, lateral. 32, urosome, dorsal. *Notodiaptomus cearensis*, ♀: 33, 5th leg. 34, 5th leg, endopod.



Figs. 35–39. *Notodiaptomus cearensis.* 35, ♂ leg 5 (copied from Wright, 1936). *Notodiaptomus venezuelanus deeveyorum.* 36–39, ♂ leg 5: 36, posterior view. 37, right leg in situ, lateral. 38, left leg, posterior. 39, left leg in situ, lateral.

than rest of urosome combined; lateral lobes bulging outward more abruptly than in *N. cearensis*; spines on lobes inserted more dorsally, inward from apex of lobe. Right posterior corner of genital segment produced into rounded lobe. 2nd urosome segment very short, on left side not reaching ventral margins of genital and anal segments.

1st antenna reaching slightly beyond posterior margin of genital segment; segment 11 with 1 seta; segments 13–21 each with 1 seta. Except for segment 11, armature of segments exactly as in *N. cearensis.*

Maxilliped as in *N. cearensis,* with 3 setae on 4th lobe of 1st basipod.

Leg 1 as in *N. cearensis,* but with single patch of hairs on posterior surface of 1st basipod, corresponding to distal patch in *N. cearensis.* Leg 2 with triangular cuticular lobe on posterior surface of 2nd endopod segment. Leg 5 like that of *N. cearensis.*

Male: Length about 1.35 mm (prosome 0.9–1.2 mm). Greatest width at level of 1st pedigerous segment. Suture between 4th and 5th pedigerous segment complete, but weaker dorsally than sutures between other segments. Right lobe of 5th segment slightly less divergent than that of *N. cearensis.* Urosome like that of *N. cearensis* but less strongly curved to the right.

Right 1st antenna with spines on segments 10, 11, 13, 15, and 16. Third-from-last segment with very narrow hyaline fringe.

Right leg 5, exopod distinctly longer than basipod; 1st exopod segment as in *N. cearensis*; 2nd exopod segment about 2½ times as long as 1st, slightly more than twice as long as wide, subrectangular; lateral spine nearly terminal, length subequal to width of segment, about ⅓ length of terminal claw. Terminal claw as long as exopod, evenly curved. Endopod as in *N. cearensis,* but shape more triangular.

Left leg 5 reaching distal end of 1st exopod segment of right leg, closely resembling that of *N. cearensis.*

Etymology: The new subspecies is named after Edward S. Deevey, Jr., and Georgiana B. Deevey, in recognition of their many contributions to aquatic biology.

Types: Holotype ♀, USNM 142704; and 68 paratypes, USNM 142705, from shallow gully near Barrancas, Venezuela, collected 26 November 1967 by Edward S. Deevey, Jr., and Georgiana B. Deevey.

I have compared the Barrancas diaptomids with specimens of *N. venezolanus* from the type-locality, Lake Valencia, Venezuela, about 600 km (480 miles) WNW of Barrancas (Figs. 31–32). The Lake Valencia specimens (USNM 53797) were collected by A. S. Pearse and reported by him as *Diaptomus conifer* Sars (Pearse, 1921). Pearse's specimens agree closely with Kiefer's (1954, 1956) descriptions and differ from the Barrancas specimens in the smaller size (♀ about 1.12–1.18 mm; ♂ 1.02–1.06 mm) and the relatively longer 1st antennae, which reach beyond the caudal rami by the last 3 segments (Fig. 31). The armature of the ♂ and ♀ 1st antennae and the structure of the ♂ and ♀ 5th legs are identical in the two forms. The clearcut differences in first antennal length warrant subspecific recognition of the two populations, but this decision could be altered when the now largely unknown diaptomid fauna of northern Venezuela becomes adequately studied.

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PROCEEDINGS
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BIOLOGICAL SOCIETY OF WASHINGTON

MICRODESMUS BAHIANUS, A NEW WESTERN ATLANTIC WORMFISH (PISCES: MICRODESMIDAE)

By C. E. Dawson
Gulf Coast Research Laboratory Museum
Ocean Springs, Mississippi 39564

The southernmost records of western Atlantic wormfishes were heretofore represented by single collections from Union Island in the Grenadines (Lesser Antilles) and the Rio Buritaca, Colombia. I here describe a new species from the mainland coast of Brazil which represents a significant range extension for the family Microdesmidae into the South Atlantic Ocean.

The Brazilian holotype was provided by Srta. Virginia Almeida and Dr. Naercio A. Menezes, Museu de Zoologia da Universidade de São Paulo; the Martinique specimen was lent by the Academy of Natural Sciences of Philadelphia (ANSP). The holotype has been deposited in the National Museum of Natural History, Smithsonian Institution (USNM). Measurements are in millimeters (mm); proportions are shown as percentages of standard length (SL) or head length (HL); methods are those of Dawson (1972).

Appreciation is expressed to Srta. Almeida and Drs. Menezes and James E. Böhlke for making specimens available for study. The drawing is by Harry L. Moore, Jr. This work was supported in part by National Science Foundation Grants GB 15295 and GB 31053X.

Microdesmus bahianus, new species

Figure 1

Holotype: USNM 209216 (64.8 mm SL); Brazil, Bahia, tidepool at Arembepe, approx. 12°45′S, 38°10′W; chemical ichthyocide; 9 July 1971; Virginia Almeida.

FIG. 1. *Microdesmus bahianus* USNM 209216; holotype; 64.8 mm SL.

Diagnosis: Dorsal fin origin posteriad of vertical from tip of adpressed pectoral fin; pectoral fin 11, rays unbranched; gill opening broad, not tubiform; total dorsal elements 42; 1st two dorsal spines not more closely spaced than fellows; vertical fins united in adults; body and head with dorsal and lateral stripes.

Description: Dorsal spines 12, dorsal segmented rays 30, total dorsal elements 42; anal rays 28; pectoral rays 11 (2); pelvic fin I,3; vertebrae $26 + 26 = 52$.

Measurements (mm) are followed by percent of SL or HL in parentheses. Caudal fin length 6.5 (10.0, percent of SL); least depth of caudal peduncle 2.9 (4.5); body depth at anal fin origin 4.5 (6.9); predorsal length to tip of lower jaw 16.9 (26.1); preanal length 36.0 (55.6); pectoral fin length 3.6 (5.6); pelvic fin length 3.3 (5.1); distance from pelvic fin insertion to anal fin origin 28.7 (44.3); head length 6.5 (10.0). Diameter of pigmented eye 0.8 (12.3, percent of HL); distance from anterior margin of eye to tip of lower jaw 1.5 (23.1); snout length 1.0 (15.4); postorbital length 4.2 (64.6); tip of lower jaw to posterior angle of gape 1.4 (21.5).

Body moderately elongate, compressed, breadth at anal fin origin about 3 percent of SL, greatest breadth (4.2 percent of SL) at opercle; caudal fin distally rounded, not broadly expanded or fan shaped, upper and lower margins nearly parallel. Head rather long and slender, tapering anteriad, its depth on vertical through eye about 73 percent of depth at pelvic fin insertion; interorbital slightly convex, its width about 75 percent of eye diameter; eye lateral, distinct, not concealed by a semi-opaque dermal membrane, its diameter about 80 percent of snout length; lower jaw prominent, somewhat narrowed in front to form a distinct symphyseal ridge, recurved dorsad and narrowly includes snout tip when mouth is closed; gape moderate, reaches vertical from near middle of posterior naris, slightly inclined; upper lip narrow across symphysis; expanded into a short, fleshy ellipse near angle of gape; lower lip with a short, narrow and distally rounded, adnate fleshy lateral expansion near angle of gape; dorsal surface of lower lip narrow posteriad, broad and concave at sides, narrowing at symphysis to form an inverted V-shaped emargination; anterior naris a short tubule with flared orifice located dorsolaterally on snout tip; posterior naris a short simple tubule, dorsolateral, its posterior margin on vertical from anterior edge of eye; narial diameters approximately equal, about 4 in eye; longitudinal internarial snout ridges distinct but not especially prominent; teeth difficult to see, evidently in more than one row in each jaw; outer row with several separated, slightly enlarged, rounded conical teeth in front and with close-set, smaller, somewhat recurved and pointed teeth posteriad; apparently without enlarged caniniform teeth.

Gill opening (Fig. 2) large, distance between upper and lower extremities about 15 percent greater than eye diameter; opening formed by a fold of branchiostegal membrane which originates at articular base of the 4th or 5th pectoral fin-ray (counting ventrad), continues anteroventrad across pectoral base and reunites with pectoral fin along its proximoventral margin; pectoral fin base not completely concealed by the gill membrane. Dorsal fin origin well posteriad of vertical from tip of adpressed pectoral fin; the two anterior spines of similar length, not more closely spaced than those which follow; spacing of anterior segmented rays about 20 percent less than that of spinous elements; 1st anal fin-ray about 10 percent shorter than subsequent rays; last two dorsal and anal rays not approximated at their bases, the terminal rays united to caudal fin by membranes extending to tips of distal spiniform caudal elements; all segmented dorsal and anal fin-rays are branched. Caudal fin with 17 segmented rays $(2 + 12 + 3)$ and at least 5 spiniform elements above and below; pectoral fin somewhat pointed, fin-rays

FIG. 2. Left gill opening of *Microdesmus bahianus*. Upper point of origin near base of 4th (from uppermost) pectoral ray; lower point of origin on proximoventral margin of pectoral fin.

simple, the 6th–7th the longest; pelvic fin long and slender, the inner ray about 2.4 times the length of the short outer ray and 1.5 times the length of the middle segmented element. Anal fin origin beneath interspace between dorsal fin elements 16 and 17.

Scales usually well separated, seldom touching, about 25 in irregular series between anal fin origin and dorsal fin base; scale diameters range from 0.15 to about 0.3 mm, smallest on head; tip of snout and lower jaw naked, remainder of head and body scaled; proximal third of caudal fin scaled, other fins naked.

Proximal pterygiophore of 1st dorsal spine inserted between 10th and 11th neural spines; 1st neural spine slender, pointed, about a third shorter than fellows; 2nd–12th neural spines stronger and with blunt or spatulate tips, remaining neural spines slender and distally pointed; ossified frontals fail to reach mesethmoid; no predorsal interneurals visible in radiograph.

Ground color, in alcohol, tan; a broad brownish stripe originates at snout tip and continues along dorsum to caudal peduncle; a similar stripe begins near tip of lower jaw and continues posteriad across lower half of eye and above pectoral fin base to caudal peduncle where the separate identities of dorsal and lateral stripes are lost in a generalized shading of micromelanophores; presence of a third, narrow, dark stripe is indicated by a faint concentration of micromelanophores along anal fin base; venter pale. Dark stripes are formed by localized concentrations of brown micromelanophores separated by more or less immaculate stripes of ground color; widths of dark stripes, taken near middle of abdomen, approximately equal to that of intervening pale stripe; barlike extensions of the dark lateral stripe continue ventrad under lower jaw and beneath eye; scales frequently margined posteriad with brown; dorsal and caudal fin supports faintly lined with micromelanophores, fins otherwise immaculate; eye black.

Etymology: The name *bahianus* refers to the Brazilian state of Bahia wherein the type-locality is located.

Comparisons: Counts of dorsal spines and anal fin-rays of *Microdesmus bahianus* overlap those of *Cerdale floridana* Longley. The freckled coloration of *floridana* together with its combination of tubiform gill opening, dorsal fin origin in advance of pectoral tip and modal counts of 45 vertebrae and 14 pectoral fin-rays precludes confusion of these western Atlantic species.

Posterior displacement of dorsal fin origin immediately distinguishes *Microdesmus bahianus* from all congeners except the west African *M. aethiopicus* Chabanaud and *M. retropinnis* Jordan and Gilbert from the eastern Pacific. The 1st proximal pterygiophore is typically inserted between neural spines 4 and 5 in most species but it falls between 5 and 8 (usually between 7 and 8) in *aethiopicus*, between 10 and 11 in the holotype of *bahianus* and between 12 and 15 (usually between 13 and 14) in *retropinnis*. Location of this pterygiophore is a conservative character throughout the Microdesmidae wherein only *Cerdale ionthas* Jordan and Gilbert, *Microdesmus aethiopicus* and *M. retropinnis* exhibit the maximum intraspecific shift through three vertebrae.

The new Brazilian species differs from *aethiopicus* in having fewer dorsal fin elements (47–50 in *aethiopicus*), simple rather than branched pectoral fin-rays and a completely different color pattern. Fin-ray branching is ontogenetic in *Microdesmus* (Dawson, 1968) and fully branched dorsal and anal rays show the holotype of *bahianus* to be an adult or near adult fish. Presence of simple pectoral fin-rays in adults is considered to be characteristic of *bahianus*. The primary color pattern of *aethiopicus* consists of dark blotches on the head and well marked chevron-like bars on the body (Chabanaud, 1927; Robins, 1966), but there is no trace of the striped pattern found in *bahianus*.

Somewhat closer relationship is suggested between *bahianus* and *M. retropinnis* wherein pectoral fin-rays are also unbranched and young (to about 36 mm SL) may have continuous dorsal and lateral stripes. The Pacific species differs in total vertebral counts (5–9 more than *bahianus*), abdominal vertebrae are more numerous than caudal, and the juvenile stripes transform into longitudinal series of separate quadrate blotches in adults. A striped pattern also occurs in *Clarkichthys bilineatus* (Clark) and *Gunnellichthys pleurotaenia* Bleeker from Pacific waters but this character alone clearly distinguishes *Microdesmus bahianus* from known Atlantic wormfishes.

Remarks: Although not considered a paratype, I provisionally identify a distorted young fish (ANSP 103427; about 27 mm SL) from Martinique as *Microdesmus bahianus*. This specimen was collected at a depth of 11–18 meters near a reef off Point Caracoli on 7 July 1965 by J. C. Tyler and party. Due to its condition accurate measurements are impossible, but the following counts were obtained: dorsal spines 12, segmented dorsal rays 28, total dorsal elements 40; anal rays 27; pectoral rays 11; anal fin origin beneath interspace between dorsal elements 15–16; proximal pterygiophore of 1st dorsal spine inserted between neural spines 8–9; total vertebrae 49. The dorsal fin originates behind a vertical from pectoral fin tip, pectoral fin-rays are simple, some posterior dorsal and anal rays are branched, and persistent melanophores show the presence of continuous dorsal and lateral stripes in the largely faded specimen. In these characters this fish agrees with *bahianus* or falls within the expected range of variation, but I withhold positive identification due to condition of the specimen.

The holotype was collected from a rocky tidepool on a generally unprotected Atlantic shore. This habitat, together with the reef collection from Martinique, suggests that *Microdesmus bahianus* prefers open coastal environments rather than estuaries. No other microdesmids were taken with the holotype but one *Cerdale floridana* (ANSP 105753, 35 mm SL) was collected with the Martinique specimen.

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PROCEEDINGS
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NOTES ON NORTH AMERICAN *STIGMUS* PANZER (HYMENOPTERA, SPHECOIDEA)

By Karl V. Krombein
Smithsonian Institution, Washington, D.C. 20560

The following notes on the North American wasps of the pemphredonid genus *Stigmus* Panzer are published at this time so that two new taxa, some new synonyms and new status for a few taxa will be available for the forthcoming revised edition of the Catalog of Hymenoptera North of Mexico. A provisional key is included for the taxa occurring north of Mexico.

Pate (1937a:92) recognized two subgenera, *Stigmus* sens. str. and *Gonostigmus* Rohwer, in his generic reclassification of this group. I am synonymizing *Gonostigmus* herein, but I am describing a new subgenus, *Atopostigmus*, for *fulvipes* Fox. A third subgenus, *Carinostigmus* Tsuneki, has been recorded from the Palaearctic, Oriental and Ethiopian regions; so far as known it has no representatives in the New World. The tridentate mandibles of the females of typical *Stigmus* and of *Carinostigmus* separate those two subgenera at once from *Atopostigmus* which has bidentate mandibles in the female.

Neither *pendulus* Panzer nor *solskyi* Morawitz, the common European twig- and cane-nesting *Stigmus* have been collected in North America. This is odd because other European species having similar nesting habits, such as *Passaloecus insignis* van der Linden, are adventive in North America.

The North American species of typical *Stigmus* may be separated into two weakly defined species groups based on clypeal characters of the female. The Pendulus Group has the clypeus highly polished with very sparse punctures bearing fine, suberect, cinereous setae. The North American representatives are *fraternus* Say, *americanus* Packard and *fulvicornis* Rohwer; I have examined the following Palaearctic members—*pendulus* Panz., *solskyi* Mor., *quadriceps* Tsun. and *convergens* Tsun. The Inordinatus Group has the clypeal surface less shiny with denser punctures bearing coarser, decumbent, silvery setae which are frequently dense enough to obscure the basic sculpture. Its North American representatives are *inordinatus* Fox, *podagricus* Kohl, *hubbardi* Roh. and *aphidiperda* Roh.; the Antillean *thoracicus* Ashmead and Central American *temporalis* Kohl also belong here; I have seen no Palaearctic members, but judged from Tsuneki (1954: fig. 37) *verhoeffi* Tsun. apparently belongs here.

North American species of the typical subgenus nest in wood in some form or another. Reported nesting sites include: Abandoned borings of other insects, principally beetle larvae, in twigs, dead trees, structural lumber or furniture (*fraternus, americanus, fulvicornis*); in borings made by the wasps in the pith of twigs or stems (*fraternus, americanus, aphidiperda, inordinatus inordinatus*); abandoned galls of other insects (*inordinatus universitatis,* possibly *aphidiperda*); and dry shelf fungi (*hubbardi*). The nests in borings of other insects or in pith usually consist of a linear series of cells separated by partitions of small pieces of pith of the wood substrate; however, there is one record (Krombein, 1961:3–4) of an aberrant nest in which two wasps were bred from a common brood cell without such a partition to separate them. In one gall nest the wasps were reported to be in oval cells, presumably not in series. No details are available of the nest architecture in the one nest found in a shelf fungus.

The prey stored consists of aphids, mostly nymphal stages, which are probably thoroughly paralyzed by malaxation of the anterior thoracic region. More prey records have been reported for *americanus* than for any of the other species; these include *Drepanaphis*, *Myzocallis* and *Therioaphis* in the Drepanosiphinae, *Rhopalosiphum* and *Aphis* or *Anuraphis* in the Aphidinae, and *Chaitophorus* in the Chaitophorinae. S. *fraternus* preys on *Therioaphis* and *Monellia*, both in the Drepanosiphinae. S. *i. inordinatus* and *aphidiperda* prey on *Aphis* in the Aphidinae. Miss L. E. Russell advises me that all of these genera of aphids are found on woody plants except that some species of *Rhopalosiphum* and *Aphis* occur on herbaceous plants also.

Atopostigmus is quite unlike the other subgenera in its preference for a nesting site. Specimens have been reared from cells in the sand, and others were reported as occurring on sand or mud banks or in the burrow of a ground-nesting bee. I presume that the sole included species, *fulvipes*, does not dig its own burrow but utilizes abandoned burrows of other ground-nesting insects as nesting sites. There are no prey records, but probably this subgenus also selects aphids to store its nests.

Specimens in the National Collection of Insects in the Smithsonian Institution are denoted by the acronym USNM.

PROVISIONAL KEY TO AMERICAN *STIGMUS* NORTH OF MEXICO
(male of *fulvicornis* Rohwer unknown)

1\. Females 2

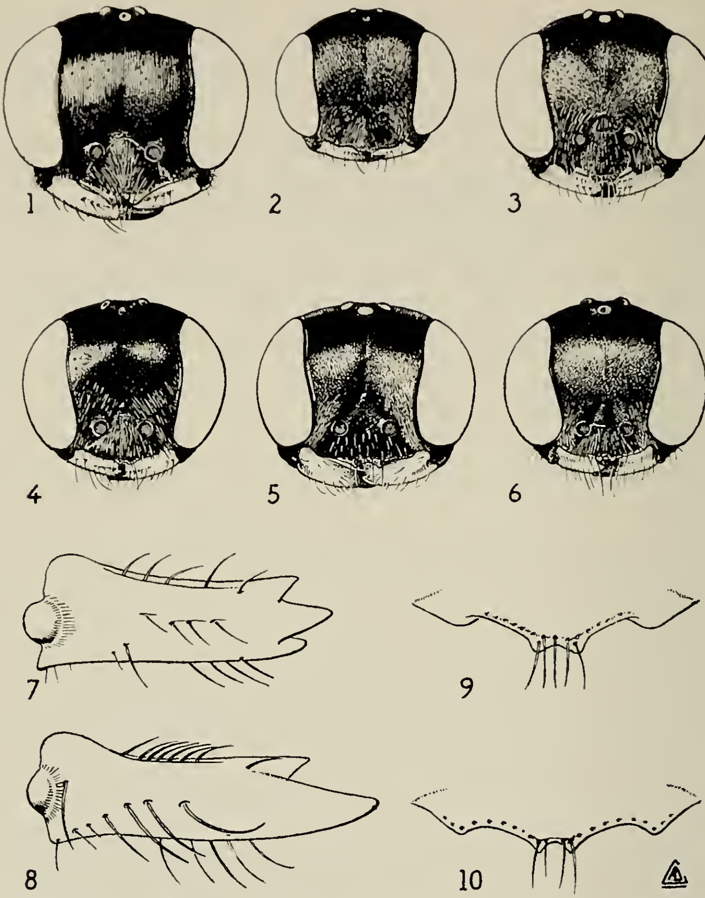
Males 11

2\. Mandible slender, bidentate, the lower tooth longer than upper; sides of head strongly convergent immediately behind eye; scutum usually with some well-developed longitudinal rugulae; posterior surface of propodeum with reticulations of extremely large mesh; petiole rather long and slender, 0.9 times as long as hind femur, the upper surface with close longitudinal ridges (*Atopostigmus*, new subgenus) .... *fulvipes* Fox

Mandible somewhat stouter, tridentate, the median tooth a little longer than other two; sides of head not so strongly convergent behind eyes; scutum rarely rugulose, though occasionally closely and very finely lineolate; posterior surface of propodeum with more numerous reticulations of smaller mesh; petiole shorter and stouter, 0.85 times or less the length of hind femur, the upper surface with several ridges, but most of surface rather irregularly rugulose (*Stigmus*, sens. str.) 3

3\. Clypeal surface less shiny, the punctures somewhat larger and rarely separated by more than twice the diameter of a puncture, the vestiture silvery, coarser, decumbent and sometimes dense enough to mask the basic sculpture 4

Clypeal surface highly polished and with very sparse, minute punctures separated by at least four times the diameter of a puncture, vestiture very fine, sparse and suberect 9



Figs. 1–10. *Stigmus* females. 1–6, frontal view of head: 1, *fulvipes* Fox; 2, *aphidiperda* Rohwer; 3, *inordinatus inordinatus* Fox; 4, *hubbardi* Rohwer; 5, *americanus* Packard; 6, *podagricus tarsalis*, new subspecies. 7–8, mandibles: 7, *americanus* Packard; 8, *fulvipes* Fox. 9–10, outline of clypeus showing apical emargination of median lobe: 9, *inordinatus inordinatus* Fox; 10, *inordinatus universitatis* Rohwer. (All drawings by A. D. Cushman.)

4. Deeply impressed pair of lines anteriorly on scutum almost punctiform, very short, about 0.2 times as long as distance between them; scutum dull from close, well-developed lineolation; ocellocular line 1.4 times as long as postocellar line .... (*podagricus* Kohl) .... 5.

Deeply impressed pair of lines anteriorly on scutum longer, 0.5 times or more as long as distance between them; scutum shinier, lineolation, if present, not so well developed 6

5. Small area of mesopleuron above transverse furrow with stronger rugulose reticulations of small mesh; scutum usually with several weak longitudinal rugulae along midline; mid and hind femora and tibiae largely infuscated; southern Mexico to southern Texas and Arizona .... *podagricus podagricus* Kohl

Small area of mesopleuron above transverse furrow with very weak oblique rugulae or shagreened; scutum without trace of rugulae; legs entirely light fulvous; central Texas to Florida and Georgia .... *podagricus tarsalis*, new subspecies

6. Antennal scape not creamy beneath; dorsal pronotal ridge strongly angulate laterally as viewed from above; head and scutum dull from close, rather strong lineolation; middle of clypeus slightly convex; Pennsylvania to North Carolina .... *aphidiperda* Rohwer

Antennal scape creamy beneath to some extent, usually for its entire length; dorsal pronotal ridge weakly or not at all angulate laterally when viewed from above; head and thorax shinier, lineolation weaker if present; middle of clypeus flattened 7

7. Lateral lobes of clypeus very weakly developed; antenna and legs mostly fulvous; dorsal pronotal ridge with lateral angles rounded, not at all angulate; scutum shining or rather dull from lineolation, with scattered punctures, rugulae lacking; New Mexico, Arizona, California, Washington .... *hubbardi* Rohwer

Lateral lobes of clypeus well developed; antenna and legs infuscated to a large extent .... (*inordinatus* Fox) 8

8. Median lobe of clypeus with apical emargination well developed, tending to be semicircular; dorsal pronotal ridge not angulate laterally when viewed from above; scutum without rugulae on center of disk; occurring east of the Rocky Mountains in Upper Austral and Alleghanian zones .... *inordinatus universitatis* Rohwer

Median lobe of clypeus with apical margin subtruncate to very shallowly emarginate; dorsal pronotal ridge angulate laterally when viewed from above; scutum occasionally with a few longitudinal rugulae on center of disk; occurring west of the Rocky Mountains in Upper Sonoran and Transition zones .... *inordinatus inordinatus* Fox

9. Thorax noticeably depressed, the dorsum strongly flattened, the scutum except very narrow anterior declivity, scutellum, postscutellum and dorsal surface of propodeum lying in one plane; antenna and fore and mid legs light fulvous; head quadrate

and lengthened behind eyes, the sides more or less subparallel for some distance behind eyes .... *fulvicornis* Rohwer

Thorax not depressed, the scutum in profile arched on anterior third or more 10

10. Sides of head behind eyes subparallel, only weakly convergent posteriorly; ocelloccipital distance 2.4–3.0 times the postocellar distance .... *fraternus* Say

Sides of head convergent behind eyes at an angle of about 30°; ocelloccipital distance 2.0–2.6 times the postocellar distance .... *americanus* Packard

11. Fore basitarsus compressed, curved near apex, longer than combined lengths of second to fourth segments; scutum usually with fine longitudinal rugulae in middle; sides and dorsum of abdominal petiole with longitudinal ridges, the petiole slender, longer than hind femur .... (*Atopostigmus*, new subgenus) .... *fulvipes* Fox

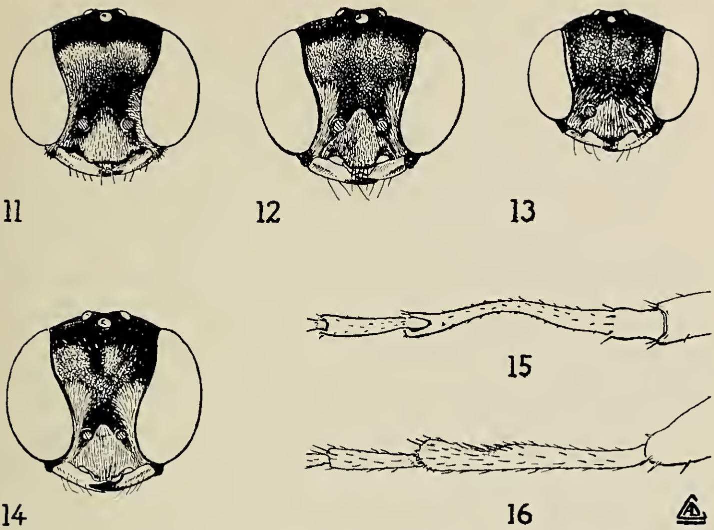
Fore basitarsus cylindrical in cross section and straight except in *hubbardi;* scutum without longitudinal rugulae; abdominal petiole shorter than or subequal to hind femur .... (*Stigmus* sens. str.) 12

12. Mid basitarsus curved on basal half, somewhat expanded about two-thirds of distance to apex, dentate beneath near apex and excavated between tooth and apex; dorsum of abdominal petiole with longitudinal ridges only 13

Mid basitarsus straight or only very slightly and evenly arcuate over its entire length, not dentate or excavate beneath near apex; dorsum of abdominal petiole with some irregular transverse rugulae or roughening between the pair of central longitudinal ridges 15

13. Mid basitarsus shorter, as long as the following two segments united; fore basitarsus compressed, curved on basal half; eyes more strongly convergent below, interocular distance across anterior ocellus 1.6 times the interocular distance across antennal insertions; pair of deeply impressed lines anteriorly on scutum long, the distance between them 1.5 times the length of lines; upper inner eye margin with a very narrow, short lineate fovea opposite posterior ocellus; New Mexico, Arizona, California, Washington .... *hubbardi* Rohwer

Mid basitarsus longer, equal to three following segments combined; fore basitarsus cylindrical in cross section, straight; eyes not so strongly convergent below, interocular distance across anterior ocellus 1.4–1.5 times the interocular distance across antennal insertions; pair of deeply impressed lines anteriorly on scutum almost punctiform; inner eye margin not foveate .... (*podagricus* Kohl) 14



Figs. 11–16. *Stigmus* males. 11–14, frontal view of head: 11, *fulvipes* Fox; 12, *inordinatus inordinatus* Fox; 13, *aphidiperda* Rohwer; 14, *americanus* Packard. 15, *fulvipes* Fox, dorsal view right foretarsus, basal segments. 16, *podagricus tarsalis*, new subspecies, lateral view left mid tarsus, basal segments. (All drawings by A. D. Cushman.)

14. Small area of mesopleuron above transverse furrow finely rugulose-reticulate; mid and hind legs infuscated in part, the foreleg entirely fulvous; southern Mexico to southern Texas and Arizona .... *podagricus podagricus* Kohl

Small area of mesopleuron above transverse furrow not rugulose; only the hind leg occasionally infuscated in part, the fore and mid legs entirely fulvous; central Texas to Florida and Georgia .... *podagricus tarsalis*, new subspecies

15. Ocelli small, the distance between posterior and anterior ocelli greater than diameter of a posterior ocellus; inner eye margins not strongly convergent below, the interocular distance across anterior ocellus about 1.2 times the interocular distance across antennal insertions; clypeal vestiture thinner so that punctures may be distinguished; Pennsylvania to North Carolina .... *aphidiperda* Rohwer

Ocelli larger, the distance between posterior and anterior ocelli less than diameter of a posterior ocellus; eyes more convergent below, interocular distance across anterior ocellus 1.4–1.5 times the interocular distance across antennal insertions; clypeal vestiture denser concealing the punctation 16

16. Median lobe of clypeus extending farther downward and somewhat lower than lateral lobes, apical margin rounded; head dull, rather densely shagreened; upper eye margin with a short linear or punctiform impression opposite lateral ocellus .... (*inordinatus* Fox) 17

    Median lobe of clypeus extending as far downward as lateral lobes and somewhat broader, apical margin truncate; head shinier, shagreening very delicate when present; upper eye margin without such a fovea .... *fraternus* Say and *americanus* Packard

17. Dorsal pronotal ridge not angulate laterally when viewed from above; occurring east of the Rocky Mountains in Upper Austral and Alleghenian zones .... *inordinatus universitatis* Rohwer

    Dorsal pronotal ridge weakly to strongly angulate laterally when viewed from above; occurring west of the Rocky Mountains in Upper Sonoran and Transition zones .... *inordinatus inordinatus* Fox

Stigmus subg. **Atopostigmus**, new subgenus

Female: Mandible slender, bidentate, the lower tooth longer than upper; clypeal margin bilobate in middle; posterior surface of propodeum with reticulations of large mesh; petiole rather long and slender as compared to typical *Stigmus*, the upper surface with close longitudinal ridges.

Male: Posterior surface of propodeum sculptured as in female; petiole slender, longer than hind femur, the dorsum and sides with longitudinal ridges.

Type-species: Stigmus fulvipes Fox, the only included species.

The differently shaped mandibles of the female indicate that the nesting behavior is probably dissimilar to that of members of the typical subgenus which tunnel in soft pith or use abandoned borings of other insects in wood as nesting sites. Label data on six specimens of *fulvipes* (USNM) state that they were taken on mud or sand banks, in cells in sand, and in the burrow of a ground-nesting bee, *Agapostemon radiatus* (Say). The lack of a pecten on the foretarsus suggests that *fulvipes* does not dig its own burrow in the ground, but appropriates that of another insect.

Stigmus (*Atopostigmus*) *fulvipes* Fox

Figures 1, 8, 11, 15

Stigmus fulvipes Fox, 1892:324.

I have studied the female holotype from California in the Academy of Natural Sciences, Philadelphia. The characters as described for the subgenus will separate *fulvipes* from any of its congeners. The species is widely distributed and I have seen specimens from District of Columbia, Virginia, North Carolina, Georgia, Iowa, Nebraska, Texas, New Mexico, Arizona, Colorado, British Columbia, Washington, Oregon, California, Morelos, Mexico and Mexico.

Stigmus subg. *Stigmus* Panzer

Stigmus Panzer, 1804: heft 86, pl. 7. Type-species: *S. pendulus* Panzer. Monotypic.

Gonostigmus Rohwer, 1911: 559. Type-species: *G. typicus* Rohwer. Original designation and monotypic. [NEW SYNONYMY.]

Females of the typical subgenus have stout, tridentate mandibles, the clypeal margin bidentate or subtruncate in the middle, the propodeum normally with reticulations of rather small mesh, and a shorter petiole as contrasted with these conditions in the subgenus *Atopostigmus*. They are distinguished from females of the subgenus *Carinostigmus* Tsuneki by the lack of crenulate eye margins and the lack of a median carina and projection on the lower front.

Rohwer (1911) based *Gonostigmus* on a unique male which he erroneously considered to be a female, stating that it was distinct from *Stigmus* "by the head being longer than wide, the facial quandrangle being narrowed below, the larger and produced clypeus, the antenna inserted very close to the orbits." Pate (1937a:92) came "to the conclusion that *Gonostigmus* should be accorded no more than subgeneric rank inasmuch as it agrees with the typical *Stigmi* in all essential features save for the character of the temporal region of the head." I do not believe that *Gonostigmus* can be retained even as a subgenus, for the chief characters of distinction are secondary sexual characters found only in the male. These are: The head beneath is concave and clothed with dense, long, erect hair; the temples are quite broad; the head beneath is angulate posteriorly; and the mesosternum is concave and clothed with dense erect hair which is shorter than that beneath the head. Males of other typical *Stigmus* do not have such bizarre characters. Eickwort (1967:68–69) reared series of both sexes; I find that the females are typical *Stigmus* in all important aspects and have only vestiges of the peculiar vestiture noted for the male.

The name *Antronius* has occasionally been cited in the synonymy of *Stigmus*. In his list of generic names of sphecoid wasps Pate (1937b:8) credited it as Dalman MS in Zetterstedt (1840: recte p. 442, not 443). Actually, Zetterstedt cites it as *Antronius* Dalman in synonymy position under the center head *Stigmus* Panzer. Under the provisions of Article 11 (d) of the Code, *Antronius* is not available.

PENDULUS GROUP

Stigmus (*Stigmus*) *fraternus* Say

Stigmus fraternus Say, 1824:340.—Packard, 1867:387.—Fox, 1892:323. —Krombein, 1958a:24.

Stigmus conestogorum Rohwer, 1911:557 [NEW SYNONYMY].
Stigmus fraternus raui Rohwer, 1923a:100 [NEW SYNONYMY].—Rau, 1928:379–381.

Say's original description of a specimen of unknown sex from Pennsylvania is too superficial for specific recognition. I am following the traditional interpretation as established by Packard and followed by Fox. The female holotypes (USNM) of *conestogorum* from Highspire, Pa., and of *fraternus raui* from St. Louis, Mo., agree with this interpretation. The three paratype females of *conestogorum* from other localities in Pennsylvania are not conspecific with the holotype, but are specimens of *americanus* Pack.

I have seen females from New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Tennessee and Missouri. I have been unable to separate males from those of *americanus.*

Packard (1867) cited Angus as having reared *fraternus* from a stem of *Syringa* in New York. Rau (1928) in St. Louis reared two males and eight females from a nest in one twig, and three specimens from a nest in a sassafras twig. The former nest contained 19 cells in a boring 8½″ long; the individual cells were a little more than 1⁄16″ in diameter and 3⁄16″–¼″ long; they were separated by partitions made of fine particles of pith; no cocoon was spun; the females emerged from the first eight cells stored, and the males emerged from the twelfth and seventeenth cells; the other cells contained either dead wasp larvae or from two to 23 dried aphids. Krombein (1958a) reported it as nesting in old anobiid burrows in a cowshed wall and storing nymphs of *Therioaphis* sp. and *Monellia* sp. A female from Clemson, S. C. (USNM), is labeled as coming from holes in a porch floor. Another female from Branford, Conn. (USNM), emerged from elm. A female from Rosedale, Mass. (USNM), bears a label, "ex burrows Pissodes strobi."

Stigmus (*Stigmus*) *fulvicornis* Rohwer

Stigmus fulvicornis Rohwer, 1923b:370.—Smith, 1923:553–554.

This species is known from females only. In the shape of the head it is like *fraternus* Say, but the flattened thorax separates it at once. However, I suspect that *fulvicornis* is actually a synonym of *fraternus*, and that the flattened thorax may be an artifact caused by development in too constricted a nesting site. The type-series was collected while "nesting in holes in a floor of a piazza."

I have seen the holotype and one paratype from Starkville, Miss. (USNM), and, through the courtesy of L. W. Hepner, two paratypes and five other specimens bearing the same locality data in the collection of Mississippi State University.

Smith (1923) reported the species as nesting in holes in the soft, punky pine floor of a piazza. Later in the year he obtained specimens nesting in hard pine floors in the interior of the same house. He believed that the wasps were constructing the burrows themselves, a conclusion at variance with later observations by Krombein (1955:16; 1958a:24) who found *americanus* Pack. sometimes nesting in abandoned, frass-filled burrows of anobiid beetles in structural lumber.

Stigmus (*Stigmus*) *americanus* Packard

Figures 5, 7, 14

Stigmus americanus Packard, 1867:386.—Fox, 1892:322.—Peckham and Peckham, 1898:44–45.—Hoffmann, 1938:118.—Krombein, 1955:16.—Krombein, 1956:42.—Krombein, 1958a:24.—Krombein, 1963:275.
Stigmus lucidus Rohwer, 1909:102 [NEW SYNONYMY].
Stigmus fraternus coloradensis Rohwer, 1911:559 [NEW SYNONYMY].
Stigmus (*Stigmus*) *americanus* Packard.—Krombein, 1954:6.—Krombein, 1961:64–65.

This is probably the commonest species in most of eastern North America. I have examined the female holotype of *americanus* from Illinois in the Academy of Natural Sciences, Philadelphia, the male holotype of *lucidus* from Kansas (USNM) and the female holotype of *fraternus coloradensis* from Colorado (USNM) and find that they are conspecific.

I am not at all certain that *americanus* can be maintained as distinct from *fraternus*. I am unable to distinguish the two in the male sex. In the females there is some variation in the shape and size of the head as noted in the key characters separating the two species. Apparently a similar degree of variation is manifest in the European *pendulus* Panz., although in that species the sides of the head behind the eyes are more convergent in smaller specimens as noted by Tsuneki (1954: footnote on p. 21). This is not the case in the *fraternus-americanus* complex, for I have seen typical specimens of *fraternus* which are decidedly smaller than typical specimens of *americanus*. Also, populations of both species are nesting at my home and I have found no intergrades between them. And, finally, females of the few available reared series show no intergrades.

Very rarely the thorax of the females may vary from light red to castaneous or may be blotched with red in varying degrees. The cause of this coloration is unknown. The four females I have seen come from Mississippi, two each from Utica and Starkville. Ashmead misidentified the Utica specimens as his West Indian *thoracicus*, but they differ from *americanus* only in the red or castaneous on parts or all of the thorax. Associated with the females is a series of males from Utica, bearing an Ashmead manuscript name; they have lesser and varying amounts of red or castaneous on the thorax or propodeum. I have also seen one male from Florida with some red on the prothorax and propodeum.

Stigmus americanus has a wider distribution in North America than any of the other species. In Canada it is known from Labrador, Nova Scotia, New Brunswick, Quebec, Ontario, Northwest Territories and

British Columbia. In the United States it has been collected in most states east of the 100th meridian, although I have not seen specimens from Louisiana, Texas and Oklahoma, nor from the Dakotas. In the west I have seen a single specimen from Washington.

In keeping with its status as the most common and widely distributed of North American *Stigmus*, more is known of the nesting habits and prey preferences of *americanus* than any of its congeners. Peckham and Peckham found it nesting in an old stump and provisioning with aphids, probably obtained from chokecherry. They mentioned that three females were using the same gallery, a most unusual observation and one which has not been confirmed by other observers. They reared a chrysidid, *Omalus janus* (Hald.) [recorded as *O. corruscans* (Nort.)] from one of the cells; the reared chrysidid could not be found in the USNM and its identity needs confirmation. The female *Stigmus* on which their notes were based is from Maitland, Wis. (USNM) and bears a determination label as *Stigmus americanus* by Ashmead.

Krombein published a series of notes on nesting and prey records. In 1954 he captured a female hovering before its burrow opening in the wall of a log cabin at Lost River State Park, W. Va., while carrying an aphid nymph belonging to the tribe Panaphini. In Arlington, Va. (1955, 1956), he found it nesting in deserted anobiid burrows in the wall of an old cowshed. He took it with prey as early as 2 May and as late as 20 September. All specimens of prey being transported by wasps were immature aphids belonging to *Drepanaphis acerifoliae* (Thos.), *Rhopalosiphum* sp., *Aphis* or *Anuraphis* sp., *Myzocallis* (?) sp., and undetermined species belonging to the Aphini or Panaphini. In 1955 he reported a female transporting an aphid nymph, possibly a species of *Chaitophorus*, at Dunn Loring, Va., on the trunk of a dead tree with punky wood. Later (1958a) he recorded it as preying on nymphs of *Drepanaphis* and Panaphini and one *Drepanaphis* adult in Arlington, and on *Drepanaphis* nymphs at Plummers Island, Md. At Plummers Island, Md. (1961), he found a nest in an old boring 1.5 mm–1.8 mm wide in a dead *Chionanthus* twig. Thirty nymphal and adult aphids of a species of *Therioaphis* were packed into a brood chamber 10 mm long with two wasp eggs. The nest was quite unusual in that this chamber was not divided into two cells by the usual partition of pith particles. Two *americanus* females were reared from the eggs. Finally, Krombein (1963) noted that the species was actively nesting in deserted anobiid borings in the cabin rafters and porch floor at Plummers Island from 8 May to 26 October.

There are in the USNM some specimens of *americanus* bearing label data on nesting sites. A female from Lyme, Conn., was nesting in chestnut supports in the basement of a barn; one from Philadelphia, Pa., was taken from burrows in porch furniture; several from the District of Columbia were in "wooden mortar"; one from Winchester, Va., came from pine lumber; and one from Tryon, N. C., was in the siding of a house. One series from Barcroft, Va., was reared from borings in pith of *Rhus glabra.* A series from Liberty Corner, N. J., bears a label "reared from L. aculeatus." C. H. Hoffmann, reared this series and published notes (1938) on the parasites of a scolytid beetle, *Lesperisinus aculeatus* (Say) reared from old galleries of the beetle in a felled ash tree. He stated that the *Stigmus* was not likely to be associated as a parasite of the beetle. In view of other rearing records it is certain that the wasp was merely using abandoned borings of the beetle as a convenient nesting site. A specimen from Chambersburg, Pa., J. R. Stear, collector, was "reared from L. molesta"; there is no bush or tree in northeastern U.S. having this specific name in a genus beginning with L, so it is probable that this label may similarly refer to a nesting site in the abandoned boring of some beetle.

Inordinatus Group

Stigmus (*Stigmus*) *inordinatus* Fox

This taxon is readily separable into two subspecies, typical *inordinatus* occurring west of the Rocky Mountains and *inordinatus universitatis* east of the Rockies. The nominate subspecies has the pronotal ridge angulate laterally when viewed from above and the apical margin of the median lobe of the clypeus of the female weakly emarginate or subtruncate; in *universitatis* the pronotal ridge is not angulate and the median lobe of the clypeus of the female is almost semicircularly emarginate. I have seen three intergrade females from Colorado, having the pronotal keel as in *universitatis* and the clypeal lobe as in typical *inordinatus.*

It is possible that the two subspecies are also separable on ethological grounds. The only nesting records for typical *inordinatus* are from series of linear cells in the pith of twigs or stems and the only records for *universitatis* are in galls.

Stigmus (*Stigmus*) *inordinatus inordinatus* Fox

Figures 3, 9, 12

Stigmus inordinatus Fox, 1892: 322.
Stigmus fulvipes var. *coquilletti* Rohwer, 1911: 559 [NEW SYNONYMY].
Stigmus reticulatus Mickel, 1918 (1917):330.—Krombein, 1958b:190.

I have examined the holotypes of all of the taxa listed above. Fox described *inordinatus* from both sexes from Colorado; the holotype is a female in the Academy of Natural Sciences, Philadelphia. Rohwer had both sexes of *coquilletti* from Los Angeles Co., Calif. (USNM); a female is the holotype. Mickel described *reticulatus* from a unique female from Marin Co., Calif., in the University of Nebraska collection; I synonymized it with typical *inordinatus* (1958b).

I have seen typical *inordinatus* from Colorado, New Mexico, Arizona, Utah, Nevada, California, Oregon, Washington, British Columbia and Montana.

Rohwer (1909:102) stated that Mrs. Cockerell saw a female catching aphids at Beulah, New Mexico. Wasbauer and Simonds (1964) reported this taxon as constructing linear series of cells in twigs of mulberry and peony. The cells were 2.4–9.0 mm long, and were separated by partitions of bits of pith 5.0–8.5 mm thick. The wasps stored the cells with wingless *Aphis*, possibly *frangulae* Kalt. The cells in one nest contained 12–16 aphids per cell, and in another 20–30 aphids per cell. Parker and Bohart (1966:95) reported rearing typical *inordinatus* from elderberry stems in both Nevada and California; they also recorded the chrysidid wasps *Omalus variatus* (Aar.). *O. glomeratus* (Buyss.) and *O. cressoni* (Aar.) as parasites. A female from Utah (USNM) was reared from a raspberry cane and three females from Washington (USNM) are labeled "in peach."

Stigmus (*Stigmus*) *inordinatus universitatis* Rohwer
Figure 10

Stigmus inordinatus universitatis Rohwer, 1909:102.

Rohwer's type-series was from Colorado and Kansas. He did not mention the sex in his description. There are in the USNM the holotype female and a paratype female, both from Colorado. Fortunately, Rohwer's holotype belongs definitely to the eastern subspecies and is not an intergrade. There is occasionally variation in the density of the clypeal punctation in the female, one from Washington, D.C., having the punctures quite separated.

I have seen specimens from Colorado, Illinois, West Virginia, Virginia, District of Columbia, Maryland, New Jersey and Connecticut.

This subspecies has been reared only from galls of other insects. Rohwer misidentified as *conestogorum* Roh. a specimen of *universitatis* which Richardson (1915) reported to be storing green aphids in numerous oval chambers in a dried gall on white oak; he called the gall-maker *Holcaspis globulus*, a cynipid we now recognize as *Disholcaspis quercusglobulus* (Fitch). Richardson's wasp from New Brunswick, N.J., is in the USNM. Another female from the District of Columbia (USNM) is pinned with part of a gall; the label states "Stigmus from galls of C. q. globulus, 5 July 1883," presumably a gall of the same species as the preceding. Still a third female from Urbana, Illinois (USNM), was reared from an oak club gall. The absence of rearing records from other kinds of nesting sites suggests that abandoned galls may be the preferred nesting sites of *inordinatus universitatis*, in contrast to the nests of typical *inordinatus* which consist of a linear series of cells in pith of twigs.

Stigmus (*Stigmus*) *hubbardi* Rohwer, new status
Figure 4

Stigmus inordinatus hubbardi Rohwer, 1911:559.

Females of this are rather readily separable from *inordinatus* Fox, the closest relative, by the weakly developed lateral lobes of the clypeus and the predominantly fulvous antennae and legs. Females from Palm Springs, Calif., the type-locality, and Asotin, Washington, agree in having the scutum shining and with scarcely noticeable lineolation. Females from Arizona and New Mexico agree with all males in having the scutum rather dull because of well-developed lineolation. A similar situation occurs in females of *fulvipes* Fox from the same areas. Perhaps two subspecies should be recognized on the basis of this difference in scutal sculpture, but it seems advisable to defer a final decision until more extensive material is at hand.

The species has been collected in Colorado, Utah, New Mexico, Arizona, California and Washington.

The type-series (USNM) was "bred from pupae in *Polyporus*," a shelf fungus.

Stigmus (*Stigmus*) *podagricus* Kohl

This species may be readily recognized by the combination of the following characters: Both sexes with a pair of extremely short, punctiform impressions anteriorly on the scutum; the male with the middle basitarsus in profile somewhat arcuate, narrowed on basal two-thirds and rather abruptly expanded on apical third; and the female with the median lobe of the clypeus narrowly, semicircularly emarginate apically.

S. *podagricus* has not been recorded previously from America north of Mexico. The material at hand ranges from the states of Veracruz and Morelos, Mexico, north into Arizona and Texas, thence eastward into Florida and Georgia.

Stigmus (*Stigmus*) *podagricus podagricus* Kohl, new status

Stigmus podagricus Kohl, 1890:65.

My interpretation of the typical subspecies is based on study of the holotype male from Orizaba, Veracruz, Mexico, in the Natural History Museum, Vienna, a short series of both sexes from Cuernavaca, Morelos, Mexico, and females from Madera Canyon, Ariz., and Hidalgo Co., Tex.

Both sexes differ from those of *p. tarsalis*, new subspecies, by the rugose reticulate sculpture of the upper triangular area of the mesopleuron, and in the female by the infuscated areas on the legs and the presence of a few weak, central, longitudinal rugulae on the scutum. A female from San Antonio is transitional to *p. tarsalis* in that the scutum lacks rugulae, but the upper mesopleuron is as in typical *podagricus*; only the hind femur is infuscated rather than the mid and hind femora and tibiae.

Stigmus (Stigmus) podagricus tarsalis, new subspecies

Figures 6, 16

This subspecies is known from Georgia, and in the Gulf States from Florida to central and northern Texas. The upper area of the mesopleuron in both sexes is either shagreened or has only very weak, oblique rugulae, and the females have the legs entirely light fulvous and the scutum without median longitudinal rugulae.

Holotype: ♂, Coleta, Alabama, H. H. Smith (USNM Type No. 72510).

Male: Length 5.2 mm. Black: Mandible except teeth, scape narrowly beneath and pronotal lobe, creamy; rest of antenna except apical half of flagellum, tegula, axillary sclerites and legs except hind femur and tibia, light fulvous; hind femur and tibia, and last abdominal segment, castaneous.

Allotype: Same data as type.

Female: Length 5.2 mm. Coloration as in holotype except all legs light fulvous.

Paratypes: TEXAS: 2♂, 1♀, Devils River, 5 May 1907, F. C. Bishopp (USNM); 1♂, Hunt, Guadalupe River, 12 June 1953, W. W. Wirth (USNM). ALABAMA: 2♂, same data as holotype (USNM); 1♀, Langdale, Chambers Co., H. H. Smith (USNM). FLORIDA: 1♀, Monticello, 15 March 1919, W. A. Hoffmann (USNM); 1♂, Palatka, 3–4 May 1916, J. C. Bradley (Cornell); 2♂, Alachua Co., 10 March 1955, H. V. Weems, Jr. (Fla. State Coll. Arthropods); 1♂, Levy Co., 6 May 1955, F. W. Mead (Fla. State Coll. Arthropods); 1♂, 1♀, Gainesville, 22 April 1952, G. S. Walley (Ottawa); 1♀, Oneco, 25 March 1955, J. C. Martin (Ottawa); 1♂, Fort Ogden, 10 April 1952, O. Peck (Ottawa). GEORGIA: 1♂, DeWitt, Mitchell Co., 8 June 1914, C. S. Spooner (Cornell).

Male paratypes are 4.3–5.2 mm long, and females 5.2–5.3 mm. About half of the males have entirely fulvous legs.

Stigmus (*Stigmus*) *aphidiperda* Rohwer

Figures 2, 13

Stigmus aphidiperda Rohwer, 1911:558.

The type-series of both sexes came from Highspire, Pa. (USNM). The specimen bearing Rohwer's determination as the type female is actually a male. In his original description Rohwer mentioned having two females from Colorado, but these were actually specimens of typical *inordinatus* Fox not *aphidiperda*; they were not part of the type-series.

The type-series from peach bore a label, Quaintance No. 5692. The notes under this number state—"Pith had been tunneled by this small wasp. Cells completely filled with wingless specimens of *Aphis persicae-niger* Sm." A series of both sexes from District of Columbia (USNM) bears labels "bred with *Agrilus ruficollis*," a buprestid beetle which makes galls in raspberry and blackberry; it is not clear from this label whether the *aphidiperda* had nested in the gall or in the pith of the cane.

Specimens are known from Pennsylvania, District of Columbia, Virginia and North Carolina.

Stigmus (*Stigmus*) *temporalis* Kohl

Stigmus temporalis Kohl, 1892:204, pl. 13, figs. 31, 32.
Gonostigmus typicus Rohwer, 1911:560 [NEW SYNONYMY].
Stigmus (*Gonostigmus*) *temporalis* Kohl.—Eickwort, 1967:68–69, fig. 26.

S. temporalis, a member of the Inordinatus Group, is not known to occur north of the states of Morelos and Veracruz, Mexico. It is treated here because of the new synonymy involved at both the subgeneric and specific levels. The known distribution (south to Panama) suggests that it occurs primarily in tropical areas of Central America.

Kohl described *temporalis* from a male from Guatemala; it is in the Natural History Museum, Vienna. Rohwer's holotype from Motzorongo, Veracruz (USNM), is a male and not a female as supposed by Rohwer. I have studied both holotypes and can find no basis for maintaining *typicus* as a discrete taxon. After examination of Rohwer's holotype, Pate (1937a:92) suggested that *typicus* might prove to be a synonym of *temporalis* Kohl. He failed to recognize that Rohwer's holotype was a male which agrees in all essential details with Kohl's description and figures of *temporalis*.

In addition to the two holotypes I have seen specimens from Morelos, Mexico; Honduras; Guatemala; Costa Rica and Panama. A positive association of sexes was made on the basis of Eickwort's (1967) rearing from twig nests in Costa Rica. As mentioned under the subgeneric heading, the male of *temporalis* is quite aberrant in secondary sexual characteristics, such as the broadened temple, and the concave underside of the head and mesosternum, each of which is clothed with dense, erect hair. The female of *temporalis* agrees with females of typical *Stigmus* in the conformation and sculpture of the head and mesopleuron. It has vestiges of the pubescence which is so striking in the male, but the vestiture is much shorter and more limited in extent. There is a small posterolateral patch beneath on head, and the mesopleuron anteriorly and mesosternum have similar vestiture. In females of other typical *Stigmus* this vestiture is very much sparser. Females of *temporalis* are superficially very similar to those of *podagricus* Kohl in the shape and vestiture of the clypeus and the sculpture of the pronotum and scutum, but they differ in the vestiture of the head beneath and the mesopleuron, in the broader temples, and in the weaker epicnemial suture.

In Costa Rica Eickwort (1967) found *temporalis* in competition with the colletid bee *Chilicola ashmeadi* (Cwfd.) for nesting sites in dead hollow *Erythrina* twigs. The wasp constructed a linear series of 4–9 cells separated by partitions 1.5–10.0 mm thick of wood particles chewed from the sides of the twig. Wingless aphids were stored as prey.

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PROCEEDINGS
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STATUS OF THE OBER TOBAGO COLLECTION, SMITHSONIAN INSTITUTION, AND THE PROPER ALLOCATION OF *AMIVA SURANAMENSIS TOBAGANUS* COPE (SAURIA: TEIIDAE)[1]

By Robert G. Tuck, Jr., and Jerry David Hardy, Jr.
Smithsonian Institution, Washington, D.C. 20560,
and Natural Resources Institute, Chesapeake Biological
Laboratory, Solomons, Md. 20688

Cope (1879:276) reported upon 36 amphibians and reptiles, supposedly from Tobago, West Indies, sent to the Smithsonian Institution by Frederick A. Ober, an amateur ornithologist collecting throughout the Lesser Antilles for the Institution.

Cope identified the single frog represented in Ober's collection as *Hylodes* (=*Eleutherodactylus*) *martinicensis*, USNM 10121. Although Barbour (1916) and Mertens (1969) doubted the correctness of Cope's assignment, we have carefully examined the specimen in question, and we concur with Cope's identification. However, *E. martinicensis* is known only from Martinique, Dominica, Guadeloupe, and Antigua (Schwartz, 1967:32). Our own investigations on Tobago, 1970–1972, have failed to produce a specimen of this species. Ober (1880:123) mentioned the nocturnal din of frogs on Dominica and described encountering the small creature producing the noise. For no other island did he remark on the frogs, and it is logical to assume the example in question originated there.

Thirty-one of Ober's specimens are anoles, referred by Cope to *Anolis alligator* (=*Anolis roquet roquet*), USNM 10102–12, 10114–15, 10117–20, and 10123–36. Cope's assignment

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[1] Contribution No. 535 from the Natural Resources Institute, University of Maryland.

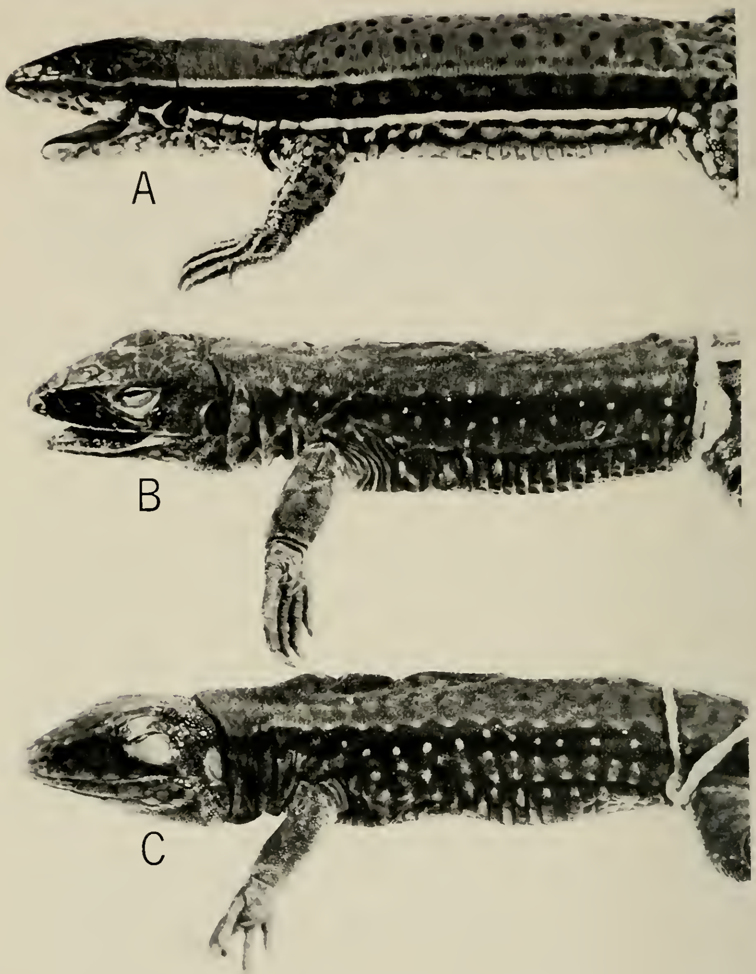

Fig. 1. *Ameiva ameiva* from southeastern Caribbean islands. A. USNM 167481, Charlotteville, St. John Parish, Tobago, 106.2 mm. B. USNM 101113, holotype of *Ameiva surinamensis tobaganus*, 89.0 mm. C. USNM 43222, topotype of *Ameiva aquilina*, St. George, Grenada, 87.1 mm.

stands, but this form is known only from Martinique (Gorman and Atkins, 1969).

Two of Ober's specimens are *Bothrops lanceolatus*, USNM 10116 and 10122, a species also endemic to Martinique (Lazell, 1964). In point of fact, Ober (1879:450; 1880:319) described the capture and preservation in rum of these two examples on Martinique after he had left Tobago.

A snake, USNM 10137, Cope identified as *Drymobius* (=*Mastigodryas*) *boddaertii*. Stuart (1938:7) designated this specimen a paratype of his *Eudryas amarali*, a species otherwise known to inhabit "Margarita Island and dry areas in northeastern Venezuela" (Peters and Orejas-Miranda, 1970: 191). We have examined this individual, as well as the holotype of *E. amarali*, USNM 22534. These two specimens do not appear to belong to the same population, and we agree with Brongersma (1956:178) that it is difficult to form a definite opinion as to the identity, or provenance, of the "Tobago" specimen, which now lacks a clear pattern. In some respects USNM 10137 resembles *Mastigodryas bruesi*, another member of Stuart's (1941) *pleei* group known from Grenada, St. Vincent, and the Grenadines. As pointed out below, Ober spent considerable time on these islands. Aside from the single supposed example of *M. amarali*, the only other representative of *Mastigodryas* known to inhabit Tobago is the endemic *M. boddaerti dunni* (Stuart, 1933) (Peters and Orejas-Miranda, 1970: 193). We have examined two recently collected examples of this genus, one each in the American Museum of Natural History, AMNH 108743, and the National Museum of Natural History, USNM 195126. Both specimens appear best to fit the description of *M. b. dunni.*

There remains a single lizard, USNM 10113, which Cope described as *Amiva suranamensis tobaganus*. Subsequent authors have referred all Tobago *Ameiva* to Cope's taxon. Barbour and Noble (1915:459) recognized *tobagana* as a full species distinct from the Trinidad representative, *Ameiva atrigularis* Garman 1887. They based their decision upon a photograph of Cope's holotype supplemented by a description of the specimen supplied by Leonhard Stejneger. They had no examples available for their own examination. Later, Barbour (1916:223) reported a series of specimens from Milford
scription or with the type. Brongersma (1956:167) concluded
Bay, Tobago, but he did not compare them with Cope's de-

TABLE 1.

Museum number (USNM)	Locality	Subspecies	Sex	Snout/vent length	Upper labials	Lower labials	Femoral pores	Lamellae fourth toe	Ventral lateral series	Ventral transverse series
10113	Uncertain (see text)	*tobagana* (holotype)	female	89.0	7/7	7/6	17/17	37	32	12
17721	Trinidad	*atrigularis*	male	156.0	6/6	6/5	16/17	32	30	12
17722	Trinidad	*atrigularis*	male	116.0	6/6	6/6	17/18	35	32	10
17723	Trinidad	*atrigularis*	female	120.0	6/6	5/5	18/19	35	33	10
17724	Trinidad	*atrigularis*	female	123.0	7/6	6/5	16/17	35	31	10
166635	Trinidad, Maracas	*atrigularis*	male	130.0	6/6	5/5	17/18	35	31	10
166636	Trinidad, Maracas	*atrigularis*	male	107.6	6/6	6/5	16/17	35	32	10
166637	Trinidad, Maracas	*atrigularis*	female	95.6	6/6	6/5	17/17	36	31	10
166638	Trinidad, Maracas	*atrigularis*	male	116.8	6/6	5/6	17/16	33	30	10
166639	Trinidad, Maracas	*atrigularis*	juvenile	89.5	6/6	5/5	17/17	36	31	10
167481	Tobago, Charlotteville	*atrigularis*	female	106.2	6/6	6/5	19/20	39	32	10
195008	Tobago, Charlotteville	*atrigularis*	juvenile	47.5	6/6	6/5	19/16	39	30	10
195009	Tobago, Roxborough	*atrigularis*	male	116.2	6/6	6/6	19/19	37	30	10

TABLE 1. (Continued)

Museum number (USNM)	Locality	Subspecies	Sex	Snout/ vent length	Upper labials	Lower labials	Femoral pores	Lamellae fourth toe	Ventral lateral series	Ventral trans-verse series
195072	Tobago, Charlotteville	*atrigularis*	male	136.0	6/6	6/5	20/22	40	31	10
195073	Tobago, Charlotteville	*atrigularis*	female	126.8	6/6	6/6	18/18	38	30	10
195074	Tobago, Charlotteville	*atrigularis*	male	127.4	6/6	5/6	16/18	37	30	10
195075	Tobago, Charlotteville	*atrigularis*	female	115.8	6/6	6/6	19/19	37	31	10
195076	Tobago, Charlotteville	*atrigularis*	male	115.9	6/7	5/7	18/19	37	32	10
195077	Tobago, Charlotteville	*atrigularis*	female	115.1	6/6	6/5	19/18	36	32	10
195078	Tobago, Charlotteville	*atrigularis*	juvenile	76.5	6/6	5/6	19/20	38	31	10
195079	Tobago, Charlotteville	*atrigularis*	female	116.9	6/6	5/5	21/21	39	30	10
195080	Tobago, Charlotteville	*atrigularis*	male	147.7	6/6	6/5	20/19	40	31	10
195081	Togabo, Charlotteville	*atrigularis*	male	134.0	6/6	5/5	19/18	39	31	10
195082	Tobago, Charlotteville	*atrigularis*	female	124.5	6/6	6/5	18/18	39	31	10

TABLE 1. (Continued)

Museum number (USNM)	Locality	Subspecies	Sex	Snout/vent length	Upper libials	Lower labials	Femoral pores	Lamellae fourth toe	Ventral lateral series	Ventral transverse series
195083	Tobago, Charlotteville	*atrigularis*	juvenile	86.0	6/6	5/6	20/20	37	32	10
195084	Tobago, Charlotteville	*atrigularis*	juvenile	81.5	6/6	6/5	18/20	41	32	10
195085	Tobago, Charlotteville	*atrigularis*	male	126.1	6/6	5/6	20/19	35	31	10
195086	Tobago, Charlotteville	*atrigularis*	male	126.4	6/6	5/5	20/20	39	31	10
195087	Tobago, Charlotteville	*atrigularis*	female	111.1	6/6	6/6	17/17	38	31	10
195088	Tobago, Charlotteville	*atrigularis*	male	167.0	6/6	5/5	19/19	40	28	10
195089	Tobago, Charlotteville	*atrigularis*	male	141.9	6/6	6/6	19/19	37	31	10
195090	Tobago, Charlotteville	*atrigularis*	male	113.5	6/6	6/6	19/18	39	31	10
195091	Tobago, Charlotteville	*atrigularis*	male	134.6	6/6	6/6	19/22	40	30	10
195092	Tobago, Charlotteville	*atrigularis*	female	104.7	7/6	6/5	18/18	40	31	10
195093	Tobago, Charlotteville	*atrigularis*	female	109.3	6/6	6/6	19/19	42	30	10

Table 1. (Continued)

Museum number (USNM)	Locality	Subspecies	Sex	Snout/vent length	Upper labials	Lower labials	Femoral pores	Lamellae fourth toe	Ventral lateral series	Ventral trans-verse series
195094	Tobago, Charlotteville	*atrigularis*	female	122.0	6/6	6/6	19/20	38	31	10
195095	Tobago, Charlotteville	*atrigularis*	male	106.9	6/7	6/5	19/19	41	32	10
43222	Grenada, St. George,	*tobagana*	juvenile	87.1	6/6	6/6	20/20	38	32	10
43223	Grenada,	*tobagana*	juvenile	74.7	6/6	6/6	18/17	37	31	10
79111	Grenadines, Petit Mustique	*tobagana*	male	137.2	7/7	6/6	19/21	38	32	10
79112	Grenadines, Frigate Island	*tobagana*	female	123.7	6/6	7/6	20/21	39	33	12
79147	Grenadines, Frigate Island	*tobagana*	male	138.5	7/6	6/6	19/21	34	32	10
79148	Grenadines, Frigate Island	*tobagana*	male	127.8	7/7	5/5	20/21	33	31	12
79149	Grenadines, Frigate Island	*tobagana*	male	149.5	6/6	6/6	20/21	36	31	10
79194	Grenada, Mineral Springs	*tobagana*	female	95.2	6/7	6/6	18/19	38	31	12
79195	Grenada, Mineral Springs	*tobagana*	male	83.9	7/6	6/6	17/18	35	31	12

TABLE 1. (Continued)

Museum number (USNM)	Locality	Subspecies	Sex	Snout/vent length	Upper labials	Lower labials	Femoral pores	Lamellae fourth toe	Ventral lateral series	Ventral transverse series
104198	Grenadines, Bequia	*tobagana*	male	117.4	7/7	6/6	19/19	38	32	12
104199	Grenadines, Bequia	*tobagana*	male	112.0	7/7	6/6	19/19	37	32	12
104200	Grenadines, Mayreau	*tobagana*	juvenile	75.9	6/6	6/6	19/19	37	32	12
104201	Grenadines, Mayreau	*tobagana*	juvenile	61.9	6/6	6/5	19/20	34	33	10
104202	Grenadines, Union Island	*tobagana*	juvenile	45.5	6/6	5/5	20/21	40	33	10

that the Trinidad and Tobago forms were identical, both representing a single race of the widespread *Ameiva ameiva.* He reasoned that Cope's name took priority over Garman's, the proper designation therefore being *Ameiva ameiva tobagana.* He did not examine the Ober specimen. Baskin and Williams (1966) also did not consider material from Trinidad and Tobago, but they recognized the two islands as being both inhabited by *Ameiva ameiva tobagana.*

Ober collected birds on St. Vincent from October 1877 to February 1878 (Ober, 1879:448–449; 1880:180, 219). He visited at least two of the Grenadines, Balliceaux and Battowia, in February 1878 (Ober, 1880:219–220) and moved to Grenada in early March 1878, where he spent about a month (Ober, 1879:449; 1880:254). In his popular account, Ober (1880) refers to lizards only in his discusson of Grenada, and his description fits well the activities of ameivas: "Especially do they love the cliffs, and if you are walking through the bushes at the base of any sunny precipice, or over any rocky tract, you will be startled by the frequent dashes made by these reptiles across your path" (Ober, 1880:255–256).

We have compared the holotype of *A. a. tobagana* with recently collected specimens of *A. ameiva* from Trinidad and Tobago, and we have found that Ober's specimen does not resemble examples from these two islands. We have also compared Ober's *Ameiva* with specimens of *Ameiva ameiva aquilina* Garman 1887, which inhabits Grenada, St. Vincent, and the Grenadines (Baskin and Williams, 1966:155, Table 16), and we conclude that the holotype of *Ameiva ameiva tobagana* was actually taken from that populaton. A vivid, well-developed lateral white stripe passing through the ear is evident on all recently collected Tobago ameivas but is lacking or poorly developed on Grenada-St. Vincent examples and absent on the holotype of *tobagana* (Fig. 1). Meristic data taken from Ober's specimen and from specimens of *Ameiva* collected on the islands in question are summarized in Table 1. Counts for ventral transverse series are 10 in 100% of specimens known to have been collected on Tobago (27 examples), while the same counts are 12 in 50% of the Grenada-Grenadine specimens at hand (14 examples), as well as for the holotype of *tobagana.* It will be noted that our measurements and counts for the Grenada and Grenadine examples correspond closely with the same figures given for these specimens by Cochran (1934, 1938). Unfortunately, following the laws of priority, ameivas native to St. Vincent, Grenada, and the Grenadines, must henceforth be known as *Ameiva ameiva tobagana* Cope 1879, of which *Ameiva ameiva aquilina* Garman 1887 becomes a junior synonym.

The Trinidad-Tobago form should be designated *Ameiva ameiva atrigularis* Garman 1887, which is the next available name. If further investigation indicates the racial separation of Tobago ameivas from those of Trinidad, then Garman's taxon will refer only to the population inhabiting the larger island, and the Tobago *Ameiva* will require renaming.

We thank Dr. A. Wetmore and Mr. J. P. Angle of the Division of Birds, National Museum of Natural History, for their kind assistance. Dr. G. R. Zug, Division of Reptiles and Amphibians, National Museum of Natural History, read the manuscript and offered helpful suggestions.

Specimens examined: (All are in National Museum of Natural History, USNM.)

Ameiva amevia atrigularis, 36 specimens: TRINIDAD: no other data, USNM 17721–24; Maracas, USNM 166635–39.—TOBAGO: Charlotteville, USNM 167481, USNM 195008, USNM 195072–95; near Roxborough, USNM 195009.

Ameiva ameiva tobagana, 15 specimens: "TOBAGO" (in error): USNM 10113 (holotype).—GRENADA: St. George, USNM 43222–23; Mineral Springs, USNM 79194–95.—GRENADINES: Bequia, USNM 104198–99; Frigate, USNM 79112, USNM 79147–49; Mayreau, USNM 104200–01; Petit Mustique, USNM 79111; Union, USNM 104202.

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PROCEEDINGS
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TWO NEW SPECIES OF *GONODONTA* HÜBNER (LEPIDOPTERA: NOCTUIDAE)

By E. L. Todd
Systematic Entomology Laboratory, A.R.S.,
U.S. Department of Agriculture[1]

The specimens on which the following descriptions are based were located in the British Museum (Natural History) by Alan Hayes. Being unable to find the species in my paper, The fruit-piercing moths of the genus *Gonodonta* Hübner, U.S. Department of Agriculture Technical Bulletin No. 1201, 1959, he kindly sent the specimens to me for study and description.

Gonodonta aeratilinea, new species

Front of head white, contrasting with dark reddish-brown vertex, thorax and abdomen; palpi reaching about to middle of frons, third segment very short, clothed with appressed white scales, second segment tufted below at apex wedge-shaped, gray brown laterally, white ventrally and before base of third segment. Pectus white tinged with gray brown, thorax paler than abdomen. Legs gray, slightly darker than pectus. Outer margin of forewing rounded; tornus produced to a moderate tooth; scale tooth of inner margin moderate, coppery red. Pattern of maculation of forewing (Fig. 1) vague; forewing dark reddish brown, darker between fold and inner margin than on anterior part, ordinary lines and spots obsolescent or scarcely discernible, inner element of postmedial band and border of reniform spot slightly darker than ground color of wing, a transverse row of five weak bronze-yellow spots present in subterminal area, termen, fringe and costal margin speckled with pale gray and opalescent scales, a fine, short oblique row of the pale gray scales at postmedial band on costa. Hindwing with a well-developed orange spot in median area; remainder of wing dark brown, nearly black. Underside of forewing dull, dark brown; hindwing ventrally marked like uppersurface; fringe of both wings dark gray brown below. Length of forewing: Female, 18 mm.

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[1] ℅ National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.

Figs. 1–2. Dorsal view of adults: 1, *Gonodonta aeratilinea*, new species, holotype female; 2, *G. sphenostigma*, new species, holotype male.

Type: Holotype, female, S. Domingo, Carabaya [Perú], 6500′, Wet season, Dec. 02, G. Ockenden in the collection of the British Museum (Natural History), London, England.

Remarks: This species will run to *Gonodonta clotilda* (Stoll) in the key to species in my revision of the genus. It is not at all closely related to that species. The coloration of the forewing is most like that of *Gonodonta fulvidens* Felder and Rogenhofer, but that species has a dark head and lacks the orange spot in the hindwings. *Gonodonta amianta* (Hampson) and *G. immacula* Guenée are related to *aeratilinea*, but they also lack the orange spot in the hindwing. *Gonodonta fulvangula* Geyer is a related reddish-brown species with white head and orange spot in the hindwings, but that species has orange in the tornus, a band of orange extending from tornus in the subterminal area and the fold of the forewing is distinctly marked with pale scales.

Gonodonta sphenostigma, new species

Head with erect reddish-brown scales on frons, a triangular patch of dark brown or black scales in the middle of the weak crest of the vertex; thorax dark gray brown, abdomen paler; palpi clothed mostly with appressed, dark brown scales, those of ventral margin of second segment looser and much paler, third very short; palpi reaching about to middle of frons. Pectus gray brown to white, the darker scales overlaying the white scales and hair; venter of abdomen uniformly gray brown. Legs gray brown, the forelegs darkest. Termen of forewing very rounded; the inner margin of wing shortened, about one-half as long as the costal margin; the tooth at tornus and scale tooth of inner margin both very small. Pattern of maculation as illustrated (Fig. 2). Forewing of various shades of brown, gray brown or yellow brown with pink or purple reflections; antemedial band well developed and evenly curved, the basal element red brown, a thin white medial element in anterior half of wing and the distal element black brown, narrow at inner margin and expanding to near middle of wing at costa, forming a distinctive triangular patch, coloration of patch becoming red brown toward costa; median part of forewing dark gray brown, caudal half darkest and with purple reflections; reniform spot indicated by an indistinct outline formed of irregular pale and dark spots, caudal part of outline absent, a short straw-yellow dash or spot at basal end of reniform outline; postmedial band with distal and basal elements red brown between Cu_2 and inner margin, dark brown from Cu_2 to near costa; subterminal area mostly straw yellow, but with irregular bronze and gray-brown shade between M_1 and fold, the entire area with pink reflections; a dark brown shade extending from postmedial band at costa around apex to vein M_3, the shade containing two series of small oval spots between apex and M_3 of termen, two larger oval spots in interspaces M_3 and Cu_1 between adterminal and terminal lines; adterminal and terminal lines fused, distinctive, of dark black-brown and red-brown scales between Cu_2 and tornus, slightly curved but nearly longitudinal in direction due to incurving of termen. Hindwings with a medial orange spot, remainder of wing dark brown. Underside of forewing mostly dull brown, paler along inner margin and a tuft of yellow hairs in basal part of cell, fringe pale gray brown. Underside of hindwing much like dorsal surface but with orange spot paler and broader, variable in size; in the female from Manaos, Brazil the yellow-orange extends to inner margin with only a spur of dark brown along distal half of anal vein. Length of forewing: Male, 18 to 19 mm; female, 18 mm.

Types: Holotype, male and 1 female paratype, Manaos [Brazil], September 1906, M. de Mathan; 1 female paratype, Pará [Brazil], A. M. Moss; and 1 female paratype, Guyane Française, Collection C. Bar, in the collection of the British Museum (Natural History), London, England. One male paratype, Fonte Boa, Upper Amazons [Brazil], May 1906, S. M. Klages, in the collection of the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Food plant: Unknown. The female paratype from Pará was reared from a pupa. The pupal cocoon is attached to and covered with pieces of leaves of a legume, probably a sensitive plant. In view of the known food plants of some of the other species of the genus, it would seem more likely that the plant association represents a chance pupation site rather than a food plant.

Remarks: The pattern of maculation is so distinctive that the species should not be confused with any other species. It appears to be most closely related to *Gonodonta lincus* (Cramer). In my key to the species, *sphenostigma* would run to the second part of couplet 22 which leads to couplet 23, but it does not agree with either part of couplet 23.

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PROCEEDINGS
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PARAUGAPTILUS (COPEPODA:CALANOIDA): TWO SPECIES, ONE NEW, FROM THE SARGASSO SEA[1]

By Georgiana B. Deevey
Florida State Museum, University of Florida
Gainesville, Florida 32601

Four species of *Paraugaptilus* have been described: *P. buchani* Wolfenden 1904 from 59°–60° N in the eastern Atlantic, *P. similis* Scott 1909 from the Malay Archipelago, *P. meridionalis* Wolfenden 1911 from west of the Cape Verde Islands in the Atlantic, and *P. mozambicus* Gaudy 1965 from the Indian Ocean off Madagascar. Wolfenden (1904, 1911) described *P. buchani* from a single female specimen and *P. meridionalis* from two females; these species differ primarily in the relative lengths of the cephalothorax and urosome and caudal rami and in the size and degree of protrusion of the female genital segment. Scott (1909) described both male and female *P. similis* from 26 specimens, including 14 females and 12 males. Gaudy (1965) had 14 females, 5 males and 3 copepodites of *P. mozambicus*. Sars (1924, 1925) identified and described as *P. buchani* male and female specimens collected near the Azores and west of the Canary Islands; however, his description differs from Wolfenden's, and it is unlikely that he had this species.

There have been no further records of *P. similis* and *P. meridionalis*, but undocumented reports of the occurrence of *P. buchani* have been published by Sars (1907), Farran (1908), Lysholm, Nordgaard and Wiborg (1945), Fraser (1961), Vervoort (1965), Calef and Grice (1967), and Roe (1972). Esterly (1911) recorded and figured female specimens from off the

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California coast. Wilson (1950, Figs. 382, 383) listed female and male *P. buchani* from stations in the Philippines and off the Alaska Peninsula; he figured only the fifth legs of the two females, and both differed from *P. buchani*, one closely resembling those of female *P. similis*. Tanaka (1964) described and figured an immature female he referred to *P. buchani*, but the structure of the first maxilla differs from that of *P. buchani*. Species of this genus have therefore been only rarely recorded.

Zooplankton samples were collected monthly, between July 1968 and September 1970, over four depth levels between the surface and 2,000 m at Station "S", 32°10′N, 64°30′W, in 3,200 m of water, in the Sargasso Sea 15 miles southeast of Bermuda (Deevey and Brooks, 1971). Continued sampling at this station yielded 39 specimens of *Paraugaptilus*, including 19 *P. buchani* Wolfenden, 19 of a new species, and a single male with different fifth legs, possibly malformed *P. buchani*. The new species is very close to *P. mozambicus* Gaudy in the shape of the female genital segment, but differs in other respects. Specimens of *Paraugaptilus* were caught usually in spring and summer only within the upper 1,000 m, and predominantly between 500 and 1,000 m.

Genus *Paraugaptilus* Wolfenden 1904

Head narrowed anteriorly, separated or weakly fused with 1st thoracic segment. Two long slender divergent rostral filaments. Fourth and 5th thoracic segments fused, posterior margin slightly indented laterally, with a short dorsal tooth or curved spine on each side. Urosome 4 segmented in female, 5 segmented in male. First antenna of 20–21 segments; male left first antenna geniculate, of 18–20 segments. Endopodite of second antenna much longer than exopodite. Mouth-parts similar to those of *Arietellus*. Mandibular palp uniramous. Maxilla 1 with greatly reduced inner lobe. Long distal bristles of maxilla 2 and maxilliped furnished with augaptiloid cups as in *Augaptilus*. Leg 1 with long outer edge spines. Legs 1–4 wih 3-segmented rami, although endopod of female leg 1 may not be completely segmented. Female 5th legs consisting of a foliaceous plate not separated on midline, with lateral and distal setae. Male 5th legs 3 jointed, with rudimentary endopodites, last segment of left leg with pincerlike spines.

Key to Females of *PARAUGAPTILUS*

1. Urosome relatively short, not more than 30% of cephalothorax length 2

Urosome at least 33% of cephalothorax length 3

2. First antenna short, not as long as cephalothorax, genital segment with asymmetrically placed ventral prolongation, caudal rami twice as long as wide .... *P. mozambicus* Gaudy 1965

First antenna as long as or longer than cephalothorax, genital segment rounded ventrally, caudal rami less than twice as long as wide .... *P. buchani* Wolfenden 1904

3. First antenna extending to urosome, dorsal and lateral thoracic segments covered with hairs .... *P. similis* Scott 1909

First antenna approximately length of cephalothorax, thoracic segments without hairs, caudal rami at least twice as long as wide 4

4. Genital segment with asymmetrical ventral prolongation, dorsal urosome hairy .... *P. bermudensis* new species

Genital segment only slightly swollen ventrally, no hairs on body .... *P. meridionalis* Wolfenden 1911 (also *P. buchani*.—Sars 1925)

KEY TO MALES OF *PARAUGAPTILUS*

1. Urosome 30% or less of cephalothorax length 2

Urosome 33% or more of cephalothorax length 3

2. Right 1st antenna less than cephalothorax length .... *P. mozambicus* Gaudy 1965

Right 1st antenna at least as long as cephalothorax .... *P. buchani* Wolfenden 1904

3. Dorsal thorax hairy, urosome without hairs .... *P. similis* Scott 1909

Dorsal thorax without hairs, dorsal urosome hairy .... *P. bermudensis* new species

Paraugaptilus bermudensis, new species

Material: Male 2.75 mm, VII/30/68; Female 2.90 mm, IX/12/68; Female 2.90 mm, Male 2.70 mm, XII/19/68; Female 3.00 mm, 2 males 2.80 mm, VI/25/69; Female 2.75 mm, immature female 2.50 mm, VII/22/69; Female 2.90 mm, VIII/11/69; Female 2.75 mm, V/20/70; 2 Females 2.80 mm, 2.90 mm, VII/11/70. 0–500 m night haul. Female 3.00 mm, 500–1,000 m day haul; Female 2.90 mm, immature female 1.95 mm, VIII/21/70; Immature female 2.00 mm, male 2.70 mm, IX/15/70; Male 2.75 mm, IX/16/70.

Locality: Station "S", 32°10′N, 64°30′W. All specimens caught between 500 and 1,000 m, except 2 females taken in a 0–500 m night tow.

Female holotype, 2.80 mm long, on 2 slides, collected in a 0–500 m night haul, VII/11/70, and male allotype, 2.70 mm, on 2 slides, collected XII/19/68, 500–1,000 m depths, will be deposited in the National Museum of Natural History. Paratypes are deposited in Florida State Museum, University of Florida.

Description: Female (Fig. 1a-h; Fig. 3a, e-g, i, j): 2.75–3.00 mm total length. Head narrowed anteriorly, around ½ cephalothorax length, separated but weakly fused with 1st thoracic segment. Cephalothorax

FIG. 1. *Paraugaptilus bermudensis*, new species, Female. a, and b, Dorsal and lateral views of female; c, Lateral view of genital segment from left side; d, Maxilla 1; e, Mandible; f, Other views of mandible blade; g, Second antenna; h, Maxilliped. Scale at bottom right for a and b, on right margin for c-h. Scales in mm.

76–78% of total length, 4th and 5th thoracic segments fused, the posterior dorsolateral edge produced to a sharp hooked spine, clearly visible in lateral view (Fig. 1b, c). Urosome 33–34% of cephalohorax length; covered dorsally, except for the anterior genital segment, with hairs or spinules. Caudal rami twice as long as wide, with hairs on inner and outer margins; 5 caudal setae, 2nd inner longer than others, the 3 inner setae jointed near base and strikingly and darkly plumose over a little more than the proximal half of their lengths, the rest of the setae finely plumose, 1 bent dorsal seta visible in lateral view. Genital segment somewhat asymmetrical in dorsal (Fig. 1a) and ventral (Fig. 3g) views with a large ventrolateral projection extending left of the midline (Fig. 1c, 3f). First antenna at least as long as cephalothorax, of 20 segments. Second antenna (Fig. 1g) exopodite with 4 long terminal setae; endopodite with 5 terminal setae and a short dorsal seta midlength of distal segment; exopodite less than ½ as long as endopodite, 42% of endopodite length. Mandible (Fig. 1e) 1-branched as in *Arietellus*, with 4 long terminal setae on palp. Maxilla 1 (Fig. 1d) similar to *Arietellus*, 1st inner lobe with 5 spines, 1st outer lobe with 5 long and 3 shorter setae, endopodite and exopodite fused, with 3 long distal setae. Maxilla 2 (Fig. 2g) and maxilliped (Fig. 1h) similar in the 2 sexes, the longer setae furnished with augaptiloid cups. Leg 1 (Fig. 3a) endopod not clearly segmented into 3 joints. Leg 4 (Fig. 3j) lacks the plumose seta present on the 1st basipod segment of legs 1–3, but a rudimentary spinule may be present. Fifth legs (Fig. 3e) similar to those of female *P. buchani*, *P. meridionalis*, and *P. mozambicus*, with a long marginal and longer apical plumose seta, the marginal seta 2/3rds the length of the apical one.

Male (Fig. 2a-j; Fig. 3b-d, h, k): 2.70–2.80 mm total length. Proportions of body and rostrum similar to female. Cephalothorax 77–78% of total length, with a sharp hook dorsally on each side of the last thoracic segment. Urosome 33–34% of cephalothorax length, segments covered dorsally with hairs. Caudal rami twice as long as wide with hairs laterally on each side. Second inner caudal seta much longer than others, setae pale plumose, lacking thick dark hairs characteristic of female. Right first antenna (Fig. 2b) of 20 segments, as long as cephalothorax; left (Fig. 2f) geniculate, of 19 segments, jointed between the 17th and 18th segments. Second antenna (Fig. 3c) differs from that of the female and resembles that of male *P. similis* in having a long seta dorsally midlength of last endopodite segment; exopodite relatively longer than in female, 49% of endopodite length, bearing distally a 5th shorter seta not present in female or in either sex of *P. buchani* or *P. similis.* Mandibular palp (Fig. 2e) differs from female's in having a long extra seta near base of last segment. Maxilla 1 and 2 and maxilliped as in female. Endopod of leg 1 clearly 3 segmented. Fifth legs (Fig. 2h) apparently most similar to those of male *P. mozambicus* (Gaudy, 1965, Fig. 7), last segment of left leg with a strong pincerlike spine and a weaker process of the same length, not bifid at tip as in *P. similis* and *P. buchani.*

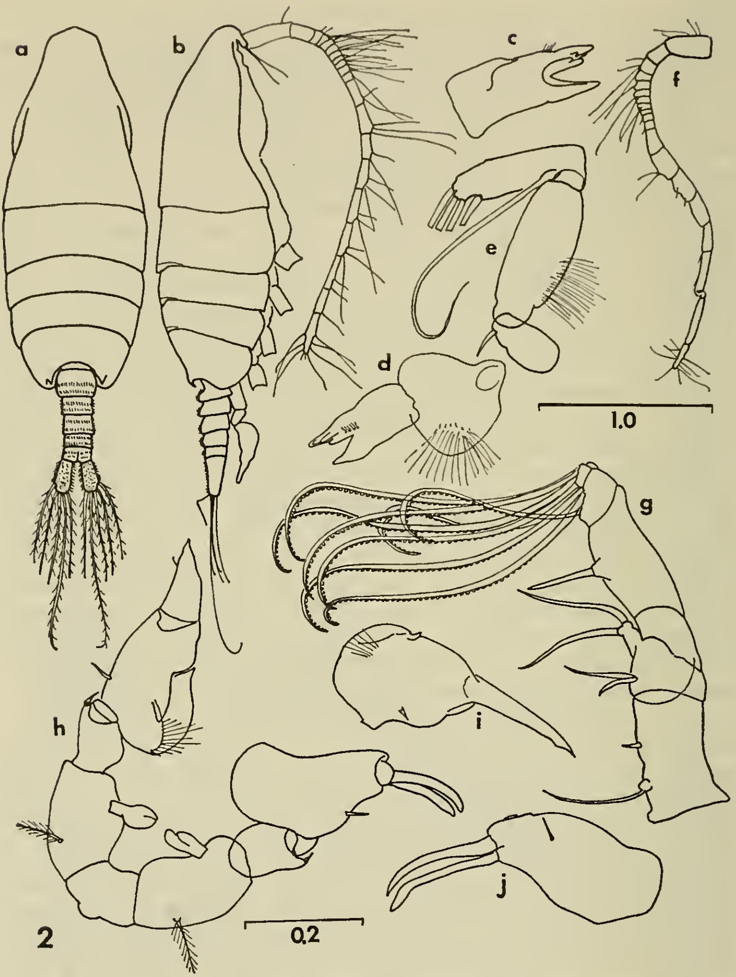

FIG. 2. *Paraugaptilus bermudensis*, new species, Male. a, and b, Dorsal and lateral views of male; c, d, Two views of mandible blade; e, Mandible palp; f, Left first antenna; g, Maxilla 2; h, Fifth legs; i, Another view of last segment of right 5th leg; j, Another view of last segment of left 5th leg. Scale at right center for a, b, f, at bottom for c-e, g-j. Scales in mm.

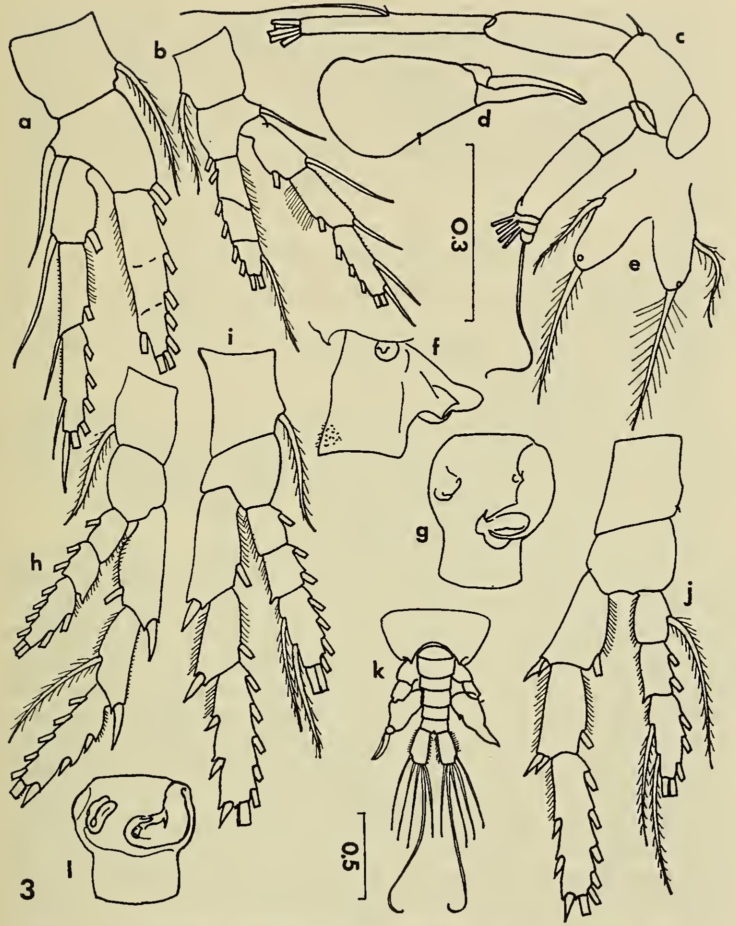

FIG. 3. *Paraugaptilus bermudensis*, new species, a, Female leg 1; b, Male leg 1; c, Male second antenna; d, Another view of last segment of male left 5th leg; e, Female 5th legs; f, g, Right lateral and ventral view of female genital segment; h, Male leg 2; i, Female leg 3; j, Female leg 4; k, Dorsal view of male urosome and 5th legs; l, Ventral view of genital segment of female *P. buchani* Wolfenden. Scale at bottom center for k, upper center for a-j, l. Scales in mm.

Relationships: Female *P. bermudensis*, new species, closely resembles female *P. mozambicus* in the ventral prolongation on the genital segment, but both sexes of *bermudensis* differ from the latter species in having longer first antennae, a relatively longer urosome, hairs or spinules on the dorsal surface of the urosome, and a short curved hook on the last thoracic segment. Also the 3 inner caudal setae of female *P. mozambicus* are not darkly plumose as in female *P. bermudensis* new species.

Paraugaptilus buchani Wolfenden 1904

Paraugaptilus buchani Wolfenden, 1904:123, Pl. 9, Fig. 45; 1911, Pl. 39, Figs. 5–7.

Paraugaptilus buchani.—Esterly, 1911:335, Pl. 26, Fig. 6; Pl. 28, Fig. 39; Pl. 29, Fig. 57; Pl. 31, Figs. 94, 98.

Material: 4 females and 2 males in 0–500 m tows on 28 March and 11 July 1970. 3 females, 7 males and 3 copepodites from 500–1,000 m tows on 15 Sept. and 19 Dec. 1968, 25 June and 22 July 1969, 25 April, 12 June, 11 July, 14 July, 21 Aug., and 15 September 1970.

Locality: Station "S", 32°10′N, 64°30′W.

Wolfenden's (1904) single female specimen of *P. buchani* was 3.25 mm long; the cephalothorax 2.55 mm, the urosome 0.70 mm in length, the urosome therefore being relatively short, only 27.5% of cephalothorax length. He stated that the genital segment was very protuberant ventrally and that the caudal rami were less than twice as long as wide. For his two *P. meridionalis* females (Wolfenden, 1911) he gave the following measurements: 2.90 mm total length; cephalothorax 2.15 mm, urosome 0.75 mm, the urosome therefore being relatively long, 34.8% of cephalothorax length. The genital segment was little protuberant ventrally, and the caudal rami twice as long as wide. Sars' (1925) specimens that he described as *P. buchani* have body proportions similar to *P. meridionalis*. Sars gave the female length as 3.30 mm and said the urosome was around 1/3rd the length of the cephalothorax, the genital segment little dilated ventrally, and the caudal rami around twice as long as wide. Because of the similarity between Sars' specimens and Wolfenden's *P. meridionalis* females, it is probable that Sars' (1924, 1925) description and figures are of *P. meridionalis*.

Description: Female (Fig. 3l, Fig. 4a-i): 3.00–3.20 mm total length. Head around ½ cephalothorax length, weakly fused with first thoracic segment, last segment with blunt tooth dorsally on each side. Urosome 30% or less of cephalothorax length; genital segment very slightly asymmetrical in dorsal view, dilated ventrally (Fig. 4i), developed asymmetrically ventrally on the left side (Fig. 3l). Caudal rami less than half as long as wide; with fine hairs laterally, caudal setae subequal, 2nd and 3rd inner setae jointed near base, finely plumose, short bent dorsal seta visible in lateral view. First antenna (Fig. 4c) of 21 segments, the 20th and 21st partially fused, reaching to genital segment.

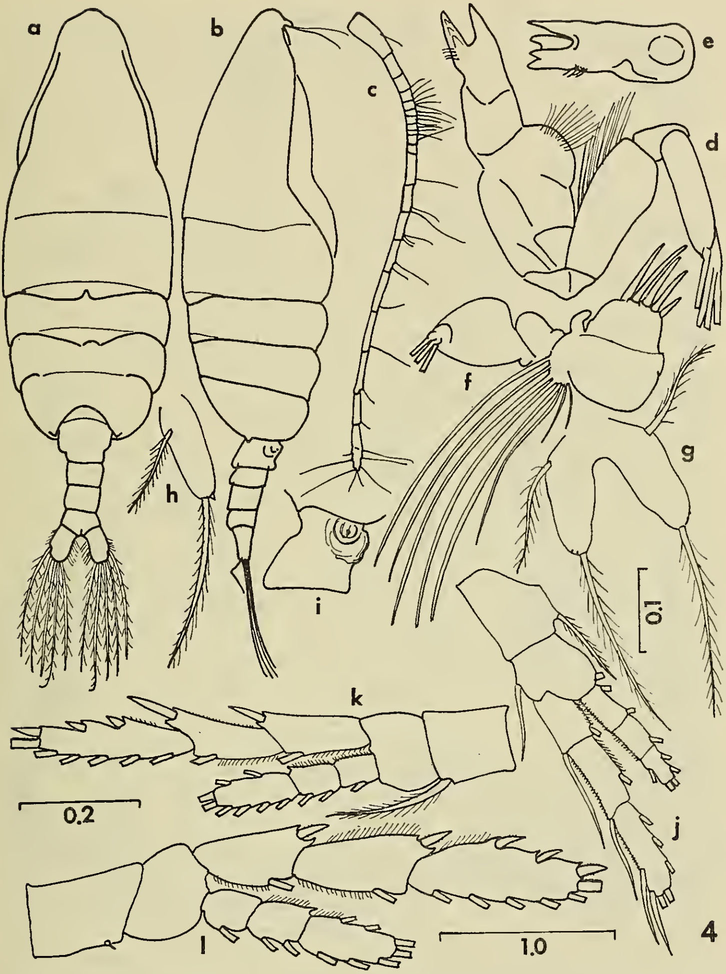

FIG. 4. *Paraugaptilus buchani* Wolfenden, a, b, Dorsal and lateral views of female; c, Female first antenna; d, Female mandible; e, Another view of mandible blade; f, Female maxilla 1; g, Female 5th legs; h, Lateral view of female 5th leg; i, Lateral view of female genital segment; j, Male leg 1; k, Male leg 2; l, Male leg 4. Scale at bottom right for a-c, on right margin for d-l. Scales in mm.

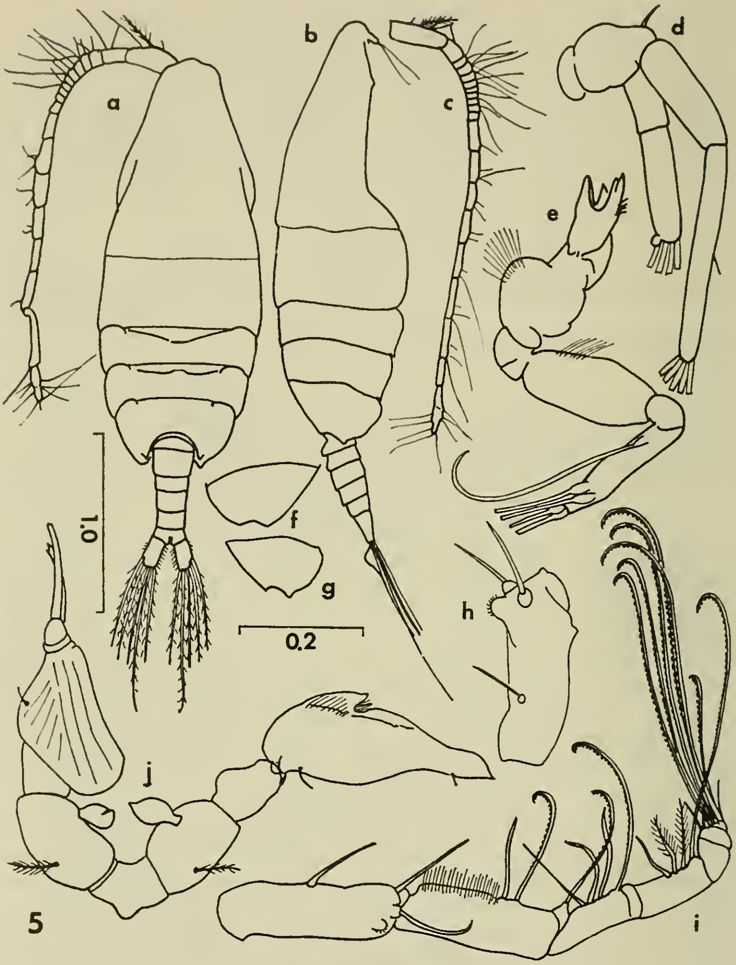

FIG. 5. *Paraugaptilus buchani* Wolfenden, Male. a, b, Dorsal and lateral views of male; c, Right first antenna; d, Second antenna; e, Mandible; f, Left side of last thoracic segment; g, Right side of last thoracic segment; h, Inner side of first segment of maxilliped; i, Maxilliped; j, Fifth legs. Scale at left for a-c, lower center for d-j. Scales in mm.

Second antenna exopodite 42–43% length of endopodite, endopodite with tiny seta midlength of distal segment. Mandible (Fig. 4d, e), maxilla 1 (Fig. 4f), maxilla 2 and maxilliped similar to those of *P. bermudensis*, new species. Leg 1 endopod clearly segmented. Leg 5 (Fig. 4g) with a finely plumose lateral and apical seta, sometimes a tiny blunt spinule beside apical seta (Fig. 4h).

Male (Fig. 4j-l; Fig. 5a-j); 2.85–3.00 mm total length. Head aound ½ cephalothorax length, weakly fused with 1st thoracic segment; last thoracic segment with a blunt tooth dorsally on each side, more prominent on right side (Fig. 5b, g) than on left (Fig. 5f). Urosome 30% or less of cephalothorax length; caudal rami less than twice as long as wide, with fine hairs on lateral margins, caudal setae finely plumose, the 2nd inner seta much longer than the others. Right first antenna of 21 segments, the 20th and 21st partially fused. Left first antenna geniculate; of 20 segments, the 19th and 20th partially fused, jointed between 17th and 18th segments. Second antenna (Fig. 5d) similar to female's, exopodite 46% of endopodite length, endopodite with tiny seta midlength of last segment. Mandible (Fig. 5e) as in *P. bermudensis,* new species, males, with extra seta near base of last palp segment. Maxilla 1 and 2 and maxilliped as in female. Legs 1–4 similar to female's. Fifth legs (Fig. 5j) similar in structure to those of other *Paraugaptilus* males; last segment of left leg with a strong pincerlike spine and a shorter, curved process, bifid at the tip. This process is also bifid in *P. similis* males (Scott, 1909, Pl. XLII, Fig. 19). Roe's (1972) male specimen of *P. buchani* has 5th legs similar to those here described (personal communication), except that the small proximal spine on the last segment of the left leg (Fig. 5j) is missing.

As previously noted, a single male specimen, 2.85 mm long, with different fifth legs was caught in the 500–1,000 m tow on 15 October 1968. In the proportions of the body, the length of the caudal rami and structure of the other appendages, this specimen is similar to the *P. buchani* male. The fifth legs are also similar in structure, except that the two pincerlike spines on the last segment of the left leg are lacking and replaced by two short spinules. It is assumed that this specimen is a *P. buchani* male with malformed 5th legs.

Geographical Distribution: Around 28° to 60°N in the Atlantic; eastern Pacific off California coast.

DISCUSSION

The different species of *Paraugaptilus* have closely similar appendages. The fifth legs of female *P. buchani*, *P. meridionalis*, *P. mozambicus*, and *P. bermudensis*, new species, are apparently indistinguishable; only the *P. similis* female has somewhat different, slightly asymmetrical fifth legs. The male fifth legs differ primarily in the shape and relative lengths of the two pincerlike spines on the last segment of the left leg. The mouthparts are very similar. The species vary in the length of the first antenna and caudal rami, the relative proportions of cephalothorax and urosome, the presence or absence of hairs or spinules on the cephalothorax and urosome, and the symmetry or degree of asymmetry of the female genital segment. Such asymmetry occurs in at least three species, *P. buchani*, *P. mozambicus* and *P. bermudensis*, new species, in that the left ventral side of the genital segment is more developed than the right.

The species of *Paraugaptilus* are also all of about the same size, ± 3 mm, the overall range in recorded length being 2.70 mm (*P. bermudensis*, new species, males) to 3.75 mm (Scott's *P. similis* females). The records indicate that all apparently live within the upper 1,000 m. In the Sargasso Sea most specimens were caught between 500 and 1,000 m depths, the region of the permanent thermocline, where temperature decreases with depth from 17° or 18°C to 7°C; a few specimens were found within the upper 500 m, especially in night tows. Gaudy's (1965) 22 specimens of *P. mozambicus* were caught between 300 and 400 m, where the temperature was 14°–15°C, although he later recorded immature specimens near the surface (1967). Lysholm, Nordgaard and Wiborg's (1945) specimens were taken at varying depths (200–500 m, 440–740 m or with 300–1,000 m of wire out) above 1,000 m. Vervoort's (1965) male was taken at around 600 m depth, Farran's (1908) female at 600 fathoms, Wolfenden's (1904) female at 300 fathoms, and Esterly's (1911) females at 315–320 fathoms. Roe's (1972) specimens were caught at 500 and 830 m depths. Other records are from open net hauls from 1,000–2,000 m to the surface.

The scarcity of records for *Paraugaptilus* must be due in part to the fact that the intermediate depths have been insufficiently sampled, but in addition the different species may have relatively restricted ranges, as suggested by Seymour Sewell (1948). Members of the genus are also rare, since, despite intensive sampling, *Paraugaptilus* was not commonly caught in the Sargasso Sea. Total estimated numbers, for the 500–1,000 m depth level, ranged from 5–77 specimens/1,000 m^3. However, despite the paucity of numbers, the genus has a wide geographical distribution, having been recorded from around 23°S in the Indian Ocean off Madagascar, from 1°30′N in the Gulf of Guinea to 60°N in the Atlantic, and from about 54°N in the Pacific off the Alaska Peninsula to 10°N in the Philippines, and south of there in Indonesian waters between the Halmahera Sea at 0°17.6′S and the Banda Sea at 3°32.5′S.

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PROCEEDINGS
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DESCRIPTIONS OF THE LARVAE OF SOME PREDACIOUS WATER BEETLES (COLEOPTERA:DYTISCIDAE)

BY PAUL J. SPANGLER AND ROBERT D. GORDON
Smithsonian Institution, Washington, D.C. 20560 and
Systematic Entomology Laboratory, Agricultural
Research Service, U.S. Department of Agriculture[1]

During our occasional local collecting trips in the past few years we have been searching for the immature stages of aquatic beetles belonging to genera whose larvae have not been described previously or whose larvae were described only briefly. As a result, we have obtained the larvae of *Agabetes acuductus* (Harris) and *Matus bicarinatus* (Say) and the larva and pupa of *Laccornis difformis* (LeConte). Descriptions of the immature stages of these species follow; bionomic notes are included. The illustrations for this paper were prepared by Mr. Michael Druckenbrod, Smithsonian Institution staff artist.

Genus *Agabetes* Crotch

Agabetes Crotch, 1873:401.

Agabetes is a monotypic genus occurring primarily in shaded woodland ponds although specimens occasionally have been collected in unshaded ponds in or adjacent to wooded areas. The only species known in the genus, *Agabetes acuductus*, is recorded from southern Canada to Florida on the east coast and to Michigan, Missouri, and Arkansas in the midwestern United States.

Agabetes acuductus (Harris)

C[olymbetes] acuductus Harris, 1829:164.

Bionomics: Sherman (1913) discussed the habitat of *A. acuductus* and reported that the species is wingless. However, Leech (1942) dis-

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[1] Mail address: % National Museum of Natural History, Washington, D.C. 20560.

agreed with Sherman because all of the specimens he dissected were fully winged. Young (1954) reported that observations indicated that *acuductus* is never taken at light and is found in woods ponds that are drying up and after other species have migrated to other situations; thus suggesting that *A. acuductus* is flightless. Jackson (1956) reported that in specimens of *A. acuductus* sent to her by Dr. Young, "The Flight muscles are underdeveloped and the metatergum is reduced, yet the wings which must be useless for flight are of full size." We can now report that specimens of *A. acuductus* can fly because they were attracted in considerable numbers to an ultraviolet light operated in a forest close (100 ft. to 200 ft. distant) to a woodland pond at Easton, Maryland. These specimens were collected at a time when the pond was drying up and the beetles may have been forced to fly or die. Although we believe that *A. acuductus* is attracted rarely to ultraviolet or other lights and that specimens probably do not fly far, the fact that they can fly is significant to their distribution and survival.

The majority of the larval specimens of *A. acuductus* that we collected were found among the leafy substrate in woodland ponds. However, one specimen was found among the roots of *Typha* growing in water held in a partially intact basement in the foundation of an old house. The remains of the house except for the small area directly above the foundation were shaded by the surrounding forest.

A living larva of *A. acuductus* is distinguishable immediately from larvae of other known larvae of nearctic dytiscid genera when viewed dorsally by its reddish-yellow head contrasting with the very dark gray thoracic and abdominal segments. Unfortunately, the attractive coloration fades in preserved specimens.

Although we attempted to rear the larvae to the imago, we were unsuccessful and the larvae were preserved after they died.

Description of the Third-Instar Larva of *Agabetes acuductus* (Harris)

Figures 1–4

Length, 11.0 mm; greatest width of pronotum, 1.6 mm. Color of head testaceous except ocelli black; thoracic segments and abdominal segments 1 through 7 dark infuscate; 8th abdominal segment testaceous at basal third and at apex, intermediate area dark reddish brown. Ventral surface of head testaceous; thoracic sterna and abdominal sterna of segments 1 through 4 and narrow medial area of segment 5 creamy white. Legs light testaceous. Last abdominal segment colored ventrally as described for its dorsal surface.

Head subquadrate, narrowed basally. Labroclypeus evenly arcuate,

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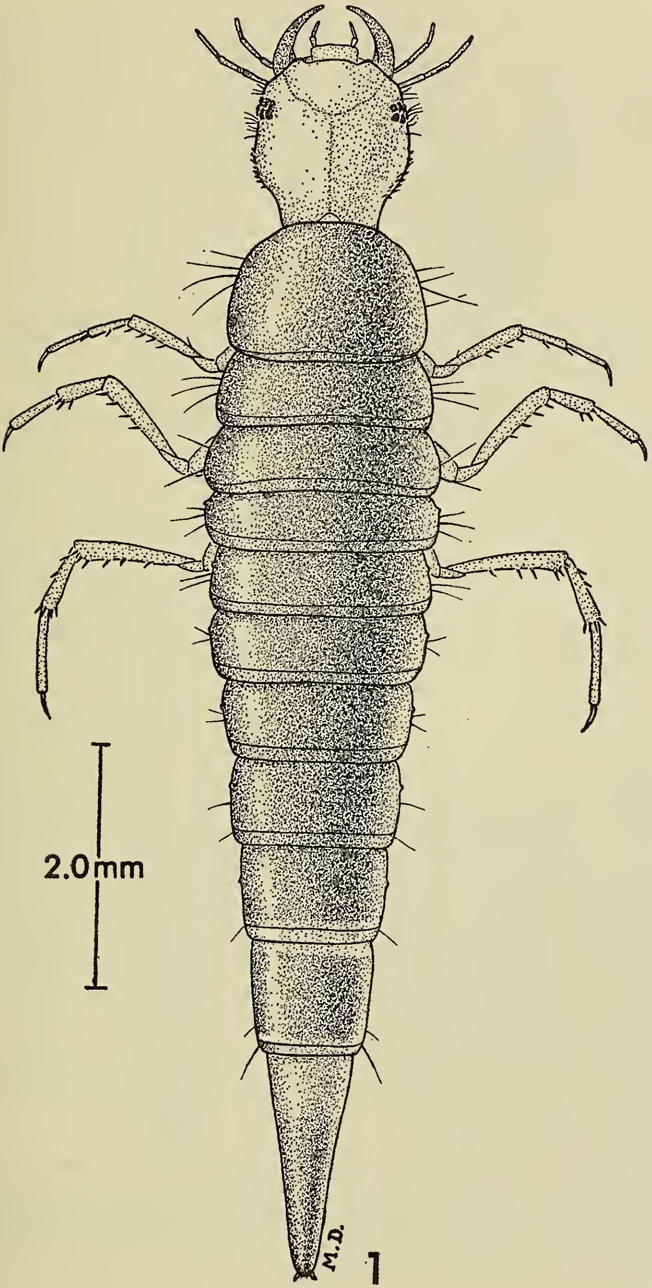
FIG. 1. *Agabetes acuductus*, larva, habitus, dorsal view.



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with a row of setae along anterior margin. Ecdysial cleavage line distinct and united at base of head, abruptly forked at apical third of head; frontal arms sinuate laterally, terminating at bases of mandibles in front of antennal insertions. Dorsal surface of head weakly alutaceous; with 3 long slender setae on posterior margin of ocular region and 23 to 25 stout temporal setae. Ventral surface of head (Fig. 2) also weakly alutaceous; with 4 or 5 long slender setae along apicoventral margin of ocular region and a few short stout setae basally and mediad of temporal setae; with 2 large tentorial pits, 1 on each side of midline at apical third of head. Ocular areas oval, each with 6 large ocelli in 2 close vertical rows; lowermost ocellus of each row more widely separated from middle ocelli than upper and middle ocelli are from each other.

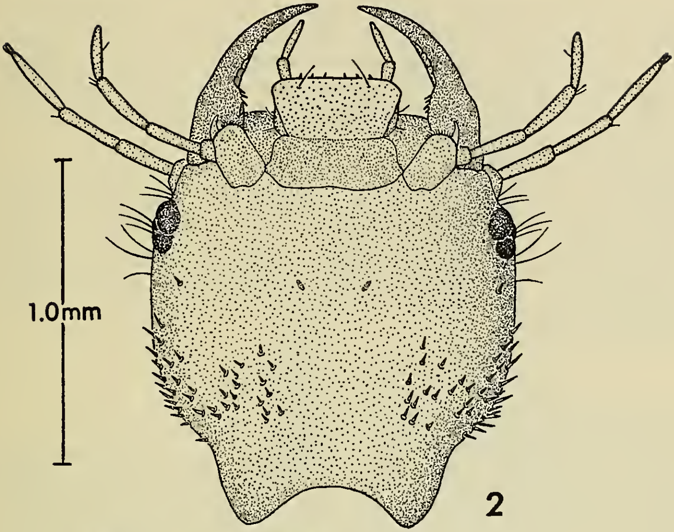
Antenna cylindrical, 4 segmented, glabrous; 1st, 2d, and 3d segments subequal; 4th segment short, about ⅙ as long as penultimate segment, with a stout seta arising from apex of penultimate segment beside it.

Mandible falciform, stout at base, slender and tapering to sharp apex, deeply grooved along inner surface, and bearing a cluster of short setae ventrobasally. Maxilla with stipes broad; stipes with brushlike, incurved setae and 2 small incurved teeth apicomedially; galea elongate, hooklike. Maxillary palpus slender, glabrous, elongate, 4 segmented; basal segment (palpifer) shortest, about ¼ as long as 2d segment; 2d and 4th segments subequal; 3d segment slightly longer than 2d and 4th segments. Labium large, rectangular, broad, with scattered asperities and 4 small setae on anterior margin between palpi; ligula absent. Labial palpi robust, glabrous, 2 segmented; basal segment shortest, about ½ as long as ultimate segment.

Pronotum twice as broad as long; anteromedial region slightly prolonged; lateral margins strongly rounded and bearing 11 or 12 long slender setae. Mesonotum slightly wider than and almost half as long as pronotum; with 2 or 3 short setae laterally; spiracle present in pleural region beneath anterolateral angle of sclerite. Metanotum slightly wider than and about as long as mesonotum; setation similar to mesonotum.

Legs slender, elongate, 5 segmented; coxa long; trochanter about a third as long as coxa; femur about as long as tibia and tarsus combined; tarsus with 2 elongate, slender claws, outer (upper) claw shorter than inner claw. Foreleg with coxa bearing 1 short stout seta on ventromedial surface, 3 or 4 small setae apically on ventromedial margin, and 8 or 9 setae on ventrolateral margin; trochanter bearing 2 or 3 long slender setae ventroapically; femur with 1 stout seta dorsobasally, 7 stout setae along ventral surface, and 5 or 6 setae encircling apex; tibia bearing 2 stout setae ventroapically and 5 or 6 setae encircling apex; tarsus bearing 2 stout setae dorsoapically.

Abdomen of 8 segments. Segments 1 through 5 sclerotized dorsally, membranous ventrally (5th segment narrowly so); segments 6 through 8 completely sclerotized, ringlike. Terga of all abdominal segments bearing many small setae over surface and along posterior margins and 2 or



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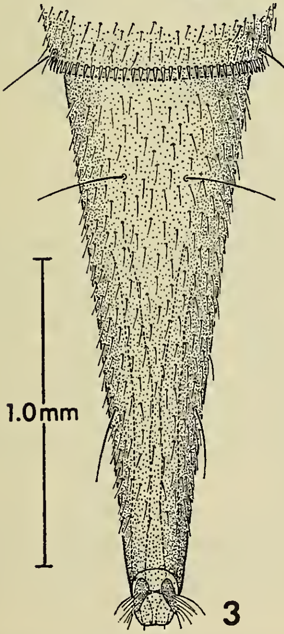

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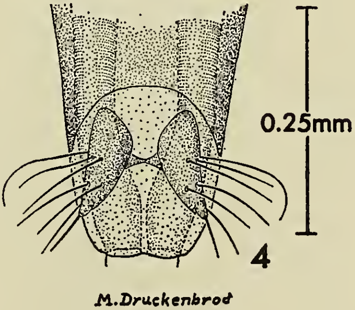

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Figs. 2–4. *Agabetes acuductus*, larva, ventral view: 2, head; 3, last abdominal segment; 4, cerci.

3 very long slender lateral setae. Segment 8 (Fig. 3) prolonged posteriorly and bearing 2 very short stout cerci (Fig. 4) ventroapically. Each cercus with 3 long setae at midlength and 4 setae subapically. Lateral margins of segments 1 through 7 each with a spiracle; spiracles on 6th and 7th segments small and ventrolateral instead of lateral as in preceding segments.

The following larval specimens of *A. acuductus* were available for examination. MARYLAND: Anne Arundel County: Friendship, 9 June 1968, P. J. Spangler, 2 specimens. Talbot County: Easton, 5 July 1971, R. D. Gordon, 5 specimens.—VIRGINIA: Accomack County: Chincoteague National Wildlife Refuge, 7 May 1972, J. L. Cross, 2 specimens. Prince William County: Prince William State Park, 26 Sept. 1970, R. D. Gordon, 1 specimen.

Genus *Laccornis* Des Gozis

Laccornis Des Gozis, 1914:111.

The genus *Laccornis* includes 10 species primarily from the cooler regions of the world. Five species are known to occur in the United States. Fall (1923) reports *L. conoideus* (LeConte) from British Columbia, Canada, to New England. Other species of *Laccornis* are known to occur from Maine to Calhoun County, Florida, west to Illinois and Indiana. Also, two species of *Laccornis* are known from Europe, two from southern South America, and one from the mountains of Central Africa.

Laccornis difformis (LeConte)

H[ydroporus] difformis LeConte, 1855:298.

Bionomics: North American members of the genus *Laccornis*, like those of *Agabetes*, are inhabitants primarily of woodland ponds. Sherman (1913) discussed their habitat preference and our collections confirm his observations. We collected larvae and adults of *Laccornis* on several occasions during May of 1965 and May of 1967 from a woodland pond on the mainland near Plummers Island, Montgomery County, Maryland. The pond was in dense woods and was well shaded. Larvae were found among leaves along the margins of the pond. Kirk (1969) reported an adult *Laccornis difformis* from Sardis, South Carolina, that was collected "in hollow tree."

The South American species of *Laccornis* occur in the southern temperate to cold regions of Chile and Argentina. Specimens from Chile are found abundantly in weedy roadside ditches and in shallow weedy ponds in open fields. Perhaps specimens of *Laccornis* may be found

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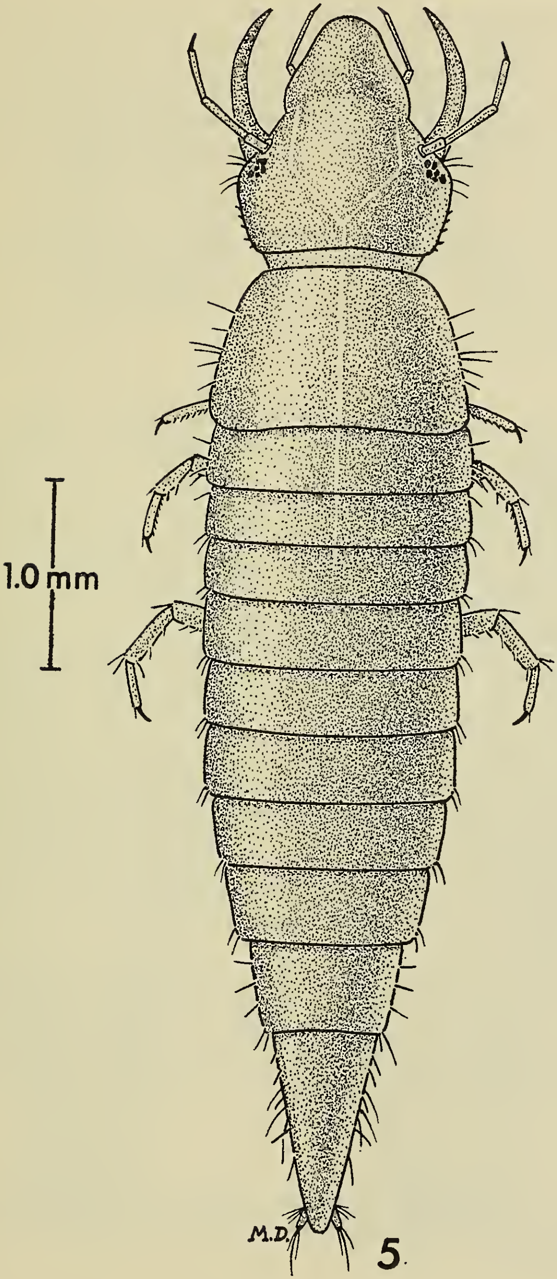
FIG. 5. *Laccornis difformis*, larva, habitus, dorsal view.



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also in woodland ponds in Chile but this has not been confirmed. According to the data of reported localities from which *Laccornis* has been collected in Argentina, those specimens must have occurred in shallow ponds in the short grass pampas and these areas are not forested.

Adult specimens of *L. difformis* have fully developed metathoracic wings and probably are capable of flight. However, we know of no specimens collected at light so we assume they are not attracted readily to it.

The larva of *Laccornis conoideus* (LeConte) was described briefly by Watts (1970) and the genus was included in a key to the larvae of the dytiscid genera of the world by Bertrand (1972). The pupa of *Laccornis* has not been described previously. The larva (Fig. 5) and pupa (Figs. 8, 9) of *Laccornis difformis* (LeConte) are described below.

Description of the Third-Instar Larva of *Laccornis difformis* (LeConte)

Figures 5–7

Length, 8.20 mm; greatest width of pronotum, 1.33 mm. Color of integument white; dorsal sclerites of thorax and abdomen yellowish brown, small yellow maculae on all segments except 7th and 8th abdominal segments. Head yellowish brown except nasale and maculae yellow; ventral surface of head and mouthparts pale yellow. Legs white except base of coxae at point of articulation black.

Head ovate with clypeus prolonged to a broad and bluntly rounded nasale. Nasale with dorsal surface glabrous; anterior margin curved downward, edge serrate, with 3 rows of spatulate setae of varying lengths. Ventral surface of nasale with a semicircular row of setae; setae long and slender laterally and clusters of 2 to 4 short, stout setae medially. Dorsal surface of head glabrous except some fine hairs near bases of antennae and ocular areas. Ecdysial cleavage line united at base and forked at basal ¼ of head; frontal arms curving laterally to area between ocular areas, then anteriorly to base of nasale. Lateral margins of head with 5 to 8 short stout setae behind each ocular area. Ventral surface of head (Fig. 6) glabrous. Ocular areas each with 6 ocelli in 2 vertical rows of 3 ocelli.

Antenna 4 segmented; 2d and 3d segments longest, subequal; ultimate segment smallest, less than ¼ as long as penultimate segment; basal segment less than ½ as long as penultimate segment; segments glabrous except for a single short seta near apex of penultimate segment.

Mandible long, slender, falciform, curved upward and inward apically,

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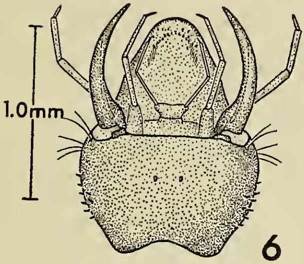
FIGS. 6–9. *Laccornis difformis*: 6, larva, head, vv; 7, larva, last abdominal segment, vv; 8, pupa, dv; 9, pupa, vv. dv = dorsal view; vv = ventral view.



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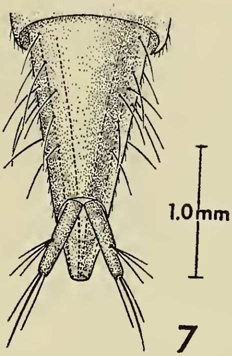

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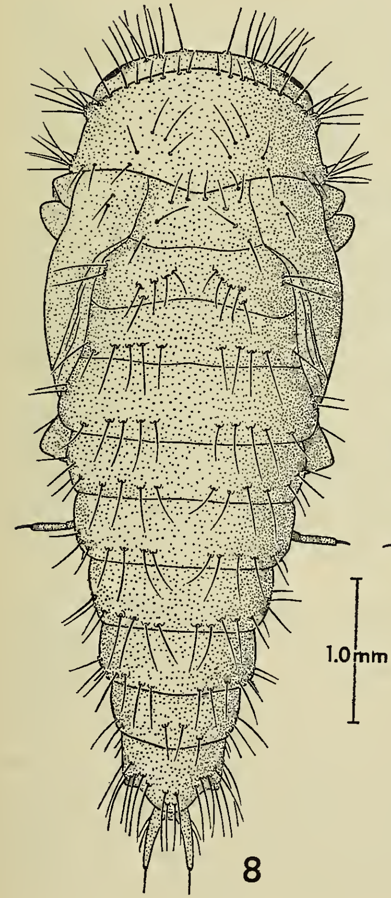

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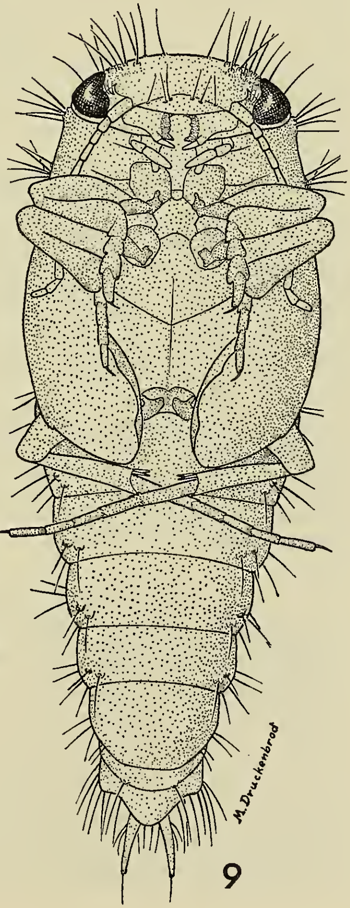

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grooved along inner surface. Maxillary stipes short, stout. Maxillary palpus slender, elongate, 4 segmented; 2d and 3d segments subequal in length; 2d segment more than twice as long as 1st segment; ultimate segment ¼ as long as penultimate segment; all segments glabrous. Labium triangular with 2 or 3 setae on each side dorsally; ligula absent; labial palpus 2 segmented, 2d segment ¾ as long as 1st segment.

Pronotum subquadrate, wider basally; with 1 large seta and several small setae laterally and a few small setae along hind margin at lateral angles. Mesonotum wider than and less than half as long as pronotum; with setae on lateral margin and on hind margin at lateral angles; a spiracular opening present in pleural region below anterolateral angles of sclerite. Metanotum similar to mesonotum.

Legs 5 segmented; coxa long; trochanter ¼ as long as coxa; femur as long as tibia and tarsus combined; tarsus with 2 slender claws, outer claw shorter than inner claw. Coxa with 1 large seta and several small setae on upper surface and several small setae on ventral surface. Trochanter with 1 seta on ventral surface. Femur with a row of setae on posterior edge. Tibia with a row of small setae on posterior edge, large setae around apex. Tarsus with a row of small setae on posterior edge, large setae around apex.

Abdomen of 8 segments. Segments 1 through 6 with dorsal sclerites; segments 7 and 8 completely sclerotized, ringlike. Terga of segments 1 through 6 with short appressed setae on entire surface. Segment 7 with short appressed setae on entire segment and 1 long erect seta laterally. Segment 8 (Fig. 7) cone shaped, posterior end bluntly pointed with 2 short cerci arising ventrally; short appressed setae over surface, several long erect setae on each lateral margin. Cercus with 3 long lateral setae and 4 long terminal setae. Lateral margins of segments 1 through 7 each with a spiracle.

This larva is typically hydroporine in appearance with the nasale present and the mandibles slender, curved upward and inward apically. In Chandler's (1956) key to the known larvae of Nearctic genera the larva of *Laccornis* keys to couplet 3, *Hydroporus* and *Hygrotus*. The following couplet will separate *Laccornis* from *Hydroporus* and *Hygrotus*.

Cerci on 8th abdominal segment long, as long as or longer than 8th segment .... *Hydroporus* and *Hygrotus*
Cerci on 8th abdominal segment short, ¼ as long as 8th abdominal segment .... *Laccornis*

Table 1 shows the results of four rearing attempts. In addition to the four larvae listed in Table 1, the following larval specimens also were available for examination. All larvae studied were from Maryland, Montgomery County, on the mainland near Plummers Island and with the following data: 9 May 1965, R. D. Gordon, 8 specimens; 6 May 1967, P. J. Spangler, 3 specimens; 13 May 1967, P. J. Spangler, 21 specimens.

TABLE 1. Rearing data for pupation of *Laccornis difformis* (LeConte).

Larva No.	Date larva Collected	Date Pupated	Preserved Date	Date Eclosed	Days in Pupation
1	6 V 1967	12 V 1967	16 V 1967	———	—
2	6 V 1967	19 V 1967	22 V 1967	———	—
3	6 V 1967	22 V 1967	22 V 1967	———	—
4	13 V 1967	18 V 1967	———	22 V 1967	5

Description of the Pupa of *Laccornis difformis* (LeConte)
Figures 8, 9

Length, 5.00 mm; greatest width, 2.80 mm; color white except eyes black; glabrous except for setae described below.

Head with 28 setae arranged as follows: 5 between each eye and vertex, 5 in a group at lower anterior corner of each eye, 1 lateromedially, 6 on anterior clypeal margin.

Pronotum with 52 setae arranged as follows: 26 on anterior margin, 18 on posterior margin, 4 on each side of median line on disc.

The dorsum of some of the remaining segments has some groups of setae with unequal numbers on opposite halves of the pupa; a numerical formula is used that gives the number of setae in each group from the left side of the segment to the right side. First and last numbers refer to lateral groups and the middle numbers refer to groups on each side of the median line. When only two numbers are given they refer to lateral groups. The arrangement of the setae is as follows: Mesonotum, 2-4-6-2; metanotum, 2-5-5-2; 1st abdominal segment, 2-4-4-1; 2d and 3d abdominal segments, 3-4-4-3; 4th abdominal segment, 3-4-4-1; 5th abdominal segment, 3-4-4-4; 6th abdominal segment, 3-4-4-3; 7th abdominal segment, 2-1-2-3; 8th abdominal segment, 9-10. Abdominal segment 9 terminating in 2 cerci slightly longer than length of 8th abdominal segment; cerci each with 1 apical and 2 basolateral setae. Abdominal segments 1 through 5 each with 2 setae on ventrolateral margin; abdominal segment 6 with 1 seta on ventrolateral margin. 1st through 6th abdominal segments each with a pair of spiracles.

Antenna extending obliquely outward basally, then curving down to lie below elytron, nearly parallel to body axis. Legs extend outward at right angles from body axis. Tibiae of first 2 pairs of legs folded against femora; tarsi turned backward parallel with body axis. Femur and tibia of each hind leg not folded against each other; femora directed obliquely away from midline; tarsi almost parallel with body axis.

Variations: The number of setae on the mesonotum of all three pupae examined was different, ranging from a total of 9 to 16. The number of setae on the dorsum of the abdominal segments was fairly constant; the fourth abdominal dorsum seems to have a normal complement of 3-4-4-3;

fifth abdominal, 3-4-4-3; seventh abdominal, 4-2-2-4; eighth abdominal, 9-9.

The pupa illustrated had been in the pupal stage for 4 days and probably would have eclosed within 24 hours. The age of the pupa may explain the advanced stage of development of the segmentation of the appendages.

Genus *Matus* Aubé

Matus Aubé, 1836:189.

The genus *Matus* occurs only in the Western Hemisphere and includes four species and two subspecies from the eastern half of the United States. In the most recent review of the genus, Young (1953) reports that species of *Matus* occur from Massachussetts to Florida on the east coast and to Illinois, Arkansas, and south to Texas. To this distribution we can add Maine, Iowa, and Missouri.

Matus bicarinatus (Say)

C[*olymbetes*] *bicarinatus* Say, 1823:98.

Bionomics: Sherman (1913) reported that *Matus bicarinatus* (Say) is another inhabitant of woodland ponds. Most of our specimens of *Matus* were collected in that type of habitat, but we have found *Matus* in other habitats such as unshaded roadside drainage ditches, in a muddy pool of water in the bottom of an old canal, and in a tree-bordered, largely unshaded pond in a field close to a wooded area. Young (1954) said he believes that *M. ovatus blatchleyi* Leech breeds in woods ponds or flatwoods situations in Florida and that adults migrate into many other types of situations. Young also found *M. leechi* Young along the edges of flatwoods streams and in emergent vegetation in these streams.

Specimens of *Matus* are fully winged and they have been collected at ultraviolet lights. However, they are among the less common genera of aquatic beetles collected at lights.

Adults of *Matus* are collected commonly, but the larvae are not often found, perhaps because of the burrowing habit described by J. Balfour-Browne (1947). Balfour-Browne described the peculiar pseudochelate legs of the larva of *Matus* and discussed the function of these legs and the behavior of the larva but did not discuss other structural details. Also, Peterson (1960) illustrated and briefly described the larva of *Matus* sp.

The larva described below is presumed to be that of *M. bicarinatus* because the pseudochelate structure of the tarsi of the front and middle legs identifies the larva as *Matus*; and adult specimens of only one species, *M. bicarinatus*, were taken on many occasions from the pond. In this paper we describe the larva (Fig. 10) of *M. bicarinatus* in detail and place it in Chandler's (1956) key to the known larvae of the nearctic dytiscid genera.

Description of the Third-Instar Larva of *Matus bicarinatus* (Say)

Figures 10–16

Length, 11.0 mm; greatest width of pronotum, 1.60 mm. Color of integument white; dorsal sclerites of thorax and abdomen brown with yellow maculae on all segments except 7th and 8th abdominal segments; lateral margins of thoracic segments yellow. Head brown except along basal portion of ecdysial cleavage line, around ocular area, 2 median spots, and small posterolateral maculae yellow; ventral surface of head and mouthparts yellow. Legs yellowish white except base of coxae at point of articulation black.

Head subquadrate, slightly narrower posteriorly; anterior margin broadly curved and a fringe of setae hanging downward from median area. Ecdysial cleavage line united at base and forked between ocular areas; frontal arms curve laterally and terminate anterior to antennae. Dorsal surface of head glabrous except for 12 to 16 fine hairs along anterior margin and 5 or 6 fine hairs around ocular area. Ventral surface of head (Fig. 11) glabrous except for 3 to 5 long hairs around ocelli, a row of 5 or 6 long stout black setae and 5 to 8 tiny black setae laterally posterior to ocular area, and a long stout seta on each side of middle near posterior margin; tentorial pit present on each side of midline antemedially. Ocular areas each with 6 ocelli in 2 close vertical rows of 3 ocelli.

Antenna 4 segmented; 2d and 3d segments longest, subequal; ultimate segment smallest, less than ¼ as long as penultimate segment; basal segment slightly more than half as long as penultimate segment; all segments glabrous.

Mandible long, stout, falciform, grooved along inner surface. Maxilla with stipes narrow (Fig. 12); stipes with 2 short reddish-brown setae anteromedially and 1 stout black seta on inner margin near apex; galea elongate, hooklike. Maxillary palpus (Fig. 12) slender, elongate, 4 segmented; basal segment (palpifer) shortest; 2d and 3d segments subequal in length; ultimate segment 2½ times as long as basal segment; 3d segment with 1 long hair anterolaterally; other segments glabrous. Labium (Fig. 13) broadly triangular, with a row of 4 stout black setae and 1 small black seta on each side anterodorsally, with a small black seta ventrally at base of palpus; ligula absent; labial palpus slender, 2 segmented.

Pronotum subquadrate, wider basally, with a fringe of fine hairs laterally and 4 setae on posterior angle. Mesonotum slightly wider than and a little more than half as long as pronotum; with a few setae dorsally and several long setae on lateral margins and posterior angle; a spiracular opening present in pleural region below anterolateral angle of sclerite. Metanotum slightly wider than and about as long as metanotum, with similar setation.

Fore- and midlegs short, stout, 5 segmented; coxa long; trochanter about ⅓ as long as coxa; inner apex of tibia with a long serrated process parallel to and as long as tarsus; tarsus with inner margin serrate, 2 claws at apex, inner claw long, outer claw short (Figs. 14, 15). Foreleg (Fig. 14) with coxa with a row of setae on inner margin, 1 seta medially near inner margin; femur with a row of short setae on dorsal (anterior) margin and a row of long setae on ventral (posterior) margin, without row of swimming hairs; tibia with a few short setae ventrolaterally. Midleg (Fig. 15) with coxa with a row of 8 to 10 short stout spines on dorsal (outer) margin, ventral (inner) margin with short stout spines scattered unevenly; femur with a row of long spines on ventral (inner) margin and a row of 9 short spines ventrolaterally, a row of very long swimming hairs interspersed with short setae present on dorsal (outer) margin; tibia with 9 or 10 short stout spines on ventrolateral surface and long swimming hairs on dorsal (outer) margin. Hind legs long, slender; coxa with a row of short setae on dorsal (outer) margin, short setae scattered on ventral (inner) margin and lateral surface; femur with short setae laterally and on dorsal (outer) margin and a few long swimming hairs on dorsal margin, long stout setae on ventral (inner) margin; tibia with a row of stout setae near dorsal (outer) margin, dorsal margin with long swimming hairs, ventral (inner) margin with 2 rows of stout setae, lateral surface with 10 to 12 stout setae near dorsal margin; tarsus with long swimming hairs on dorsal (outer) margin, stout spines on ventral (inner) margin and on lateral and medial surfaces.

Abdomen of 8 segments. Segments 1 through 6 with dorsal sclerites; segments 7 and 8 completely sclerotized, ringlike. Terga of segments 1 through 6 with setae on lateral margins, across hind margins and sparsely on surface; setae mostly short, appressed; a few long erect setae present. Segments 7 and 8 with short appressed setae intermixed with short, stout, erect spines and long erect setae. Segment 8 (Fig. 16) with 2 short slender cerci posteroventrally. Cerci with 8 long erect setae as illustrated. The pleura and venter of segments 1 through 6 covered with short appressed setae with an occasional long erect seta present. Lateral margins of segments 1 through 7 each with a spiracle.

Matus is a member of the Colymbetinae and keys to couplet 10 in Chandler (1956), but does not fit either choice there. It may be separated from both parts of couplet 10 and all known larvae of dytiscid genera by the pseudochelate structure of the fore- and midlegs.

Our larvae of *Matus bicarinatus* were collected in a small partially shaded pond with clumps of grass, algae, and some *Sagittaria* growing in the water along part of the margin of the pond. The rest of the margin of the pond was heavily shaded by trees and shrubs and had little or no low herbaceous vegetation in this area. The *Matus* larvae were

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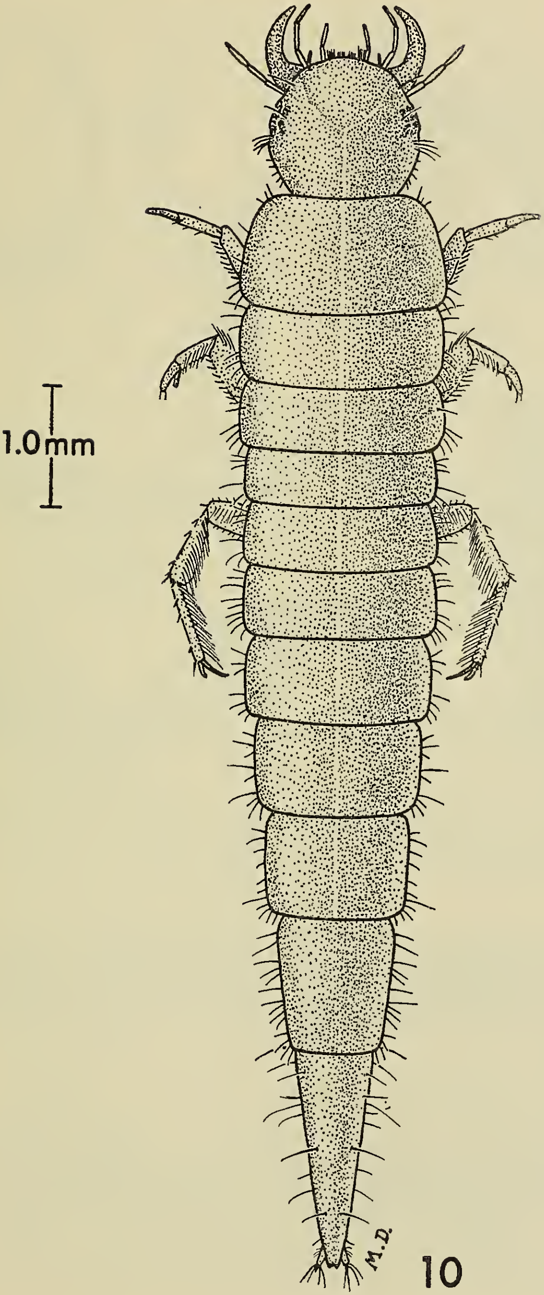
FIG. 10. *Matus bicarinatus*, larva, habitus, dorsal view.



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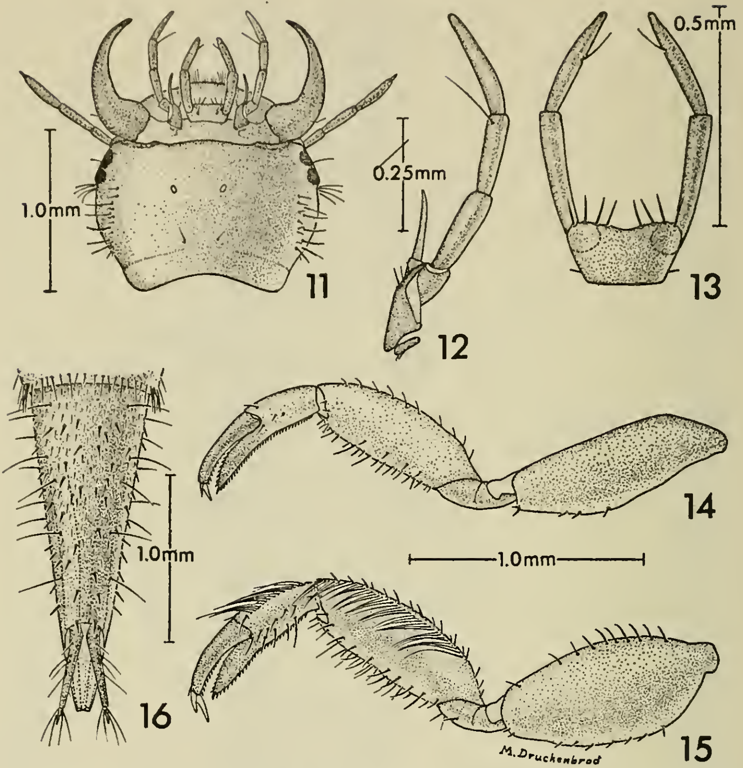

FIGS. 11–16. *Matus bicarinatus*, larva: 11, head, vv; 12, maxilla, vv; 13, labium, dv; 14, foreleg, dv; 15, midleg, dv; 16, last abdominal segment, vv. vv = ventral view; dv = dorsal view.

found in muck in the exposed grassy area. An attempt was made to rear the larvae to obtain pupae and the adults, but the larvae died and were then preserved for study. Our five larvae of *Matus* were collected from Maryland, Anne Arundel County, Friendship, 9 June 1968 and 26 July 1970.

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PROCEEDINGS
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THE MONOTYPIC INDO-PACIFIC LABRID FISH GENERA *LABRICHTHYS* AND *DIPROCTACANTHUS* WITH DESCRIPTION OF A NEW RELATED GENUS, *LARABICUS*

By John E. Randall and Victor G. Springer
Bernice P. Bishop Museum, Honolulu, Hawaii 96818, and
Smithsonian Institution, Washington, D.C. 20560

The wrasse genus *Labrichthys* Bleeker (1854) has been a source of confusion to ichthyologists almost from its inception. Günther (1862) erred in uniting the genus *Pseudolabrus* Bleeker with *Labrichthys.* As a result, more species of *Pseudolabrus* have been described and reported in *Labrichthys* than in the proper genus. Gill (1891) corrected this mistake, adding that Bleeker placed these two genera in different subfamilies (his Labrichthyiformes and Pseudolabriformes).

Labrichthys and its allies differ from *Pseudolabrus* (here compared only with the type-species of *Pseudolabrus, P. rubiginosus* = *P. japonicus*) in having five instead of six branchiostegal rays, tubes of lateral-line scales simple instead of ramose (but simple in young *Pseudolabrus*), specialized dentition, a difference in mouth structure, and a reduced, weakly ossified lower pharyngeal bone with relatively few teeth which extend uniserially onto the anterior shank of the bone (figures 1–3) as opposed to a robust, heavily ossified lower pharyngeal bone with more teeth which extend irregularly biserially, or as a patch, onto the anterior shank of the bone (figure 4). Table 1 augments the comparison of pharyngeal bones, and is based on much larger specimens than were used for the pharyngeal bone illustrations. The difference in structure of the lower pharyngeal bones is undoubtedly correlated with diet: the labrichthyiform fishes feed on relatively soft-bodied prey; *Pseudolabrus*, based on the stomach contents of specimens we examined, include shelled molluscs in their diet.

Among the species other than those of *Pseudolabrus* attributed to *Labrichthys* are *L. bicolor* Day, a synonym of *Hemigymnus melapterus* Bleeker (as noted by Gill, 1891), "*Labrichthys* sp. one" of Harry (1953), a species of *Wetmorella*, and *L. caudovittatus* Steindachner (1898).

Although *L. caudovittatus* Steindachner (1899) has fin-ray and lateral-line scale counts comparable to *Labrichthys* and *Pseudolabrus*, it belongs in neither genus. Realizing the error in generic allocation, Smith (1957) erected *Suezia* for it. S. *caudovittatus*[1] is slender [depth 3.9 in standard length (SL)] with a short rounded caudal fin (5.3 in SL), 6 branchiostegal rays, 25 lateral-line scales with a single tube on each, 5 predorsal scales, 3 diagonal rows of scales on cheek, a fully exposed, smooth preopercular margin, a single pair of moderately straight, projecting canine teeth anteriorly in the jaws, a row of small teeth on the sides, a prominent posterior canine in upper jaw, and a long opercular flap (extending posterior to upper pectoral-fin base, 8.3 in SL).

Guichenot (1847) described a small labrid fish from Guam as *Cossyphus unilineatus*; Günther (1862) correctly referred it to *Labrichthys*. Fowler (1928) stated that this species was possibly the same as *L. cyanotaenia* Bleeker; Smith (1957) and Randall (1958) expressed the same opinion. We are now able to demonstrate that *Labrichthys unilineatus* is indeed a senior synonym of *L. cyanotaenia*.

In addition to *Labrichthys*, Bleeker described the related genera *Labroides* and *Diproctacanthus*, which he grouped in his "Labrichthyiformes." Schmidt (1930) added the genus *Labropsis* to this assemblage.

Rüppell (1835) named a small wrasse from the Red Sea *Labrus quadrilineatus*, which Günther (1862), Klunzinger (1871) and Fowler (1928) classified in *Labroides*. Estève in Roux-Estève and Fourmanoir (1955) described the same species as *Labrichthys cousteaui*. This fish does not fit in either

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[1] One specimen, BM(NH) 1935.9.30.42, 95 mm SL, from Ghardaqa, Red Sea, examined at British Museum (Natural History).

TABLE 1. Comparison of lower pharyngeal bones of 123 mm SL specimens of *Pseudolabrus japonicus* and *Labrichthys unilineatus*

	Labrichthys (USNM 209180)	*Pseudolabrus* (USNM 209179)
1. Length overall:	7.2 mm	8.2 mm
2. Width overall:	6.1 mm	12.6 mm
3. Length posterior arms:	3.9 mm	6.4 mm
4. Length anterior shank:	3.7 mm	3.8 mm
5. Length tooth patch:	2.0 mm	5.9 mm
6. Width tooth patch:	1.0 mm	8.4 mm
7. Angle formed at junction of posterior arms:	approximately 70°	approximately 120°
8. Teeth on shank:	uniserial	in a patch
9. Nature of teeth:	pointed	bluntly rounded to molariform
10. Diameter of largest tooth:	approximately 0.1 mm	0.9 mm
11. Ossification:	very weak	very strong
12. General description:	thin, fragile	heavy bodied, strong

Labroides or *Labrichthys*; therefore, we propose herein a new genus, *Larabicus*, for it.

The fishes of these five genera are all small with dorsal-fin elements IX,11 or 12[2], anal-fin elements II or III,10 or 11; vertebrae 10 + 15; 5 branchiostegal rays; a continuous, abruptly curved lateral line; preopercular margin restricted and smooth (margin inapparent on *Labrichthys*); 10 or more predorsal scales; scales on thorax smaller than those on rest of body; mouth small, terminal; a prominent canine tooth posteriorly on each side of upper jaw; and distinctive lip morphology (either a bilobed lower lip or pursed fleshy lips that form a short tube when mouth is closed). Most of the species have been observed picking at the bodies of other fishes, at least as juveniles (Randall, 1958; Randall and Helfman, 1972).

In view of the close relationship of these genera, a key is presented, followed by generic descriptions of *Labrichthys*, *Larabicus*, and *Diproctacanthus* and accounts of the single species known in each of these genera. The four species of *Labroides* were treated by Randall (1958), and Springer and Smith-Vaniz (1972) discussed geographic variation in *L. dimidiatus*.

Labropsis, which consists of *manabei* Schmidt and five undescribed species, is being revised by the senior author.

Key to the Labrichthyiform Genera of Labridae

1a. Lower lip bilobed (two halves separated by a prominent U-shaped notch); body slender, the depth 3.5 to 4.4 in SL; one pair of enlarged canine teeth anteriorly in jaws .... *Labroides*

1b. Lower lip not bilobed (lip occasionally split on *Larabicus*, as if cut by a knife, but U-shaped notch never present); body not slender, the depth 2.6 to 3.3 in SL; one or two pairs of enlarged canine teeth anteriorly in jaws (in *Diproctacanthus* the anterior canines not markedly longer than more posterior teeth) 2

2a. Anal-fin spines III; ventral part of head fully scaled except for chin 3

2b. Anal-fin spines II (some species with three spines but the tiny first spine is detectable only by dissection or from radiograph); ventral part of head naked 4

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[2] The last two dorsal and anal rays are articulated to a single pterygiophore; nevertheless, they are counted as separate rays (as long as each has its own expanded basal portion).

3a. Two pairs of enlarged canine teeth anteriorly in upper jaw; no small teeth on side of upper jaw; lips thickly plicate externally; top of head scaled to nostrils; last dorsal-fin spine much shorter than posterior dorsal-fin rays; caudal fin rounded; pectoral-fin rays 14 or 15 (including rudimentary upper ray); pelvic fins of large males elongate, reaching well beyond origin of anal fin .... *Labrichthys*

3b. One pair of enlarged canine teeth anteriorly in upper jaw; small teeth on side of upper jaw; lips faintly or not plicate externally, fringed on anterior margin; top of head scaled to posterior edge of eye; last dorsal-fin spine longer than posterior dorsal-fin rays; caudal fin truncate, becoming slightly emarginate in large males; pectoral-fin rays 13 (including rudimentary upper ray); pelvic fins not reaching anus .... *Larabicus*, new genus

4a. No small teeth on side of upper jaw between anterior canines and posterior canine; dorsal profile of snout convex (except juveniles); length of caudal peduncle (measured horizontally from rear of anal-fin base to caudal-fin base) 1.7 to 3 in least depth of caudal peduncle .... *Labropsis*

4b. Small canine teeth present along side of upper jaw; dorsal profile of snout straight; length of caudal peduncle 1.2 to 1.5 in least depth of caudal peduncle .... *Diproctacanthus*

Labrichthys Bleeker

Labrichthys Bleeker, 1854. Nat. Tijdschr. Ned.-Indië, 6:331 (type-species: *Labrichthys cyanotaenia* Bleeker, by monotypy).

Thysanocheilus Kner, 1864. Anz. Akad. Wiss. Wien, 1:185 (type-species: *Thysanocheilus ornatus* Kner by monotypy).

Description: Body moderately elongate, depth 2.6 to 3.2 in SL; body compressed, width behind gill opening 2.2 to 2.7 in depth; head length 2.4 to 2.8 in SL; caudal peduncle deep, least depth 1.7 to 2.2 in head; length of caudal peduncle (measured horizontally from rear of anal-fin base to caudal-fin base) 2.1 to 2.6 in least depth of caudal peduncle; snout moderately pointed, 2.8 to 3.3 in head; eye 1.0 (26.5-mm specimen) to 2.4 in snout; lips thick, fleshy, strongly plicate externally as well as internally; lips form short tube when mouth is closed; thin epidermal sheath from front of snout partially covering upper lip; two pairs of well-separated, incurved canine teeth at front of upper jaw and large canine tooth at posterior end of jaw on each side, but no intervening teeth; pair of close-set, moderately straight, stout canines at front of lower jaw, followed by row of 3–5 small teeth on side of jaw (one specimen lacked these teeth on one side of jaw); dorsal fin IX,11 (rarely 12); anal fin III,10 (rarely 11); branched caudal-fin rays 12; pectoral-fin rays 14 or 15 (usually 14); lateral-line scales 26 (rarely 25 or 27) (plus 2 scales posterior to end of hypural); head entirely scaled except for sheath over base of upper lip, preorbital, and chin (scales on head of variable size, the largest on opercle nearly as large as scales on body; scales anteriorly on head small, about 18 rows across interorbital); preopercular margin usually scaled over; basal half or more of median fins scaled (except posterior part of dorsal and anal fins where less than half is scaled); caudal fin rounded, 1.3 to 2 in head; dorsal-fin spines progressively longer posteriorly, ninth spine 2.8 to 3.6 in head; dorsal- and anal-fin soft rays also progressively longer, last fin rays 1.6 to 3 in head (spines and rays relatively longer in adults); pectoral fin short, rounded, longest ray 1.8 to 2.2 in head; pelvic fins variable, short in juveniles and females, very long in adult males (longest pelvic-fin ray half or more of SL); gill membranes broadly attached to isthmus; cleft between membranes short, not extending anteriorly beyond level of postorbital margin (cleft hidden by overlying scales for most of its length); gill-rakers small, 9 or 10, all on lower limb; vertebrae 10 + 15.

Labrichthys unilineatus (Guichenot)

Figs. 1, 5, 8,

Cossyphus unilineatus Guichenot, 1847. Rev. Zool. Soc. Cuvierienne, p. 284 (type-locality: Guam).

Labrichthys cyanotaenia Bleeker, 1854. Nat. Tijds. Ned-Indië, 6:331 (type-locality: Larantuka, Flores).

Thysanocheilus ornatus Kner, 1865. Akad. Wiss. Wien, Denk., 24(1): 5, pl. 3 (type-locality: Upolu, Samoa).

Chaerojulis castaneus Kner and Steindachner, 1867. Akad. Wiss. Wien, Sitz., 54:393, figs. a, b (mouth) and pl. 2, fig. 8 (type-locality: Samoa Islands).

Description: Characters of the genus. Life colors as follows: small juveniles (such as Fig. 8a) brown, with light bluish reflections on scales, especially on head, anteriorly on body and over thorax and abdomen; two narrow bluish white stripes on body, the most conspicuous stripe passing from snout through lower edge of eye and ending in middle of caudal fin, the second stripe from chin across thorax below pectoral fin to ventral caudal-fin base; faint pale longitudinal banding on body following centers of scale rows; median fins edged in clear light blue, broadest anteriorly on soft portions of dorsal and anal fins and at corners of caudal fin; mouth region faintly yellowish; caudal fin slightly yellowish basally.

Larger individuals lack the lower stripe; the mid-lateral stripe be-

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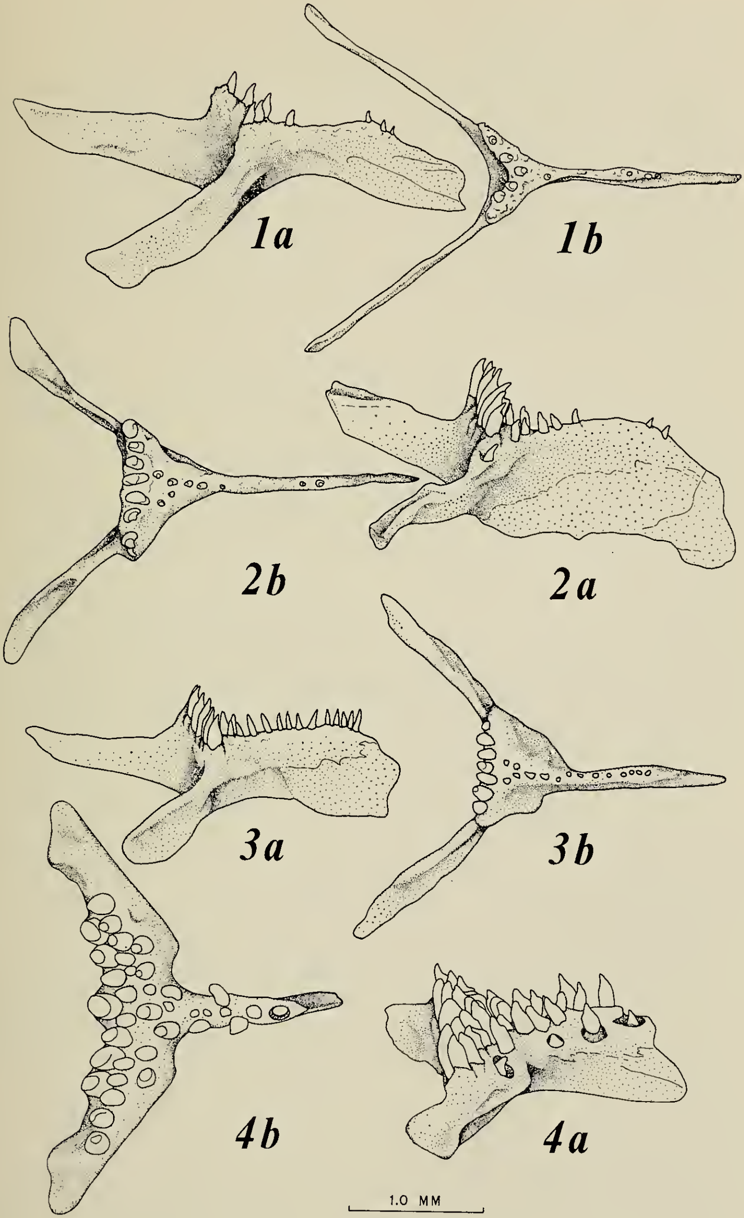
FIGS. 1–4. Lower pharyngeal bones; a, lateral views; b, dorsal views. Fig. 1. *Labrichthys unilineatus*, female, 53 mm SL, USNM 208451; Fig. 2. *Larabicus quadrilineatus*, female, 52 mm SL, USNM 208452; Fig. 3. *Diproctacanthus xanthurus*, female, 46 mm SL, USNM 208453; Fig. 4. *Pseudolabrus japonicus*, juvenile, 38 mm SL, USNM 208589.


1a
1b
2b
2a
3a
3b
4b
4a
1.0 MM

comes light yellowish and the mouth more yellow. Still larger fish lose the lateral stripe.

70 mm female (Fig. 8b): yellowish brown with faint, dull blue, longitudinal lines along centers of scale rows; irregular faint blue bands on head, most prominent band passing from corner of mouth to eye; caudal fin dull yellowish brown with pale bluish border and narrow dark brown sub-marginal zone; curved bluish band faintly visible on outer third of caudal fin paralleling posterior margin; dorsal and anal fins similarly colored, with bluish band, partially broken into spots, about half way out in rayed portion of fins; pectoral fins hyaline with pale bluish rays and large dark brown spot at base followed by yellow zone; pelvic fins brownish yellow with two faint longitudinal light bluish streaks; lips primarily yellow.

The 67-mm male (Fig. 8c) displayed intensification and brightening of narrow blue stripes on body and blue bands on head (which have broadened to form a coarse reticulum); large yellow area evident beneath and above pectoral fins; margins of median fins bright blue; most of central and basal part of caudal fin and basal parts of dorsal and anal fins irregularly marked with blue; proximal yellow zone on pectoral fins next to basal dark brown spot broader and deeper in hue than in female; pelvic fins yellowish brown with lateral blue edge and median blue streak; yellow of lips reduced.

94-mm male (Truk, Caroline Islands, BPBM 7495): dark olive with longitudinal, bright blue lines on body; blue markings (broader anteriorly) on head; diffuse yellow bar extending dorsally from beneath pectoral fins; median and pelvic fins edged in bright blue; outer third of caudal fin with curved band composed of linked hemispherical segments of blue; pelvic-fin base dark brown; pelvic fins bright yellow proximally and clear distally.

Remarks: Guichenot described *unilineatus* from two small specimens (the length of only one specimen was given: a little more than 6 cm) with a single mid-lateral pale stripe. The type-specimens were not located; they are not listed in Bauchot's (1953) catalogue of labrid types in the Museum National d'Histoire Naturelle, and she informs us that a recent (1972) search of the collections did not uncover them.

The holotype of *Labrichthys cyanotaenia* Bleeker was not found by us. No specimens of the genus *Labrichthys* are present in the Rijksmuseum van Naturlijke Historie at Leiden. One specimen attributed to Bleeker was examined at the British Museum (Natural History); this

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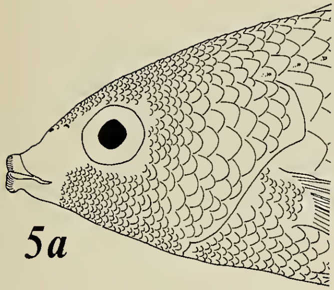
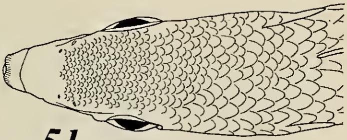
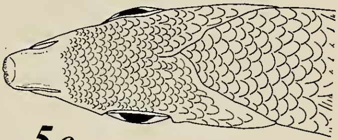
Figs. 5–7. Head topography; a, lateral views; b, dorsal views; c, ventral views. Fig. 5. *Labrichthys unilineatus*, 51 mm SL, USNM 117706; Fig. 6. *Larabicus quadrilineatus*, 50 mm SL, USNM 208452; Fig. 7. *Diproctacanthus xanthurus*, 50 mm SL, USNM 207468.



5a



5b



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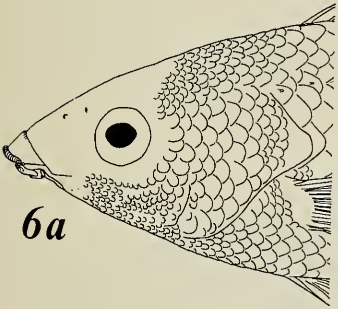
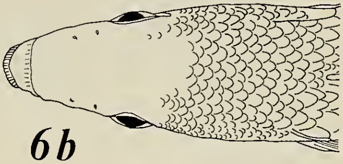


6a



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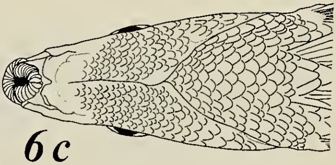

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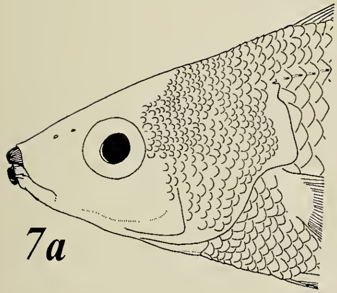
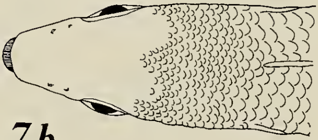
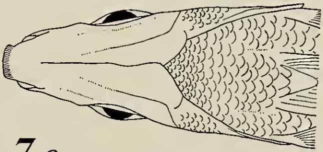


7a



7b



7c

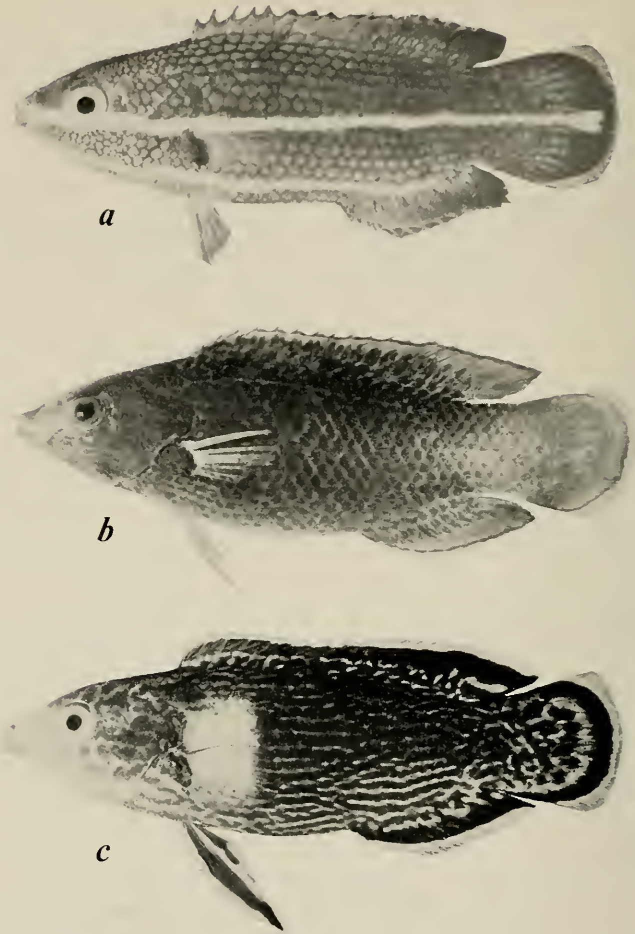


Fig. 8. *Labrichthys unilineatus.* a, juvenile, 31 mm SL, Upolu, Western Samoa, BPBM 6162; b, female, 70 mm SL, Tutuila, American Samoa, BPBM 11305; c, male, 67 mm SL, Tutuila, American Samoa, BPBM 6161.

fish, No. 1864.5.15.38, 64 mm SL and 82.5 mm TL, could not have been Bleeker's type, which was 128 mm long.

A syntype of *Thysanocheilus ornatus* Kner from Samoa was examined in the British Museum (Natural History), No. 1865.5.29.16. It measures 125 mm SL and is clearly a large male *unilineatus.* There is a broad pale bar running dorsally from beneath the pectoral fin; the pelvic fins are 61 mm long. We here designate this syntype as lectotype of *T. ornatus*.

Some authors have placed *Platyglossus ocellatus* Kner and Steindachner in the synonymy of *Labrichthys cyanotaenia* (= *unilineatus*). de Beaufort (1940) noted that this resulted from a mistake in ascribing Fig. 8 (a recognizable drawing of *unilineatus*) to *Platyglossus ocellatus*. *Chaerojulis castaneus* Kner and Steindachner is the correct junior synonym.

Fowler (1928) placed *Labrichthys australis* Steindachner (1866) in the synonymy of *L. cyanotaenia* (= *unilineatus*); however, it is evident from Steindachner's description that *australis* is not a *Labrichthys*.

We have collected *L. unilineatus* in the Ryukyu Islands, Mariana Islands, Caroline Islands, Gilbert Islands, Samoa Islands, southern Molucca Islands, One Tree Island (Capricorn Group, Great Barrier Reef) and Lord Howe Island. We have examined, in addition, museum specimens from Kenya, Zanzibar, Indonesia, New Guinea, Philippines, Palau Islands, New Caledonia, and the Marshall Islands. Smith (1955) recorded the species from Aldabra; Smith (1957) reported it from Malindi (3°S) to Bazaruto (21°S) in East Africa, adding that it is rare; and Herre (1931, 1936) recorded it from the Solomon Islands. There is no record from the Red Sea (where the junior author made numerous collections and observations). Nearly 2 years of field work by the senior author in French Polynesia have failed to turn up any specimens, thus the record from Tahiti by Fowler (1931) (after Pohl) is questionable. Also, this species was not observed or collected in the Line Islands, Cook Islands, or islands of the Pitcairn Group. It seems likely that it does not range to the east of the Samoa Islands.

The largest specimen we have examined is 135 mm SL. It was collected by E. Postel in New Caledonia and was deposited in the Museum National d'Histoire Naturelle under number 1964–309. The pelvic fins measure a remarkable 74.6 mm in length.

Labrichthys unilineatus is usually seen in shallow lagoon reefs. Our specimens have come from a depth range of 0.7 to 15 meters, though the species probably ranges into somewhat deeper water. We have seen it most often swimming agily through thickets of staghorn coral (*Acropora*). Large males have been observed in courtship with drab brown females. In Samoa we observed this fish frequently picking at several species of live coral, including two of *Acropora*; thus it appears to feed on coral polyps. We have not seen it clean other fishes, but our observations have been limited. In view of the occasional cleaning by related genera, it would not be surprising if juvenile *Labrichthys*, at least, are part-time cleaners.

Larabicus, new genus

Description: Body moderately elongate, depth 2.9–3.3 in SL; body compressed, width 1.8 to 2.3 in depth; head length 2.6 to 2.9 in SL;

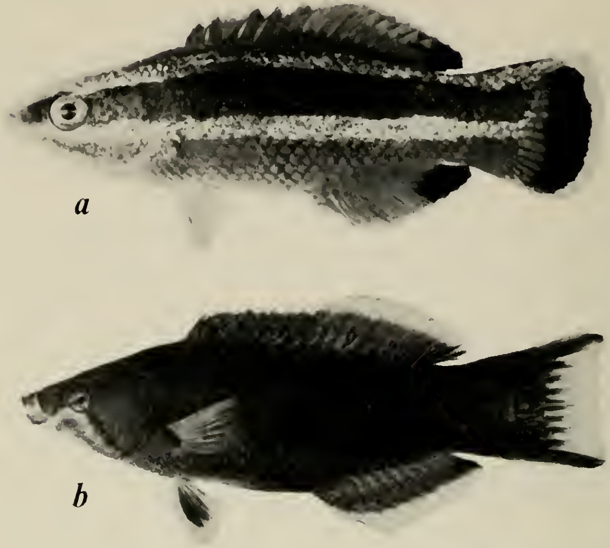


FIG. 9. *Larabicus quadrilineatus*, Gulf of Aqaba, Red Sea. a, juvenile, 31 mm SL, BPBM 13385; b, male, 88 mm SL, BPBM 13400.

caudal peduncle deep, least depth 1.8 to 2.2 in head; length of caudal peduncle 1.7 to 2.4 in least depth of caudal peduncle; snout pointed, 2.7 to 3.4. in head; eye 1.3 (31-mm specimen) to 2.4 in snout; lips thick, fleshy, strongly plicate internally, smooth to faintly plicate externally with fringed area at anterior margin; lips form short tube when mouth is closed; anterior part of lower lip curves ventrally; no sheath from front of snout covering part of upper lip anterior to frenum; single pair of enlarged incurved canine teeth at front of upper jaw, followed by close-set, small, slender canines along side of jaw (in about three irregular rows anteriorly); lower jaw with one pair of enlarged, slightly incurved, canine teeth anteriorly, followed by close-set, small canines along side of jaw (in two irregular rows anteriorly); dorsal fin IX,11; anal fin III,10; branched caudal-fin rays 12; pectoral-fin rays 13; lateral-line scales 26 or 27 (plus 1 or 2 scales posterior to end of hypural); head scaled dorsally to posterior interorbital space, ventrally to just behind corner of mouth; largest head scales (on opercle) noticeably smaller than largest body scales; scales anteriorly on head much smaller than other head scales; preopercular margin free over broadly rounded angle and for short distance above; scales covering approximately basal third of dorsal and anal fins and basal half of caudal fin; caudal fin truncate, slightly emarginate in adult males, 1.3 to 1.9 in head; dorsal-fin spines progressively longer posteriorly, the ninth spine 2.8 to 4.3

FIG. 10. *Diproctacanthus xanthurus*, Palau Islands. a, juvenile, 27 mm SL, BPBM 9562; b, male, 62 mm SL, BPBM 6385.

in head; anterior dorsal- and anal-fin soft rays longer than posterior rays; last vertical-fin rays 3.6 to 5.3 in head; pectoral fin short, rounded, longest ray 2 to 2.3 in head; pelvic fins short, 2 to 2.4 in head; gill membranes broadly attached to the isthmus; cleft between gill membranes extending anteriorly to or beyond level of mid-orbit; gill-rakers small, 11 to 13, all on lower limb; vertebrae 10 + 15.

Monotypic, type-species, *Labrus quadrilineatus* Rüppell (1835).

Etymology: An arbitrary combination of letters; gender, masculine.

Larabicus quadrilineatus (Rüppell)

Figs. 2, 6, 9

Labrus quadrilineatus Rüppell, 1835. Neue Wirbel. Fauna Abyssinien, p. 6, pl. 2, fig. 1 (type-locality, Massaua, Red Sea).

Labrichthys cousteaui Estève in Roux-Estève and Fourmanoir, 1955. Ann. Inst. Oceanogr. Paris, N.S., 30:199 (type-locality, Abulat, Red Sea).

Description: Characters of the genus. Life color as follows: Juvenile (of Fig. 9a) dark purplish gray with two brilliant blue stripes, the upper stripe passing from front of snout through upper edge of eye to upper edge of caudal fin, the lower stripe from chin through lower edge of eye across upper pectoral-fin base to middle of caudal fin (upper edge of lower stripe along mid-side of body); zone of dark purplish-gray ground color between blue stripes about twice as wide as each blue stripe; ventral part of head blue; each scale of thorax and abdomen with broad basal bluish area; scaled basal part of caudal fin colored like body, the two stripes in fin interconnected with indistinct vertical blue band; less distinct band running ventrally from caudal end of lower stripe; unscaled part of caudal fin with large, vertically elongate, black area; posterior margin of fin whitish; dorsal and anal fins dusky, the scaled basal part of each fin darker, with large black area posteriorly (covering most of last five interradial membranes of anal fin and last three interradial membranes of dorsal fin); margins of dorsal and anal fins whitish—more evident on soft portions; pectoral fins pale, black at base; pelvic fins bluish white with large central dusky region.

Females retain the two blue stripes but have the black area posteriorly in the median fins reduced; a large black spot is developed on each interspinous membrane of the dorsal fin between the second and fifth spines (some dark pigment may extend onto the sixth membrane).

Large male (of Fig. 9b) dark purplish gray without stripes; curved light blue band extends from chin to eye, continuing posteroventrally in direction of isthmus; abdomen light bluish ventrally; scaled basal portion and upper and lower caudal-fin lobes dark purplish gray except for narrow, indistinct blue margins on upper and lower edges; caudal fin with large crescentic pale area posteriorly, the membranes of which are blue proximally, whitish distally, rays dark purplish proximally, becoming whitish distally; dorsal and anal fins dark purplish with broad blue margins (one-fourth to one-third height of soft portions of fins) shading to whitish distally; black area on membranes between third and sixth dorsal-fin spines, some pigment extending onto second membrane; pectoral fins pale, black at base pelvic fins blue with large centrobasal area dark purplish (most intense on second interradial membrane); basal part of upper lip bluish, fringed margins of both lips whitish.

Remarks: Wolfgang Klausewitz has informed us that the holotype of *Labrus quadrilineatus*, which was once housed in the Senckenberg Museum, Frankfurt, has been lost.

The holotype (No. 52–254, 64 mm SL) and three paratypes of *Labrichthys cousteaui* Estève from the Red Sea were examined at the Muséum National d'Histoire Naturelle. These specimens are examples of *quadrilineatus* Rüppell.

The authors have collected specimens of *quadrilineatus* in the Red Sea from Elat, northern end of the Gulf of Aqaba, to Massawa, Ethiopia, in depths from 2 to 7 meters, and have observed individuals at depths up to 32 meters. All specimens that we have seen have come from the Red Sea, except one (USNM 209719) from Aden, near the entrance to the Red Sea.

Lev Fishelson, University of Tel Aviv, and David Fridman, Elat, (personal communication) have observed the young of *quadrilineatus* picking at the bodies of other fishes. Abel (1960) reported that *L. quadril-*

ineatus is an occasional fish "cleaner" but feeds mostly on coral polyps. He observed one group of 10 fish of this species living among the low branches of a violet *Acropora*. These fish grazed about two-thirds of a square meter of coral in 4 weeks. The damaged area could be recognized by its white color. The tips of the coral were spared the longest.

The dark form of *L. quadrilineatus* was positively linked to the smaller, two-striped phase when the senior author observed a large male in courtship with a presumed blue-striped female at 32 meters off Coral Island, Gulf of Aqaba. We have mature females as small as 43 mm SL. Our largest specimen of *quadrilineatus* is a male, 90.8 mm SL (USNM 208450).

Diproctacanthus Bleeker

Diproctacanthus Bleeker, 1861. Proc. Zool. Soc., p. 415 (type-species: *Labroides xanthurus* Bleeker, by original designation).

Description: Body moderately elongate, the depth 3.1 to 3.7 in SL; body compressed, width behind gill opening 2.0 to 2.3 in depth; caudal peduncle moderately slender, the least depth 2.3 to 2.7 in head; length of caudal peduncle 1.2 to 1.5 in least depth of caudal peduncle; snout pointed, 3.2 to 3.6 in head, dorsal profile straight; eye 1.0 to 1.6 in snout; lips thick, fleshy, strongly plicate internally and externally, forming short tube when mouth closed; sheath at front of snout covering part of upper lip anterior to frenum; two pairs of enlarged, slightly incurved canine teeth at front of upper jaw, the anterior pair largest; two to seven smaller teeth along side of upper jaw, the anteriormost teeth not markedly smaller than second pair of anterior canines; two pairs of small canines medial to large anterior canines; large canine tooth posteriorly on upper jaw; lower jaw with pair of enlarged, slightly incurved canine teeth anteriorly in jaw, followed by five or six progressively smaller teeth on side of jaw; another row of two or three small teeth medial and just posterior to large anterior canines; dorsal fin IX,9 or 10 (usually 10); anal fin II,9 or 10 (usually 9); branched caudal-fin rays 12; pectoral-fin rays 12 to 14 (including rudimentary upper ray); lateral-line scales 34 to 39 (plus two posterior to end of hypural); apex of V-shaped area of scales on nape reaching nearly to a vertical at posterior edge of eye; postorbital region of head scaled ventrally to about level of lower pectoral-fin base; scales on cheek reaching to, or slightly anterior to, vertical at center of eye; head scales small, the largest scales on opercle less than half size of largest body scales; approximately upper half of vertical margin of preopercle scaled over; dorsal and ventralmost rows of body scales encroaching slightly on bases of dorsal and anal fins; caudal fin rounded to truncate, 1.5 to 1.7 in head length; dorsal-fin spines progressively longer posteriorly, the ninth spine 3.3 to 4.5 in head; anterior dorsal and anal-fin rays longer than posterior rays, the posteriormost rays 4.8 to 5.4 in head; pectoral fins rounded, short, longest ray 2.2 to 2.5 in head; pelvic fins short, 2.1 to 2.5 in head; gill membranes broadly attached to isthmus, the cleft between membranes extending anteriorly beyond level of anterior orbital margin; gill rakers small, 6 to 8, all on lower limb, vertebrae 10 + 15.

Diproctacanthus xanthurus (Bleeker)

Figs. 3, 7, 10

Labroides xanthurus Bleeker, 1856. Acta Soc. Sci. Indo-Neerl., 1:52 (type-locality, Manado, Celebes).

Description: Characters of the genus. Life color as follows: juveniles with three broad, black stripes extending from anterior of head to caudal fin where stripes merge; intervening narrower stripes on head and body white; caudal fin black with upper and lower edges narrowly bluish white and corners hyaline light blue; dorsal and anal fins black basally, shading to hyaline light blue distally; pectoral fins hyaline; pelvic fins bluish white; lips light bluish and black.

With growth, a suffusion of yellow appears over the black of the caudal fin; with further growth, the fin becomes entirely yellow, the lower black stripe on head and body disappears, and the upper stripe is less distinct.

62-mm male (Fig. 10b): blackish stripe passing from lips through eye across full width of opercular flap to caudal base slightly above mid-side, the stripe darkest on opercular flap (light bluish margin along stripe present on flap); dusky olivaceous mid-dorsal stripe passing from front of snout to upper caudal peduncle; narrow band between two black stripes (which contains anterior part of lateral line) greenish white; head and body below lateral black stripe white except for light salmon streak running from chin along lower side of head, and scant dusky pigment on scales of first two scale rows below lateral stripe; dorsal fin light greenish; remaining fins whitish.

Remarks: Bleeker had two syntypes, 39 and 62 mm TL. A specimen in the British Museum (Natural History) labelled as a type is probably the smaller of the two syntypes. This fish, BM(NH) 1864.5.15.17, 31 mm SL, has the juvenile pattern of three broad black stripes. The second syntype seems to be the larger of two Bleeker specimens in the Rijksmuseum van Naturlijke Museum at Leiden (RMHN 6544, 47 mm SL, 60 mm TL). The damaged fin rays and cut gill membranes on one side suggest that it has been well studied. A printed strip above the main label reads "144 *Diproctacanthus xanthurus*," and a piece of old red tape on the jar may have indicated a type. This fish has the adult color pattern (as figured by Bleeker in his *Atlas Icthyologique*, 1862, vol. 1, pl. 21, fig. 2). It is here designated the lectotype.

In addition to Bleeker's types, *D. xanthurus* is known in the literature from Ambon (de Beaufort, 1913), Teomabal Island, Philippines (Fowler and Bean, 1928), and the Palau Islands (Randall and Helfman, 1972). We here record it from Madang Harbor, New Guinea from a 49-mm specimen (USNM 207468) collected by Bruce B. Collette, from Ambon and Ceram, based on specimens we collected, and from Java from specimens at the Senckenberg Museum, Frankfurt (SMF 9516, 4:34–52 mm SL; SMF 3792, 8:31–52.5 mm SL).

In Palau *D. xanthurus* occurs in lagoons, most commonly at 2 to 3 meters depth, where the bottom is mainly coral. Randall and Helfman (1972) reported that this fish feeds in part on coral polyps and in part on the ectoparasites of other fishes. In contrast to species of *Labroides*, which tend to occupy relatively restricted sectors of reefs for cleaning, *D. xanthurus* is more of a rover. As a result, it services mainly territorial fishes such as the pomacentrids that are less apt to seek out cleaning stations.

The largest known specimen is the one from the Philippines recorded by Fowler and Bean; they gave the length as 97 mm TL. Randall and Helfman reported a ripe female 43 mm SL.

Acknowledgments

In addition to the authors' institutions (BPBM and USNM), specimens of *Labrichthys*, *Larabicus*, and *Diproctacanthus* were examined at the British Museum (Natural History), London; California Academy of Sciences, San Francisco; Museum National d'Histoire Naturelle, Paris; Rijksmuseum van Naturlijke Historie, Leiden; Senckenberg Museum, Frankfurt; Universitetets Zoologiske Museum, Copenhagen; Zoological Institute, University of Tokyo; Zoölogisch Museum, Amsterdam; and Zoologisches Museum, Humboldt-Universität, Berlin. We thank the curators of fishes at these museums and their staffs for their assistance. We also acknowledge the cooperative program on the biota of the Red Sea sponsored by the Smithsonian Institution and the Hebrew University, which enabled the authors to make observations and collections of *Larabicus* in the Red Sea and the Rumphius Expedition I, sponsored by the Indonesian Institute of Oceanology, which enabled the junior author to collect and observe *Diproctacanthus* and *Labrichthys* in the southern Moluccas. Special appreciation is accorded to Martin F. Gomon for preparation of the drawings and criticially reviewing the manuscript.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

ELMINTHIDAE OF LIBERIA (COLEOPTERA)

BY J. DELÈVE
Institut royal des Sciences naturelles de Belgique,
Brussels, Belgium

Almost all of the specimens discussed in this paper were collected by Dr. C. C. Blickenstaff at Suakoko, Liberia, most frequently by light trap. I presume that they were captured during their first flight, just after eclosing. Indeed, in all of the specimens dissected for the extraction of the genitalia, the abdomen was empty and the tergal sclerites were closely depressed against the sternal ones.

Twenty-seven species are listed here; five are new to science, the others, new to Liberia, belong to species already reported from several countries of West Africa.

Types and paratypes are deposited in the National Museum of Natural History, Smithsonian Institution collections. Some paratypes are deposited in the Institut royal des Sciences naturelles (Brussels) and in the author's collections.

I thank Dr. Paul J. Spangler, Department of Entomology of the National Museum of Natural History, Smithsonian Institution who not only gave me the opportunity to study these Liberian elmids, but was kind enough to revise the English translation of the manuscript.

Subfamily LARINAE

Potamodytes tuberosus Hinton

1937. Ann. Mag. Nat. Hist., ser. 10, 19:294.

Reported Distribution: This species was described from Ogoué, Sam Kita (French Congo), and was reported from Brazzaville Congo, and from the Central African Republic by Delève (1967a, 1967b, 1970).

Specimens Examined: 16 specimens from Suakoko, Liberia, between

March and June 1952; 1 specimen from Gibi, W. W. Mann (Smithsonian-Firestone Exp. 1940).

Potamodytes antennatus (Dohrn)

1882. Stett. Ent. Zeit., 43:251.

Reported Distribution: Described from Guinea; this species was reported also from the Ivory Coast by Delève (1968).

Specimens Examined: 9 specimens, Liberia, 8 miles Samoy Trail, 27 Apr. 1952, C. C. Blickenstaff.

Potamodytes spangleri, new species

Male: Length, 9.5 mm; breadth, 2.6 mm. Moderately convex; black above; antenna less dark, with first segment rufous; pubescence grayish, short, recumbent.

Head feebly impressed along the inner margins of the eyes; surface very densely, finely punctate.

Pronotum (Fig. 1) trapezoidal; punctate as the head; moderately convex on the disc; as long as broad on apex (1.75 mm); broadest at base where it is 1$\frac{4}{7}$ times broader than long (2.75 mm:1.75 mm). Apical margin truncate, almost a right angle. Sides moderately arcuate, scarcely and briefly sinuate after the apical angles which are inconspicuous and rounded at apex; basal angles briefly rounded at apex, feebly reflexed. Apical transverse impression deep and distinct on middle where it cuts disc at about 0.5 mm behind apical margin; median longitudinal impression very feeble, with a shallow triangular impression and 2 punctures at base in front of scutellum. On each side, on basal third, a deep oblique sulcus limits internally the large depressed area of the posterior angle.

Elytra about 4 times as long as pronotum (7.5 mm:1.75mm), as broad at base as pronotum, narrowed from humeri to apex. Humeri gibbous, separated by a longitudinal depression from the more convex part of the elytra; this somewhat gibbous portion extending on basal fifth between 1st and 4th striae. Strial punctures distinct; intervals punctate as head and pronotum. Outer apical angle in the shape of a rather long triangular spinous process, about 0.7 mm long (Fig. 2).

Genitalia (Fig. 3) 2.4 mm long; parameres more or less rectangular, very long (1.3 mm); apex of median lobe regularly curved, followed on dorsal side by a very small spine.

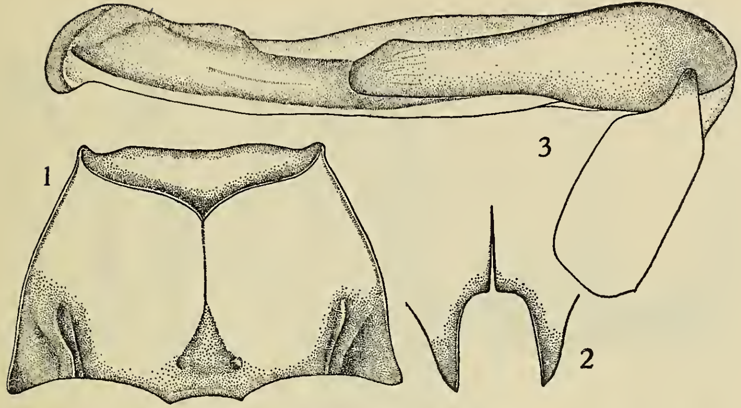
Female: Externally similar to ♂ except metasternum and abdomen more concave (as is usual in the genus).

Holotype: ♂, Liberia, Suakoko, 20 Mar. 1952, C. C. Blickenstaff.

Allotype: Same locality, 18–19 Mar. 1952 (light trap).

Paratypes: 33 specimens, same locality, on diverse dates from December 1951 to March 1952; 1♂, 8 miles Samoy Trail, Liberia, 27 Apr. 1952, on wet rocks (this specimen has rufous coloration).

This species belongs to the *africanus* Boheman group characterized



FIGS. 1–3. *Potamodytes spangleri*, new species: 1, pronotum, schematic, about × 25; 2, elytral apices, about × 25; 3, aedeagus, about × 50.

by the form of the apices of the elytra together with the form of the male genitalia which has more or less rectangular parameres. It may be distinguished from other species of this group by the deep basal sulcus of the pronotum, by the length of the parameres and by the curved apex and small dorsal spine of the median lobe.

I am pleased to name this species for Dr. Paul J. Spangler.

Omotonus angolensis Delève

1963. Bull. Ann. Soc. Roy. Ent. Belg., 99:439.

Reported Distribution: Angola.

Specimens Examined: 2♂♂, Suakoko, 31 Jan. and 10 July 1952.

Subfamily ELMINTHINAE

Stenelmis aphela Alluaud

1933. Ann. Soc. Ent. Fr., 102:156.

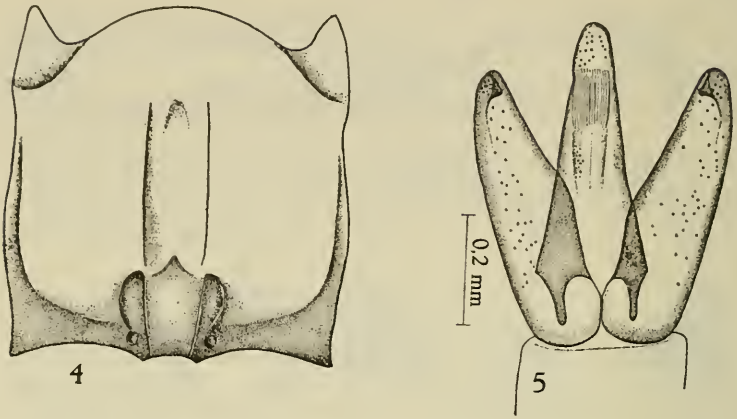
Reported Distribution: This species was described from the Ivory Coast and Upper Volta; it was reported also from Guinea by Delève (1966a).

Specimens Examined: 19 specimens from Suakoko, 26 Feb. 1952, 7 Nov. 1952, and 11–22 Oct. 1952.

Stenelmis simplex Delève

1938. Rev. Zool. Bot. Afr., 31(3–4):360.

Reported Distribution: Described from the Belgian Congo (Mayumbe); also reported from Cameroon by Delève (1963) and from Brazzaville Congo, by Delève (1963, 1967a).



FIGS. 4–5. *Stenelmis liberiana*, new species: 4, pronotum, female, about × 50; 5, aedeagus.

Specimen Examined: 1 ♂, Suakoko, 18 Nov. 1952.

Stenelmis cristata Delève

1966. Bull. Ann. Soc. Roy. Ent. Belg., 102:63.

Reported Distribution: Described from the Ivory Coast and reported from Cameroon and from Brazzaville Congo, by Delève (1966, 1967a).

Specimens Examined: 93 specimens from Suakoko, between December 1951 and February 1953.

Stenelmis phymatodes Alluaud

1933. Ann. Soc. Ent. Fr., 102:156.

Reported Distribution: This species was described from the Ivory Coast; it was reported also from Upper Volta by Alluaud (1933) and from Guinea by Delève (1966a).

Specimens Examined: 34 specimens, Suakoko, between 1951 and July 1952.

Stenelmis laeticollis Delève

1966. Bull. Ann. Soc. Roy. Ent. Belg., 102:69.

Reported Distribution: Ivory Coast.

Specimens Examined: 17 specimens, Suakoko, between December 1951 and March 1953.

Stenelmis clavareaui Grouvelle

1900. Ann. Soc. Ent. Belg., 44:425.

Reported Distribution: This species was described from the Belgian

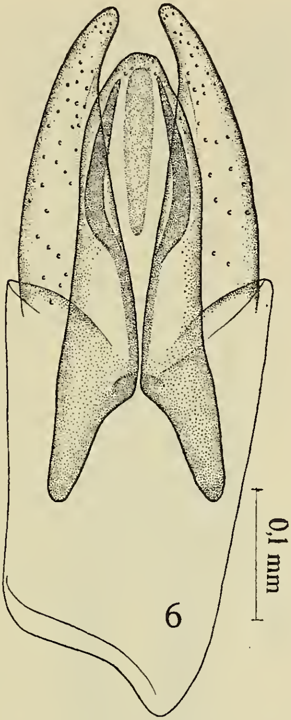


FIG. 6. *Microdinodes blickenstaffi*, new species, aedeagus.

Congo; it was reported also from Guinea, Upper Volta, Angola, and the Central African Republic by Delève (1966a, 1966b, 1970).

Specimen Examined: 1♂, Suakoko, 19 Dec. 1951.

Stenelmis merella Hinton

1941. Trans. roy. Ent. Soc. Lond., 91(3):101.

Reported Distribution: Sierra Leone.

Specimens Examined: 13 specimens, Suakoko, between December 1951 and November 1952.

Stenelmis decellei Delève

1966. Bull. Ann. Soc. Roy. Ent. Belg., 102:85.

Reported Distribution: Ivory Coast.

Specimens Examined: 38 specimens, Suakoko, between December 1951 and July 1952.

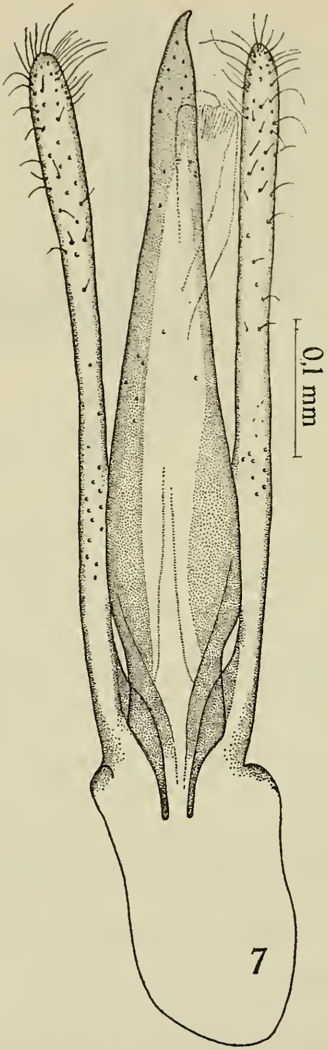


FIG. 7. *Pachelmis bigibbulosa*, new species, aedeagus.

Stenelmis soror Delève
1938. Rev. Zool. Bot. Afr., 31(3–4):362

Reported Distribution: This species was described from Faradje (Belgian Congo); also reported from the Ivory Coast and from the Central African Republic by Delève (1968, 1970).

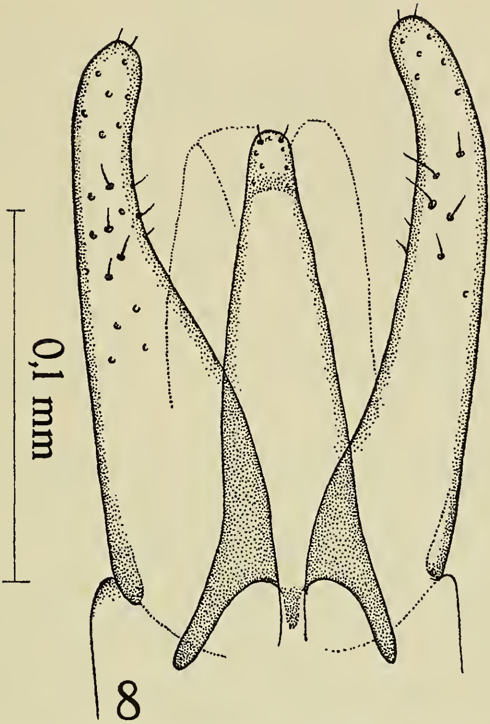


FIG. 8. *Helminthopsis marginalis*, new species, aedeagus.

Specimens examined: More than 100 specimens, Suakoko, between December 1951 and October 1952.

Stenelmis liberiana, new species

Male: Length, 3.9 mm (including head). Oblong, about 2⅗ times longer than broad at greatest width, moderately convex. Head and pronotum blackish, elytra less dark; antennae and tarsi rufous. Ventral surface dark rufous. Pubescence of dorsal surface grayish, very short.

Head depressed on each side, margin of front raised along inner border of eye; frontoclypeal suture straight. Anterior margin of clypeus, when seen from above, feebly arcuate medially; lateral angles rounded, produced anteriorly. Surface of head on front with shallow punctures, much broader than their intervals.

Pronotum slightly longer than broad at base (1.2 mm:1.1 mm) and base broader than apex (1.1 mm:0.87 mm). Sides feebly sinuate behind apical angles and before hind angles; apical angles acute, strongly produced; posterior angles acute, slightly diverging; base and lateral margin narrowly depressed, more broadly near basal angles; disc regularly convex; median longitudinal impression broader than scutellum but not very deep, obliterated near apex; sides of impression strongly raised at base; 2 punctures on front of scutellum in depressed area. Surface with large, shallow punctures, separated by less than 1 diameter; surface between punctures covered with very short, feltlike pubescence.

Elytra about twice as long as pronotum; a little broader at humeri than base of pronotum; about 1⅔ times as long as broad at greatest combined width (2.5 mm:1.5 mm), which is about ⅗ of their length. 3rd interval briefly but distinctly raised at base; sublateral carina (on 6th interval) prominent, extending from base to apical declivity; other intervals flat, broader on disc than the strial punctures which are large and deep, separated longitudinally by 1 or less than 1 diameter; 2nd stria ending before apex; 3rd and 4th joined at beginning of apical declivity.

Sides of prosternum granulose; intercoxal process rugose. Metasternum depressed behind on median line where it is rugose, coarsely punctured, gibbous on anterior part, with a round, deep depression between posterior coxae; sides granulose; median longitudinal line impressed posteriorly, very reduced anteriorly. Abdomen with middle region of 1st sternum depressed, coarsely punctate, granulose on the sides; 2nd sternum strongly punctate on anterior half, finer posteriorly; almost indistinctly punctate on the other sterna; emargination of middle apical margin of 5th sternum semicircular.

Posterior side of hind trochanter with a low median tubercle. Middle and hind tibiae with an acute tooth on middle of inner side, this tooth somewhat stronger on middle tibia.

Genitalia (Fig. 5): median lobe 560μ long; parameres 465μ long (at external margin) apices with a ventral recurved tooth; striated collar about 110 μ long.

Female: Differs from ♂ as follows: (1) pronotum (Fig. 4) reddish brown on basal region; (2) feltlike pubescence less dense; (3) sides of median longitudinal impression not only become strongly raised at base but constitute 2 protuberances; (4) base of median impression, between the protuberances, moderately raised in the form of a triangle; (5) metasternum without depression behind, without gibbosity on anterior part; (6) posterior margin of hind trochanter without tubercle; (7) middle and hind tibiae without tooth on inner side.

Holotype: ♂, Liberia, Suakoko, 19 Dec. 1951, C. C. Blickenstaff.

Allotype: With same collection data.

Paratypes: 82♂♂, 95♀♀ with same data; 101 additional specimens from dates between 18 Nov. and 11 Dec. 1952.

By the middle and hind tibiae of the male and by the form of the apices of the parameres, this species is related to *Stenelmis clavareaui*

Grouvelle from which it is easily distinguished (especially the females) by the sculpture of the pronotum.

Microdinodes nigrolineatus Delève

1937. Bull. Ann. Soc. Ent. Belg., 77:156.

Reported Distribution: This species was described from Mayumbe (Belgian Congo) and was reported from Angola and Brazzaville Congo, by Delève (1966b, 1967a, 1967b).

Specimens Examined: 15 specimens, Suakoko between November 1951 and November 1952.

Microdinodes illustris (Grouvelle)

1902. Ann. Soc. Ent. Belg., 46:190.

Reported Distribution: Described from Kinshasa (Belgian Congo) and was reported from Angola and from Brazzaville Congo, by Delève (1966b, 1967a).

Specimens Examined: 12 specimens, Suakoko; 27 Mar., 24 June, and 11–22 Dec. 1952.

Microdinodes balfouri Delève

1967. Bull. Ann. Soc. Roy. Ent. Belg., 103:435.

Reported Distribution: Described from Northern Rhodesia and was reported from Angola by Delève (1970).

Specimens Examined: More than 100 specimens, Suakoko, between December 1951 and November 1952.

Microdinodes blickenstaffi, new species

Male: Length, 2 mm. Oblong, a little more than twice as long as broad at greatest width. Head and pronotum black. Elytra dark brown with 3 yellow spots on each elytron; the 1st spot on the humeral callosity; the 2nd spot orbicular, at base, on intervals 2–4; the 3rd spot elongate, subapical, on interval 4–5. Legs and antennae reddish brown. No perceptible pubescence.

Head without impressions, surface densely and very minutely alutaceous, with some small widely separated punctures.

Pronotum slightly broader at base than long (0.61 mm:0.58 mm); about a third narrower at apex than at base (0.5 mm:0.61 mm); broadest point (0.66 mm) before basal middle. Lateral edges thick, double, chiefly at base. Sides arcuate, feebly sinuate as far as greatest width, then straight to apical angles which are acute and produced; basal angles acute. No carina nor sublateral sulcus; median longitudinal impression distinct, a little more abbreviated at apex than at base; 2 lines, finely raised, in front of scutellum. Surface finely alutaceous, with small, well-separated blunt granules.

Elytra about 2³⁄₇ times as long as pronotum, distinctly broader between humeri than base of pronotum (0.8 mm:0.6 mm); slightly more than 1½ times longer than broad combined at broadest point (1.41 mm:0.9 mm) which is near their midlength; striae feebly impressed at base; strial punctures broader than intervals; intervals flat, alutaceous as pronotum; 2nd, 4th, 6th, 7th and 8th intervals each with a row of fine, smooth granules; 6th row more prominent, extending to apical declivity.

Prosternal process coarsely punctate; hypomera alutaceous with rather large, well-separated punctures.

Metasternum coarsely punctate on disc, alutaceous on sides; median longitudinal impression deep and broad posteriorly, obliterated anteriorly, without distinct crest on each side of median impression. Abdomen alutaceous with an area of large punctures along anterior margin of first three segments, this area doubled on middle of anterior margin of first segment.

Base of claws strongly toothed.

Genitalia (Fig. 6) 530μ long; median lobe broadly linguiform, 335μ long, including the basal apophysis which enters rather deeply in the basal piece; parameres 205μ (at outer margin), arcuate and narrowed at distal apices; basal piece as long as median lobe.

Female: Externally similar to male, with median impression of metasternum less deep behind.

Holotype: ♂, Liberia, Suakoko, 19 Dec. 1951 (light trap, Blickenstaff).

Paratypes: 59 specimens with same data as holotype; 12 specimens from dates between February and March 1952.

Related to *M. multimaculatus* Delève and *elegans* Delève by the finely alutaceous cuticle and the absence of carina or sulcus on the pronotum. May be distinguished from these two species by the presence of a median longitudinal impression on the pronotum. But, as usual in this genus, the best distinctive character remains the male genitalia.

Helminthopsis elegans Alluaud

1933. Ann. Soc. Ent. Fr., 102:158.

Reported Distribution: Described from Upper Volta and reported from the Belgian Congo, Angola, and Ivory Coast by Delève (1938, 1966b, 1968).

Specimens Examined: 1♂, 1♀, Suakoko, 20–29 Nov. 1952, and 19 Dec. 1951.

Helminthopsis reticulata Delève

1945. Bull. Mus. roy. Hist. nat. Belg., 21(10):5.

Reported Distribution: Described from the Belgian Congo, this species was reported from Brazzaville Congo, by Delève (1967a, 1967b).

Specimens Examined: 1♂, Suakoko, 13 Dec. 1951; 2 specimens, 19 Dec. 1951.

Helminthopsis punctulata Delève

1945. Bull. Mus. roy. Hist. nat. Belg., 21(10):7.

Reported Distribution: This species was described from the Belgian Congo and was reported from Angola and from Brazzaville Congo, by Delève (1966a, 1966b).

Specimens Examined: 2♂♂, 2♀♀, Suakoko, 19 Dec. 1951 and 26 Feb. 1952.

Helminithopsis quadrinotata Delève

1965. Bull. Inst. roy. Sci. nat. Belg., 41(11):18.

Reported Distribution: This species was described from Brazzaville Congo.

Specimens Examined: 8 specimens, Suakoko, 19 Dec. 1951, 26 Feb. 1952, and Nov. 1952.

Helminthopsis marginalis, new species

Male: Length, 1.7 mm. Macropterous. About twice as long as broad at greatest width. Head appearing grayish because of alutaceous sculpture. Pronotum black. Elytra dark brown; shining; with 2 elongate clearer, alutaceous spots on the inner edge of the sublateral carina, on intervals 4 and 5; the 1st spot extending from base to basal third; the 2nd spot on the declivity, interrupted before apex; lateral part (between carina and lateral margin) completely of the same clear alutaceous color. Ventral surface brownish. Antennae and legs clearer. Pubescence short; sparsely distributed on pronotum; arranged in rows on elytral intervals.

Head with sparse granules, finer than facets of eyes, showing through the grayish alutaceous sculpture.

Pronotum more convex on anterior part than posteriorly; slightly broader at base than long (0.53 mm:0.47 mm), narrowed at apex (0.41 mm), greatest width (0.60 mm) before the basal half. Sides thickened, crenulate, regularly curved, feebly sinuate before basal angles which are almost rectangular; apical angles acute, narrow, deflexed. Median longitudinal impression entire, narrow, bordered with a narrow shiny zone sparsely punctate; 2 punctures in front of scutellum; on each side closer to lateral margin than to middle, a distinct sulcus raised and finely carinate on outer side, ending before basal half in an oblique, rather broad depression. Surface narrowly smooth and shiny on middle of base, more broadly in the area laterally limited by the sulcus; rest of surface alutaceous with sparse granules, a few coarser than facets of eyes.

Elytra distinctly broader at humeri than pronotum at base (1.2 mm: 0.47 mm), then feebly enlarged, with greatest width slightly behind midlength, where they are 1⅖ times longer than broad combined (1.2 mm:0.83 mm). First four rows of punctures marked at base by a large, deep puncture; punctures in the rows generally more distant than 1 diameter, narrower than intervals; 6th interval narrow, raised in a fine, granulose carina; punctures of 5th and 6th rows (on both sides of the carina) closer; punctures of 7th and 8th rows (in the alutaceous lateral region) finer, more distant than in the other rows. Bear a row of broad, close punctures along the granulose crenulate margins.

Intercoxal process of prosternum alutaceous with sparse granules, about as coarse as facets of eyes; hypomera more finely alutaceous, with granules broader and more distant. Metasternum with coarse punctures, broader than their interstices; cuticle alutaceous; median longitudinal impression distinctly abbreviated anteriorly. Abdomen finely alutaceous, with some superficial punctures on first segment.

Genitalia (Fig. 8) 335μ long; median lobe triangular (140μ) with a few very short hairs on apex; basal apophyses entering only a short distance into basal piece; parameres (140μ, on outer side) extending beyond apices of median lobe, with a few short spines on their distal half; basal piece 215μ.

Female: Externally similar to male.

Holotype: ♂, Liberia, Suakoko, 26 Feb. 1952 (Blickenstaff).

Paratypes: 17 specimens with same data as holtoype; 40 specimens from diverse dates between December 1951 and December 1952.

This species is related to *H. quadrinotata* Delève, especially by the form of the male genitalia. It may be distinguished from this species by its alutaceous spots on elytral intervals 4 and 5 and the lateral region also alutaceous, while on *quadrinotata* the spots are yellow, otherwise disposed and not at all alutaceous. On some specimens the two inner alutaceous spots are joined.

Helminthopsis (*Elmidoliana*) *zambezica* Delève

1965. Bull. Inst. roy. Sci. nat. Belg., 41(11):27.

Reported Distribution: This species was described from Northern Rhodesia (Zambezi Rapids) and was reported from Angola, Brazzaville Congo, and the Ivory Coast by Delève (1966b, 1967a, 1968).

Specimens Examined: 58 specimens from Suakoko on diverse dates between December 1951 and February 1952.

Pachyelmis bigibbulosa, new species

Male: Length, 1.4 mm. About 1 4/5 times as long as broad at greatest width; convex; acuminate and strongly declivous behind; glabrous. Cuticle reddish brown, pronotum darker, head black.

Head without impression, alutaceous with distant granules smaller than facets of eyes.

Pronotum about 1¼ times broader than long (0.63 mm:0.5 mm); broadest point at base; strongly narrowed at apex (0.38 mm). Lateral edges crenulate, granulose; sides regularly curved, deflexed toward the apical angles which are acute, invisible from above; basal angles almost rectangular. Disc regularly convex with a very shallow median longitudinal impression; very finely punctate, somewhat alutaceous, with very small distant granules, each of these granules being the center of a small areola; sublateral sulcus extending from base to near apex; area between sulcus and lateral margin a little raised and densely covered with large, somewhat elongated granules.

Elytra as broad as pronotum at base, nearly twice as long as pronotum, about 1⅙ times longer than broad at greatest combined width (0.9 mm:0.78 mm) which is slightly behind their midlength. On each, 8 rows of large rather deep punctures broader than intervals, with exception of 1st (sutural) which is broader and depressed on basal part along gibbosity of 2nd interval; this gibbosity located just behind base and about 0.16 mm long; 3rd interval with a row of slightly distinct granules, beginning slightly behind base and extending to midlength; 5th and 7th intervals also with a row of granules but extending to apex; row of granules of 8th interval starting from humeral gibbosity (as in seventh one) but shorter; sutural interval densely microscopically granulose, less shiny than the others.

Prosternal process finely granulose on anterior part, almost inconspicuously so posteriorly; hypomera covered with large, elongated granules. Metasternum alutaceous and granulose on disc; median longitudinal impression deep and broad posteriorly, obliterated anteriorly; adjacent to posterior margin of middle coxal cavity, an area of very large punctures; sides alutaceous. Abdomen alutaceous; 1st segment feebly granulose, with an area of large punctures along anterior margin; on each side, behind posterior coxa, granules rather regularly disposed in a row crossing first four segments; granules present also on lateral sides of the 4th segment and near lateral margins of 1st segment.

Genitalia (Fig. 7) 745μ long; median lobe (length 575μ) ending at apex in a rather short point; parameres long (510μ) narrow, slightly broadened at apices which bear very fine, rather long hairs; basal piece short (195μ).

Female: Externally similar to male.

Holotype: ♂, Liberia, Suakoko, 26 Feb. 1952, C. C. Blickenstaff.

Paratypes: More than 200 specimens, from the same locality, on diverse dates from December 1951 to March 1952.

Closely related to *P. madudana* Delève, from which it may be distinguished at once by the presence of small gibbosity on the base of the second interval of the elytra.

Helminthocharis schoutedeni Delève

1938. Rev. Zool. Bot. Afr., 31(3–4):372.

Reported Distribution: This species was described from Uele (Belgian Congo) and was reported from the Central African Republic by Delève (1970).

Specimens Examined: 14 specimens, Suakoko, on diverse dates between December 1951 and November 1952, (light trap).

This very minute species is rarely collected.

Pseudomacronychus scutellatus Delève

1965. Bull. Inst. roy. Sci. nat. Belg., 41(22):7.

Reported Distribution: This species was described from Kivu; the subspecies *circumcinctus* Delève (1968) was reported from the Ivory Coast.

Specimens Examined: 14 specimens, Suakoko, between December 1951 and May 1952.

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PROCEEDINGS
OF THE
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HEMICYCLOPS PERINSIGNIS, A NEW CYCLOPOID COPEPOD FROM A SPONGE IN MADAGASCAR

By Arthur G. Humes
Boston University Marine Program,
Marine Biological Laboratory,
Woods Hole, Massachusetts 02543

Eight species of the poecilostome genus *Hemicyclops* Boeck, 1873 (Clausidiidae) are known from Madagascar (Humes, Cressey, and Gooding, 1958; Humes, 1965). Four of these are associated with crustaceans (*Acanthosquilla*, *Axius*, and *Upogebia*), and four are known only from burrows of uncertain origin.

Only one species attributed to the genus, *Hemicyclops leggei* (Thompson and A. Scott, 1903) known only from a single male specimen from the Gulf of Manaar, Ceylon, has been reported from sponges. (The spelling of the specific name should be *leggei* and not *leggii* as used in the original description, since it is derived from the proper name Legge.)

The copepods were collected in 1967 during field work supported by a grant (GB-5838) from the National Science Foundation, and their study has been aided by another grant (GB-8381X) from the same foundation.

I am greatly indebted to Dr. Willard D. Hartman, Peabody Museum of Natural History, Yale University, for the generic name of the host sponge.

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. The abbreviations used are: P = paragnath, MXPD = maxilliped, and $P_1 - P_4$ = legs 1–4. Measurements other than the dimensions of the entire body were made on dissected specimens comprising two females and one male.

Hemicyclops perinsignis, new species
Figures 1–27

Type-material: 10 ♀♀, 5 ♂♂, and 1 copepodid from an orange-red sponge, *Agelas* sp., in 23 m, Tany Kely, a small island south of Nosy Bé, northwestern Madagascar, 30 July 1967. Holotype ♀, allotype, and 10 paratypes (7 ♀♀, 3 ♂♂) deposited in the National Museum of Natural History (USNM), Washington; the remaining paratypes in the collection of the author.

Other specimens: 4 ♀♀, 4 ♂♂ from *Agelas* sp., in the type-locality, 30 June 1967.

Female: The body (Fig. 1) has a broad flattened prosome. The length (not including the setae on the caudal rami) is 1.66 mm (1.44–1.92 mm) and the greatest width is 0.78 mm (0.70–0.86 mm), based on 10 specimens in lactic acid. The epimeral areas of the segments bearing legs 2–4 flare outwardly. The ratio of the length to the width of the prosome is 1.25:1. The ratio of the length of the prosome to that of the urosome is 1.38:1.

The segment of leg 5 (Fig. 2) is 121 × 297 μ. Between this segment and the genital segment there is no ventral intersegmental sclerite. The genital segment is elongated, 253 × 231 μ, in dorsal view moderately expanded in its anterior half. The genital areas are located laterally on the expanded portion. Each area (Fig. 3) bears two minute spiniform elements. The three postgenital segments from anterior to posterior are 126 × 150 μ, 77 × 132 μ, and 77 × 124 μ. The membranes between these segments are finely striated. The posterior dorsal border of the second postgenital segment bears extremely small spinules. The posteroventral margin of the anal segment has a row of minute spinules on each side.

The caudal ramus (Fig. 4) is 100 × 58 μ, the ratio of length to width being 1.72:1. The outer lateral seta is 73 μ long, the dorsal seta 100 μ, and the outermost terminal seta 88 μ, all three naked. The innermost terminal seta is 180 μ with prominent lateral spinules especially along the inner side. The two long median terminal setae are 385 μ (outer) and 580 μ (inner), both inserted between dorsal (smooth) and ventral (with minute spinules) flanges, and both with lateral spinules along

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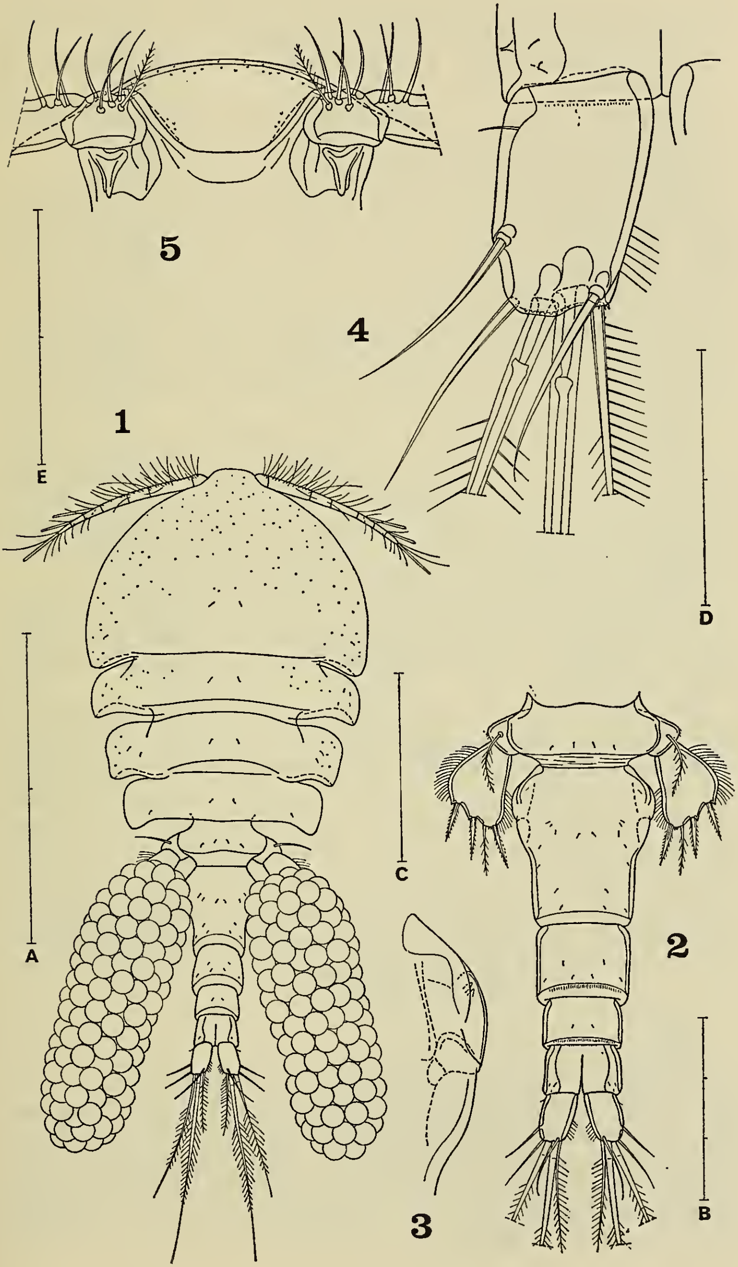
FIGS. 1–5. *Hemicyclops perinsignis*, new species, female: 1, dorsal (A); 2, urosome, dorsal (B); 3, genital area, dorsal (C); 4, caudal ramus, dorsal (D); 5, rostrum, ventral (E). Scale A = 1.0 mm, B = 0.3 mm, C = 0.1 mm, D = 0.1 mm, E = 0.2 mm.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their midregions. The outer margin of the ramus bears a proximal setule and the inner margin has distally a row of hairs.

The body surface (Figs. 1 and 2) bears small hairs (sensilla) and refractile points.

The egg sac (Fig. 1) is elongated, 968 × 300 μ, reaches well beyond the caudal rami, and contains many eggs 65–73 μ in diameter.

The rostrum (Fig. 5) has a broad posteroventral margin.

The first antenna (Fig. 6) is 440 μ long and slender. The lengths of the seven segments (measured along their posterior nonsetiferous margins) are 17, (55 μ along the anterior margin), 112, 62, 78, 47, 46, and 42 μ respectively. The formula for the armature is 5, 15, 7, 4, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All the setae are naked except the proximalmost seta on the first segment which is weakly plumose. The proximalmost seta on the third segment is directed proximally. In one female an extra small hyaline seta was seen on the first segment of the right first antenna (Fig. 7).

The second antenna (Fig. 8) is four segmented, with the armature 1, 1, 3 + I, and 7. On the third segment (52 × 37 μ in greatest dimensions) the spine is clawlike distally and the outermost seta is often curved proximally (Fig. 9). The fourth segment is 52 × 29 μ in greatest dimensions (its length equal to that of the third segment) and bears three slender setae and four stout prehensile setae.

The labrum (Fig. 10) has six long setules, two median transverse rows of long spines, and two lateral groups of smaller spines. The postoral area has a complex ornamentation of small setules and spines (Fig. 10).

The mandible (Fig. 11) has terminally two stout elements and two setae (Fig. 12). The paragnath (Fig. 13) is a small lobe with an area of slender spinules apically and numerous hairs. The first maxilla (Fig. 14) has a small lobelike process on its anterior surface and bears terminally eight setae in two groups of 5 and 3 respectively. The second maxilla (Fig. 15) has three setae on the first segment, one of them short and slender. The second segment bears three setae and terminates in a slender prolongation having four unequal distal spiniform processes. The maxilliped (Fig. 16) has two setae on the first segment, two on the second segment, and one (naked) on the small third segment. The

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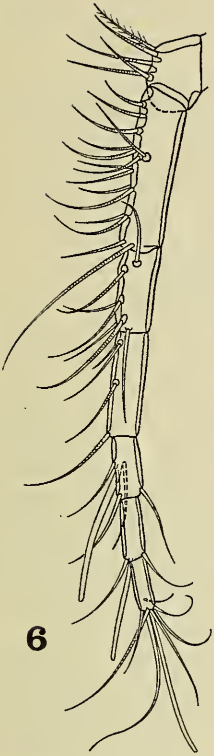
FIGS. 6–13. *Hemicyclops perinsignis*, new species, female: 6, first antenna, anterodorsal (E); 7, first segment of right first antenna, posteroventral (C); 8, second antenna, anterior (C); 9, third and fourth segments of second antenna, posterior (C); 10, labrum and postoral area, ventral (C); 11, mandible, anterior (D); 12, tip of mandible, posterior (F); 13, paragnath, ventral (D). Scale C = 0.1 mm, D = 0.1 mm, E = 0.2 mm, F = 0.05 mm.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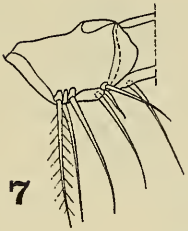
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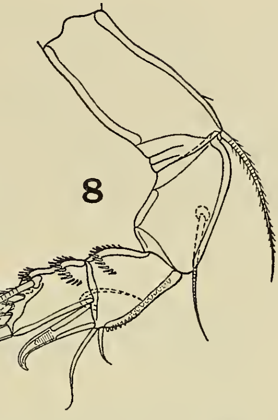
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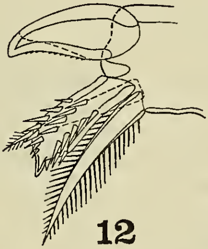
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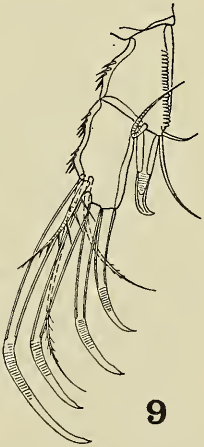
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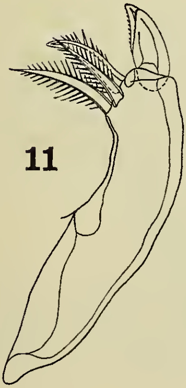
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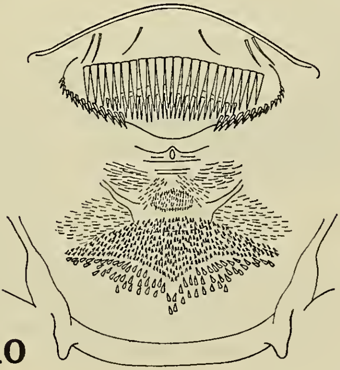
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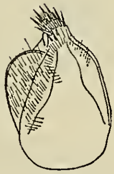
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fourth segment has four elements, two prominent barbed spinelike setae and two small naked setae. The second segment bears a distal row of slender spinules on its anterior surface.

The ventral area between the maxillipeds and the first pair of legs (Fig. 17) is not protuberant. A sclerotized bar extends between the bases of the maxillipeds.

The armature of legs 1–4 is as follows (the Roman numerals representing spines, the Arabic numerals setae):

P_1	coxa	0–1	basis	1–I	exp	I–0;	I–1;	I, I, 6
					enp	0–1;	0–1;	I, 5
$P_2 + P_3$	coxa	0–1	basis	1–0	exp	I–0;	I–1;	II, I, 6
					enp	0–1;	0–2;	I, II, 3
P_4	coxa	0–1	basis	1–0	exp	I–0;	I–1;	II, I, 6
					enp	0–1;	0–2;	I, II, 2

Leg 1 (Fig. 18) bears on its basis an inner spine 23 μ, this spine being absent in legs 2–4. The inner margin of the basis is smooth, but in legs 2–4 bears a few hairs. All outer spines on the exopod have subterminal flagella, while in legs 2–4 only the distalmost of these spines is so flagellated. The intercoxal plate has slender setules along its ventral margin, but in legs 2–4 this plate has spines (Fig. 17). Leg 2 (Fig. 19) and leg 3 are alike in all major respects. Leg 4 (Fig. 20) lacks the hairs on the outer coxal surface seen in legs 1–3 and has one less seta on the third endopod segment than in leg 3.

Leg 5 (Fig. 21) has a short broad free segment 130 × 87 μ in greatest dimensions or 1.5 times longer than wide. The three barbed spines are 73, 62, and 73 μ from outer to inner and the plumose seta is 81 μ. The seta on the body near the free segment is 86 μ. Both outer and inner margins of the free segment have a row of slender spinules.

Leg 6 is probably represented by the two minute spiniform elements on the genital area.

Living specimens in transmitted light were very pale tan, the eye red, the eggs sacs brown.

Male: The body (Fig. 22) is a little less broadened than in the female. The length (without the ramal setae) is 1.26 mm (1.12–1.41 mm) and the greatest width is 0.58 mm (0.49–0.63 mm), based on 5 specimens in lactic acid. The ratio of the length to the width of the prosome is 1.29:1. The ratio of the length of the prosome to that of the urosome is 1.33:1.

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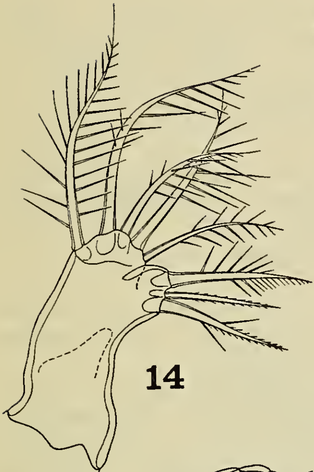
Figs. 14–18. *Hemicyclops perinsignis*, new species, female: 14, first maxilla, posterior (D); 15, second maxilla, posterior (C); 16, maxilliped, posterior (C); 17, median area from level of maxillipeds to leg 4, ventral (G); 18, leg 1 and intercoxal plate, anterior (E). Scale C = 0.1 mm, D = 0.1 mm, E = 0.2 mm, G = 0.2 mm.



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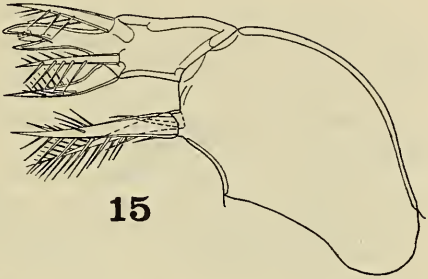

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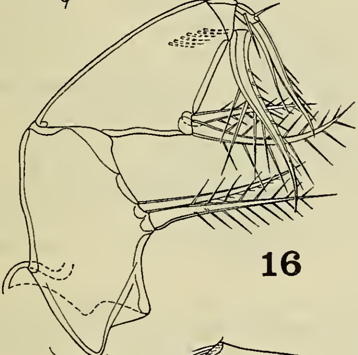

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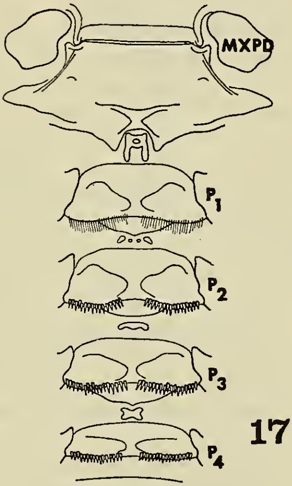

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The segment of leg 5 (Fig. 23) is 100 × 250 μ. There is no ventral intersegmental sclerite. The genital segment is wider than long, 138 × 213 μ. The four postgenital segments from anterior to posterior are 107 × 153 μ, 104 × 135 μ, 62 × 112 μ, and 60 × 101 μ.

The caudal ramus resembles that of the female but is smaller, 73 × 46 μ, with a ratio of 1.59:1.

The body surface bears hairs and refractile points as in the female. The refractile points are especially numerous on the ventral surface of the first, second, and fourth postgenital segments.

The rostrum, first antenna, and second antenna are like those in the female.

The labrum (Fig. 24) has fewer and much shorter median spines than in the opposite sex. The postoral area (Fig. 24) has a somewhat different ornamentation than in the female.

The mandible, paragnath, and first maxilla resemble those of the female. The second maxilla (Fig. 25) shows sexual dimorphism, the prolongation of the second segment here being stout, almost clawlike, and with an entire tip. The maxilliped (Fig. 26) has one seta on the first segment and two setae and three rows of spines on the second segment. The very small third segment is unarmed. The claw is 148 μ along its axis and bears proximally a setiform process closely appressed to the concave surface of the claw and two very unequal setae.

Legs 1–4 are like those in the female.

Leg 5 resembles that of the female but is smaller, 104 × 78 μ.

Leg 6 (Fig. 27) consists of a posteroventral flap on the genital segment bearing a single barbed seta 45 μ.

The spermatophore was seen only within the body of the male (Fig. 23).

Living specimens were of a color similar to that of females.

Etymology: The specific name *perinsignis*, Latin = very remarkable, alludes to the unusual combination in this species of five setae on the first segment of the first antenna and five segments in the female urosome.

Comparison with other species in the genus: For the purpose of the differentiation of *Hemicyclops perinsignis* from other species in the genus, I have adopted the list of 23 sufficiently known species in the work of Vervoort and Ramirez (1966). Several forms which are insufficiently described or based on juvenile specimens are not considered here.

Hemicyclops perinsignis may be readily separated from those species

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Figs. 19–21. *Hemicyclops perinsignis*, new species, female: 19, leg 2 and intercoxal plate, anterior (E); 20, leg 4 and intercoxal plate, anterior (E); 21, leg 5, dorsal (E). Scale E = 0.2 mm.

Fig. 22. *Hemicyclops perinsignis*, new species, male: 22, dorsal (A). Scale A = 1.0 mm.

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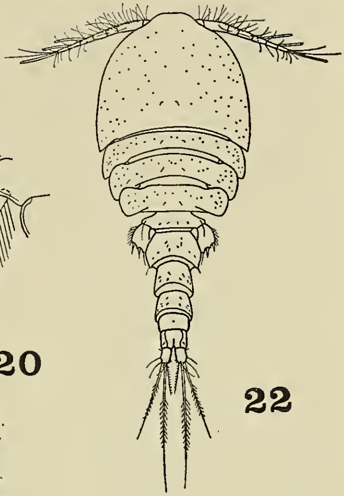

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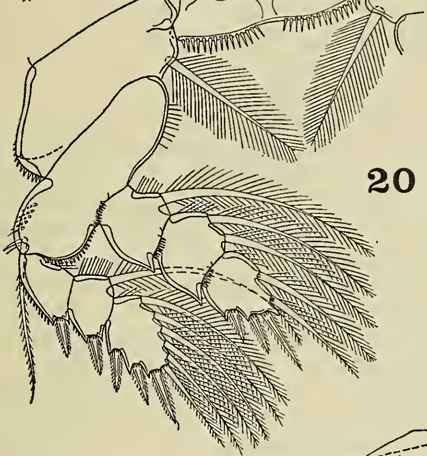

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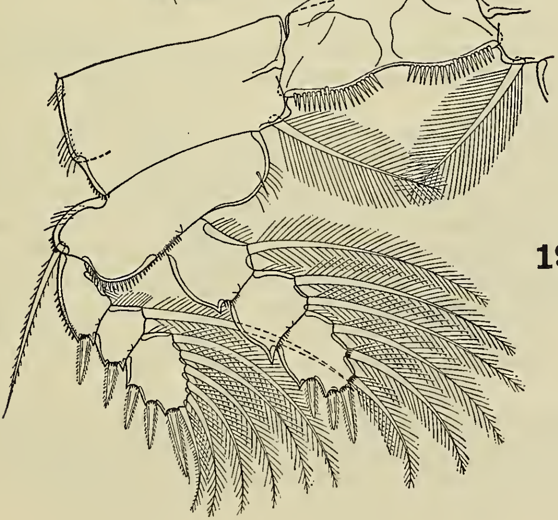

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of *Hemicyclops* which have only four setae on the first segment of the first antenna, and where the fourth segment of the second antenna is distinctly shorter than the third segment [*H. aberdonensis* (T. and A. Scott, 1892), *H. acanthosquillae* Humes, 1965, *H. amplicaudatus* Humes, 1965, *H. axiophilus* Humes, 1965, *H. bacescui* Şerban, 1956, *H. biflagellatus* Humes, 1965, *H. diremptus* Humes, 1965, *H. intermedius* Ummerkutty, 1962, *H. kombensis* Humes, 1965, *H. purpureus* Boeck, 1873, *H. thalassius* Vervoort and Ramirez, 1966, *H. thysanotus* C. B. Wilson, 1935, and *H. visendus* Humes, Cressey, and Gooding, 1958].

The new species may be further distinguished from those species in which there are six urosomal segments in the female, where the fourth segment of the second antenna is longer than the third segment, and where the tip of the mandible has only three elements [*H. adhaerens* (Williams, 1907), *H. arenicolae* Gooding, 1960, *H. carinifer* Humes, 1965, and *H. subadhaerens* Gooding, 1960].

The remaining species are mostly imperfectly described, but they may be distinguished from the new species in the following characters: *H. australis* Nicholls, 1944, and *H. leggei* (Thompson and A. Scott, 1903) have two setae on the first segment of the male maxilliped; *H. cylindraceus* (Pelseneer, 1929) has six urosomal segments in the female and only two elements on the tip of the mandible; *H. elongatus* C. B. Wilson, 1937, and *H. tamilensis* (Thompson and A. Scott, 1903), both poorly known, have six urosomal segments in the female; and *H. livingstoni* (T. Scott, 1894) has short robust segments in the first antenna and the third segment of the second antenna has two stout curved spines.

The single adult male *Hemicyclops* sp. described by Pillai (1963) is much longer (2.3 mm) than the new species, the caudal ramus is nearly 3:1, the fourth segment of the first antenna is the longest, and the free segment of leg 5 is more slender.

The two new species and the new combination mentioned by Gooding (1963, unpublished thesis) differ clearly in important ways from *H. perinsignis.*

Several distinctive characters of the new species which may be used in combination to differentiate it from other species within the genus are: the five-segmented female urosome, five setae on the first segment of the first antenna, the fourth segment of the second antenna about as long as the third segment, four terminal elements on the mandible, sexual dimorphism in the second maxilla of the male, and one seta on the first segment of the male maxilliped.

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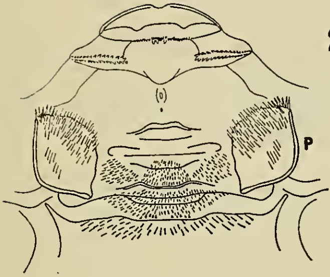
FIGS. 23–27. *Hemicyclops perinsignis*, new species, male: 23, urosome, dorsal (G); 24, labrum, paragnaths, and postoral area, ventral (C); 25, second maxilla, anterior (C); 26, maxilliped, anterior (D); 27, leg 6, ventral (C). Scale C = 0.1 mm, D = 0.1 mm, G = 0.2 mm.



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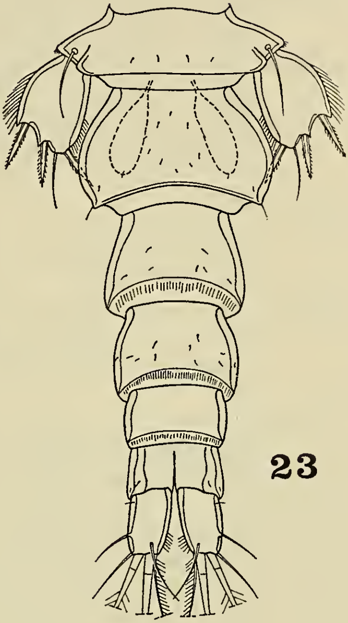

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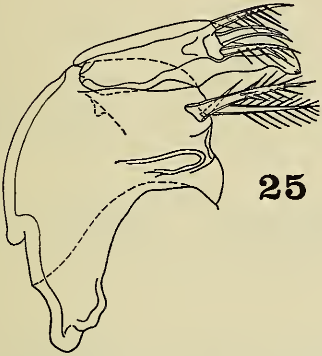

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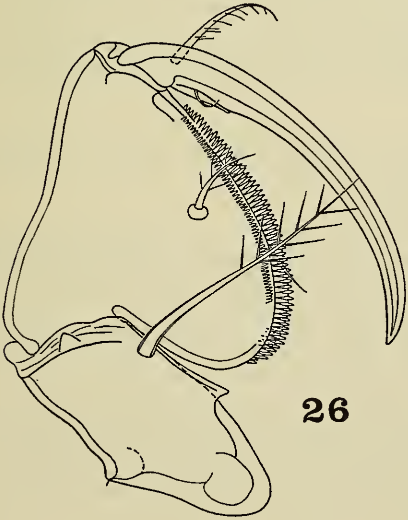

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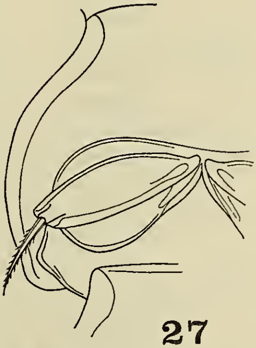

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PROCEEDINGS
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A NEW SPECIES OF *DAMALINIA* (MALLOPHAGA: TRICHODECTIDAE) FROM THE FORMOSAN SIKA DEER (*CERVUS NIPPON TAIOUANUS*)

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

Recently the authors acquired a small series of Mallophaga collected off the Formosan Sika Deer which represents an undescribed species. This new species is herewith described and illustrated.

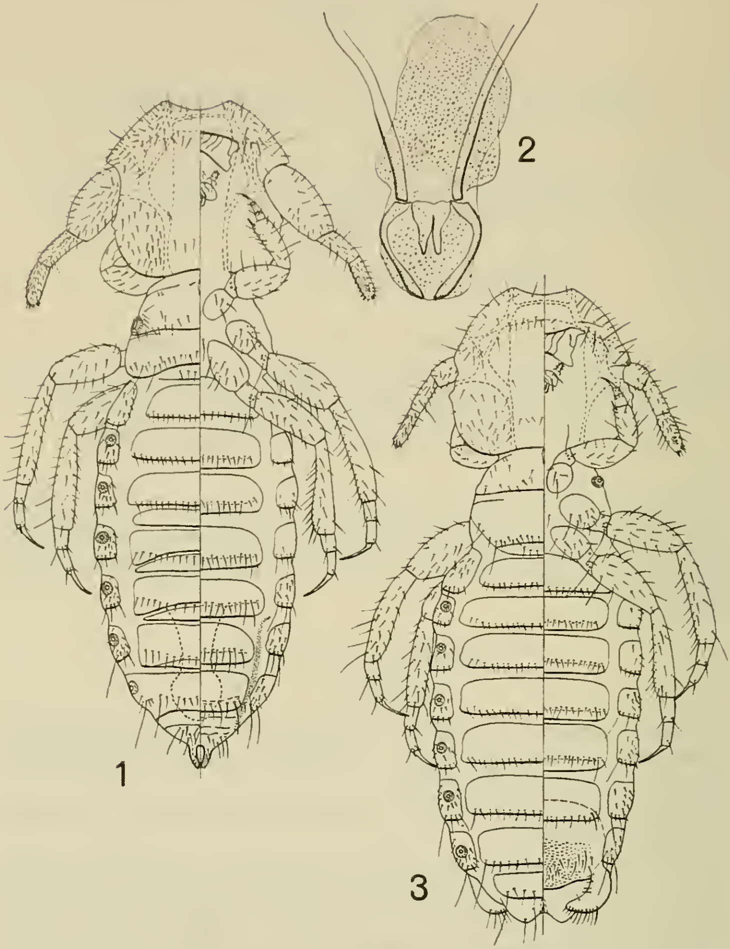
Damalinia maai new species
Figures 1–3

Holotype male: Total length, 2.16 mm. External morphology and chaetotaxy as shown in Figure 1. Genitalia as shown in Figure 2; genital sac large and prominent.

Allotype: Total length, 2.09 mm. External morphology and chaetotaxy as shown in Figure 3.

Discussion: *Damalinia maai* is closely related to *D. forficula* (Piaget, 1880). It is readily separated from *D. forficula* by the much longer legs in both sexes; in *D. forficula* the posterior pair, when a normal position, extends to the third apparent abdominal segment; in *D. maai* they extend to the sixth apparent abdominal segment. The posterior protuberances of the terminal abdominal segment of the male are each parallel sided, not triangular, in *D. maai.* The parameres of *D. forficula* are pointed at the distal ends, and enlarged in *D. maai.* The gonopods of the female terminalia are broad in *D. maai* and not bent forward at the tip as in *D. forficula.* The forehead (preantennal region) is short and broadly rounded in both sexes of *D. maai* and much longer and triangular shaped in *D. forficula. D. maai* is also larger in both sexes than *D. forficula.*

Damalinia meyeri (Taschenberg, 1882) is the only previously known species with legs longer than normal. The legs of *D. meyeri* are



FIGS. 1–3. *Damalinia maai* new species. 1, dorsal-ventral view of male. 2, male genitalia. 3, dorsal-ventral view of female.

approximately 30% longer than those of *D. forficula*; but are shorter than in *D. maai*, reaching only to the fourth apparent abdominal segment.

Type-host: *Cervus nippon taiouanus* (Blyth, 1860).

Type-material: Holotype male, allotype, and two paratypes collected off the type-host at Chia-I, Formosa on 16 March 1961. The holotype and allotype will be deposited in the National Museum of Natural History, Smithsonian Institution.

We have selected the specific name *maai* to honor our colleague, Dr. T. C. Maa, who has made many collections of Mallophaga on Formosa, and who has made significant contributions to our knowledge of the Pupipara.

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PROCEEDINGS
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A NEW SPECIES OF *SESARMA*, S. (*HOLOMETOPUS*) *RUBINOFFORUM*, FROM THE PACIFIC COAST OF PANAMÁ (CRUSTACEA, DECAPODA, GRAPSIDAE)

By Lawrence G. Abele
Smithsonian Tropical Research Institute, P. O.
Box 2072, Balboa, Canal Zone

This species of *Sesarma* was collected during a survey of the decapod crustacean fauna of Panamá. It was referred to by Abele (1972:132) as an undescribed species of *Sesarma* and is now described below.

The abbreviation *cb* refers to carapace breadth measured at midline; *cl* to carapace length measured at midline; AHF to the Allan Hancock Foundation, Los Angeles, California; RMNH to the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; UPRC to the University of Panama Reference Collection, Panama City, Republic of Panamá; USNM to the National Museum of Natural History, Washington, D. C.

Sesarma (Holometopus) rubinofforum, new species

Figures 1–3

Material: Panamá, Pacific coast, Canal Zone, Diablo Heights, mangrove swamp on east bank of Panama Canal; 18 February 1969; L. G. Abele, LGA 69-30; 1 male paratype, *cb* 6.7 mm, UPRC; 1 ovigerous female paratype, *cb* 8.4 mm (illustrated, Fig. 1), USNM. Panamá, locality data as above; salinity 22.4%; temperature 27.9° C; 25 January 1971; L. G. Abele, T. A. Biffar, LGA 71-5; male holotype, *cb* 8.8 mm, 5 male paratypes, *cb* 3.3–10.4 mm, 4 female paratypes, *cb* 6.0–8.8 mm, USNM; 1 male, *cb* 8.0 mm, 1 female, *cb* 7.8 mm (paratypes), RMNH; 1 male, *cb* 6.8 mm, 1 female, *cb* 7.0 mm (paratypes), AHF.

Description: The carapace is wider than long, the width being about 1.16 (1.11–1.23) times the length. The frontal region does

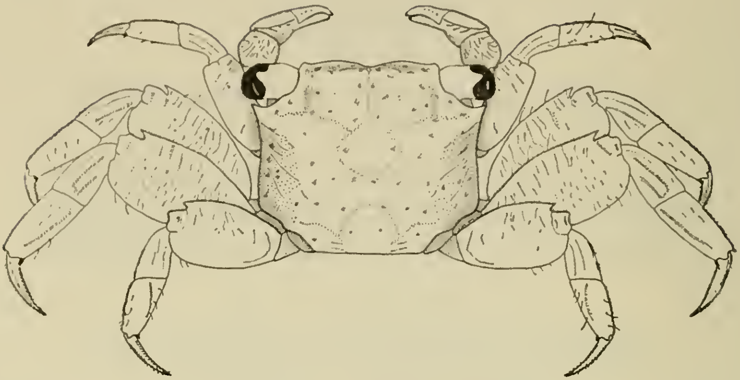

FIG. 1. *Sesarma rubinofforum*, new species. Ovigerous female paratype. cb 8.4 mm. USNM.

not widen distally and is about 0.60 of the carapace width. The frontal margin is sinuous with a broad median depression. The interorbital region is divided into four distinct lobes; the lateral (outer) lobes are indistinctly subdivided into two lobes by two patches of pubescence. The regions of the carapace are distinct. The dorsal and lateral surfaces of the carapace have many patches of short, brown pubescence. The outer orbital angle is acute; there is no tooth or lobe posterior to it. There are about four granular ridges on the lateral surfaces of the carapace. The carapace narrows posteriorly.

The cornea is rounded and well pigmented. The width of the cornea is about two-thirds of the length of the eyestalk and cornea combined.

The merus of the chelipeds has the margins distinctly serrate; a subdistal lobe is present on the lateral margin. There are many subacute granules along the border of the carpus and on its dorsal surface; there is no tooth or lobe at the medial angle. There is a strong granulate ridge extending the length of the dorsal surface of the palm; it is weakly bifurcate proximally. Other poorly defined rows of granules arise from this ridge and extend onto the medial surface of the palm. The lateral surface of the palm is smooth except for a few scattered granules. The movable finger is slightly longer than the palm; there are about seven strong, acute tubercles along the dorsal surface of the finger, of which the median ones are the strongest.

The walking legs are robust with the third (fourth periopod) being the longest. The length of the merus of the third is about 1.9 times the width; the superior borders have minute widely spaced teeth and a strong, acute subdistal tooth; the inferior border is smooth. There are short horizontal rows of granules present on the meri of the walking legs. The carpus has some scattered setae present on the dorsal sur-

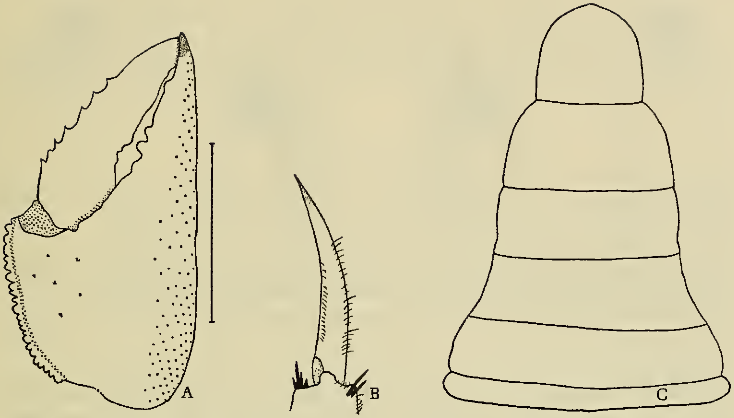

FIG. 2. *Sesarma rubinofforum*, new species. A, lateral view of chela of male holotype. B, dactylus of walking leg, male holotype. C, abdomen of male paratype. Scale = 2 mm.

face. There is light pubescence on the dorsal surface of the propodus and less on the ventral surface; there are three pairs of strong, black spines on the distal inferior margin. The dactylus has three dorsal and two ventral poorly defined rows of pubescence. The merus is slightly less than twice the length of the carpus which is subequal in length to the propodus. The dactylus is slightly shorter than both the propodus and carpus.

The male abdomen is subtriangular in shape narrowing distally from the third segment. The telson is broadly rounded; the length and width are subequal. The female abdomen is subcircular in outline.

The male gonopod is simple and unarmed. The endpiece (amber-colored apex) is rectangular, directed laterally and covered with simple setae.

Variation: Females have less pubescence on the carapace than males; the female chelae are not as robust as those of males, the tuberculation is weaker and there are three or four rather than seven or eight tubercles on the dorsal surface of the movable finger.

Measurements: Immature males have a *cb* of about 3.3 mm; immature females, *cb* 6.0 to 6.3 mm; mature males, *cb* 6.2 to 10.4 mm; mature females, *cb* 7.0 to 8.4 mm; ovigerous females, *cb* 8.8 to 9.0 mm; eggs small and numerous, diameter 0.3–0.5 mm.

Type-locality: Pacific coast of Panamá on the east bank of the Panama Canal in a mangrove swamp near Diablo Heights, Canal Zone.

Distribution: Known only from the type-locality.

Habitat: The specimens were collected from damp areas beneath litter deep inside a mangrove swamp composed primarily of *Rhizophora*

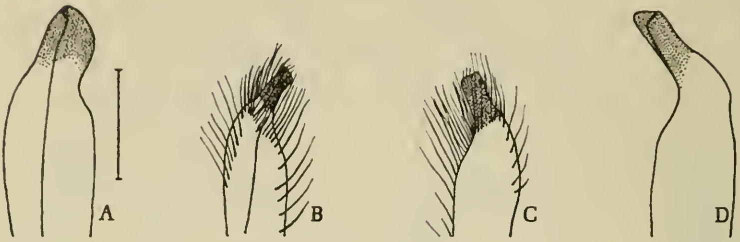

FIG. 3. *Sesarma rubinofforum*, new species. Apex of male gonopods. A, D lateral and mesial views of male holotype without setae. B, C lateral and mesial views of male paratype with setae. Scale = 0.5 mm.

mangle L. Salinity in the swamp varies from 16 to 24‰. Air temperature varies from about 27° to 29° C. This locality has been much modified during the last year by clearing and only a small stand of mangroves remain. Twenty species of decapods were collected before clearing, including *Sesarma rhizophorae* Rathbun and *S. sulcatum* Smith.

Remarks: *Sesarma* (*Holometopus*) *rubinofforum* appears to be the Pacific analogue of *S. rectum* Randall, 1840. It can be distinguished from *S. rectum* by the following characters: there is a slight emargination posterior to the outer orbital angle in *S. rectum* which is lacking in *S. rubinofforum*; the carpus of the cheliped of *S. rectum* is armed with a sharp tooth at the medial angle while that of *S. rubinofforum* is rounded; the movable finger of the chela of *S. rectum* is armed with 14–16 acute tubercles while that of *S. rubinofforum* is armed with 3–8; the endpiece of the gonopod of *S. rectum* is somewhat flared while that of *S. rubinofforum* is not flared; adults of *S. rectum* are from *cb* 13–44 mm while adults of *S. rubinofforum* range from *cb* 6–10 mm.

Discussion: White (1847:38) in his list of the Crustacea in the British Museum listed "*Sesarma subintegra*, n. s." based on material from Brazil. No description or reference to a figure or description accompanied the use of the name and it is therefore a nomen nudum. However, no reference to this name is made in works on American Sesarminae (Rathbun, 1897, 1918) and its true identity appears never to have been established. Through the kindness of Dr. R. W. Ingle, British Museum (Natural History), I was able to examine one of the two extant syntypes. The specimen is a dried male (*cb* 37.3, *cl* 32.0 mm) in poor condition but there is little doubt that it belongs to the species known today as *Sesarma rectum* Randall, 1840, of which *Sesarma mulleri* A. Milne Edwards, 1869, is also a synonym.

Etymology: The specific name is for Ira and Roberta Rubinoff, of the Smithsonian Tropical Research Institute, who have, in many ways, aided efforts toward an understanding of the biota of Panamá.

Acknowledgments: I thank Dr. Thomas A. Biffar, Old Dominion University, for his company and assistance in the field and Dr. R. W. Ingle, British Museum (Natural History), for allowing me to examine material of *Sesarma subintegra.*

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VIVIPAROUS OPHIDIOID FISH GENUS *CALAMOPTERYX*: NEW SPECIES FROM WESTERN ATLANTIC AND GALAPAGOS

By Daniel M. Cohen
Systematics Laboratory, National Marine Fisheries Service, NOAA, Washington, D. C.

Since the appearance of the original description of *Calamopteryx goslinei* as a new genus and species (Böhlke and Cohen, 1966), additional material of *C. goslinei* and of two unnamed species has come to hand. In this paper I present revised and supplementary diagnostic and descriptive data for the genus, original descriptions for the two heretofore unknown species, and additional descriptive and distributional data for *C. goslinei.*

Calamopteryx Böhlke and Cohen

The following characters in the original generic diagnosis require comment. The description of the male intromittent organ was based on immature specimens; in adults it consists of a variously developed fleshy postanal pad (Figure 1), and the penis, enclosed by an elongate hood which is continuous at its base on each side with a compressed lappet (clasper ?). Caudal fin rays eight or 10 rather than always 10. Dermal papillae not always prominent, weak and sparsely distributed in one of the new species. Developed gill rakers two or three rather than always two.

Other characters common to the three species include the following. Hypurals two. Abdominal vertebrae 10 or 11. Parietals separated by supraoccipital. Lower angle of preopercle with a curved, anteriorly-directed spine. Pseudobranch absent. Teeth not all tiny and granular, some enlarged. No median basibranchial tooth patch; paired tooth patches at the base of gill arches three and five. Head squamation incomplete. Pyloric caecae two.

C. goslinei was found to be unique among 12 species of viviparous ophidioids examined in having spermatozoa free rather than contained

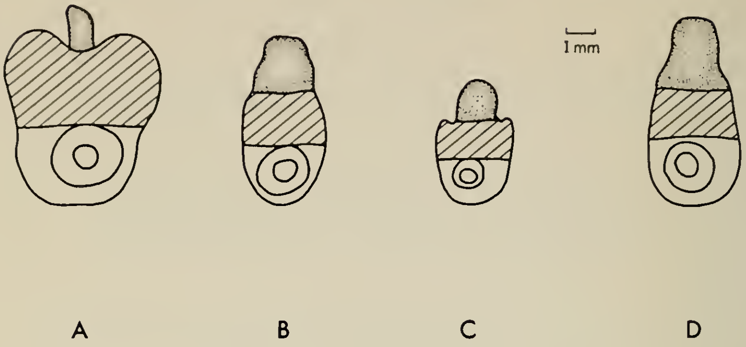

FIG. 1. Ventral view (anterior to the bottom) of genital area of ♂ in three species of *Calamopteryx*. A, *jeb*, FMNH 71604, 55.4 mm SL; B, *goslinei*, USNM 198218, 38.2 mm SL; C, *goslinei*, ANSP 120409, 78.6 mm SL; D, *robinsorum*, UMML 22293, 36.2 mm SL. Stippled region at top is hood enclosing penis, hatched area is fleshy pad, circle is vent. Penis and claspers not shown.

TABLE 1.—Selected characteristics of three species of *Calamopteryx*.

	goslinei	*robinsorum*	*jeb*
Caudal fin rays	10	8	10
Anal fin rays[1]	51–57	40–49	46–50
Relative eye size[2]	intermediate 6.1–7.6 in hl	large 5.2–7.5 in hl	small 7.5–10.9 in hl
Relative pre-anal length[3]	short 1.8–2.0 in SL	long 1.6–1.7 in SL	short 1.7–2.0 in SL
Papillae on head	prominent	weak and sparse	prominent[4]
Genital pad of ♂[5]	little broader than hood over penis, lobes small or lacking	as in *goslinei*	much broader than hood over penis, with prominent lobes
Distribution	tropical western Atlantic	tropical western Atlantic	Galapagos
Depth	6 m or less to 55 m	64 to 210 m or more	to 25 m

[1] See Table 2.
[2] See Figure 2 and Table 3.
[3] See Figure 3 and Table 4.
[4] See Figure 6.
[5] See Figure 1.

TABLE 2.—Counts in three species of *Calamopteryx.*

Anal fin rays

	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
goslinei												2	16	4	3	6	–	1
robinsorum	2	1	1	1*	2	1	1	2	2	1								
jeb							2	3	10	13*	4							

Dorsal fin rays

	58	59	60	61	62	63	64	65	66	67	68	69	70
goslinei						1	1	3	2	6	9	11	7
robinsorum	2	–	–	2*	1	2	1	–	1	1	1		
jeb								2	2	10*	6	6	1

Pectoral fin rays

	13	14	15	16	17	18	19
goslinei	7	20	7	–	1		
robinsorum		3*	4	4	4	–	1
jeb			2	11*	21	2	1

Vertebrae

	37	38	39	40	41	42	43	44	45	46
goslinei		1	–	–	4	6	9	4	–	1
robinsorum	3	3*	5	1	2	1				
jeb				3	14*	14	4			

* Holotype.

in spermatophores (Nielsen et al., 1968). Both of the species described as new in this paper have spermatophores (Nielsen, in litt.).

Species: The three species of *Calamopteryx* may be distinguished by means of the characters contrasted in Tables 1, 2, 3 and 4 and Figures 1, 2 and 3.

Distribution and habitat: The genus is apparently restricted to the New World tropics. *C. jeb* thus far has been caught only at the Galapagos Islands, where it has been taken with rotenone from rocky areas at depths to 25 m. Although extensive collecting of appropriate habitats along tropical Pacific shores of Central America has failed to reveal *jeb* (W. Bussing, R. Rosenblatt, personal communications) it eventually may be found there, as was true of *Oligopus diagrammus* and *Petrotyx hopkinsi*, two other species of shallow-water ophidioids originally described from the Galapagos and with congeneric relatives in the Caribbean.

C. goslinei and *robinsorum* are both tropical western North Atlantic species (see Figure 4); however, they live at different depths. *C.*

Table 3.—Frequency diagram of HL/Eye ratio in three species of *Calamopteryx*.

	robinsorum	*goslinei*	*jeb*
5.2	1		
5.4	1		
5.6	–		
5.8	–		
6.0	4	3	
6.2	–	2	
6.4	2	4	
6.6	1	5	
6.8	2	2	
7.0	1	3	
7.2	1	2	
7.4	1	2	2
7.6		1	2
7.8			6
8.0			3
8.2			6
8.4			3
8.6			3
8.8			1
9.0			–
9.2			3
9.4			1
9.6			1
9.8			1
10.0			–
10.2			–
10.4			1
10.6			–
10.8			1

robinsorum is a deeper living species and has been trawled from known depths ranging between about 64 and 210 meters. *C. goslinei* has been taken only with rotenone from reef areas, at depths ranging from 6 m or less to 55 meters.

Species relationships: The three species of *Calamopteryx* vary in a mosaic of characters summarized in Table 1. I believe that the resemblances of parts of the male copulatory apparatus in the two western Atlantic species (see Figure 1) is fundamental, and outweighs the several similarities shared by the ecological analogues *goslinei* and *jeb*, which may have been independently selected for.

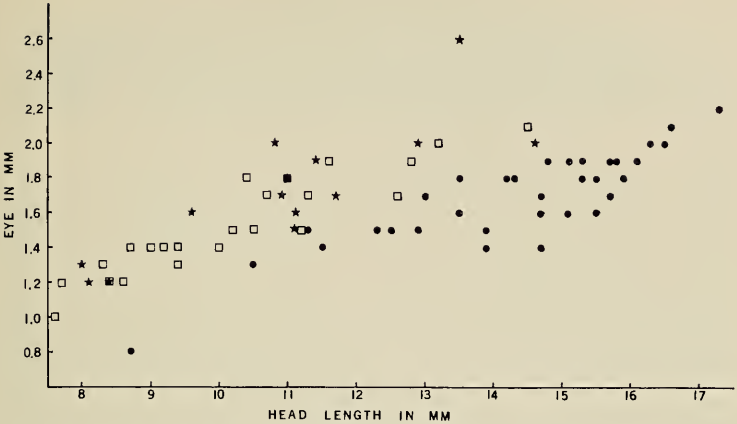

FIG. 2. Relationship of eye diameter to head length in three species of *Calamopteryx.* Star = *robinsorum*; square = *goslinei*; circle = *jeb.*

Calamopteryx jeb, new species

Figures 5, 6

Description: Counts are given in Table 2. Measurements in percent of SL for 20 to 25 specimens ranging in SL from 30.3 to 54.8 mm. Mean first, followed by range in parentheses: greatest body depth 20.0 (18.6–21.8); predorsal length 37.0 (35.0–38.5); preventral length 23.6 (22.2–28.1); preanal length 55.0 (51.1–58.5); head length 28.8 (27.6–30.4); eye diameter 3.3 (2.6–3.9); snout length 5.7 (5.2–6.3); pigmented interorbital 4.2 (3.6–5.1); upper jaw length 14.1 (13.2–15.3); ventral fin length 15.2 (10.8–18.5); pectoral fin + pectoral peduncle length 21.9 (20.2–23.5); pectoral fin length only 17.0 (14.5–19.3); least width pectoral peduncle 5.0 (4.3–5.5); ventral fin base to symphysis of cleithra 4.5 (3.6–5.3).

Body relatively short and stubby, most specimens lacking the pronounced nuchal rise common in *C. goslinei.*

TABLE 4.—Frequency diagram of SL/Pre-anal ratio in three species of *Calamopteryx.*

	1.6	*1.7*	*1.8*	*1.9*	*2.0*
robinsorum	1	9	–	–	–
jeb	–	4	13	6	1
goslinei	–	–	7	12	6

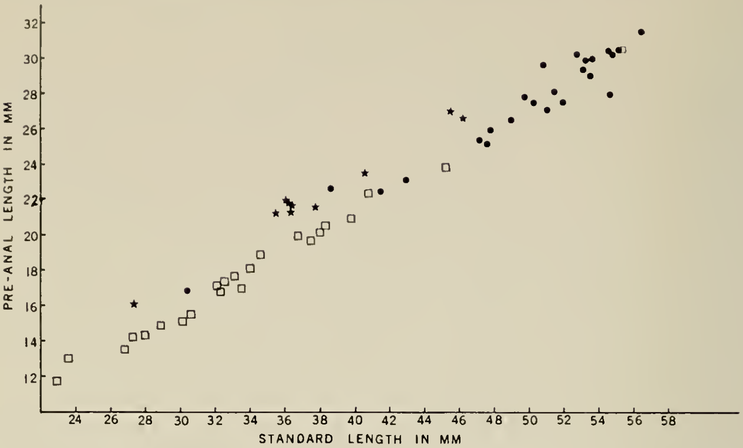

FIG. 3. Relationship of preanal length to standard length in three species of *Calamopteryx*. Star = *robinsorum*; square = *goslinei*; circle = *jeb.*

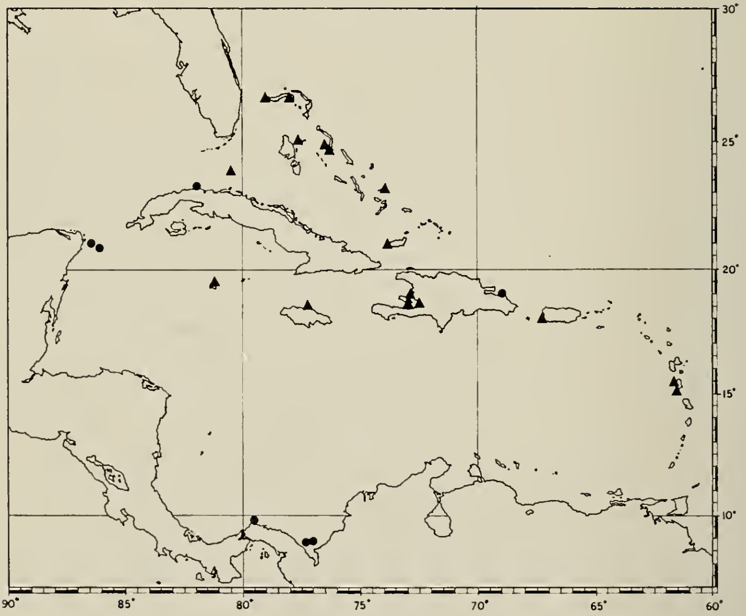

FIG. 4. Distribution of two species of *Calamopteryx* in the western N. Atlantic. Circle = *robinsorum*; triangle = *goslinei.*

FIG. 5. *Calamopteryx jeb*, holotype, FMNH 71603, 53.2 mm SL. Drawn by Mildred H. Carrington.

Head compressed; snout not notably depressed as in *C. goslinei*, broadly rounded. Jaws subequal, but the fleshy snout projecting beyond the jawbones. Eyes elliptical, directed laterally, covered by a transparent spectacle. Anterior nostril a prominent, stiffened tube located over the upper lip; posterior nostril circular, with a raised rim directed postero-laterally, slightly closer to eye than to anterior nostril. Width of pigmented interorbital greater than eye diameter. Dorsal rim of maxillary sheathed for most of its length, but expanded rear part free.

Head with prominent papillae and raised flaps (buried in mucous in some specimens), which are most numerous on the snout and the lower surface of the head; most specimens with a particularly notable flap at the tip of the upper lip. Sensory pores large: lateral canal 1; supraorbital 1; suborbital 3; preopercular-mandibular 7. Small white papillae in two series on the side of the body (see Figure 5), 12 to 20 in the upper row and 21 to 26 in the lower (which does not reach the base of the caudal fin).

Gill rakers on first arch in the form of several flat spiny pads on the upper arm, a spiny tubercle at the angle, followed by 2 or 3 similar tubercles and 5 to 7 pads on the lower arm.

Premaxillaries with a lateral narrow band of minute granular teeth which is broader near the tip of the jaw, and medially a widely-spaced series of larger, sharply pointed teeth; near the tip of the upper jaw 3 to 5 closely spaced larger teeth posterior to the granular teeth. Vomerine teeth in a broadly U-shaped double series, on each side a single row of very small teeth in front, a row of 2–5 larger teeth behind. Palatines bearing a continuation of the vomerine series, with small teeth in a row 1 to several teeth wide laterally, and 6 to 10 larger teeth medially. Dentary with a double series of teeth extending the length of the jaw, a narrow band of minute granular teeth laterally, the other series a widely spaced row of 10 to 20 longer sharp pointed teeth.

Scales on top of head in a patch which extends forward to about the level of the hind margin of the orbits, bounded laterally by a naked streak over the lateral canal. On the side of the head, scales cover the opercular region and the cheek; the most anterior and posterior head

FIG. 6. *Calamopteryx jeb*, head of holotype. Drawn by Mildred H. Carrington.

scales largest. Head naked ventrally, around the orbits and on the snout. Lateral scale rows along the body, 75 to 80 in 16 specimens.

Male intromittent organ consisting of a prominent fleshy pad (Fig. 1A) extending posteriorly from the vent, which has 2 to 5 lobes along its hind margin. From the center of the hind margin (or from slightly inside of it) extends an elongate hoodlike structure, supported on each side by a cartilaginous (?) rod (in some specimens one or both rods have come free from the skin of the hood and resemble a pair of claspers or an independent papilla), which is continuous at its base with an expanded flattened lappet, the pair of which encloses a small penis at the base of the hood.

Pyloric caecae 2 broad protuberances.

Color in alcohol varying from straw to dark brown-purple, belly and ventral part of head pale; heavier pigmentation along the bases of the dorsal and anal fins, a light spot at the base of the caudal fin. Many of the more lightly pigmented specimens have two or three indistinct brown lines radiating posteriorly from the orbit.

Etymology: The name *jeb* is coined from the initials of James E. Böhlke, noted ichthyologist and co-describer of the genus *Calamopteryx*.

Study material: All from the Galapagos, collected with rotenone.

ALBEMARLE ID. HOLOTYPE: FMNH 71603, ♀, 53.2 mm SL, 1 mile N of Tagus Cove, open lava reefs, surge surf and pools, 0–5 m, "Te Vega" cr. 13, 26 Feb., 1967. All of the following (from all islands) PARATYPES: FMNH 71640 (24), data as for holotype. USNM 208339 (1), 0°14′27″ S, 91°23′22″ W, rocky promontory, 0–3 m, "Anton Bruun" cr. 16, st. HA-114-24. USNM 208340 (6, including 2 cleared and stained) and

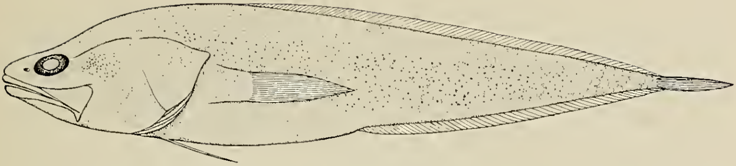

FIG. 7. *Calamopteryx robinsorum,* a composite picture modified from an 1888 drawing of USNM 39494, found in the files of the USNM Division of Fishes. Head pores not shown. Original artist unknown, modified by Keiko H. Moore.

ZMUC (2), one-half mile NW of Tagus Cove rock area along shore, 1–15 m. "Anton Bruun" cr. 16, st. 66132.—BALTRA ID. USNM 208342 (2), 0°26′01.5″ S, 90°17′0.6″ W, cove at angle formed by shore and boat landing, 0–5 m, "Anton Bruun" cr. 16, st. HA-106.—BARRINGTON ID. UCLA W64-32 (3), cove on NE shore, lava rock, 12–15 m.—HOOD ID. UCLA W67-39 (3), north side, rocks, 5 m.—INDEFATIGABLE ID. W64-38 (11), north coast, small cove in South Channel, rock and coral, 2–9 m. W64-37 (37), north coast, South Channel, rock and coral, 3–8 m. W64-21 (14), Academy Bay, W. side of entrance, rocks, 0–9 m.—NARBOROUGH ID. USNM 208341 (5), Espinosa Pt., one-half mile offshore, 10–25 m, "Anton Bruun" cr. 16, st. 66138. UCLA W53-162 (1), tidepool, 0–2 m. UCLA W64-10 (21), 1 mi. S Espinosa Pt., rock, 1–5 m. UCLA W64-9 (1), 3 mi. SE Espinosa Pt., rock, 3–5 m. UCLA W64-3 (6), 1 mi. S Espinosa Pt., rock, 0–5 m.

Calamopteryx robinsorum, new species
Figure 7

Description: Counts are given in Table 2. Measurements in percent of SL for 7 to 12 specimens ranging in SL from 26.9 to 46.2 mm. Mean first, followed by range in parentheses: greatest body depth 19.3 (18.0–21.2); predorsal length 37.5 (34.4–40.7); preventral length 25.5 (22.1–28.2); preanal length 68.9 (57.0–60.7); head length 30.6 (29.2–32.2); eye diameter 4.8 (4.1–5.6); snout length 6.0 (5.0–7.3); pigmented interorbital 4.3 (3.3–5.2); upper jaw length 15.0 (13.8–16.0); ventral fin length 12.4 (9.8–15.2); pectoral fin + pectoral peduncle length 22.7 (19.1–25.3); pectoral fin length only 18.3 (14.1–20.9); least width pectoral peduncle 4.2 (3.9–4.4); ventral fin base to symphysis of cleithra 5.4 (4.9–6.2).

Body relatively short and stubby, a pronounced nuchal rise in the largest specimen only. Head depth behind eyes about equal to or slightly less than head width; snout depressed, broadly rounded. Lower jaw slightly inferior, snout slightly inflated but no projecting fleshy area. Eyes elliptical, directed dorso-laterally, covered by a transparent spectacle.

Anterior nostril a thin-walled tube located over the upper lip (not shown on Fig. 7); posterior nostril circular, closer to eye than to anterior nostril. Width of pigmented interorbital equal to or slightly less than eye diameter. Dorsal rim of maxillary sheathed, barely so posteriorly.

Head with only a few weak papillae. Sensory pores difficult to discern in the thin, tissue-like head skin, probably distributed as in *C. jeb* and *C. goslinei.* Lateral line papillae few, counts not possible.

Gill-rakers on first arch in the form of several flat spiny pads on the upper arm, a spiny tubercle at the angle, followed by 2 or 3 similar tubercles and 4 to 6 pads on the lower arm.

Dentition of premaxillaries a band of minute granular teeth, in some specimens a few of the innermost teeth are enlarged; 4 to 8 enlarged, sharp pointed teeth at the tip medial to the smaller ones. Vomerine teeth in a broadly U-shaped double series, on each side a single row to a narrow band in front, a row of 2 to 6 larger teeth behind. Palatines bearing a continuation of the vomerine series, with small teeth in a single row or narrow band laterally, and 4 to 10 larger teeth medially. Dentary with a double series of teeth extending the length of the jaw, a single row or narrow band of minute granular teeth laterally; medially a widely spaced row of 10 to 20 larger, sharp-pointed teeth.

Head squamation similar to that in *C. jeb* and *C. goslinei,* but scales very thin and transparent, largest scales on opercle. Lateral scale rows difficult to count, probably 50 to 60.

Male intromittent organ similar to that of *C. goslinei.* Fleshy pad described for *C. jeb* is reduced or essentially lacking (Fig. 4D), the most prominent structure being an elongate hood which encloses a small penis and is continuous at its base on each side with an expanded flattened lappet.

Pyloric caecae represented by 2 broad bumps.

Color in alcohol pale straw; large, widely spaced brown chromatophores along the sides but absent along the bases of the median fins; more densely distributed on the cheeks and over the top of the postorbital part of the head, but absent over the lateralis canals.

Distribution: Western Caribbean, north coast of Cuba, northeast coast of Hispaniola (see Figure 4).

Etymology: Named for Dr. C. Richard Robins and Dr. Catherine H. Robins in recognition of their contributions to knowledge of the taxonomy of western Atlantic fishes.

Study material: All from the tropical western Atlantic. HOLOTYPE: USNM 209256, ♀, 40.5 mm SL, 9°38.9′ N, 79°15.3′ W to 9°40.2′ N, 79°17.4′ W, 64–70 m, 10′ otter trawl, "Pillsbury" st. 425, 19 July, 1966. PARATYPES: ANSP (1), 8°50′ N, 77°02′ W, 73 m, 10′ otter trawl, "Pillsbury" st. 402, 17 July, 1966. UMML 22293 (3), 8°48′ N, 77°13′ W, 97–99 m, 10′ otter trawl, "Pillsbury" st. 403, 17 July, 1966. USNM 209257 (4), 19°03.1′ N, 68°47.2′ W, 84–110 m, "Pillsbury" st. 1158, 16

Jan. 1970. USNM 39494 (2), 23°10′54″ N, 82°17′45″ W, 210 m, tangles over coral bottom, "Albatross" st. 2322, 17 Jan. 1885. USNM 209258 (2) and ZMUC (2), 21°05′ N, 86°23′ W, 146–265 m, 10′ otter trawl, "Pillsbury" st. 581, 22 May, 1967. ANSP (1), 20°57′ N, 86°34′ W, 40–165 m, 10′ otter trawl, "Gerda" st. 899, 30 Sept. 1967.

Calamopteryx goslinei Böhlke and Cohen

See Table 2 for a supplement to counts given in the original description. Data on eye size, head length and preanal length presented in Figures 1, 2 and 3 and Tables 3 and 4 were taken in part from type-material and in part from more recently collected specimens listed below.

Male intromittent organ similar to that of *C. robinsorum*, in that the elongate fleshy hood enclosing the penis is the most prominent structure and the basal fleshy pad is not inflated or greatly expanded laterally. Other variation is present, for example in the largest specimen (Fig. 1C) the pad has two small lobes.

Pyloric caecae two hemispherical protuberances.

Dentition in new material much as in original description, but in some specimens, a few of the inner teeth along the band of otherwise granular premaxillary teeth, are slightly enlarged.

One new specimen (ANSP 120409, from Eleuthera, Bahamas) agrees with other specimens in most respects but differs in its greater size, 78.6 mm SL (vs. 55.7), its regular row of evenly spaced enlarged teeth along the inside of the premaxillary tooth band (see above) and its high number of dorsal fin rays, 76 (vs. 63–70, see Table 2).

Distribution: Probably widespread throughout the Antilles, also taken at Grand Cayman and Jamaica (see Figure 4).

Study material: The type-material was re-examined and 1 paratype (ANSP 106701, 12.7 mm SL) was redetermined as a juvenile *Ogilbia*. Additional material: Jamaica, Discovery Bay, UMML 30231 (1), 27 m; all of the following ANSP: Grand Bahama, 117339 (1), 41 m.—New Providence, 120407 (1), 16–19 m.—Eleuthera, 120409 (1), 27–31 m and 111926 (7), 9–12 m.—Samana Key, 115204 (1), 30–34 m.—Great Inagua, 120410 (1), 30–37 m.—Haiti: Gulf of Gonave, 120408 (2), 35–39 m, 114403 (1), 26–30 m, 111392 (1), 37–41 m, 119119 (2), 1–6 m, 120512, 18–20 m; Port-au-Prince Bay, 112520 (3), 18–24 m.

Acknowledgments

For the loan or gift of specimens I thank J. Böhlke, Academy of Natural Sciences, Philadelphia (ANSP); L. Knapp, Smithsonian Oceanographic Sorting Center; C. Richard Robins, University of Miami (UMML); B. Walker, University of California at Los Angeles (UCLA); and L. P. Woods, Field Museum of Natural History (FMNH). J. Nielsen, Zoological Museum, University of Copenhagen (ZMUC), has

kindly provided information on spermatophores. For reading the manuscript I am indebted to B. B. Collette, R. Rosenblatt and B. Walker.

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PROCEEDINGS
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THE LARVA OF *PACHYDRUS PRINCEPS* (COLEOPTERA:DYTISCIDAE)[1]

By Paul J. Spangler and George W. Folkerts
Smithsonian Institution, Washington, D. C. 20560 and
Dept. of Zoology-Entomology, Auburn University,
Auburn, Alabama 36830

The genus *Pachydrus* with nine described species is known only from the tropical regions of the Western Hemisphere. A single species, *Pachydrus princeps* (Blatchley), occurs in the United States in subtropical Florida and southern Georgia.

Larvae of *Pachydrus* were recognized for some years (Spangler, 1963) because they were frequently collected in association with adults in the Neotropics. However, they were not described because more than one species occurred together and it was impossible to ascertain the correct species name without rearing the larvae to the adult stage. Bertrand (1968) described a larva of *Pachydrus* sp. and illustrated the nasale and last abdominal segments in his treatment of the aquatic coleoptera larvae collected in Brazil by M. G. Marlier.

By elimination of known larvae of hydroporine genera and because *P. princeps* is the only species of that genus to occur in Florida the larva may be identified confidently to species by association. Therefore, a search was made in Florida by Folkerts and the typical hydroporine larvae were collected in association with adults of *P. princeps* at 11.6 miles southeast of Trenton, Gilchrist County, Florida, on 3 Sept. 1969. The Floridian larva described below agrees generically with the presumed *Pachydrus* larvae from the Neotropics.

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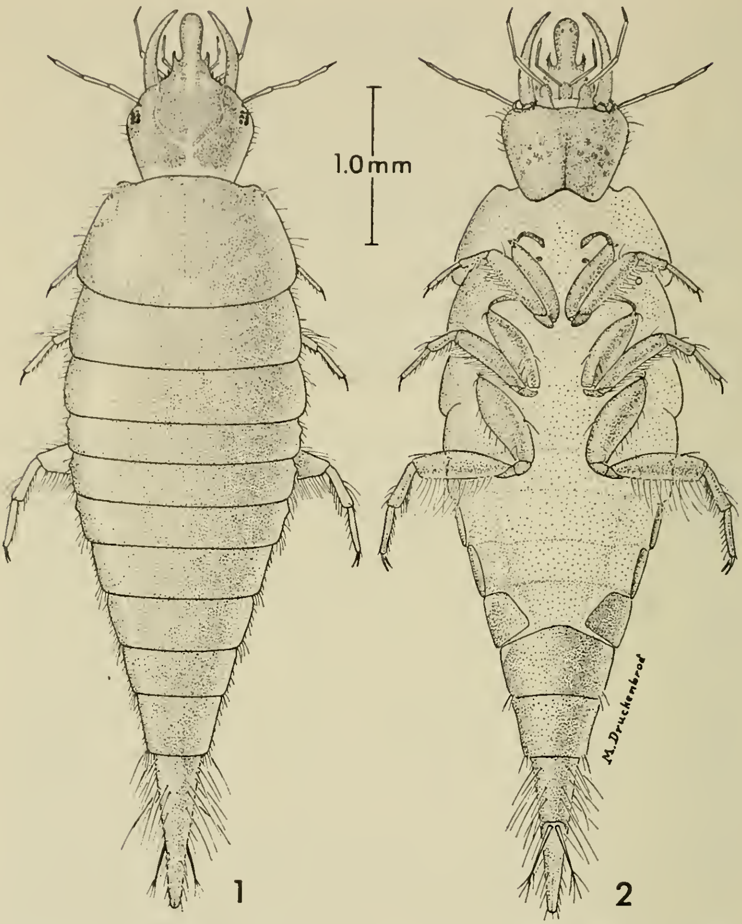
[1] This study was made possible in part by Smithsonian Institution Grant No. SG 063310.



Figs. 1–2. *Pachydrus princeps* (Blatchley), larva: 1, habitus, dorsal view; 2, habitus, ventral view.

Description of the Third-instar Larva

Length, 6.1 mm; greatest width of pronotum, 1.4 mm. Body fusiform (Figs. 1, 2); dorsum convex, venter flat. Color infuscate dorsally except nasale, area of antennal insertion, ocular area around black ocelli, base of head, 6 maculae on pronotum, anterolateral angles of each thoracic nota and 4th through 6th abdominal terga creamy yellow. Dorsum of 7th abdominal segment testaceous at base. Dorsum of 8th abdominal segment infuscate at basal third and becoming testaceous

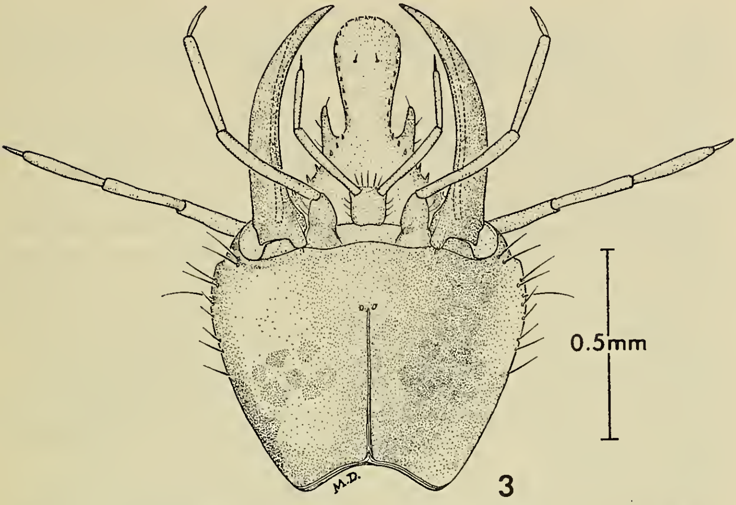


FIG. 3. *Pachydrus princeps* (Blatchley), larval head capsule, ventral view.

to apex. Basal antennal segment testaceous; 2nd and 3rd antennal segments infuscate basally, lighter apically; 4th antennal segment infuscate. Ventral surface of head capsule (Fig. 3) creamy yellow to testaceous, with poorly defined transverse band of infuscate maculae across middle of head and a longitudinal stripe on midline. Mandibles testaceous; maxillae and labium lightly infuscate to creamy yellow. Venter of thoracic and abdominal segments 1 through 5 greyish white. Coxae, trochanters, and femora greyish white; tibiae, tarsi, and tarsal claws testaceous.

Head subquadrate, narrower posteriorly, with distinct spatulate nasale. Nasale with a short but distinct branch on each side at base; anteroventral margin with numerous setae and 8 to 10 long hairs; lateroventral margin with 6 to 8 stout setae and 1 long hair between basal branch and anterolateral corner of nasale, and 8 stouter setae between basal branch and mandibular articulation; ventral surface with 1 stout seta on each side of midline at apical third. Each basal branch of nasale bears 3 stout setae; 1 basolateral, 1 mediolateral, and 1 apicoventral. Ecdysial cleavage line united at base and forked at basal fourth of head; frontal arms curve laterally and sinuously and terminate between base of nasale and antenna. Dorsal surface of head with alutaceous sculpture behind base of nasale; with 3 to 5 stout temporal setae behind each ocular area, 17 to 20 long slender setae below and behind each ocular area, 7 or 8 setae bordering each frontal arm of ecdysial cleavage line, and 5 or 6 setae near midline at base of nasale. Ventral surface of head

(Fig. 3) feebly alutaceous basally; 2 tentorial pits behind base of labium; concave anteriorly along midline. Ocular area with 6 ocelli; upper 4 arranged as in a square, lower 2 diagonally oriented to bottom of square.

Antenna 4 segmented; basal segment longest; 2nd and 3rd segments subequal; apical segment shortest, about ⅓ as long as 3rd segment, with an elongate appendage beside it arising from apex of penultimate segment; segments glabrous.

Mandible long, slender, falciform, curved upward and inward apically, grooved along inner surface, with a small basolateral seta. Maxillary stipes rudimentary. Maxillary palpus slender, elongate, 4 segmented; 1st segment (palpifer) slightly longer than last segment; 2nd and 3rd segments subequal; basal segment bearing 2 lateral setae; 2nd, 3rd, and 4th segments glabrous. Labium small, subrectangular, dorsal surface with 4 short slender medial setae and 4 long slender setae on each side and behind medial pair; ligula absent. Labial palpus very slender, 3 segmented; 2nd segment with a short slender apicolateral seta.

Pronotum broad basally, narrowed anteriorly; lateral and posterior margins arcuate; anterior margin bisinuate; with many short setae scattered irregularly over surface and numerous long slender setae along lateral margins. Mesonotum slightly wider than and about half as long as pronotum, with numerous short setae scattered irregularly over surface and a few long slender setae along lateral margins; a spiracular opening present in pleural region below anterolateral angle of mesonotal sclerite. Metanotum slightly wider than and about as long as mesonotum; setation similar to that of mesonotum.

Legs moderately long, 5 segmented; coxa long; trochanter about ⅓ as long as coxa; femur about as long as tibia and tarsus combined; tarsus with 2 elongate, slender claws, inner (lower) claw longer than outer claw. Procoxa with 2 long setae along lower medial margin and 6 or 7 long setae on lower lateral margin. Meso- and metacoxa each with 1 long seta on upper surface; 3 long setae on lower apicomedial margin and 6 or 7 long setae on lower lateral margin. Trochanters each with 1 short slender seta at apicoventral angle (abraded on some specimens). Femora each with 1 or 2 long apicodorsal setae and numerous setae scattered along ventral surface. Protibia with 2 long apicodorsal setae and 5 or 6 stout setae scattered along ventral surface. Mesotibia and metatibia with 2 or 3 very long and 1 shorter setae apicodorsally and 16 to 18 stout setae on ventral surface. Protarsus with 1 apicodorsal seta and 12 to 14 setae on ventral surface. Mesotarsus and metatarsus with 1 apicodorsal seta and 16 to 18 setae on ventral surface.

Abdomen of 8 distinct segments; terga of segments 1 through 5 completely sclerotized; sterna of segments 1 through 5 membranous; sternal membrane setose between procoxae and on abdominal segments 1 through 5; segments 6 through 8 completely sclerotized, ringlike.

Abdominal terga all with numerous short setae scattered irregularly over surface. Segment 8 elongate, tapering to apex, about twice length of 7th segment; lateral tracheal trunks visible through integument and terminating at apex; ventrally 2 short cerci arise at midlength. Cerci about ¼ length of 8th segment, unsegmented; each cercus with 8 setae, 4 along sides and 4 on apex. Lateral margins of abdominal segments 1 through 4 each with a spiracle.

The larva of *Pachydrus* runs to couplet 2 in Chandler's (1956) key to the larvae of the known nearctic genera of Dytiscidae. By modifying Chandler's couplet 2, *Pachydrus* may be recognized from the other hydroporines as follows.

2. Frontal projection of nasale with a notch or short lateral branches on each side .... 2A.
   Frontal projection of nasale without notches (Chandler's couplet number) 4
2A. Frontal projection of nasale with a short lateral branch near base (Fig. 3) on each side .... *Pachydrus* Sharp
   Frontal projection of nasale only notched on each side (Chandler's couplet number) 3

We thank Mr. Michael Druckenbrod, Smithsonian Institution staff artist, for the illustrations included in this paper.

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PROCEEDINGS
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BATHYPONTIA (COPEPODA: CALANOIDA): SIX SPECIES, ONE NEW, FROM THE SARGASSO SEA[1]

By Georgiana B. Deevey
Florida State Museum, University of Florida
Gainesville, Florida 32601

The genus *Isocalanus* Wolfenden 1906 is congeneric with *Bathypontia* Sars 1905 (Grice and Hulsemann, 1965). Ten species have been described: *B. elongata* Sars 1905, *Isocalanus minor* Wolfenden 1906, *I. major* Wolfenden 1906, *B. minor* Sars 1907, *B. spinifera* Scott 1909, *B. elegans* Sars 1920, *B. longiseta* Brodsky 1950, *B. similis* Tanaka 1965, *B. longicornis* Tanaka 1965 and *B. regalis* Grice and Hulsemann 1967. *B. minor* Sars and *I. minor* Wolfenden are different species, so Sars' species has been renamed *B. sarsi* Grice and Hulsemann 1965. *B. longicornis* Tanaka is very similar to *B. elongata* Sars, the only difference apparent in the descriptions being that *B. longicornis* has the first leg with a 1-segmented endopod, whereas *B. elongata* has a 2-segmented endopod on the first leg. Sars (1925, p. 356; 1924, Pl. 126, Fig. 12), however, confused the 2nd and 3rd legs of *B. elongata*, and described the long spine on the 2nd basipod segment of the 3rd leg as being on the 2nd leg; Tanaka (1965, Fig. 242i) described and figured this spine on the 3rd leg for *B. longicornis*. This long external spine on the 2nd basipod segment of the 3rd leg only is characteristic of all species of *Bathypontia*.

Grice and Hulsemann (1965) stated, without documentation, that *B. elegans* Sars is synonymous with *B. major* (Wolfenden). Wolfenden (1906, 1911) described *B. major* from a single immature female 3.9 mm (1906) or 3.6 mm (1911) long, collected in a 3,000 m haul west of the Cape

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[1] Contribution No. 577 from the Bermuda Biological Station. This work was supported by Grants GA-31736 and GA-36512 from the National Science Foundation.

Verde Islands in 1903. The status of *B. major* is uncertain; it might be an immature female of *B. elongata*, or of an otherwise undescribed species, but it differs from the immature female of *B. elegans* in the shape of the rostrum, the segmentation of the 4th and 5th thoracic segments, the segmentation of the endopod of the 1st leg, and the shape and proportions of the 5th legs. *B. elegans* Sars is therefore here considered a valid species.

B. elongata Sars is the commonest species, having been reported from 18°N to 12°S in the Indian Ocean (Grice and Hulsemann, 1967), from 22°50′S to 5°11′S in the eastern Pacific (Wilson, 1950), from the Gulf of Guinea between 1°30′N and 5°27′N (Vervoort, 1965), the Caribbean Sea at 15°N (Owre and Foyo, 1972) and throughout the North Atlantic up to 63°38′N south of Iceland (Farran, 1908; Sars, 1925; Jespersen, 1940; Lysholm et al., 1945). *B. spinifera* Scott was described from 1°4.5′S, 127°52.6′E in the Halmahera Sea, and has also been recorded from 5°48′N–27°31′S in the Indian Ocean (Grice and Hulsemann, 1967). *B. similis* Tanaka was described from Sagami Bay and Suruga Bay on the Pacific coast of Japan. It has also been found at 2°38′S in the Indian Ocean (Grice and Hulsemann, 1967), at 11°N in the Caribbean Sea and at 22°N in the Gulf of Mexico (Park, 1970). *B. minor* (Wolfenden) was described from 2 females caught in the Atlantic west of the Cape Verde Islands; Park (1970) has recorded it from 22°N in the Gulf of Mexico and 19°N in the Caribbean Sea, and Grice and Hulsemann (1965) from 26°N in the Atlantic. *B. sarsi* Grice and Hulsemann has a questionably spotty distribution record in that it was described from 2 specimens caught off the Azores, and has been reported from the Philippines and the China Sea off Formosa (Wilson, 1950), from 1°30′N in the Indian Ocean (Grice and Hulsemann, 1967) from 36°N in the Atlantic (Lysholm et al., 1945) and from the Strait of Yucatan, the Caribbean Sea and Florida Current (Owre and Foyo, 1964, 1967, 1972). The male described by Wheeler (1970) as *B. sarsi* does not belong to this species. *B. elegans* Sars was described from 4 stations off the Azores; Grice and Hulsemann

(1967) listed *B. major* (= *B. elegans?*) from a station at 22°11′S, 64°53′E in the Indian Ocean. *B. longiseta* Brodsky from the northwest Pacific, *B. longicornis* Tanaka from the Pacific coast of Japan, and *B. regalis* Grice and Hulsemann from 2°38′S, 65°E in the Indian Ocean have not been noted from other localities.

Zooplankton samples were collected monthly between July 1968 and September 1970 over 4 depth levels between the surface and 2,000 m at Station "S", 32°10′N, 64°30′W, in the Sargasso Sea off Bermuda (Deevey and Brooks, 1971). A total of 46 specimens belonging to 6 species of *Bathypontia* were obtained during this period, of which 36 were mature individuals and 10 immature. The adult specimens include 10 *B. similis* Tanaka, 4 *B. spinifera* Scott, 13 *B. minor* (Wolfenden), 5 *B. elongata* Sars, 2 *B. elegans* Sars, and a single female belonging to a new species. Although 1 *B. minor* female was caught within the upper 500 m, the other specimens were taken between 500 and 2,000 m depths.

Genus *Bathypontia* Sars 1905

Body elongate, head separate or partially fused with 1st thoracic segment, 4th and 5th thoracic segments usually separate, last segment asymmetrical in some species. Rostrum usually large, a stumpy or rounded plate of chitin sometimes bifid at tip, without filaments. Female urosome of 4 segments, male's of 5, caudal rami usually very short. First antenna of 22–23 segments. Male right first antenna modified, of 19–20 segments. Rami of antenna 2 and mandibular palp about equal. Maxilla 1 with well-developed exopod, endopod absent. Maxilla 2 strong, with 6 or more long curved spines, serrulate distally. Maxillipeds weak. Leg 1 endopod with 1–2 joints, 1st and 2nd exopod segments without outer edge spines. Leg 2 with 2–3-jointed endopods; legs 3–4 with 3-jointed endopods. Legs 1–4 with 3-jointed exopods. Leg 2 with outer edge spine of right 2nd exopod segment much larger than other edge spines in some species, especially in the males. Marked asymmetry of leg 2, due to enlargement of this spine, occurs most notably in male *B. spinifera*, and to a lesser extent in male *B. elongata*, *B. elegans*, *B. longicornis*, and *B. similis*; leg 2 symmetrical in male *B. minor* (Wolfenden). Female 5th legs 3-jointed, usually symmetrical, with an apical spine and usually a small external spine. Male 5th legs of 4–5 segments, in some species almost symmetrical, in others notably asymmetrical, the left leg sometimes with a plumose seta on the 2nd basipod segment.

Key to Females of *Bathypontia*

1. Mature females over 4 mm long 2
Mature females less than 4 mm long 3
2. Last segment of P5 at least twice as long as preceding segment, genital segment almost as long as 3 following segments .... *B. elegans* Sars
Last segment of P5 little longer than preceding segment, genital segment slightly longer than following segment .... *B. elongata* Sars
3. Th5 asymmetrical in dorsal view 4
Th5 symmetrical in dorsal view 5
4. Left side of Th5 longer than right, apical spine of P5 as long as or longer than leg, no outer edge spines leg 1 .... *B. longiseta* Brodsky
Right side of Th5 longer than left, apical spine of P5 about as long as leg, outer edge spines on exopod segment 3 of leg 1 .... *B. similis* Tanaka
5. P5 with single apical spine, no accessory spine .... *B. minor* (Wolfenden)
P5 with apical spine and small accessory spine 6
6. P5 asymmetrical, small 2nd spine asymmetrically placed on the 2 legs .... *B. intermedia* new species
P5 symmetrical 7
7. Mature females 3 mm or more long, Th5 pointed in dorsal view, rounded in lateral view .... *B. spinifera* Scott
Mature females less than 3 mm long, Th5 pointed in dorsal and lateral view .... *B. sarsi* Grice and Hulsemann

Key to Males of *Bathypontia*

1. Mature males over 4 mm long 2
Mature males less than 4 mm long 4
2. Caudal rami about twice as long as wide .... *B. elegans* Sars
Caudal rami about as long as wide 3
3. Endopod of leg 1 2-jointed .... *B. elongata* Sars
Endopod of leg 1 1-jointed .... *B. longicornis* Tanaka
4. B2 of left P5 with a long plumose seta 5
B2 of left P5 without a long seta 6
5. Bunch of hairs on inner side of B2 of right P5, long distal spine about ⅔ as long as distal segment .... *B. spinifera* Scott
No hairs on inner side of B2 of right P5, distal spine less than half as long as distal segment .... *B. similis* Tanaka
6. P5 not markedly asymmetrical, both legs about the same length .... *B. regalis* Grice and Hulsemann
P5 notably asymmetrical 7
7. Distal spines on both P5 very long, no accessory spines .... *B. minor* (Wolfenden)
Distal spine of right P5 short, distal accessory spines on both P5 .... *B. sarsi* Grice and Hulsemann

Bathypontia intermedia, new species

Figures 1 and 2

Material: 1 female, 3.60 mm total length, cephalothorax 2.85 mm to tip of Th5, urosome 0.80 mm. Caught in a No. 2 net night haul, 11 July 1970.

Locality: Station "S", 32°10′N, 64°30′W, 500–1,000 m.

Type-specimen: On 2 slides, to be deposited in the National Museum of Natural History, Smithsonian Institution.

Diagnosis: Body oblong, head separated from Th1, Th4 and 5 separate, 5th thoracic segment pointed in dorsal view, rounded laterally (Fig. 1a, b). Urosome around 30% of cephalothorax length; genital segment swollen ventrally, relatively long, as long as 2 following segments together, which are each of about the same length. Caudal rami relatively long, as long as anal segment, with 3 caudal setae, the 2nd much longer than the others, and a 4th short inner seta. Rostrum prominent, single, rounded and bent downwards. Antenna 1 (Fig. 2d) of 23 segments, extending not quite to end of cephalothorax. Antenna 2 endopodite slightly longer than exopodite, which is 6/7 the length of the endopodite (Fig. 1c). Mandible blade (Fig. 1d) strongly developed, palp with 5 long setae on exopodite, 8 on endopodite. Maxilla 1 (Fig. 1e) with 10 fairly stiff setae of varying lengths on 1st inner lobe, 2nd and 3rd inner lobes and basis each with 1 seta, 8 setae on exopodite and 3 on outer lobe. Maxilla 2 (Fig. 2a) strongly developed, distal portion with 6 strong subequal setae plus 3 shorter ones, all with distal combs, and proximal portion with 6 shorter strong subequal setae. Maxilliped (Fig. 1f) weak, basal segment with strong distal spine, 2 small spines distally, 1 median and 1 proximal. Leg 1 (Fig. 2f) with 2-jointed endopod; 2 slim outer edge spines, difficult to see, noted on exopod segment 3. Leg 1 B2 with a distal internal long curving seta. Legs 2–4 with 3-segmented endopods. B1 of legs 1–3 (Fig. 2b, c, f) with a plumose seta and a bunch of hairs on inner edge; B1 of leg 4 (Fig. 2e) with hairs only. Legs 2 and 4 with sharp external denticle on B2; leg 3 B2 with long slightly curved external spine almost as long as exopod segment 1 (Fig. 2b). Exopod segment 1 of leg 2 with a distal internal spine-like seta, exopod segment 2 with a slightly longer outer edge spine. Plumose setae of legs 1–4 jointed. Leg 5 (Fig. 1g) 3-jointed, asymmetrical, basal segment slightly longer than 2nd segment, 3rd segment of right leg about twice as long as 2nd segment, with distal spine as long as 2 distal segments, and a small distal external spine; distal segment of left leg slightly shorter, not twice as long as 2nd segment, apical spine slightly longer than 2 distal segments, and 2nd small external spine set back from the tip of the distal segment about ⅓rd of the length of this segment.

Remarks: *B. intermedia* new species differs from all other known female *Bathypontia* in having asymmetrical 5th legs. Like *B. spinifera*, it is intermediate in size between the larger *B. elongata*, *B. elegans*, and

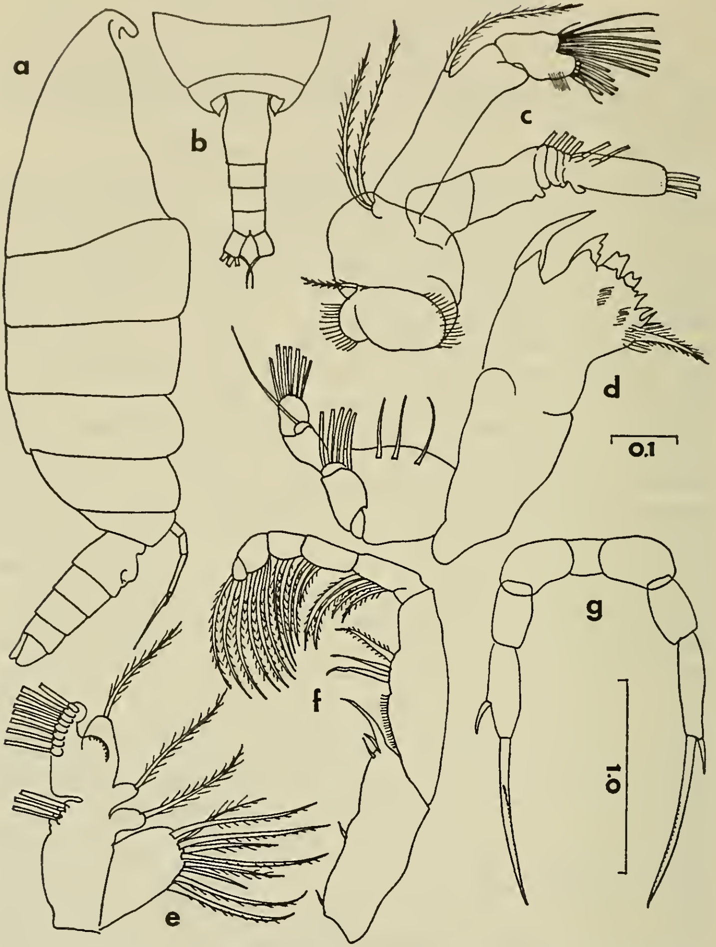

FIG. 1. *Bathypontia intermedia*, new species, female. a, Lateral view. b, Dorsal view of 4th and 5th thoracic segments and urosome. c, Antenna 2. d, Mandible, e, Maxilla 1. f, Maxilliped. g, 5th legs. Scale at bottom right for Figs. a, b; at center right for Figs. c–f. Scale in mm.

B. longicornis and the smaller *B. minor*, *B. sarsi*, *B. similis*, *B. regalis*, and *B. longiseta*. The caudal rami are proportionately longer than in other species, except *B. elegans*. The mandible blade is strongly toothed and resembles that of *B. elegans* and *B. elongata*, and is unlike that of *B. sarsi*, *B. minor* and *B. similis*. The basal segment of the maxilliped

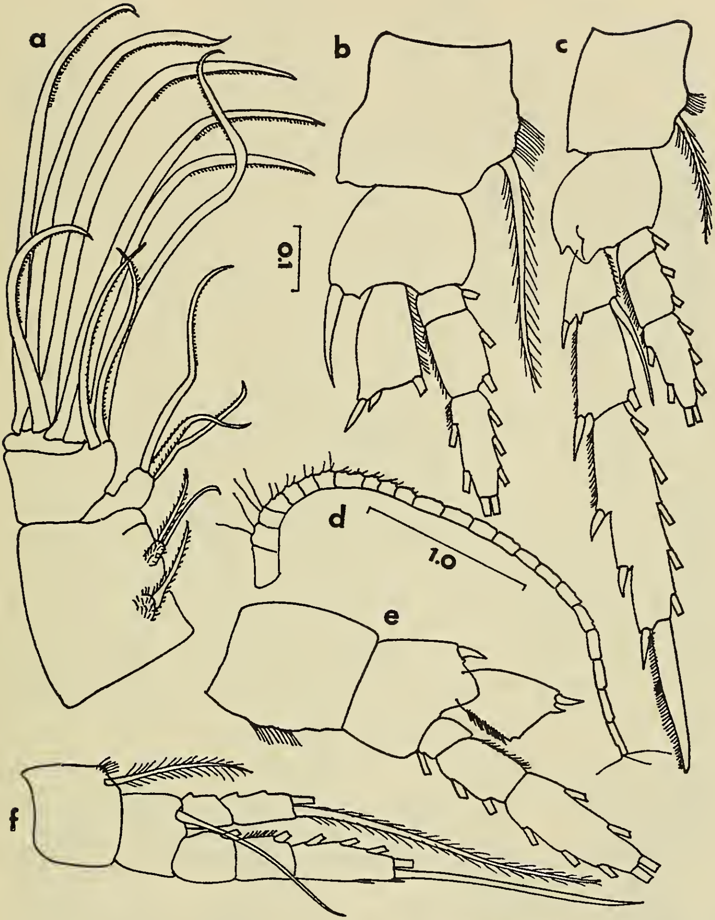

FIG. 2. *Bathypontia intermedia*, new species, female. a, Maxilla 2. b, Leg 3. c, Leg 2. d, First antenna. e, Leg 4. f, Leg 1. Scale by d for Fig. d, between a and b for Figs. a–c, e, f. Scales in mm.

has an intermediate number of spines, between *B. spinifera* and *B. minor* with 1 distal spine and *B. elegans* with 7 spines. *B. intermedia*, new species, also differs from other species in the numbers of setae on the various segments of maxilla 1. The 5th thoracic segment is pointed in dorsal view, as in *B. spinifera* and *B. sarsi*. The 2nd caudal seta is very long, as in *B. elegans*; unfortunately it was broken on this specimen, but even so was twice as long as the urosome.

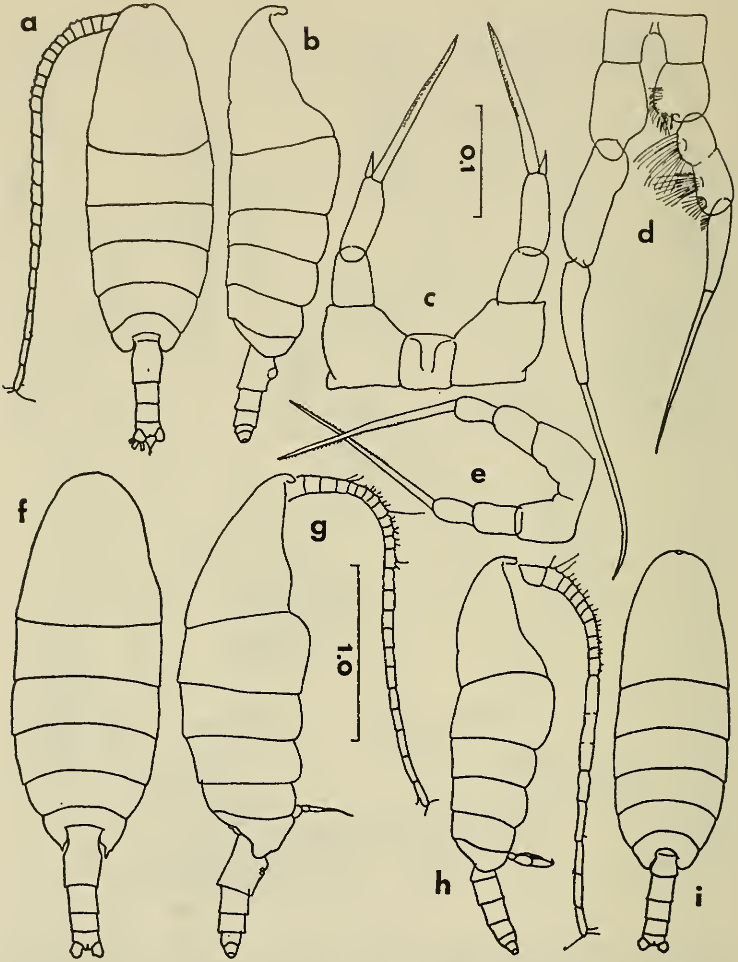

FIG. 3. a and b, Dorsal and lateral views of *Bathypontia minor* (Wolfenden) female. c, 5th legs of *B. similis* female. d, 5th legs of male *B. minor*. e, 5th legs of female *B. minor*. f and g, Dorsal and lateral views of female *B. similis*. h and i, Lateral and dorsal views of male *B. minor*. Scale beside g for Figs. a, b, f–i, beside c for Figs. c–e. Scales in mm.

Bathypontia similis Tanaka
Figures 3c, f, g; 4f

Bathypontia similis Tanaka, 1965, p. 45, Fig. 241a–k.
Bathypontia similis.—Park, 1970, p. 543, Figs. 386–402.

Material: 9 females, 2.6–2.9 mm long, 1 damaged male.

Three females and the male were caught between 500 and 1,000 m in August 1968, June and October 1969, and January 1970. Three females were taken between 1,000 and 1,500 m in November 1968, August and October 1969, and the remaining 3 females were found in 1,500–2,000 m hauls collected in March and June 1969 and June 1970. The specimens were therefore evenly distributed throughout the water column between 500 and 2,000 m depths. Park's (1970) specimens were caught over a similar overall depth range of 509–1,900 m. Tanaka stated only that his specimens were "from deep layer."

The female (Fig. 3f, g) is recognized by the asymmetry of the 5th thoracic segment; the 5th legs (Fig. 3c), however, are identical in structure with those of female *B. sarsi* (Sars, 1925, Pl. 127, Fig. 16) and *B. spinifera* (Scott, 1909, Pl. 3, Fig. 16). The male 5th legs (Fig. 4f) resemble those of the *B. spinifera* male (Fig. 4g) in having a plumose seta on the 2nd basipod segment of the left leg, but differ in the proportions of the segments and length of distal spines and in lacking a bunch of hairs on the 2nd basipod segment of the right leg. The male leg 2 is asymmetrical with a larger outer edge spine on exopod segment 2 of the right leg.

Distribution: Pacific coast of Japan, 2°38'S in the Indian Ocean, Caribbean Sea and Gulf of Mexico, Sargasso Sea at 32°N.

Bathypontia minor (Wolfenden)
Figure 3a, b, d, e, h, i

Isocalanus minor Wolfenden 1906, p. 36, Pl. 12, Figs. 1–5; 1911, p. 349, Pl. 38, Figs. 6–8, Textfig. 78a, b.
Bathypontia minor.—Grice and Hulsemann, 1965, p. 249, Fig. 19(e)–(q).
Bathypontia minor.—Park, 1970, p. 541, Figs. 372–385.

Material: 8 females 2.5–2.8 mm long; 5 males 2.3–2.45 mm long.

One female was caught within the upper 500 m in August 1970, but 5 females and the 5 males were taken between 500 and 1,000 m depths in October and December 1968, June and July 1969, and June, August and September 1970; 2 females were collected between 1,000 and 1,500 m in September 1970. This species, therefore, occurs primarily between 500 and 1,000 m depths in the Sargasso Sea. Also, although they appear to be living within the permanent thermocline where seasonal changes do not occur, most of the specimens were collected in summer. Roe (1972) recorded this species from a day depth of 940 m, and from 580–800 m at night in the Canary Island region. Park's (1970) specimens were found between 980 and 1,900 m, and

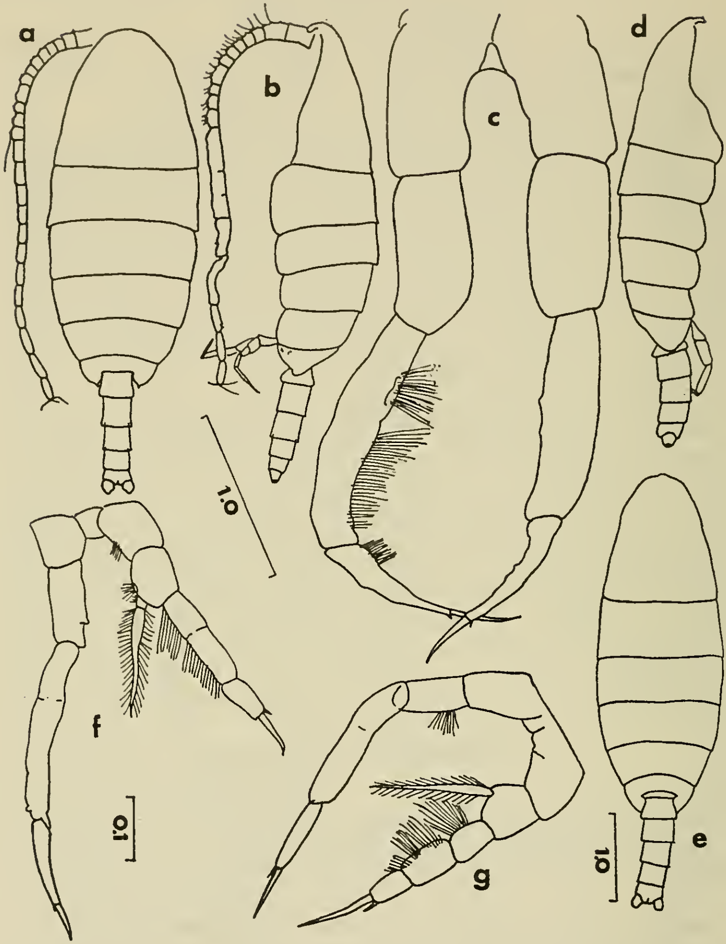

FIG. 4. a. Dorsal view of male *B. spinifera* with left antenna 1. b, Lateral view of male *B. spinifera* with right antenna 1. c, 5th legs of male *B. elongata.* d and e, Lateral and dorsal views of male *B. elongata.* f, 5th legs of male *B. similis.* g, 5th legs of male *B. spinifera.* Scale at left center for Figs. a, b; at lower right for Figs. d, e; at bottom left for Figs. c, f, g. Scales in mm.

Grice and Hulsemann's (1965) female was from approximately 1,000 m. Wolfenden's specimen was caught in a 1,500–0 m haul.

B. minor is distinguished by its relatively small size and the 5th legs of both sexes (Fig. 3d, e). The female 5th legs are symmetrical, the male's notably asymmetrical, but both have very long distal spines and no accessory spines. Leg 2 is symmetrical in both sexes.

Distribution: 20°–32°N in the Atlantic, Caribbean Sea and Gulf of Mexico.

Bathypontia spinifera Scott
Figure 4a, b, g

Bathypontia spinifera Scott, 1909, p. 183, Pl. 3, Figs. 1–16.
?*Bathypontia sarsi.*—Wheeler, 1970, p. 12, Figs. 77–90.

Material: 4 males, 2.60–2.80 mm long.

One male was taken in a 500–1,000 m sample collected in August 1969, one in a 1,000–1,500 m haul in January 1969, and two from depths of 1,500–2,000 m in May and September 1970. Scott (1909) obtained 2 females and a male from a vertical haul, 1,000–0 m. Grice and Hulsemann's (1967) specimens were from an overall depth range of 1,000–2,000 m. This species, like *B. similis*, was fairly evenly distributed between 500 and 2,000 m depths.

At first sight these males were thought to be males of *B. similis*, because their size is smaller than described for *B. spinifera*. Males of *B. similis* and *B. spinifera* (Fig. 4a, b) are identical in appearance, with symmetrical pointed 5th thoracic segments, viewed dorsally. All 4 specimens, however, have the characteristic 5th legs (Fig. 4g) of *B. spinifera* (Scott, 1909, Pl. 3, Fig. 15), with a bunch of hairs on the inner side of the 2nd basipod segment of the right leg, and the partially fused 1st and 2nd exopodite segments proportionately much shorter than in the *B. similis* male right leg. The male described and figured by Wheeler (1970, Fig. 90) as *B. sarsi* has identical 5th legs, and agrees in other characters, such as the marked asymmetry of leg 2, with the description of *B. spinifera*.

Distribution: 1°4.5′S in the Halmahera Sea, 5°48′N–27°31′S in the Indian Ocean, 32°N in the Sargasso Sea.

Bathypontia elongata Sars
Figures 4c–e; 5a, b, d, g, h

Bathypontia elongata Sars, 1905, p. 24; 1924, Pl. 126, Figs. 1–17; 1925, p. 356.
?*Isocalanus major* Wolfenden 1906, p. 37, Pl. 12, Figs. 6–11; 1911, p. 347, Pl. 38, Figs. 3–5, Textfig. 77.
Bathypontia elongata.—Farran, 1908, p. 87, Pl. 9, Figs. 16, 17.
Bathypontia elongata.—Grice and Hulsemann, 1967, p. 38, Figs. 271–274.

Material: 3 females, 4.7–5.2 mm; 2 males, 5.0–5.1 mm; 1 immature male 3.85 mm.

The males and 1 female were collected between 500 and 1,000 m in November 1968 and May and July 1970; 2 females and the immature male were taken in 1,000–1,500 m hauls in August 1968, October 1969 and June 1970. The depth range was therefore 500–1,500 m. Farran's

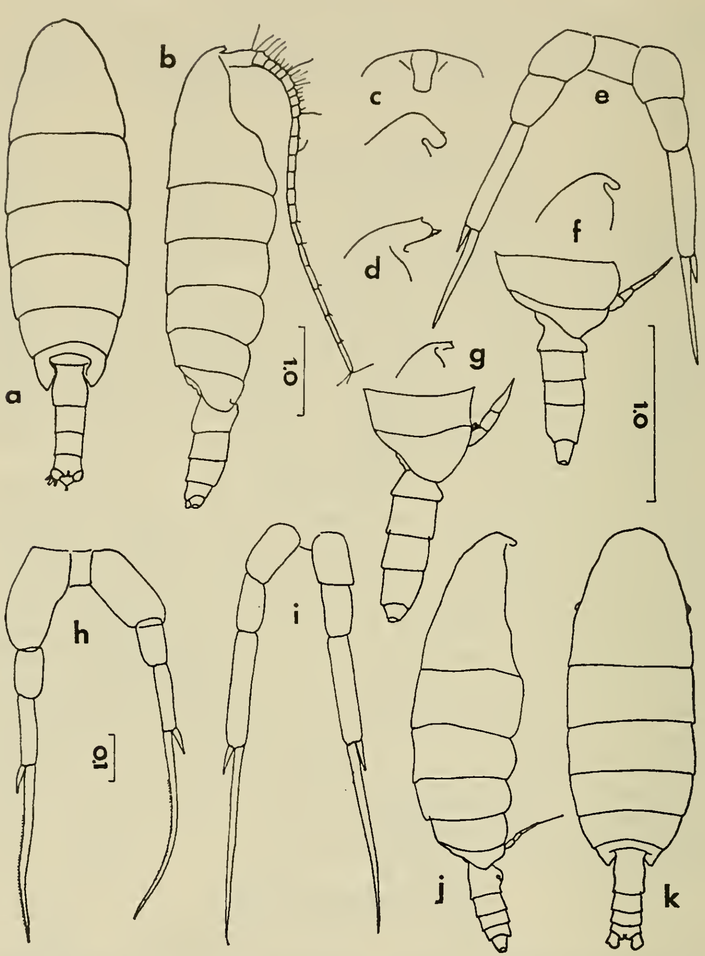

FIG. 5. a and b, Dorsal and lateral views of female *B. elongata.* c, Ventral and lateral views of *B. elegans* rostrum. d, Lateral view of *B. elongata* rostrum. e, 5th legs of immature female *B. elegans.* f, Lateral view of rostrum, 4th and 5th thoracic segments, and urosome of immature female *B. elegans.* g, Lateral view of rostrum, 4th and 5th thoracic segments, and urosome of immature male *B. elongata.* h, 5th legs of female *B. elongata.* i, 5th legs of female *B. elegans.* j and k, Lateral and dorsal views of female *B. elegans.* Scale beside b for Figs. a, b, j, k; at right center for Figs. f, g; at lower left for Figs. c–e, h, i. Scales in mm.

(1908) specimens were caught at 600 and 700 fathoms, Lysholm, Nordgaard and Wiborg's (1945) specimens with 1,500 m and 2,000 m of cable out, and Jespersen's (1940) with 1,800 m of wire out. Roe (1972) recorded specimens from 720 m, 900 m and 940 m, and Owre and Foyo (1972) from 435 m. Grice and Hulsemann (1967) listed sampling depths of 1,000–2,000 m, 225–1,930 m, and 750–2,000 m; most of Wilson's (1950) specimens were caught in 0–300 fathom hauls. Vervoort (1965) recorded a male from a night surface sample in the Gulf of Guinea; most of Sars' specimens were collected in 0–1,500 to 0–5,000 m hauls, but he also listed one specimen from a surface sample. This species apparently lives primarily between 500 and 1,500 m depths, and would not be found normally below 2,000 m.

B. elongata is distinctive because of its large size, the shape of the rostrum (Fig. 5d), the proportions of the urosome (Figs. 4d, e; 5a, b, g) and the 5th legs (Figs. 4c; 5h); the male leg 2 is asymmetrical. Wolfenden's (1906, Pl. 12, Figs. 6, 8–10) immature female *B. major* resembles the female *B. elongata* in the shape of the rostrum, the proportions of the 5th legs, and the setation of the maxilliped and maxilla 2. *B. major* is here considered synonymous with *B. elongata*.

Distribution: North Atlantic up to 63°38′N, Gulf of Guinea, Caribbean Sea 18°N–12°S in the Indian Ocean, eastern Pacific Ocean.

Bathypontia elegans Sars
Figure 5c, e, f, i–k

Bathypontia elegans Sars, 1920, p. 26; 1924, Pl. 127, Figs. 1–11.

Material: 2 females, 4.2 & 4.6 mm long, 1 immature female 3.47 mm long.

One female was collected in October 1968 from depths of 1,000–1,500 m; one female and one immature female were caught in July 1970 in a haul from 1,500–2,000 m. Grice and Hulsemann's (1967) specimen, identified as *B. major*, was taken in a 350–2,500 m haul in the Indian Ocean. This species apparently lives at greater depths than *B. elongata*, and is also rare, having been recorded only once, and without documentation, since it was described by Sars in 1920. Sars's specimens were collected in 0–2,500 m and 0–3,000 m hauls near the Azores.

This species is almost as large as *B. elongata*, from which it differs primarily in the shape of the rostrum (Fig. 5c, f, j), the proportions of the urosome (Fig. 5j, k), and the 5th legs (Fig. 5e, i). In the female the distal segment of the 5th legs is at least twice as long as the preceding segment. This is also true of the 5th legs of the immature female (Fig. 5e), which differ from those of the adult female in the length of the longer distal spine. The 5th legs figured by Wolfenden (1906, 1911) for his immature female *B. major* are quite different from those of the immature female *B. elegans*, and, therefore, the two species cannot be synonymous. The 5th legs of male *B. elegans* differ strikingly from those of male *B. elongata*, since both legs terminate in long distal spines (Sars, 1924, Pl. 127, Fig. 11).

Distribution: 32°–38°N in the Atlantic, 22°11'S in the Indian Ocean.

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PROCEEDINGS
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MACROURIDS (GADIFORMES:PISCES) COLLECTED OFF ANGOLA BY THE R/V UNDAUNTED, WITH THE DESCRIPTION OF A NEW SPECIES

By Tomio Iwamoto
Department of Ichthyology, California Academy of Sciences, San Francisco, California 94118

A trawl survey was made off the west coast of Africa from Angola to the northern border of South-West Africa in March and April of 1968 using the research vessel Undaunted. The results of this survey, conducted under the Systematics Program of the Bureau of Commercial Fisheries (now National Marine Fisheries Service), Miami, Florida, has been compiled for publication by Miller (manuscript). Examination of the macrourid fishes collected in four hauls revealed specimens of an undescribed species of *Nezumia* and five other species, including representatives of two subspecies of *Coelorinchus coelorhincus* which have since been described by Marshall and Iwamoto (1973a).

Macrourid fishes from the Gulf of Guinea, the region immediately north of the area covered by the R/V Undaunted, were reported in an earlier paper (Iwamoto, 1970). The present material helps to fill the gap in our knowledge of the macrourid fauna of the west coast of Africa, particularly in that important area around Mossamedes, where changes in hydrographic conditions greatly alter distributions of macrourids, as well as of other fishes (Ekman, 1953). Significant in this respect is the presence south of Mossamedes of three temperate west African macrourids (*Nezumia milleri, Coelorinchus coelorhincus polli* and *C. fasciatus* (Günther, 1878)) not found in the tropical Gulf of Guinea.

Counts and measurements were taken according to methods described by Hubbs and Lagler (1958) with modifications by Iwamoto (1970), but with the following change: Postorbital length—taken on a horizontal line through the center of the eye from the posterior orbital margin to the posterior opercle margin.

In the "Material" sections, the depository and catalog number is given first, followed (in parentheses) by the number of specimens and range of head lengths. Abbreviations are as follows: BMNH—British Museum (Natural History); CAS—California Academy of Sciences; TABL—Southeast Fishery Center, National Marine Fisheries Service, Miami, Florida (specimens with these TABL numbers are now housed in the fish collections of the Florida State Museum (UF)); UF—University of Florida, Florida State Museum; UMML—University of Miami, Rosenstiel School of Marine and Atmospheric Sciences; UN—R/V UNDAUNTED; USNM—National Museum of Natural History, Smithsonian Institution.

Data for the four UNDAUNTED stations at which macrourids were captured are as follows:

UN cr. 6801, sta. 105—lat. 17°13′S, long. 11°27′E, off Kunene River, Angola, 155 m, 40-ft otter trawl, 24 March 1968.
UN cr. 6801, sta. 106—lat. 17°18′S, long. 11°24′E, off Kunene River, Angola, 229–274 m, 40-ft otter trawl, 24 March 1968.
UN cr. 6801, sta. 107—lat. 17°23′S, long. 11°20′E, off Kunene River, Angola, 366–412 m, 40-ft otter trawl, 24 March 1968.
UN cr. 6801, sta. 111—lat. 10°36′S, long. 13°12′E, north of Lobito, Angola, 366 m, 40-ft otter trawl, 12 April 1968.

I give special thanks to Mr. George C. Miller of the National Marine Fisheries Service, Miami, Florida, whose collecting efforts resulted in the material for this paper. He also made suggestions for improving the manuscript. I also thank William N. Eschmeyer and Lillian P. Dempster, California Academy of Sciences, for their comments and critical review of the manuscript.

Nezumia milleri, new species

Figures 1, 2

Holotype: USNM uncat. (♀ with gonads moderately enlarged, 28.1 mm HL, 175 mm TL), off Angola, in 366–412 m, UN cr. 6801, sta. 107.

Paratypes: USNM uncat. (1, 28 mm HL), UMML uncat. (5, 26–29 mm HL), BMNH uncat. (1, 27 mm HL), and CAS uncat. (2, 26–28 mm HL); all 9 specimens taken with the holotype.

Diagnosis: A species of *Nezumia* with 8 pelvic fin rays. Snout short, acute, 25.5–27 percent HL (1.47–1.64 into orbits). Orbits large, 40–42 percent HL. Scale spinules moderately slender, lanceolate. First dorsal fin long (98–109 percent HL), black tipped. Ventral surface of suborbital region completely and evenly covered with small scales; ventral surface of snout in front of premaxillary symphysis naked. Barbel short, 11–14 percent HL. Body depth 77–83 percent HL.

Counts: First dorsal fin rays II, 9–10; pectoral fin rays 18–21; pelvic fin rays 8. Gillrakers on first arch 2 + 8–9; on second arch 1–2 + 8–9. Scales below origin of first dorsal fin 8–9; below origin of second dorsal fin 6–7. Lateral line scales counted from the anteriormost scale posteriorly over a distance equal to predorsal length 31–37.

Morphometry: Total lengths of specimens examined ca. 134–180 mm; head lengths 26.2–28.9 mm. The following in percent of head length (measurements for holotype in brackets): snout length [26] 25–27; preoral length of snout [23] 20–25; orbit diameter [40] 40–42; suborbital width [11] 11–13; interorbital width [17] 16–23; postorbital length [34] 33–35; length orbit to angle of preopercle [35] 30.5–35; length upper jaw [32] 29–33; length barbel [12] 11–14; length first (outer) gill-slit [13] 11–15; predorsal length [113] 113–118; preanal length [142] 140–148; isthmus to anal [72] 57–77; outer pelvic to anal [37] 36–42; greatest body depth [82] 77–83; length longest dorsal ray [101] 98–109; length pectoral fin [57] 56–63; length pelvic fin 51–79; D_1–D_2 interspace [48] 42–56.

Description: *Nezumia milleri* (Fig. 1) is a small species of macrourid with a short, moderately acute (in lateral view) snout that has moderately prominent scutes at the terminal and lateral angles. The dorsal profile has inflections over the snout and posterior portion of the orbits, the inflections being more prominent in the holotype than in most of the paratypes. A pale mesial streak marks the anterodorsal edge of the nape. The suborbital ridge is sharply delineated by a row of stout, scute-like scales. Much smaller and weaker-spined scales lie dorsal to the ridge row; these smaller scales are arranged in a single row at the narrowest part of the suborbital region. The narrow interorbital region showed considerable variation in width, ranging from about 0.4 to 0.6 of the orbit diameter. There was a tendency for the measurement to be greater in the males than in the females examined. The mouth is small with the posterior edge of the upper jaw extending back to a vertical just past the middle of the eye. The gill opening extends forward to a point below the

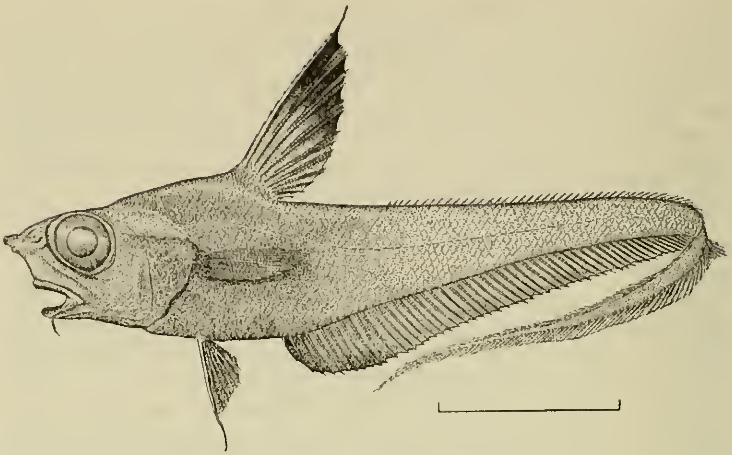

FIG. 1. *Nezumia milleri* Iwamoto, new species. Holotype, USNM uncat., 28 mm head length, from off Angola, R/V UNDAUNTED cruise 6801, station 107 in 200–225 fathoms (366–412 m). Scale represents 25 mm.

posterior margin of the orbits. The chin barbel is short and slender and about equal in length to the suborbital width.

The first dorsal fin is high and about as long as the head length. Its first ray is short, stout and thornlike; the second spinous ray is slightly longer than other rays of the fin and armed with slender sharp teeth along the leading edge. Pectoral and pelvic fins are rather small; the outer pelvic ray is slightly longer than the other rays of the fin and extends slightly beyond the anal-fin origin. Males appeared to have slightly longer pelvic rays, but this could not be substantiated with the small number of specimens available.

Body scales are similar to those of *N. aequalis* illustrated by Holt and Calderwood (1895). Spinules tend to be broader on chest scales than those on the dorsal surfaces of the trunk and tail. A small area on the leading ventral portion of the snout is apparently scaleless. Rami of the lower jaws, as well as the lower exposed margin of the interopercle, are scaled; but the gular and branchiostegal membranes are naked.

The anus is situated close behind the bases of the pelvic fins (as in most other species of the genus) and separated from the anal-fin origin by a considerable distance. A lenticular bulge of naked black skin surrounds the anal opening; a small, black, circular, dermal window of the light organ lies in front of this region and between the inner edge of the pelvic-fin bases.

Coloration (from color transparencies of fresh specimens): The head

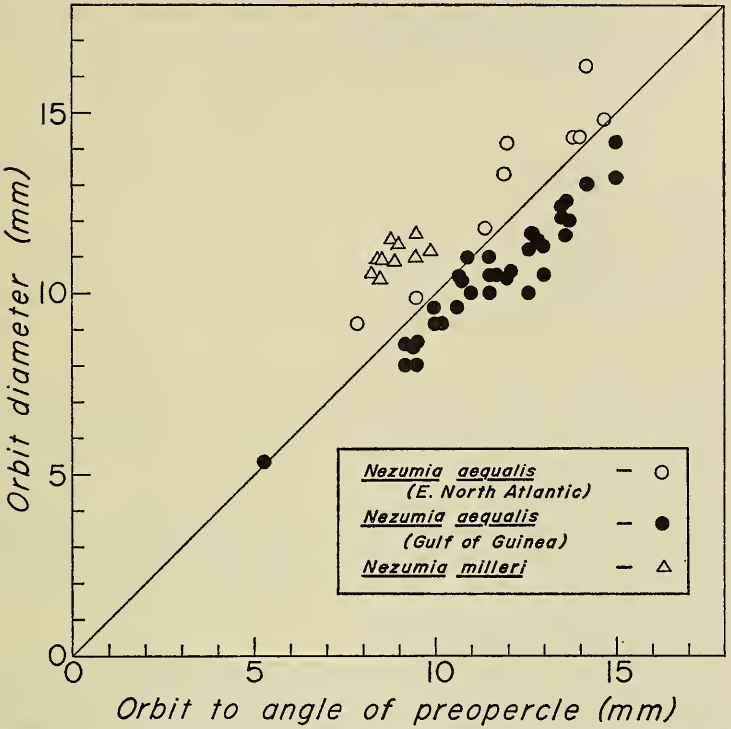

FIG. 2. Orbit diameter compared with distance orbit to angle of preopercle for *Nezumia milleri* and *N. aequalis*. Specimens of *N. aequalis* are distinguished according to two eastern Atlantic localities; the differences between various populations of *N. aequalis* are discussed by Marshall and Iwamoto (1973b). Diagonal line represents 1:1 ratio of two measurements.

is pale grayish brown dorsally, posteriorly on the occipital region and ventrally on the lower surfaces of the snout and the suborbital region. The rest of the head is mostly swarthy. Anteroventral rims of the orbits and the margins of the upper and lower lips are black. The nape, trunk and the anteriormost part of the tail are a dark brownish violet, but more posteriorly on the tail the color fades to medium brown. Median fins are mostly pale except for a prominent black blotch on the distal half or so of the first dorsal fin and dusky pigmentation on the anteriormost portion of the anal fin. Pelvic fins are black with the outermost ray on each fin whitish.

The oral cavity is almost entirely black, but small pale areas are

TABLE 1.—Pelvic finray counts of *Nezumia milleri* compared with those of two eastern Atlantic populations of *N. aequalis*. See Marshall and Iwamoto (1973b) for description of populations of *N. aequalis*.

	Pelvic finrays*			
	8	9	10	x̄
Nezumia milleri	20	—	—	8.00
Nezumia aequalis				
Gulf of Guinea	9	93	1	8.92
E. North Atlantic	20	4	—	8.09

* Includes counts of both right and left fins.

present behind the angles of the jaws. Gill cavity walls are mostly black, with the anterior portion of the outer wall and an elongate strip along the hyoid muscle generally pale. The area around the anus (and between the pelvic fins) is black.

Size: The moderately developed gonads of the 175-mm holotype indicate that this is a small species in the size range of *N. aequalis* (Günther, 1878) and *N. sclerorhynchus* (Valenciennes, 1838) and smaller than species like *N. bairdii* (Goode and Bean, 1877), *N. micronychodon* Iwamoto, 1970, and *N. longebarbatus* (Roule and Angel, 1933), whose maximum lengths exceed 350 mm.

Relationships: *Nezumia milleri* is very closely related to the wide-ranging and morphologically diverse species *N. aequalis* and has probably been derived from that species. Some populations of *N. aequalis* appear to be strongly differentiated (particularly those of the Gulf of Guinea and the Gulf of Mexico), but Marshall and Iwamoto (1973b) chose to call them populations rather than subspecies or species because of the considerable overlap present in most of the characters they analyzed. *Nezumia milleri* shows in these same characters (especially snout length and orbit diameter) substantially greater differences from the various populations of *N. aequalis* than the populations show from each other—this led me to consider *milleri* as a full species rather than a population of *N. aequalis*. Moreover, the populations of *aequalis* most similar to *milleri* appear to be those from the eastern North Atlantic and western Caribbean Sea, while the Gulf of Guinea population, which lies geographically closest, appears to be the one least similar to *milleri*. Because of the pronounced differences in hydrographic conditions off Angola (created by extensive upwelling and the offshore movement of the Benguela Current), an effective zoogeographic barrier off Angola is developed (Ekman, 1953). This barrier probably allowed *N. milleri* to diverge from the *N. aequalis* line and develop its own species characteristics.

TABLE 2. Comparisons of orbit diameters of *Nezumia milleri* with those of eight populations of *N. aequalis*. Data for populations of *N. aequalis* from Marshall and Iwamoto (1973b).

	Orbit diameter (per cent HL)														
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	$\bar{x}$
N. milleri	—	—	—	—	—	—	—	—	—	—	—	6	2	2	40.6
N. aequalis															
Gulf of Guinea	1	3	11	9	17	5	3	1	—	—	—	—	—	—	32.4
E North Atlantic	—	—	—	—	1	1	1	5	—	2	1	1	—	1	36.8
W North Atlantic	—	2	—	7	8	6	4	2	1	—	—	—	—	—	33.4
Gulf of Mexico	—	—	—	1	—	7	11	17	10	10	3	1	—	—	36.7
Antilles	—	—	1	—	3	5	8	2	2	—	—	—	—	—	34.5
W Caribbean	—	—	—	—	—	—	2	5	3	9	—	1	1	—	37.3
Venezuela-Colombia	—	—	—	—	1	—	3	8	4	6	3	1	—	—	36.9
NE South America	—	—	—	1	—	5	6	3	1	1	—	—	—	—	35.0

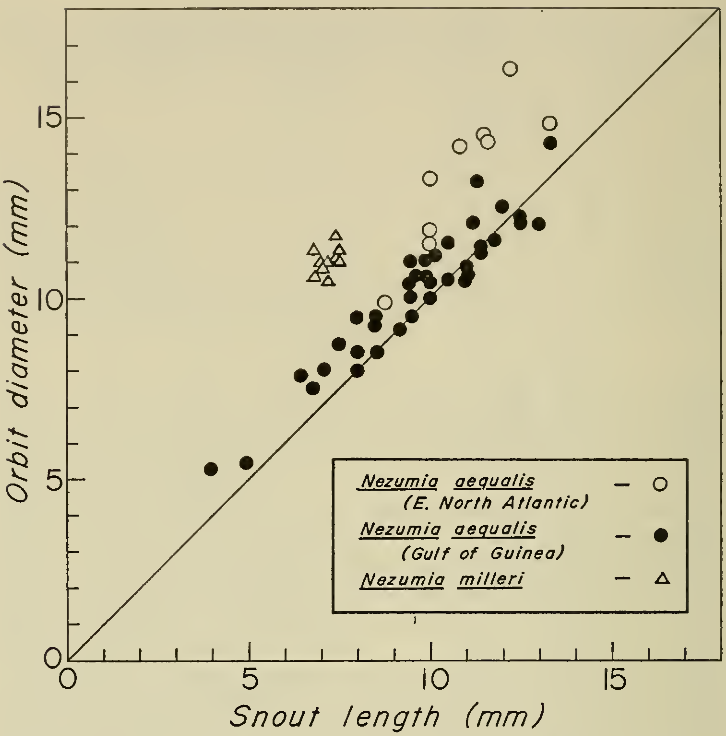

FIG. 3. Orbit diameter compared with snout length for *Nezumia milleri* and *N. aequalis*. Data for specimens of *N. aequalis* are distinguished according to two eastern Atlantic localities, the populational differences of which are discussed by Marshall and Iwamoto (1973b). Diagonal line represents 1:1 ratio of two measurements.

The large orbits of *N. milleri* in combination with the short snout and 8 pelvic fin rays distinguish the species from adult specimens of all other Atlantic members of the genus. Young specimens of *N. aequalis* from the eastern North Atlantic show overlap in orbit diameter measurements (Table 2), but they can be distinguished from the new species by their longer snout (28–32 percent HL vs. 25–27 percent for *milleri*) (Fig. 2), deeper body (greatest depth 88–91 percent HL vs. 77–83 percent for *milleri*), and broader suborbital region (14–16 percent HL vs. 11–13 percent for *milleri*). The population of *N. aequalis* from the Gulf of Guinea differs from *milleri* in having smaller orbits (Table 2), longer snouts (Fig. 2), and generally higher pelvic fin ray counts (usually 9) (Table 1). Western Atlantic populations of *aequalis* showing slight

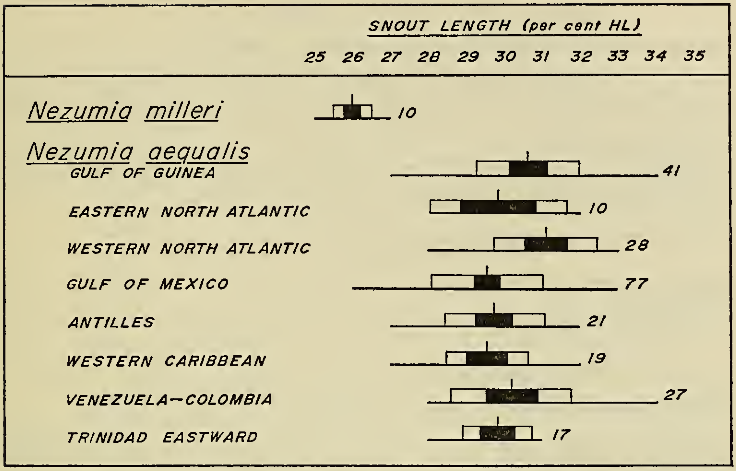

FIG. 4. Comparison of snout lengths of *Nezumia milleri* and eight populations of *N. aequalis*. Data for *N. aequalis* from Marshall and Iwamoto (1973b). Method of presentation of data from Hubbs and Hubbs (1953).

overlap with *milleri* in orbit diameter measurements include those from the Gulf of Mexico, the western Caribbean and the Venezuelan-Colombian region. Snout length measurements of these populations, however, show frequency distributions that are generally much higher than for *milleri* (Fig. 2). Some overlap with *milleri* can be seen for both snout length and orbit diameter measurements in these three western Atlantic populations, but the degree of overlap is very slight. The Gulf of Mexico population can further be distinguished by having predominantly 9 pelvic fin rays.

Distribution: Temperate waters off Angola and South-West Africa.

Etymology: This species is named for Mr. George C. Miller of the National Marine Fisheries Service, Miami, Florida, whose efforts resulted in the collections of the macrourids here reported.

Nezumia micronychodon Iwamoto

Nezumia micronychodon Iwamoto, 1970:385, figs. 17a, 18, 19, 20a, 21a, 22, 23.

Material: TABL uncat. (16, 24.5–46 mm HL), UN cr. 6801, sta. 107.

Remarks: These small specimens (most under 38 mm HL), captured with the type-specimens of *N. milleri*, showed well the size-related differences in physiognomy of the head noted by Iwamoto (1970).

Malacocephalus occidentalis Goode and Bean

Malacocephalus occidentalis Goode and Bean, 1885:597.

Material: TABL 107413 (6, 56–71 mm HL) and CAS 14536 (5 specimens), UN cr. 6801, sta. 111; TABL 107415 (24, 21–56 mm HL), UN cr. 6801, sta. 105.

Remarks: These specimens mark the southernmost area from which the species has been reported in the eastern Atlantic.

Malacocephalus laevis (Lowe)

Macrurus laevis Lowe, 1843:92.

Material: TABL 107414 (12, 45–50 mm HL), UN cr. 6801, sta. 111.

Hymenocephalus italicus Giglioli

Hymenocephalus italicus Giglioli *in* Giglioli and Issel, 1884:228.

Material: TABL 107416 (125, ca. 15–38 mm HL), UN cr. 6801, sta. 111.

Coelorinchus coelorhincus (Risso)

Lepidoleprus coelorhincus Risso, 1810:200–201.

Remarks: Two recently described subspecies of this widespread species were captured. Subspecies *C. coelorhincus geronimo* Marshall and Iwamoto was taken at the more northerly station (sta. 111) while subspecies *polli* Marshall and Iwamoto was captured at the two more southerly stations (sta. 105 and 107). The UNDAUNTED specimens constituted part of the type-material for the first subspecies and all of the type-material for the second subspecies.

Coelorinchus coelorhincus geronimo Marshall and Iwamoto

Coelorhynchus coelorhynchus geronimo Marshall and Iwamoto, 1973a: 124–218, figs. 11d, 14.

Material: USNM 205872 (holotype), TABL 107688 (36 paratypes, 45–65 mm HL), and UF uncat. (5 paratypes), all from UN cr. 6801, sta. 111.

C. coelorhincus polli Marshall and Iwamoto

Coelorhynchus coelorhynchus polli Marshall and Iwamoto, 1973a:141–144, figs. 11e, 17.

Material: USNM 206490 (holotype, 50 mm HL), USNM 206491 (9 paratypes, 42–70 mm HL), and BMNH uncat. (2 paratypes, 47–61 mm HL), all from UN cr. 6801, sta. 105; TABL 107698 (7 paratypes, 41–59 mm HL) and CAS 13647 (2 paratypes, 46–54 mm HL), UN cr. 6801, sta. 106.

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PROCEEDINGS
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BIOLOGICAL SOCIETY OF WASHINGTON

BODIANUS BIMACULATUS, A NEW SPECIES OF WRASSE (PISCES: LABRIDAE) FROM THE PALAU ARCHIPELAGO

By Gerald R. Allen
The Australian Museum, Department of Ichthyology
Sydney, Australia

The Palau Archipelago is characterized by an unusually wide variety of marine habitats. Of special interest to biologists are the many outer reef dropoffs which fall away steeply to deep water. Dr. Walter A. Starck II and the author made several fish collections during February–March 1972, at a particularly spectacular dropoff adjacent to Bairakaseru Island, Ngemelis Islands (7°05′45″N, 134°15′15″E; U.S.H.O. Chart 6073). This submarine cliff is situated only 20 meters from shore and plunges almost vertically from knee-depth water, at low tide, to at least 120 meters. At depths between 30 and 60 meters the cliff face is covered with growths of black coral (*Antipathes*). Among our collections from this locale are five specimens of an undescribed *Bodianus* which is reported herein. An additional paratype was collected by the author on a steep slope at Augulpelu Reef, about 20 nautical miles northeast of the type-locality.

Type-specimens have been deposited at the following institutions: Australian Museum, Sydney (AMS); Bernice P. Bishop Museum, Honolulu (BPBM); National Museum of Natural History, Smithsonian Institution, Washington, D. C. (USNM). Measurements were made with a needle-point dial caliper to the nearest one-tenth millimeter (mm).

Special thanks are due William D. Madden of Oceanic Institute, Waimanalo, Hawaii for making comparisons of *B. bimaculatus* with specimens of *B. opercularis* and *B. sanguineus*. I also thank Martin Gomon and Walter A. Starck II

Fig. 1. *Bodianus bimaculatus*, holotype, 37.8 mm standard length, Palau Archipelago.

for comparing *B. bimaculatus* with the holotype of *sanguineus* at the National Museum of Natural History, Smithsonian Institution. Mr. Gomon is presently studying the systematics of *Bodianus*.

Bodianus bimaculatus, new species

Figure 1

Holotype: BPBM 12444, 37.8 mm standard length, collected with quinaldine on vertical dropoff at Bairakaseru Island, Ngemelis Islands, Palau Archipelago, Philippine Sea at 42 meters depth by G. R. Allen on 5 March 1972.

Paratypes: AMS I.16763-001, 2 specimens, 35.0 and 41.1 mm, same data as holotype except collected on 12 March 1972; BPBM 12445, 2 specimens, 34.1 and 39.3 mm, same data as holotype except collected with rotenone at 40 to 48 meters depth by G. R. Allen and W. A. Starck II on 20 February 1972; USNM 208347, 50.2 mm, collected with quinaldine at Augulpelu Reef, off Aurapushekaru Island, Palau Archipelago at 42 meters depth by G. R. Allen, March 1972.

Diagnosis: A species of *Bodianus* with the following combination of characters: Greatest body depth 3.6 to 4.0 in standard length; dorsal rays XII,10; anal rays III,12; pectoral rays 14 to 16; lateral line scales 30 to 32; gill rakers 14 to 16; color pale (red-orange in life) with black spot on opercle and another on caudal base.

Description: The counts and proportional measurements which appear in brackets apply to the five paratypes. Table 1 gives measurements of the types expressed as percentage of the standard length.

Dorsal rays XII,10; anal rays III,12; pectoral rays 16 [14(1), 15(1), 16(3)]; pelvic rays I,5; branched caudal rays 12. Lateral line gently curved and continuous, with 31 [30(1), 31(3), 32(1)] scales to caudal base (as indicated by line of flexure) and 2 to 3 pored scales posteriorly; horizontal scale rows above lateral line to base of first soft dorsal rays

TABLE 1.—Morphometric proportions (in percent of standard length) of the six type-specimens of *Bodianus bimaculatus*

Morphometric measurement	Range	Mean
Standard length (mm)	34.1–50.2	–
Greatest body depth	25.4–27.7	26.4
Head length	34.3–38.4	36.4
Snout length	8.6–9.7	9.0
Eye diameter	8.6–11.5	9.9
Interorbital width	5.4–7.6	6.4
Least depth of caudal peduncle	14.0–15.8	15.0
Length of caudal peduncle	10.0–11.4	10.9
Snout to origin of dorsal fin	34.7–37.8	36.1
Snout to origin of anal fin	58.4–64.2	61.8
Snout to origin of pelvic fin	33.1–36.0	34.7
Length of dorsal fin base	49.1–52.9	51.9
Length of anal fin base	23.1–26.5	24.8
Length of pectoral fin	17.1–21.9	19.2
Length of pelvic fin	17.2–19.0	17.9
Length of pelvic spine	12.2–13.2	12.7
Longest (12th) dorsal spine	11.0–12.2	11.5
Longest (6th) soft dorsal ray	13.1–16.4	14.9
Length of 1st anal spine	4.5–6.1	5.2
Length of 2nd anal spine	7.8–8.0	7.6
Length of 3rd anal spine	11.2–13.5	12.1
Longest (11th) soft anal ray	11.4–14.8	13.3
Length of middle caudal rays	21.9–24.6	23.2

3½; below lateral line to base of first anal soft rays 10; predorsal scales 7 [6(1), 7(4)]; snout, chin, throat, and dorsal portion of head naked; preopercle and opercle scaled; a row of small sheath scales at base of dorsal and anal fins; enlarged scales covering about basal half of caudal fin; hindborder of preopercle entire (finely denticulate on most of the paratypes); gill rakers (including rudiments) 16 [14(1), 15(3), 16(1)].

Body elongate and compressed, its greatest depth 3.8 (3.6 to 4.0) in the standard length. Width of body at gill opening 2.4 (2.2 to 2.4) in the head length. Head pointed and laterally compressed, its length 2.6 (2.7 to 2.9) in the standard length. Snout 4.1 (3.7 to 4.2), eye 3.9 (3.1 to 4.4), interorbital width 6.0 (5.0 to 6.8), least depth of caudal peduncle 2.6 (2.3 to 2.7), length of caudal peduncle 3.5 (3.0 to 3.7), of pectoral fin 2.1 (1.6 to 2.2), of pelvic fin 2.2 (1.9 to 2.1), of middle caudal rays 1.6 (1.5 to 1.6), all in the head length.

TABLE 2.—Comparison of certain characters of three species of *Bodianus* (Number of specimens indicated in parentheses)

	Species		
Character	*B. bimaculatus* (6)	*B. opercularis* (4)	*B. sanguineus* (2)
Lateral line scales	30–32	40–41	40–41
Gill rakers	14–16	24	19
Color pattern:			
anal fin	yellow	yellow	red
caudal spot	present	absent	present
opercular spot	above pectoral base with stripe connecting eye	extends below pectoral base no stripe to eye	same as *bimaculatus*

Dorsal spines gradually increasing in length to last spine which fits 3.2 (3.2 to 3.3) in the head length; first anal spine 7.6 (6.0 to 8.1), second anal spine 4.8 (4.4 to 4.7), third anal spine 3.0 (2.7 to 3.2), all in the head length; caudal and pectoral fins rounded.

A pair of enlarged, posteriorly curved canines in front of upper and lower jaw, and in between, two (one in upper jaw of 34.1 mm paratype) close set, enlarged teeth as symphysis of each jaw; a pair of canines (inconspicuous) at posteriormost portion of upper jaw; remaining teeth small and conical, in a single series.

Color in alcohol: Body and most of head whitish; prominent black spot, about size of pupil, on upper portion of opercle; a slightly smaller spot on upper caudal fin base; faint dusky stripe from posterior edge of eye to opercle spot (on one paratype it extends onto the middle of the sides to below last soft dorsal ray); spinous dorsal fin dusky with membranous portion between first two rays intensely blackish; remainder of fins translucent except distal portion of pelvics which are slightly dusky.

Color when alive: Most of head and body bright reddish-orange; abdomen, breast, and chin whitish; black ocellus surrounded by narrow yellow ring on upper portion of opercle; black spot on upper caudal base; brownish stripe extending from tip of snout to rear edge of opercle, passing through eye and opercular ocellus; six faint reddish longitudinal lines on side of body (corresponding with middle of six dorsalmost scale rows); spinous dorsal fin blackish with narrow marginal band of yellow; remainder of fins yellowish.

Remarks: *Bodianus bimaculatus* is closely related to *B. opercularis* (Guichenot, 1847) from the western Indian Ocean and *B. sanguineus* (Jordan and Evermann, 1903) from Hawaii. It differs from these species primarily on the basis of color pattern and counts for the lateral line scales and gill rakers on the first arch. These differences are represented in Table 2. William D. Madden recently collected several specimens of *B. sanguineus*, previously known only from the holotype, off Oahu, Hawaiian Islands. He plans to publish a note on his findings and will include comparisons of this species with *B. opercularis*.

All three species are inhabitants of deep reefs and are known from only a few specimens. *B. bimaculatus* appears to be a small species. The 50.2 mm paratype was the largest of many individuals observed. *B. opercularis* and *B. sanguineus* are known from specimens ranging from 61 to 185 mm in standard length. *B. bimaculatus* was moderately common at the type-locality between depths of 40 and 60 meters.

The specific name, *bimaculatus*, refers to the characteristic black spots on the opercle and caudal peduncle.

Addendum: *B. bimaculatus* was recently collected by John E. Randall at Rabaul, New Britain, and Madang, New Guinea. At the latter locality specimens were taken from a sandy reef passage area in 30 meters and were primarily yellowish in color.

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ANATOMICAL AND NOMENCLATURAL NOTES ON OPOSSUMS

By Ronald H. Pine*
Smithsonian Institution, Washington, D.C. 20560

From the time that specimens of different species of didelphids became available to zoologists there has been confusion concerning which names to apply to the various genera and species. Uncertainty in regard to the presence or absence of a pouch in the different forms still persists also. This paper attempts to clear up much of this confusion.

My investigations as outlined below show that the brown four-eyed opossum (currently called *Metachirus nudicaudatus*) totally lacks a pouch. Other characters of this species are pale-colored spots above the eyes, a basically reddish-brown coloration dorsally and little extension of fur onto the base of the tail.

The gray and black four-eyed opossums (now called *Philander opossum* and *Philander mcilhennyi* respectively) possess fully developed pouches, also have pale spots above the eyes, have basically gray or blackish coloration dorsally and show considerable extension of fur onto the base of the tail.

The generic epithet *Philander* Tiedemann will be shown to apply to the brown four-eyed opossum. This makes *Metachirops* Matschie the proper generic epithet for the gray and black four-eyed opossums.

Seba (1734) described and figured opossums designated *Philander, Opassum, sive Carigueja, Brasiliensis*; *mas* and *Philander, Americanus, seu Carigueja, cum catulis, saccum ventris intrantibus*; *foemina.* The description of the male animal reveals that the opossum in question has light tawny spots above the eyes and that fur of this color also covers the area

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* Present address: George Williams College, 555 Thirty-First Street, Downers Grove, Illinois 60515

around the mouth, the ventral surface, the legs and the feet. The upper parts of the body are dark chestnut and the tail is covered with hair for a distance equal to the length of a human finger. No description of coloration is given for the female but the pouch is illustrated and amply described. The copy of the Latin-French edition of Seba available to me has uncolored plates but (Mrs.) Ruth M. Farrow (personal communication) has informed me that the coloration of both the male and female opossums in a Latin-Dutch edition of Seba at McGill University essentially agrees with the description given for the male.

Based on the coloration alone, the descriptions and figures would leave no doubt that the animal in question is the brown four-eyed opossum—the one currently known as *Metachirus nudicaudatus* (É. Geoffroy St.-Hilaire). The extent of the hairy covering as described on the tail of the male, and the presence of a pouch (figured as containing three young) in the belly of the female argue against this determination, however.

Although other authors have stated that the brown four-eyed opossum does not have a pouch, Enders (1935, 1937a, 1937b) claimed that old females at least have well-developed pouches. Examination of thawed lactating specimens with young in place sent to the National Museum of Natural History have convinced me that brown four-eyed opossums, young or old, lack a pouch. Enders (personal communication) has recently informed me that he is now convinced that the specimens he based his conclusions on were woolly opossums (*Caluromys* J. A. Allen) although this does not seem to be the case with his (1935) observations on Barro Colorado Island. Unfortunately, Enders' specimens have been discarded and cannot have their identifications checked. Statements have appeared in the literature to the effect that *Caluromys* lack pouches. Dilford C. Carter (personal communication) has informed me that in *Caluromys derbianus* (Waterhouse) at least, full pouch development does occur and this appears to be borne out upon examination of dry skins. There is apparently considerable interspecific variation in this regard, however. Living and freshly killed examples of *Caluromys philander* Linnaeus which I examined at Belém, Pará, Brazil possessed rudimentary lateral abdominal folds as the only indication of pouch development. Old lactating individuals might have shown less equivocal pouch development than the individuals I have examined, however. Carter's and my findings support statements made by some (but not all) authors concerning differences in pouch development in *Caluromys.* As recently as 1941, Gilmore recognized the subgenus *Mallodelphys* Thomas (which Gilmore and other authors have misspelled "*Mallodelphis*") containing "*Caluromys laniger*" [= *C. lanatus* (Illiger)] and "[*Caluromys*] *derbiana*" [= *C. derbianus* (Waterhouse)] and stated it is characterized in part by a fully developed pouch. Miranda-Ribeiro (1936) regarded *Mallodelphys* as a full genus. Tate (1939) stated *Mallodelphys* and *Caluromys* "appear to be definitely congeneric" and wrote "In both the pouch is reduced to simple lateral folds . . ." These statements influenced Cabrera (1957) to not recognize *Mallodelphys* even as a subgenus. Gilmore's view that *Mallodelphys* is worthy of subgeneric recognition is probably correct.

Absence of a pouch in the brown four-eyed opossum provides evidence for my view that it is not as closely related to the gray four-eyed opossum as the latter is to the animals now known as *Didelphis.* Cranial characters seem to support this view also. Now that the genus containing the gray four-eyed opossum has been shown to be polytypic (Gardner and Patton, 1972) some zoologists may take my suggestion (1972) that this genus might be "lumped" with *Didelphis* (in the current sense) somewhat less seriously. Certainly subgeneric separation (at least) seems called for.

Although the brown four-eyed opossum lacks a pouch, this animal has been figured as possessing a structure which could be interpreted as a pouch. Schreber (1778, pl. CXLVI. B.) depicted an animal called "*Didelphys Opossum* Linn. femina." The pose is calculated to show the belly which displays a dark brown streak which is probably meant to represent a pouch. Actually, specimens of both male and female brown opossums may show a midventral streak on the belly. In stuffed skins of females this may be caused by stitching bringing the sides of the dark mammary region close together.

In males, at least, it is caused by a secretion from a midventral gland. In an adult male I examined in the Canal Zone I found this elongate, relatively dark-colored, somewhat teardrop-shaped gland (with the blunt end anterior) was about 80 mm. long with its anterior end corresponding in position with the posterior end of the sternum. The greatest width was about 13 mm. The secretion of the gland had stained the overlying skin with an orangish color, had stiffened the overlying hairs and stained them a buffy orange. The secretion had a (to me) extremely strong and disgusting odor. A second gland was present on the throat. This gland, about 26 mm. anterior to the larger midventral gland terminated anteriorly at the level of the anterior end of the sternum. The throat gland was paler than the inside surface of the skin, about 28 mm. long and about 6 mm. wide. The skin over this gland was completely or nearly hairless. The dark-colored groin glands were similar to those found in the gray four-eyed opossum and *Didelphis marsupialis* Linnaeus. I have not had the opportunity to investigate the nature of these glands in females since I became aware of their existence in males.

Glandular secretions cannot explain the appearance of the unequivocal pouch shown in Seba's figure of the female brown opossum. The identities of Seba's opossums have some importance from a nomenclatural point of view because Linnaeus (1758) gave Seba as the only authority for his description of *Didelphis Opossum*. The actual description given by Linnaeus most closely fits the common gray four-eyed opossum or else the animal named *Philander mcilhennyi* (the black four-eyed opossum) by Gardner and Patton (1972). Specimens of the latter, however, are much less likely to have reached Europe in the eighteenth century and for this reason and reasons of nomenclatural stability it is best to regard Linnaeus' *Didelphis Opossum* as being the common gray four-eyed opossum. The combinations of characters described and figured by Seba fit no known opossums and the identity of his material will almost certainly remain unknown (assuming it does not represent an unrecognized species). The identity of *Philander* Tiedemann (1808), however, still presents resolvable problems which will be dealt with below.

In 1698, Tyson discussed the anatomy of a female opossum [which must have been the animal now known as *Didelphis marsupialis virginiana* (Kerr)] from Virginia and in 1704, Cowper described the anatomy of a male opossum from Virginia.

Buffon (1763) discussed the "sarigue" or "opossum." Buffon concluded, in effect, that all of the earlier references dealing with the larger sorts of American opossums referred to one and the same animal. Buffon's "sarigue" is therefore a composite involving *Didelphis*, possibly the brown four-eyed opossum and probably the common gray four-eyed opossum as well. The "sarigue" of Daubenton (1763) in the succeeding pages is also a composite. The coloration as given in the text seems to resemble that of the brown four-eyed opossum most. The length of the haired portion of the tail as described and figured is most like that of the common gray four-eyed opossum and the proportions of the male shown in plate 45 resemble those of the latter more than they do those of the brown four-eyed opossum. Judging from its shape and the large measurements given for it, the skull figured on plate 51 must be that of a *Didelphis*.

Schreber (1778) gave an account of "*Didelphys Opossum* . . . LINN." Schreber's synonymy includes names for opossums of several genera. His written description, however, gives the coloration diagnostic of the brown four-eyed opossum and his figures of both sexes also show the same coloration. The bodily proportions and distribution of hair on the tail in the figure of the male correspond to those of the gray four-eyed opossum. The female figured has the bodily proportions of the brown four-eyed opossum and the tail, which is long, slender, uniformly pale-colored and ventrally naked to its base unequivocally confirm this identification. As discussed above, the brownish midventral line on the abdomen which might be interpreted as the opening of a pouch could be explained in another way. Schreber gave the geographic range of the animal in question as including Brazil, Perú, Guiana, México, Florida, Virginia and the Antilles, which reflects the confusion concerning the identity and zoogeography of the larger opossums at that time.

In 1808, Tiedemann described the genus *Philander* (which he attributed to Brisson, 1762) and listed "Das Virginische Opossum. P. virginianus (Did. opossum L.)" as the first species of the genus to be dealt with. No authority is given for the name *P. virginianus* and there is therefore no particular reason to assume that this is not a new name attributable to Tiedemann rather than a citation of Kerr's (1792) name *Didelphis virginiana.* Tiedemann indicated that "Das Virginische Opossum" is the same species as those mentioned by Tyson (1698), Cowper (1704), Buffon (1763), and Schreber (1778). He gave the range as "Virginien, Mexico, Peru u.s.w." All of this indicates a composite creature but his description of the animal he had in mind ("Körper röthlich braun. Ueber jedem Auge ein gelblich weisser Flecken.") can only refer to the brown four-eyed opossum.

Burmeister (1856) coined the epithet *Philander* (a junior homonym of *Philander* Tiedemann) to refer to the woolly opossums (now known as *Caluromys* Allen). Thomas (1888) attributed the original authorship of the epithet *Philander* to Tiedemann but regarded Burmeister's erection of the homonym *Philander* as a restriction of *Philander* Tiedemann to include only the woolly opossums. This interpretation is incorrect. Burmeister clearly indicated that he was to be considered as author of the epithet *Philander.* In addition, the woolly opossums were not specifically mentioned as being included in the genus *Philander* by Tiedemann.

In 1900, Rehn concluded that *Didelphis opossum* Linnaeus should be the type-species of *Didelphis* Linnaeus and stated that the proper generic epithet for the larger opossums (presently called *Didelphis*) was *Sarigua* Muirhead.

In 1900, Allen claimed that the epithet *Philander* should not be used for any of the opossums. Allen credited the name to Brisson (1762). Since the specific contents of *Didelphis* Linnaeus and *Philander* Brisson were essentially the same, Allen suggested that *Philander* be merely regarded as a junior synonym of *Didelphis* and should be abandoned. Allen claimed that *Philander* Tiedemann should be abandoned for the same reasons. Allen's contention that *Philander* Tiedemann as originally conceived was a mere synonym of *Didelphis* (in the old sense of including all the opossums) and had the same specific contents was more or less correct. This is clearly indicated by Tiedemann's statement that the genus included "*gegen 10 Arten.*" For some reason, Tiedemann listed but three of these, one, the brown four-eyed opossum, a *Marmosa* and a *Monodelphis.* Another claim made by Allen was that *D.[idelphis] opossum* is the type-species of *Metachirus.* In this he was in error. In the original description of *Metachirus* (Burmeister, 1854) the specific epithet *opossum* does not appear [although *opossum* is included in *Metachirus* along with *myosuros* and *quica* in Burmeister (1856) and is the first-listed species]. Only two species are mentioned, *myosuros* Temminck and *quica* Temminck. As *myosuros* is the first mentioned, it should be regarded as the type-species (as has been done by a number of authors). It is of interest that Temminck (1824) described *myosuros* as having a fully developed pouch.

In 1916, Matschie erected the genus *Metachirops* for the common gray four-eyed opossum. The first (on p. 262) species specifically referred to the new genus was *Didelphis quica* Temminck. Matschie regarded *Philander* Tiedemann as a synonym of *Didelphis* Linnaeus.

Cabrera (1919) erected the generic epithet *Holothylax.* It is obvious that the name was intended to apply to the common gray four-eyed opossum. Cabrera cited *Didelphis opossum* Linnaeus as the type-species. Cabrera treated *Philander* Tiedemann as a senior synonym of *Caluromys* J. A. Allen. An entertaining discussion of the origin of the term "*Philander*" may be found in Cabrera and Yepes (1940).

Tate (1939) maintained that Tiedemann's *Philander virginianus* was a *Didelphis* (as in current usage). He also declared that *Didelphis* Linnaeus and *Philander* Brisson were not synonyms. He indicated that if Brisson's names were available then *Philander* was the proper generic epithet for the common gray four-eyed opossum.

Gilmore (1941) stated the name *Philander* should date from Brisson (1762) and that the name was applicable to the common gray four-eyed opossum.

Hopwood (1947) pointed out that *Philander* Brisson (1762) is not available owing to the non-binomial nature of Brisson. He also pointed out that names dating from Brisson (1762) are not available in any event owing to the fact that the latter work is essentially a reprint of Brisson (1756) and should, therefore, be regarded as pre-Linnaean. Hopwood thought that the name *Philander* should date from Gronovius, 1763 (which I have not seen). Hopwood followed Thomas (1888) in regarding *Didelphis philander* Linnaeus as the type-species of *Philander* Tiedemann and designated *Didelphis philander* as the type-species of *Philander* Gronovius.

In 1949, Hershkovitz concluded the name *Philander* Tiedemann should be applied to the common gray four-eyed opossum. No reasons were given for this action—it was merely stated that this was clearly the obvious course to take if one reads Tiedemann's description and synonymy. In spite of this, subsequent authors have followed Hershkovitz. Concerning the type-species of *Philander* Tiedemann, Hershkovitz wrote "As *P. virginianus* is virtually tautonymic [?], it is here designated genotype of *Philander* Tiedemann." He pointed out that since the names of Brisson *and* Gronovius are unavailable, the earliest authorship for *Philander* is that of Tiedemann.

Owing to the fact that the generic epithet *Philander* Tiedemann 1808 has not been applied to the proper animal (namely, the one presently known as *Metachirus nudicaudatus*) but has been applied in a most confusing manner to a number of different kinds of animals it would probably be best if it be suppressed. If this course of action meets with approval, a formal proposal will be drawn up for consideration by the International Commission on Zoological Nomenclature.

Metachirops Matschie 1916 is the proper generic epithet for the gray and black four-eyed opossums. Although Hershkovitz (1949) stated that *Didelphis opossum* Linnaeus was the type-species of *Metachirops*, *D.[idelphis] quica* was the only species mentioned on the occasion of the first proposal of the name (Matschie, *op. cit.*, p. 262). On p. 268, Matschie listed nine specific epithets to go with his *Metachirops*. One of these (the fifth) is *opossum*. Since I have been unable to find a formal proposal of a species to be regarded as the type-species of *Metachirops* and all evidence points to *quica* as being the most reasonable species to be so designated, *Didelphis quica* Temminck (1824) is here declared to be the type-species of *Metachirops* Matschie. In this regard, it should be noted that Hall and Kelson (1959) listed *quica* as the type although without explanation. Since the name *Metachirops* came into rather general use for the gray four-eyed opossum prior to Gilmore (1941) this name is the most desirable epithet for this animal for reasons other than sheer "legality."

I am grateful to Dr. Robert K. Enders who has been most helpful to me throughout this study. Dr. Dilford C. Carter and (Mrs.) Ruth M. Farrow supplied me with useful information and Dr. Hannelore E. Hinsch supplied the frozen opossums which were critical to my conclusions. Duane A. Schlitter, Drs. Charles O. Handley, Jr., and Karl F. Koopman kindly read the manuscript and made useful suggestions. The research upon which this publication is based was performed pursuant to Contract No. PH-43-67-59 with the National Institutes of Health, Public Health Service, Department of Health, Education and Welfare.

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A STUDY OF THE NEOTROPICAL RAIL *ANUROLIMNAS CASTANEICEPS* (AVES: RALLIDAE) WITH A DESCRIPTION OF A NEW SUBSPECIES

By Storrs L. Olson
Smithsonian Institution, Washington, D. C. 20560

On noting what appeared to be marked geographic variation among three specimens of the Chestnut-headed Crake, *Anurolimnas castaneiceps*, in the National Museum collections, I assembled a series of 57 skins of the species for comparison. As it is poorly known, I have summarized the little available information on this species from the literature as well as that obtained from the skins and their labels, in addition to investigating geographic variation.

The species was first described as *Porzana castaneiceps* by Sclater and Salvin (1868), who included it in a subgenus *Rufirallus* with the species now known as *Laterallus viridis*, *L. levraudi*, *L. ruber*, and *Amaurolimnas concolor*. The unique type was purchased from Gould and was received by him in 1854 from the Rio Napo, Ecuador. A plate depicting the type was subsequently published by Sclater and Salvin (1869). Salvin (1874:321) later discovered that the type of *Micropygia verreauxi* Bonaparte 1856 (labelled "Perou") was also a specimen of *castaneiceps*. Bonaparte's description, consisting only of the word "*major*," was considered by Salvin to be "utterly insufficient for the recognition of the species," and the name *verreauxi* was regarded by him as a nomen nudum. Whether or not this interpretation is correct, the name *verreauxi* has not been used for the species since, and the name *castaneiceps* definitely should be preserved.

Sharpe (1893) created the genus *Anurolimnas* with *castaneiceps* as the type and only species. Later (1894; 1899) he also included the species *hauxwelli* (= *Laterallus fasciatus* of current lists) in *Anurolimnas.* Peters (1934) removed *hauxwelli* from *Anurolimnas* and placed it in *Laterallus*, in which he was followed by Hellmayr and Conover (1942) and by most subsequent authors. On the basis of molt pattern, Stresemann and Stresemann (1966) returned *hauxwelli* (= *fasciatus*) to *Anurolimnas.* I, too, feel that it is the closest relative of *A. castaneiceps* (Olson, 1973).

Sharpe (1894) and Goodefellow (1902) listed additional specimens of *A. castaneiceps* from Ecuador. Chapman (1917) extended the known range of the species to La Morelia, Caquetá, Colombia, and later (1926:177) recorded specimens from three new localities in Ecuador, while noting that the La Morelia specimen "is paler throughout than any of our seven Ecuadorean birds, and its more slender feet and tarsi are brownish flesh-color instead of black as in the Ecuadorean specimen [sic]." Although "subsp. nov." was pencilled on the label of the La Morelia specimen, no notice of it as a new subspecies was published. Northern birds are indeed separable from those from most of Ecuador and Peru and may now be known as:

Anurolimnas castaneiceps coccineipes, new subspecies

Holotype: USNM no. 445909, female, from Puerto Venecia, 15 km SE of Florencia, Caquetá, Colombia. Collected 2 June 1952 by M. A. Carriker, Jr. (collector's no. 22878).

Measurements of type: wing (flat) 114, culmen (from base) 22.9, tarsus 49.9, middle toe without claw 36.8 mm.

Diagnosis: Similar to *A. castaneiceps castaneiceps* but in dried skins the tarsi and toes are a conspicuous light yellowish orange rather than dark fuscous (see notes on soft part colors); the plumage is similar to *castaneiceps* but the dorsum is more greenish (less brown), the olive brown of the abdomen is more greenish and tends not to extend as far up the breast as in *castaneiceps*, and the chestnut of the underparts is usually lighter (more orange, less brown).

Range: Southwestern Colombia (Departments of Putumayo and Caquetá) and northeastern Ecuador (northern part of Napo Pastaza Province).

Paratypes: (see specimens listed under distribution).

Etymology: Latin; *coccineus*—red, *pes*—foot.

Individual variation: Measurements (Table 1) disclose no significant size differences between the races of *A. castaneiceps.* Specimens from Caquetá at a glance look smaller than others of *coccineipes* or *castaneiceps* but as measurements do not substantiate this impression, the appearance

TABLE 1. Measurements in millimeters of the two races of *Anurolimnas castaneiceps*.

	Wing (flat)	Culmen (from base)	Tarsus	Middle toe without claw
♂ *castaneiceps* (n = 20)	111–126 (118)	22.1–25.7 (24.1)	47.9–57.1 (52.3)	35.3–40.9 (37.7)
♀ *castaneiceps* (n = 22)	109–124* (115)	21.6–24.9 (22.7)	46.8–53.4 (50.2)	33.8–38.6 (36.3)
♂ *coccineipes* (n = 6)	113–122 (118)	22.5–24.4 (23.4)	49.8–56.1 (52.8)	35.1–37.5 (36.4)
♀ *coccineipes* (n = 7)	112–119 (116)	21.1–24.7 (23.2)	49.9–53.3 (51.3)	35.1–38.8 (36.6)

* Only one female (missexed?) had the wing greater than 119 mm.

is probably due to the "make" of the skins. The admittedly small samples suggest that there is a slight sexual dimorphism in size (males larger). The alleged slenderness (Chapman 1926) of the tarsi and toes of *coccineipes* does not hold up on comparison with adequate material.

There is a considerable amount of variation in the amount of chestnut on the crown and nape of both races that does not appear to be correlated with either age or sex. In some specimens the entire crown and nape is chestnut, while in others the drab dorsal coloration extends up the nape onto the middle of the crown, leaving only the forecrown chestnut. There is every degree of intermediacy, including some birds in which the nape is rufous leaving a spot of olive drab on the posterior crown. The extent of the chestnut on the breast also varies; in some specimens it stops in the middle of the breast and in others it extends farther down onto the abdomen. The latter condition prevails in *coccineipes*, the former in *castaneiceps*.

Within *coccineipes* there is some additional geographic variation. The specimens from Caquetá (including the type and the La Morelia specimen) are lighter both above and below than those from other localities. The single Ecuadorean specimen and those from Putumayo are exceptionally dark above. The throat color varies in both races from chestnut to nearly white, with the lightest individuals from Caquetá.

In a few individuals of both races there are small scattered pale flecks in the primaries and in the primary shafts. In one specimen of *castaneiceps* (AMNH 254919) there is a mottled patch of dark buff on the inner web of the third from the outermost primaries and in one *coccineipes* (FMNH 24993) there is a large pale-colored patch in the fourth from the outermost primaries.

Juvenal plumage: Only one of the specimens seen in this study was in juvenal plumage (ROM 107591, female; Mocoa, Putumayo, Colombia; 7 October 1969). As this plumage has not previously been recorded, it merits description here. The entire breast and abdomen is dull brown like the abdomen of the adult but darker and with a slightly reddish tinge. There are some scattered chestnut feathers of the adult plumage in the cheeks, sides of neck, throat, and breast. The throat is light grayish buff. The dorsum, nape, and crown are brownish olive, darker than in the adult. The forecrown is dull chestnut brown, much duller than in the adult.

Soft part colors: Feet.—As mentioned in the diagnosis above, the foot color differs dramatically in the two races of *A. castaneiceps*. In the nominate race the feet are an apparently unnoteworthy dull color as only four of the 50 specimens examined by me, or for me, had the foot color noted on the label. This was variously recorded as "braun," "olive-green," "gray," or "dark red"—probably reflecting a greater variability in the color terminology of the collectors than in the foot color of the birds. In the dried skins the foot color is dark fuscous, with some individuals a slightly lighter dark-tan color.

FIG. 1. Distribution of *Anurolimnas castaneiceps castaneiceps* (solid dots) and *Anurolimnas castaneiceps coccineipes*, new subspecies (open circles). Numbers refer to localities mentioned in the text. Balta, Rio Curanja, Peru, the site of the southernmost known specimen of *castaneiceps*, is approximately 700 km south of the origin of the arrow. Scale = 100 km.

In *coccineipes* the foot color is conspicuous and was recorded in 8 of the 13 specimens as "red" (4), "reddish" (3), or "pink" (1). Another specimen (ANSP 164723) is annotated "legs orange-red when received" and is the source of Meyer de Schauensee's (1964, 1970) description of the foot color as "orange-red" in the species as a whole. In dried skins the much lighter colored tarsi, toes, and exposed tibiae of *coccineipes* are so conspicuous that they may be distinguished from *castaneiceps* at a glance. The feet in the dried specimens range in color from light ochraceous yellow to a clear yellow-orange. The plantar surface of the intertarsal joints and the bottoms of the toes are dark in most specimens. The feet of the single juvenile, although recorded on the label as "reddish," are darker and more brownish than in the adults, but are still lighter than in *castaneiceps*.

Bill.—With two exceptions, where the bill color is recorded, it is mentioned only as "black." One specimen (FMNH 17397) is noted as having the "max. black with green below nostril, mand. green with black point," and another (LSU 35128) as having the bill "pea green with black ridge on culmen." These two descriptions are more accurate, as even in the dried skins of both races, the lighter greenish area below the nostril and on the mandible is evident.

Iris.—The iris in a specimen of *castaneiceps* is described as "dark brown" by Goodfellow (1902) but is not noted at all on the label of the same specimen (AMNH 472029) although the other soft part colors are recorded. The published description in this case may be an error as the iris color is given as "red," "red-orange" or "carminrot" in three specimens of *castaneiceps* and as "red" in three specimens of *coccineipes*. In five other *coccineipes*, including the single juvenile, it is recorded as "yellow" or "yellowish-brown." The discrepancy is possibly due to post-mortem changes. I have noticed in dying individuals of the Giant Cowbird (*Scaphidura oryzivora*) and Ruddy Ground-Dove (*Columbina talpacoti*) that the iris color changed within seconds from bright red, to orange, to pale straw-yellow as the bird died. Perhaps the same phenomenon takes place in *A. castaneiceps*.

Distribution: *Anurolimnas castaneiceps* has a limited range in northwestern South America, as yet being found only in eastern Ecuador, eastern Peru, and southwestern Colombia. In the following paragraphs, the bracketed numbers in boldface refer to the numbered localities in Figure 1.

Specimens from Peru and all but one from Ecuador are of the nominate race, *castaneiceps*. Most of those from Ecuador come from a small area [**1**] in the province of Napo Pastaza, northwest of the upper part of the Rio Napo, including the following localities: Rio Payamino (ANSP 162754—the northernmost record of the race); upper Rio Suno (MCZ 94282); Rio Suno above Avila (AMNH 178890 to 94); Rio Suno (BMNH 1953.68.54 and 55); lower Rio Suno (AMNH 185261, 63, and 64; ANSP 82988); El Loreto [on the Rio Suno] (ANSP 162752); San José (ANSP 162755 and 56) and below San José (AMNH 185265 and 68, MCZ 137751, USNM 323004, MLZOC Ec-A720) are indicated by Chapman (1927, pl. 3) to refer to a "San José de Sumaco" but there is no San José on the Rio Sumaco and the locality refers to San José Viejo on the nearby Rio Suno; Rio Pucuno (MCZ 263758); Concepción [= Cotapino of Norton 1965; on the Rio Pucuno] (FMNH 8027, MLZOC Ec-H1032 and 36); Cerro Galera (ANSP 148244); Archidona (AMNH 472029). A specimen (FMNH 8028) labelled Raya Yaco [= Yacu, which signifies "river" in Quechua], a locality I was unable to find, is probably from this same area, as it was collected by the Olallas on 2 June 1930 and they had been in Concepción on 20 May of the same year. I have also been unable to find the locality of one Ecuadorean specimen (ANSP 148243) labelled "Chaquisca Yacu" but it is probably from somewhere in Napo Pastaza.

Elsewhere in Napo Pastaza there are five specimens of *castaneiceps* from farther south at Sarayacu [**2**] (BMNH 1889.11.20.135 to 137; FMNH 9022 and 9638); one from Montalvo [**3**] (ANSP 162753); and five from Rio Tigre at the headwaters of the Rio Tigre [4] (FMNH 10772 to 74 and 18382; UMMZ 7330) which is on the present Peruvian border.

A disjunct record is of a specimen (AMNH 166685) taken by G. K. Cherrie in 1920 and marked "Zamora, Rio Zamora, Prov. de Loja" [5]. This is now in the province of Santiago-Zamora, Ecuador, and represents the westernmost known locality for the species. Six specimens collected by the Olallas in 1925 (AMNH 254918, 19, 21, and 23; ANSP 82989; MCZ 137752) are labelled "voca [sic = boca] Rio Cururay" [6], a locality that was in Ecuador but which has been in Peru since the 1942 boundary settlement (Parkes 1970:212). These specimens considerably antedate a Peruvian record of the species from Quistococha, Loreto [7] reported *fide* Koepcke in Meyer de Schauensee (1966). A specimen (AMNH 406826) labelled only "Boca Santiago" may possibly pertain to the mouth of the Rio Santiago [8] emptying into the Rio Marañon, in which case it, too, would have been taken in what is now Peru. A recently collected specimen (LSU 35128) from Balta, on the Rio Curanja, Loreto, Peru, extends the range of the species much farther south than previously known, as this locality is over 700 km south of Quistococha. This indicates that the range of the species is probably much more extensive than as yet known and it no doubt includes westernmost Brazil.

The race *coccineipes* is known from thirteen specimens, all but one from Colombia. In the Department of Caquetá it has been taken 10 km SE of Florencia [9] (MVZ 120452); 15 km SE of Florencia at Puerto Venecia [9] (USNM 445909 and 10); and at La Morelia [10] (AMNH 115701). From the Dapartment of Putumayo there are specimens from Mocoa [11] (ROM 107591); Umbria [12] (FMNH 17397); and Rio San Miguel [13] (ANSP 164723). Also from Putumayo there are four specimens labelled "Guascayaco" (FMNH 24992 and 3; YPM 79034; ROM 101158) and one from "Guayuyaco" (ROM 103820), neither of which names I was able to locate.

The single Ecuadorean specimen of *coccineipes* (LSU 52911) comes from Santa Cecilia [14] on the Rio Aguarico, Napo Pastaza. No more than 50 to 70 km separate this locality from the nearest known occurrence of the nominate race.

Discussion: In none of the specimens examined in this study was there any evidence of intergradation between the two subspecies of *A. castaneiceps*. Physiographic barriers that might have acted to isolate the two races are not apparent. Nor is there any apparent reason why selection should favor such bright, distinctive foot coloration in one population and not in the other. Indeed, as Phillips (1959:24) has remarked, subspecific differences in soft part colors are rare in birds.

Virtually nothing is known of *Anurolimnas castaneiceps* in life. The only comments I have found are those of Goodfellow (1902:230) who remarked that his specimen from Archidona, Ecuador "was shot among the thick undergrowth of the forest," and of Meyer de Schauensee who gives the habitat in Colombia as "banks of forest streams" (1964:72) or simply "forest" (1970:67). It is an inhabitant of the tropical zone and according to skin labels has been taken at altitudes from 200 to 1500 m. The nest and eggs are apparently unknown. Specimens have been taken during all months of the year. Nine specimens of *coccineipes* have the condition of the gonads noted. The juvenile female, taken in October in Putumayo, was recorded as having the ovary 8 × 10 mm, while two adult females taken in September and October had ovaries 5 × 10 and 15 × 20 mm, respectively. Three males taken in October had testes 2 × 4, 3 × 6, and 5 × 10 mm and thus probably were not breeding. A February female from Caquetá had the largest ovum only 1 mm in diameter. A male and female taken in June in Caquetá were noted as having the gonads enlarged, which, with the October juvenile, are the only possible indications as yet of the breeding season in this species.

Several collectors noted the colloquial names of the species—usually "pituro" or "piturito" but also "pituro grande" and "gallaseta" (= gallacita?). One may imagine that these names apply to a number of other species as well. The vocalizations are unrecorded. The weight of a female *coccineipes* (MVZ 120452) was given as 126.2 g.

Stresemann and Stresemann (1966) noted that the primary molt in this species is ascendent, which was true of the molting specimens I examined. Specimens with primaries in sheaths were represented in the months of February (1), March (2), and August (1).

Nothing else seems to be known of *Anurolimnas castaneiceps.*

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PROCEEDINGS
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STUDIES ON DECAPOD CRUSTACEA FROM THE INDIAN RIVER REGION OF FLORIDA. I. *ALPHEUS THOMASI*, NEW SPECIES, A NEW SNAPPING SHRIMP FROM THE SUBTROPICAL EAST COAST OF FLORIDA (CRUSTACEA: DECAPODA: CARIDEA)

By Gary Y. Hendrix and Robert H. Gore
Everglades National Park, Homestead, Florida 33030, and
Smithsonian Institution, Ft. Pierce, Florida 33450

Snapping shrimps of the genus *Alpheus* are a common and colorful component in the tropical and subtropical waters of the Florida peninsula. Until recently, however, no systematic survey of this genus as it occurred in Floridan waters had been undertaken. During the course of such a survey in south Florida in 1970, one of us, (GYH) collected specimens of a form which was recognized as being undescribed. Unfortunately, the press of time and other matters prevented immediate publication of the new species, (Hendrix, 1971:137 unpubl.). Subsequently, the second author collected additional material of the new species while carrying out a survey of the decapod crustaceans of the Indian River region on the east central Florida coast. We present here a complete description based both on this new material and that already cited in Hendrix.

A more comprehensive report of the decapod crustaceans of the Indian River is presently undergoing preparation.

In the following description, the abbreviation cl refers to carapace length measured from the tip of the rostrum to the truncated posterior margin of the carapace; USNM refers to the National Museum of Natural History, Washington, D. C.; HBFL refers to The Harbor Branch Foundation Laboratory, Ft. Pierce, Florida.

Grateful appreciation and thanks are extended to Dr. Fenner

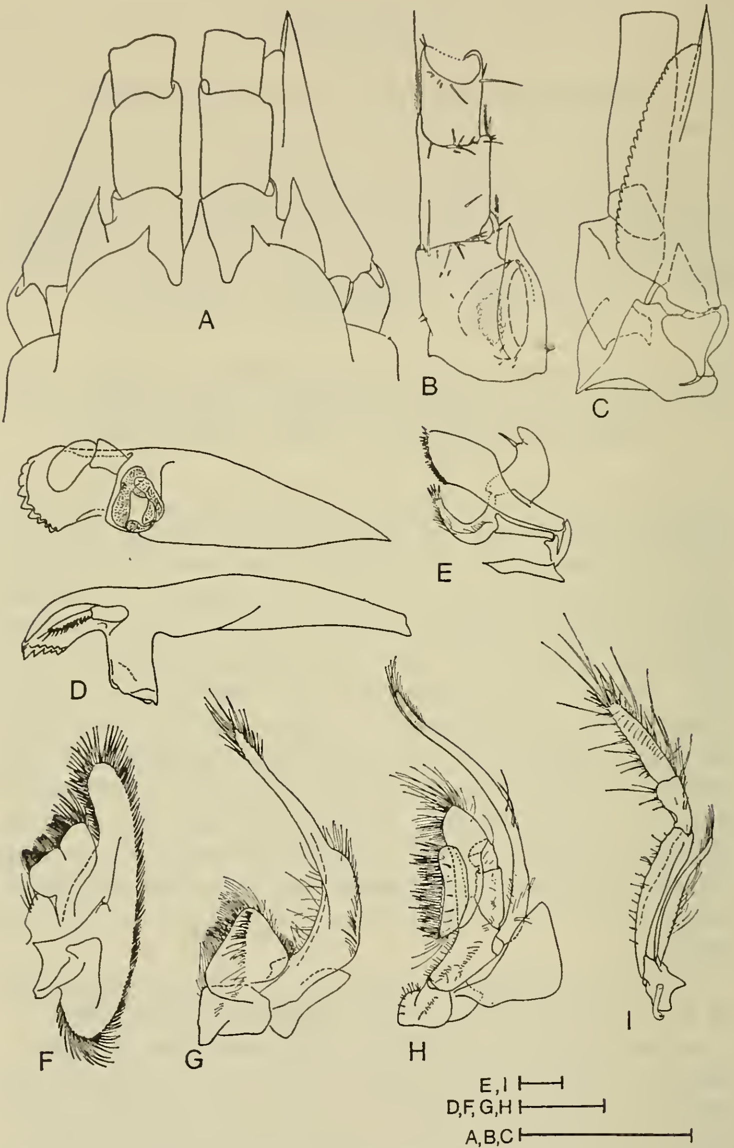

FIG. 1. *Alpheus thomasi*, new species. Paratypic and Holotypic females: A, anterior carapace region. B, antennular peduncle. C, antennal peduncle and scale. D, right mandible, posterior view (upper), dorsal view (lower). E, left maxillule. F, left maxilla. G, left maxilliped

A. Chace, Jr., (USNM) for his generous aid and advice concerning the new species. Dr. Lawrence G. Abele, Smithsonian Tropical Research Institute, Balboa, Canal Zone, critically read the manuscript. We also acknowledge the very able and willing help of Mrs. Bonnie Wicken (HBFL) during a collecting trip on which the paratypic material from Ft. Pierce was obtained, and that of Messrs. R. Grant Gilmore and Gregg Stanton for obtaining the paratypic specimens from Jupiter Inlet.

Alpheus thomasi, new species

Figures 1 to 3

Material: Holotype: female, ovigerous, cl 9.3 mm; Virginia Beach, Virginia Key, Miami, Florida; 1 m depth, among tubes of sabellariid polychaete worms; 14 August 1970; coll. Gary Hendrix; USNM 134698.—Paratypes: mated pair; male, cl 4.8 mm, female cl 3.8 mm; Cape Florida, Key Biscayne, Florida; 1 m depth, among tubes of sabellariid polychaete worms; 22 August 1969; coll. Gary Hendrix; USNM 134699.—female, cl 5.0 mm; Bear Cut, Key Biscayne, Florida; 1–3 m depth, near rocky platform, among tubes of sabellariid polychaete worms; 10 June 1969; coll. Gary Hendrix; USNM 134700.—2 males, cl 6.0 and 7.5 mm; 1 female, ovigerous, cl 7.7 mm; Atlantic Ocean, St. Lucie County, Florida; Walton Rocks, in phragmatopomid worm reef in surf zone along shore; 19 January 1973; coll. Robert H. Gore, Bonnie S. Wicken; HBFL 89:432.—2 juveniles, cl 2.2 and 3.4 mm; Jupiter Inlet, Palm Beach County, Florida; intertidal area by jetties, south side of inlet, inside coquinoid limestone rocks; 8 March 1973; coll. R. Grant Gilmore, Gregg R. Stanton; HBFL 89:505.

Diagnosis: Rostrum dorsally rounded, with adrostral depressions; ocular hoods spined; ventrolateral tooth on basicerite not overreaching stylocerite; major first chela not noticeably twisted, a sinus on proximolateral dorsal surface, palm without sharp tooth at lateral articulation with movable finger, merus with sharp tooth on distal mesial flexor margin; pereiopods 3 and 4 with movable spine on ischium.

Description: Rostrum (Fig. 1,A) triangular, dorsally rounded, falling short of disto-mesial margin of proximal article of antennular peduncle, separated anteriorly from ocular hoods by shallow adrostral depressions blending into carapace just posterior to ocular hoods. Latter prominent,

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1. H, left maxilliped 2. I, left maxilliped 3. Female, paratype, USNM 134700, A–C. Female, holotype, USNM 134698, D–I. Scale lines equal 1 mm.

anteriorly produced, armed on anterior margin with short, small sharp tooth directed forward and slightly mesially, shorter than rostrum. Anterior carapace margin descending vertically from ocular hood to ventral margin of basal antennal segment, continuing ventrad and posteriad to base of maxilliped 3. Posterior carapace margin with distinct dorsolateral notch.

Eyes entirely concealed by ocular hoods.

Antennule (Fig. 1,B) with stylocerite dorsally flattened, prolonged anteriorly into sharp point reaching to or just beyond anterolateral margin of basal antennular segment; basal segment with triangular-shaped carina on ventromesial surface; second segment subequal to basal, about twice as long as third.

Scaphocerite (Fig. 1,C) three times longer than wide; distal portion of stout spine overreaching antennular peduncle but equal to carpocerite; lamella well developed, distal portion narrow, falling short of tip of spine, but equal to antennular peduncle. Basicerite with sharp lateral tooth below articulation of scaphocerite, tooth equal to about one-fifth length of same, but shorter than stylocerite.

Mouth parts (Fig. 1,D–I) as illustrated; mandible (Fig. 1,D) with nine or ten teeth on incisor process. Maxilliped 3 (Fig. 1,I) falling short of carpocerite tip, exopod of same overreaching anterior margin of antepenultimate article of endopod.

Major first pereiopod (Fig. 2,A,B) overreaching carpocerite by most of chela; latter compressed; subcylindrical, lacking dorsal or ventral notches, but with faint shallow groove on lateral and mesial surfaces; movable finger slightly less than one-fourth length of chela, compressed, slightly rotated to plane of chela, distally arched, one and one-half times longer than high, tip compressed and truncate, ventral margin with sinus distal to molar process; molar process at angle to long axis of finger, mesial surface bulbous, a low setose ridge encircling proximal ventral surface, ventral margin nearly parallel to long axis of finger; lateral surface of palm with shallow flattened depression extending from opposable margin of fixed finger along same, onto, and blending with general area at midlength of palm; depression blends additionally into ridge along ventral margin of palm causing same to appear more flat than round; palm narrowing distally proximal to articulation of fingers; mesial surface of palm with narrow, shallow dorsal groove deepening distally but not forming dorsal notch; distomesial margin of palm convex and serrate prior to articulation with movable finger; fixed finger with socket to receive molar process on dactyl, opposable margin short, carinate, tip of finger somewhat concave mesially, directed laterally to accommodate movable finger; merus with small sharp tooth on distal mesial flexor margin.

Minor first pereiopod (Fig. 2,C,D) overreaching carpocerite by most of chela; latter subcylindrical, without dorsal or ventral notches, faint groove on dorsomesial margin; fixed finger slightly more than half length of chela, subcylindrical; mesial surface of palm with low indistinct ridge extending distally from middorsal surface onto distal margin, ending at articulation with movable finger; distal margin there produced into prominent acute tooth, shallow depression produced between dorsal margin and aforementioned ridge; merus with small sharp tooth on distomesial flexor margin.

Pereiopod 2 (Fig. 2,E) extending beyond carpocerite by length of chela and distal four articles of carpus; fixed finger equal to half chela length; latter nearly as long as distal three articles of five comprising carpus; ratio of same in decreasing length as follows: 1, 2 = 5, 3 = 4; merus equal to proximal two articles of carpus, about equal to ischium.

Pereiopod 3 (Fig. 2,F) longer than carpocerite by dactyl and two thirds of propodus; dactyl unarmed, but extensor margin with few setae arising from notch, flexor margin entire; propodus four times longer than dactyl, ventral margin armed with row of six or seven stout spines; carpus two-thirds length of propodus, distal extensor margin projecting somewhat beyond articulation with propodus; merus about four times longer than wide, distal flexor margin unarmed, this article about twice as long as carpus, three times longer than ischium; latter armed with ventral movable spine.

Pereiopod 4 longer than carpocerite by dactyl and distal third of propodus, similar to pereiopod 3 but shorter and more slender; ischium with ventral movable spine.

Pereiopod 5 (Fig. 2,G) not reaching end of carpocerite; dactyl unarmed; propodus three times length of dactyl, armed ventrally with row of five or six stout spines, distal third with several lateral bands of comb-like setae; merus about one and one-half times longer than carpus, twice as long as ischium; latter unarmed.

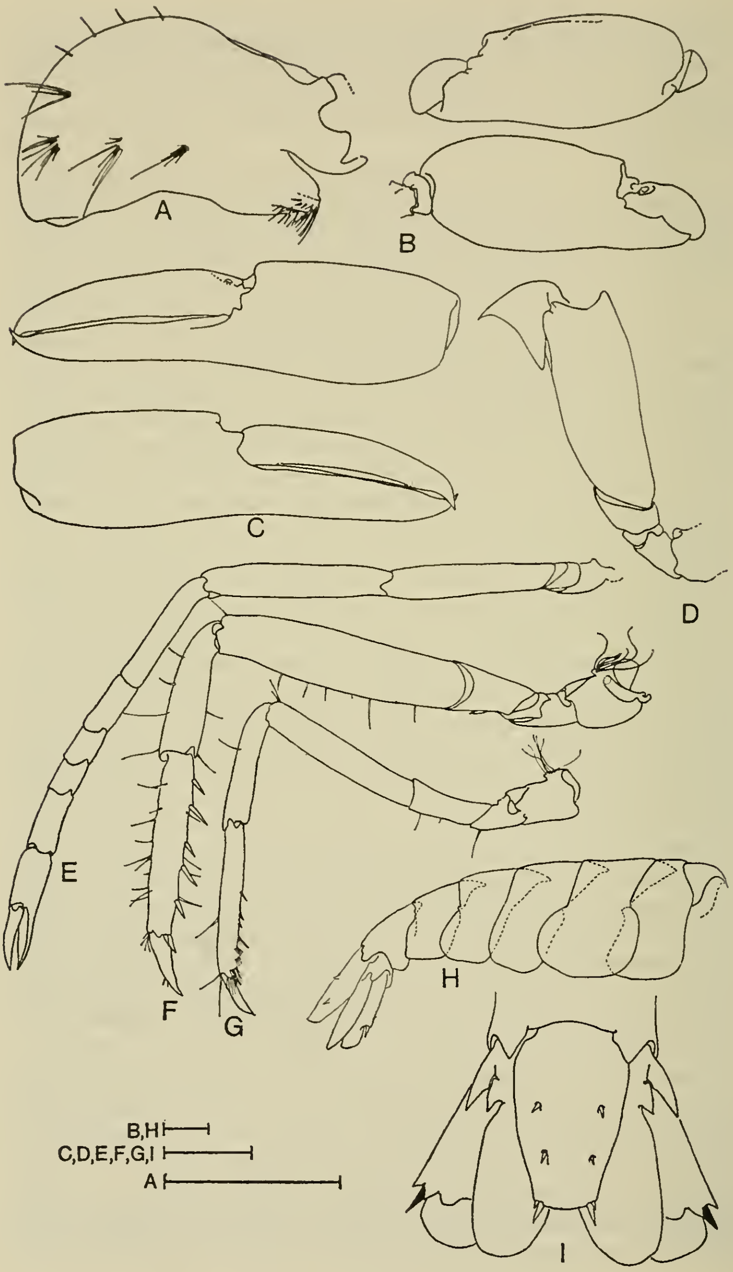
Abdominal pleura (Fig. 2,H) of four anterior somites broadly rounded, fifth subrectangularly so, sixth truncate above, sharply rounded below articulation of uropod.

Male pleopod 2 with appendix masculina subequal to appendix interna.

Telson (Fig. 2,I) about one-third longer than wide, anterior margin nearly twice as wide as posterior, lateral margin faintly sinuous or straight; dorsal surface with two pairs of stout spines, anterior pair slightly anterior to telson midlength, posterior pair halfway between preceding and posterior telson-margin; latter weakly convex with two pairs of stout lateral spines, mesial pair twice as long as adjacent pair, with double row of elongate setae between.

Uropodal basal segment with two stout, pointed teeth directed posteriorly, separated by narrow cleft. Exopod of same with conspicuous, dark-colored spine at posterolateral margin in socket formed by two stout triangular teeth; spines dark-colored in both sexes.

Color: Carapace and abdomen (Fig. 3) with nine distinct transverse bands of brown, blue gray or orange on clear to white background as follows: first, extending along anterior margin of carapace, including


A
B
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A

rostrum, and outlining mesial and posterior margin of eyes; a small spot of brown immediately posterior to rostrum; second, originating in region of pereiopod 3, bordered by a narrow band of yellow or orange; third, originating in region of pereiopod 5, also with yellow or orange border; fourth, band extreme posterior margin of carapace and anterior portion of abdominal somite 1; pair of yellow spots anterior to band on either side of carapace, yellow border of band broken posteriorly; fifth, on abdominal somite 2, bifurcating conspicuously on pleura of somite, also bordered in yellow anteriorly and posteriorly; sixth through ninth, on abdominal somites 3 to 6, respectively, not bifurcate but bordered as before in yellow or orange. Telson with yellow T-shaped mark on anterodorsal surface, midregion with broad dark blue, blue-gray or brown transverse band connecting similar band on uropods; posterior margin of telson bordered in yellow. Uropodal lateral tooth yellow, speckled yellow or clear; lateral and posterior margins of exopod and endopod yellow; conspicuous dark-colored spine at posterolateral margin of exopod.

Carpocerite brown, scaphocerite clear, flagellum faint blue. Maxilliped 3 with scattered red chromatophores. Major first chela with three irregular reddish-brown or tan bands separated by clear to yellow, pale yellow-white, or white areas; midportion of movable finger dark gray or brown, finger with white tip; carpus and merus brown. Minor first chela with one broad reddish-brown band across middle of palm, dark gray or blue-gray band across midlength of both fingers.

Measurements: Smallest ovigerous female from St. Lucie County, Florida was 7.7 mm; juveniles from Jupiter Inlet measured 2.2 and 3.4 mm respectively.

Habitat: This species appears to be restricted to shallow water, among the crevices and spaces of sand grain tubes constructed by sabellariid polychaete worms (*Phragmatopoma lapidosa* Kinberg, 1867). These worms form extensive "reefs" adjacent to sandy and grassy areas of sufficient tidal flow in south Florida, as well as in the surf zone along exposed shores in east central Florida.

Distribution: Presently known from the type-locality and nearby vicinity of Cape Florida, Key Biscayne, Dade County; and from Jupiter Inlet in Palm Beach County, and Walton Rocks, St. Lucie County, about 5 miles south of Ft. Pierce, Florida. All localities are on the southeastern or central eastern coast of Florida.

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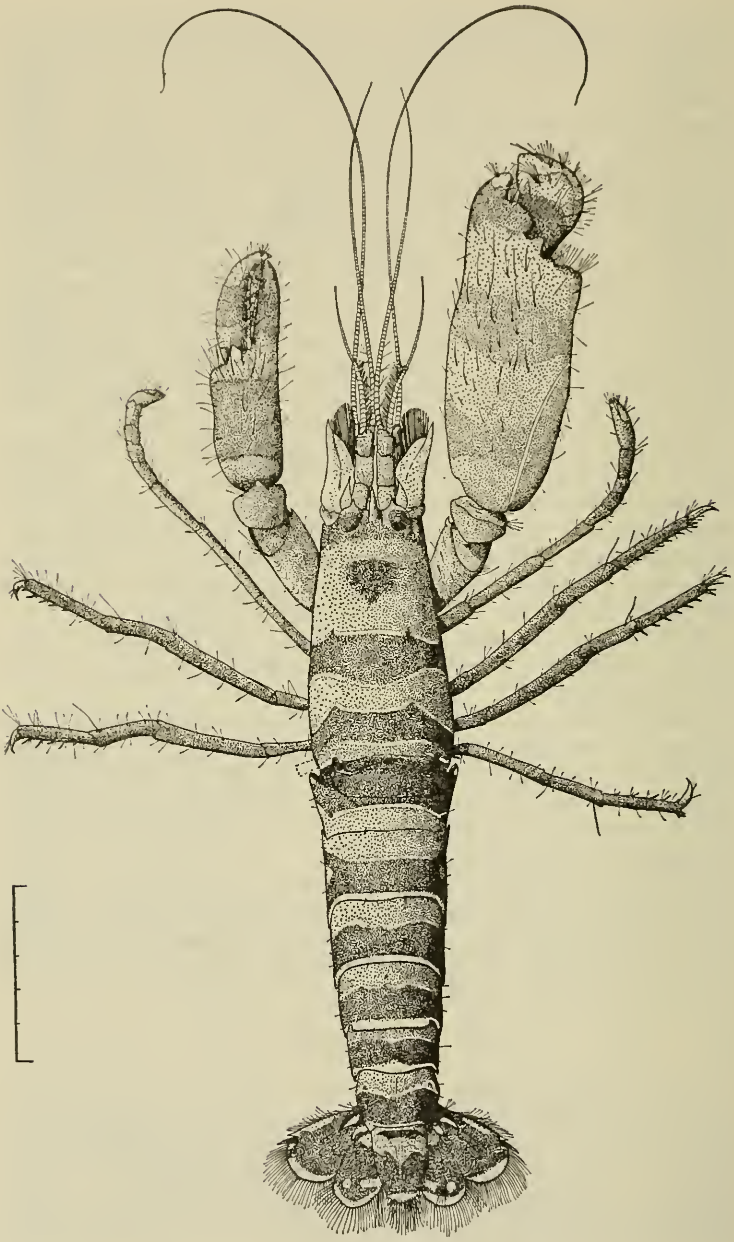
FIG. 2. *Alpheus thomasi*, new species. Paratypic male and female: A, dactyl, major chela. B, right major chela, mesial view (upper), lateral view (lower). C, left minor chela, lateral view (upper), mesial view (lower). D, merus, left pereiopod 1. E, left pereiopod 2. F, left pereiopod 3. G, left pereiopod 5. H, abdomen, lateral view. I, telson and uropods. Male, paratype, USNM 134699, A–D. Female, paratype, USNM 134700, E–I. Scale lines equal 1 mm.



Etymology: We honor colleague, friend, and fellow sybarite in naming this species after Dr. Lowell P. Thomas, University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami, Florida.

Discussion: The possession of armed ocular hoods and a conspicuous dark-colored spine at the posterolateral corner of the uropodal exopod shows that *Alpheus thomasi* belongs to the *Macrochirus* group of the genus. Other species sharing these characters include *Alpheus formosus* Gibbes, 1850, and *A. armatus* Rathbun, 1901. The new species may be separated from *A. formosus* by its dorsally rounded rostrum, its more massive major chela, and by its non-balaeniceps minor chela. In *A. formosus* the rostrum is flattened, the major chela is not as deep-bodied, and the minor chela is balaeniceps in the male. *Alpheus armatus* also differs from the new species by its flattened rostrum, plus an extra ocular tooth and a noticeable tooth posterior to the rostrum. In addition, the chelipeds of *A. armatus* are conspicuously tuberculate, while those of *A. thomasi* are smooth. Other closely related species include *Alpheus ridleyi* Pocock, 1890 (= *A. nigrospinatus* Rankin, 1898), *A. fagei* Crosnier and Forest, 1965, *A. rugimanus* A. Milne Edwards, 1878, and *A. amblyonyx* Chace, 1972. However, all but the latter species lack ischial spines on pereiopods 3 and 4. In addition, the major first chela in *A. ridleyi* is notched dorsally whereas only a sinus appears in *A. thomasi*; the major chela is more noticeably setose overall in *A. fagei* and *A. rugimanus* while being more or less setose primarily near the articulation of the movable finger in *A. thomasi*. The scaphocerite spine does not surpass the carpocerite and is nearly equal to the length of the antennular peduncle in *A. fagei*, whereas it equals the carpocerite and surpasses the antennular peduncle in *A. thomasi*. *A. rugimanus* possesses two small spinules on the distal extensor margin of pereiopods 3 and 4, which are lacking in *A. thomasi*. The basicerite lateral spine clearly extends beyond the stylocerite in *A. rugimanus*, whereas in *A. thomasi*, as in *A. fagei*, the stylocerite is longer. While *A. amblyonyx* has ischial spines on pereiopods 3 and 4, and the basicerite spine is also shorter than the stylocerite, this species may be separated from *A. thomasi* by its twisted major first chela, and by the presence of a distinct sharp tooth on the palm of that appendage at the mesiolateral articulation with the movable finger; both features are lacking in the new species.

Remarks: *Alpheus fagei* and *A. rugimanus* are eastern Atlantic species which are not, so far as is known, found in sabellariid worm reefs, but seem instead to prefer hard bottom of rocks, coral, and calcareous algae (Crosnier and Forest, 1966:234). Both *A. ridleyi* and *A. amblyonyx* are found in the Caribbean but have not yet been reported from Florida,

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FIG. 3. *Alpheus thomasi*, new species. Male, paratype, HBFL 89:432. Left pereiopod 5 missing, but position indicated. Scale equals 5 mm.

and both have also been collected in coral or coral-associated habitats (see Chace, 1972).

Perhaps the most distinctive field character separating the previously mentioned Caribbean species from *A. thomasi* is the distinctly banded color pattern of the new species (Fig. 3). As such, it enables immediate identification since only *Alpheus armillatus* H. Milne Edwards, 1837, is similarly banded, and that species can be distinguished both by color and by other morphological features from *A. thomasi*. *Alpheus armillatus* is also more properly an estuarine or grass flat species which would not be expected to occur in the sabellariid worm reef habitat in Florida.

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PROCEEDINGS
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THE BIONOMICS, IMMATURE STAGES, AND DISTRIBUTION OF THE RARE PREDACIOUS WATER BEETLE, *HOPERIUS PLANATUS* (COLEOPTERA:DYTISCIDAE)

By Paul J. Spangler
Smithsonian Institution, Washington, D.C. 20560

The genus *Hoperius* was described by Fall (1927) for the species *H. planatus* from Hope, Arkansas. The species is rare in collections and it was an enigma to me until January 1968 when I identified three specimens as *H. planatus* from a shipment of water beetles received for determination from Dr. Vernon M. Kirk. A short time later, I identified two additional specimens of *H. planatus* that were collected by Mr. John L. Hellman at a blacklight operated near a woodland pond at Easton, Talbot County, Maryland. The occurrence of *H. planatus* nearby in Maryland prompted the investigation of its immature stages and resulted in this report.

I am grateful to the following individuals for the loan of their specimens or specimens in their care; the acronyms following the names will identify the source of the material listed under specimens examined: Dr. Robert D. Gordon (RDG); Dr. Vernon M. Kirk (VMK); Mr. Warren Steiner (WS); Ms. Janice White, Museum of Comparative Zoology, Harvard University (MCZ). I also thank Dr. James Matta, Mr. John L. Hellman, and Ms. Joyce Utmar for donating specimens of *H. planatus* to the National Museum of Natural History, Smithsonian Institution (USNM).

I also tender my thanks to Mr. Michael Druckenbrod, Smithsonian Institution staff artist, for the illustrations of the adult, larva, and pupa of *planatus* included in this study.

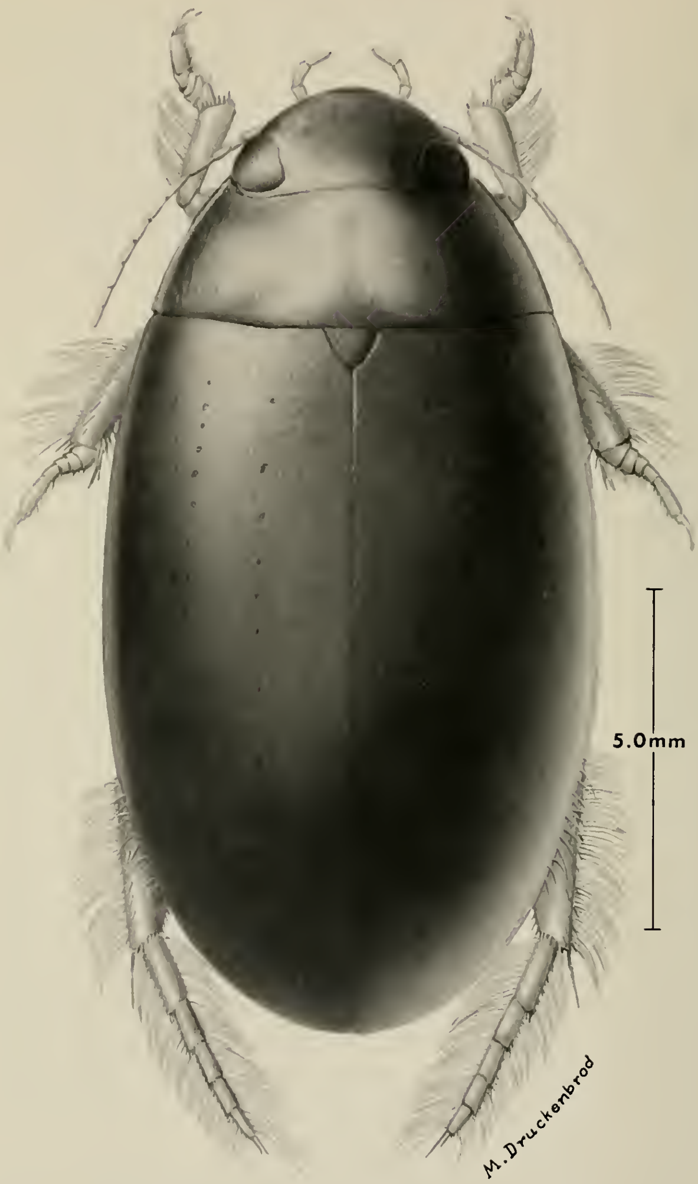

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Fig. 1. *Hoperius planatus* Fall, adult ♂, habitus.

Genus *Hoperius* Fall

Hoperius Fall, 1927:177; type-species, *Hoperius planatus*, by monotypy.—Leech, 1956:312.—Spangler, 1972:429.

Hoperius planatus Fall

Figures 1–6, 12

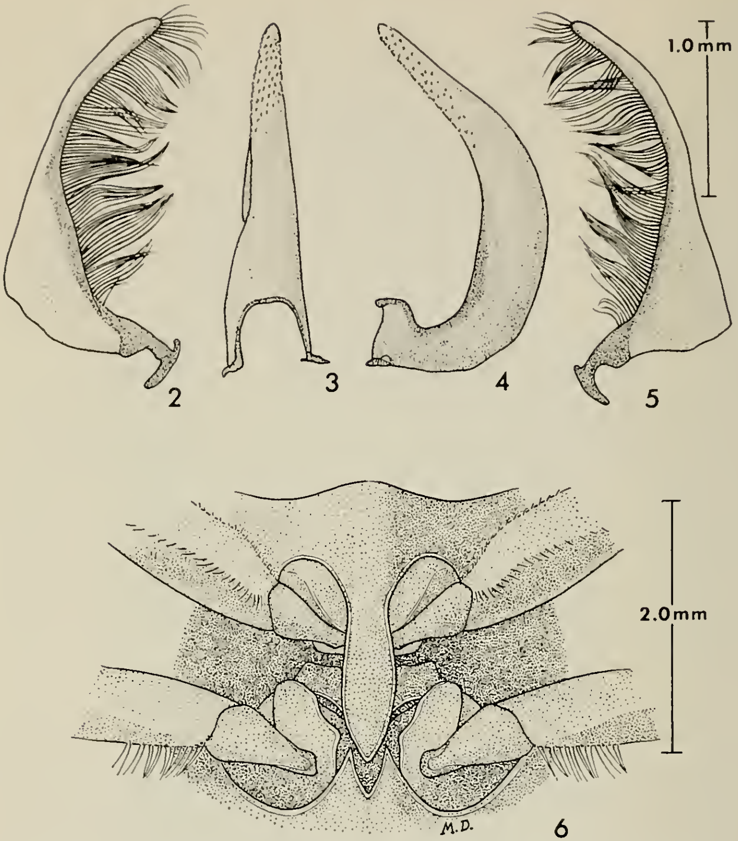
Hoperius planatus Fall, 1927:179; type-locality: Hope, Hempstead County, Arkansas; type, ♂, in the Museum of Comparative Zoology, Harvard University, examined.—Blackwelder, 1939:17.—Kirk, 1969:20.

The male type-specimen was described adequately by Fall. The female of *H. planatus* is similar to but differs from the male (Figs. 1–6) as follows. Females average slightly longer (13 mm–14 mm) than males (12 mm–13 mm); pro- and mesotarsus of female not broadened, lacking sucker bearing setae; inner (lower) surface of hind tibia and outer (upper) surface of hind tarsus of female lack the long golden natatory setae that are present on inner as well as outer surfaces of both tibia and tarsus of male.

Bionomics

The discovery of *planatus* near the woodland pond suggested that it was a woodland-pond inhabitant and led to five subsequent collecting trips to the pond to search for the beetle and its larva. The first of these visits to the pond was unfruitful but on each of the four subsequent visits a few adults or adults and larvae were collected.

The pond in which the adults and larvae of *Hoperius* were found is located within a beech-maple forest at Easton, Maryland. The main pond is bordered with a stand of *Cephalanthus occidentalis* L. Adults of *Hoperius* were found first in a small (approximately 15 feet by 10 feet and 1½ feet deep) pool that was isolated from the main pond because of a midsummer drought. This isolated pool lacked aquatic plants and the bottom was covered with rotting leaves; the beetles were found by sorting through the leaves dipped from the shallow margins of the pool. Adults and larvae of *Hoperius* were collected later from among leaves dipped from the edges of the main pond.



Figs. 2–6. *Hoperius planatus* Fall, adult ♂: Figs. 2–5, Aedeagus: 2, right paramere, lv; 3, median lobe, vv; 4, median lobe, lv; 5, left paramere, lv. Fig. 6. Prosternal process, vv. lv = lateral view; vv = ventral view.

In addition to *Hoperius planatus*, the following species of aquatic coleoptera were collected from the pond at Easton, Maryland. Dytiscidae: *Acilius fraternus* (Harris), *Acilius semisulcatus* Aubé, *Agabetes acuductus* (Harris), *Bidessonotus inconspicuus* (LeConte), *Coptotomus interrogatus* (Fab.), *Desmopachria grana* (LeConte), *Dytiscus hybridus* Aubé, *Graphoderus liberus* (Say), *Hydaticus bimarginatus* (Say), *Laccophilus fasciatus rufus* Melsheimer, *Laccophilus maculosus*

maculosus (Germar), *Matus bicarinatus* (Say), *Rhantus calidus* (Fab.), *Thermonectus basillaris* (Harris), *Uvarus granarius* (Aubé). Noteridae: *Hydrocanthus iricolor* Say, *Suphisellus puncticollis* Crotch. Hydrophilidae: *Enochrus ochraceus* (Melsheimer), *Enochrus perplexus* (LeConte), *Helocombus bifidus* (LeConte), *Hydrochara obtusata* (Say), *Tropisternus blatchleyi* d'Orchymont, *Tropisternus lateralis nimbatus* (Say), *Tropisternus collaris striolatus* (LeConte).

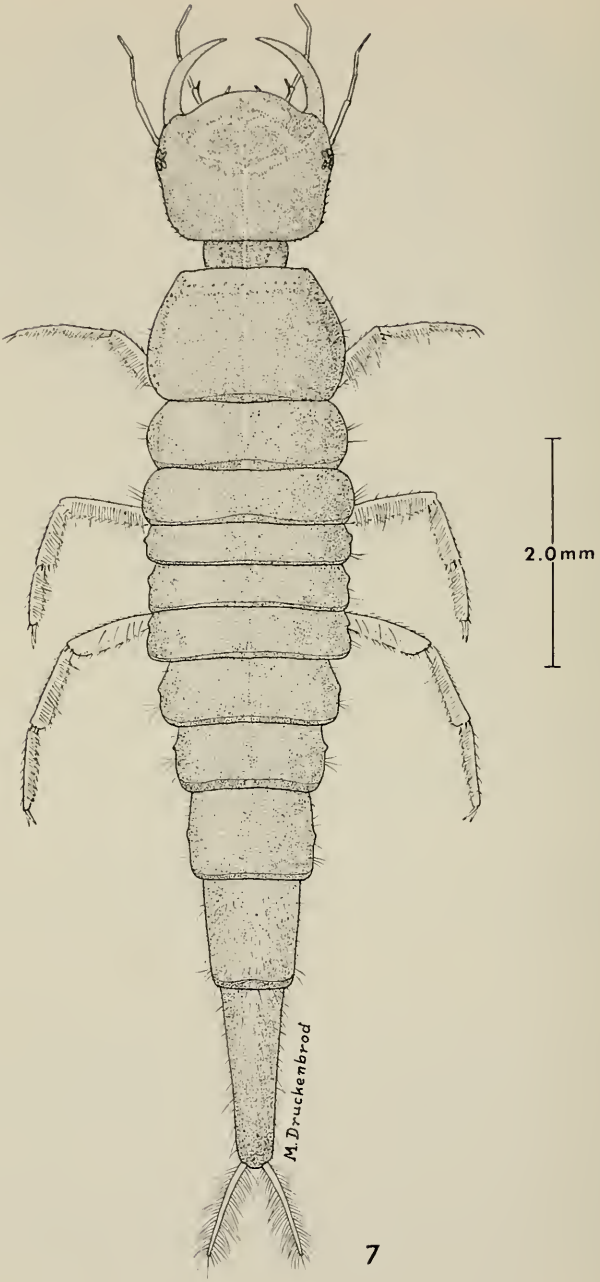
On 8 May 1972, Phyllis Spangler and I collected a larva from the pond at Easton that by elimination had to be *Hoperius planatus* or *Rhantus calidus* Fabricius. When the larva from Easton was compared casually with larvae of *R. calidus* the differences between the two were obvious and it was presumed to be the larva of *Hoperius*. To eliminate doubt as to the identity of the larva I tried to rear it but the larva died. Before I found that the larva had died, specimens of an ostracod ate their way into the body cavity and devoured most of the viscera. The specimen was preserved but was not described because the presumed identity of the larva was unconfirmed and the larva was partially destroyed.

On 6 May 1973, Phyllis Spangler and I returned to the Easton pond and obtained one adult and four last-instar larvae of *H. planatus* in 4 hours of collecting. The four larvae were kept alive for several days but would not eat food offered to them. The larvae were then transferred to small finger bowls containing damp leaves. Two of the larvae died and two pupated. One pupa was allowed to eclose after which the remaining pupa was photographed and then preserved for descriptive purposes. Table 1 shows the results of four

TABLE 1.—Rearing data for pupation of *Hoperius planatus*.

Larva No.	Date collected	Larva died	Date pupated	Date eclosed	pupation Days in	Date preserved
1	6 V 1973	12 V 1973	———	———	–	12 V 1973
2	6 V 1973	15 V 1973	———	———	–	———*
3	6 V 1973	———	2 V 1973	———	–	26 V 1973
4	6 V 1973	———	17 V 1973	26 V 1973	9	———

* Larva decayed and was not preserved.



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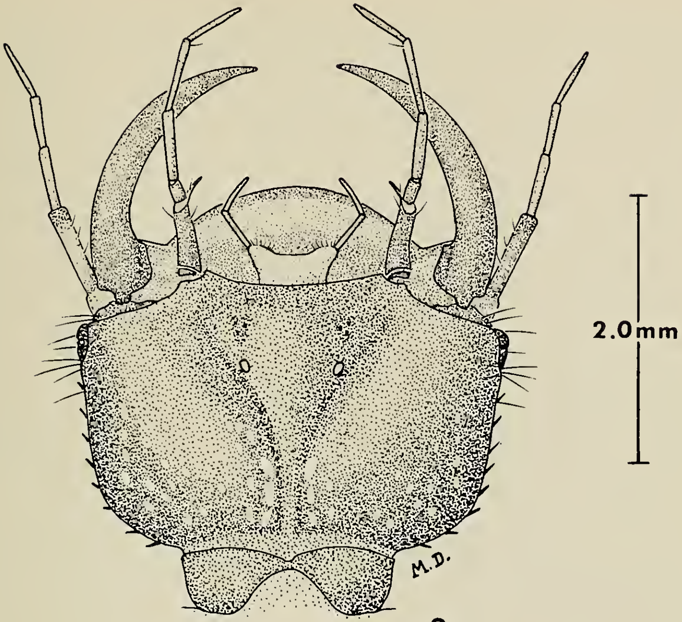

FIG. 8. *Hoperius planatus* Fall, larva, head, ventral view.

rearing attempts, and the larva and pupa of *planatus* are described below.

Description of the Third-Instar Larva of *Hoperius planatus*

Figures 7–8

Length, 18.5 mm; width of pronotum at base, 3.5 mm. Body depressed, elongate, almost parallel sided to 4th abdominal segment then tapering to apex of last abdominal segment. Color of integument infuscate, with numerous cream-colored and a few darker maculae as illustrated (Fig. 7). Abdominal segments 1–6 each with a dark brown lateral band ventrolaterally of each spiracle; integument below bands creamy white. Unsclerotized areas of venter creamy white.

Head robust, broader than long, broadest across anterolateral angles (at ocelli). Labroclypeus with dense row of yellowish setae along anterior

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FIG. 7. *Hoperius planatus* Fall, larva, habitus.

margin; anterolateral angles prominent and extended in front of bases of antennae. Ecdysial cleavage line distinct at base of head, forked at midlength between ocular areas; frontal arms of ecdysial cleavage line diverge and extend to bases of mandibles anteriad of antennal insertion. Ocular areas each with 6 large ocelli arranged in an ellipse, 3 ocelli in anterior row and 3 ocelli in posterior row; several long slender setae adjacent to ocelli. A horizontal row of 8 or 9 stout temporal setae behind each ocular area. Antenna tetramerous, cylindrical; basal segment longer than subsequent segments and bearing 3 short setae apicomedially.

Mandible long, slender, falciform; incurved and sharp apically; hollow, with aperture on inner apical margin. Maxillary stipes elongate. Galea small, slender, elongate, bearing 1 small seta on lateral margin near base. Maxillary palpus 4 segmented; basal segment (palpifer) shortest and bearing 2 apical setae, 1 on lateral margin and 1 on medial margin; 2nd and 3rd segments subequal; 3rd segment bearing 1 small seta apicomedially; ultimate segment about twice as long as basal segment. Labium broadly rectangular; anterior margin broadest, moderately emarginate and bearing 8 to 10 setae mediad of insertion of each labial palpus; labial palpus very slender, 2 segmented; ligula absent.

Pronotum broader than long; lateral margins strongly arcuate, moderately explanate, and bearing a few long slender setae; anterior margin truncate and bearing a few long slender setae; posterior margin feebly bisinuate. Mesonotum slightly broader than and less than half as long as pronotum and bearing a few long lateral setae and a spiracle in pleural region below each anterolateral angle of mesonotal sclerite. Metanotum slightly wider than and slightly shorter than mesonotum and bearing a few long lateral setae.

Legs moderately elongate; 5 segmented. Forelegs with coxa 3 times as long as trochanter and bearing several stout setae on ventromedial margin and on dorsomedial surface; trochanter short and bearing 3 to 5 short setae on dorsomedial surface; femur slightly shorter than tibia and tarsus combined, bearing numerous short setae and a row of natatory hairs on anterior (upper) surface and numerous long stout setae on posterior (ventral) surface; tibia about as long as tarsus, bearing several short stout setae and a row of natatory hairs on anterior surface and numerous long stout setae on posterior surface; tarsus with a few short setae and a row of natatory hairs on anterior surface and numerous long stout setae on posterior surface, terminating in 2 elongate moderately stout claws.

Abdomen of 8 distinct segments; segments 1 through 6 with dorsal sclerites; segments 7 and 8 completely sclerotized, ringlike. Terga of segments 1 through 8 with scattered setae over surface and along lateral and posterior margins. Segments 7 and 8 bearing numerous long, slender, lateral setae in addition to the short setae scattered over the surface. Segment 8 elongate, slightly more than twice length of 7th segment, terminating in 2 cerci that arise from beneath apex. Cerci elongate, almost as long as 8th segment, bearing numerous long black setae primarily on lateral and medial margins. Lateral margins of segments 1 through 7 each with a spiracle. Mesopleura, metapleura, and pleural folds of abdominal segments 1 through 6 each with 1 or 2 long setae arising from the integument. Segments 1 through 6 also with 1 or 2 long, slender, dark setae arising from integument ventrally near posterior margins on each side of midline.

The larva of *Hoperius* runs to couplet 8 in Chandler's (1956) key to the larvae of the known Nearctic genera of Dytiscidae. By modifying Chandler's couplet 8, the larva of *Hoperius* may be distinguished from larvae of the other North American colymbetine genera as follows.

8\. Fourth (last) segment of antennae more than ⅔ the length of 3rd segment 8A
Fourth (last) segment of antennae less than ⅔ the length of 3rd segment .... (Chandler's couplet number) 9
8A. Tarsal claws not spinulose in basal half on lower margin .. *Hoperius*
Tarsal claws spinulose in basal half on lower margin 8B
8B. Last-instar larva no longer than 25 mm; occurs throughout North and South America .... *Rhantus**
Last-instar larva longer than 27 mm; occurs primarily in the Boreal Region of North America following mountains south at least into Pennsylvania, Colorado, and southern California .... *Colymbetes*

Description of the Pupa of *Hoperius planatus*

Figures 8–11

Length (including cerci), 14.0 mm; greatest width, 5.0 mm. Color creamy white except eyes grayish black. With setae as described.

Head (Fig. 10) with 33 setae as follows: 8 or 9 on each ridge dorsomedially of each eye; 1 at upper corner of each eye; 5 at anteroventral angle of each eye; and 4 across labroclypeal impression.

Pronotum with approximately 170 setae arranged along anterior, lateral, and posterolateral margins and on the disc as illustrated. There are 19 setae on each side of the midline of the mesonotum and 17 setae on each side of the midline of the metanotum.

On several of the abdominal segments, the setae are unequal in number on opposite halves of the pupa; therefore, a numerical formula is used that gives the number of setae on the left and right side of the midline. The midline is indicated by a -M- between the number of setae. The setae are arranged as follows: abdominal segment 1, 16-M-14; abdominal segment 2, 24-M-24; abdominal segment 3, 23-M-28; abdominal segment 4, 28-M-25; abdominal segment 5, 28-M-26; abdominal

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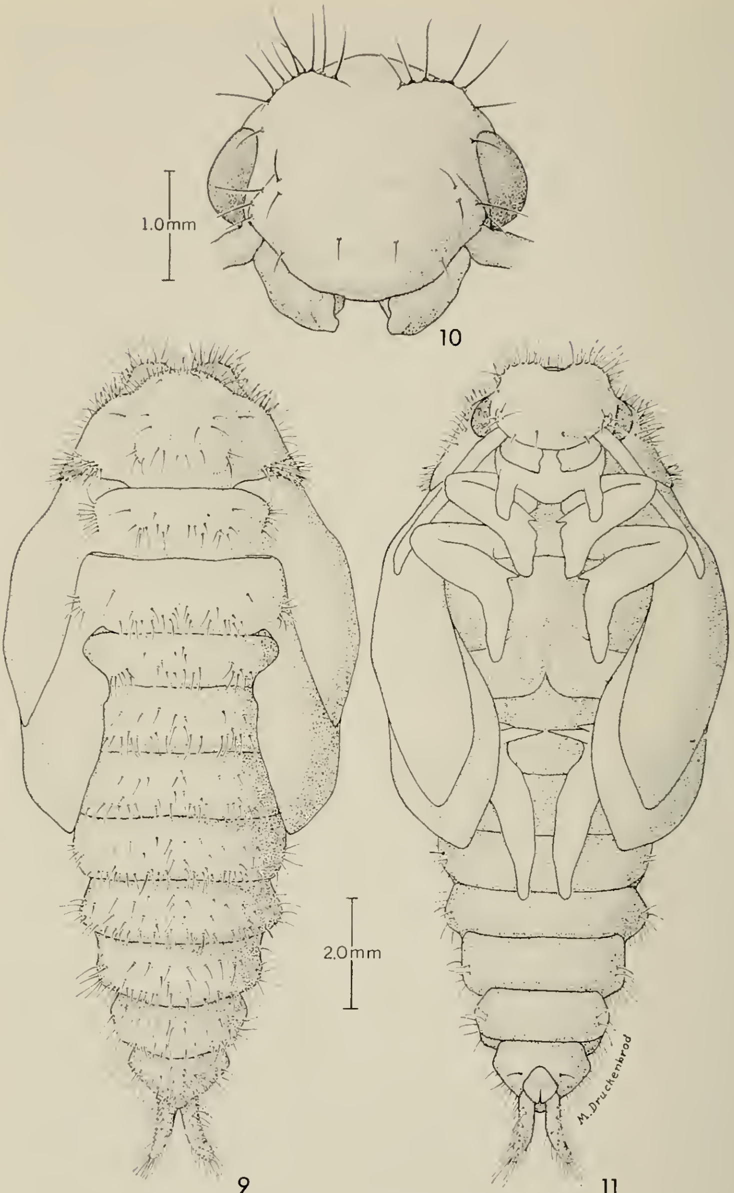
* The shortcomings of couplet 8B are obvious but it is provided to assist in recognizing *Rhantus* larvae at least from southern localities as well as the large last-instar *Colymbetes* larvae.



Figs. 9–11. *Hoperius planatus* Fall, pupa: 9, habitus, dorsal view; 10, head, frontal view; 11, habitus, ventral view.

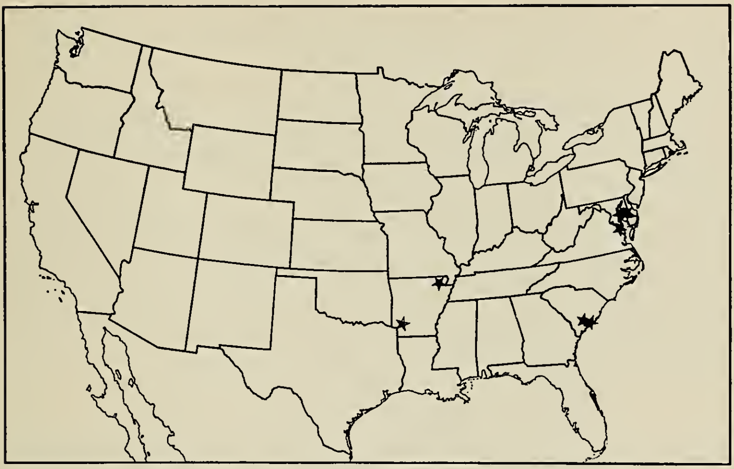


FIG. 12. *Hoperius planatus* Fall, known distribution.

segment 6, 29-M-23; abdominal segment 7, 24-M-19; abdominal segment 8, 24-M-21. Some abdominal setae are hidden under the wing pads and along the sides of the pupa and, therefore, do not show on the habitus view (Fig. 9).

Abdominal segment 9, mostly hidden by expanded 8th segment, terminates in 2 stout cerci about equal in length to the 8th segment; each cercus bearing 35–45 setae, most of these setae on lateral and apicomedial margins.

First through sixth abdominal segments each with a pair of spiracles, 1 on each anterolateral corner of each segment; no spiracles visible on 7th abdominal segment.

Antennae directed posteriorly and obliquely beneath head, lying between wing pads and femora. Front and middle femora extend outward at right angles from body axis and lie beneath elytral wing pads. First 2 pairs of legs with tibiae folded against femora; tarsi turned backward parallel with body axis. Hind femora and tibiae hidden between abdomen and pads of hind wings. Each hind leg with femur and tibia not folded against each other; femur directed obliquely away from midline; tibia directed obliquely toward midline; tarsus almost parallel with body axis.

DISTRIBUTION

I have examined the following adult and larval specimens of *Hoperius planatus*: ARKANSAS: Hempstead County: Hope (at light), 11 June 1926, L. Knobel, ♂ holotype (MCZ). Lawrence County: Imboden, 9 Feb. 1927, B. C. Marshall, 1 adult (MCZ); Imboden, York Springs, 18 May

1927, B. C. Marshall, 1 adult (MCZ).—MARYLAND: Talbot County: Easton, Seth State Forest, 13 June 1967, J. L. Hellman, 2 adults (USNM); Easton, Seth State Forest, 19 July 1971, P. Spangler, 2 adults (USNM); Easton, Seth State Forest, 6 May 1972, P. and P. Spangler, 1 larva (USNM); Easton, Seth State Forest, 8 May 1973, P. and P. Spangler, 1 adult, 4 larvae (USNM); Easton, Seth State Forest, 19 July 1971, R. D. Gordon, 6 adults (RDG); Easton, Seth State Forest, 26 Sept. 1971, J. Utmar, 1 adult (USNM); Easton, Seth State Forest, 29 July 1973, Spangler and Cross, 8 adults (USNM); Wittman, 26 May 1973, W. Steiner, 1 adult (WS).—SOUTH CAROLINA: Florence County: Florence, 4 May 1953, 28 Nov. 1957, V. M. Kirk, 2 adults (VMK). Horry County: Myrtle Beach (at light on beach), 19 May 1955, V. M. Kirk, 1 adult (VMK).—VIRGINIA: Nansemond County: Dismal Swamp, 11 June, 29 July 1970, J. Matta, 2 adults (USNM).

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PROCEEDINGS
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COMMENTS ON THE TYPE-SPECIMEN OF *NEOTOMA DESERTORUM SOLA* MERRIAM 1894 (MAMMALIA: RODENTIA)

Clyde Jones and Robert D. Fisher
Bird and Mammal Laboratories
Bureau of Sport Fisheries and Wildlife
National Museum of Natural History
Washington, D.C. 20560

This report includes a clear definition of the type-specimen of *Neotoma desertorum sola.* Also presented is a chronological review of the nomenclatorial history of the taxon.

The description of *Neotoma desertorum sola* by Merriam (1894) included limited details of several external morphological features and four external measurements. In addition, remarks were made about several conspicuous cranial characters. A holotype, skin and skull, (USNM 31516/43381) was designated in the account.

Goldman (1910) placed *Neotoma desertorum sola* in synonymy with *Neotoma intermedia gilva* on the basis of pelage features. In this account, Goldman (1910) expressed an opinion that the holotype of *Neotoma desertorum sola* was a composite specimen. The "*Neotoma lepida* group" of wood rats was formed by Goldman (1932) by combining the "*Neotoma desertorum* group" and the "*Neotoma intermedia* group" as they were recognized at the time. No mention was made of the opinion expressed previously with regard to the holotype of *Neotoma desertorum sola.*

The holotype of *Neotoma desertorum sola* is clearly a composite specimen; the skin is an example of *Neotoma lepida gilva.* The skin is designated herein as the lectotype of *Neotoma desertorum sola* Merriam. This designation is made with the assumption, based on the following facts, that the data on the label are associated correctly with the skin. The skin carries a Death Valley Expedition label, that has been colored red, with the place and date of capture, sex, the name of the collector, and the museum and collector's numbers given in the original description (Merriam, 1894). A second label attached to the skin is a red tag used routinely for type-specimens of the Biological Survey Collections housed in the United States National Museum of Natural History. This label bears the museum number, name of the taxon, and a complete reference to the original description.

The lectotype is very similar to the skin of another specimen of *Neotoma lepida gilva* (USNM 31517/43382) obtained at the same locality by the same collector 1 day before the lectotype was collected. Measurements of this specimen, a female, were included in the original description of *Neotoma desertorum sola* (Merriam, 1894). Presumably, this is the same specimen that Goldman (1910) referred to as ". . . a topotype taken at the same time." Examination of the records reveals that these two specimens of *Neotoma lepida gilva*, as well as a specimen of *Neotoma fuscipes simplex* (USNM 31515/43380) collected on October 25, 1891, at the same locality, were catalogued on November 25, 1891.

The lectotype does not belong with the skull that is matched with it. The skull (USNM 43381) is from a specimen of *Neotoma fuscipes*; it compares closely with skulls of *Neotoma fuscipes macrotis* from San Bernardino, California, some of which were obtained during the Death Valley Expedition.

A review of the pertinent synonymy involving *Neotoma desertorum sola* is as follows:

Neotoma lepida gilva Rhoads

1894. *Neotoma intermedia gilva* Rhoads, American Nat., 28:70. (Holotype: adult, male, skin and skull, Number 1665, Academy of Natural Sciences of Philadelphia.)

1894. *Neotoma desertorum sola* Merriam, Proc. Biol. Soc. Washington, 9:126. (Lectotype: adult, male, skin only, Number 31516, United States National Museum of Natural History.)

1932. *Neotoma lepida gilva* Goldman, J. Mamm., 13:63.

ACKNOWLEDGMENTS

The authors are grateful to Barbara Harvey for help in assembling literature and searching through museum records. Guy Musser provided some technical advice.

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PROCEEDINGS
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THREE NEW CAVERNICOLOUS SPECIES OF FULGOROIDEA (HOMOPTERA) FROM MEXICO AND WESTERN AUSTRALIA

By R. G. Fennah
Commonwealth Institute of Entomology,
c/o British Museum (Natural History), London, SW7 5BD

Three species of cavernicolous Fulgoroidea, *Cixius orcus* (Cixiidae), *Oeclidius hades* (Kinnaridae) and *Phaconeura pluto* (Meenoplidae) are described as new, the first two from Mexico, the last from Western Australia. All exhibit adaptation to a wholly underground existence: sclerotization is weak, eyes and ocelli are absent, the tegmina are brachypterous and the wings greatly reduced. The male genitalia, though sufficiently different from those of known species in the corresponding genera to justify the erection of new species, do not show much more than the usual degree of interspecific variation.

Through the kindness of Dr. J. P. Kramer, of the Systematic Entomology Laboratory, U.S. Department of Agriculture, and of Mrs. J. Lowry, of the University of New South Wales, Australia, the writer has been able to examine representatives of three populations of Fulgoroidea taken in caves in Mexico and Western Australia. They proved to belong to the families Cixiidae, Kinnaridae and Meenoplidae, and showed adaptations for a wholly underground existence that were similar between themselves and also similar to those recently noted by the writer (1973) in species of *Oliarus* (Cixiidae) from caves in Hawaii. These included loss of the eyes and ocelli, accompanied by reduction in the length of the upper part of the head, reduction in size of the tegmina, wings, and tarsal empodia, a lesser degree of sclerotization of the segments of the derm and virtual loss of pigmentation. Though the evidence is so far meagre, it appears possible that the form of the head in part represents a persistence of that found in the nymphal stages. As far as is known, the immature stages of members of the three families mentioned are passed underground, with the nymphs feeding on roots. Where roots penetrate down into a cave far from its mouth, an opportunity is created for free underground movement and mating of adults, and no stimulus to move towards light is present. It is not improbable that this factor has served to initiate the isolation of cave-dwelling populations of species that range widely in their normal above-ground adult stage. If this is so, every cave in which such conditions exist may potentially harbor its own breeding population. Adaptation to total existence in darkness and a stable environment by regressive development may reasonably be expected to occur more rapidly than change in genital structure, and it is the latter that offers the best clue to the extent of divergence of a cave population from fraternal populations with fully winged adults.

FAMILY CIXIIDAE

Genus *Cixius* Latreille

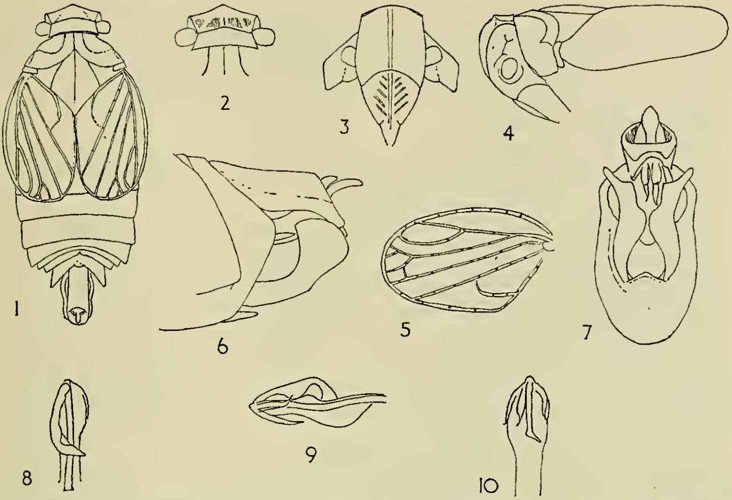
Cixius Latreille, 1804:310. Type-species, *Cicada nervosa* L., 1758:437.

Cixius orcus, new species

Figures 1–10

Holotype male: length, 2.5 mm.; tegmen, 1.3 mm.

Head in dorsal view broader at base than long (1.5 : 1) with lateral margins concave; vertex with posterior compartment flat, posterior margin shallowly concave, a fine shallowly angulate transverse carina bounding posterior compartment anteriorly; anterior compartment of vertex slightly declivous, almost curving smoothly into base of frons, bounded apically by a feeble broad transverse callus, disc shallowly impressed on each side of middle line, a faint indication of a median fossette present; frons in middle line as long as broad, transversely and in profile convex, basal margin convex, lateral margins shallowly convex, produced laterad, apical margin strongly concave; median carina percurrent, thick; clypeus tricarinate, with median carina thickened, rostrum surpassing post-trochanters. Eyes and ocelli absent. Antennae with basal segment very short, ringlike, second segment subovoid. Pronotum with posterior margin rectangulately excavate, disc in middle line as long as posterior compartment of vertex, medially carinate; lateral carinae well developed, each



FIGS. 1–10, *Cixius orcus*, new species: 1. Head, thorax and abdomen, dorsal view; 2. head and portion of pronotal carinae, dorsal view; 3, frons, clypeus and lateral lobes of pronotum; 4, head, thorax and tegmen, side view; 5, tegmen; 6, male genitalia, left side; 7, the same, posterior view; 8, aedeagus, dorsal view; 9, the same, right side; 10, aedeagus, ventral view.

directed caudad then curving laterad to join a horizontal carina at lateral margin. Mesonotum broader than long, median disc flat, tricarinate, with lateral carinae converging anteriorly almost to meet median carina at apex. Post-tibiae with two minute teeth laterally, one at base, the other in basal third, and six teeth apically; basal metatarsal segment with four teeth apically, second segment with three teeth. Tarsal claws slender. Tegmina brachypterous, with apical margin broadly rounded, Sc + R, M and Cu 1 present, claval suture obsolete, second claval vein bent abruptly to unite with first claval vein near its middle. Wings scarcely half as long as tegmina, with a few longitudinal veins.

Frons, clypeus, vertex, pronotum and mesonotum pallid yellow, polished, body otherwise pallid, almost white. Tegmina and wings hyaline, colorless, with pallid veins.

Anal segment twice as long as broad, in dorsal view with lateral margins parallel, apical margin transverse, anal foramen situated in apical quarter. Pygofer moderately long, lateral margins obtusely angulately convex, medioventral process mucronate, as long as broad at base. Aedeagus relatively long, directed caudad, an unequal pair of spinose processes arising ventrally at apex, that on right side half as long as aedeagus, that on left slightly shorter, both directed laterocaudad at apex, pair of short spinose processes arising dorsally at apex, directed cephalad, a submembranous tubular lobe arising dorsally on right at apex, directed cephalad then curving shallowly towards left. Genital styles rather long, simple, each rather narrow basally, expanding in distal third, with distal margin shallowly convex.

Type-data: Holotype ♂, MEXICO: Queretaro, Cueva de Emilia, 14 km. NNW Ahuacatlan, 24.xii.72 (R. Jameson) in the National Museum of Natural History, Smithsonian Institution.

The arrangement of spines laterally and apically on the post-tibiae, the relative length of the rostrum, the form of the frons and clypeus and the carination of the head agree with the condition found in species of *Cixius*, and ignoring the adaptive features of eyelessness, brachyptery, lack of pigment and slender tarsal claws, there is no reason why this species should not be referred to *Cixius*. The dentition of the post-tibiae and the form of the medioventral process of the pygofer rule out any close relationship with *Haplaxius* and the long rostrum and slender legs any similar relationship with *Microledrida*. Of the Central American genera nearly related to *Cixius*, *Pachyntheisa* has a rostrum just attaining the post-trochanters, and *Oliarus* has a differently shaped frons. The genitalia of *C. orcus* differ from those of such Central American species of the genus as it has been possible to examine.

FAMILY KINNARIDAE

Genus *Oeclidius* Van Duzee

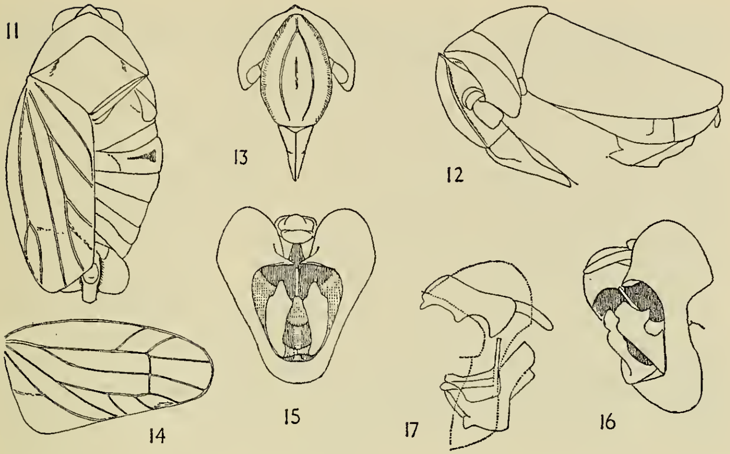
Oeclidius Van Duzee, 1914:40. Type-species, *Oeclidius nanus* Van Duzee, 1914

Oeclidius hades, new species

Figures 11–17

Holotype male: length, 2.0 mm., tegmen, 1.7 mm.

Head in dorsal view comprising a very short transverse compartment of vertex and basal part of frons, separated by a short strong narrow transverse carina; frons in middle line longer than broad (about 1.5 : 1), convex transversely and in profile, basal margin very short, lateral margins obliquely elevated, rather strongly convex, apical margin short, only slightly longer than basal margin, a pair of arcuate carinae, united a little before base of frons, percurrent to apex, or nearly so, not meeting distally; frontoclypeal suture impressed; clypeus relatively small, medially and laterally carinate, with median carina prominent, almost foliaceous; rostrum long, slender, surpassing apex of abdomen, gradually tapering at apex; eyes and ocelli absent, antennae with basal segment broader than long, collarlike, second segment longer than broad (1.8 : 1), cylindrical, truncate apically. Pronotum relatively large, anterior margin strongly carinate, angulately convex and overlapping vertex medially, posterior margin sinuately excavate, median carina strongly developed;



FIGS. 11–17, *Oeclidius hades*, new species: 11. Head, thorax, left tegmen, right wing, and abdomen, dorsal view; 12, adult, except legs, left side; 13, frons, clypeus and lateral lobes of pronotum; 14, tegmen; 15, male genitalia, posterior view; 16, the same, posterolateral view from right; 17, the same, left side, with pygofer shown in broken line.

lateral lobes of pronotum almost flat, facing cephalad; mesonotum broader than long (about 1.5 : 1), strongly transversely convex, with faint indication of median and lateral carinae. Post-tibiae long, slender, laterally unarmed, apically with seven teeth, basal metatarsal segment with five teeth, second segment with four teeth, tarsal claws set close together, slender. Tegmina reaching to apex of abdomen, broadest at base, tapering distad and narrowly rounded at apex, Sc + R, M, Cu 1, claval veins and a few supernumerary transverse veins present, claval suture absent. Wings each reduced to a scale.

Pallid yellowish brown; abdominal membrane sordid white.

Anal segment rather long, tongue-like in distal half with apical margin convex, sides moderately deep, each produced ventrad at middle in a narrowly rounded lobe. Pygofer moderately long, dorsolaterally much inflated, with angles acute and inflexed mesad, lateral margins concave, ventral margin entire. Aedeagus relatively long, in basal half with a broad phallobase (periandrial tube) which is suspended from sides of pygofer by oblique struts; a narrowly tubular phallus directed caudad through phallobase, then abruptly bent dorsocaudad at its point of emergence. Genital styles moderately long, broad, produced mesad at base to meet in middle line, in posterior view with outer margin sinuate, inner margin foliaceous, almost straight, apical margin deeply convex, inner apical angle acute.

Type-data: Holotype ♂, MEXICO: San Luis Potosi, Cueva de Valdosa, 8 mi. E. Valles, 24 Nov. 1967 (J. Reddell & S. Fowler), in the National Museum of Natural History, Smithsonian Institution.

The general form of the male genitalia is similar to that found in species of *Oeclidius*, but in finer detail they do not agree with those of any known species. The most curious feature is the enlargement and inflation of the dorsolateral areas of the pygofer: a rather similar development, though less pronounced, is to be found in a Cuban population of *O. fuscosus* Van Duzee (sensu Myers 1928:18), which also has genital styles of the same general pattern as *O. hades*.

Superficially, *O. hades* is readily distinguishable from all species known that in the adult stage emerge above ground by the absence of eyes and ocelli, and the general form of the head. Another external feature in which the present species differs appreciably from other adults of this genus is in the fewer teeth on the basal and second metatarsal segments (these usually being 7,7 or 6,6 as compared with 5,4).

FAMILY MEENOPLIDAE

Genus *Phaconeura* Kirkaldy

Phaconeura Kirkaldy, 1906:427. Type-species *Phaconeura froggatti* Kirkaldy

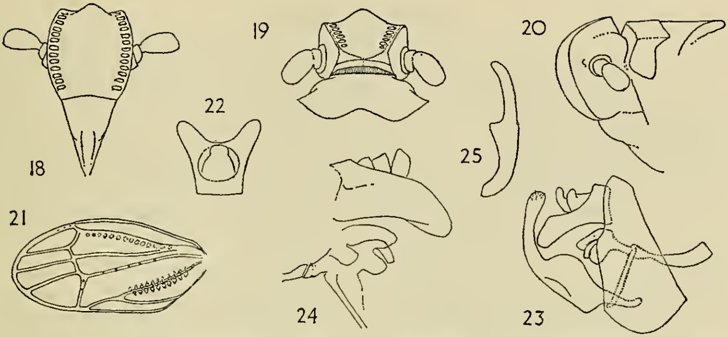
Phaconeura pluto, new species

Figures 18–25

Holotype male: length, 2.5 mm., tegmen, 1.6 mm.

Head in dorsal view about as long as broad at base, with vertex evenly and obtusely rounding into frons, lateral margins carinate, apical margin strongly convex, basal compartment of vertex represented by an ill-defined triangular facet on each side laterobasally; frons in middle line only slightly longer than wide at widest part, widest at middle, lateral margins arcuate, median carina absent, median ocellus obsolete; clypeus at base as wide as frons at apex, postclypeal disc tumid, shorter in middle than broad at base, ecarinate medially and laterally, anteclypeus in profile straight, rostrum reaching at least to middle of abdomen; antennae short, basal segment broader than long, second segment longer than first (about 3 : 1) and longer than broad (about 1.7 : 1), eyes and lateral ocelli absent. Pronotum with disc shorter in middle line than broad at anterior margin (about 1 : 2.5), a shallow impression on each side of middle, carinae feeble, lateral carinae strongly diverging basad. Total length of mesonotum equal to length of vertex and pronotum combined. Post-tibiae laterally unarmed, apically with eight small spines, basal metatarsal segment with six spines, second segment with five; tarsal claws slender. Tegmina reaching to apex of abdomen with distal venation reduced and claval suture obscure or absent. Wing absent.

Sordid white, with sclerites slightly darker than membrane. Tegmina



FIGS. 18–25, *Phaconeura pluto*, new species: 18. Frons and clypeus; 19, head and pronotum, dorsal view; 20, head and upper part of thorax, left side; 21, tegmen; 22, anal segment of male, dorsal view; 23, male genitalia, right side; 24, anal segment of male and aedeagus, left side; 25, genital style, posteroventral view.

with apical cells, and clavus posterior to anterior vein, with a very dilute yellowish-brown suffusion.

Anal segment moderately long, in dorsal view with lateral margins diverging caudad, apical margin deeply excavate, anal foramen situated at about middle of total length. Pygofer ventrally moderately long, dorsally short, posterior opening laterally compressed, dorsolateral angles not produced, lateral margins sinuate. Aedeagus very short, comprising a broad horizontal lobe dorsally, a decurved tubular process, and a pair of short lobes ventrolaterally. Genital styles moderately long, broad in basal half, each abruptly narrowed at middle and upcurved in distal half, and narrowly rounded apically, styles contiguous ventrally at base, then separating but reuniting at middle, then abruptly separating again and thence converging to meet, or almost meet, at apex.

Type-data: Holotype, male, WESTERN AUSTRALIA: Nambung National Park, Quandong Cave, 25.xi.72 (J. Lowry) in collection of C.S.I.R.O., Canberra. Other material examined. WESTERN AUSTRALIA: 2 ♂♂, with same data as holotype.

This species belongs to the pallida group of *Phaconeura* but differs from its members, *P. pallida* Kirk. (1906), *P. brimblecombei* Woodward and *P. smithi* Woodward (1957), in the relatively longer lateroapical angles of the anal segment and the structure of the aedeagus. The most obvious distinguishing features are those associated with adaptation to a wholly subterranean existence, such as the absence of eyes and ocelli and the reduction of the tegmina and wings. The collection included also two nymphs labelled "Nambung National Park, Cadda Cave, 25.xi.72 (J. Lowry)." These appear to belong to *Phaconeura* but cannot be specifically identified in the absence of adults from the same population.

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STUDIES OF TROPICAL AMERICAN LEGUMINOSAE—VII

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

The last previous number in this series of publications, devoted to discussions of older taxa and the description of new ones which come to light in the course of research and curation of neotropical legumes, appeared in 1963. The time-gap is one result of my preoccupation during the intervening years with other matters which precluded scientific investigation of these plants.

Arapatiella psilophylla (Harms) Cowan, comb. nov.

Tachigalia psilophylla Harms, Notizblatt 59:305. 30 June 1915.
Dicymbe psilophylla (Harms) Dwyer, Ann. Missouri Bot. Gard. 41:254. May 1954.
Arapatiella trepocarpa Rizzini & A. Mattos, Rev. Brasil. Biol. 32(3):323–333. Sep 1972.

Description: Tree (8–) 12–20 [25] m tall, the trunk 15–40 [–60] cm in diameter, [the bark dark brown, 5–8 mm thick], the branchlets at first minutely puberulous but soon becoming glabrous; stipules conspicuous, usually persistent, 15–37 [–60] mm long, [15–] 20–40 [–45] mm wide, semicircular to oblate in outline, coriaceous, glabrous, sometimes narrowly revolute marginally, venation prominulous on both sides; leaves paripinnate [or imparipinnate], the petioles 15–40 mm long, minutely puberulous sparingly, the rachis 3–8 cm long, minutely puberulous, terete; leaflets 2- or 3-jugate, glabrous, the petiolules 2–5 mm long, the blades (3.5–) 5–15 cm long, 3–5 (–7) cm wide, elliptic, acute to acuminate apically, the base acute, chartaceous to subcoriaceous, nitid above, the venules plane above, prominulous and slightly salient on the lower surface; inflorescences terminal, (2–) 3.5–6 [–10] cm long, racemose or panicles of racemes, the axes strigulose, the old ones with prominently raised bract-scars, the bracts and bracteoles caducous, 1–3 mm long, 1.5–3 mm wide, ovate-oblate, densely strigulose externally, glabrous within; pedicels [4–] 7–10 mm long, strigulose, the hypanthium tubular-turbinate, [4–] 5 mm long, 2.5–3 mm in diameter, strigulose externally, glabrous within; sepals 5, green, strongly imbricate, oval, rounded apically, cucullate, 4.5–7 mm long, 3.5–5.5 [–6] mm wide, strigulose externally and on the basal one-third on the inner surfaces, ciliolate, arising from the apex of the hypanthium, somewhat reflexed in anthesis; petals 5, white, free, oblanceolate to obovate, the claw 3–5 mm long, sericeous externally, glabrous within, the blade glabrous, 5.5–9 mm long, 5–8 mm wide; stamens 10, all fertile, white, glabrous, the filaments 13–19 mm long, the anthers versatile, dorsifixed, oblong, [3–] 3.5 mm long, 2–2.5 mm wide, the pollen grains globose, about 65μ in diameter, the surface conspicuously and loosely reticulate; stigma disciform, peltate, about 1 mm in diameter, glabrous, the style slender, white, 13 [–25] mm long, strigose sparingly at the base, the ovary densely strigose, 4–5 [–8] mm long, 1.5–2 mm wide, the ovules 6–8, the gynophore 3.5–4 mm long, glabrous basally but strigulose in the upper half, attached centrally at the base of the hypanthium; fruit (immature fide Harms) very narrowly oblanceolate, flattened laterally, strigulose densely, 31 [–40] cm long, 2 [–4] cm wide near apex, [the valves at maturity forming spirals in dehiscing, the seeds ellipsoid-complanate, black, ca. 3.5–4 cm long and 2 cm wide].

Collections Examined: BRAZIL-BAHIA: Centro de Pesquisa do Cacau (CEPEC), Ilhéus, May 1965, Belém & Magalhães 1097 (NY, US) and 1121 (NY, US); Rodovia, BR 5, 16 km S. Eunapolis, Sept. 1966, Belém & Pinheiro 2622 (NY, US) and 2679 (NY, US); near Esperança, Jan. 1822, Riedel 804 (type collection of *Tachigalia psilophylla* Harms) (two leaflets and type photograph at F); CEPLAC; Itabuna, July 1964, Silva 58299 (NY, US).

Although I have not had the opportunity to study the two collections on which Rizzini and Mattos based the new genus, there is no reasonable doubt that they represent the same taxon as those above. They are also from Bahia: Una, July 1970, A. Mattos & H. da C. Monteiro Netto 507 (RB 145159) (RB); Camacan-Mascote, May 1970, T. S. dos Santos 834 (RB 150708) (type collection of *Arapatiella trepocarpa* Rizzini & Mattos; holotype RB). Both collections record the same vernacular name: Faveca-vermelha.

Discussion: During conversations at the First International Congress of Systematic and Evolutionary Biology in August 1973, Mary Arroyo and Howard Irwin of the New York Botanical Garden alerted me to the publication of a monotypic new genus, which they had also considered publishing, but which I had in press at that time! I had become aware of the plant in about 1955 when I was working with some collections of *Tachigalia*. Dwyer in revising this genus in 1954 had transferred *T. psilophylla* Harms to *Dicymbe*, which I was then studying, on the basis of the Field Museum's type-fragment and type-photograph from the Berlin Herbarium. When I saw these materials I was convinced that the taxon involved was certainly not a *Dicymbe*-species but I requested

Leningrad to lend me the isotype which Harms reported in his original description to be there, so that correct disposition of the species might be effected. The specimen could not be located in the herbarium of the Komarov Botanical Institute then, nor in a second search in mid-1973.

Early this year, two new collections came to hand showing the enormous foliose stipules I had been remembering for years as characteristic of the enigmatic *Tachigalia psilophylla* Harms. Comparison with the original description, the Chicago fragment from the Berlin holotype, and with the type photograph left no doubt whatever that they were conspecific. Only one problem remained—the original one: To what genus should the species be referred? That question has now been answered by the publication of *Arapatiella* Rizzini & Mattos.

After very considerable study, I had come to the same conclusion as these authors—that a new genus of the Tribe Sclerolobieae-Caesalpinioideae required description. Rizzini and Mattos included an extensive, detailed description of the wood anatomy which I have not repeated here, but I have included my own description of the vegetative and floral morphology, enclosing in brackets details from the Rizzini and Mattos description which were not evident in the collections I studied. I am also presenting below the key I had prepared to distinguish the new genus from its relatives.

Only a few, perhaps minor, discrepancies emerge from comparison of the Rizzini-Mattos description with those of Harms and Cowan. They describe the bracts as being similar in form and size to the stipules but I have considered the foliose structures at the base of the inflorescence to be barely reduced stipules at the generally leafless terminal nodes. According to my interpretation then, the bractlets at the base of each pedicel (true bracteoles) and at the base of each branch of the inflorescence are identical in shape, size, and persistence. Of more fundamental importance is the fact that *Arapatiella* is described as having imparipinnate leaves and the drawing in the article confirms this interpretation. On the other hand, all the material I have seen, as well as Harms' description and the type photograph, exhibit only paripinnate leaves. This is usually a quite conservative, reliable characteristic for distinguishing genera in the legumes, so I look forward to determining whether the difference is the result of unusual variability or faulty observation and interpretation. Following is the key to the new genus and related genera.

1. Hypanthium shallow-cupular, much shorter than the sepals and petals; leaves sometimes bipinnate 4
   Hypanthium more or less tubular, as long as, or only slightly shorter than, the sepals 2
2. Hypanthium excentric, the gynophore adnate to its inner wall for at least part of its length; stigma simple, punctiform .... *Tachigalia*
   Hypanthium equilateral, tubular-turbinate, the gynophore arising from the center of its base; stigma broadly disciform and peltate or expanded-truncate 3

3\. Stigma peltate broadly; stamens 10; legume valves coiling retrorsely at dehiscence .... *Arapatiella*
Stigma truncate; stamens 12–20; legume valves never coiled at dehiscence .... *Campsiandra*
4\. Leaves bipinnate; stigma massive, peltate .... *Peltophorum*
Leaves pinnate; stigma not peltate, mostly truncate 5
5\. Innermost sepal glandular-fimbriate marginally; fruits flat with undulating margin .... *Melanoxylon*
None of the sepals glandular-fimbriate marginally; fruits not undulate-margined 6
6\. Ovary nearly sessile, the gynophore broader at the apex and with small wing-like processes; fruit a woody follicle with red seeds .... *Batesia*
Ovary clearly stalked, the gynophore tapering gradually to the base of the ovary; fruit not follicular 7
7\. Stigma almost punctiform, smaller than the diameter of the style; leaves paripinnate; fruits flat, indehiscent .... *Sclerolobium*
Stigma truncate, equal to the diameter of the style, penicillate; leaves imparipinnate; fruits dehiscent .... *Recordoxylon*

Macrolobium conjunctum Cowan, sp. nov.

Description: Arbor 2 m alta, ramulis glabris, stipulis caducis, non visis; petioli anguste alati, 12–13 mm longi, glabri, rhachibus 4.5–6 cm longis, anguste alatis, glabris; foliola glabra, sessilia, 4-jugata, 3–4.5 cm longa, 2–2.5 cm lata, oblonga, ad apicem truncata, ad basim inaequilateralia, obtusa, venis venulisque manifestis supra, inflorescentiae axillares, 5.5–9.5 cm longae, glabrae, pedunculo 15–22 mm longo, bracteis bracteolisque caducis, non visis, pedicello 7–8 mm longo, bracteolis chartaceis, rubris, glabris, 12–14 mm longis, 4–5 mm latis, lanceolatis, acutis ad subacuminatis; hypanthium zygomorphum, cupulare, 3 mm altum, glabrum, sepalis 4, 5–5.5 mm longis, 1–2.5 mm latis, lanceolatis, longo-acuminatis, glabris; petali stipes ca. 4 mm longus, glaber, lamina ca. 3.5 mm longa et 3 mm lata, obovata, glabra; stamina fertilia 3 (vel 4?), staminodia 2 vel 3, filamentis omnibus connatis in tubo 1–1.5 mm longo, 18–20 mm longis, glabris; gynoecium glabrum, stigma capitellato, stylo filiformi, ca. 17 mm longo, ovario 2–2.5 mm longo, 1 mm lato, gynophoro 3–4 mm longo; fructus non visus.

Type-Collection: W. A. Egler 1025 (holotype NY, isotype-frag. US), "lagedas de arenito, Erererí, Rio Cururú, Tapajós, Pará, Pará," Brazil, 25 July 1959.

Discussion and Etymology: The specific epithet for the new species calls attention to one of its most striking characteristics, one which is startling to find in the genus. This is the first known species with a true staminal tube, formed by the connation of the filaments basally. In this respect it is easily set off from other species of the genus but it also differs markedly from its near-relative (*M. multijugum* and *M. longipes*) in still other characteristics. The bracteoles are similar in the new species and in *M. longipes*, with respect to color and texture but smaller and not attenuate apically. Unlike *M. longipes*, but like *M. multijugum*, the new species has inflorescences with an elongated peduncle; the flowers of the latter two species are quite different morphologically.

Macrolobium dressleri Cowan, sp. nov.

Description: Arbor 10 m alta, glabra; folia glabra, petiolo ca. 3 mm longo, foliola unijugata, sessilia, laminis anguste oblongo-ellipticis, 27.5–31.5 cm longis, 7.5–8 cm latis, valde inaequilateralibus ad basim, latere superiore acuto et inferiore rotundato, ad apicem obtuse acuminatis, conspicue punctatis infra, costa salientibus utrinque, venis caeteris planis obscuris; inflorescentiae 2.5–7 cm longae, axe minute puberulo, bracteis non visis; pedicelli 2–2.5 mm longi, minute puberuli, bracteolis 9–10 mm longis, 5–5.5 mm latis, obovatis, rotundatis cucullatisque, minute puberulis extus, intus glabris; hypanthium tubulare, 7.5–9 mm longum, minute puberulum, stipite 1–1.5 mm longo, minute puberulo, sepalis 4, elliptico-oblongis, 11–12 mm longis, 5 mm latis, costa extus minute puberula excepta glabris, intus viridibus et rubido-lineatis; petalum album, lamina sessili, margine undulata, 25–30 mm longa, 11–15 mm lata, elliptica, glabra extus, intus costa villosa; filamenta leviter villosa, 24–26 mm longa, antheris ellipticis, ca. 4 mm longis et 2 mm latis, glabris; gynoecium pubescens, stylo ca. 20 mm longo, leviter puberulo, ovario ca. 5 mm longo et 1.5 mm lato, oblongo, velutino omnibus lateribus sed etiam villoso ad suturam inferiorem, gynophori parte libera ca. 4 mm longa, puberula et leviter villosa; fructus non visus.

Type-Collection: Mireya D. Correa A., R. L. Dressler, and D. Sucre 1837 (holotype US, sheet no. 2698430), "Camino de Llano a Cartí. Aproximadamente 14 kms. de la carretera a Chepo. Altura 350–400 m.," Prov. Panama, 9 January 1973.

Discussion and Etymology: Two other Panamanian species—*M. pittieri* and *M. modicopetalum*—are obviously related to this new one, named for one of the collectors of the type-material. From these and three other relatives—*M. obtusum* (Venezuela) *M. archeri* (Colombia), and *M. floridum* (Venezuela)—the new species can be separated most readily by a combination of leaflet shape, gynoecial pubescence, flower size, and by details of the petal. The following key facilitates recognition of existing collections assigned to these five taxa, which clearly share a common ancestor.

1. Ovary pubescent on all surfaces 2
   Ovary only pubescent marginally or glabrous 3
2. Leaflets narrowly oblong-elliptic, the apex bluntly acuminate; petal sessile; ovary villose on the lower suture, velutinous on all surfaces; Panama .... *M. dressleri*

Leaflets oblance-elliptic, the apex bluntly acute; petal claw about 3 mm long; ovary pilosulose marginally, puberulous laterally; Venezuela .... *M. floridum*
3. Leaflets oblanceolate, caudate-acuminate; petal ca. 42 mm long with a 5 mm stipe .... *M. pittieri*
Leaflets elliptic; petal smaller, sessile or with a shorter stipe 4
4. Flowers 8–13 mm long*, the petal 11–14 mm long; Panama .... *M. modicopetalum*
Flowers 17–36 mm long, the petal 20–28 mm long; South America .. 5
5. Leaflets rounded apically; flowers 17–23 mm long, the petal 20 mm long with a claw 3 mm long; Venezuela .... *M. obtusum*
Leaflets acuminate; flowers 34–36 mm long, the petal 28 mm long, sessile; Colombia .... *M. archeri*

It appears that the closest relative (on the basis of morphological similarity) of the new species is the Venezuelan *M. floridum*, the most poorly known of this complex. However, since the differences separating the several taxa are mostly quantitative there is little profit from further speculation on relationships. There are very few collections of any of the taxa and additional ones are eagerly anticipated.

Macrolobium extensum Cowan, sp. nov.

Description: Arbor 10 m alta, trunco 20 cm diametro, ramulis minute puberulis; petioli 18–27 mm longi, minute puberuli, supra sulcati, petiolulis nullis; foliola unijugata, 13–16 cm longa, 6–7.5 cm lata, ad basim inaequilateralia, latere superiore attenuato-acuto et inferiore acuto, ad apicem perabrupte acuta ad acuminata, utrinque et marginaliter minute puberula ad costam et venas primarias, venis planis supra, infra salientibus; inflorescentiae 4–6 cm longae, ramuligerae, axe minute puberulo, bracteis caducis, ca. 1 mm longis, triangularibus; pedicelli 10–20 mm longi, minute puberuli, bracteolis 10–11 mm longis, 4–5 mm latis, obovatis ad oblanceolatis, obtusis, glabris, carnosis; hypanthium 6–8 mm longum, glabrum, stipite ca. 2 mm longo, glabro; sepala 6–7 mm longa, 2.5 mm lata, oblonga, obtusa, cucullata; petalum album, 10 mm longum et 6 mm latum, obovatum, glabrum ad basim intus villosulosum; filamenta sparse villosa basim versus, ca. 8 mm longa; gynoecium glabrum, stylo ca. 7.5 mm longo, ovario oblongo, 3 mm longo et 1 mm lato, gynophori parte libera ca. 1 mm longa; fructus non visus.

Type-Collection: H. P. Fuchs and L. Zanella 21787 (holotype US sheet No. 2639666, isotypes COL, F,G,K,S), right bank of Río Baudó about 120 km from estuary of Quebrada Birudó at foot of Loma Los Choritos, Depto. Chocó, Colombiá, 6 Feb. 1967.

Discussion and Etymology: The long pedicels of this species (to which the specific epithet alludes) separates it from all other species of Section

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* Length of hypanthium plus sepal.

Stenosolen with unijugate leaflets. It appears no more closely related to one than the other species from which it differs in one or more of the following characters: (1) puberulous leaf parts, (2) size of the bracteoles, sepals, and petal, (3) length and pubescence of the hypanthium, and (4) the glabrous gynoecium, in addition to the long pedicels.

Macrolobium rigidum Cowan, sp. nov.

Description: Arbor 8 m alta, trunco 12 cm diametro, ramulis glabris, stipulis persistentibus, rigidis, 5–6 mm longis, 2–2.5 mm latis, lanceolatis acutis, glabris, foliolis glabris; petioli 16–17 mm longi, ad apicem rudimento rhachis persistenti aciculari ad 5 mm longo, laminis late ellipticis, rigidis, inaequaliter, obtusis ad basim, ad apicem rotundatis vel raro obtusis, 7–10 cm longis, 4.5–5.5 cm latis, ad margine revolutis, costa plana sed venulis primariis salientibus supra, infra salientibus; inflorescentiae axillares, 4–6 cm longae, axe minute puberulo, pilis inflatis et ad apicem apiculatis, bracteis deciduis, late triangularibus, ca. 2 mm longis et 3 mm latis, acutis, ciliolatis, intus glabris, extus minute inflato-puberulis, pedicello 1–1.5 mm longo, minute inflato-puberulo, bracteolis deciduis, obovatis, apiculatis, 6.5–8.5 mm longis, 4–5 mm latis, minute inflato-puberulis extus, intus glabris, crasso-carnosis; hypanthii stipes 3–3.5 mm longus, inflato-puberulus, hypanthio cupulare, 2.5–3 mm longo, minute inflato-puberulo; sepala 4, late elliptica, rotundata ad apicem, ca. 5 mm longa et 4 mm lata, leviter minute inflato-puberula extus, intus glabra, margine ciliolata; petalum album, obovatum, stipite lato, ca. 3 mm longo, basaliter puberulo extus, intus glabro, petalodiis 2.5–4 mm longis, glabris; filamenta ca. 12 mm longa, pilosula, rosea; gynoecium dense inflato-puberulum minute, stylo 5.5 mm longo excepta, ad basim leviter puberulo, ovario elliptico, ca. 3.5 mm longo et 1.5 mm lato, gynophoro ca. 1.5 mm longo; fructus non visus.

Type-Collection: R. P. Belém 1733 (holotype US, Sheet no. 2639669, isotype NY), "Margem da Rodovia Camacan-Canavieiras, 32 Km. W de Canavieiras. Restinga," Bahia, Brazil, 8 September 1965.

Discussion and Etymology: Once again the richness of the coastal forest of Bahia is emphasized by the discovery of yet another species of *Macrolobium* there. Although clearly related to *M. latifolium*, this is a very distinct species by virtue of its rigid-coriaceous leaflets (to which characteristic the specific epithet refers) with the margins obviously revolute. Like its relative, *M. rigidum* has minute, inflated hairs on most of the floral parts but the hairs are unique in the genus in that there is an apiculum surmounting each hairlet. Both species have thick bracteoles, four sepals, and an eccentric gynophore.

Recordoxylon irwinii Cowan, sp. nov.

Description: Arbor ca. 6 m alta, trunco 15 cm diametro, ramulis juvenalibus ferrugineo-puberulis sed mox glabrescentibus, stipulis nullis; petioli 4–6 cm longi, glabri; rhaches 6–10 cm longae, leviter puberulae, teretes; foliola 8-jugata, petiolulis 2–3 mm longis, sparse puberulis, laminae ad medium foliorum 40–45 mm longae, 15–20 mm latae, lanceolato-ellipticae ad lanceolatae, laminis basalibus minoribus et ovatis ad ellipticis, laminis omnibus plus minusve inaequilateralibus, ad basim obtusis, apicaliter acutis, leviter puberulis infra sed glabrescentibus, supra glabris, venis planis supra, infra leviter salientibus; inflorescentiae terminales, paniculato-racemosae, axe dense ferrugineo-puberulo, bracteis bracteolisque caducis non visis, bracteolis prope medium pedicellorum nascentibus; pedicelli 7–9 mm longi, dense ferrugineo-puberuli, hypanthio ca. 1 mm profundo, extus ferrugineo-puberulo; sepala 5, concava, ca. 5 mm longa et 3 mm lata, ovalia, ferrugineo-puberula extus, intus albovillosula; petala 5, glabra, lutea, unguiculo ca. 1.5 mm longo, lamina ca. 7 mm diametro, orbiculata; stamina 10, fertilia, 2.5–3.5 mm longa, basaliter dense puberula, antheris 2–2.3 mm longis, 0.8–1 mm latis, oblongis; stigma truncatum, minute penicellatum, stylo ca. 3 mm longo, crasso, leviter puberulo; ovarium ca. 3 mm longum et 0.8 mm latum, oblongum, dense puberulum, gynophoro centrali in hypanthio, ca. 0.5 mm longo, glabro; fructus non visus.

Type-Collection: H. S. Irwin, R. M. Harley, G. L. Smith 31179 (holotype US, sheet no. 2698429, isotype NY), "cut-over gallery forest, ca. 28 km. N. of Seabra, road to Agua de Rega, ca. 1000 m. elev., Serra de Agua de Rega," Bahia, Brazil, 27 February 1971.

Discussion: The new species is quite distinct from the three other species in the genus by its much smaller flowers—less than half the size of those of the other species. It would be extremely interesting to find fruiting material, as well as more open flowers. The flowers of the type-collection are almost entirely in pre-anthesis. Having mature fruits might be helpful for unraveling the relationships in this complex of genera.

Swartzia calva Cowan, sp. nov.

Description: Arbor 9–10 m alta, ubique glabra, trunco 35 cm diametro, ramulis glabris, stipulis caducis, non visis; petioli 4–4.5 cm longi, teretes, rhachibus 17.5–23 cm longis, teretibus; foliola 4- vel 5-jugata, petiolulis 4–8 mm longis, laminis 8–14.5 cm longis, 4.5–6.5 cm latis, ellipticis ad ovato-ellipticis, basi obtusis, apice acuminatis et mucronulatis, lucidis et venis venulisque salientibus ambobus; inflorescentiae cauligerae vel ramigerae, ca. 17 cm longae, axe crasso, bracteis caducis non visis, bracteolis persistentibus, triangularibus, ca. 0.8 mm longis latisque, prope medium pedicellorum nascentibus; pedicelli 12–14 mm longi, alabastris globosis, ca. 10 mm diametro; calycis segmenta 3, coriacea; petalum album, unguiculo ca. 6 mm longo, lamina oblato-ovata, ca. 25 mm longa et 32 mm lata; stamina maiora 2, filamentis ca. 26 mm longis, antheris oblongis, ca. 3.5 mm longis, minora filamentis 17 mm longis, antheris oblongis, ca. 2.5 mm longis et 0.8 mm latis; ovarium anguste oblongum, 12–14 mm longum, 2.5 mm latum, stylo 11–13 mm longo, gynophoro 11–12 mm longo; fructus non visus.

Type-Collection: J. Schunke V. 2509 (holotype US, sheet no. 2615454, isotype F), "Al borde del bosque alto, y bosque bajo. En abundante luz solar. Tracha a Pisco, a 4 km. de Santa Maria de Nanay. Dtto. Alto Nanay. Altura sobre nivel del mer 130 m.," Prov. Maynas, Peru, 9 March 1968.

Discussion and Etymology: There are many species in this genus characterized by some parts that are glabrous or glabrescent, but one with all parts glabrous from the beginning is most unusual—thus the specific epithet. The new species is related to S. *polyphylla* and to S. *reticulata*. From the first of these, S. *calva* differs in its much larger buds and flowers, as well as in its "baldness." The second relative, S. *reticulata*, shares the distinction of being completely glabrous and it has large flowers like S. *calva*. However, the new species has style and ovary about equal in length whereas in S. *reticulata* the style is much shorter than the ovary. The latter also has much larger coarsely coriaceous leaflets.

Swartzia flaemingii Raddi, variety **polita** Cowan, var. nov.

Description: Arbor 25 m alta, trunco 40 cm diametro; stipulae caducae, 0.7 mm longae, anguste triangulares; petioli 8–9 mm longi, supra canaliculati, dense strigulosi; rhaches 8.5–12.5 cm longae, alatae, aliis valde recurvatis, pernitidis supra, infra strigulosis, axe dense striguloso; foliola (10–) 11–15 (–17)-jugata, petiolulis 0.7 mm longis, dense strigulosis, laminis 20–34 mm longis, 7–10 mm latis, coriaceis, nitidissimis et reticulatis costa valde impressis supra, infra brunneolis dense strigulosisque obtusis ad apicem basimque, aliquando leviter emarginatis; inflorescentiae ramigerae vel cauligerae, 7–15 cm longae, axe dense striguloso, bracteis persistentibus, strigulosis, triangularibus, ca. 1 mm longis, bracteolis persistentibus, ca. 0.6 mm longis; pedicelli 12–16 mm longi, dense strigulosi, alabastra globosa, ca. 10 mm diametro, dense striguloso; calycis segmenta 3–5, glabra intus; petalum album, strigosum extus, intus glabrum, unguiculo ca. 2 mm longo, lamina late cordata, ca. 25 mm longa lataque; stamina maiora 4 vel 6, glabra, filamentis ca. 17 mm longis, antheris 2.5 mm longis, 1.5 mm latis, ovalibus, connectivo verrucoso, minoribus brevioribus, antheris oblatis 0.8 mm longis, 1 mm latis; gynoecium dense alboseriсeum, stigma punctiformi, stylo ca. 1 mm longo, ovario arcuato-elliptico, 5 mm longo, 2.5 mm lato, gynophoro 5 mm longo; fructus non visus.

Type-Collection: R. P. Belém et R. S. Pinheiro 3078 (holotype US, sheet No. 2639671, isotype NY), "mata costeira," Maraú, Bahia, Brazil, 12 January 1967.

Discussion and Etymology: Certainly the closest relationship of this variety is to the second new one distinguished briefly below. Variety *polita* differs most conspicuously by the highly polished appearance of the upper surface of the leaflets (which the varietal epithet emphasizes) but it also has coriaceous, revolute-margined leaflets that are brownish-strigulose on the undersurfaces. In the flower the most striking difference is in the number of larger stamens, up to six in variety *polita* and twice that many or more in its nearest relative.

Swartzia flaemingii Raddi, variety **cognata** Cowan, var. nov.

Diagnosis: A var. *polita* foliolis 18–20-jugatis, laminis chartaceis, subplanis, flexuoso-pilosis infra, supra hebetibus, inflorescentiis longioribus (ad 22 cm longis), staminibus 10–12 differt.

Type-Collection: R. P. Belém et R. S. Pinheiro 2944 (holotype US, sheet no. 2639670, isotype NY), "Plantação de cacau, Coarcí, Babia," Brazil, 30 November 1966.

Discussion: These varieties share a large number of characteristics, including the phytogeography: Both occur in the strip of coastal forest (or remnants thereof) along the eastern coast of Bahia. They differ from the other varieties of S. *flaemingii* Raddi by the generally larger number of pairs of narrowly oblong leaflets, and by greater number of large stamens (except for variety *arumateuana* Cowan which has oblong-elliptic, acute leaflets). From two other relatives, S. *multijuga* Vogel and S. *prolata* Cowan, these new subspecific taxa differ among other things, in having densely pubescent gynoecia, but otherwise they are most similar to S. S. *prolata* which has a much longer gynophore proportionately. *Swartzia macrostachya* Bentham, part of this same complex, has fewer pairs of larger leaflets that are never narrowly oblong as in the new taxa.

Etymology: The epithet for this variety was given to emphasize its morphological similarity, implying relatedness, to variety *polita*.

Swartzia jimenezii Cowan, sp. nov.

Description: Arbor 25 m alta, trunco 50 cm diametro, ramulis dense micro-puberulis; stipulae triangulares, persistentes, ca. 1 mm longae lataeque, dense puberulae; folia immatura, petiolis 2.5–3.3 cm longis, dense puberulis, teretibus; rhaches 3.5–5 cm longae, dense puberulae, teretes; foliola 3-jugata, opposita, petiolulis 3 mm longis, dense puberulis, laminis 5–7 cm longis, 2.5–3.5 cm latis, ellipticis, basi acutis, apicem obtusis, laminis minute strigulosis (leviter supra), costa et venis primariis planis supra, infra leviter salientibus; inflorescentiae ramuligerae, fasciculatae, 4–11 cm longae, axe dense striguloso, bracteis persistentibus, triangularibus, acutis, ca. 1 mm longis latisque, minute strigulosis, bracteolis nullis; pedicelli 7–10 mm longi, minute strigulosi, alabastra globosa, ca. 5 mm diametro, minute strigulosa extus, intus glabra; petalum luteum, glabrum, unguiculo 2–2.5 mm longo, lamina oblata, ca. 10 mm longa et 8 mm lata; stamina maiora 2 (?), glabra, filamentis 7 mm longis, minora glabra, ca. 5 mm longa; stigma oblique truncatum, subsessile, stylo ca. 0.5 mm longo, glabro; ovarium lineare, leviter arcuatum, 5–6 mm longum, 0.8 mm latum, sparse strigulosum, gynophoro 1.5–3 mm longo, glabro; fructus non visus.

Type-Collection: H. Jimenez Saa. 1301 (holotype US, sheet No.

2639667) "Reserva Forestal de Caparo, Estado Barinas, Venezuela," 3 December 1971, 100 m elevation, 2000 mm rainfall.

Discussion and Etymology: Superficially, this new species (named for the collector of the only known material) looks quite similar to S. *leptopetala* but closer examination reveals at least one significant difference. The nearly glabrous gynoecium of S. *jimenezii* immediately separates it from all its near relatives which have sericeous gynoecia. Locally, it is called "orura barrialera."

Swartzia micrantha Cowan, sp. nov.

Description: Arbuscula 2 m alta, ramulis microstrigulosis sed mox glabrescentibus; stipulae caducae, lineari-lanceolatae, 1–1.5 mm longae; petioli 2.5–3 cm longi, canaliculati, ad apicem stipellati, leviter minuteque strigulosi; rhaches 5–5.5 cm longae, canaliculatae, stipellatae, leviter micro-strigulosae; foliola 2-vel 3-jugata, petiolulis ca. 1 mm longis, laminis 6–8.5 cm longis, 2.5–4.5 cm latis, ellipticis, basi obtusis cordatis, apice obtusis et micro-mucronatis, supra lucidis ad costam leviter microstrigulosis alioqui glabris, infra leviter microstrigulosis, venis planis excepta costa impressa supra et venis primariis salientibus infra: inflorescentiae ramuligerae, 5–7 cm longae, axe minuto-striguloso, bracteis persistentibus, 1.5–2 mm longis, triangularibus, bracteolis ca. 1 mm longis, lineari-lanceolatis ad apicem pedicellorum nascentibus; pedicelli 2–3 mm longi, minute strigulosi; alabastra globosa 4 mm diametro; calycis segmenta 3, intus glabra extus minute strigulosa, decidua; petalum album, unguiculo 3–3.5 mm longo, extus sericeo, lamina oblata, 3.5 mm longa, 5.5 mm lata, extus ad medium sericea; stamina maiora 2 (?), filamentis ca. 6 mm longis, sparse strigulosis, antheris ovali-oblongis, 2 mm longis et ca. 1.2 mm latis, minora glabra, ca. 5 mm longa, antheris subquadratis, ca. 0.7 mm longis et latis; gynoecium sericeum, stigmate punctiformi, stylo ca. 1 mm longo, ovario ca. 2.5 mm longo et 1.2 mm lato, obovata, gynophoro ca. 2 mm longo; fructus non visus.

Type-Collection: R. P. Belém and R. S. Pinheiro 2522 (holotype NY, isotype US), "restinga at Belmonte, Bahia," Brazil, 7 July 1966.

Discussion and Etymology: The relationships of this distinctive species is not altogether clear but it appears to be most nearly allied to S. *macrostachya* which has much larger flowers and more pairs of leaflets. The new species grows in the restinga of coastal Bahia where many others of restricted range occur. The epithet provided refers to the small flowers.

Swartzia peremarginata Cowan, sp. nov.

Description: Arbuscula 2 m alta, ramulis novellis tomentosis; stipulae persistentes lanceolatae, 2.5–3 mm longae, 0.7–1 mm latae, tomentosae extus; petioli 1.5–1.8 cm longi, tomentosi, teretes, brevi-stipellati; rhaches ca. 4 cm longae, tomentosae, teretes sed bistipellatae ad foliis; foliola 2-jugata, petiolulis 1.5–2 mm longis, tomentosis, laminis 5.5–8 cm longis, 3.5–6.5 cm latis, rigidis, obovatis vel ovatis ad basim aequilateralibus vel inaequilateralibus cordatis, ad apicem rotundatis et profunde emarginatis, supra venis primariisque planis sed infra plus minusve salientibus, glabris costa pilosa excepta, supra infra pilosa; inflorescentiae fructiferi ramuligerae, 11–14 cm longae, axe leviter pilosuloso, bracteis persistentibus, 1.5 mm longis et latis, triangularibus, strigulosis extus, bracteolis nullis; pedicelli 5–9 mm longi, glabri; calycis segmenta 3 vel 4, persistens glabra, ca. 7 mm longa, margine incrassata extus; flores non vidi; fructus submaturus globosus, glaber, ca. 2 cm diametro.

Type-Collection: R. P. Belém et R. S. Pinheiro 2377 (holotype NY, isotype US), coastal scrub," margem da Rodovia, Una Olivença, Bahia," Brazil, 1 June 1966.

Discussion and Etymology: This is an extremely interesting new species, so distinctive that it can safely be described without flowering material. The form of the fruits suggests a relationship with the S. *apetala* complex but it is quite dissimilar vegetatively. Its rigid, obovate, deeply emarginate leaflets (which the specific epithet emphasizes) separate it clearly from any part of that complex or from any other species in the genus.

Flowering material would be most welcome, especially in view of the unique structure of the persistent calyx segments. In this instance, these might be referred to as "sepals," because each segment has a thickened, well-differentiated margin that probably causes the buds to exhibit about three prominent longitudinal ridges. If the sepals are as clearly determined as appears to be the case, this is the only species so characterized.

Swartzia tillettii Cowan, sp. nov.

Description: Arbor ad 25 m alta, ad basim 4 dm diametro, ramulis dense nigro-tomentosis, plus minusve striatis; stipulae caducae, 8–10 mm longae, 6–7 mm latae, oblique ovatae acutae, extus dense tomentosae; petioli 5.5–6 cm longi, dense tomentosi, supra leviter canaliculati, rhachi 11–17 cm longa, tereti sed leviter canaliculata et inconspicue stipellata; foliola (2-) vel 3-jugata, petiolulis ca. 4 mm longis, tomentosis, laminis margine late devolutis, 11–21 cm longis, 7–10 cm latis, rotundatis ad obovatis, basi rotundato-obtusis, apice rotundatis, supra ad costam strigulosis infra albo-strigulosis (ad venas tomentosis exceptis), venis primariis et costa supra impressis sed infra salientibus; inflorescentiae ramuligerae, 6–15 cm longae, axe atro-brunneo-tomentoso, bracteis persistentibus, ca. 4 mm longis et latis, late ovatis concavis extus tomentosis, bracteolis persistentibus, 3–4 mm longis, ca. 2 mm latis, lanceolatis, ad apicem pedicellorum nascentibus; pedicelli 25–30 mm longis, laterale valde compressi clavati, tomentosi; alabastra ovalia, 18–20 mm longa, 14–16 mm diametro; calycis segmenta crassa, rigido-coriacea, extus atro-brunneo-tomentosa, intus glabra; petalum luteum, mox deciduum, lamina ad basim intus et extus villosa, venis extus et intus villosis, extus brunneis, unguiculo ca. 4 mm longo, lamina 70–80 mm longa, 90–95 mm lata, oblata, base valde cordata; stamina maiora ca. 6, glabra, filamentis ca. 20 mm longis, antheris non visis; stamina minora glabra, filamentis ca. 10 mm longis, antheris ovalibus; gynoecium tomentosum, stigma et stylo non visis, ovario ca. 55 mm longo et 3.5 mm lato, lineare, recto, gynophoro ca. 12 mm longo; fructus non visus.

Type-Collection: Stephen S. and Carolyn L. Tillett 45568 (holotype US, sheet no. 2448842, isotypes NY), "slopes of Karowtipu at ca. 950 m, Kako River, Guayana," 30 September 1960.

Discussion and Etymology: The nearest relative of S. *tillettii* (named for the collectors in recognition of the extremely valuable collections obtained by them on this expedition) is S. *pachyphylla* from the Mt. Roraima area. The new species has larger stipules, terete leaf rachis, differently shaped, larger leaflets, less obvious venation in the leaflets and the blades are strongly devolute. The pedicels are longer, the buds larger, and the petal is as large as in any species of the genus.

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PROCEEDINGS
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NEW SPECIES AND RELATIONSHIPS OF THE MEMBERS OF THE GENUS *FALLICAMBARUS*

By Horton H. Hobbs, Jr.
Smithsonian Institution, Washington, D.C. 20560

In an attempt to obtain additional specimens of *Fallicambarus strawni* (Reimer, 1966:11), Jean E. Pugh, my wife Georgia, and I spent several days in the southwestern part of Arkansas, in April 1973, collecting burrowing crayfishes. Due to recent heavy rains, the task of digging for them was made somewhat less arduous than it otherwise might have been, and, as a result, not only was a good series of this crayfish secured from four localities, but also members of two undescribed species of the genus were obtained.

Upon comparing the undescribed forms with specimens of other members of the genus, it became apparent that *Fallicambarus* as now defined comprises two rather distinct species groups for which subgeneric designations are here proposed. Among the morphological features that deserve mention are the undivided, uniformly calcified telson (Fig. 3*h*) in *F. strawni* and *F. byersi* (Hobbs, 1941:118). To my knowledge, such a telson is known elsewhere only in certain crayfishes occurring in the Southern Hemisphere (e.g., members of the genera *Engaeus* and *Parastacus*). In *F. strawni* (Fig. 3*h*), *F. byersi*, and in other members of the genus, the mesial ramus of the uropod is devoid of lateral, and frequently of median, spines; in contrast, that of *F. macneesei* (Black, 1967:173) (Fig. 3*f*) rivals in its spination the corresponding ramus in *Procambarus* (*Acucauda*) *fitzpatricki* Hobbs (1971:461) and *Procambarus* (*Girardiella*) *hagenianus* (Faxon, 1884:141).

Another similarity to certain crayfishes of the Southern Hemisphere exists in at least two members of the genus *Fallicambarus*. In them, the cephalic lobe of the pleuron of the second abdominal segment is reduced to the extent that it fails to overlap the pleuron of the first segment (Fig. 3*b*, *c*). In most crayfishes, this overlap is typical (Fig. 3*a*).

Of unusual interest to me was finding that in some of the members of this genus the ischium of the first pereiopod possesses a recurved, or at least angular, prominence on the proximal postaxial lateral surface that articulates with an elevated knoblike condyle on the corresponding distolateral surface of the coxa. This prominence (Fig. 3*d*), here designated the *sufflamen*, serves as a brake in the backward elevation of the cheliped. In some members of the genus, not only is the sufflamen absent, but also the distolateral knob on the corresponding coxa is small and deflected distally (Fig. 3*e*). The presence or absence of the sufflamen in the several members of the genus is noted below.

Following are diagnoses of the genus *Fallicambarus* and of proposed subgenera, descriptions of two new species, notes on *F. strawni*, and a discussion of relationships within the genus and its probable common origin with *Procambarus* (*Tenuicambarus*) *tenuis* Hobbs (1950:194). Figure 4 depicts my concept of the relationships of these crayfishes and provides a key for recognizing the members of the genus *Fallicambarus*.

Acknowledgments: Special thanks are extended to Dr. Pugh and to my wife for their invaluable assistance in collecting the specimens on which most of this manuscript is based. I am also grateful to Fenner A. Chace, Jr., and to Margaret A. Daniel for their critical reading of the manuscript.

Genus *Fallicambarus*

Fallicambarus Hobbs, 1969:111.

Diagnosis: Adults with rostrum devoid of marginal spines. Mesial margin of palm of chela with row of fewer than 12 tubercles; opposable margin of dactyl usually with prominent excision. Areola linear or obliterated. Antennal scale more than twice as long as broad. First pleopods of first form male symmetrical and terminating in two or three distinct parts (mesial process, central projection and, occasionally, cephalic process; caudal element always absent) bent caudally or caudomesially at angle of 90 degrees or more to main shaft or forming broad arc; central projection corneous, blade-like or tapering (but flattened laterally) and lacking, except in *F. byersi*, subapical notch; non-corneous mesial process never bulbiform but often appearing twisted and usually with eminence on cephalic (morphological) border slightly distal to base; cephalic process, when present, small, at least partially corneous, situated mesially at base of mesial process, and directed caudally or caudodistally (modified from Hobbs, 1969:111).

Type-species: *Cambarus strawni* Reimer, 1966:11.

Gender: Masculine.

Subgenus *Fallicambarus*

Diagnosis: First pleopod of male with proximomesial spur. Cheliped lacking sufflamen except in *F. macneesei*; chela with tubercles over most of dorsal surface, and lateral margin of palm and basal portion of immovable finger rounded or subserrate. Second pereiopod with mesial surface of chela and that of carpus lacking dense mats of plumose setae. Ischium of third or third and fourth pereiopods with hooks. Coxa of fourth pereiopod with conspicuously large boss. Abdomen narrowly joined to thorax except in *F. macneesei* and *F. dissitus*. Antennal scale very narrow except in *F. macneesei*.

List of Species: *Fallicambarus (F.) dissitus* (Penn, 1955:73); *F. (F.) jeanae*, new species; *F. (F.) macneesei* (Black, 1967:173;) *F. (F.) spectrum*, new species; *F. (F.) strawni*.

Subgenus **Creaserinus**, new subgenus

Diagnosis: First pleopod of male lacking proximomesial spur. Cheliped with sufflamen; chela with tubercles on dorsal surface largely limited to mesial two rows, and lateral margin of palm and basal portion of immovable finger costate. Second pereiopod with mesial surface of chela and part of that of carpus bearing dense mats of plumose setae except in *F. byersi*. Ischium of only third pereiopod with hooks. Coxa of fourth pereiopod with boss not conspicuously large. Abdomen broadly joined to thorax except in *F. byersi* and *F. oryktes*. Antennal scale comparatively broad except in *F. byersi* and *F. oryktes*.

Type-species: *Astacus fodiens* Cottle, 1863:217.

Gender: Masculine.

List of Species: *Fallicambarus (Creaserinus) byersi* (Hobbs, 1941:118); *F. (C.) fodiens*; *F. (C.) hedgpethi* (Hobbs, 1948:224); *F. (C.) hortoni* Hobbs and Fitzpatrick, 1970:829; *F. (C.) oryktes* (Penn and Marlow, 1959:197); and *F. (C.) uhleri* (Faxon, 1884:116).

Etymology: Named in honor of Dr. Edwin P. Creaser whose contribution to our knowledge of American crayfishes is invaluable.

Fallicambarus (Fallicambarus) jeanae, new species

Figure 1

Diagnosis: Mesial ramus of uropod without distolateral spine; telson with transverse suture but lacking lateral spines; abdomen conspicuously narrower than cephalothorax; width of palm of chela of first pereiopod usually no less than 1.7 times length of its mesial margin, its color

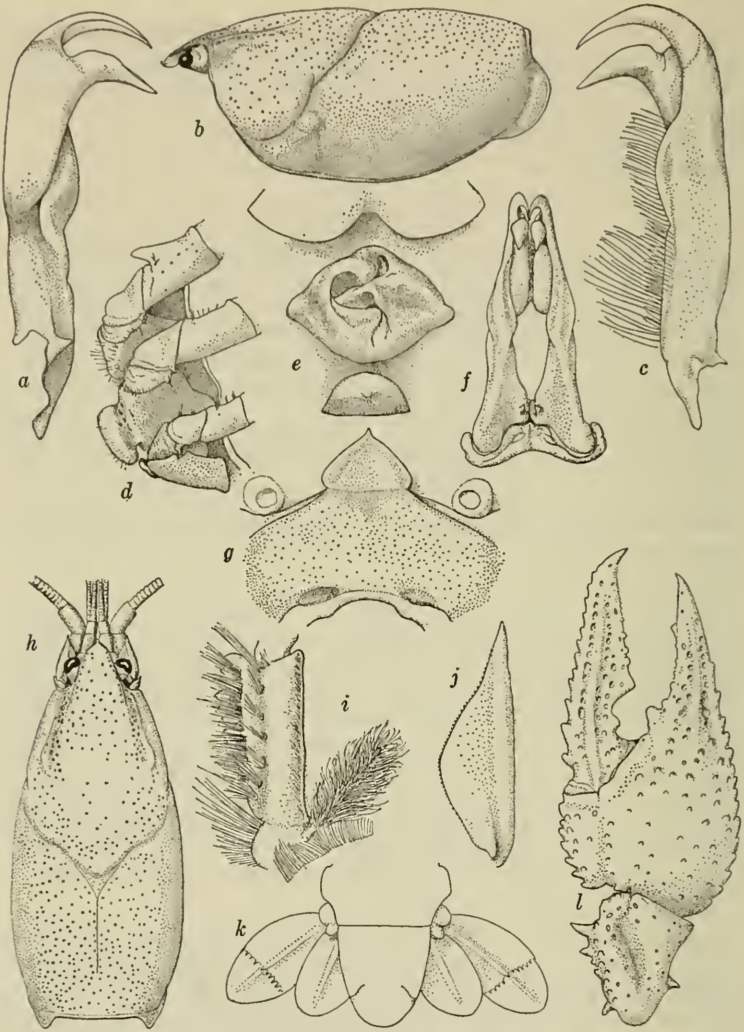

FIG. 1. *Fallicambarus (Fallicambarus) jeanae*, new species (pubescence removed from all structures illustrated except *c*, *d*, and *i*, and all depicting holotype except *e*, *f*, and *i*). *a*, Mesial view of first pleopod; *b*, Lateral view of carapace; *c*, Lateral view of first pleopod; *d*, Basal podomeres of third, fourth, and fifth pereiopods; *e*, Annulus ventralis of allotype; *f*, Caudal view of first pleopods of paratypic male, form I; *g*, Epistome; *h*, Dorsal view of carapace; *i*, Basal podomeres of third maxilliped of paratypic male, form I; *j*, Antennal scale; *k*, Dorsal view of telson and uropods; *l*, Dorsal view of distal podomeres of cheliped.

yellowish tan with bluish-brown tubercles. Male with hook on ischium of third pereiopod only; first pleopod without cephalic process, and central projection strongly recurved with apex reaching, or almost reaching, level of cephalic base of projection and almost to level of arc of mesial process.

Holotypic Male, Form I: Body subovate, compressed (Fig. 1*b*, *h*). Abdomen much narrower than cephalothorax (11.0 and 16.2 mm); greatest width of carapace slightly greater than depth at caudodorsal margin of cervical groove (16.2 and 15.9 mm). Areola linear over much of its length; length 39.0 percent of entire length of carapace (44.4 percent of postorbital length). Rostrum with convergent moderately thickened margins, lacking marginal spines or tubercles and contracting rather suddenly near apex to form short subtriangular acumen; upturned tip almost reaching distal end of penultimate podomere of antennular peduncle; dorsal surface of rostrum concave with submarginal setiferous punctations and scattered ones between. Subrostral ridges well developed and evident in dorsal aspect almost to midlength of rostrum. Postorbital ridge strong, grooved laterally and truncate cephalically. Suborbital angle obsolete. Branchiostegal spine vestigial, represented by slight obtuse prominence at junction of cervical groove and cephalolateral margin of carapace. Cervical spine or tubercle absent. Carapace punctate dorsally and laterally with few weak tubercles on extreme cephaloventral portion of branchiostegite.

Abdomen distinctly shorter than carapace (30.4 and 35.1 mm); pleura very short and rounded, only that of sixth segment with angular caudoventral margin; pleuron of first abdominal segment slightly overlapped by cephalic lobe of that of second. Cephalic section of telson (Fig. 1*k*) without spines but with dense setal tufts in caudolateral corners; entire telson and uropods setose dorsally. Proximal podomere of uropod (Fig. 1*k*) without spines. Both rami narrow, studded with dense short stiff setae and with conspicuous strong median rib, rib on mesial ramus extending almost to distal margin but lacking distal spine; distolateral spine absent; median rib on proximal lobe of lateral ramus terminating in spine; rib on distal lobe merging with flattened distal portion and not reaching distal margin.

Cephalomedian lobe of epistome (Fig. 1g) subtriangular with margins elevated (ventrally) and with transverse groove at base; main body comparatively long and lacking fovea. Ventral surface of proximal podomere of antennule lacking spine. Antennal peduncle without spines, flagellum reaching third abdominal tergum. Antennal scale (Fig. 1*j*) about 3.1 times longer than broad and with mesiodistal margin of lamellar area sloping distolaterally almost from midlength to distolateral spine; row of setae on mesial margin of scale continuing onto base of corneous tip of spine; spine reaching distal end of penultimate podomere of antennular peduncle. Ventral surface of ischium of third maxilliped (Fig. 1*i*) with setae abraded, but, in other specimens, with submedian row of long stiff setae and submarginal lateral row of short finer ones.

Right chela (Fig. 1*l*) about twice as long as broad, strongly depressed; mesial margin of palm with row of 7 tubercles subtended dorsolaterally by row of 5 smaller ones; dorsal surface of palm with scattered squamous tubercles; lateral margin of chela with serrate row of tubercles extending almost from base to midlength of fixed finger; ventral surface with few scattered tubercles, large one opposite base of dactyl with other smaller ones proximal to it. Opposable margin of fixed finger with row of 6 tubercles along proximal three-fifths, proximalmost much larger than others in series; single large tubercle on lower level immediately distal to distal member of row; dorsal surface of finger with prominent submedian longitudinal ridge flanked by large deep punctations; proximally, ridge merging into flattened distal third of finger; distal half of lateral margin with row of 5 setiferous punctations; ventral surface with submedian ridge flanked by setiferous punctations. Opposable margin of dactyl with prominent tubercle in proximal excavation and with 7 tubercles, decreasing in size distally, between distal margin of excavation and base of distal fourth of finger; dorsal surface with submedian longitudinal ridge flanked in proximal fourth of finger by tubercles and distally by large deep punctations, ridge merging with flattened surface of finger in distal third of latter; mesial surface with serrate row of tubercles decreasing in size distally; ventral surface as in fixed finger but with few tubercles flanking ridge proximolaterally.

Carpus of cheliped with sinuous furrow and scattered punctations dorsally; dorsomesial surface tuberculate; mesial surface with row of 4 tubercles increasing in size distally, distalmost spikelike and directed mesiodistally; ventromesial surface with several small tubercles, ventrodistal margin with large tubercle on lateral condyle and another near median line; lateral surface punctate. Merus with dorsal surface tuberculate, tubercles increasing in size distally and three subdistal ones acute with corneous tips; mesial and lateral surfaces sparsely punctate; ventral surface with lateral row of 8 small tubercles and mesial one of 12 slightly larger ones increasing in size distally; ventral distolateral margin without spine. Mesioventral margin of basioischial podomere with single rounded tubercle slightly distal to fracture suture.

Chela of second pereiopod with marginal rows of setae on palm, and carpus with dorsal row of long setae; mesial surfaces of both without tuft of plumose setae.

Ischium of third pereiopod with simple hook extending proximally over basioischial articulation (Fig. 1*d*), not opposed by tubercle on basis. Coxa of fourth pereiopod with massive caudomesial boss compressed laterally, thus directed almost in longitudinal plane of body; mesial and lateral surfaces of boss setiferous. Coxa of fifth pereiopod lacking caudomesial boss but with setiferous ventral membrane.

First pleopods (Fig. 1*a*, *c*, *f*) reaching coxa of third pereiopods, held

TABLE 1.—Measurements (mm) of *Fallicambarus (F.) jeanae*

	Holotype	Allotype
Carapace:		
Entire length	35.1	34.3
Postorbital length	30.8	30.2
Width	16.2	16.4
Height	15.9	16.3
Areola:		
Width	—	—
Length	13.7	13.1
Rostrum:		
Width	5.0	5.0
Length	5.5	5.0
Chela:		
Length, palm mesial margin	7.9	6.5
Palm width	13.7	11.4
Length, lateral margin	25.8	21.2
Dactyl length	19.1	15.1
Abdomen:		
Width	11.0	11.0
Length	30.4	30.6

deep within sternum, and largely hidden by setae extending caudally and mesially from ventral margins of sternum and mesial surface of boss on fourth pereiopod; proximomesial spur well developed; terminal elements subparallel and curved throughout their length; mesial process somewhat grooved and acute distally; central projection tapering from base and recurved with apex almost reaching same level as cephalic base of projection; cephalic process absent.

The second form male is unknown.

Allotypic Female: Excluding secondary sexual characteristics, differing from holotype in following respects: rudiment of branchiostegal spine slightly more prominent; left chela with row of 8 tubercles on mesial margin of palm; second tubercle from base in row on opposable margin of fixed finger of chela larger than first, ridge on dorsal surface of finger less prominent; opposable margin of dactyl of chela with row of only 5 tubercles distal to excavation; merus of chela with ventromesial row of only 10 tubercles on right chela and ventrolateral row of only 6 on left. (See measurements.)

Annulus ventralis (Fig. 1*e*) subrhomboidal, 1.3 times broader than long, moderately deeply embedded in sternum, and immovable, although broad fissure present between it and adjacent cephalic sternal plate.

Cephalomedian area excavate with trough curving dextrally, concavity limited caudosinistrally by prominent sloping tongue; sinus originating in trough on cephalic side of tongue, curving around dextral base of latter and extending sinistrally slightly across median line, there turning caudally in sinuous course and ending on caudal wall, not reaching caudal margin. Sternite between fifth pereiopods broadly oval cephalically, about twice as broad as long, elevated ventrally, and with submedian prominence.

Color Notes: Dominant color of carapace pale mauve; rostral margins, postorbital ridges, and paired subtriangular areas caudal to postorbital ridges dark brown; latter joining along cervical groove and in caudal gastric area where almost black; caudal margin of carapace dark brown. First abdominal tergum dark brown, remaining ones pale yellowish tan with paired dorsolateral cream splotches and each edged caudally with vermilion. Telson and uropods cream with pale tan suffusion basally. Antennule and antenna with dark yellowish-brown peduncles; flagella with each article yellowish tan basally and dark brown distally; lateral margin of antennal scale almost black. Cheliped mostly yellowish tan dorsally with dark bluish-brown tubercles and bluish-brown suffusion on dorsal margin of merus, dorsomesial surface of carpus, and dorsomesial part of dactyl. Ventral surface of cheliped yellowish cream. Remaining pereiopods with coloration similar to that of cheliped but lacking dark brown tubercles.

Type-locality: A seepage area, 1.8 miles east of the Clark County line, Hot Springs County, Arkansas, on State Route 84. The crayfish were dug from complex (highly branching) burrows with two or three openings to the surface. The soil was basically a sandy clay with shallow pockets rich in organic material and some gravel. The area supported a moderate growth of grasses and sedges, and nearby was a stand of trees including members of the genera *Acer*, *Juniperus*, and *Pinus*. This crayfish is known only from the type-locality.

Disposition of types: The holotypic male, form I (no. 144672) and the allotypic female (no. 144673) are deposited in the National Museum of Natural History, Smithsonian Institution, as are the paratypes consisting of 4 ♂ I, 1 ♀, 3 juvenile ♂, and 2 juvenile ♀. All of the specimens were collected on 21 April 1973.

Variations: The apex of rostrum reaches between the midlength and the distal extremity of the penultimate podomere of the antennular peduncle. The branchiostegal spine is absent or very small. The cephalomedian lobe of the epistome ranges from subtriangular to suboval. The antennal scale is highly variable both in width and in the contour of the mesial margin and cannot always be distinguished from that of the species described below. The mesial margin of the palm of the chela of the first pereiopod bears 6 to 8 tubercles, and there are 5 or 6 tubercles in the row immediately dorsolateral to it; the opposable margin of the fixed finger bears 4 to 7 tubercles, and that of the dactyl, 5 to 8. The mesial surface of the carpus supports 1 to 3 tubercles. The ventral surface of the merus has a lateral row of 6 to 9 tubercles and a mesial one of 11 to 13; the ischium may lack or possess as many as 3 small tubercles on its ventromesial margin. The mesial process of the right first pleopod of the holotype is somewhat flared distally and bears paired subapical angles.

Relationships: See the section on Affinities below.

Etymology: This crayfish is named in honor of my friend and former student, Dr. Jean E. Pugh, who, in company with my wife and me, assisted in collecting the specimens on which this description is based.

Fallicambarus (Fallicambarus) spectrum, new species

Figure 2

Diagnosis: Mesial ramus of uropod without distolateral spine; telson with transverse suture and with or without paired lateral spines; abdomen conspicuously narrower than cephalothorax; width of palm of chela of first pereiopod usually no more than 1.6 times length of its mesial margin, its color grayish blue with dark blue tubercles. Male with hook on ischium of third pereiopod only; first pleopod without cephalic process, and central projection strongly recurved with apex extending proximal to level of cephalic base of projection as well as proximal to that of "distal" margin of arc of mesial process.

Holotypic Male, Form I: Body subovate, compressed (Fig. 2*b*, *h*). Abdomen narrower than cephalothorax (9.8 and 14.3 mm); greatest width of carapace subequal to depth at caudodorsal margin of cervical groove (14.3 and 14.4 mm). Areola linear along most of its length; length 39.3 percent of entire length of carapace (44.3 percent of postorbital length). Rostrum with convergent moderately thickened margins, lacking marginal spines or tubercles, ending rather suddenly at base of short triangular acumen, latter limited only by prolongation of subrostral ridges; upturned tip reaching midlength of penultimate podomere of antennular peduncle; dorsal surface of rostrum deeply concave with submarginal setiferous punctations and few scattered between. Subrostral ridges well developed and evident to tip of rostrum. Postorbital ridges strong, grooved laterally and gently merging with carapace cephalically. Suborbital angle absent. Branchiostegal spine small but with corneous acute tip. Cervical spine absent. Carapace punctate dorsally and laterally with few weak tubercles cephalolaterally, few moderately large ones on ventral flank of upturned cephalolateral portion of cervical groove.

Abdomen shorter than carapace (28.8 and 30.8 mm); pleura very short and rounded, only that of sixth segment with subangular caudoventral margin; pleuron of first abdominal segment not overlapped by cephalic lobe of that of second. Cephalic section of telson (Fig. 2*k*) with caudolateral angle produced in acute spine; entire telson and uropods setose dorsally. Proximal podomere of uropod (Fig. 2*k*) without spines; both rami similar to those in *F. jeanae*.

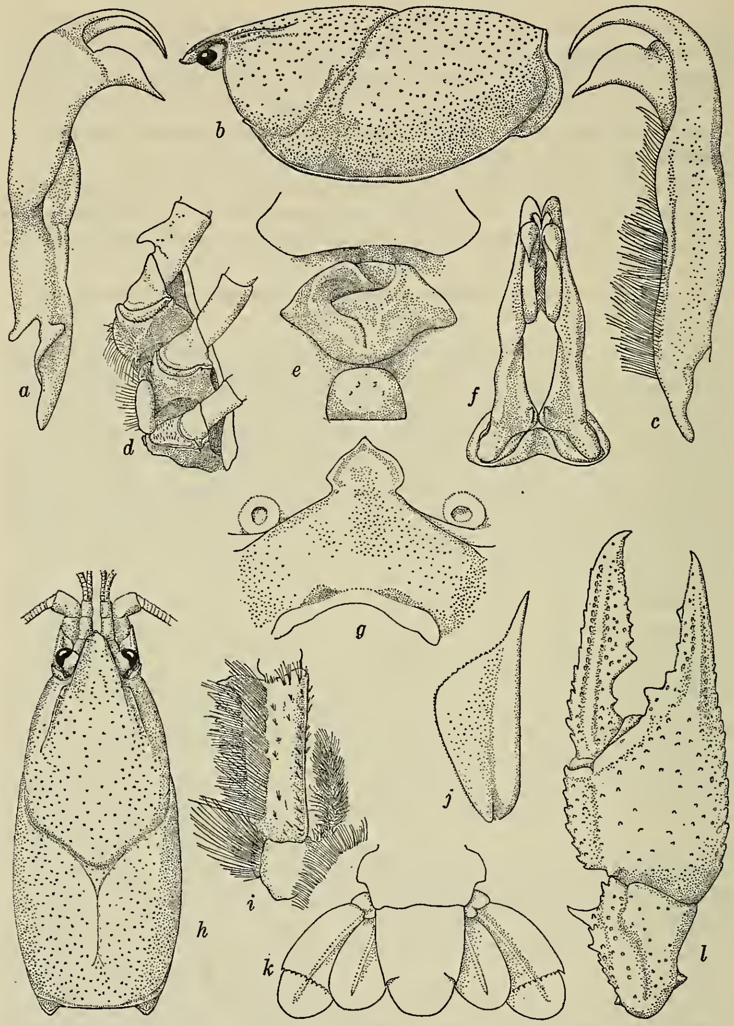

FIG. 2. *Fallicambarus (Fallicambarus) spectrum*, new species (pubescence removed from all structures illustrated except *c*, *d*, and *i*, and all depicting holotype except *e*, *f*, and *i*). *a*, Mesial view of first pleopod; *b*, Lateral view of carapace; *c*, Lateral view of first pleopod; *d*, Basal podomeres of third, fourth, and fifth pereiopods; *e*, Annulus ventralis of allotype; *f*, Caudal view of first pleopods of paratypic male, form I; *g*, Epistome; *h*, Dorsal view of carapace; *i*, Basal podomeres of third maxilliped of paratypic male, form I; *j*, Antennal scale; *k*, Dorsal view of telson and uropods; *l*, Dorsal view of distal podomeres of cheliped.

Cephalomedian lobe of epistome (Fig. 2*g*) subcordiform with margins slightly thickened and elevated ventrally; main body long and lacking fovea. Ventral surface of proximal podomere of antennule with vestigial spine (tubercle) near midlength. Antennal peduncle without spines, flagellum reaching third abdominal tergum. Antennal scale (Fig. 2*j*) about 2.8 times longer than wide; mesiodistal margin of lamellar area with base of distolateral slope originating distinctly distal to midlength; row of setae on mesial margin of scale continuing onto base of corneous tip of spine; spine reaching slightly beyond midlength of penultimate podomere of antennular peduncle. Third maxilliped (Fig. 2*i*) with ischium bearing submedian longitudinal row of long stiff setae, submarginal lateral row of shorter finer ones, and few additional short, some plumose, setae between rows.

Right chela (Fig. 2*l*) slightly more than twice as long as broad, distinctly depressed; mesial margin of palm with row of 7 tubercles subtended dorsolaterally by row of 6 smaller ones; dorsal surface of palm with scattered squamous tubercles; lateral margin of chela with serrate row of tubercles extending almost from base to level of second tubercle on opposable margin of fixed finger; ventral surface of palm also with squamous tubercles and 1 prominent tubercle opposite base of dactyl. Opposable margin of fixed finger bearing row of 3 tubercles, proximalmost largest, along proximal half and single large tubercle on lower level at base of distal third; dorsal surface of finger with broad submedian longitudinal ridge flanked by setiferous punctations; distal three-fifths of lateral margin with row of 5 setiferous punctations; ventral surface with weak submedian ridge flanked by setiferous punctations. Opposable margin of dactyl with moderately large tubercle in proximal excavation, latter followed distally by row of 7 tubercles, decreasing in size distally, and reaching distal fifth of finger; dorsal surface with submedian longitudinal ridge flanked proximally by tubercles, and, along most of its length, by setiferous punctations; mesial surface with serrate row of tubercles decreasing in size distally; ventral surface similar to that of fixed finger but with cluster of small tubercles at lateral base.

Carpus of cheliped with sinuous furrow and punctations dorsally; dorsomesial surface tuberculate; mesial surface also tuberculate with 2 tubercles distinctly larger than others, distalmost heavier and acute; ventromesial surface with few small tubercles; ventrodistal margin with large tubercle on lateral condyle and another submedian in position; lateral surface punctate. Merus tuberculate dorsally with tubercles increasing in size distally; 2 subdistal members with corneous tips; mesial and lateral surfaces punctate; ventral surface with lateral row of 13 small rounded tubercles and mesial row of 14 of which several more distal ones subacute with corneous tips. Distolateral articular knob without spine. Mesioventral margin of basioischial podomere with 3 small tubercles distal to fracture suture.

Chela of second pereiopod with marginal rows of setae on palm, and carpus with dorsal row of long setae, but mesial surfaces of both lacking tuft of plumose setae.

Ischium of third pereiopod with simple hook extending proximally to distal extremity of basis (Fig. 2*d*), not opposed by tubercle on latter. Coxa of fourth pereiopod with very large laterally compressed boss directed almost in longitudinal plane of body; mesial and lateral surfaces of boss setiferous. Coxa of fifth pereiopod without boss but with setiferous ventral membrane.

First pleopod (Fig. 2*a, c, f*) reaching coxa of third pereiopod, situated deep in sternum, and largely concealed by setae borne on margins of sternum and bosses of fourth pereiopods; proximomesial spur prominent; terminal elements subparallel and curved throughout their length; mesial process somewhat flattened distally but acute; central projection tapering from base with apex directed proximally, surpassing level of cephalic base of projection and "distal" margin of arc of mesial process; cephalic process absent.

The second form male is unknown.

Allotypic Female: Excluding secondary sexual characteristics, differing from holotype in following respects: left rostral margin merging with subrostral ridge; tubercle on ventral surface of proximal podomere of antennular peduncle virtually obsolete; antennal scale distinctly narrower with cephalomesial margin sloping almost to midlength before turning proximolaterally, and spine on right member almost reaching base of ultimate podomere; chela about twice as long as broad; opposable margins of both fingers of chela with row of 5 tubercles, second from base largest; ventral surface of merus with mesial row of 12 (right with 8) tubercles and lateral row of 7; ischium with no tubercle on right and only 1 on left.

Annulus ventralis (Fig. 2*e*) subrhomboidal, about 1.7 times broader than long, deeply embedded in sternum, and immovable. Cephalomedian area excavate with trough curving strongly dextrally; prominent tongue extending almost horizontally from sinistral wall of concavity; sinus originating at cephalic base of tongue following it caudodextrally across median line, then turning sharply caudosinistrally to median line, there extending caudally and terminating before reaching caudal extremity of annulus. Sternite between fifth pereiopods subrectangular; about 1.5 times as broad as long, elevated ventrally, but lacking submedian prominence.

First pleopod uniramous but well developed with distinct protopodite. (See measurements.)

Color Notes: Dominant color of carapace pale mauve gray; rostral margin and postorbital ridges almost black; paired subtriangular reddish-brown markings extending caudally from caudal extremity of postorbital ridges, their basal portions coalescing in median posterior gastric region, slightly overlapping cervical groove, and filling cephalic triangular vestige of areola. Hepatic region with pale reddish-tan suffusion; caudal margin of carapace edged with black. First abdominal tergum reddish brown

TABLE 2.—Measurements (mm) of *Fallicambarus (F.) spectrum*

	Holotype	Allotype
Carapace:		
Entire length	30.8	32.1
Postorbital length	27.3	28.2
Width	14.3	14.0
Height	14.4	14.4
Areola:		
Width	—	—
Length	12.1	12.8
Rostrum:		
Width	4.4	4.4
Length	5.0	5.1
Chela:		
Length, palm mesial margin	6.6	6.6
Palm width	10.0	9.3
Length, lateral margin	21.9	18.5
Dactyl length	14.7	12.5
Abdomen:		
Width	9.8	8.4
Length	28.8	28.5

with succeeding terga progressively fading to uniformly reddish-tan telson and uropods; tergum also fading laterally, and pleuron concolorous with telson. Peduncle of antennule and antenna dark mauve gray, flagella with each article pale tan proximally, becoming dark gray distally; antennal scale with lateral thickened portion almost black. Chelipeds grayish blue dorsally with dark blue tubercles; ventral surface cream; remaining pereiopods similar to cheliped but lacking dark blue tubercles.

Type-locality and Range: Complex burrows in roadside ditch, 2 miles east of Daisy, Pike County, Arkansas, on U.S. Hwy. 70. In addition to the grasses and sedges in the ditch, members of the genus *Pinus* and *Cornus florida* were abundant nearby.

The only other locality in which this species is known to occur is 1 mile east of Amity, Clark County, Arkansas, on St. Rte. 84 where the crayfish were also found in complex burrows. There, a first form male and a female were taken from the same burrow on 21 April 1973. The dominant trees there were members of the genus *Pinus* and *Liquidamber styraciflua.*

Disposition of types: The holotypic male, form I (no. 144674) and the allotypic female (no. 144675) are deposited in the National Museum of Natural History, Smithsonian Institution, as are the paratypes consisting of 2 ♂ I, 3 ♀, and 1 juvenile ♀. Those specimens (1 ♂ I, 4 ♀, 1 juvenile ♂ and 2 juvenile ♀) from Clark County are not included in the type-series. The specimens from both localities were collected on 21 April 1973.

Variations: The rostrum is unique in the holotype in that the rostral ridges end abruptly at the base of the acumen instead of fusing with the subrostral ridges and continuing to the apex; the same occurs on the right side of the rostrum of the allotype; in all other specimens, however, the corresponding ridges fuse, and the subrostral ridge is sometimes evident, in dorsal aspect, only along the basal one-fourth or half of the rostrum. In only one specimen does the apex of the rostrum reach the distal end of the ultimate podomere of the antennular peduncle. The branchiostegal spine, always small, is absent in some specimens. Whereas in all of the specimens from the type-locality the pleuron of the second abdominal segment does not overlap that of the first, in only one of those from Clark County does it not overlap. The cephalic lobe of the epistome varies from subcordiform to subtriangular. The telson may lack lateral spines (possibly due to abrasion) or may have a pair of immovable spines and/or a pair of more mesial movable ones. The tubercles on the ventral surface of the proximal podomere of the antennular peduncle are either vestigial or absent. The antennal scale varies considerably in length and width, reaching various levels of the penultimate podomere of the antennular peduncle—as wide as in the holotype to narrower with the distomesial slope angling from midlength to the base of the distal third of the scale. The mesial margin of the palm of the chela bears a row of 6 to 9 (usually 7, and 9 only on 2 largest specimens from Clark County) tubercles subtended dorsolaterally by another row of 3 to 5. The number of tubercles on the opposable margin of the immovable finger varies from 4 to 7, and on that of the dactyl, 4 to 9. The number of tubercles in the ventrolateral row on the merus of the cheliped ranges from 4 to 13, and in the ventromesial row, 8 to 15. The number of tubercles on the ventromesial margin of the ischium of the cheliped ranges from 0 to 4. (See measurements.)

Relationships: See the section on Affinities below.

Etymology: Spectrum L.—apparition; so named because of the ghost-like appearance resulting from the predominantly pale cephalothorax, especially the branchiostegites.

Fallicambarus (Fallicambarus) strawni (Reimer)

Figure 3*c*, *e*, *h*

Cambarus strawni Reimer, 1966:11, figs. 9–18.

Fallicambarus strawni.—Hobbs, 1969:111, figs. 2*f*, 13*j*, 20*i*.

Color Notes: Dominant color of carapace pinkish cream overlain by markings of various shades of gray and vermilion: most of dorsum of cephalic region pink, fading laterally to buff with lavender suffusion; rostrum and postorbital ridges very dark gray; caudal gastric area and

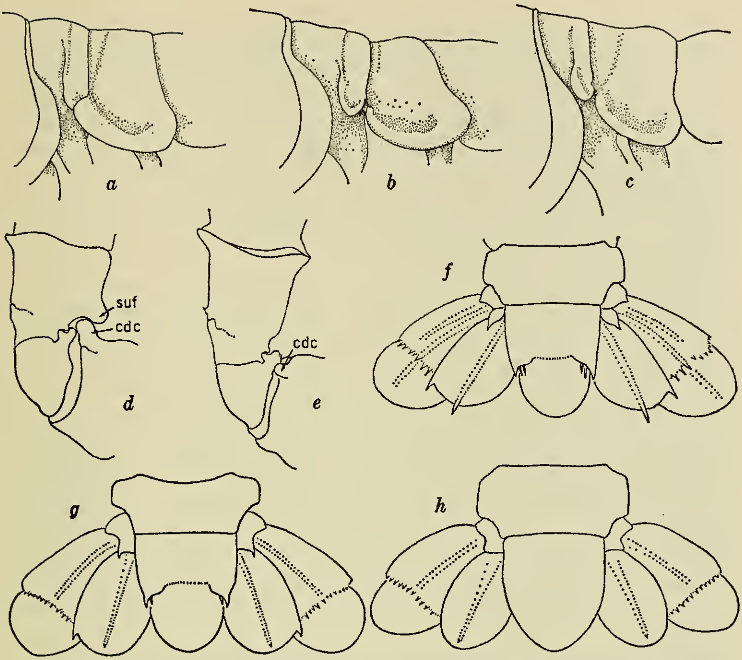

FIG. 3. Variations in *Fallicambarus. a,* Lateral view of caudal carapace and cephalic abdominal region of *F. (F.) macneesei; b,* Same of *F. (C.) byersi; c,* Same of *F. (F.) strawni; d,* Lateral view of coxa, basis and ischium of cheliped of *F. (C.) uhleri* (cdc, condyle on coxa; suf, sufflamen); *e,* Same of *F. (F.) strawni; f,* Dorsal view of caudal abdominal region of *F. (F.) macneesei;* g, Same of *F. (C.) fodiens; h,* Same of *F. (F.) strawni.*

cervical groove pale gray; cephalic triangle of areola dark gray, and linear portion and caudal triangle vermilion; paired pale gray longitudinal stripes flanking linear areola; remainder of branchiostegites, excluding dark bluish-gray caudal margin, very pale cream tan. Tergum of first abdominal segment and cephalic part of that of second maroon; terga of other segments yellowish tan, with vermilion splotches dorsally, fading caudally to telson, and all pleura lighter tan toward ventrolateral margin. Telson largely translucent but with vermilion to brick-red splotches cephalically, laterally, and along caudal margin. Uropod similarly translucent, but peduncle reddish tan; lateral ramus with reddish splotches lateral to median rib and over entire distal section; mesial ramus with red pigment largely restricted to median rib and distal third. Exposed parts of peduncles of antennules and antennae mostly bluish gray, and flagella with each article buff proximally becoming dark gray distally; antennal scale margined in very dark bluish gray. Chelipeds basically tan with dense reticulations of intense dark grayish blue dominating dorsum of distal half of merus, that of carpus, and most of that of chela, lateral portion of propodus fading to pinkish cream; all tubercles, except for corneous extremities of some, very dark blue, almost black. Remaining pereiopods similar in color to that of cheliped although with more red and less blue pigment on fifth. Ventral surface of body and pereiopods cream, latter with blue pigment concentrated around more distal articulations.

Range and Specimens Examined: No specimens of this species have been reported to have been collected since the original description appeared. Reimer (op. cit.) recorded it from 2.7 miles northwest of Dierks, Howard County, Arkansas, on U.S. Hwy. 70, the type-locality, and from 4 miles west of Umpire, also in Howard County.

Additional collections were made in the following localities in Arkansas by Hobbs, et al., during April 1973: (1) Type-locality—2♂I, 1♂II, 1♀, 1 juvenile ♂, 1 juvenile ♀, April 21; (2) Seepage area on road shoulders, 0.1 mile east of the junction of U.S. Hwys. 59 and 70 on latter, Sevier County—4♂I, 4♂II, 13♀, 2 juvenile ♂, 5 juvenile ♀, April 20; (3) Seepage area 5.0 miles northeast of the junction of U.S. Hwys. 59 and 70 on latter, Sevier County—1♂I, April 20; (4) Roadside ditch, 0.9 mile northeast of Pike-Howard County line, Pike County—1♂I, 1♀, April 21.

Life History Notes.—First form males have been collected in April and June. No ovigerous females have been obtained, but the female specimen from Pike County was brought into the laboratory where she laid yellowish-orange eggs on May 17, most of which became detached. Believing those remaining on the abdomen to be infertile, I failed to note the date on which two of them hatched—probably in early June. The two young appeared to be devoid of body pigment when they became free from the mother; only the dark alimentary canal, pigment in the eye, and later the yellowish coloration of the hepatopancreas contrasted with the otherwise whitish translucent body. Unfortunately, neither of the young survived the third molt.

THE AFFINITIES OF THE MEMBERS OF THE GENUS *Fallicambarus*

In discussing the phylogeny of the genus *Cambarus* and related genera, Hobbs (1969:123) indicated several adaptive modifications in the cambaroid stock that enabled *Fallicambarus* derivatives from it to become independent of open bodies of water. He also discussed (p. 124) those secondary sexual features he considered to be primitive and commented on their subsequent modifications.

In comparing these crayfishes with those belonging to related genera, one is impressed by the similarities existing between *Fallicambarus macneesei* and *Procambarus (Tenuicambarus) tenuis*, likenesses that are far too numerous to assume that they have resulted from convergence in two independently evolving stocks. Among the characters that they share in common are: (1) a somewhat compressed cephalothorax; (2) an abdomen broadly attached to the cephalothorax, not conspicuously narrower cephalically than the caudal thoracic region; (3) a divided telson with one or more spines in the caudolateral corners of the cephalic section; (4) a moderately broad antennal scale; (5) a cheliped with a well-developed sufflamen on the ischium; (6) a chela with the palm subovate in cross section, subserrate laterally, and possessing a dactyl with a very weak excision on the opposable margin; (7) a second pereiopod in which the mesial surface of the palm and distal portion of the carpus lack mats of plumose setae; (8) hooks on the ischia of the third and fourth pereiopods of the male; (9) a conspicuous boss on the coxa of the fourth pereiopod of the male; (10) a male first plepod with three terminal elements and a proximomesial spur; (11) a rather broad mesial ramus of the uropod bearing a distolateral spine; and (12) an annulus ventralis with two comparatively simple, interlocking lobes.

These characteristics are considered here to be those of the ancestors of *P. tenuis* and of the *Fallicambarus* stock which existed during the middle Tertiary along the western flank of the early Cenozoic Mississippi embayment. Among the descendants from this stock, *F. macneesei* is the only member of the genus that exhibits all of these features, and thus links its congeners with the disjunct *Procambarus tenuis*, the only species assigned to the subgenus *Tenuicambarus*. Closely allied to *F. macneesei*, but having lost or modified certain of the primitive features, is *F. dissitus* in which the abdomen and the antennal scale are somewhat narrower; the cheliped has lost the sufflamen; the chela is more depressed, and the excision on the opposable margin of the dactyl is strong; the cephalic process of the first pleopod is lacking, and the annulus ventralis is strongly asymmetrical.

Fallicambarus jeanae, *F. spectrum*, and *F. strawni* are, in general, more similar to *F. dissitus* than to *F. macneesei*. All three species have a somewhat laterally inflated carapace; the abdomen is distinctly narrow basally; the telson of *F. jeanae* (Fig. 1*k*) and *F. spectrum* (Fig. 2*k*) retain the transverse suture on the telson, but in *F. strawni* (Fig. 3*h*) there is no trace of it; the antennal scale is quite narrow; the cheliped of the three lack the sufflamen (Fig. 3*e*); the palm of the chela is strongly depressed and broad, especially so in *F. jeanae* and *F. spectrum*, and is subserrate laterally; the excision on the dactyl of the chela is conspicuous in the three; the mesial surface of the propodus and distal part of the carpus of the second pereiopod have few to no setae; hooks are limited to the third pereiopod, and the coxa of the fourth bears a conspicuously large boss in *F. jeanae* and *F. spectrum*; there is no trace of a cephalic process on the first pleopod of the male in the latter two species or in *F. dissitus*, but it is distinct in *F. strawni*; the distolateral spine is lacking from the slender mesial ramus of the uropod in all three, and the entire

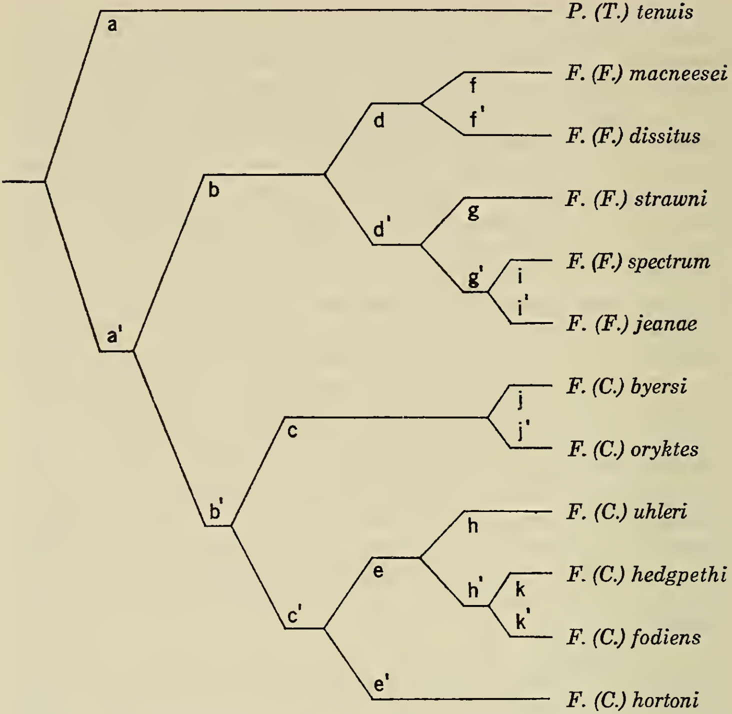

FIG. 4. Interrelationships of the members of *Fallicambarus* and their common origin with *Procambarus (Tenuicambarus) tenuis.*

"tail fan" is comparatively small; finally, the annuli ventrales are much more complexly sculptured than in *F. macneesei* and *F. dissitus.* In most respects, *F. strawni* appears to have diverged from the postulated primitive mien to an extent almost as great as *F. jeanae* and *F. spectrum.* With a larger series of specimens from throughout the ranges of the latter two, *F. spectrum* may prove to be a subspecies of *F. jeanae.*

The remaining species of the genus, those assigned to the subgenus *Creaserinus,* have diverged in several respects from the primitive facies. All of them possess a more inflated cephalothorax; a strongly depressed chela, the dactyl of which bears a deep excision on its opposable surface; hooks on the ischia of only the third pair of pereiopods; a comparatively small boss on the coxa of the fourth pereiopod; and only two terminal elements on the first pleopod. The abdomen is broad at its base except in *F. byersi* and *F. oryktes*; the telson is provided with a transverse suture (Fig. 3g) except in *F. byersi* (similar to Fig. 3*h*); the antennal scale is broad except in *F. byersi* and *F. oryktes*; the mesial surface of the propodus and mesiodistal surface of the carpus of the second pereiopod bear conspicuous mats of plumose setae except in *F. byersi*; and the mesial ramus of the uropod is provided with a distolateral spine except in *F. byersi* and *F. oryktes.*

Obviously, *F. byersi* and *F. oryktes* are more closely allied than is either to the remaining species of the subgenus. Most of the characters that set them apart are features of one or more members of the typical subgenus, and ones that are considered to be advanced rather than primitive, suggesting convergence in the two stocks.

Figure 4 depicts the interrelationships of members of the genus *Fallicambarus.*

EXPLANATION OF FIGURE 4 AND KEY TO SPECIES

a First pleopod of male with terminal elements bent caudally at angle much less than 90°; annulus ventralis movable, not fused to sternum .... *P. (T.) tenuis*

a′ First pleopod of male with terminal elements bent caudally at no less than 90°; annulus ventralis fused to sternum .... b

b First pleopod of male with proximomesial spur; coxa of fourth pereiopod with large caudomesial boss; dorsal surface of chela with tubercles other than in two mesial rows and with rounded or subserrate lateral surface; sufflamen present or absent .... d

b′ First pleopod of male lacking proximomesial spur; coxa of fourth pereiopod with moderate caudomesial boss; dorsal surface of chela with tubercles largely limited to two mesial rows, never in lateral half, and with costate lateral surface; sufflamen present c

c Abdomen conspicuously narrower than cephalothorax; antennal scale greatly reduced, almost bladelike; mesial ramus of uropod without distolateral spine .... j

c′ Abdomen not conspicuously narrower than cephalothorax; antennal scale comparatively broad; mesial ramus of uropod with distolateral spine .... e

d Mesial ramus of uropod with distinct distolateral spine; male with hooks on ischia of third and fourth pereiopods; abdomen not conspicuously narrower than thorax; sufflamen present or absent ... f

d′ Mesial ramus of uropod without distolateral spine; male with hook on ischium of third pereiopod only; abdomen conspicuously narrower than thorax; sufflamen absent .... g

e First pleopod of male with central projection subtruncate, broad distally, and directed caudally .... *F. (C.) hortoni*

e′ First pleopod of male with central projection somewhat tapering and directed caudoproximally .... h

f First pleopod of male with cephalic process, central projection not inclined laterally and never overlapping that of corresponding pleopod; mesial ramus of uropod with distomedian spine projecting beyond margin; chela with sufflamen .... *F. (F.) macneesei*

f′ First pleopod of male without cephalic process, central projection inclined laterally and frequently overlapping that of corresponding pleopod; mesial ramus of uropod with distomedian spine never reaching margin; chela without sufflamen .... *F. (F.) dissitus*

g First pleopod of male with cephalic process; telson lacking transverse suture .... *F. (F.) strawni*

g′ First pleopod of male without cephalic process; telson with transverse suture .... i h Areola usually constituting less than 39 percent of entire length of carapace; rostrum subplane dorsally and only moderately deflexed anteriorly; proximolateral ½ of postaxial surface of ischium of third maxilliped with many hirsute punctations mesial to lateral row .... *F. (C.) uhleri*

h′ Areola usually constituting more than 39 percent of entire length of carapace; rostrum concave dorsally and strongly deflexed anteriorly; proximolateral ½ of postaxial surface of ischium of third maxilliped with few, if any, hirsute punctations mesial to lateral row .... k

i First pleopod of male with apex of central projection over-reaching level of cephalic base of projection; width of chela usually no more than 1.6 times length of mesial margin of palm, its color grayish blue with dark blue tubercles .... *F. (F.) spectrum*

i′ First pleopod of male with apex of central projection almost reaching level of cephalic base of projection; width of chela usually no less than 1.7 times length of mesial margin of palm, its color yellowish tan with bluish black tubercles .... *F. (F.) jeanae*

j First pleopod of male with distal half of shaft strongly inclined caudally; ventral surface of propodus of chela with longitudinal row of long stiff setae near lateral margin, lacking row of tubercles at base of dactyl; mesial surface of palm of chela of second pereiopod without plumose setae .... *F. (C.) byersi*

j′ First pleopod of male with distal half of shaft not strongly inclined caudally; ventral surface of chela without conspicuous stiff setae but with row of tubercles on propodus opposite base of dactyl; mesial surface of palm of chela of second pereiopod with dense mat of plumose setae .... *F. (C.) oryktes*

k Hump on mesial process of first pleopod obscuring part of central projection in lateral aspect; central projection with subapical notch (often abraded in middle to late intermolt stages); opposable margin of fixed finger of chela with only 1 tubercle markedly larger than others .... *F. (C.) hedgpethi*

k′ Hump on mesial process of first pleopod never obscuring part of central projection in lateral aspect; central projection lacking subapical notch; opposable margin of fixed finger with 2 major tubercles .... *F. (C.) fodiens*

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PROCEEDINGS
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THE VALIDITY OF *CANDACIA TUBERCULATA* WOLFENDEN AND COMPARISON WITH *C. BRADYI* SCOTT (COPEPODA, CALANOIDA)

By Thomas J. Lawson
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

As part of a study of the copepod family Candaciidae in the surface waters of the Indian Ocean, specimens have been examined from over 300 zooplankton collecting stations of the International Indian Ocean Expedition. A species of *Candacia*, closely resembling *C. bradyi* Scott, 1902, was found at 16 stations and another species referable to *C. bradyi* was found at 9 stations. As a result of closer examination it was concluded that the former species is actually *C. tuberculata* Wolfenden, 1905, a species hitherto considered a junior synonym of *C. bradyi*. The morphological features which distinguish the two species are discussed below.

Candacia tuberculata Wolfenden, 1905
Figures 1–10, Plate I a,b; Plate II c,d; Plate III a,b

C. tuberculata Wolfenden, 1905:1013, plate 96, figures 40–44 (♂). NEW SYNONYMY.

C. catula var. *similis* Wofenden, 1905:1012–1013 (♀). NEW SYNONYMY.

C. bradyi Scott, 1909:156, plate 47, figures 1–9 (♂).—Pesta, 1912:49, figures 9a–d (♀, ♂).—Sewell, 1912:366, plate 23, figures 6,7 (♀).—Sewell, 1914:229.—Tanaka, 1935:210–227, plate 4, figures 5–17 (♀, ♂).—Mori, 1937:80, plate 53, figures 8–12 (♀).—Grice, 1963: 174, figures 9, 47 (♀, ♂).—Tanaka, 1964:244. NEW SYNONYMY.

C. curva Mori, 1932:171, 175, plate 53, figures 8–12 (♀). NEW SYNONYMY.

The first segment of the female urosome (Figs. 1–4) is slightly asymmetrical. A slender spine projects posteriorly from the ventral surface of the second segment (Fig. 5), and there are two small bulblike

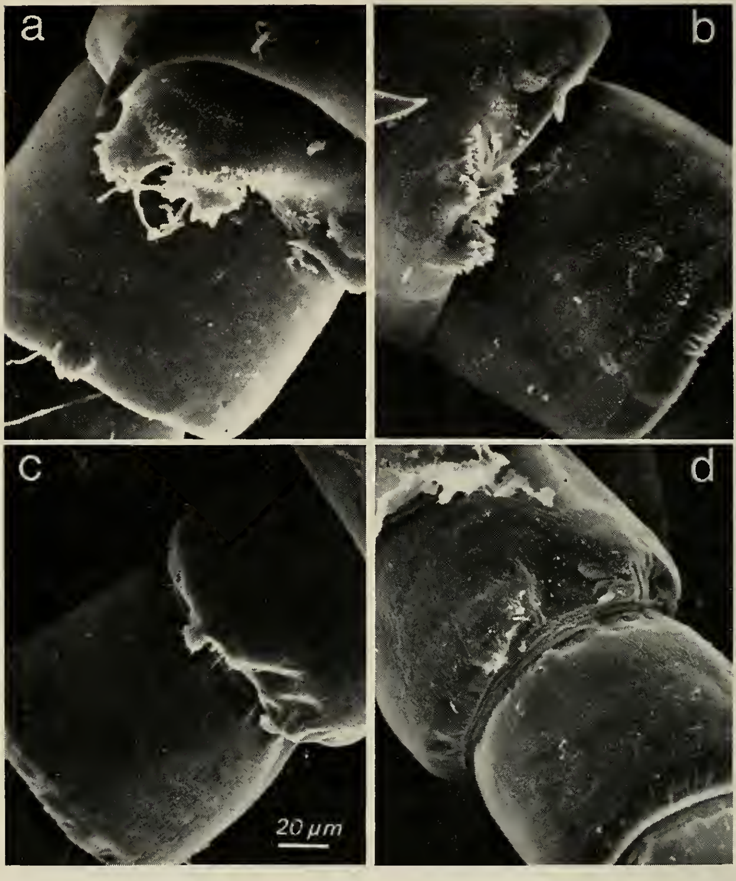
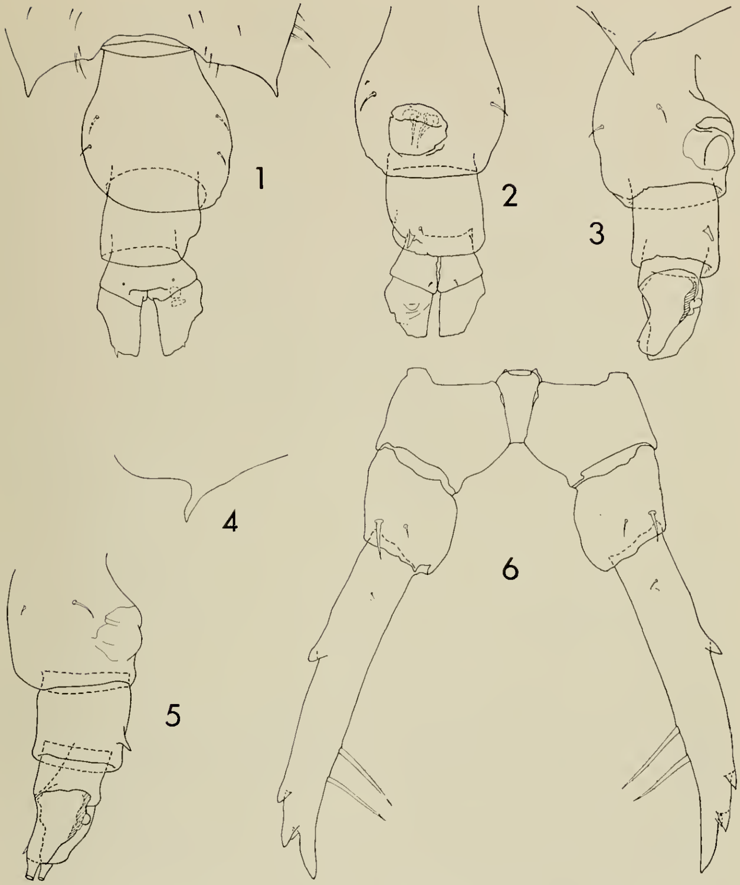


PLATE I. Scanning micrographs of the right side of the male urosome segments 1 and 2 of *Candacia tuberculata* (above) and *C. bradyi* (below). Specimens from the following locations: a. CONCH cr. 198, sta. 55 (1°19′N, 75°37′E); b. DANA sta. 3685 (4°22′N, 121°16′E); c,d. Pola-Rotes Meer Expedit. sta. 150 (12°34′N, 43°36.6′E).

processes on the ventral surface of the right furca, beneath which the cuticle is thickened. The distal third of the left fifth foot is pigmented. Spines on the left foot (Fig. 6) are also pigmented and rounded.

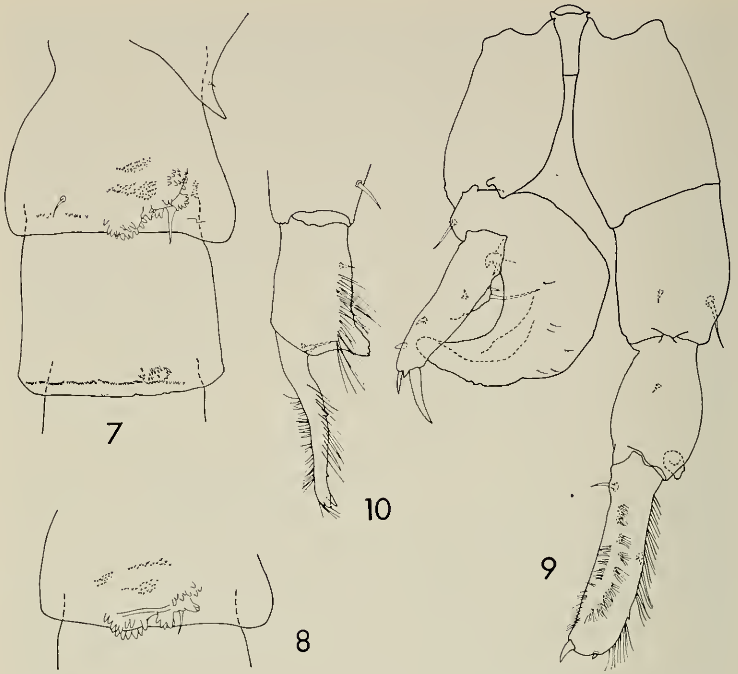
The first segment of the male urosome bears an outgrowth on the right side (Figs. 7, 8; Plate I:a,b) consisting of a conspicuous dorsal lobe and two smaller ventral lobes and is ornamented with short, pointed protuberances. There is a smaller outgrowth on the right side of the



FIGS. 1–6. *Candacia tuberculata* Wolfenden. Female. 1–3, urosome, dorsal, ventral, right side respectively; 4–5, ventral spine on urosome segment 2; 6, fifth feet, posterior. Figs. 1–2 from CONCH cr. 198, sta. 55 (10°19′N, 75°37′E); Figs. 3–6 from VARUNA 2041 (15°00′N, 73°28′E).

second urosome segment (Fig. 7; Plate II:c,d) which is also ornamented with short, pointed protuberances. The fourth segment of the left fifth foot is longer than the third segment (Figs. 9, 10). The flattened toothlike process on the third segment bears terminally a hooklike blunt point and subapically two broadly rounded points (Fig. 10; Plate III:a,b).

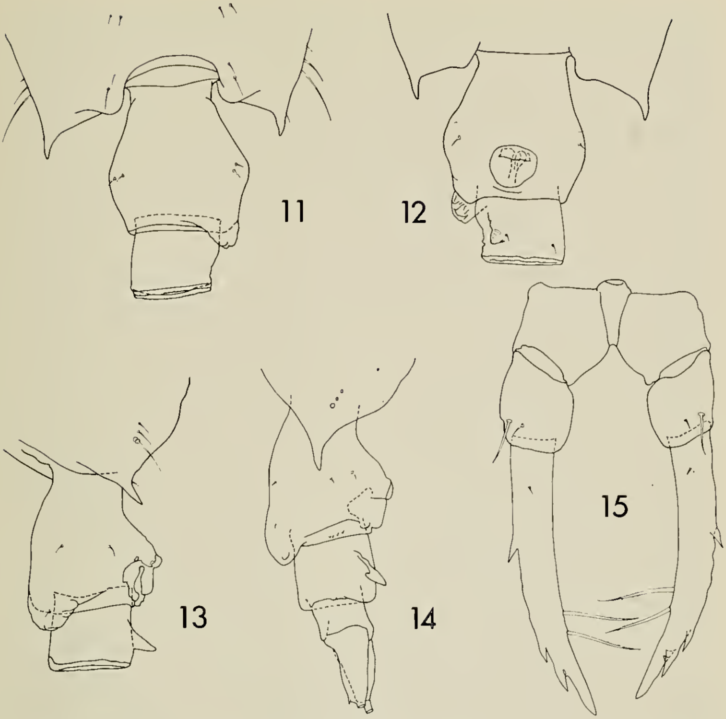
C. tuberculata was identified from 16 stations located in neritic waters of the northern and eastern Arabian Sea, the Strait of Malacca and from



FIGS. 7–10. *Candacia tuberculata* Wolfenden. Male. 7, urosome segments 1 and 2, right side; 8, urosome segment 1, right side (another specimen); 9, fifth feet, anterior; 10, left fifth foot, segments 3 and 4, left side. Figs. 7–10 from VARUNA 2041 (15°00′N, 73°28′E).

one station near the southern coast of Java. The author was able to examine 22 vials of specimens collected from the Red Sea, Persian Gulf and Indonesian waters and identified by Pesta (1912, 1941) as *C. bradyi.* Another vial from Pesta's collection contained 2 females and 1 male collected in Indonesian waters and identified as *C. tuberculata.* All Pesta's specimens are referable to *C. tuberculata* except those collected in the Red Sea. The species was also found at Dana Stas. 3685 and 3696 in the Celebes and Sulu Seas, respectively. Specimens identified as *C. bradyi* (Tanaka, 1964) from Japanese waters were also made available to the author and are referable to *C. tuberculata.*

A female specimen from CONCH cruise 198, sta. 55 (10°19′N, 75°37′E, 0–200 m depth of collection, 10 Oct. 1963) has been designated a neotype and deposited in the National Museum of Natural History, Smithsonian Institution (USNM 143824). Specimens of both sexes from this same collection have been designated plesiotypes and deposited in the National



FIGS. 11–15. *Candacia bradyi* Scott. Female. 11–13, urosome segments 1 and 2—dorsal, ventral, right side respectively; 14 urosome, right side; 15, fifth feet, posterior. Figs. 11–13 from METEOR cr. 1, sta. 95 (11°42′N, 48°49′E); Figs. 14–15 from ATLANTIS II, cr. 15, sta. 545 (11°52′N, 46°52′E).

Museum of Natural History (USNM 143825), the Indian Ocean Biological Centre, Cochin, India and the Woods Hole Oceanographic Institution.

Candacia bradyi Scott, 1902

Figures 11–20; Plate I c,d; Plate II a,b; Plate III c,d

C. bradyi Scott, 1902:406, plate 1 figures 9–12 (♂).—Pesta, 1941:163, figure 3 (♀, ♂). NEW SYNONYMY.

non-*C. bradyi* Carl, 1907:9–17, plate 1, figures 8–14 (partim?) (= *C. discaudata*). NEW SYNONYMY.

The first segment of the female urosome (Figs. 11–14) bears a prominent dorsal lobe which is displaced somewhat to the right side and extends posteriad. The second segment bears a stout ventral spine

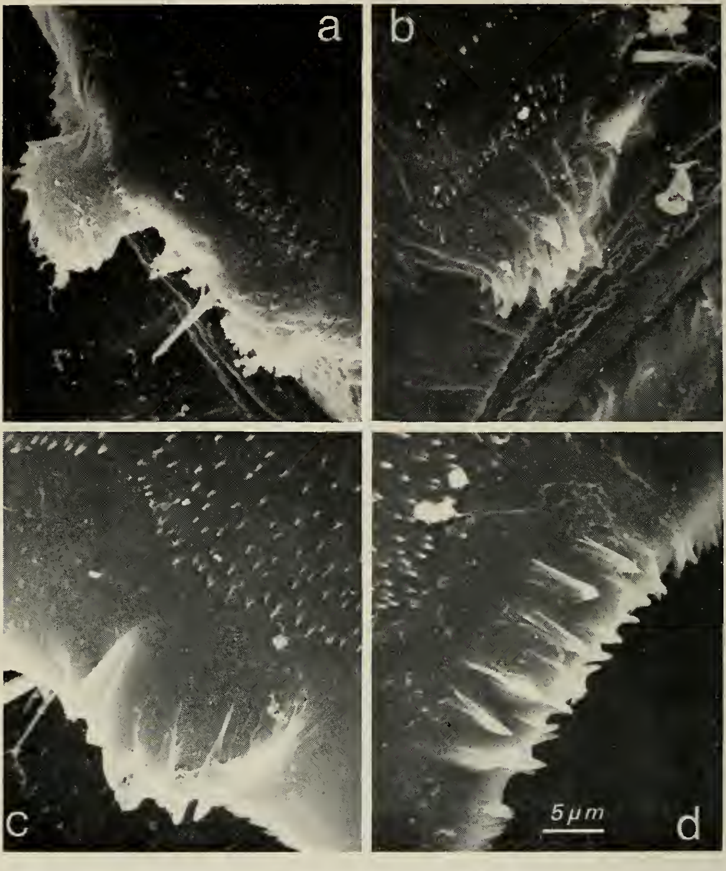
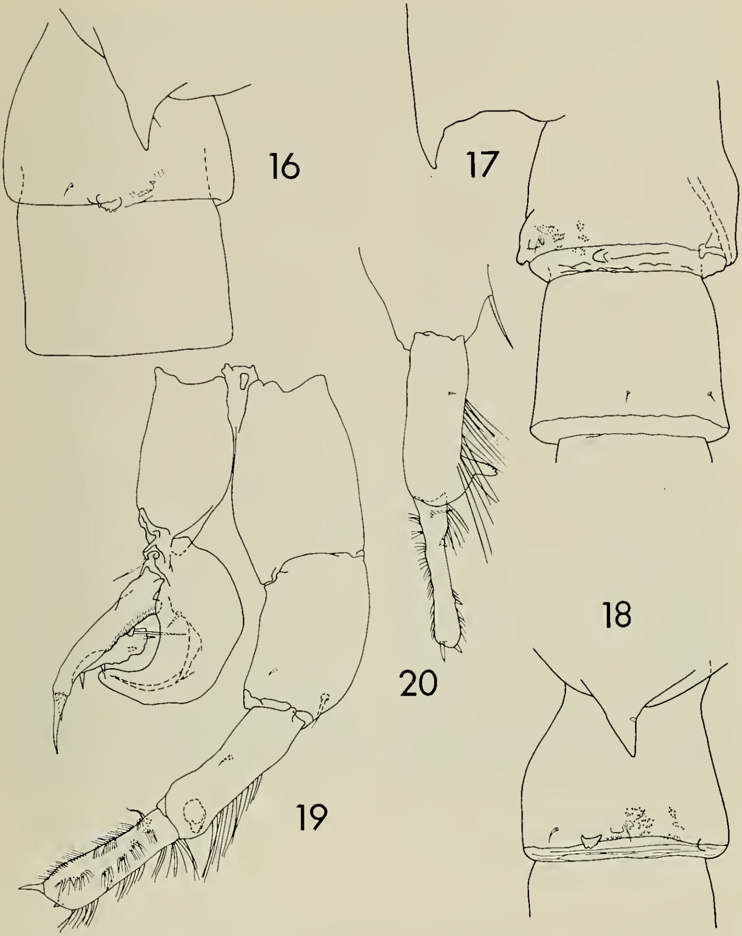


Plate II. Details of ornamentation on the urosome of *C. bradyi* segment 1 (above); *C. tuberculata*, segment 2 (below). Figs. a, b, c, d from the same specimens as Plate I Figs. c, d, a, b respectively.

projecting posteriorly. Both fifth feet bear sharp, pointed external spines (Fig. 15). There is a small outgrowth on the right side of the first segment of the male (Figs. 16–18; Plate I:c,d; Plate II:a,b) which is often indistinctly lobate. The fourth segment of the left fifth foot (Figs. 19, 20) is shorter than the third segment. An elongate toothlike process on the third segment (Fig. 20; Plate III:c,d) terminates in about 10 small rounded truncated nodules arranged in several rows.

C. bradyi was found at 9 stations: 3 in the Red Sea, 2 in the Gulf of Aden, and 4 in the western Arabian Sea; its occurrence at 11 stations in the Red Sea (Pesta, 1941) has been confirmed.



Figs. 16–20. *Candacia bradyi* Scott. Male. 16, urosome segments 1 and 2, right side; 17, urosome segments 1 and 2, ventral and slightly from the right side; 18, urosome segment 1, right side; 19, fifth feet, anterior; 20, left fifth foot, segments 3 and 4, left side. Figs. 16, 20 from Atlantis II, cr. 15, sta. 545 (11°52′N, 46°52′E); Figs. 17–19 from Meteor cr. 1, sta. 93A (12°43′N, 48°31′E).

A female specimen from Anton Bruun cruise 9, station 473 (17°05′N, 40°53′E, 0–50 m depth of collection, 12 July 1965) has been designated a neotype and deposited in the National Museum of Natural History (USNM 143826). Specimens of both sexes from this same collection have

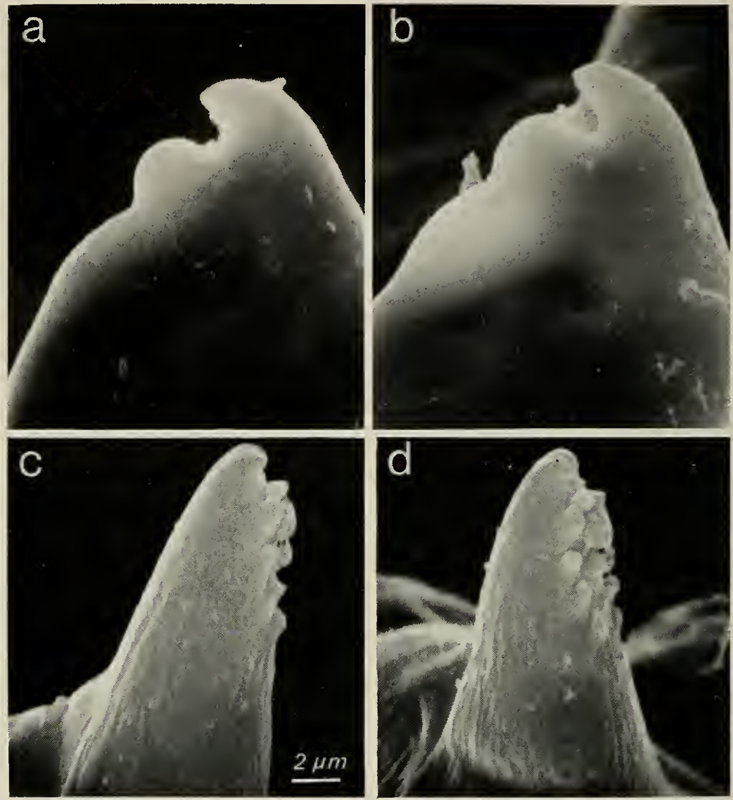


Plate III. Toothlike process on the fourth segment of the fifth foot from the same specimens as in Plate I Figs. a, b, c, d respectively.

been designated plesiotypes and deposited in the National Museum of Natural History (USNM 143827). Plesiotypes of both sexes have been deposited at the Indian Ocean Biological Centre, Cochin, India and at Woods Hole Oceanographic Institution.

Remarks: At the time of the original description of *C. tuberculata,* Wolfenden (1905) mentioned that this species may actually be *C. bradyi,* a species which at that time was known only from male specimens collected in the Gulf of Aden. Scott (1909) synonymized *C. tuberculata* with *C. bradyi* and provided a new description of *C. bradyi* based on specimens collected in waters of the East Indies, far removed from the type-locality. Scott's description was based on male specimens of *C. tuberculata.* The author has been unable to locate the type material upon which Scott's original and subsequent descriptions were based, nor

TABLE 1. Size comparisons of *Candacia tuberculata* with *C. bradyi*. The Mann-Whitney U test, corrected for ties, indicated a significant difference ($P < .01$) between the species for all measurements. Measurements in mm.

			C tuberculata	*C. bradyi*
Female:				
	Cephalothorax	n	36	29
		mean	1.40	1.25
		range	1.28–1.60	1.06–1.70
		std. dev.	.069	.123
	Total length	n	21	18
		mean	1.71	1.59
		range	1.56–1.98	1.40–2.10
		std. dev.	.094	.179
Male:				
	Cephalothorax	n	38	30
		mean	1.29	1.19
		range	1.16–1.42	1.08–1.46
		std. dev.	.061	.092
	Total length	n	22	22
		mean	1.71	1.53
		range	1.60–1.88	1.44–1.78
		std. dev.	.068	.086

Wolfenden's type material although inquiries were made at the British Museum; Royal Scottish Museum, Edinburgh; Marine Laboratory, Aberdeen; Biology Dept., Liverpool Univ.; and at the Leiden Museum.

Both species are very similar in external morphology and, although *C. tuberculata* is significantly larger than *C. bradyi* ($P < .01$), there is considerable overlap in cephalothorax and total lengths (Table 1). In the female the most obvious differences are found in the urosome. The conspicuous dorsolateral lobe on the first segment of the urosome of *C. bradyi* is not present on the urosome of *C. tuberculata*; the ventral spine on the second segment is more slender in *C. tuberculata* and *C. bradyi* lacks the bulblike processes found on the right furca of *C. tuberculata.*

The female fifth feet have a similar pattern of spines and setae in both species. However, in *C. tuberculata* the distal third of the left foot is pigmented. The spines on the left foot are also pigmented and rounded. The fifth feet of *C. bradyi* lack pigmentation and the spines on both feet are pointed.

In the male, the outgrowth on the right side of the first segment of the urosome is considerably more prominent in *C. tuberculata.* The outgrowth on the second segment of *C. tuberculata* is absent from *C. bradyi.* No obvious differences were observed in the geniculate antennae of the two species.

Wolfenden (1905) noted what appeared to be a difference in the last segment of the male left fifth foot between *C. tuberculata* and *C. bradyi.* In my specimens, the ratio of the length of the last segment to the third segment is greater than one in *C. tuberculata* and less than one in *C. bradyi.* The toothlike process on the third segment is more blunt in *C. tuberculata* and produced distally into a few distinct blunt points (Wolfenden, 1905; Scott, 1909). In *C. bradyi,* the toothlike process terminates in a single, blunt point and bears a cluster of rounded truncated nodules on one side.

Wolfenden did not consider the possibility that *C. catula* var. *similis* represented the unknown female of his species although both came from the same area and he stated that *C. tuberculata* "has most affinity with *C. catula.*" I have examined 20 female specimens of *C. catula* from collections obtained near the type-locality of *C. catula* var. *similis* (ANTON BRUUN Stations 106 (17°27′N, 70°27′E), 111 (8°09′N, 70°02′E), 114 (01°30′N, 70°01′E). The mean length of these females was only 1.39 mm ± .046 std. dev. and the maximum length was 1.50 mm. In agreement with *C. catula* sensu strictu, all of these specimens had 3 setae on the inner margins of the fifth pair of feet with one exception, a specimen which had 3 setae on the left fifth foot and 2 setae on the right. Wolfenden reported measurements for *C. catula* var. *similis* that are in the upper range for *C. tuberculata* (approx. 2.00 mm). He also described the fifth feet as bearing 2 setae which is also in agreement with *C. tuberculata.* Even though no figures were provided, there is little doubt that Wolfenden's *C. catula* var. *similis* is referable to *C. tuberculata.*

The known distribution of *C. tuberculata* is the northern and equatorial Indian Ocean and warm waters of the eastern Pacific Ocean. The distribution of *C. bradyi* appears to be limited to the Red Sea and eastern Arabian Sea.

ACKNOWLEDGMENTS

Most of the samples used for this study were provided by the Indian Ocean Biological Centre, Cochin, India, and I express my appreciation to T. S. S. Rao and his staff for sending me the candaciid specimens. I also thank O. Tanaka of Kyushu University, W. Vervoort of Leiden University and G. Pretzmann of Naturhistorisches Museum Wien for providing me with candaciid specimens and V. Peters for operating the scanning microscope. G. D. Grice of the Woods Hole Oceanographic Institution read the manuscript and offered many helpful suggestions for which I am grateful. This study was supported in part by National Science Foundation Grant GA 27405 and is contribution number 3163 of the Woods Hole Oceanographic Institution.

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PROCEEDINGS
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THE NOMENCLATURE, BIONOMICS, AND DISTRIBUTION OF *NOTATICUS FASCIATUS* (COLEOPTERA:DYTISCIDAE:AUBEHYDRINAE)[1]

By Paul J. Spangler
Smithsonian Institution, Washington, D.C. 20560

During a visit to some European museums I examined the holotype of *Aubehydrus speciosissimus* Guignot (1942) in the Museum National d'Histoire Naturelle, Paris, France, and the holotype of *Notaticus fasciatus* Zimmerman (1928) in the Zoologische Sammlung des Bayerischen Staates, Munich, Germany. I found that the two names were applied to the same taxon; therefore, I am placing *Aubehydrus speciosissimus* as a junior subjective synonym of *Notaticus fasciatus.*

Notaticus fasciatus and its synonym, *Aubehydrus speciosissimus*, were described from specimens from the state of Mato Grosso, Brazil, and no additional reports of its occurrence have been found in the literature. In 1969, Phyllis M. Spangler and I collected specimens of the attractive *Notaticus fasciatus* in several South American countries. In addition, we found specimens of *N. fasciatus* bearing several different manuscript names in some South American collections. The synonym created by Guignot and the manuscript names on specimens indicated to me that this taxon has been misidentified frequently. Therefore, I hope this report will assist in the recognition of this species and help to prevent further synonymies.

I am indebted to the following individuals for allowing me to examine types and other specimens in their institutions; acronyms following the names of the institution will identify the source of the material listed under specimens examined: Dr. Heinz Freude (now retired), Zoologische Sammlung des

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[1] This study was made possible in part by Smithsonian Institution Grant No. SG063310 and the Thomas Lincoln Casey Fund.

Figs. 1–6. *Notaticus fasciatus* Zimmerman: 1, ♂, habitus; 2, right paramere, lv; 3, median lobe, vv; 4, median lobe, lv; 5, left paramere, lv; 6, prosternum and prosternal process, vv. lv = lateral view; vv = ventral view.

Bayerischen Staates, Munich, Germany (ZSBS); Dr. Luis De Santis, Universidad Nacional de LaPlata, LaPlata, Argentina (ULP); Mme. A. Bons, Museum National d'Histoire Naturelle, Paris, France (MNHN). Specimens in the National Museum of Natural History, Smithsonian Institution are identified by the acronym USNM.

I am indebted to Mr. Michael Druckenbrod, Smithsonian Institution staff artist, for the illustrations included in this article.

When Zimmerman described his monotypic genus *Notaticus*, he assigned it to the tribe Hydaticini. Guignot being unaware of Zimmerman's previous description of this taxon established the subfamily Aubehydrinae for what he thought was a new genus and species. According to Article 40, Example (1) of The Code (1961), the subfamily name remains Aubehydrinae and the type-genus is *Notaticus* because *Aubehydrus speciosissimus* is a junior synonym of *Notaticus fasciatus*.

The current synonymies for the subfamily Aubehydrinae and the genus *Notaticus* follow.

Subfamily Aubehydrinae

Aubehydrinae Guignot, 1942:11. Type-genus, *Notaticus* Zimmerman [not *Aubehydrus* Guignot, a junior subjective synonym of *Notaticus*].

Genus *Notaticus* Zimmerman

Notaticus Zimmerman, 1928:182. Type-species, *Notaticus fasciatus*, by monotypy.—Blackwelder, 1944:79.

Aubehydrus Guignot, 1942:11 [NEW SYNONYMY].

Notaticus fasciatus Zimmerman

Figures 1–8

Notaticus fasciatus Zimmerman, 1928:183; type-locality: Brazil, Mato Grosso, Carandasiuh; type ♀, in Zoologische Sammlung des Bayerischen Staates, Munich, Germany, examined.—Blackwelder, 1944:79.

Aubehydrus speciosissimus Guignot, 1942:12; type-locality: Brazil, Mato Grosso; type ♀, in Museum National d'Histoire Naturelle, Paris, France, examined; [NEW SYNONYMY].

Neither Zimmerman nor Guignot had males in their type-material, and their descriptions, therefore, refer to the external morphology of the female of the species. Males of *N. fasciatus* average slightly shorter (6.5 mm to 7.0 mm) than females (7.0 mm to 8.0 mm). The protarsi and

FIG. 7. *Notaticus fasciatus* Zimmerman, Biotope, Lago de los Patos, 15 km south of Calabozo, Venezuela.

mesotarsi of the females are unmodified; whereas, the males have the 3 basal protarsal segments broadened and bearing 3 large basal cupules and 9 small cupules along the inner and outer margins and the 2 basal mesotarsal segments slightly broadened and bearing 12 or 13 small cupules. I have included a habitus view (Fig. 1) and illustrations (Figs. 2–6) of some of the distinguishing characters of the male.

The specimens of *Notaticus fasciatus* collected by P. and P. Spangler were collected from the shallow margins of ditches and ponds (Fig. 7) in association with *Eichornia*, *Pistia*, and various nymphaceous and alismataceous plants. Also, the one specimen collected by R. Cumming at the Saavedra Experiment Station in Bolivia was collected in a light trap. The species is distributed widely (Fig. 8) in South America, and I have examined specimens from the following localities.

Argentina: Santa Fe: Dept. Garay-C. Macias, M. J. Viana, 6 specimens (ULP).

Bolivia: Santa Cruz: Santa Cruz (60 miles north), Saavedra Experiment Station, 3–5 Jan. 1960, R. Cumming, 1♂ (USNM).

Brazil: Mato Grosso: No additional locality, 1886, P. Germain, (type ♀ of *Aubehydrus speciosissimus* Guignot) (MNHN); Carandasiuh (type ♀ of *Notaticus fasciatus* Zimmerman) (ZSBS).—Para: Belém, 3 July 1969, P. and P. Spangler, 1♂, 3♀♀ (USNM).

Colombia: Atlantico: Barranquilla, 18 Mar. 1969, P. and P. Spangler, 1♂ (USNM).

Paraguay: No additional locality, Dec. 1936, (♀ paratype of *Aubehydrus speciosissimus* Guignot) (MNHN).

FIG. 8. *Notaticus fasciatus* Zimmerman, known distribution.

Uruguay: Bassin del Juculuja, Feb. 1952, 1♀ (MNHN).
Venezuela: Guarico: Calabozo (15 km south), 9–13 Feb. 1969, P. and P. Spangler, 1♂, 4♀♀ (USNM); Calabozo, 7 Feb. 1969, P. and P. Spangler, 1♂ (USNM).

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PROCEEDINGS
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REASSIGNMENT OF *COLPIUS INFLATUS* AND A DESCRIPTION OF ITS LARVA (COLEOPTERA:NOTERIDAE)[1]

By Paul J. Spangler and George W. Folkerts
*Smithsonian Institution, Washington, D.C. 20560 and
Department of Zoology–Entomology, Auburn University,
Auburn, Alabama 36830*

The aquatic beetle family Noteridae presently includes 12 genera primarily from the tropical regions of the world although a few genera and species are established also in the temperate regions. Eight genera of noterids are known to occur in the Western Hemisphere, and of these genera, *Notomicrus*, *Pronoterus*, *Suphisellus*, *Hydrocanthus*, and *Colpius* are reported from the United States. *Mesonoterus* and *Suphis* are known from the tropical regions of Mexico, Central America, the West Indies, and South America and *Siolius* is known only from South America.

The monotypic genus *Colpius* was described by LeConte (1861) for the species, *C. inflatus* LeConte from Florida. Although *C. inflatus* is distinct from the other noterid genera known to occur in the United States, it is very similar to the neotropical noterid genus described as *Suphis* by Aubé (1836). The globose shape of members of the genus *Suphis* is so distinctive that they may be recognized immediately by the unaided eye. The similarity of the adults of *C. inflatus* (Fig. 1) to those of *Suphis* (Fig. 2) aroused our curiosity and resulted in this study.

Adults of *Colpius inflatus* are extremely similar to adults of *Suphis* except that the anterior face of the prosternal process (Fig. 2) is vertical and forms almost a right angle with the

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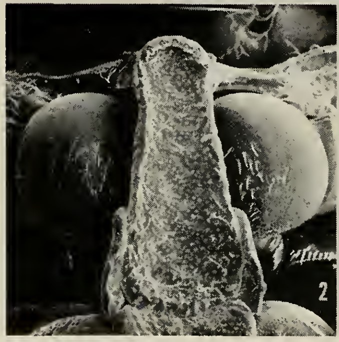
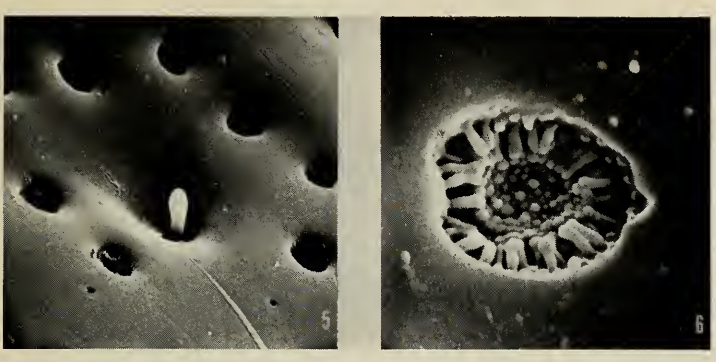
[1] This study was made possible in part by Smithsonian Institution Grant No. SG 063310.



FIGS. 1–2. *Suphis inflatus* (LeConte): 1, adult ♂, ventral view, left elytron removed, photographed at 25 ×, reduced one-half; 2, adult ♂, prosternum, photographed at 115 ×, reduced one-half.

FIGS. 3–4. *Suphis* sp.: 3, adult ♂, ventral view, both elytra removed, photographed at 25 ×, reduced one-half; 4, adult ♂, prosternum, photographed at 100 ×, reduced one-half.

inferior face which is concave and margined. In *Susphis* the prosternum (Fig. 4) is bent in a gradual curve in front of the anterior coxae and does not form a prominent angle. The close similarity in habitus and morphology between *C. inflatus* and species of *Suphis* suggested that perhaps *Colpius* is a synonym of *Suphis*. However, additional evidence supporting this interpretation was desirable before any change was proposed.



Figs. 5–6. *Suphis inflatus* (LeConte): 5, elytral punctures, humeral area, photographed at 2600 ×, reduced one-half; 6, puncture on prosternal process, photographed at 11,000 ×, reduced one-half.

When Aubé described the genus *Suphis* (1836) he stated (p. 208), "Nous n'en connaissons que deux especes: l'une du Bresil, et l'autre de l'Amerique du Nord." From this statement it appears that Aubé was aware of the species from North America that LeConte described 25 years later as *Colpius inflatus* and that Aubé considered it to be congeneric with *Suphis.*

To compare further the adults of *Colpius inflatus* to adults of *Suphis,* we examined the prosternum of *C. inflatus* and the prosternum of a species of *Suphis* with a scanning electron microscope and found nothing in their shapes that was enlightening. We also examined the dorsal and ventral surface sculpture of both specimens with the scanning electron microscope and found that the densely punctate *C. inflatus* has a cluster of tubelike structures (Figs. 5, 6) of undetermined function in most of the punctures and a few of the punctures contain only a stout seta. The specimen of *Suphis* is much less densely punctate and the punctures lack the tubelike structures present in the punctures on *inflatus.* We do not consider these differences, although distinctive when seen on the micrographs, as generic characters; they are no different than the variation in punctation we see among species of *Hygrotus,* species of *Hydroporus,* and among species within other genera.

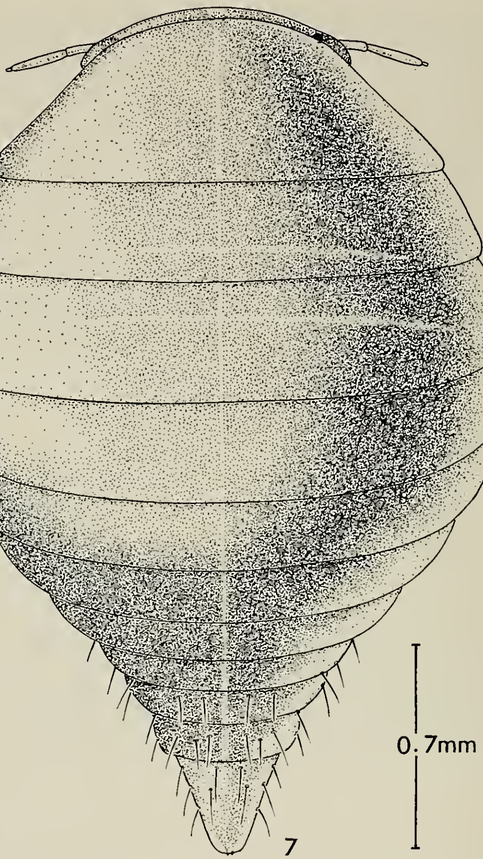


FIG. 7. *Suphis inflatus* (LeConte), larva, habitus, dorsal view.

The lateral margins of the prosternum are narrow and the laminate metacoxal processes are almost parallel sided in *Suphis*. In *Colpius inflatus*, the lateral margins of the prosternum are broader and the laminate metacoxal processes are strongly divergent posteriorly. However, another undescribed species with the angulate *inflatus*-like prosternum has the laminate metacoxal processes almost parallel sided as in *Suphis*. Therefore, we consider these differences comparable to those that occur between species within other genera.

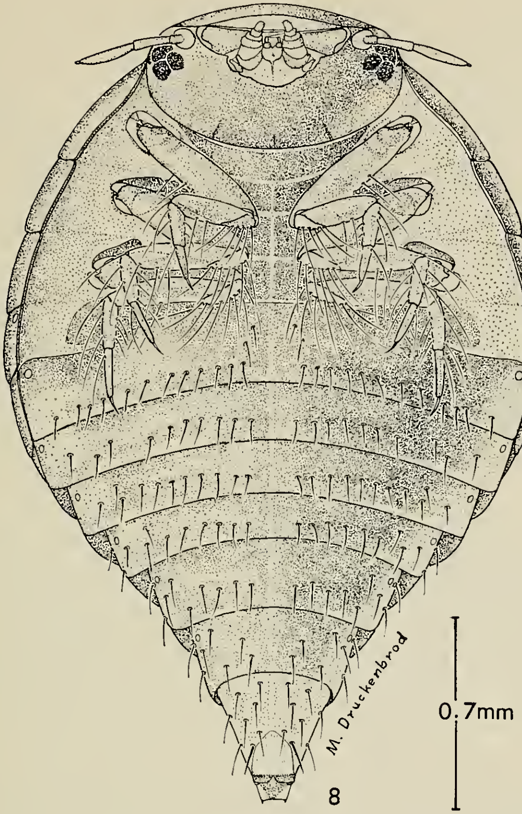


FIG. 8. *Suphis inflatus* (LeConte), larva, habitus, ventral view.

The larvae of three noterid genera have been described and because each of these has distinctive larvae, it was hoped that a comparison of the larvae of *inflatus* and *Suphis* would help determine whether or not they are two valid genera. The distinctive gibbose and fusiform larvae of *Suphis* spp. resemble the adults in shape and have been collected frequently in association with adults in the neotropics. With *Suphis* larvae available, a search was made by Folkerts for larvae of *Colpius inflatus* so that larvae of the two genera could be compared. Larvae of *Colpius inflatus* were collected and a subsequent comparison of these larvae with larvae of *Suphis* revealed no morphological differences comparable to those that distinguish larvae of other noterid genera.

The only differences found between the larvae of *Colpius inflatus* and larvae of *Suphis* were as follows. The larva of *inflatus* has a slightly more impressed alutaceous sculpture on the terga, a slightly different arrangement of the setae on the sterna, and the last abdominal segment reddish yellow and contrasting with the preceding segment; the larva of *Suphis* has the last abdominal segment the same castaneous color as the preceding segment.

As a result of our study of the adults and larvae we believe that the differences we found are specific ones and are not sufficient to maintain *Colpius* and *Suphis* as separate genera. Therefore, we relegate *Colpius* to synonymy under *Suphis*.

Genus *Suphis* Aubé

Suphis Aubé, 1836, Icon. hist. nat. Coleop. Europe 5:207; type of the genus, *Suphis cimicoides*, by monotypy; type-locality: "Cayenne et au Brésil."

Colpius LeConte, 1861, Smithsonian Misc. Coll. 3(136):40 (described as a new genus but without included species).—LeConte, 1863, Smithson. Misc. Coll. 6(167):22 [*Colpius inflatus* described and becoming type of the genus by subsequent monotypy]. [NEW SYNONYMY.]

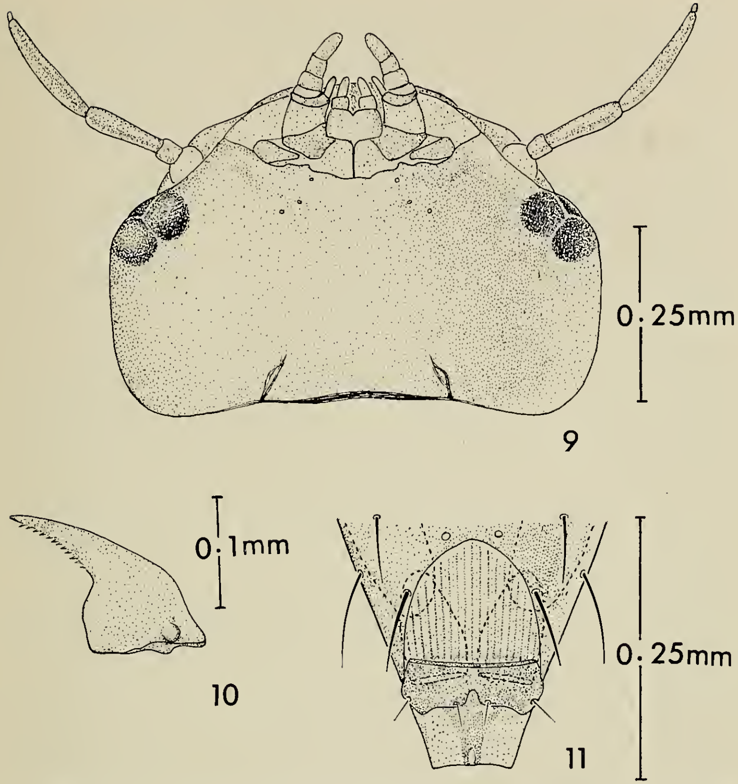
Suphis inflatus (LeConte), new combination

Colpius inflatus LeConte, 1863, Smithson. Misc. Coll. 6(167):22.

DESCRIPTION OF THE THIRD-INSTAR LARVA

Length 2.8 mm; greatest width of pronotum 1.3 mm. Body form (Figs. 7, 8) fusiform and gibbose; head retracted and mostly hidden in pronotum. Color castaneous except genae, hind margin of head dorsally (hidden beneath anterior edge of pronotum), ventrolateral margins of thoracic segments, ventrolateral margins of 1st abdominal segment, last abdominal segment, and longitudinal stripe on middle of abdominal sterna light reddish yellow; legs and thoracic sternites between coxae light reddish brown.

Head (Fig. 9) broader than long, ovoid, compressed dorsoventrally. Ecdysial cleavage lines widely separated at base, consticted near midlength, and terminating midway between point of antennal insertion and anterior margin of head. Labroclypeus feebly emarginate medially. Ventral surface of head glabrous except 2 widely separated tentorial pits at base of head. 6 oval ocelli in each ocular area; 2 large ocelli above



FIGS. 9–11. *Suphis inflatus* (LeConte), larva: 9, head, vv; 10, left mandible, vv; 11, last abdominal segment, vv. vv = ventral view.

temporal margin, 2 medium ocelli on temporal margin, and 2 medium ocelli below temporal ocelli.

Antenna cylindrical, 4 segmented; 1st segment short and broad; 2nd and 3rd segments longest and broad; 2nd segment about ¾ length of 3rd segment; 4th segment short and slender.

Mandible (Fig. 10) stout and broad at base, curving, and tapering to slender apex; serrulate on inner margin. Maxilla with trapezoidal stipes. Palpifer narrow, straplike, bearing slender cylindrical galea on inner margin. Maxillary palpus 3 segmented; 1st and 2nd segments subequal; ultimate segment longest, twice as long as penultimate segment. Labium small, rectangular, glabrous; ligula absent. Labial palpus short, stout, 2 segmented; apical segment longer than basal segment.

Pronotum, mesonotum, and metanotum strongly convex dorsally and arcuate laterally. Pronotum glabrous. Meso- and metanotum each with 4 small lateral setae; 1 on each lateral margin at about midlength and 1 near each posterolateral angle.

Legs short, 5 segmented. Foreleg with coxa longer than femur and bearing 1 seta on dorsal surface and 6 long setae on ventral surface; trochanter about a third as long as femur and bearing 7 long setae on ventral surface; femur about half as long as coxa and bearing 1 long seta at apex and 1 short seta at base on dorsal surface and 3 long setae on ventral surface; tibia slightly shorter than tarsus and bearing 2 long setae on dorsal surface and 4 shorter, stout setae on ventral surface; tarsus bearing 1 long slender seta near base and 1 small short seta at apex on dorsal surface, 1 small short seta on ventral surface at base and 2 slender tarsal claws, outer (upper) claw slightly shorter than inner (lower) claw.

Abdomen of 8 distinct segments. Terga of segments 1 through 6 each separated from sterna by pleural suture. Segments 7 and 8 without pleural suture, fused and completely sclerotized, cylindriform, and tapering posteriorly. Tergum of segment 5 with a few lateral setae. Terga 6 and 7 with lateral setae and a transverse row of setae. Tergum 8 with 3 lateral setae on each side and 2 pairs of setae on discal area. Sterna of abdominal segments with rows of setae as illustrated (Fig. 8). Last tergum of abdomen with truncate apex. Last sternum with inverted U-shaped membranous area (Fig. 11).

Lateral tracheal trunks terminate between last tergum and sternum. Spiracles present on abdominal segments 1 through 7 as follows: 1 on each anterolateral angle of 1st tergum and 1 on each anterolateral angle of sterna 2 through 7.

Young (1954) reported *inflatus* from Florida and Cuba. We have seen specimens also from South Carolina, Georgia, Alabama, and Louisiana. The larvae of *inflatus* used for this study came from the following locality: Florida, Gilchrist County, 7.9 miles south of Fort White on Route 47, 13 Sept. 1969, G. W. Folkerts, 4 specimens.

The larva of *Suphis inflatus* (LeConte) may be distinguished from the known larvae of other genera of nearctic Noteridae by the following key.

KEY TO THE KNOWN LARVAE OF GENERA OF THE NEARCTIC NOTERIDAE[1]

1. Mandible with a stout preapical tooth; 3rd antennal segment not longer than 4th antennal segment .... *Suphisellus* Crotch
   Mandible not strongly toothed, simple or serrulate; 3rd antennal segment more than twice as long as 4th antennal segment 2
2. Body form gibbose; mandible serrulate; 3rd antennal segment about 12 times longer than 4th antennal segment .... *Suphis* Aubé
   Body form not gibbose, cylindriform; mandible simple; 3rd antennal segment about 3 times longer than 4th antennal segment .... *Hydrocanthus* Say

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[1] The larvae of *Notomicrus* and *Pronoterus* are unknown.

We thank Mr. Michael Druckenbrod, Smithsonian Institution staff artist, for preparing the illustrations of the larva and Miss Mary Jacque Mann, Smithsonian Institution scanning electron microscopist, for taking the micrographs of the adults.

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PROCEEDINGS
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A NOTE ON THE MILLIPED GENERA *MYRMECODESMUS* AND *ILYMA* (POLYDESMIDA: STYLODESMIDAE)

By Richard L. Hoffman
Radford College, Radford, Virginia 24141

During recent attempts to comprehend and perhaps refine the existing classifications of the so-called "cryptodesmoid" millipeds, I had occasion to examine a fair variety of tropical species on a comparative basis. Tangential to the main purpose of this work I discovered some previously unsuspected synonymy, some of which forms the basis of the following note.

Myrmecodesmus

Myrmecodesmus Silvestri, 1910, Zool. Anz. 35:359. Type-species, *M. formicarius* Silvestri, by monotypy.

Ilyma Chamberlin, 1941, Bull. Univ. Utah, biol. ser. 6(4):24. Type-species, *I. orizaba* Chamberlin, by original designation and monotypy. [NEW SYNONYMY!]

Definition: A stylodesmoid genus in which the ozopores are stalked on segments 5, 7, 10, 13, and 16 and open on the surface of the paranota of segments 17, 18, and 19. Collum with ten marginal lobes, covering the head. Dorsum convex, with two major paramedian longitudinal series of three rounded tubercules each, those of segment 19 sometimes prolonged into an apically bilobed process extending beyond apex of 20th segment; paranota small, set low on body, the lateral margin normally bilobed.

Gonopod aperture narrowly transverse, its edges not flared or modified, coxae very large and carried mostly outside the body in the form of two opposed galeate structures, narrowly in contact medially. No evident sternal remnant present. Telopodites small, the prefemora elongate and parallel to distal edge of coxae on aboral side, without prefemoral processes; seminal groove terminating on a subapical branch beyond which the telopodite is multiramous or distally bifid (Figs. 1 and 2).

Commentary: Seven names have been based upon specimens referable to this group, some of these are known to be synonyms (see below) and others may possibly be found redundant—synonyms of each other or of names published in other genera. As presently understood, *Myrmecodesmus* ranges between Louisiana and southern Mexico; two species occur in the United States.

The circumstances leading to the proposal of *Ilyma* are easy to reconstruct and are here recounted for the benefit of other people working on small polydesmoids. Aside from re-emphasizing the importance of a highly skeptical attitude when following in the footsteps of Dr. Chamberlin, the case is instructive in casting some doubt on the significance of characters which have hitherto been regarded as paramount.

Myrmecodesmus was proposed for a single species found in ant nests in Jalapa, Vera Cruz, Mexico. *Myrmecodesmus formicarius* was briefly but accurately described, and its major structural features carefully illustrated; the species was again treated by Silvestri in 1911, in connection with the description of a presumed congener, *M. modestus*, also from Jalapa. Rearranged descriptions and copies of the original drawings were published in 1940 by Attems, and since that time the genus has been mentioned in keys compiled by Chamberlin (1943) and Schubart (1945), and appeared in Loomis's checklist of Central American millipeds (1968). These appear to be essentially all of the literature references to the genus.

Silvestri (1910) noted that ozopores occurred on segments 5, 7, 10, 13, and 16 through 19, those of the first five segments opening through cylindrical processes at the posterior corner of the paranota, and those of segments 17–19 opening directly on the paranotal surface, and his figures showed these locations precisely.

When Chamberlin proposed *Ilyma* for the new species *I. orizaba* in 1941, he stated that pores occurred on segments 5, 7, 10, 13, and 16 (as also stipulated for the Cuban genus *Heteropente* Loomis) and that the dorsal tubercules of segment 19 were enlarged and produced posteriorly into a long, apically notched process covering the 20th segment. No other features were stipulated, no contrast was made with any other genus, nor was anything said about gonopod structure as the unique type of *orizaba* was a female. Subsequently a variety of other "Ilyma" species were named, *I. colotlipa* by Chamberlin in 1942, *potosina* and *morela* by Chamberlin in 1943, *cajuni* by Loomis in 1944, and finally *digitata* by Loomis in 1959, who provided a key to these taxa.

Despite the shortcomings of existing descriptions (the type-species and two other species being known only from females), it appears that the various forms described in *Ilyma* are congeneric. Such a relationship can be attested at least for *morela*, *cajuni*, and *digitata*, in which the gonopod structure is known. It must be confessed, however, that so far only small and schematic drawings exist for these forms, and that the concept of *Ilyma* as a group of related species rests upon purely nonsexual characters.

In trying to discover some justification for such family-group names as Stylodesmidae, Stiodesmidae, Hercodesmidae, Chytodesmidae, and others, I looked into the gonopod structure of as many species of small cryptodesmoids as I had available, and shortly after having made a preparation of *Ilyma cajuni*, I recalled having seen something remarkably similar in the literature. Only a brief search through Lief. 70 of Das Tierreich was needed to locate the match, namely the gonopod drawing of *Myrmecodesmus formicarius* on page 312. Although I now have slight regard for pore characters in the definition of genera, I nonetheless investigated this variable by cleaning some of the detritus from the posterior segments of a specimen of *cajuni* and was interested but not surprised to find pores on segments 17, 18, and 19 in exactly the position illustrated by Silvestri (1910).

Because of the general overall similarity of the nominal species involved, I am now confident that pores occur on these segments also in *I. orizaba* and the other forms; and considering the similarity of gonopods in three species of *Ilyma* with those of *M. formicarius*, there seems to be no justification for continued recognition of *Ilyma*. That generic name, regardless of whatever its original justification may have been in its author's mind (he did not share this with his readers), was maintained subsequently, as in his 1943 key to Mexican stylodesmoids, only because of his assumption that pores occurred in these forms exclusively in the form of styliform pore-processes. An additional chore now imposed on present and future workers will be that of re-examining posterior paranota for the presence of pores overlooked through obsession with the conspicuous processes. One wonders how many "genera" will fall as a result. For such work I find that a small camel's hair brush, with the bristles cut off close to the handle, provides sufficient abrasiveness for cleaning segments. Doubtless an ultrasonic vibrator would be useful if available.

In the past, as noted, much emphasis has been placed on pore-processes (for which the term *porostele* is here suggested) at both the generic and family level. The fact that a given organism may have part of its pore series on stalks, and part opening flush on the segmental surface, seems to me a deathblow to the utility of that character at any level beyond that of species.

Obviously, the lesson here is that in the cryptodesmoid groups, as elsewhere in the Diplopoda, resort must be made first and last to gonopod characters in the definition of genera as well as higher categories.

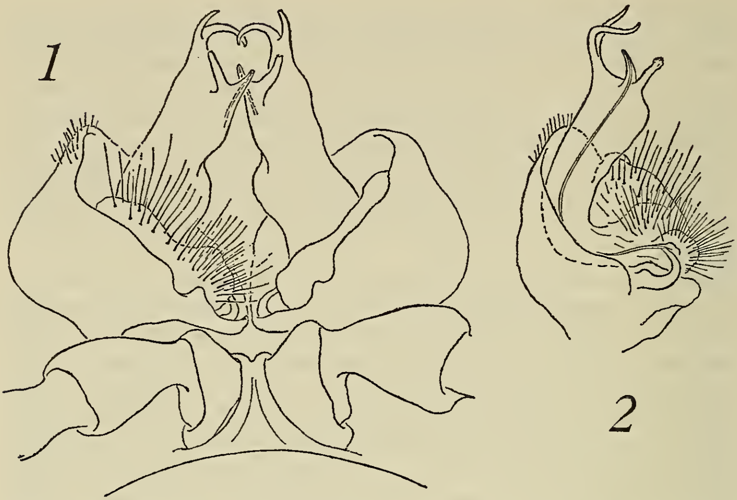
Myrmecodesmus formicarius Silvestri

Figures 1, 2

Myrmecodesmus formicarius Silvestri, 1910, Zool. Anz. 35:360, figs. ♂ and ♀ syntypes (Coll. Silvestri, Portici), from Jalapa, Veracruz.

Ilyma cajuni Loomis, 1944, Psyche 51:175, figs. 6a, 6b. ♂ holotype (Mus. Comp. Zool.) from Venice, Plaquemines Parish, Louisiana. [NEW SYNONYMY!]

Association of the two cited names as synonyms is based upon a comparison of material identified as *I. cajuni* by H. F. Loomis with Silvestri's



Figs. 1–2. *Myrmecodesmus formicarius* Silvestri, male genitalia: 1, gonopods in situ, ventral (aboral) aspect, with bases of 7th pair of legs shown, setae omitted from left side; 2, left gonopod mesal aspect.

published account of *formicarius.* The original gonopod drawing given for *cajuni* was made from the lateral aspect, that for Silvestri's species showed the gonopods in situ from an anterior (oral) view. I give here drawings made from comparable positions, based on the same gonopods, and think that if they are compared with the originals alluded to, anyone will be convinced that only one species is involved. I think that Silvestri was misled by the transparency of his preparation into showing some lines in the wrong focal plane, but it is clear that the drawing was made from the anterior side.

There is an interesting implication arising from the union of the two names. The range of *formicarius* is now known to extend from central Veracruz to the Mississippi delta, extensive enough to suggest the possibility that the species is capable of dispersion through commerce. Following are the localities of the distribution of *formicarius* known to me, some of them previously unpublished:

Mexico: veracruz: Jalapa, in nests of *Solenopsis geminata* F. and *Pheidole crassicornis* (Silvestri, 1910).

United States: texas: Cameron Co.: Rabb Ranch near Southmost, under palm logs, 12 December 1954, Leslie Hubricht. Guadeloupe Co.: near the Guadeloupe River at Sequin, 4 June 1955, Hubricht. Goliad Co.: Goliad State Park, 7 April 1955, Hubricht.

louisiana: Plaquemines Par.; Venice, under bark of orange trees (Loomis, 1944).

In will be a matter of interest to investigate the relationship of this genus to the West African species referred to *Monachodesmus*, and some from the West Indies described in the genera *Lophodesmus* and *Heteropente*. One suspects that the number of valid genera in the Stylodesmidae may fall far short of the number of existing generic names!

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PROCEEDINGS
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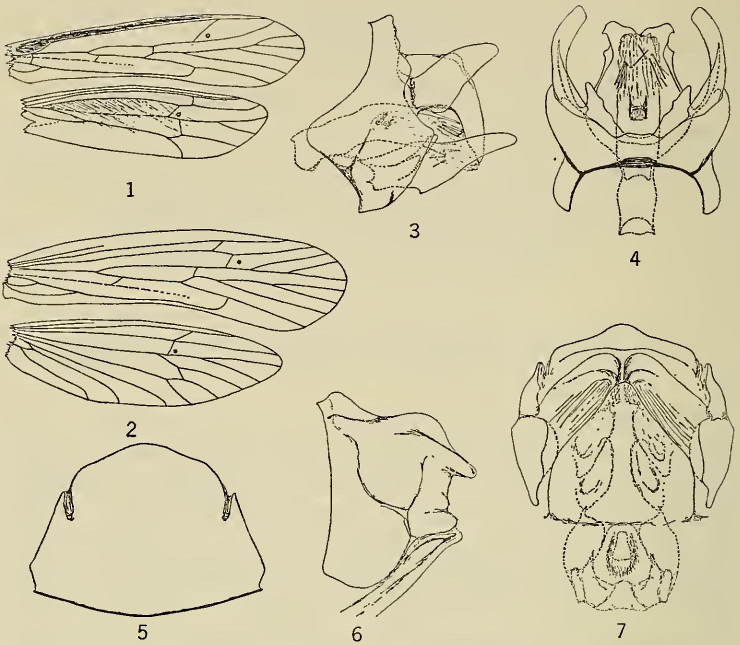
THE FIRST MOLANNID CADDISFLY FROM CEYLON, *MOLANNA TAPROBANE*, NEW SPECIES (TRICHOPTERA, MOLANNIDAE)

By Oliver S. Flint, Jr.
Smithsonian Institution, Washington, D. C. 20560

The caddisfly family Molannidae is a rather small one, containing only three genera and some two dozen species. The family is primarily north temperate in distribution, although one species is known from as far south as the Celebes. The few forms described from further south (South Africa and Australia) and originally placed in the Molannidae, are in fact, not molannids (Riek 1968, Marlier 1962). Wiggins (1968) treated the Asian Molannidae, especially those of Japan and the Indian subcontinent. He did find one species, *Molanna paramoesta* Wiggins, widespread over India as far south as the states of Kerala and Madras, but did not record any species from Ceylon.

The only reference to a molannid from Ceylon is in Hagen (1858), wherein *Molanna mixta* was described from Ramboda. Recent study of the types of *mixta* has shown that the species is in reality a species of *Marilia* and thus belongs in the family Odontoceridae (Schmid 1958).

I was, therefore, somewhat surprised and excited when I discovered larvae of a molannid in a small pool on the Horton Plains of Ceylon in October of 1970. Considerable effort was taken to supplement the initial collection of larvae, with the result that several pupal exuviae and two adult males were taken at the locality. Subsequently, larvae and adults were taken at a second locality in Pattipola. In 1972 Dr. Hans Malicky wrote that he had a female of a species of *Molanna* in the collection made by Professor Starmühlner that he was



Figs. 1–7. *Molanna taprobane*, new species: 1, male venation; 2, female, venation; 3, male genitalia, lateral; 4, male genitalia, ventral; 5, female tenth tergum dorsal; 6, female genitalia, lateral; 7, female genitalia, ventral.

studying. Dr. Malicky very generously lent this specimen to me for inclusion in this paper. All these materials appear to be referable to a single species of *Molanna* that is herewith described.

Molanna taprobane, new species

This species is very distinctive and does not show any close relationship to any other known species in the genus. The reflexed costal cell of the male forewing is unique as is the venation in the hindwing. The male genitalia with the simple cerci, tenth tergites, and claspers are most similar to the European and North American species rather than the Asian species in which one or more of these structures are bifid. The venation of the females of most species, including *M. taprobane*, seems to be nearly identical. The genitalia of the female sex in only a few species have been described, but fortunately the geographically closest species,

Table 1. Arrangement of larval gills

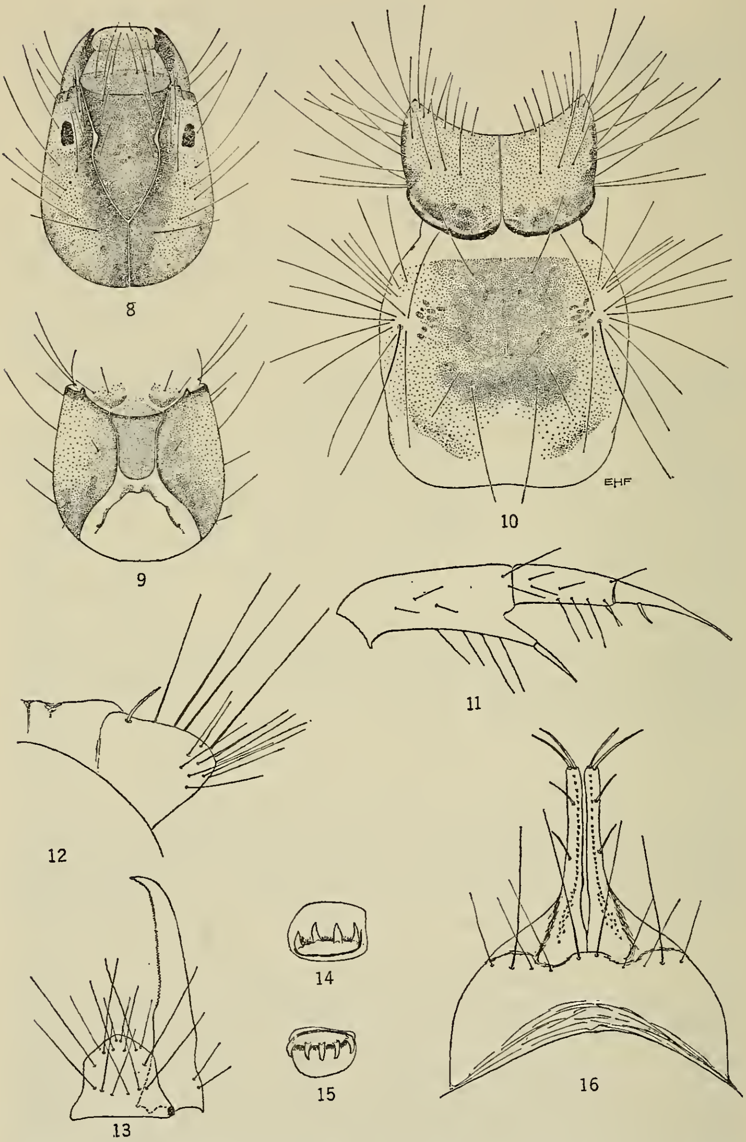
Segment	Dorsal	Lateral	Ventral
1	4		
2	4	1	3
3	4		3
4	3–4		3
5	3–2		3–2
6	2		2
7	2		2
8	2		

M. paramoesta, is well figured (Wiggins 1968, Fig. 3), and clearly differs in the shape of the tenth tergum and vagina.

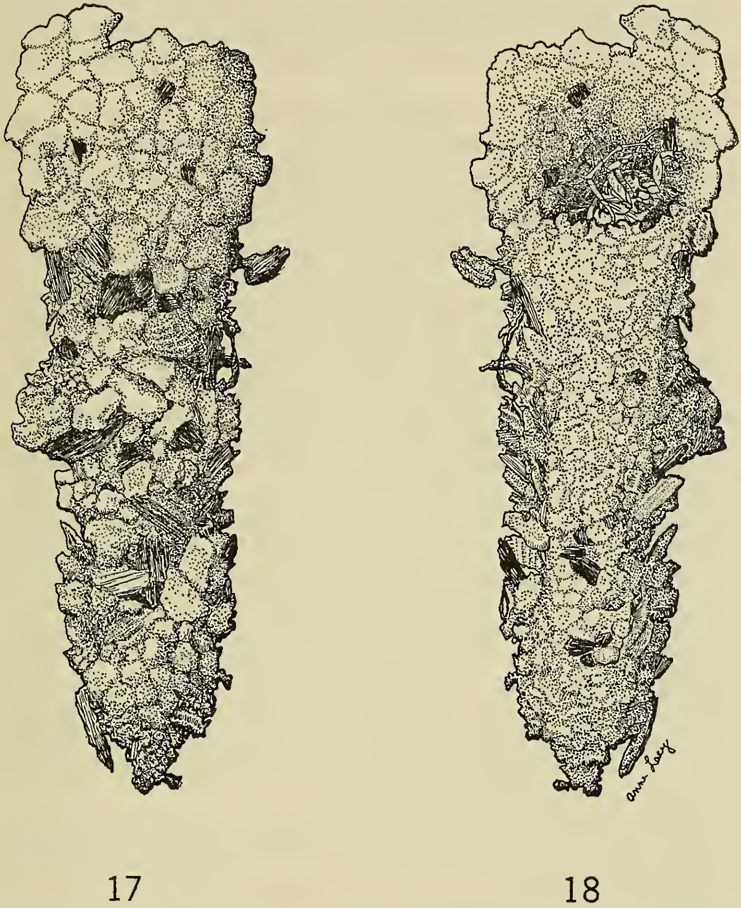
The larvae of a few species are well described, but none of these is a species known from south of the Himalayas. Of the species described all except *M. albicans* Zett. have a color pattern on the head consisting of a nearly black "V" following the epicranial sutures (Lepneva 1971, Sherberger and Wallace 1971). *M. albicans* by lacking the transverse fracture on the mesonotum can be separated from *M. taprobane.* Even fewer pupae than larvae are known in the genus, and none is described completely enough to permit specific recognition. In general, specific characters in the pupal stage are shown most frequently in the number of hooks per plate, in the arrangement of the gills, and in the structure of the apical appendages.

Adult: Length of forewing, 13–14 mm. Color grayish brown; mid and hind legs cinereous; forewing mottled with irregular paler areas. Male with maxillary palpi and foretibia and tarsus densely covered with fuscous hairs; forewing with costal area reflexed onto lower surface and pocket thus formed filled with a pencil of long dark hairs; anal area with scattered, small, dark scales; hindwing with central area bearing long, black hairs concentrated along vein Rs (Fig. 1–2). Male genitalia (Figs. 3–4): Ninth segment typical for genus. Tenth tergum composed of decurved, beaklike lateral plates bearing a small dorsolateral shoulder. Cercus simple, elongate, directed posterodorsally. Clasper elongate, tapering regularly from base to apex, in ventral aspect with a narrow ventral shelf; with a small basomesal process. Aedeagus tubular with a small central sclerite and a number of apical spines. Female genitalia (Figs. 5–7): Eighth sternum simple, posterior margin slightly emarginate mesally. Ninth and tenth segments fused; tenth tergum projecting slightly, posterior margin rounded. Vagina with anterior sclerite bearing a central opening and lateral winglike lobes connecting to several slightly sclerotized folds posteriorly.

Larva: Length to 15 mm. Color of sclerites mostly pale yellowish, marked with brown. Head, pro- and mesonota irregularly clouded with



FIGS. 8–16. *Molanna taprobane*, new species: 8, larval head, dorsal; 9, larval head, ventral; 10, larval pro- and mesonotum, dorsal; 11, larval fore tibia, tarsus, and claw; 12, larval left sclerite "B" of anal proleg, dorsal; 13, pupal labrum and mandible, dorsal; 14, pupal hook plate 5



Figs. 17–18. *Molanna taprobane*, new species: 17, larval case, dorsal; 18, larval case, ventral (Drawings by Ann Lacy).

brown (Figs. 8–10). Frontoclypeus without enlarged membranous areas at lateral constrictions. Gular sclerite long, widened anteriad (Fig. 9). Mesonotum with transverse and anteromesal fractures (Fig. 10). Base of tibial spur of foreleg extending beyond base of tarsus and with 3 or 4

←

posterior, dorsal; 15, pupal hook plate 6 anterior, dorsal; 16, pupal apical processes, dorsal (Drawings 8–10 by Elsie H. Froeschner).

large setae along ventral margin (Fig. 11). Gills generally borne in small groups (Table 1). Eighth segment laterally with 13–16 small bifid processes. Sclerite "B" of anal proleg with a single, posteromesal, pale spine (Fig. 12).

Pupa: Length 15 mm. Mandible and labrum, Fig. 13. Front of head with a small, dark knob and 3 pairs of hairs mesally; with 2 long hairs between base of mandible and eye. Basal segment of antenna with 6–8 setae; antenna reaching to eighth abdominal segment. Fore and midtarsi with lateral hair fringes. Abdominal segments 3–8 with well-developed lateral line fringes, those of segment 8 meeting posteroventrally. Segments 2–8 with strong dorsolateral and ventrolateral, longitudinal, sclerotized bars. Gills present on segments 2–8, apparently similar in arrangement to those on larvae. Segment 1 dorsally with a transverse, arcuate ledge mesally; posterior margin with a broad band of small, posteriorly directed points. Hook plates anteriorly on segments 3–6, each with 4–6 hooks; segment 5 with 4 hooks posteriorly (Figs. 14–15). Apical processes long, rodlike, contiguous; dorsally with an irregular row of points; with a short, pale seta at midlength, another at ¾ length, and 2 apically (Fig. 16).

Case: Length to 30 mm, width to 10 mm. Structure generally typical of *Molanna*, but narrower than usual and generally incorporating much plant matter which often extends loosely from case dorsally and laterally producing a "shaggy" appearance (Figs. 17–18).

Material: Holotype, male: Ceylon, Nuwara Eliya Dist., Horton Plains, 7000 ft. elev., 3–4 Oct. 1970, O. S. Flint, Jr. USNM Type 72828. Allotype: Kandy Dist., Gartmore Dola, 2000 m elev., 29 Nov. 1970, Starmühlner, Vienna Museum. Paratypes: Same data as holotype, 1♂. Nuwara Eliya Dist., Pattipola, 6100 ft. elev., 3–6 Oct. 1970, O. S. Flint, Jr., 3♂. Other: Same data as holotype, many larvae, 2 pupal exuviae. Same data as Pattipola locality, 5 larvae.

Biology: This species appears to be limited to high elevations in the central mountains of Ceylon: all three localities lie between 6100 and 7000 feet in elevation.

The larvae that were taken at Horton Plains were found in a small, sandy-bottomed pool close to the Belihul Oya. Although the larvae were very abundant, and in all sizes, they were very hard to see because the cases blended in so closely with the bottom. The pool was searched for pupae, and although none was found, 2 pupal exuviae were found floating along the margin of the pool. The two males were taken by net from under the adjacent, overhanging wall of the pit.

The situation at Pattipola was quite different. Here the larvae were found in a stream 2–3 feet wide by only a few inches in depth in riffle areas. However the stream was rather deeply incised into the meadow and had many long pools up to 3 feet in depth where the water flow was very slight. The larvae were found sparingly on the bottom in company with larvae of Lepidostomatidae and Calamoceratidae. The adults at this locality were probably taken at an ultraviolet light operated close to the stream, but the banks of the stream were also swept with a net and the two collections pooled.

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INDEX TO NEW TAXA

VOLUME 86

(New taxa indicated in **boldface**; n.c. = new combination; n. var. = new variety)