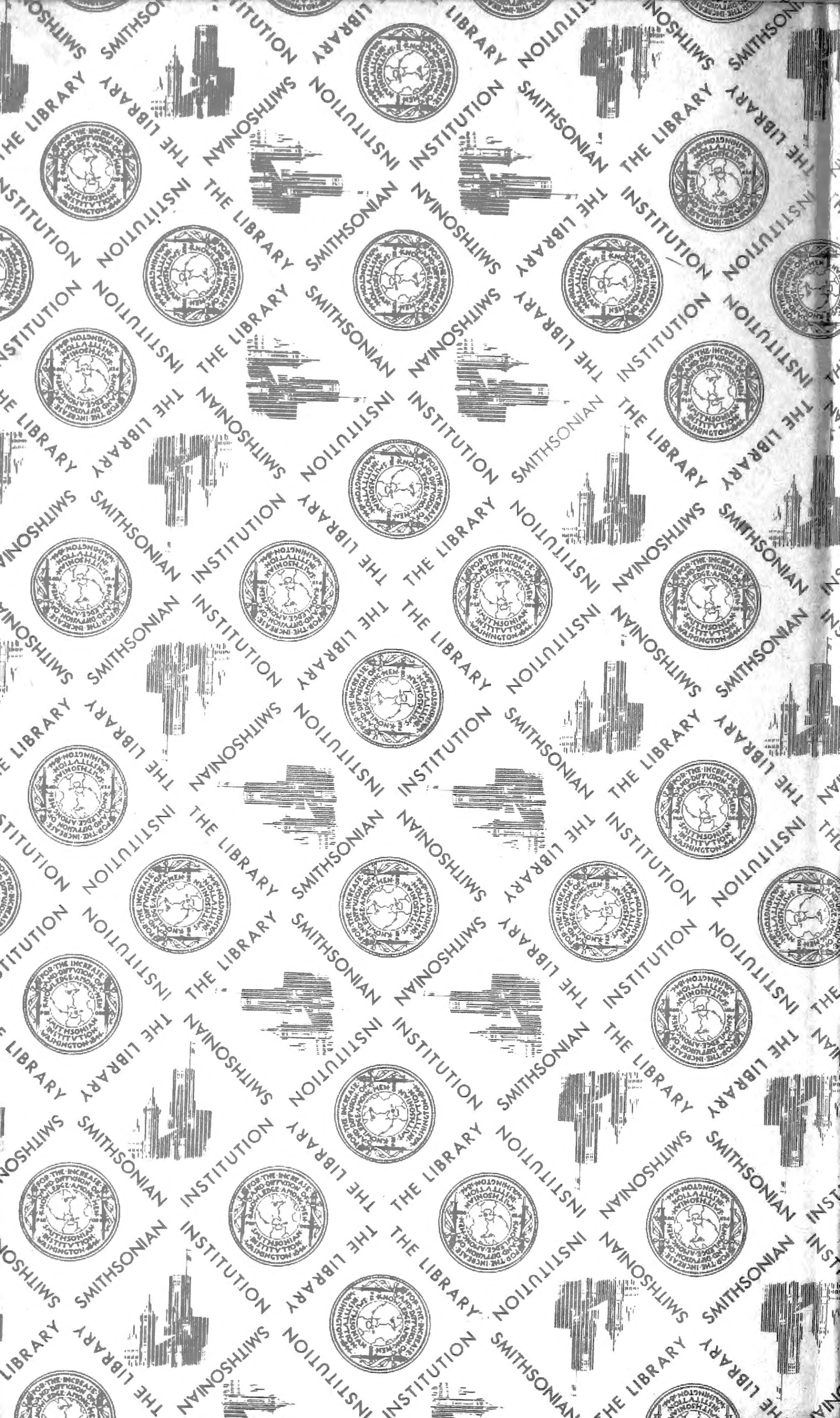
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PROCEEDINGS

OF THE

Biological Society of Washington

VOLUME 76
1963

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BIOLOGICAL SOCIETY OF WASHINGTON

PROCEEDINGS

1034th Meeting—20 December 1962

The meeting was chaired by President A. C. Smith, with about 25 members and friends of the Society in attendance.

The report of the Treasurer and the minutes of the last meeting were presented and approved.

New members elected: Karl Banse, Everett D. Cashatt, Edward T. Green, Theodore A. Heist, Philip S. Humphrey, James O. Lane, Robert E. Lewis, Charles F. Lytle, Lowell P. Thomas, Robert H. Kanazawa, Kellie O'Neill, George H. Penn, Neil D. Richmond, Roy R. Snelling, Fred G. Thompson, Pyong-oh Won, Keith H. Woodwick, and Charles D. Wise.

Formal communication: Mr. Stanwyn Shetler, Department of Botany, Smithsonian Institution, reported on his botanical work in Alaska, during several expeditions.

1035th Meeting—7 June 1963

EIGHTY-FOURTH ANNUAL MEETING

President A. C. Smith called the meeting to order with 45 members and friends present.

The minutes of the last meeting were read and accepted, as were the reports of the Corresponding Secretary, and of the Treasurer.

New members elected: Robert H. Gibbs, Jr., W. H. Anderson, Maureen E. Downey, Harold J. Higbee, Frank E. Kurczewski, M. Raymond Lee, Iyad A. Nader, Ronald H. Pine, David C. Rentz, Victor G. Springer, William L. Witt, Roberto H. Gonzales, and William J. Schaldach, Jr.

The following officers and Members of the Council were elected: *President,* Albert C. Smith; *Vice Presidents,* Charles O. Handley, Jr., Richard H. Manville, Joseph P. E. Morrison, Henry W. Setzer; *Recording Secretary,* Richard S. Cowan; *Corresponding Secretary,* John L. Paradiso; *Treasurer,* John W. Armstrong; *Members of Council,* Daniel M. Cohen, Fenner A. Chace, Horton H. Hobbs, Jr., Ernest A. Lachner, Ralph E. Crabill, Jr.

Formal communications: The morning hours were taken up by five contributed papers of 15 minutes each, on a wide range of biological subjects. At the end of the morning session, which was moderated by President Smith, the business meeting was held; at adjournment, the members retired to O'Donnell's Sea Grill for a luncheon. The speakers and their subjects were as follows:

Joseph Rosewater, Natural History and Taxonomy of the Giant Killer Clams (Bivalvia: Tridacnidae) in the Marshall Islands; George A. Llano, Biological Work aboard the USNS *Eltanin* in the Antarctic; Karl V. Krombein, Biology of the Hibiscus Wasp, an Abundant Rarity; William L. Stern and Edward S. Ayensu, Taxonomy, Form and Stem Anatomy of the Passifloraceae; Robert H. Gibbs, Jr., Anatomy and Systematics of the Tunas; Frederick M. Bayer, Recent Investigations of the Deepwater Invertebrate Fauna of the Northern Florida Straits.

The afternoon session consisted of a symposium entitled "Adaptations of Plants and Animals to Their Environment" with R. S. Cowan as Chairman. The speakers and subjects on the symposium were:

Stanwyn Shetler, Plants in the Alpine–Arctic Environment; Henry W. Setzer, Mammalian Adaptations, with Special Reference to Desert Mammals; Robert Traub, Some Adaptations of Fleas to their Environment; Horton H. Hobbs, Jr., Morphological Adaptations of Invertebrates to the Freshwater Habitat.

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PROCEEDINGS
OF THE
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THE GENUS *FREYCINETIA* (PANDANACEAE) IN THE SOLOMON ISLANDS*

By Benjamin C. Stone
College of Guam, Agana

In attempting to identify a relatively small number of specimens of *Freycinetia* collected by the writer in the Solomon Islands in 1957, it became apparent that a review of the known species was necessary, and that two apparently undescribed species were represented. This paper is an outcome of this review, and includes descriptions of two species proposed as new, bringing up to fourteen the total number of species reported from this region.

Only one species of Section *Oligostigma* as yet is known from the Solomon Islands, namely *Freycinetia tessellata* Merrill & Perry. This is rather unusual, since species of this section are both numerous and apparently common in New Guinea. In this respect the Solomon Islands may be grouped with Polynesia in a geographic division of the genus by sections, since only species of Section *Freycinetia* occur in Polynesia. The type species of the genus is *Freycinetia arborea* Gaudichaud, which is endemic to the Hawaiian Islands; this was included in the Section *Pleiostigma* Warburg, which must now be known as Section *Freycinetia,* in accordance with the International Code of Botanical Nomenclature, Article 22 of the 1956 edition.

KEY TO SPECIES OF *FREYCINETIA* IN THE SOLOMON ISLANDS

I. Stigmas mostly 3–10 or more per berry. .... Section *Freycinetia*
  A. Syncarps elongate, cylindric.
    1. Inflorescences terminal.

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*This is the fourth in a series of studies of plants of the Solomon Islands. The first appeared in Bot. Not., 112 (3): 372–376, 1959; the second in Brittonia, 13 (2): 212–224, 1961; the third in Proc. Biol. Soc. Wash., 75: 25–32, 1962. I am indebted to the Curator of the Arnold Arboretum Herbarium of Harvard University for the opportunity of examining types and other specimens mentioned herein.

a. Auricles markedly pectinate; leaves only 15–20 cm long, about 9 mm broad; pedicels distally scaly-scabrid. .... *F. pectinata*

b. Auricles not as above; leaves mostly 10–30 mm broad; pedicels various.

a′. Leaves mostly longer than 30 cm, sometimes much longer.

Seeds narrow, slightly curved, with a broad raphe, but lacking strophiole. .... *F. solomonensis*

Seeds ellipsoid, with a distinct strophiole. .... *F. bicolor*

b′. Leaves mostly 15–30 cm long.

Syncarps about 4 cm long and 1 cm in diameter; pedicels about 4 cm long; stigmas 3–6, mostly 4–5, cushion-like, distinct. .... *F. anomala*

Syncarps about 2.5 cm long and 1.2 cm in diameter; pedicels up to 5 cm long; stigmas 4–8, confluent. .... *F. oligodonta*

2. Inflorescences lateral, subtended by distichous vegetative bracts. .... *F. funicularis*

B. Syncarps globose, ovoid, ellipsoid, or shortly oblong.

1. Pedicels scabrid at least in part.

a. Leaves 13–18 cm long, 2.5–3.5 cm broad, the margins almost unarmed. .... *F. decipiens*

b. Leaves mostly about 60 mm long and 1.5 cm broad, armed in part.

a′. Auricles splitting lengthwise into fibers; leaves distinctly coriaceous; berries relatively few per syncarp, rather short and thick, with plump seeds 0.6 mm in diameter. .... *F. nesiotica*

b′. Auricles splitting transversely into fragments; leaves less markedly coriaceous; berries numerous per syncarp, about 12 mm long, obclavate to sublageniform, the pileus 4–5 mm long; seeds about 0.4 mm in diameter. ....*F. membranacea*

2. Pedicels quite smooth and glabrous.

a. Leaves 2–6 cm broad.

a′. Leaves 12–17 cm long, 5–6 cm broad. .... *F. marantifolia*

b′. Leaves mostly 20–50 cm long and 2–5 cm broad.

Leaves about 35 cm long and 3.5–5 cm broad, at base abruptly tapered into a narrow pseudo-petiole; pedicels about 7 cm long. .... *F. petiolacea*

Leaves 20–50 cm long, 2–4 cm broad, not tapered at base as above; pedicels about 5 cm long. .... *F. humilis*

b. Leaves considerably narrower, up to 2 cm broad.

a′. Syncarps shortly oblong to subpyramidal.

Leaves mostly 25–30 cm long and 1.3 cm broad; syncarps about 2.5 cm long and 1.2 cm in diameter, mostly oblong. .... *F. oligodonta*

Leaves mostly 18–24 cm long, narrowly linear-lanceolate; syncarps about 3.5–4.5 cm long and 1.6–1.7 cm in diameter, often subpyramidal. (Known only from New Britain to date.) .... *F. novo-pomeranica*

b′. Syncarps elliptical-ovoid, about 3 cm long and 2 cm in diameter; leaves about 18 cm long and 2 cm broad. .... *F. divaricata*

II. Stigmas 1–3, rarely 4–5 per berry. .... Section *Oligostigma*

One species, with leaves 80–120 cm long and 6–7 cm broad. .... *F. tessellata*

ENUMERATION

Section *Freycinetia*

1. *Freycinetia anomala* Merr. & Perry *in* J. Arn. Arb. 20: 152, pl. 1, f. 8, 1939.

Type locality: San Cristoval Island, Hinuahaoro, 900 m (*Brass* 2886).

2. *Freycinetia decipiens* Merr. & Perry *in* J. Arn. Arb. 20: 154, 1939.

Type locality: San Cristoval Island, Star Harbor, 50 m (*Brass* 3113) (Type: *Brass* 3138).

3. *Freycinetia divaricata* Merr. & Perry *in* J. Arn. Arb. 20: 154, pl. 1, f. 2, 1939.

Type locality: Florida Islands, N'gela, Olevuga Island, lowland forest (*Brass* 3480).

Malaita Island: Kwara'ai District, Kwalo, 600 m (rainforest climber, syncarps small, ovoid, red when mature, with berries 6 mm long, pileus rounded, stigmatic area raised on a substylose rostrum with 1–5 but mostly 3–4 stigmas; local name "ari-ari"), 24 Sept. 1957, *Stone* 2359 (BISH, US). Some leaves from this collection are only 7.5 cm long and 1.1 cm broad, while in the type they are mostly 16–18 cm long and 1.5–2 cm broad. The syncarps here are slightly smaller, up to 2.5 cm in diameter. It should be noted that my collection was from a fallen trunk in a sunny clearing; some of the plants had withered, others were stunted. The specimen bears a branch which nearly matches the type, but others are smaller in all respects. No significant differences occur, however, and the berries and seeds are very similar. Rarely there will be found some berries with 5 stigmas, and sometimes with only 1 or 2 stigmas; most have 3 or 4 stigmas.

From this it may be appreciated that the species does not fit clearly into either section of the genus, and could just as well be considered a member of Section *Oligostigma*.

4. *Freycinetia funicularis* (Savigny) Merr., Interpret. Rumph. Herb. Amboin. 83, 1917; Merr. & Perry *in* J. Arn. Arb., 20: 155, 1939.

Type locality: Amboina.

Recorded from San Cristoval Island by Merrill and Perry on the basis of collections (No. 3016, 3017) by Brass.

5. *Freycinetia humilis* Hemsley *in* Kew Bull., 1896: 164, 1896; Warburg *in* Pflanzenr. 3 (IV.9): 40, 1900; Martelli *in* Webbia 3: 311, 1910.

Type locality: Fauro Island (*Guppy* 323).

6. *Freycinetia marantifolia* Hemsley *in* Kew Bull. 1896: 164, 1896; Warburg *in* Pflanzenr. 3 (IV.9): 36, 1900; Martelli *in* Webbia, 3: 312, 1910; Merr. & Perry *in* J. Arn. Arb. 20: 154, 1939.

Type locality: Fauro Island (*Guppy* 324).

Reported from San Cristoval Island (*Brass* 2932) and Ysabel Island (*Brass* 3230) by Merrill and Perry.

Ysabel Island: Southwestern end, in forest just back of Sesedo village, near sea-level, a vine climbing on *Pandanus nemoralis*, local name "sokite," 15 October 1957, *Stone* 2485 (BISH).

7. *Freycinetia membranacea* Merr. & Perry *in* J. Arn. Arb. 20: 156, pl. 1, f. 5, 1939. (Fig. 3).

Type locality: Bougainville Island, Siwai (*Waterhouse* 168).

Ysabel Island: Southwestern end, in swamp-forest near Nagolau village, a vine climbing in mangrove trees, leaves 60 cm long and 1.1 cm broad, syncarps 3, terminal, oblong; 12 October 1957, *Stone* 2475 (BISH). Seeds c. 1.6 mm long, with a broad white raphe; strophiole lacking.

8. *Freycinetia nesiotica* Merr. & Perry *in* J. Arn. Arb. 20: 156, pl. 1, f. 6, 1939.

Type locality: San Cristoval Island, Hinuahaoro, 900 m alt. (*Brass* 2929).

9. *Freycinetia oligodonta* Merr. & Perry *in* J. Arn. Arb. 20: 155, 1939.

Type locality: San Cristoval Island, Hinuahaoro, 900 m alt. (*Brass* 2930).

10. *Freycinetia pectinata* Merr. & Perry *in* J. Arn. Arb., 20: 153, 1939.

Type locality: Ysabel Island, Kakatio, 900 m alt. (*Brass* 3247).

11. *Freycinetia petiolacea* Merr. & Perry *in* J. Arn. Arb. 20: 157, 1939.

Type locality: Ysabel Island, Kakatio, 900 m alt. (*Brass* 3256). This species was also collected on San Cristoval Island (at Hinuahaoro: *Brass* 2931) and on Bougainville Island (at Koniguru, Buin: *Kajewski* 2147).

The leaves, which are narrowed toward the base and appear almost as if petiolate, are unlike those of any other species that I have seen except *Freycinetia caudata* Hemsl. of Fiji.

12. **Freycinetia bicolor** B. C. Stone, sp. nov. (Fig. 1).

Scandens; caulis robustis; folia lineari-ensiformia, conferta, erecto-patentia, apice anguste sensim acutata, ca. 70 cm longa et 1.6–1.9 cm lata, basi compressi-amplectentia, margine ad basim apiecemque serrato-dentata, cetera laevia, costa media dorsaliter in parte superiore serrato-dentata, auriculis conspicuis, deciduis, ad 7 cm longis et 5 mm latis, scarioso-membranaceis, fragilibus; inflorescentia terminalis, pedunculata, syncarpiis 3 oblongo-cylindraceis, ca. 9.5–10.5 cm longis et 3–4 cm diametro, pedicellis laevibus ca. 4.5 cm longis et 0.4 cm crassis subteretibus, spathis caducis; baccae supra coriaceae infra (⅔) carnosae, ca. 13 mm longae et 3–4.5 mm crassae, apice aurantiacae, acuminatae, angulatae, truncatae, parte inferiore seminiferis rubrae, areola stigmatica truncato annulo nitente cincta, stigmatibus 5–10, vulgo 6–8, seminibus ellipsoideis ca. 0.9 mm longis, raphe et strophiolo conspicuis, cellulis raphidophoris in raphem nitentibus, strophiolo usque ad 0.1 mm lato.

Type: In the herbarium of the B. P. Bishop Museum (Honolulu), collected in a mangrove swamp near Sesedo village on the southwestern coast of Santa Ysabel Island, British Solomon Islands, near sea-level, 15 October 1957, by Benjamin C. Stone (No. 2484).

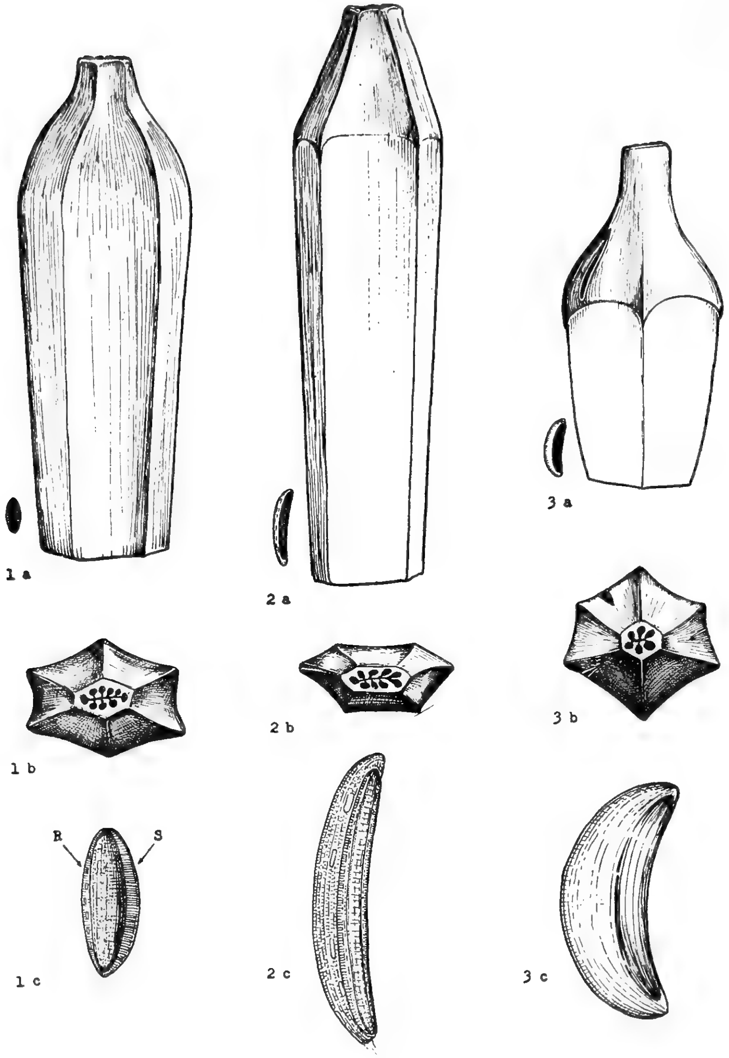
This species is close taxonomically to the following (*F. solomonensis*) and occurs in the same locality. It is also similar to *Freycinetia percostata* Merr. & Perry of New Guinea, but differs from that species in being generally smaller (even in the seeds, which are about 1.3 mm long in *F. percostata*). From *Freycinetia solomonensis* the present species differs chiefly in the smooth pedicels, the slightly shorter and broader berries, and most conspicuously in the very different ellipsoidal strophiolate seeds.

The name indicates the color of the ripe berries, which are reddish-orange in the rigid apical portion and dark red in the lower fleshy seed-bearing two-thirds.

13. **Freycinetia solomonensis** B. C. Stone, sp. nov. (Fig. 2).

Liana scandens, subrobusta, caulibus ad 12 mm diametro, folia erecto-patentia, conferta, basi amplectentia, 70–85 cm longa, 17–22 mm lata, anguste ensiformi-linearia, apice anguste sensim acutata subflagellata, basi ad 3.5–4 cm lata caulem amplectente, margine apicem versus minute serrato-denticulata, basin versus (ca. 5–10 cm) serrato-dentata, costa media dorsaliter apicem versus serrato-denticulata, ceterum laevia, auriculis ad 7 cm longis et 5 mm (vel ultra?) latis, deciduis, margine integris (?); inflorescentia terminalis, pedunculata, syncarpiis 3 cylindraceis, 6.5–11 cm longis et 3–4 cm diametro (vel usque 15 cm longis?), pedicellis 4–5 cm longis et 4–7 mm crassis, perminute scabridulis, in angulis scabridis, dentibus scabridis erecto-antrorsis ca. 0.2–0.3 mm longis; baccae 15–17 mm longae et 3–4 mm crassae, apice coriaceae, pileo ca. 4–5 mm longo, anguloso, anguste pyramidato, apice truncato, areola stigmatica annulum pallidum perangustum cincta, stigmatibus 5–11, vulgo 6–8, seminibus sublunulatis, angustis, ca. 2 mm longis, rubro-miniatis (vel violaceis?), raphe alba ca. 0.15 mm lata, cellulis paucis argenteis raphidophoris linearibus nitentibus, strophiolo nullo.

Type: In the herbarium of the B. P. Bishop Museum (Honolulu), col-



FIGS. 1–3. Berries and seeds of *Freycinetia*. 1, *F. bicolor*, sp. nov., 2, *F. solomonensis*, sp. nov., 3, *F. membranacea* Merr. & Perry. In all cases, a—berry in profile, × 5; b—berry in top view, × 5; c—seed, × 20. 1 and 2 from type specimens; 3 from *Stone* 2475. R = raphe; S = strophiole.

lected in lowland forest just back of Sesedo village, on the southwestern coast of Santa Ysabel Island, British Solomon Islands, near sea-level, 15 October 1957, by Benjamin C. Stone (No. 2484-a).

Additional specimen examined: Bougainville Island: Kugumaru, Buin, alt. 150 m (climbing up tree; syncarps ca. 6.5 × 3.5 cm), 6 July 1930, *Kajewski* 1830 (BISH).

Very close to *Freycinetia percostata* Merr. & Perry, described from New Guinea; but with somewhat fewer stigmas per berry, and greatly different seeds, which lack a strophiole. In habit, syncarp-shape, and berry-shape, there is little difference between these species, although the leaves are here narrower (1.7–2.2 cm rather than 2.5–3 cm broad), and the middle region of the leaf is unarmed; the berries are also slightly shorter, and not so uniformly laterally compressed.

Sect. *Oligostigma* Warburg

14. ***Freycinetia tessellata*** Merr. & Perry *in* J. Arn. Arb. 20: 149, 1939.

Type locality: Ysabel Island, Maruto, 300 m alt. (*Brass* 3384). Also reported from Meringe, Ysabel Island (*Brass* 3176), and from San Cristoval Island (Star Harbor: *Brass* 3122).

Additional specimen examined: Santa Ysabel Island: southwestern end, just inland of Sesedo village, in lowland forest (a woody broad-leaved liana in forest; syncarps 3–4, cylindric, bright red, with very numerous filiform berries with generally 2–4 black stigmas each), 14 October 1957, *Stone* 2481 (A, BISH, US).

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PROCEEDINGS
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MISCELLANEA MEGADRILOGICA
VII. Greenhouse Earthworms

By G. E. Gates
University of Maine, Orono

Records of earthworms from artificial environments of North America are few and widely scattered through taxonomic publications of the last seventy years. The present note brings together the more interesting of previously published greenhouse records and such new ones as have accumulated during recent years. Collecting in central Maine for exercise and recreation during tenure of a John Simon Guggenheim Fellowship was continued for the same reasons while the author was engaged in research financed by the Rockefeller Foundation and by the National Science Foundation.

In the listings beyond, the convention of three figures following the date of collection refers to the numbers of juvenile, aclitellate, and clitellate specimens, respectively.

LUMBRICIDAE

Fifteen species of this family now are known (*cf.* Gates, 1961) from central Maine. One was secured, during a period of more than a dozen years, only in greenhouses. Eleven were found indoors as well as outside and one of them is of sufficient interest in the present connection to warrant inclusion of all outdoor records for central Maine.

Allolobophora Eisen, 1874
Allolobophora chlorotica (Savigny, 1826)
Bangor, Maine

Sunnyside Greenhouses, in hard packed soil above stiff clay floor under plant benches, 5 November, 1–6–6, 28 February, 3–3–4. In outside plant beds, 5 November, 0–2–1, 18–20 April, 2–1–16, 9 May, 3–0–6. Bare area probably covered during previous fall and winter with a pile of leaves, 13 May, 10–6–24. (Several years' samplings.)

Lougee-Frederick Greenhouses, in soil under plant benches, 25 November, 0–0–1.

Seavey Greenhouses, in soil under plant benches, 13 December, 0–1–0.

City dump, among matted leaves, 28 October, 1–1–2.

Roadside ditch, among leaves of previous year, 19 October, 2–0–0. Gerald Kinney.

Ellsworth, Maine

Clark Greenhouses, in soil under plant benches, 24 March, 4–0–14.

Corinna, Maine

Garden, soil with stiff clay and ashes, 27 November, 0–4–1. Gerald Kinney.

Newport, Maine

Maple leaves, 7 May, 1–0–3. C. L. Kinney.

Marblehead, Massachusetts

Brown's Greenhouses, in undisturbed soil under plant benches, 27 February, 24–7–13. G. W. McKey.

Ardsley, New York

Wilson Greenhouses, in earth under plant benches, 7 August, 0–0–5.

The original home of the species is unknown but probably is somewhere in Europe below the southern limit of Pleistocene glaciation.

After more than 12 years of collecting in central Maine the writer suspects that *A. chlorotica* goes out of the greenhouses more often than it comes inside.

Eisenia Malm, 1877

Eisenia hortensis (Michaelsen, 1890)

Bangor, Maine

Bangor Floral Company, in soil under plant benches of greenhouses, 7 March, 0–0–9.

Bar Harbor, Maine

Conservatory of Reef Point Gardens, in undisturbed soil beneath a pot under a plant bench, 24 July, 0–0–1.

Ardsley, New York

In compost of hot bed with temperature of 80–85°F, October, 0–4–5. Carl Deuber per Libbie Hyman. April, 0–0–3. Carl Deuber.

Eisenia hortensis was previously recorded from natural habitats in Urbana (Illinois), San Francisco (California), and McMinnville (Oregon). The single record for Ohio is of a clitellate specimen found in a Cleveland toilet bowl! The original home of the species is believed to be in some portion of Eurasia that was not covered by the Pleistocene glaciers.

ACANTHODRILIDAE

Microscolex Rosa, 1887

Excepting two widely distributed peregrine forms little is known about this unrevised classical genus.

Microscolex phosphoreus (Duges, 1837)

Bangor, Maine

Sunnyside Greenhouses, in soil under plant benches, 28 February, 0–0–2.

Bangor Floral Company, in soil under plant benches in greenhouses, 7 March, 0–0–1.

Devil's Lake, North Dakota

From greenhouse soil, 2–0–3. W. J. Colberg per P. W. Oman.

M. phosphoreus was erected in 1837 on specimens from a greenhouse of the Jardin des Plantes at Montpellier, France, and has been reported from greenhouses in Germany (Berlin and Hamburg) as well as from soil of a plant plot in a private apartment at Poznan, Poland, and of a pot brought prior to 1900 from Honolulu to San Francisco. Outdoors in North America the species has been recorded from Washington, D. C., North Carolina, Florida, Louisiana and California.

M. phosphoreus long was believed to be native to southern France but later on was thought to have come originally from Australia, New Zealand or southern South America.

The only previous record of an oligochaete from the state of North Dakota was of the exotic *Eisenia foetida* (Savigny, 1826) and the site from which the specimens were obtained also was artificial.

OCTOCHAETIDAE

Dichogaster Beddard, 1888

Dichogaster bolaui (Michaelsen, 1891)

Belle Glade, Florida

Under ten-gallon jars on concrete floor (presumably in a greenhouse), 15 May 1956, 1–0–10. D. S. Questel per U. S. Dept. Agriculture.

D. bolaui was erected on specimens from warm, fermenting bark at a tannery in Bergedorf, Germany, and in 1895 was found in the orchid house of Golden Gate Park, San Francisco. Though not uncommon in Mexico, Panama, Haiti, Jamaica, Dominica, St. Vincent, and Trinidad, the species has not been found outdoors on the mainland north of the Mexican border. The original home of *D. bolaui* has been thought to be in equatorial Africa.

MEGASCOLECIDAE

Pheretima Kinberg, 1867

The area of endemicity is from eastern Burma and the Andaman Islands through Japan, from Korea and China through Sumatra, Java, New Guinea. Nine of the 17 species (for key *cf.* Gates, 1958) recorded from the western hemisphere have been found in artificial environments.

Pheretima agrestis (Goto & Hatai, 1899)

P. agrestis has been reported from culture beds in the aquarium building at the Bronx Zoo, New York City, from a florist's nursery in Albany

(New York) and from natural environments at Boston (Massachusetts), Greenwich (Connecticut), Rye and Schenectady (New York), and Shreveport (Louisiana). At Boston the species was found in an arboretum. The original home of *agrestis* is in Japan.

Pheretima bicincta (Perrier, 1875)

Bangor, Maine

Bangor Floral Company, in soil under plant benches of greenhouses, 22 December, 11–2–12, 7 January, 8–2–8, 7 March, 0–2–3.

Bar Harbor, Maine

Browning Greenhouses, in soil under plant benches, 25 May, 1–1–1.

P. bicincta had not previously been reported from mainlands of American continents, but has been recorded from Trinidad, Grenada, St. Thomas, India, Burma (only from earth with potted plants), Penang, Taiwan, Java, Philippine Republic, and the Caroline Islands. The original home of the species is unknown but presumably is to be sought in the region from Java to the Philippines.

Pheretima californica Kinberg, 1867

This species, erected on specimens from San Francisco, has been recorded from a Vassar College greenhouse at Poughkeepsie (New York) and from natural North American habitats in Louisiana, Arkansas, and California. The original home of *californica* may be in China.

Pheretima diffringens (Baird, 1869)

Bangor, Maine

Bangor Floral Company, from earth of plant benches in greenhouses, 14 October, 0–0–3. In soil under plant benches, 7 January, 5–1–5, 7 March, 0–2–1.

Bangor Nursery, from earth of plant benches, 20 October, 0–0–2.

Lougee-Frederick Greenhouses, in soil under plant benches, 25–26 November, 0–0–2.

Ellsworth, Maine

Clark Greenhouses, in soil under plant benches, 24 March, (10?)–10–5.

Bar Harbor, Maine

Dorrance Greenhouses, in soil under plant benches, 25 May, 0–3–2.

Malvern Flower Shop, in soil under plant benches of greenhouses, 25 May, 0–1–1.

West Brooksville, Maine

David's Folly Earthworm Farm, from culture bed in cellar of residence, 21 July 1956, 0–0–1. Gerald Kinney.

P. diffringens was erected in 1869 on specimens from an orchid bed in a "plant stove" at Plas Machynlleth, North Wales, but had been present in a hot house at Bury St. Edmunds (Suffolk, England) at least since 1849.

The species was recorded subsequently from greenhouses in Scotland, Denmark, Germany, Poland, Russia, France, Italy, Urbana and Chicago (Illinois), Dayton (Oregon), and was first reported from Australia in earth of pots with plants distributed by a Sydney nursery to which the worms were thought to have been brought from Mauritius. Outdoors in North America and Europe the species has been recorded from Connecticut, New York, Virginia, North Carolina, Georgia, Alabama, Florida, Mississippi, Louisiana, Texas, Arkansas, Nebraska (from soil in vicinity of greenhouses at Lincoln), California, Mexico, Costa Rica, Guatemala, and from gardens around greenhouses in France, Italy and Portugal. Although escapes and evictions from British greenhouses must have been numerous during a period of more than a hundred years, domicile apparently has never been acquired. Introduction to California was prior to 1852 and to Florida and Georgia before 1894. The original home of the species probably is in China.

In Scotland, *diffringens* was found only in greenhouses kept at a temperature of 60° or more.

The superstructure of a Maine greenhouse in which *diffringens* lives was destroyed by fire in 1947. Subsequent introduction of the species from outside the town, according to the gardener in charge, was impossible.

Pheretima hawayana (Rosa, 1891)

Bangor, Maine

Bangor Floral Company, in soil under plant benches in greenhouses, 7 January, 0–1–0, 7 March, 0–0–5.

Ellsworth, Maine

Clark Greenhouses, in soil under plant benches, 24 March, 1–0–0.

Chatham, New Jersey

Greenhouses, August 1954, 0–4–9. Harold Davies.

P. hawayana, erected on specimens from Hawaii, was reported previously from greenhouses in St. Petersburg (Russia), Poznan (Poland), France, England, Uruguay, Chicago, Evanston, Pana and Urbana (Illinois), Nashville (Tennessee), Hadley (Massachusetts) and Dayton (Oregon). Outdoors in North America (no records for Europe) the species has been recorded from Alabama, Florida, Louisiana and California. The original home of *hawayana* may be in China.

Pheretima hupeiensis (Michaelsen, 1892)

Orono, Maine

University of Maine, in earth with rocks under plant benches of greenhouses, 25 October, 5–2–2–1, 18 June, 1–3–2.

Greenwich, Connecticut

Saxon-Krueger Greenhouses, in soil under plant benches, 26 August 1957, 0–4–0.

Ithaca, New York

Old soil dumped outside a greenhouse, 28 October 1960, 0–2–3. David Pimentel.

P. hupeiensis was recorded previously from a greenhouse in Beltsville (Maryland), from golf courses at Stamford (Connecticut), Rye and Pelham (New York), Catonsville (Maryland), and from other outdoor habitats in New York City, Philadelphia (Pennsylvania), Washington (D. C.), New Orleans and other but unspecified localities in Louisiana. Louisville (Kentucky) and Chattanooga (Tennessee) now can be added to the list. There are no records for rural sites.

Although already common at Washington in 1910, the species for some time seemingly attracted little attention to itself. Its casting habits by 1948 had become so mush of a nuisance in enough places to stimulate golfers to finance the research that revealed methods of exterminating earthworms in the greens. Memoranda, privately circulated as the funds were being raised, indicated that the "Oriental earthworm" was distributed along the Atlantic seaboard "to a depth" from western Connecticut into Florida. Confirmation of the supposed "massive infestation of scores of country clubs" has not yet been obtained.

The original home of the species probably is in China but *hupeiensis* has been recorded from Japan and specimens from southern South America may have been mistakenly referred to another but quite different species.

Pheretima levis (Goto & Hatai, 1899)

P. levis was previously recorded from culture beds in the aquarium building of the Bronx Zoo at New York City, and from a presumably natural habitat at Schenectady (New York). The species is known elsewhere only from Japan which is its original home.

Pheretima morrisi (Beddard, 1892)

Bangor, Maine

Seavey Greenhouses, in soil under plant benches, 13 December, 5–5–4–1.

P. morrisi was previously recorded from greenhouses in England, Poughkeepsie (New York) and from natural habitats of the continental United States, in Florida, Louisiana and Texas. The original home of the species may be in China.

Pheretima rodericensis (Grube, 1879)

Orono, Maine

University of Maine, in earth with rocks under plant benches of greenhouses, 25 October, 1–2–6, 18 June, (9?)–3–3.

Bar Harbor, Maine

Browning Greenhouses, in soil under plant benches, 25 May, 1–0–3.

P. rodericensis was reported previously from greenhouses in Russia, Germany, Poland, Czechoslovakia, Switzerland, France, England, and from natural American habitats in Florida. Elsewhere, the species has been found in Puerto Rico, Bermuda, Grenada, Martinique, Dominica, Trinidad, British, French and Dutch Guiana, South Africa, Comores, Rodriguez, Mauritius, Madagascar, Nossi Be, Christmas Island, and New Caledonia. The latter island may be near the unknown original home of *rodericensis.*

Pheretima sp.

Bangor, Maine

Bangor Floral Company, in soil under plant benches of greenhouses, 7 March, 8–0–0 and two posterior fragments of larger specimens.

GLOSSOSCOLECIDAE

The area of endemicity, as the family now is defined (*cf.* Gates, 1959, p. 255), comprises tropical South America, Central America, and the West Indies.

Pontoscolex Schmarda, 1861

The area of endemicity seemingly includes Central America, perhaps along with a small northern portion of South America, but very little is known about the genus.

Pontoscolex corethrurus (Müller, 1857)

P. corethrurus was reported previously from greenhouses at Pana (Illinois), Chatham (New Jersey), and Berlin (Germany). At Chatham the worms were brought inside from a bank of soil (behind the greenhouses) where they had been living at least from 1937 to 1947. Several attempts to get more recent information about the outdoor colony were unsuccessful.

Presence of the species in a golf green of a New Jersey Country Club was indicated by information available to B. T. Thompson, technical director of an insecticide company, who supplied data regarding activities at the Chatham site.

EUDRILIDAE

Eudrilus Perrier, 1871

Eudrilus eugeniae (Kinberg, 1867)

This species, originally from equatorial Africa but now with a pantropical distribution, has not been reported from greenhouses. In equally artificial environments, culture beds of earthworm farms (often indoors), *E. eugeniae* has been raised for sale in various northern states and even in Canada. Mr. Baker, who initiated commercial culture of the species, says (*in lit.*) that he has shipped it to every state including Hawaii (where it was fed to a platypus). In spite of a continuous and wide distribution for 15 years, *eugeniae* has not yet been recorded from a natural habitat on the American mainland north of Panama. That statement is, however, of little significance because of the gaps in our knowledge of the earthworm faunas of the continent.

DISCUSSION AND SUMMARY

Earthworms from 12 sets of greenhouses and from one conservatory in central Maine belonged to 19 species, eight of which were not found outside. Indoor species, one to five of them in a single set of greenhouses, were represented by 194 of 900+ specimens. Five individuals of *P. diffringens* were found in the earth of plant benches, the other 189 specimens of indoor species in undisturbed soil, mainly under the plant benches. Most worms of other species were secured from earth in plant benches. Digging in the benches often was restricted or inadvisable. Hence, indoor species may have been above the ground level more often than the records show.

The fauna of no Maine greenhouse was restricted to indoor species. Eight of the 12 lumbricid species inhabiting Maine greenhouses probably are often brought inside, in cocoons or after hatching, with soil, manure, or compost. Direction of movement, for three lumbricid species, now seems likely to be more often in the reverse direction, from the greenhouses to the outside world. One lumbricid and the seven species of other families must have been introduced, at least originally, in earth with potted plants from outside the state of Maine. One of the pheretimas probably had been in its greenhouse for more than 12 years. Earth from the plant benches often is discarded at more or less regular intervals. Presumably, then, individuals of indoor species were evicted on many occasions during the last 50 or more years from their sheltered environment. The colonies of *P. corethrurus* and *P. hupeiensis* outside New Jersey and New York greenhouses probably were initiated in just that way. Nevertheless, none of the inside species has been able to establish itself in natural Maine environments. Presumably, then, the Maine climate, like that of Denmark, Germany, Poland and Russia, is unfavorable. One factor that may be of considerable importance is temperature. Supporting evidence is provided by the out-of-doors colonizations of pheretimas in states with milder climates. However, the climate of England would seem, at least to the layman, to be milder than that of central Maine. Yet domicile for more than a century in British greenhouses has resulted, so far as can be determined from the literature, in no outside colonizations such as are recorded for France, Italy and Portugal.

Greenhouses, in certain parts of the world, have provided centers for introduction and local distribution of exotic earthworms from China, Japan, the southern hemisphere and the tropics. As yet, only the more obvious instances have been recognized. Much remains to be learned about the role of man in modifying local earthworm faunas throughout the world.

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PROCEEDINGS
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NEW LAND SNAILS FROM EL SALVADOR

By Fred G. Thompson
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Drs. Andrew Starrett, Priscilla H. Starrett, and Thomas M. Uzzell, Jr., assembled a moderate collection of land snails while collecting reptiles and amphibians in various Central American countries during June through August 1957. Their work was well rewarded with many new species, four of which are herein described. The collection is particularly valuable because many of the species are represented by animals preserved in alcohol.

Only a few localities in El Salvador were visited. Of particular interest was Hacienda Monte Cristo, Cerro de Monte Cristo, Metapán, Santa Ana. Collections were made at an elevation of about 2,200 meters on this mountain, which lies on the borders of El Salvador, Guatemala, and Honduras. At this elevation the mountain is covered with cloud forest, and is one of the few undisturbed natural areas in El Salvador. Collections were made from bromeliads and forest floor debris. Additional material was purchased from a native collector.

The success of the collectors' work in El Salvador was due to a large extent to Dr. Aristides Palacios, Director General of the Instituto Tropical de Investigaciones Científicas, at San Salvador, and to the staff of the institution. Dr. Palacios generously provided the collectors with quarters and transportation during their short stay in El Salvador.

I am grateful to Dr. Henry van der Schalie of the University of Michigan Museum of Zoology (UMMZ), Ann Arbor, Michigan, for providing me with the facilities of his division. I also wish to express my gratitude to Dr. Adolf Zilch of the Senchenbergische Naturforschende Gesellschaft (SMF), Frankfurt, a. M., Germany. Dr. Zilch has offered critical comments concerning this paper, and has allowed me to include material from his extensive collection from El Salvador.

TABLE 1.—Measurements of ten paratypes of *Amphicyclotus parvus*

HEIGHT	WIDTH	H/W RATIO	UMBILICUS	APERTURE	WHORLS
14.5	20.7	0.70	4.9	9.9	4⁶⁄₈
13.0	18.7	0.69	4.0	8.7	4⁴⁄₈
13.1	17.8	0.74	3.8	7.7	4⅝
12.0	17.0	0.70	3.6	7.5	4⅜
11.2	16.7	0.67	3.8	8.0	4⅜
11.7	16.5	0.71	3.6	7.7	4⁴⁄₈
11.6	16.5	0.70	3.4	7.5	4⁴⁄₈
11.0	16.5	0.67	3.5	7.8	4⁴⁄₈
12.1	16.4	0.74	3.0	7.8	4⁴⁄₈
11.0	16.2	0.68	3.3	7.2	4²⁄₈

The color nomenclature is taken from Ridgway (1912). Measurements of all specimens are in millimeters.

Amphicyclotus parvus, new species
(Plate II, figs. 4–7)

Shell helicoid, thin, covered with a sulphine yellow periostracum; spire low, conical; umbilicus large, open; 4⅝–4¾ whorls; 1¼ embryonic whorls, smooth (corroded in adults); following whorls crossed by fine axial ribs, which progressively grow stronger and more irregular, until on the last whorl they become vermiculated; vermiculations extending from suture into umbilicus and usually most distinct on dorsal and peripheral sides of last whorl; vermiculations lost near umbilicus and lip in larger specimens; vermiculated ribs in turn crossed by numerous fine, incised spiral lines which are broken into short segments on each rib, discernible only on last whorl; suture deeply impressed, descending slightly to the aperture; lip simple, sharp; aperture ovate, slightly or not at all indented by last whorl; peristome thin, slightly convex; inside of aperture bluish white.

Operculum corneous, circular, and consisting of about six whorls; suture on outside distinct and coarse; nucleus sunken, surface of attachment smooth and glossy; area directly behind nucleus elevated into a low circular plate with its center raised into a small conical point.

Measurements of type: Height, 12.2; width, 19.3; height of aperture, 8.7; width of aperture, 8.8; width of umbilicus, 4.5; 4⅝ whorls.

Type: UMMZ 195882; Hacienda Monte Cristo, Metapán, Santa Ana, El Salvador, 2,200 meters altitude; collected 6 July 1957, by Andrew Starrett, Priscilla H. Starrett, and Thomas M. Uzzell, Jr.

Paratypes: UMMZ 195881 (35), SMF 101151–6 (120); same locality as the type.

A. parvus is similar in shell characters to *A. texturatus* (Sowerby), *A. t. goldfusi* (Boettger) and *A. boucardi* (Pfeiffer). It differs from these

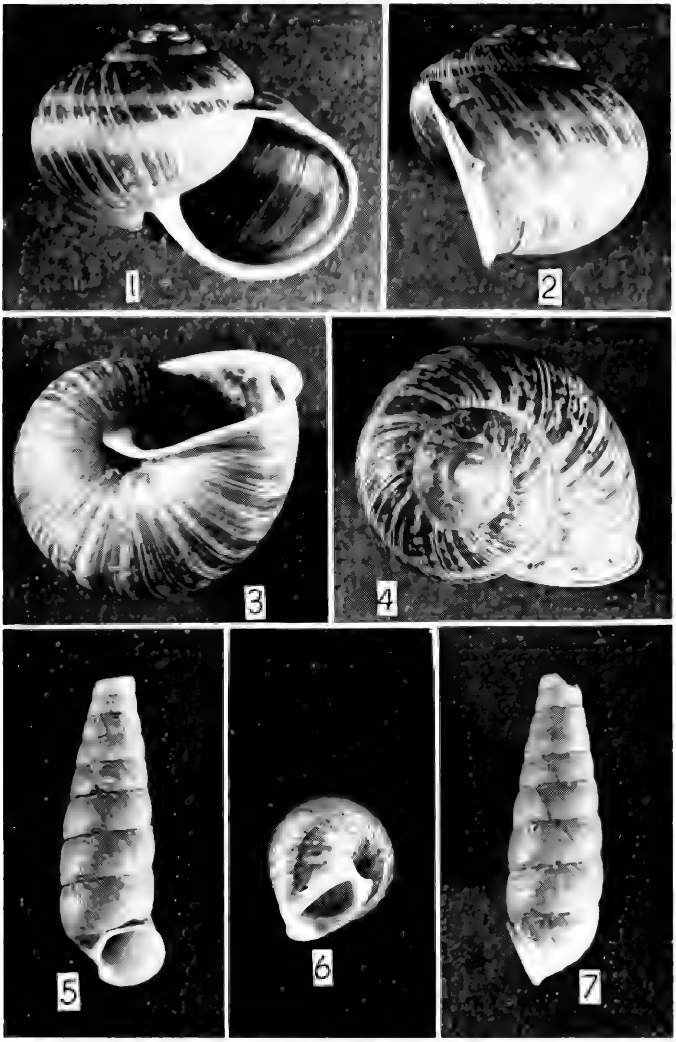

PLATE I

Figs. 1–4. Type of *Lysinoe starretti*, new species, UMMZ 195327; Figs. 5–7, paratype of *Eucalodium australis*, new species, UMMZ 195762.

species by its much smaller size. It is also distinguished from *A. texturatus* and A. *t. goldfusi* by its more elevated spire and its sculpture. The vermiculated ribs of *A. parvus* are much finer, and are reduced in texture or absent on the underside of the last whorl and near the lip. In *A. texturatus* and *A. t. goldfusi* the vermiculations are much more distinct over the whole shell, and are continuous into the umbilicus and to the edge of the lip.

Besides its small size, *A. parvus* is distinguished from *A. boucardi* as follows. In *A. parvus* the size of the whorls increases more rapidly, and the umbilicus is proportionately smaller. The spiral sculpture of *A. boucardi* is heavier and more deeply incised, and the vermiculations are continuous over the surface of the shell.

A. parvus is so named because of its small size.

Streptostyla propinqua, new species

(Plate II, figs. 1–3)

Shell cylindric-oblong, solid, subpellucid, amber yellow, glossy, with weak growth lines; spire elevated, conoidal, moderately long, obtuse at the apex; whorls 5½, slightly convex, nearly flattened, margined at the suture; the first whorl slightly wider at its termination then the second whorl at the point directly below it; remaining whorls regularly increasing in size to the last whorl, which, in its last ¾ turn, descends more rapidly; last whorl cylindric; suture slightly impressed; aperture narrowly auriform, dilated at the base; outer lip slightly impressed in the center, strongly arched forward in the middle, retracted below and above; lip slightly recurved at suture; columella moderately twisted, calloused, narrow in front view and only a little wider as seen in profile; parietal callus thin, white.

Measurements of type: Height, 14.9; width, 6.9; height of aperture, 8.4.

Measurements of two paratypes (SMF): Height, 14.8, 17.4; width, 6.5, 7.2; height of aperture, 8.9, 9.4.

Type: UMMZ 195760; Hacienda Monte Cristo, Metapán, Santa Ana, El Salvador, 2,200 meters altitude; collected 6 July 1957, by Andrew Starrett, Priscilla H. Starrett, and Thomas M. Uzzell, Jr.

Paratypes: UMMZ 195761 (1), SMF 101157 (2); same locality as the type.

S. propinqua is most similar to *S. sololensis* Crosse and Fischer. It differs from that species in five ways: (1) it is more obese, (2) the auriform aperture is wider, (3) the lip is not as strongly impressed, (4) the anteriorly arched portion of the lip is wider, and (5) the columella is weaker and less strongly twisted. *S. propinqua* also resembles *S. meridana* (Morelet) and *S. yucatanensis* Pilsbry. It can readily be separated from these species by its larger size, and its more rapidly descending last whorl.

The name *propinqua* alludes to the similarity of this species to *S. sololensis.*

Eucalodium australis, new species

(Fig. 2, A–E; Plate I, figs. 5–7)

Shell cylindric-tapering, arcuate-rimate, imperforate, solid, moderately thick, decollate, 6¼–8⅛ whorls remaining; whorls slightly convex and regularly increasing in size; internal pillar slender and slightly sigmoid; no internal lamella present; last whorl with or without a fine, sharp angle which lies below periphery and continuous with suture; aperture extending

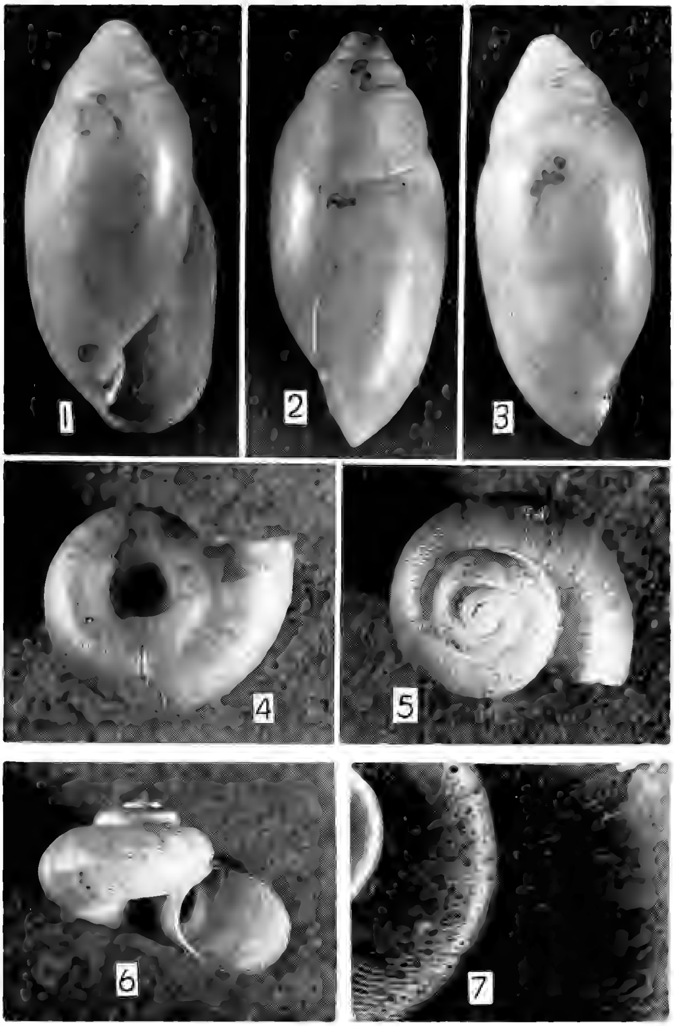

PLATE II

FIGS. 1–3. Type of *Streptostyla propinqua,* new species, UMMZ 195760; Figs. 4–7, type of *Amphicyclotus parvus,* new species, UMMZ 195882.

only slightly or not at all beyond margin of previous whorl; lip thick, rounded, reflected; surface of whorls somewhat glossy, with numerous close, distinct, slightly arched riblets; last whorl with 146 riblets; riblets on earlier whorls very distinct, heavy and continuous across whorls; riblets on later whorls lower in center of whorl than at margins, and on last whorl they occasionally become indistinct in center of whorl; intervals between riblets wider than individual riblets, and without sculpture paralleling riblets; in addition to riblets, the whorls bear several irregularly spaced spiral threads; threads generally higher than riblets, though not as broad; threads on early whorls vaguely discernible, becoming more distinct on later whorls.

Ground color snuff brown; interspaces between riblets slightly lighter than riblets; several fine, light colored spiral lines accompany the spiral threads; inside of aperture and columella livid white.

Measurements of type: Height, 33.1; width, 11.3; height of aperture, 7.9; width of aperture, 7.9, 7 whorls remaining.

Type: SMF 161266; Hacienda Monte Cristo, Metapán, Santa Ana, El Salvador, 2,350 meters altitude, collected by Adolf Zilch, 27 August 1951.

Paratypes: SMF 101158–60 (31); UMMZ 195762–3 (6); same locality as the type.

Radula: See Fig. 2, D. Radular formula $(C\,\frac{1}{1}\,L\,\frac{1\;3}{2}\,M\,\frac{1\;4}{1-3})$ 116; central tooth relatively long and slender with a large, slender mesocone, which is flanked on both sides by a buttress; lateral teeth with a short, broad entocone, and a much larger mesocone, which increases in size toward the marginals; first two marginal teeth both with two small entocones as well as an enlarged mesocone; remaining marginals very irregular in size, shape and structure, their cusps too irregular to be determined.

Reproductive system: See Fig. 2, B–C. Genital atrium slender, about 3.0 mm long; penis short and stout, about twice as long as wide, its upper limits marked by a slight constriction; a small, simple bulbous verge extends into penial cavity; wall of penis with four large, fleshy pilasters, which continue through the penis; epiphallus rapidly expanding, and then slowly tapering to width of vas deferens; lumen of epiphallus with seven nearly equal longitudinal folds, length of epiphallus about 3.0 mm; penial retractor muscle long and slender, attaching to inner wall of lung, 8 mm long; vas deferens very long and slender, extending considerably beyond epiphallus and doubling back to atrium where it attaches to vagina with fine bands of muscle, and continues to prostate; length of vas deferens, about 40 mm; vagina about 9 mm long, bulbous at first, becoming very slender above spermathecal duct; uterus and prostate tightly appressed throughout their length to albumen gland, which is a relatively small, finger-shaped structure; highly convoluted hermaphroditic duct leaving albumen gland near its middle; ovotestes tri-lobed; two lobes are small, round, and of nearly equal size; remaining lobe much larger and elongate; spermatheca small and sausage-shaped, with a long, stout duct; a long, narrow, tubular, convoluted appendix arises from spermathecal duct shortly above vagina, and lies connected to side of duct by a thin membrane; spermathecal duct, 24 mm long; spermatheca, 3 mm long; appendix, 13 mm long.

Retractor muscles: Free retractor muscles similar to those of *E. blandianum* as described by Strebel (1880: 66); columellar muscle has the usual

TABLE 2.—Measurements of twelve paratypes of *Eucalodium australis*

HEIGHT	WIDTH	APERTURE HEIGHT	APERTURE WIDTH	WHORLS
40.0	12.2	8.8	8.6	8⅖
38.6	12.2	8.2	8.1	7⅜
37.6	11.8	7.8	7.9	6⁴⁄₈
37.4	12.2	8.8	8.6	7²⁄₈
37.1	12.1	8.6	8.6	6⅜
37.1	11.1	8.4	8.1	8²⁄₈
36.5	12.2	8.2	8.3	7²⁄₈
35.4	11.1	8.0	7.5	6⅝
34.5	11.6	8.0	8.0	6⅞
33.9	11.0	7.8	7.4	7²⁄₈
33.6	11.3	7.8	7.7	6⁴⁄₈
33.4	11.6	7.9	7.8	6⁴⁄₈

distal insertion on posterior integument of mantle and gives off three bands in the following order: (1) pharyngeal retractor, (2) left pedal retractor, and (3) right pedal retractor; right and left ocular retractors attach to corresponding pedal retractors; ocular retractors each give off a branch which connect to form a muscular plate over pharynx.

Pallial organs: See Fig. 2, A. Lung long and slender, about 50 mm long and 6 mm wide; kidney long (46 mm), narrow and curved, about twice as wide at its base as at its distal end, sigmourethrous; primary ureter originates at distal end of kidney, and borders it at its base, tightly adhered to kidney; secondary ureter becoming much broader, narrowing again before reaching mantle collar, lying on and slightly below middle of rectum; rectum and ureter open between two folds of mantle collar; each inner surface of these two folds is impressed with three narrow winding grooves; pneumostome with two small lunar valves, forming two channels, one which passes between the two valves, and one which passes between the outer valve and the underside of the mantle folds; pericardium bordering inner margin of kidney, slightly more than half length of kidney (26 mm); auricle about one-half size of ventricle; a single long artery leads from heart to mantle collar, about half distance from collar becoming convoluted and loosely attached.

The anatomy of only two other species of *Eucalodium* has been described. Strebel (1880: 66) described the soft parts of *E. blandianum*, and Fischer and Crosse (1878: 355–360) described those of *E. ghiesbreghti*. Pilsbry (1903: 1–2) summarized these two accounts. The most characteristic anatomical feature of this genus is the union of the branches of the ocular retractor muscles to form a plate over the pharynx.

Essentially, the anatomy of *E. australis* is like that of the other two species, except that no investigator mentioned the presence of an appendix on the spermathecal duct, nor do their figures illustrate one. This structure

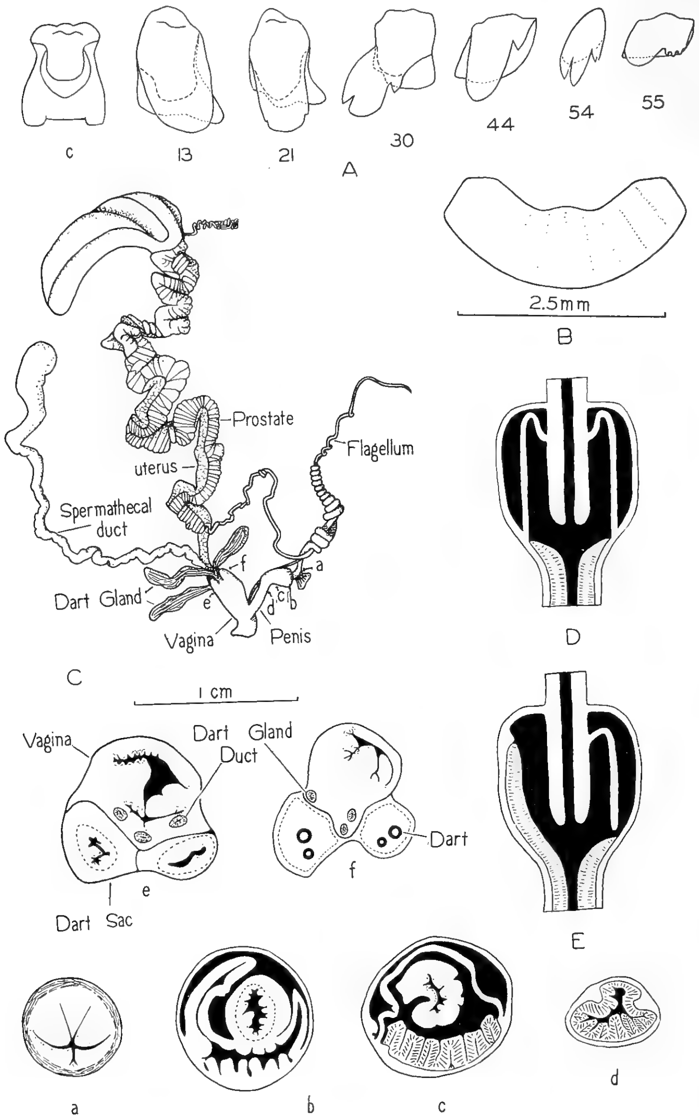

FIG. 1. Soft parts of *Lysinoe starretti,* new species. A, Radula (c, central tooth; 13, lateral tooth; 21, 30, 44, 54, 55, marginal teeth); B, jaw; C, reproductive system; D, E, diagrammatic reconstruction of penis; a, b, cross sections through penis; e, f, cross sections through vagina.

was found in *Holospira nelsoni* by Pilsbry (1903: 71), and I have found it in four species of *Bostrichocentrum* (in press).

E. australis is readily distinguished by its sculpture. Its relationships are obscure, although it apparently belongs to the *splendidum* group as defined by Pilsbry (1903: 8, 13–19). The shell does not suggest closer relationship to one species than to another. Martens (1897: 269) described two urocoptid snails from southwestern Guatemala as *Coelocentrum championi* and *C. clathratum*. Although both species apparently possess the hollow axis that characterizes *Coelocentrum*, other features of the shell more strongly resemble *Eucalodium*. The axis of *C. championi* as illustrated by Pilsbry (1903: pl. 9, fig. 14) is very similar in shape and structure to that of *E. australis*. Until the anatomy of *championi* and *clathratum* is examined, it seems best to provisionally retain them in the genus *Coelocentrum*.

The name *australis* is proposed for this species because it is the southernmost known member of the genus *Eucalodium*.

Lysinoe starretti, new species
(Fig. 1, A–E, a–f; Plate I, figs. 1–4)

Shell globose, relatively thin; spire raised, obtuse, forming an angle of about 120°; whorls 4¾, globular, shouldered, rapidly increasing in size, heavily, irregularly and closely wrinkled, wrinkles equal to or narrower than their intervals, posteriorly arched and continuous into umbilicus; wrinkles and interspaces with numerous small granules, which become elongate and indistinct on last half of last whorl; granules continuous into umbilicus where they become finer and sparser; embryonic whorls 2¼, moderately large, raised, crossed by fine, slightly incised lines which slant backward; suture moderately impressed, descending slightly to aperture, which is large and ovate, lying at an angle of about 30° to axis of shell, lip reflected and rounded, originating at lower edge of second color band of preceding whorl; directly behind lip there is a slightly impressed groove which continues into umbilicus; columellar margin reflected, half concealing umbilicus; parietal callus thin, finely granular.

Ground color mars yellow with four black bands; first band lies above periphery of whorl; second band very close to first (in mature specimens the zone that separates these two bands may become obscured so that first two bands may appear as a single dark zone); third band generally the narrowest, separated from second band by a light zone nearly twice as wide as that which separates preceding two bands; fourth band widest of all, separated from third band by a wide peripheral light zone; between fourth band and umbilicus is a wide dark zone, which in immature shells appears to be a very wide fifth band; ground color and banding obscured by color of growth wrinkles which are generally streaked with aniline yellow. This color also occurs in patches and flecks between the wrinkles; embryonic whorls cinnamon rufous; lip and interior of aperture livid brown; parietal callus tinted with same color, but is so thin that color pattern of preceding whorl shows through.

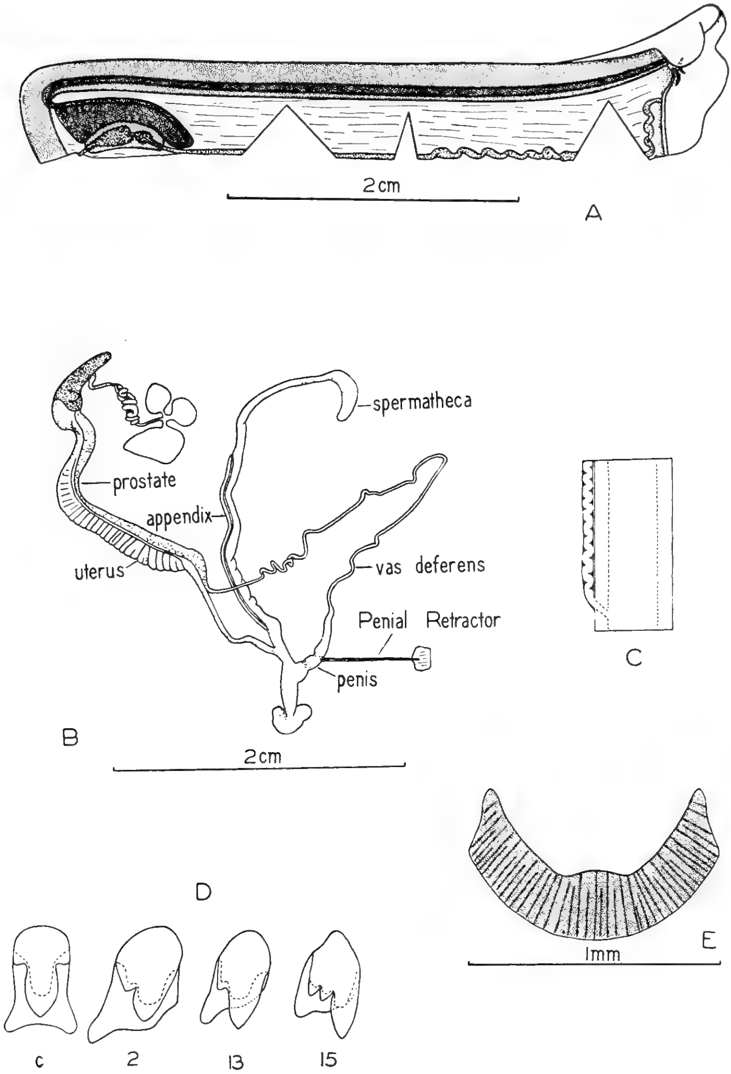

FIG. 2. Soft parts of *Eucalodium australis*, new species. A, Pallial organs; B, reproductive system; C, enlarged section of spermathecal duct and associated appendix, diagrammatical reconstruction; D, radula (c, central tooth; 2, 13, lateral teeth; 15, marginal tooth); E, jaw.

Measurements of type: Height, 31.7; width, 41.8; height of aperture, 25.0.

Measurements of two paratypes: Height, 31.8, 35.0; width, 38.9, 45.3; height of aperture, 23.5, 24.7.

Type: UMMZ 195327; Hacienda Monte Cristo, Metapán, Santa Ana, El Salvador, 2,200 meters altitude; collected 6 July 1957, by Andrew Starrett.

Paratypes: UMMZ 195326 (2), UMMZ 195328 (1), SMF 89593–4 (8); same locality as type.

Jaw: See Fig. 1, B. Large, solid, with five moderate grooves and several smaller grooves alternating with these; numerous fine striations crossing grooves and extending length of jaw. In cross section the face surface is straight, and the surface of attachment is moderately arched.

Radula: See Fig. 1, A. Radular formula $(C\frac{1}{1}\,L\frac{19}{1}\,M\frac{23}{3}+\frac{13}{2\text{-}4})$ 86; central higher than wide, with a single broad mescone; lateral teeth with a single broad mesocone; length of this cone successively increasing to 13th tooth; first marginal marked by appearance of an ectocone and an entocone; remaining marginals acquire and lose cusps quite freely, except for last marginal which appears to have no cusps.

Reproductive system: See Fig. 1, C–E, a–f. Penis and vagina unite near body wall, penis small and club-shaped about 12 mm long; internal structure complex, verge extending into lumen of penis; end of verge unipartite, impressed with two shallow winding grooves which begin at end of verge and continue for a third of its length; several smaller grooves present between these; a partition of muscular tissue extends from opposite sides of penis to top of verge, partition folded in a sigmoid curve one-fourth of distance down from top of penial chamber, and continues as a wall through penial chamber to end of verge; an opening is present at bottom of partition so that chamber formed by partition is continuous with lower portion of lumen of penis (Fig. 1, D, E, b–d); side of penial lumen opposite partition with six longitudinal glandular columns, which begin near top of lumen and continue to vagina (Fig. 1, b–d, E); at bottom of partition additional glandular columns appear and also continue to vagina (Fig. 1, d, E). Penis terminated by a long epiphallus; lumen of epiphallus with five large folds and five smaller folds alternating with these, folds surrounded by a thick layer of muscular tissue (Fig. 1, a); epiphallus and flagellum continuous, tightly coiled a short distance from penis to form a long springlike structure around vas deferens; first six coils formed by epiphallus; remaining 4–6 coils formed by flagellum; after forming coils flagellum becomes a long, loosely convoluted appendage about 25 mm in length; from base of flagellum vas deferens passes down through center of coils formed by epiphallus, and continues along penis to atrium, and up along and encircling female system to prostate. Penial retractor muscle short and wide, about 5 mm long;

originating on epiphallus and attaches to lung wall; and additional long slender muscle passes through center of coils formed by epiphallus and flagellum; it originates on genital atrium and extends slightly beyond last coil of flagellum, where it attaches to that structure. Vagina short and stout, about 10 mm long, with two dart sacs; each dart sac contains two unequal darts which have a common opening into vagina (Fig. 1, f); there are three long club-shaped dart glands slightly above point of origin of dart sacs; two dart glands enter between dart sacs; third gland originates behind left dart sac; within wall of vagina ducts of dart glands which enter between dart sacs diverge so that openings of all three glands become equally spaced (Fig. 1, e), and open into deep grooves extending from lumen of vagina; uterus and prostate closely appressed, long; albumen gland large and lunar shaped, with two deeply impressed grooves formed by sigmoid loop of intestine; hermaphroditic duct entering albumen gland near its base; ovotestis lost during dissection. Spermathecal duct originating on vagina opposite dart sacs, about 75 mm long, terminated by a large bulbous spermatheca about 10 mm long.

Retractor muscles: Columellar muscle extending a distance of one whorl into shell, tripartite; pharyngeal retractor narrowest; left ocular retractor attaching to underside of left pedal retractor; right ocular retractor passes through atrium of vagina and penis, and attaches to right margin of pharyngeal retractor.

Pallial organs: Length of lung about 2⅓ times width of its base, and about twice length of kidney; aereated surface supplied by a heavy network of arteries and veins; pericardium about one-half length of kidney and overlaps kidney internally; auricle about one-fourth size of ventricle; kidney irregularly trapezoidal, about five times as long as wide, sigmourethrous; primary ureter slightly larger than secondary ureter, which drains through a groove in right corner of pneumostome; mantle collar wide and thick, heavily pigmented with black; mantle marked with numerous spots which are particularly concentrated along secondary ureter and collar.

Fischer and Crosse (1878: 206–211) superficially described the anatomy of *Lysinoe ghiesbreghti* and *L. eximia*. On the basis of anatomical and conchological characters, *L. starretti* is most closely related to *L. eximia*. Both species have a short spermathecal duct as compared to the much longer duct of *L. ghiesbreghti*. Conchological similarities between *L. eximia* and *L. starretti* are (1) size of shell, (2) size of embryonic whorls, and (3) width of umbilicus.

L. starretti differs from *L. eximia* in several characters. The color pattern of *L. eximia* consists of five unequal dark bands on a lighter background. *L. starretti* has homologous bands, but they are obscured by the aniline yellow streaks and specks on the growth wrinkles. The interior of the aperture of *L. eximia* is white, while that of *L. starretti* is livid brown. The shell of *L. eximia* is thick and solid; *L. starretti* is thinner and considerably more fragile. In *L. eximia* the growth wrinkles are finer and more sparse, and the granules are more numerous, much larger and more distinct than they are in *L. starretti.*

I take pleasure in naming this species after Dr. Andrew Starrett, who collected the type.

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PROCEEDINGS
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BIOLOGICAL SOCIETY OF WASHINGTON

A NEW GENUS IN THE CHILOPOD FAMILY TAMPIYIDAE

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University of Utah, Salt Lake City

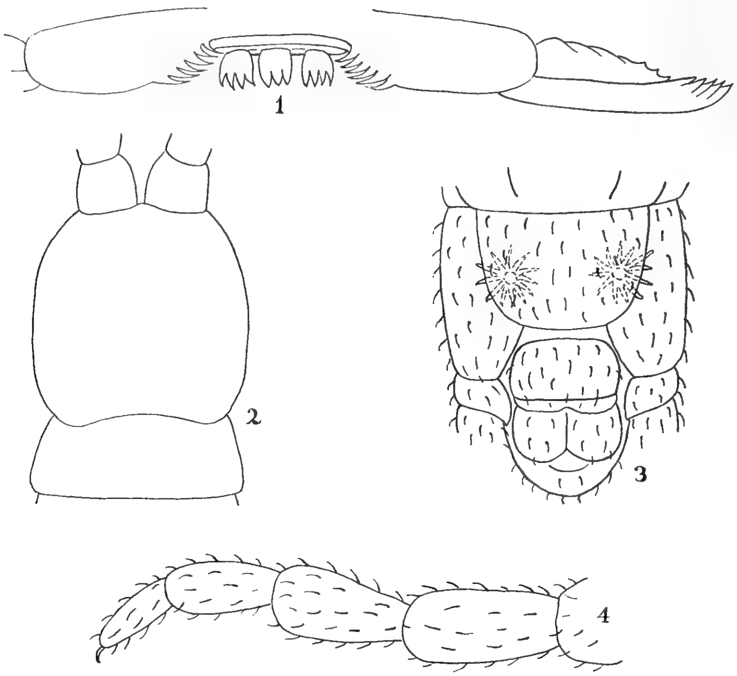
The family Tampiyidae was based upon a genus, *Tampiya,* which was established by the present writer in 1912 for the California species, *T. pylorus.* A second genus conforming to the family was proposed in 1955 for a Chilean species, *K. brattströmi,* the types of which were taken by Dr. Hans Brattström on the Lund University Chile Expedition of 1948–49. Now, fifty years after the first of these genera was named, I am able to add a third genus to the family, herein described from two specimens of a new species found in a collection made at the Nevada Test Area and submitted to me for identification by Dr. D. E. Back of the Brigham Young University. The three genera may be separated by means of the following key.

KEY TO THE GENERA OF TAMPIYIDAE

1. Median piece of labrum bearing several sclerotized dental plates; lateral pieces of labrum free laterally .... **Eremorus,** new genus
— Median piece of labrum with no such distinct dental plates, the teeth being simple and separate; lateral pieces not free at outer ends 2
2. Coxopleural glands several on each side, simple and well-separated from each other; prosternum armed anteriorly with two stout teeth or processes; last sternite narrow .... *Tampiya* Chamb.
— Coxopleural glands composite, one on each side beneath last sternite; prosternum unarmed; last sternite broad .... *Ketampa* Chamb.

Eremorus, new genus

Most distinct from the two previously known genera of the family in having the median piece of the labrum armed with several dental plates aside from which there are no separate single teeth, each of these plates presenting from three to five marginal teeth; also distinct in having the lateral pieces of the labrum fused only at mesal end and otherwise free. First maxilla bearing two large ectal lappets, one from coxa and one from first article of the telopodite; one coxal pore on each side opening beneath



FIGS. 1–4. *Eremorus becki*, new species. 1, labrum; 2, head in outline; 3, caudal end of body, ventral view, showing composite coxopleural glands, etc.; 4, last four articles of anal legs.

the sternite and giving exit to a large composite gland. Terminal pores absent. Type species: *E. becki*, new species.

Eremorus becki, new species

Form of head as shown in Fig. 2.

Clypeus with no differentiated spot or fenestra; bearing 5 or 6 setae caudad of base of each antenna and a similar median patch in the area of the median patch being slightly depressed.

Median piece of labrum fused with clypeus and mesal ends of the lateral pieces. First maxillae with palpus biarticulate, its first article bearing a long spinulose lappet; a similar lappet from corner of coxa.

Second maxillae with coxae broadly united at middle; claw of palpus straight and smooth, distally narrow, a little shorter than the adjacent setae.

Prosternum of prehensors unarmed anteriorly, showing distinct sclerotic lines or raphes each of which ends anteriorly a little caudad of the condyle; none of articles of prehensors armed with a tooth.

Anterior sternites with caudal margin obtusely angular, the angle extending somewhat beneath caudal border of the succeeding plate in each case; clothed with subsparse, short fine hairs; ventral pores absent.

Last sternite broad, strongly narrowed caudad, trapeziform, the caudal margin straight. One large composite coxopleural gland on each side, these opening beneath the sternite through a single circular pore.

No anal pores detected.

Anal legs crassate; second tarsal joint rather abruptly narrower than the first, as shown in Fig. 4.

Pairs of legs in the holotype: 85.

Length: 41 mm.

Type locality: Nevada Test Area. Two specimens taken 6 March 1961.

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NEW AND LITTLE KNOWN MEXICAN AND NEOTROPICAL DELTOCEPHALINAE (HOMOPTERA: CICADELLIDAE)

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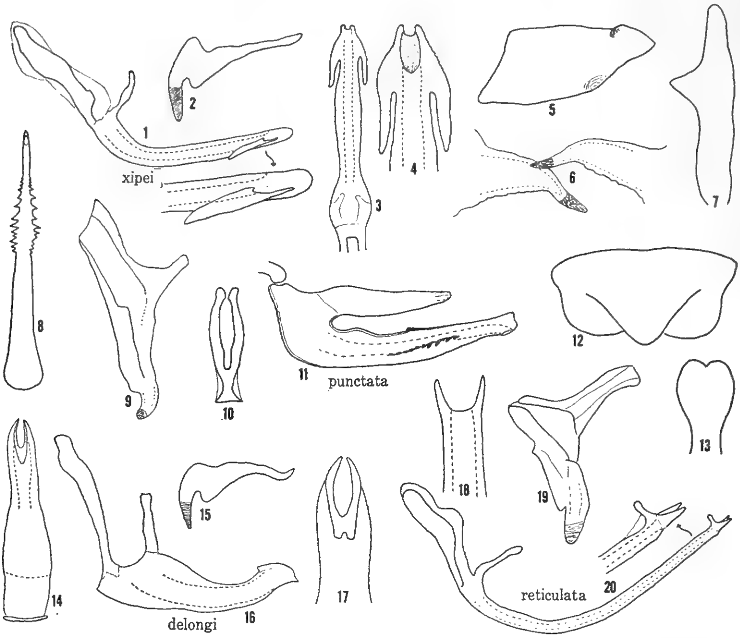
The deltocephaline leafhoppers of the Americas south of the United States are known largely through the numerous papers of D. M. DeLong and R. Linnavuori. Dr. DeLong has published extensively on various Mexican genera, whereas Dr. Linnavuori has treated those of Central and South America. For the interested student, the most valuable single paper is by Linnavuori (1959).

This paper includes descriptions of two new *Polyamia,* three new *Deltocephalus,* one new *Sanctanus,* and a new genus, *Bolotheta,* for *Neocoelida punctata* Osborn and *Coelidiana rotundiceps* Linnavuori and Heller. *Maricaona reticulata* Linnavuori is transferred to *Polyamia,* and the male genitalia of this species are illustrated for the first time. The combination *Sanctanus lepidellus* (Stål) is reinstated, and a description of the previously unknown male is included. The types of all new species are in the collection of the U. S. National Museum.

Polyamia arachnion, new species

Length: 3.4 mm.

Coloration: Venter brown; legs light brown marked with darker areas. Face light brown, heavily marked with dark brown or black arcs on upper portion of clypeus, large ill-defined dark area at each antennal base, each lorum bordered and laterally bisected by a brown area, clypellus marked with a basal transverse band and an apical subtriangular spot of dark brown. Crown light brown with anterior marginal markings consisting of a pair of dark arcs extending up from clypeus and a minute pair of apical spots and a single quadrangular dark-brown spot flanking each ocellus mesally. On either side the minute apical spot and quadrangular spot are connected to each other and to the coronal suture by a triradial reddish-brown mark.



FIGS. 1–20. *Deltocephalus xipei*: 1, lateral view of connective and aedaegus; 2, distal portion of style shown ventrally; 3, ventral view of aedeagus; 4, distal portion of aedeagus shown dorsally. *Bolotheta punctata*: 5, lateral view of pygofer (setae omitted); 6, ventral process of pygofer; 7, dorsal view of pygofer; 8, ventral view of aedeagus; 9, ventral view of style; 10, ventral view of connective; 11, lateral view of aedeagus. *Polyamia* sp.: 12, pregenital sternum; 13, ventral outline of first valvulae. *Deltocephalus delongi*: 14, ventral view of aedeagus; 15, distal portion of style shown ventrally; 16, lateral view of connective and aedeagus; 17, distal portion of aedeagus shown dorsally. *Polyamia reticulata*: 18, distal portion of aedeagus shown ventrally; 19, dorsal view of style; 20, lateral view of connective and aedeagus.

Additional markings on crown consist of a narrow reddish area around each ocellus, an irregular dark-brown spot behind each ocellus, and a pair of right-angular dark-brown marks at center of disc. Some ill-defined lighter areas on disc as well. Pronotum light brown marbled anteriorly and mesally with various lighter and darker hues. Scutellum light brown with anterior angles, a pair of anterior spots, and a cruciform mark dark brown. Forewings brown hyaline, light-brown veins sharply distinct due to dark infuscations at borders of cells.

Male genitalia: Aedeagus in lateral view stoutest basally, shaft greatly narrowed, and with apical portion asymmetrically elaborated (Fig. 30). Aedeagus in ventral view almost uniform in width with asymmetrical apex deeply cleft (Fig. 32). Gonopore opens at base of apical cleft. Mesal lobe of style widened distally and subtruncated at apex (Fig. 31).

Female genitalia: Females not definitely associated with male holotype.

Type: Holotype (USNM Type No. 66348) male, Chapingo (east of Mexico City), Mexico, 11 April 1957, Gibson and Carillo.

Discussion: This species together with *gangamon* n. sp. and *reticulata* (Lnv.) form a compact species–group within *Polyamia*. In all three species, the forewings are reticulated by many extra veinlets, particularly in the claval area.

Polyamia gangamon, new species

Length: 3.4–3.5 mm.

Coloration: Not distinguishable from *arachnion.*

Male genitalia: Aedeagus in lateral view uniformly very narrow, rapidly upturned distally, and with a distinct, sharp, decumbent preapical dorsal tooth (Fig. 26). Gonopore opens at base of sharply and deeply forked apex (Fig. 25). Mesal lobe of style blunt apically (Fig. 24).

Female genitalia: Females not definitely associated with male holotype.

Types: Holotype (USNM Type No. 66349) male, Cuernavaca-Acapulco Road, Mexico, 23 August 1936. Ball and Stone. Paratype male, Paricutín, Mexico, 28 November 1944, W. F. Foshag.

Polyamia reticulata (Linnavuori), new combination

Maricaona reticulata Linnavuori 1959: 98.

Length: 3.3 mm.

Coloration: Not distinguishable from *arachnion.*

Male genitalia: Aedeagus in lateral view uniformly very narrow, rapidly upturned distally, and with a short, blunt projection near apex (Fig. 20). Gonopore opens at base of moderately deep forked apex (Fig. 18). Style undistinguished (Fig. 19).

Female genitalia: Females not definitely associated with male holotype.

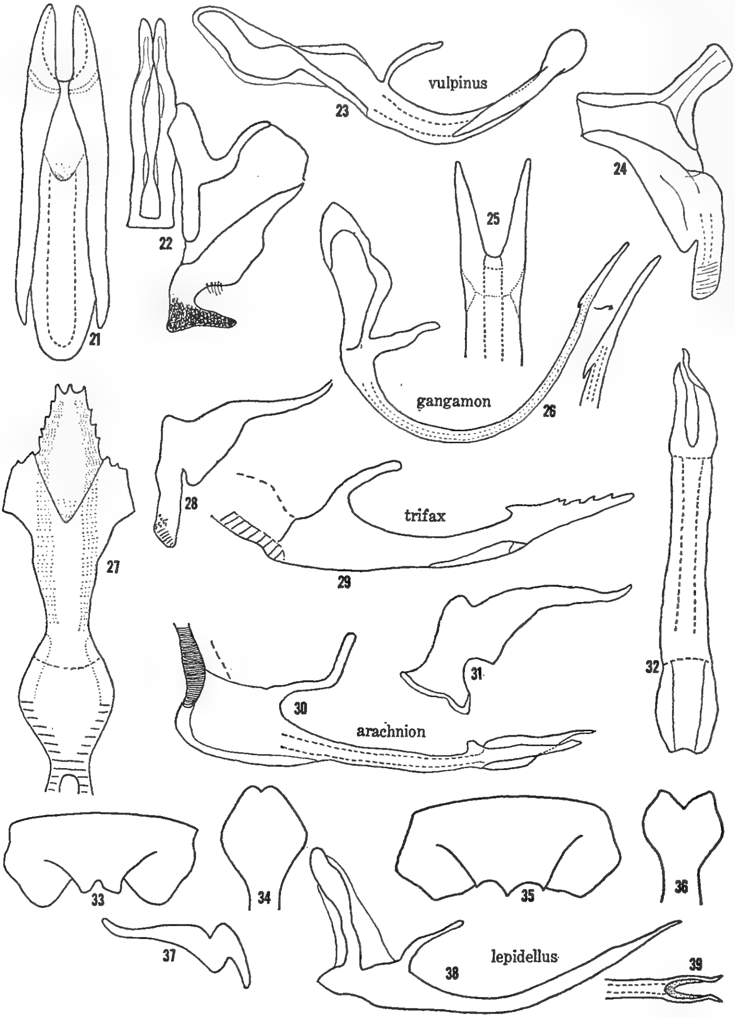
Types: Holotype (USNM Type No. 66350). Paricutín, Mexico, 28 November 1944, W. F. Foshag.

Discussion: Linnavuori's type series was mixed and contained at least two species. The male genitalia were not illustrated with the original description. The drawings used here were prepared from the holotype in the U. S. National Museum collection. The generic transfer to *Polyamia, sensu lato,* is conservative treatment.

The genus *Maricaona* Caldwell was based upon a unique female from Puerto Rico. This single female is still the lone representative of the genus. Without a conspecific male, a generic evaluation is only speculation.

Polyamia sp. females

There are at hand three different females from several Mexican localities which may represent the three previous species. As in the males, only genital characters provide adequate differences for separation. In the



FIGS. 21–39. *Sanctanus vulpinus*: 21, distal portion of aedeagus shown ventrally; 22, dorsal view of connective and style; 23, lateral view of connective and aedeagus. *Polyamia gangamon*: 24, dorsal view of style; 25, distal portion of aedeagus shown ventrally; 26, lateral view of connective and aedeagus. *Deltocephalus trifax*: 27, ventral view of aedeagus; 28, distal portion of style shown ventrally; 29, lateral view of aedeagus. *Polyamia arachnion*: 30, lateral view of aedeagus; 31, distal portion of style shown ventrally; 32, ventral view of aedeagus. *Polyamia* sp.: 33, pregenital sternum; 34, ventral outline of first valvulae. *Polyamia* sp.: 35, pregenital sternum; 36, ventral outline of first valvulae. *Sanctanus lepidellus*: 37, distal portion of style shown ventrally; 38, lateral view of connective and aedeagus; 39, aedeagal apex shown ventrally.

first female (Figs. 33, 34), the pregenital sternum is concave posteriorly with a pair of irregular mesal teeth, and the bases of the first valvulae are sharply widened laterally. In the second female (Figs. 35, 36), the pregenital sternum is concave posteriorly with a sharp mesal tooth flanked by an additional highly inconspicuous tooth on either side, and the bases of the first valvulae diverge apically. In the third female (Figs. 12, 13), the pregenital sternum is barely concave with a single wide blunt mesal tooth, and the bases of the first valvulae are smoothly rounded laterally. No attempt is made at this time to associate these females with any male. Linnavuori, however, designated as allotype of *reticulata* a female with genital structures as shown in Figs. 12 and 13.

Deltocephalus xipei, new species

Length: 2.3 mm.

Coloration: Venter and legs dark brown touched with yellow on legs. Face dark brown with pale arcs on clypeus and yellowish areas on genae and lora. Crown stramineous to pale brown with only definite markings occurring on anterior margin as an irregular narrow dark-brown band. This band follows the curvature of the anterior coronal margin curving behind an ocellus on either side. The band is interrupted at the extreme apex and near each ocellus. A long series of specimens would probably show that the anterior coronal marking varies from a solid band to six distinct spots. Pronotum stramineous to pale brown and without definite markings. Scutellum stramineous to pale brown with mesal area darkened. Forewings milky-hyaline with most cells narrowly infuscated marginally except for heavier darkening of inner discal cells and adjacent costal margins.

Male genitalia: Aedeagus in lateral view simple with curvature near base, shaft straight, and a simple preapical appendage (Fig. 1). Aedeagus in ventral view rounded basally and with a pair of simple appendages near the notched apex (Fig. 3). Gonopore opens dorsally near apex (Fig. 4). Mesal lobes of style slender (Fig. 2).

Female genitalia: Female unknown.

Types: Holotype (USNM Type No. 66351) male, Ixmiquilpan, Mexico, 27 August 1936, E. D. Ball.

Discussion: This generic placement is based upon a broader definition of *Deltocephalus* than rendered by Oman (1949). The limits of *Deltocephalus* and related genera are the subject of a paper in preparation.

Deltocephalus delongi, new species

Length: 2.7 mm.

Coloration: Venter and legs dark brown touched lightly and variably with yellow. Face dark brown with genae and a few variable lines on clypeus, clypellus, and lora yellow. Crown stramineous, anterior margin with dark arcs (an extension of color from the face) and four black to brown spots, the mesal apical pair triangular and the lateral pair rounded (holotype with additional dark spot behind each ocellus connected to the lateral spot), a broken black transverse band between anterior margins of eyes which is widest at middle of crown, narrowest near eyes, and broken at middle and near eyes (three breaks), additional ill-defined light-brown markings on coronal disc. Pronotum stramineous with some brown spotting anteriorly and color fading posteriorly. Scutellum stramineous marked variably with dark-brown anterior spots and lateral lines. Forewings and veins milky-hyaline with margins of cells lightly to moderately infuscated.

Male genitalia: Aedeagus in lateral view transverse with sharp basal heel and an avicephaliform apex (Fig. 16). Aedeagus in ventral view with gonopore opening at cleft apex (Fig. 14). Apex of aedeagus in dorsal view with a proximally notched rim (Fig. 17). Mesal lobe of style narrowing apically (Fig. 15).

Female genitalia: Pregenital sternum strongly concave with base of concavity nearly transverse.

Types: Holotype (USNM Type No. 66352), male and allotype female, Teotihuacan Pyramids 33 miles from Mexico City, Mexico, 19 August 1936, E. D. Ball. Both holotype and allotype are mounted on the same cardboard point.

Discussion: The generic placement of *delongi* is in accord with the definition of *Deltocephalus* rendered by Oman (1949). The species is named for Dwight M. DeLong, one of America's most outstanding workers in the Cicadellidae.

Deltocephalus trifax, new species

Length: 3.5–3.8 mm.

Coloration: Venter brown to dark brown touched with yellow. Legs stramineous to yellow banded with brown, banding most striking on femora of pro- and mesothoracic legs. Face yellow heavily marked with dark brown as arcs on clypeus, lines on sutures, and irregular spots under eyes, on genae, on lora, and on clypellus. Crown yellow with two pairs of brown spots on anterior margin, the middle pair are elongate, the lateral pair more or less rounded. An additional dark spot occurs behind each ocellus. The central portion of the coronal disc with an approximately pi-shaped black to tan marking on each side of the coronal suture. Both the shapes and colors of these markings vary greatly. The pronotum is light brown, yellow anteriorly, some irregular brown spots preapically, and with five pale narrow longitudinal stripes. Scutellum yellow with a few brown spots and lines. Forewings light brown hyaline, veins largely white, cells lightly infuscated marginally except outer apical cell, basal portion of inner discal cell, and adjacent costal area. All of these are solid dark brown. The costal vein is frequently distinctly yellow.

Male genitalia: Aedeagus in lateral view undistinguished except apically where the dorsum is expanded and irregularly toothed (Fig. 29). In ventral view the aedeagus is rounded basally, with truncated lateral expansions distally, and margin toothed on extreme apex (Fig. 27). The gonopore opens on the venter of the shaft at the base of a V-shaped notch (Fig. 27). Mesal lobe of style moderately long with inner margin irregular (Fig. 28).

Female genitalia: Pregenital sternum with posterior margin nearly truncated.

Types: Holotype (USNM Type No. 66353) male, Camaron, Panama, 17 July 1952, F. S. Blanton. Allotype female, Mojinga Swamp, Canal Zone, 9 January 1953, F. S. Blanton. Four paratypes: One, same data as holotype; one, Los Lajos, Panama, 26 October 1952, F. S. Blanton; one Madden Dam, Canal Zone, 21 October 1946, A. O. Meyer; and one, Margarita, Canal Zone, 25 August 1946, A. O. Meyer.

Discussion: See discussion of *Deltocephalus xipei.*

Sanctanus lepidellus (Stål), reinstated combination

Jassus (*Deltocephalus*) *lepidellus* Stål 1862: 53.

Deltocephalus lepidellus: Osborn 1924: 408, Plate 57, Fig. 1.

Sanctanus lepidellus: Oman 1938: 371.

Sanctanus lepidellus: Linnavuori 1954: 141, Fig. 13A.

Amplicephalus (*Nanctasus*) *lepidellus*: Linnavuori 1959: 100.

The generic placement of *lepidellus* has long troubled students of neotropical leafhoppers. Stål described the species from a unique Brazilian female (the original description erroneously recorded it as a male) and up to this time additional specimens were unknown. Through the splendid cooperation of Dr. E. Kjellander and the Stockholm Museum, Stål's type was loaned to me for study and comparison with the unique male reported below.

Length: 4 mm.

Coloration: Osborn has given a very detailed account of the color pattern of this species together with an outstandingly accurate habitus illustration. It is sufficient here to state that the male at hand agrees exactly with Stål's type and with Osborn's illustrations of the species.

Male genitalia: Aedeagus in lateral view a trifle bowed, slender, and tapering to a pointed apex with connective short (Fig. 38). Gonopore opening at base of forked apex (Fig. 39). Mesal lobe of style undistinguished (Fig. 37).

Specimens: Unique male São Paulo, Brazil, May 1954, N. L. H. Krauss.

Discussion: The type locality of *lepidellus* is the state of Rio de Janeiro, Brazil. This locality is near enough to São Paulo to afford additional proof for the correct association of the female and male of *lepidellus.* Linnavuori and Heller (1961: 7) described a male from Peru which they determined as *lepidellus.* I believe their determination was incorrect. Their specimen did not come from the type locality, and it appears to be too small to be properly associated with Stål's type. I refrain from giving their species a new name because the generic placement is uncertain. According to their illustrations (Pl. 4, Fig. 3), the species has a closed Y-shaped connective.

Sanctanus vulpinus, new species

Length: 3.8 mm.

Coloration: Venter dark brown irregularly touched with pale brown. Legs pale brown with prothoracic femora dark-brown banded, mesothoracic and metathoracic femora and tibiae mainly dark brown. Face pale brown washed irregularly with darker shades particularly on clypeus. Crown stramineous with a pair of dark minute crescent-shaped anterior marginal markings, a minute spot behind each ocellus, and a small darkened area at middle of hind margin. There is a pale orange band between the anterior margin of the eyes which is widest and broken mesally. Pronotum mainly orange with anterior margin changing to stramineous and posterior margin fading to translucent milky-white. Scutellum yellowish without definite markings. Forewings pale orange-brown hyaline, most veins in clavus and corium bright white although a few are orange. Most cells are narrowly infuscated at margins except for inner anteapical cell, inner apical cell, outer apical cell, and an undefined area at center of costal margin. All of these are heavily infuscated. The extreme apex of each wing is white.

Male genitalia: Aedeagus in lateral view slightly bowed and apex roundly enlarged with a straight basally directed process (Fig. 23). Aedeagus in posterior-ventral view with a pair of simple tapered processes closely appressed to the shaft and with the gonopore opening below the cleft apex (Fig. 21). Mesal lobe of style at apex subtruncated and strongly expanded laterally (Fig. 22).

Female genitalia: Female unknown.

Types: Holotype (USNM Type No. 34860) male, Jussaral, Angra-E. Do. Rio, Brazil, 9 October 1934, Travassos and Lopes.

Discussion: The generic placement of *vulpinus* is based upon DeLong's definition as stated in his revision of *Sanctanus* (DeLong and Hershberger, 1946). The coloration and male genitalia of *vulpinus* are similar to those in several Mexican species described by DeLong. The crown of most species of *Sanctanus* is flat to slightly concave. In *vulpinus* the crown is distinctly concave.

Bolotheta, new genus

Type-species: *Neocoelidia punctata* Osborn

Description: Head much narrower than pronotum and bluntly angled anteriorly, length of crown next to eyes much shorter than median length. Ocelli located on anterior margin of crown, one near each eye. Clypellus no wider distally than basally. Antennae about as long as entire length of body including forewings at rest. Scutellum very large, as long as pronotum. Venation of forewings fairly distinct with two apical and two subapical cells. Ground color pale yellowish with some dark brown or black markings. Male genitalia: Plates flat and triangular beset laterally with both uniserate setae and cilia. Valve distinct and triangular in shape. Pygofer with ventral processes. Connective closed Y-shaped and not fused with aedeagus. Aedeagus moderately stout with large dorsal apodeme and subapical gonopore.

Bolotheta punctata (Osborn), new combination

1923. *Neocoelidia punctata* Osborn, 15 (1): 77.

Length: 6.5–7.0 mm.

Coloration: Basic ground color stramineous. Venter, legs, and face unmarked. One pair of moderately large dark-brown or black spots on anterior margin of crown. A single dark-brown spot at each posterior angle of pronotum. Scutellum with or without a pair of small preapical dark-brown spots. Forewings stramineous hyaline with markings as follows: portions bordering scutellum narrowly dark brown, commissural margins narrowly light brown with veins darker, and with a single moderately large black spot at center of each forewing.

Male genitalia: Pygofer in lateral view simple and without visible processes (Fig. 5); but in ventral view with partially crossed paired processes (Fig. 6); and in dorsal view with a preapical mesal projection (Fig. 7). Connective closed Y-shaped (Fig. 10) and not fused with aedeagus. Aedeagus in lateral view elongate with gonopore distinct (Fig. 11); in ventral view with sharp teeth on lateral margins (Fig. 8). Style undistinguished (Fig. 9).

Female genitalia: Female unknown.

Types: This species is known only from two males, the type and a paratype, both of which were collected in Province del Sara, Bolivia, and were deposited in the collection of the Carnegie Institute in Pittsburgh, Pennsylvania. The drawings were prepared from the genitalia of the holotype.

Discussion: Osborn's placement of *punctata* in *Neocoelida* is quite understandable. The exceedingly long antennae and the rather obscure venation of the forewings, both of which are characteristic of the Neocoelidiinae, are probably the features which influenced him. However, *punctata* lacks the typical antennal ledge of the Neocoelidiinae and has male genitalia characteristic of the Deltocephalinae. The exceedingly long antennae readily distinguish *Bolotheta punctata* from all other neotropical Deltocephalinae. This species was recognized as a deltocephaline by Kramer (1959: 30) with uncertain generic placement.

The Peruvian species, *Coelidiana rotundiceps,* described by Linnavuori and Heller (1961: 4) also belongs in *Bolotheta.* The generic transfer is made here: *Bolotheta rotundiceps* (Linnavuori and Heller) NEW COMBINATION. The exceedingly long antennae readily distinguish *Bolotheta* from all other neotropical Deltocephalinae.

KEY TO SPECIES OF *Bolotheta*

Male pygofer in lateral view without long terminal process (Fig. 5); dorsal portion of aedeagus more than half as long as shaft (Fig. 11) .... *punctata* (Osborn)

Male pygofer in lateral view with long terminal process (L. & H., 1961, Pl. 2, Fig. 7); dorsal portion of aedeagus half as long as shaft (L. & H., 1961, Pl. 2, Fig. 9) .... *rotundiceps* (L. & H.)

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PROCEEDINGS
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TEN NEW REARED SPECIES OF TETRASTICHUS (HYMENOPTERA, EULOPHIDAE)

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Since my revision of the North American species of *Tetrastichus* appeared (1943, Proc. USNM, 93: 505–608), a large number of undescribed species of the genus have turned up. Of these, 10 are described in this paper, most of them providing names for use in papers by other workers.

The name *Tetrastichus* is here used in the traditional sense of Haliday, 1844, type, *Cirrospilus attalus* Walker, as employed in the literature for over a century. At present this name is unavailable. In 1940, Neave (Nom. Zool., 4: 442) indicated that Walker, 1842, first used the name *Tetrastichus*. Peck (1951, U. S. Dept. Agr., Monog. 2: 443), consequently used the name *Tetrastichus* Walker, 1842, designating *Cirrospilus lycidas* Walker as type. *C. lycidas* is, however, an *Aprostocetus*, as pointed out by Lindroth and Graham (1960, Opusc. Ent., 25: 94). This would require the use of the name *Trichoceras* Ratzeburg, 1848, type *Trichoceras erythrophthalmus* Ratzeburg, for the genus long known as *Tetrastichus*. Since there is an enormous literature now extant in which the name *Tetrastichus* is used in the traditional sense, an application has been made to the International Commission on Zoological Nomenclature to suppress *Tetrastichus* Walker. Such an action would make *Tetrastichus* Haliday again available.

The characterizations of the new species given in this paper are uniform with the species descriptions given in my revision, and it is expected that this paper will be used with that one. It may be noted, however, that the comparative lengths of the scutellum, metanotum, and propodeum given here are all taken at the meson. The length of the praescutum is measured at the meson, and the width is taken as the greatest straight-line distance between the anterolateral angles.

Tetrastichus politi, new species

This species agrees with *pattersonae* Fullaway in having the praescutum setose, a triangular fracture at the dorsal end of the malar furrow, and the ocelli encircled by a suture, the surface within this suture being strongly sculptured. The two differ in that in *politi* the funicular segments of the antenna are elongate, the gaster is shorter than the thorax and propodeum, and the ovipositor sheaths do not reach the apex of the gaster. In *pattersonae* the funicular segments are globular, the gaster is longer than the thorax and propodeum, and the ovipositor sheaths surpass the apex of the gaster.

Female: Length 1.5–2.2 mm. Dark, metallic blue, sometimes with a lavender tint; antennal scape yellow, pedicel and flagellum tan; wings hyaline, veins yellow; apices of femora, tibiae, and basal three segments of each tarsus yellow, apical segment of each tarsus brown.

Antennae inserted at level of ventral margins of compound eyes, apex of scape not reaching anterior ocellus; posterior face of apex of scape and dorsal surface of pedicel bearing numerous, short bristles; pedicel and first and second funicular segments equal in length, third slightly shorter, club 1½ times as long as pedicel; width of malar space ½ as great as height of compound eye; a depressed, triangular fracture at dorsal end of malar furrow; vertex with numerous, umbilicate punctures, each bearing a short bristle; ocelli enclosed by a suture, ocellocular suture depressed, a minute, triangular fracture present at each end; ocellocular line slightly more than ½ as long as postocellar line. Pronotum clothed dorsally with dense, posteriorly directed setae; praescutum slightly wider than long, entire surface densely clothed with bristles, some bristles contiguous with median furrow; submarginal vein of forewing bearing 4 or 5 dorsal bristles, marginal vein 3 times as long as stigmal, apex of hindwing broadly rounded; prepectus, metapleuron, and posterior coxa lightly shagreened, mesepimeron and dorsal triangle of mesepisternum smooth, rest of mesepisterum faintly sculptured; scutellum arched, a faint, median longitudinal carina present, 2 pairs of bristles present; metanotum ⅓ as long as scutellum. Propodeum ⅖ as long as scutellum, surface shagreened, strong median carina present, paraspiracular carinae absent; spiracles almost touching anterior propodeal margin; gaster slightly shorter than thorax and propodeum, almost circular in dorsal outline, ovipositor sheaths not quite reaching apex of gaster, ventral surface of gaster flattened at apex.

Male: Length 1.8–2.2 mm. Antennal scape only slightly broader than in female, minute anterior carina extending almost from base to apex; funicular segments enlarged near bases and bearing long bristles; pedicel and first funicular segment equal in length, second to fourth funiculars equal in length and each twice as long as pedicel, club 3½ times as long as pedicel; gaster narrower than in female, shorter than thorax and propodeum.

Type locality: Vienna, Virginia.

Type: USNM No. 65995.

Described from the type ♀, allotype ♂, and 45 ♀ and 43 ♂ paratypes from Vienna, Va., specimens emerged during December 1941 from galls of *Xanthoteras politum* (Bassett) on post oak, *Quercus stellata.*

Host relationships: This species probably is a primary parasite of *Xanthoteras politum,* a cynipid that makes small oak-apple galls on the leaves of post and chinquapin oaks.

Tetrastichus garryana, new species

This species agrees with *pattersonae* Fullaway in having the praescutum completely setose, the hind tibiae yellow, and the body with metallic green coloration. The two species differ in that *garryana* lacks the prominent, triangular fracture at the dorsal end of the malar furrow, present in *pattersonae,* and has funicular segments 1 and 2 equal in length, rather than the first being the longer, as in *pattersonae.*

Female: Length 1.4–1.5 mm. Dark brown to black with faint green metallic luster, surface minutely and closely sculptured, not smooth; antennae tan; coxae, trochanters, and basal areas of femora same color as body, apices of femora, tibiae, and tarsi tan, apices of tibiae sometimes slightly darkened; wings hyaline, venation tan.

Antennae inserted slightly dorsal to level of ventral margins of compound eyes, apex of scape not reaching anterior ocellus; pedicel as long as first 2 funicular segments, the 3 funiculars equal in length, but becoming progressively slightly broader apically; club as long as funiculus and wider than widest segment; width of malar space as great as height of compound eye, the latter with scattered, coarse, short hair; postocellar line 1½ times as long as ocellocular. Praescutum wider than long, with numerous bristles distributed over its entire surface, some bristles contiguous with median furrow; submarginal vein of forewing with 4 or 5 dorsal bristles, marginal vein 3½ times as long as stigmal; apex of hindwing blunt; prepectus shagreened, adjacent areas of mesopleuron almost smooth, metapleural sculpture the same as that of prepectus; scutellum somewhat flattened and bearing 2 pairs of bristles; metanotum ⅓ as long as scutellum. Propodeum 1½ times as long as metanotum, surface sculptured, median carina present, paraspiraculars absent, spiracles almost touching anterior propodeal margin; gaster subequal in length to thorax and propodeum.

Male: Length 1.4–1.5 mm. Antennal scape broadened and bearing a darkened anterior carina in its apical ⅔; funicular segments broadened at bases and bearing long bristles; club 1⅙ times as long as apical 2 funiculars.

Type locality: Corvallis, Oregon.

Type: USNM No. 65996.

Described from the type ♀, allotype ♂, and 11 ♀ and 10 ♂ paratypes, Corvallis, Ore., June–July 1953, emerged from twig gall on *Quercus garryana,* W. J. Chamberlin.

Host relationships: This species apparently is a primary parasite of a cynipid gall maker in the twigs of *Quercus garryana.*

Tetrastichus phidippi, new species

This species agrees with *T. modestus* Howard in having the praescutum densely setose with some setae contiguous with the median furrow, the hind tibiae dark, and the male funicular segments semiquadrate and without basal enlargements or long bristles; the two differ in that *phidippi* is larger and metallic blue in color, with the praescutum as wide as long, and marginal vein of the forewing only twice as long as the stigmal, the scutellum with 3 pairs of bristles, the propodeum with paraspiracular carinae, and the gaster 1½ times as long as the thorax. *T. modestus* is black, with the praescutum wider than long, the marginal vein 3 times as long as the stigmal, the scutellum with 2 pairs of bristles, the propodeum without paraspiracular carinae, and the gaster as long as the thorax. *T. phidippi* is, apparently, also related to *grioti* Blanchard, which parasitizes the eggs of *Metepeira labyrinthea* (Hentz) in Argentina. Blanchard's species, known to me only from the description, is black, the median area of the praescutum is asetose, and the scutellum has 2 pairs of bristles.

Female: Length 2.0–2.5 mm. Dark metallic blue, surface not shining but minutely and closely sculptured; antennal pedicel and flagellum dark brown; apices of femora, bases and apices of tibiae, and basal 3 segments of each tarsus yellow; wings hyaline, veins slightly darker than membrane.

Antennae inserted slightly above level of ventral margins of compound eyes, apex of scape not quite reaching level of anterior ocellus; pedicel and each funicular segment equal in length, club 2¼ times as long as pedicel; length of malar space ⅔ height of compound eye, postocellar line twice as long as ocellocular. Praescutum as long as wide and bearing numerous bristles irregularly and densely distributed over surface, some bristles contiguous with median furrow; submarginal vein of forewing with 5 or 6 dorsal bristles, marginal vein twice as long as stigmal, apex of hindwing blunt, prepectus shagreened, mesopleuron weakly sculptured, almost smooth, metapleuron with surface sculpture slightly less intense than that of prepectus; scutellum bearing 3 pairs of bristles; metanotum relatively long, its median length equal to that of propodeum, and ¼ as long as scutellum. Propodeum sculptured, with strong median and paraspiracular carinae, spiracles almost touching anterior propodeal margin; gaster 1½ times as long as thorax, its exposed surfaces sculptured; apices of ovipositor sheaths slightly projecting.

Male: Length 1.8–2.0 mm. Antennal scape broadened and with darkened anterior carina extending from near base to apex; funicular segments semiquadrate, not enlarged at bases nor bearing long bristles; club as long as third and fourth funiculars combined. Gaster as long as thorax, apex acuminate.

Type locality: Portal, Arizona.

Type: USNM No. 66002.

Described from 12 ♀ and 13 ♂ specimens, as follows: Type ♀, Portal, Ariz., emerged 20 Jan. 1961 from the eggs of the jumping spider, *Phidippus opifex* (McCook), M. Cazier; allotype ♂, the same, but emerged 22 Jan. 1961; 11 ♀, 12 ♂ paratypes, the same, but emerged 18 Dec. 1960 to 22 Jan. 1961. There are 7 pupae, in various stages of maturity, associated with the paratypes.

Host relationships: This species is a primary parasite of the eggs of the salticid spider *Phidippus opifex* (McCook).

Tetrastichus nordi, new species

This species agrees with *agrili* Crawford in having the malar furrow curved, a deep femoral groove on the pronotum, and the gaster elongate and slender. The two differ in that this species has 3 or 4 dorsal bristles on the submarginal vein of the forewing, the propodeum lacks paraspiracular carinae, and the first funicular segment is as long as the pedicel; in *agrili* the submarginal vein has only 1 dorsal bristle, the propodeum is strongly sculptured, with paraspiracular and oblique carinae, and the first funicular is longer than the pedicel.

Female: Length 2.2–2.5 mm. Dark, iridescent blue or blue-green, surface faintly sculptured, subshining; antennal scape tan, darkened dorsally, pedicel brown at base, yellow at apex, flagellum brown; wings hyaline, veins white; apices of femora and middle and hind tibiae, and basal 3 segments of middle and hind tarsi, white; entire fore tibia and basal 3 segments of fore tarsus, and basal ¾ of middle and hind tibiae tan; apical segment of each tarsus brown; hind tibia usually with a vague, sub-basal and median brown annulus, these annuli also sometimes visible on fore and middle tibiae.

Antennae inserted at level of ventral margins of compound eyes, apex of scape not quite reaching level of anterior ocellus; funicular segments equal in length, each as long as pedicel, and twice as long as wide, club twice as long as pedicel; malar furrow curved, width of malar space ½ as great as height of eye; ocellar area with scattered, umbilicate punctures, ocelli partly enclosed by a suture, this suture interrupted behind lateral ocelli; ocellocular line ½ as long as postocellar. Pronotum laterally with deep femoral groove; praescutum as long as wide, bearing 1 row consisting of 4 or 5 bristles at each lateral margin; submarginal vein of forewing with 3 or 4 dorsal bristles, marginal vein 3 times as long as stigmal, apex of hindwing blunt; prepectus and mesepisternum faintly sculptured, mesepimeron smooth, metapleuron and metacoxa slightly more strongly sculptured than prepectus; scutellum with 2 pairs of bristles, metanotum ⅙ as long as scutellum. Propodeum as long as metanotum, surface lightly sculptured, median carina only present; spiracle large, as long as median carina, and almost touching anterior propodeal margin; gaster 2 to 2¼ times as long as thorax and propodeum, slender and produced at apex in an acuminate point.

Male: Length 1.5–1.8 mm. Antennal scape white, pedicel and funiculus yellow, club brown; pale areas at apices of femora broader than in female, brown annulations of tibiae faint or wanting. Scape broad, bearing darkened anterior carina on subapical ⅓ of its length; funicular segments not basally enlarged and lacking long bristles; pedicel and funicular segments 2–4 equal in length, first funicular slightly shorter, club twice as long as fourth funicular segment; width of malar space ⅗ as great as height of eye; gaster slightly longer than thorax and propodeum, apex acuminate.

Type locality: Iron River Township, Iron Co., Michigan.

Type: USNM No. 65997.

Described from 86 ♀ and 23 ♂ specimens, as follows: Type ♀, allotype ♂, and 27 ♀, 15 ♂ paratypes from Iron River Twp., Iron River Co., Mich., 15 May 1961, emerged from pupal chamber of *Agrilus* sp. in the trunk of *Populus tremuloides* seedling, J. C. Nord; 41 ♀, 2 ♂ paratypes, same data, but emerged 30 July 1961; 17 ♀, 5 ♂ paratypes, same data, but emerged 31 July 1961. Each of the 3 lots of parasites emerged from 1 pupal chamber of the host.

Host relationships: This species probably is a primary parasite of *Agrilus* sp. in *Populus tremuloides* seedlings; larvae, presumably those of *nordi*, have been found inside both larvae and pupae of the *Agrilus*.

Tetrastichus barbarae, new species

This species agrees with *dolosus* Gahan and *coerulescens* Ashmead in having more than 2 rows of bristles at each lateral margin of the praescutum, with the meson bare, in having the stigmal vein ½ as long as the marginal, and in lacking paraspiracular carinae on the propodeum. It differs from both those species in having the compound eyes hairy, the antennal club short, and the scutellum subflattened and almost smooth, rather than strongly arched and sculptured.

Female: Length 1.5–1.8 mm. Brown, with metallic blue luster; antennae tan; wings hyaline, veins tan; apices of femora, bases and apices of tibiae, and basal tarsal segments tan.

Antennae inserted at level of ventral margins of compound eyes, scape not reaching anterior ocellus; pedicel long, ½ as long as scape, funicular segments equal in length, each 5/7 as long as pedicel, subquadrate in form, as wide as long, club twice as long as a funicular segment; width of malar space ⅔ as great as height of compound eye, the latter conspicuously hairy at 50× magnification; ocellocular line ½ as long as postocellar; vertex strongly sculptured and bearing numerous, short, bristly hairs. Pronotum bristly on dorsum; praescutum as wide as long, bearing 3 or 4 rows of bristles on each side, asetose on meson; submarginal vein of forewing bearing 2 dorsal bristles, marginal vein twice as long as stigmal, apex of hindwing blunt; prepectus, mesopleuron, metapleuron, and metacoxa uniformly and faintly sculptured, almost smooth; scutellum subflattened, surface almost smooth, bearing 2 pairs of bristles; metanotum smooth, ⅕ as long as scutellum. Propodeum ¼ as long as scutellum, surface faintly sculptured, median carina broad and smooth, paraspiraculars absent, spiracle separated by a space ½ as great as its length from anterior propodeal margin; gaster 1⅔ times as long as thorax and propodeum, apex acuminate, apices of ovipositor sheaths conspicuously bristly and slightly protruding.

Male: Length 1.0–1.2 mm. Antennal scape inflated, anterior carina extending over apical ⅘ of its length; funicular segments equal in length, each slightly shorter than pedicel, subquadrate, not enlarged basally nor bearing long bristles, club 2⅕ times as long as a funicular segment; gaster as long as thorax and propodeum.

Type locality: Ashland, Oregon.

Type: USNM No. 66004.

Described from 7 ♀ and 2 ♂ specimens, as follows: Type ♀, allotype ♂, and 3 ♀ and 1 ♂ paratypes, Ashland, Ore., reared 1 Aug. 1914 from cones of *Abies concolor* infested by the olethreutid moth *Barbara colfaxiana* (Kearfott), F. P. Keen (Hopkins U. S. No. 12529-d_2); 3 ♀ paratypes, Colestin, Ore., reared 18 July 1914 from cones of *Abies concolor,* J. M. Miller *et al.* (Hopkins U. S. No. 12538-c_2).

Host relationships: This species probably is a secondary parasite of *Barbara colfaxiana*, as the types were reared out along with *Elachertus glacialis* Ashmead, which is a primary parasite. The other species of *Tetrastichus* that are most closely related to *barbarae* are secondary parasites.

Tetrastichus byersi, new species

This species agrees with *paracholus* Burks in having 1 dorsal bristle on the submarginal vein of the forewing, paraspiracular carinae on the propodeum, the apex of the hindwing blunt, and the antennal scape and tibiae yellow. The two species differ in that *byersi* lacks metallic coloration, the pedicel is entirely yellow, the mesopleuron has an anteromedian smooth area, and the gaster is subequal in length to the thorax and propodeum. *T. paracholus* has brassy metallic coloration, the pedicel is brown at the base, the entire mesopleuron is sculptured, and the gaster is longer than the thorax and propodeum.

Female: Length 1.3–1.8 mm. Shining, dark brown, without metallic sheen; antennal scape and pedicel yellow, flagellum tan; apices of femora, tibiae, and basal 3 segments of each tarsus yellow, apical tarsal segment tan; wings hyaline, veins faint yellow; hair of body and appendages long and bristly.

Antennae inserted at level of ventral margins of compound eyes, apex of scape not quite reaching level of anterior ocellus; all funicular segments equal in length, twice as long as wide, pedicel slightly shorter than a funicular segment, club 1¾ times as long as 1 funicular; width of malar space ½ as great as height of compound eye, malar furrow curved; eyes with dense, relatively long, bristly hair; lateral ocellus large, its long diameter ½ as great as length of postocellar line, ocellocular line ¾ as long as postocellar. Praescutum wider than long, bearing 1 row of bristles at each lateral margin; submarginal vein of forewing bearing 1 dorsal bristle, marginal vein 2½ times as long as stigmal, apex of hindwing blunt; prepectus and metapleuron lightly shagreened, anteromedian area of mesopleuron shagreened, mesopleuron otherwise smooth; scutellum arched and bearing 2 pairs of bristles; metanotum flat, smooth, ⅕ as long as scutellum.

Propodeum ⅖ as long as scutellum, surface shagreened, median and paraspiracular carinae present, spiracle separated by a space as great as its length from anterior propodeal margin; gaster subequal in length to thorax and propodeum; apices of ovipositor sheaths just reaching apex of gaster.

Male: Length 1.5 mm. Antennal scape broadened and bearing anterior carina in middle half of its length; first funicular segment ⅘ as long as pedicel, 3 following funicular segments each as long as pedicel and twice as long as wide, not enlarged basally nor bearing long bristles, club twice as long as apical funicular segment; gaster shorter than thorax and propodeum.

Type locality: Ann Arbor, Michigan.

Type: USNM No. 65998.

Described from 7 ♀ and 1 ♂ specimens, as follows: Type ♀ and 1 ♀ paratype, Ann Arbor, Mich., 23–25 June 1952, reared from the pupa of *Dolichopeza walleyi* (Alexander), G. W. Byers; allotype ♂ and 5 ♀ paratypes, Turkey Run State Park, Ind., 20–21 June 1953, reared from the pupa of *Dolichopeza americana* Needham, G. W. Byers.

Host relationships: This species is a primary parasite of tipulid flies of the genus *Dolichopeza.* The parasites emerge from the pupae of their hosts, but at present it is not known in which stage of the host the eggs are deposited.

Tetrastichus psyllaephagus, new species

This species agrees with *malacosomae* Girault in having the propodeum extremely short, so that the gaster appears to be broadly joined to the propodeum, the head and body have a metallic iridescence, the gaster is twice as long as the thorax and propodeum, and the anterior and middle tibiae are yellow, with the hind tibiae usually shaded with brown. They differ in that *psyllaephagus* has brassy or green iridescent coloration, the first and second funicular segments are equal in length, the width of the malar space is ⅔ the height of the compound eye, and the submarginal vein of the forewing has 4 or 5 dorsal bristles; *malacosomae* is metallic blue or blue-green, the first funicular is shorter than the second, the malar space is ½ the eye height, and the submarginal vein bears 2 dorsal bristles.

Female: Length 1.5–1.8 mm. Black, with faint metallic green or brassy iridescence visible on head and body; antennal scape tan, shaded with dark brown dorsally, pedicel and flagellum brown; wings hyaline, with tan veins; apices of femora, tibiae, and basal tarsal segments yellow; hind tibiae often shaded with brown.

Antennae inserted at level of ventral margins of compound eyes, apex of scape not reaching anterior ocellus; pedicel ⅞ as long as a funicular segment, all segments of funiculus equal in length, club twice as long as pedicel; width of malar space ⅔ as great as height of compound eye; ocellocular line ¾ as long as postocellar. Praescutum as long as wide and bearing 1 row of bristles at each lateral margin; prepectus and metapleuron sculptured, mesopleuron smooth; submarginal vein of forewing bearing 4 or 5 dorsal bristles, marginal vein 3 times as long as stigmal, apex of hindwing blunt; scutellum arched, 5 times as long as propodeum, and bearing 2 pairs of bristles; metanotum flattened medially. Propodeum extremely short at meson, only ⅔ as long as metanotum, surface faintly sculptured, paraspiracular carinae absent, spiracles touching anterior propodeal margin; gaster twice as long as thorax and propodeum; apices of ovipositor sheaths slightly protruding.

Male: Length 1.2–1.5 mm. Antennal scape black, broadened apically, with anterior carina on apical ⅓; funicular segments enlarged basally and bearing long bristles; hind tibiae seldom lacking subapical darkening; gaster as long as thorax and propodeum.

Type locality: Two miles NE of Portal, Arizona.

Type: USNM No. 65999.

Described from the type ♀, allotype ♂, and 90 ♀ and 110 ♂ paratypes from 2 miles NE of Portal, Ariz., 6–26 Nov. 1960, reared from nymphs of *Trioza collaris* Crawford on *Baccharis glutinosa,* M. Cazier.

Host relationships: This species is a primary parasite of the nymphs of the psyllid *Trioza collaris* Crawford.

Tetrastichus auplopus, new species

This species agrees with *johnsoni* Ashmead in having the ovipositor sheaths barely reaching the apex of the gaster, the propodeum possessing paraspiracular carinae, the praescutum bearing 1 row, consisting of only 3 or 4 bristles, at each lateral margin, and the submarginal vein of the forewing bearing 1 dorsal bristle. The two species differ in that *auplopus* is metallic blue, the apex of the hindwing is acute, the scutellum bears 3 pairs of bristles, and the width of the malar space is ⅔ as great as the height of the compound eye; *johnsoni* is nonmetallic in color, the apex of the hindwing is blunt, the scutellum bears 2 pairs of bristles, and the malar space is ½ the eye height.

Female: Length 0.8–1.0 mm. Metallic blue, surface strongly sculptured, not shining; antennal scape and pedicel yellow, flagellum brown; wings hyaline, veins yellow; basal half of each femur shaded with brown, legs distad of coxae otherwise yellow.

Antennae inserted slightly below level of ventral margins of compound eyes, apex of scape not reaching anterior ocellus; pedicel and first funicular segment equal in length, all three funiculars equal in length but becoming progressively slightly broader apically, club 2½ times as long as a funicular segment; width of malar space ⅔ as great as height of compound eye; ocellocular line ⅔ as long as postocellar. Praescutum wider than long and bearing 1 row composed of only 3 bristles at each lateral margin; prepectus, metapleuron, and posterior coxa shagreened, mesopleuron smooth posteriorly, anteriorly sculptured, but less strongly so than prepectus; submarginal vein of forewing bearing 1 dorsal bristle, marginal vein 3 times as long as stigmal, apex of hindwing acute, fringe at posterior margin ½ as wide as wing at hamuli; scutellum arched and bearing 3 pairs of bristles; scutellum 4 times as long as metanotum and twice as long as propodeum; metanotum flat, sculptured. Propodeum shagreened, median and paraspiracular carinae present, and short, oblique carinae extending anteriorly from posterior margin; spiracle separated by a space as great as its diameter from anterior propodeal margin; gaster slightly shorter than thorax and propodeum, apex of gaster blunt, ovipositor sheaths barely reaching apex of gaster.

Male: Unknown.

Type locality: Vienna, Virginia.

Type: USNM No. 66000.

Described from the type ♀ and 17 ♀ paratypes from Vienna, Va., reared 10 May 1942 from a mud cell of *Auplopus* sp., J. C. Birdwell.

Host relationships: This parasite emerged from the prepupa of the pepsine pompilid wasp *Auplopus;* it may be a primary parasite.

Tetrastichus milleri, new species

Tetrastichus sp. A, Telford, 1961, Canad. Ent., 93: 397.

This species agrees with *marcovitchi* (Crawford) in having faint metallic blue luster on the head and body, the marginal vein of the forewing 3½ times as long as the stigmal, the spiracles touching the anterior propodeal margin, and the tibiae mostly brown. The two species differ in that *milleri* has the width of the malar space ⅔ as great as the height of the compound eye, the ocellocular line is ½ as long as the postocellar line, the submarginal vein of the forewing has 2 dorsal bristles, and the gaster is 1¼ times as long as the thorax and propodeum; in *marcovitchi* the malar space is ½ the eye height, the ocellocular line is ⅓ as long as the postocellar, the submarginal vein bears 4 or 5 dorsal bristles, and the gaster is 1½ times as long as the thorax and propodeum.

Female: Length 1.1–1.25 mm. Dark brown, with faint metallic blue sheen on head, body, coxae, and femora; antennal scape and pedicel tan, flagellum brown; wings hyaline, veins tan; anterior margin of fore tibia, narrow areas at apices of all femora, bases and apices of tibiae, and basal tarsal segments tan.

Antennae inserted slightly dorsad of level of ventral margins of compound eyes, apex of scape reaching ventral margin of anterior ocellus; pedicel and each funicular segment equal in length, funiculars twice as long as wide, club slightly longer than apical 2 funicular segments; width of malar space ⅔ as great as height of compound eye; at 100× magnification, eyes with a few, short, scattered hairs; ocellocular line ½ as long as postocellar. Praescutum wider than long, with 1 row of bristles at each lateral margin; prepectus faintly sculptured, adjacent areas of mesopleuron smooth, surface sculpture of metapleuron similar to that of prepectus; submarginal vein of forewing with 2 dorsal bristles, marginal vein 3½ times as long as stigmal; apex of hindwing blunt; scutellum arched and bearing 2 pairs of bristles, both located posterior to middle; metanotum inflated, ⅕ as long as scutellum. Propodeum ¼ as long as scutellum, surface smooth, median carina only present, spiracles touching anterior propodeal margin; gaster 1¼ times as long as thorax and propodeum, apex acuminate, ovipositor sheaths slightly protruded.

Male: Unknown.

Type locality: Yosemite National Park, California.

Type: USNM No. 66001.

Described from the type ♀ and 5 ♀ paratypes, from Forsythe Pass or Porcupine Flat, Yosemite National Park, Calif., June–Aug. 1937, reared from *Evagora milleri* (Busck) material, J. S. Yuill, Hopkins U. S. No. 32255–Q.

Host relationships: This species is a secondary parasite of *Recurvaria milleri* (Busck), a gelechiid needle miner on lodgepole pine.

Tetrastichus megachilidis, new species

This species agrees with *T. holbeini* Girault in having the body elongate and slender with the gaster twice as long as the thorax, in having the antennae inserted below the level of the ventral margins of the compound eyes, the eyes noticeably hairy at 50× magnification, and the hind tibiae entirely light yellow or white. The two differ in that *megachilidis* is metallic blue, the first and second funicular segments are equal in length and each is 1½ times as long as wide, and the marginal vein of the forewing is 2½ times as long as the stigmal. In *holbeini*, the head and body are black with metallic green iridescence, the first funicular segment is longer than the second and twice as long as wide, and the marginal vein is 3½ times as long as the stigmal.

Female: Length 1.6–2.5 mm. Metallic blue, with surface not smooth, but minutely and closely reticulated; antennal scape tan, shaded with dark brown at apex, pedicel dark brown with apex tan; flagellum dark brown; wing veins, fore tarsus, and apical segment of middle and hind tarsus tan; trochanters, apices of femora, tibiae, and basal 3 segments of middle and hind tarsus yellow or white.

Antennae inserted slightly below level of ventral margins of compound eyes, apex of scape reaching level of anterior ocellus; pedicel and each funicular segment equal in length, club twice as long as a funicular segment; length of malar space ⅘ as great as height of compound eye; head, except for scrobes and occiput, clothed with numerous, short, closely set, bristly hairs, eyes hairy, under 50× magnification; length of ocellocular line twice as great as diameter of lateral ocellus and ⅖ as great as length of postocellar line. Pronotum dorsally hairy; praescutum wider than long and with 3 rows of bristles at each lateral margin; prepectus and metapleuron lightly sculptured, mesopleuron faintly sculptured, almost smooth; submarginal vein of forewing with 3 or 4 dorsal bristles; marginal vein thickened and 2½ times as long as stigmal, apex of hindwing blunt; scutellum flattened, longitudinal grooves distinct but shallow, two pairs of bristles present; metanotum smooth and slightly inflated medially, sculptured and depressed laterally. Propodeum faintly sculptured, almost smooth, weak median and paraspiracular carinae present; propodeum ⅐ as long as scutellum; spiracle separated by a space equal to its length from anterior propodeal margin; gaster twice as long as thorax; gaster narrower than propodeum at base, gradually widening to its greatest width at posterior margin of fourth tergum, constricting posteriorly to acuminate termination of seventh tergum, posterior end of seventh tergum produced so as partially to envelop the slightly protruding ovipositor, extension of seventh tergum beyond cerci less than ⅓ dorsal length of entire tergum.

Male: Length 1.5–2.0 mm. Antennae tan, legs mostly yellow or white, only hind femora extensively darkened. Antennal scape slightly inflated, darkened anterior carina extending from near base to apex; pedicel and first funicular segment equal in length and each slightly shorter than second funicular segment, all segments of funiculus subquadrate, not enlarged at bases nor bearing long bristles. Gaster ⅓ longer than thorax, acuminate at apex.

Type locality: Granite Reef Dam, Maricopa Co., Arizona.

Type: USNM No. 66003.

Described from 918 ♀ and 217 ♂ specimens, as follows: Type ♀, allotype ♂, and 34 ♀, 20 ♂ paratypes, Granite Reef Dam, Maricopa Co., Ariz., reared 16 June 1961 from cells of *Megachile gentilis* Cresson, K. V. Krombein; 710 ♀, 177 ♂ paratypes, same data, but emerged 18–22 May 1961; 173 ♀, 19 ♂ paratypes, Scottsdale, Ariz., emerged 16 June 1961 from cells of *Megachile gentilis*, K. V. Krombein. An additional large number of specimens from Granite Reef Dam are on hand, but are not included in the type series. Additional specimens, also not included in the type series, are from Pompano Beach, Fla., Oct. 1961, reared from the nests of *Megachile (Melanosarus) xylocopoides* Sm., K. V. Krombein.

Host relationships: This species has been reared from resting larvae or prepupae of the solitary bee *Megachile* (*Litomegachile*) *gentilis* Cresson, as well as from the nests of *Megachile* (*Melanosarus*) *xylocopoides* Smith. All the specimens were reared from trap nests. For a discussion of these nests, see Krombein, 1956 (Yearbook Amer. Phil. Soc., 1955: 138–40).

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A NEW CATFISH, *CORYDORAS PASTAZENSIS* (CALLICHTHYIDAE) FROM ECUADOR

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New species of the catfish genus *Corydoras* continue to make their appearance almost every year. Undescribed specimens from eastern Ecuador were sent to me for identification by Leonard P. Schultz of the U. S. National Museum. They belong to the long-snouted group of *Corydoras* (see Weitzman, 1961: 109) and appear most closely related to *Corydoras treitlii* Steindachner (1906). However, they differ in color pattern and certain proportions from this and any other known species.

I am indebted to Dr. Schultz for the loan of the specimens of this species; to Prof. George S. Myers of Stanford University, W. I. Follett of the California Academy of Sciences, and Dr. Paul Kähsbauer of the Naturhistorisches Museum, Vienna, for the loan of specimens for comparative examination.

Corydoras pastazensis, new species
(Fig. 1)

Holotype: U. S. National Museum 177216, 49.1 mm in standard length, collected during January 1954 by Ramon Olalla at Chicherata near the mouth of the Río Bobonaza, a tributary of the Río Pastaza, itself a tributary of the Río Maranon, Pastaza Province, Ecuador, about 2° 33′ S latitude and 76° 40′ W longitude.

Paratypes: USNM 164464, three specimens collected 19 January 1954 by Ramon Olalla near the mouth of Río Bobonaza, Napo-Pastaza settlement, Ecuador.

Diagnosis: *Corydoras pastazensis* may be distinguished from all known species of *Corydoras* by the following combination of characters. Least interorbital width 37 to almost 42% of snout length, least depth of the caudal peduncle 14.4 to 15% of the standard length, predorsal length about 78 to 80% of the postdorsal length, least caudal peduncle depth about 65 to 69% of the snout length, and caudal fin barred.

Description: All proportions and percentages are based on standard

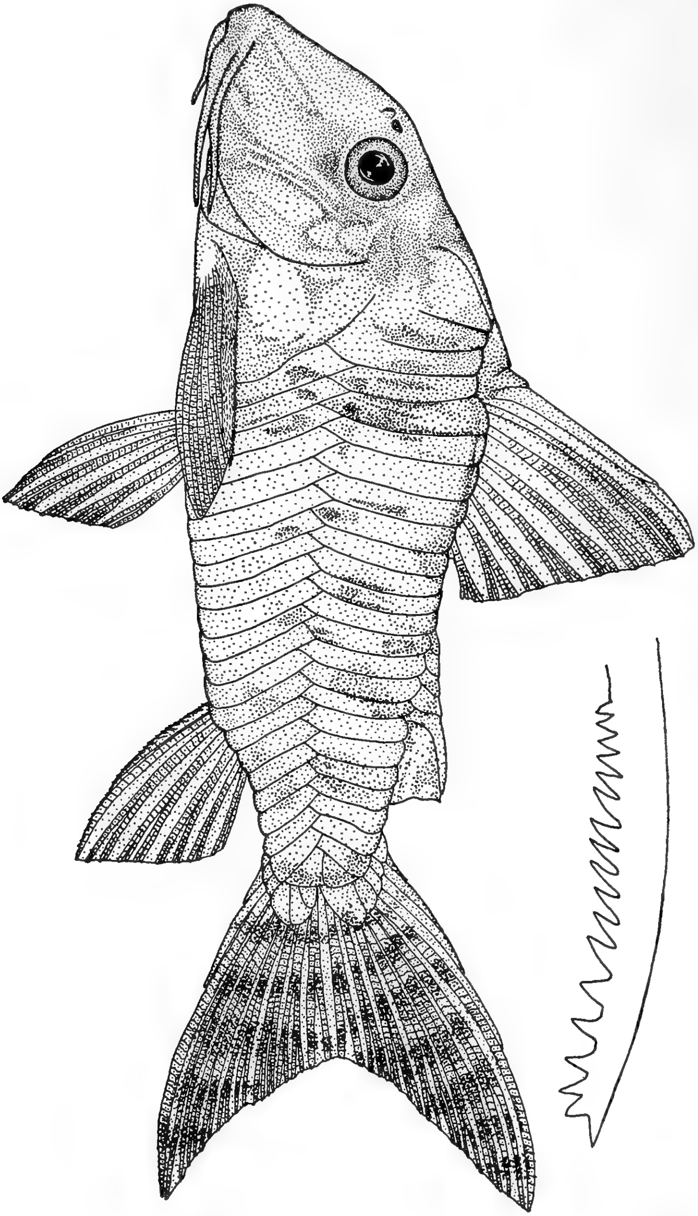

FIG. 1. *Corydoras pastazensis,* holotype USNM 177216. Standard length 49.1 mm. INSET: Ventral view of left pectoral fin spine.

TABLE 1.—Measurements in millimeters of specimens of *Corydoras pastazensis*

MEASUREMENTS	HOLOTYPE, USNM 177216	PARATYPES, USNM 164464		
		A	B	C
Standard length	49.1	49.6	50.6	60.7
Head length	16.7	16.3	16.3	20.0
Snout length	11.0	10.9	11.2	13.7
Least width of bony interorbital	4.6	4.2	4.6	5.1
Greatest diameter of bony orbit	4.5	4.3	4.6	5.1
Greatest width of suborbital	0.8	0.9	1.0	1.7
Length of fontanel	6.1	6.2	5.9	6.5
Length of predorsal scale	3.3	3.3	3.4	4.1
Greatest width of head	9.7	10.4	11.5	14.6
Snout tip to dorsal fin origin	24.6	24.3	25.0	31.0
Snout tip to adipose fin origin	40.9	41.3	42.4	51.7
Snout tip to anal fin origin	39.3	38.9	41.1	48.2
Snout tip to anterior edge of anus	26.1	27.2	27.0	31.5
Greatest body depth	17.5	18.2	18.6	22.5
Least depth of caudal peduncle	7.3	7.5	7.3	9.0
Distance between coracoids	5.0	5.3	5.1	6.3
Length of dorsal spine	11.2	11.9	12.6	14.4
Length of pectoral spine	10.9	12.0	11.8	13.3
Length of adipose spine	4.7	4.9	4.6	4.9
Postdorsal fin length	31.0	31.1	31.4	39.0
Post head length	35.1	34.6	35.3	43.7
Caudal peduncle length	7.2	7.2	6.7	9.3

length. Data for the holotype are given first, followed by data for paratypes in brackets. Specimens are listed as follows: Specimen A has a standard length of 49.6, specimen B 50.6, and specimen C 60.7 mm. Standard length of the holotype is 49.1 mm. Body fairly deep, greatest depth 2.7(36.4%) [A, 2.7(36.8%); B, 2.7(36.8%); C, 2.7(37.1%)]. Least depth of caudal peduncle 6.7 (14.9%) [A, 6.6(15.1%); B, 6.9 (14.4%); C, 6.7(14.8%)]. Dorsal fin origin nearer to snout tip than to caudal fin base (see Fig. 1). Distance between snout tip and dorsal fin origin 2.0(50.1%) [A, 2.0(49.0%); B, 2.0(49.5%); C, 2.0(51.1%)]. Distance between snout tip and anus 1.9(53.2%) [A, 1.8(54.8%); B, 1.9 (53.4%); C, 1.9 (51.9%)]. Anal fin origin to snout tip 1.3(80.0%) [A, 1.3(78.4%); B, 1.2(81.2%); C, 1.3(79.3%)]. Lateral scutes 24/21 in all specimens. Abdomen and thorax covered with fine posteriorly pointing, bony prickles in all specimens. Bony plates on abdomen and thorax absent. Azygous mid-dorsal scutes 4 [A, 6; B, 5; C, 4] before adipose fin and one before dorsal fin in all specimens. Pectoral fin base incompletely surrounded by coracoid. Area between coracoids 9.8(10.2%) [A, 9.4 (10.7%); B, 9.9(10.1%); C, 9.6(10.4%)]. Head length 2.9(34.0%) [A, 3.0(32.9%); B, 3.1(32.2%); C, 3.0(33.0%)]; its greatest width 1.7 (58.1%) [A, 1.6(63.8%); B, 1.4(70.6%); C, 1.4(73.0%)] in its length. Least width of bony interorbital 3.6 (27.6%) [A, 3.9(25.8%); B, 3.5 (27.2%); C, 3.9(25.5%)] in head length. Snout acute in dorsal view, snout tip well rounded; its length 1.5(65.9%) [A, 1.5(66.9%); B, 1.5 (68.8%); C, 1.5(68.5%)] in head length. Dorsal profile of snout concave in all specimens. When directed posteriorly rictal barbels reach a point directly on a vertical with the posterior margin of the eye. Greatest diameter of orbit 3.7(27.0%) [A, 3.8(26.4%); B, 3.5(27.2%); C, 3.9(25.5%)] in head length. Greatest width of suborbital 5.6(17.8%) [A, 4.8 (21.0%); B, 4.6(21.8%); C, 3.0(33.3%)] in orbit.

Dorsal fin I, 7 in all specimens, last fin ray split to its base. Neither depressed spine nor first soft ray of dorsal fin reaches adipose fin spine. Adipose fin spine 1.0(104.4%) [A, 0.9(114.0%); B, 1.0(100.0%); C, 1.0 (96.0%)] in orbit. Anal fin I, 5 in all specimens, last fin ray split to its base. Pectoral fin I, 10 in all but specimen C which had I, 11. Pelvic fin rays i, 5 in all specimens. Caudal fin with principal rays 7/7 in all specimens. Pectoral fin spine (Fig. 1) has 17 [A, 16; B, 18; C, 20] prominent, mostly recurved spinules along its posterior border.

Color: The holotype has the following color in alcohol. The overall body color is a pale yellowish brown. The anterior part of the head (that portion exclusive of the opercula) is a grayish brown. In life the belly may have been white as it is in many species of *Corydoras;* however, in the preserved specimens it is a pale brown. A rather indistinct brown vertical bar occurs below the dorsal fin in all specimens. Posterior to this band the body is irregularly spotted with moderate sized blotches. The caudal fin has a series of 7 to 9 narrow vertical dark bars (7 in the holotype) in the upper lobe, usually one or two less in the lower lobe. Color in life is unknown.

Discussion: *Corydoras pastazensis* appears definitely related to long-snouted *Corydoras* such as *Corydoras acutus* (Cope, 1872), *treitlii* Steindashner (1906), *spilurus* Norman (1926), *septentrionalis* Gosline (1940), *ellisae* Gosline (1940), *fowleri* Böhlke (1950), and *concolor* Weitzman (1961). *Corydoras pastazensis* is very similar to *treitlii* in body shape and proportions, interorbital width and snout length. On the basis of least interorbital width in snout length, *pastazensis* keys to *treitlii* in Gosline's key (1940: 13). Of the species described subsequent to Gosline (1940), only *fowleri* has the least interorbital width less than 50% of the snout length. The least interorbital width is 37.2 to 41.8% of the snout length in *pastazensis,* 46% in the unique type of *fowleri,* and 37.8 to 44.0% in two type specimens of *treitlii* at hand. These two specimens, from Steindachner's original series, plus the single known specimen of *fowleri* will be treated more fully in another paper.

Both *treitlii* and *fowleri* have similar color patterns and these patterns are very different from that of *pastazensis.* The upper body scutes are dark brown to black in *treitlii* and *fowleri* and these two species lack a barred caudal fin.

Corydoras fowleri is quite different from *pastazensis* in several respects. For example, the least depth of the caudal peduncle is 14.4 to 15.1% of the standard length in *pastazensis* while it is 10% in *fowleri.* The bony orbit is 25.5 to 27.8% of the head length in *pastazensis* while it is 22.8% in *fowleri.* In *fowleri* the predorsal length is about 67% of the postdorsal length while in *pastazensis* this percentage varies from 78.1 to 80.0%. In body proportions both *pastazensis* and *treitlii* are very similar, almost all proportions being within the same range. However, the least caudal peduncle depth in specimens of *treitlii* is 57 to 62% of the snout length while in *pastazensis* it is 65.2 to 68.8%.

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EVIDENCE AGAINST THE EXISTENCE OF CROCODILES IN VIRGINIA AND MARYLAND DURING THE PLEISTOCENE

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In 1917, Peterson reported finding a large crocodile tooth associated with the remains of a mastodon in a Pleistocene deposit found at Saltville in western Virginia. Later Gidley (1920) reported finding a single crocodile or alligator tooth in the material from the Cumberland Cave in western Maryland where it was associated with a temperate to boreal fauna.

These two teeth have had a remarkable effect on interpretations of eastern Pleistocene events. Any author attempting to discuss the faunal association of these deposits has had to either postulate some involved theory to account for the presence of crocodiles in a predominantly boreal fauna or to dismiss the whole assemblage as being such an obvious mixture of different periods that it could not be considered a unit fauna. To dismiss the collection as a hopeless mixture of different periods still leaves the problem posed by the presence of crocodiles in the mountains of western Virginia and Maryland at any time during the Pleistocene. The known changes in climate could not have produced in these mountains the habitats required by crocodilians. In addition to a warm, relatively stable climate, they require large bodies of water and/or extensive swamps and there is no evidence that either ever existed in the mountains of Virginia and Maryland during the Pleistocene.

Since the presence of crocodiles in the Appalachian mountains associated with Pleistocene mammals poses so many problems, it seems timely to review the evidence on which these records are based. In each case the evidence consists of a single tooth. With the discussion of each of these teeth an effort has been made to list every reference in which they are mentioned.

Museum No.: Carnegie Museum 3953.

Locality: Virginia, Smyth Co., Saltville.

References: Peterson, 1917 (Fig. 3); Hay, 1923; Nicholas, 1954.

This specimen is 95 mm long and 32 mm in diameter at its widest point. The specimen today is in three pieces. Whether or not it was broken when Peterson and Holland examined it is not known but it seem unlikely that it was since there is no indication of the breaks in the drawing presented by Peterson (1917, Fig. 3). With all three pieces in place it superficially resembles a large peg-like tooth, but the broken portions disclose the object to be composed of a stack of concavo-convex discs each approximately 7 mm thick at the edge. The outer surface is covered with a layer 2–3 mm thick of a whitish hard mineral. It appears to be a fossil invertebrate and most likely an orthoceran cephalopod. In any event, it is not the tooth of a vertebrate animal and it is not of Pleistocene origin. Presumably it had eroded from one of the limestones in the area and was deposited as a component of the gravel in which the Pleistocene mammals were found.

Museum No.: U. S. National Museum 8084.

Locality: Maryland, Allegany Co., Cumberland Cave, 4 mi NW Cumberland.

References: Gidley, 1920; Hay, 1923; Gidley and Gazin, 1938; Nicholas, 1953, 1954; Hibbard, 1958.

This tooth is 16 mm long, slightly flattened and slightly curved with a distinct keel on each side. The tooth is hollow with very thin and fragile walls. The absence of a root combined with the very large pulp cavity gives this tooth a distinctly reptilian appearance. However, in details of surface, shape, and thickness it does not agree with either *Alligator mississipiensis* or *Crocodylus acutus,* the two forms currently living in the southeastern United States. In shape it is closer to *Crocodylus acutus* but the crocodile tooth is more nearly round in cross section, the enamel has fine longitudinal striations and, in teeth of similar size, the enamel is thicker and more massive. In fact the very thinness of the enamel and the lack of a dentine layer in the cave specimen suggested an immature tooth of some mammal. Available for comparison was an unerupted canine of a dog. This tooth when dissected from the jaw presented the same "reptilian" appearance—rootless and hollow. It was little more than the enamel cap of the tip of the canine.

The specimen from Cumberland Cave was then compared with wolf and bear canines and found to agree in detail with the tip of the canine of a black bear (*Ursus americanus*). The conclusion is that this specimen is the enamel cap of an unerupted bear canine. This also accounts for the very fragile appearance of the tooth. Bears were numerous in this deposit. As estimated by Gidley and Gazin (1938: 23) no less than 25 individuals were represented by the material recovered.

The supposed presence of a crocodile in the Cumberland Cave has cast doubt on the contemporaneity of the animals in this deposit. As Hibbard

(1958: 9) said, "Some vertebrate collections cannot be considered as a unit fauna; they are assemblages consisting of both glacial and interglacial elements. One such is the well-known Cumberland Cave fauna of Maryland. . . . the presence of a crocodile or alligator with the remains of a boreal lemming, *Synaptomys* (*Mictomys*), indicates the mixture of an interglacial with a glacial fauna." With the crocodile removed from the list, the Cumberland Cave fauna becomes one of the best known examples of a local Pleistocene fauna in eastern United States.

It should be noted here that all of the other reported finds of Pleistocene crocodilians in the eastern United States are from the extreme southeast coastal plain and Florida, well within the present-day range of these animals.

Not to be plagued with montane Pleistocene crocodiles should aid both the zoogeographer and the climatologist in their interpretations of the many changes that took place in this area during the Pleistocene.

I wish to thank both Dr. Craig C. Black, Carnegie Museum, and Dr. C. Lewis Gazin, U. S. National Museum, for permission to borrow and study the specimens in their care. I also wish to acknowledge the assistance of Dr. J. Kenneth Doutt and Mr. John E. Guilday, Carnegie Museum, for supplying comparative material and suggestions that led to the identification of the Cumberland Cave tooth.

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PROCEEDINGS
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ADDITIONS TO THE LEIOLOPISMID LIZARDS KNOWN FROM THE PHILIPPINES, WITH DESCRIPTIONS OF A NEW SPECIES AND SUBSPECIES

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At the time of our review (1956) of the Philippine lizards belonging to the section *Leiolopisma* of the genus *Lygosoma,* six species were known to occur in the Philippines. Subspecies were recognized for three of the species: *auriculatum* (three subspecies), *quadrivitatum* (two subspecies), and *pulchellum* (two subspecies). In the case of *L. quadrivitatum,* one of the subspecies (*infralineolatum*) is wholly outside of the Philippine archipelago, occurring in the Celebes and adjacent small islands.

Extensive field work by the authors on Zamboanga Peninsula, Mindanao Island, in 1959 adds two more species, one previously undescribed, to the Philippine list; and collections by Professor D. S. Rabor in the mountains of northern Luzon in 1957 indicate the need of recognizing three rather than two subspecies of *L. pulchellum.*

We are deeply grateful to J. C. Battersby of the British Museum (Natural History) who reexamined the types of *L. infralineolatum* and *L. subvittatum* for us. We are grateful also to Neil Richmond of the Carnegie Museum in Pittsburgh (hereafter designated as C. M.), Robert F. Inger of the Chicago Museum of Natural History (C.M.N.H.), and Alan Leviton of the California Academy of Sciences (C.A.S.) for permitting us to examine pertinent material in the collections of their respective institutions. We also wish to thank Dr. Inger for his suggestion that we describe the new subspecies of *L. pulchellum.* Drawings were prepared by Mr. Walter Zawojski, Stanford Research Institute. This study is a part of the senior author's research program on the systematics and ecology of the amphibians and reptiles in the tropical forests of the Philippines, supported by National Science Foundation Grant 13085.

The field work on Dapitan Peak of the Malindang massif, in Zamboanga Peninsula, revealed the presence of a population of *L. q. quadrivitatum* and of a second species, similar in many characteristics, including ear covered by scales, but larger in size and differing in some features of the color pattern. The color pattern of the second species reminded us of that described for *L. subvittatum* by Günther (1873: 167) and suggested that the status of this species should be reexamined. *L. subvittatum* was placed by Boulenger (1887: 328), without comment, in the synonymy of *L. infralineolatum.*

Original color descriptions of Günther are as follows:

> *L. subvittatum*: "A broad bluish-white band runs along the middle of the back from the snout, and appears to be continued on the tail; it is bordered on each side by a narrower black band, which becomes indistinct in the posterior half of the trunk. Along the side of the head and neck there is another similar white and black band, the white band proceeding from the supraciliary edge, but this band is lost behind the shoulder. Sides of the body and lower parts whitish, immaculate. Legs with very faint brownish spots."
>
> *L. infralineolatum*: "Black above, with three golden-yellow longitudinal bands, as broad as the black ground-colour between. The middle band commences on the end of the snout, and is continued on the tail; the lateral band commences on the supraciliary edge, and runs along the side of the back to the root of the tail, where it is lost. The entire lower side with fine brown, longitudinal lines running along the meeting edges of the rows of scales. Limbs finely reticulated, and the toes annulated with black."

Careful comparison of a series, including one of the syntypes, of *L. q. quadrivitatum* and two specimens, including the type of *L. q. infralineolatum* (reexamination was made for us by Mr. Battersby), with the series of the larger species from Mindanao reveals that the dark longitudinal stripes are consistently prominent, relatively unvarying in width, and unbroken for the length of the body in both subspecies of *L. quadrivitatum,* whereas in the case of the larger species from Mindanao the dark stripes become narrow and fade out (except for one juvenile specimen) on the anterior part of the body (Fig. 1). This is similar to the fading out which is characteristic of *L. semperi* from eastern Mindanao.

The comparison also reveals one more significant difference, other than size and color; namely, the number of middorsal scale rows between the

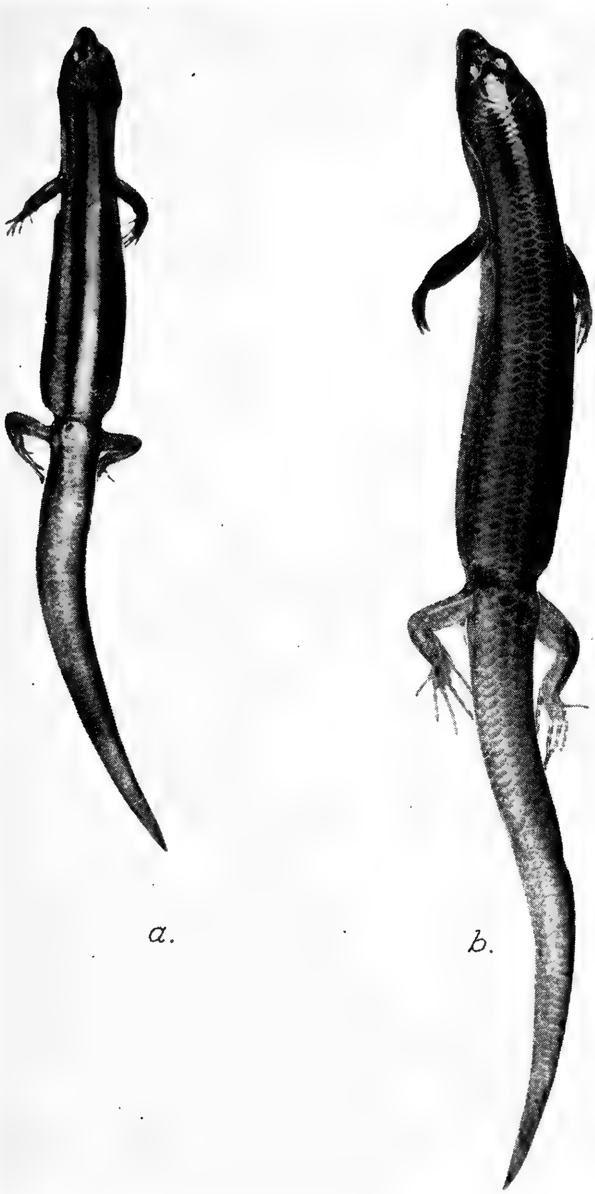

FIG. 1. Dorsal views of *Lygosoma* (*Leiolopisma*) sp. *a*, *L. q. quadrivitatum*, snout-vent length 36 mm; *b*, *L. subvittatum*, snout-vent length 52 mm.

TABLE 1.—Scale counts and body length for five Asiatic–Pacific forms of *Lygosoma* (*Leiolopisma*) having the ear opening covered by scales*

SPECIES	MIDBODY SCALE ROWS							MIDDORSAL SCALE ROWS (parietals to middle of hind limb)																				4TH TOE LAMELLAE									SIZE AT MATURITY	
	18	19	20	21	22	23	24	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	14	15	16	17	18	19	20	21	22	29–41 mm S-V	47–56 mm S-V
L. subvittatum			2		8		1													2	3 T		2	1	1		1				1	3	3	3	1	1 T	S-V of type = 39	9
L. surdum			1 T																						1 T						1 T							S-V length of type = 52
L. q. quadrivitatum	4		16 S					2	7	2	4 S	3	3	1	2	1												1			3	3	7	10 S	4	1	14	
L. relictum				1												1 S																1					1	
L. q. infralineolatum†					2 T							1		1 T																				2 T			2 S-V length of type = 27	

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* The numbers following each species indicate the number of specimens for which the characteristic was observed. *T* indicates the type specimen is included; S indicates syntype.

† In addition to the two specimens indicated here, as pointed out by Brown and Alcala (1956: 3), Boulenger (1897: 216) examined 10 specimens from Celebes and did not mention any variation from 22 midbody scale rows. Pending availability of additional material from Celebes, we continue, as in 1956, to follow Boulenger in regarding the Celebes population (*infralineolatum*) as distinct from the Philippine population (*quadrivitatum*).

parietals and the point even with the middle of the hind limbs. In our review of the Philippine species of *Leiolopisma* (1956) and in other papers dealing with various genera of skinks, this middorsal count has been made between the parietals and the point opposite the vent. In the present paper, since the counts for the types of *infralineolatum, subvittatum,* and *surdum* were made between the parietals and the middle of the hind limbs, we have made corresponding counts for those species reported in Table 1. Elsewhere in the present paper, the counts for middorsal scale rows were made as usual, between the parietals and the point opposite the vent. It is interesting to note that the range of middorsal scale rows, based on counts from the parietals to the point opposite the vent for 17 specimens of *quadrivitatum* (Brown and Alcala, 1956), was 48 to 53; while the range for the present series of 25 specimens, based on counts from the parietals to the middle of the hind limb, is 45 to 53. As shown in Table 1, *L. q. infralineolatum* from Celebes and *L. q. quadrivitatum* from the Philippines exhibit a range of middorsal scale rows from 45 to 53. Counts for nine of the specimens of the undetermined species from the Philippines exhibited a range in middorsal scale rows from 57 to 64. The type of *L. subvittatum* has a count of 58 middorsal rows. The count for the types of *L. subvittatum* and *L. infralineolatum* was made for us by Mr. Battersby, who also very kindly compared one specimen of our series from Mindanao Island with the type of *subvittatum.* He states that the larger size of the Mindanao specimen is the only real difference he can note. Since the type of *L. subvittatum* is in much closer agreement with the series constituting the sample of the larger species from western Mindanao than with the series of *L. q. quadrivitatum* or of *L. q. infralineolatum,* we revive the name *subvittatum* from the synonymy of *infralineolatum,* as available for the larger species from Mindanao. Whether or not the populations of Mindanao and Celebes are subspecifically distinct cannot be determined at this time. The other two known oriental species which share the character, ear covered by scales, are *L. relictum* from Engano Island and *L. surdum* from Malay. Dr. Robert F. Inger, who has reexamined the type of *L. nitens* Peters from Sarawak, Borneo, states (personal communication) that this specimen also has the ear opening covered by scales, not minute as originally stated by Peters. Inger further states that he believes it to be conspecific with *L. quadrivitatum.* Pending the availability of a much larger series from the Sarawak area, only four species—*surdum, relictum, subvittatum,* and *quadrivitatum* (the latter with two subspecies, *quadrivitatum* and *infralineolatum*—are recognized and included in Table 1. On the basis of the characters shown, and the assumption that these four species do comprise a phylogenetic group of related species, it appears that *L. subvittatum* may have closer affinities with *L. surdum* than with either of the other species.

Lygosoma (*Leiolopisma*) *subvittatum* (Günther)

Cophoscincus subvittatus Günther, 1873: 167 (original description); holotype in British Museum; Manado.

Material examined: Depitan Peak, Zamboanga Peninsula, Mindanao Island, 11 specimens (Stanford University, 22199–22209).

Diagnosis: A *Leiolopisma* of small to medium size, snout-vent length 47 to 56 mm at maturity (9 specimens); habitus moderately slender, snout not strongly depressed, rounded; its length about 6 to 8½ per cent of the snout-vent length; prefrontals separate or barely in contact; four large supraoculars; fourth supralabial beneath the center of the eye; ear covered by scales; nuchals present; midbody scale rows 20–24; fourth toe lamellae 17–21; scale rows between parietals and the point even with the middle of the hind limb 57–64; limbs pentadactyl, moderate in length.

Color (*in alcohol*): Dorsum (adults) rather brownish tan with a lighter dorsolateral stripe, bordered laterally by a darker area which, in some specimens, is in the form of a narrow stripe in the region of the neck and forelimb; a dark brown stripe on either side of the light vertebral area, beginning in the frontoparietal and supraocular region and narrowing and fading out in the region of the forelimbs (Fig. 1, *b*); upper surface of limbs dusky; toes with dark transverse blotches; venter rather uniformly light. One juvenile, 35 mm snout-vent length, approaches more closely Günther's original description of a whitish middorsal stripe. Also in this juvenile, the dorsal and dorsolateral dark stripes continue with only moderate fading to the region of the hind limbs, as is typical of *L. quadrivitatum*.

Habitat: The 11 specimens of *L. subvittatum* from Mindanao Island were all found in humus of epiphytic ferns in original forest in the upper dipterocarp and the submontane zones on Dapitan Peak at altitudes of about 3,000 to 4,500 feet. The four specimens of *L. quadrivitatum* from the same locality were collected at altitudes of 2,400 to 2,500 feet, three from under moss on the trunks of trees and only one from an epiphytic fern. On Negros Island, also *quadrivitatum* has been taken only at low altitudes, below 2,000 feet, where specimens have been taken from leaf axils of Pandanus trees and sago palm. On Palawan Island, in the area around Thumb Peak and Central Peak, where no other species of *Leiolopisma* is presently known, *L. quadrivitatum* occurs primarily in the aerial fern habitat. Twenty-eight of 31 specimens, collected in dipterocarp forest at altitudes between 200 and 1,500 feet, were found in aerial ferns. The other three were found beneath bark or in tree holes.

Lygosoma (Leiolopisma) zamboangensis, new species

The unique specimen of this species was collected in the transitional submontane–montane forest zone on the west side of Dapitan Peak, Zamboanga Peninsula, Mindanao Island, by the junior author in April 1959.

In the counts for midbody scale rows, middorsal scale rows between parietals and base of tail, and subdigital lamellae, as well as in the moderate dilation of the basal lamellae, it is in close agreement with a series of *Lygosoma* (*Leiolopisma*) *semperi* Peters (1867: 18) from Mindanao Island. However, it differs markedly from *semperi* in the shorter, more

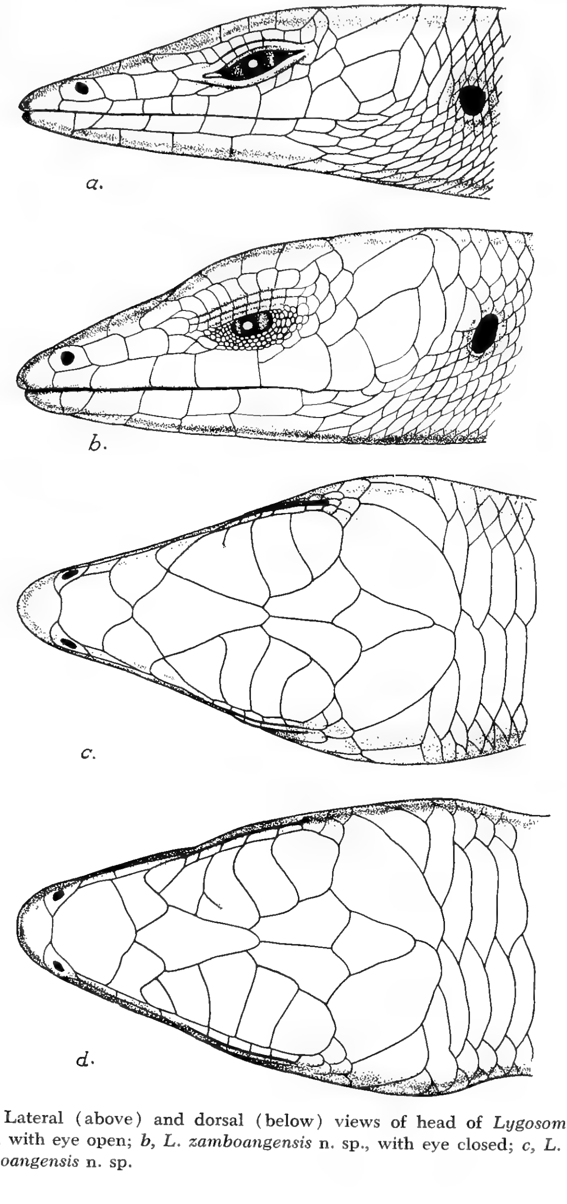

FIG. 2. Lateral (above) and dorsal (below) views of head of *Lygosoma* sp. *a*, *L. semperi*, with eye open; *b*, *L. zamboangensis* n. sp., with eye closed; *c*, *L. semperi*; *d*, *L. zamboangensis* n. sp.

blunt, less depressed snout, the number of the supralabials anterior to the center of the eye, the shape of the large temporal (Fig. 2), and the color pattern.

Holotype: Natural History Museum, Stanford University, No. 22425, a male, collected 24 km southeast of Buena Suerte, New Piñan (about 5,200 feet altitude), on the west side of Dapitan Peak, Mount Malindang massif, Zamboanga Peninsula, Misamis Occidental Province, Mindanao Island, Philippine Islands.

Description of type: A small *Leiolopisma*, snout-vent length 44.5 mm for a mature male; habitus rather slender, snout not much depressed, relatively short and bluntly rounded, its length about 8¾ per cent of the snout-vent length; prefrontals separated by the frontal which is in contact with the frontorostal; frontorostral slightly broader than long; frontal 1½ times as long as the fronto-parietals; interparietal distinct; 4 large supraoculars; nuchals 4–4; postnasal and frenal of about equal length; 6 supralabials, fourth longest and beneath the center of the eye; temporals enlarged; ear opening moderate; tympanum slightly sunk; 24 midbody scale rows; 54 middorsal scale rows between the parietals and the base of the tail; 19 lamellae beneath the fourth toe on the right hind foot, the 11 beneath the basal phalanges moderately dilated. Snout-vent length 44.5 mm, axilla to groin 24 mm; snout to forelimb 16 mm; hind limb 17.5 mm; snout 3.75 mm.

Color (Kodachrome slide from life and alcohol preservation): Ground color of dorsal and upper lateral surfaces greenish with a rust-brown iridescence along the middorsal region in life; a pair of black or blackish-brown stripes, each stripe about half the width of the vertebral scale rows, beginning on the supraocular and fronto-parietal region and continuing unbroken but with increasingly uneven outer margin onto the anterior part of the body. On the posterior part of the body these dark stripes are broken into a series of blotches which become progressively smaller and more widely separated and dispersed posteriorly (Fig. 3, *a*). A second black stripe begins on either side of the head in loreal region, passes through the eye and above the ear and undergoes a similar breaking-up and dispersal posterior to the region of the fore-limb. The upper sides of the limbs are spotted with black or blackish-brown blotches; the venter is uniformly light.

Lygosoma (*Leiolopisma*) *semperi* Peters

Lygosoma (*Lipinia*) *semperi* Peters, 1867: 18 (original description); holotype probably in Berlin Museum; Mindanao Island, Philippines.

At the time (1956) of publication of our previous paper on this group of lizards we had examined only one specimen (C.N.H.M. 22552) from eastern Mindanao Island. We have since examined a series of additional specimens from eastern Mindanao (C. M. 1685, 1687, 1689–92, 1694–95) which are in close agreement with the previously examined specimens in both scale counts and color pattern. Another specimen (C.N.H.M. 9651) collected by D. S. Rabor and party at San Isidro, Matuquinas, Samar Is-

FIG. 3. Dorsal views of *Lygosoma* (*Leiolopisma*) *pulchellum*. *a*, *L. p. levitoni*, snout-vent length 41 mm; *b*, *L. p. pulchellum*, snout-vent length 43 mm; *c*, *L. p. taylori*, snout-vent length 50 mm.

land, in May 1957 is tentatively referred to this species. Unfortunately, the specimen is poorly preserved but appears to differ from the Mindanao series primarily in the lighter ground color and the darker and longer dorsolateral stripes which extend to the region of the hind limbs.

Lygosoma (*Leiolopisma*) *pulchellum* (Gray)

Lipinia pulchella Gray, 1845: 84 (original description); holotype in British Museum; Philippine Islands.

In our previous paper (1956) we recognized two subspecies, one from Negros Island and the other from Mindanao, Bohol, Luzon, and Pollillo islands. These were distinguished primarily on differences in the color pattern (Fig. 3) and the number of supraoculars. A recent collection made by D. S. Rabor in the mountains of northern Luzon, although limited to three specimens, reveals the presence of a population in the northern mountains which is more closely related, on the basis of the above characteristics, to the Negros population than it is to the population in southern Luzon.

Since this population is completely separated from the Negros population by the Mindanao subspecies, which occupies southern Luzon, we conclude that three subspecies should be recognized. Also we note, at this point, that the populations from southern Luzon and Polillo islands, which are grouped in one subspecies with those from Bohol and Mindanao islands, do exhibit some minor color differences; but in view of the lack of material from the intervening islands of Leyte and Samar, we have chosen to retain these disjunct populations in a single subspecies.

The three subspecies of *pulchellum* which we do recognize may be distinguished by the following key:

1*a*. Six large supraoculars, 4 of which are more or less rectangular in shape and much broader than long 2

1*b*. Four or 5 large supraoculars, 2 or 3 of which are more or less rectangular and much broader than long .... *pulchellum*

2*a*. A whitish vertebral stripe occupying the mesial third of the vertebral rows of scales, marked by occasional encroachments of brown flecks; a series of irregularly shaped brown spots on either side of the vertebral stripe, each spot three or four scales in length and separated from adjacent spots by lighter, brown-flecked areas one to two scales in length (Fig. 3, *c*) .... *taylori*

2*b*. Light vertebral stripe absent, the area with brown flecks throughout; dorsolateral series of irregularly shaped dark brown spots present, each spot two or three scales in length, separated by light brown areas of about equal length (Fig. 3, *a*) .... *levitoni*

Lygosoma (Leiolopisma) pulchellum levitoni, new subspecies*

Holotype: Chicago Natural History Museum No. 120953, a male, collected by D. S. Rabor and party in May 1957, in the Cordillera Mountains in northern Luzon Island.

Paratypes: C.N.H.M. 120954–55, same locality as the holotype.

Diagnosis: A small *Leiolopisma*, snout-vent length 41 to 44 mm (two specimens); snout sharply pointed; head and snout strongly depressed; midbody scale rows 22–24 (three specimens); scale rows between parietals and base of tail 53–55 (three specimens); 6 supraoculars, second through fifth more or less rectangular as in the population from Negros Island; narrow middorsal whitish stripe not present; a longitudinal series of dark brown spots at the outer edges of the two middorsal scale rows.

Color: Dorsum light brownish, the result of a dense pattern of small, brown flecks on a light (whitish) background; a dorsolateral series of irregularly shaped dark brown spots present; each spot two or three scales in length and separated by lighter areas of about the same length on the body; spots on the base of the tail somewhat smaller and more widely separated; a dark brown line beginning at the nostril, passing through the eye, above the ear and forelimb, and broken into a series of spots on the

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*Named for Dr. Alan Leviton who worked extensively on Philippine snakes.

posterior part of the body; upper surface of limbs spotted with brown (Fig. 3, *a*); venter uniformly light without brown markings.

From a zoogeographic standpoint it is interesting to note that only a single species of *Lygosoma* (*Leiolopisma*), *L. quadrivitatum*, is known from north Borneo, as is also true for Palawan Island. Dr. Robert F. Inger (personal communication) states that *L. nitens*, from Borneo, the type of which he has examined, is a synonym of *L. quadrivitatum*. From Celebes only *L. subvittatum* and *L. quadrivitatum infralineolatum* are recorded. Thus the Philippine group of eight species appears to be primarily an endemic, relict group or, in part, a group which has evolved in situ.

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GEOGRAPHIC VARIATION AND PLUMAGE SEQUENCE OF THE TANAGER *HEMITHRAUPIS FLAVICOLLIS* IN THE GUIANAS AND ADJACENT BRAZIL

By Kenneth C. Parkes and Philip S. Humphrey[1]
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A request by Humphrey for the assistance of Parkes in determining the subspecific identification of a Surinam specimen of the tanager *Hemithraupis flavicollis* proved to be impossible to fulfill without additional revisionary study. In turn, geographic variation could not be studied properly until we had come to some understanding of the sequence of plumages in this species. Accordingly, pertinent specimens were borrowed through the courtesy of the authorities of the Chicago Natural History Museum and American Museum of Natural History to supplement those available in our own institutions. We are especially obliged to Emmet R. Blake for information and advice as well as for specimens loaned to us. Terminology for plumages and molts is that of Humphrey and Parkes (1959).

PLUMAGE SEQUENCE

In males of this species, four age classes are apparently separable. The juvenal plumage is greenish yellow, with the typically fluffy feather texture of juvenile passerines. This is succeeded by a second yellow plumage, brighter in color, acquired by a body molt, the juvenal wing and tail feathers being retained. The juvenal wing is easily recognizable, as it lacks a white speculum but has broad yellow wing-bars and edgings. This second yellow plumage is lost at the first *complete* molt. Stages of this molt are illustrated by two specimens before us: CM 83293, Obidos, Brazil, 18 January, is just beginning to acquire the yellow rump and has begun wing and tail molt, while CNHM 260731, Kaysergebergte Airstrip, Surinam, 19 December, has completed the wing molt except for the two outermost primaries (which are still sheathed), has completed the tail molt, and has the body molt completed or under way in most tracts. The

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[1] Present address: United States National Museum.

plumage acquired at this molt resembles the definitive plumage of the male, but is browner or greener (less blackish) above, and has broader yellow edgings to the wing and tail feathers. This difference is illustrated by CM 61913, 4 June, and CM 62526, 17 July, both from French Guiana. The dorsal coloration in this "subdefinitive" plumage varies with the degree of blackness of the definitive plumage. In the Carnegie Museum material of the deep, velvety black race *centralis*, the one younger male, CM 91974, is just noticeably duller black dorsally than the two definitive males, but can be immediately identified by the yellow-edged upper wing coverts. In a duller-backed population like that of the lower Amazon, this "subdefinitive" stage is decidedly brownish above, as illustrated by two AMNH specimens from Faro. Birds of this age also tend to be yellower below than definitive males, this again varying with the general "yellowness" of the population as manifested in both sexes. The oldest available Surinam bird is a YPM specimen (Kaysergebergte Airstrip, 3 December), which has almost completed the second (i.e., first complete) molt, but still has some juvenal rectrices. This male is exceptionally yellow below and, judging from the comparisons of other available plumages, belongs to a rather yellowish population.

Since there is no evidence among any specimens we have examined that there is any alternate plumage in the cycle of adult birds, the four successive plumages of males described above may be called juvenal, first basic, second basic, and definitive basic. Plumage sequence in females has not been studied.

GEOGRAPHIC VARIATION

Blake (1961: 182) was the first to record specimens of this species with accurate data from Surinam. He reported two males from the Kaysergebergte Airstrip (spelled "Kaisersberg" by Blake). A third male from this same locality was reported by Humphrey and Freund (1962: 10). There is a fourth Surinam specimen in the Chicago Natural History Museum, a male from the Paloemeu Airstrip (for Surinam localities, see map in Humphrey and Freund, *op. cit.*: 3). Both Blake and Humphrey and Freund listed their specimens as *Hemithraupis f. flavicollis,* a race for which the type locality is Cayenne.

The three specimens from the Kaysergebergte Airstrip, all males, suggest the presence here in southwestern Surinam of a very yellowish race, which apparently extends southwest in the Acary Mountains at least to "Boundary Camp," British Guiana (see map in Blake, 1950: frontispiece). The one female examined (CNHM 120484, "Boundary Camp") resembles females of the undescribed lower Amazon population in having the upper tail coverts and adjacent rump area brighter than the back, but has yellows which are richer (more chrome yellow, less greenish), especially on the under tail coverts. This population almost certainly constitutes a valid subspecies, but formal naming should await the availability of males in definitive plumage.

Specimens from lowland British Guiana and the one male from the

Paloemeu Airstrip, Tapanahoni River, Surinam, differ so little in color from a good series from French Guiana and, as shown by Blake (1950: 469), differ so slightly in size, that they are best placed with *flavicollis*. It might be considered surprising, as Blake has pointed out to us (*in litt.*), that birds from Paloemeu Airstrip differ from those of Kaysergebergte, only some 80 miles away. However, there is a major drainage divide between these two localities which influences the respective taxonomic affinities of the two populations of *Hemithraupis flavicollis*, Kaysergebergte toward the west and Paloemeu toward the east.

Males of this population from lowland British Guiana differ from French Guiana specimens in color only in having a slight tendency toward the scaly blackish marks below the yellow throat patch typical of several races of this species; this could be interpreted as the beginning of intergradation toward *aurigularis*, the next race to the west, which possesses these marks. We have nothing to add to Blake's pertinent remarks (1950: 468–469), which should be consulted, about the validity of the supposed race *hellmayri* from western British Guiana.

Pinto (1944: 534) did not list this species from the lower Amazon region of Brazil, but mentioned in a footnote that the nominate race of the Guianas probably extended into adjacent extreme northern Brazil. He overlooked the record of Griscom and Greenway (1941: 331), who listed the Carnegie Museum specimens from Obidos. The latter authors made no taxonomic comments, nor did they mention that this was the first report of the (supposed) nominate race from Brazil. Zimmer (1947: 16) listed without comment two males from Faro, just upstream from Obidos, in the American Museum of Natural History. However, as shown by his list of specimens examined, he had only one male of true *flavicollis*, a trade skin from "Cayenne," for comparison.

The population of the lower Amazon proves to constitute another recognizable race, and of these enough material is available to permit formal separation, as follows:

Hemithraupis flavicollis obidensis, new subspecies

Type: Carnegie Museum No. 83807, adult ♂, Obidos, Pará, Brazil, collected 23 February 1921, by S. M. Klages (original No. 26904).

Characters: Males in definitive basic plumage differ from *flavicollis* of French Guiana in being duller, more brownish black above, and in having the yellow of throat, rump, and under tail coverts less intense. The difference in dorsal coloration is even greater in males in the second basic ("subdefinitive") plumage, in which Cayenne males are brownish black, Amazonian males dark brownish olive. Amazonian males in the latter plumage also have more of a pale yellow wash over the white portions of the underparts than do corresponding Cayenne males. Males in the first basic plumage and females are paler and more greenish above and below, with the upper tail coverts and lower rump more contrasting with the back.

Range: North bank of the lower Amazon in Brazil; known from Obidos and Faro in Pará. A single young male from the Rio Manacapurú, Amazonas (Carnegie Museum) also appears to belong here.

Remarks: There is some noticeable variation in nominate *flavicollis* even within French Guiana, with the characters best developed in the eastern part of that country (Pied Saut, Oyapock River), where both sexes are darkest in dorsal coloration. Separation of *obidensis* does not delete nominate *flavicollis* from the list of Brazilian birds, as the Carnegie Museum has one male (in 2nd basic plumage) from "Upper Arucauá," in northernmost Pará near the French Guiana frontier (on this locality see Todd, 1942: 369).

SPECIMENS EXAMINED

H. f. flavicollis: FRENCH GUIANA: Pied Saut, Oyapock River, 14; Tamanoir, Mana River, 8. BRAZIL: "Upper Arucaua," Pará, 1. SURINAM: Paloemeu Airstrip, Tapanahoni River, 1. BRITISH GUIANA: Rockstone, 1; Potaro Landing, 4; Tumatumari, Potaro River, 1; Caramang River, 2.

H. f. obidensis: BRAZIL: Obidos, Pará, 10; Faro, Rio "Jamunda"(= Nhamundã), Pará, 2; Rio Manacapurú, Amazonas, 1.

H. f. subsp.: SURINAM: Kaysergebergte Airstrip, 3. BRITISH GUIANA: "Boundary Camp," Acary Mountains, 2.

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PROCEEDINGS
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THE NOMENCLATURE OF SOUTH AMERICAN PECCARIES

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According to Cabrera (1961: 316), the name for the white-lipped peccary, *Tayassu pecari* G. Fischer, 1814, is a junior homonym of *Sus pecari* Link, 1795. The latter, in the opinion of the same authority, is based on a collared peccary described by Buffon in volume 10 of the *Histoire Naturelle* . . . (1763: 21, pls. 3, 4, 13). Consequently, Cabrera replaced *Tayassu pecari* G. Fischer with *Tayassu albirostris* Illiger, 1815. Although Cabrera's judgments in nomenclatorial matters are rarely questioned, his present conclusions appear to be without foundation. First, *Tayassu pecari* G. Fischer is obviously no homonym of *Sus pecari* Link. Second, *T. pecari* G. Fischer and *S. pecari* Link are actually objective synonyms, both being based on the same white-lipped peccary originally described by Buffon in supplementary volume 3 of the *Histoire Naturelle* . . . (1776: 92–94), as shown below.

Fischer (1814: 284–287) erected the genus *Tayassu* for the two living American species of peccaries, as follows:

> [p. 284] "68. TAYASSU. [description follows]
>
> [p. 285] "*Pecari.* 1. *T*[*ayassu*] corpore nigro, maxillâ inferior albâ. [synonymy follows]
>
> [p. 287] "*patira.* 2. *T*[*ayassu*] corpore nigro, fasciâ humerali albâ. [synonymy follows]."

The full synonymy of *Tayassu pecari* given by Fischer is a composite of white-lipped and collared peccaries. The diagnosis, however, refers specifically to the white-lipped form described in the Sonnini edition of Buffon (1800, 27: 93 [but see p. 101]) as well as the white-lipped peccary, or *tagnicati,* of Azara (1801: 25). *T. patira,* also based on the Sonnini edition of Buffon (loc. cit.), is clearly the collared peccary.

In his classification of mammals, Link (1795: 104) employed the then current generic name *Sus* for the known species of suiforms, as follows:

[p. 104] "*Gen.* 9 *Sus.* Schwein [description follows]
"S[us] Scrofa, Porcus
"S. *Pecari,* niger, dorso cystifero, cauda nulla. Ist grosser als die folgende Art.
[p. 105] "*T* [= lapsus for S?] *Tajassu,* fuscus, dorso cystifero, cauda nulla.
"S. *Patira,* fuscus, litura dorsi alba, dorso cystifero, cauda nulla.
"S. *africanus* . . .
"S. *aethiopicus* . . .
"S. *Babyrussa* . . ."

The preceding diagnoses of *pecari, tajassu,* and *patira* are quoted in full. No types or bibliographic references are cited by Link but it is implicit from the text that all three names are based on Buffon (1776: 92–94), who describes them as follows (translated from the original French): "M. de La Borde remarks that there are two species of pecari in Cayenne which are quite distinct and which never intermix. The larger has white hair on its chops and a round white spot the size of a crown piece on each side of the jaw. The rest of the body is black and the animal weighs about 100 pounds. The smaller species [i.e., *tajassu*] has reddish hair and as a rule does not weigh more than 60 pounds. . . . M. de La Borde mentions [p. 94] another species called patira also found in the Guianas. . . . It is the size of the smaller one but differs from it only by having a white line along the spine from neck to tail."

Sus tajassu Link is a variant spelling of S. *tajacu* Linnaeus, the first name for the collared peccary. S. *patira* Link applies to the Guianan form of the same species but is preoccupied by *Sus patira* Kerr (1792: 353) with identical type. As for *pecari* Link, it is impossible to escape the conclusion that it is the first valid name proposed for the *grosser,* or white-lipped, peccary. The priority of *pecari* Link had already been pointed out by first reviser Osgood (1921: 39).

The names for South American peccaries recognized by Cabrera (1961: 315) may be summarized as follows:

Tayassu G. Fischer; type *Tayassu pecari* Fischer (= *Sus pecari* Link), designated by Miller and Rehn (1901, Proc. Boston Soc. Nat. Hist., 30: 12).

Tayassu pecari Link, 1795 (white-lipped peccary)
Synonyms: *pecari* Fischer, 1814, *albirostris* Illiger, 1815, *labiatus* Cuvier, 1817, *spiradens* Goldman, 1912, *aequatoris* Lönnberg, 1921, *beebei* Anthony, 1921. Type locality: Cayenne, French Guiana.

Tayassu tajacu tajacu Linnaeus, 1758 (Brazilian collared peccary)
Synonyms: *tajassu* Erxleben, 1777 and *tajassu* Link, 1795, *minor* Schinz (not Kerr), 1825, *caitetu* Liais, 1872, *torquatus* of authors, not Cuvier. Type locality: Pernambuco, Brazil.

Tayassu tajacu patira Kerr, 1792 (Guianan collared peccary)
Synonyms: *minor* Kerr, 1792, *patira* Link, 1795, *torquatus* Cuvier,

1817 (based on the *patira* of Buffon), *macrocephalus* Anthony, 1921. Type locality: Cayenne, French Guiana.

Cabrera also recognized *T. t. bangsi* Goldman, 1917 [= *modestus* Cabrera, 1917], *niger* J. A. Allen, 1913, and *torvus* Bangs, 1898. Subspecific distinction of these from each other and from *patira* Kerr is doubtful.

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REVISION OF SOME GENERA OF POLYCHAETE WORMS OF THE FAMILY SPIONIDAE, INCLUDING THE DESCRIPTION OF A NEW SPECIES OF *SCOLELEPIS*

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In reviewing the Spionidae from the New England region, the genera have proved to be particularly difficult. The characters that have been used to distinguish some of them are questionable. The same generic names have sometimes been based on different type species and so used in dissimilar senses. Monographic works on the Spionidae by Mesnil (1896) and Söderström (1920) have added considerably to our knowledge of the group but they are in disagreement on some basic points in regard to generic names. An attempt is made in the present paper to lessen the generic confusion that has prevailed in two groups of spionids: those with branchiae and pointed prostomia, and those with branchiae and distinct frontal horns.

Among the spionid material examined, a new species of *Scolelepis* was found among some polychaetes collected in the Gulf of St. Lawrence and sent to me by E. L. Bousfield of the National Museum of Canada. The holotype, four paratypes and seven additional specimens are deposited in the National Museum of Canada; five paratypes and five additional specimens are deposited in the U. S. National Museum.

This study was carried out for the most part at the U. S. National Museum and aided by grants from the National Science Foundation (NSF G-4833 and GR-136).

The spionid genera with branchiae and with pointed prostomia include *Scolelepis* Blainville (including the subgenus *Nerinides* Mesnil), *Aonides* Claparède, and *Dispio* Hartman. The prostomia are distinctly pointed, without frontal horns,

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and the peristomia surround the prostomia like a hood. The pharynx tends to be eversible as a bulbous proboscis. The eggs usually have thick membranes and membrane vesicles. Development is predominantly pelagic (Hannerz, 1956). The species of this group are characteristically burrowers and form no definite tube. Some of the species have a wide geographic distribution.

KEY TO THE SPIONID GENERA WITH BRANCHIAE AND WITH POINTED PROSTOMIA

1. Branchiae distinct from dorsal lamellae, on anterior region of body only .... *Aonides* Claparède
1. Branchiae fused basally to dorsal lamellae, continued to near posterior end 2
2. Branchiae beginning on setiger 1. Pygidium a simple collar or with anal cirri .... *Dispio* Hartman
2. Branchiae beginning on setiger 2. Pygidium with anal disc or bilobed to multilobed appendage .... (*Scolelepis* Blainville) 3
3. Neuropodial lamellae in middle and posterior regions notched, with smaller lower lobe or "ventral cirrus" .... Subgenus *Scolelepis* Blainville
3. Neuropodial lamellae not notched, without "ventral cirrus" .... Subgenus *Nerinides* Mesnil

Genus *Aonides* Claparède, 1864

Aonides Claparède, 1864, p. 505. Type species, by monotypy: *A. auricularis* Claparède, 1864, p. 505 (= *Nerine oxycephala* Sars, 1862).

Paranerine Czerniavsky, 1881, p. 359. Type species, by monotypy: *Nerine oxycephala* Sars, 1862, p. 64.

Diagnosis: Prostomium acutely conical, spindle-shaped, without frontal horns. Peristomium more or less fused with prostomium. Branchiae beginning on setiger 2, confined to anterior region of body, not fused to dorsal lamellae. Hooded hooks in both notopodia and neuropodia in posterior region; hooks bidentate and tridentate. Pygidium with anal cirri. Eggs with thick membranes and membrane vesicles. Development entirely pelagic and lecithotrophic (Hannerz, 1956).

KEY TO THE SPECIES OF THE GENUS *AONIDES*

1. Hooded hooks tridentate. Branchiae 10–11 pairs. Ireland. .... *A. paucibranchiata* Southern, 1914
1. Hooded hooks bidentate 2
2. Branchiae 20–30 pairs. Norway and Mediterranean. .... *A. oxycephala* (Sars, 1862)
2. Branchiae 13–14 pairs. West coast of Mexico. .... *A. californiensis* Rioja, 1947

Aonides diverapoda Hoagland, 1920, from the Philippine Islands, belongs to the Trochochaetidae (= Disomidae), not to the Spionidae. The type specimen (USNM 18961) is in poor condition and the original description is incomplete. It is here referred to the genus *Trochochaeta.* See Pettibone (in press) for revision of the Trochochaetidae.

Genus *Dispio* Hartman, 1951, emended

Dispio Hartman, 1951, p. 86. Type species, by monotypy: *D. uncinata* Hartman, 1951, p. 87.

Diagnosis: Prostomium fusiform, without frontal horns, with nuchal ridge extending posteriorly. Peristomium enclosing prostomium like a hood. Branchiae beginning on first setiger, not confined to anterior region of body, fused basally to dorsal lamellae. With (in type) or without digitiform accessory branchiae on posterior part of notopodia in middle and posterior regions. With neuropodial hooks. Without notopodial hooks. Hooks hooded, entire. Pygidium a simple collar or with anal cirri.

The following four species are here referred to the genus *Dispio*:

D. uncinata Hartman, 1951. Gulf of Mexico.
D. remanei Friedrich, 1956. Central America.
D. schusterae Friedrich, 1956. Central America.
D. magna (Day, 1955). South Africa.

D. remanei and *D. schusterae* are incompletely described. Day's species was originally described as *Spio magnus.* It is similar to *D. uncinata.* No mention is made of the accessory branchiae characteristic of that species, but those structures are transparent and easily overlooked.

Genus *Scolelepis* Blainville, 1828, emended

Scolelepis Blainville, 1828, p. 492. Type species, by monotypy: *Lumbricus squamatus* Müller, 1806, p. 39 (cited erroneously as *Scolelepis squamosa*).

Aonis Audouin and Milne-Edwards, 1833, p. 400. Type species, by monotypy: *A. foliosa* Audouin and Milne-Edwards, 1833, p. 402. Invalid junior homonym of *Aonis* Savigny, 1820, p. 45.

Nerine Johnston, 1838, p. 68. Type species, selected by Quatrefages, 1843, p. 9: *N. coniocephala* Johnston, 1838, p. 70 (= *Aonis foliosa* Audouin and Milne-Edwards, 1833). See remarks on page 98.

Pseudomalacoceros Czerniavsky, 1881, p. 361. Type species, by monotypy: *Malacoceros longirostris* Quatrefages, 1843, p. 13 (= *Lumbricus squamatus* Müller, 1806).

Nerinides Mesnil, 1896, p. 152. Type species, by original designation: *Nerine longirostris* Saint-Joseph, 1894, p. 74 (= *Nerinides cantabra* Rioja, 1918). Invalid junior homonym of *Malacoceros longirostris* Quatrefages, 1843, p. 13.

Scolecolepis Michaelsen, 1897, p. 45. Erroneous spelling of *Scolelepis* Blainville, 1828, p. 492. Not Malmgren, 1867, p. 90.

Pseudonerine Augener, 1926, p. 159. Type, by monotypy: *P. antipoda* Augener, 1926, p. 159. Invalid junior homonym of *Pseudonerine* Czerniavsky, 1881, p. 361.

Diagnosis: Prostomium pointed anteriorly, without frontal horns, with cephalic ridge and pointed tip posteriorly. Peristomium enlarged, surrounding prostomium like a hood. Proboscis massive. Branchiae beginning on setiger 2, continued to near posterior end, more or less completely fused to notopodial lamellae, at least in anterior region. Ventral lamellae deeply cleft in posterior part, with distinct upper and lower lobes, with hooks and setae between, the lower lobe appearing as a "ventral cirrus" (in subgenus *Scolelepis*) or ventral lamellae without distinct notch (in subgenus *Nerinides*). With neuropodial hooks; without notopodial hooks or with few notopodial hooks in far posterior region. Hooks hooded, entire, bidentate to quadridentate. Pygidium with oval disc or multilobed membranous appendage, without anal cirri. Eggs with thick reticulated shells and membrane vesicles. Development entirely pelagic and predominantly planktotrophic (Hannerz, 1956). Burrowing species, forming vertical burrows, without definite tubes.

According to the revision herein, the following are referred to *Scolelepis* (*Scolelepis*):

1. S. *squamata* (Müller, 1806). Denmark, as *Lumbricus squamatus;* Mediterranean, as *Lumbricus cirratulus* Delle Chiaje, 1822; France, as *Malacoceros longirostris* Quatrefages, 1843; New Jersey, as *Nerine agilis* Verrill, 1873; Virginia, as *Nerine heteropoda* Webster, 1879; California, as *Spio acuta* Treadwell, 1914; South Africa, as *Nerine capensis* McIntosh, 1925; Texas, Gulf of Mexico, as *Nerine minuta* Treadwell, 1939; Jamaica, West Indies, as *Nerinides goodbodyi* Jones, 1962.
2. S. *foliosa* (Audouin and Milne-Edwards, 1833). France, as *Aonis foliosa*; England, as *Nerine coniocephala* Johnston, 1838; locality?, as *Aonis vittata* Grube, 1855; Italy, as *Nerine sarsiana* Claparède, 1869; California, as *Nerine foliosa occidentalis* Hartman, 1961.
3. S. *bonnieri* (Mesnil, 1896). France, as *Nerine Bonnieri.* Perhaps young of S. *foliosa.*
4. S. *perrieri* (Fauvel, 1902). Senegal, West Africa, as *Nerine Perrieri.*
5. S. *lefebvrei* (Gravier, 1905). Red Sea, as *Nerine Lefebvrei.*
6. S. *alaskensis* (Treadwell, 1914). Alaska, as *Scolecolepis alaskensis.* Incomplete description, perhaps S. *foliosa* (Audouin and Milne-Edwards, 1833).
7. S. *antipoda* (Augener, 1926). New Zealand, as *Pseudonerine antipoda.* Incomplete description.
8. S. *squamata saipanensis* (Hartman, 1954). Saipan, Marianas, as *Nerine cirratulus saipanensis.*
9. S. *oligobranchia* (Chlebovitsch, 1959). Kurile Islands, as *Nerine oligobranchia.* Similar to S. *foliosa* (Audouin and Milne-Edwards, 1833)?

10. S. *williami* (De Silva, 1961). Ceylon, as *Nerinides Williami.* Near S. *squamata* (Müller, 1806).
11. S. *kinghtjonesi* (De Silva, 1961). Ceylon, as *Nerinides Knight-Jonesi.*

According to the revision herein, the following are referred to *Scolelepis* (*Nerinides*):

1. S. *tridentata* (Southern, 1914). Ireland, as *Nerinides tridentata.*
2. S. *cantabra* (Rioja, 1918). Spain, as *Nerinides cantabra*; France, as *Nerine longirostris* Saint-Joseph, 1894; France, as *Nerinides st. josephi* Jones, 1962.
3. S. *papillosa* (Okuda, 1937). Korea, as *Nerinides papillosus.*
4. S. *yamaguchii* (Imajima, 1959). Japan, as *Nerinides yamaguchii.*
5. S. *arenicola* (Hartmann-Schröder, 1959). Central America, as *Nerinides arenicola.* Incomplete description.
6. S. *gilchristi* (Day, 1961). South Africa, as *Nerinides gilchristi.*
7. S. *bousfieldi* (see below). Gulf of St. Lawrence.

The following species is indeterminable:

1. *Nerine auriseta* Claparède, 1869. Italy.

KEY TO SELECTED SPECIES OF *SCOLELEPIS*

1\. Neuropodial lamellae bilobed posteriorly, with neurosetae and hooks between the lobes, the lower lobe ("ventral cirrus") smaller .... (Subgenus *Scolelepis*) 2

Neuropodial lamellae not notched, without distinct lower lobe ("ventral cirrus") .... (Subgenus *Nerinides*) 8

2\. Hooded hooks unidentate 3

Hooded hooks bidentate 6

3\. Prostomium with distinct occipital antenna. Branchiae completely united to dorsal lamellae in anterior region, absent in extreme posterior region. Neuropodial hooks beginning on setiger 58–60, up to 16–20 per lobe. Notopodial hooks beginning on setiger 60–65, about 10 per lobe .... S. (S.) *foliosa*

Prostomium without occipital antenna. Branchiae and dorsal lamellae distinct distally 4

4\. Neuropodial hooks beginning about setiger 31. Notopodial hooks beginning about setiger 55 .... S. (S.) *bonnieri*

Neuropodial hooks beginning after setiger 35. Notopodial hooks absent, or apparently so 5

5\. Neuropodial hooks beginning about setiger 38. Without notopodial hooks .... S. (S.) *lefebvrei*

Neuropodial hooks beginning about setiger 43. Without notopodial hooks? (posterior end missing) .... S. (S.) *knightjonesi*

6\. First setiger with notosetae .... S. (S.) *squamata*

First setiger without notosetae 7

7\. With notopodial hooks in posterior region. Branchiae without papillae .... S. (S.) *perrieri*

Without notopodial hooks. Some anterior branchiae terminating in

2–6 clavate papillae .... S. (S.) *williami*

8\. Without notosetae on first setiger 9

With notosetae on first setiger. Neuropodial hooded hooks tridentate and quadridentate. Prostomium with erect occipital antenna 11

9\. Hooded neuropodial hooks tridentate, beginning on setiger 15–16. Prostomium with erect occipital antenna, with 4 eyes in transverse row .... S. (*N.*) *tridentata*

Hooded neuropodial hooks bidentate 10

10\. Prostomium with erect occipital antenna, without eyes. Neuropodial hooks beginning on setiger 16. Basal portion of tentacular palps with papillated membranous sheath .... S. (*N.*) *papillosa*

Prostomium without erect occipital antenna, with 4 eyes arranged in a square. Neuropodial hooks beginning on setiger 33–45. Basal portion of tentacular palps without papillated membranous sheath .... S. (*N.*) *cantabra*

11\. Neuropodial hooks beginning anterior to setiger 19 12

Neuropodial hooks beginning posterior to setiger 19 13

12\. Neuropodial hooks beginning on setiger 13–15 .... S. (*N.*) *bousfieldi*

Neuropodial hooks beginning on setiger 17–18 .... S. (*N.*) *gilchristi*

13\. Neuropodial hooks beginning on setiger 20–21 .... S. (*N.*) *yamaguchii*

Neuropodial hooks beginning on setiger 25 .... S. (*N.*) *arenicola*

Scolelepis (Nerinides) bousfieldi, new species

(Figs. 1, 2)

Nerinides sp. Sanders, 1958, pp. 247, 249, 250.

Materials: Southwestern part of Gulf of St. Lawrence, E. L. Bousfield, National Museum of Canada (NMC), 1960—PRINCE EDWARD ISLAND: New London Bay, mud, muddy sand, detritus, 1.7–2.5 fathoms, 16 July (2, USNM); Bideford Estuary, fine mud, shells, dead eelgrass, 2 fathoms, 21 July (3, USNM; 3, NMC; Malpeque Bay, off Bideford Estuary, mud, dead eelgrass, 4 fathoms, 22 July (1, NMC); Conway Narrows Reserve, mouth of Cascumpeque Bay, sand, eelgrass, shallow flats, 28 July (1, NMC). NEW BRUNSWICK: Richibucto Harbor, below NW arm, sand, stones, shells, 5 fathoms, 2 August (1, NMC), St. Simon, Inlet North Channel, sand, sandy mud, shells, 1.7–4 fathoms, 5 August (1, NMC), Shediac Island, Channel, sand, shells, 2 fathoms, 14 August (holotype, NMC 1103; 5, USNM; 4, NMC).

MASSACHUSETTS: Buzzards Bay, silty clay, 7–10 fathoms, 1955, H. L. Sanders, Woods Hole Oceanographic Institution (40, USNM; 10, WHOI).

Description: Length up to 12 mm, width up to 1.5 mm, segments up to 42. Body widest anteriorly, flattened dorsoventrally, with short segments; posterior region narrower, subcylindrical, with segments longer, moniliform. Prostomium (Fig. 1, A, B) spindle-shaped, tapering anteriorly

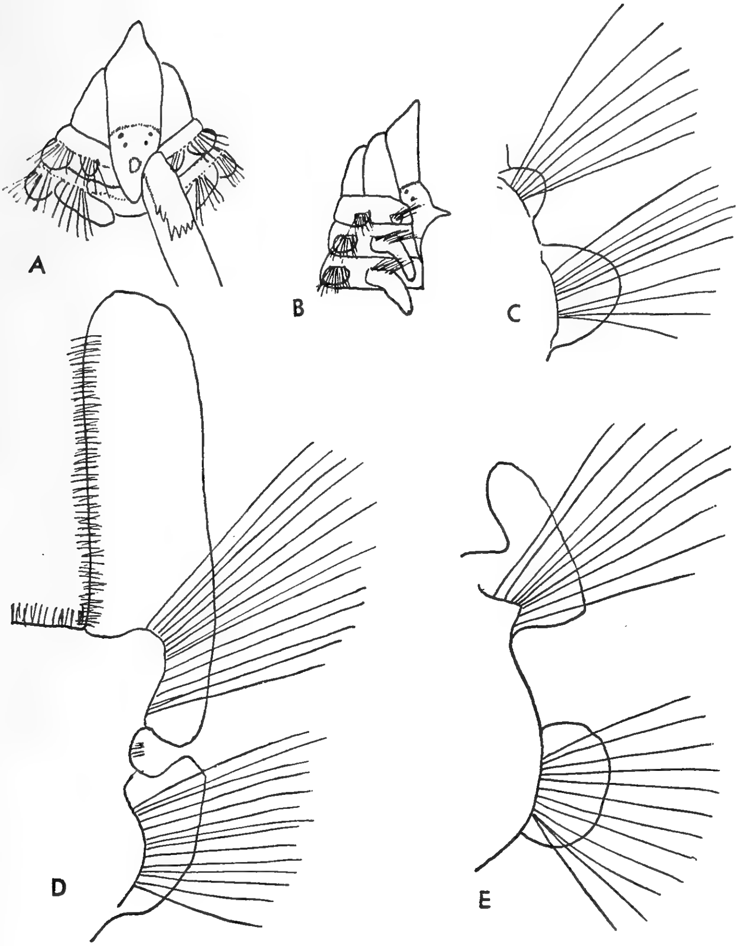

FIG. 1. *Scolelepis* (*Nerinides*) *bousfieldi*, new species. A—Dorsal view anterior end, base of right tentacular palp only shown. B—Lateral view anterior end, tentacular palps missing. C—Left parapodium from setiger 1, anterior view. D—Same, from setiger 2. E—Same, from setiger 6.

to a pointed tip, with cephalic crest on posterior part extending to setiger 2; with erect occipital antenna in middle and 4 eyes on anterior part of cephalic crest (or without eyes; eyes not observed on specimens from Buzzards Bay). Peristomial segment achaetous, enlarged, lateral and ventral to prostomium, surrounding prostomium like a hood. Tentacular palps extending posteriorly as far as setiger 13, thicker at base, with papillated membrane on lateral part. First setigerous segment (Fig. 1, A–C), with small rounded postsetal notopodial lamellae and larger rounded postsetal neuropodial lamellae, with spreading bundles of notosetae and neurosetae.

Branchiae beginning on setiger 2, continuous with dorsal lamellae on setigers 2–13, ciliated on inner border (Fig. 1, D, E). Branchiae and dorsal lamellae distally distinct from about setiger 14; branchiae becoming gradually smaller posteriorly, very small or lacking after setiger 26 (Fig. 2, A, B). Dorsal transverse ciliated bands at level of branchiae, with additional ciliated band between, making 2 transverse ciliated bands per segment. Ciliated sensory organs between rami.

Body divided roughly into 3 regions. Anterior region (setigers 2–13, Fig. 1, D) with notopodial postsetal lamellae continuous with branchiae and with elongate oval postsetal neuropodial lamellae. Notosetae wider basally, tapering to capillary tips. Neurosetae similar to but shorter than notosetae. Middle region (setigers 14 to about 25, Fig. 2, A) with notopodial lamellae and branchiae distinct distally. Neurosetae replaced by neuropodial hooks beginning on about setiger 14 (13–15), up to 7–15 hooks per row. Neuropodial hooks hooded, tridentate in lateral view (Fig. 2, C), 5-toothed in end view, consisting of one main tooth and 2 smaller upper pairs. Neuropodial lamellae suboval, dorsal to hooks. Large yolky eggs or sperm massed in middle region; body thin-walled, appearing transparent, gelatinous. Posterior region (beginning at about setiger 26, Fig. 2, B, D) with branchiae small or lacking and notopodial lamellae elongate, digitiform, posterior to few long notosetae. Neuropodia similar to those of middle region. Pygidium with anus dorsal and with oval anal disc (Fig. 2, D).

Remarks: *Scolelepis* (*Nerinides*) *bousfieldi* differs from the species of the typical subgenus in having the neuropodial lamellae entire, not notched. Of the species of the subgenus *Nerinides,* it most closely resembles S. *gilchristi* (Day) from South Africa and S. *yamaguchii* (Imajima) from Japan. The three species have spindle-shaped prostomia with an erect occipital antenna, basal portion of tentacular palps with papillated sheath (palps were missing in S. *gilchristi*), with notosetae on first setiger, with branchiae completely fused to notopodial lamellae in anterior region, without notopodial hooks. The hooded hooks are tridentate in lateral view in S. *bousfieldi* and S. *yamaguchii,* quadridentate in S. *gilchristi.* Pygidium with oval anal disc in S. *bousfieldi,* with flattened expansion more or less bilobed in S. *yamaguchii* (posterior end missing in S. *gilchristi*). The neuropodial hooks in S. *bousfieldi* begin on setiger 13–15, up to 7–15 per row; in S. *gilchristi,* they begin on setiger 17–18, up to 10–12 per row; in S. *yamaguchii* they begin on setiger 20–21, up to 20–30 per row. The posterior notopodia of S. *bousfieldi,* with elongate cylindrical notopodial lamellae and branchiae lacking, are characteristic. The very large yolky eggs of S. *bousfieldi* and the gelatinous thin-walled egg-bearing segments of the middle region of the body suggest the possi-

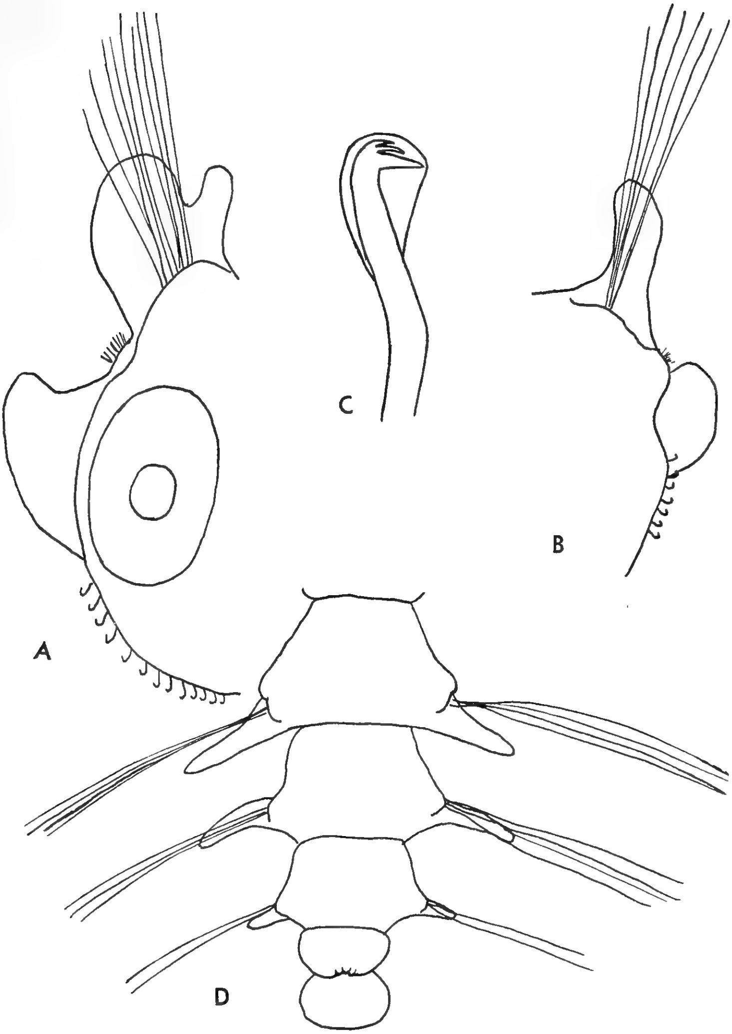

FIG. 2. *Scolelepis* (*Nerinides*) *bousfieldi,* new species. A—Right parapodium from middle region (setiger 25), anterior view (one of large yolky eggs in body shown). B—Left parapodium from posterior region (setiger 32), anterior view. C—Hooded neuropodial hook, lateral view. D—Dorsal view posterior end.

bility of a development similar to that of *S. yamaguchii,* in which there is formed a gelatinous spawn-mass where early development takes place, as described by Imajima.

According to Sanders (1958, as *Nerinides* sp.), it was one of the dominant species of the deposit-feeding infauna; it formed 6.85% of the population of a soft-bottom association.

The species is named for E. L. Bousfield of the National Museum of Canada.

Distribution: Gulf of St. Lawrence (Prince Edward Island, New Brunswick), Massachusetts (Buzzards Bay, Woods Hole). In low water to 10 fathoms.

Genus *Malacoceros* Quatrefages, 1843, emended

Malacoceros Quatrefages, 1843, p. 8. Type species, by present selection: *Spio vulgaris* Johnston, 1827, p. 335. See remarks below.

Colobranchus Schmarda, 1861, p. 66. Type species, by monotypy: *C. tetracerus* Schmarda, 1861, p. 66.

Uncinia Quatrefages, 1865, p. 439. Type species, by monotypy: *Colobranchus ciliatus* Keferstein, 1862, p. 118 (= *Colobranchus tetracerus* Schmarda, 1861).

Scolecolepis Malmgren, 1867, p. 90. Type species (original designation): *Spio vulgaris* Johnston, 1827, p. 335.

Rhynchospio Hartman, 1936, p. 51. Type species, by monotypy: *R. arenincola* Hartman, 1936, p. 51.

Remarks: *Nerine* Johnston, 1838, was proposed for *Spio vulgaris* Johnston, 1827 and *N. coniocephala* Johnston, 1838. The latter species was selected as the type of *Nerine* by Quatrefages, 1843 (p. 9). The former species was referred by Quatrefages to *Malacoceros* Quatrefages, 1843. *Nerine coniocephala* Johnston, 1838, was referred to *Aonis foliosa* Audouin and Milne-Edwards, 1833, by Malmgren, 1867 (as *Nerine foliosa*). It follows then that *Nerine* Johnston, 1838, would fall as a junior synonym of *Scolelepis* Blainville, 1828 (see page 91). Söderström, 1920, on the other hand, selected *Spio vulgaris* Johnston, 1827, as the type species of *Nerine.* However, the earlier selection by Quatrefages, 1843, and by Malmgren, 1867, should be followed. *Scolelepis,* as used by Mesnil, 1896, and followed by the majority of polychaete workers was used in a different sense from *Scolelepis* Blainville, 1828.

Malacoceros Quatrefages, 1843, was proposed for the following three species:

Spio vulgaris Johnston, 1827.

M. giardi Quatrefages, 1843 (= *Spio vulgaris* Johnston, 1827).

M. longirostris Quatrefages, 1843 (= *Lumbricus squamatus* Müller, 1806).

Diagnosis: Prostomium with distinct frontal horns, with a slightly projecting crest posteriorly. Branchiae beginning on setiger 1 (subgenus

Malacoceros) or setiger 2 (subgenus *Rhynchospio*), continuing posteriorly to last few segments; branchiae more or less free from notopodial lamellae. With neuropodial hooks; without notopodial hooks. Hooks hooded, bidentate or tridentate. Pygidium with anal cirri. Eggs with thick shells and membrane vesicles. Development largely pelagic and predominantly planktotrophic (Hannerz, 1956).

According to the revision herein, the following nine species are referred to *Malacoceros* (*Malacoceros*):

1. *M. vulgaris* (Johnston, 1827). England, as *Spio? vulgaris;* France, as *Malacoceros giardi* Quatrefages, 1843; France, as *Nerine floroeensis* Saint-Joseph, 1894.
2. *M. laevicornis* (Rathke, 1837). Crimea, Black Sea, as *Spio laevicornis.*
3. *M. tetracerus* (Schmarda, 1861). France, as *Colobranchus tetracerus;* France, as *Colobranchus ciliatus* Keferstein, 1862.
4. *M. fuliginosus* (Claparède, 1869). Italy, as *Spio fuliginosus* (? = *Spio laevicornis* Rathke, 1837).
5. *M. gravieri* (McIntosh, 1915). England, as *Euspio gravieri* (? = *Colobranchus tetracerus* Schmarda, 1861).
6. *M. vanderhorsti* (Augener, 1927). West Indies, as *Scolecolepis vanderhorsti.*
7. *M. indicus* (Fauvel, 1928). Gulf of Manaar, Indian Ocean, as *Scolelepis indica.*
8. *M. derjugini* (Uschakov, 1948). Murman Coast, as *Scolelepis derjugini.*
9. *M. murmanicus* (Uschakov, 1948). Murman Coast, as *Scolelepis murmanica.*

According to the revision herein, the following three species may be referred to *Malacoceros* (*Rhynchospio*):

1. *M. glutaeus* (Ehlers, 1897). Magellan Strait, as *Scolecolepis glutaea;* Antarctic, as *Scolecolepis cornifera* Ehlers, 1913.
2. *M. arenincolus* (Hartman, 1936). California, as *Rhynchospio arenincola.*
3. *M. arenincolus asiaticus* (Chlebovitsch, 1959). Kurile Islands, as *Rhynchospio arenicola asiatica.*

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PROCEEDINGS
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A NEW SPECIES OF GONATID SQUID FROM THE NORTHEASTERN PACIFIC[1]

By William G. Pearcy and Gilbert L. Voss
Department of Oceanography, Oregon State University and The Marine Laboratory, University of Miami

This paper describes a new species of squid, *Gonatus anonychus,* which was collected in oceanic waters of the northeastern Pacific Ocean off the Oregon coast during 1960–62.

Gonatus anonychus belongs to the family Gonatidae which is composed of two genera, *Gonatus* and *Gonatopsis.* The genus *Gonatus* includes two other species: *G. fabricii* (Lichtenstein, 1818) and *G. magister* Berry, 1913.

The authors are grateful to Bruce Wyatt, Michael Laurs, Ward Renshaw, and to the crew of the R/V *Acona* for making collections at sea, to William Aron and the University of Washington for the loan of the *G. magister,* to Shirley Moorhead for preparing the illustrations, and to James McCauley for comments on the manuscript.

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Gonatus anonychus, new species

Holotype: Male, in alcohol, mantle length 69.5 mm, from 45°26.8′N, 125°08.1′W, 11 September 1960. USNM 575559.

Paratypes: Two males, mantle length 70.0–73.0 mm, and two females, mantle length 61.0–65.0 mm, deposited at The Marine Laboratory, University of Miami. (Twenty other specimens are located at the Department of Oceanography, Oregon State University.)

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[1] Contribution No. 466 from the Institute of Marine Science, University of Miami.

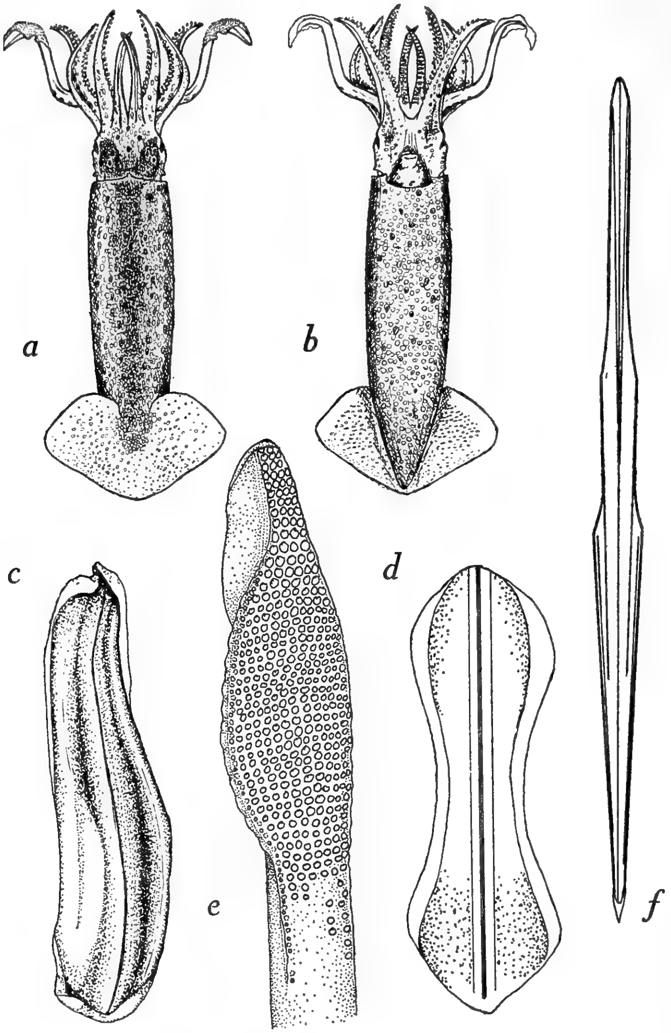

FIG. 1. *Gonatus anonychus,* new species. *a,* Dorsal view. *b,* Ventral view. *c,* Funnel cartilage. *d,* Nuchal cartilage. *e,* Left tentacular club. *f,* Ventral view of gladius.

Description: The mantle (Fig. 1*a,b*) is long, loliginiform, cylindrical for two-thirds its length, from the anterior mantle edge to the insertion of the fins; the posterior one-third of the mantle is conical, ending in a blunt point. The maximum mantle width may occur anywhere in front of the fins and is from one-fourth to one-fifth of the dorsal mantle length. There is a small triangular projection on the anterodorsal midline of the mantle margin and a broad ventral emargination beneath the funnel bordered laterally by acute projections. The mantle wall is thick, measuring 2.5–3.0 mm.

The *fins* are subterminal, their length about one-third of the mantle length. The breadth of the combined fins is about 1.6–1.9 times their length. The anterior margins are convex with anterior lobes; the posterior margins are nearly straight.

The *funnel* extends anteriorly to about the middle of the eye and has rounded margins, a blunt end and a transverse groove on the ventral surface. The funnel organ consists of a dorsal inverted V-shaped member and smaller, slightly angular ventral pads. The funnel-locking apparatus (Fig. 1*c*) consists of a slightly sinuous funnel cartilage which is slightly expanded posteriorly with a broad depression or sulcus on the anterior two-thirds, ending posteriorly as an angular ridge.

The *nuchal cartilage* (Fig. 1*d*) is expanded at both ends, with a median minimum width only about one-fifth of the total length. The longitudinal crest has a median groove along its entire length.

The *head* is short, somewhat compressed, constricted at the neck and not quite as wide as the anterior edge of the mantle. The funnel groove on the ventral surface of the head is well defined and has a number of longitudinal ridges entending anteriorly. There are three nuchal folds on each side of the head, of which the middle one is largest with a small free olfactory lobe. The *eyes* are large, with variable-sized lid openings which have a distinct sinus on the anterior border between the third and fourth arms.

The *arms* are short, the arm order formula usually 2.4.3.1. The first arms are very short and the others are subequal. The first pair possess a low keel along the full length of each arm; the second pair are smooth; the third arms are flattened and equipped aborally with a broad well-developed swimming keel; the ventral pair are flattened with a broad tentacular sheath along the dorsal edge. There is no hectocotylization in the males.

All of the arms possess four rows of suckers. The suckers of the marginal rows are strongly pedicillate and the chitinous rings have generally six flattened, rectangular teeth with blunt tips (Fig. 2*b*); these large teeth are sometimes bordered laterally by one or two small teeth. The suckers of the inner rows are larger, particularly on the middle portion of the arms. The chitinous rings of the suckers from the basal two-thirds to three-fourths of the inner rows are not differentiated into separate narrow teeth, but consist of distal and proximal chitinous lips (Fig. 2*a*). A few (less than six) of the inner suckers in the basal portion of the first three pairs

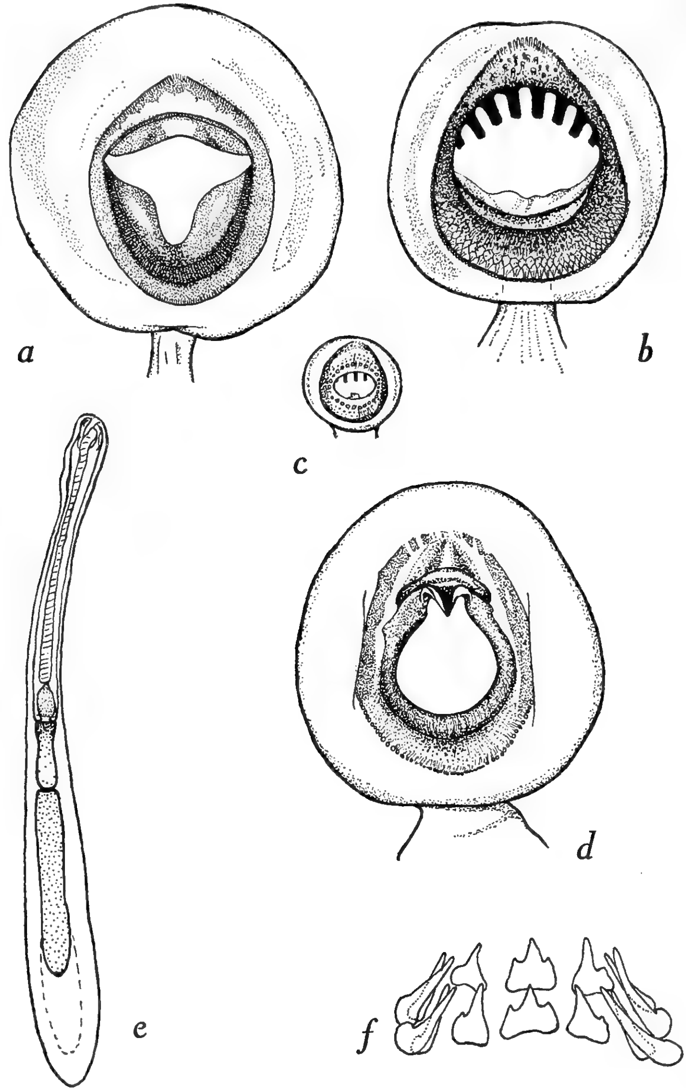

FIG. 2. *Gonatus anonychus,* new species. *a,* Sucker from basal two-thirds of inner rows of third arms. *b,* Sucker from outer row of third arms. *c,* Sucker from tentacular club. *d,* Sucker from inner row of basal portion of third arm of female. *e,* Spermatophore. *f,* Radula.

TABLE 1.—Measurements (in mm) of the holotype and selected paratypes of *Gonatus anonychus*, new species

	HOLOTYPE	PARATYPES			
Sex	♂	♂	♀	♂	♀
Mantle length	69.5	73.0	65.0	70.0	61.0
Mantle width	18.0	17.1	14.8	15.0	15.0
Head width	15.5	14.7	15.0	16.1	14.0
Fin length	20.7	23.0	21.0	21.0	18.0
Fin width	37.0	39.2	36.0	35.0	31.0
Arms I	20.0	18.0	16.0	20.0	16.0
II	22.0	22.0	21.0	22.0	19.0
III	20.5	20.5	20.0	21.0	17.2
IV	21.5	21.7	19.8	21.5	20.0
Tentacle length	25.0	31.0	30.0	34.0	26.0
Club length	12.0	15.2	14.5	15.0	14.0

of arms of the female are equipped with small, weakly developed hooks on the sucker ring (Fig. 2*d*). There are no hooks present in the males.

The *tentacles* are only slightly longer than the arms. The clubs (Fig. 1*e*) are about one-half the tentacle length, bordered on either side by a protective membrane and with a well-developed dorsal swimming keel distally. The club possesses numerous minute suckers whose chitinous rings bear three or four rectangular teeth distally and a small broad tooth proximally (Fig. 2*c*). There are no hooks present. The fixing apparatus consists of a series of alternating small suckers and whitish pads which extend along the dorsal margin of the club from the carpal region to about the middle of the hand.

The *buccal membrane* has seven lappets and supports.

The *radula* (Fig. 2*f*) possesses seven teeth in each transverse row: a tricuspid rhachidian, a bicuspid admedian, and two lateral unicuspid sabre-shaped teeth.

The *gladius* (Fig. 1*f*) is long and narrow, widest just posterior to the midpoint and tapering with straight sides to a small shallow cone. The maximum width is about one-eighth the length.

Measurements of selected specimens are listed in Table 1.

A spermatophore is shown in Fig. 2*e*.

Coloration: The general body color is whitish or silvery with scattered reddish-brown chromatophores densest on the dorsal midline of the mantle and the posterodorsal region of the head.

Type locality: Collected at 45°26.8′N, 125°08.1′W, near the surface by M. Laurs with a dipnet while nightlighting aboard the R/V *Acona*, at 0045 on 11 September 1960.

Discussion: It was originally thought that these specimens were juve-

TABLE 2.—Data on collections of *Gonatus anonychus* made by the Department of Oceanography, Oregon State University

DATE OF COLLECTION	LOCATION		DORSAL MANTLE LENGTH (MM)
1 July 1960	45°15.0′ N,	126°29.0′ W	62, 75, 78
10 July 1960	42°49.5′ N,	125°55.5′ W	69, 70, 70, 70, 71, 71, 72, 75
11 September 1960	45°26.8′ N,	125°08.1′ W	69.5 (Holotype)
12 September 1960	44°00.0′ N,	125°15.7′ W	72
1 August 1961	44°50.4′ N,	125°09.7′ W	72
15 August 1961	44°27.0′ N,	125°15.6′ W	68, 73, 73, 75, 75
23 August 1961	46°14.5′ N,	127°06.0′ W	70
9 January 1962	44°39.1′ N,	127°27.0′ W	70

niles of one of the known species of the Gonatidae. However, the presence of fully formed spermatophores lodged in the penis of male specimens and of well-developed nidamental glands in the females indicates that this is not the case. Although the family Gonatidae is in need of revision at the generic level, *G. anonychus* may be separated from the other species of the genus *Gonatus* by the following characters.

It may be distinguished from *G. fabricii* by the lack of tentacular club hooks, seven instead of five teeth in each transverse row of the radula, the reduced number of teeth on the sucker margins, and the absence of true hooks on the arms, particularly in the males. In general appearance it resembles *G. magister* but differs from that species by the presence of only three nuchal folds instead of four, the complete lack of hooks on the arms of mature males, and the presence of only a few small unsheathed hooks on the suckers of all but the ventral arms of the female, the smaller fins in *anonychus,* and only three or four teeth on the chitinous rings of the club suckers of *anonychus* compared with 20 teeth on the same rings in *magister.* The teeth on the suckers of both the tentacles and the arms of *G. magister* are shown by Berry (1912) and Sasaki (1929) to be acute, whereas those of *G. anonychus* are truncate.

Gonatus fabricii from our collection, while even smaller than *G. anonychus,* have well-developed tentacular hooks. One small specimen of *G. magister* has been examined (43.0 mm ML), and although its fins are smaller relative to the mantle length than those proportions given by Berry (1912), the hooks on the arms are numerous and large, and the teeth on the sucker margins agree with Berry's description.

Both *G. anonychus* and *G. fabricii* occur sympatrically off Oregon, occasionally both species appearing in collections from the same station. *G. magister* also occurs in the northeastern Pacific (Berry, 1912).

Although nightlight collections were made during every season of the year out to 165 miles offshore, most of the *G. anonychus* were collected during late summer about 50 miles offshore in the vicinity of the 1000-fathom contour (Table 2). This may be due to the better sea conditions for nightlighting during this season or perhaps may reflect an inshore movement during the summer. The one specimen taken in January was captured the farthest distance from shore, about 145 miles.

The name *anonychus* is taken from the Greek *an* meaning "without" and *onychos* meaning "hooks" or "claws," and refers to the absence of hooks on the arms of the males and only degenerate ones in the females.

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PROCEEDINGS
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A NEW DIPLOPOD GENUS AND SPECIES FROM GEORGIA (POLYDESMIDA: XYSTODESMIDAE)[1]

By Richard L. Hoffman
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The millipeds of the Piedmont and Coastal Plain of the southeastern United States are as poorly known as those of any comparable area in the world, probably because these regions, so arid and unproductive during the summer months, have only recently been visited during the cooler seasons by a collector interested in obtaining samples of the diplopod fauna.

During the years 1958–61, my good friend Leslie Hubricht resided at Savannah and Atlanta, Georgia, and made these two cities the focal points for numerous excursions during which he generously picked up millipeds for me. Since his collections represent a year-round sampling, I am fortunate in having a fairly good representation of Georgia species. It has been possible so far to study only a part of this rich material, chiefly members of the large and diverse family Xystodesmidae, but the existence of an interesting endemic fauna has already been revealed.

The most characteristic xystodesmid genera occurring in Georgia are *Cleptoria, Dynoria, Dicellarius, Pachydesmus, Cherokia* and *Stelgipus.* Most of these genera are represented by several species and will be treated in revisionary studies now in preparation (synopses of *Cherokia* and *Pachydesmus* have already been published). In addition, there are at hand several unnamed species which do not fit into any of the established genera and which, because of their isolated position, can be put on record singly. The following description accounts for one of these disjunct genera which seems to be endemic to central Georgia.

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[1] Contribution from a project supported by Grant G-21519 from the National Science Foundation.

Family Xystodesmidae Cook

Lyrranea, new genus

Type species: *Lyrranea persica,* new species.

Diagnosis: A genus of large, robust xystodesmids belonging in the general group of *Sigmoria, Cleptoria, Dynoria* and *Stelgipus,* with the following diagnostic characters: Head smooth and polished, epicranial suture distinct and with a single row of punctures, but not bifurcate ventrally. Facial setae reduced, with only 2-2 frontals detectable, aside from the usual clypeal and labral series. Genae convex, with prominent deep, median impressions. Antennae moderate in length, with four small terminal sensory cones.

Body above average size for the family, robust, broad, the width/length ratio about 25%. Collum elongated laterally, the ends extending well below level of following paranota. Tergites prominently sculptured, surface of metatergites and posterior part of prozonites vermiculate rugulose. Interzonal constriction not developed across dorsum of segments, the pro- and metatergites essentially isoplanar. Paranota broad, moderately depressed, all of the anterior corners rounded, the posterior corners caudally produced on segments posterior to the 6th, the posterior edges not margined. Ozopores in normal sequence, opening dorsally near the midlength of elongate, slender peritremata. Scapulorae distinct and marginal on most segments.

Sterna of metazonites elevated into podosterna, sloping upward from the interzonal suture to form an acute, overlapping rim between the posterior pair of legs, the surface essentially smooth and flat except for being produced into distinct, acute, subcoxal spines. Sides of segments unmodified. Stigmata similar in size, shape and location, the rims only slightly elevated. Sterna of segments 4 and 6 each with a pair of low paramedian processes, sternum of segment 5 with two pairs of subconic tubercules.

Coxae and prefemora of legs with acute distal spines. Pretarsi long and bisinuately curved, the upper surface medially carinate.

Gonopod aperture large, oval, its posterior and lateral edges elevated into a distinct but low marginal rim. Gonopods short and massive, the coxae subglobose and larger than the telopodites, without coxal apophyses. Prefemora crassate, densely setose, without traces of prefemoral processes. Distal, glabrous, parts of telopodite lamellate, divided into two slender subequal branches which basally form a deep concavity. The dorsal branch is the smaller and carries the seminal groove in nearly a straight line from its end down to the base of prefemur. The ventral branch is larger, setose on its ventral surfaces, and presumably functions as a solenophore.

Characters of the female sex unknown.

Classification: *Lyrranea* is apparently related most closely to three other local genera occurring in Georgia and South Carolina: *Dynoria, Cleptoria* and *Stelgipus.* These groups have the following characteristics in common, and perhaps are worthy of a formal tribal recognition:

1. Short, stout, massive gonopods.
2. Loss of nearly all of the normal cranial setae.
3. Elongation of the collum laterally.
4. Development of subcoxal sternal spines.
5. Prominent, rugulose tergal texture.

In two of these genera, *Cleptoria* and *Stelgipus,* the telopodite of the gonopod terminates simply, there being no traces of branching, or the formation of a distinct solenomerite. In *Dynoria,* however, the telopodite is distally bifid (in *D. medialis*) or even trifid (in *D. icana;* illustrations of these gonopods are planned for early publication), one of the branches being small, thin, and laminate and carrying the seminal groove. As seen in mesial aspect, this solenomerite branch in either case is the *ventral* branch, so that the seminal groove must, upon leaving the prefemur, run *obliquely distolaterad* across the telopodite to gain access to the base of the solenomerite. In *Lyrranea,* on the other hand, the solenomerite is the *dorsal* branch of the telopodite, and this entire segment of the gonopod is very much shortened and more massive in appearance. I think there can be no doubt that *L. persica* is generically distinct from *D. icana.*

Lyrranea persica, new species
(Figs. 1–4)

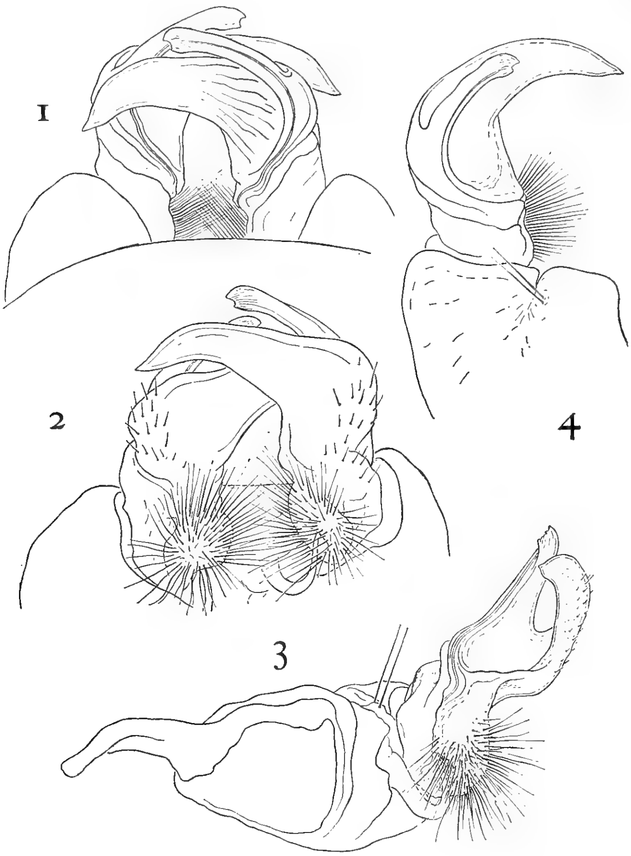
Holotype: Adult male, U. S. Nat. Mus. No. 2929(2-652), from a wooded hillside, 3 miles west of Fort Valley, Peach County, Georgia; collected 24 April 1960 by Leslie Hubricht.

Diagnosis: With the characters of the genus. Easily recognized by the combination of (1) spined sterna, (2) broad collum, (3) vermiculately rugulose tergal texture, and (4) short, massive, bilobed and basally cupulate gonopods.

Description of holotype: Length about 43 mm, greatest width 10.6 mm; width/length ratio about 25 per cent. Paranota only slightly depressed, moderately broad, producing a moderate height/width ratio of 61 per cent at midbody. Body broad, robust, approximately parallel-sided between segments 4 and 15, narrowing abruptly at both ends as indicated by the following width values:

Collum	7.8 mm	10th	10.6 mm
2nd	9.5	12th	10.6
4th	10.2	14th	10.5
6th	10.6	16th	9.4
8th	10.6	18th	6.4

Color in life unknown. Preserved specimen (after two years in alcohol) with dorsal surface of prozonites and median area of metatergites dark brown, almost black. Both anterior and posterior corners of paranota, a transverse band on caudal margin of tergites, antennae, legs, and tip



FIGS. 1–4. *Lyrranea persica,* new species. FIG. 1—Gonopods of male holotype, in situ, anterior or dorsal aspect. FIG. 2—Gonopods of male holotype, in situ, posterior or ventral aspect. FIG. 3—Left gonopod, mesial aspect. FIG. 4—Left gonopod, dorsal aspect.

of epiproct yellowish. Ventral and lateral surfaces of segments probably sordid whitish-gray in life.

Head capsule normal in appearance, oval, convex, smooth and polished; width across genal apices 5.0 mm. Epicranial suture short, forming a slightly impressed groove with a single row of indistinct punctures, not bifurcate ventrally. Interantennal isthmus broad (1.7 mm) and smooth. Genae not margined laterally, convex, with very prominent median impression, this becoming broader and deeper ventrally. Antennal sockets with distinct marginal rims medially and dorsally.

Facial setae apparently considerably reduced, no trace of the vertigial, interantennal, and subantennal setae can be detected. *Frontal* 2-2, the outermost seta of each pair located in a slight depression at lower end of the genal region; no genal setae present; *clypeal* about 10-10; *labral* about 12-12, the setae of the last two series compound and irregularly placed, as usual.

Antennae moderate in length (8.0 mm) and slender, reaching back to middle of paranota of segment 3. Article 1 broadest, short, globose, glabrous except for two macrosetae. Articles 2–6 approximately equal in length (6th slightly shorter than the others) and similar in shape, all moderately clavate distally. Article 7 small, as broad as long, conic-cylindric, apically truncate, its distal edge not inturned between the four small terminal sensory cones. Antennae nearly glabrous proximally, becoming more densely invested distally, each article with a terminal whorl of 3 or 4 macrosetae; article 6 covered with fine, short, procumbent setae.

Collum broad, elongate-trapezoidal in outline, both anterior and posterior edges tapering about evenly laterad, the lateral ends prolonged ventrad about 1.0 mm beyond paranota of 2nd segment; anterior marginal ridge unusually prominent and elevated, sharply defined up to level of the mandibular-cranial articulation, ventrally setting off lateral ends of collum but not attaining the rear edge, latter slightly emarginate-sinuous just before the end.

Tergites of segments 1–4 essentially smooth, those of remaining segments prominently vermiculate-rugose, including posterior strip of the prozonites. Numerous microtubercules, with tiny erect setae, visible on the metatergites, tending to form 3 to 5 irregular transverse rows; usually only the caudalmost row on the paranota are at all distinct. Paranota rather broad, depressed but interrupting slope of mid-dorsum; peritremata elongate, slender, distinctly set off from discal surface of paranota, the submarginal depression extending to caudal edge. Ozopores opening dorsally, at about the midlength of each peritreme, with the usual distribution. Prozonites and metazonites nearly isoplanar dorsally, separated by a slight depression the anterior edge of which is sharply defined, this interzonal constriction is longitudinally costulate dorsally, the ridges merging into the texture of the metatergites as elongate rugae.

Segments 2–4 similar in shape and texture, the paranota broadly overlapping, depressed, and projecting cephalad, both anterior and posterior corners broadly rounded, scapulorae distinct, submarginal toward the body. Paranota of segment 5 more nearly transverse and less depressed, but otherwise similar to the preceding.

Segments 6–14 similar, the paranota essentially transverse, anterior corners broadly rounded, the posterior corners at first rectangular, then progressively produced caudally, the caudal edges remaining straight. Scapulorae distinct, sharply defined on the anterior paranotal arc but becoming submarginal toward the body and exposing front surface of the paranotal base as seen in dorsal aspect. Segments 15–19 decreasing in width gradually, owing to reduction of the paranota, which become more horizontal and caudally produced. Ozopores of these segments retain their original median location, and do not tend to occur more caudally along the peritreme. Paranota of segment 18 form elongate subtriangular lobes which extend caudally as far as tips of paranota of segment 19, the latter small, short, with suboblique inner edges. Texture of caudalmost tergites more pronounced than on anterior segments.

Epiproct evenly conical in dorsal aspect, its surface smooth and polished, and with the typical setal arrangement. Paraprocts essentially flat and smooth, a little wrinkled near the ventrolateral corners; the median paraproctal seta set on a small discal tubercule removed from the compressed and elevated mesial rims. Dorsal paraproctal seta set on the broadest part of the rim, near the upper end. Hypoproct a broadly oval, convex plate, its surface smooth and polished, without a distinct median apical projection, the paramedian setiferous tubercules large and extending slightly beyond hyproctal edges.

Sides of segments unmodified; caudal edge of each metazonite with a fine but distinct raised rim preceded by a submarginal depression extending from underside of paranota to top of posterior coxal sockets. Interzonal constriction becoming broad and distinct down sides, shallow but with anterior edge slightly elevated; surface of the constriction smooth. Stigmata of moderate size, similar in shape on midbody and posterior segments (the anterior stigma larger and more triangular on anterior segments), elongate-oval, with slightly elevated but not flared rims. Both stigmata about equally separated from the adjacent coxal sockets.

Sternal areas of metazonites modified as podosterna, the intercoxal space sloping upward from the interzonal suture, the surface smooth and glabrous, wider between anterior pair of legs; produced into prominent acute subcoxal spines at base of posterior pair of legs, the spines connected by the sharp-edged and overhanging posterior margin of the podosterna. Sternum of 4th segment with two small, erect, closely appressed processes; sternum of 5th segment with four distinct subconical tubercules, those of each pair almost in contact medially; sternum of segment 6 with two low indistinct paramedian knobs between the 6th pair of legs, sternum between 7th pair of legs depressed.

Legs long, most of femur visible from above when legs are extended laterad. Podomeres in decreasing order of length: 3–2–6–5–4–1, all are only sparingly setose except tarsus which is covered with numerous stout setae particularly near distal end. Coxae with sharp ventral spines; prefemora with the usual acute and slightly curved distal ventral spine. Pretarsi long, bisinuately curved, compressed and ellipsoidal in cross-section, with prominent thin carina on the dorsal side.

Prozonite of 7th segment reduced to a very thin, transverse strip by the large (3.8 mm wide) suboval gonopod aperature. Front edge of latter not elevated, caudal edge produced into a narrow elevated flange extending laterally to ends of the aperature; sternal surface between 8th pair of legs depressed and flat.

Gonopods large and massive in appearance, the telopodites overlapping in situ (Figs. 1 and 2), distal ends of the coxae exposed. Coxae robust, subpyriform, attached only by thickened membrane, of the form shown in Fig. 3, no coxal apophyses present; two macrosetae on the dorsal side. Telopodites short, not apparently divided into recognizable regions beyond the prefemur; latter short, nearly as broad as long, densely setose on the mesial surfaces, without trace of prefemoral process; distal half of telopodite lamellate, nearly glabrous, divided into two terminal branches enclosing a deep concavity. The smaller, dorsal branch (?tarsus) carries the seminal groove, distally it is slightly enlarged and finely laciniate; the much larger ventral branch (?tibia) is elongate-lanciform, basally setose, probably it functions as a protective solenophore.

Distribution: Central Georgia; so far known only from the type locality.

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A NEW CRAWFISH FROM THE HATCHIE RIVER IN MISSISSIPPI AND TENNESSEE (DECAPODA, ASTACIDAE)

By George Henry Penn[1]
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The species described here belongs to the *Spiculifer* group of the genus *Procambarus.* The first specimen, a female, was collected in 1955; subsequent visits to the Hatchie River in 1956 and 1960 added only six additional specimens. The Hatchie originates in northeastern Mississippi and flows roughly in a northwesterly direction across southwestern Tennessee before emptying into the Mississippi River about 30 miles north of Memphis. The timber of most of this area was cut long ago and the land heavily farmed thereafter. As a result of this exploitation, soil erosion was serious and most of the streams and small rivers are laden with silt, making conditions unfavorable for many forms of aquatic life. At most of the potential collecting sites no crawfishes were found despite vigorous efforts on the part of two graduate students and myself. At other sites the total yield was sparse to say the least.

I am indebted to Messrs. Joe B. Black and Joseph F. Fitzpatrick, Jr., for their efforts in the field. This investigation was supported by research grants from the National Science Foundation (Nos. G-947 and G-2330).

Procambarus ablusus, new species[2]

Holotype, male form I: Cephalothorax (Figs. 1, 2) subovate; greatest width of cephalothorax just posterior to midpoint of areola; greatest height of cephalothorax at anterior end of areola. Abdomen narrower than and slightly longer than cephalothorax.

Areola broad, nearly four times longer than wide at its narrowest width where there are three punctations. Cephalic portion of cephalo-

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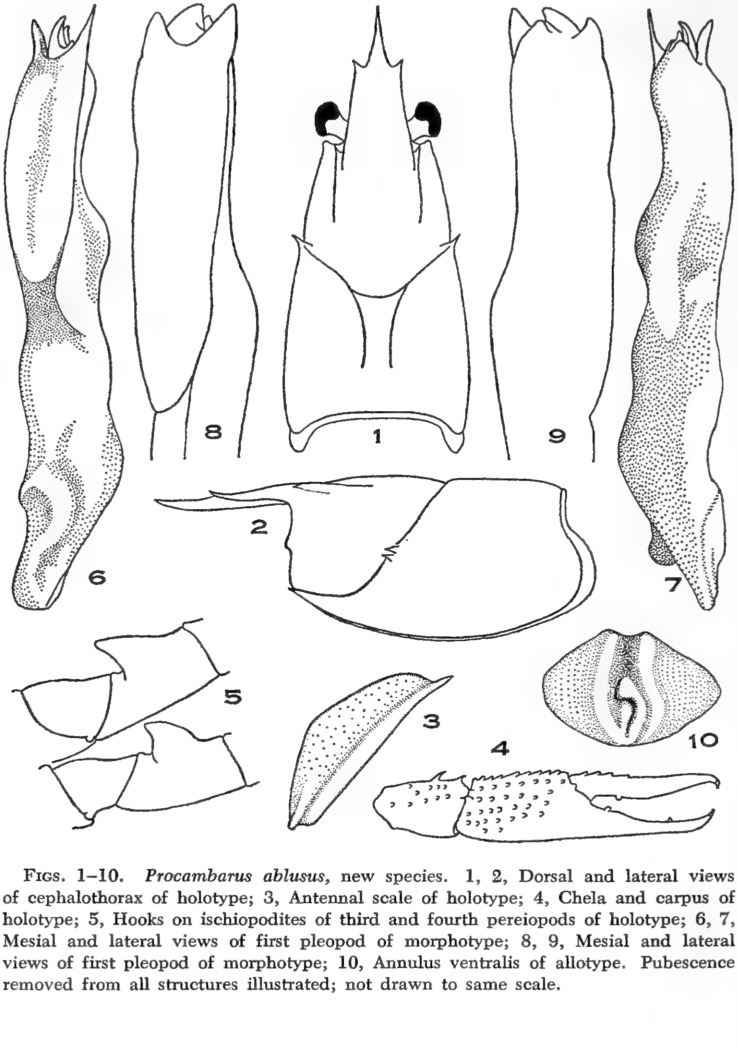
[1] We regret to report the death of Dr. Penn on 10 May 1963. *Ed.*

[2] *ablusus,* L. = different.



FIGS. 1–10. *Procambarus ablusus,* new species. 1, 2, Dorsal and lateral views of cephalothorax of holotype; 3, Antennal scale of holotype; 4, Chela and carpus of holotype; 5, Hooks on ischiopodites of third and fourth pereiopods of holotype; 6, 7, Mesial and lateral views of first pleopod of morphotype; 8, 9, Mesial and lateral views of first pleopod of morphotype; 10, Annulus ventralis of allotype. Pubescence removed from all structures illustrated; not drawn to same scale.

thorax a little more than twice as long as areola; length of areola less than one-third (29%) of total length of cephalothorax.

Rostrum with acute lateral spines. Rostrum widest at its base; margins raised, slightly sinuous, and converging anteriorly; no median carina. Acumen long; its length about 46 per cent of total length of rostrum.

Postorbital ridges well developed, each terminating cephalad in an acute spine. Branchiostegal spine small, acute. Cervical groove interrupted laterally; two conspicuous acute spines on each side at point of interruption. Epistome slightly wider than long, terminating in an acute spine anteriorly.

Antennules of usual form, with a prominent acute spine on ventral side of basal segment. Antennae reaching beyond tip of telson. Antennal scale (Fig. 3) extending beyond tip of rostrum; lateral margin straight, terminating in an acute spine; lamellar portion of scale flat, fringed with long hairs from base to apex; greatest width of scale just proximal to middle; length about three times greatest width.

Cephalic section of telson with two spines in right and one spine in left caudolateral corners.

Chela (Fig. 4) ovoid in cross-section, long, and slender; a row of eight tubercles along inner margin of palm; smaller, flat tubercles in four to five irregular longitudinal rows on upper face of palm. Both fingers terminating in short, corneous tips bent toward each other. Occluding portions of fingers curved so they meet when dactyl is flexed; dactyl with four acute tubercles on inner margin and one large rounded tooth on opposable (outer) margin near base; opposable margin of immovable finger with one large rounded tooth proximally, and one conical tooth about one-third of distance from apex. Fingers long; dactyl about 56 per cent of total length of the outer margin of chela. Ischiopodites of first pereiopods each with four spines on inner margin; basipodites without spines. Carpus (Fig. 4) ovoid in cross-section; with two prominent acute tubercles near distal end on inner margin; a few flat tubercles between inner margin and longitudinal groove.

Hooks on ischiopodites (Fig. 5) of third and fourth pereiopods; approximately equal in size; length of each slightly less than half the width of its ischiopodite. Coxopodites of fourth and fifth pereiopods with caudomesial projections; projection of fourth inflated, that on fifth smaller and forming a somewhat oblique cephalomesial-caudolateral ridge.

First pleopod (Figs. 6, 7) extending to anterior edge of the coxopodite of the third pereiopod when abdomen is flexed. Pleopods essentially straight; apical parts not bent. Appendage terminating in four distinct parts projecting distally. Mesial process spiculiform, noncorneous, and directed distad. Cephalic process slightly excavate caudally, lying cephalolaterad of central projection and extending distad. Caudal element consisting of three parts: caudal knob noncorneous, prominent, rounded at apex; caudal process corneous, acute, lying between central projection and caudal knob, directed distad; accessory process a thin corneous transverse ridge caudad of caudal process. Central projection corneous, rounded and somewhat hooked caudally at distal end, fusion line of its component parts clearly marked.

Morphotype male, form II: In most respects similar to the holotype; chelae and hooks on ischiopodites reduced; caudomesial process on fourth coxopodite undeveloped, that on fifth coxopodite pronounced; ischiopodites of first pereiopods with two spines on right, three on left. First pleopods (Figs. 8, 9) reach to anterior edge of coxopodites of fourth pereiopods when abdomen is flexed; all processes reduced and noncorneous, but caudal knob remains prominent.

Allotype female: Similar to holotype in most respects; chelae reduced; ischiopodites of first pereiopods each with three spines; left side of cephalothorax with three lateral spines. Annulus ventralis (Fig. 10) movable, about one and one-half times longer than wide, with anteromedian depression delineated laterally by strong ridges that run posteriorly and diverge around a posteriorly placed protuberance; sinus originates in anterior depression near the midline, then proceeds caudodextrad to caudal protuberance, turns sinistrad a short distance, and then caudad to its terminus near caudal margin. Sternum of fourth thoracic segment not produced and nontuberculate.

Measurements: Data from the types are given (in mm) in the following table.

	HOLOTYPE	MORPHOTYPE	ALLOTYPE
Cephalothorax:			
Length	34.0	28.5	39.0
Width (greatest)	15.0	12.0	17.0
Height (greatest)	14.0	11.0	16.0
Areola:			
Length	9.8	7.8	10.5
Width (at narrowest point)	2.5	2.3	2.5
Rostrum:			
Length	12.0	11.0	14.0
Width at base	5.0	4.3	6.0
Length of acumen	5.5	5.1	5.0
Antennal scale:			
Length	11.0	10.2	12.0
Width	3.6	3.4	4.5
Epistome:			
Length	2.0	1.5	1.7
Width	2.4	2.0	2.5
First pleopod (males only):			
Length	9.4	6.4	—
Abdomen:			
Length (to tip of telson)	36.0	30.0	41.0
Right chela:			
Length of outer margin	21.5	12.0	20.0*
Length of dactyl	12.0	7.2	10.5
Width of palm	6.0	3.3	6.0
Thickness of palm (greatest)	4.7	2.5	4.5

*Dactyl broken on right chela; measurements for left chela.

Type locality: The holotype and morphotype were collected from Hatchie River, 12.1 miles E of Ripley (State hwy. 4), Tippah County, Mississippi, 12 July 1956 by the writer and Joe B. Black. Crawfish associates included only *Orconectes immunis*. The allotype was collected from Hatchie River, 1.5 miles NE of Bolivar (State hwy. 18), Hardeman County, Tennessee, 17 September 1955 by Leslie Hubricht.

Disposition of types: The holotype, morphotype, and allotype are deposited in the U.S. National Museum, numbers 108200, 108201, and 108202, respectively. The four paratypes are in the Tulane University collection as follows: one ♂ II, tributary to Hatchie River, 3 miles N of Biggersville (U.S. hwy. 45), Alcorn County, Mississippi, 12 July 1956, G. H. Penn and J. B. Black (TU 3463); one ♂ juv. and one ♀ juv., Hatchie River, 1.5 miles NE of Bolivar, Hardeman County, Tennessee, 8 September 1960, J. F. Fitzpatrick (TU 3641); and, one ♂ juv., tributary to Hatchie River, 2.5 miles N of Biggersville, Alcorn County, Mississippi, 8 September 1960, J. F. Fitzpatrick (TU 3642).

Relationships: This makes the eleventh species to be described in the *Spiculifer* group of the *Blandingi* section of *Procambarus*. Hobbs (1962) recently stated his interpretations of the relationships within the group. On the basis of the structure of the first pleopod of the form I male, *P. ablusus* appears to be most closely related to *P. penni* Hobbs, although its closest geographic neighbor is *P. vioscai* Penn.

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GRASSHOPPERS OF THE TRIBE OMMEXECHINI: A KEY TO GENERA, A NEW ARGENTINE GENUS, AND NOTES ON OTHERS (ORTHOPTERA, ACRIDIDAE)

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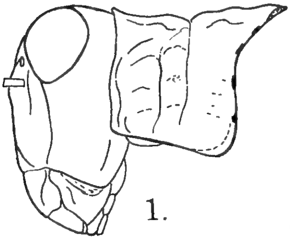
In order to compare a new genus with other genera of the Ommexechini, we have prepared a key to the seven genera now included in the tribe. The last previous key, by Bruner (1911: 38), was to the four genera included in the group at that time. In literature, several tribal characters of the Ommexechini have been confused by different interpretations, and explanations to clarify these interpretations have been given here. Brief notes on the species of each genus are given also, and two new synonymies are indicated, one in *Spathalium*, the other in *Graea*.

This tribe, recently discussed by Eades (1961) and Dirsh (1961), includes about 32 known species. The species are found in South America, in the area from Colombia to Argentina.

Grateful acknowledgments are due James A. G. Rehn and Robert L. Randell, Academy of Natural Sciences of Philadelphia, for their cooperation in loaning material, and for hospitality and technical assistance during our visit to the Academy. David C. Eades of State University College, Oneonta, N. Y., has read the manuscript.

Tetrixocephalus, new genus

Generic description: General form much like *Calcitrena*. Head with interocular distance on vertex about equal to width of one eye in dorsal view; eyes of moderate size; lateral carinae bordering fastigium strongly developed; disk of fastigium deeply (male) to moderately (female) sul-



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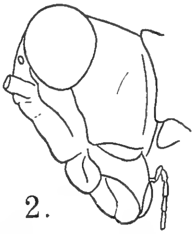

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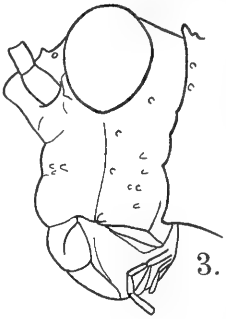

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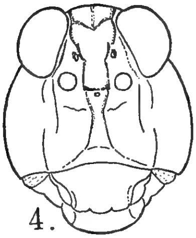

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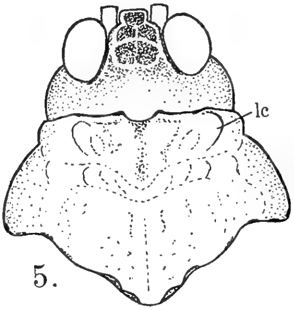

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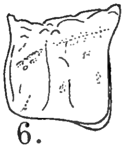

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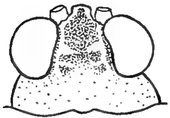

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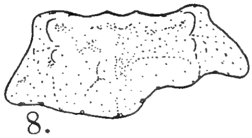

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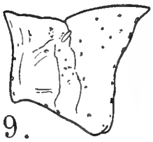

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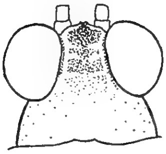

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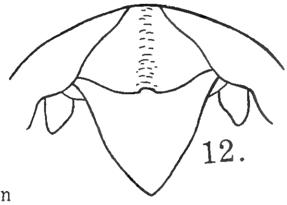

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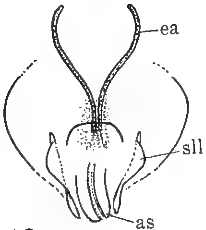

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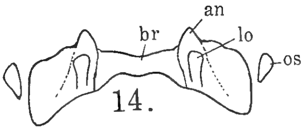

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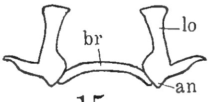

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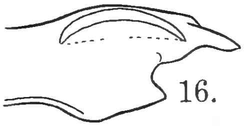

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cate, strongly declivant ventroanteriorly, narrowing to and merging with frontal costa opposite lateral ocelli; frontal costa with transverse carina just dorsad from median ocellus, this carina the maximum anterior development of a weak projection of costa between antennae when seen in lateral view, shallowly sulcate ventrad from ocellus, flaring toward clypeus; width of head in frontal view across genae much greater than across eyes.

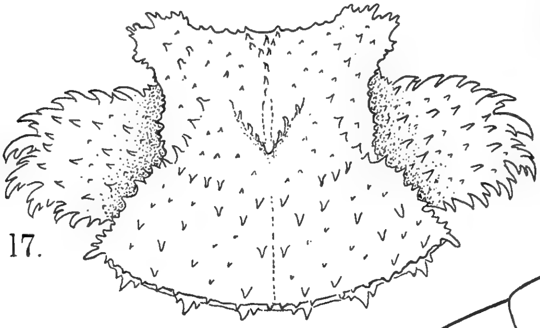
Pronotum about two-thirds as long as total width (female), shorter (male); median carina indistinct, represented by irregular rugosities on prozona, a faint line on metazona; indefinite lateral carinae, indicated by rounded boss on prozona (Fig. 5, *lc*); anterior margin narrowly emarginate mesally, remainder weakly sinuate; posterior margin obtuse-angulate (female), broadly and somewhat irregularly rounded (?) (male); lateral lobes moderately flaring, ventral margin entire, somewhat more produced ventrally toward posterior margin; disk with low rugosities of larger size on prozona than metazona; disk and lateral shoulders cut by two transverse sulci, anterior one extending far posterior at median line of disk, principal sulcus moderately and broadly curved posteriorly (female), sulci indistinct on disk (male); prosternum with transverse, ventrally very broadly curved carina, no trace of prosternal spine; mesosternal interspace about 4 times as wide as long, lateral lobes wider than long; metasternal interspace a little narrower than mesosternal one, lateral lobes with mesal margins angular (Fig. 18, *mm*); tegmina and wings fully developed; front and middle legs moderately slender, unspecialized; hind femur about 4 times as long as wide, simple, upper basal lobe distinctly longer than lower basal lobe so far as main outer faces are concerned, but of subequal length regarding basal attachment lobe, genicular lobes unarmed, carinae of femur with sparse short setae arising directly from cuticle (rather than from tubercles as in *Calcitrena*), Brunner's organ present; hind tibia slender, a little shorter than femur, with fairly numerous short setae, inner marginal spines 10, outer ones 7 to 9, usually 7, an apical spine on inner margin only, two inner and two outer apical spurs, inner ones much longer and about equal to basal tarsomere; tarsomeres slender, the basal one nearly 3 times length of second; claws simple; arolium very small and narrow.

FIGS. 1–16. Figs. 1, 4–8, 11–15: *Tetrixocephalis willemsei*, n. sp. 1, Lateral view of head and pronotum, allotype; 4, Front view of head, same; 5, Dorsal view of head and pronotum, same (*lc*—lateral carina); 6, Lateral view of pronotum, holotype; 7, Dorsal view of head, same; 8, Dorsal view of pronotum, same; 11, Basal tarsomere, right middle leg, female paratype; 12, Dorsal view of supra-anal plate and associated structures, holotype; 13, Dorsal view of phallic complex, epiphallus removed, holotype; 14, Dorsal view of epiphallus, holotype; 15, Front view of epiphallus, holotype.

Figs. 2, 9, 10: *Calcitrena maculosa* Eades. 2, Lateral view of head, holotype; 9, Lateral view of pronotum, allotype; 10, Dorsal view of head, holotype.

Figs. 3, 16: *Ommexecha brunneri* Bolivar. 3, Lateral view of head, male from Huadquina, Peru; 16, Lateral view of apical portion of left hind femur, female from Torontoy, Peru.

(Parts of copulatory organs: *an*—ancora; *as*—aedeagal sclerite; *br*—bridge; *ea*—endophallic apodeme; *lo*—lophus; *os*—oval sclerite; *sll*—sclerite of lateral lobe.)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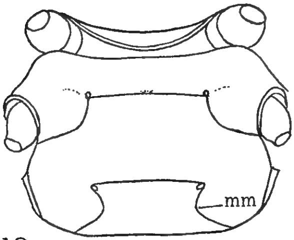

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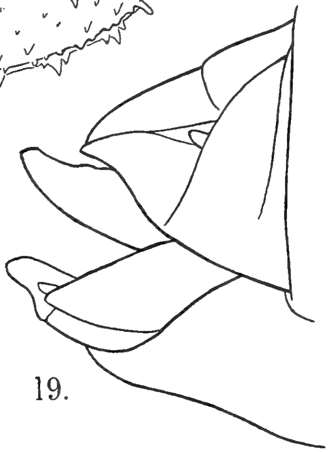
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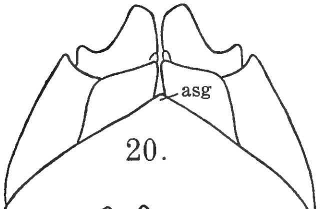

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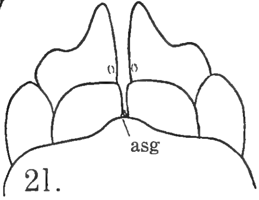

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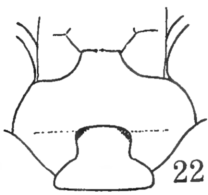
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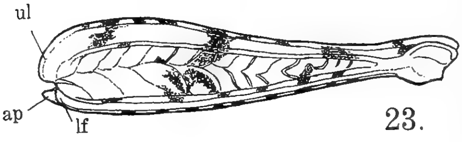

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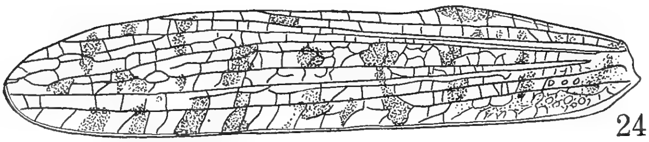
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Abdomen with tympanum apparently absent; no stridulatory mechanism on hind femur, abdomen, or tegmen; male with last apparent tergum deeply emarginate; supra-anal plate also typical of tribe, with prominent transverse carina; cercus small, unspecialized; subgenital plate blunt, simple; female supra-anal plate with weak transverse carina; subgenital plate obtusely angulate at apex; ovipositor valves short, blunt; cerci minute.

Concealed male genitalia described under the species, typical of tribe, comparable to, but differing in details from those of *Calcitrena*.

Type of genus: *Tetrixocephalus willemsei*, new species.

Tetrixocephalus resembles *Calcitrena* much more than any other genus, and the main differences between the two genera are given in the key. When seen in dorsal view, the frontal costa shows as an anterior projection in advance of the fastigium; the costa does not appear in the male of *Calcitrena* unless the head is viewed from a more anterior position, and in the female of *Calcitrena* the frontal costa in dorsal view is less conspicuous than in *Tetrixocephalus*. In lateral view, the upper margin of the eyes is considerably above the pronotum in the male of *Calcitrena* (Fig. 2), but in the male of *Tetrixocephalus* the upper margin is only moderately above the pronotum (Fig. 1). Differences between females, in this respect, are less decided, but are significant.

Direct comparison of the male genitalia of the two type species shows: 1. Lophi of *Calcitrena* are shorter, with the apices directed mesally more acutely; 2. Endophallic apodemes (Fig. 13. *ea*) of *Tetrixocephalus* are more recurved at their anterior ends; 3. Sclerites of lateral lobes (Fig. 13, *sll*) are proportionately larger in *Calcitrena*. (See Eades (1961: 169) for figures of *Calcitrena*.)

The name *Tetrixocephalus* is chosen because of the superficial resemblance of the head in frontal view to that of many Tetrigidae.

Tetrixocephalus willemsei, new species

(Figs. 1, 4–8, 11–15, 18–20, 23, 24)

Holotype: Male. Laguna Blanca, Neuquen, Argentina, 1300 meters

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Figs. 17–24. Fig. 17: *Graea horrida* (Philippi). Dorsal view of pronotum, male from Argentina.

Figs. 18–20, 23, 24: *Tetrixocephalus willemsei*, n. sp. 18, Ventral view of sternal plates, holotype (*mm*—mesal margin of lateral lobe); 19, Lateral view of apical portion of abdomen, female paratype; 20, Ventral view of apical portion of abdomen, female paratype (*asg*—apex of subgenital plate); 23, Lateral view of left hind femur, holotype (*ap*—attachment portion of lower lobe; *lf*—lateral face of lateral lobe; *ul*—upper lobe); 24, Left tegmen, holotype.

Fig. 21: *Calcitrena maculosa* Eades. Ventral view of apical portion of abdomen, allotype.

Fig. 22: *Parossa bimaculata* (Giglio-Tos). Ventral view of sternal plates, male from Sapucay, Paraguay.

(Fig. 23 drawn by Miss Barbara Hartke of the Entomology Research Division; others by the senior author.)

elev., March 1959 (M. Gentili). [U. S. National Museum, Type No. 66392.]

General form very small for tribe; broad across posterior part of prothorax, appendages slender and delicate; tegmen slightly surpassing hind femur, about one-fourth of tegmen length extending posterior to apex of abdomen; no conspicuous vestiture, but sparse short hairs on legs and lower parts of head and pleura.

Head with ratio of total width across dorsum of eyes and narrowest dorsal interocular width 3:1; width across eyes in front view compared to width across genae as 20:22; lateral carinae bordering fastigium extending posteriorly slightly more than one-half eye length; occiput with depressions behind carinae, otherwise only feebly rugose; carinae irregularly constricted just above lateral ocelli; lateral facial carina conspicuous, extending from eye near lateral ocellus to about halfway between antennal base and clypeal suture; genal suture interrupted a short way below eye; (antennae lost); front of head with smooth low rugosities.

Pronotum (Fig. 8) with right side shorter than left, apparently due to injury; principal transverse sulcus only broadly indicated on disk, anterior sulcus cutting lateral shoulders and weakly represented on disk; lateral lobe with ventroposterior corner (Fig. 6) with more prominent rounded marginal area than in female (Fig. 1); sternal interspaces and lobes as in Fig. 18; tegmen (Fig. 24) with 7 distinct longitudinal veins at mid-length, several intercalary veins, cross veins numerous; (front legs lost); middle femur 8.5 times as long as wide; middle tibia with 4 spines each side; basal tarsomere of middle leg with prominent pulvilli (Fig. 11); hind femur as in Fig. 23; pulvilli as described for *Calcitrena.*

Abdomen without evident specialization; supra-anal plate and adjacent structures as in Fig. 12. Concealed genitalia: Aedeagal sclerites (Fig. 13, *as*) closely appressed; outline of lateral lobes (*sll*) only partially distinct in available preparation, but apparently differing from constricted form in *Calcitrena*; endophallic apodemes (*ea*) conspicuous and dorsally recurved at anterior ends. Epiphallus with bridge (Fig. 14, *br*) narrow and sinuate; ancorae part of separate lateral plates, blunt, scarcely downcurved or hooklike; lophi erect, narrow, the distal end not so acute as in *Calcitrena*; small oval sclerites (*os*) present.

Coloration: Background of head, pronotum, and tegmina light gray, with weak overtones of pale brown, of hind femur and ventral surface of abdomen pale clay yellow; sternum of thorax whitish gray; head with very few small blotches of brownish black, such blotches on pronotum sparse along anterior and posterior margins, as well as disk and lateral lobes; blotches on tegmen and lateral surface of hind femur as in Figs. 24 and 23; wing membrane transparent, veins pale brown; front surface of middle femur with three broken dark bands on light gray background; tibia and tarsus dark spotted; hind tibia dirty gray with sparse brown spots, mainly short rectangular spots most numerous in basal half of lateral surface; dorsum of abdomen shiny blackish brown, dark area reduced to small median and lateral spots toward apical segments; supra-anal plate pale.

Measurements: Length of body, 10.0 mm; median length of pronotum, 1.5; maximum width of pronotum, 3.5; length of tegmen, 9.2; of hind femur, 6.5; max. width of hind femur, 1.5; length of hind tibia, 6.0.

Allotype: Female, same data as holotype [U. S. National Museum]. Differing from holotype as follows: General build more robust; eyes a little less bulging; interocular distance at vertex slightly less than width of an eye (as 7:8); width across eyes in front view compared with width across genae as 22:27; fastigium and interantennal portion of frontal costa broadly sulcate instead of deeply so; pronotum (Fig. 5) with disk more elongate, the two transverse sulci distinct; ovipositor and associated structures as in Figs. 19 and 20 (from paratype).

Coloration: Agrees well with holotype except that background color scarcely includes brown; it is a purer gray.

Measurements: Length of body, 12.4 mm; length of pronotum, 2.6; maximum width of pronotum, 4.2; (apex of tegmen broken); length of hind femur, 7.6; maximum width of hind femur, 1.7; length of hind tibia, 7.2.

Variation: An undamaged tegmen of a female paratype extends 1.5 mm beyond the apex of abdomen and 1 mm beyond the apex of hind femur. Color of the two paratypes agrees better with the holotype than the allotype. Measurements of paratypes (2 ♀♀) are: Length of body, 12.0, 14.5 mm; length of pronotum, 2.4, 2.8; maximum width of pronotum, 3.9, 4.5; length of tegmen, 12.0; length of hind femur, 7.6, 8.3; width of hind femur, 1.7, 1.8; length of hind tibia, 7.3, 7.5.

Because of the deformed male pronotum, it is uncertain how the posterior pronotal margin of perfect males compares with that of the female.

Specimens examined: 4 (holotype, allotype, 2 ♀ paratypes, all with same data). One paratype is deposited in the Instituto de Patología Vegetal, Buenos Aires; the other is in the Academy of Natural Sciences of Philadelphia. The specimens noted by Liebermann (1944: 301) as having been taken at Tejas Verdes, Chile, and then thought to be a new genus, probably are *willemsei,* but they are not available now for examination.

The type locality, Laguna Blanca, is shown in the TIMES ATLAS (John Bartholomew, ed., 1957, vol. 5, plate 119), is located about 40 km west of Zapala, in the western part of Neuquen Province. This is some 1000 km south of La Rioja Province, type locality of *Calcitrena maculosa.* The habitat, like that of *Calcitrena, Graea,* and *Spathalium,* is an arid zone with hot sandy hills characterized by volcanic rocks and shrubby vegetation. The area is part of the Patagonian Desert.

This grasshopper is named for our late friend, Dr. C. J. M. Willemse (1889–1962), of Eygelshoven, The Netherlands, a devoted student of Orthoptera, notably the Acridoidea of Southeastern Asia.

COMMENTS ON TRIBAL CHARACTERS

Dirsh (1961) considered the Ommexechini, as defined by Eades (1961), to represent a distinct family, the Ommexechidae, because he felt family rank was in keeping with the overall classification of the Acridoidea. We accept Eades' definition, and treat the group as a tribe, since we are inclined toward a more conservative course in raising the ranks of taxonomic groups until more comparative studies have been made.

It was stated by Dirsh (l.c., p. 384) that, as a group character, the lower basal lobe of the hind femur, in the Ommexechini, is as long as, or slightly longer than, the upper basal lobe. On the other hand, Eades (l.c., p. 162) stated that the upper basal lobe is at least as long as the basal one, and he described *Calcitrena* (p. 170) as having the upper basal lobe distinctly longer than the lower one. It is evident that Eades utilized the lateral face of the lower lobe adjacent to the paginal area, but Dirsh included the extreme basal portion of the lower lobe which is attached to the trochanter. As an example, the lateral face of the lower lobe in *Tetrixocephalus* (Fig. 23, *lf*) is much shorter than the upper lobe (*ul*), but when the attachment portion of the lower lobe (*ap*) is considered, the lobes are of subequal length. Thus, Eades and Dirsh have referred to different structures and, when we realize that, their apparent disagreement is explained.

Tetrixocephalus has definite but rather blunt ancorae (Fig. 14, *an*). By the definitions of Roberts (1941: 241) and Dirsh (1956: 229), ancorae are hooklike structures which project from the anterior margin of the dorsal surface of the epiphallus. In *T. willemsei* the ancorae are part of the lateral plates of the epiphallus, the plates being lightly joined to the median portion, the bridge. In various other Acridoidea the bridge may be solidly joined to the lateral plates and the ancorae borne sometimes by the bridge portion, or by the lateral plates. Frequently, ancorae are distinct, fingerlike appendages arising from the dorsal surface well back from the anterior margin of the epiphallus; in other cases they are projections of the margin itself. The ancorae in *Tetrixocephalus* are more conspicuous than drawn for *Calcitrena* (Eades, l.c., fig. 15), where they are merely the rounded mesoanterior corners of the lateral plates, though structurally they are the same in both genera, and their presence requires a modification of the diagnosis of the Ommexechini which, according to Dirsh (1961: 384), have no ancorae.

Another character ascribed by Dirsh (l.c., p. 381) is a prosternal spine (or process), and Eades (l.c., p. 168) has stated that a spine may occur or be represented by a slight swelling of a carina. In *Tetrixocephalus* (Fig. 18) there is a strong, broadly curved transverse carina, but no indication of a spine, so within the tribe there is a gradation from a well-developed spine to none at all.

COMMENTS ON THE OTHER GENERA OF OMMEXECHINI

Calcitrena Eades.—This genus and its single species, *maculosa* Eades, was described in 1961 from La Rioja Province, Argentina. Only two adults and a nymph are known. We have compared the genus with *Tetrixocephalus* under our description of the latter.

Parossa Bruner.—This genus has been reviewed, with a key to species, by Rehn (1941). The five species occur in southern Brazil, Paraguay, eastern Bolivia, and as far south as Mendoza in west-central Argentina.

Pachyossa Rehn.—No specimens of *Pachyossa* have been reported in literature since Rehn's original generic description (1913*b*: 324) and that of the only species, *signata*, based on a unique female taken in Misiones, Argentina. Recently, important material of the genus has been found in Uruguay by C. S. Carbonell of the Universidad de la República Uruguay and his associates, and a further publication is expected.

Ommexecha Serville.—There are nine species of *Ommexecha*, including *apolinari* Hebard (1923: 218) from Colombia and *walkeri* Kevan (1959: 161, footnote) from Santarem, Brazil, in addition to the seven species documented by Liebermann (1939: 164–165). *O. walkeri* is a replacement name for the preoccupied *O. gracilis* Walker (1870: 798). The genus occurs from Colombia to eastern Argentina (Entre Rios and Santa Fe), where specimens occur on sandy soils.

Spathalium I Bolivar.—Except for *S. paranense* Rehn (1913*a*: 86–88, figs. 3–4) from Paraná, Brazil, the 13 known species of *Spathalium* were enumerated by Liebermann (1938). The genus extends from central Brazil to central Argentina (La Pampa). We consider *S. Rehni* Liebermann a synonym of *S. viridis* Bruner (New synonymy).

Graea Philippi.—A single species, *horrida* Philippi, is known, though a second, *monstrosa*, was described by Bruner (1900: 52). The drawing of *monstrosa* by Bruner (1900, fig. 20) is the same one for which he later used the name *horrida* (1906, pl. 37, fig. 1). Liebermann (1942: 438) discussed the variation shown by *horrida* and questioned the distinctness of *monstrosa*. The type of *monstrosa*, loaned by the University of Nebraska, was examined in 1962 (by Liebermann) and found to be *horrida* (New synonymy). The distribution of the species is centered in northwestern Argentina, especially the arid zones of San Luis, Mendoza, Cordoba, and La Pampa.

KEY TO THE GENERA OF OMMEXECHINI

1. Color green, often tinged with yellow, frequently with orange spots at bases of tegmina which may be concealed by pronotum; mesosternal interspace quadrate or but little wider than long (Fig. 22); hind femur simple, not adorned by lobes, tubercles, or spines; pronotum without a pronounced flare of lateral lobes and not ornate .... *Parossa* Bruner

   Color usually brown or gray, if green differing in other characters from above; mesosternal interspace much wider than long; hind femur variable, often lobate, tuberculate, or with spines projecting posteriorly from genicular lobes; pronotum frequently flared and very ornate 2

2\. Tegmina and wings absent; metanotum and several abdominal terga each with a pronounced spinelike hook or tubercle on midline; lateral lobes of pronotum very flared and ornate (Fig. 17), but posterior margin of pronotum broadly rounded and tuberculate .... *Graea* Philippi

Tegmina and wings present; no hooks or tubercles on midline of metanotum or abdomen; lateral lobes of pronotum variable; if degree of *flare* approaches condition shown in Fig. 17, then posterior margin or pronotum usually is very ornate 3

3\. Frontal costa but little produced between antennae (Figs. 1, 2); pronotum with median carina absent or weakly indicated on metanotum only, pronotal surface rugose but tubercles scattered and inconspicuously low; tegmina of gray to buff color with numerous well-scattered dark blotches (Fig. 24); size small, pronotal length not exceeding 4 mm 4

Frontal costa conspicuously produced between antennae (Fig. 3) or, if not (*Pachyossa*), tubercles on pronotum are numerous and strongly developed; pronotum variable, median carina present on prozona, frequently crestlike or, if not, then strong tubercles occur; tegmina of uniform color, streaked, or spotted, but not spotted as in Fig. 24 above; size variable, pronotum often much longer than 4 mm 5

4\. Lateral lobe of pronotum with ventral margin conspicuously oblique (Fig. 9); male with anterior surface of head decidedly oblique (Fig. 2); male with interocular area narrower than width of an eye in dorsal view (Fig. 10); female with apex of subgenital plate broadly rounded (Fig. 21, *asg*)
.... *Calcitrena* Eades

Lateral lobe of pronotum with ventral margin moderately oblique (Figs. 1, 6); male with anterior surface of head not oblique; male with interocular area about equal to width of an eye (Fig. 7); female with apex of subgenital plate angulate (Fig. 20)
.... *Tetrixocephalus,* new genus

5\. Flagellum of antenna flattened on dorsal surface, especially on basal half; prozona of pronotum with a crestlike development of median carina, though some species have the crest restricted to scattered hooklike lobes ....*Spathalium* Bolivar

Flagellum of antenna not flattened; prozona of pronotum with median carina absent or poorly developed, may be represented by tubercles which are not hooklike or in form of crest 6

6\. Projection of frontal costa between antennae moderate; genicular lobes of hind femur without spinelike projections; pronotum rather uniformly covered with low rounded tubercles, without spinelike tubercles or angular corners at lateroposterior angles of lateral lobes, posterior margin of dorsal surface broadly rounded and may be strongly tuberculate .... *Pachyossa* Rehn

Projection of frontal costa between antennae conspicuous (Fig. 3); genicular lobes of hind femur often (in most species) with spinelike posterior projections extending posteriorly (Fig. 16); pronotum usually with some sharp and conspicuous tubercles instead of a uniform covering of them, lateroposterior angles of lateral lobes angulate or with sharp spinelike tubercles, posterior margin usually angulate or with tubercles creating that appearance .... *Ommexecha* Serville

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NOTE: Too late for full correction of the names, we have learned that Rosas Costa (Neotropica, 8: 79–80, 1962) reported that *Parossa* Bruner 1911 and the preoccupied *Ossa* Giglio-Tos 1894, which it replaced, are synonyms of *Clarazella* Pictet & Saussure 1887, and that *P. viridis* G.-T. 1897 is a synonym of *C. patagona* P. & S. All the species referred to *Parossa* by Rehn (1941) were referred to *Clarazella* by Rosas Costa.

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BIOLOGICAL NOTES ON THREE FLORIDIAN WASPS (HYMENOPTERA, SPHECIDAE)

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During the summer of 1962, while both of us were in residence at the Archbold Biological Station, Lake Placid, Florida, we had an opportunity to observe the life history and behavior of a number of solitary wasps. Each of us made observations on three sphecid wasps, *Nitelopterus slossonae* Ashmead, *Tachytes (Tachyoides) mergus* Fox, and *Oxybelus emarginatum* Say. We have pooled our notes on these, and present joint accounts in order to give a more complete coverage than would be possible in separate contributions.

Our observations were made 5 miles south of Lake Placid on the grounds of the Station, in sandy scrub areas adjacent to Lake Annie, just north of the Station property, at Lake Placid, and at Arcadia, 35 miles west of the Station, on sparsely vegetated sand flats adjacent to and above the Peace River (Fig. 4).

We are grateful to the following specialists for identification of the prey and parasites of the wasps: W. J. Gertsch and W. Ivie, American Museum of Natural History, Araneae; and A. B. Gurney, C. W. Sabrosky and G. C. Steyskal, Entomology Research Division, Orthoptera and Diptera. We are also indebted to H. E. Evans, Museum of Comparative Zoology, for his kindness in allowing us to incorporate some brief field notes on *Tachytes mergus* made by him and C. M. Yoshimoto along Blackjack Creek and on the Medora sand dunes in Kansas in 1952.

Nitelopterus slossonae Ashmead

Our observations were made on a population of typical *slossonae*[1], at Arcadia, and on populations of *slossonae barberi* Krombein[2] at Lake Annie and Lake Placid. Males of the two subspecies are indistinguishable, but females are recognized readily by some slight behavioral traits as detailed below, and by the entirely red abdomen and slightly larger size of *slossonae barberi* as contrasted with the somewhat smaller size and red and black abdomen of typical *slossonae.*

We observed burrow excavation by *s. barberi* only (62462 A, 62562 A, 62762 A, NI-1, 2, 3 and 5). Usually the burrows were begun on slightly sloping areas of open sand, but one nest was started on the side of a pit we had dug to obtain the nest of another wasp, and another was begun in a spoil heap of loose sand 5–6 cm above the adjacent sand. In searching for a place to dig, one wasp made several false starts and finally disappeared without having completed a burrow, and another began a second burrow after making a false start 0.8 cm long elsewhere. The burrows were always begun in loose, dry sand, and the wasps used only the forelegs, working in unison, to excavate. As the sand was thrown backward, the wasp held her wings raised nearly vertically and bobbed her abdomen up and down in synchrony with the action of her forelegs. At intervals, the wasp backed from the burrow and cleared away the loose sand which accumulated in a spoil heap below the burrow entrance. The spoil heap was raked flat as she moved forward to the entrance, throwing sand backward as she went. She kept her wings raised nearly vertically until she entered the burrow, at which time she lowered them over the dorsum of her abdomen. We timed the burrow excavation of three females at 35, 45 and 55 minutes for burrows 2.5 to 4.0 cm in length.

We observed males digging short burrows in the sand with their forelegs, probably to serve as shelters during the rain or for overnight. We are uncertain whether females remain overnight in their nests, or whether they, too, dig a short temporary burrow for shelter.

Immediately upon completion of the burrow the *barberi* females left the entrance open and proceeded to make orientation "tours" over an area 1–2 meters from the entrance. Usually, three or four brief orientation "tours" were made in the immediate vicinity, mostly on foot or in short, low flights, alternating with short visits inside the burrow. The wasps then began to hunt for prey, still leaving the entrance open. Occasionally, the wasp returned without prey several times during the hour, entered her burrow for a few seconds, and then departed for another period of hunting, still leaving the entrance open.

In making the temporary closure, one *barberi* female (62462 B) raked in sand from the spoil heap and then appeared to pound it with the venter

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[1] Based on KVK notes 7362 A, C, D, E, 7462 C and E, and FEK notes NI-6, 7, 8, 9 and 11.

[2] Based on KVK notes 62462 A, B, C, 62562 A and 62762 A, and FEK notes NI-1, 2, 3, 4, 5 and 10; observations 62762 A and NI-1 were made on the same individual.

of her abdomen. This element of her behavior needs confirmation by additional observations. The apparent pounding of sand with the abdomen may have actually been just the bobbing up and down of the abdomen, such as we noted during excavation of the burrow and during prey transport. Our observations (62462 A, B) indicate that *barberi* may make a temporary closure nearly an hour after the orientation "tours" and subsequent visits, even though no prey has been brought into the nest. Once typical *slossonae* (7362 C) left her burrow entrance open after placing a spider in the cell; we are uncertain whether this behavior is typical for that subspecies.

Females of both typical *slossonae* and *s. barberi* hunted for prey mostly on the open sand or on or under prostrate vegetation. Most of the hunting was done rapidly, either on foot or in short, "skipping" flights less than a centimeter above the ground surface. Probably the wasps are poor fliers because of the short wings, which explains why so much of the hunting and prey transport is done on foot. While hunting on foot, the wasp held her abdomen upward at an angle and bobbed it up and down, and flicked her wings incessantly. In our experience females of typical *slossonae* held the abdomen at a somewhat lower angle than did those of *barberi,* and the short, "skipping" flights were less rapid. However, these apparent ethological differences may simply reflect variation among individuals we observed, and may not be typical of all females of these subspecies.

We were not fortunate enough to witness capture of the prey. Presumably, it is stung, because the spiders which we recovered from wasps during prey transport or which we found in provisioned burrows were thoroughly paralyzed. Occasionally, one or more of the spiders' legs were missing at the coxal joint. Possibly, the wasp amputated a leg in order to feed on the exuding blood, and not to make transport easier, since only one to four legs were missing on three of the nine spiders used as prey. The possibility should not be overlooked that the few spiders with missing legs may have lost them by some other agency than amputation by the wasp. We took one spider with one missing leg from a wasp during transport, and recovered from partially provisioned nests two others with one or more legs missing.

We observed prey transport by five females of typical *slossonae* (7362 A, D, E and 7462 C, E) and by one of *s. barberi* (NI-10), and could distinguish no behavioral differences. Usually, the wasp walked rapidly over the sand, straddling the spider, but twice we saw females of typical *slossonae* make periodic, low, "skipping" flights with their spiders. The spider was always held venter to venter, head forward, and usually the wasp clutched the forelegs, or a foreleg and a pedipalp of her prey between her mandibles. The wasp bobbed her abdomen up and down rhythmically, while she walked with her spider over the ground. Krombein and Evans (1954: 232) recorded a female of typical *slossonae* transporting her prey on the ground, and later (1955: 231) noted another female of *s. slossonae* flying with her spider.

We obtained only two specimens of prey from *barberi* (62562 A, NI-10). One was a small (2 mm long) female linyphiid, *Meioneta formica* (Emerton); the other was a large (4.2 mm) immature salticid, *Pellenes* sp. We recovered six spiders from females of typical *slossonae* or from their nests as follows:

7362 A—Linyphiidae, ♀ *Meioneta formica*, 2 mm long (wasp 4 mm)
7362 C—Lycosidae, young *Lycosa* sp., 2 mm long
" Dictynidae, ♀ *Dictyna altamira* Gertsch and Davis, 2 mm long
7362 D—Lycosidae, young *Lycosa* sp., 2.5 mm long (wasp 5 mm)
7362 E—Lycosidae, young *Lycosa* sp., 3.5 mm long
7462 C—Lycosidae, young *Arctosa* sp., 2.8 mm long (wasp 5.5 mm).

None of these spiders is a snare-builder, and it is probable that both subspecies of *slossonae* flush their prey from the bare sand, from prostrate vegetation, or from leaves or other debris on the ground. Krombein and Evans (1954: 232; 1955: 231) recorded two salticids, *Metaphidippus galathea* (Walck.) and *Habrocestum pulex* (Hentz) as prey of typical *slossonae.*

The available data suggest that two or more spiders are stored per cell, but we are uncertain whether there is only one or perhaps more cells per nest. We dug up two nests of *barberi* (62562 A, NI-1); each contained one cell with a single spider but no wasp egg. Krombein and Evans (1955: 231) noted a nest of typical *slossonae* with a single spider but no egg. We dug up another single-celled nest (7362 C) of typical *slossonae* which contained two spiders but no egg. Ferton (1896: 266) recorded 7 to 12 spiders per cell in nests of the European *Miscophus bicolor* Jurine, which genus is very closely related to *Nitelopterus.* He did not mention whether there were one or more cells per nest, so the assumption is that there was only one.

We had only moderate success in tracing the burrow to the cell. Usually, the burrow was in dry sand and frequently led into a mass of fibrous grass roots, so that its course was often lost. We were unable to detect any differences between nests of *barberi* (62462 A, B, 62562 A, NI-1) and of typical *slossonae* (7362 C, NI-11). Usually, the burrows had a diameter of 2 mm, and entered the sand at an angle of 40–45° with the horizontal. They were straight, 2–4 cm long, and ended in a crude cell 1.8–3.5 cm below the sand surface.

We observed final closure by a single female of typical *slossonae* (7462 E). When first observed, this wasp was clutching the anterior end of a spider in her mandibles and was holding the cephalothorax and abdomen of her prey with her fore- and mid-legs. Perhaps she had just stung the spider, or perhaps she assumed this position to malaxate it. Ferton (1896: 267) recorded malaxation of the spider prey to obtain a liquid (blood?)

by two European species of *Miscophus.* Our wasp then carried the spider over the sand for 6 meters, walking most of this distance, but occasionally making short, low flights. We lost sight of the wasp just before she entered the burrow head-first with the spider at 1447 hours. We do not know whether there had been a temporary closure at the entrance. Seventeen minutes later she came out of the burrow head-first, crawled around for a few seconds, and then began to make a permanent closure. She threw sand backwards from the spoil heap toward the burrow, gradually backing up, and raking it down into the burrow with her forelegs. She continued this for 2 or 3 minutes and then began to pull down sand with her mandibles from the overhanging upper edge of the entrance, and to pack it into the burrow. She completed filling the burrow at 1508, but 15 minutes later was still smoothing sand for a distance of 3–5 cm over and around the entrance. She did not pound the sand with her abdomen either while filling the burrow or subsequently smoothing over the entrance and surrounding area. Neither did she bob her abdomen as she raked sand backward, keeping her wings folded flat over her abdomen. We scared her away when we attempted to capture her at 1523, and unfortunately lost her nest due to the dry shifting sand and interspersed grass roots.

Tachytes (*Tachyoides*) *mergus* Fox[1]

This is the only valid, described species in the United States belonging to this distinctive subgenus; as compared with *Tachytes* of other subgenera, *mergus* is peculiar in having two strong teeth on either side of the median lobe of the clypeus, more slender mandibles, and very sparse decumbent setae on the pygidium. Presumably, the distinctive characters of the clypeus and mandibles are related to the unusual (for the genus) way in which it digs its burrow. *T. mergus* ranges from New Jersey and Nebraska southward through Central and South America to Brazil. For so widely distributed a wasp there is a surprising lack of published biological data. The only previous life-history note is by Williams (1928: 53–54).

Most of our *mergus* nests were either near water, or in sand having a high water table. This apparent preference for sandy areas near the water's edge was noted earlier by Williams (1913: 198) in Kansas and by Krombein (1953: 281) in North Carolina.

We observed various aspects of the excavation of the nesting burrow by six wasps (63062 B, 7362 B, TY 4, 8, 9, 14). All of the nests were begun on a flat or slightly sloping surface, except for one started in the side of an impressed heel print and one on a 45° slope of a sand pile on a concrete platform. When discovered, the wasps had already been at work on these burrows, so we have no information on selection of a nesting site.

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[1] Based on KVK notes 63062 B and 7362 B, and FEK notes TY 1, 2, 3, 4, 6, 7, 8, 9, 13, and 14, made at Archbold Biological Station, Lake Annie, Lake Placid and Arcadia sites. We have also incorporated some data from notes made by H. E. Evans and C. M. Yoshimoto in Kansas, HEE notes 60, 64, 87, 96, 113 and 199, and CMY note 74.

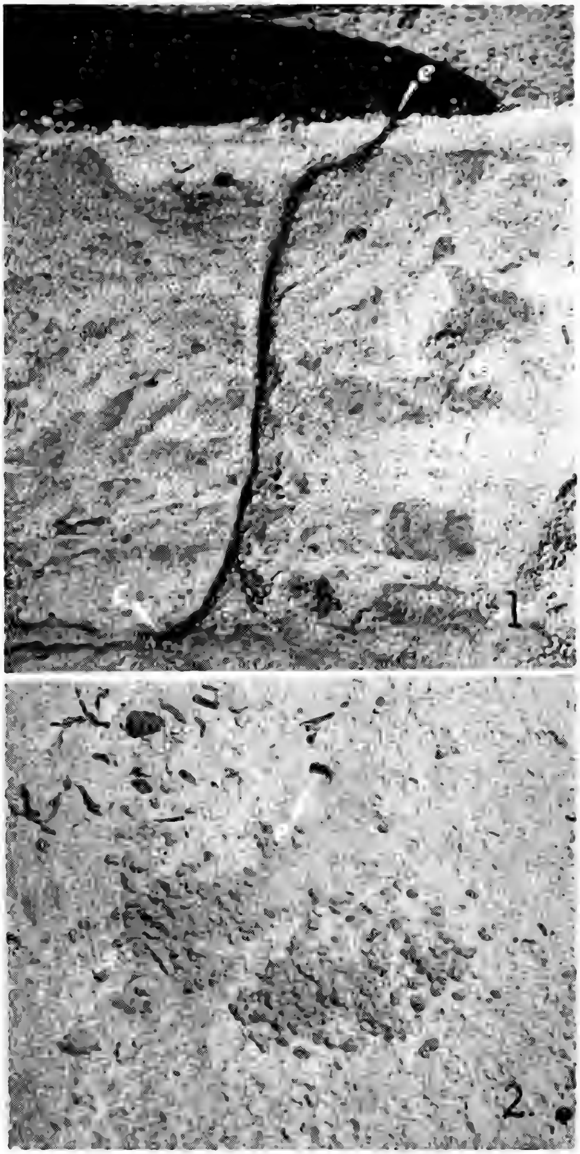

Plate I. *Tachytes mergus* Fox. Fig. 1, burrow profile (*c*, cell; *e*, entrance), nest 63062 B, July 1962, × 0.54. Fig. 2, burrow entrance (*e*) and excavated sand pellets, nest TY-4, 2 July 1962, × 0.50. (Both figures by KVK.)

Four of the burrows were marked by a roughly crescentic spoil heap of large lumps of damp sand 2–8 cm from the burrow entrance (Fig. 2). A fifth burrow begun on a 45° slope had a reniform spoil heap of large pellets 2–6 cm from the entrance. The crescent-shaped spoil heap was usually about 3 cm wide in the middle and about 0.5 cm high. Evans observed similar disposition of the excavated pellets in Kansas.

The behavior during digging was quite consistent in the several individuals observed. In the early stages of the excavation, where the sand may be finer and less damp, the wasp used her forelegs to fling the sand beneath and a few centimeters behind her. Evans also observed this behavior early in the burrow excavation. Later, when she reached the damper, more coarse sand, she backed out of the burrow, carrying a formed pellet 2–3 mm in diameter between her mandibles and forelegs. Evans observed this pellet being formed by the mandibles and forelegs. The forelegs were bent upward to form a sort of basket with the mandibles, as was observed also by Williams (1928: 54). She then walked backward several centimeters and dropped the sand pellet on the spoil heap. Her wings were kept folded flat over the dorsum of her abdomen and her antennae extended downward and slightly outward while she walked to and from the spoil heap. Her actions were rapid but not at all nervous. Occasionally, the wasp backed away from the entrance and cleaned her antennae and rubbed her hind legs against the sides of the abdomen. One female was troubled twice by a small, red ant while she was digging. Each time, she chased it off with threatening motions, deserting the burrow for sometimes as long as 5 minutes. Females of *mergus* were also frequently troubled by miltogrammine flies while digging. The latter were usually chased off and immediately thereafter the wasps resumed digging. Females worked very diligently, one bringing out as many as 6 or 7 loads of sand a minute during an early stage of her excavation. Later, as the burrow grew deeper, the wasp brought out loads of sand less frequently.

The excavation of nearly the entire burrow was observed only once (63062 B). It was estimated, from the size of the spoil heap at 1045, when the burrow was discovered, that the wasp had already been digging for about 20 minutes. At 1145 she made a temporary closure from within with several large pellets of damp sand. It is assumed that the making of this closure marked the completion of the burrow, for the wasp did not reappear for another hour. At 1245 she exited from the burrow headfirst, walked over to the spoil heap, and then reentered her burrow, throwing up another temporary closure in the entrance. It seems unlikely that any digging was done from 1145 to 1245, for no sand was brought out nor was there a large accumulation of loose sand in the empty burrow when it was dug up several days later. These data indicate that excavation of a burrow requires somewhat more than an hour, but that the wasp does not necessarily begin hunting prey immediately thereafter.

Presumably, when the wasp is ready to provision a cell, she temporarily closes the burrow entrance. At least such a closure is maintained between provisioning flights and consists of a few scuffs of loose sand thrown backwards with the forelegs into the burrow. One wasp did not even reach the sand surface before she began making the temporary closure while still within the entrance. It seems likely that the wasp also makes some sort of orientation flight after completing the burrow and prior to hunting prey, but we did not observe such a flight.

Prey consisted of pigmy mole crickets belonging to two tridactylid species, *Tridactylus apicalis* Say and *T. minutus* Scudder. Williams (1928: 54) also found *mergus* preying on *Tridactylus,* probably *apicalis* Say, in Brazil. His earlier guess (1913: 198) that it probably preyed on immature Tettiginae in Kansas was certainly erroneous. Evans captured a female *mergus* in Kansas flying with a paralyzed *apicalis* adult. In our experience most of the prey were immature, but there were a few adults. The specimens we preserved consisted of 12 nymphs of *apicalis,* 3.8–6.0 mm long, and 2 adults of *minutus,* 3.5–4.8 mm long. The only other wasp which is known to prey on pygmy mole crickets is *Tachytes* (*Tachynana*) *minutus* Rohwer. Previously unpublished observations at Plummers Island, Maryland (by KVK), and at the Archbold Biological Station, Lake Placid, Florida, and at Auburn, New York (by FEK), establish that *Tachytes minutus* also uses *Tridactylus apicalis* Say as prey.

In hunting for prey the wasps made short, rapid flights about 3–4 cm above the surface of the sand, interspersed with equally rapid, short, zigzag walks on the sand. Frequently, the wasp paused on the sand, tapping the surface rapidly with the outstretched distal segments of its antennae. When the wasp finally located a hidden pygmy mole cricket, sometimes only after some 20 minutes of hunting, she began to dig for it, using her mandibles to loosen large pellets of sand. These pellets were carried backward very rapidly and deposited 1–2 cm from the excavation. One hunting female (TY 1), at intervals, turned in a rapid circle on one side or the other of its excavation. These circles were made every few seconds at the start, but the intervals became longer as the excavation deepened. This female dug downward from 0.8 to 4.2 cm to reach her prey (based on three observations). When the wasp reached the *Tridactylus,* she pulled it rapidly out of its burrow, clutching its head in her mandibles. She then flew a short distance, landed on the sand surface and, holding the prey beneath her, stung it. In 1–3 seconds, she flew off, usually at a higher level than when hunting. During flight, the wasp held the cricket with all six legs. Usually, the prey was carried venter up and head forward, but once the wasp carried the cricket to its nest dorsum up and head forward. One female (TY 3) brought in prey at 1345 and then subsequent crickets at 1420, 1425, 1428, 1435, and 1447. She landed with prey at the nest entrance, holding the sides of the cricket's head with her third pair of legs while she raked open the temporary closure with her forelegs. The cricket was venter up, its body extending beyond that of the wasp. On two other occasions, this same female used her mandibles as well as her forelegs in opening the temporary closure. Usually the wasp remained inside for only a few seconds, just long enough to place the cricket in the prepared cell.

H. E. Evans has a brief note made by C. M. Yoshimoto as to prey capture in Kansas. Yoshimoto observed the *mergus* locate a nymph a couple of millimeters below the surface, fly into the air with it, and sting it during flight. The wasp alighted on the sand seconds later, and stung the prey again in the thoracic sternum.

The final closure of the burrow after complete provisioning of the nest was observed twice (TY 3, 6). One of the wasps (TY 3) made a temporary closure from within at 1448 after bringing in five mole crickets in a period of 27 minutes. Presumably this closure was made so that oviposition and closure of the cell could be effected. At 1507 this female made an elaborate final closure which ended with her throwing sand with her forelegs from various directions, followed by a few hovering flights and then more leveling of sand over the entrance. In the other observation (TY 6) the entire closure took 25–30 minutes. The wasp first made a closure from within, then opened the closure and appeared headfirst in the entrance; she came out onto the sand surface, began picking up large pellets of sand from the spoil heap in her mandibles and, transferring these to the forelegs, threw them backward into the burrow. As the sand grains accumulated inside the entrance, the wasp raked these with her forelegs, while backing down into the burrow, nearly out of sight. When the upper part of the burrow was filled to the ground level, the wasp came onto the sand surface and threw loose sand backwards with her forelegs over the area of the entrance. After 30 seconds she made a few hovering flights above the area of the entrance and was then captured.

We dug up eight burrows (63062 B, 7362 B, TY 3, 4, 6, 8, 9, 14), but five of them had been abandoned by the wasps before completion, and a sixth was abandoned after completion but before any prey had been stored within. This latter nest (63062 B) demonstrates the normal burrow profile (Fig. 1). The initial section is about 2.5 cm long, and enters the sand at a rather shallow angle; the burrow then turns sharply downward at an angle of about 85° for 11 cm, and ends in a horizontal cell 15 mm long and 7.5 mm high, 12.5 cm below the sand surface. One nest dug up by Evans in Kansas had an initial section 10 cm long entering the sand at a 40° angle, and then a vertical section ending 19 cm below the surface. Another partially completed burrow dug up by Evans in Kansas was in a sloping sand bank; it went in at a steep angle for about 9 cm, then at a shallower angle for 9 cm more, and ended about 25 cm below the surface. Our five partially completed burrows all had an initial section 2–5 cm long at a shallow angle of 25–40° and then the burrow turned downward sharply, ending blindly 5–8 cm below the surface where each of the wasps encountered clay or extremely hard-packed sand which apparently discouraged further digging. Ordinarily, the burrow entrance was 4.5–5.5 mm in diameter, and the burrow itself about 4.5 mm.

One completed nest (TY 3), whose final closure had been observed on

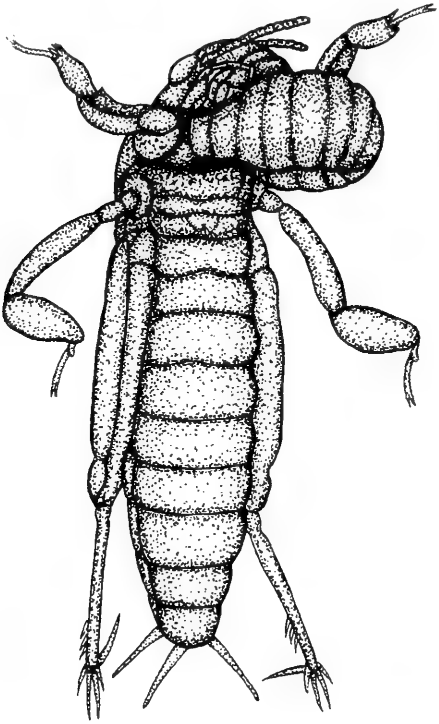

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PLATE II. Fig. 3, young larva of *Tachytes mergus* Fox feeding on *Tridactylus* nymph. Fig. 4, sand flats adjacent to Peace River, Arcadia, Fla.; *Tachytes mergus* nested in foreground, *Nitelopterus s. slossonae* Ashm. on sloping bank above river in center. (Fig. 3 by FEK, Fig. 4 by KVK.)

29 June, was dug up on 3 July. The main burrow began at a shallow angle for several centimeters, and then went downward at a very steep angle. The oldest cell, containing a wasp larva about half-grown and eight remaining *Tridactylus,* was at a depth of 16.4 cm. A second cell, containing a smaller larva and 13 mole crickets, was located about 1.5 cm from cell 1 at a depth of 15.6 cm. The last cell, which held a very recently hatched larva and six mole crickets, was 13.5 cm deep, about 4 cm from and on the other side of cell 1. Cells 1 and 2 were 19 cm from the entrance, and cell 3 was 15.5 cm from the burrow entrance.

The final closure of the other completed nest (TY 6) was made on 6 July, and the nest was dug up the next day. It was in an abandoned sandpile on a concrete platform, and differed in several respects from nests dug in a more normal site. The sand had an angle of 45° where the wasp commenced digging. The burrow itself was 15.5 cm long, and the vertical distance to the cell was only 12.6 cm. There was only a single cell directly on the concrete surface. It contained the wasp egg, six *apicalis* nymphs, and two *minutus* adults. This wasp may have stored only a single cell because of the shallow depth of the first cell.

Williams' observations (1928: 54) on the burrow length are not at all concordant with ours. He found only a "rather short sloping burrow." He also noted that the "nest seems to be a single-celled affair."

All prey were placed in the cells head inward, but either venter up, venter down, or on their sides. Prey taken from the cells were only lightly, if at all, paralyzed and some could jump 15–20 cm into the air. Williams (1928: 54) also noted this very active behavior by released prey, and surmised that the anterior (digging) legs must have been paralyzed or the crickets would have been able to dig their way out of the cell.

The egg is white, sausage-shaped, 2 mm long, and 0.4 mm in diameter. In the one example noted, it was attached at the base of the right fore coxa of the cricket and extended transversely across the thorax. The newly hatched *mergus* larva begins to feed in the soft intersegmental membrane behind the fore coxa with its body extending transversely across the thorax between the fore and mid coxae (Fig. 3). We did not obtain precise data on the duration of the egg and larval stages. Rather fragmentary data indicate that the larva may hatch in 2–3 days, and that the larval stage may last 5–6 days. We preserved the few mature larvae for taxonomic study, so have no information on the cocoon or duration of time between spinning the cocoon and emergence of the adult. Williams (1928: 54) stated that the cocoon is "cylindrical and rounded at both ends and composed of grains of sand glued and spun together to form a rigid cask."

As mentioned above, *mergus* is frequently attended by miltogrammine flies during excavation of her burrow, particularly by *Phrosinella fulvicornis* (Coq.). We observed and captured these parasitic flies during three excavations (63062 B, 7362 B, TY 9), but never saw any flies trailing a wasp with prey, or lurking at the burrow entrance when the wasp entered with its prey. A specimen of *Phrosinella* was captured after it entered the burrow trailing behind the wasp during one excavation (63062 B), and a second *Phrosinella* was taken as it investigated the temporary closure of this burrow while the wasp was still inside. During another excavation (TY 9) three flies, one of which was a *Phrosinella*, hovered over the female wasp and constantly forced her to interrupt her digging and fly to a plant nearby; the other two flies were identified as *Gymnoprosopa* sp. near *filipalpus* Allen, and *Senotainia* sp. possibly of the *trilineata* complex. After capturing these, a fourth miltogrammine came upon the scene. Still another *Phrosinella fulvicornis* hovered above a third wasp (7362 B) as she dug in the sand, and afterwards, sat watching on a plant nearby.

The frequency with which *Phrosinella fulvicornis* observed the wasps excavating their burrows, its audacity in investigating the burrow entrance while the wasp was inside digging, and its absence from the area of the burrow entrance while the wasp brought in prey, suggest to us the possibility that this fly may customarily deposit larvae or eggs in the burrow entrance before any prey are stored in the nest. One of us (FEK) observed this fly at Groton, New York, sitting motionless on the sand surface while nearby a female *Tachysphex terminatus* (Smith) excavated its burrow. Allen (1926: 73), quoting J. B. Parker, mentioned that *fulvicornis* wanders "about over the sand apparently engaged in smelling, and then digging in the sand." One female dug a small pit at the entrance of an *Oxybelus emarginatum* burrow and then apparently oviposited or larviposited. Allen did not record *fulvicornis* trailing wasps, as he did other genera of Miltogrammini. The lack of specially enlarged compound eye facets might indicate that *fulvicornis* does not shadow its host.

Oxybelus emarginatum Say

This is another widely distributed wasp which occurs transcontinentally in southern Canada and the United States, ranging even into many inland areas of Mexico. Females of this species show considerable variation in size, ranging from 3 to 5.5 mm long. Our observations[1] were made at Lake Annie and Arcadia, and were essentially fragmentary. However, few biological data have been published on the North American species of *Oxybelus* and nothing on *emarginatum*. Since the latter differs from many U. S. species in some essential behavioral details, we feel that our limited data will be illuminating.

Some details of the burrow excavation were noted only once (62562 B). This female was digging her burrow, which entered a gentle slope of sand at almost right angles, standing practically on her head, and flinging the sand beneath and behind her rapidly with her forelegs. All the while, the digging female was shadowed by an unnamed miltogrammine fly. During our subsequent excavation, we were unable to trace this nest because of the constant shifting of the dry sand under the trowel.

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[1] Based on KVK notes 62562 B, 62562 C and 62762 C, and FEK note OX-11.

A second, rather large female (62562 C), 5.5 mm long, was observed at 1434 as she flew out of her burrow, leaving the entrance open. She returned in flight 2 minutes later carrying a paralyzed fly underneath, and darted immediately into the open burrow without landing on the sand near the entrance. She flew out of the burrow at 1443, again leaving the entrance open and returned in flight 3 minutes later, presumably with a fly, but darted into her burrow so quickly and close to the ground that we could not see whether she was actually carrying prey. At 1450 she pushed up some sand from below, closing the entrance. Presumably oviposition and/or closure of the provisioned cell took place during the next 12 minutes, as there was no change in the appearance of the burrow entrance. However, when we returned at 1517, a permanent closure had been made.

This burrow, begun in a heel print on a 20° slope, went approximately straight downward. There was a small crescent of excavated sand about 3 mm high extending downhill about 10 mm from the burrow entrance. We found a single cell 3.8 cm below the area of the heel print, slightly to one side. It contained four stocky, female muscid flies, *Atherigona orientalis* Schiner, 3.1–3.5 mm long. The sausage-shaped wasp egg, 1.8 mm long and 0.5 mm wide, was attached upright to one of the flies on the left side between the head and left foreleg. The flies were paralyzed and could move only the legs and proboscis weakly.

We observed a third female (62762 C and OX-11) nesting just below the sand surface in the side of an abandoned pit, which one of us had dug to obtain the nest of a *Cerceris*. This female, smaller than the one reported above, only 5 mm long, was captured flying toward her open burrow entrance carrying a slender, paralyzed cecidomyiid midge, *Anarete buscki* (Felt), 1.6 mm long, beneath her. This nest could not be traced because of the dry, shifting sand.

O. emarginatum is the second Nearctic species of this genus which has been found not carrying its prey impaled on the sting. In the North American fauna only *sericeum*, both typical *sericeum* Robertson (Bohart and Marsh, 1960: 116, 118) and *s. crocatum* Krombein (1955: 74), which belongs to a quite different species group from *emarginatum*, is also known to carry the prey beneath the body. In the other North American species for which biological notes have been recorded, the prey is always carried impaled on the sting whether in flight or on the ground. None of the flies, recovered from our nests nor from wasps in flight, showed any signs of having been impaled on the sting. Another unusual facet of the behavior of *emarginatum* is that it is not known to make a temporary closure of its burrow entrance when it departs to hunt flies. This behavioral trait may be linked to its unusual type of prey carriage, for some species which impale their prey on the sting are also known to make temporary burrow closures which they open with their forelegs without relinquishing the prey. Ferton (1902: 517) also postulated this correlation with some species of Palaearctic *Oxybelus*.

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THE PLETHODONTID SALAMANDER *PHAEOGNATHUS*: EXTERNAL MORPHOLOGY AND ZOOGEOGRAPHY

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On 18 June 1960, while collecting in the Coastal Plain of southern Alabama, Leslie Hubricht discovered a single individual of a remarkable new salamander. The specimen was sent to the U. S. National Museum, and the following year it was described by Highton (1961) as a new genus and species, *Phaeognathus hubrichti.* Since the publication of Highton's description, herpetologists have been split into two camps, those who believe that *Phaeognathus* is a normal salamander, just the first known individual from an unusual but natural population, and those who believe that *Phaeognathus* is a freak—a lonely, hopeful monster in the tradition of Goldschmidt's evolution by macromutation. The adherents of these opposing points of view are vocal, but relatively few people have seen *Phaeognathus,* and no one really knows very much about it.

Thanks to the kindness and cooperation of Dr. Doris M. Cochran of the U. S. National Museum, I recently examined the holotype of *Phaeognathus,* and can provide some morphological details not in the original description. The many other features which I have repeated from Highton's paper are those which have been verified by the present study.

REDESCRIPTION

Phaeognathus hubrichti Highton, 1961, Copeia, No. 1, p. 66–67

Holotype: USNM 142486, Alabama, Butler County, 3 miles NW McKenzie, 18 June 1960, coll. Leslie Hubricht.

Female: Head 20, body 88, snout to posterior end of vent 108, tail 104, total length 212 mm; 21 costal grooves; 14½ intercostal spaces between adpressed limbs, arm almost reaches fourth costal groove when adpressed, leg extends about a similar distance anteriorly when adpressed; legs more robust than arms; digits very short, broad, almost truncate, thumb reduced. *Note*: The dimensions of this specimen have caused considerable difficulty. My measurements for head, snout-vent, and total length are 18, 103, and 206 mm, respectively. For the same parts, Highton gives 20, 107, and 221 mm. Since the discrepancy was not noticed until I had returned to Columbus, I wrote Dr. Cochran requesting her to remeasure the type. Her answer, dated 11 July 1962, is as follows: "The type of *Phaeognathus hubrichti* has the head bent forward. When I measured it that way, I got 18 mm from snout to gular fold, but when I straightened it, this length was 20 mm. I measured 108 mm [by a slip of the pen Dr. Cochran wrote 208 mm] from snout to posterior edge of vent. . . . The total length with extended head I get as 212 mm." By subtracting snout-vent from total length, Valentine, Cochran, and Highton obtain tail measurements of 103, 104, and 114 mm, respectively. Apparently the tail has shrunk about 10 mm since measured by Highton. Because of her awareness of the situation, and her use of an accurate ivory ruler, I have adopted Dr. Cochran's data.

Head very long and depressed with a distinct median concavity deepest just behind a line drawn between the posterior corners of the eyes, remainder of upper surface slightly convex; dorsal head skin smooth, neither rugose nor pitted; both lips with very fine longitudinal wrinkles, those beneath the eye curving to parallel the eye margin; nostril extremely small; nasolabial groove sinuous, not swollen; in lateral view the jaw line almost straight to below hind angle of eye, then gently curved downward; eyes sufficiently dorsal so as not to interrupt the head outline when viewed from above; the eyelids unique for the anterior and posterior ends of the upper eyelid overlap the lower; length of eye slightly less than distance from its anterior corner to tip of snout; gular fold present, fused to the throat; other head grooves very poorly indicated, the lateral extension of the gular fold extending dorsally to slightly above the level of the arm insertion, curving anteriorly, then forking, the dorsal and more prominent branch extending anteriad to the rear of the eye and forming the lower margin of a weakly raised "paratoid" area, the lower and less distinct fork running anteriad toward the external hind angle of the jaw but not crossing a vertical groove just posterior to the jaw angles; the vertical groove continuing ventrally as a fold across the throat where the head is deflexed, and extending dorsally across the upper fork of the gular groove, then curving posteriorly, ending opposite the gular fold and forming the dorsal margin of the "paratoid " area; vomerine teeth uniserial, 9 on right, 11 on left, the rows converging posteriorly, completely between orbits, extending anteriorly to a line drawn between the anterior margins of the orbits, separated from the internal nares (which are similar to those in *Desmognathus*) by about 1½ narial diameters on the right side and 2 narial diameters on the left; paravomerine patches elongate, widened posteriorly, converging anteriorly and forming the two lower arms of a long narrow X, the vomerines forming the shorter upper arms, the point of intersection marked by a narrow transverse depression free of teeth (the X appearance heightened by the closeness of the vomerine series to the left paravomerine patch which extends farther anteriorly than that on the right); dentary, maxillary, and premaxillary teeth short, blunt, bicuspid as in female *Desmognathus*, the premaxillary teeth not modified, not set off from maxillary series, and appearing to number about twelve.

Body with skin smooth; no indication of a dorsal fin nor of lateral-line organs; vent with a high, swollen margin anteriorly, crossed by pronounced wrinkles which extend into the cloaca, the posterior margin of vent also wrinkled but depressed, not elevated.

Tail with a thick, fleshy, low, dorsal ridge from above the vent to the tip, this ridge less obvious distally; about halfway to tip the tail cross section gradually changing from round with a dorsal ridge to oval with the upper edge more acute than the lower; midventral line of tail with a narrow depression containing a fine median ridge anteriorly, the ridge disappearing simultaneously with the dorsal one.

Color dark brown with the margin of the lower jaw, the gular fold, the limb insertions, elbows, knees, carpal, and tarsal areas all paler brown; indications of small pale areas at the intersections of the lateral longitudinal body groove with the costal grooves; no light line from eye to angle of jaw; microscopically, the pigment forming a dark reticulum enclosing tiny round pigment-free spots, the individual melanophores not distinguishable.

DISCUSSION

I do not doubt that *Phaeognathus* is a valid genus. Even if the extra seven vertebrae were removed, *Phaeognathus* has several unique structural features. The legs are disproportionately short; if the body lacked seven vertebrae the adpressed limbs would still be separated by more than 6 intercostal spaces, whereas the maximum count yet observed in *Desmognathus* is less than 6. The eyelids are different, not only in the overlapping at the posterior corner, but also in other ways. In *Desmognathus,* when the eye is depressed or closed, the edges of the two lids meet in a curving line, and only overlap anteriorly. In *Phaeognathus,* the margin of both lids is more strongly concave so that even with the eye depressed, the animal can have both corners of the eye closed and still peer out of an oval slit in the center. This appears to be a remarkable adaptation for a burrowing, subterranean existence; certainly no such condition is known in either *Desmognathus* or *Leurognathus.* The deep groove which limits the upper eyelid posteriorly is much more pronounced and longer in *Phaeognathus* than in *Desmognathus.* The exaggerated, swollen, and corrugated collar around the anterior half of the vent is not found in either *Desmognathus* or *Leurognathus,* although it is suggested in these two genera by the presence of convex lips traversed by grooves. The tail, too, is very different, for despite the keel, the tail of *Phaeognathus* is not similar to those of other desmognathines. In the largest and most aquatic desmognathines, including *Leurognathus marmoratus* and *Desmognathus quadramaculatus* and *monticola,* the tail keel is least developed basally and rises to a pronounced fin apically. In the more terrestrial species the keel, if present, is still most pronounced apically. In *Phaeognathus,* both dorsal and ventral fin rudiments are differentiated only on the basal half, with no recognizable fin apically. This suggests that *Phaeognathus* is not intimately related to the remaining desmognathines, and is the least aquatic member of the subfamily.

Many anatomical features of *Phaeognathus* fit the pattern of a specialized burrower: very elongate cylindrical body form, short, heavy legs, stubby digits, tiny nostrils, absence of lateral-line organs, absence of an apical tail fin, and of course, the remarkable eyelids. The combination seems too well integrated to be the result of a fortuitous series of mutations in one animal; rather it makes more sense to consider *Phaeognathus* a product of natural selective forces acting over many generations. Certainly the array of specializations is far too complex to be attributed to a point mutation and too harmonious to be due to a series of random mutations at several loci. Polyploidy does not provide the perfect answer either, for all known salamander polyploids, both natural and induced, are recognizable to genus and species in presently known taxa.

In the other desmognathines, larger sizes are correlated with increasingly aquatic tendencies. *Phaeognathus* is the largest known desmognathine, yet appears to be the most terrestrial. The type was collected under leaf litter on a wooded hillside, distant from the stream below. Thanks to Mr. Hubricht, who provided an excellent map, I made a hurried stop at the type locality. The actual site is on a densely shaded, humid, north-facing slope with steeper relief than usual on Coastal Plain sediments. The thick surface leaf litter lies on a dense mat of interwoven roots making digging virtually impossible, and the ground is, in spots, honeycombed with holes. The humus fauna is very rich; arthropods, annelids, and mollusks are all abundant. I know of no finer place for the survival of an endemic salamander.

The Coastal Plain area where *Phaeognathus* was discovered is of Eocene age (Adams *et al.*, 1926); thus this region has been available for colonization even longer than the Miocene "Island" area of central Florida. Florida supports unusual endemic genera (the lizards *Rhineura* and *Neoseps,* the snake *Stilosoma,* the blind camel cricket *Typhloceuthophilus,* and the remarkable subterranean crayfish *Troglocambarus* (see Neill, 1957, for much additional information); an older area might do likewise. The survival of a rare, endemic, terrestrial salamander in the hot mid-Gulf Coastal Plain must be dependent on local conditions where such interlocking features as exposure, humidity, and substrate combine to provide favorable conditions. Surviving populations should be restricted to optimum areas, not widespread; local extinction in some areas and survival in others should result in a haphazard distribution. If one or more geological formations are better suited for the development of favorable microclimates, the relict amphibian populations should follow the outcrops of these strata.

It is instructive to look at the areas of Eocene and Oligocene deposits in Alabama and Georgia. (Although these two periods are distinct to a geologist, in the field there is no unconformity; also, each contains calcareous formations in contact with the other so that they form a continuous habitat.) Both formations show local tendencies for developing unusually steep relief, resulting in deep, shaded valleys reminiscent of more montane areas. These formations outcrop in a broad east-west belt across southern Georgia and Alabama. In Alabama these lower Coastal Plain formations support a relict population of *Rana palustris* (Brown and Boschung, 1954) more than 150 miles from the closest locality in the northern portion of the state, and an isolated population of *Drymarchon* (Neill, 1954). The coastal rivers which drain this area contain five endemic species of sawback and map turtles, *Graptemys pulchra* Baur, *barbouri* Carr and Marchand, *oculifera* (Baur), *flavimaculata* Cagle, and *nigrinoda* Cagle (Cagle, 1952, 1954). And finally, the same formations in Georgia and adjacent Florida have yielded another remarkable salamander, the extraordinary, blind, white *Haideotriton wallacei* (Carr, 1939; Pylka and Warren, 1958). On the basis of these records, it would not be surprising if other relicts and novelties were discovered in the area. Also on the basis of these records, the presence of *Phaeognathus* itself is part of a pattern which, although still incomplete, spotlights the zoogeographic interest of the mid-Gulf Coastal Plain.

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ADDENDUM: On 15 and 16 March 1963, a party from The Ohio State University (the author, David Dennis, John Jenkinson, Steven Tilley, and Roger Troutman) visited the *Phaeognathus* type locality, observed about 60 specimens, and managed to collect 15. The smallest measures 56 (33 + 25) 8 mm; the numbers stand for total length, followed in parentheses by snout to posterior end of vent plus tail, and then head length to the gular fold. The largest, a female, is 213 (106 + 107) 20; another female has a longer body but a shorter tail, 209 (108 + 101) 20. Two other females (snout-vent 92 and 76) have the premaxillary bones fused, the nasal spines in broad contact but not fused posteriorly and enclosing a narrow, elongate fontanelle, and the prefrontal bones absent. The three characteristic myological features of the Desmognathinae—large quadratopectoralis, small gularis, and heavily tendinous temporalis muscles—are all present. The five largest specimens (snout-vent 108, 106, 106, 95, and 92) are females with numerous very small ovarian eggs, and slender oviducts; they are either immature or sexually inactive. The single male measures 175 (91 + 84) 18, its Wolffian ducts are slender and black, the testes are one-lobed and lack melanophores, there is no external or internal indication of a mental gland, the maxillary and premaxillary teeth show no sexual dimorphism, and the vomerine teeth (actually prevomerine) are numerous (7/10 on left/right sides). Thus, the male is also either immature or sexually inactive. *Phaeognathus* may well be the longest terrestrial salamander in the world.

Hubricht's salamander is a secretive, nocturnal, highly specialized burrower. No specimens were seen during 20 man-hours of strenuous daytime collecting. Fourteen specimens were dug from the mouths of their burrows after dark, most after 10:00 PM, and one was found crawling on damp leaf litter.

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AMPHIBIANS AND REPTILES OF KEEWATIN AND NORTHERN MANITOBA

By Francis Harper

This is the thirteenth paper to appear on the results of my biological observations and collections in 1947 in the Nueltin Lake area of Keewatin and between The Pas and Churchill, Manitoba. The trip was supported by the Arctic Institute of North America (through contractual arrangements with the Office of Naval Research). The preparation of the results has been aided by grants from the National Science Foundation. Reproduction in whole or in part is permitted for any purpose of the United States Government.

The herpetological observations began at The Pas on 20 May, as I was setting out by rail to Churchill. From 31 May, when I departed by air from Churchill, to 4 December, my headquarters were on the Windy River at the northwestern extremity of Nueltin Lake. In this extremely isolated spot I enjoyed the fine hospitality of a little trading post operated by Charles Schweder and Fred Schweder, Jr.

Previous literature on the herpetology of Keewatin, as the district is constituted at present, with a southern boundary at latitude 60° N, appears to be all but non-existent. Up to 1912 the southern boundary was fixed at latitude 52°50′ N, in present Manitoba. The territory covered by the present report extends southward to approximately the same latitude. Nearly all of this territory, except for a coastal strip extending from Churchill southeastward to (and beyond) the Ontario boundary and an area reaching from the northern part of Lake Winnipeg westward to Saskatchewan, is occupied by Pre-Cambrian rocks of the Canadian Shield (Map 1045A, Geological Map of Canada, Geological Survey of Canada).

The greater part of our information on the amphibians of northern Manitoba, up to very recent years, has been based upon the investigations of Edward A. Preble (1902: 133–134). In the region between Hudson Bay on the east and the Athabaska and Slave Rivers on the west, I have only now and then been able to reach any considerable expanse of country that did not already bear the imprint of his pioneering footsteps. Since Preble's time, only two other papers dealing with the herpetofauna of northern Manitoba as a whole, and supplying detailed distributional records, seem to have appeared; they are by Logier and Toner (1955 and 1961).

Among the four amphibians and one reptile that are treated here, *Bufo hemiophrys* and *Thamnophis sirtalis parietalis* apparently do not advance beyond the Canadian Zone into the Hudsonian Zone. *Rana pipiens pipiens* extends into the latter zone (Norris-Elye, 1949: 91)—at Limestone River, 7 miles north of Mile 349, Hudson Bay Railway. *Pseudacris nigrita septentrionalis* and *Rana sylvatica cantabrigensis* occur in both zones, reaching north to the edge of the Barren Grounds. The distributional status of these last two species evidently refutes Noble's statement (1931: 456) that "Amphibia are unable to live in regions having a permanently frozen subsoil" (*cf.* Thomas, 1953: chart 8-1). Oliver (1955: 117) repeats essentially the same statement. Both the southern and the northern boundaries of the Canadian Zone have doubtless advanced northward beyond the limits indicated by Merriam *et al.* (1910), since the second decade of the present century (*cf.* Harper, 1962).

My particular thanks are extended to Sam Waller for specimens and information that he has generously provided from The Pas and Cedar Lake. Single wood frogs were kindly presented by John Ingebrigtsen and Fred Schweder, Jr. For the privilege of examining comparative material in the Division of Reptiles and Batrachians of the U. S. National Museum, I am much indebted to Dr. Doris M. Cochran. My own specimens will be deposited in that institution. Additional material has been obligingly placed at my disposal by T. Paul Maslin, of the University of Colorado, and by Stanley W. Gorham, of the National Museum of Canada. Douglas G. Alexander, of the University of North Carolina, has helped by applying his anatomical knowledge of *Pseudacris* to the determination of the gonadial condition of two specimens. Roger Conant has kindly read an early draft of this paper.

ACCOUNTS OF SPECIES

Bufo hemiophrys Cope. Dakota Toad.

One or several of these toads were heard about 8:50 PM, 20 May (temp. approx. 50°), at Wabowden, 136 miles northeast of The Pas.

This is the only species of *Bufo* recorded in Manitoba north of the southern end of Lake Winnipeg. The northernmost locality hitherto reported in the province is The Pas (Logier and Toner, 1961: 32, map 27); their record for Lake St. Martin (lat. 51°35′) seems to have been misplaced at Cedar Lake (lat. 53°10′) on their map.

A careful comparative study by Blair (1957) of the structural characters, coloration, behavior, voice, and distribution of *B. hemiophrys*, *B. americanus*, *B. woodhousei*, and *B. cognatus* leads him to the conclusion that "*B. hemiophrys* is behaving as a distinct species of the *americanus* group, to which it unquestionably belongs." In this I heartily concur.

It may be appropriate at this time to refer to a long-standing but evidently erroneous report of a *Bufo* in the far northwest of Canada. Günther (1858: 63) lists a young "*Bufo americanus*" from Great Bear Lake, as "presented by Sir J. Richardson," while Boulenger (1882: 309) records it as "*Bufo lentiginosus* var. *A. americanus*." The specimen was almost certainly mislabeled as to locality. Although Logier and Toner (1955: 29, map 27) accept this without question as a record of "*Bufo woodhousei hemiophrys*," the next northernmost locality of that toad is Fort Smith on the Slave River (Preble, 1908: 501, as "*Bufo lentiginosus woodhousei*"). Preble's specimen was determined as *hemiophrys* many years ago by Remington Kellogg and by myself. Logier and Toner (1961: 32, map 27) delete the record of Richardson's specimen in their text, but inadvertently leave a dot for Great Bear Lake on their map. All trustworthy records of *Bufo* in Canada are south of the limit of permafrost (*cf.* Thomas, 1953: chart 8-1), whereas Great Bear Lake is well to the north of it.

Pseudacris nigrita septentrionalis (Boulenger). Northern Chorus Frog.

This species was heard trilling on 20 May at several places: The Pas, apparently one individual during the morning; Big Eddy (on the north side of the Saskatchewan River opposite The Pas), a considerable number near mid-day; Mile 107 of the Hudson Bay Railway, several at 7:35 PM; and Wabowden, several at 8:50 PM. It was a sunny day, with temperatures ranging from about 45° to 55° or higher.

An interesting series of eight specimens, collected at The Pas and Cedar Lake, has been received from Sam Waller. All have plain, uninflated throats, covered practically entirely with areolae. Seven of the specimens, taken between 20 May and early June, represent at least two, and possibly three, age groups: two adult females (length, 25.5, 26.5; tibia, 10, 11); three presumed yearlings (length, 16.5–18.5; tibia, 7–8); and two (male and female) with intermediate measurements (length, respectively, 21.5, 22, and tibia, 8.5, 9). The last group of two are possibly two-year-olds: the male with a throat not differing in color from the venter and with a testis 1.6 × 7 mm; the female with a similar throat, a small, simple unconvoluted ovary, and eggs mostly white, but some light brown. At a season when the local adult males are normally calling actively, these two individuals were evidently approaching the breeding season rather than taking an active part in it. An eighth specimen, taken at The Pas in early September, was probably a yearling, with measurements (length, 19; tibia, 8) very close to those of May or June specimens. Dorsal stripes are progressively less sharply defined in the smaller specimens. The upper surface of the limbs is more or less obscurely spotter rather than barred. In general, the light maxillary streak is not sharply defined.

Wright and Wright (1949: 252) record the length of immature specimens from Manitoba, Mackenzie, Minnesota, and Montana as varying from 14.5 to 19 mm (approximate average, 16.4); probably these were all yearlings.

There appear to be no very trenchant differences in proportions between my Manitoba specimens and *P. n. triseriata,* but the dorsal and lateral stripes in the latter may be, in general, more distinct. I am merely following general usage in referring the Manitoba material to *septentrionalis.*

Agassiz (in Agassiz and Cabot, 1850: 378, pl. 6, figs. 1–3) proposed the name *Hylodes maculatus* for a chorus frog, apparently from somewhere along the north shore of Lake Superior, though no locality was mentioned. Schmidt (1953: 75) placed this name in the synonymy of *Pseudacris nigrita triseriata* (Wied) and presumed to restrict the type locality to the "vicinity of Sault Ste. Marie," without indicating whether he meant the city in Ontario or the one in Michigan. It so happens that no *Pseudacris* has ever been recorded in Ontario in the vicinity of Sault Ste. Marie (E. B. S. Logier, *in litt.,* 19 January 1959, and Logier and Toner, 1961: 38, map 32); consequently Schmidt's restriction is invalid.

Subsequently P. W. Smith (1956: 171) proposed to place *septentrionalis* in the synonymy of *maculata.* However, until fresh topotypical or near-topotypical material of *septentrionalis* becomes available and a zone of intergradation between this subspecies and *triseriata* is more definitely established, I prefer to hold the nomenclatural question in abeyance.

In comparison with Manitoba specimens, seven adult males from Boulder, Colorado, collected on 18 May 1953, by Jim Froiland (Univ. of Colo. Mus.), have the following extreme and average measurements: length (snout–vent), 24–30 (26.8); intergenual extent, 19–21.5 (20.4); tibia, 10–11.5 (10.8). These measurements average slightly larger than those of the two adult females from Manitoba. Since females average larger than males in a given population, the disparity between individuals of the same sex from the two areas would doubtless be still greater. The average ratio of tibial length to body length in the Colorado specimens is .403, compared with .404 for the two adult females from Manitoba. The inflated throats, as usual in the breeding males of the *P. nigrita* group, are darkened and have scarcely any visible areolae on the anterior half. The dorsal stripes are mostly continuous and well defined, but in one specimen they are mostly broken up into spots. Two of seven specimens have faint spotting on the breast. The limbs of all are spotted rather than barred.

Aside from an apparently slightly greater size, there is perhaps nothing very tangible in the Colorado specimens to separate them from *septentrionalis* of the Canadian Northwest.

The highly commendable practice of such herpetologists as Cope, Miss Dickerson, and Sherman C. Bishop, in indicating the provenance of the specimens that they illustrate, has unfortunately been neglected by the authors of various recent manuals. Thus, in the case of subspecies, the reader has no certain means of knowing whether a given specimen is a typical representative; it may be an intergrade from the boundary zone between two subspecies, or even another subspecies from the far side of that zone.

Preble (1902: 134) presents records of *septentrionalis* from Great Playgreen Lake, Norway House, Oxford House, and York Factory. The most northerly point in Manitoba where any *Pseudacris* has been found is Landing Lake, near Churchill (D. A. Smith, 1953: 181). Logier and Toner (1961: 38) record it from The Pas.

Central Manitoba and western Ontario include most of the Canadian localities within the vast Canadian (or Laurentian) Shield from which *Pseudacris* has been recorded (*cf.* Bruce, 1939: 232, map; Wright and Wright, 1949: 7; Smith and Smith, 1952: 176).

Rana pipiens pipiens Schreber. Northern Leopard Frog.

This is one of the two species of frogs reported from the vicinity of The Pas by Sam Waller. It was found by Preble (1902: 133) near Norway House and at Sea River Falls, 20 miles to the northeast. Norris-Elye (1949: 91) records it from Mile 33 (Hudson Bay Railway) and from 7 miles north of Mile 349, on the Limestone River. Logier and Toner (1961: 44, map 37) give records from The Pas and Wabowden.

[*Note*: The last authors (1961: 46) attribute to Preble (1902: 133) a record of *Rana palustris* at the mouth of Nelson River. I have been unable, however, to find such a record in Preble.]

Rana sylvatica Le Conte. Wood Frog.

Several wood frogs were heard at Wabowden, Manitoba, at 8:50 PM, 20 May.

In the Windy River area I found this species only at a pond 2 miles northwest of the mouth of the river, near mid-day on 22 June (temp.

about 56°). This pond was then ice-free, while some neighboring ones were not. It is about 150 by 100 yards in extent, and it is essentially a tundra pond, although there is a patch of black spruce at the south end. Willow, dwarf birch, *Chamaedaphne, Ledum groenlandicum, Empetrum,* and sedge also grow about its borders. At least two frogs were calling there, in series of two, three, or four notes: *c'ruck, c'ruck, c'ruck,* or *c'tuck, c'tuck, c'tuck.* I secured a male with a shot and captured a female by hand; they were in the water, among or near dwarf birch bushes. No eggs were detected.

An adult female was captured by Fred Schweder, Jr., on 25 July in grass near the shore at the mouth of Red River, about 9 miles west-southwest of the mouth of Windy River. An adult male was collected at Churchill about 1 July by Johan Ingebrigtsen.

The measurements (mm) of the four specimens (all adult) are:

	LENGTH (SNOUT TO VENT)	ELBOW TO TIP OF 3RD FINGER	INTER-GENUAL EXTENT	TIBIA	WHOLE HIND FOOT
♂, Windy River	45.5	19	44	21	34
♂, Churchill	43	18.5	43	20	31
♀, Windy River	51.5	22	48	24	37
♀, Red River	46	20	43	22	35

Some of these measurements are slightly larger than those of an adult male and an adult female from northern Quebec (Harper, 1956: 99). The Keewatin and Churchill specimens appear distinctly more robust than the Quebec specimens. The two males of the former lot, in a preserved state (with paper labels attached), have an average weight of 9 grams, while a male from Quebec (with label) weighs only 6.1 grams.

The Keewatin and Churchill specimens, unlike the Quebec specimens, show no light vertebral stripe. The median dorsal area is occupied by a broad, dark, lengthwise stripe, not very sharply defined, though contrasting with a lighter and narrower area on each side that occupies the space between the median stripe and a dorsolateral fold (Fig. 1). The general color of the upper parts (body and limbs) of the Red River female, as revealed in a Kodachrome, is pale grayish brown. The irregular raised areas, or tubercles, on dorsum and sides appear considerably more prominent than in specimens from the southeastern range of *sylvatica.*

Two immature specimens (presumably yearlings), collected by Sam Waller at The Pas in early June 1953 and early September 1951, are, respectively, 18.5 and 22.5 mm in length.

In applying merely a binominal designation to the wood frogs of this region, I am following the suggestion of Martof and Humphries (1959) in their careful study of geographical variation within the species. The inconstancy of characters in a supposedly more or less homogeneous population extending over wide areas is indicated in the following data. With an average body length falling between 45 and 50 mm, my four adult specimens show affinity with distant and widely scattered populations rather

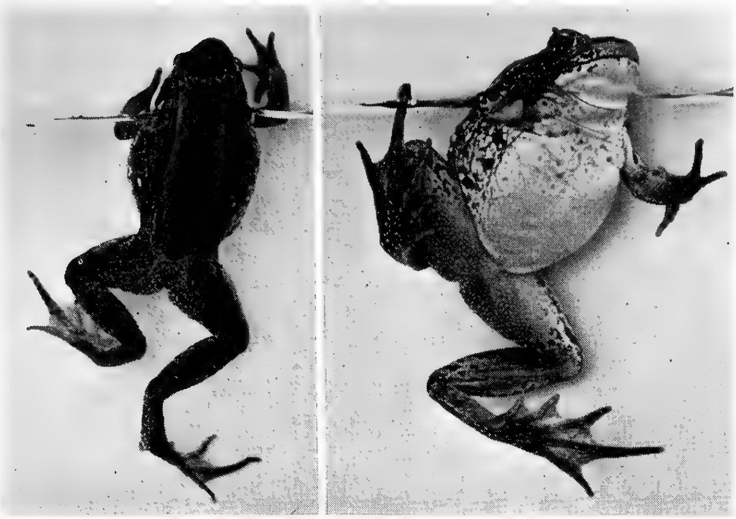

FIG. 1. Dorsal view (left) and ventral view (right) of *Rana sylvatica*, ♀ adult, in aquarium jar. Captured 25 July 1947, at mouth of Red River, 9 miles WSW of mouth of Windy River, Keewatin. Photographed 26 July.

than with the Alaskan phenotype, with which Martof and Humphries (1959: 370, fig. 7) would associate the local population. In the average ratio of tibial length to body length (.468), they accord with the Alaskan phenotype. In the average ratio of body length of females to that of males (1.12), and in the absence of a middorsal white stripe, they accord more closely with the Midwest and Labrador phenotypes than with the Alaskan. The number of transverse bars on the tibia is too variable in these specimens to serve as a dependable character. All told, the four specimens, in the majority of the above-mentioned characters, accord less with the Alaskan than with other phenotypes. More definite conclusions could doubtless be derived from a much larger number of specimens.

Schmidt's attempt (1953: 81) to restrict the type locality of *Rana cantabrigensis* Baird to "Moose Jaw, Saskatchewan" seems essentially invalid, in view of the apparent lack of any record of a wood frog from that locality (*cf.* Martof and Humphries, 1959: 386; Logier and Toner, 1961: 43, map 36).

Preble (1902: 133) collected the wood frog at Great Playgreen Lake, Norway House, York Factory, and Fort Churchill. Patch (1939: 235) had specimens from The Pas, Moose Lake, and Herchmer. Shelford and Twomey (1941: 60, 64) report the species apparently from the Little Barren, about 40 miles south of Churchill. McClure (1943: 30, 32, 33, 34) found it in the tundra about Churchill. Martof and Humphries (1959: 385) examined specimens from Cedar Lake and Ilford.

Thamnophis sirtalis parietalis (Say). Northern Garter Snake.

This is said by Sam Waller to be the only snake occurring in the vicinity of The Pas. There seems to be no other record in the territory covered by the present report.

REMARKS

Fifteen additional species of amphibians and reptiles occur in the more southerly parts of Manitoba, below latitude 52° 50′, as follows:

	Salamanders
Necturus m. maculosus (Rafinesque)	Ohio Mudpuppy
Ambystoma jeffersonianum (Green)	Jefferson's Salamander
Ambystoma tigrinum diaboli Dunn	Devil's Lake Tiger Salamander
	Toads and Frogs
Bufo a. americanus Holbrook	American Toad
Hyla c. crucifera Wied	Northern Spring Peeper
Hyla v. versicolor Le Conte	Northern Tree-frog
Rana clamitans melanota (Rafinesque)	Northern Green Frog
Rana septentrionalis Baird	Mink Frog
	Turtles
Chelydra s. serpentina (Linnaeus)	Northern Snapping Turtle
Chrysemys picta bellii (Gray)	Western Painted Turtle
	Lizard
Eumeces s. septentrionalis (Baird)	Northern Prairie Skink
	Snakes
Storeria o. occipito-maculata (Storer)	Northern Red-bellied Snake
Thamnophis radix haydeni (Kennicott)	Western Plains Garter Snake
Heterodon n. nasicus Baird and Girard	Plains Hog-nosed Snake
Opheodrys vernalis blanchardi Grobman	Western Smooth Green Snake

As far as we may judge from the distributional records assembled by Logier and Toner (1955; 1961), the zonal affiliations of the species in this group may be stated as follows. Nearly all of them seem to be largely or wholly restricted in Manitoba to the territory south of the July isotherm of 65° (*cf.* Thomas, 1953: chart 1-5), which marks the approximate boundary between the Transition and the Canadian Zones of Merriam *et al.* (1910). This is also approximately the northern limit of the Aspen Grove Section of the Boreal Forest Region (map in *Native Trees of Canada,* Canada Department of Resources and Development, Forestry Branch Bull. 61, ed. 4, 1950).

Like these amphibians and reptiles, various fishes seem to have about the same northern boundary to their ranges. Mrs. Radforth (1944) suggested that nine minnows (Cyprinidae) "had a distributional trend in Ontario apparently related to the 65° (F.) July isotherm . . . . All but one of these have their northern limit of known distribution in Manitoba between the 64° and 66° isotherms." (Keleher, 1956: 265.)

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PROCEEDINGS
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ANOTHER NEW WATER SNAKE OF THE GENUS *NATRIX* FROM THE MEXICAN PLATEAU

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The presence of a water snake in one of the isolated river systems of north central Mexico was unsuspected until 1946 when a single specimen was collected in the Río Nazas near the village of La Goma, Durango. Studies made upon it and a series of eight additional specimens acquired in 1949 resulted in the description of the population as *Natrix erythrogaster bogerti* (Conant, 1953). This form is confined to the drainage system of the Río Nazas, a stream that rises in the highlands of western Durango and which, prior to the use of most of its water for agriculture and industry, emptied into the Laguna de Mayrán, a desert bolson in southwestern Coahuila near the city of Torreón.

Recent collecting has demonstrated the presence of another race of the same species in a second isolated drainage system, in the Río Aguanaval, which rises in the highlands of Zacatecas but becomes an intermittent stream before reaching its mouth in the Laguna de Viesca, another bolson of southwestern Coahuila. For this form I propose the name:

Natrix erythrogaster alta, new subspecies

Holotype: American Museum of Natural History No. 84152, a young adult ♂, collected 19 July 1959, in the Río Trujillo (known locally as the Río Florido), at the village of Río Florido, approximately 15 miles NW of Fresnillo, Zacatecas, by Roger Conant.

Paratypes: AMNH No. 84151, 85320–322 and University of Michigan Museum of Zoology No. 118398–400, 123259, all from approximately one mile downstream from the type locality at or near a small impoundment of the river; AMNH No. 88954–89056, all from the Río Trujillo (known locally as the Río Medina) near Rancho Grande, Zacatecas. This last group includes 93 young born in captivity shortly after their mothers were collected.

Diagnosis: A *Natrix* of the *erythrogaster* complex distinguished from (a) the pallid, pinkish *bogerti* by its dark coloration and marked contrast between the black or dark brown dorsal blotches and the pale ground color, and by a lower number of ventrals and a greater number of subcaudals; and from (b) *transversa,* the only other race of *erythrogaster* occurring in Mexico, by its narrow lateral markings and presence of only one upper labial entering the orbit.

Description of holotype: Head scutes the same in number and general arrangement as in other races of the species. Two nasals, the anterior bearing the nostril entirely within it. Loreal subtrapezoidal, about as high as wide. One preocular; postoculars two (on left side of head) and three (on right), the lowermost extending well forward beneath the eye, nearly reaching the preocular and completely cutting off the 5th labial from the orbit. One temporal in the first row and two in the second row. Supralabials 8, the 6th and 7th the largest; the 4th entering the orbit. Infralabials 10 on the left side of the head and 9 on the right, the 6th the largest on both sides, and the first pair meeting on the midventral line; first 5 on each side in contact with the corresponding anterior chin shield. Two pairs of chin shields, the posterior slightly longer than the anterior.

Dorsal scales with two apical pits. Scale rows 23–25–23–21–19, all carinate throughout the length of the body and tail; the increases and decreases may be expressed by the Dowling system (1951) as follows:

$$23\,\frac{+6\ (33)}{+6\ (37)}\,25\,\frac{6+7\ (65)}{5+6\ (57)}\,23\,\frac{5+6\ (80)}{5+6\ (82)}\,21\,\frac{4+5\ (103)}{4+5\ (103)}\,19\ (140)$$

The scales of the 6th row on the left drop out irregularly between points above the 57th to the 82nd ventral, so that counts of 24 are possible in several places.

The ventrals, as indicated at the end of the formula, are 140, plus a divided anal plate; two half ventrals are not counted, one wedged in between the 10th and 11th ventral on the left side of the body and one between the 16th and 17th ventral on the right. Subcaudals 87 pairs. Total length 785 mm; tail length 226 mm; tail length/total length 27 per cent. Both hemipenes are everted.

Dorsum marked with a series of dark dorsal blotches numbering 42 from the head to a point directly above the anus; the blotches are 2½ to 3 scales long (in the longitudinal axis of the body) and average 10 scales wide on the anterior part of the body, but they narrow toward the tail and are reduced to 4 scales in width in the anal region. Smaller, vertically elongated lateral blotches, hereinafter called bars, alternate with the dorsal blotches from a point posterior to the second dorsal blotch all the way to the anal region. The bars are one scale in width and involve the 2nd to 6th row of scales on the anterior parts of the body and the 2nd to 5th posteriorly.

The colors were recorded in life; capitalized names in the following descriptions are in accordance with Ridgway (1912).

Dorsal blotches Olive-Brown bordered anteriorly and posteriorly with dark brown. Lateral bars also Olive-Brown, the skin between the scales within their borders very dark gray, almost black. Dorsal ground color light olive-brown (between Light Brownish Olive and Isabella Color), the skin between the scales between adjacent dorsal blotches is pale yellow (Colonial Buff); on the sides of the body the edges of the scales and the skin between them is Honey Yellow. Tail Buffy Brown, not patterned.

Top of head almost plain Sepia but with a pair of scarcely discernible pale spots on the frontal and a similar pair situated farther posteriorly, one spot at the anterior corner of each parietal. A pair of faint spots along the common suture of the two parietals, followed posteriorly by a smaller but similar pale spot. A median post-parietal light streak the width of one scale and the length of about a scale and a half. Temporal region reddish (Mahogany Red). The sutures between the labials, both upper and lower, are Burnt Sienna. Pupil of eye black, narrowly edged with gold; iris Brownish-Olive, but flecked with dark pigment. Tongue pink but stippled with gray, especially on the tips.

Belly pale yellowish-orange (Ochraceous-Buff) turning to pale yellow in the neck region and changing to cream-color on the chin, throat, and labials. Belly virtually uniform in coloration except that the lateral tips of the ventrals are pigmented with the dorsal ground color and the anterolaterad edges of the ventrals are lightly stippled with brownish-gray. Similar dusky stipplings appear across the anterior portions of the subcaudals. A patch of orange (Xanthine Orange) on the side of the neck postero-ventrad to the angle of the jaw. Underside of tail Ochraceous-Buff but becoming browner (Ochraceous-Tawny) near the tip.

Comparisons with allied races: The contrast between the strongly patterned *alta* and the pale pinkish *bogerti* is strongly evident at all ages, except in the very young. At birth, both forms exhibit a pattern of dark blotches and lateral bars on a pale gray ground color, but the markings are grayer, hence less intensely in contrast with the ground color in *bogerti*. The skin between the scales in the ground color of newborn individuals of both forms is pink or orange-pink. In *alta* the dorsal markings remain dark and continue to be sharply differentiated from the ground color as the snake grows and increases in size. This pattern feature is strikingly evident in the field or when specimens are submerged in liquid. In the largest adults the ground color darkens and the markings lighten with the net result that the dorsum approaches a uniform brown or olive-brown coloration. In *bogerti* the dark gray markings of the juveniles grow paler with age, and even half-grown individuals may be nearly unicolored, especially on the posterior part of the body. In *alta* the lateral bars are prominent in all specimens except the largest adults; the scales involved in the bars are strongly pigmented. In *bogerti* the lateral bars pale rapidly with growth, and in adults all really dark pigment is confined to the skin between the scales.

Ventrals and subcaudals (with the number of specimens involved indicated within parentheses) may be summarized as follows:

(a) *alta*—Ventrals in (58) ♂♂ 138 to 143, mean 140.0; in (54) ♀♀ 140 to 144, mean 142.1. Subcaudals in (58) ♂♂ 84 to 90, mean 87.1; in (48) ♀♀ 69 to 76, mean 73.0.

(b) *bogerti*—Ventrals in (12) ♂♂ 141 to 145, mean 142.9; in (18) ♀♀ 143 to 148, mean 145.3. Subcaudals in (12) ♂♂ 82 to 85, mean 83.3; in (18) ♀♀ 68 to 76, mean 71.7.

The meristic differences are best demonstrated by subtracting the number of subcaudals from the number of ventrals in each individual specimen. The resulting figure (the remainder) among males of *bogerti* is 57 or greater in all (100%); among males of *alta* it is fewer than 57 in 98.3% of the specimens. The corresponding remainder among females of *bogerti* is 72 or more in 88.9%; among females of *alta* it is fewer than 72 in 91.7%.

There are other minor differences in scutellation between *alta* and *bogerti,* but comment upon these is reserved for a monographic study of the genus *Natrix* in Mexico, which is now in preparation.

The lateral bars in *transversa* are almost always one and one-half to two scales or more in width, whereas in *alta* (and *bogerti*) the bars are about the equivalent of one scale wide or less. Every specimen of *alta* (100%) has only one upper labial entering the eye; among 86 specimens of *transversa* from Mexico two labials enter the eye in 140 cases (81.9%) and only one enters in 31 cases (18.1%). The condition in *bogerti* is somewhat intermediate.

The name *alta* (L. *altus,* high) is in reference to the upland elevations of the localities, circa 6500 to 6700 feet, from which this snake is known and which represent the highest stations for *Natrix* yet recorded for the western hemisphere.

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AN ADDITIONAL RACE OF THE PILEATED TINAMOU FROM PANAMÁ

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Detailed studies of recently collected specimens of the Pileated Tinamou, *Crypturellus soui* (Hermann), from Panamá, where this bird is known as the Perdiz de Rastrojo, have indicated an additional race from the northwestern province of Bocas del Toro. It is to be known as

Crypturellus soui capnodes, new subspecies

Characters: Similar to *Crypturellus soui modestus*, described by Cabanis (1869: 212), with the type locality given as Costa Rica, but decidedly darker throughout; much darker above, with the sides of the head blacker; darker below; lower breast and abdomen deeper buff.

Description: Type, U. S. Nat. Mus. No. 477516, female, marked as laying, from Almirante, Bocas del Toro, Panamá, taken 10 July 1962, by R. Hinds, of the Gorgas Memorial Laboratory. Crown and upper hindneck dusky purplish gray; lower hindneck and edge of upper back dark grayish brown; base color of back (except the anterior area), rump, and upper tail coverts warm sepia, lined and dotted very narrowly and closely with black; wing coverts and tail with black mottling reduced, so that these areas are brighter brown; scapulars like back, with distal edgings of Mikado brown; primaries and secondaries fuscous-black, with the outer webs and tips fuscous; side of head dark neutral gray becoming paler toward the malar area where the darker color blends with the lighter gray of the side of the upper neck; throat dull white; upper foreneck mouse gray, changing to deep mouse gray on lower portion; upper breast Mikado brown, changing to cinnamon on lower breast, and to cinnamon-buff on abdomen; sides snuff brown to bister; upper tail coverts Mikado brown centrally, cinnamon-buff distally, mottled slightly with dusky; edge of wing fuscous; under wing pale to pallid mouse gray.

Measurements: Males (5 specimens), wing 117.4–125.0 (121.9); culmen from base 19.4–21.3 (21.0), tarsus 38.1–40.8 (39.7) mm.

Females (4 specimens), wing 124.0–127.4 (125.5), culmen from base 20.0–22.1 (21.2), tarsus 40.7–42.8 (41.6) mm.

Range: Lowlands of northwestern Panamá, in western and central Bocas del Toro. Presumed to range along the lower Río Sixaola in Costa Rica.

Remarks: Griscom (1932: 307–310)was the first to examine sufficient material of the Pileated Tinamou, a definitely plastic species, to allow an understanding of the main populations that may be recognized as subspecies, his treatment being one that has been followed in the main for a period of 30 years. Further field work, and the accumulation of specimens from Panamá and northwestern Colombia, now make it possible to clarify details of the races of this area that have remained obscure or uncertain. The principal confusion has come from the application of the name *panamensis,* which has been used for the birds of the central and eastern Pacific slope of Panamá. When Carriker (1910: 379) recognized that birds of central Panamá were different from *C. s. modestus* of Costa Rica and Chiriquí and proposed this name, he chose as a type an adult female in the Bangs collection taken by W. W. Brown at Loma del Leon (Lion Hill), then a part of Colombia, on 25 March 1900. It has been overlooked frequently that this locality, now submerged in Gatun Lake within the limits of the Canal Zone, was in the valley of the lower Río Chagres, and in an airline only about 7 miles from Limón Bay on the coast, and therefore a typical site of the Caribbean slope. Through this misunderstanding the name *panamensis* has been used for the quite different birds of the Pacific side of the Isthmus. When Aldrich (1937: 30) described the race of the Azuero Peninsula under the name *poliocephalus* he separated it from *panamensis* mainly on the basis of the type and four topotypes of Carriker's *panamensis* and of specimens taken by Goldman, most of which also came from the Caribbean side, or from Darién.

It is now practicable to indicate that *Crypturellus soui panamensis* ranges in the tropical and lower subtropical zone on the Caribbean slope from western Colón (probably through northern Veraguas and eastern Bocas del Toro) east through the northern Canal Zone, the eastern sector of Colón, and the Comarca de San Blas into northeastern Chocó (Unguía, Acandí), Colombia, where it intergrades with *C. s. caucae.* In that part of the eastern area of the Province of Panamá that lies in the Caribbean drainage this race is found on the upper Río Chagres (Río Boquerón). At the Río Majé, *panamensis* crosses to the Pacific side and then continues through Darién (Jesucito, Cana, Jaqué).

The race *Crypturellus soui poliocephalus* (Aldrich), described from the head of the Golfo de Montijo (Paracoté) in Pacific Veraguas, separated from *panamensis* by paler color, is resident from the southern slope of western Veraguas (Soná), the Azuero Peninsula, the Pacific slope of Coclé, the western Province of Panamá, and the Canal Zone (Empire), into the eastern area of the Province of Panamá, eastward to the lower Río Bayano (Chepo, San Antonio), these areas as stated being in the Pacific drainage. It is found also on Isla del Rey in the Archipiélago de las Perlas. Its range as outlined includes most of the area assigned by recent authors under the name *panamensis.*

Crypturellus s. modestus extends from Costa Rica into western Chiriquí along the southern slopes of the volcano. It is probable that *poliocephalus* ranges through western Veraguas into eastern Chiriquí, a region from which specimens have not been obtained as yet. It is also probable that *panamensis* ranges west on the Caribbean side to eastern Bocas del Toro but here again specimens are not available.

The treatment here outlined restricts the name *harterti,* formerly applied to birds of part of Panamá, described from the Province of Esmeraldas, Ecuador, to tinamou from western Ecuador and a part of western Colombia. I have not seen material to indicate the identity of birds from west of the western Andes in Colombia. It is probable that *panamensis* may cross the border, and that it may meet *harterti* in northwestern Chocó.

The name *capnodes* for the race described from Bocas del Toro is from the Greek *kapnodes,* in the sense of dark or dusky.

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PROCEEDINGS
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GEOGRAPHIC VARIATION IN THE CEDAR WAXWING (*BOMBYCILLA CEDRORUM*)

By Thomas D. Burleigh

A routine comparison of cedar waxwings taken in Idaho during the breeding season with specimens taken during this season in the eastern United States revealed that the breeding population of Idaho is morphologically different. Cedar waxwings occur in small numbers during the winter months over much of Idaho, but in common with other resident species there is an interval in the late fall when no waxwings have been observed. Specimens taken during the winter were found to differ noticeably from the breeding birds as well as from examples from the east. This difference appeared to be too pronounced to be the result of seasonal wear. On the assumption that the winter examples represented a more northern breeding population, summer specimens from the extreme northern limits of the cedar waxwing's range were compared with winter specimens from Idaho. They appeared the same. It was at once apparent that the breeding waxwings of Idaho are replaced in the late fall by birds from farther north that represent another morphologically distinct population. *Bombycilla cedrorum* is, therefore, a composite of at least three geographic races. Two of these are of southerly distribution—one in the east and one in the west. The third extends across the continent north of the breeding range of the first two forms.

Before describing and applying names to these three subspecies it is necesary to determine to which geographical group the name *Bombycilla cedrorum* was originally applied.

The type locality of *Bombycilla cedrorum*, as given in the 5th edition of the A. O. U. Check-List (1957) is "Amérique depuis le Canada jusqu'au Mexique = eastern North America." This is based on *Bombycilla cedrorum* Vieillot, Hist. Nat. Ois. Amer. Sept., vol. 1, 1807 (1808), p. 88, pl. 57. Vieillot's observations, where the cedar waxwing is concerned, were made largely in Pennsylvania and New York, and it is logical to assume that the specimen he used in describing and naming this species was collected in one of these two states. The type locality is herewith restricted to Pennsylvania and, although it cannot be determined whether the original description was based on a breeding bird of that area or a migrant, it is presumed most likely that the more southern breeding population in the east was the basis for Vieillot's description and plate, and thus becomes the nominate race. Thus the western and northern populations appear to be the ones without names and are, therefore, described as follows.

Bombycilla cedrorum larifuga, new subspecies

Characters: Adults of both sexes similar to *Bombycilla cedrorum cedrorum* but paler both above and below. Crown straw-colored and distinctly paler than the neck. Line at base of bill, lores and postocular patch dull black rather than velvety black, and much reduced; dull black of chin also much reduced, or wanting. Brown of throat and chest distinctly vinaceous, this character being obscure or wanting in *cedrorum*. There is no appreciable size difference.

Immatures of *larifuga* are equally distinct from *cedrorum*, being also paler, both above and below. Back grayish-olive rather than dark brown, crown vinaceous brown. The broad streaks on the under surface grayish brown, in contrast to the dark brown streaking of *cedrorum*.

Measurements: Adult male (8 breeding specimens from Idaho, eastern Washington and Oregon): Wing, 91–96 (93.3) mm; tail, 53–60 (57); exposed culmen, 8–11 (10.2). Adult female (3 breeding specimens from Idaho and British Columbia): Wing, 92–95 (93.5) mm; tail, 57–58 (57.5); exposed culmen, 8–10 (9.0).

Type: Adult male, No. 419709, U. S. National Museum (Biological Surveys collection), Headquarters, Clearwater County, Idaho, 21 August 1951; Thomas D. Burleigh, original number 14052.

Distribution: Breeds in southern British Columbia east of the coast ranges, southern Alberta, southern Saskatchewan, and southern Manitoba, south through eastern Washington east of the Cascades to southern Oregon, southern Idaho, and northern Montana. Winters irregularly within its breeding range and south to Panama and Colombia.

Remarks: Specimens of *Bombycilla cedrorum* from Washington and Oregon, west of the Cascades, proved rather puzzling. The upper parts, while distinctly gray, have a dark brown wash lacking in *larifuga*, and the crown is dark brown rather than straw-colored. The lines at the base of the bill, lores, and postocular patch are velvety-black, and noticeably less reduced. This darker coloration agrees with one of the characters of numerous races described from this area of morphological differentiation notable examples being the hairy and downy woodpeckers, the brown creeper, and the song sparrow. Specimens available for critical study were too limited in number to justify any definite conclusions, and further collecting is necessary to determine whether the cedar waxwings of the coast region of Washington and Oregon represent a distinct race. For the time being they may be considered as a darker variant of *larifuga*.

Specimens of Bombycilla cedrorum larifuga *examined*: Total number, 38, from the following localities: *Idaho*: Harvard, 15 June 1952, 2 ♂ adult; Moscow, 29 September 1948, ♂ im., 2 July 1949, ♀ adult, 27 June 1955, ♂ adult; Boville, 19 July 1948, ♀ adult; Potlach, 16 October 1949, ♀ im., 4 August 1951, ♀ im., 13 July 1952, ♂ adult, 8 October 1952, ♀ im.; Headquarters, 21 August 1951, ♂ adult; Weippe, 21 October 1952, ♂ im.; New Meadows, 18 July 1960, ♂ adult. *Washington*: Grand Ronde River, 15 June 1919, ♂ adult; Pullman, 8 September 1948, ♀ im., 31 July 1950, ♂ adult. *Oregon*: Pendleton, 16 July 1955, ♂ adult. *Montana*: Darnalls, 26 June 1910, ♂ adult, 9 July 1910, ♂ adult; Kalispell, 11 August 1955, ♀ adult; Leedy, 14 July 1919, ♂ adult; Zortman, 25 July 1910, ♀ adult; Crazy Mts., 16 June 1917, ♀ adult. *British Columbia*: Vanderhoof, 12 August 1919, ♀ adult; Okanagan, 27 July 1920, ♂ adult; mouth of Couldery Creek, 14 July 1952, ♂ adult; Flathead Valley, 13 July 1956, ♂ adult. *Saskatchewan*: Kutawagan Lake, 16 June 1920, ♂ adult; Carnduff, 17 July 1956, ♂ adult. *Manitoba*: Shoal Lake, 30 July 1918, ♂ adult; Oak Lake, 6 August 1921, ♂ adult; Thicket Portage, 7 August 1936, 2 ♂ adult; Swan River, 24 June 1937, ♂ adult, 15 July 1937, ♀ adult; Clear Lake, 13 July 1938, ♂ adult; Bouscjour, 22 June 1951, ♀ adult; Overflowing River, 1 August 1951, 2 ♂ adult.

Bombycilla cedrorum aquilonia, new subspecies

Characters: This is the grayest of the three races, the upper parts being uniformly dark gray. Color of crown variable, but in most instances distinctly vinaceous. Similar to *larifuga* in having the line at the base of the bill, lores, and postocular patch dull black, and much reduced and in having the black of chin much reduced, or entirely wanting. Throat and chest vinaceous, in contrast to the dark brown of *cedrorum*. There is no appreciable size difference.

Measurements: Adult male (8 breeding specimens from Newfoundland, Ontario, Canadian Labrador, Alberta and Alaska): Wing, 93–97 (94.0) mm; tail, 52–59 (54.5); exposed culmen, 8–9.5 (9.1). Adult female (11 breeding specimens from Newfoundland, Quebec, Ontario, Manitoba, and Alberta): Wing, 91–97 (92.6) mm; tail, 51–57 (53.7); exposed culmen, 9–11 (9.3).

Type: Adult male, No. 381593, U. S. National Museum (Biological Surveys collection), Searston, Newfoundland, 13 July 1943, H. S. Peters and T. D. Burleigh, original number 512.

Distribution: Breeds from Newfoundland west through the northern part of the Canadian Provinces to Alaska. Winters irregularly from the northern part of the United States, south to the gulf coast and eastern Mexico, and rarely to Costa Rica.

Remarks: Through the kindness of W. Earl Godfrey, of The National Museum of Canada, an excellent series of breeding cedar waxwings from the Canadian Provinces was available for critical examination. A study of this material showed that *aquilonia* is a distinct race with a relatively narrow but continuous breeding range through the northern portion of the Canadian Provinces, extending from Newfoundland westward through Quebec, Ontario, Manitoba, Saskatchewan, and Alberta. Specimens from southern Alberta, Saskatchewan and Manitoba proved to a large extent referrable to *larifuga,* but there were a sufficient number intermediate in their characters (5 from Manitoba, 3 from Saskatchewan, and 13 from Alberta) to show clearly that this is the area of intergradation between *larifuga* and *aquilonia.* These intermediate specimens are characterized by having the gray back tinged with brown as in *larifuga* but with the crown distinctly vinaceous rather than straw-colored.

Specimens of Bombycilla cedrorum aquilonia *examined*: Total number, 41, from the following localities: *Alaska*: Juneau, 22 August 1949, ♂. *Idaho*: Moscow, 22 November 1948, ♂, 8 November 1949, ♂, 3 December 1949, 2♀, 15 December 1949, 2 ♀, 24 December 1949, ♂, 4 January 1950, ♀, 27 January 1951, ♀, 15 November 1952, ♀, 23 April 1953, ♂, 16 December 1953, ♂, 25 December 1953, ♀, 30 January 1954, ♀, 28 December 1954, ♂, 3 November 1956, ♂; Genesee, 16 February 1950, ♂; Lewiston, 5 February 1950, 2 ♀. *Alberta*: Jasper Park, 27 July 1918, ♂, 15 August 1918, ♀, 16 August 1918, ♀; Cypress Hills, 7 July 1945, ♂, ♀, 10 July 1945, ♂; Banff, 15 June 1891, 2 ♀. *Manitoba*: The Pas, 18 June 1937, ♀. *Ontario*: South March, 5 July 1927, ♂; Ottawa, 11 August 1931, ♀; North Gower, 26 June 1948, ♀. *Quebec*: Ste. Foy, 13 June 1945, 2 ♀. *Canadian Labrador*: Trout River, Moisie Bay, 22 June 1928, ♂, 29 June 1928, ♂. *Newfoundland*: Balena, 1903, ♀; Searston, 13 July 1943, ♂.

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STATUS OF CERTAIN FOX SQUIRRELS IN MEXICO AND ARIZONA

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The *Sciurus nayaritensis* group of fox squirrels previously was composed of three nominal species—*Sciurus chiricahuae* Goldman, 1933, *Sciurus apache* J. A. Allen, 1893, and *Sciurus nayaritensis* J. A. Allen, 1889. These squirrels inhabit the mixed pine-oak forests of the Chiricahua Mountains in Arizona and the Sierra Madre Occidental of Mexico southward as far as southern Jalisco.

In the course of investigations of mammals of the Southwest, we were confronted with the problem of the relationships and taxonomic status of S. *chiricahuae.* Goldman (1933: 72) regarded certain differences between S. *chiricahuae* and S. *apache* and the complete geographical isolation of the former as sufficient evidence for regarding the two as specifically distinct. He stated, however, that they are obviously very closely related. Other authors have also indicated that these forms are related and in fact may be only subspecifically distinct (Hall and Kelson, 1959: 392). Earlier descriptions of S. *chiricahuae* and S. *apache* indicated that differences in size—external and cranial—were of lesser importance than were those of shape and proportions of the skull and coloration. No one subsequently has examined an adequate number of specimens to verify these contentions. Finally, our interest in the taxonomic relationship of S. *chiricahuae* and S. *apache* also has led us to reevaluate the position of S. *nayaritensis,* whose range is complementary to that of S. *apache.*

For permitting us access to their collections we are indebted to the following persons: R. G. Van Gelder and Sydney Anderson, American Museum of Natural History; E. R. Hall and J. K. Jones, Jr., Museum of Natural History, University of Kansas;

David H. Johnson, U. S. National Museum; Rollin H. Baker, The Museum, Michigan State University; William H. Burt, Museum of Zoology, University of Michigan; Richard H. Manville, U. S. Fish and Wildlife Service, Bird and Mammal Laboratories. The figures were prepared by Harry C. Henriksen. This research was supported by the National Science Foundation, grant G-19392.

All measurements are in millimeters. Specimens were used for measurement and comparisons if permanent Pm^4 was completely erupted. Averages of selected measurements, location of collecting stations, and sample sizes are shown in Table 1. Not all measurements discussed are shown in Table 1.

In order to more clearly present our findings on the relationships among these three kinds of squirrels, we have dealt with the matter as two problems: an evaluation of *apache* and *chiricahuae* and an analysis of *apache* and *nayaritensis*.

COMPARISON OF *APACHE* AND *CHIRICAHUAE*

External and cranial measurements: External size varies but little from the Chiricahua Mountains (A) on the north to near the southern limits near El Salto, Durango (F) (see Table 1 and Fig. 1). In length of tail and length of hind foot the Chiricahuan population is smallest but the difference is not marked. A clinal trend is suggested in length of hind foot. Total length is slightly greater in the southernmost populations but again the difference is not great.

Skull measurements indicate an increase in length (basilar, greatest length, and condylobasal) from north to south (see Table 1). Also, the skull tends to decrease in relative breadth (using zygomatic breadth, breadth of rostrum, and postorbital constriction) from north to south (see Table 1), causing a moderate elongation and narrowing of the skull from the Chiricahua Mountains (A) to El Salto (F). None of these gradients is of large magnitude nor is there a strong break within them. A moderate break does appear in most characters between samples A and B (Table 1).

Conformation of skull: Most specimens of *chiricahuae* (A) can be distinguished from most of those of *apache* (B, C, D, E, and F) in having a shorter and broader rostrum and both bulbous and laterally expanded distal ends of nasals. This last condition is also reflected in the larger apertures of the external nares and more concave lateral margins of the nasals in *chiricahuae*. Specimens of *chiricahuae* usually show a more prominent convexity of the anterior region of the frontals. With regard to the aforementioned characters, specimens of *apache* from more northern localities (B and C) exhibit the closest approach to *chiricahuae* while those from the southernmost localities (E and F) least resemble *chiricahuae*. For example, in dorsal profile and shape of margins of nasals, some specimens from the San Luis Mountains, Chihuahua (B, Fig. 1), are indistinguishable from *chiricahuae*. One specimen from near Colonia García, Chihuahua (C, Fig. 1), also resembles *chiricahuae* in shape of nasals. A specimen from near Huachinera, Sonora (C, Fig. 1), has inflated nasals as in *chiricahuae*. None of these characters is well demonstrated in specimens from areas D, E, and F.

Color: Specimens of *chiricahuae* differ from the majority of those of *apache* in having the underparts (see Fig. 2), orbital ring, and postauricular areas a richer, darker ochraceous. Examination of 45 adult specimens of S. *apache* from several localities within its range shows them to vary considerably. Eight of these specimens are indistinguishable from those of *chiricahuae*; 30 specimens are perceptibly (but only slightly) lighter, and 7 specimens are markedly lighter. Thus, the supposed distinctive coloration of *chiricahuae* is encompassed by the range of variation in color of *apache*.

Remarks: At present it is unlikely that genetic exchange occurs between populations of *chiricahuae* and those of *apache*. The intervening terrain between their ranges creates entirely unsuitable habitat for these squirrels. It is likely that within the range of *apache* there are similar cases where no genetic interchange occurs because of local isolation. However, the close relationship between *chiricahuae* and *apache* is quite obviously shown by the considerable number of characters of *chiricahuae* which appear in varying frequencies within populations of *apache*. In fact, there is no single character of *chiricahuae* which cannot be duplicated in some specimens of *apache*.

Further evidence of close relationship is afforded by the apparent fact that most of the cranial characters of *chiricahuae* are simply the terminal expressions of clinal tendencies within the range of S. *apache*.

COMPARISON OF *APACHE* AND *NAYARITENSIS*

External and cranial measurements: In total length, specimens of *apache* and *nayaritensis* average almost the same (556.8 vs. 557.3). However, length of tail averages less and length of body averages more in *nayaritensis* than in *apache* (see Table 1). The hind foot averages very slightly shorter in *nayaritensis* than in *apache*.

Cranial measurements indicate a very slight increase in length, especially basilar length (also nasal, condylobasal, and palatilar lengths), and decrease in width (postorbital and interorbital) in *nayaritensis* when compared to *apache* (see Table 1). None of these differences is judged to be of significant taxonomic value. Most notable is the difference in interorbital breadth (21.26 in *apache*; 20.70 in *nayaritensis*) which is statistically significant ($P = .01–.001$) but which in itself is of little taxonomic value. The differences between the skulls of *apache* and *nayaritensis* are considerably fewer than those between *apache* and *chiricahuae*.

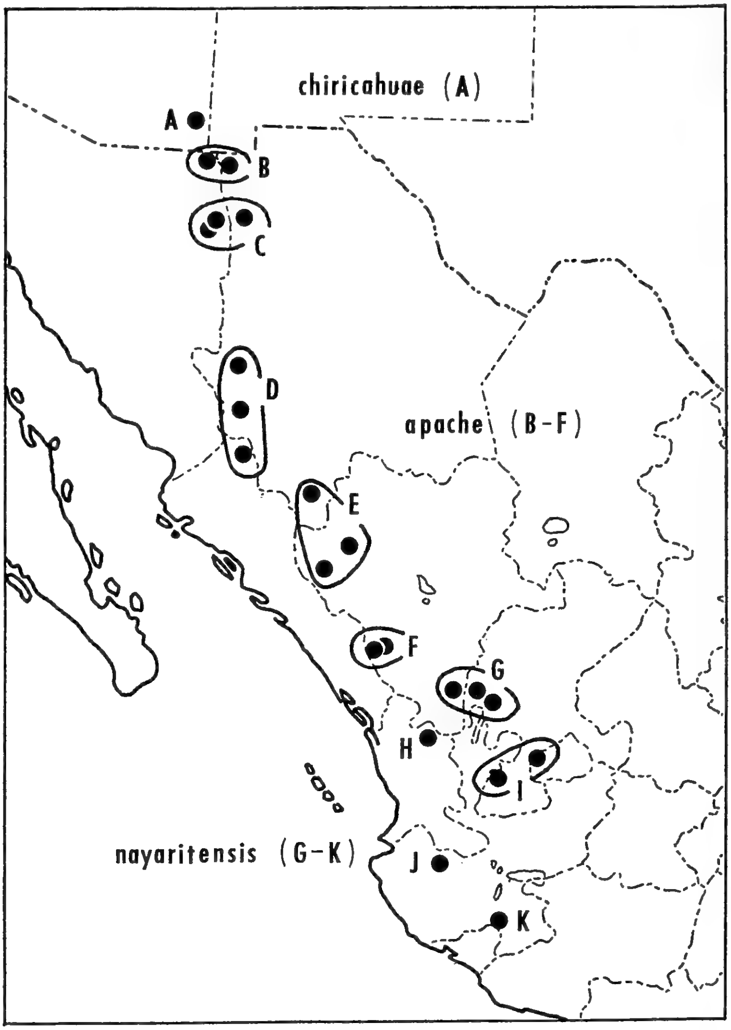

FIG. 1. Solid circles indicate localities from which specimens have been examined. For statistical purposes, specimens from nearby localities were combined. These groupings are indicated by letters which correspond to those in Table 1.

In shape of nasals and dorsal profile, specimens of *nayaritensis* are indistinguishable from *apache*. Specimens of *nayaritensis* do have slightly longer auditory bullae than those of *apache*.

Color: The difference in coloration between *apache* and *nayaritensis*

TABLE 1.—Average external and cranial measurements of *Sciurus nayaritensis* group; locality letters correspond to those on map (Fig. 1)

LOCALITY	N	LENGTH BODY	LENGTH TAIL	LENGTH HIND FOOT	BASILAR LENGTH	ZYGOMATIC BREADTH	POST-ORBITAL BREADTH	LENGTH NASALS	PALATILAR LENGTH	ALVEOLAR LENGTH MOLARS
A	14	282.6	263.9	75.1	48.55	37.87	21.24	21.06	27.51	11.75
B	8	277.1	277.9	77.0	49.94	36.67	20.43	21.96	27.98	12.06
C	7	281.7	273.8	76.3	49.64	37.20	20.90	21.56	27.95	11.99
D	6	282.8	274.8	78.2	50.16	38.31	20.93	22.09	27.97	12.00
E	4	—	—	—	50.08	37.43	19.80	21.88	28.20	11.85
F	14	283.7	274.2	77.9	50.33	37.54	20.17	21.66	28.00	12.04
G	25	287.7	266.9	76.1	50.27	37.31	20.18	21.84	28.19	12.07
H	7	284.0	278.6	79.2	50.41	37.98	20.25	22.17	28.31	12.15
I	9	289.4	270.6	77.3	50.32	37.57	20.41	21.88	27.81	12.15
					chiricahuae					
av.	14	282.6	263.9	75.1	48.55	37.87	21.24	21.06	27.51	11.75
s.		± 9.89	± 8.50	±2.98	±0.88	±0.50	±0.36	±0.55	±0.41	±0.21
min.		267	250	71	47.5	37.2	20.5	20.0	26.8	11.3
max.		301	281	80	50.6	38.7	21.9	21.9	28.3	12.2
					apache					
av.	39	281.8	275.0	77.5	50.03	37.48	20.46	21.77	27.98	12.02
s.		±10.60	±10.00	±2.60	±0.98	±0.87	±0.64	±0.87	±0.62	±0.28
min.		258	259	73	48.5	35.1	19.4	20.1	26.7	11.2
max.		309	298	82	52.5	39.9	21.6	23.7	29.2	12.5
					nayaritensis					
av.	41	287.4	269.9	77.0	50.31	37.48	20.27	21.91	28.10	12.10
s.		±11.55	±12.40	±2.99	±1.09	±0.86	±0.62	±0.79	±0.74	±0.33
min.		264	237	70	48.0	35.7	19.2	20.4	26.3	11.5
max.		315	294	84	52.7	39.1	21.7	23.7	30.4	13.0

is considerable. Dorsally, *apache* is blackish washed with buff or yellow whereas *nayaritensis* is grayish washed with white. In *apache* the hairs of the dorsum have a subterminal black band followed by a buffy band. In *nayaritensis* the hairs are white-tipped (some specimens have a middorsal patch with rusty-tipped hairs) with a subterminal black band followed by a prominent rusty band. In both kinds the hairs basally are dark plumbeous. The upper forearms and hind legs of *apache* are strongly ochraceous-buff compared with mostly grayish limbs (with slight wash of light buff) in *nayaritensis.* Differences in the tail are the broad, white lateral margins in *nayaritensis* compared to the buffy margins in *apache.* The tail of *apache* in the midventral region is usually bright ochraceous compared to hazel in *nayaritensis* (see Fig. 2). The light-tipped hairs are more numerous on the ventral surface of the tail in *nayaritensis.* The underparts in *apache* vary from light buff to bright ochraceous and rarely dark ochraceous. The underparts in *nayaritensis* are usually whitish or rarely (2 of 60 specimens) ochraceous-buff to ochraceous cinnamon. The dark underparts and feet in these two are of a slightly different color than

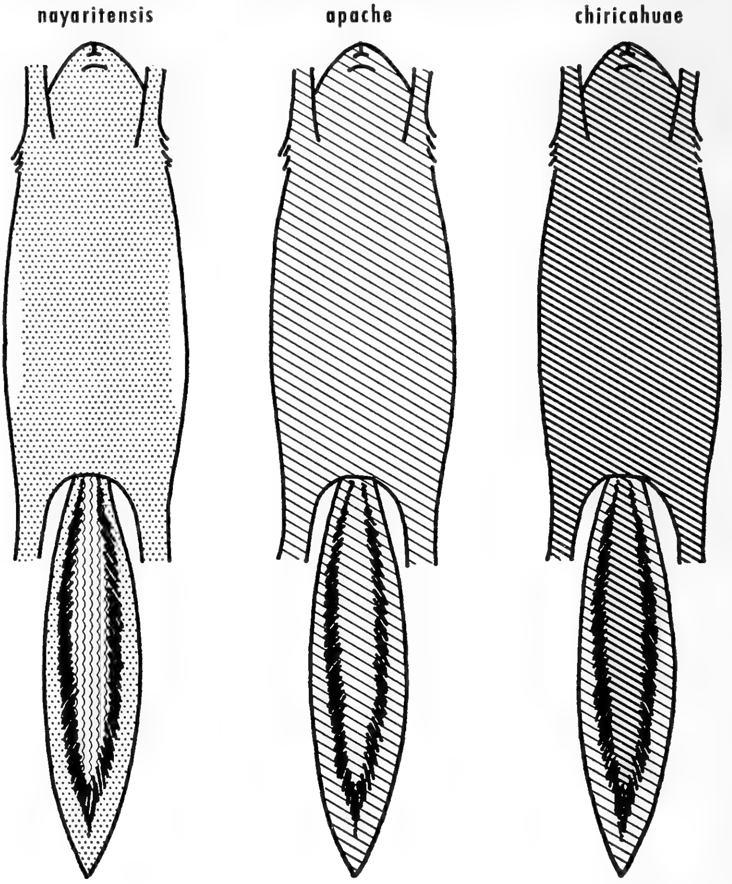

FIG. 2. Diagramatic, ventral views showing coloration and color-patterns in *nayaritensis, apache,* and *chiricahuae.* Dots represent whitish; straight lines, ochraceous (closeness of lines proportional to intensity); wavy lines, hazel; black, black.

in *apache* but distinctly reminiscent of certain specimens of *apache.* We do not regard these two specimens as geographic intergrades. However, they do demonstrate that the genetic basis of the color pattern which is characteristic of *apache* and *chiricahuae* is also present, albeit at a low frequency, in the gene pool of *nayaritensis.*

Remarks: No taxonomically significant differences were found between the skulls of *apache* and *nayaritensis.* Certainly, on the basis of their skulls, the two do not constitute even good subspecies. In fact, the similarity of skulls of these two kinds seems anomalous in view of the striking differences in color.

The form *nayaritensis* seems to exhibit a continuation of certain clinal trends running from *chiricahuae* through *apache*. Although the changes from *apache* to *nayaritensis* are slight, the skull does appear to become still longer and narrower (see Table 1). External size, however, does not show even these weak clinal tendencies. Length of body in *nayaritensis* exceeds that in both *apache* and *chiricahuae* while length of tail and length of hind foot average smaller than those in *apache* but larger than those in *chiricahuae*.

The Río Mesquital, which traverses the entire width of the Sierra Madre in southern Durango, is probably the southern boundary of *apache* and the northern limit of *nayaritensis* (also see Baker and Greer, 1962). No specimens are known of either "species" to indicate otherwise. However, it should be pointed out that no specimens of either of these kinds of squirrels are known from areas immediately adjacent to the river. From published information regarding their habitats, it appears that there are no important differences, if any, among these squirrels. All live in mixed pine-oak woodlands (Baker and Greer, 1962: 86; Nelson, 1899). Direct intergradation between *apache* and *nayaritensis* at present is highly unlikely. Baker and Greer (1962: 37, 51) and also Leopold (1959: Fig. 6) indicate that much of the valley of the Río Mesquital in the Sierra Madre supports a tropical vegetation.

DISCUSSION

That the three kinds, *chiricahuae, apache,* and *nayaritensis,* are phylogenetically closely allied is quite indisputable. Sufficient evidence is available to show conspecificity of *apache* and *chiricahuae*. Any reluctance to regard the three as a single species stems solely from the distinctive color of *nayaritensis*. Genetic exchange which in all likelihood has occurred between *apache* and *nayaritensis* should still be evident in intermediate specimens in present populations of these forms. No specimens of *apache* have been examined which would suggest any similarity to *nayaritensis* in coloration. However, two specimens of *nayaritensis* do have the dark ventral coloration suggestive of *apache*.

In view of the great similarity in cranial features between *nayaritensis* and *apache* and notwithstanding the difference in color between the two kinds, we suggest that the two be regarded as conspecific. This conclusion receives support from the findings of other students of variation in the family Sciuridae. Harris (1937) considered a group of taxa, some of which differ strikingly from each other in coloration, to belong to one species, *Sciurus variegatoides*. Banks (1931) concluded that a group of squirrels (*Callosciurus prevosti*) occurring in Sarawak were conspecific although color differences between certain forms were very outstanding and no intergradation was demonstrable between certain subspecies. Nelson (1899) synonymized a group of forms under the name *Sciurus poliopus* although color variation between certain subspecies was extreme. Within the species *Sciurus niger*, which is closely allied to the *nayaritensis* group, spectacular differences occur between subspecies, as for example, between S. *niger niger* and S. *n. rufiventer.* As a matter of fact, a high degree of intraspecific color variation is not unusual in Mexican and Central American tree squirrels (viz., *Sciurus socialis, S. yucatanensis,* S. *oculatus, S. poliopus, S. deppei*) and is probably the general rule.

Careful evaluation will likely reveal a close relationship between S. *nayaritensis,* as herein delimited, with the species S. *oculatus* and even S. *alleni.* Possibly the similarities are sufficient to justify the inclusion of all these forms under one specific name although we have not critically studied *oculatus* or *alleni.*

Actually, *Sciurus nayaritensis* is closely allied with *Sciurus niger.* The resemblance of skulls and color in *nayaritensis* (especially the color in *apache* and *chiricahuae*) is close to the *rufiventer*-group of S. *niger* (as delimited by Lowery and Davis, 1942: 154) with their smaller skulls and orange-cinnamon or yellowish underparts. The skulls of S. *nayaritensis* differ from those in this group most prominently in more inflated braincase, especially far posteriorly, slightly larger auditory bullae, and greater nasofrontal inflation. The range of variation within the species *Sciurus niger* as presently understood is so great that many workers may regard the differences between S. *nayaritensis* and S. *niger* as those of only subspecific degree.

In light of our present investigation, we feel confident that the following nomenclatural arrangement is warranted:

Sciurus nayaritensis nayaritensis J. A. Allen

1889. *Sciurus alstoni* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 2: 167, 21 October, type from Sierra Valparaíso, Zacatecas. Not *Sciurus alstoni* Anderson 1879 [= *Callosciurus alstoni*], type from Borneo.

1890. [*Sciurus*] *nayaritensis* J. A. Allen, Bull. Amer. Mus. Nat. Hist., 2: vii, footnote, February, a renaming of S. *alstoni* J. A. Allen, 1889.

Specimens examined: Total, 63, as follows: DURANGO: Rancho Las Margaritas, 8350 ft, 28 mi. S, 17 mi. W Vicente Guerrero, 12 (MSU). ZACATECAS: Sierra Madre, 8500 ft, 1 (US); Sierra Valparaíso, 8200 ft, 8700 ft, 4 (AM), 19 (US); Plateado, 8500 ft, 12 (US). AGUASCALIENTES: Sierra Fría, 7500–8200 ft, 3 (MU). NAYARIT: Santa Teresa, 6800 ft, 9 (US). JALISCO: Sierra de Nayarit, 1 (AM); La Laguna, 5000 ft, Sierra de Juanacatlán, 1 (US); Agosto nr. Atenquiqui, 1 (US).

Sciurus nayaritensis apache J. A. Allen

1893. *Sciurus apache* J. A. Allen, Bull. Amer Mus. Nat. Hist., 5: 29, 16 March, type from western slope of the Sierra de Nacori, 6300 ft, in eastern Sonora.

Specimens examined: Total 53, as follows: CHIHUAHUA: Devils Cañon, 3 mi. SE Mon. 66, 1 (UI); San Luis Mts., Mexican Boundary line, 9 (US); 20 mi. W Casas Grandes, 1 (KU); 3 mi. SW Pacheco, 2 (KU); Río Gavilán, 9 mi. SW Pacheco, 1 (KU); 25 mi. (?) W Colonia García, 1 (US); Sierra Madre Mts., head of Yakui [= Yaqui?], 1 (US); Mojarachic, 1 (US); 3 mi. NE Temoris, 3 (KU); near Guadalupe y Calvo, 2 (US). SONORA: about 3 mi. from New Mexico line, SE of Cloverdale, 1 (US); 4 mi. N Huachinera, 1 (US); 4 mi. SW Huachinera, 1 (US); western slope of Sierra de Nacori, about 29 trail miles NE Nacori, 6300 ft [not head Río Bavispe, Chih., see Burt, 1938: 38–39], 1 (US). DURANGO: Arroyo de Bucy, 3 (AM); Ciénega Corrales, 1 (AM); La Ciénega de las Vacas, 1 (AM); El Salto, 17 (US); 3 mi. E La Ciudad, 1 (UI); Laguna del Progresso, 1 (AM). SINALOA: 50 mi. NE Choix [= about 19 mi. E Choix], Sierra de Choix, 3 (US).

Sciurus nayaritensis chiricahuae Goldman

1933. *Sciurus chiricahuae* Goldman, Proc. Biol. Soc. Wash., 46: 71, 27 April, type from Cave Creek, Chiricahua Mts., Cochise County, Arizona.

Specimens examined: Total, 14, as follows: ARIZONA: Pinery Canyon, 4 (US); Fly Park, 1 (US); Green House Canyon, 1¼ mi. E Fly Park, 2 (UI); 4¼ mi. W Research Station, 1 (UI); Herb Martyr Dam, 1 (UI); Cave Creek, 5200 ft, 5 (US).

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TYPE FIXATION AND VALIDATION OF CERTAIN CALCAREOUS NANNOPLANKTON GENERA

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During the course of study of calcareous nannoplankton it has become evident that many genera are as yet invalidly described, lack type species, or are homonyms. In order that these genera may be useful in studies now in progress the following genera are herein validated under the *International Code of Botanical Nomenclature* (ICBN) or the *International Code of Zoological Nomenclature* (ICZN), depending on their original placement as unicellular algae or as flagellate protozoans.

Algirosphaera Schlauder, 1945, p. 22. Described with three included species: *A. oryza*, *A. spinulosa*, and *A. campanula* without selection of type species. *Algirosphaera oryza* Schlauder, 1945, p. 23, is here designated as type species.

Asterolithes Sujkowski, 1931, p. 508, 509, 617, 618. Described with eight included species, all new: *A. cayeuxi*, *A. grodnensis*, *A. niemeni*, *A. octoradiatus*, *A. polyradiatus*, *A. pyszkiensis*, *A. sexradiatus*, and *A. simplex* without selection of type species. *Asterolithes sexradiatus* Sujkowski, 1931, p. 509, 618, fig. 1 (12) (given as *A. sextiradiatus*, p. 618), is here designated as type species. As *A. sexradiatus* is a probable synonym of *Discoaster brouweri* Tan, 1926, *Asterolithes* is a junior synonym of *Discoaster*. Sujkowski reported his species to occur in Cretaceous chalk near Grodno, Poland, but they seem most likely to be of post-Cretaceous age.

Brachiolithus Loeblich and Tappan, n. gen. [proposed by Noël, 1959, p. 171, with three included centuriae (= species): *B. quadratus*, *B. pentagonus*, and *B. hexagonus*. As none was selected as type, the genus and all species are invalid (ICBN Art. 37)]. The herein validated genus is described in Noël, 1959, p. 171, and the species *Brachiolithus quadratus* Loeblich and Tappan, n. sp., herein (described by Noël, 1959, p. 171, pl. 3, fig. 25), is here designated as type species. The species and genus occur in Jurassic Upper Portlandian to Lower Cretaceous Valanginian strata from Algeria.

Bucculinus Noël, 1957, p. 326. Described with two included species: *B. algeriensis* and *B. hirsutus*. *Bucculinus algeriensis* Noël, 1957, p. 327, pl. 4, fig. 31, 32, is here designated as type species.

Coccosphaera Wallich, 1877, p. 348 (*non Coccosphaera* Perty, 1852). Described with two included species: *C. pelagica* and *C. carterii*, neither designated as type species. *Coccosphaera pelagica* is here designated as type species. As *Coccolithophora* Lohmann, 1902, p. 93, 136, 137, is a *nomen substitutum*, it has the same type species and hence is a junior isogenotypic synonym of *Cyathosphaera* Haeckel, 1894 (see Hay and Towe, 1962 [1963], p. 507) and *Cyatholithus* Huxley, 1868.

Cribrosphaerella Deflandre, 1952, p. 462, 466. Proposed as *nom. subst. pro Cribrosphaera* Arkhangel'skiy, 1912, *non* Popofsky, 1906, with two included species, neither cited as type. *Cribrosphaera ehrenbergi* Arkhangel'skiy, 1912, p. 412, pl. 6, fig. 19 (not fig. 20) is here designated as type species for *Cribrosphaera* Arkhangel'skiy, 1912, and for the substitute name *Cribrosphaerella* Deflandre, 1952. Fig. 19 is here designated as lectotype for *C. ehrenbergi*.

Cyatholithus Huxley, 1868, p. 206. Described and figured, but without included species. *Coccosphaera pelagica* Wallich, 1877, is here designated as type species. *Coccosphaera, Cyathosphaera,* and *Coccolithophora* are junior isogenotypic synonyms.

Cyclolithella Loeblich and Tappan, n. name [*nom. subst. pro Cyclolithus* Kamptner, 1948, p. 3 (invalid ICBN Art. 34 & 41) and *Cyclolithus* Deflandre, 1952, p. 465, *non Cyclolithus* Koenig, 1825]. Type, *Cyclolithus inflexus* Deflandre, 1952, p. 465, text-fig. 362-B (= invalid *C. inflexus* Kamptner, 1948, p. 7).

Discoaster Tan Sin Hok, 1927, p. 412. Described with seven included species: *D. barbadiensis, D. ehrenbergi, D. hilli, D. brouweri, D. pentaradiatus, D. molengraaffi,* and *D. triradiatus,* none of which was selected as type species. *Discoaster pentaradiatus* Tan Sin Hok, 1927, is here designated as type species.

Discolithina Loeblich and Tappan, n. name (*nom. subst. pro Discolithus* Huxley, 1868, p. 206, *non Discolithus* Fortis, 1802). *Discolithus* was described by Huxley without originally included species. The first species to be placed in the genus were the eight included by Kamptner, 1948, p. 4: *D. pulvinus, D. multiporus, D. vigintiforatus, D. patera, D. latus, D. sparsiforatus, D. circumcisus,* and *D. staurophorus,* none of which was designated as type. *Discolithus vigintiforatus* Kamptner, 1948, p. 5, pl. 1, fig. 8, is here designated type species for *Discolithina,* as it is readily recognizable in topotype material. Vekshina, 1959, p. 65, designated *Discolithus glabrus* Vekshina, 1959, as type species for *Discolithus,* but this is an invalid type designation, because *D. glabrus* was not among the first included species.

Lecalia Loeblich and Tappan, nom. nov. (*nom. subst. pro Rhab-*

docyclus Lecal in Bernard and Lecal, 1960, p. 21, *non* Lang and Smith, 1939). Type species, *Rhabdocyclus simplex* Lecal in Bernard and Lecal, 1960, p. 21, text-fig. 2(9).

Martiniaster Loeblich and Tappan, nom. nov. (*nom. subst. pro Coronaster* Martini, 1961, p. 102, *non* Perrier, 1884). Type species, *Coronaster fragilis* Martini, 1961, p. 102, text-fig. 2.

Meringosphaera Lohmann, 1903, p. 68. *Meringosphaera* was described with four included species: *M. baltica*, *M. mediterranea*, *M. divergens*, and *M. hydroidea*, none of which was selected as type. In a generic revision Pascher, 1932, pp. 209–210, removed the coccolithophorid species *M. hydroidea* Lohmann, 1903 [= *Ophiaster*], from the green algal genus *Meringosphaera*. *Meringosphaera mediterranea* Lohmann, 1903, is here designated as type species for true *Meringosphaera*.

Pontosphaera Lohmann, 1902, p. 129. Described with five included species: *P. huxleyi*, *P. syracusana*, *P. haeckeli*, *P. pellucida*, and *P. inermis*, none of which was selected as type. *Pontosphaera syracusana* Lohmann, 1902, p. 129, 130, pl. 4, fig. 10, is here designated as type species.

Rhabdolithes Schmidt, 1870, p. 680. Described with no included species. *Rhabdolithes* was first proposed by Schmidt, 1870, not by Voeltzkow in 1902 as stated by Neave, 1940, p. 27, although the first species included in the genus were *Rhabdosphaera tubifer* Murray and Blackman, 1898, and *R. claviger* Murray and Blackman, 1898, by Voeltzkow, 1902, p. 493. *Rhabdosphaera claviger* Murray and Blackman, 1898, p. 438, 439 = *Rhabdolithes claviger* (Murray and Blackman) Voeltzkow, 1902, p. 493, is here designated as type species. Thus *Rhabdosphaera* Haeckel, 1894, becomes an isogenotypic synonym of *Rhabdolithes* Schmidt, 1870 (see Hay and Towe, 1962 [1963], p. 504, for type designation for *Rhabdosphaera*. The prior type designation by Vekshina (1959, p. 74) of *Rhabdosphaera elliptica* Vekshina, 1959, as type of *Rhabdosphaera* is invalid as *R. elliptica* was not among the first included species).

Syracolithus Kamptner, 1941, p. 73, 81, 101. Described with four included species: *Syracosphaera catillifera*, *S. dalmatica*, *S. quadriperforata*, and *S. schilleri*, none of which was cited as type species. *Syracosphaera dalmatica* Kamptner, 1927, p. 178, text-fig. 2, is here designated as type species.

Syracosphaera Lohmann, 1902, p. 129, 133. Described with six included species: *S. spinosa*, *S. mediterranea*, *S. pulchra*, *S. tenuis*, *S. dentata*, and *S. robusta*, none of which was selected as type species. *Syracosphaera pulchra* Lohmann, 1902, p. 133, 134, pl. 4, fig. 33, 36, 36a, b, 37, is here designated as type species.

Umbellosphaera Paasche in Markali and Paasche, 1955, p. 96. Described with two included species: *U. irregularis*, n. sp. and *U. tenuis* (Kamptner), 1937 = *Coccolithus tenuis* Kamptner, 1937, without type citation. *Coccolithus tenuis* Kamptner, 1937, p. 311, pl. 17, fig. 41, 42, is here designated as type species of *Umbellosphaera.*

Vekshinella Loeblich and Tappan, nom. nov. (*nom. subst. pro Ephippium* Vekshina, 1959, p. 63, 69, *non* Bolten, 1798, *nec* Latreille, 1805). Type species, *Ephippium acutiferrus* Vekshina, 1959, p. 69.

Zygolithus Matthes, 1956, p. 223 [= *Zygolithus* Kamptner, 1949, p. 78, invalid (ICBN Art. 41)]. Described by Matthes but without type citation. First valid species included in the genus were *Z. bijugatus* Deflandre, *Z. diplogrammus* Deflandre, *Z. dubius* Deflandre, *Z. erectus* Deflandre, *Z. tenansa* Deflandre, and *Z. turriseiffeli* Deflandre (all 1954, in Deflandre & Fert). *Zygolithus erectus* Deflandre in Deflandre & Fert, 1954, p. 150, pl. 15, fig. 14–17, text-figs. 60–62, is here designated as type species.

Zygosphaera Kamptner, 1936, p. 244. Described originally with no included species. Kamptner, 1937, p. 305, again described the genus as new and included three species: *Z. amoena, Z. hellenica,* and *Z. wettsteini* without citation of type species. *Zygosphaera hellenica* Kamptner, 1937, p. 306, pl. 16, figs. 27–29, is here designated as type species.

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POLYCHAETOUS ANNELIDS FROM PUGET SOUND AND THE SAN JUAN ARCHIPELAGO, WASHINGTON[1]

By Karl Banse
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In view of pending investigations of the level bottom fauna of the inshore waters of Washington by the Department of Oceanography, polychaetes were studied at the Friday Harbor Laboratories of the University of Washington during the summers of 1961 and 1962. Some species new to the area or new to science are treated here.

FAMILY PHYLLODOCIDAE

Eteonides coineaui difficilis, new subspecies

Several anterior and posterior fragments, with up to 65 setigers 4.6 mm long were dredged in July 1961 at about 20 m south of Cattle Point, San Juan Island (appr. 48° 25.0′ N; 122° 59.0′ W) from coarse, not too clean sand. Other specimens were dredged in August 1962 between Reid Rock and Turn Island, near San Juan Island (appr. 48° 32.5′ N; 122° 58.5′ W), at about 100 m from a coarse, fairly clean sediment mostly made up of broken shells.

Description: The living animal (Fig. 1A) has a very elongated, pseudoannulated prostomium with four antennae of equal length and, on its posterior margin, two eyes. The proboscis is about three times as long as the prostomium and is covered with fairly large, round papillae which are not arranged in rows. The first two segments carry three tentacular cirri and are apparently free from each other, although a separation could not be clearly seen mid-dorsally. The cirrus on the first segment, and the dorsal one on the second segment, are long and slender, whereas the ventral cirrus on the second segment is ovoid and hardly larger than the ventral cirri on the setigers. All tentacular cirri are placed on cirrophores. There are no bristles or aciculae on the second

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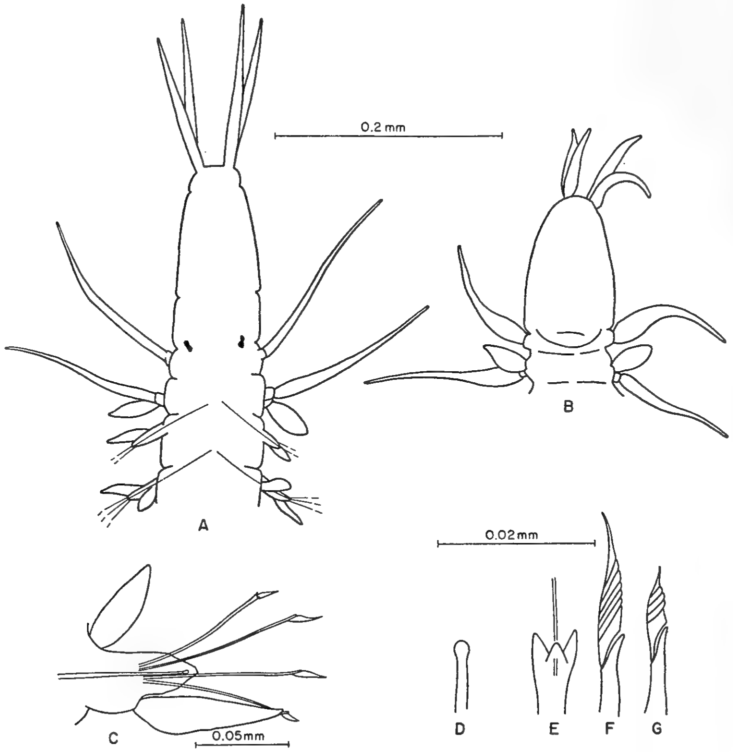

FIG. 1. *Eteonides coineaui difficilis.* A, Living animal, dorsal view. B, Preserved specimen, ventral view. C, 10th parapodium. D, Acicula, approximately to scale with setae. E, End of shaft of uppermost seta. F, Median seta. G, Lowermost seta.

segment. There is no dorsal cirrus on the third segment. Thus, the formula of the tentacular cirri is $1 + O\frac{ol}{ol} + S\frac{oO}{aN}$. Hartmann-Schröder (1960) has established the genus *Eteonides* for phyllodocid species with this formula.

The prostomium of the preserved animal (Fig. 1B) is shortened, and of oval shape. The eyes are difficult to make out. The cirrophores of the tentacular cirri are less distinct than in the living animals, and the shape of these cirri is more bulbose than filiform.

The tenth foot is shown in Fig. 1C. The dorsal cirrus which sometimes appears to sit on a small cirrophore, is inserted at the origin of the parapod. In the posterior setigers (60th to 70th) it grows from the very base of the parapod. Also in this region, it does not reach beyond the tip of the foot, in contrast to the ventral cirrus. The ventral cirrus sits on a moderately distinct cirrophore in the middle and posterior (60th to 70th) setigers. The acicula has a rounded point (Fig. 1D). Anteriorly there are four, posteriorly, five compound setae. The shafts are bifid except the dorsal bristle which is trifid (Fig. 1E); the dorsal bristle usually is slightly thicker than the others. The bristle below it has a very broad blade. The blade of the one or two middle setae is fairly long (Fig. 1F); that of the lowest seta is given in Fig. 1G.

The anal cirri are slender and slightly longer than the tentacular cirri on the first segment.

Living and dead specimens are rather pale. There is little yellow-green pigment on the ventral cirri.

Diagnosis: A subspecies of *Eteonides coineaui* Laubier with at least 65 setigers and 4.6 mm length, living on coarse sand in cold water of high salinity. Dorsal cirri shorter than, or equal in length to, parapodia. Uppermost bristle slightly thicker than the others. Tip of the blades of the median bristles long and thin. Yellow-green pigment on the ventral cirri.

Type locality and habitat: San Juan Archipelago, Washington. Because of the strong tidal mixing in the area, the environment on the stations between Reid Rock and Turn Island, and south of Cattle Point, San Juan Island, should be similar. An idea of the prevailing conditions may be obtained from the observations by Phifer and Thompson (1934; see also Herlingvaux and Tully, 1961, with other references) at the Friday Harbor Laboratories. During the year the average monthly means of the surface salinity range from 29.7 to 30.7‰ S, with a deviation from the average for individual months of roughly 0.5‰ either way. The annual range of the temperature values is 7.2 to 10.8° C, also with little variation. At the first station, the salinity of water near the bottom does not drop below 29.0‰, and the oxygen content is not likely to fall much below 50% of saturation.

Types: Holotype—U. S. National Museum Cat. No. 30493. Paratypes—U. S. National Museum Cat. No. 30494.

Discussion: There are four species of *Eteonides* known, *E. elongata* (Southern, 1914), *E. augeneri* (Friedrich, 1937), *E. serrata* Hartmann-Schröder (1960), and *E. coineaui* (Laubier, 1961) which, except for *E. serrata*, were described as species of *Pseudomystides*. The first two species have very small dorsal cirri which are inserted on the parapodium itself, whereas in the two other species the cirri are inserted on the base of the parapod. The tips of the bristles of the present material are drawn out more than those of *E. serrata* and *E. coineaui coineaui* from the type locality. Dr. Laubier kindly sent one of his specimens. In material of *E. coineaui* from other Mediterranean localities, the blades of the setae are of similar shape to those in the present material, according to drawings sent by Dr. Hartmann-Schröder. It would be difficult to distinguish the new subspecies from the type subspecies on purely morphological characters. Laubier (1961) stated that the type subspecies has wine-red and violet pigmentation. The main reason for keeping the present material separate from the Mediterranean form is that it lives on coarse sand in cool water of high salinity. In Europe, *E. elongata* and *E. augeneri*, which are clearly distinct from *E. coineaui*, are found in this environment. *E. coineaui coineaui* has been found in brackish water of high temperature. The new subspecies is distinguished from *E. serrata* by its bristles and by the dorsal cirri which in *E. serrata* reach beyond the tip of the parapodium in the middle region of the body.

FAMILY EUNICIDAE (DORVILLEINAE)

Ophryotrocha vivipara, new species

Two mature specimens of 0.8 and 1.0 mm length were collected by Dr. R. Zimmer in August 1962 from the water standing above a mud sample dredged by him at 22 m in Lopez Sound west of Decatur Island (appr. 48° 30.8′ N; 122° 50.7′ W). Fig. 2A is based on photographs of the living paratype and sketches of the living holotype.

Description: The prostomium carries a pair of antennae and a pair of palps which are both situated behind a complete ring of cilia. There is no second complete ring of cilia behind the antennae, as in *O. puerilis* Claparède and Metschnikow (1869) but only two pits of cilia (Fig. 2A); ventrally, cilia seem to encircle the mouth but details could not be made out. A pair of eyes is found beneath the border of the first segment.

The first two segments are apodous, each with a complete ring of cilia. There are six setigerous segments. In cross section, the body is almost elliptical; the feet insert below the end of the major axis of the figure. The parapods (Fig. 2B) are without rudiments of dorsal or ventral cirri or lips. In the fourth and fifth parapods, a pointed acicula, two dorsally inserted needle-like capillaries, and two to three compound setae with long blades (Fig. 2C) are found. There are complete rings of cilia on the posterior parts of the setigers. The pygidium is girdled by another ring, and carries an inconspicuous ventral median appendage and two anal cirri. Long stiff hairs are found on palps, tentacles, anal cirri and the distal ends of the parapods (the latter are omitted in the drawings). Short hairs line the front of the prostomium.

The dark brown jaws are visible through the body wall. The mandible of an embryo taken from the type specimen is shown in Fig. 2D. (The broken line indicates its shape in the adults.) Characteristic is the almost straight anterior margin. Fig. 2E and F show the broken forceps and the maxillary apparatus of the paratype pressed under a coverglass; the jaws of the holotype were lost. Looking from above at the forceps (marked by "x") and the apparently very short carrier, one sees a piece with large teeth, above the forceps and presumably free from it; it appears to be less complicated on the left side than on the right side. The caudal end of the carrier of the forceps is widened. Beneath the forceps is a thin piece with many sharp teeth. The left maxillae are shown in Fig. 2E. The right maxillae seem to consist of five strong

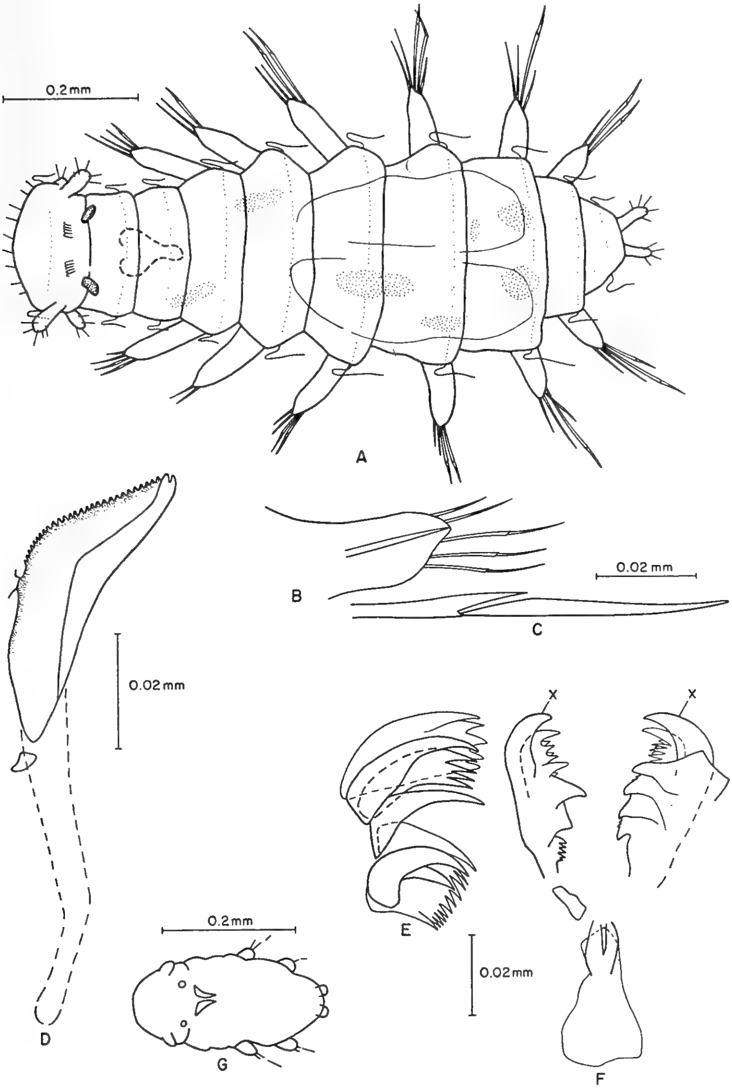

FIG. 2. *Ophryotrocha vivipara.* A, Adult, dorsal view. B, Parapodium. C, Compound seta. D, Mandible of an embryo, the broken line indicating the size in the adults. E, Left maxillary apparatus. F, Forceps, broken. G, Largest embryo taken from the holotype, ventral view.

hooks, that may be separate pieces, and about the same number of thinner plates with many teeth. Maxillary plates with a fairly smooth anterior margin, as known in *O. puerilis* (Korschelt, 1893; Hartman, 1944), are not present. There is no such forceps in the embryos as is known from young specimens of *O. puerilis* (Korschelt, 1893).

In the paratype, two oval dark masses, presumably the gonads, filled almost the entire space in setigers 3–5, on both sides of the midline (Fig. 2A). In the holotype were found eight embryos in varying states of development, between 200 and 250 μ long. The two oldest were as in Fig. 2G, and had fairly well-developed jaws which could be seen through the mother's body wall; the mandible shows that they were embryos, and not parasites.

The epithelium of the dead animals appears in many places like foam, as observed in living and dead *O. puerilis* by Korschelt (1893). The color of the living adults is pale; the gonads give a pink color to the middle part of the body. Deep red pigment, irregularly distributed in the epidermis, does not fade after one month in formalin (dotted areas in Fig. 2A). The animals swim rapidly by their cilia along the bottom of a dish and up to the water surface. The parapods are seldom used for crawling. The shape of the body changes rapidly from the form shown in Fig. 2A to that of an electric bulb.

Diagnosis: A viviparous species of *Ophryotrocha* of 0.8–1.0 mm length with six setigers. Frontal edge of mandible almost straight, with teeth. Parapods without cirri and distinct lips. Compound setae with long blades.

Type locality and habitat: San Juan Archipelago, Washington. The salinity, temperature and oxygen content at the station must be quite similar to those prevailing near the Friday Harbor Laboratories (p. 199).

Types: Holotype—U. S. National Museum Cat. No. 30491. Paratype—U. S. National Museum Cat. No. 30492. (The jaws are kept on a slide with this same number.)

Discussion: The other known species of the genus (cf. Hartman, 1959) have considerably more segments than *O. vivipara* when mature, and have generally less simplified feet. This new species can be distinguished from young specimens of the others by the straight anterior margin of the mandible, which is toothed. According to Wesenberg-Lund (1938), the margin is fairly straight also in *O. geryonicola* (Esmark, 1878) but in young animals there is a lateral keel not present in *O. vivipara.*

The development of *O. vivipara* differs from that of *O. puerilis* not only in respect to the viviparity, but also because the embryos with four segments bear two pairs of feet. In *O. puerilis* with four segments, no feet (or one pair only) are observed (cf. Korschelt, 1893; Braem, 1893).

It is not yet known whether there are males in the new species, at least temporarily, or whether self-fertilization prevails. *O. puerilis*, one of the few fairly well-known polychaetes (although not well known taxonomically, see below), is a protandric hermaphrodite; Bacci (1951), however, has stated for the Naples population that a few true males and females do occur. Self-fertilization is rare although not impossible; the offspring develops abnormally (Korschelt, 1895). Normally, the male fertilizes the laid eggs (Korschelt, 1894). The forms described by Huth (1933) as *O. hartmanni* and *O. gracilis* are hermaphroditic throughout their life; self-fertilization usually does not occur (Hartmann and Huth, 1936). These forms have a chromosome number different from *O. puerilis*, behave differently from each other and from *O. puerilis*, and have different ways of developing and depositing their eggs.

Concerning the behavior of *O. puerilis*, it may be mentioned that the author was told by G. E. MacGinitie and N. MacGinitie that the observations reported by them (1949) refer to worms from Newport Bay, near Corona del Mar, Southern California. The authors observed pairing, and brood protection by the male. European observers found brood protection by the female (for Triest, cf. Korschelt, 1894, 1895) although the male is around for some days before the deposition of the eggs. Hartman (1944), describing North American material, did not find morphological differences justifying the taxonomic separation from the European representatives. According to a personal communication from Dr. O. Hartman, the description was probably based on specimens from La Jolla, Southern California. It may be remembered that the previously lumped populations of *O. puerilis* from Naples and Plymouth do not interbreed successfully (Bacci and La Greca, 1953) and are now regarded as different subspecies. Thus, a new study of the Pacific *O. puerilis* may be worthwhile.

FAMILY SPIONIDAE

Rhynchospio arenincola Hartman, 1936

Syn.: *Rhynchospio* (cf. *arenincola*) Wieser, 1959, p. 105

Many large specimens were collected in August 1962 in the outermost part of False Bay, San Juan Island (appr. 48° 28.9′ N; 123° 04.3′ W) on medium to fine, fairly clean sand at about –2 ft tide level. This level is exposed on a very few days during low spring tides which do not occur every month. Wieser (1959), however, found the species at +2 to +3 ft. With the prevailing tides of the mixed type, this means many hours of exposure. There is very little freshwater discharge into False Bay.

In the preserved material, the frontal horns point obliquely forward as mentioned by Chlebovitsch (1959) for his *R. arenincola asiatica*. The anterior pair of eyes is, in five or six of the nine specimens studied, larger than the posterior one, and in three specimens equal in size. In the type (Hartman, 1936), the posterior eyes were the larger ones; the subspecies *R. arenincola asiatica* is distinguished from the type by its larger anterior eyes. It seems doubtful that this character is a valid one.

Chlebovitsch (1959) has pointed out that the known species of the genus are distinguished from each other mostly by the shape of the anal cirri. In the present material, a young individual of 30 setigers has only six conical cirri, instead of the eight in adults. Two insert dorsally and are about 1½ times as long as the ventral ones; there is a fifth cirrus about as long as the ventral cirri and a sixth just budding. A specimen with 64 setigers, of 14 mm length, has one conical cirrus along with filiform cirri of about 0.2 mm length. Chlebovitsch recorded very thin cirri whereas Hartman (1936) described conical cirri for the holotype.

Dr. O. Hartman kindly sent the animals collected by Wieser (1959), which are all small. The anal cirri are also filiform. The specimens seem to be identical with those from the new collection.

FAMILY CIRRATULIDAE

Cossura longocirrata Webster and Benedict, 1887

One complete specimen with 45 setigers and almost 3 mm length, and an anterior fragment of a presumably older individual, have been found in a dredge haul by Dr. E. Kozloff in August 1962, on mud bottom at 15 m in Massacre Bay, West Sound, Orcas Island (appr. 48° 38′ N; 122° 59′ W).

Berkeley and Berkeley (1956) have reported only one achaetous segment (the buccal segment) in material from East Sound, Orcas Island, as has been observed elsewhere. In both the present specimens, there are two achaetous segments following the prostomium, as in the specimens of Webster and Benedict (1887), indicating variability of this character. The tentacle inserts at the posterior border of the second setiger.

The station in West Sound is situated behind a sill. Although the pycnocline usually is shallow, as in East Sound, the temperature at the sampling depth may occasionally reach at least 15° C during summer. The salinity is not much lower than outside (see conditions near the Friday Harbor Laboratories, p. 199) but the oxygen saturation of the bottom water possibly could be low during summer.

FAMILY SABELLIDAE

Laonome kroyeri Malmgren, 1866

Several specimens, up to 25 mm long, were dredged by Dr. E. Kozloff in August 1962 in Massacre Bay, West Sound, Orcas Island (appr. 48° 38′ N; 122° 59′ W) from mud bottom in 15 m depth (for the environmental conditions, refer to the preceding species).

In a large specimen, there are seven to eight pairs of radioli, without eyes or dorsal appendages, or a palmar membrane. The collar is formed as figured by Malmgren (1866) with a broad dorsal gap and a pair of large, elongated, pointed ventral lobes. There are limbate and spatulate bristles in the thoracic notopodia. The thoracic tori are short and contain only hooks (Figs. 3A and B).

The thoracic uncini are quite similar to those figured by Malmgren (1866) and McIntosh (1922). Fauvel (1927) and Uschakov (1955) have used a figure of Hofsommer (1913) which is very different from

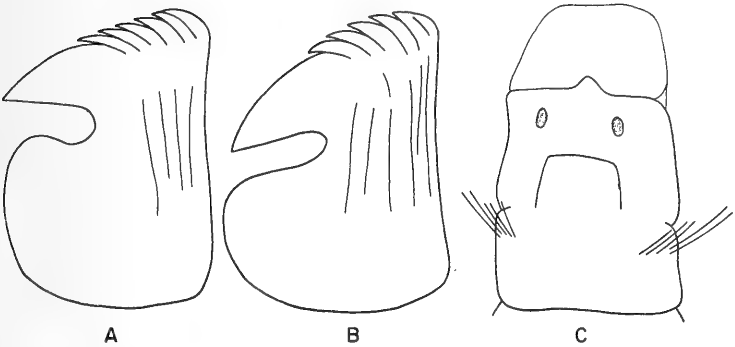

Fig. 3. A and B, *Laonome kroyeri* from West Sound, thoracic uncini from dorsal or youngest part (A) and from ventral or oldest part (B) of torus. C, *Fabricia sabella oregonica,* dorsal view of front end, tentacular crown removed.

either one. Prof. Siewing kindly checked the sample O. X. from the Bay of Kiel which Hofsommer apparently had used. The uncini were found to be fairly similar to those in Fig. 3 (see also Evenkamp, 1931, for other material from Kiel).

Previously known in the Pacific from the area near Kamchatka and from the Sea of Japan (Uschakov, 1955).

Fabricia sabella (Ehrenberg) subsp. *oregonica* Banse, 1956

Many specimens were collected by Mr. M. G. Hatfield in August 1962 in the high intertidal zone in False Bay, San Juan Island (appr. 48° 29′ N; 123° 04′ W). The animals were taken in felt-like mats of algae which can become lukewarm from the sun during low tide.

The specimens agree with the subspecies described from material collected in Coos Bay, Oregon, in their subspatulate thoracic notosetae which have a very long tip and differ little in shape and length from the other notosetae. The number of thoracic hooks reaches 14 only in one out of four animals checked, the specimens being not more than 2 mm long. This high number was thought to be characteristic of the subspecies. In the other individuals, there were only eight to nine hooks in the thoracic neuropods.

Additions to the original description: The tentacular crown makes up ⅙ to ¼ of the total length. The radioli bear 3 to 5 pairs of pinnulae ending at the same level. The collar (Fig. 3C) is broader than in the type subspecies, and occupies ⅓ of the circumference of the prostomium. The blood is bright green.

It is unknown whether the previous record of *Fabricia sabella* from neighboring areas (Berkeley, 1930 *partim*, see Banse, 1956) refers to this subspecies. The original material is lost (personal communication from Dr. C. Berkeley). The collar of the present specimens is considerably broader than shown in Fig. 1C of Berkeley.

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TAXONOMIC REVISION OF TWO POLYDORID SPECIES (ANNELIDA, POLYCHAETA, SPIONIDAE)

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Polydora tricuspa Hartman (1939) is herein referred to the closely related genus *Boccardia*. *Polydora ciliata* (Johnston) var. *spongicola* (Berkeley and Berkeley, 1950) is herein raised to species status. Bases for the revision and further information concerning the morphology and geographical and ecological distributions of the species are presented below.

This study was aided by a grant from the National Science Foundation (NSF G-17990).

Boccardia tricuspa (Hartman)

The single adult specimen originally described by Hartman was taken on the Presidential Cruise of 1938 at Sullivan Bay, James Island, Galapagos, in shore and tide pool collecting. She related this specimen to larvae found in the plankton at Scripps Institution of Oceanography at La Jolla, California (March–April, 1938), but was unable to find the adults in shore collecting at the latter region.

Hartman described the branchiae as being present first on segments posterior to the modified fifth (in this species on segment 7); this is the usual arrangement in members of the genus *Polydora*. The author found specimens at Morro Bay and Cayucos (central California coast) which agreed with the diagnosis of Hartman's species but small branchiae were found on segments 2, 3, 4, –, 6, and posteriorly (Fig. 1a). This information based on study of preserved material was corroborated by observation of live material taken on a subsequent collection. Specimens of this species in the Allan Hancock Foundation collections were made available by Hartman and comparative studies indicated the identical nature of the original and the Morro Bay–Cayucos forms; it was necessary then to remove the species to the genus *Boccardia* in which the appearance of branchiae on segments anterior to the modified fifth segment is a prime characteristic.

The specimens from Morro Bay agree with the original description in many respects and especially in the morphology of the two kinds of enlarged setae of segment 5 (Fig. 1b) and in the absence of notosetae

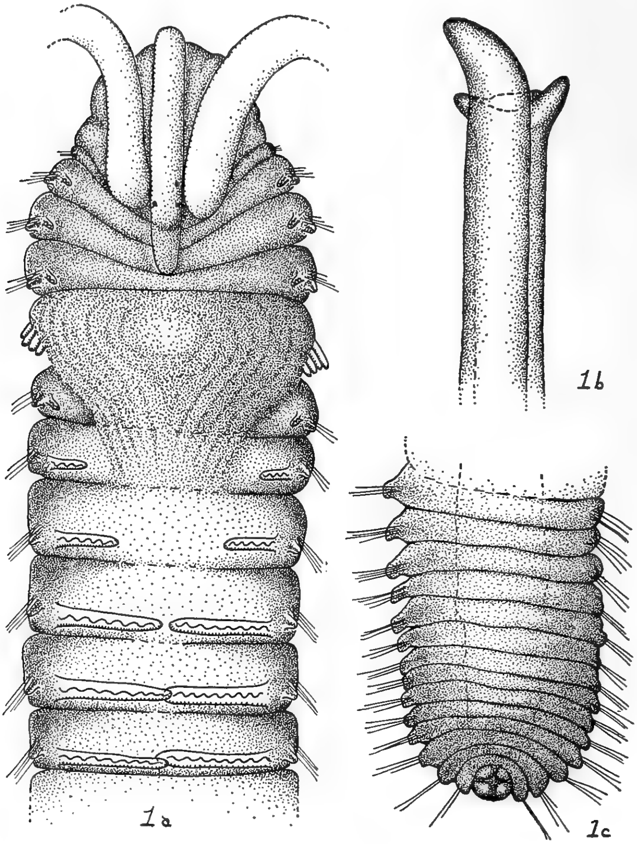

FIG. 1. *Boccardia tricuspa*—a, dorsal view of anterior end, × 35; b, modified seta of segment 5, × 300; c, pygidium, × 30.

in segment 1 of the adult. In describing the first setigerous segment of the larval form, Hartman (1939: 17) stated that it ". . . has both dorsal and ventral fascicles, the ventral setae much the shorter, and not present in the adult . . . ." In all other polydorids in which parapodial setae are absent in segment 1 of the adult, it is the notosetae which are so lost, and the neurosetae and lobe are shifted dorso-medially. This is suggested to be the case in *Boccardia tricuspa* after study of the Morro Bay form.

The specimens from Morro Bay–Cayucos differ from Hartman's original description in the branchial distribution and the posterior extent of the caruncle. The branchiae are present on segments 2, 3, 4, –, 6, 7 and about 10 more additional segments. From segment 6 through the next five or six segments the branchiae gradually increase in size so that the tips, as they approach one another, form a V-shaped interbranchial space (Fig. 1a). The caruncle reaches only to the posterior border of segment 3 rather than segment 4. However, the latter segment is very narrow dorsomedially and exact determination of the posterior extent of the caruncle is not possible in all specimens. There are no anterior dorsal setae in the modified fifth segment (Fig. 1a). The pygidium (Fig. 1c), which was not described in the original work, is barely distinguishable from preceding segments and is unlike the disc-shaped pygidium found on most polydorids. The prepygidial segments are reduced in size; the last one is U-shaped and surrounds the small pygidium which opens dorsally between four weakly developed lobes.

The geographical distribution is extended from the original Galapagos Island and La Jolla, California, areas, north to Santa Barbara and the central California coast at Morro Bay–Cayucos.

The habitats of *Boccardia tricuspa* are made known here for the first time and include diverse situations. It was found in encrusting coralline algae (*Lithophyllum*) from the upper tide region and with a mass of serpulid tubes from the base of aggregated anemones (*Anthopleura elegantissima*). It occurred with sponge and with *Phragmatopoma californica* scraped from the surface of a rock from the lower tide region, a region of dense growth of *Postelsia palmaeformis*.

In the *Lithophyllum* it produced a clean burrow suggesting the ability to bore and erode the calcareous material. In this habitat it was associated with *Polydora ciliata* and a new species of *Polydora*, both able to bore through the algae, and with *Boccardia proboscidea* and *B. columbiana*; the latter two species, although able to erode calcareous materials, were found here more as nestling forms in accumulations of sand and silt between the algal lamellae.

Boccardia tricuspa was also a common inhabitant of gastropod shells inhabited by hermit crabs. In three separate collections at Cayucos of *Tegula brunnea*, with *Pagurus granosimanus* being the only associated hermit crab, the infestation rate was 11 of 42, 7 of 29, and 5 of 38 shells. The incidence of 21% indicated other than a chance occurrence in the shells. *Boccardia tricuspa* was associated in these shells with two other boring-type polydorids, *P. ciliata* and *B. columbiana.* At Santa Barbara *B. tricuspa* was found in *Ceratostoma nuttalli* as an associate with *P. commensalis*, in *Olivella biplicata* with *P. commensalis* and *P. ciliata*, and in *Thais emarginata* with *P. commensalis, P. ciliata, P. limicola*, and *B. columbiana.* All the Santa Barbara shells were inhabited by *Pagurus samuelis.*

Egg cases were found in material from Cayucos in late June 1961 and early July 1962 and 3-segment larvae within egg cases were also found in the June 1961 collections. A free-moving 17-segment larva was found in material collected 27 August 1961 at Santa Barbara. Hartman (1939) found 19-segment larvae in plankton at La Jolla during March–April

1938. It is possible that the reproductive cycle is initiated earlier in the warmer southern waters or that the data, when supplemented through additional collections, may indicate a continuous cycle with one or two peaks in reproductive activity during the year.

In the original description Hartman emphasized the fact that this species differed from other *Polydora* in having two kinds of stout setae in the modified fifth segment. Rioja (1939) noted in his description of *Polydora heterochaeta* that it also had two kinds of setae in the modified segment and he therefore established a section within the genus for the two species. As a result of the revision of *Boccardia tricuspa*, the position of *P. heterochaeta* should be reexamined. It was described from a post-larval stage, a stage in which the exact branchial distribution cannot always be determined. Other forms which should also be reviewed in this respect are *P. laticephala* and *P. punctata* described by Hartman-Schröder (1959). Each of these forms has two types of setae in segment 5; the former, which is very similar to *P. heterochaeta*, was apparently described from a larval form.

Hartman (1939: 17) stated in discussing the larvae taken at La Jolla, ". . . these pelagic larvae had up to 19 setigerous segments, indicating a long pelagic life, and hence the possibility of being widely disseminated by ocean currents." Egg cases observed in the present study were found only with 2- or 3-segment larvae, closely packed, with no nurse eggs present. This compares with the type of development described by Wilson (1928) for *Polydora ciliata*, in which it hatched at about the 3-segment stage and had a long planktonic existence. This supports Hartman's suggestion concerning the pelagic life of *Boccardia tricuspa*; however, the presence of larvae at La Jolla did not necessarily depend on their wide dissemination by ocean currents for, with the finding of adult *B. tricuspa* in many California coastal habitats, it is likely that the adults are present in the La Jolla intertidal in hermit crab shells and in encrusting coralline algae.

Settling of *B. tricuspa* may occur at approximately the 17-segment stage for a post-larval form of that stage was found associated with other polydorids in a *Thais emarginata* shell from Santa Barbara (27 August 1961). It had not lost the dorsal pigmentation characteristic of free-swimming larvae.

Polydora spongicola Berkeley and Berkeley

E. and C. Berkeley (1950) described *Polydora ciliata* var. *spongicola* as a new variety from sponges encrusting rocks at False Narrows and *Pecten hindsi* shells dredged in Northumberland Channel; both localities are near Nanaimo on the east coast of Vancouver Island.

They indicated that this variety differed from the stem species only in the form of the specialized hooks of segment 5. They stated (l. c.: 53), "It has also been found, together with representatives of the stem species, amongst bryozoa coating tubes of *Spirorbis*. This close association of the stem species and the variety suggests that no more than phases of a single form may be involved." Because the setae of the fifth are so characteristic in *P. spongicola* and because of other morphological differences it is considered herein as a separate species.

Polydora spongicola and *P. ciliata* are compared below. Because *P. ciliata* has been described from many geographical and ecological areas, the comparisons made here are with that species as described by E. and C. Berkeley (1952).

The tip of the prostomium of *P. ciliata* is indistinctly notched; the prostomium in *P. spongicola* is rounded. In *P. spongicola* the palps are shorter and heavier (Fig. 2a). Neither species has notosetae on segment 1 but in *P. ciliata* the notopodial lobes are poorly developed compared to the other species. Segment 5 of *P. spongicola* is extremely well developed, overlapping segments 6 and 7. The large setae are very stout, having a heavy, falcate main fang with two lateral knob-like flanges which are joined by a raised collar located under the convex portion of the main fang. There is a third smaller knob slightly proximal to one of the lateral knobs (Fig. 2b). The main fang may show considerable erosion. Unlike *Polydora ciliata* the stout setae project freely from the lateral surface of the segment for quite some distance and there are no accessory setae.

The branchiae begin on both species at segment 7, but in *P. spongicola* they are very small on 7, intermediate on 8, and full-sized on 9 (Fig. 2a). They are present up to about the 10th last segment and are reduced to small, thin structures posteriorly. The pygidium of *P. ciliata* is described as cup-shaped, having a broad ventral rim which almost disappears dorsally (on the California specimens it is scoop-shaped). There is a dusky pigmentation on the pygidium, the anterior end, and the palps. In *P. spongicola* the pygidium is cuff-like (Fig. 2c) and is no greater in diameter than the last few prepygidial segments. It is refractile and in a few specimens had a brownish pigmentation at the edge. Most specimens possess a brownish anterior pigmentation beginning as a band across the dorsal surface of segment 5 and mid-dorsally on the next ten segments.

There is a variation in size between the two species, but while size may be a contributing factor in differentiation, it should not be the sole basis for separation. That size difference may be the result of ecological and other factors is emphasized in a comparison of specimens of *P. ciliata* and *P. spongicola* from British Columbia (specimens from E. and C. Berkeley) with those from California; specimens of both species from British Columbia are larger than their southern counterparts.

These morphological differences serve to separate the two species and support the contention that spatial relationship does not necessarily indicate taxonomic identity or even close relationship. *Polydora ciliata* is more similar morphologically to *P. hermaphroditica* Hannerz, *P. pacifica* Takahashi, and *P. websteri* Hartman, than it is to *P. spongicola.*

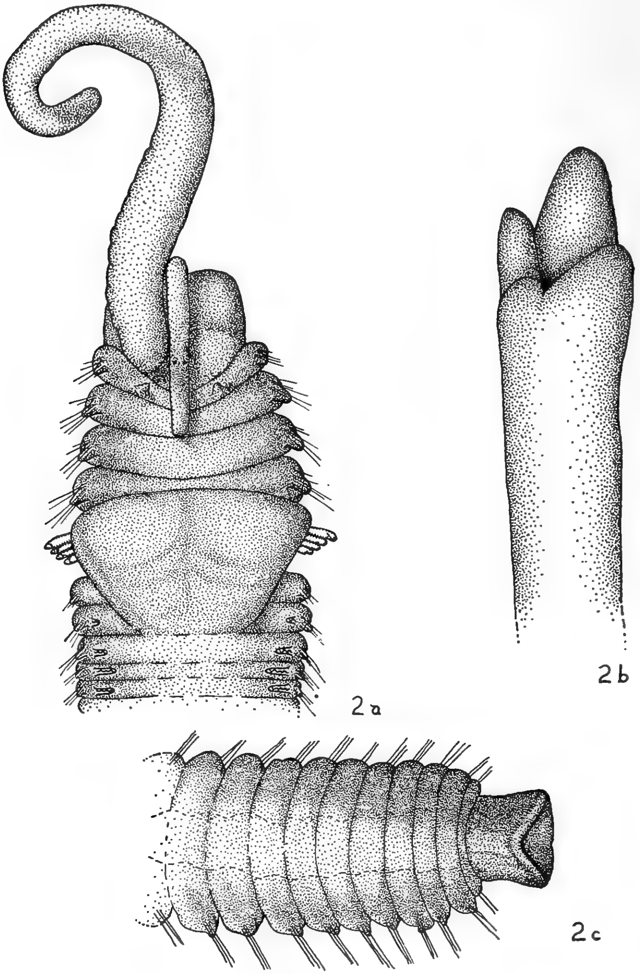

FIG. 2. *Polydora spongicola*—a, dorsal view of anterior end, × 30; b, modified seta of segment 5, × 300; c, pygidium, × 30.

The geographical distribution of *P. spongicola* (originally limited to the east coast of Vancouver Island) is herein extended to Trinidad Head in northern California, Cayucos and Avila in central California, and farther south at Santa Barbara.

Polydora spongicola is well named for in this study it was only found associated with sponge, a red encrusting sponge at Cayucos from the low tide zone near *Postelsia*, and a tannish-gray free-rolling sponge from the upper intertidal zone at Santa Barbara. It occurred in association with *P. ciliata* at three of the six stations and with *P. limicola* at three of the six. However, only at Avila were all three found together. Study of these collections indicate *P. ciliata* has a broader ecological spectrum than *P. spongicola*, for while the latter was found only in sponge, the former was found there and also in gastropod shells inhabited by hermit crabs, debris from surface of low-tide rock along with *Phragmatopoma californica*, piling material, a *Dodecaceria* mass, *Macrocystis* holdfast, rock oyster shells, and coralline algae.

No reproductive material was found that could be associated unquestionably with *Polydora spongicola.*

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PROCEEDINGS
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A REDESCRIPTION OF THE AMPHIURID BRITTLESTAR *OPHIOCNIDA CUBANA* A. H. CLARK, 1917[1]

By Lowell P. Thomas
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University of Miami

Ophiocnida cubana A. H. Clark, 1917 was described from a specimen, with a disc 4.3 mm in diameter, collected at Ensenada de Santa Rosa, Cuba. Austin Clark's unillustrated description unfortunately lacks any mention of color or color pattern; however, Hubert Lyman Clark (1933: 55, Plate 7) published two photographs of the type showing the color pattern of the arms. The latter author suggested that the specimen was a young one, basing his opinion, no doubt, on the presence of primitive plates and the fan-shaped dorsal arm plates. Since its description 47 years ago no further material of *Ophiocnida cubana* has been reported.

In 1958 I found a specimen of an apparently undescribed *Ophiophragmus* tangled in *Thalassia* roots in about one foot of water at Coral Harbor, St. John, Virgin Islands. I examined a second specimen, also from the Virgin Islands, at the U. S. National Museum in 1960, and at the same time made an unsuccessful attempt to locate the type of *Ophiocnida cubana* (C. E. Cutress, of the National Museum, informs me that the type has since been found). In the summer of 1961 I examined two specimens of *Ophiocnida cubana* at the Museum of Comparative Zoology at Harvard. These had been identified by Ailsa M. Clark of the British Museum (N. H.) after H. L. Clark labeled them "*Amphiodia* Sp. Nov. A." Examination of these specimens and the photographs of the type revealed that

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[1] Contribution No. 501 from The Marine Laboratory, Institute of Marine Science, University of Miami. This constitutes a technical report to the National Science Foundation of work supported under Grant G-23649.

Ophiocnida cubana is the juvenile of the large *Ophiophragmus* from the Virgin Islands.

The following descriptions are intended to clarify the systematic position of this inadequately described species. In addition, new distribution records from Florida and the Virgin Islands are given.

I am indebted to Charles E. Cutress, Associate Curator, Division of Marine Invertebrates, U. S. National Museum, and to Elisabeth Deichmann, Curator of Marine Invertebrates, Museum of Comparative Zoology at Harvard, who offered assistance on a number of occasions.

The material at Harvard was studied during the tenure of a visiting curatorship under National Science Foundation Grant G-5183. The material at the National Museum was examined during a trip supported by the National Geographic Society, and the material from St. John, V. I., was collected during a trip supported by the National Science Foundation (Grant No. G-5941) and Dingell-Johnson project funds (Project No. F-2-R-2).

Ophiophragmus cubanus (Clark, 1917) new combination
(Figs. 1–3)

Ophiocnida cubana A. H. Clark, 1917: 69.—H. L. Clark, 1933: 55, Pl. 7, Figs. a, b.

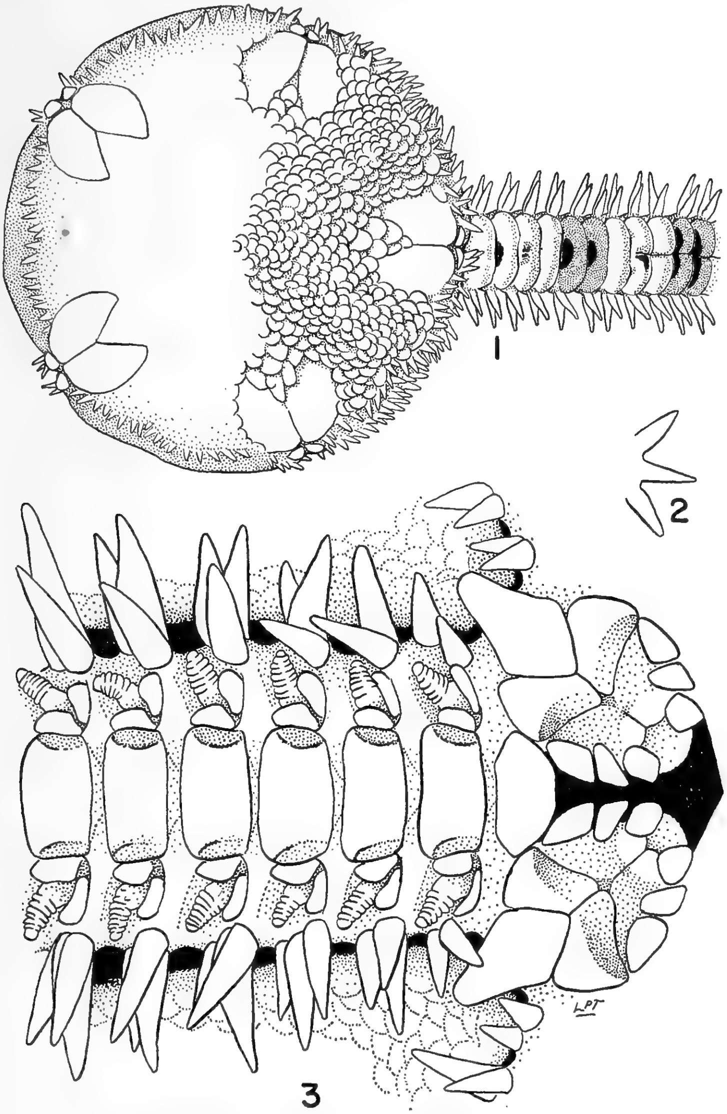
Material examined: 1 spec., disc 11.2 mm in diameter; Coral Harbor, St. John, Virgin Islands; 1 m; 20 December 1958; S. B. and L. P. Thomas; UMML 41.69.

1 spec., disc 14.1 mm in diameter; Gorda Sound, Virgin Gorda, Virgin Islands; 14 April 1956; W. L. Schmitt; USNM E. 9302.

2 spec., discs 6 and 11 mm in diameter; White Shoal, the Dry Tortugas, Florida; 16–18 m; 24 July 1931; W. L. Schmitt; MCZ 4735.

Description: A specimen with a disc 14.1 mm in diameter has arms approximately 145 mm long.

Each jaw bears three pairs of oral papillae. The papillae of the infradental pair are blocklike and widely separated; those of the middle pair are the smallest and are often truncate on their outer sides, and those of the distal pair are the largest and are almost twice as wide as the middle ones. The oral shields are long and narrow. They are pointed proximally, widening distally for about two-fifths of their length, then gradually narrowing to their rather broadly rounded distal ends. The adoral shields meet proximally and are roughly triangular or tear-drop shaped, with a pronouncedly concave proximal face. The half jaws are



Figs. 1–3. *Ophiophragmus cubanus*, new combination. Fig. 1—Dorsal surface of disc and one arm. Fig. 2—Arm spines. Fig. 3—Ventral surface of arm base showing two jaws.

as wide, between the second papillae, as they are long. Both the oral and adoral plates are swollen rather than tabulate.

The ventral arm plates at the twenty-fifth segment are wider than long and slightly wider distally than proximally. They are roughly rectangular, with the distal side almost straight and the proximal side slightly convex. The portions of the plate adjacent to the tentacle scales are excavated. The two tentacle scales, about equal in size, are at right angles to one another and are wider than long. The outermost scale becomes smaller on the distal quarter of the arm and finally disappears near the tip of the arm. Apparently the outermost tentacle scale of the type is undeveloped along most of the arm (A. H. Clark, 1917: 70). The side arm plates are narrow and project laterally. They bear three, slightly flattened, pointed spines of similar proportions. The tentacle pore is prominent. The dorsal arm plates are about three times wider than long and are slightly concave distally. The lateral sides are broadly rounded. Most of the dorsal arm plates, even near the arm tips, are split along the midline of the arm.

The dorsal surface of the disc, covered by slightly swollen, imbricating scales, is bordered by a fence of conical papillae. There are no primitive plates. In the two larger specimens (UMML 41.69 and USNM E. 9302) there is still evidence of the juvenile spination on the disc. The UMML specimen has a single spiniform papilla proximal to the fence, and the USNM specimen has about eight such papillae. Scattered spiniform papillae extend ventrally from the fence onto the interbrachial regions, forming V-shaped papillose areas, which are bordered laterally by scales. The small holotype and the smallest MCZ specimen (disc 6 mm in diameter) have a number of spinulose papillae scattered about on the dorsal surface of the disc. Their dorsal arm plates, as Austin Clark (1917) pointed out, are fan-shaped, with broadly rounded outer angles. The larger MCZ specimen (disc 11 mm in diameter) lacks scattered dorsal papillae.

The four specimens that I examined display a color pattern identical to that of the type as shown in H. L. Clark's (1933) photograph. One to four or more dorsal arm plates are darker than the next one to several adjoining plates. There is a black line extending part-way across the proximal side of each darker plate. Thus the dark arm bands are themselves incompletely banded by black bands. The ventral surfaces of the arms were pinkish orange in the live UMML specimen. This color was similar to Ridgway's (1912: Plate 2, 9d) "bittersweet pink" or Kornerup and Wanscher's (1961: Plate 7, A6) "reddish orange." The dorsal arm bands were greenish brown, and the smaller bands within these were black. The remaining dorsal surface of the arm was similar in color to the ventral surface. These colors all have partially faded in alcohol.

Type: Ensenada de Santa Rosa, western Cuba, 1–3 fathoms; USNM 34,763.

Distribution: The Dry Tortugas, Florida; Cuba; and the Virgin Islands.

Discussion: The holotype and the smaller MCZ specimen have scattered, spinulose papillae on the dorsal surface of the disc. These are reduced in number during growth and are either rare or absent in the three larger specimens. However, a well-defined fence of papillae encircles the disc in all the material examined. Hence it becomes impossible to refer large examples of *Ophiocnida cubana* to the genus *Ophiocnida,* and the species must be placed instead in the genus *Ophiophragmus.*

Ophiophragmus cubanus is similar to *O. filograneus* (Lyman) in that both have ventral interbrachial papillae. These are smaller and more numerous in the latter species.

Variation in spination is not unknown in *Ophiophragmus.* A fence may be lacking entirely in *Ophiophragmus pulcher* (H. L. Clark) and *O. filograneus* (Thomas, 1962: 640, 672). As more information dealing with growth changes and phenotypic variation is obtained it is likely that many of the taxonomic characters used at present will be reevaluated or discarded.

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A NEW MILLIPED OF THE XYSTODESMID GENUS *BRACHORIA* FROM SOUTHWESTERN VIRGINIA[1]

BY RICHARD L. HOFFMAN
Radford College, Virginia

The following new species is described individually in order that the name be available for use in a paper now being prepared on the significance of color-pattern variations in xystodesmid millipeds.

Brachoria versicolor, new species
(Figs. 1, 2)

Type specimens: Male holotype (USNM D-655), two male and three female paratypes (RLH), from the Gullion Fork Wildlife Management Area, west of Blacklick, Wythe County, Virginia; R. L. Hoffman leg., 28 July 1962.

Diagnosis: A member of the Separanda Group of Brachoria (cf. W. T. Keeton, Proc. U. S. Nat. Mus., 109: 1–58, 1959), distinguished from all other species of the genus by the proximally recurved solenomerite which is set off by a prominent projection from the outer margin of the telopodite. The postcingular telopodite is considerably wider than in other members of the group with the possible exception of *B. calcaria*. Color pattern highly variable: bimaculate, trimaculate, and cross-banded.

Holotype: Length about 38.5 mm, greatest width 9.1 mm, W/L ratio, 23.7%. Body essentially parallel-sided for most of its length, widest at segment 12. Widths of various segments across metatergites and paranota:

Segment	1—6.9 mm	Segment	10—9.0 mm
	2—8.0		12—9.1
	4—8.8		14—8.9
	6—8.9		16—8.0
	8—9.0		18—5.4

Dorsum dark brown, almost black, caudolateral halves of paranota, a broad band on anterior margin of collum, entire epiproct, and legs bright yellowish-orange. Labrum and antennae light brown.

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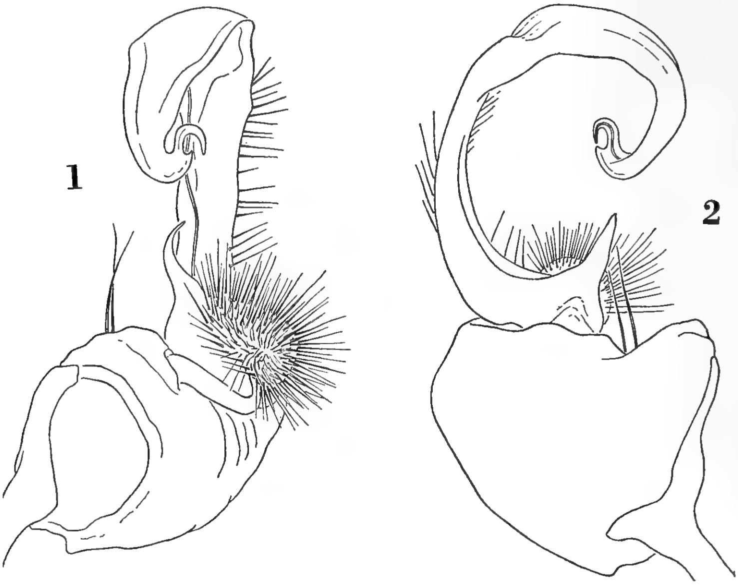
[1] A contribution from studies supported by a grant (G-21519) from the National Science Foundation.



FIGS. 1, 2. *Brachoria versicolor*, n. sp., left gonopod of holotype. 1, mesial aspect; 2, dorsal aspect; both × 45.

Anterior marginal ridges of collum very faint, obliterated toward the ends. Middorsum of collum and following segments smooth and polished, upper surface of paranota becoming distinctly coriaceous. Stricture reduced to a transverse suture dorsally, prozonites and metazonites meeting at an even plane. Paranota large, depressed, continuing slope of middorsum; anterior corners broadly rounded, posterior corners rounded back to 7th segment, subrectangular back to 10th, thence becoming gradually more produced caudally, but not acutely angular except on 18th and 19th segments; posterior edge not margined, slightly convex and thus meeting dorsum at a slight reentrant angle. Scapulorae prominent, submarginal toward body and thus exposing front edge of paranota; peritremata poorly defined, nearly flat.

Stricture broad, deep, and well defined down sides, its surface densely punctate; sides of metazonites striate–coriaceous, the caudal edge of each set off by a prominent marginal ridge. Stigmata subsimilar, but anterior stigma somewhat larger than posterior and proportionately narrower; both stigmata are close to dorsal coxal condyles but distinctly separated from them.

Legs set upon distinct podosterna, these broad and sloping up gradually from the stricture; glabrous, medially depressed between posterior pair of legs; forming an acute-edged transverse, overhanging rim between coxae of posterior legs. Sterna of some posterior segments with tendency for the development of low, blunt subcoxal spines. Legs long and slender, coxae with blunt, short coxal spines; prefemoral spines prominent, acute. Pretarsi elongate, slender, bisinuate, dorsally carinate, the tip curved caudad.

Anterior sterna with low, vague, subcoxal processes between legs of 3rd, 4th, and 5th pairs. Gonopod aperture large, broadly oval, the margin strongly elevated laterally, flush with sternal surface anteriorly and posteriorly. Gonopods large and robust, of the form shown in Figs. 1 and 2. Pre- and postcingular sections of telopodite about equal in length, postcingular section laminately broadened, then tapering gradually distad; a distinct, hamate, recurved solenomerite is developed, set off by a prominent projection from the outer margin of the telopodite.

Remarks: On the basis of gonopod structure, the present species is clearly related to *B. eutypa ethotela* and *B. hamata*, both of which occur at adjoining areas in southwest Virginia. Aside from the singular termination of the gonopod, *B. versicolor* differs from these two congeners in its polychromatic characteristic: both of the others occur so far as is known only in one color phase.

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A NEW GENUS AND SPECIES OF WATER-STRIDER FROM CALIFORNIA (HEMIPTERA: MACROVELIIDAE)

By Carl J. Drake[1] and Harold C. Chapman[2]

The present paper describes a new genus and new species of water-strider of the family Macroveliidae from California, divides the macroveliines into the subfamilies Ocelloveliinae and Macroveliinae, and then segregates the latter subfamily into the tribes Macroveliini and Oraveliini. Original keys are included to the taxa of the hierarchal categories.

The paper is based upon specimens in the collections of the authors and U. S. National Museum. We are most grateful to Miss Lisa Biganzoli, Washington, D. C. for the fine illustrations.

KEY TO SUBFAMILIES OF FAMILY MACROVELIIDAE

Head very short, shorter than width across eyes, sharply declivent just in front of eyes, subvertical, anteocular part about as long as an eye, postocularly with hind margins of eyes and front margin of pronotum subcontiguous; tarsal claws slightly preapical. (Type Genus, *Ocellovelia* China and Usinger, 1949.) South Africa .... Ocelloveliinae, new subfamily

Head very long, much longer than transocular width, porrect, anteocular part more than twice as long as an eye; postocular part short, approximately one-half as long as an eye; tarsal claws apical. (Type Genus, *Macrovelia* Uhler, 1872.) United States (west of the Missouri River); Mexico (Lower California) .. Macroveliinae McKinstry (1942)

KEY TO TRIBES, GENERA, AND SPECIES OF MACROVELIINAE

Ocelli absent; antennae very long, each segment longer than transocular width of head; abdominal tergites and usually also sternites II–IV mostly flavous; lateotergites with prominent anterior spot on upper and lower sides of segments II–VI. Length 5.25–5.56 mm. California. (Oraveliini, new tribe) (Fig. 1) .... *Oravelia pege*, new gen., new sp.

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[1] Smithsonian Institution, Washington, D. C.

[2] Entomology Research Division, Agricultural Research Service, U.S.D.A.

Ocelli prominent, well developed; antennae much shorter, segments I–III each shorter than transocular width, IV subequal to width across eyes (60 : 54); abdominal tergites and connexival segments without flavous markings. Length 3.75–4.00 mm. United States (west of Missouri River) (Tribe Macroveliini, McKinstry, 1942) (Fig. 2) .... *Macrovelia hornii* Uhler (1872)

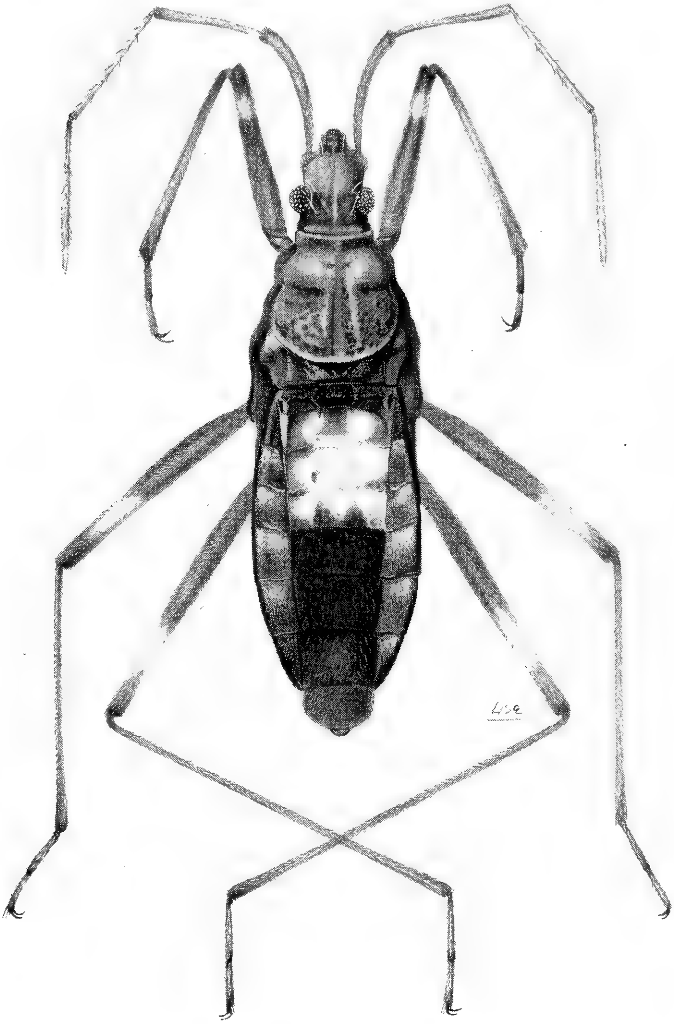

FIG. 1. *Oravelia pege*, n. sp. (holotype).

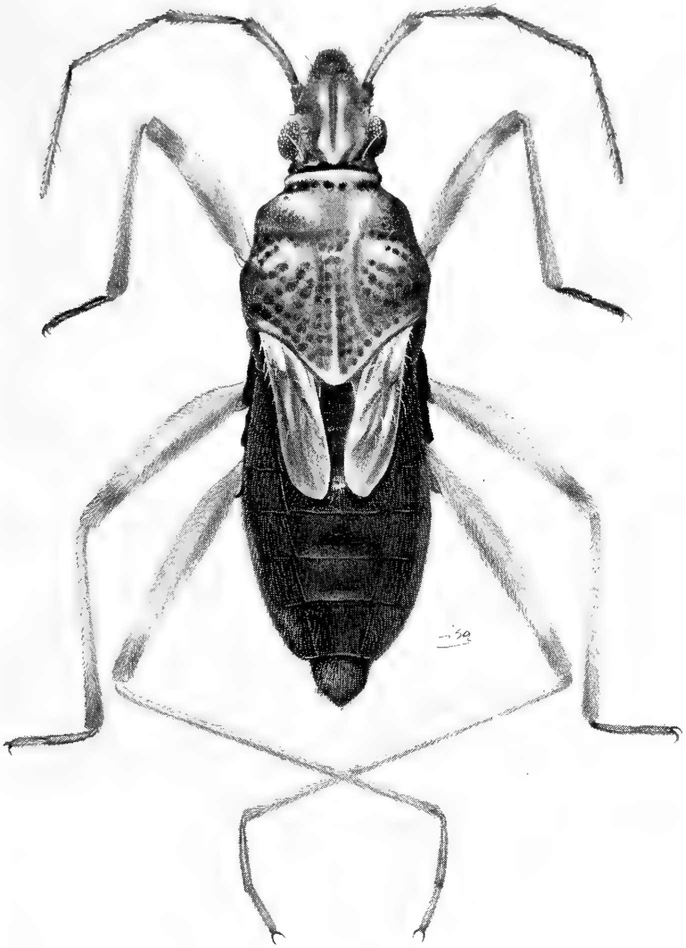

FIG. 2. *Macrovelia hornii* Uhler.

Oravelia, new genus

Apterous form: Elongate, three times as long as wide. Head very long, longitudinally sulcate, porrect, feebly curved downward in front of eyes, twice as long in front of eyes as transocular width, with three pairs of trichobothrial hairs; postocular space about half as long as the length of an eye; anteocular space three times the length of an eye; interocular space slightly greater than twice the width of an eye; ocelli absent; buccal sulcus wanting. Antennae long, slender, segments I and II slightly thicker than apical two; I and III nearly subequal, each longer than II; IV longest. Labium long, slender, feebly bowed; segment I short, much thicker and slightly longer than II; III longest, swollen at base, then gradually tapering to apex, more than twice as long as IV.

Pronotum very wide, long, lobate, produced backwards, extending over almost all of meso- and metanotum, clearly divided across the middle into front and hind lobes; collar raised, short, impunctate, ridgelike, set off from front lobe of pronotum by a narrow cross-furrow; front lobe wide impunctate, slightly shorter than hind lobe, distinctly separated into right and left divisions by a wide, median, lengthwise impression, with a pair of large pits (1+1) in the bottom of the depression midway between the tumescent divisions; median longitudinal carina vague, lying in the bottom of the lengthwise depression, extending from the collar backward to base of pronotum; hind lobe large, coarsely rugosely punctate, broadly rounded behind, with rear and lateral margins carinate. Mesonotum very short, wide, rectangular. Metanotum shorter than mesonotum, nearly rectangular, with backward projection of hind margin short, rectangular, and occupying about the middle third of hind border.

Legs long, slender, without spines or other armature; femora only slightly swollen, the hind pair with apices slightly surpassing tip of last genital segment. Tarsi composed of three segments: segment I very short; II long, slightly longer than III; claws paired, symmetrical, apical, situated adjacent to each other, often appearing as a single claw. Rostral sulcus set off on meso- and metasternum by paired longitudinal ridges, which are slightly divergent posteriorly and become obsolete behind middle of metasternum. Metasternal omphalium well developed, openings of scent glands paired, contiguous inward, placed at middle of rear side; ostiolar canal shallow, very narrow, running across hind face just beneath ostiolar openings, then arcuately curving forward and outward on each side, imperceptible on either metapleuron.

Abdomen broad, long, more than twice as long as wide, gently tapering backwards; tergites 2–4 each with a pair of longitudinal ridges divergent posteriorly, each ridge concave on inner side; laterotergites wide, reflexed obliquely upward, distinctly sutured off from one another and from abdominal sternites; connexival segment VII not prolonged rearward.

Macropterous and brachypterous forms unknown.

Type species: *Oravelia pege*, n. sp. (Fig. 1).

This genus is allied to *Macrovelia* Uhler but is easily distinguished from it by the lack of ocelli, much longer legs and antennae.

The absence of short- and long-winged forms in *Oravelia* and of the apterous form in *Macrovelia* makes it impossible to collate alary and pronotal structures between the genera. The extremely short, sharply declivous head and position of the compound eyes separate at once *Ocellovelia* China and Usinger, of South Africa, from the macroveliines.

The ocelli are very distinct in *Macrovelia* and *Ocellovelia*, but absent in *Oravelia.*

Oravelia pege, new species
(Figs. 1, 3a, b, c, d)

Apterous form: Large, chocolate-brown, with a prominent spot on upper and a smaller one on lower sides of laterotergites II–VII, space between paired longitudinal ridges (sometimes entire segment) of abdominal tergites II–IV, coxae and trochanters of all legs, usually also abdominal sternites II–IV, and a wide subapical band on each femur flavous. Inferior side and basal half above middle and hind femora somewhat yellowish. Antenna dark brown with inferior side of segment I pale brown. Length ♂ 5.25 mm, ♀ 5.56 mm; width ♂ 1.25 mm, ♀ 1.55 mm.

Head very long, porrect, twice as long as wide, interocular space three times as wide as depth of an eye; median longitudinal furrow moderately wide, with one to two rows of tiny pits in its bottom; V-shaped impression at base of vertex pitted, becoming obsolete before reaching anterior margin of interocular space.

Antennae very long, slender, shortly pubescent; measurements: segment I, 1.12 mm; II, 0.90 mm; III, 1.15 mm; IV, 1.25 mm (all segments longer than transocular width, 0.78 mm). Rostrum long, slender: segments I and II very short, together about one-third as long as IV; III two and one-half times as long as IV (0.94 mm : 0.38 mm).

Pronotum 1.05 mm long, divided crosswise near the middle into fore and hind lobes of about equal size; collar short, truncate in front, ridge-like, deeply furrowed back of collar, coarsely pitted in bottom of furrow; median longitudinal ridge barely indicated; fore lobe swollen, impunctate, divided by a wide longitudinal impression into right and left divisions of equal size; hind lobe slightly longer than fore lobe, very coarsely punctate, with rugosity of surface frequently appearing like short broken ridges; hind and lateral margins jointly rounded, ridged.

Legs very long, slender, without armature, hind femora extended backwards with their apices projecting beyond tip of last genital segment. Fore femur 1.75 mm long; tibia 1.80 mm; tarsal segment I, 0.06 mm; II, 0.38 mm; III, 0.30 mm. Middle legs: femur 2.25 mm long; tibia 2.37 mm; tarsal segment I, 0.06 mm; II, 0.45 mm; III, 0.35 mm. Hind legs: femur 2.55 mm long; tibia 3.50 mm; tarsal segments I, 0.06 mm; II, 0.50 mm; III, 0.37 mm. Metasternal omphalium prominent, with ostioles of metathoracic scent glands paired, placed on hind ledge.

Abdomen long, broad, tergites slightly tapering posteriorly; abdominal scent gland openings placed on tergite IV slightly behind middle of segment; laterotergites wide, suberect, widest at middle, entire outer margin on each side gently convexly rounded. Male genital segments small; segment VIII beneath transversely convexly impressed; IX with parameres and aedeagus (anal lid removed) as in figures 3a–d. Female slightly stouter than male.

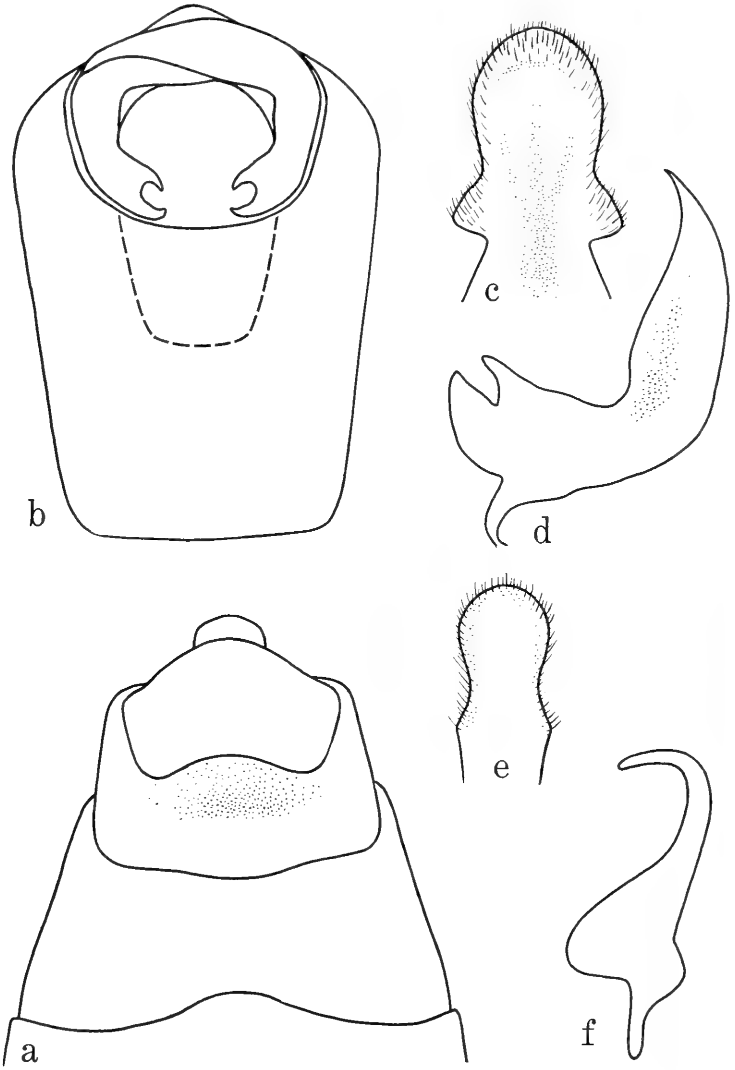

FIG. 3. *Oravelia pege*, n. sp.: a) ventral aspect of ♂ sternite VII and genital segments; b) dorsal aspect of segment IX showing parameres and aedeagus; c) anal lid; d) left ♂ paramere *Macrovelia hornii* Uhler; e) anal lid; f) left ♂ paramere.

Holotype ♂ *and allotype* ♀: Both apterous, Tollhouse, Fresno Co., Calif., 16 October 1962, Drake Coll. (USNM).

Paratypes: 8 ♂♂ and 20 ♀♀, collected with type; also 30 ♂♂ and

32 ♀♀ taken near the same spot as holotype, 1 October 1962, in collections of U. S. National Museum, California Academy of Sciences, University of California, and Southern California Academy of Sciences (Los Angeles).

The type specimens of *O. pege* were collected along the shore of a small intermittent stream (dry creek), elevation 1,600 feet, in the foothills of Sierra Nevada, near highway 168, between 2 and 3 miles southwest of Tollhouse, Calif., by H. C. Chapman. The first lot of specimens were secured by diligently searching cracks and fissures in the basal section of a 25-foot sheer rocky cliff on the shore of the creek. The face of the craggy cliff is kept constantly wet by water always oozing out of interstices of the rocks and trickling downward slowly over the rugged face into the creek. Some specimens were also taken at the same time, secreted under rocks, leaves, and other moist debris on the ground at the foot of the cliff.

In collecting a short distance upstream, several individuals were flushed off the steep bank a little above the edge of the water. Several specimens were also found on the underface of overhanging rocks above a temporary pool along the creek. In every instance, the water-striders were always found in deep shade by means of a flashlight. Unless prodded or otherwise disturbed, the specimens remained quiet in the crevices of the rocks and on the steep bank above the edge of the stream.

Genus *Macrovelia* Uhler

Macrovelia Uhler 1872, p. 422.—Kirkaldy and Torre-Bueno 1896, p. 207. —China and Usinger 1949, p. 350.

This monotypic genus is represented by *M. hornii* Uhler. It can be separated from *Oravelia* by the structures employed in the key. The ocelli are well developed, and the opening of the abdominal scent gland is situated on the median line behind the middle of tergite IV. The apterous form is unknown.

Macrovelia hornii Uhler

(Figs. 2, 3e, f)

Macrovelia hornii Uhler 1872, p. 422; 1876, p. 334; 1894, p. 289.—Gillette and Baker 1895, p. 62.—Kirkaldy and Torre-Bueno 1896, p. 207. —Van Duzee 1916, p. 44.—McKinstry 1942, pp. 90–96.—China and Usinger 1949, p. 350.—Usinger 1956, p. 219, fig. 7:34.

Moderately large, elongate, reddish or fulvous brown with varied markings of flavous and fuscous; antenna yellowish testaceous with terminal segment slightly fuscous. Opening of abdominal scent gland on median in front of middle of tergite IV. Legs yellowish with apical part of femur more or less fuscous. Hemelytron with a few white spots. Length 4.00–4.50 mm, width (across humeri) 1.35 mm.

Antennae long, shortly pubescent; measurements: segment I, 0.50 mm; II, 0.42 mm; III, 0.52 mm; IV, 0.74 mm. Transocular width, 0.72 mm.

Distribution: United States—Calif., Ariz., New Mex., Ore., Utah, Colo., Nev., N. Dak., S. Dak., Neb.; Mexico: Lower California (Uhler 1894).

This species lives largely in close proximity to permanent streams, lakes, ponds, and springs. Adults and nymphs are found in mosses growing at the water's edge and beneath rocks, logs, and other debris on the shore within a few feet of the water. They are capable of walking on the surface of the water. On several occasions, we have collected them on open water among emergent vegetation and in the narrow canal formed by the overhanging vegetation along the shore line. The lectotype, macropterous ♂, "Ft. Defiance, New Mex.," is in the U. S. National Museum (No. 1140).

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PROCEEDINGS
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RECORDS AND DESCRIPTIONS OF SOME INTERESTING SPECIES OF *EUCOSMA* IN CALIFORNIA (LEPIDOPTERA: TORTRICIDAE)

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During the past few years an increasing amount of field work in the southwestern states has resulted in the accumulation of numbers of olethreutine moths for which there has been incomplete distributional data, or which appear to be undescribed. Since there evidently are no revisionary studies in progress on this group, which might incorporate such knowledge, it seems reasonable to present this information while it is assembled.

Eucosma langstoni, new species

A moderately large moth with nearly unicolorous rust-orange forewings.

Holotype male: Length of forewing 12.2 mm. *Head*—Labial palpus moderately large, second segment about one-third longer than vertical eye diameter; scales elongate, thin dorsally and ventrally, forming a roughened dorsal crest on distal half and a long, more or less appressed, ventral brush which entirely obscures the short, thin, appressed-scaled third segment; pale rust-orange, paler at base, dorsally, and anteriorly. Antenna less than one-half costal length; banded dorsally and ventrally by pale scaling; scape pale rust-orange above, whitish below. Scale tufts spreading, of elongate, thin, very pale ochreous-orange scales. *Thorax*—Dorsal scaling unicolorous pale rust-orange; shining pale tan below. Prothoracic leg dark rust-brown exteriorly, whitish interiorly, meso- and metathoracic legs paler, rust-orange exteriorly. *Forewing*—Conspicuously broadened distally, length about 2.9 times width at end of cell; costal fold less than one-third costal length, tightly appressed, enclosing a brush of about 40 stiff, dark gray hairs; costa nearly straight on basal half, only slightly curved beyond, apex rather acute, termen rather strongly angled back, broadly curved to dorsum, latter straight except near base. Ground color pale rust-orange, costal fold, fold through

PLATE I

FIGS. 1–2. Male genitalia: 1, *Eucosma langstoni* Powell, ventral aspect, aedeagus removed and figured in lateral aspect. 2, *Eucosma williamsi* Powell, ventral aspect.

cell, and veins beyond cell slightly darker, scarcely discernible to naked eye; a few scattered blackish scales beyond cell in dorsal half, not forming a pattern. Fringe whitish at base, with a median brown band, becoming rust-orange towards dorsum, and a rust-orange marginal band. Underside pale gray except costa rust-orange, fringe as above. *Hindwing*—About one-fourth broader than forewing; costa rather strongly excavate on distal half, apex rounded, termen and dorsum slightly convex. Pale gray above, the hair tufts whitish. Fringe broad, whitish, with subbasal and marginal grayish bands. Underside a little paler, faintly orangish towards apex. *Abdomen*—Shining pale tan dorsally, pale rust-orange ventrally including the relatively sparse genital tuft. Genitalia as in Fig. 1 (drawn from paratype, JAP prep. No. 1197; two preparations examined).

Allotype female: Length of forewing 11.0 mm. Eessentially as described for male, color throughout paler. Labial palpus with elongate, thin scales more diffuse, no distinct elongate, appressed, ventral brush, third segment not entirely obscured. Forewing broader basally, costa gently curved on basal third, nearly straight beyond, length about 3.0 times width. Ground color brighter rust-orange, veins scarcely darker, no scattered black scales. Underside very pale grayish, costal area in outer third and fringe pale rust-orange. Hindwing above very pale gray, below whitish, apical area, fringe and veins beneath faintly tinged with pale rose-orange. Abdomen pale, faintly tinged with orange above and below; a well-developed tuft of broad, dark ochreous, amber-appearing scales ventrally; genital tuft otherwise of normal scales. Genitalia as in Figs. 3, 4 (drawn from paratype JAP prep. No. 1442; two preparations examined); papillae anales with median anterior portion folded outwardly, posterior portion flap-like, densely clothed with elongate, curved setae; sterigma a simple plate, setate; seventh abdomnial sternite with a dark, sclerotized region produced anteriorly into lateral lobes; ductus bursae with two weakly sclerotized patches; signa well developed, hornlike.[1]

Holotype male and allotype female, Pozo, San Luis Obispo County, Calif., 3 May and 27 April 1962, respectively, collected at light (J. Powell), deposited in the California Academy of Sciences. Three male and four female paratypes, same data, 27 April to 5 May (R. L. Langston & J. Powell), deposited in the California Insect Survey collection and U. S. National Museum.

Taxonomic discussion: Length of forewing of paratypes, males 11.5 to 12.2, females 10.7 to 11.0 mm. Color variation similar to that of the holo- and allotypes. No males are darker than the holotype, but one female is, having a slight infusion of dark brownish scales beyond cell, a few blackish scales, the dark fringe bands, and the hindwing grayish. One female is paler than the allotype, with the forewings having the orange brighter, appearing almost as a diffuse reticulated pattern on a pale ground, and with the hindwings white.

According to the male genitalia, the species belongs to the agricolana group, members of which are superficially wholly unlike *langstoni*; and it seems closest to *E. heathiana* Kearfott (Manitoba to New Mexico) which has whitish forewings with a diffuse dark dorsal blotch. Other related species are generally smaller moths with pale tan to brownish forewings indistinctly marked with white lines or are silver marked.

Eucosma williamsi, new species

A large moth having whitish forewings heavily mottled with shades of gray and brown.

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[1] Unfortunately, female genitalia of only a few of the 150-odd species of North American *Eucosma* have been illustrated. Thus, at the present time there is little value in presentation of these characters with regard to comparison to related forms. Although obvious differences exist, it cannot be stated whether the female genitalia will offer diagnostic characters within closely related species groups.

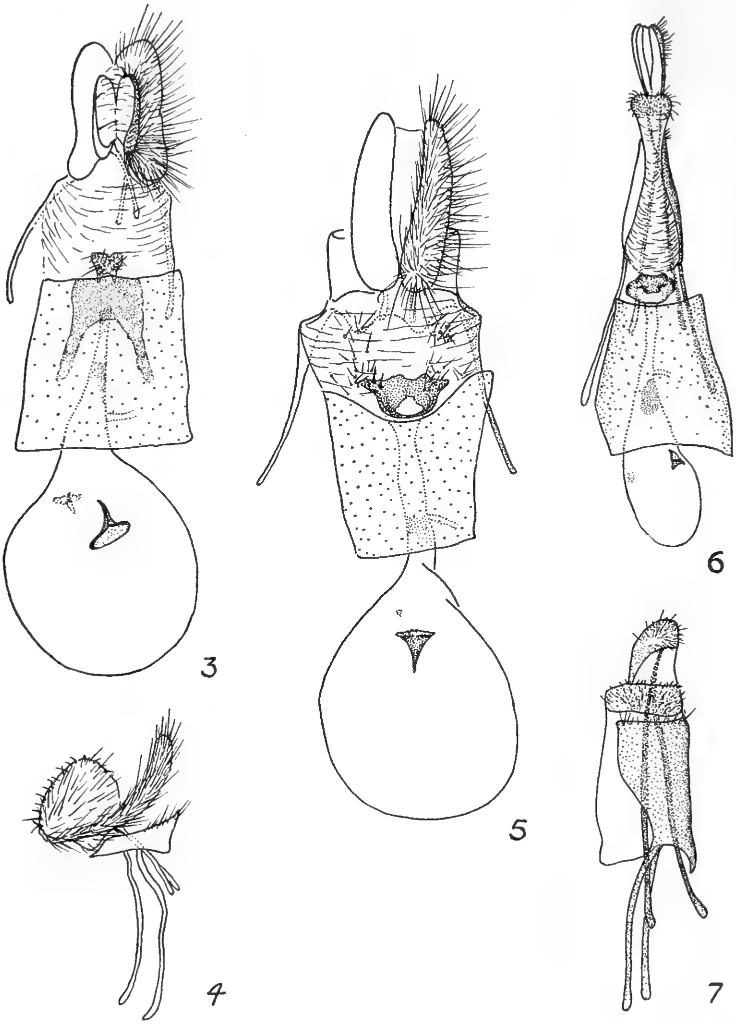

PLATE II

FIGS. 3–7. Female genitalia: 3, 4, *Eucosma langstoni* Powell: 3, ventral aspect; 4, lateral aspect of segments VIII–X. 5, *Eucosma williamsi* Powell, ventral aspect. 6, 7, *Eucosma hohana* Kearfott: 6, ventral aspect; 7, lateral aspect of segments VIII–X.

Holotype male: Length of forewing 11.3 mm. *Head*—Labial palpus broad, short, second segment length about equal to vertical eye diameter; scaling elongate, broadly spreading distally into a truncate tuft, produced below and almost entirely obscuring third segment; dark brownish-gray exteriorly, the scales paler at their bases and narrowly tipped with white; pale interiorly; third segment small, pointed, appressed-scaled, purplish. Antenna weakly scaled dorsally, pale brownish; scape and basal few segments scaled, purplish. Scaling of head dense, elongate, strongly directed mesad; the scales dark brownish gray, reflecting purplish apically, pale basally. *Thorax*—Collar and notum anteriorly brownish, remainder of notum white; tegulae white with intermixed gray scales; metanotum unscaled anteriorly, with broad white scales and lateral hair tufts posteriorly. Underside shining whitish; legs brownish exteriorly with pale tibial and tarsal bands; metathoracic leg paler. *Forewing*—Broad, length about 2.5 times width; costal fold appressed, narrow, short, extending along basal one-fourth, enclosing a brush of about 50 white, hairlike scales and an imbricate row of small, narrow, white scales along middle portion of fold, below vein Sc; costa straight beyond, termen concave, rather sharply angled at tornus. Whitish, heavily marked with indistinct brownish and grayish as follows: basal area to one-fourth grayish with a few short blackish strigulae; a broad median area of ground color heavily clouded with transverse gray strigulae, becoming a well-defined broad band in dorsal half; a large dark brownish dorsal spot follows just before tornus, the most contrasting marking of the wing; apical area indistinctly clouded with grayish and pinkish scales, in part forming shining, transverse strigulae and enclosing an ill-defined subapical blackish mark; fringe of intermixed pinkish and gray scales. Underside dark gray-brown, reflecting purplish; paler dorsally; costa with a series of whitish marks. *Hindwing*—Slightly broader than forewing, costa slightly emarginate before apex; termen concave, broadly curved with dorsum. Dark brown, slightly paler basally; fringe scales with a whitish median band and narrowly tipped with white. Underside similar with some whitish strigulae in apical area. *Abdomen*—Dorsum whitish basally, following segments successively darker grayish with posterior whitish bands; underside shining whitish; genital tuft moderately conspicuous and spreading, shining whitish. Genitalia as in Fig. 2 (drawn from paratype, Pleasant Hill, JAP prep. No. 809; three preparations examined).

Allotype female: Length of forewing 13.8 mm. Essentially as described for male; in general paler, the forewing markings more distinct and contrasting on a white ground. Costal fold lacking, costa gently curved on basal half, straight beyond. Hindwing paler than in male, underside strongly clouded with whitish. Genital tuft not spreading, purplish ventrally. Genitalia as in Fig. 5 (drawn from paratype, Pleasant Hill, JAP prep. No. 1444; two preparations examined); papillae anales simple, densely clothed with elongate setae; sterigma broad, funnel-like, setate laterally; ductus bursae with a lightly sclerotized patch near corpus bursae; dorsal signum minute.

Holotype male: Leona Heights, Oakland Hills, Alameda County, California, 26 July 1909 (F. X. Williams) [reared from larvae collected February 1909 in stems of *Baccharis pilularis*]; and allotype female, Hastings Natural History Reservation, near Jamesburg, Monterey County, California, 23 July 1959 (D. D. Linsdale) deposited in the California Academy of Sciences, San Francisco; 70 paratypes, all California, as follows: *Napa Co.*: St. Helena, 1 ♀ 27 Aug. 1935 (E. C. Johnston). *Contra Costa Co.*: Orinda, 1 ♂ 16 Aug. 1952 (R. L. Langston); Pleasant Hill, 9 ♂, 1 ♀ 8–11 July 1959, 2 ♀ 1 Aug. 1959, 1 ♂, 2 ♀ 1, 4 Aug. 1960 (W. E. Ferguson). *Alameda Co.*: Berkeley, 1 ♂ 1 July 1931 (D. Meadows), 1 ♀ 29 Aug. 1954, 1 ♀ 29 June 1959, 1 ♀ 7 July 1959 (R. L. Langston); Leona Heights, Oakland Hills, 1 ♂ 10 July 1909, 1 ♀ 26 July 1909, 1 ♀ 31 July 1909, 1 ♂ 3 Aug. 1909 (F. X. Williams). *Santa Clara Co.*: Stanford, 1 ♀ 29 July 1947 (J. W. Tilden); Los Gatos, 8 ♂ 1–15 Aug. 1933 (J. A. Kusche), 1 ♂, 1 ♀ 25 July 1942, 2 ♀ 30 Aug. 1942, 2 ♂ 12 Sept. 1942 (G. E. Pollard); 12 mi S Los Gatos, 1 ♂ 29 Aug. 1959 (D. C. Rentz); Alma, 1 ♂ 5 Sept. 1944, 1 ♀ 2 July 1946 (G. E. Pollard). *Santa Cruz Co.*: Santa Cruz, 2 ♂, 1 ♀ 8 Aug. 1939 (J. W. Tilden); "Santa Cruz Co.," 1 ♀ 17 July 1935 (J. W. Tilden). *Monterey Co.*: Carmel, 1 ♀ 23 Aug. 1938 (L. S. Slevin); Bixby Canyon, 1 ♀ 7 Aug. 1947 (J. W. Tilden); Hasting's Reservation near Jamesburg, 2 ♂ 17–30 July 1949, 1 ♂ 23 July 1959 (D. D. Linsdale); 3 ♂ 23 July to 20 Aug. 1954 (B. S. Davis); Paradiso Hot Springs, 1 ♂, 1 ♀ 15 July 1954 (O. & L. Bryant); 10 mi S Big Sur, 1 ♀ 20 Aug. 1948 (C. I. Smith). *Ventura Co.*: Ventura, 1 ♂ 7 Aug. 1936, 1 ♀ 16 July 1944 (C. W. Kirkwood); Ventura River, 1 ♂ 4 June 1945, 1 ♂ 26 July 1945, 1 ♀ 9 Aug. 1946 (C. W. Kirkwood). *Riverside Co.*: Rancho La Sierra, Arlington, 1 ♀ 23 July 1941, 1 ♂ 30 July 1941 (F. H. Rindge), 1 ♂ 1 July 1949, 1 ♀ 6 Aug. 1949 (A. H. Rindge). *San Diego Co.*: San Diego, 1 ♂ 30 July 1931 (no further data); "San Diego Co.," 2 ♂ 9 Sept. 1921 (E. Piazza). Paratypes deposited in the collections of American Museum of Natural History, British Museum, California Academy of Sciences, California Insect Survey, California State Department of Agriculture, Canadian National Collection, R. L. Langston, Los Angeles County Museum, San Diego Museum of Natural History, J. W. Tilden, and U. S. National Museum.

The following additional material has been studied but not designated as paratypic due to incomplete condition of data or specimens. *Santa Clara Co.*: "Santa Clara, Calif.," 1 ♀ (no further data); Alma, 1 ♂ 13 July 1944 (G. E. Pollard). *Monterey Co.*: Salinas River near King City, 3 ♂ 12 June 1937 (M. L. Walton). *Ventura Co.*: Ventura River, 1 ♀ 14 Aug. 1933, 1 ♀ 6 July 1944, 1 ♂ 2 July 1945 (C. W. Kirkwood). *Riverside Co.*: Palm Springs, 1 ♂ 20 Oct. 1940 (F. H. Rindge). *County unknown*: "California," 1 ♀ "7873," "No. 14 676, collection Hy. Edwards."

Taxonomic discussion: Forewing length range of paratypes—males, 9.8 (reared) to 12.4; females 11.2 to 14.0 mm. The wing color is variable, but the pattern and general appearance are constant. The white is replaced by vertical gray strigulae to a greater or lesser degree, resulting in darker or paler specimens. At times the outer dorsal and apical spots are more heavily scaled with black. A male from Palm Springs has a very washed-out appearance, being pale and without dark markings. The genitalia are not distinguishable from typical *williamsi*, however.

The species appears to be most similar to *E. denverana* Kearfott in structure of the male genitalia. However, it seems most closely related to *E. eburata* Heinrich in general appearance, having a similar but darker color pattern. In addition to color, it differs from *eburata* by having the valva rather strongly constricted and by a more produced uncus. *E. williamsi* is superficially similar to *Epiblema carolinana* (Walsingham) and specimens have been confused with the latter in collections. Specimens were also found in the California Academy of Sciences and U. S. National Museum bearing a "TYPE" label and manuscript name of Kearfott.

Biology: The species was reared from *Baccharis pilularis* (Compositae) in 1909 by F. X. Williams. With the exception of a penciled label, "ex Baccharis," on one female, the specimens bear no biological data; but notes on the collection appear in Williams' 1909 notebook[2] and were correlated through the emergence dates. Collections of Baccharis stems were made on 14 and 22 February 1909, and the "rather small, very sluggish" larvae were in the base of the plants. Williams noted the affected plants were "not particularly healthy." In May he observed that a larva had lined its gallery (presumably with silk) and, along with several other larvae, it had prepared an emergence hole. The exit apertures were closed with wood dust and chips. Adults emerged from 7 to 26 July. Subsequent collection records, based on adults of both sexes taken at lights, indicate that a similar emergence period occurs throughout the range.

I take pleasure in naming the species for Dr. F. X. Williams, dean of American insect biologists, who wrote on 22 February 1909, "Went out especially to obtain this borer, was moderately successful."

Eucosma biplagata (Walsingham)

Paedisca biplagata Walsingham, 1895, Trans. Ent. Soc. London, 1895: 507.

This large species with straw yellow forewings was described from north central Colorado. Walsingham gave the type locality as "Loveland, 10,000 ft," but Loveland itself is located at only about 5,000 feet elevation; and subsequent records have not represented boreal regions. Heinrich (1923) recorded it from Pullman in eastern Washington, and the U. S. National Museum also has specimens from nearby Walla Walla.

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[2] Deposited in the historical files of the Pacific Coast Entomological Society at the California Academy of Sciences and kindly made available by Hugh B. Leech.

Two other records, those of Braun (1925) "lower west slopes of the mountains" near Logan, Utah, and of McDunnough (1927) in the Seton Lake area of southern British Columbia, are in accordance. Specimens I have examined from Plumas County, California, extend the distribution to eastern California, and lend further evidence to the suggestion that the species occupies a broad range through the foothills adjacent to the Great Basin.

The California specimens are a little larger (expanse 26 to 29 mm) and show somewhat more variation in wing color than is given by Walsingham's description. The two oblique bands of the forewing tend to be a little more well developed and distinct, and either one may be somewhat sigmoid rather than straight. In addition, Walsingham reported the hindwing upperside as pale reddish brown; while the Plumas County examples have primarily gray hindwings tending towards reddish brown apically. The underside of the forewing is dark gray with a pale costa and fringe, of the hindwing white. In genitalia a California slide agrees with Heinrich's (1923) figure (Fig. 174) of a Washington specimen in nearly all respects but has a slightly less pointed uncus than his microphotograph shows.

California material examined: *Plumas Co.*: Nelson Creek, 6 ♂, 4–30 Aug. 1940 (W. R. Bauer).

Eucosma hasseanthi Clarke

Eucosma hasseanthi Clarke, 1952, Bull. So. Calif. Acad. Sci., 52: 60.

This species was described from a series of specimens reared at Orange, California, from *Hasseanthus* [= *Dudleya*] *variegatus* (Wats.) (Crassulaceae). It seems likely that this plant is *Dudleya blochmanae* (Eastwood) according to present concepts (see Munz & Keck, 1959). Clausen *et al.* (1945) treated as distinct *Hasseanthus blochmanae*, a form which had been considered a variety of *H. variegatum* by earlier authors. The latter species does not range northward as far as Orange County.

During the spring of 1962, while investigating Hydrophyllaceae for Ethmiidae, I found larvae of *E. hasseanthi* boring in the woody roots of *Phacelia ramosissima* Dougl.[3] (var. *suffrutescens* Parry) at Riverside, California.

The collection was made 13 May on the dry hills back of the Citrus Experiment Station, where exceptionally heavy rains of the current season had resulted in a tremendous growth by annual and perennial herbs, including *P. ramosissima.* Although individual plants of this species had formed large, semiprostrate bushes 10 to 12 feet in diameter, the woody portions of their roots were comparatively small, the crown extending only a few inches downward before separation into individual roots which diminished in size abruptly. The larvae were all found within the crown area in tunnels about 2.5 mm in diameter, which extended at least 4 to 6

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[3] Determined by P. H. Timberlake, Citrus Experiment Station, University of California, Riverside.

inches through the roots. Every *P. ramosissima* examined showed evidences of feeding in the form of the characteristic tubes of tightly packed, pale, sawdust-like frass; and larvae were collected in several different plants, two of which had two larvae each.

One larva, exposed by splitting the root, spun a silken shelter enclosing itself in its tunnel within 24 hours. During the course of feeding or in preparation for emergence, two larvae formed elongate tubes of silk covered with frass which projected upward from the root pieces. These tunnels, which served as emergence exits, were about 12 and 25 mm in length; in the case of the second, it extended along and through layers of paper toweling. Other individuals emerged from burrows which opened directly at the root surface. Pupae were not observed *in situ*, but not all occupied tunnels collected were opened for examination. Apparently pupation began soon after the roots were excavated, since adults emerged from 28 May to 11 June. Under field conditions probably pupation does not begin until June or July. The type series was reared in August, but the collection date was not given.

Although most North American species of *Eucosma* are thought to be root borers, very few have been reared, and some of those from only a single locality. Thus, little information is available on host specificity of individual species or species groups, and the occurrence of *E. hasseanthi* in representatives of two plant families is noteworthy. Even though the distance between the cities of Orange and Riverside is only about 40 road miles, the two represent areas of differing ecological conditions, on the coastal and east sides of the Santa Ana Mountains. *Dudleya blochmanae* in southern California is limited to the seaward foothills (Munz & Keck, 1959) and would not be expected to occur in arid, inland parts of the range of *E. hasseanthi*, such as at Riverside. In addition, the growth form of *D. blochmanae* is described as stems from a globose or fusiform corm, which should provide a somewhat different habitat for borers from the dry, woody rootstocks of *P. ramosissima*.

Eucosma hohana Kearfott

Eucosma hohana Kearfott, 1907, Trans. Amer. Ent. Soc., 33: 28.

This curious, little known species was described from Mt. Piran, Alberta and subsequently was reported by Heinrich (1923) from Paradise Valley, Mt. Rainier, Washington. Colonies which recently have been turned up in California indicate that the species is a resident of true boreal zones above climatic timberline. In the Mono Pass area of the southern Sierra Nevada and in the White Mountains, it flies in association with such Lepidoptera as *Hesperia meriamae* MacNeill (Hesperiidae) and *Catastia bistriatella* (Hulst) (Pyralidae), species which were not encountered during investigations of subtending Hudsonian Zone areas of 10,000–11,000 feet elevation.

California specimens average a little smaller than Kearfott's two types, which were given as 20–22 mm. I suspect that the latter were males, since in my material males range about 17–20 mm in wing expanse, and females about 15–16 mm. Since the original description was based on only two specimens and was somewhat superficial, the species (based on California specimens) may be further characterized as follows:

Male: Length of forewing 9.1 to 10.5 mm. *Head*—Labial palpus moderately elongate, second segment length 1.5 times vertical eye diameter, clothed by spreading scales especially ventrally, which become more elongate distally to form a broad, apical tuft which completely obscures third segment; gray exteriorly, the tuft scales blackish distally, tipped with white. Antenna less than one-half forewing length; dark, the scale bands pale gray; minutely setate. Head scaling dense, bushy, shorter on front; pale grayish, tipped with white. *Thorax*—Dorsal scales dark gray tipped with white; metanotum scales posteriorly dark gray. Underside scaling shining gray; metathoracic leg whitish. *Forewing*—Elongate, narrow at base, expanding apically, length about 3.3 times width at end of cell. Costal fold narrow, short, less than one-third costa length; costa beyond almost straight, slightly concave at middle; apex acute, termen strongly angled back, broadly curved with dorsum. Ground color whitish, tinged with ocreous; more or less evenly and lightly to heavily speckled with slate gray; the gray tending to form a series of parallel, transverse lines; a series of outer costal dashes being the only constant marks. In pale forms the ochreous overscaling combined with the grayish gives an olivaceous appearance; the gray dusting often concentrated into two more or less well-defined dorsal spots, one at basal one-third, which tends to form the margin of a basal patch, and a triangulate one just before tornus; area between these at times evident as a broad, median, paler band. Fringe gray, tipped with white. Underside pale grayish, whitish areas of upperside evident.

In male genitalia California examples compare well with Heinrich's figure (Fig. 241) of a Washington specimen, although a White Mountains male has slightly narrower, less angulate valvae.

Female: Length of forewing 6.9 to 9.4 mm. Essentially as described for male, tending to be darker, ranging to a form which is almost entirely dark gray with the whitish restricted to narrow, ill-defined bands. Costal fold lacking, costa slightly convex in basal area. Genitalia as in Figs. 6, 7 (drawn from plesiotype, Mt. Barcroft, JAP prep. 1449; two preparations examined); papillae anales rotated outward 90°, apparently forming a blade-like ovipositor; sclerotized portion of abdominal segments IX–X bearing short hook-like setae; eighth abdominal tergite elongate, laterally compressed; sterigma a concave plate; ductus bursae gradually broadened distally, bearing a broad, lightly sclerotized patch distad of ductus seminalis; ventral signum small, dorsal signum reduced to a trace.

The general grayish, speckled appearance is similar to that of granite rocks which the moths frequent. Both sexes were taken during the day amongst rocky outcroppings around the small, dry alpine meadows at Mt. Barcroft.

California material examined: *Mono Co.*: Mt. Barcroft, 12,500 ft., White Mts., 2 ♀ 5 July 1961 (D. C. Rentz), 20 ♂, 14 ♀ 21 July 1961 (D. C. Rentz and J. Powell). *Inyo Co.*: near Mono Pass, 12,000 ft., 2 ♂ 13 August 1957 (J. Powell), 1 ♀ 8 August 1961 (MacNeill, Rentz, Lundgren).

Acknowledgment is made to the following, whose cooperation enabled the use of private and institutional collections in their care: F. H. Rindge and N. S. Obraztsov, American Museum of Natural History; C. D. MacNeill, California Academy of Sciences; R. L. Langston, Berkeley, California; L. M. Martin, Los Angeles County Museum; C. F. Harbison, San Diego Museum of Natural History; J. W. Tilden, San Jose, California; and J. F. Gates Clarke, U. S. National Museum. Dr. Clarke also reviewed the manuscript and offered critical suggestions. Additional thanks are due to David C. Rentz, California Academy of Sciences, who has made special efforts to collect Microlepidoptera in my interest, despite being governed by the modes of an orthopterist.

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NOTES ON THE *ENTOMOGNATHUS* OF EASTERN UNITED STATES (HYMENOPTERA: SPHECIDAE)

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The species of the genus *Entomognathus* are among the least common of the crabronine wasps in the eastern United States. I have seen only 60 specimens of the four species occurring in this area, all of which belong to the subgenus *Toncahua* Pate. The two more common species in the Middle Atlantic States, *lenapeorum* Viereck and *memorialis* Banks, are sylvicolous forms which nest in rather heavy soil. A third species from Florida and possibly North Carolina, *arenivaga*, n. sp., occurs in open, sparsely vegetated sandy areas. The fourth species, *texanus* Cresson [= *panurgoides* Viereck, NEW SYNONYMY], ranges from Texas to Kansas and also has been taken in Pennsylvania; its habitat preferences are not known.

Nothing is known about the prey preferences of any of our Nearctic species. Perhaps they prey on adult halticine Chrysomelidae, as do certain of their Palaearctic congeners which belong to the typical subgenus. Presumably our species visit honeydew secretions of various insects for food. At least many of the specimens of *lenapeorum* and *memorialis* are labeled as having been taken on honeydew secretions and on oak foliage. However, one male of *memorialis* was collected on *Chrysanthemum Parthenium* Pers., which it may have visited for nectar.

The following key will separate the four species of *Entomognathus* (*Toncahua*) occurring in the eastern United States.

1. Large species (♀♀, 6.1–8.4; ♂♂, 5.5–7.3 mm); pale body markings lemon yellow; mesopleural disk not margined anteriorly by a vertical carina nor by a foveolate groove; posterior margin of only fourth and fifth terga shallowly emarginate in middle; a large,

shallow, oblique, supraorbital fovea present; Kansas south to Mexico (Tamaulipas), Pennsylvania .... *texana* Cresson

Smaller species, ♀♀ not over 6.8 and ♂♂ not over 5.2 mm long; pale body markings ivory or whiter; mesopleural disk margined anteriorly by a vertical carina behind which is a foveolate groove; posterior margin of third to fifth terga shallowly emarginate in middle 2

2. Smaller species (♀, 3.7; ♂♂, 3.4–3.7 mm), occurring on sparsely vegetated, sandy areas in Florida and possibly North Carolina; propodeum dull, the posterior surface punctate laterad of median cuneate impression; mandible yellow at base, light red at apex; tarsi pale yellow; male with a short lateral ridge or elongate tubercle on sixth tergum, and third to fifth sterna with a transverse row of coarse, confluent pits, female with one blunt lateral tooth on median lobe of clypeus .... *arenivaga*, new species

Larger species (♀♀, 5.3–6.8; ♂♂, 4.2–5.2 mm), occurring in open wooded areas with heavy soil, Connecticut or New Jersey to Virginia, Kansas; propodeum shining, the posterior surface more or less irregularly rugulose reticulate on lateral areas, occasionally with a few scattered small punctures; mandible usually black at base, dark brown to dark red at apex, occasionally yellow subbasally; tarsi infuscated entirely or in part; male without ridge or tubercle laterally on sixth tergum, and without such rows of pits on sterna; female with two acute lateral teeth on median lobe of clypeus 3

3. Slightly smaller (♀♀, 5.3–5.5; ♂♂, 4.5–4.8 mm), the punctation relatively coarser and denser, particularly on mesopleuron and first two terga; fovea near upper inner margin of compound eye well developed, lenticular in outline; pronotal lobe in anterior aspect angulate laterally. FEMALE: Creamy markings as follows—scape beneath, pronotal tubercle, fore and mid tibiae except beneath, fore basitarsus above, and basal two or three segments of mid and hind tarsi. MALE: Fore basitarsus strongly flattened, its apical width 0.5 the length, the posterior margin curved; mid basitarsus noticeably thickened on apical half when viewed from the front; creamy markings as follows—scape beneath, fore tibia with a stripe above, mid tibia with a narrower stripe on basal two-thirds, all basitarsi above and sometimes second segment of hind tarsus .... *lenapeorum* Viereck

Slightly larger (♀♀, 5.5–6.8; ♂♂, 4.2–5.2 mm), the punctation relatively finer and sparser; supraorbital fovea obsolete; pronotal lobe in anterior aspect rounded laterally. FEMALE: Creamy markings as follows—scape beneath, pronotal collar except in middle, pronotal tubercle, base of tegula, a pair of rounded lateral spots on scutellum, paired posterolateral oval spots on first four terga, fore femur at apex in front, fore tibia except beneath, stripe on outer surface of mid tibia, and hind basitarsus above at base. MALE: Fore basitarsus not so strongly flattened, its apical width 0.3 the length, the posterior margin straight; mid basitarsus not abruptly thickened on apical half; creamy markings as follows—scape beneath, lateral spots on pronotal collar, pronotal tubercle, base of tegula, paired posterolateral oval spots on first two terga (those of second quite small) and rarely on third and fourth also, fore and mid tibiae except beneath, hind tibia above at base and along posterior margin, fore and mid basitarsi (the former above, the latter entirely), and three basal segments of hind tarsus .... *memorialis* Banks

Entomognathus (Toncahua) arenivaga, new species

? *Entomognathus* sp., Brimley, 1938. The Insects of North Carolina, p. 450.

Entomognathus (*Toncahua*), n. sp., Krombein and Evans, 1954. Proc. Ent. Soc. Wash., 56: 235 (♀; Arcadia, Fla.).

E. arenivaga is quite easily distinguished from the other two species occurring in the eastern United States by its smaller size, dull and partially punctate propodeum, entirely pale tarsi, and in its preferred habitat (sparsely vegetated, sandy areas). At the present time it is known certainly by only a short series from the banks of the Peace River at Arcadia, Florida. Undoubtedly it is more widely distributed and may be found eventually in some of the adjacent Southeastern States when the small wasp fauna is more thoroughly explored. I have seen a male from Bryson City, N. C., which may be this species, although it differs in some details. The collection data indicate that there are two or more generations annually in peninsular Florida.

Type: ♂; Arcadia, DeSoto County, Florida; 30 June 1962 (K. V. Krombein) [U. S. National Museum, Type No. 66662].

Male: Length 3.5, forewing 2.8 mm. Black, the following creamy: Basal half of mandible, antenna beneath, pronotal tubercle, spot above at apex of fore femur, outer surface of fore and mid tibiae, base of hind tibia, and all tarsi. Apical half of mandible, tegula, narrow apical margins of first five terga, and last abdominal segment entirely, light red. Wings slightly infumated, stigma and veins brown.

Head shining, dense, appressed silvery hair on lower sides of face and on clypeus except just above apex of median lobe, the rest of head with short cinereous vestiture which is appressed on temple, erect on eyes, front and vertex; apical margin of median lobe of clypeus slightly rounded and with a small, blunt lateral tooth; lower half of face with fine dense punctures laterally, impunctate on a narrow median strip; upper part of face with delicate punctures mostly separated from each other by two to three times the diameter of a puncture; supraorbital fovea obsolete; ocelli in a low triangle, the ocellocular distance 0.8 times the postocellar distance; vertex with minute, more scattered punctures; temple with minute, denser punctures; flagellum short, moderately clavate toward apex, none of segments modified.

Thorax shining except propodeum dull, the vestiture sparse, short, cinereous, erect on dorsum, decumbent on sides; pronotum not carinate anteriorly or on tubercle; scutum with irregularly scattered, small punctures, separated from each other by two to five times the diameter of a puncture; scutellum sparsely punctate, anteriorly with a deep, moderately broad foveate groove; postscutellum anteriorly with a narrower, shallower foveolate groove; mesopleuron anteriorly with a sharp carina behind which is a foveolate groove, episternal suture foveolate as is a vertical groove along posterior margin, the surface elsewhere with scattered, minute punctures and without a tubercle or carina before mid coxa; metapleuron with rather dense, minute punctures, margined posteriorly by a foveolate groove; propodeum short, dorsal surface in middle with a rectangular areole on each side of which are small irregular areoles; posterior surface with a median, more or less cuneate areole, on each side of which the surface is punctate and crossed by a few weak, transverse rugulae; lateral surface granulate, with longitudinal rugulae posteriorly.

Legs essentially unmodified, the fore tarsus flattened but not widened.

Abdomen shining, vestiture sparse, short and mostly appressed, apical margins of third to fifth terga arcuately emarginate in middle, those of fourth and fifth more noticeably so; first and second terga with fine punctures separated by two to three times the diameter of a puncture, the third and fourth terga with more scattered punctures; fifth tergum with punctures a little larger and closer; sixth and seventh terga with coarse, subcontiguous punctures, the sixth with a short lateral ridge, the seventh with a marginal carina; second sternum with moderately large punctures mostly separated by one to two times the diameter of a puncture; third to fifth sterna each with a transverse row of coarse, confluent pits across middle.

Allotype: ♀; Arcadia, Florida; 2 April 1953 (W. R. M. Mason) [Canadian Dept. Agr.].

Female: Length 3.7, forewing 3.0 mm. Color and vestiture as in male.

Head the same as in male, but with a narrow, sublunate supraorbital fovea; clypeal lobe with only one blunt lateral tooth.

Thorax the same but median rectangular areole of propodeal dorsum crossed by several weak rugulae.

Anterior tarsi without a comb.

Abdomen in general the same as in male, but pygidium with sides forming an angle of about 30° at apex, the surface with coarse, contiguous punctures and suberect setulae, and pits on sterna weaker, present only on third and fourth.

Paratypes: 3 ♂♂; same locality as type, but one each on 2, 3, and 4 July 1962 (K. V. Krombein). The paratypes range in length from 3.4 to 3.7 mm and are otherwise identical with the type. In addition, I have seen a male from Bryson City, North Carolina, 20 August 1923 (J. C. Crawford) [N. C. Dept. Agr.], which may be this species. It agrees in all respects with the Florida males except that the mandible is dark at base, the pronotal disk has a tiny, lateral pale spot, and the sixth tergum lacks the lateral tubercle or ridge.

Entomognathus (*Toncahua*) *lenapeorum* Viereck

Entomognathus lenapeorum Viereck, 1904. Trans. Amer. Ent. Soc. 30: 239 (♀; Lehigh Gap, Pa.; type in Academy of Natural Sciences, Philadelphia).—Cresson, 1928. Mem. Amer. Ent. Soc. 5: 54.—Krombein, 1951. Ann. Ent. Soc. Amer. 44: 143 (♀, ♂; Dunn Loring, Va.).

Entomognathus (*Toncahua*) *lenapeorum* Viereck, Krombein *in* Muesebeck *et al.*, 1951. U. S. Dept. Agr., Agr. Monogr. 2: 1013.—Leclercq, 1954. Monogr. Crabroniens, p. 203.

This species and *memorialis* are obviously closely related and quite distinct from *arenivaga*. *E. lenapeorum*, as compared with *memorialis*, is a slightly smaller, somewhat less maculated species and has a well-developed supraorbital fovea. The pale markings vary less than in *memorialis*, possibly because fewer specimens are available. The tarsi are all dark in one female, and another female has a small, pale, posterolateral spot on the first tergum. The male from Kansas has a small pale spot on the pronotal tubercle.

The available label data indicate that *lenapeorum* is double-brooded. Banks captured a male on May 30, and my series from Dunn Loring probably emerged just a few days before the dates of capture in early September.

Specimens examined: 10 ♀♀, 5 ♂♂, with the following data.

New Jersey: 1 ♀; Glassboro; 12 August 1942 (W. F. Rapp) [USNM].

Pennsylvania: 1 ♀; Lehigh Gap, 29 June 1901 [ANSP, the type]. 1 ♀; Hazelton; September 1896 (W. G. Dietz) (= Baker #, Pa. 2071) [USNM].

Maryland: 2 ♀♀, 2 ♂♂; Takoma Park; 20 June (♀) and 9 August 1942 (♀, 2 ♂♂) (H. and M. Townes) [HKT, KVK]. 1 ♀; Glen Echo; 30 August 1923 (J. R. Malloch) [USNM].

Virginia: 1 ♀; Falls Church; 30 May (N. Banks; on chinquapin) [MCZ]. 3 ♀♀, 2 ♂♂; Dunn Loring; 4 (♀♀) and 5 (♂♂) September 1949 (K. V. Krombein; visiting honeydew secretions of *Toumeyella liriodendri* (Gmel.) on foliage of *Liriodendron tulipifera* L. at edge of woods) [KVK].

Kansas: 1 ♂; Clay Co.; August 1901 (J. C. Bridwell) [USNM].

Entomognathus (*Toncahua*) *memorialis* Banks

Entomognathus memorialis Banks, 1921. Ann. Ent. Soc. Amer. 14: 16 (♀; Glencarlyn, Va.; type in Museum of Comparative Zoology, Cambridge).

Entomognathus (*Toncahua*) *memorialis* Banks, Krombein *in* Muesebeck *et al.*, 1951. U. S. Dept. Agr., Agr. Monogr. 2: 1013.—Krombein, 1952. Trans. Amer. Ent. Soc. 78: 95 (♀; Westmoreland State Park, Va.).—Leclercq, 1954. Monogr. Crabroniens, p. 203.

There is some variation in the extent of pale markings, but *memorialis* always has more pale markings than does *lenapeorum*. In less maculated *memorialis* females the scutellum is dark in one specimen, and the hind basitarsus is dark in two, whereas two females have a small, pale, posterolateral spot on the fifth tergum. The two males from Kansas are more brightly marked than eastern males; they have posterolateral pale spots on the first four terga. In a few less strongly marked eastern males the pale markings may be lacking on all terga as well as on the pronotal dorsum and hind tibia.

The available label data suggest that this species is definitely bivoltine in the Washington metropolitan area.

Specimens examined: 12 ♀♀, 11 ♂♂, with the following data.

Connecticut: 1 ♀; Cornwall [MCZ].

New Jersey: 1 ♂; Ramsey; 16 June 1916 (on *Chrysanthemum Parthenium pinnatifidum* Lec. and Lam.) [USNM].

Maryland: 2 ♀♀, 2 ♂♂; Plummers Island; 28 June 1958 (♂; K. V. Krombein; on oak foliage), 3 July 1921 (2 ♀♀; J. Bequaert; one nesting in ground along woodland path), and 4 July 1961 (♂; K. V. Krombein; on oak foliage) [KVK, USNM].

District of Columbia: 4 ♀♀; 26 June 1949 (D. G. Shappirio), 27 June 1944 (M. Vogel), 11 July 1916 (H. L. Viereck), and 22 August 1903 (J. C. Bridwell) [DGS, USNM].

Virginia: 1 ♀, 1 ♂; Glencarlyn, Arlington Co.; 28 June (♂; N. Banks) and 26 July (♀; type of *memorialis*; N. Banks) [USNM, MCZ]. 1 ♂; Arlington; 11 July 1954 (K. V. Krombein) [KVK]. 1 ♀, 1 ♂; Falls Church; June 1916 (J. N. Knull) [USNM] and 2 June (N. Banks) [MCZ]. 1 ♀, 3 ♂♂; Dunn Loring; 15 and 28 July 1951 (2 ♂♂; visiting honeydew of *Toumeyella liriodendri* (Gmel.) on foliage of *Liriodendron tulipifera* L.), 24 July 1949 (♀) and 26 July 1947 (♂; on leaf of *Quercus montana* Willd.) (all K. V. Krombein) [KVK]. 1 ♀; Mt. Vernon; 4 July 1917 (W. L. McAtee; on honeydew) [USNM]. 1 ♀; Westmoreland State Park; 6 July 1951 (K. V. Krombein; on honeydew of *Toumeyella liriodendri* (Gmel.) on *Liriodendron tulipifera* L.) [KVK].

Kansas: 2 ♂♂; Baldwin; 10 July and 9 August 1906 (J. C. Bridwell) [USNM].

Entomognathus (*Toncahua*) *texana* Cresson

Entomognathus texanus Cresson, 1887. Trans. Amer. Ent. Soc., Sup. Vol., p. 286 (♀, ♂; Texas; type in Academy of Natural Sciences, Philadelphia).—Fox, 1895. Trans. Amer. Ent. Soc. 22: 132.—Dalla Torre, 1897. Cat. Hym. 8: 631 (erroneously placed *E. texanus* Cr. in synonymy of *Crabro texanus* Cr.).—Cresson, 1916. Mem. Amer. Ent. Soc. 1: 103.

Anothyreus panurgoides Viereck, 1904. Trans. Amer. Ent. Soc. 30: 239 (♂, ♀ misdet.; lectotype, Lehigh Gap, Pa.; Academy of Natural Sciences, Philadelphia).—Cresson, 1928. Mem. Amer. Ent. Soc. 5: 55. NEW SYNONYMY.

Entomognathus (*Toncahua*) *texana* Cresson, Pate, 1944. Amer. Midl. Nat. 31: 341 (*texanus* cited as genotype of *Toncahua*, n. subg.).—Krombein *in* Muesebeck *et al.*, 1951. U. S. Dept. Agr., Agr. Monogr. 2: 1014.—Leclercq, 1954. Monogr. Crabroniens, p. 203.

Entomognathus (*Toncahua*) *panurgoides* (Viereck), Krombein *in* Muesebeck *et al.*, 1951. U. S. Dept. Agr., Agr. Monogr. 2: 1014.—Leclercq, 1954. Monogr. Crabroniens, p. 203.

Viereck described *Anothyreus panurgoides* from one female and one male but neglected to select a type. His description of the female (actually labeled ♂ in error in the description) is first, and is followed by the description of the male. The female is actually a specimen of what was described later as *Crabro* (*Crabro*) *juniatae* Krombein, but the male is a true *Entomognathus* and a specimen of *texana* Cresson. Viereck must have based his generic assignment of *panurgoides* on the female, and probably would have selected that sex as type had he made a selection. Viereck's assignment of a male *Entomognathus* as the opposite sex of *panurgoides* is inexplicable, particularly because of his correct generic assignment of *Entomognathus lenapeorum* on the preceding page. However, Cresson's designation of the male as lectotype of *panurgoides* makes it necessary to apply the name as I am doing here. I have seen both Viereck's lectotype and Cresson's type, and I regard them as being conspecific.

This is the only known species of *Toncahua* in which the mesopleural disk is not margined anteriorly by a sharp carina and foveolate groove. It is more brightly marked than any of the other three species treated here. The pale markings are lemon yellow as contrasted to the ivory or whiter markings of the other eastern species. Usually the clypeus has a median yellow spot, and the mandible is yellow at the base. The western specimens vary to some degree in the extent of the pale markings, but they are all more brightly marked than the male lectotype of *panurgoides* from Pennsylvania. Additional eastern material may demonstrate the desirability of recognizing the eastern population as a distinct race, *texana panurgoides*.

Specimens examined: 7 ♀♀, 9 ♂♂, with the following data.

Pennsylvania: 1 ♂; Lehigh Gap; 26 June 1901 [ANSP, the lectotype of *panurgoides*].

Kansas: 1 ♂; Clay Co. [USNM]. 1 ♀; Decatur Co., 2,560 ft. (F. X. Williams) [KU]. 1 ♂; Cowley Co., 1,114 ft.; 1916 (R. H. Beamer) [KU].

Oklahoma: 1 ♀, 1 ♂; Ardmore; 1 June 1909 (F. C. Bishopp) [USNM].

Texas: 2 ♀♀, 1 ♂; no other data (Belfrage) [ANSP, the ♀ type of *texana*; 1 ♀, 1 ♂, USNM]. 1 ♀; Progreso; 12 April 1950 (Michener, Rozens, Beamers, Stephen) [KU]. 1 ♂; 5 mi E of Riogrande; 12 April

1950 (Beamers, Stephen, Michener, Rozens; on *Quincula lobata* (Torr.)) [KU]. 2 ♀♀, 2 ♂♂; Brownsville; 19 and 25 March 1945 (1 ♀, 2 ♂♂; D. E. Hardy), and 21 June 1945 (1 ♀; on cotton) [USNM].

Mexico: 1 ♂; Victoria, Tamaulipas; 10 December (F. C. Bishopp) [USNM].

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NATURAL HISTORY OF PLUMMERS ISLAND, MARYLAND[1]

XVII. Annotated List of the Wasps (Hymenoptera: Bethyloidea, Scolioidea, Vespoidea, Pompiloidea, Sphecoidea)

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On 16 May 1902, five members of the Washington Biologists' Field Club—H. S. Barber, R. P. Currie, W. R. Maxon, J. H. Riley, and Wm. Palmer—visited Plummers Island, Maryland, in the Potomac River just above Washington, D. C. Although the only observation they made for that date in the Club register was a prosaic "river muddy," it can be assumed that it was a day of tranquil enjoyment such as our members anticipate to this day. The date is of importance in the present context, because Currie collected a queen of the common yellow jacket, *Vespula maculifrons* (Buysson). So far as I know, this was the first wasp specimen taken on the island, or at least the earliest one to be preserved in the National Museum collection.

Many of our early members had an intense interest in collecting and cataloguing the fauna and flora of the island. No wasp specialist was numbered among this group, and the insects collected most thoroughly were Coleoptera, Hemiptera, Diptera, and bees among the Hymenoptera. However, 10 members and 13 of their guests collected 303 wasp specimens plus the occupants of two yellow jacket nests between 1902 and 1923. H. S. Barber, J. C. Crawford, E. A. Schwarz, R. C. Shannon, and H. S. Viereck were the most active of this early group in collecting wasps; the others collected less than a dozen spe-

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[1] The preceding number in this series was published in Proc. Biol. Soc. Wash., 75: 237–249, 1962. Publication costs of the present number have been defrayed by the Washington Biologists' Field Club to promote its primary objective of research on the fauna and flora of Plummers Island and adjacent areas.

cies each. Remarkably, these 303 specimens represent 123 different species. No additional wasp collections are known until my own efforts from 1956 through 1963, which resulted in the collection or rearing of 245 species. Altogether, a total of 274 species is now known from the island.

The early collecting was not thorough enough to enable me to detect any definite successional changes, such as are apparent in the flora of Plummers Island. Later collections include 100 of the 123 species taken by earlier workers. However, many of the 23 species which I did not capture are quite small and probably with rather obscure habits; some of the others may have been strays and not representatives of actual populations breeding on the island.

BIOLOGICAL STUDIES

Little attention was given to field studies of wasp biology in the early years. Barber in 1908 reared several specimens of *Trypoxylon politum* Say from the clay, "pipe organ" nests of this wasp, and dug up several subterranean nests of the common yellow jacket in 1912. He also reared a specimen of *Rhopalosoma nearcticum* Brues from a parasitized tree cricket, *Orocharis saltator* Uhler, collected by J. D. Hood in 1912 (Hood, 1913; recorded in error as *Rhopalosoma poeyi* Cresson).

Beginning in 1956 I carried on extensive biological studies of a number of solitary wasps. These resulted in several publications (Krombein, 1958, 1959, 1961, 1962*b*, and in press) containing short notes on the following species: *Calicurgus hyalinatus alienatus* (Smith), *Auplopus a. architectus* (Say), *Episyron q. quinquenotatus* (Say), *Tachytes crassus* Patton, *Trypoxylon pennsylvanicum* Saussure, *T. Richardsi* Sandhouse, *Mimesa basirufa* Packard, *Xylocelia virginiana* Rohwer, *Stigmus americanus* Packard, *Passaloecus annulatus* (Say), *Xysma ceanothae* (Viereck), *Podium luctuosum* Smith, *Gorytes canaliculatus* Packard, *Cerceris insolita* Cresson, *Euplilis rufigaster* (Packard), *Crossocerus planipes* (Fox), and *Oxybelus emarginatum* Say. A more extensive study is in preparation dealing with several crabronine wasps, *Ectemnius paucimaculatus* (Packard), *Crossocerus stictochilos* Pate, *Euplilis coarctata modesta* (Rohwer) and *E. rufigaster*, which breed in *Hibiscus* stems. I have also made life-history studies of a number of solitary wasps nesting in wooden borings;

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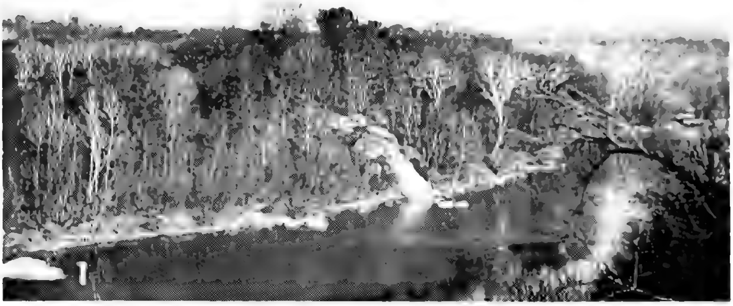
PLATE I. Fig. 1, Plummers Island looking NW from S end of Cabin John Bridge, 2 December 1962; upper (west) end of island not visible; cabin chimney just visible to left and above large rock formation (Cactus Rock) at center. Fig. 2, Cabin (Winnemana Lodge) viewed from SW, 5 May 1961; many species of wasps nest in borings in porch rafters and posts. Fig. 3, Cabin viewed from NNE, 5 May 1962; foreground left and center is nesting site of large colony of *Xylocelia virginiana* Roh.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these will be published in a separate report including results from similar studies carried on in New York, Virginia, North Carolina, Florida, and Arizona.

HABITATS

Despite its small extent (12 acres), Plummers Island offers a variety of habitats because of the varied topography, soil, and vegetative cover. The island is elongate, triangular in shape, with the attenuated eastern end pointing downstream (Fig. 1). It is a short distance above the fall line of the Potomac River and below Great Falls. The highest point is about 110 ft. above sea level and about 60 ft. above the mean low-water mark. There are several rocky bluffs, ridges, and knolls which bear varying depths of soil and a moderately open tree cover dominated by oak, hickory and hop hornbeam, among which is interspersed a rich undercover of small shrubs and herbaceous vegetation (Figs. 3, 5). At the west end is a small area of coarse, alluvial sand exposed to sunlight through most of the day (Fig. 4). Similar deposits of coarse sand occur at points along the channel separating the island from the Maryland mainland and on the entire lower end, but these areas are mostly rather shaded. There are also mud flats along the river which, like the sandy areas, are subject to annual inundation during the spring floods. The lower end of the island, which is mostly a flood-plain, is quite densely shaded by a mixture of sycamore, elm, cottonwood and pawpaw, and a variety of other trees and shrubs.

The varied soil types and the degree of shade to which each is exposed offer a variety of nesting sites for ground-nesting wasps. Wasps that nest in abandoned borings of other insects in dead wood have available a great number of nesting sites in the dead standing or fallen trees (Fig. 6) and in the cabin porch rafters and posts (Fig. 2). Other wood-nesting wasps, which bore in soft pith, find nesting sites in such plants as *Hibiscus* on the mud flats or in such shrubs as the fringe tree, *Chionanthus*. Parasitic wasps of the families Bethylidae and Dryinidae can find a number of appropriate hosts in the rich insect fauna.

There have been some marked successional changes in the vegetative cover over the years, and it is likely that there have been corresponding changes in the insect fauna, particularly in such groups as Coleoptera and Lepidoptera, which are associated more intimately with the vegetation than are the wasps. For example, early photographs show that the knoll on which the cabin stands had a number of red cedars. These died off

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PLATE II. Fig. 4, Sandy area at upper (west) end of island, nesting site of many psammophilous wasps, 6 October 1962; stand of *Hibiscus militaris* Cav. in middle distance at right in whose stems *Ectemnius paucimaculatus* (Pack.) and *Euplilis* spp. nest. Fig. 5, Open wooded slope west of cabin, 5 May 1962. Fig. 6, Wooden trap nests containing hollow borings attached to trunk of dead standing tree, 5 May 1961; many wood-nesting wasps used these traps as nesting sites at various stations on the island.

and were supplanted largely by oak and hickory, thus decreasing the amount of shade beneath and on the ground cover.

ANNOTATED LIST OF WASPS

The annotated list which follows enumerates 274 species of wasps which have been collected on, reared from, or sighted on Plummers Island. It is thought that most of these species, especially those which nest in the ground, are represented by breeding populations. However, some are undoubtedly strays which flew in from adjacent areas. The number of species represented by single specimens causes one to wonder how many species may be present that have not yet been captured. Undoubtedly, we can also expect to find additional species in the years to come as a result of three factors. One is the newly constructed circumferential highway which crosses the Potomac River just west of the island. The broad, grassy right-of-way for this highway offers an excellent avenue to the island for field-dwelling species which formerly did not penetrate the forested shores of the river. A second factor is the annual spring flooding of the Potomac which deposits a certain amount of driftwood which may contain nests of wood-dwelling species. The third is the introduction of collecting techniques not used previously on the island, such as the Malaise insect trap, which may result in the capture of species not taken by other methods.

The list is based entirely on two sources. The first was a careful scrutiny of identified wasps in the collection of the U. S. National Museum, and the recording of label data for all specimens bearing Plummers Island locality labels. Club members, indicated by an asterisk before their names, and their guests who made collections from 1902 to 1923 are as follows:

*Herbert S. Barber (HSB)
Jos. Bequaert (JB)
Nathan Banks (NB)
D. H. Clemons (DHC)
*J. C. Crawford (JCC)
*Rolla P. Currie (RPC)
*Albert K. Fisher (AKF)
George M. Greene (GMG)
J. Douglas Hood (JDH)
L. O. Jackson (LOJ)
Josef N. Knull (JNK)
John R. Malloch (JRM)
P. R. Myers (PRM)
*Waldo L. McAtee (WLM)
Alan H. Pottinger (AHP)
F. C. Pratt (FCP)
*Wm. Palmer (WP)
Sievert A. Rohwer (SAR)
*Eugene A. Schwarz (EAS)
*Raymond C. Shannon (RCS)
*Henry L. Viereck (HLV)
*Alexander Wetmore (AW)
W. V. Warner (WVW)

The other, and major source, is the material collected from 1956 through 1963 by the following members and guests:

Donald B. Baker (DBB)
Oscar L. Cartwright (OLC)
Howard E. Evans (HEE)
*Henry S. Fuller (HSF)
Frank E. Kurczewski (FEK)
*Karl V. Krombein (KVK)
*Paul J. Spangler (PJS)
George C. Steyskal (GCS)
Jacobus van der Vecht (JvdV)

The information recorded for each species is as follows: The scientific name, author, and common name if there is one; extreme dates of capture on the island and initials of collectors who captured specimens; an indication as to whether the species is univoltine (one generation annually) or multivoltine (two or more generations); and brief biological data where any are known. It should be noted that the extreme dates of capture are not the same as the seasonal flight range, which is frequently much longer. The number of specimens collected is usually a rough measure of the relative abundance except for social wasps belonging to the genera *Vespula* and *Polistes*, of which only representative samples were taken. Readers who are interested in consulting more detailed biological accounts will find most sources listed under the appropriate species headings in the catalog, "Hymenoptera of America north of Mexico," and its two supplements (Muesebeck, Krombein and Townes, 1951, U. S. Dept. Agr., Agr. Monogr. 2: 1–1420; Krombein, *op. cit.*, pp. 1–305, 1958; Krombein and Burks, *op. cit.*, in preparation).

SUPERFAMILY BETHYLOIDEA

FAMILY CHRYSIDIDAE

All of the Plummers Island cuckoo wasps are parasitic on other solitary wasps or bees except for *Mesitiopterus kahlii* Ashm., which parasitizes walking-stick eggs.

Omalus (*Omalus*) *aeneus* (Fabricius). 2 ♀, 1 ♂; 28–30 May (KVK); multivoltine; parasitic on wood-nesting pemphredonine wasps, *Passaloecus*.

Omalus (*Omalus*) *iridescens* (Norton). 17 ♀, 4 ♂; 19 May to 26 October (HSB, HEE, KVK, WLM, HLV); multivoltine, parasitic on wood-nesting pemphredonine wasps, *Stigmus* and *Diodontus*.

Omalus (*Pseudomalus*) *auratus* (Linnaeus). 1 ♀; 3 August (KVK); multivoltine; parasitic on wood-nesting pemphredonine wasps, *Pemphredon* and *Passaloecus*.

Omalus (*Pseudomalus*) *janus* (Haldeman). 1 ♂; 26 April (HSB); multivoltine; parasitic on wood-nesting pemphredonine wasps, *Pemphredon*.

Omalus (*Pseudomalus*) *macswaini* Bohart and Campos. 4 ♀, 1 ♂; 28 May to 13 August (JCC, KVK); multivoltine; parasitic on wood-nesting pemphredonine wasps, *Stigmus* and *Pemphredon*.

Omalus (*Diplorrhos*) *intermedius* (Aaron). 66 ♂ and 1 reared ♀; 26 May to 14 June (KVK); univoltine; parasitic on the ground-nesting pemphredonine wasp, *Xylocelia virginiana* Roh., which flies at the same time and nests near the outdoor fireplace.

Elampus viridicyaneus Norton. 5 ♀, 9 ♂; 2 June to 9 July (KVK, EAS, PJS); multivoltine; parasitic on the ground-nesting gorytine wasp, *Psammaecius costalis* (Cr.).

Hedychridium dimidiatum Say. 1 ♀, 3 ♂; 3–21 July (JB, KVK, HLV); multivoltine; host unknown.

Hedychrum violaceum Brullé. 1 ♀, 1 ♂; 25–29 June (KVK, RCS); multivoltine; parasitic on *Cerceris architis* Mick.

Chrysura kyrae Krombein. 3 ♀, and many reared ♀ ♂; 25 April to 3 May (KVK); females may be active at the island from 9 April until the end of May; univoltine; I have reared it at the island from the wood-nesting vernal megachilid bee, *Osmia* (*Osmia*) *l. lignaria* Say; described from Plummers Island.

Chrysura pacifica (Say). 3 ♀, 1 ♂; 17–23 May (KVK); univoltine; I have reared it at the island from the wood-nesting vernal megachilid bee, *Osmia* (*Nothosmia*) *pumila* Cresson.

Chrysogona verticalis (Patton). 61♀, 114 ♂; 5 May to 26 October (JB, KVK, HLV, JvdV); multivoltine; I have reared it at the island from several species of wood-nesting sphecid wasps, *Trypoxylon* subg. *Trypoxylon.*

Chrysis (*Trichrysis*) *carinata* Say. 3 ♀ and many reared ♀ ♂; 2 June to 18 August (HSB, KVK); multivoltine; I have reared it at the island from wood-nesting sphecid wasps, *Trypoxylon* subg. *Trypargilum.*

Chrysis (*Trichrysis*) *tridens* (Lepeletier). 2 ♀; 6–23 June (HSB, EAS); multivoltine; presumably parasitic on the mud-dauber wasp, *Sceliphron caementarium* (Dru.).

Chrysis (*Chrysis*) *alabamensis* Mocsáry. 1 ♀; 17 July (KVK); multivoltine; hovering around standing dead tree in woods and presumably parasitic on the sphecid wasp, *Podium luctosum* Sm. nesting therein; has been reared in North Carolina and Florida from *Podium rufipes* (F.).

Chrysis (*Chrysis*) *cembricola* Krombein. 6 ♀, 2 ♂; 5 May to 17 August (KVK, RCS, JvdV); most specimens on cabin porch; usually univoltine; parasitic on the wood-nesting vispid wasp, *Symmorphus canadensis* (Sauss.).

Chrysis (*Chrysis*) *coerulans* Fabricius. 17♀, 2♂; 9 May to 19 October (HSB, JCC, KVK, PRM, EAS, RCS, JvdV); multivoltine; parasitic on wood-nesting vespid wasps, *Rygchium, Symmorphus,* and *Ancistrocerus;* I have reared it at Plummers Island from an unidentified vespid wasp.

Chrysis (*Chrysis*) *nitidula* Fabricius. 8 ♀ and some reared specimens; 21 May to 4 September (HSB, KVK, EAS, HLV); most specimens on cabin porch, one hovering before dead standing tree trunk; I have reared it at the island from the wood-nesting vespid wasp, *Ancistrocerus a. antilope* (Panz.).

Chrysis (*Chrysis*) *smaragdula* Fabricius. 1 ♀ and a few reared specimens; 30 July; (DBB, KVK); multivoltine; I have reared it at the island from the wood-nesting vespid wasp, *Monobia quadridens* (L.), and also from the same host in North Carolina.

Mesitiopterus kahlii Ashmead. 3 ♀, 36 ♂; 17 August to 23 September (JCC, HEE, KVK); univoltine; parasitic on eggs of the walking stick, *Diapheromera femorata* Say; swept from herbaceous vegetation in open woods.

FAMILY BETHYLIDAE

Scleroderma carolinense (Ashmead). 3 ♀; 25 April to 1 June (KVK, EAS, RCS); probably multivoltine; parasitizes larvae of old house borer and probably other wood-boring coleopterous larvae (1 ♀ at island taken on trunk of dead fallen sapling in woods).

Laelius trogodermatis Ashmead. 3 ♀; 11 June to 2 September (JCC, KVK); multivoltine; parasitizes *Trogoderma* (dermestid) larvae in wood borings.

Epyris bifoveolatus (Ashmead). 1 ♀, 10 ♂; 23 September to 22 October (HEE, KVK); univoltine; swept from herbaceous vegetation in open woods.

Epyris brachypterus (Ashmead). 6 ♀, 19 ♂; 25 June, 19 September to 22 October (HEE, KVK); univoltine; swept from herbaceous vegetation and leaf litter in open woods.

Epyris vierecki Krombein. 2 ♀, 18 ♂; 28 August to 5 October (JCC, HEE, KVK); univoltine; swept from herbaceous vegetation in open woods; described from Plummers Island.

? *Holepyris coronatus* (Ashmead). 4 ♂; 12–22 October (KVK); univoltine; swept from herbaceous vegetation in open woods.

Holepyris marylandicus Fouts. 1 ♀, 1 ♂; 6 June, 23 September (HEE, KVK); probably univoltine; ♂ swept from herbaceous vegetation and ♀ on leaf litter, both in open woods.

Anisepyris columbianus (Ashmead). 20 ♂; 19 September to 26 October (KVK); univoltine; swept from herbaceous vegetation in open woods.

Pristocera armifera (Say). 37 ♂; 27 August to 22 October (HEE, KVK); univoltine; swept from herbaceous vegetation in open woods; has been reared from elaterid larva, *Limonius* sp., in soil.

Pseudisobrachium ashmeadi Evans. 27 ♂; 30 August to 22 October (HEE, KVK); univoltine; this and the following species of the genus swept from herbaceous vegetation in open woods; members of this genus are parasitic in ant nests, presumably on ant larvae.

Pseudisobrachium carbonarium (Ashmead). 35 ♂; 30 August to 22 October (HEE, KVK, HLV); univoltine.

Pseudisobrachium prolongatum (Provancher). 325 ♂; 19 August to 22 October (HEE, KVK); univoltine.

Pseudisobrachium rufiventre (Ashmead). 4 ♂; 23 September to 22 October (HEE, KVK); univoltine.

Dissomphalus barberi Evans. 1 ♀, 2 ♂; 10 August to 17 October (HSB, KVK); probably univoltine; 1 ♂ swept from herbaceous vegetation in open woods, ♀ reared from log infested with cecidomyids and micromalthids; described from Plummers Island.

Dissomphalus foveolatus (Brown and Cheng). 1 ♀; 22 October (EAS); probably univoltine.

Goniozus columbianus (Ashmead). 15 ♀, 11 ♂; 5 May to 9 June and 4 September to 10 October (KVK); probably multivoltine; this and the following species swept from herbaceous vegetation in open woods and along the river.

? *Goniozus electus* Fouts. 1 ♀; 19 October (KVK); visiting aphid honeydew on oak leaf.

Goniozus platynotae Ashmead. 2 ♀; 30 July to 7 October (KVK); multivoltine; parasitizes a number of lepidopterous larvae.

Perisierola cellularis (Say). 1 ♀; 11 June (HSB); multivoltine; parasitizes several spp. of lepidopterous larvae.

Perisierola n. sp. 1 ♀; 26 May (KVK).

FAMILY DRYINIDAE

Most species of this family are parasitic on Homoptera (Cicadellidae and Fulgoridae), but hosts are unknown for all but one of the Plummers Island species. Records are so scanty that it is impossible to determine whether there are one or more generations per year.

Mesodryinus crawfordi Krombein. 1 ♀; 11 July (JCC); described from Plummers Island.

Eucamptonyx secundus Fenton. 2 ♀; 5–30 July (KVK); crawling on semirecumbent trunk of live maple sapling on sandy soil at lower end of island.

Chalcogonatopus areolatus Fenton. 1 ♀; 24 July (KVK); crawling on plant stem on sandy beach.

Gonatopus curriei Krombein. 1 ♀; 3 August (RPC); described from Plummers Island.

Anteon puncticeps Ashmead. 1 ♀, 2 ♂; 6 June to 20 July (RCS).

Chelogynus virginiensis Fenton. 5 ♀; 9 June to 30 July (KVK); on vegetation in sandy areas.

Deinodryinus variabilis Fenton. 1 ♀; 3 June (KVK).

Aphelopus albopictus Ashmead. 2 ♀; 30 June to 27 August (KVK); on beach vegetation and in wooden boring.

Aphelopus comesi Fenton. 1 ♀; 12 August (KVK); on beach vegetation; the type was reared from the leafhopper, *Erythroneura comes* (Say).

SUPERFAMILY SCOLIOIDEA

FAMILY TIPHIIDAE

The species of *Tiphia* and *Myzinum*, so far as known, are parasitic on soil-dwelling scarabaeid beetle larvae. Most specimens of *Tiphia* and *Myrmosa* were captured in open woods, and those of *Myzinum* on the upper sandy beach on flowers.

Tiphia affinis Malloch. 1 ♂; 23 June (KVK); univoltine.

Tiphia egregia Viereck. 14 ♀, 45 ♂; 3 July to 22 October (HSB, RPC, HEE, KVK, JRM, EAS, HLV); multivoltine.

Tiphia illinoensis Robertson. 1 ♂; 13 August (KVK).

Tiphia inaequalis Malloch. 5 ♂; 18 July to 25 August (HSB, KVK, PRM, HLV); 2 ♂ taken on lower sandy beach; univoltine.

Tiphia infossata Allen. 5 ♀, 167 ♂; 26 May to 30 June (HSB, JCC, GMG, KVK, EAS); univoltine; part of the type series of *T. hollowayi* Allen, a synonym, came from Plummers Island.

Tiphia intermedia Malloch. 2 ♀, 1 ♂; 27 July to 9 September (KVK); multivoltine.

Tiphia jaynesi Allen. 1 ♀; 1 September (HLV).

Tiphia relativa Viereck. 2 ♀, 10 ♂; 15 June to 27 August (HSB, NB, JCC, KVK, JRM, PRM); multivoltine; *T. winnemanae* Malloch, a synonym, was described from Plummers Island.

Tiphia rugulosa Malloch. 7 ♀, 24 ♂; 5 May to 28 June and 6–19 October (KVK, RCS, HLV); probably univoltine.

Tiphia subcarinata Malloch. 1 ♀, 24 ♂; 25 June to 28 July (JCC, KVK, WP, HLV); univoltine.

Tiphia vernalis Rohwer. 6 ♀, 3 ♂; 5 May to 11 June (KVK); univoltine; liberated in U. S. in late 1920's to control Japanese beetle.

Myzinum maculatum (Fabricius). 1 ♀; 6 September (KVK); multivoltine; on flowers of *Polygonum* on upper beach.

Myzinum obscurum (Fabricius). 1 ♀; 8 August (JCC); univoltine (?).

Myzinum quinquecinctum (Fabricius). 1 ♀; 30 August (KVK); on upper beach on flowers; univoltine (?).

Myrmosa (*Myrmosa*) *unicolor* Say. 6 ♀, 34 ♂; 6 June to 6 September (HSB, KVK, EAS); multivoltine; parasitic on small ground-nesting wasps and bees.

FAMILY SIEROLOMORPHIDAE

Sierolomorpha canadensis (Provancher). 1 ♀, 1 ♂; 17–27 June (DHC, KVK); on vegetation on lower beach.

FAMILY MUTILLIDAE

So far as known, the velvet ants are parasitic on mature, resting insect larvae, usually of other wasps and bees but occasionally of Lepidoptera, Diptera, or Coleoptera. Hosts are known for very few of the Plummers Island species.

Photomorphus (*Photomorphus*) *banksi* (Bradley). 2 ♀; 3–13 August (KVK); univoltine (?); one near the cabin and one on the upper beach.

Sphaeropthalma (*Sphaeropthalma*) *pennsylvanica scaeva* (Blake). 4 ♀, 6 ♂ and several reared specimens; 13 June to 2 September (HSB, HVK, EAS); multivoltine; mostly in wooded areas; I have reared it from cocoons of the sphecid wasps, *Trypoxylon* (*Trypargilum*) *collinum rubrocinctum* Pack. and *striatum* Prov. at the island, and it has been reared elsewhere from other mud-daubing wasps.

Pseudomethoca frigida frigida (Smith). 19 ♀, 16 ♂; 4 May to 23 September (HSB, JCC, KVK, WLM); multivoltine; occurs both in wooded and sandy areas; parasitizes small ground-nesting bees, *Lasioglossum* subg. *Chloralictus.*

Pseudomethoca simillima (Smith). 2 ♀, 15 ♂; 11 April to 17 October (JCC, HEE, KVK, PRM); multivoltine; mostly in wooded areas.

Pseudomethoca vanduzeei Bradley. 1 ♂; 31 August (KVK); multivoltine; flying in open wooded area.

Dasymutilla alesia Banks. 1 ♀; 4 July (JB, HLV); a woodland species.

Dasymutilla nigripes (Fabricius). 3 ♀, 1 ♂; 25 June to 4 September (HSB, KVK, EAS); multivoltine; in wooded areas; parasitic on the ground-nesting sphecid wasp, *Cerceris flavofasciata* H. S. Sm.

Dasymutilla vesta vesta (Cresson). 6 ♀, 1 ♂; 11 June to 12 September (JCC, KVK, SAR, RCS, HLV); multivoltine; 2 ♀ in wooded areas.

Timulla (*Timulla*) *dubitata* (Smith). 2 ♀; 10 May to 10 August (HSB, JCC, EAS); multivoltine.

Timulla (*Timulla*) *dubitatiformis* Mickel. 1 ♀; 11 June (HSB); a paratype. This is a composite species known only from females; the Plummers Island ♀ listed here is quite likely to be the opposite sex of the following species.

Timulla (*Timulla*) *hollensis melanderi* Mickel. 3 ♂; 5 July to 22 August (JCC, EAS, RCS); one ♂ is a paratype.

Ephuta (*Ephuta*) *pauxilla pauxilla* Bradley. 5 ♀, 15 ♂; 9 June to 13 October (KVK); multivoltine; in sandy areas; has been reared from the spider wasp, *Dipogon* (*Deuteragenia*) *s. sayi* Bks.

Ephuta (*Ephuta*) *scrupea* (Say). 12 ♀, 24 ♂; 26 May to 4 November (HSB, JCC, KVK, PRM, WLM, EAS, RCS); multivoltine; mostly in wooded areas, occasionally on sand; parasitic on the spider wasp, *Phanagenia bombycina* (Cr.).

FAMILY RHOPALOSOMATIDAE

Rhopalosoma nearcticum Brues. 1 ♀ reared; emerged in spring; parasitic on adult tree cricket, *Orocharis saltator* Uhl. (Hood, 1913).

Oxilon banksii (Brues). 1 ♀; 17 August (JvdV); also represented in National Museum collection by a field cricket nymph, *Nemobius* sp., August (HSB), bearing the cast exuviae of a small rhopalosomatid larva.

FAMILY SCOLIIDAE

Members of this family are parasitic on scarabaeid beetle larvae in the ground or in rotten wood.

Scolia (*Scolia*) *bicincta* Fabricius. 4 ♀, 5 ♂; 4 August to 6 September (RPC, KVK, JvdV); univoltine; mostly in open wooded areas.

Scolia (*Scolia*) *dubia dubia* Say. 3 ♀, 1 ♂; 25 August to 6 September (KVK, WLM); on upper beach on flowers; univoltine; parasitic on larvae of *Cotinis nitida* (L.).

Campsomeris (*Dielis*) *plumipes plumipes* (Drury). 1 ♂; 6 May (JCC).

FAMILY SAPYGIDAE

Sapyga centrata Say. 4 ♀ and reared specimens; 25 April to 21 May (KVK); univoltine; 2 ♀, one of which slept overnight in a boring in post, hovering in front of cedar posts of cabin; I have reared this from nests from Plummers Island in borings in wood of the megachilid bees, *Osmia* (*Centrosmia*) *bucephala bucephala* Cr. and *O.* (*Nothosomia*) *pumila* Cr.

SUPERFAMILY VESPOIDEA

FAMILY VESPIDAE

The vespid wasps include the social wasps (hornets, yellow jackets, and paper wasps) of the genera *Vespa, Vespula,* and *Polistes,* as well as a large number of solitary species belonging to several genera which nest in borings in wood, fabricate clay cells or nest in the ground. No attempt has been made to collect more than a sampling of the social wasps of the genera *Vespula* and *Polistes,* so the specimens cited do not reflect the relative abundance. In the social wasps each colony is started in the spring by a single overwintering fertilized queen. Successive broods of sterile females (workers) are produced during the summer, and males and new queens develop late in August and September.

Vespa crabro var. *germana* (Christ), the European hornet. 1 ♀; April 29 (HSF); in cabin.

Vespula (*Vespula*) *maculifrons* (du Buysson), the yellow jacket. 28 ♀, 28 ☿; queens captured 14 April to 17 June and again in mid-October, workers taken 6 June to 26 October (HSB, JCC, OLC, RPC, LOJ, KVK, WLM, FCP, WP, JvdV); this is our most common and troublesome ground-nesting yellow jacket.

Vespula (*Vespula*) *squamosa* (Drury). 2 ♀; 23–30 May (LOJ, KVK); queens thought to be temporary parasites in young colonies of *maculifrons*; *squamosa* workers, males, and queens are developed later in the season.

Vespula (*Vespula*) *vidua* (Saussure). 4 ♀, 15 ☿, 1 ♂; queens captured 28 April to 20 May and again in late October, workers taken 13 June to 8 September (HSB, KVK, JvdV).

Vespula (*Dolichovespula*) *arenaria* (Fabricius). 6 ☿; 28 June to 21 July (KVK, PJS); on beach. This species, like the following, builds a paper nest in a tree.

Vespula (*Dolichovespula*) *maculata* (Linnaeus), the bald-faced hornet. 3 ♀, 5 ☿; queens captured 29 April to 11 June, workers 16 July to 6 September (DHC, KVK).

Polistes annularis (Linnaeus). 16 ♀, 2 ♂; 18 April to 26 October (KVK, WP, AW); females frequently overwinter in the cabin in large numbers; the pendent single-comb nests are placed beneath eaves or other sheltered situations as is the case for the following species of the same genus.

Polistes exclamans exclamans Viereck. 3 ♀; 25 April to 12 September (KVK, JvdV).

Polistes fuscatus fuscatus (Fabricius). 3 ♀, 1 ♂; 2 May to 18 October (HSB, AKF, WLM).

Polistes fuscatus pallipes Lepeletier. 6 ♀, 4 ♂; 25 April to 28 September, and 9 November (in cabin ?) (HSB, KVK, WVW, JvdV).

Polistes metricus Say. 7 ♀, 2 ♂; 27 March to 2 May (HSB, KVK, JvdV).

Zethus (*Zethusculus*) *spinipes* Say. 2 ♂; 30 August to 8 September (KVK, JvdV); on upper beach.

Eumenes fraternus Say. 10 ♀, 12 ♂; 30 May to 19 October (AKF, KVK, WLM, JvdV); in wooded areas and on beach; multivoltine; builds the familiar jug nest of mud in which it stores caterpillars.

Pseudodynerus quadrisectus (Say). 6 ♀, 5♂; 6 June to 28 August (AKF, KVK, WLM, PJS, HLV); multivoltine; mostly in wooded areas; nests in old carpenter bee burrows in wood.

Monobia quadridens (Linnaeus). 14 ♀, 10 ♂, and reared specimens; 2 June to 13 October (AKF, KVK, WLM, EAS, JvdV); multivoltine; I have reared this species from wooden trap nests from the island; it also nests frequently in rafters of the cabin porch in abandoned carpenter bee borings and provisions its nests with caterpillars (Krombein, 1962*b*).

Rygchium foraminatum foraminatum (Saussure). 9 ♀, 32 ♂, and reared specimens; 19 May to 9 September (JCC, KVK, JvdV); multivoltine; common in open wooded areas; I have reared this and the following species from wooden trap nests from the island; both species provision with caterpillars.

Rygchium schwarzi Krombein. 3 ♀, 9 ♂, and reared specimens; 19 May to 10 September (HSB, KVK, HLV); multivoltine; frequents open wooded areas; described from the island.

Ancistrocerus antilope antilope (Panzer). 10 ♀ and reared specimens; 18 August to 13 October (KVK, JvdV); multivoltine; in open wooded areas, sometimes hovering in front of dead standing trees, and visiting *Polygonum* flowers on upper beach; I have reared this and the three following species from wooden trap nests from the island; all four species store caterpillars as prey.

Ancistrocerus campestris (Saussure). 6 ♀, 25 ♂, and reared specimens; 2 June to 23 September (KVK, JvdV); multivoltine; in open wooded areas and visiting flowers on upper beach.

Ancistrocerus catskill catskill (Saussure). 2 ♂ and reared specimens; 2 June to 12 August (KVK); multivoltine; on flowers on upper beach and in open woods.

Ancistrocerus tigris tigris (Saussure). 41 ♀, 5 ♂, and reared specimens; 10 May to 26 October (JCC, KVK, JRM, JvdV); multivoltine; in open wooded areas, occasionally nesting in cedar posts on cabin porch, and visiting *Polygonum* flowers on upper beach.

Ancistrocerus unifasciatus unifasciatus (Saussure). 1 ♀; 30 May (KVK); multivoltine.

Symmorphus albomarginatus (Saussure). 5 ♀ and reared specimens; 12 June to 28 July (KVK); univoltine, though occasionally with a small partial second generation; in open wooded areas and on beaches; I have reared this and the following species from wooden trap nests from the island; this species stores its nests with *Chrysomela* beetle larvae.

Symmorphus canadensis (Saussure). 38 ♀, 7 ♂ and reared specimens; 19 May to 17 October (HSB, JCC, KVK, EAS); univoltine, but occasionally with a small partial second generation; stores its nests with leaf-mining lepidopterous and coleopterous larvae.

Symmorphus cristatus (Saussure). 1 ♀; 9 June (KVK).

Stenodynerus (*Stenodynerus*) *blepharus* Bohart. 11 ♀, 15 ♂; 19 May to 18 August (KVK, PJS); apparently multivoltine; in open wooded areas.

Stenodynerus (*Parancistrocerus*) *fulvipes fulvipes* (Saussure). 2 ♀, 6 ♂; 2 June to 6 September (KVK); multivoltine; mostly on upper beach but occasionally in open wooded areas; I have reared this in North Carolina from wooden trap nests which were provisioned with caterpillars.

Stenodynerus (*Parancistrocerus*) *pedestris pedestris* (Saussure). 23 ♀, 19 ♂; 19 May to 28 September (KVK, SAR, HLV, JvdV); multivoltine; in open wooded areas; I have reared this from wooden trap nests from New York; it provisions its nests with caterpillars as do the following two species.

Stenodynerus (*Parancistrocerus*) *perennis perennis* (Saussure). 43 ♀, 10 ♂; 23 May to 24 September (DHC, KVK, PRM, HLV, JvdV); multivoltine; in open wooded areas, on beaches, and hovering in front of standing dead tree trunk containing borings; 1 ♂ transitional to *p. anacardivora* (Rohwer); it has been reared from borings in sumach stems and provisions its nest with caterpillars.

Stenodynerus (*Parancistrocerus*) *vogti* Krombein. 1 ♀, reared from wooden trap nest, 23 May (KVK); described from Plummers Island.

SUPERFAMILY POMPILOIDEA
FAMILY POMPILIDAE

This family consists of the spider wasps. All species prey on spiders except *Ceropales* and *Evagetes,* which are social parasites of other pompilid wasps.

Chirodamus albopilosus (Cresson). 7 ♀, 14 ♂; 2–30 June (HSB, KVK, PJS, RCS); multivoltine; in open wooded areas.

Chirodamus fortis (Cresson). 5 ♀; 2 July to 17 October (KVK, HLV); apparently multivoltine; in open wooded areas.

Priocnessus nebulosus (Dahlbom). 4 ♀, 4 ♂; 5 April to 28 August (KVK); multivoltine; in open wooded areas; preys on *Agelenopsis.*

Dipogon (*Deuteragenia*) *calipterus calipterus* (Say). 1 ♀; 18 July (KVK); multivoltine.

Dipogon (*Deuteragenia*) *papago anomalous* Dreisbach. 5 ♀ and reared specimens; 28 May to 13 October (JCC, KVK); I have reared this and the following species from wooden trap nests placed on dead standing tree trunks; these species store their nests with jumping spiders.

Dipogon (*Deuteragenia*) *sayi sayi* Banks. 10 ♀ and reared specimens; 14 May to 23 September (HSB, HEE, KVK, EAS); in woods; preys principally on crab spiders.

Dipogon (*Dipogon*) *brevis brevis* (Cresson). 2 ♀, 6 ♂; 21 May to 13 September (KVK); multivoltine; in open woods, males on foliage; preys on *Phidippus.*

Dipogon (*Winnemanella*) *fulleri* Krombein. 1 ♀; 18 August (KVK);

on standing dead tree trunk in woods; described from Plummers Island; preys on *Icius hartii* Em.

Priocnemis (*Priocnemissus*) *minorata* Banks. 12 ♀, 3 ♂; 30 March to 12 June (JCC, KVK, PRM, WLM, AHP, RCS, HLV); univoltine; on leaf litter in woods; preys on a variety of errant and snare-building spiders and nests in soil.

Priocnemis (*Priocnemis*) *cornica* (Say). 16 ♀, 14 ♂; 4 June to 28 September (FEK, KVK); multivoltine; most specimens taken on sand along river bank; preys on a variety of errant spiders and nests in pre-existing holes in ground.

Priocnemis (*Priocnemis*) *germana* (Cresson). 33 ♀, 35 ♂; 30 May to 17 October (JDH, KVK, WP, HLV, JvdV); multivoltine; on leaf litter in woods and on beaches in shade; preys on *Amaurobius* and probably nests in pre-existing holes in ground.

Priocnemis (*Priocnemis*) *hestia* Banks. 1 ♀; 13 October (HLV); multivoltine; preys on immature clubionids.

Priocnemis (*Priocnemis*) *scitula scitula* (Cresson). 58 ♀, 70 ♂; 19 May to 13 October (HEE, KVK, GCS, HLV); multivoltine; mostly in sandy areas.

Calicurgus hyalinatus alienatus (Smith). 26 ♀, 5 ♂; 4 June to 1 October (KVK, PJS); multivoltine; in woods and on sandy areas. I collected this at Plummers Island transporting araneid spiders (Krombein, 1958, 1961); nests in ground.

Calicurgus hyalinatus rupex (Cresson). 1 ♀; 18 August (KVK); multivoltine; a southern race not recorded previously north of North Carolina; this particular specimen may be just a variant in a population of *h. alienatus.*

Phanagenia bombycina (Cresson). 2 ♀, 1 ♂; 3 July to 28 August (KVK); multivoltine; builds clay cells under stones and preys on errant spiders.

Auplopus adjunctus (Banks). 3 ♀, 3 ♂; 4 June to 13 September (KVK); in wooded areas; multivoltine; constructs mud cells.

Auplopus architectus architectus (Say). 7 ♀, 1 ♂; 30 July to 26 October (KVK); multivoltine; constructs mud cells under stones: I captured it on Plummers Island with prey, a *Clubiona* sp. (Krombein, 1961).

Auplopus caerulescens caerulescens (Dahlbom). 4 ♀, 4 ♂; 23 May to 28 September (JCC, GMG, KVK); multivoltine; constructs mud cells under loose bark.

Auplopus mellipes mellipes (Say). 18 ♀, 5 ♂ and reared specimens; 3 June to 13 October (JCC, KVK, HLV, JvdV); multivoltine; usually in woods, several ♀ nesting in abandoned borings in dead standing trees; it constructed clay cells in several of my wooden trap nests; preys on errant spiders.

Auplopus nigrellus (Banks). 61 ♀, 36 ♂; 17 May to 13 October (HSB, HEE, FEK, KVK, JvdV); multivoltine; in open woods; builds clay cells under stones and stores errant spiders.

Ageniella (*Ageniella*) *mintaka* Brimley. 1 ♂; 20 July (KVK); univoltine; in woods.

Ageniella (*Ageniella*) *norata* Banks. 1 ♀, 2 ♂; 3 July to 31 August (KVK); univoltine; in woods.

Ageniella (*Priophanes*) *arcuatus* (Banks). 1 ♂; 12 August (KVK); multivoltine; on upper beach; preys on *Oxyopes.*

Ageniella (*Priophanes*) *agenioideus* (Fox). 3 ♀; 21 July to 28 August (KVK).

Minagenia clypeata (Banks). 19 ♀, 1 ♂; 25 June to 23 September (KVK); multivoltine; on shaded, vegetated, sandy area.

Minagenia julia (Brimley). 6 ♂; 3–13 July (JB, KVK, HLV); multivoltine; in open woods.

Minagenia osoria (Banks). 2 ♀, 8 ♂; 6 July to 9 September (KVK); on shaded, vegetated, sandy area; larva an external parasite on abdomen of active spider.

Ceropales hatoda Brimley. 1 ♀, 3 ♂; 20 July to 13 August (KVK); multivoltine (?); probably a social parasite of *Ageniella* (*A.*) *partita* Bks.

Ceropales maculata fraterna Smith. 2 ♂; 13 August to 6 September (KVK); multivoltine.

Aporus (*Aporus*) *niger* (Cresson). 3 ♀, 21 ♂; 28 June to 31 August (KVK); univoltine (?); in open woods.

Allaporus rufiventris (Cresson). 1 ♀, 3 ♂; 6 June to 31 August (KVK, RCS); univoltine (?); in open woods.

Psorthaspis legata (Cresson). 2 ♂; 22–26 June (HSB, EAS); univoltine (?).

Psorthaspis mariae (Cresson). 11 ♀, 6 ♂; 6 June to 1 October (HSB, KVK, RCS, JvdV); multivoltine; in open woods.

Evagetes parvus (Cresson). 2 ♀; 21–30 July (KVK); multivoltine; on sand; apparently parasitic on several species of *Anoplius* and *Pompilus.*

Agenioideus (*Agenioideus*) *humilis* (Cresson). 5 ♀, 23 ♂; 3 June to 2 September (HSB, JCC, KVK, EAS, RCS); multivoltine; abundant about cabin and presumably nesting among or under rocks supporting porch; preys on orb weavers.

Sericopompilus apicalis (Say). 1 ♂; 29 June (RCS); multivoltine; preys on a variety of errant and snare-building spiders and nests in ground.

Episyron biguttatus biguttatus (Fabricius). 19 ♀, 4 ♂; 4 June to 9 September (DBB, HSB, FEK, KVK, EAS, HLV); multivoltine; a woodland species.

Episyron quinquenotatus quinquenotatus (Say). 21 ♀, 22 ♂; 2 June to 16 September (DBB, FEK, KVK); on open sand; I have taken it at Plummers Island preying on orb weavers and nesting in sand (Krombein, 1961, in press).

Tachypompilus ferrugineus ferrugineus (Say). 5 ♀, 1 ♂; 17 August to 6 September (KVK, JvdV); multivoltine; on cabin wall attacking large orb-weaver spider; reported as preying on wolf and fishing spiders and nesting in soil.

Anoplius (*Lophopompilus*) *aethiops* (Cresson). 2 ♀, 2 ♂; 23 September to October (KVK, WP); multivoltine (?); on beach on *Polygonum* flowers; preys on wolf spiders.

Anoplius (*Lophopompilus*) *carolina* (Banks). 4 ♀, 2 ♂; 4 July to 13 August (JB, KVK, HLV); a woodland species; preys on agelenids and nests in pre-existing holes in ground.

Anoplius (*Notiochares*) *amethystinus atramentarius* (Dahlbom). 5 ♀, 2 ♂; 14 August to 28 September (KVK, JvdV); multivoltine; preys on wolf spiders and nests in ground.

Anoplius (*Arachnophroctonus*) *americanus trifasciatus* (Beauvois). 5 ♀, 2 ♂; 17 June to 21 August (KVK); multivoltine; on sand along river margin.

Anoplius (*Arachnophroctonus*) *semirufus* (Cresson). 2 ♀, 2 ♂; 6–17 August (KVK); multivoltine; on bare sand; preys on wolf spiders and nests in sand.

Anoplius (*Pompilinus*) *insolens* (Banks). 5 ♂; 2 June to 6 July (KVK); multivoltine (?).

Anoplius (*Pompilinus*) *marginatus* (Say). 3 ♀; 6–19 June (KVK, RCS); multivoltine; in open woods. The females of several species may be confused under this name; Plummers Island males are needed to determine what species actually occurs here.

Anoplius (*Anoplius*) *depressipes* Banks. 1 ♀, 1 ♂; 28 August to 6 September (KVK); multivoltine; on upper beach; nests in pre-existing holes in soil or wood and preys on fishing spiders.

Anoplius (*Anoplius*) *ithaca* (Banks). 2 ♀, 10 ♂; 12–31 August (DBB, KVK, JvdV); multivoltine; on upper beach near rock jetty built for bridge construction; preys on small wolf spiders and nests in ground.

Anoplius (*Anoplius*) *virginiensis* (Cresson). 22 ♀, 28 ♂; 21 May to 17 October (DHC, HEE, KVK, JvdV); multivoltine; a woodland species; nests in decaying wood and preys on agelenid and amaurobiid spiders.

Pompilus (*Anoplochares*) *apicatus* Provancher. 29 ♀, 28 ♂; 26 May to 30 July (HSB, JCC, KVK, EAS); univoltine (?); a woodland species.

Aporinellus completus Banks. 6 ♀, 5 ♂; 4 June to 2 September (KVK); multivoltine; on knoll near cabin and on upper beach; preys on jumping spiders.

Aporinellus medianus Banks. 1 ♀; 21 June (KVK); multivoltine; on knoll near cabin; preys on errant spiders and nests in ground.

SUPERFAMILY SPHECOIDEA

FAMILY AMPULICIDAE

Dolichurus greenei Rohwer. 1 ♀, 1 ♂; 18 August to 23 September (HEE, KVK); univoltine; in open wooded areas; preys on the woods cockroach, *Parcoblatta*, and nests under leaf litter.

FAMILY SPHECIDAE

This is the largest family of wasps, and its members exhibit the most diversified prey preferences and nesting behavior.

Lyroda subita (Say). 2 ♀, 5 ♂; 17 July to 19 August (KVK); probably multivoltine; on sandy areas; nests in ground and provisions with field cricket nymphs, *Nemobius*.

Miscophus americanus Fox. 3 ♀, 2 ♂; 6 June to 9 September (KVK, JvdV); in open woods and on sand; multivoltine; preys on orb-weaver spiders and nests in ground.

Nitela virginiensis Rohwer. 3 ♀; 17 August to 26 October (KVK, JvdV); multivoltine; one female visiting aphid honeydew on oak leaf; nests in preexisting borings in twigs of smooth sumac.

Tachytes (*Tachyplena*) *crassus* Patton. 4 ♀, 13 ♂; 21 July to 27 August (KVK); univoltine; visits flowers of swamp milkweed along river; preys on katydid nymphs, *Orchelimum*, and nests in ground (Krombein, 1961).

Tachytes (*Tachynana*) *minutus* Rohwer. 5 ♀, 1 ♂; 11 July to 19 August (KVK); probably univoltine; I have watched it hunting its pygmy mole cricket prey, *Tridactylus*, on the muddy edges of the river.

Tachytes (*Tachynana*) *obscurus* Cresson. 1 ♀; 1 September (KVK); probably univoltine; at upper end of island.

Tachysphex (*Tachysphex*) *similis* Rohwer. 1 ♀, 2 ♂; 13–30 August (KVK); multivoltine; on upper beach sand.

Motes (*Notogonius*) *argentata* (Beauvois). 7 ♀, 2 ♂; 29 March to 1 October (JCC, KVK, HLV); multivoltine, adult females apparently overwintering; nests in ground and stores field crickets, *Gryllus* and *Nemobius*.

Pison (*Krombeiniellum*) *koreense* (Radoszkowski). 1 ♀; 13 September (KVK); probably multivoltine; gathering mud near outdoor fireplace; stores spiders in diagonal row of delicate clay cells.

Trypoxylon (*Trypoxylon*) *backi* Sandhouse. 3 ♀, 3 ♂; 26 May to 8 September and reared specimens (KVK, JvdV); multivoltine; this species nests in cedar posts of the cabin porch and I have also reared it from trap nests from the island; provisions its cells with a sheet-web spider, *Tennesseellum formicum* (Em.), an ant mimic.

Trypoxylon (*Trypoxylon*) *carinatum* Say. 4 ♀, 9 ♂ and reared specimens; 2 June to 18 August (KVK); multivoltine; nests in cedar posts of cabin porch and I have reared it from wooden trap nests from the island.

Trypoxylon (*Trypoxylon*) *clarkei* Krombein. 1 ♂ and reared specimens from trap nests; 26 May (KVK); multivoltine; described from Plummers Island.

Trypoxylon (*Trypoxylon*) *frigidum* Smith. 24 ♀, 85 ♂ and reared specimens; 17 May to 27 September (JCC, KVK); multivoltine; I have reared it from trap nests from Plummers Island; preys on orb-weaver spiders.

Trypoxylon (*Trypoxylon*) *johnsoni* Fox. 3 ♀, 1 ♂ and reared specimens; 6 June to 5 July (KVK); multivoltine; I have reared it from trap nests from Plummers Island; it also nests in hollow twigs.

Trypoxylon (Trypoxylon) pennsylvanicum Saussure. 50 ♀, 29 ♂; 17 May to 26 October (KVK); multivoltine; preys on orb-weaver spiders (Krombein, 1961).

Trypoxylon (Trypoxylon) richardsi Sandhouse. 20 ♀, 14 ♂; 28 May to 20 July (KVK); multivoltine; this species was reared from a nest in a *Chionanthus* twig at Plummers Island (Krombein, 1959).

Trypoxylon (Trypargilum) clavatum Say. 2 ♀, 3 ♂ and many reared specimens; 22 June to 5 August (HSB, GMG, KVK, EAS); multivoltine; nests commonly in wooden trap nests at Plummers Island and provisions the cells with wandering spiders.

Trypoxylon (Trypargilum) collinum rubrocinctum Packard. 9 ♀ and many reared specimens; 26 June to 21 July (JCC, KVK, RCS); univoltine, though occasionally with a very small second generation; nests commonly in wooden trap nests at Plummers Island and provisions the cells with snare-building spiders.

Trypoxylon (Trypargilum) politum Say. 11 ♀, 1 ♂; 11 June to 16 July (HSB, DHC, KVK); probably univoltine; this builds the clay "pipe organ" nests on the cabin porch and in rock clefts; it stores snare-building spiders.

Trypoxylon (Trypargilum) striatum Provancher. 3 ♀, 3 ♂; 15 June to 18 July and many reared specimens (HSB, KVK, RCS); multivoltine; nests commonly in wooden trap nests at Plummers Island and provisions the cells with snare-building spiders.

Diodontus atratus parenosas Pate. 3 ♀; 4 July to 13 October (KVK, WLM); multivoltine; nests in wooden trap nests and abandoned beetle borings in wood; provisions its cells with aphids (Krombein, 1958).

Psen (Psen) barthi Viereck. 2 ♀; 25 June to 5 July (KVK); univoltine (?); in open woods; nests in wood and preys on membracids.

Psen (Psen) erythropoda Rohwer. 5 ♀; 4 June to 11 July (JCC, AKF, KVK); probably univoltine; in open woods.

Psen (Psen) monticola Packard. 1 ♀; 28 July (HLV); probably univoltine.

Psen (Pseneo) kohlii kohlii Fox. 15 ♀; 13 June to 19 September (HSB, JCC, AKF, KVK, EAS); multivoltine; in woods and on beach around pokeweed; nests in soil and preys on leafhoppers.

Psen (Pseneo) simplicicornis Fox. 1 ♀; 16 July (KVK); probably multivoltine; in open woods; preys on leafhoppers.

Mimesa (Mimesa) basirufa Packard. 6 ♀, 1 ♂; 4 June to 5 September (KVK); usually univoltine; nests in soil near outdoor fireplace at the island and preys on leafhoppers (Krombein, 1961).

Mimesa (Mimesa) ezra Pate. 2 ♀; 13–31 August (KVK); on upper beach.

Mimesa (Mimumesa) leucopus (Say). 24 ♀, 52 ♂; 19 May to 1 October (KVK, JvdV); multivoltine; in woods and on beaches.

Mimesa (*Mimumesa*) *longicornis* (Fox). 3 ♀, 9 ♂; 6–19 August (KVK); on upper beach.

Xylocelia franclemonti Krombein. 5 ♂; 28 July to 28 August (KVK); on upper beach flying around scrub cottonwood infested with aphids; the colony from which these came apparently is along the new circumferential highway right-of-way just off the island.

Xylocelia virginiana Rohwer. 65 ♀, 132 ♂; 30 May to 30 July and 31 August to 13 October (JB, KVK, HLV); usually multivoltine; a large colony nests near the outdoor fireplace; nests in soil and provisions with woolly alder aphid, *Prociphilus tesselatus* (Fitch) (Krombein, 1958).

Pemphredon (*Pemphredon*) sp. 1 ♂; 13 June (KVK); in open woods at lower end of island; apparently a new species, but description withheld until associated females are available.

Pemphredon (*Cemonus*) *harbecki* Rohwer. 2 ♀, 1 ♂; 9 June to 28 September (KVK).

Pemphredon (*Cemonus*) *lethifer lethifer* (Shuckard). 2 ♀, 7 ♂ and reared specimens; 4 July to 13 August (KVK, HLV, JvdV); multivoltine; on upper beach; preys on *Aphis* and nests in sumac stems.

Pemphredon (*Cemonus*) *tenax* Fox. 12 ♀, 28 ♂; 19 May to 16 September (KVK); multivoltine; on both beaches around herbaceous vegetation; nests in twigs and preys on aphids.

Stigmus americanus Packard. 45 ♀, 26 ♂; 8 May to 26 October (HEE, KVK, RCS, JvdV); multivoltine; mostly in wooded areas and around cabin; nests in small deserted beetle borings in porch rafters, and *Chionanthus* twigs, and preys on aphids (Krombein, 1958, 1961).

Passaloecus annulatus (Say). 19 ♀, 10 ♂; 20 May to 13 October (JCC, KVK); multivoltine; mostly in woods and around cabin; nests in abandoned beetle borings in porch rafters and cedar stump at the island (Krombein 1958, 1961).

Passaloecus mandibularis (Cresson). 1 ♀; 19 May (KVK); univoltine; nests in abandoned beetle borings and wooden trap nests; preys on aphids.

Passaloecus relativus Fox. 2 ♀, 1 ♂; 21 May to 2 June (KVK); multivoltine; around cedar post on cabin porch; preys on aphids and nests in deserted beetle borings.

Spilomena barberi Krombein. 3 ♀, 1 ♂; 19 May to 31 August (KVK); multivoltine; nests in abandoned beetle borings and preys on nymphal thrips; described from Plummers Island.

Spilomena pusilla (Say). 2 ♀, 1 ♂; 26 May to 6 June (KVK); multivoltine; nests in rafters on cabin porch; preys on thrips.

Xysma ceanothae (Viereck). 6 ♀; 2–29 June (KVK); univoltine; preys on thrips; nests in deserted anobiid beetle borings in porch rafters at island (Krombein, 1958).

Chlorion (*Ammobia*) *ichneumoneum* (Linnaeus). 1 ♀ (?); 9 July (sight record, KVK); at upper end of island; nests in ground and preys on katydids.

Chlorion (*Ammobia*) *pennsylvanicum* (Linnaeus). 1 ♀; 21 August

(KVK); on beach on swamp milkweed flowers; nests in soil and preys on katydids.

Isodontia auripes (Fernald). Reared from several wooden trap nests in woods (KVK); multivoltine; preys on tree crickets.

Isodontia azteca (Saussure). 2 ♀, 1 ♂; 1–8 September (KVK, HLV, JvdV); multivoltine; on upper beach on *Polygonum* flowers.

Isodontia cinerea (Fernald). 2 ♀; 9 July to 31 August (KVK); multivoltine; in woods.

Sphex aureonatatus (Dahlbom). 12 ♀, 15 ♂; 25 June to 29 September (HSB, DHC, AKF, GMG, KVK, WLM, JvdV); multivoltine; in open woods and on beach; nests in ground and preys on notodontid caterpillars.

Sphex nigricans (Dahlbom). 2 ♀, 1 ♂; 8 September to October (WP, JvdV); multivoltine; preys on noctuid caterpillars and nests in ground.

Sphex urnarius (Dahlbom). 3 ♀, 9 ♂; 2 June to 9 September (HSB, JCC, KVK, JvdV); multivoltine; nests in ground and preys on noctuid and geometrid caterpillars.

Sceliphron caementarium (Drury), the black and yellow mud-dauber. 2 ♀; 25 June to 21 July (AKF, KVK); multivoltine, preys on spiders.

Chalybion californicum (Saussure). 5 ♀, 2 ♂; 11 June to 17 August (AKF, KVK, JvdV); appropriates *Sceliphron* nests; preys on spiders.

Podium luctuosum Smith. 18 ♀ and reared specimens; 11 June to 18 August (JB, JCC, JNK, KVK, HLV); probably univoltine; nests in wooden traps and abandoned insect borings in dead standing trees; preys on woods cockroaches (Krombein, in press).

Alysson conicus Provancher. 18 ♀, 6 ♂; 17 June to 30 August (KVK); multivoltine; on beach.

Alysson melleus Say. 1 ♀, 3 ♂; 22 July to 12 August (KVK); multivoltine; on beach; nests in sand and preys on leafhoppers.

Alysson oppositus Say. 6 ♀, 2 ♂; 30 June to 8 September (KVK, GCS); multivoltine; on beach.

Alysson triangulifer triangulifer Provancher. 1 ♀, 2 ♂; 9–25 June (KVK); multivoltine; on beach.

Didineis texana (Cresson). 1 ♀; 19 August (KVK); multivoltine; preys on fulgorids.

Nysson (*Nysson*) *lateralis* Packard. 1 ♀; 4 July (JB, HLV); multivoltine.

Nysson (*Epinysson*) *hoplisivora* Rohwer. 1 ♂; 28 July (FEK); upper beach; social parasite of the sphecid wasp, *Psammaecius costalis* (Cr.).

Nysson (*Epinysson*) *opulentus* Gerstaecker. 1 ♂; 28 June (PJS); multivoltine.

Argogorytes (*Archarpactus*) *nigrifrons* (Smith). 1 ♀; 18 August (RCS).

Ochleroptera bipunctata (Say). 9 ♀; 28 July to 9 September (KVK); probably univoltine; mostly on beach, but also around cabin; nests in ground and preys on leafhoppers.

Sphecius (*Sphecius*) *speciosus* (Drury), the cicada killer. 2 ♀; 25

August to 5 September (KVK); univoltine; one of these females had a nest in the sand on the lower beach; preys on cicadas.

Gorytes (*Gorytes*) *canaliculatus* Packard. 6 ♀, 1 ♂; 9 June to 22 July (AKF, KVK); probably univoltine; I have observed this species nesting in sand on the upper beach and preying on leafhoppers, *Idiocerus* sp. (Krombein, in press).

Gorytes (*Gorytes*) *mcateei* Krombein and Bohart. 2 ♀; 3–6 June (KVK); probably univoltine; in open wooded areas; described from Plummers Island.

Gorytes (*Pseudoplisus*) *phaleratus* Say. 1 ♀; 20 July (PRM); possibly multivoltine.

Bembix spinolae Lepeletier. 1 ♀; 9 September (KVK); multivoltine; on upper beach; nests in sand and provisions with a variety of flies.

Philanthus gibbosus (Fabricius). 11 ♀, 15 ♂; 6 June to 23 September (DBB, KVK, JvdV); on beach and near cabin; nests in ground and preys on solitary bees.

Cerceris atramontensis Banks. 1 ♀; 6 September (KVK); probably multivoltine; near upper end of island; nests in soil in open wooded areas and preys on *Conotrachelus* weevils.

Cerceris clypeata Dahlbom. 1 ♀, 12 ♂; 5 July to 28 September (JCC, KVK, PJS, JvdV); multivoltine; near upper end of island and on beach; several male species may be confused under *clypeata*.

Cerceris compacta compacta Cresson. 1 ♀; 6 September (KVK); probably multivoltine; on upper beach.

Cerceris fumipennis Say. 6 ♂; 19 August to 6 September (KVK); multivoltine; on flowers on upper beach; preys on buprestid beetles, and, secondarily, on chrysomelid beetles.

Cerceris halone Banks. 2 ♀; 8 September (JvdV); on *Solidago* and *Eupatorium* flowers.

Cerceris insolita Cresson. 4 ♀, 1 ♂; 21 June to 31 August (RPC, KVK); probably univoltine; on sandy beaches; I have taken it on the island with its chrysomelid beetle prey, *Rhabdopterus praetextus* (Say) (Krombein, in press).

Anacrabro ocellatus ocellatus Packard. 2 ♀; 17 July to 30 August (KVK); probably multivoltine; nests in ground and preys on *Lygus* bugs.

Entomognathus (*Toncahua*) *memorialis* Banks. 2 ♀, 2 ♂; 28 June to 4 July (JB, KVK, HLV); probably multivoltine; in open wooded areas; males on foliage, one female labeled "nest in soil along wood path."

Crabro (*Paranothyreus*) *snowii* Fox. 3 ♀, 9 ♂; 3–30 July (KVK); univoltine; in open woods.

Crabro (*Crabro*) *cribrellifer* (Packard). 1 ♀, 1 ♂; 9–21 June (KVK); probably univoltine; in open wooded area.

Euplilis (*Corynopus*) *coarctata modesta* (Rohwer). 13 ♀, 14 ♂ and reared specimens; 17 May to 17 October (KVK); multivoltine; in wooded areas and on beach; nests in *Hibiscus* stems and preys on midges (Krombein, in press).

Euplilis (*Corynopus*) *rufigaster* (Packard). 65 ♀, 4 ♂ and many reared specimens; 19 May to 17 October (KVK); multivoltine; in wooded areas and on beach; nests in abandoned beetle borings in cabin steps, wooden trap nests, and *Hibiscus* stems; preys on midges (Krombein, 1958, in press).

Crossocerus (*Microcrabro*) *xanthochilos* Pate. 1 ♀; 16 September (KVK); multivoltine; on mud flat adjacent to river; nests in ground.

Crossocerus (*Crossocerus*) *lentus* (Fox). 11 ♀, 2 ♂; 12 May to 9 September (KVK); multivoltine; around post on cabin porch and on beach.

Crossocerus (*Crossocerus*) *planifemur* Krombein. 2 ♀; 11–17 June (KVK); apparently univoltine; in open woods.

Crossocerus (*Crossocerus*) *planipes* (Fox). 4 ♀; 26 May to 9 June (KVK); multivoltine; nests in soil along woodland path and preys on empidid flies (Krombein, in press).

Crossocerus (*Crossocerus*) *similis* (Fox). 4 ♀, 1 ♂; 28 May to 17 August (KVK); probably multivoltine; nesting in soil along woodland path.

Crossocerus (*Crossocerus*) *spangleri* Krombein. 7 ♀, 2 ♂; 19 May to 18 July (KVK, PJS); multivoltine; mostly on beach, but one male near cabin; described from Plummers Island.

Crossocerus (*Blepharipus*) *ambiguus* (Dahlbom). 3 ♀, 2 ♂; 9 June to 26 October (KVK); multivoltine; on beach; nests in beetle borings in wood and preys on leafhoppers.

Crossocerus (*Blepharipus*) *harringtonii* (Fox). 4 ♀, 2 ♂; 5 May to 30 June (KVK); multivoltine; hovering before borings in cedar posts of cabin porch and standing dead tree.

Crossocerus (*Blepharipus*) *impressifrons* (Smith). 5 ♀, 7 ♂; 6 May to 13 October (JB, KVK, PJS, HLV); multivoltine; hovering before borings in cedar posts of cabin porch and around beach vegetation.

Crossocerus (*Blepharipus*) *stictochilos* Pate. 5 ♂ and several specimens reared from nest in green *Hibiscus* stem; 4 June to 5 September (KVK, JvdV); multivoltine; around beach vegetation.

Crossocerus (*Blepharipus*) *tarsalis* (Fox). 4 ♀, 22 ♂; 17 May to 28 September (JB, KVK, HLV); multivoltine; in open woods and around beach vegetation.

Crossocerus (*Nothocrabro*) *nitidiventris* (Fox). 3 ♀, 2 ♂; 6 May to 23 September (KVK); multivoltine; in woods, on beach, and in borings of cedar posts of cabin porch; preys on crane flies.

Ectemnius (*Clytochrysus*) *lapidarius* (Panzer). 4 ♀, 3 ♂; 17 May to 6 September (KVK); multivoltine; around vegetation on beach; nests in rotten wood and preys on syrphid and anthomyid flies.

Ectemnius (*Lophocrabro*) *singularis* (Smith). 2 ♀; 6 June to 1 September (KVK, HLV); multivoltine; preys on syrphid flies.

Ectemnius (*Hypocrabro*) *continuus* (Fabricius). 5 ♀, 1 ♂; 26 May to 6 September (KVK); multivoltine; on beach, in woods, and hovering before cedar post on cabin porch; nests in logs and preys on muscoid flies.

Ectemnius (*Hypocrabro*) *paucimaculatus* (Packard). 24 ♀, 24 ♂ and many reared specimens; 19 May to 16 September (KVK); multivoltine; nests in green *Hibiscus* stems at edge of river and preys on flies occurring on mud flats, principally Ephydridae and Agromyzidae (Krombein, in preparation).

Ectemnius (*Hypocrabro*) *stirpicda* (Packard). 4 ♀; 19 May to 19 October (KVK); multivoltine; nests in twigs and preys principally on small acalyptrate muscoid flies.

Ectemnius (*Apoctemnius*) *excavatus banksi* (Rohwer). 8 ♀, 2 ♂; 4 June to 28 August (KVK, PRM); multivoltine; in open woods and occasionally on beach; nests in rotten logs.

Ectemnius (*Ectemnius*) *brunneipes* (Packard). 1 ♀; 5 July (KVK); multivoltine; nests in logs.

Ectemnius (*Ectemnius*) *dives* (Lepeletier and Brullé). 1 ♂; 2 June (KVK); multivoltine; in woods; nests in logs, timber, and stems and preys on muscoid flies.

Lestica (*Solenius*) *producticollis* (Packard). 7 ♀, 3 ♂; 26 May to 1 September (HSB, KVK, PJS); multivoltine; in woods and on beach hovering in front of stump.

Oxybelus bipunctatum Olivier. 5 ♀, 1 ♂; 26 May to 25 August (KVK); multivoltine; on sandy beach; nests in sand and preys on flies.

Oxybelus cressonii Robertson. 9 ♂; 29 June to 24 July (KVK, RCS); multivoltine; on sandy beach.

Oxybelus emarginatum Say. 1 ♀, 8 ♂; 2 June to 19 August (KVK); multivoltine; on sandy beach; I have taken it on the island with its prey, a male dolichopodid fly, *Gymnopternus* sp. (Krombein, in press).

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PROCEEDINGS
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TWO NEW SPECIES OF OPHICHTHID EELS FROM THE WESTERN ATLANTIC

By Robert H. Kanazawa
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The following two new species of eels of the family Ophichthidae were received by the U. S. National Museum in collections taken in 1957 by the Fish and Wildlife Service exploratory fishing vessels *Oregon* and *Combat.* The specimens were trawled from the continental shelf off the coast of French Guiana and in the Bahama Islands.

The methods used in measuring and counting follow Kanazawa (1958: 220).

Genus *Mystriophis* Kaup

Mystriophis Kaup, 1856: 10; type species, *Ophisurus rostellatus* Richardson, by monotypy.

The characters of the specimen from off the coast of French Guiana agree with Kaup's description of the genus *Mystriophis,* which he defined as an eel with two rows of palatine and mandibular teeth, one row of vomerine teeth; end of snout dilated to a spoon shape; anterior nasal tube rudimentary and in middle of rostral dilation; eyes over middle of front half of gape, directed somewhat upward rather than laterally; gill openings large and near one another. Only two species of *Mystriophis* having the spoon-shaped snout are known, *M. rostellatus* and the species described below.

Jordan and Snyder (1901: 874) referred *Ophisurus porphyreus* Temminck and Schlegel to the genus *Mystriophis.* I disagree with them and tentatively place *porphyreus* in the genus *Brachysomophis* Kaup because it agrees in the following respects: vomerine canines large, two rows of teeth in upper and one row in lower jaw, head depressed and tapered to tip of snout, posterior nostrils opening to the ventral edge of upper lip instead of on the lateral side, and a row of small papillae on the edge of the lower jaw.

Jordan and Snyder (1901: 874, footnote) also wrote that the American species hitherto referred to *Mystriophis* have small vomerine teeth, a narrow snout and black spotting. They referred the American species to the genus *Crotalopsis* Kaup (a junior synonym of *Echiopsis* Kaup). I agree that the species they treated do not belong in *Mystriophis.*

Ginsburg (1951: 469) doubted that the western Atlantic species *intertinctus* Richardson, *mordax* Poey, and *punctifer* Kaup were congeneric with *Mystriophis rostellatus,* from the eastern Atlantic. He stated that if these species were generically distinct from *rostellatus,* they should be placed in the genus *Echiopsis* Kaup. I agree with Ginsburg.

Mystriophis blastorhinos, new species

(Fig. 1, 2A, Pl. I, left)

Holotype: USNM 158960, 418 mm total length, collected off the coast of French Guiana, 07° 18′ N, 53° 32′ W, 100 fathoms, 40-foot shrimp trawl, 8 Nov. 1957, M/V *Oregon*, Sta. 2021.

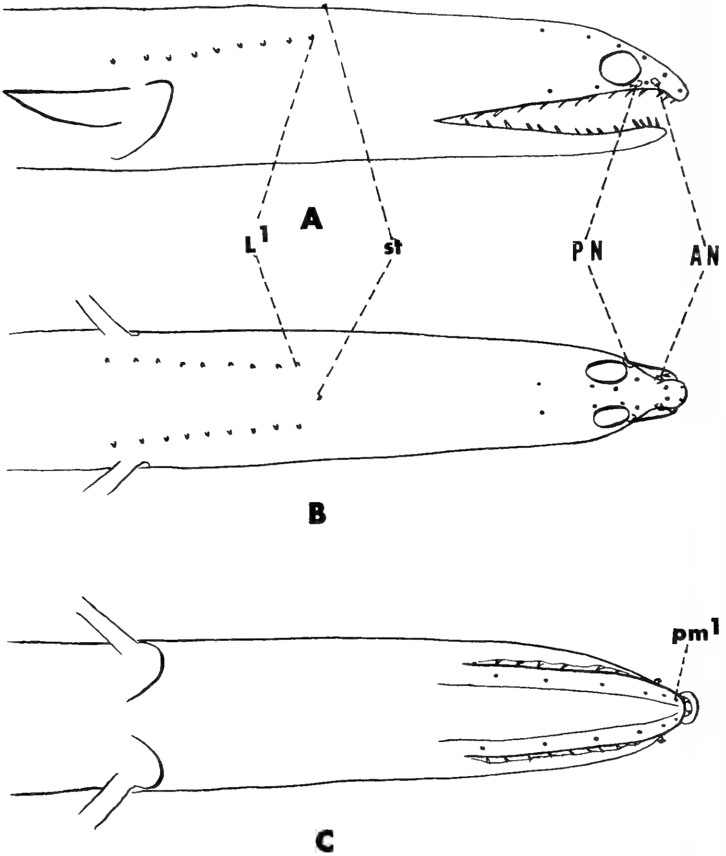

FIG. 1. Views of the head of *Mystriophis blastorhinos*: A, lateral; B, dorsal; C, ventral; showing position of surface sensory pores. Symbols: AN, anterior nostrils; PN, posterior nostrils; st, supratemporal pore; L[1], first lateral line pore; pm[1], first preoperculo-mandibular pore. (Terminology after Allis, 1903.)

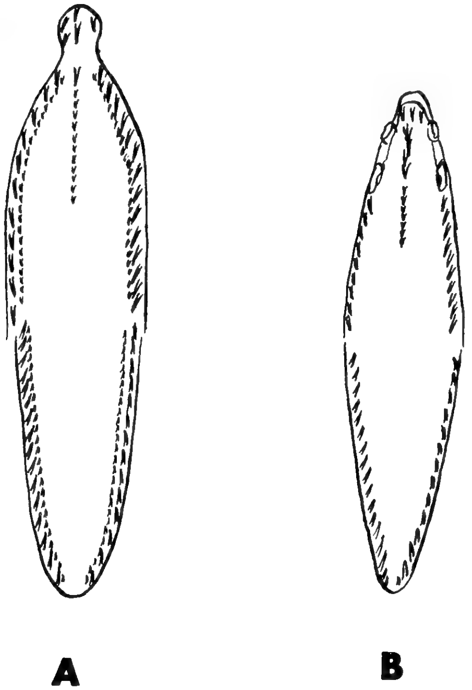

FIG. 2. Dental patterns of upper and lower jaws: A, *Mystriophis blastorhinos*; B, *Ophichthus melanoporus*.

Diagnosis: Snout spoon-shaped, overhanging tip of lower jaw; origin of dorsal fin on a vertical about one and one-half pectoral fin lengths behind posterior tip of pectoral fin; body grayish brown, lighter ventrally.

Description: The following numbers are expressed in thousandths of total length. Tip of snout to anus 436; tip of snout to origin of dorsal fin 187; length of head 125; depth of head 34; tip of snout to rictus of jaw 55; snout length 11; diameter of eye 8; tip of lower jaw to tip of snout 3; interorbital width 6; pectoral fin length 28.

Upper edge of gill opening on level with upper edge of pectoral fin base (upper edge of gill opening designated as that point where free edge joins the body); anus in anterior half of body; rictus of jaws below middle of head; eye small, its diameter two-thirds snout length; interorbital width about one-half eye diameter; eye over anterior one-third of gape; snout produced, overhanging tip of lower jaw, constricted near middle, its anterior end budlike; anterior nostrils tubular, midway between anterior edge of eye and tip of snout; posterior nostrils with flap, just below anterior edge of eye; tongue adnate to floor of mouth; jugostegalia present; vertebrae 142.

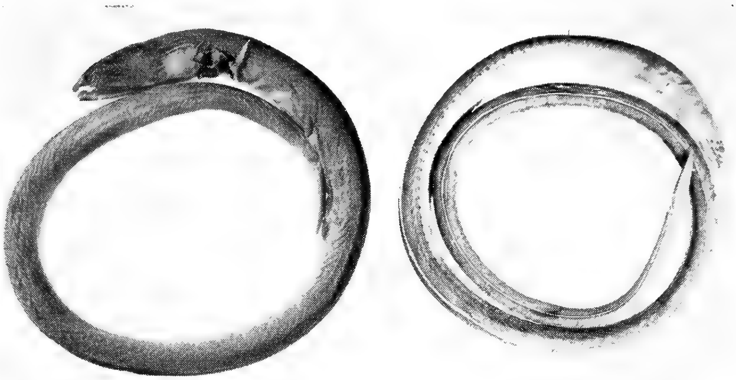

PLATE I
Left, holotype of *Mystriophis blastorhinos*, USNM 158960; right, holotype of *Ophichthus melanoporus*, USNM 191118.

Teeth in jaws conical, in two rows; the inner row in each jaw of small teeth; the outer row of widely spaced canines, with about 10 in upper and 9 to 14 in lower jaw; vomerine teeth small, in single row extending posteriorly two-thirds distance from tip of snout to rictus of jaws (Fig. 2A).

Color in alcohol: Body grayish brown, lighter ventrally, covered with fine brownish speckling; dorsal fin pale with distal edge dusky; anal fin whitish; pectoral fins pale with speckling on basal half; lower jaw speckled with brown.

Remarks: This species is closely related to *rostellatus* Richardson, but differs in the more posterior insertion of the dorsal fin and in the absence of a black longitudinal stripe. It differs from *Mystriophis creutzbergi* Cadenat from the coast of Sierre Leone and from all other western Atlantic members of the genus by the presence of the spoon-shaped snout and by the absence of large spots on the body.

Genus *Ophichthus* Ahl

Ophichthus Ahl, 1789: 9; species, *Ophichthus ophis* Linnaeus, 1758 by subsequent designation of Bleeker, 1865.

Because the generic limits of this group are not well defined, I follow the broader definition of the genus *Ophichthus* by Bleeker (1865). If the genera proposed by Kaup were to be recognized the species described below would be best assigned to *Centrurophis.*

Ophichthus melanoporus, new species
(Fig. 2B, 3, Pl. I, right)

Holotype: USNM 191118, a female, 691 mm total length, collected in the Straits of Florida, west of Andros Island, Bahamas, 24° 04′ N,

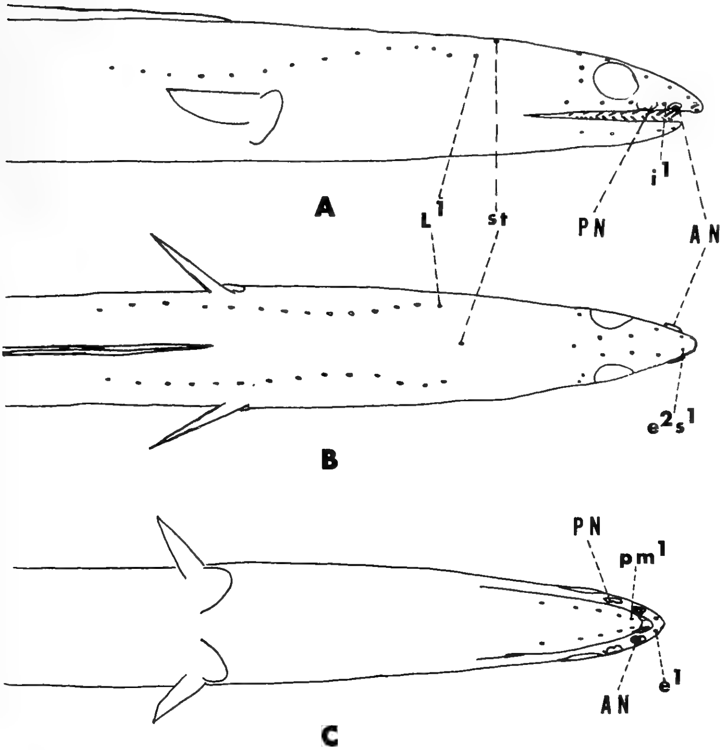

FIG. 3. Views of the head of *Ophichthus melanoporus*: A, lateral; B, dorsal; C, ventral; showing the position of the surface sensory pores. Symbols: AN, anterior nostrils; PN, posterior nostrils; st, supratemporal pore; L^1, first lateral line pore; i^1, first infraorbital pore; e^1, first ethmoidal pore; e^2s^1, compound pore, i.e., second ethmoidal and first supraorbital pores; pm^1, first preoperculo-mandibular pore. (Terminology after Allis, 1903.)

79° 15′ W, 250 fathoms, 40-foot flat net, 24 July 1957, M/V *Combat*, Sta. 448.

Paratypes: USNM 191119, 3 specimens, all males, collected with the holotype, 542 to 672 mm total length. One specimen, 599 mm total length with the same data as above, in the collection of the U. S. Bureau of Commercial Fisheries, Biological Laboratory, Brunswick, Georgia.

Diagnosis: Teeth in both jaws and on vomer in single row, vomerine teeth extending posteriorly to opposite middle of gape length, pores on head and lateral line with conspicuous black spotting.

Description: The counts and measurements are recorded first for the holotype, followed by those for the four paratypes in parentheses, all in thousandths of total length. Tip of snout to anus 311 (287–312);

tip of snout to origin of dorsal fin 84 (82–94); head length from tip of snout to upper edge of gill opening 65 (64–70); greatest body depth 20 (17–26); gape from tip of snout to rictus of jaw 29 (28–31); snout length 9 (9–11); diameter of eye 7 (6–9); tip of snout to tip of lower jaw 2 (2–3); length of pectoral fin 12 (13–17).

Pores in lateral line 56 (52–54); supratemporal pore 1 (1); pectoral rays 16 (15–17); number of vertebrae 186 (177–186); upper edge of gill opening just below upper edge of pectoral fin base; origin of dorsal fin on a vertical from 63% of pectoral fin length posterior to insertion of pectoral fin (3% anterior to insertion to 46% posterior to insertion); posterior edge of eye about midway from tip of snout to rictus of jaw; mouth in front of middle of head; anterior nostril tubular, about midway between tip of snout and posterior nostril; posterior nostril with flap, on the upper lip, below vertical line through anterior edge of eye; teeth in both jaws conical, in single row; premaxillary tooth patch with three teeth; single row of vomerine teeth extending backward to middle of distance from tip of snout to rictus of jaws, teeth smaller posteriorly (Fig. 2B); jugostegalia present.

Color in alcohol: General color brownish; fine, darker brown specks over head and body, sparser ventrally where they form fine, wavy, oblique lines; edge of lower jaw and area around gill opening pale; pores of head and lateral line in black spots; vertical and pectoral fins pale.

Remarks: This species is closely related to *Ophichthus hispanus* Belotti from the Mediterranean Sea but differs by having the teeth in jaws uniserial and those on vomer, biserial.

The species is named *melanoporus* for the conspicuous black pores on head and lateral line.

Acknowledgments: I wish to thank W. W. Anderson and Frederick H. Berry of the U. S. Bureau of Commercial Fisheries Biological Laboratories at Brunswick, Georgia, for furnishing the material; and William R. Taylor of the U. S. National Museum for reading the manuscript and making valuable comments.

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REDESCRIPTION OF THE PLETHODONTID SALAMANDER *BOLITOGLOSSA LIGNICOLOR* (PETERS), WITH REMARKS ON THE STATUS OF *B. PALUSTRIS* TAYLOR

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Los Angeles 7, California

Recently, while examining Costa Rican and Panamanian salamanders, we found that the holotype of *Bolitoglossa palustris* bore a remarkable similarity to salamanders assigned by us to *B. lignicolor*. This discovery prompted a thorough investigation into the status of the two taxa. It is now apparent that only a single species is represented, and it is rediagnosed and redescribed below. In addition, information concerning intraspecific variation and ideas concerning relationships of *B. lignicolor* and its allies are presented.

Acknowledgments and abbreviations: We thank the following curators and museums for allowing us to examine and report upon material in their care: Norman E. Hartweg and Charles F. Walker, University of Michigan Museum of Zoology (UMMZ); Charles E. Bogert and Richard G. Zweifel, American Museum of Natural History (AMNH); James E. Böhlke, Academy of Natural Sciences, Philadelphia (ANSP); Doris M. Cochran, U. S. National Museum (USNM), William E. Duellman, University of Kansas Museum of Natural History (KUMNH), and Heinz Wermuth, formerly of the Berlin Museum (ZMB). We are grateful to Jay M. Savage for reading the manuscript and offering his advice. Part of the research was conducted while the junior author held a National Science Foundation Cooperative Graduate Fellowship.

Bolitoglossa lignicolor (Peters)

Spelerpes (*Oedipus*) *lignicolor* Peters, 1873. Monatsb. König. Preuss. Akad. Wiss. Berlin, 1873: 617.

Oedipus ahli Unterstein, 1930. Zool. Anz., 57. (9/10): 272.

Bolitoglossa lignicolor Taylor, 1944. Univ. Kansas Sci. Bull., 30, Pt. 1 (12): 219.

Bolitoglossa palustris Taylor, 1949. Univ. Kansas Sci. Bull., 33, Pt. 1 (6): 283.

Holotype: ZMB 7736, Chiriquí, Panamá.

Material examined: Panamá, ANSP 22875–77, UMMZ 58489–90, 58492–95, USNM 118784, Boquete, 4,000 feet (1,220 meters), Provincia de Chiriquí; UMMZ 58496–98, Progresso, 100 ft (30 m), Prov. Chiriquí; ANSP 21639–42, Puerto Armeulles, near sea level, Prov. de Chiriquí; ZMB 31801 (2 specimens, syntypes of *Oedipus ahli*), "Val de Pilaton, Cordillera" = Chiriquí, Prov. Chiriquí, fide Dunn (1940); ANSP 22480–95, Cerro Mangillo, 2,800 ft (850 m), Peninsula de Azuero, Prov. Los Santos; ANSP 22549–50, Tiger Ridge Camp, 2,600 ft (800 m), Peninsula de Azuero, Prov. Los Santos. Costa Rica: UMMZ 123196, Río Rincon, 164 ft (circa 50 m), Peninsula de Osa, Prov. Puntarenas; KUMNH 23817 (holotype of *B. palustris*), 34924, San Isidro del General, 2,400 ft (730 m), Prov. San José; KUMNH 66164, east of Isla Bonita, 3,040 ft (925 m), Prov. Heredia; AMNH 11725, Sarapiquí, 300 ft (92 m), Prov. Heredia; and holotype.

Diagnosis: A large species of *Bolitoglossa* (11 adult males: 47.3–67.7, mean 59.2 mm, standard length; 10 adult females: 47.9–81.2, mean 66.8 mm) with moderate numbers of maxillary teeth (21 adults: 23–60, mean 35) and fully webbed hands and feet distinguished from *B. alvaradoi* by fewer maxillary teeth and banded rather than patched light dorsal coloration; from *B. arborescandens* by more robust habitus, fewer maxillary teeth, and tendency for light dorsal pigmentation; from *B. borburata* by larger size and fewer maxillary teeth; from *B. striatula* by larger size, more robust habitus, darker ground color, and solid rather than striated color ventrally; from *B. yucatana* by slightly broader head, less robust tail, and tendency for broad dorsal band of light color rather than paired dorsolateral light stripes.

Description: *B. lignicolor* is a large, robust species with a moderately long and broadly rounded to subtruncate snout. As is typical of the genus, females are larger than males. The nostril is small. Labial protuberances are moderately developed in adult males, but poorly developed in females and young. Mental hedonic glands are present in adult males but are only faintly indicated. Heads are moderately broad, but head width is variable (standard length 5.6 to 7.1 times head width, mean 6.3 in males; 6.3 to 7.2, mean 6.6 in females). A relatively deep, slightly curved groove about the same length as the eye opening is found just below the eye, but it does not communicate with the lip. The eyes are moderate in size, and are but slightly protuberant. A poorly defined postorbital groove extends posteriorly from the eye as a shallow, irregular depression. At the posterior end of the mandible the groove proceeds sharply ventrally and extends across the throat anterior to the gular fold

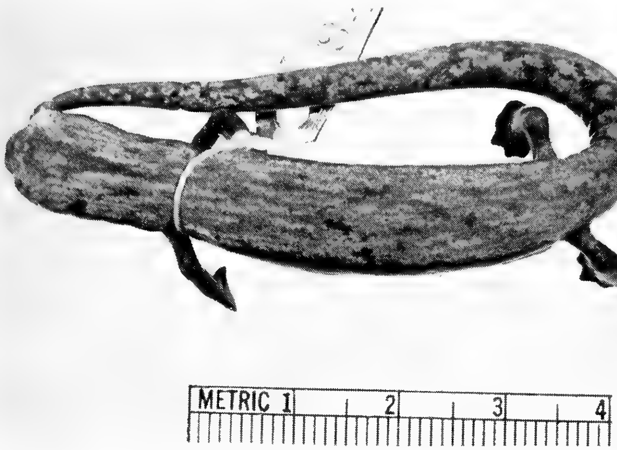

FIG. 1. Dorsal view of *Bolitoglossa lignicolor*, UMMZ 58498, adult female, from Progresso, Provincia de Chiriquí, Panamá.

as a moderately to poorly defined depression. Vomerine teeth range from 18 to 40 (mean 28) in adult males, and from 24 to 38 (mean 32) in adult females. Vomerine teeth increase in number with size, in general, and the larger number in females is probably a reflection of their larger size. The teeth are either in patches or single series and always extend beyond the medial border, and sometimes extend beyond the lateral border of the internal nares. Maxillary teeth extend to about the center of the eyes and range from 23 to 43 (mean 34) in adult males, and from 24 to 60 (mean 36) in adult females. Premaxillary teeth are few in number (0–6), and pierce the lip of adult males. Many slightly enlarged and pigmented glandules cover the dorsal surface of the head, trunk, and tail. The trunk and tail are robust. Tails are almost round in cross section and are moderately constricted at their bases. Light gray postiliac glands are usually present. Limbs are robust and of moderate length. Limb interval (costal folds between appressed limbs) varies from 2½ to 3½ (mean 3) in males; 2½ to 4½ (mean 3½) in females. Hands and feet are relatively large, and are extensively and virtually completely webbed. Digits are well demarcated by grooves in the webbing between them. Tips of the longer digits protrude from the webbed pad as broadly rounded points. The longest digit has a more pointed tip than the other digits. Webbing between the digits is very thickened and the digits are not greatly flattened as in certain other *Bolitoglossa* (e.g., *striatula*, *colonnea*). Subterminal pads are not evident. The fingers are in order of decreasing length: 3, 2, 4, 1; toes in order of decreasing length: 3, 4, 2, 5, 1. Pertinent counts and measurements of material studied by us are found in Table 1.

Ground color of the lateral and ventral surfaces is very dark and

TABLE 1.—Data on *Bolitoglossa lignicolor*

MUSEUM NUMBER		SNOUT–VENT LENGTH	AXILLA–GROIN	HEAD WIDTH	HIND LIMB LENGTH	SNOUT–GULAR FOLD	LIMB INTERVAL	TAIL LENGTH	MAXILLARY TEETH	VOMERINE TEETH
ANSP	22877	♂ 67.7	37.4	10.7	16.3	15.0	3	70.2	40	34
UMMZ	58489	♂ 64.3	36.2	9.8	14.0	13.8	3½	54.2	28	40
ANSP	22876	♂ 62.3	33.7	11.1	16.2	14.9	2	60.8	31	30
ANSP	22480	♂ 61.3	34.1	9.8	13.5	13.6	2½	50.2	45	28
ANSP	22482	♂ 60.9	33.8	9.5	13.8	13.0	2½	47.1	35	18
ANSP	22481	♂ 60.5	33.6	9.6	13.2	13.2	3	54.2	41	23
UMMZ	123196	♂ 59.2	32.8	8.3	13.9	13.3	2½	64.2	31	21
ANSP	22875	♂ 59.1	32.7	9.6	13.3	13.2	2½	55.8	33	34
ANSP	22484	♂ 54.9	31.2	9.2	12.0	12.4	3	47.1	43	23
UMMZ	58497	♂ 53.3	28.1	8.1	12.0	12.8	3½	53.5	25	28
UMMZ	58493	♂ 47.3	25.5	7.9	10.4	10.8	3	41.2	23	24
UMMZ	58495	♀ 81.2	46.9	11.3	17.0	17.2	4	67.0	48	26
KUMNH	66164	♀ 78.6	45.5	12.3	18.0	17.0	4	80.2	60	42
KUMNH	34924	♀ 76.4	44.7	10.6	16.3	16.8	4½	77.8	40	24
AMNH	11725	♀ 73.0	42.1	10.9	—	16.8	—	—	—	19*
UMMZ	58490	♀ 71.5	40.9	10.7	15.8	15.0	4	—	32	28
ANSP	22549	♀ 64.6	35.9	10.1	14.2	14.1	4	45.2	48	29
UMMZ	58498	♀ 63.1	36.6	10.0	14.6	14.0	4	64.0	44	34
UMMZ	58494	♀ 61.6	33.7	9.8	13.3	14.1	3½	—	33	38
ANSP	21639	♀ 49.8	27.3	7.8	12.0	10.9	3	—	33	29
KUMNH	23817	♀ 47.9	27.0	7.6	11.2	11.1	4	33.0	24	28
ANSP	21642	♀ 45.5	25.7	7.4	10.8	10.8	2½	30.4	27	22
ANSP	22550		44.5	22.8	7.5	10.8	10.4	3	35.0	23	19
UMMZ	58491		44.5	23.4	7.4	9.9	10.2	3	37.4	13	25
ANSP	21641		43.2	24.2	7.1	10.2	10.6	3	39.3	25	23
UMMZ	58492		39.5	21.9	6.5	8.9	8.8	3	28.4	18	22
UMMZ	58496		29.7	15.6	4.8	6.8	7.8	3	21.7	4	16

* Vomerine teeth counted on one side only.

ranges in preservative from lead gray to gray to gray-brown. Broad dorsal bands of cream to light tan with slight pinkish tints are present in most individuals. The band is often streaked or washed with darker coloration and the amount of dark dorsal coloration is rather variable. Some have only a few spots of dark color dorsally, most have a central irregular dark streak that expands on the head, and some are very dark dorsally with only a few streaks of light coloration. One specimen is uniformly dark dorsally. The dark ventral coloration appears to undergo some ontogenetic change. In smaller specimens the dark color is arranged in punctate melanophores, but with increasing size the melanophores fuse to form dense reticula. The ventral surface of the tail is colored similar to the trunk venter. Tiny white guanophores are common on all ventral surfaces and on the dark-colored limbs, and some striations of white pigment are found on the throats of many individuals.

Remarks: Taylor (1949) described a new species of salamander, *Bolitoglossa palustris* (KUMNH 23817), which he considered to be a member of the *Bolitoglossa rufescens* group. He did not mention the possibility of relationship to *B. lignicolor.* In 1952, however, Taylor compared *B. palustris* with *B. lignicolor* and stated: "The two chief characters, which seem to separate *Bolitoglossa palustris* from this species is that each of the ridges has the vomerine teeth arranged in a patch or multiple series, rather than in a single line, and the tail is much shorter than head–body length (approximately 0.7)."

The characters used by Taylor to separate *B. palustris* and *B. lignicolor* are not consistent. Nineteen of 22 specimens of *B. lignicolor* with unregenerated tails have tails that are shorter than their standard lengths, including eight that have tails 10 mm or more shorter than their standard lengths. Two individuals have body–tail dimensions very closely approximating the holotype of *B. palustris.* As a taxonomic character, tail length in salamanders is hazardous, and in the case under consideration the character appears to be valueless.

Taylor's statement concerning the arrangement of vomerine teeth in *B. lignicolor* does not hold. The numbers and arrangement of vomerine teeth are subject to clinal variation, and range from low numbers arranged in single rows in central Panamá to high numbers arranged predominantly in patches in Costa Rica (Table 2).

In 1954, Taylor reported finding a specimen of *B. lignicolor* from the type locality of *B. palustris.* The vomerine teeth are arranged in two rows (patched) somewhat like *B. palustris,* and the tail is but 1 mm longer than the standard length. Taylor therefore revised his analysis

TABLE 2.—Clinal arrangement of vomerine teeth organization in *Bolitoglossa lignicolor*

AREAS	PATCH	INTERMEDIATE	SINGLE
Northeastern and Central Costa Rica	2	0	1
Southern Costa Rica and Far-western Panamá	7	6	4
Central Panamá	1	2	8
TOTAL	10	8	13

of distinguishing characters for separating *B. palustris* from *B. lignicolor* as follows: "Vomerine teeth forming an irregular patch on strongly elevated ridges (low in *lignicolor*), the domelike character of the palate (much less so in *lignicolor*), the choanae of the type actually larger than those of this specimen of *lignicolor* (KUMNH 34924), more than double its size, the tail compressed, higher than wide, the color different . . . ." Examination of a series of *B. lignicolor* reveals that these characters are highly variable. The majority of *B. lignicolor* which have vomerine teeth arranged in patches have an irregular arrangement like that of the holotype of *B. palustris.* Elevation of the vomerine ridges shows considerable variation as does the relative choanal size. Curvature of the palate ranges widely in shape from dome shape to gentler curves, and is at least partially influenced by preservation. Degree of tail compression in many of the specimens of *B. lignicolor* matches that of *B. palustris*, and the color of *B. palustris* agrees with the coloration of several small individuals of *B. lignicolor.*

In addition to the above similarities, *B. palustris* falls within the range of variation for *B. lignicolor* in regard to the following characters (proportional to standard length): numbers of vomerine and maxillary teeth,

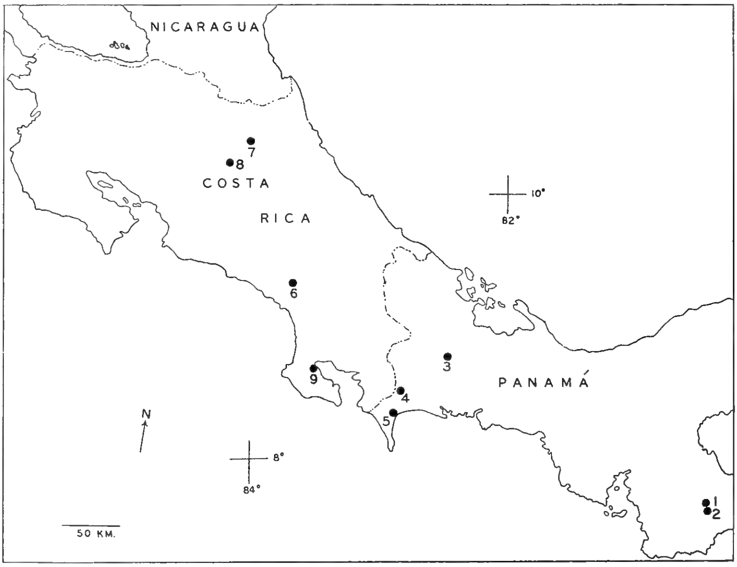

FIG. 2. Range of *Bolitoglossa lignicolor* with localities indicated by black dots; 1—Cerro Mangillo, Peninsula de Azuero, Provincia de Los Santos; 2—Tiger Ridge Camp, same region as locality 1; 3—Boquete, Prov. Chiriquí; 4—Progresso, Prov. Chiriquí; 5—Puerto Armeulles, Prov. Chiriquí; 6—San Isidro del General, Prov. San José; 7—Sarapiquí, Prov. Heredia; 8—east of Isla Bonita, Prov. Heredia; 9—Río Rincon, Peninsula de Osa, Prov. Puntarenas.

head width, head length, and hind limb length (see Table 1). The taxon is left without distinguishing characters, and it seems apparent that *B. palustris* should be considered a subjective junior synonym of *B. lignicolor.*

The senior author recently examined the two syntypes of *Oedipus ahli* Unterstein in the Berlin Museum, and concurs with Dunn (1940) in considering this name to be a subjective junior synonym of *B. lignicolor.*

The closest relative of *B. lignicolor* is apparently *B. yucatana.* Dunn (1926) first pointed out this close relationship and Taylor (1952) concurred. The two species resemble each other very closely in size, proportions, and numbers of teeth. *B. yucatana* tends to have a slightly narrower head than *B. lignicolor.* The tail of adult *B. yucatana* is extremely robust, and is much larger than that of *B. lignicolor.* The broad, light dorsal band of *B. lignicolor* is replaced in *B. yucatana* by paired dorsolateral light stripes. *B. lignicolor* is a little less closely related to *B. mexicana, B. flaviventris, B. salvinii,* and *B. platydactyla* from which it differs in being more robust, in shape of hands and feet, and in coloration. It resembles *B. alvaradoi* in size, proportions, and shape of hands and feet but differs in lacking spots or patches of light coloration dorsally, and in having fewer maxillary teeth. It is probably more closely related to *B. alvaradoi* than to any other southern Central American species. There is some indication of a relationship between *B. lignicolor* and *B. borburata* of Venezuela, especially in coloration. *B. lignicolor* is larger, however, and has far fewer maxillary teeth, and differently shaped hands and feet.

Range: Central Panamá to northeastern Costa Rica (Fig. 2).

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THE SYSTEMATIC STATUS OF THE LINED SNAKE OF IOWA[1]

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In the recent review of the systematics and biogeographic significance of *Tropidoclonion lineatum* (Hallowell) in Illinois (Smith and Smith, 1962), we overlooked the description by R. Ellsworth Call (1891) of *Tropidoclonium lineatum Iowae* from Story and Polk counties, Iowa. Although we plotted a Story County record on our distribution map, we did not allocate the specimens on which the record was based to subspecies, and indeed we were then not even aware that the record represented the type-locality of *iowae.*

Shortly after the appearance of our paper, Kraig K. Adler called our attention to the generally overlooked description by Call and to the availability of specimens from additional Iowa localities. The new material enables us to allocate Call's name *iowae,* but at the same time it raises doubt that the Iowa distribution of the lined snake is relictual, as we had presumed, and it requires reexamination of the data and interpretations presented in our 1962 paper.

Acknowledgments: We are grateful to Kraig K. Adler of the University of Michigan for calling our attention to the Iowa situation and the location of some of the syntypes, and to him and to Dr. Kenneth D. Carlander of Iowa State University for the loan of specimens and other courtesies. We are indebted to Joseph T. Collins and Corson Hirschfeld of the Ohio Valley Herpetological Laboratory for information on a syntype of *T. l. Iowae* and to Dr. Jack L. Gottschang of the University of Cincinnati for generously donating the type to the University of Illinois Museum of Natural History. We acknowledge information received from Roger Conant, Philadelphia Zoological Garden, and from Charles W. Myers and Dr. William E. Duellman, University of Kansas Museum of

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[1] Contribution from the University of Illinois Museum of Natural History, Urbana.

Natural History, regarding the Missouri range of the species, made available through the researches of the late Paul Anderson of Independence. We thank Dr. Doris M. Cochran for checking the identification of an old Yarrow specimen in the U. S. National Museum.

History of Tropidoclonium lineatum Iowae: The name *T. l. Iowae* was proposed by Call (1891: 298–9) on the basis of four syntypes, two from Ames, Story Co., and two from Des Moines, Polk Co., Iowa. Two of the specimens were stated (p. 299) to be in the "Iowa Agricultural College, at Ames, Iowa; one in the collection of the Indiana University, Bloomington, and one in the West High School, Des Moines, Iowa." The only specimen of *Tropidoclonion* in the Iowa State University Museum collected before 1922 is a badly faded example bearing the notation "B. F. Osborne collection." The specimen, No. 403, is in excellent condition except for depigmentation. Collectors were not recorded in Call's account, and we can find no information on the history of an Osborne collection, although the name of Herbert Osborn is well known in the Iowa zoological literature. There is a reasonable possibility that the specimen in question was one of the syntypes of *iowae*; it is certainly the only specimen there that could logically be regarded as a syntype.

During the course of our investigation, Mr. Joseph T. Collins wrote us that he and Mr. Corson Hirschfeld had discovered the syntype that Call originally deposited at Indiana University among specimens donated to the University of Cincinnati by the Cincinnati Museum of Natural History. Dr. Jack L. Gottschang of the University of Cincinnati generously presented the specimen, now UIMNH 53022, to us.

This syntype is clearly the last of the four for which characteristics are tabulated on page 299 of Call's paper; that specimen had 35 caudals as does UIMNH 53022, whereas the other syntypes had 31, 29, and 18. (All four apparently had incomplete tails.) Call's fourth specimen had 145 ventrals, whereas our count (from the first ventral of full width) for No. 53022 is 141; however, if all the scales are counted back of the posterior chinshields, the count comes to exactly 145. Assuming that Call was consistent in his method of scale counting, we have adjusted all the ventral counts for specimens in his table by subtracting four from the figures given, to make the counts comparable to ours. This adjustment gives figures that agree well with our counts on specimens from central Iowa, whereas the unadjusted counts would be higher than expected. The total length and tail length recorded by Call are, respectively, 15 and 3 mm greater than our measurements of No. 53022, but this degree of shrinkage in over 60 years of preservation is to be expected. Except for fading, the specimen is in excellent condition.

Accordingly, we hereby designate UIMNH 53022 lectotype (more exactly, the lectoholotype, the other specimens listed becoming, in effect, lectoparatypes) of *Tropidoclonium lineatum Iowae* Call, 1891. The type-locality is thus restricted to Des Moines, Polk Co., Iowa, the locality data borne by No. 53022.

Iowa specimens examined: Adams Co.—3 mi W Corning, Iowa State Univ. 485 (3 specs.); Cherokee Co.—Cherokee, Iowa State Univ. 2816; Keokuk Co.—5½ mi W Sigourney, Iowa State Univ. 401; Lee Co.—6 mi NE Ft. Madison, Iowa State Univ. 179; Lucas Co.—near Chariton, Univ. Michigan Mus. Zool. 94200; 1½ mi E Chariton, Iowa State Univ. 402; Montgomery Co.—2.6 mi N Morton Mills, Iowa State Univ. 404; Polk Co.—Des Moines, Univ. Illinois Mus. Nat. Hist. 53022 (lectotype; collected by R. E. Call in 1888), Univ. Michigan Mus. Zool. 92970 (2 specs.) and 92971; Scott Co.—Davenport, Univ. Illinois Mus. Nat. Hist. 50885–6; Story Co.—Ames, Iowa State Univ. 403; Wapello Co.—N of Ottumwa, Univ. Michigan Mus. Zool. 92972.

Subspecific status of Tropidoclonium lineatum Iowae: Stejneger (1891: 504) synonymized *iowae* almost immediately after its proposal and commented that he was unable to find any characters that would separate it from Hallowell's type (*lineatum*) or from Missouri specimens (now assigned to the subspecies *annectens*). Inasmuch as the currently recognized subspecies *annectens* and *texanum* were described much later (Ramsey, 1953), subspecific allocation of the generally overlooked name *iowae* becomes of pressing taxonomic importance.

Including data that Call gave for four syntypes (with the ventral counts adjusted, as described in a preceding paragraph), ventral counts are available for six females and one male from Story and Polk counties; of these, caudal, and ventral plus caudal, counts are available for three females (three other females and the male lectotype have incomplete tails). Ventrals are 135–144 (mean 140) in females and 141 in the male and suggest the subspecies *lineatum* or *texanum* but not *annectens* or the Illinois population (Table 1). Caudals are 32–35 (mean 33.3) in the three females and inconclusive; the mean, although slightly closer to that of the Illinois relict population, could as easily have occurred in a sample of *lineatum* or *annectens* (Table 1) but not of *texanum*. Ventrals plus caudals range from 167–176 (mean 171.6) in females and are closest to the counts of *texanum*, next closest to *lineatum*. The similarity of the means (except caudals) for samples of topotypic *iowae* and the geographically remote *texanum* is undoubtedly fortuitous. All seven specimens from Story and Polk counties have 17–19–17 scale rows, the formula modal for *lineatum*. Accordingly, the central Iowa population can be referred to the nominate subspecies.

Subspecific status of specimens from other areas in Iowa: The 10 Iowa localities from which specimens are now available happen to be aligned so that it is convenient to divide them into four samples. From west to east, these samples consist of (1) two females and three males (in Table 1, "Western Iowa") from Adams, Montgomery, and Cherokee counties, all assignable to *lineatum*; (2) five females and one male plus counts for two other specimens given by Call (in Table 1, "Central Iowa"), from Story, Polk, and Lucas counties, all closer to *lineatum* than to *annectens* or the Illinois relict; (3) two females (in Table 1, also included in "Cen-

TABLE 1.—Three principal characters for three Iowa samples of female *Tropidoclonion lineatum*, showing relationships to *T. l. lineatum*, to the Illinois relict population, and to *T. l. annectens*[1]

POPULATION	NO. OF SPECIMENS	VENTRALS	CAUDALS	VENTRALS PLUS CAUDALS
T. l. lineatum	35	141.2 ± 0.46 (135–148)	34.6 ± 0.42 (31–40)	175.5 ± 0.66 (169–184)
Western Iowa[2]	2	141.5 (138–145)	34.0 (33–35)	175.5 (171–180)
Central Iowa[3]	10	140.9 ± 1.0 (135–147)	33.4 ± 0.45 (32–35)	172.0 ± 1.1 (167–175)
Eastern Iowa	3	144.3 (141–148)	33.0 (32–34)	175.5 (173–178)
Illinois Relict[4]	25	144.8 ± 0.62 (138–150)	33.0 ± 0.50 (26–38)	177.9 ± 0.79 (170–184)
T. l. annectens	118	147.0 ± 0.23 (142–156)	34.3 ± 0.17 (24–39)	181.8 ± 0.29 (168–189)

[1] For each character the scale count range, enclosed in parentheses, is immediately beneath the mean and one standard error.

[2] The sample from this area also contains three males, not entered in this table, all with typical *lineatum* scale counts.

[3] Includes Keokuk, Lucas, and Wapello as well as Story and Polk counties, but does not include the lectotype, which is a male with an incomplete tail.

[4] Although means for ventrals and ventrals plus caudals for Illinois relict females are intermediate between those of *lineatum* and *annectens*, the corresponding means for Illinois males are almost identical with those of *annectens*.

tral Iowa") from Keokuk and Wapello counties, not definitely assignable but suggesting *lineatum*; and (4) three females (in Table 1, "Eastern Iowa") from Lee and Scott counties, assignable to *lineatum* in ventrals plus caudals but decidedly closer to the Illinois population in ventral and caudal counts. Accordingly, all Iowa populations, except those bordering the Mississippi River (Lee and Scott counties) are provisionally referred to the nominate race; the two easternmost populations, to *lineatum* × *annectens* intergrades. The availability of larger series, particularly from eastern Iowa, may require revision of present assignments.

Relictual versus continuous range of Tropidoclonion: In our 1962 paper, we assumed that all known colonies of *Tropidoclonion* in Iowa, Missouri, and Illinois are relicts, derived from Great Plains populations that occurred farther north and east during the postglacial Hypsithermal interval. Our contention is strengthened by distributional data provided by Anderson's work in Missouri where, as in Illinois, there is little doubt that present populations are scattered remnants. It would appear to be weakened by the data now available for Iowa, where the 10 known localities are seemingly distributed evenly across the southern half of the state from the Missouri River to the Mississippi River.

In a sense, the entire range of the lined snake is relictual, occurring as the species does in urban and suburban vacant lots. However, in Kansas, Oklahoma, and central Texas, *Tropidoclonion* is generally common, widely distributed, and predictable. In Illinois and Missouri, it is locally common, sparsely distributed, and distinctly unpredictable. In Iowa, where habitats with ecological characteristics approaching those of the Great Plains are more widely distributed than in Illinois or Missouri, the range of the species may be at a level intermediate between relictual and continuous.

All known records for Iowa, Illinois, and Missouri are plotted in Figure 1, and their probable subspecific identities indicated by hatching. Whether the Iowa range is considered continuous or disjunct, the distributional and variational data afforded by populations in Illinois and Missouri are best explained by assuming a more northern and eastern distribution sometime between the last glacial advance and the present time, as we postulated in our 1962 paper.

Two other outlier records for the species deserve comment. Yarrow (1882: 13) cited a specimen from Hughes, Ohio, a record that could be readily explained by our interpretation since Ohio is within the Prairie Peninsula. Stejneger (1891: 504) pointed out that the specimen in question is in reality a misidentified *Storeria occipitomaculata*; Conant (1938: 8) reidentified the same specimen as *Tropidoclonion* and more recently Dr. Doris M. Cochran, at our request, confirmed Conant's identification. We are in accord with Conant (*ibid.*) that the specimen probably has incorrect locality data but, should additional Ohio specimens be found, Yarrow's record could be validated.

Dellinger and Black (1938: 34) cited a specimen from Imboden, Arkansas. Dowling (1957: 23) dismissed the record as erroneous, but Wright and Wright (1957: 881) published two photographs of the specimen allegedly from Imboden. The Arkansas record is certainly not acceptable on face value, for the collector, B. C. Marshall, was a dealer who received specimens from many parts of the country and demonstrably did confuse locality data on some of the material he sent to museums.

Conclusions: (1) *Tropidoclonium lineatum Iowae* Call is a synonym of *Tropidoclonion l. lineatum* (Hallowell) and is nomenclaturally fixed by the presently designated lectotype, Univ. Illinois Mus. Nat. Hist. No. 53022, and the herewith-restricted type-locality of Des Moines, Polk Co., Iowa. (2) The range of *T. lineatum* is perhaps incipiently relictual in Iowa, certainly more nearly continuous there than in Missouri or Illinois, and distinctly relictual in Missouri and Illinois. (3) All Iowa populations, except those near the Mississippi River, are referable to *T. l. lineatum*, whereas those bordering the Mississippi River are best regarded as intergrades of *T. l. lineatum* and *T. l. annectens*. (4) The Missouri and Illinois populations, although somewhat atypical, are most intimately re-

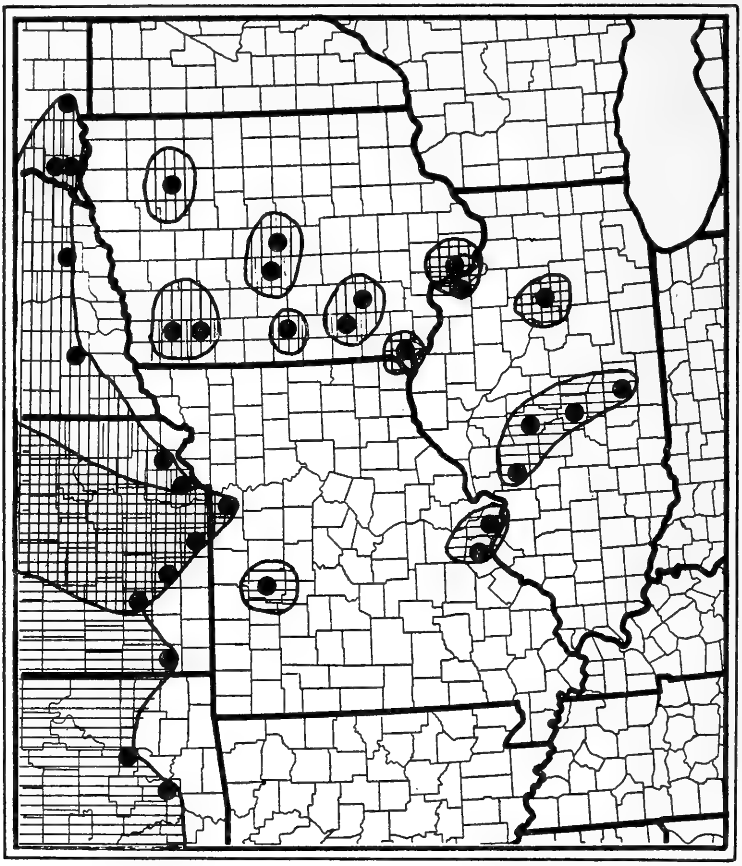

FIG. 1. Distribution of *Tropidoclonion lineatum* in the Prairie Peninsula area. Vertical hatching indicates range of the subspecies *lineatum*; horizontal, the subspecies *annectens*; crosshatching, the areas of intergradation. All known records for Iowa, Missouri, and Illinois but only marginal records for Oklahoma, Kansas, Nebraska, and South Dakota are plotted.

lated to *T. l. annectens,* and the most plausible explanation for the distributional and variational data they provide is that *Tropidoclonion* had a somewhat more northern and eastern distribution, probably during the Hypsithermal interval, than it does at present, as we have postulated elsewhere (Smith and Smith, 1962).

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Vol. 76, pp. 305–306 31 December 1963

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DISTRIBUTIONAL NOTES ON SOME VIRGINIA REPTILES

By William L. Witt
1412 Patrick Henry Drive, Arlington, Virginia

Clemmys guttata

In the collection of the Museum of Comparative Zoology, Harvard University, is a specimen of the spotted turtle (MCZ 45979, shell length 98 mm) taken at Magnolia Swamp, Augusta County, Virginia, in 1940. Magnolia Swamp is located on the south fork of the Shenandoah River at the crossing of the Norfolk and Western Railroad nearest the intersection with County Route 658, 4 miles south of Stuart's Draft. I found the species still there in June 1962. This represents a range extension of 110 miles southward from Charles Town, West Virginia, the previous southernmost record in the Shenandoah Valley (M. G. Netting, Proc. W. Va. Acad. Sci., 14: 146–147, 1940).

Opheodrys v. vernalis

Linzey (Herpetologica, 15 (2): 94, 1959) listed the eastern smooth green snake from Iron Mine Hollow (presumably at the overlook at milepost 96.5), Blue Ridge Parkway, Botetourt County, but failed to mention that this was the southernmost record for the species in the Blue Ridge. Two additional specimens have been taken in Shenandoah National Park, at the eastern edge of Big Meadows, Madison County (USNM 145929, S-V length 330 mm), and near milepost 97 at Jarman Gap, Augusta County (USNM 146633, S-V length 350 mm). These are the first records of the species from these counties, and the species is now known from six Blue Ridge counties: Amherst, Augusta, Botetourt, Madison, Page, and Rockbridge.

Tantilla c. coronata

The southeastern crowned snake has been reported in Virginia only from Buckingham County (E. R. Dunn, Copeia, No.

76: 100, 1919). Through the efforts of the Virginia Herpetological Society, three additional records have been brought to light. These are a juvenile in the Carnegie Museum collection (CM 19005), from 9.5 miles west of Spencer, Patrick County; a juvenile in the collection of Randolph-Macon College (Lynchburg), from 3 miles east of Madison Heights (a suburb of Lynchburg), Amherst County; and a specimen in the National Museum collection (USNM 144504, S-V length 200 mm), from Smith Mountain, Pittsylvania County. The specimen from east of Madison Heights is the first record of the species north of the James River, and suggests that it may have a wider distribution in Virginia than formerly suspected. It is now known from Amherst, Buckingham, Patrick, and Pittsylvania counties, and probably occurs in the higher Piedmont section of the state.

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(new names in **boldface**; see p. v for list of authors)

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BIOLOGICAL SOCIETY OF WASHINGTON

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1036th Meeting—26 June 1964

EIGHTY-FIFTH ANNUAL MEETING

Vice President Joseph Morrison called the meeting to order at 3:05 p.m. with about 20 members present. The reading of the minutes of the last meeting was dispensed with, but the reports of the Corresponding Secretary and the Treasurer were approved and accepted.

New members elected: Donald M. Anderson, T. P. Copeland, Bertha M. Cutress, Arthur M. Greenhall, Francis M. Greenwell, C. W. Hart, Jr., H. H. Hobbs, III, Alfred Loeblich, III, Michael C. Mound, Kitty F. Parker, Donald R. Patten, Randolph L. Peterson, Clayton E. Ray, Douglas C. Robinson, H. H. Ross, Velva E. Rudd, Lester L. Short, Jr., Donald F. Squires, Robert C. Stephens, and Dallas A. Sutton.

The following officers and Members of the Council were elected: *President*, Charles O. Handley, Jr.; *Vice Presidents*, Fenner A. Chace, Ernest A. Lachner, Richard H. Manville, Henry W. Setzer; *Recording Secretary*, Richard S. Cowan; *Corresponding Secretary*, John L. Paradiso; *Treasurer*, Henry B. Roberts; *Members of Council*, J. F. Gates Clarke, Daniel M. Cohen, Ralph E. Crabill, Jr., Horton H. Hobbs, Jr., and Leonard P. Schultz.

No formal communications were scheduled.

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PROCEEDINGS
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ELSINOË STAGE OF *SPHACELOMA SACCHARI*

By T. C. Lo

Department of Plant Pathology, College of Agriculture, Taiwan Provincial Chung-Hsing University, Taichung, Taiwan, China

In their account of spotted anthracnose of sugarcane (*Saccharum officinarum* L.), in Taiwan called "white speck," Jenkins and Bitancourt (1960) showed that in Brazil, S. C. Arruda had discovered (1957) *Elsinoë* fruiting on the leaf spots, while in Taiwan, in the same year, Lo (1957) had described *Sphaceloma sacchari* as the cause of the disease. Discovery (1961) of *Elsinoë* on white speck lesions in Taiwan substantiates Jenkins and Bitancourt's implication of the new species of *Elsinoë* as the perfect stage of *S. sacchari*.

In order that the new species may have a specific name it is here described as *Elsinoë sacchari*.

Elsinoë sacchari, sp. nov.

Ascomata organismi causalis pulvinata, intraepidermalia 50 × 31.2 μ in epithecio pseudoparenchymatico. Asci elliptici vel globosi, 10.3–13 × 9.6–10.6 μ, in ascomatibus dispersi. Ascosporae hyalinae, oblongo-ellipticae, rectae vel plus minusve curvatae, unitriseptatae, saepe quoad septa notabiliter constrictae, 8–10 × 3.3 μ.

Forma imperfecta, *Sphaceloma sacchari* Lo (J. Agr. & Forest., 6: 71, pls. 1–3. 1957).

Hab.: In foliis *Saccharum officinarum* L.

Loc.: Tainan, Taiwan, China.

Typus est in foliis *Saccharum officinarum* L., cv. 'NCO:310.' Tainan, Taiwan, China, 25 Feb. 1961, T. C. Lo 22 (TPU 60-4-22). TPU numbers are accession numbers in the Taiwan Provincial Chung Hsing Univ., Coll. Agr. Herb. Likewise, BPI numbers are accession numbers in the National Fungus Collections, Crop Research Division, U. S. Department of Agriculture, Beltsville, Maryland. SPIB numbers are accession numbers in the Herb. Secção Fitopat., Instituto Biológico, São Paulo, Brazil.

Ascomata pulvinate, intraepidermal, 50 × 31.2 μ, with a dark pseudoparenchymatic epithecium; asci elliptical to spherical, 10.3–12 × 9.6–

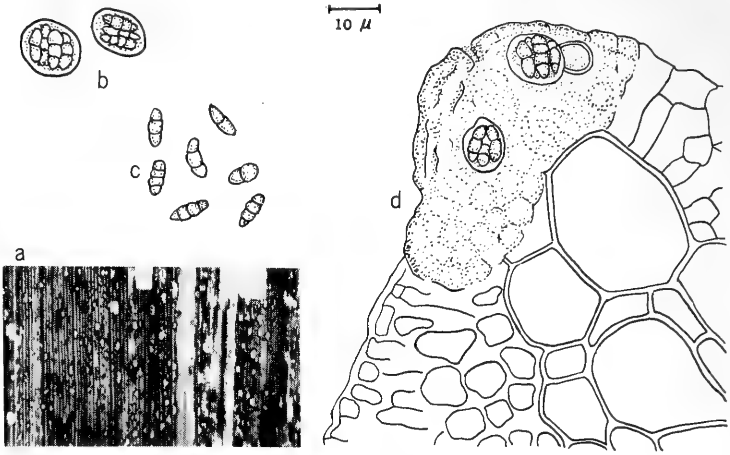

FIG. 1. *Elsinoë sacchari. a,* White speck lesions on the specimen from Florida, by virtue of the dark epithecium, ascomata vaguely visible particularly on the linear lesions to the right; × ca. 3. *b, c,* and *d,* from the specimen from Taiwan, camera lucida drawings of two asci (*b*), several ascospores (*c*), and a cross-section through diseased leaf tissue showing an ascoma in situ (*d*).

10.6 μ, scattered in the ascomata; ascospores hyaline, oblong-elliptical, straight or more or less curved, unitriseptate, often markedly constricted at the septa, 8.6–10 × 3.3 μ.

Conidial stage, *Sphaceloma sacchari* Lo.

Pathogenic on sugarcane (*Saccharum officinarum* L., Gramineae), causing the leaf-spotting disease "white speck."

Type: On sugarcane, cv. 'NCO:310,' Tainan, Taiwan, China, 25 Feb. 1961, T. C. Lo 22 (TPU 60-4-22). Fig. 1, *b, c, d.* During the course of study of *Elsinoë sacchari* material of this collection was contributed to both BPI and SPIB.

A culture of the fungus isolated in Taiwan as *Sphaceloma sacchari* has been deposited in the Centraalbureau voor Schimmelcultures, Baarn, Netherlands, also in the American Type Culture Collection, Rockville, Maryland.

Paratypes: On sugarcane, cv. 'C. B. 38/22,' Experimental Sugarcane Station, Piracicaba, State of São Paulo, Brazil, April 1957, S. C. Arruda (TPU 61-4-31, ex BPI 91288, this, in turn, ex SPIB 9116).

On sugarcane, cv. 'F. 31-436,' U. S. Sugarcane Field Station, Canal Point, Florida, 16 Nov. 1959, E. F. Todd (TPU 61-4-32, ex BPI 91417). Fig. 1, *a.*

The several earlier published illustrations of the leaf spot are those by Lo (1957, pl. 1), Todd (1960, fig. 1), and Jenkins and Bitancourt (1960, fig. 1).

Altogether, the specimen material reported by Jenkins and Bitancourt reveals the wide, world distribution of sugarcane white speck. Additional Pacific area distribution is shown by the following specimen: Uturoa, Raiatea Island, Society Islands, 31 Jan. 1961, N. L. H. Krauss 623. Det. A. E. J., ex BPI 91438.

Elsinoë sacchari, with its earlier (1957) described imperfect stage, *Sphaceloma sacchari,* and *E. panici* Tiffany and Mathre (1961) on *Panicum virgatum* are the initial and thus far the only known gramineous Elsinoaceae.

Acknowledgments: The writer acknowledges the courtesy of Dr. C. R. Benjamin, through whose office as curator of the National Fungus Collections, Crops Research Division, U. S. Department of Agriculture, Beltsville, Maryland, was contributed the specimen material from that source herein cited. This was selected and transmitted by Dr. Anna E. Jenkins of that Division. Credit is due her, also Dr. A. A. Bitancourt, Instituto Biológico, São Paulo, Brazil, for helpful suggestions while this article was in preparation.

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PROCEEDINGS
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NEW TARDIGRADA FROM WESTERN NORTH AMERICA: I, *PSEUDECHINISCUS*

By Albert A. Grigarick, Franc Mihelčič, and Robert O. Schuster
University of California, Davis, and St. Johann i. Walde, Osttirol

This is the first article of an intended series describing Tardigrada from western North America, the primary purpose of which is to provide names for a later faunal study.

Pseudechiniscus goedeni, new species

Length excluding legs IV about 400 μ; width 180 μ. Eyespots present, reddish. Dorsal plates with longitudinal and tranverse pattern comprised of numerous closely spaced granules; plates otherwise essentially smooth except for widely scattered larger granules. At high focus (400 diameters conventional or phase microscopy) granulation appears dark on a light background, while at low focus the identical pattern appears light on a dark background. Legs have plates with granules of moderate size. Intersegmental areas and venter are smooth; venter without plates. Both dorsal plates and pseudosegmental plate are medianly divided. Moderately long spines occur at five lateral positions, and dorsally on the pseudosegmental plate; lateral spines measure 105 μ, 67 μ, 80 μ, 85 μ, and 110 μ; dorsal spine 40 μ. (Spinules occasionally occur near bases of last three lateral spines, and also the dorsal spines.) Three spinules may be present on the lateral margin of body, between spine and leg IV. Head with internal cirrus short, 17 μ; papilla 13 μ, about three times longer than wide; external cirrus 34 μ. Leg I with small basal spine, leg IV with larger basal papilla. Internal claws of all legs with large recurved spur near base. Collar of leg IV with 8–9 sharp teeth

The type and 42 paratypes were collected 6 miles south-southwest of Breitenbush Hot Springs, Marion County, Oregon, 18 October 1962, by K. Goeden. The specimens were in lichens, on Douglas fir and on cedar.

This series was mounted in iodine-tinted Hoyer's. One skin contained three large eggs of about 100 μ diameter. Two individuals measured 250 μ, the rest between 320 μ and 450 μ, with most of the specimens between 350 μ and 370 μ.

The type and some of the paratypes are deposited in the Department of Entomology, Davis, and the remaining paratypes with Dr. Franc Mihelčič.

This species is related to *P. islandicus* and to *P. hannae.* It differs from *P. islandicus* in the subequal length of the lateral spines, and in the granulation of the cuticle not forming a reticulate pattern. It differs from *P. hannae* in possessing an extra lateral spine and by having some lateral spines shorter. Further, the cuticular granules of *P. hannae* are randomly dispersed, not concentrated in longitudinal and transverse bands.

Pseudechiniscus raneyi, new species

Length excluding legs IV about 300 μ; width 150 μ. Eyespots present, reddish. Cuticle of dorsal plates comprised of rather uniform polygons, somewhat larger toward the anterior margins of the dorsal and intersegmental plates. At high focus the polygons appear dark, at low focus, light. Leg plates have polygonal pattern of finer texture. Intersegmental areas and venter are smooth; venter without plates. Head and scapular plates appear subdivided by bands of smooth cuticle. Scapular, dorsal and pseudosegmental plates are to some extent longitudinally divided. Five lateral spines, moderately long at ends and shorter at middle of series; lateral spines measure 57 μ, 15 μ, 25 μ, 25 μ, and 175 μ. Long dorsal spines lacking but posterior edges of some dorsal segments have numerous small spines of varying length. Head with internal cirrus short, 10 μ; papilla 9 μ long, almost as wide; external cirrus 25 μ. Leg I with small basal spine; leg IV with larger basal papilla. Internal claws of all legs with recurved spur near base. Collar of leg IV with 8–10 teeth.

The holotype with 16 paratypes are from 46 miles east of Fresno on highway 180, Tulare County, California, 4300 feet, 31 October 1962, taken from mixed lichen and moss on pine, by A. A. Grigarick. Twelve paratypes, 12 miles west of Tuolumne Meadows, Yosemite National Park, California, 8600 feet, 22 November 1962, from lichen on *Pinus jeffreyi,* by F. C. Raney.

The shortest specimen measured 220 μ, the longest 390 μ, with a length of 300 μ being most frequent. The type and some of the paratypes are at Davis, other paratypes are in the possession of Dr. Franc Mihelčič.

Lateral spines in all positions and a cuticle composed of polygons are not found in any other species of *Pseudechiniscus.* The greatest length of a lateral spine was noted to be 60 μ, on the right side of one specimen, on the left side of two specimens, and on both sides of one specimen.

A total of four species of *Pseudechiniscus* are now known to occur in Oregon and California. The finding of *P. suillus* on Santa Catalina is reported (Mathews, 1938) but we have not seen this species. *P. goedeni* is from southwestern Oregon. *P. victor* has been collected in mountain areas of northern California, in the Siskiyou Range and in the northern part of the Sierra Nevada. *P. raneyi* occurs in the Sierra south of Lake

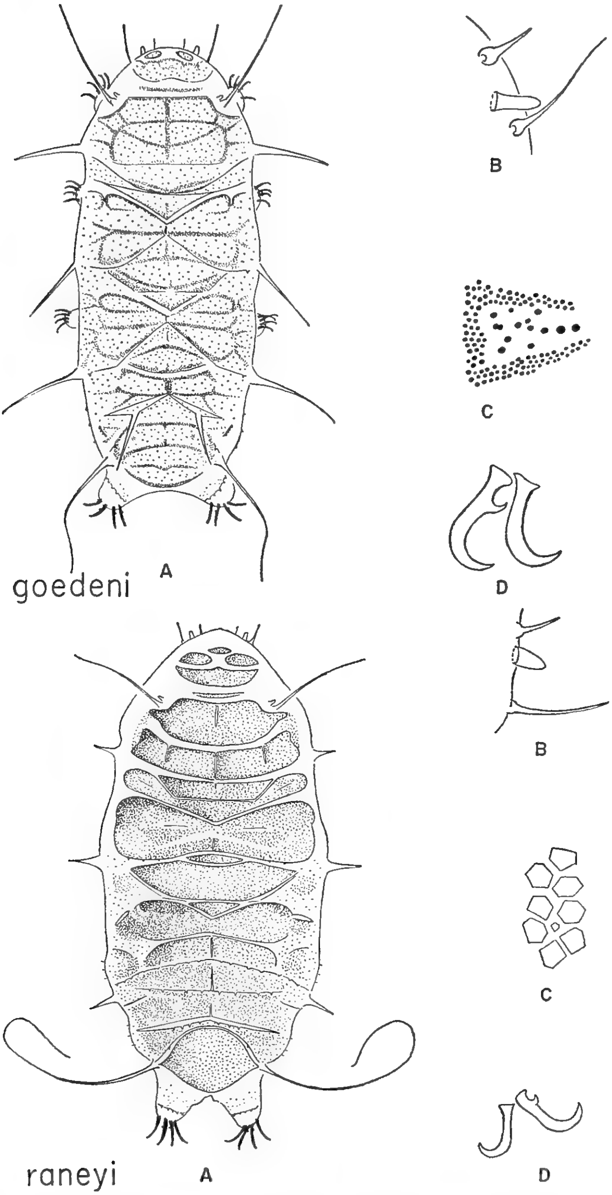

FIG. 1. New species of tardigrades; *Pseudechiniscus goedeni*, above, and *P. raneyi*, below. A, dorsal aspect; B, head appendages; C, section of cuticle; D, claws of leg IV.

Tahoe but two specimens, probably referrable to this species, have been collected in the Coast Range of Mendocino County.

On the basis of collection data available, it now appears that each of the species mentioned above has a definable distribution and that no two species are present in any of these areas.

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PROCEEDINGS
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A NEW TROGLOBITIC CRAYFISH OF THE GENUS *CAMBARUS* (DECAPODA, ASTACIDAE) FROM ARKANSAS WITH A NOTE ON THE RANGE OF *CAMBARUS CRYPTODYTES* HOBBS[1]

By Horton H. Hobbs, Jr. and M. S. Bedinger
Smithsonian Institution and U. S. Geological Survey

In a survey of the troglobitic crayfishes of the genus *Cambarus,* Hobbs and Barr (1960: 14) indicated that these animals occur "in three geographically disjunct cave regions: the Ozark region in which is found *C. setosus* and *C. hubrichti;* the Tennessee Valley in northern Alabama and southern Tennessee occupied by *C. hamulatus, C. jonesi* and *C. cahni;* and the Florida Panhandle region, in which *C. cryptodytes* is the only representative, known from a single locality."

Hobbs and Barr (*loc. cit.*) overlooked the reference to *C. cryptodytes* by Pylka and Warren (1958) in their report on *Haideotriton wallacei.* Through their work and the subsequent study of Warren (1961), *C. cryptodytes* is now known from the following localities: Gerard's Cave, Judge Cave, Pottery Cave, Soda Straw Cave, and Washed-out Cave, Jackson County, Florida, and from Climax Cave, Decatur County, Georgia.

The present paper describes a new species, *C. zophonastes,* from the Ozark region. This species, known from a single locality, is the third species of troglobitic crayfish described from the region and the first from Arkansas. *Cambarus zophonastes* has its closest affinities with *C. setosus* Faxon (1899: 237) which is known from a number of localities in southwestern Missouri (Hobbs and Barr, 1960: 27).

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[1] Publication authorized by the Secretary, Smithsonian Institution, and the Director, U. S. Geological Survey.

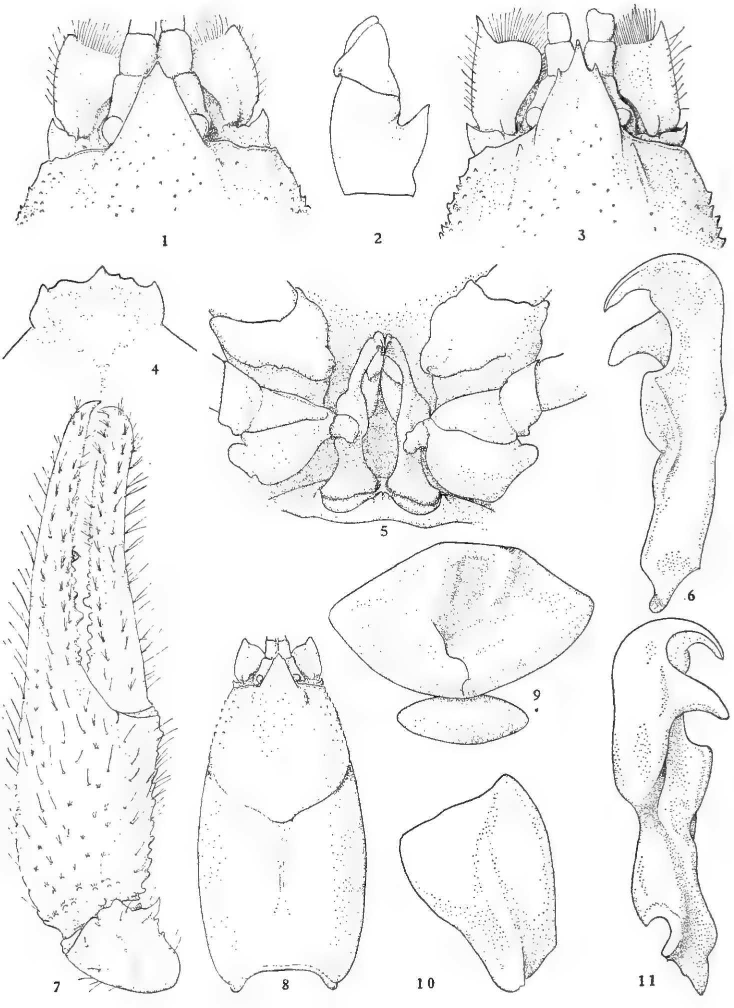

Plate I. Fig. 3 is *Cambarus setosus* Faxon; all others are *Cambarus zophonastes*, sp. nov. 1, Dorsal view of cephalic region; 2, Basipodite and ischiopodite of third pereiopod of male, form I; 3, Dorsal view of cephalic region of *C. setosus*; 4, Epistome; 5, Bases of fourth and fifth pereipods and first pleopods of male, form I; 6, Lateral view of first pleopod of male, form I; 7, Distal podomeres of cheliped of male, form I; 8, Dorsal view of carapace; 9, Annulus ventralis; 10, Antennal scale; 11, Mesial view of first pleopod of male, form I.

Cambarus zophonastes,* new species

Diagnosis.—Albinistic; eyes reduced and without pigment; rostrum broadest at base and with small marginal spines; margins strongly convergent and acumen reaching only slightly cephalad of distal margin of basal segment of antennule; postorbital ridges strongly depressed and terminating cephalically in weak tubercles; areola narrow (more than 29 times longer than broad); one to several lateral tubercles on carapace which may or may not be spiniform, never more prominent than tubercles on cephalolateral surface of carapace; chelae conspicuously setose with a single well-defined row of tubercles along inner margin of palm. First pleopod of male and annulus ventralis of female as figured.

Holotypic Male, Form I.—Albinistic, eyes reduced. Body subovate, markedly depressed. Abdomen narrower than thorax (16.3 and 12.0 mm in widest parts, respectively). Width of carapace greater than depth in region of caudodorsal margin of cervical groove (16.3 and 10.1 mm); greatest width of carapace slightly cephalic to midlength of areola.

Areola narrow, 29.2 times longer than wide with one punctation in narrowest part. Cephalic section of carapace 1.2 times longer than areola; length of areola 46.2 per cent of entire length of carapace. Rostrum with non-thickened, strongly convergent margins bearing corneous marginal spines; upper surface slightly concave with the usual submarginal row of setiferous punctations, scattered setiferous punctations in basal half. Acumen short with corneous up-turned tip and extending cephalad just beyond distal end of basal segment of antennule. Subrostral ridges poorly developed and evident in dorsal aspect for only a short distance at base of rostrum. Postorbital ridges strongly depressed, each with a conspicuous groove and terminating cephalically in very weak tubercles. Suborbital angles weak, that on left obtuse and that on right broadly rounded. Branchiostegal spine small but acute. Surface of carapace punctate dorsally and strongly granulate laterally; granules becoming tuberculate ventrally, those on cephalolateral portions of carapace tuberculate and subspiniform; several small tubercles present in area usually occupied by lateral spines, only one conspicuously spiniform and it not larger than those tubercles on cephalolateral portions of carapace.

Abdomen longer than carapace (33.2 and 31.6 mm). Cephalic section of telson with four spines in sinistral corner and two in dextral.

Epistome (Fig. 4) much broader than long, with elevated margins provided with an anteromedian spine and a pair of lateral spines. Antennules of the usual form with strong spines on lower surface of basal segment slightly distal to midlength. Antennae extending caudad beyond caudal margin of telson. Antennal scale (Fig. 10) conspicuously broad with heavy lateral portion terminating cephalically in a broad triangular extension devoid of a spine; lamellate portion suddenly broadened in distal half; broadest portion slightly distal to midlength.

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* Gr., *zophus*, nether darkness; so named because of its subterranean habits.

Left chela (Fig. 7) elongate, subovate in cross section and with palm inflated; dactyl of right chela regenerated. All surfaces bearing setiferous punctations. Inner margin of palm with a row of 12 tubercles flanked proximally by additional tubercles below this row; proximal upper surface of palm with scattered tubercles and lower mesial surface with a few; lateral margin of palm with scattered tubercles extending almost to base of movable finger; lower distal margin of palm with a conspicuous tubercle at base of dactyl. Opposable margin of immovable finger with a row of 12 tubercles, fourth from base largest; a prominent tubercle below this row between seventh and eighth tubercles; fingers not gaping and both with submedian longitudinal elevations above and below. Opposable margin of dactyl with a row of 17 tubercles along proximal four-fifths of finger, sixth from base largest; mesial margin with a single tubercle at base; otherwise, both fingers bearing conspicuous setiferous punctations. Opposable margins of both fingers with a single row of minute denticles between and distal to aforementioned tubercles.

Carpus distinctly longer than broad with an oblique furrow on upper surface; upper surface punctate. Mesial surface tuberculate with one large tubercle and several smaller ones proximal to it; lower mesiodistal margin with a prominent spike-like tubercle and lower laterodistal margin with a prominent projection opposing articular knob on palm; four small tubercles arranged in an arc proximal to laterodistal tubercle.

Upper surface of merus with many small tubercles forming a row on proximal portion; lateral and mesial surfaces irregular but without punctations or tubercles except for a few tubercles near distal margin; lower mesial surface with a row of 12 spike-like tubercles and a lateral row of 10, the distal five of which extend mesiodistally across distal portion of podomere. Ischium with a ventral row of three small tubercles; otherwise punctate.

Hooks (Fig. 2) on ischiopodites of third pereiopods only; hooks strong and simple. Caudomesial surface of coxopodites of fourth pereiopods with prominent projections (Fig. 5), those on fifth without prominences.

First pleopods (Figs. 5, 6, 11) symmetrical and extending cephalad to coxopodites of third pereiopods when abdomen is flexed. Tips terminating in two distinct parts reflexed at angles greater than 90 degrees. Mesial process non-corneous, inflated and tapering gently to apex but not bulbiform; central projection corneous and not conspicuously notched near apex.

Allotypic Female.—Differs from the holotype in the following respects: right suborbital angle obtuse, left obsolete; telson with two spines in each caudolateral corner; inner margin of palm of chela with nine tubercles, opposable margin of immovable finger with 10 tubercles, corresponding margin of dactyl with 13 tubercles, and lower laterodistal margin of carpus with spine on articular process.

Annulus ventralis (Fig. 9) slightly movable. Cephalomedian area with a prominent depression, deepest toward caudodextral thickened wall; tongue sinistral and forming caudosinistral surface of depression; sinus, originating in depression dextral to median line, extends caudosinistrad across median line onto caudal wall, turning, in a gentle arc, caudodextrad to mid-caudal margin of annulus.

Measurements.—As follows (in millimeters):

Carapace	Holotype	Allotype	Paratypic ♂	Paratypic ♂	Paratypic ♀
Height	10.1	9.2	9.1	9.8	8.0
Width	16.3	13.4	14.2	13.2	10.9
Length	31.6	26.9	25.9	27.3	22.5
Rostrum					
Width	4.4	3.8	3.5	4.0	3.2
Length	4.5	4.1	3.5	4.1	3.5
Areola					
Width	.5	.4	.3	.3	.3
Length	14.6	12.2	12.0	11.9	9.3
Chela					
Length, inner margin of palm	14.0	10.8	12.0	11.1	8.3
Width of palm	10.7	8.4	9.5	8.0	6.2
Length, outer margin of hand	41.4	28.9	33.0	32.4	23.5
Length of dactyl	24.6	16.3	19.4	19.1	13.6

Type Locality.—The type locality of *Cambarus zophonastes* is Hell Creek Cave, Stone County, Arkansas (NE¼, NE¼, Sec. 30, T. 15 N, R. 10 W). Hell Creek Cave is developed in the Plattin Limestone of Ordovician Age. The length of the cave, measured principally along the course of the stream that flows through it, is about 1,500 feet. The cave stream issues as a spring from the east side at the bottom of a V-shaped valley. This spring and another which issues from a small cave on the west side of the valley make up the perennial flow of Hell Creek.

The main entrance to Hell Creek Cave is about 50 feet above the bottom of the valley. The cave stream is first encountered about 150 feet from the cave entrance. At this point the stream exits from the traversible portion of the cave by flowing through a water-filled channel to the spring outlet. The stream can be followed continuously from this point of first encounter to the end of the traversible portion of the cave.

The crayfish were collected from the cave stream within a distance of 30 feet from where the stream is first encountered. This portion of the cave, 150 feet from the entrance, is in perpetual darkness. Here the stream fills the lower portion of a vertical, joint-controlled solution channel. The stream is 3 to 4 feet wide and ranges in depth from 1 to 14 feet, being deepest where the stream enters the water-filled channel.

The temperature of the water, measured on 3 October 1961, was 58°F and, on 7 November 1961, was 56°F. Normal flow of the stream is estimated to be about 200 gallons per minute. Flow of the stream increases within a short time after moderate rainfall in the vicinity.

An epigean crayfish, *Orconectes neglectus* subsp., was collected at the same location as the troglobitic forms. Also, an epigean species of fish was observed in this location. This indicates that the cave is accessible to small aquatic organisms from the outside by way of the spring opening.

Habits.—Specimens of *Cambarus zophonastes* were observed on the steep rock sides and on the mud bottom of the cave stream. The crayfishes showed no obvious response to light of lanterns; however, they crawled slowly while being observed. They were apparently sensitive to turbid water, made by mud stirred up from the bottom of the stream, and were aware of disturbances in the water made when being approached. To avoid turbid water, some specimens crawled up the sides of the stream to clearer water near the top. Others bided their time on the bottom until the water cleared, or retreated to the deeper portions of the stream. The crayfish were sensitive to touch and swam quickly if not captured on first contact.

Disposition of Types.—The type series of five specimens are deposited in the U. S. National Museum: holotypic male, form I (No. 108356), allotypic female (No. 108357), two paratypic males, form I, and a paratypic female.

Relationships.—*Cambarus zophonastes* has its closest affinities with *Cambarus setosus* Faxon (1899: 237) which is known from a number of localities in the southwestern part of Missouri (Hobbs and Barr, 1960: 27). The similarities between the two are in the widely spaced terminal elements of the first pleopod; the broad, comparatively short antennal scale; the epistome with lateral spines; the contours of the annulus ventralis; and the heavily setose chelipeds. Like the epigean members of the *Asperimanus* Group (*ibid.*, pp. 15–16), the palms of the chelae are provided with a single row of tubercles and the distal two podomeres bear prominent long setae; too, the mesial process is elongate and "situated some distance proximal to the central projection."

Cambarus zophonastes differs from *C. setosus* in the comparatively broader and shorter rostrum with strongly convergent margins and short acumen (cf. Figs. 1 and 3) and in the shorter terminal elements of the first pleopod of the first form male; in the former, the lateral spines on the carapace immediately caudal to the cervical groove are, for the most part, reduced to small tubercles, only one of which is subspiniform.

Remarks.—In partial support of the assignment of this population of crayfishes to specific rank in preference to relegating it to a subspecies of its close relative, *Cambarus setotus*, are the apparent relationships of its ostracod commensal.

Hart and Hobbs (1961) reviewed the troglobitic entocytherids and described eight new ones. Among the latter were two from the Ozark region, *Uncinocythere pholetera* on *Cambarus hubrichti* and *U. xania* on *C. setosus*. The ostracod on *C. zophonastes* is different from both of these but is more closely allied to *U. pholetera*. This is somewhat unexpected inasmuch as *C. zophonastes* has its closest affinities with *C.*

setosus. One might have anticipated that their commensals would be more closely related than either would be to that on *Cambarus hubrichti,* particularly because *C. zophonastes* and *C. setosus* are presumably both derived from the same parent stock.

Insofar as is known, the ostracods, like their hosts, are largely confined to aquatic habitats, and it seems highly probable that they are transmitted from one host to another by contact or perhaps by a crayfish invading the "lair" of another crayfish. Under such circumstances, one can only conclude that the three associations have been isolated for some period of time. In the absence of intergrades, the three crayfishes and their respective ostracod commensals are each accorded specific rank.

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STENOCYPRINAE, A NEW SUBFAMILY OF FRESHWATER CYPRID OSTRACODS (CRUSTACEA) WITH DESCRIPTION OF A NEW SPECIES FROM CALIFORNIA

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The family Cypridae comprises a complex assemblage of ostracods, including both marine and freshwater representatives, which have been assigned to a number of subfamilies. Kaufmann (1900) divided the family Cypridae into eight subfamilies, and Müller (1912) recognized five subfamilies, two of which were marine. Hoff (1942), with some modifications, adopted the system proposed by Kaufmann and recognized six freshwater subfamilies of the Cypridae.

The subfamily Cyprinae includes a conglomeration of genera whose members possess widely varying structural differences. These morphological distinctions suggest that adaptive radiation has proceeded to a point where the Cyprinae is no longer a cohesive taxonomic group. The members of the genus *Stenocypris,* currently included in the subfamily Cyprinae, possess well-developed and distinctly dissimilar furcal rami, a character not known to occur in any other genus of freshwater Ostracoda.

I believe that the structural peculiarities of the furcal rami among representatives of the genus *Stenocypris* are of sufficient diagnostic significance to warrant establishing a new subfamily to receive members of this genus. Consequently, the new subfamily Stenocyprinae is herewith proposed:

Subfamily **Stenocyprinae**, new subfamily
  Class Crustacea
  Subclass Ostracoda
  Order Podocopa

Family Cypridae
Subfamily Stenocyprinae
Type genus: *Stenocypris* Sars 1889

Diagnosis: A subfamily of the family Cypridae. Shell elongate, narrow, elliptical from above, frequently reniform, surface smooth with scattered puncta; pore canals when present restricted to anterior, posterior, and ventral margins; dorsal margin evenly arched, occasionally flattened; hairs along margins except dorsally; inner duplicature large at anterior end; length usually greater than twice the maximum height. Natatory setae of second antennae barely reaching tips of claws. Ultimate podomere of third thoracic appendage bearing a curved claw-like seta, an extremely short one, and a very long, unreflexed seta. Furcal rami large, lamelliform, dissimilar; dorsal margin of one or both rami either denticulated or pectinated; dorsal seta absent; terminal and subterminal claws heavily pectinated. Males and females, with males unknown for many species.

Type species: *Stenocypris cylindrica major* (Baird, 1859)

Cypris cylindrica major Baird, 1859 not Sowerby, Baird 1859, p. 233; Howe 1962, p. 221.

Cypris malcomsonii G. S. Brady, 1886, Brady 1886, p. 297, pl. 38, figs. 5–7.

Cypris (*Stenocypris*) *malcolmsonii* Brady, Vávra 1897, p. 146, pl. 4, figs. 1–5.

Stenocypris malcolmsonii (Brady, 1886) Sars 1889, Sars 1889, pp. 28–34, pl. 1, figs. 7–8, pl. 5, figs. 1–4; Lowndes 1930, p. 975; Lowndes 1931, p. 1294; Furtos 1936, p. 100, figs. 76–80.

Stenocypris malcomsonii Brady, Moniez 1891, p. 33; Menzel 1923, p. 194, fig. 1; Lindroth 1948, p. 76.

Stenocypris malcolmsonii (Brady) 1886, Klie 1933*a*, p. 474; Klie 1933*b*, p. 375.

Stenocypris malcomsonii G. St. Brady, Vávra 1906, p. 426.

Stenocypris malcolmsonii (G. Brady), Müller 1912, p. 198.

Stenocypris malcomsoni (Brady), Tressler 1937, p. 202; Klie 1939, p. 316; Mehes 1939, p. 559, fig. 4, pl. 13, figs. 7–8; Bronstein 1947, p. 148, pl. 9, fig. 2; Tressler 1949, pp. 72–73, fig. k.

Stenocypris malcolmsoni (Brady, 1886), Ferguson 1962, p. 65, 67.

Stenocypris major (Baird, 1859), Daday 1898, p. 69, figs. 34 a–d; Apstein 1907, pp. 228–229, fig. S; Triebel 1953, pp. 5–14, pl. 1, figs. 1–6, pl. 2, figs. 7–14.

Sars (1889) established the genus *Stenocypris* to accommodate ostracods possessing the following characteristics: "Shell very narrow and elongate, height by far not attaining half the length, ventral margin distinctly sinuated in front of the middle. Valves subequal, free edges smooth, inner duplicature very large, especially at the anterior part. Natatory setae of lower antennae not reaching beyond terminal claws.

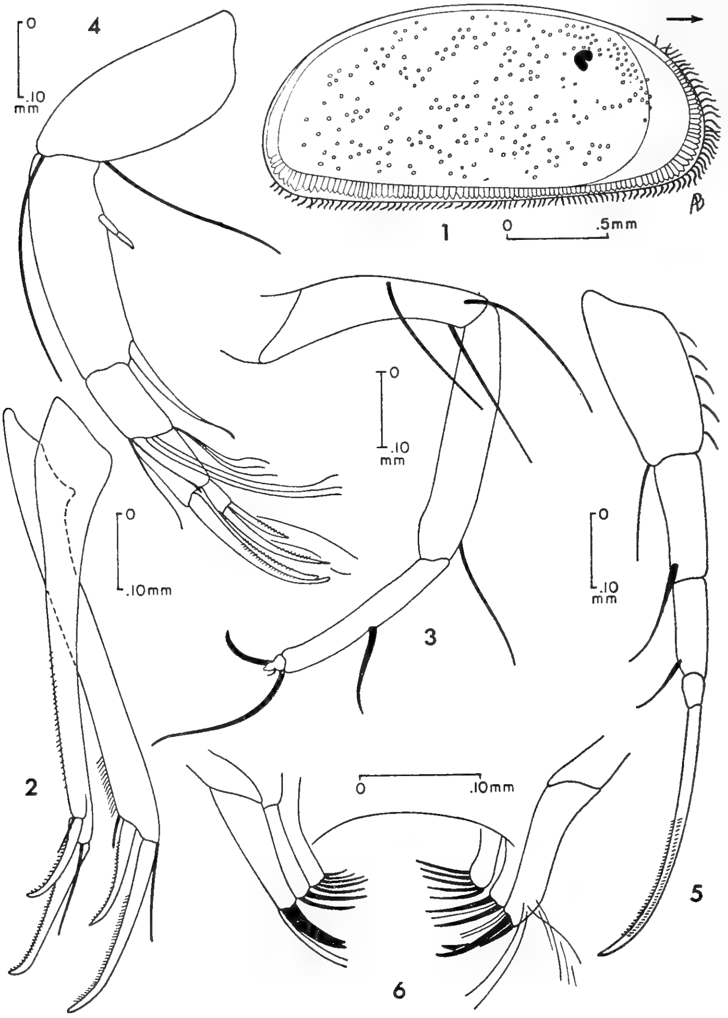
Palpus of first pair of maxillae very narrow, cylindrical, last joint small, masticatory lobes long and narrow. Caudal rami rather large, more or less lamelliform, dorsal edges sometimes pectinate, claws very unequal, both coarsely denticulate, seta of dorsal edge absent or very small, the apical one rather elongate. Reproduction exclusively parthenogenetical." Ferguson (1962) states, "The author is of the opinion that variations in the method of sexual reproduction are not valid criteria for assigning ostracods to taxonomic groups." Ferguson also recommends that Sars' generic diagnosis be emended in order that ostracods that reproduce syngamically, but otherwise generally agree with Sars' description, may be included in the genus *Stenocypris.*

The type species of the genus *Stenocypris* has been, and still is, in a state of uncertainty. Baird (1859) described some ostracods from Nagpur and designated them as *Cypris cylindrica major.* According to Baird the chief difference between his species and the fossil species *Cypris cylindrica* Sowerby is in their relative size, *C. cylindrica major* being about twice the size, in all dimensions, of *C. cylindrica.*

Following his comparison of ostracods from Ceylon with some that he believed to be similar to Baird's specimens from Nagpur, Brady (1886) considered the two series to be similar. He compared both the Nagpur and Ceylon series with fossil specimens of *C. cylindrica* Sowerby, and concluded that Baird had erred in identifying recent ostracods from Nagpur with Sowerby's fossil species. Consequently, Brady proposed the name of a new species, *Cypris malcolmsoni,* for Baird's legitimate and valid species, *Cypris cylindrica major.* Brady (1886) was aware that Baird's specimens from Nagpur were significantly different from Brady's specimens from Ceylon. He said, "The two series are undoubtedy identical; but I learn from my brother, Mr. H. B. Brady, that those preserved in the British Museum are much larger, probably Baird's variety 'major.'" There seems to be no evidence to warrant replacing Baird's *Cypris cylindrica major* with Brady's *Cypris malcolmsoni.* Sars (1886), in referring to Brady's species "malcolmsoni," stated: "This beautiful species is undoubtedly identical with the form described by Baird from Nagpur, India under the name *Cypris cylindrica* Sowb. and more especially agrees with the figures given for his variety 'major.'" Sars feels that he is unable to determine whether *C. cylindrica major* and *C. cylindrica* are conspecific.

It is our opinion that *Cypris cylindrica major* Baird, 1859 and *Cypris cylindrica* Sowerby are not conspecific. However, the evidence seems to support the position that *Cypris cylindrica major* Baird, 1859 and *Cypris malcomsonii* Brady, 1886 are conspecific. Therefore Baird's species, being the older, according to *Article 25* of the *International Rules of Zoological Nomenclature,* takes priority, and hence becomes the valid type species of the genus *Stenocypris* Sars 1889.

Reports on the genus *Stenocypris* from North America have been published by Furtos (1936) for *S. cylindrica major* (Baird, 1859) = *S. malcolmsoni* (Brady, 1886) and for *S. fontinalis* Vávra, 1892 from



FIGS. 1–6. *Stenocypris archoplites*, new species.—Drawings were made from specimens stained with a 1% alcoholic solution of eosin Y and mounted in Canada balsam. 1, Lateral view of right valve of female holotype. 2, Furcal rami of female paratype. 3, Third thoracic appendage of female paratype. 4, Second antenna of female paratype. 5, Second thoracic appendage of female paratype. 6, Right and left maxillae of female paratype.

Yucatan, and by Ferguson (1962) for S. *bolieki* Ferguson, 1962 from Leon County, Florida.

KEY TO THE KNOWN SPECIES OF *Stenocypris* FROM NORTH AMERICA

1. Pore canals form a prominent striated band along anterior, posterior, and ventral margins 2
   Pore canals either absent or not forming striated band .... S. *fontinalis* Vávra, 1892
2. Both furcal rami denticulated along dorsal margin 3
   Only the wider ramus denticulated along dorsal margin .... S. *bolieki* Ferguson, 1962
3. Length of the narrow ramus 15 × least width .... S. *cylindrica major* (Baird, 1859) = S. *malcolmsoni* (Brady, 1886)
   Length of narrow ramus 20 × least width .. S. *archoplites*, new species

Stenocypris archoplites, new species

Specific characters: FEMALE—Eye prominent. Valves elongate; elliptical from above; surface smooth, transparent, with scattered puncta; greatest height near middle, length approximately 2.3 × the greatest height; extremities rounded; dorsal margin evenly arched, sloping gradually anteriorly and posteriorly; pore canals form a prominent striated band except dorsally; ventral margin straight; short hairs along margins except dorsally; submarginal line wide at anterior; length 2.2–2.3 mm, height 0.99–1.00 mm. Natatory setae of second antennae, except in a few instances, not reaching beyond tips of terminal claws; terminal claws pectinated along distal half. Mandibular palp with four podomeres, antepenultimate and ultimate podomeres with dorsally and ventrally situated spine-like setae. Spines of masticatory processes of maxillae and of maxillary palp smooth. Second thoracic appendage with four podomeres; ultimate podomere short, rounded, and bearing an elongate terminal spine, which is distinctly curved and pectinated along distal half; length of terminal spine equal to combined lengths of antepenultimate, penultimate, and ultimate podomeres. Each podomere of second thoracic appendage, except ultimate, with a prominent seta at its distal end. Third thoracic appendage with a nipple-shaped ultimate podomere bearing a curved claw-like seta, a long seta, and an extremely short one; length of claw-like seta approximately 5 × that of shortest one. Caudal rami dissimilar, both rami pectinated along dorsal margin; length of narrower ramus approximately 20 × its least width; dorsal seta absent; terminal and subterminal spines pectinated; length of terminal seta more than one-half length of terminal spine. MALE—Unknown.

Type locality: Specimens of S. *archoplites*, new species, were collected in December 1961 by Stephen B. Mathews, a graduate student in zoology at the University of California, from the stomachs of several specimens of the Sacramento perch, *Archoplites interruptus*. The specimens of *A. interruptus* were taken from Lake Anza, a 10-acre man-made impoundment located within the city limits of Berkeley, California.

Type specimens: Stained microscopic mounts of the female holotype and of the two female paratypes are deposited in the U. S. National Museum. Catalogue numbers are, for the holotype, USNM 109322, and for the paratypes, USNM 109323 and USNM 109324, respectively.

Remarks: Stenocypris archoplites, new species, is apparently the second species of the genus recorded for the United States, and the first species to be taken from the digestive tract of a fish. Considering the widespread distribution of ostracods in all types of aquatic habitats, records of these crustaceans from the digestive tracts of freshwater fish are not as numerous as might be expected.

According to Ward (1940), the ostracod *Physocypria globula* Furtos, 1933 [= *Physocypria pustulosa* (Sharpe, 1897)] serves as the intermediate host of *Neoechinorhynchus cylindratus* (Van Cleave, 1913), an acanthocephalan parasite of the large-mouth black bass. Hoff (1943) reports finding large numbers of *P. pustulosa* in the intestine of the common buffalo fish, *Megastomatobus cyprinella.*

S. *archoplites* differs from S. *bolieki* in the overall length and shape of the valves and in the pectination of the furcal rami. The new species differs from S. *cylindrica major* (= S. *malcolmsoni*) in the length to width ratio of the narrower of the two rami. The narrower ramus in S. *archoplites* has a length that is at least 20 × the least width compared to a length that is 15 × the least width in S. *cylindrica major.*

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THE STATUS OF *FONTARIA PULCHELLA* BOLLMAN, WITH THE PROPOSAL OF A NEW GENUS AND TRIBE IN THE DIPLOPOD FAMILY XYSTODESMIDAE*

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Millipeds of the genus *Nannaria* make up a characteristic and often very abundant element in the Appalachian-Ozarkian milliped fauna. So far about 20 forms have been named, and an even greater number of undescribed species are represented in my personal collection. Yet large areas of eastern North America have not been collected for these small, dominantly psychrophilus, xystodesmids, and I venture the prediction that as many as 200 species of *Nannaria* may eventually be accounted.

Although there is considerable variation in the gonopods among different species, the non-sexual characters—including coloration—tend to remain remarkably stable throughout the genus. Concomitantly, certain features of *Nannaria* collectively set the genus rather in apposition to most other xystodesmids, so that for many years I have thought that some suprageneric category might desirably be proposed as a means of signalizing this disjunct position. Such inclinations have recently been crystallized by a sequence of events commencing with the receipt of a single male specimen from northern Georgia which, although closely related to *Nannaria*, represents a distinct and nameworthy branch of this group.

This specimen was at first taken to be of an undescribed species, and such may actually be its true status. However, a recent comparison with the two female cotypes of *Fontaria pulchella* at the U. S. National Museum shows that the male

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from Georgia agrees in every external detail with the long-enigmatic *pulchella* and is in all probability conspecific with the types. It must be remembered, however, that concordance in external features does not necessarily imply specific identity between millipeds, particularly of different sexes, so it is possible that topotypic males of *pulchella* will show gonopodal differences from the Georgia specimen. In the meantime, however, no great harm is done by the conservative treatment preferred here, and in the event of future emendation, it will merely be necessary to provide a new specific name based upon the Georgia milliped. There can be no doubt whatever, on the other hand, that the specimen is strictly congeneric with the types of *pulchella*, and differs enough from *Nannaria* to warrant separate status as a new genus. On the basis of this genus, and *Nannaria* (in the broad sense, to include "*Mimuloria*"), I venture to propose a new tribal category within the Xystodesmidae.

The occasion is also taken here to provide some illustrations of *Nannaria minor* Chamberlin, which, although the type species of its genus, has never been illustrated and which has thus remained an obstacle to a satisfactory understanding of *Nannaria* since its proposal in 1918.

I wish to thank my good friend and benefactor Leslie Hubricht for the gift of the male specimen here considered, and Dr. R. E. Crabill for access to the type material of *Fontaria pulchella* in the U. S. National Museum. The drawings are the work of my artist Anne Williams.

Family XYSTODESMIDAE Cook

Nannarini, new tribe

Components: *Nannaria* Chamberlin, 1918; *Oenomaea*, n. gen.

Diagnosis: Small, parallel-sided xystodesmids with the following characteristics: pretarsi of anterior legs of males (NOTE 1) broadened, spatulate, and usually strongly twisted; sterna of metazonites flat or but very slightly elevated medially, and produced into prominent subcoxal spines, the caudal edge of the metasterna is broadly convex and preceded by a flattened margin; anterior sterna of males narrow and unmodified except for two prominent paramedian knobs between the 4th pair of legs; gonopod aperture large, oval, extending laterad well beyond lateral ends of coxal sockets of the 7th segment; gonopods variable in form, usually elongate and slender, with acicular to laminate prefemoral process, the coxae small and connected only by membrane, no sternal element persisting.

Range: Eastern North America from northern Georgia and Mississippi to New York, northern Illinois, Arkansas, and Missouri. Species are most abundant in the central Appalachian region, where almost any well-collected area will yield about four different species.

KEY TO THE GENERA OF NANNARINI

Pretarsi of anterior legs of males simply flattened and spatulate, not strongly twisted at midlength (Fig. 4); posterior corner of paranota modified as a caudomedially projecting acumen on segments 3 through 16 (Fig. 1); solenomerite of male gonopods in the form of a broad, flat plate (Fig. 10) .... *Oenomaea*, n. gen.

Pretarsi of anterior legs of males flattened, distally spatulate, and strongly twisted at midlength (Fig. 6); posterior corners of paranota of most body segments rectangular or acutely angular, never projecting as a dentiform process (Fig. 5); solenomerite of gonopods variable but not in the form of a broad, flat plate *Nannaria* Chamberlin

Oenomaea, new genus

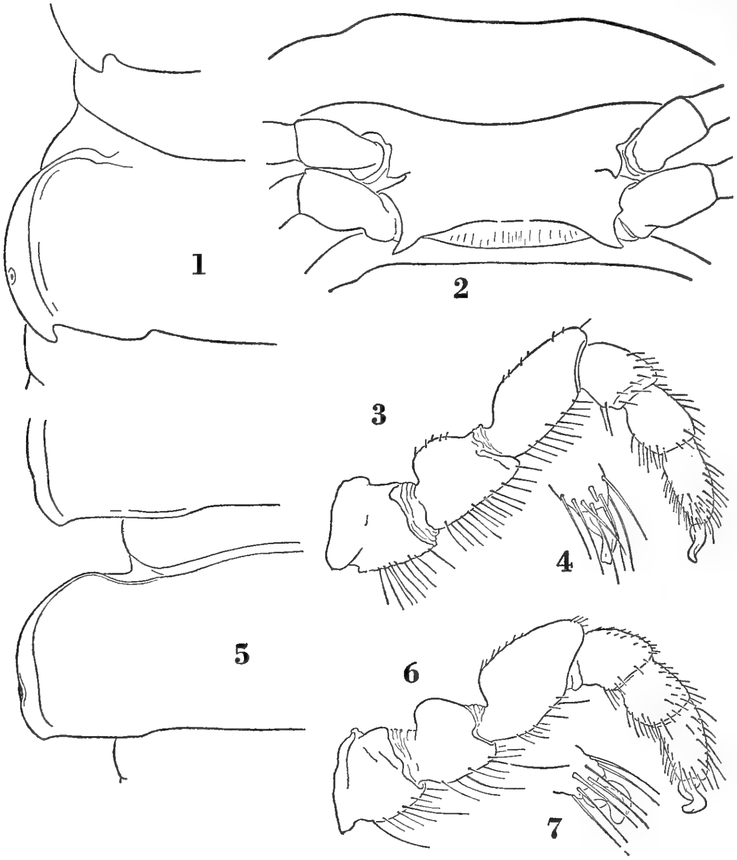
(Latinization of a classic Grecian proper name)

Type species: *Fontaria pulchella* Bollman, 1889.

Diagnosis: Differing from *Nannaria* by the characters stipulated in the preceding key. Head smooth and polished; epicranial suture distinct, ventrally bifurcate into two short, nearly horizontal interantennal sutures. Facial setae not yet determinable with assurance, but apparently as follows: epicranial 0–0, interantennal 1–1, subantennal 1–1, frontal 2–2, labral 14–14, genal 0–0. Genae nearly flat, without median impression, not margined laterally. Antennae unmodified, with four small terminal sensory cones.

Body relatively small in size, the width/length ratio about 15 per cent. Paranota small, depressed, especially on the anterior segments; anterior corners of paranota first rounded, then becoming obliquely sloped off on midbody and caudal segments; posterior corners of paranota of segments 4–16 acutely produced caudomesiad, the lateral edges convex (Fig. 1); posterior edges not margined. Ozopores in normal sequence, small, opening ventrolaterally in the caudal half of large, prominently thickened peritremata, their position gradually shifting more posteriorly on the caudal segments. Tergites smooth and polished, the metatergites slightly more convex than dorsum of prozonites, the two subsegments meeting dorsally at a fine, flat suture in a moderate interzonal stricture (NOTE 2).

Sterna smooth, nearly flat, sometimes transversely elevated between the posterior legpair, the elevated area then setting off a prominent broad, flat segmental marginal band (Fig. 2). No transverse or cruciform impressions; but sterna produced into conspicuous acutely pointed subcoxal spines. Sides of body unmodified. Stigmata similar in shape, elongate



FIGS. 1–4. *Oenomaea pulchella* (Bollman). 1, Left paranotum of 9th segment, dorsolateral aspect (perpendicular to paranotal surface); 2, Sternal areas and bases of legs of segment 10, ventral aspect; 3, 4th leg of male, anterior aspect; 4, End of tarsus and pretarsus of same, enlarged. FIGS. 5–7. *Nannaria minor* Chamberlin. 5, Left paranotum of 9th segment, dorsolateral aspect; 6, 4th leg of male, anterior aspect; 7, End of tarsus and pretarsus of same, enlarged.

vertical slits, the anterior stigmata somewhat larger than the posterior. Sternum of 5th segment produced into a prominent, median, apically notched process between the fourth pair of legs.

Coxae of legs mutic, prefemora with the usual long, sharp distal spines. Legs moderately long, the podomeres robust, densely setose ventrally; femoral segment the longest; pretarsi of anterior legs of males flattened, spatulate; those of middle and posterior legs becoming slender and acute.

Gonopod aperture large, oval, extending far laterad and reducing the prozonite to a mere narrow transverse strip; edges of aperture moderately elevated on the caudal and lateral sides. Gonopods large, the coxae widely separated in situ, and connected only by membrane; coxae subglobose, with a few setae on the dorsal side but without coxal apophyses. Telopodites long and slender, projecting cephalad over the 6th sterna, curved medially and distally overlapping. An elongate, slender prefemoral process is present; distally the telopodite is bifid into (1) an elongate, slender, tibial branch and (2) a much broader, laminate solenomerite (Fig. 10).

Female externally very similar to male, the sterna a little wider and the dorsum more convex. Cyphopodal characters not yet investigated.

Oenomaea pulchella (Bollman), new combination

(Figs. 1–4, 8–10)

Fontaria pulchella Bollman, 1889, Proc. U. S. Nat. Mus., 11: 316.
Nannaria pulchella Chamberlin and Hoffman, 1958, Bull. U. S. Nat. Mus., No. 212: 41.

Diagnosis: With the characters of the genus. This small species is readily distinguished from all other xystodesmids known to me by the peculiar formation of the paranota.

Type specimens: Two female cotypes, USNM (D-404), from Strawberry Plains, Jefferson Co., Tennessee, C. B. Branner, leg. I have designated the specimen in better condition as the *lectotype* of this species.

Description of male: (From wooded slope, 1.5 miles south of Oakman, Gordon Co., Georgia, 13 May 1961, Leslie Hubricht, leg.) Length about 26.5 mm, greatest width 4.8 mm; width/length ratio about 15 per cent. Body parallel-sided between segments 2 and 14, narrowing gradually caudal, width values for selected segments as follows:

Segment 1—4.2 mm
2—4.7
4—4.8
6—4.8
8—4.8

Segment 10—4.8 mm
12—4.8
14—4.7
16—4.3
18—4.0

Head capsule normal in appearance, oval, convex, smooth and polished, flattened between the antennae. Width across genae 2.9 mm. Epicranial suture thin but distinct, not in a depression, not punctate, but ventrally bifid, the branches horizontal and thus forming right angles with the main suture. Interantennal isthmus broad (1.0 mm), flat and smooth. Genae not margined laterally, and without evident median depression, the ends acutely rounded and projecting distinctly beyond adjacent margins of the cranium.

Facial setae partially abraded, the following data from apparent setae sockets and thus subject to emendation: epicranial ?0–0; interantennal 1–1; subantennal 1–1, each located near the lower, inner arc of the antennal socket; frontal 2–2, the outermost seta on each side more widely separated from the inner than the two inner setae are from each other; clypeal about 12–12; labral about 14–14; genal 0–0.

Antennae moderately long (4.9 mm) and slender, reaching back to middle of paranota of third segment. Article 1 globose, with a few apical setae; article 2 clavate, extending beyond genal apex; articles 2–6 similar in size and shape except that 2 is slightly more clavate than the others; articles 2–5 sparsely setose, 6 and 7 more densely setose, all with apical macrosetae; article 7 short, cylindric, truncate, its distal edge not inturned between the four small sensory cones, without sensory area on the outer surface.

Collum broad (about three times as broad as long), smooth and polished, elongate-hexagonal in shape, the anterior and posterior edges parallel, the posterior edge not emarginate middorsally; sides evenly converging laterad, the ends acutely rounded; a well-defined anterior marginal ridge.

Tergites of body segment entirely smooth and polished; paranota transverse, depressed, those of anterior segments continuing slope of dorsum, those farther back on body interrupting dorsal convexity. Peritremata thick and conspicuous, sharply set off from paranotal surface, scapulorae marginal on anterior segments, becoming submarginal farther back on body. Posterior edge of paranota thin, not margined. Prozonites and metazonites separated dorsally by a fine suture in a slightly constricted stricture, the metazonite slightly more convex and elevated.

Segments 2 and 3 similar in general appearance, the paranota transverse and depressed, with rounded anterior and posterior corners and moderately convex lateral edges. Segments 4–15 generally similar, the anterior corners of the paranota becoming gradually more rounded off and less convex, the scapulorae also becoming submarginal; posterior corners of these segments produced into acute, caudomedially directed spines formed by caudal prolongation of the peritremata. Posterior edge of these segments convex, forming a basal shoulder on the more caudal segments. Ozopores small, but distinct, opening on the ventrolateral side of the peritremata, their position gradually shifting caudally on successive segments until nearly at the base of the projecting dentation on segments 16–19.

Epiproct large, subtriangular, slightly convex, smooth and polished, distinctly decurved distally, with the usual whorls of macrosetae. Paraprocts nearly flat, smooth and glabrous with a few vertical striations, the medial edges very prominently elevated and sharply set off. Ventral seta set on a prominent discal tubercule located close to the marginal ridge; dorsal seta located in a small pit on the widest part of the ridge. Hypoproct large, transversely oval, with a faint median projection and prominent paramedian setiferous tubercules.

Sides of metatergites smooth and unmodified. Stricture very distinct down sides, especially in front of paranota, as a broad but not sharply edged groove, but reduced to a shallow depression midventrally. Stigmata similar in shape, elongate oval, the edges not elevated above segmental surface, the anterior stigmata distinctly larger than the posterior; both are distinctly separated from the dorsal coxal condyles.

Sternal surfaces of metazonites smooth, glabrous, and nearly flat except for a very faint transverse elevation between the posterior pair of legs. Caudal edge of segment convex, flattened (Fig. 2). Both pairs of legs subtended by subcoxal spines, the anterior spines small and blunt, the posterior much larger, acute, curved caudolaterally, and projecting well beyond caudal edge of segment. Subcoxal spines each with 2 or 3 small setae. Anterior pair of legs slightly farther apart than the posterior. Sterna of anterior segments narrow and unmodified except for a robust, distally notched process between the 4th pair of legs. Sternum of 6th segment not depressed or broadened.

Legs relatively long and slender, the distal half of the femora visible from above when legs are extended laterad. Coxae unarmed, prefemora with long, sharp, distal spines, these two podomeres of approximately equal size. Length relationships of podomeres: $3 > 6 > 1 = 2 > 5 = 4$. See Figure 3 for appearance of 4th leg. First pair of legs reduced in size as usual, with acute pretarsi. Pretarsi of legs of 2nd–14th pairs distinctly broadened, flattened, and spatulate, but not twisted at midlength (Figs. 3 and 4).

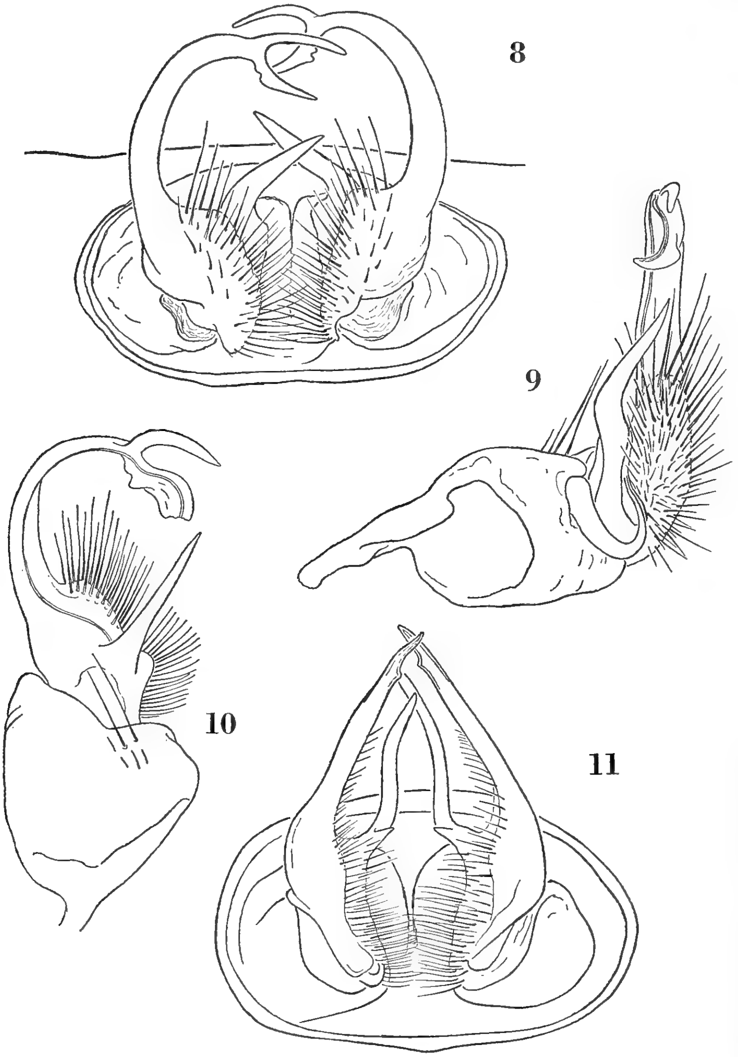
Prozonite of 7th segment reduced to a narrow, transverse strip by the large, symmetrically oval gonopod aperture, which extends laterally beyond ends of coxal sockets. Lateral and caudal edges slightly produced into a low marginal flange. Sternum behind gonopod aperture produced into two conspicuous, ventrally directed subcoxal cones. Gonopods large, of the form described in the generic diagnosis and shown in Figures 8–10.

Color in life unknown, the specimen apparently preserved shortly after moulting and at present testaceous-yellowish.

Remarks: Bollman's original description was extremely brief, but did mention most of the conspicuous features of this species. He correctly suspected a relationship with several species now referred to *Nannaria*, and described the coloration of his specimens as "Brown, lateral carinae and posterior border of segments red; legs and under parts yellow."

The recently published Checklist of North American millipeds (Chamberlin and Hoffman, 1958) refers *pulchella* to the genus *Nannaria*, without comment. It is a distinct pleasure to be able to finally dispose of this long-standing enigma and so reduce the number of dubious species of millipeds still on record for the eastern United States.

Both of Bollman's female types are smaller than the male specimen from Georgia, but the difference in size is no greater than the range of variation known for various other xystodesmids of similarly small size. The Georgia locality is about 115 miles south of Strawberry Plains, not an excessive distance for a specific range.



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10

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FIGS. 8–10. *Oenomaea pulchella* (Bollman). 8, Gonopods in situ, caudoventral aspect; 9, Left gonopod, mesial aspect; 10, Left gonopod, dorsal aspect. FIG. 11. *Nannaria minor* Chamberlin, gonopods in situ, caudoventral aspect.

Genus *Nannaria* Chamberlin
(From the Latin *nannus*: small)

Nannaria Chamberlin, 1918, Psyche, 25: 124.
Mimuloria Chamberlin, 1928, Ent. News, 39: 155. NEW SYNONYMY!
Castanaria Causey, 1950, Chicago Acad. Sci. Nat. Hist. Misc., No. 73: 1.

Type species: Of *Nannaria, N. minor* Chamberlin, by original designation; of *Mimuloria, M. missouriensis* Chamberlin, by original designation; of *Castanaria, C. depalmai* Causey, by original designation.

Synonymy: *Mimuloria*, only recently recognized as a nannarine genus, has been distinguished by the small lamellate enlargement of the distal end of the gonopod telopodite. In the material at my disposal, including nearly 30 undescribed species, I find this character to be a mutable one, and more suitable for the distinction of a species-group than a separate genus.

Range: Eastern United States, chiefly in the Appalachian mountains, the Ozarks, and intervening states in the Central Lowlands.

Species: 21 have been described. Obviously a great number of species remain to be discovered.

Nannaria minor Chamberlin
(Figs. 5–7, 11)

Nannaria minor Chamberlin, 1918, Psyche, 25: 124.

Type specimen: Adult male (M.C.Z.), from Burbank, Carter Co., Tennessee; R. Thaxter, leg. I examined this specimen and drew the gonopods in February 1949.

Remarks: The original diagnosis of this species is reasonably adequate, but does not contain illustrations of the gonopods, and it is extremely difficult to formulate a good concept of such structures from a verbal description. It has never been possible heretofore to identify the species with confidence, and since my revision of *Nannaria* will not be completed for several years, I provide here some illustrations of the paranota, legs, and gonopods of *minor* for the benefit of other workers, as well as to provide a basis for comparison with the same characters in *Oenomaea*.

Nannaria minor has so far been known only from the type locality. The illustrated specimen is from a small series taken at a second locality: the southern side of Sam's Gap, along U. S. Hy. 23, in Madison Co., North Carolina, 23 July 1961, Hoffman, leg. This locality is 27 miles southwest of Burbank, and similarly in the Unaka Mountain range.

NOTES

NOTE 1. Pretarsi. The distalmost podomere (previously referred to as the tarsal claw by many workers) occurs in various forms among xystodesmid genera. So far I have distinguished three main types: one in which the pretarsus is only slightly curved, and is not evidently modified; a second in which it is elongate and bisinuate, with three or five distinct parallel carinae on the dorsal side; and a third in which the pretarsus is flattened, spatulate, and distally truncate (these distinctions refer to the condition on the anterior legs of the male sex). Insofar as North American genera are concerned, I find that these types correspond closely to generic groupings drawn along the lines of gonopods, metasterna, and other characters, and are therefore obviously useful in the discrimination of suprageneric categories. A more detailed treatment is contemplated following the examination of exotic members of the family.

NOTE 2. Stricture. The transverse constriction between prozonite and metazonite in polydesmoids, in which the segmental suture occurs, has been referred to in my earlier papers as the "interzonal furrow." This term is awkward and vernacular, and I am now glad to adopt the term "stricture" which was proposed by K. W. Verhoeff 30 years ago, although he failed to use it consistently in his later papers.

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CHAMBERLIN, RALPH V. AND RICHARD L. HOFFMAN. 1958. Checklist of the millipeds of North America. Bull. U. S. Nat. Mus., No. 212: 1–236.

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JAPYGIDAE OF SOUTH AMERICA, 5: NEW SPECIES OF JAPYGIDAE FROM CHILE

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In this paper the genus *Teljapyx* is revised and two new species, *T. hirsutus* González and Smith and *T. costalus* González and Smith are described. Two new combinations, *T. larva* (Philippi, 1863) and *T. bidentatus* (Schäffer, 1897) are proposed for this genus. The genus *Valpjapyx* Smith (1962) is subordinated to the genus *Teljapyx* Silvestri (1949). A new species is added to *Penjapyx*, namely *P. castrii.* Recent collection records are given for *Chiljapyx caltagironei* L. Smith, *Nelsjapyx hichinsi* L. Smith, *N. soldadi* L. Smith, and for *Rossjapyx australis* L. Smith. This paper is based largely on specimens collected by Dr. Francesco di Castri, University of Chile, Santiago, and loaned to the authors for study.

Teljapyx Silvestri 1949

(Syn. *Valpjapyx* L. Smith 1962)

This genus was redescribed by Smith (1962) at which time no males were available. With additional specimens, including males, the genus may be defined by the following summary characters:

One large tooth on each arm of the forceps, tooth on the right arm distinctly premedian, tooth on the left arm median, or postmedian, both arms of forceps with biseriate predental tubercles, basal buttress distinct on both arms of forceps, seta *A* of forceps present, sometimes as large as adjacent seta, dorsal articulation of forceps pointed, antenna with 30 to 46 segments, first lamina of lacinia pectinate, abdominal tergites IV and V with 5 + 5M and a large anterolateral pair (6 + 6M of Silvestri), posterolateral angles of tergite VII projected to the rear, of tergite VI not projected, tergite X with setae *a*, *b*, *c*, and *d* present, setose sacs in abdominal segments III and IV of the male, with two or more blunt, thumb-like plumose setae.

Type: *Teljapyx riestrae* Silv. 1949 (original description).

The species of the genus *Teljapyx* are as follows:

T. riestrae Silv. 1949, Temuco, Chile.
T. megalocerus Silv. 1902, Talcahuano, Chile. Syn. *Japyx chilensis* Verh.
T. bidentatus (Schäffer), 1897, Valparaiso, Chile. Syn. *Valpjapyx botani* Smith.
T. larva (Philippi) 1863, Colchagua, Chile. Syn. *Forficula larva* R. A. Philippi.
T. talcae (Smith) 1962, Talca, Chile. Syn. *Valpjapyx talcae* Smith.
T. hirsutus new species, O'Higgins, Chile.
T. costalus new species, Santiago, Chile.
T. afer Silv. 1949, Africa.
T. parcus Silv. 1949, Africa.

The species *T. afer* Silv. was described from Port Elizabeth, Africa, and *T. parcus* Silv. was described from Tanganyika, Africa. Pagés (1952) has shown that these two species do not fit the description of the genus, and consequently will not be further considered in this paper.

The species *T. megalocerus* was described by Silvestri in 1901 as *Japyx*, was named *Japyx chilensis* by Verhoeff in 1903, was redescribed by Silvestri in 1905, and was again described and placed in the genus *Teljapyx* by Silvestri, 1949. This species lacks setae between the carinae of tergite X, tergite VI has only 4 + 4M, tergite VII has 3 + 3M. Consequently, this species does not fit well into the genus *Teljapyx* and shall be omitted from this discussion.

The species of the genus *Teljapyx* are found in the valleys and low coastal hills (Cordillera de la Costa), from sea level to 2,000 feet elevation, and from Valparaiso on the north to Temuco on the south, a distance of 880 kilometers, or between latitudes 32°–39° south.

Teljapyx bidentatus (Schäffer), new combination

Japyx bidentatus Schäffer, 1897, in Apterygoten, Ergebn. Hamb. Magalh. Samm.: 30–32 (Nec. *Japyx bidentatus*, Silvestri, 1901)
Valpjapyx botani L. Smith, 1962, Proc. Ent. Soc. Wash., 75: 277–278

Schäffer (1897) described *T. bidentatus* from Viña del Mar, Valparaiso, Chile. This species had 35 segments in the antennae, the posterior lateral angles of tergite VII projected to the rear, and M_1 was missing on tergites VI–VII. Silvestri (1901 and 1905) redescribed this species as having 32 segments in the antenna, posterolateral angles of tergite VII rounded, and M_1 was present on tergites VI–VII. In 1949 this species was again redescribed by Silvestri, and placed in the genus *Merojapyx*. However, it fits in all details into the genus *Teljapyx*, and differs from the type of *Merojapyx* in that it does not have disculi on the median subcoxal organ. We have studied three specimens from the Jardín Botánico Nacional, Viña del Mar, and one from Aculeo, Santiago, and all agree with Schäffer's original description. This species has been described in detail by Smith, 1962.

Teljapyx hirsutus, new species

(Figs. 1, 7, 9, 13)

Female: (Based on stage II). Head dorsum with about 15 + 15 typical setae and several hundred thin hair-like setae almost as long as the typical setae, distal lamina of lacinia with 13 or 14 teeth, lacinia falciform, rarely with a tooth, galea with two external setae (three in successive stages), galea with two external setae and a row of four projections, terminal segment of maxillary palpus with about 20 setae of various sizes, the longest, median, 1.7 times as long as stylus I, antenna with 40 segments, tapered, segment 3 of antenna with 45 setae of various lengths, not distinctly arranged in two whorls, segments 14 to 22 with posteroventral proliferation of setae between the basal and distal whorls, terminal segment of antenna not hemispherical, placoid sensillae 8 in two distinct whorls, trichobothria equal in length to the longest seta on the same segment, labial palpus somewhat tapered, three times as long as wide at the base with 16 setae of which the longest, terminal, almost as long as the palpus.

Thorax: Tergites 5, 6, 5 and many thin, hair-like setae, mesothorax prescutum with well-developed transverse and median apodemes, metathorax prescutum with strong transverse apodeme but no median, legs covered with hair-like setae, mesocoxa with 4 large setae, trochanter with 5 large setae, dorsal apex of femur with a close row of six setae as follows: one large, one medium, one large, one small, one large, and one small, ventral apex of tibia with two equal calcar setae, distinctly larger than other setae on the tibia, tarsi with 5 or 6 large setae in each ventral row (8 in stage IV), tarsal claws unequal, empodium subequal to pretarsus, directed upward.

Abdomen: Tergite I prescutum 1 + 1M, scutum 1 + 1M and many hair-like setae smaller than on the thorax, tergite II 3 + 3M and hair-like setae, diminishing on segments to the rear, tergites III–V 5 + 5M, and a large pair of anterolateral setae with the anteromedian pair minute or absent, tergites VI and VII 4 + 4M (M_1 absent), tergites I–VI with posterolateral angles rounded, tergite VII with angles projected to the rear, tergite VIII dorsal 4 + 4M, segment IX dorsal no setae, tergite X setae *a*, *b*, *c*, and *d* present with *d* half as long as *c*, dorsal carinae distinct, convergent, ventral carinae distinct, parallel, pygidium prominent, rounded. Sternum I apotome 4 + 5M alternating with 4 + 5m, sternite macrosetae indistinguishable from large antecedent setae, antecedent setae about 40 + 40, lateral subcoxal organs each occupying ⅓ of the distance between the styli, sensory setae separated by width of one setal socket, setae ⅓ as long as adjacent glandular setae, glandular setae in 3 rows, glandular setae in the posterior row one-third longer than those of the other two rows, median subcoxal area protruding with 3 + 3 setae on the posterior edge, no disculi or pseudopores. Sterna II–VI apotomes without setae, sternites 38 + 38M, sternite VII 20 + 20M, sternite VIII with 9 + 9M, sternite IX with pleurae not meeting in midventral line, segment X between the ventral carinae 10+ 10M or

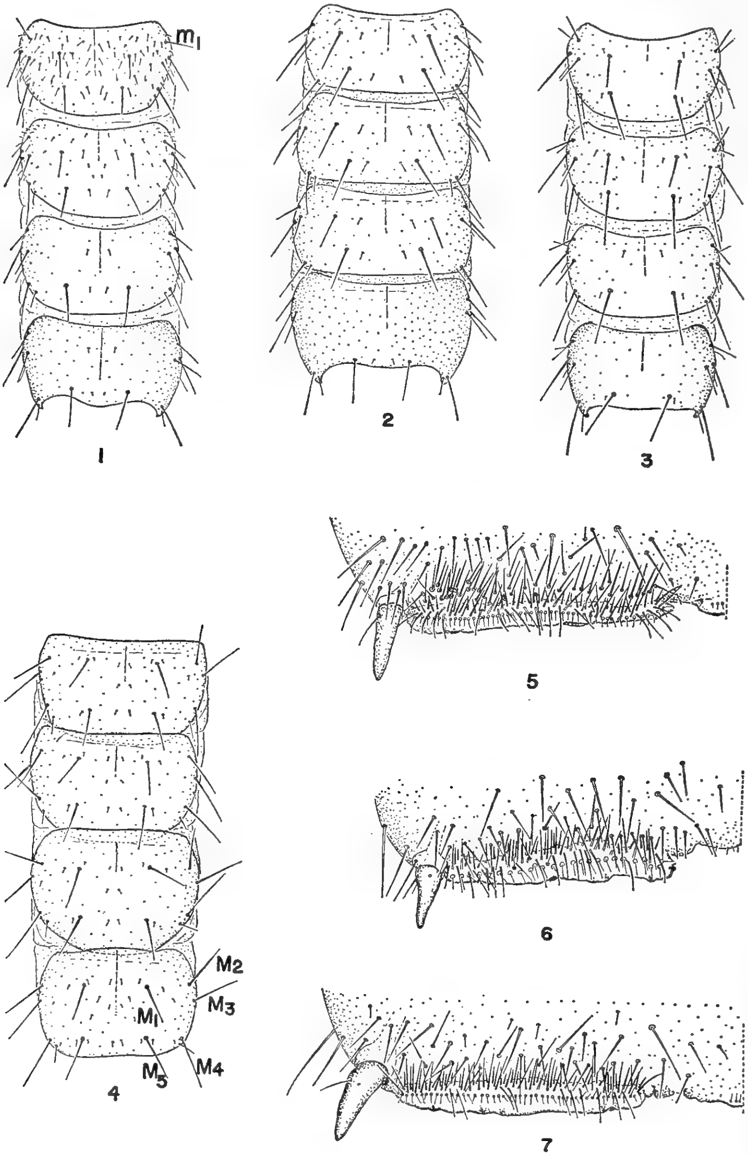


Plate I. Figs. 1–4—Tergites IV–VIII of holotypes *T. hirsutus*, *T. larva*, *T. costalus*, and *P. castrii*; m_1 = anterolateral submacroseta; M = macrosetae. Figs. 5–7—Lateral subcoxal organ and half of median subcoxal organ of holotypes *T. costalus*, *T. larva*, and *T. hirsutus*.

11 + 11M, genital area typical with 2 to 4 small sensory setae on each anterior lobe, and a cluster of 5 to 8 similar setae at either side of the genital opening.

Forceps: Typical for the genus, right arm predental tubercles 2/3, left arm tooth distinctly postmedian, predental tubercles 9/9, seta *A* one-half as long as adjacent seta.

Male: Similar to female except, setose sacs in abdominal segments III and IV containing short, thick, blunt setae, widely separated, covered with uniramous or bifid projections and minute spicules (Fig. 13) and preceded by 5 + 5 (or 6 + 6 in male stage VI) short sensory setae placed near the anterior margin of each urite; genital papillae conical, nearly as wide at the base as long, external sensory setae 2 + 2 in stage II and 3 + 3 in successive stages, distributed by pairs and widely spaced; forceps, right arm predental tubercles 2/3, left arm predental tubercles 8/9.

Teljapyx hirsutus—differentiation into stages*

Body length, mm	Distance between Styli I, mm	Glandular setae (longest) on one side	External setae on galea	Ratio length adjacent seta: seta *A*	Setae in each setose sac	Stage
			Females			
7.0	0.4	11	1	1:0.1		3rd instar juvenile
12.0	0.7	17	2	1:0.2		Stage II
14.0	1.1	23	3	1:0.4		Stage III
18.0	1.2	32	3	1:0.5		Stage IV
23.0	1.6	40	3	1:0.5		Stage V
			Males			
13.0	0.9	18	2	1:0.25	2 + 1	Stage II
20.0	1.3	33	3	1:0.4	8 + 9	Stage IV
26.0	1.7	45	3	1:0.7	19 + 19	Stage VI

* Figures averaged when more than one specimen was available

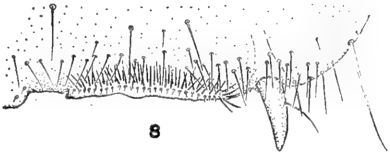
Type: Holotype ♀ in University of Chile, Santiago, paratypes in U. S. National Museum and University of California, Davis.

Habitat: 2 juveniles, 5 ♀ and 3 ♂, Palmas de Cocalán, Province of O'Higgins, 34°12′ S, 71°20′ W, under stones, in open forest of *Jubaea chilensis*, at 700–800 meters elevation, 5 August 1961 and 6 September 1962, collected by Dr. F. di Castri.

Teljapyx larva (Philippi), new combination
(Figs. 2, 6, 11, 14)

Forficula ? *larva* Philippi, 1863. Zeischr. Ges. Naturw., 21 (3–4): 219

Typholabia larva (Philippi), Scudder, 1876. Boston Soc. Nat. Hist. Proc., 18: 300



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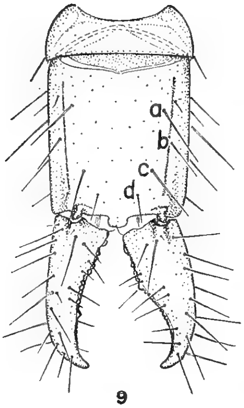

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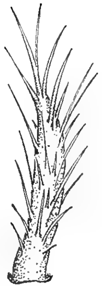

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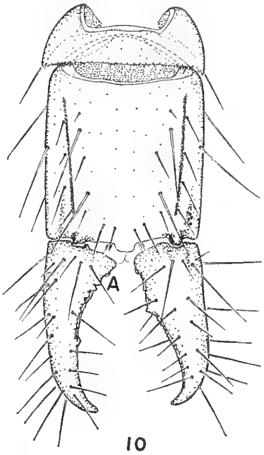

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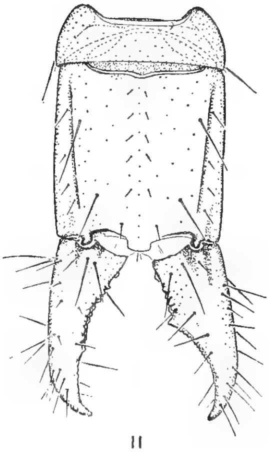

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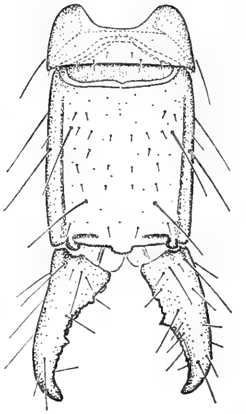

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PLATE II. Fig. 8—Lateral subcoxal organ and half of median subcoxal organ, *P. castrii* ♂ allotype. Figs. 9–12—Tergite X and forceps of holotypes *T. hirsutus*, *T. costalus*, *T. larva*, and *P. castrii*. Figs. 13–14—Setae of male setose sac, *T. hirsutus* and *T. larva*.

Japyx larva (Philippi), de Bormans, 1887. Soc. Ent. Belg. Bull. et Ann., 31: 495

R. A. Philippi (1863), in his revision of the Chilean Orthoptera existing at that time in the Museum of Natural History, Santiago, described this species as belonging to the order Dermaptera, and no drawings were provided. Due to the "remarkable" characters that Scudder (1876) found in the species' description which made it resemble no known forficularians at that time, he erected the new genus *Typhlolabia* (which is hereby declared *nomen oblitum*) for the reception of this species. De Bormans and Marquet in 1883 considered this genus as doubtful but nevertheless they added a new species, *T. subterranea.* Later in 1887, Karsch placed Philippi's species among the Japygidae but independently de Bormans (1887) consolidated this action by removing both known species of *Typhlolabia* to the genus *Japyx.*

Through the courtesy of Dr. G. Kuschel and Dr. F. di Castri of the University of Chile, we have been able to examine the type specimen of *F. larva* deposited in the Museum of Natural History, Santiago. The holotype, a pinned specimen, was in excellent condition, and has been remounted in permanent medium after a clearing and staining in lactophenol-lignin pink. Since Philippi's description, probably the first one ever made of a japygid,* was very schematic, it is worthwhile to present the following redescription:

Male: Close to *T. hirsutus* González and Smith, except: antenna with 41 segments, lacinia with a flange, longest seta on maxillary palpus 2.0 times as long as stylus I, segment 3 of antenna with 58 setae, placoid sensillae 8 in two distinct whorls, labial palpus with 20 setae, galea with 3 outer setae widely spaced, head, thoracic tergites, and legs all clothed with many small hair-like setae, abdominal segment VI with seta M_1 present, lateral subcoxal organs with three rows of glandular setae, those in the posterior row one-third longer than those on the other two rows, the longer glandular setae of the anterior row and separated by width of one setal socket, median subcoxal organ 4 + 4, setose sacs in urites III–IV each with 18 plumose setae in one single spot, plumose setae of setose sacs with shorter and more branched barbulations than those of *T. hirsutus* (Fig. 14); styli with two unequal setae on the external margin, genital papillae 1.5 times as long as wide at the base, with typical dense setae on mesad surface, sparser setae on laterad surface, and seven minute sense setae irregularly arranged from base to tip, forceps seta *A* subequal to adjacent seta, right arm with large premedian tooth, premedian tubercles biseriate 3/3, left arm with postmedian tooth, predental tubercles 8/12 with the first two tubercles in the lower row modified to toothlets.

Length of body including forceps: 17 mm; separation between styli I 1.6 mm.

Female unknown.

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* The genus *Japyx* was established by Haliday in 1864.

Teljapyx talcae (Smith)

(Syn. *Valpjapyx talcae* Smith 1962)

The species *Valpjapyx talcae* was described by L. Smith in 1962 from one female and two juveniles, taken 22 miles north of Talca, Chile. No additional specimens are at hand, but a better knowledge of the genus *Teljapyx* enables the authors to place this species in this genus. However, the presence of 3 whorls of sensilla placoidea in the last antennal segment and the noticeable proliferation of antecedent setae in the area of the lateral subcoxal organ, constitute exclusive characters not found in other species of the genus.

Teljapyx costalus, new species

(Figs. 2, 5, 10)

Male: (Described from stage III). Similar to *T. hirsutus* González and Smith, except: head with about one-fourth as many hair-like setae, galea with a row of 3 external setae of which the two anterior are close together, longest (median) seta on maxillary palpus 1.2 times as long as stylus I, antenna with 46 segments, segment III of antenna with 40 setae, segments 14 to 24 with posteroventral proliferation of setae between the basal and distal whorls, trichobothria two-thirds as long as longest setae on same segment, thoracic tergites and legs without a dense coat of hair-like setae, trochanter with 7 large setae, abdominal tergites without hair-like setae, tergites III–V 5 + 5M and a large pair of anterolateral setae (m_1 of Pagés) and M_1, decreasing in size on each posterior tergite, tergites VI and VII 4 + 4M (M_1 absent) and a pair of large anterolateral setae, tergite VI posterolateral angles obtuse, tergite X with seta *d* ¾ as long as *c*, and 4 large *m* between the carinae, sternite I with 85 + 85 antecedent setae closely grouped anterior to lateral subcoxal organs, not continuous across median subcoxal area, median subcoxal organ with 4 + 5 microsetae in a straight line on the posterior edge, sternites II and III with a straight line of 22 setae plus a few microsetae between the bases of the styli, male sac in urite III with 2 + 1 plumose setae, sac in urite IV with 2 + 2 setae in widely separated pairs, forceps: right arm predental tubercles 1/2, left arm predental tubercles 8/8, seta *A* three-fourths as long as adjacent seta.

Female unknown.

Length of body including forceps 18 mm.

Type: Holotype ♂ in Univ. of Chile, Santiago.

Habitat: One ♂ and one juvenile, Aculeo, Province of Santiago, Chile, 33°50′ S, 70°56′ W, in the Cordillera de la Costa at 450 meters elevation, under stones, 7 July 1961, collected by Dr. F. di Castri.

Teljapyx profundus Smith 1962 possesses most of the characters of the genus *Teljapyx* except that the predental tubercles of the right arm are uniseriate. No males of this species are known. When males are studied, the nature of the male setose sacs will determine if this species should belong in this genus. Until such time the species is regarded as *incaerta sedis.* The species was described in detail by Smith (1962).

KEY TO THE CHILEAN SPECIES OF THE GENUS *Teljapyx*

1. Seta M_1 present on tergite VII 2
   Seta M_1 absent on tergite VII 3
2. Antenna with 30 segments; right arm of forceps biseriate 2/3 .... *T. riestrae* Silv.
   Antenna with 44 segments; right arm of forceps predental tubercles 3/4 .... *T. talcae* (Smith)
3. Seta M_1 present on tergite VI; median subcoxal organ with 4 + 4 microsetae; styli with 2 external setae .... *T. larva* (Philippi)
   Seta M_1 absent on tergite VI; median subcoxal organ with 3 + 3 microsetae; styli with a single setae 4
4. Head, thorax and tergites I–IV densely covered with numerous thin, hair-like setae; sternum VIII with 9 + 9M *T. hirsutus* G. & S.
   Without such hair-like setae; sternum VIII with 8 + 8 or 10 + 10M 5
5. Five large setae on trochanter, sternum VIII with 8 + 8M, seta A of forceps one-third as long as adjacent seta, antenna with 35 segments .... *T. bidentatus* (Schäf.)
   Seven large setae on trochanter, sternum VIII with 10 + 10M, seta A of forceps three-fourths as long as adjacent seta, antenna with 46 segments .... *T. costalus* G. & S.

Penjapyx castrii, new species
(Figs. 4, 8, 12)

Female: Head with 9 + 9M and a few microsetae, distal lamina of lacinia with 7 teeth, galea with one external seta, thumb of galea sclerotized with 10–15 projections, not hooked, terminal segment of maxillary palpus with 10 setae of various sizes, the largest of which 1.8 times the length of the palpal segment, mandible with 4 teeth and a slight projection indicating the fifth tooth, antenna with 30 segments, segment 3 of antenna with a distal whorl of 13 setae, 6 of which long, basal whorl of 9 setae, 3 of which long, segments 8 to 13 with posteroventral proliferation of setae, terminal segment longer than wide, placoid sensillae 6 in two whorls, trichobothria half as long as longest seta on same segment, labial palpus tapered, with 8 setae, two terminal of which slightly longer than the palpus.

Thorax: Pro-5 + 5M, meso-prescutum 1 + 1M, scutum 4 + 4M, meta-prescutum 1 + 1M, scutum 4 + 4M (posteromedian pair absent), mesocoxa with 4 large setae, trochanter with 4 large setae, metatarsus with 7 large setae per ventral row, empodium a small swelling on the pretarsus.

Abdomen: Tergite I prescutum 1 + 1M, scutum 1 + 1M, tergites II–VII 5 + 5M, anterolateral seta m_1 missing, angles rounded, tergite VIII dorsal 6 + 6M, tergite X setae *a* and *c* large, *b* and *d* minute, sternum I apotome 3 + 3M, sternite 11 + 11M, antecedent setae, a group of 7 laterad of each stylus, 16 + 18 anterior to lateral subcoxal organs, and 4 + 4 anterior to median area, lateral subcoxal organs each occupying one-fourth of the distance between the styli, composed of one row of equal glandular setae 25 + 26 and sensory setae separated by the width of one setal socket, median subcoxal organ with 2 + 2 setae located at either side, sterna II–VII apotomes without setae, sternites II–VI 14 + 14M, sternite VII 13 + 13M, sternite VIII 7 + 7M, segment IX pleurae not meeting in midventral line, segment X between ventral carinae 9 + 9M, and 1 + 1m posteromedian.

Forceps: Dentition typical for the genus, left arm predental tubercles 8/5, R = 2.29.

Male: Similar to female except: lateral subcoxal organ composed of two rows of glandular setae 50 + 50. R = 2.22, genital papillae 1.5 times as long as wide, mesad surface with about 35 short thin setae, laterad surface without setae.

Length of body including forceps: ♀ 10 mm, ♂ 10.5 mm.

Types: Holotype ♀ in Univ. of Chile, Santiago, paratype ♂ in Calif. Academy of Sciences.

Habitat: One male and one female, Los Andes, Province of Aconcagua, Chile, 16–VIII–1962, collected by Dr. F. di Castri.

KEY TO THE SPECIES OF *Penjapyx*

Antenna with 32 segments, thorax mesoscutum 5 + 5M, metascutum 5 + 5M, sternite VI 15 + 15M, sternite VII 14 +14M, left arm predental tubercles 4/4, R ♂ = 1.67 .... *P. altus* Smith
Antenna with 30 segments, thorax mesoscutum 4 + 4M and 1 + 1m, metascutum 4 + 4M, sternite VI 14 + 14M, sternite VII 13 + 13M, left arm predental tubercles 8/5, R ♂ = 2.22 .... *P. castrii* G. &. S.

New collection records for existing species are as follows:

Rossjapyx australis L. Smith, one ♂ and 2 ♀, Dalcahue, Chiloé Island, Chile, 17 to 23 Jan. 1962, collected by Dr. R. L. Usinger.

Nelsjapyx hichinsi L. Smith, one ♀, Quebrada La Plata, Estacion Experimental Agronómica, Maipú, Santiago, at 30 cm depth, 600 m elevation, xerophytic plant cover of *Trichocereus chilensis* and *Trevoa trinervis*, 16–VI–1961, collected by F. di Castri.

Nelsjapyx soldadi L. Smith, a stage II ♂ showing two rows of glandular setae on the lateral subcoxal organs, Zapallar, Cordillera de la Costa, Aconcagua, 700 m elevation, 40 cm depth, 26–I–1961; one ♀ and 2 juveniles, Hacienda Las Palmas, Coquimbo Province, 31°15′ S, 71°38′ W, 26–V–1962, collected by F. di Castri.

Chiljapyx caltagironei L. Smith, 2 ♂ and 5 ♀, Aculeo, Santiago Province, 400 m elevation, 20 cm depth, 7–VII–1961; 6 ♂ and 5 ♀, Palmas de Cocalán, O'Higgins Province, 900 m elevation, 30 cm depth and under stones, 5–VIII–1961, by F. di Castri.

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PROCEEDINGS
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A REVIEW OF THE ORIENTAL LEAFHOPPER GENUS *SUDRA* DISTANT

(HOMOPTERA: CICADELLIDAE: HYLICINAE)

BY JAMES P. KRAMER

Entomology Research Division, Agric. Res. Serv. U. S. Department of Agriculture, Washington, D. C.

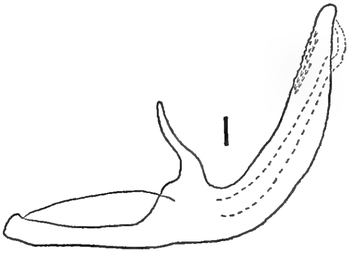
The genus *Sudra* Distant belongs to a group of leafhoppers found exclusively in the Old World tropics. This group has been treated as the family Hylicidae by both Evans (1946: 43–47) and Metcalf (1962: 1–18). The distinctness of this assemblage of leafhoppers is not questioned, but I prefer to consider the group as a subfamily of the Cicadellidae, *sensu lato.*

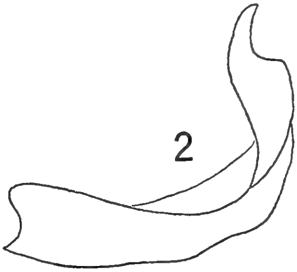
The hylicines were very thoroughly discussed by Evans (1946: 43–47). He noted that the outstanding general features include a variably produced head, coronally placed ocelli, a large pronotum and scutellum, a flattened abdomen, the occurrence of a sparse covering of scales and hairs on the body and forewings, and a wide corrugated appendix on each forewing which extends around the apex as far as the costal margin. This combination of characters will separate the hylicines from all other cicadellids.

Genus *Sudra* Distant

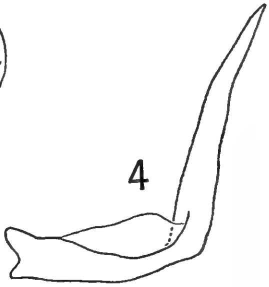
Sudra Distant 1908: 257 (type-species, *Sudra notanda* Distant).

Crown in dorsal view strongly produced beyond eyes, narrowing toward the rounded apex, ocelli near anterior inner margin of eyes; crown in lateral view straight or variably upturned at extreme apex. Pronotum convex, narrowest anteriorly, and with hind margin indented at middle. Scutellum exceptionally long, longer than either its width at base or pronotal length at middle, and acute apically. Forewings long and coriaceous. Entire body and forewings covered with a vestiture of somewhat flattened, elongated, scalelike setae. Prothoracic tibiae compressed and expanded.

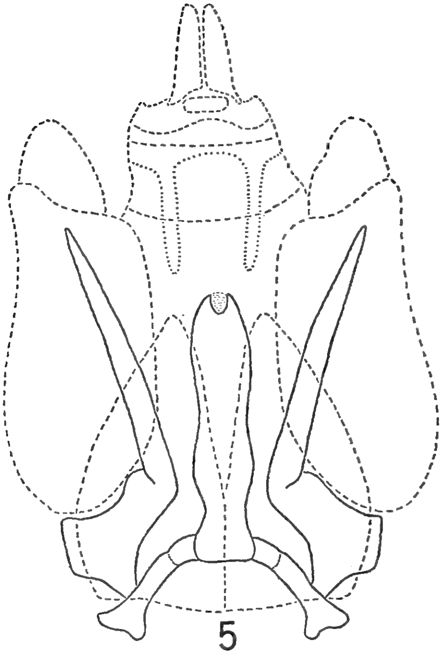


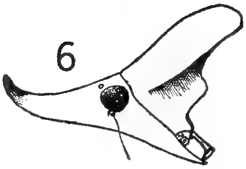


notanda



manorga





insularis

Male genitalia: Genital capsule comparatively small, valve lacking, subtriangular plates short and rounded laterally with a moderate number of randomly arranged setae on discal portion, posterior margin of pygofer indented with 2–5 short spined teeth along edge, pygofer laterally setose, anterior ventral margin of pygofer consisting of widened basal portion of concealed style, anal tube large and well developed, connective consisting of two arms (together irregularly U-shaped), simple aedeagus prolonged basally and upturned distally with a notch apically.

Female genitalia: Pregenital sternum large and longer than the two preceding segments together. As in the male, posterior margin of pygofer indented with 2–5 short spined teeth along edge.

Distribution: *Sudra* is limited to the Oriental Region.

KEY TO THE SPECIES OF *Sudra**

1\. Males 2
Females 3
2\. Scutellar apex reaching or slightly exceeding claval apices; style hooked distally (Fig. 2) .... *notanda* Distant
Scutellar apex falling far short of claval apices; style not hooked distally (Fig. 4) .... *manorga* Kramer, n. sp.
3\. Length of crown and pronotum about equal, both measured at middle .... *insularis* Schmidt
Length of crown shorter than length of pronotum, both measured at middle .... *notanda* Distant

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* The female of *manorga* and the male of *insularis* are unknown.

Sudra notanda Distant

(Figs. 1 and 2)

Sudra notanda Distant 1908: 257–258, Fig. 164.

Length: Male 13, female 15–16 mm.

Coloration: General ground color castaneous-brown. Spines of hind legs black. Extreme apex of head irregularly black. Setal vestiture sordid white to dark brown, arranged to form vague longitudinal stripes on pronotum. Vestiture of forewing mainly dark but with ill-defined light patch near base and a larger patch near scutellar apex. Scutellum sordid yellowish subapically. Dorsum of abdomen with a pair of large irregular yellow spots on segments 5 and 6.

Structure: Scutellum very long, slender, pointed apically, and attaining claval apices, sublaterally longitudinally ridged on both sides from base for about one-half length, centrally carinated longitudinally on slightly more than distal one-half.

FIGS. 1–6. *Sudra notanda* Distant: 1, lateral view of aedeagus; 2, lateral view of style. *Sudra manorga* Kramer, n. sp.: 3, lateral view of connective and aedeagus; 4, lateral view of style; 5, ventral view of male genital capsule. *Sudra insularis* Schmidt: 6, lateral view of head.

Male genitalia: Posterior margin of pygofer with 4 or 5 stout spines along edge. Aedeagus in ventral view somewhat bulbous apically with gonopore large and below the apex. Aedeagus in lateral view with some fine sharp scales dorsally near narrowed apex (Fig. 1). Style in lateral view partially folded and in distal one-half upturned with apex hooked (Fig. 2).

Female genitalia: Pregenital sternum with posterior margin subtruncated and very slightly notched at middle.

Specimens examined: One male, Thailand (no other data), in collection of U. S. National Museum, and one female, Lashio, Upper Burma, 3,000 ft., 23–24 Aug. 1914, Fletcher, in collection of British Museum (Natural History).

Discussion: Together with the original description of *Sudra notanda*, Distant published an excellent dorsal habitus illustration (see citation above). However, his illustration of the crown in lateral view seems to exaggerate the apical recurvature which, judging by the specimens available for study, is more nearly straight.

Dr. W. E. China of the British Museum very kindly compared the USNM male from Thailand with the only other known male from Haut Mekong, Pou Hai Katoui, Indochina, in their collection. He noted that in the Indochinese specimen the aedeagus was shorter and the posterior margin of the pygofer had five spined teeth versus a longer aedeagus and the posterior margin of the pygofer with four teeth in the Siamese specimen. These differences, we believe, are intraspecific variation.

Sudra notanda is now known from Burma, Thailand, and Indochina.

Sudra manorga Kramer, new species

(Figs. 3–5)

Length: Male 12 mm.

Coloration: Similar to *notanda* but darker. Clypeus and clypellus mainly black, entire dorsum including forewings very dark red-brown to black, vague ill-defined semi-hyaline patch on costal margin of each forewing in area near scutellar apex, setal vestiture dark golden-brown. Dorsum of abdomen with one pair of large irregular yellow spots on segment 5. Differs also from *notanda* in not having the extreme apex of head irregularly black and in not having bicolored pronotal setae.

Structure: Nearly identical with *notanda* except for the shorter scutellum. Scutellum neither ridged, carinated, nor reaching claval apices, but distinctly flattened apically, and its length slightly more than one-half claval length.

Male genitalia: Posterior margin of pygofer with 2–4 stout spines along edge. Aedeagus in ventral view similar to that of *notanda* but shorter. Genital capsule and concealed structures ventrally as in Fig. 5. Aedeagus and connective in lateral view similar to those of *notanda*, but aedeagus not narrowed apically (Fig. 3). Style in lateral view upturned distally with apex pointed and elongated (Fig. 4).

Female genitalia: Female unknown.

Type: Holotype male (USNM Type No. 66871), Manorg, W. Borneo, F. Muir.

Discussion: *Sudra manorga* is very distinct from both *notanda* and *insularis* on the basis of the darker coloration and the much shorter scutellum. The styles of *notanda* and *manorga* are very different as noted in the key to species.

Sudra insularis Schmidt

(Fig. 6)

Sudra insularis Schmidt 1920: 117.

Length: Female 18 mm.

Coloration: Not distinguishable from that of *notanda.*

Structure: Differing from *notanda* only in having the crown slightly larger and more distinctly upturned apically (Fig. 6).

Male genitalia: Male unknown.

Female genitalia: Not distinguishable from that of *notanda.*

Specimen examined: Holotype female, Ober-Langkat, Deli, Sumatra, 1894.

Discussion: It is not at all certain that *insularis* is, in fact, distinct from *notanda.* In the original description Schmidt noted the differences in the apical coronal recurvature and slightly larger size. He believed that the striped pattern formed by the setal vestiture on the pronotum was unique to *insularis*; this character is shared by *notanda.* More specimens, particularly males, are needed to resolve this problem.

The unique holotype female was generously made available for study through the courtesy and splendid cooperation of Dr. K. K. Günther and the Humboldt Museum in Berlin, Germany.

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PROCEEDINGS
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THE GENUS *NIDICOLA* (HEMIPTERA: ANTHOCORIDAE)

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Some twenty years ago, Harris and Drake erected the genus *Nidicola* in the subfamily Lyctocorinae to hold a new species, *N. marginata,* which occurs in a number of dissimilar habitats in Arizona, California, and New Mexico. Until now, the genus has remained monotypic.

The present paper describes four new species of anthrocorids which were intercepted at ports-of-entry in plants being imported into the United States. The plants were grown in Mexico and Guatemala.

The members of the genus live in different kinds of situations, such as nests of wood rats, caves frequented by bats, grain bins, and dumpage-heaps of decaying fruit refuse. On numerous occasions, both adults and nymphs have been intercepted in interstate and international shipments of bulbs, cut flowers, and nursery stock. Like members of other genera of the family, the species of *Nidicola* are predaceous and often referred to as "little pirates."

Pterygopolymorphism in the same species is common and apparently shared by all. The variformity of alar development within a species shows a high degree of variation, both in macroptery and brachyptery, and especially in the development of the hemelytral membrane. The hind pair of wings, although usually present and functional in macroptery, are at times much reduced or even lacking; all such long-winged individuals are thus flightless. In brachyptery, the hind wings are always greatly reduced or even completely wanting. There is little, if any, association in sex and wing development. Omitting genital structures, both sexes are about the same size, simi-

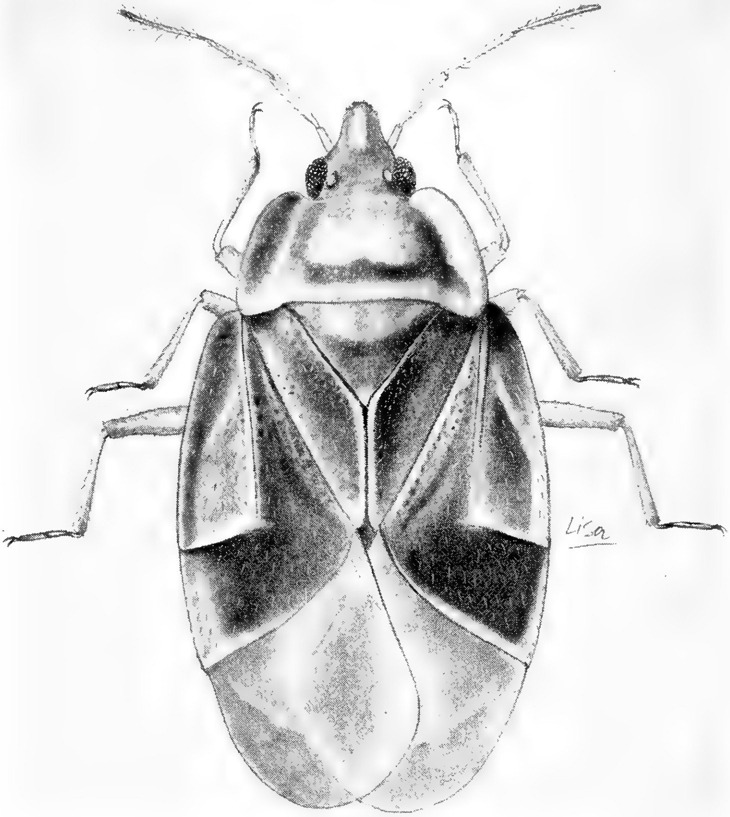

FIG. 1. *Nidicola marginata* Harris and Drake.

larly colored, and have general likenesses. The forewings are flat, lie in a horizontal state with membranes slightly overlapping each other, and may or may not completely cover the abdomen in a resting position. Total aptery is unknown in the genus.

All structural measurements were made under a stereoscopic microscope with an eyepiece micrometer divided in 100 units and recorded in microunits (80 units equal 1 millimeter). The dimensions of the body are entered in millimeters.

The authors are very grateful to Miss Lisa Biganzoli, Washington, D. C., for the fine illustrations. Adults of all species of the genus plus a fourth-instar nymph of one species are illustrated. The holotypes of the five members of the genus are lodged in the U. S. National Museum.

Genus *Nidicola* Harris and Drake

Nidicola Harris and Drake 1941, Iowa State College J. Sci., 15 (3): 343.

This curious and little-known genus comprises an assemblage of five homogeneous species, four of which are described as new below. Although the species are very similar to one another in outward appearance, each possesses structural features singular to its kind. The genus is known only from the southwestern United States, Mexico, and Central America.

The structural peculiarities include: small size, oblong or obovate form, depressed upper surface, more or less widely explanate lateral margins of pronotum, narrow embolium, cuneus clearly set off by a cuneal fracture, and by the shape and position of ostiole and ostiolar canal of the metathoracic scent glands on the evaporatorium of each metapleuron (Fig. 5). Other useful characteristics include presence of hamus in hind wings, large scutellum, and polymorphic wings. The antennae are long, each with segments I and II thickened, and III and IV thin and beset with long, outwardly projecting hairs. The legs are isomorphic, femora not much swollen, tarsi three-segmented. The claws are paired and apical. The rostrum is long, extending backward between or much beyond middle coxae in repose; it is apparently four-segmented, although the basal segment is greatly reduced or obsolete.

The membrane of the forewings varies greatly in size with veins fairly distinct or obsolete. Alarypolymorphism is common. Male genital segments are asymmetrical with paramere situated on left side in all specimens of the species we have studied (Fig. 5*a*, *c*).

In the nymphal stage, three pairs of scent gland openings are plainly visible on the dorsal surface of the abdomen. These are found (Fig. 5*f*) on tergites III, IV, and V, each pair of openings being connected by a shallow, transverse channel.

Type species: *Nidicola marginata* Harris and Drake.

This genus is readily distinguishable from other lyctocorine genera by the outward appearance or general aspect, explanate lateral margins of the pronotum, and location of ostiole and ostiolar canal on each metapleuron (Fig. 5*b*).

Although all species are small and similar in habitus, they can be readily separated from one another by the illustrations and taxonomic structures used in the key. All species are figured. The dark fuscous markings on the hemelytra are inconsistent within a species and are not of much specific value.

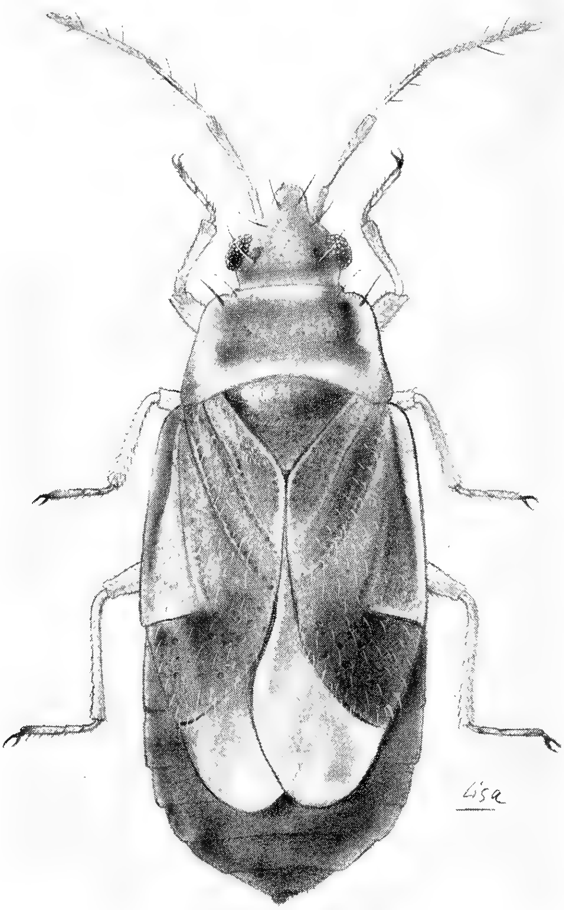

FIG. 2. *Nidicola mitra*, n. sp.

KEY TO SPECIES OF GENUS *Nidicola*

1. Veins of forewing neither elevated nor conspicuously outlined with punctures (Figs. 1, 2) 2
   Veins of forewing distinctly elevated and conspicuously outlined on sides with rows of punctures (Figs. 3, 4, 5*d*, *e*) 3

2. Anterolateral margins of pronotum prominent, extending forward beyond the front edge of the collar; head and thorax clothed with very short hairs, without long erect hairs, hemelytra finely

punctured; broadly obovate species (Fig. 1) .... *N. marginata* Harris and Drake

Anterolateral margins of pronotum not prominent nor extending forward beyond the front edge of the collar; head and thorax with prominent long erect hairs, hemelytra more coarsely punctured; smaller oblong species (Fig. 2) .... *N. mitra*, n. sp.

3. Anterolateral margins of pronotum project forward beyond front edge of collar; head, pronotum and especially the hemelytra with conspicuous, long, semierect hairs; median cell of corium devoid of punctures except for single rows outlining veins 4

Anterolateral margins of pronotum do not or only barely project anteriorly beyond front edge of collar; head, pronotum and hemelytra with much shorter hairs; median cell of corium with scattered punctures, especially near apex, in addition to the rows that set off the side limits of the veins (Fig. 3) ..... *N. engys*, n. sp.

4. Small, slender, oblong; outer margins of pronotum narrowly explanate, each side not much wider than that of pronotal collar; third antennal segment only slightly longer than second (Fig. 5*d*, *e*) .... *N. aglaia*, n. sp.

Broader, obovate species; outer margins of pronotum widely explanate, each side much wider than collar, anterior margin extending forward slightly beyond front edge of collar; third antennal segment longer than second segment (Fig. 4) .... *N. etes*, n. sp.

Nidicola marginata Harris and Drake

(Figs. 1, 5*a*, *b*, *c*)

Nidicola marginata Harris and Drake, loc. cit., p. 344.

Moderately large, obovate, brownish yellow, frequently with hemelytron becoming somewhat fuscous apically; dorsal surface clothed with short, inconspicuous hairs. Length 1.90–2.10, width (across cuneal fracture) 0.90–1.10 mm.

Head longer than transocular width (35:28), interocular space wide (19). Antennal measurements: segment I, 10; II, 18; III, 20; IV, 21. Rostrum with apex resting between hind coxae, measurements: segment II, 12; III, 24; IV, 16. Legs with femora slightly thickened.

Pronotum large, with outer margins widely explanate, extending forward on each side beyond fore margin of collar, more than twice as wide at base as median length (55:25); front lobe large, considerably swollen, feebly roughened; hind lobe much shorter, less than half as long as fore lobe, depressed, slightly rugulose. Hemelytra with veins and pits as depicted in illustration; punctures not always plainly discernible or arrayed in definite rows. Hind wings clear, shorter than fore pair. Male paramere as in illustration (Fig. 5*a*, *c*).

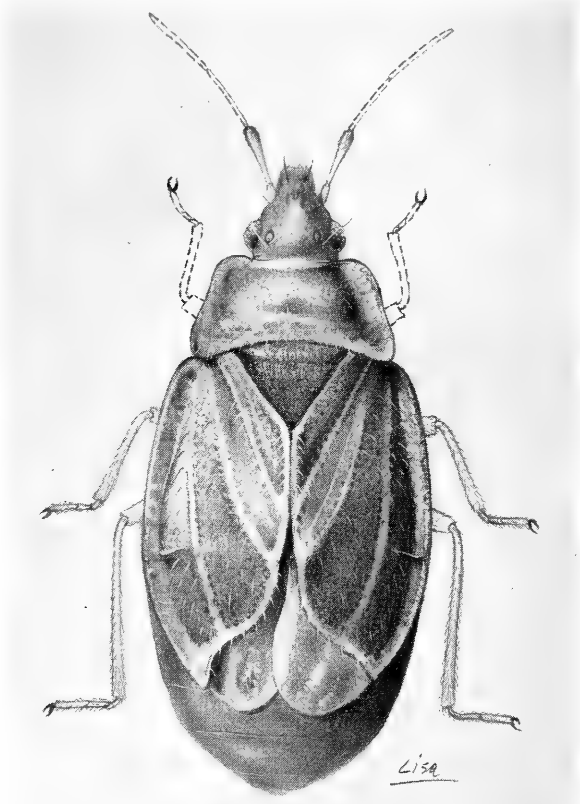

FIG. 3 *Nidicola engys*, n. sp.

Holotype, male (USNM type no. 67041) and *allotype*, female, both macropterous, Picacho Pk., Ariz., 3 Feb. 1940. *Paratypes*: Tucson, Ariz., in nests of wood rat (*Neotoma albigula*) and other paratypes from California (Indio and Palm Springs) and Arizona (Ft. Yuma and Tucson). Additional material is also at hand from the type localities, Tucson, and Mexico (Calexico, on guano of bats, and Mexicali, on bags of cotton seed meal).

This is the largest member of the genus. It is closely allied to *N. engys* and *N. etes*, which are also obovate in form and possess widely explanate margins of the pronotum. The obtusely rounded front end of the expanded pronotal margins is more prolonged anteriorly than in *N. etes*. The hairy clothing of first pair of wings is much shorter than on either of the other two species mentioned here. A female paratype from Tucson, Ariz., is figured.

Nidicola etes, new species

(Fig. 4)

Macropterous form: Obovate, brownish with explanate margins of pronotum and cunei of hemelytra testaceous; body beneath brownish. Antennae and legs pale testaceous with femora slightly darkened. Membrane clear or slightly opaque. Length 2.00, width (across cuneal fractures) 0.95 mm.

Dorsal surface moderately and evenly clothed with moderately long, slightly reclining, yellowish hairs, those on pronotum and scutellum shorter and more or less prostrate. Length of head and transocular width subequal (28:26), interocular width much shorter (17). Antennae long, measurements: segment I, 10; II, 16; III, 20; IV, 25. Rostrum extending between intermediate coxae, measurements: II, 12; III, 14; IV, 10.

Pronotum twice as wide at base as median length (52:26); collar distinct, very narrow; explanate side margins wide, much wider than collar, produced forward beyond front margin of collar; fore lobe of pronotum large, feebly roughened, the hind lobe much shorter, flat, slightly rugulose. Femora slightly thickened. Hemelytra covering abdomen, with pits in clavi and those along corial veins mostly well-defined and arranged in definite rows along corial veins. Hind wings clear, about as long as hemelytra.

Holotype, macropterous male (USNM type no. 67035), Maiz, San Luis Potosí, Mexico, 18 May 1954, intercepted on orchid shipments at Laredo, Tex. *Allotype*, macropterous female, Tepic, Nayarit, Mexico, also on orchid transports at Nogales, Ariz., 16 Sept. 1950. *Paratype*, macropterous female, taken with allotype.

This species is nearest to *N. marginata* in general aspect and can be distinguished from it by the explanate margins being less extended forward, longer hairs on dorsal surface, and more clearly defined and serial arrangement of hemelytral punctures. The female allotype is illustrated.

Nidicola aglaia, new species

(Fig. 5*d*, *e*)

Macropterous form: Small, slender, oblong, reddish brown with hind pronotal lobe and most of corium dark fuscous; head above testaceous, body beneath reddish brown; dorsal surface thinly clothed with fairly long, backwardly reclining, golden hairs. Antennae pale flavous, segments III and IV thin, with numerous, long, outwardly projecting hairs. Legs flavous with femora partly fuscous. Length 1.62, width (hemelytra) 0.62 mm.

Head convex above, median length slightly shorter than transocular width (16:20), width of interocular space three-fourths of median length of head. Eyes with a few short setal hairs; ocelli situated as shown in illustration. Antennal measurements: segment I, 8; II, 14; III, 16; IV,

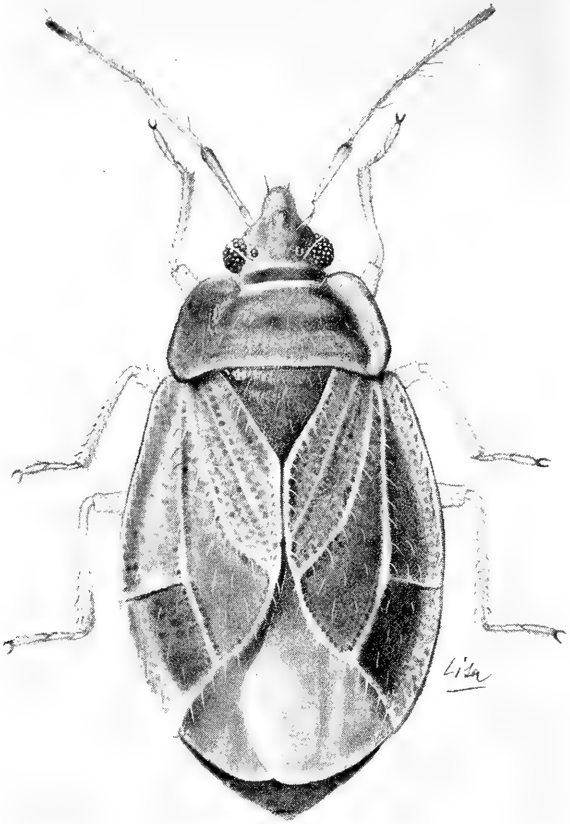

FIG. 4. *Nidicola etes*, n. sp.

20. Rostrum long, extending between hind coxae, bowed, greatly concave on inner side in repose. Measurements: segment II, 14; III, 16; IV, 20.

Pronotum slightly convexly tapering anteriorly, basal width slightly more than twice median length (46:20), with outer margins narrowly explanate, each side slightly wider than collar; front lobe large, tumid, faintly rugulose; hind lobe shorter than fore lobe, depressed, distinctly transversely rugulose, shallowly convexly excavated on hind margin. Legs with femora moderately thickened. Scutellum depressed, hairy as pronotum, triangular, median length and basal width subequal (14:15). Hemelytra each with pits clearly and sharply defined, sequentially arranged on clavus and corium in regular rows as depicted in illustration; membrane clear, veins imperceptible.

Holotype, macropterous male (USNM type no. 67038), Mexico, on orchid imports at Nogales, Ariz., 6 July 1953.

This is the smallest member of the genus. It is closely allied to *N. mitra* below, but readily separated from it by the hairy vestiture, greatly roughened hind pronotal lobe, and sharply defined hemelytral pits arranged in regular rows. The holotype is illustrated.

Nidicola mitra, new species

(Figs. 2, 5*f*)

Small, oblong, brownish with corium of hemelytra often becoming fuscous apically; body beneath pale brown. Legs and antennae pale testaceous. Dorsal surface clothed sparsely with pale hairs, these shorter on pronotum. Length 2.15, width (across cuneal fracture) 0.88 mm.

Head slightly longer than transocular width (32:28), interocular space wide (18). Antennal measurements: segment I, 8; II, 20; III, 19; IV, 24. Rostrum extending between hind coxae, measurements: segment II, 13; III, 28; IV, 20. Legs smooth, femora slightly thickened.

Pronotum twice as wide at base as median length (50:25); explanate margins moderately wide, a little wider than collar; frontal lobe large, swollen, twice as long as hind lobe, slightly rugulose; hind lobe short, depressed, transversely rugulose. Hemelytra with veins fairly prominent, punctures somewhat obscure, not always clearly defined, nor as long as abdomen.

Holotype, macropterous male (USNM type no. 67037), Mexico, taken on unknown species of nuts, 12 Nov. 1955, at San Antonio, Tex. *Allotype,* ♀ and 12 *paratypes,* collected on *Caladium* bulbs from Guatemala, 4 May 1950, Nogales, Ariz.; 1 paratype, on orchids (*Laelia*) from San Miguel de Allende, Guanajuato, Mexico, at Nogales.

Similar to *N. aglaia* in form, but easily distinguished from it by having the hemelytral punctures sharply defined and arranged in regular rows as depicted in the illustration. The holotype is figured.

Nidicola engys, new species

(Fig. 3)

Obovate, brown with hemelytra testaceous-brown; body beneath brownish, dorsal surface rather thinly clothed with fairly long, suberect, yellowish hairs. Legs, rostrum, and antennae pale testaceous. Length 2.00, width (across cuneal fractures) 1.62 mm.

Head longer than transocular width (30:25), interocular space wide (18). Rostrum extending between intermediate coxae, measurements: segment II, 7; III, 13; IV, 8. Legs moderately long, smooth, femora slightly thickened.

Pronotum with basal width more than twice the median length (48:20); collar narrow; front lobe large, swollen, feebly rugulose; hind lobe much narrower than fore lobe, depressed, transversely ridged; explanate

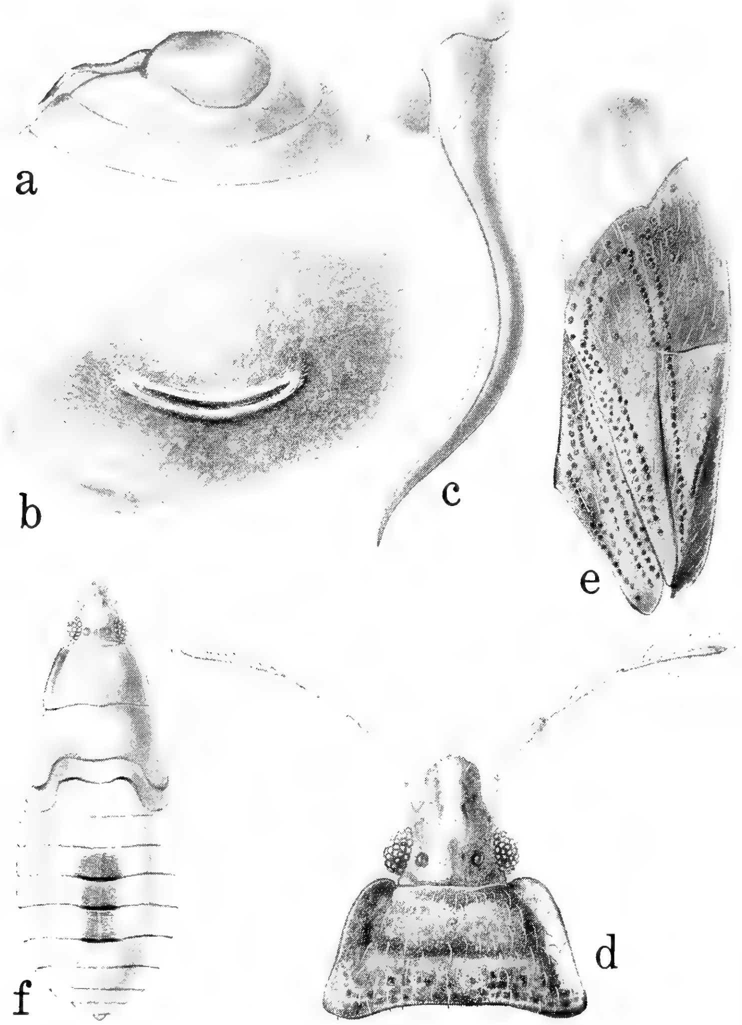

Fig. 5. *Nidicola marginata* Harris and Drake; *a*, ventral aspect of male genital segments; *b*, evaporatorium showing ostiole and ostiolar canal on left metapleuron; *c*, left male paramere. *Nidicola aglaia*, n. sp.; *d*, dorsal aspect of head, pronotum and antennae; *e*, left hemelytron. *Nidicola mitra*, n. sp.; *f*, dorsal aspect of fourth instar nymph showing 3 pairs of scent gland openings on abdominal tergites-segments III, IV, and V.

margins wide, three times as wide as collar, with obtusely rounded anterior end not produced further forward than front margin of collar. Scutellum depressed apically, wider across base than median length (26:22). Hemelytra not extended backwards over apical part of abdomen, rather thinly clothed with moderately long, reclining, yellowish hairs; punctures largely obscure; veins of corium raised; membrane small, without visible veins.

Holotype, submacropterous female (USNM type no. 67036), Alamos, Sonora, Mexico, 4 Jan. 1955, intercepted on orchids and bromeliads, Nogales, Ariz.

This lyctocorine belongs to the group of species possessing widely explanate pronotal borders, which do not extend anteriorly farther than the front edge of the collar. The holotype, which lacks forelegs and the last two antennal segments, is figured.

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NOMENCLATURAL AND DESCRIPTIVE NOTES ON *ORODESMA APICINA* H.-S. AND ITS SUBSPECIES (LEPIDOPTERA, NOCTUIDAE)

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The erebine noctuid species of Cuba were last treated as a group by Gundlach (1881) in his paper on the lepidopterous fauna of that island. The majority of the included species occur elsewhere in the Antilles and/or continental America and, accordingly, have been treated in subsequent World catalogues, or in faunal studies of the other areas where they occur, or in taxonomic works of the different groups to which they belong. A few names applicable to species occurring in Cuba have remained unused or have been used only a few times in the last 50 years or more. They are mostly names referable to species that are restricted to Cuba and/or belong to groups that have not been subsequently treated in catalogues or taxonomic revisions. One name, *Orodesma apicina* Herrich-Schäffer, does not fall within the categories listed above. The combination has been overlooked or ignored. Wolcott (1923: 174 and 1936: 438) is the only author to utilize the name during the past 50 years. He either misspelled the generic name or a typographical error occurred because the name appears as *Orodesmia.* In the more recent literature the names *Lois lorina* (Druce) or *Boryzola lorina* (Druce) have been applied to the species.

The generic name, *Orodesma* H.-S., is listed in the nomenclators of Schulze *et al.* (1933: 2387) and Neave (1940, 3: 463); but that name and the specific name *apicina* were not utilized by Richards (1936, 1939) in his generic and specific studies of the group to which the species belongs. It is difficult to understand why the name was overlooked or ignored since in taxonomic studies of that kind all generic names applicable to a group should be considered. It is especially surprising that Richards did not consult the literature pertaining to the Cuban fauna since he had two records of the species from Florida! Failure to consult the literature pertaining to this species has resulted in other confusing aspects relating to the synonymy of *apicina.* Draudt and Gaede (1944: 498, pls. 73, row g and 82, row *d*) listed *Boryzola lorina* (Druce) and *Boryzola juanita* (Schaus) as distinct species even though Schaus had synonymized his name to *lorina* 18 years before! Their illustrations of specimens representing the two names are quite different; that of *juanita* (pl. 73, row *g*) is excellent, but that of *lorina* (pl. 82, row *d*) is extremely poor and not at all like the figure provided by Druce (1898, pl. 94, fig. 15)!

A strict interpretation of Article 23, Section (b), of the 1961 International Code of Zoological Nomenclature would require that *Orodesma apicina* Herrich-Schäffer be considered a nomen oblitum. This section, a limitation of the Law of Priority, states, "A name that has remained unused as a senior synonym in the primary zoological literature for more than fifty years is to be considered a forgotten name (nomen oblitum)." To determine whether a name is a nomen oblitum, a zoologist must first determine whether the papers utilizing the name in question are to be classified as "primary zoological literature." Others have already written papers commenting on the impracticability of attempting to categorize the literature in such a manner. Personally, I do not believe that we should so categorize the literature; and even if we were so inclined, I doubt that the category—primary zoological literature—could be satisfactorily defined.

In the case of *Orodesma* Herrich-Schäffer, it is not important whether the nomenclators of Schulze *et al.* (1933) and Neave (1940) are considered to belong to the "primary zoological literature" because those important, commonly used works do not indicate synonymy. Wolcott (1923, 1936) merely listed the combination *Orodesmia apicina* H.-S. and did not cite synonyms. Since Article 23, Section (b), specifically defines a nomen oblitum as a name that has remained unused as a *senior synonym* [my italics] in the primary zoological literature for more than 50 years, the preceding usage of the name in question would not make it available. Thus, we would be required to utilize junior synonyms, conceivably even the most recently proposed ones, in all instances in which the synonymy has not been recognized and the oldest name is more than 50 years of age. It seems obvious that the proponents of the limitation of the Law of Priority never intended that the limitation would be so applied; but in the absence of a knowledge of their intent, we have only the wording of the limitation to serve as a guide. If we are to follow the limitation of the Law of Priority, we would also have to consider as nomina oblita all names that are more than 50 years old and that have no junior synonyms. They have no synonyms and accordingly could not have been used as senior synonyms as defined in the "Glossary" of the new Code, p. 152. It would not matter how many references to the name existed nor how recent they might be.

The import of the application of the limitation of the Law of Priority, at least as presently worded, certainly will vary according to the group of animals concerned, the differences in the size of the group and our state of knowledge of the group being important factors in the variation. In the Insecta, because of the tremendous number of names involved, the infrequency of treatment of many of them, and the specific wording of the limitation, a very large number of taxa would have to be considered to be nomina oblita. Within this class, its orders and families, the import of application of the limitation of the Law of Priority would vary. In the lepidopterous family Noctuidae the effect of application of Article 23, Section (b), would be chaotic. In that family, the work of almost all of the major describers occurred more than 50 years ago, many of the described species have not been subsequently treated, and several subfamilies have never been catalogued. As an example of the infrequency of treatment, I refer the reader to the genus *Gonodonta* Hübner, a member of the huge, uncatalogued subfamily Erebinae. I select this genus as an example because the bibliographic references are available as the result of a taxonomic revision (Todd, 1959). At the time of the generic revision, 26 of the 57 previously proposed names had not been used in the preceding 50 years, and 9 of the 26 had not been used in the preceding 100 years. Seven other names had not been used for more than 45 years. It is also interesting that the only reference for 18 of the 57 names was the original description! Application of the limitation of the Law of Priority appears to me to penalize the taxonomists whose works were published more than 50 years ago for the failure of more recent workers to completely survey the literature and the resultant inability to recognize the zoological entities described and the names applied thereto. Even worse, it would reward slipshod taxonomy by considering junior synonyms to be the correct names for such entities! I do not believe that such a system will better serve the stability and universality of nomenclature.

It is my opinion, therefore, that *Orodesma apicina* Herrich-Schäffer should be considered to be the valid name for the genus and species more recently referred to as *Lois lorina* (Druce). The generic and specific synonymical biblographies are as follows:

Orodesma Herrich-Schäffer

Orodesma Herrich-Schäffer, 1868, Corresp.-Blatt Zool.-Min. Ver. Regensburg (Naturw. Ver. Regensburg), 22 (12/13): 179.—Zool. Rec.

(1869) 1870, p. 399.—Gundlach, 1881, Contribución á la Entomología Cubana, Lepidopteros, Vol. 1, p. 325.—Möschler, 1890, Senck. Naturf. Gesell. Abhandl., 16: 350 (Genus # 185 in Systematische Aufzahlung der auf Cuba und Portorico aufgefundenen Lepidopteren.).—Anonymous, 1895, Catalogo Numerico del Museo Zoologico Cubano (Museo Gundlach), p. 76, # 765.—Schulze *et al.*, 1933, Nomenclator animalium generum et subgenerum, p. 2387.—Neave, 1940, Nomenclator Zoologicus, Vol. 3, p. 463. (Type of genus: *Orodesma apicina* Herrich-Schäffer, monobasic.)

Orodesmia Herrich-Schäffer, Wolcott, 1923, J. Dept. Agric. Porto Rico, 7 (1): 174; 1936, J. Agric. Univ. Puerto Rico, 20 (1): 438. (Lapsus pro *Orodesma* H.-S.)

Lois Dyar, 1924, Ins. Insc. Menst., 12: 16.—Zool. Rec., (1924) 1925, p. 196.—Colcord, 1925, Index 3, Lit. Amer. Econ. Ent., p. 241.—Barnes and Benjamin, 1926, Washington Ent. Soc. Proc., 28 (1): 20.—Richards, 1936, Revista Ent., 6 (3/4): 371; 1939, Ent. Amer., n. s., 19 (1): 72.—Neave, 1940, Nomenclator Zoologicus, Vol. 2, p. 986.—Draudt and Gaede, 1944, *in* Seitz, Die Gross-schmetterlinge der Erde, Vol. 7, p. 498. (Type of genus: *Lois monoflex* Dyar, monobasic.) [New synonymy.]

Boryzola Hampson, 1926, New Genera and Species of Noctuinae in the British Museum, p. 46.—Zool. Rec., (1926) 1927, p. 265.—Richards, 1936, Revista Ent., 6 (3/4): 371 (as jr. syn. of *Lois* Dyar).—Neave, 1939, Nomenclator Zoologicus, Vol. 1, p. 454.—Draudt and Gaede, 1944, *in* Seitz, Die Gross-schmetterlinge der Erde, Vol. 7, p. 498. (Type of genus: *Polia* (?) *lorina* Druce, original designation and monobasic.)

Draudt and Gaede (1944: 498) treated *Boryzola* and *Lois* as distinct genera, stating the third papal segment of the former was short, that of the latter slender, as long as the second. In *apicina* and other species of *Orodesma*, except *monoflex*, the third segment of the labial palpi of the males is short; but that structure is long and slender in the females. In the males of *monoflex* the third segment of the labial palpus is long and slender. Only males of that species have been available to me for study and accordingly the nature of the palpus in the female is unknown. It is my opinion that the palpal difference between the males of *monoflex* and the other species of *Orodesma* should be considered to be a specific difference. This opinion is based on the similarity of other characters and on the known variation of secondary sexual characters in the closely related genus *Boryzops* Richards. The generic name *Pseudbarydia* Hampson (1924: 425) may also prove to be a synonym of *Orodesma* H.-S., but further study will be required to determine whether this conjecture is correct.

Orodesma apicina Herrich-Schäffer

Orodesma apicina Herrich-Schäffer, 1868, Corresp.-Blatt. Zool.-Min. Ver. Regensburg (Naturw. Ver. Regensburg), 22 (12/13): 179.—

Gundlach, 1881, Contribución á la Entomología Cubana, Lepidopteros, p. 325.—Möschler, 1890, Senck. Naturf. Gesell. Abhandl., 16: 350 (Species # 417 in Systematische Aufzahlung der auf Cuba und Portorico aufgefundenen Lepidopteren.).—Anonymous, 1895, Catalogo Numerico del Museo Zoologico Cubano (Museo Gundlach), p. 76, # 765.

Polia (?) *lorina* Druce, 1890, Proc. Zool. Soc., p. 515; 1898, *in* Godman and Salvin, Biologia Centrali-Americana, Insecta, Lepidoptera, Heterocera, Vol. 2, p. 486, pl. 94, fig. 15. [New synonymy.]

Catacala juanita Schaus, 1894, Trans. Amer. Ent. Soc., 21: 241; 1926, *in* Barnes and Benjamin, Proc. Ent. Soc. Washington, 28 (1): 20 (As synonym of *lorina* Druce).

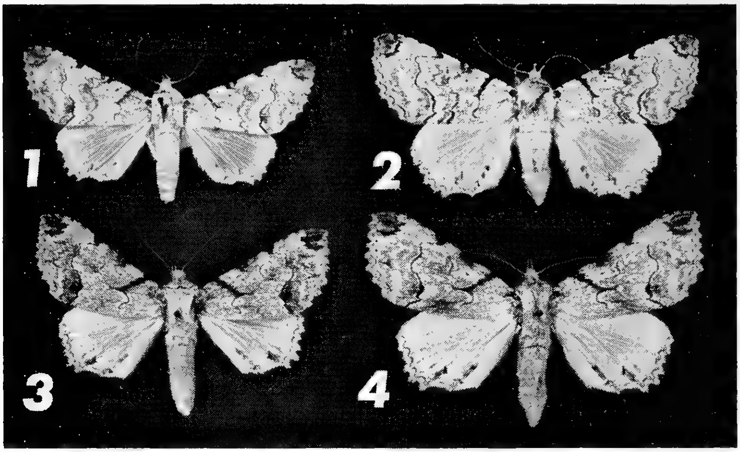
Lois lorina (Druce), Barnes and Benjamin, 1926, Proc. Ent. Soc. Washington, 28 (1): 20.—Richards, 1936, Revista Ent., 6 (3/4): 371; 1939, Ent. Amer., ser. n. 19 (1): 72, pl. 5, fig. 19.

Boryzola lorina (Druce), Hampson, 1926, New Genera and Species of Noctuinae in the British Museum, p. 46.—Draudt and Gaede, 1944, *in* Seitz, Die Gross-schmetterlinge der Erde, Vol. 7, p. 498, pl. 82, row *d.*

Boryzola juanita (Schaus), Draudt and Gaede, 1944, *in* Seitz, Die Gross-schmetterlinge der Erde, Vol. 7, p. 498, pl. 73, row *g.*

Orodesma apicina H.-S. is known to occur in Cuba, Florida, México, Guatemala, Venezuela, Ecuador, and Brazil. The specimens from the latter two countries, from localities of the eastern watershed of the Andes, are of a different phenotype than the other 19 specimens in the collection of the U. S. National Museum and are described below as a new subspecies. The other specimens are all presently considered to be typical *apicina.* Some slight differences have been observed in various geographical populations of *O. apicina apicina* H.-S., but they do not appear to be completely constant and our series are far too small to determine the importance of the differences noted. Specimens from Sinaloa in western México, including the type of *lorina* Druce, appear to be paler and much less conspicuously marked than specimens from other areas. Specimens from Cuba and some from Florida appear to have the postmedial line between Cu_1 and the inner margin of the forewing straighter than in specimens agreeing with the type of *juanita* Schaus and occurring in eastern México, Central America, and northwestern South America.

Types: The type of *apicina* H.-S. from Cuba is now in the newly formed National Collection, Havana, Cuba via the Gundlach collection. The original description and the subsequent redescription by Gundlach are quite adequate for recognition of the species. In addition, I have received, through the courtesy of Fernando de Zayas of Havana, a photograph of another Cuban specimen that he has compared with the type. The type of *lorina* Druce from Presidio de Mazatlán, Sinaloa, México, is in the British Museum (Natural History), London; that of *juanita* Schaus from Paso San Juan, Veracruz, México, is in the U. S. National Museum, Washington.



FIGS. 1–2, ♂ and ♀, *Orodesma apicina apicina* H.-S., Cayuga, Guatemala. FIGS. 3–4, Holotype ♂ and paratype ♀, *Orodesma apicina obliqua*, n. subsp., Santa Catarina, Brazil.

Orodesma apicina obliqua, new subspecies

This subspecies differs primarily from typical *apicina* in the shape, size, and direction of the costal half of the antemedial line. In *apicina obliqua* the antemedial line is more oblique, heavier, and extends to the median line in cell Cu_1 (Figs. 3–4). Specimens of this subspecies also average slightly larger than those of *apicina apicina* and have the forewings darker, the black marks more conspicuous than in the typical subspecies (Figs. 1–2). Length of forewing: Male, 29 to 34; female, 35 mm.

Types: Holotype, male, Santa Catarina, Brazil, Type No. 64638; 1 female paratype, same place; 1 male paratype, same place, donor F. Johnson; 1 male paratype, Joinville, Santa Catarina, Brazil, 286, Collection Wm. Schaus; 1 male paratype, Nova Teutonia, Santa Catarina, Brazil, Fritz Plaumann; 1 male paratype, Jatunyacu, Oriente, Ecuador, March 1937, Wm. C. MacIntyre; in the collection of the U. S. National Museum.

OTHER SPECIES OF *Orodesma* H.-S.

In addition to *apicina* H.-S. and *monoflex* (Dyar) two other species are presently included in *Orodesma* H.-S. They are: *Orodesma ameria* (Druce) n. comb., (1890, Proc. Zool. Soc. London, 515) and *Orodesma fearni* (Schaus) n. comb., (1911, Ann. Mag. Nat. Hist., ser. 8, 7: 58). The original generic placement of *ameria* was "*Polia* (?)." To my knowledge there has been no other reference to the species. Richards (1936: 373) removed *fearni* from *Barydia* Guenee and placed it in *Lois* Dyar.

Draudt and Gaede (1944: 498, pl. 73, row *g*) placed this species in *Boryzola* Hampson.

The name, *nigrosparsata*, proposed as a form of *Boryzola juanita* by Draudt and Gaede (1944: 498) has not been considered in this paper because I have not seen examples and because the name is of infrasubspecific rank.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NATURAL HISTORY OF PLUMMERS ISLAND, MARYLAND[1]

XVIII. The Hibiscus Wasp, an Abundant Rarity, and Its Associates (Hymenoptera: Sphecidae)

By Karl V. Krombein

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The hibiscus wasp, *Ectemnius* (*Hypocrabro*) *paucimaculatus* (Packard), is a rather small (♀, 6–8 mm long) crabronine wasp with reduced yellow markings. Its closest relatives are *E. stirpicola* (Packard) and *E. spiniferus* (Fox). Until 1961 it was known from only a few specimens. There were 14 in the U. S. National Museum from scattered localities ranging from New Jersey to Florida, Texas and Missouri. The wasp was described from Illinois, and Fox (1898) in his revision recorded it also from New Jersey, the District of Columbia, and Florida. Three of the specimens in the National Museum were reared from a hibiscus stem at Black Pond, Fairfax Co., Va., in 1919, by F. C. Craighead, but no reference was made in the original brief rearing notes as to whether the hibiscus stem was dead or alive.

In 1961, while collecting at Plummers Island for an annotated list of the wasps of that locality (Krombein, 1963), I collected a male of *E. paucimaculatus* on 6 August along the Potomac River near the upper end of the island. In an attempt to secure some data on its life history, I tried to provide ready access to the soft pith in the hibiscus stems by topping a number of green and of dead hibiscus stems on mud flats along the river. Several years earlier a similar program of topping stag-

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[1] The preceding number in this series was published in Proc. Biol. Soc. Wash., 76: 255–280, 1963. Publication costs of the present number have been defrayed by the Washington Biologists' Field Club to promote its primary objective of research on the fauna and flora of Plummers Island and adjacent areas.

horn and smooth sumac branches had resulted in data on several wasps nesting in the pith so exposed (Krombein, 1960). I examined the cut tips of these green and dead hibiscus stems at weekly or lesser intervals during the remainder of August and September 1961, but did not find any wasps nesting in them. However, while working in the hibiscus stands on 23 September 1961, I noticed two green stems each with a small (3–4 mm diameter) hole chewed in the side of the stem about half a meter from the ground. Upon splitting these open, I found that each contained the nest of another crabronine wasp (92361 A, B), *Euplilis* (*Corynopus*) *rufigaster* (Packard). (I discovered later that this species nests in cavities excavated by the hibiscus wasp, and does not itself make borings in green stems.) On 7 October 1961, I found another entrance hole in the side of a green hibiscus stem; this stem did contain a nest (10761 E) of the hibiscus wasp, from which adults emerged the following spring. Four additional nests of *E. paucimaculatus* were found in green hibiscus stems on 10 October 1961. I found 65 additional nests of this supposedly rare wasp in 1962, and 23 more in June and July 1963. I have combined the data on nesting architecture and life history from these nests with a few behavioral observations made in 1962 and 1963 in the following account of the biology of this wasp.[2]

I am indebted to the following of my colleagues in the Entomology Research Division for their esteemed services in identification of the prey and parasites of the wasps discussed herein: E. W. Baker, Acarina; B. D. Burks and C. F. W. Muesebeck, Hymenoptera; L. M. Russell, Homoptera; and R. H. Foote, C. W. Sabrosky, G. C. Steyskal and W. W. Wirth, Diptera. I am also indebted to J. de Beaumont, Musée Zoologique, Lausanne, Switzerland, for identifying *Pemphredon lethifer* form *littoralis* Wagn., to H. C. Huckett, Riverhead, N. Y., for identifying the first specimens of the fly *Eustalomyia vittipes* (Zett.), and to H. K. Townes, Ann Arbor, Michigan, for determining a pupa of the ichneumonid *Messatoporus*.

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[2] The nests or specimens on which this account is based are numbered as follows: 10761 E; 101061 A–D; 71162 A–J; 72162 C; 72262 A–C; 72862 A–E; 8362 A–D; 9162 A–M, P–R; 9962 A, B; 91662 A, C–I, L–N, Q–T, W–Z, AA–EE, GG–II; 51963 A; 52663 A–D; 6263 A–C; 61663 E–X; 72163 A. The specimens and notes are on deposit in the U. S. National Museum.

THE NESTING MEDIUM, *Hibiscus militaris* Cavanilles

Although a number of our North American crabronine wasps are known to nest in the soft pith of living plants, *Ectemnius paucimaculatus* is the first one to be recorded as chewing directly through the side of a green stem to reach the soft pith. The other species, e.g., *E. stirpicola* (Packard) and *E. spiniferus* (Fox), apparently nest only in soft pith which has been exposed by injury or pruning, such as stems of rose, elderberry and sumac. The hibiscus plants are not injured by penetration of the plant stem by the hibiscus wasp.

Three crabronine wasps outside of the United States have been recorded as chewing through green stems of growing plants to reach a nesting site in the pith. Berland (1932) reported *Dasyproctus bipunctatus jucundus* (Arnold) as nesting in gladiolus stems in Johannesburg, South Africa, and causing great damage. J. van der Vecht (1951) found *Dasyproctus ceylonicus* (Sauss.) nesting in green stems of sorghum in Java; this species also entered green stems of *Helianthus* and *Clerodendron.* Tsuneki (1960) summarized accounts by several other Japanese hymenopterists, who reported that *Ectemnius* (*Hypocrabro*) *rubicola nipponis* Tsuneki entered and nested in the green stems of such herbs as *Sophora, Macleya, Gladiolus, Erigeron, Aster* and *Artemisia.* (Oddly enough, the nominate race of *rubicola* (Duf. and Per.) from Europe nests in the soft pith of broken or pruned stems of *Rubus* and *Sambucus.*)

The plant which *E. paucimaculatus* uses (exclusively ?) as a nesting site is the halberd-leaved hibiscus, *Hibiscus militaris* Cav.[3] It has a wide range in eastern North America, where it occurs along river and stream edges from Pennsylvania west to Minnesota and south to Florida and Texas. On Plummers Island and along the adjacent banks of the Potomac River it grows on mud flats (Figs. 1, 2) which are subject to prolonged inundation by high water during the spring floods and to occasional short periods of immersion during heavy summer storms.

This hibiscus is a perennial which sprouts each spring from rootstocks. The old, dead, dry stems remain attached to the rootstocks for one or more years. The new growth begins to leaf out early in May. On 19 May, the date on which the first male and female wasps were observed in 1963, the young hibiscus plants were mostly 15–30 cm high. The stems were quite succulent. I split the stem of a 45-cm plant and found that it had a central cavity 1–2 mm wide extending from the base to a height of 30 cm. The pith was too juicy on this date to be used in nest construction. A week later one of the stems was 60 cm tall and had a central cavity with a diameter of 2.5 mm about 9 cm above ground level. On 2 June

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[3] There is a possibility that the hibiscus wasp may attempt occasionally to nest in other herbaceous plants growing along the river margin. In 1963 I found a specimen of *Polygonum lapathifolium* L. with a stem about 10 mm in diameter in which an insect had made a boring through the side. The entrance hole was exactly like that made by the hibiscus wasp in an hibiscus stem. However, the pith of this plant was so juicy that the insect apparently did not attempt to nest in the central cavity.

1

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some plants were a meter high, by 16 June the average height was a little over a meter, on 28 June the average height was a meter and a half, and by 6 July some plants were 2 meters high. At maturity the plants are 2 to 2.5 meters high. The plants begin to bloom late in July.

In most plants there is a central cavity of varying diameter and length, and it is in this cavity that the wasp nests. The cavity begins at or slightly above ground level and usually extends upward for half to two-thirds the height of the plant, gradually narrowing until it becomes evanescent. The diameter of the central cavity at the base of a mature plant is usually 5–6 mm, though it may be as large as 7 mm. In plants of the same size the diameter of this cavity at a given distance from the ground may vary as much as 5 mm. The cavity is caused by the differential in growth rates of various parts of the stem. The cells forming the inner pith layer multiply much more slowly than the others. Consequently, as the stem increases in girth and height, the pith is pulled apart to form a central cavity.

THE NEST ARCHITECTURE OF THE HIBISCUS WASP

In beginning the entrance boring, the wasp rasps away a roughly elliptical area of green epidermis about 5 mm high by 3 mm wide. She then chews away bits of fiber to form a cylindrical boring about 3 mm wide perpendicular to the axis of the plant (Figs. 3, 4). I made some detailed observations on one female (72862 C) as she constructed her entrance boring on 28 July 1962. She had selected a spot 40 cm above the ground where the stem had a diameter of 17 mm. I first observed her at 1355 hours; at that time she had penetrated only 1 or 2 mm into the stem, and I estimated that she had started the boring at 1330. She braced herself on the stem with all legs, head upward, and chewed out narrow strips of fiber 2–3 mm long, letting them drop at random on the ground beneath. At 1418 she flew off for a few seconds, returned and then left again because a phorid fly was investigating the entrance. The wasp finally returned at 1436 and continued the excavation. By 1450 the entrance was deep enough so that the wasp could get her entire head inside. By 1510 her head and thorax were both in the excavation. By this time the wasp was working on all sides of the boring so that it was circular in cross-section. She flew off at 1553; at this time the boring was 6 mm deep and had not penetrated to the central cavity. She had not returned to the excavation by 1618, but she was at work there by 1625. As she increased the length of the boring, the wasp backed partly out and passed the gnawed-out bits of fiber backward with her hind legs and tip of her abdomen; sometimes she crawled out backward, pushing the bits of fiber behind her. This was happening every 30–40 seconds

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PLATE I. *Hibiscus militaris* Cav., the halberd-leaved hibiscus. Fig. 1, Several clumps of hibiscus on mud flat along river bank, October 1962. Fig. 2, Habitat view along Potomac River, large hibiscus stand in right foreground, August 1963. (All photographs, Plates I–VI, by author.)


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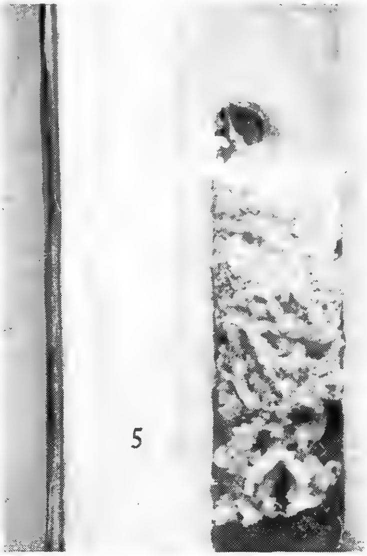
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by 1630, and the gnawed-out material was now composed of quite fine particles. Apparently the wasp reached the central cavity at 1659 when she pushed out the last load of pith. She went out of sight and reappeared at 1701 at the entrance head first, a sure sign that she had reached the central cavity.

In a second nest (72163 A) I observed a female just beginning to gnaw into a green stem at 1420 on 21 July 1963. I did not keep this wasp under observation, but by 1720 on the same day she had chewed through to the central cavity.

In nests begun in June the entrances were gnawed out 10 to 60 cm (mean 31 cm) above the ground where the stem diameter ranged from 8 to 15 mm (mean 11 mm). In July to September, after the plants reached maturity, the nest entrances were 10 to 70 cm (mean 39 cm) above the ground, and the stem diameter at the entrance was 10 to 22 mm (mean 16 mm). The diameter of the entrance itself was 2.5 to 4 mm (mean 3.3).

After reaching the central cavity the female went downward a considerable distance and constructed a plug from particles of pith. The only exceptions to this procedure were when the central cavity had a diameter of more than 4 mm or when the cavity closed in solidly beneath. This plug was built at distances of 5.5 to 33 cm (mean 18 cm) below the entrance in June nests, and at distances of 7 to 43 cm (mean 26 cm) in later nests. The plugs were 1 to 60 mm in thickness (mean 9 mm), and were constructed from bits of pith which the wasp rasped from the upper end of the central cavity. Occasionally, a wasp made a series of several such plugs before provisioning any cells. In two nests where the central cavity closed in solidly below, the wasp did not make a plug of pith particles. In a number of nests where the diameter of the central cavity exceeded 4 mm below the entrance, the wasp built no cells below the entrance but went upward and built cells in that part where the diameter was less than 4 mm.

The wasp then built a series of linear cells separated by partitions of pith particles (Fig. 7*b*). Forty-one cells from which females were reared ranged from 8 to 21 mm in length (mean 14 mm); 60 male cells were 5 to 23 mm long (mean 12 mm). Although males were produced in cells having a shorter mean length than female cells, it was impossible to predict the sex of the wasp from the length of the cell because of the overlapping ranges in the two sexes. The partitions of pith particles capping the cells were 1 to 15 mm thick (mean 4 mm). The lower end

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PLATE II. *Ectemnius paucimaculatus* (Pack.), the hibiscus wasp; details of nest construction. Fig. 3, Entrance to incompleted nest 72862 C, 3 August 1962, × 2.5. Fig. 4, Entrance boring in profile, incompleted nest 72862 C, 3 August 1962, × 2.5; note short plug of pith particles above entrance and evanescent central cavity above plug. Fig. 5, Closing plug below entrance, completed nest 71162 E, 11 July 1962, × 3.6; note longer, looser pith particles below, and smaller, firmly packed particles above. Fig. 6, Cell 4, nest 9162 C, 2 September 1962, × 3.9; large flies are *Melanagromyza diantherae* (Mall.), smaller flies are *Hydrellia* spp.

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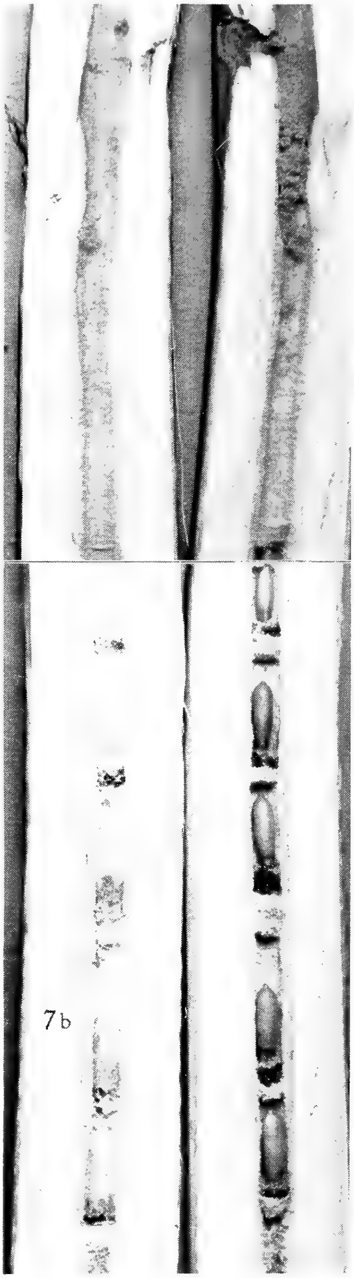

7b

of the partitions below the entrance was roughly convex and the upper end smoothly concave due to pressure from the wasp's head during construction (Fig. 7*b*). The boring diameter in which the cells were constructed ranged from 2.5 to 4 mm.

Ordinarily there were no empty intercalary cells between the stored series in the lower part of the nest. However, 11 of the nests had such cells; there was one intercalary cell in each of 9 nests, and two and three intercalary cells respectively in the other 2 nests. These cells were 10 to 95 mm long. The reason for constructing these cells is unknown; in some cases it may have been occasioned by infestation by phorids in some of the preceding cells.

The number of stored cells below the entrance ranged from 1 to 13 in 58 completed nests, with a mean of 5 cells per nest. There was an empty vestibular cell 10 to 230 mm long between the uppermost stored cell and the entrance; in three nests there were two such vestibular cells separated by pith partitions. Above each vestibular cell was a closing plug of pith particles 3 to 50 mm thick (mean 21 mm) which usually extended upward right to the entrance. Usually the closing plugs consisted of rather loose, larger pith particles at the lower end which gradually became smaller and more solidly compacted above.

Occasionally the wasps nested above the entrance. This happened if the central cavity had a diameter greater than 4 mm below the entrance; it also occurred occasionally after a wasp had made a series of provisioned cells below the entrance. In either case the procedure was the same. The wasp made a plug of pith particles some distance above the entrance unless the central cavity became evanescent. Then she constructed a linear series of cells separated by partitions of pith fragments (Fig. 7*a*). In these partitions, as contrasted to those below the entrance, the upper end was roughly convex and the lower end smoothly concave due to pressure from the wasp's head during construction (Fig. 7*a*). The pith fragments to separate these cells were obtained from the sides of the central cavity. The number of stored cells above the entrance ranged from 1 to 8 in 21 completed nests, with a mean of 3 cells per nest. Each series of cells above the entrance had an empty vestibular cell between the last (lowest) stored cell and the closing plug, which was constructed just above the entrance. In those nests where there was a series of cells both below and above the entrance, some of the pith particles were probably borrowed from the plug closing the lower series so that the wasp could construct the closing plug for the upper series.

The largest number of provisioned cells in a single nest (91662 Y) was 18, a series of 12 below the entrance and one of 6 above the entrance. In this nest there was a pith plug 29 cm below the entrance, then a

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Plate III. *Ectemnius paucimaculatus* (Pack.), the hibiscus wasp; completed nest 9962 A split open, 9 September 1962, × 1.0. Fig. 7*a*, Cells 6–13 and entrance boring (cell 6 at top). Fig. 7*b*, Cells 1–5 (cell 5 at top) and entrance boring. Note closing pith plugs both above and below entrance and solid pith above cell 6.

series of 12 provisioned cells in the next 20 cm, then a vestibular cell of 8.5 cm and a 5-mm closing plug below the entrance. Cells 13–18 were in a 10-cm space 21 cm above the entrance; below these provisioned cells was a vestibular cell of 9 cm and a closing plug of 20 mm just above the entrance.

There were 19 stems in which two wasps nested, using separate entrances. In a dozen stems the second wasp nested above an old *paucimaculatus* nest from which the occupants had already emerged, but in seven stems nesting by the two occupants may have gone on concurrently. In these multiple nests the later female chewed out her entrance some distance above the earlier occupant, went downwards in the central cavity, and constructed a pith plug above the uppermost cells of the first wasp or above the entrance to the first nest. The rest of her nest construction proceeded in the orthodox manner as detailed above. There was still another stem which had been penetrated three separate times by wasps in the first half of June, but only the lowest occupant had begun provisioning cells when the stem was gathered on 16 June.

I encountered three other anomalous nests in this study. In each of three stems the wasp excavated a sinuous boring in the pith, separated from the central cavity. In one nest there were three cells in a section of boring 7 cm below the entrance with two more cells in a section 4 cm long above the entrance; the central cavity was empty and may have been too wide to permit nesting. In the second nest the central cavity had been used by another hibiscus wasp earlier; the second one made her entrance 9 cm below that of the first. A sinuous boring went downward in the solid part of the stem for 9 cm; there were three cells at the end of this boring, a vestibular cell of 20 mm and a closing plug of 10 mm at the entrance; above the entrance was an empty sinuous boring 40 mm long which supplied the pith particles for the partitions and plugs in the nest proper. In the third stem there was an old abandoned nest in the lowest 30 cm of the central cavity. There was a second entrance 40 cm above that of the older nest. The second wasp made a spiral boring in the stem tissue which made a complete turn around the stem to a depth of 82 mm. There were two cells in the lower 30 mm, then a vestibular cell and a closing plug of 11 mm at the entrance.

I found three stems in each of which the wasp made an entrance, and then constructed a series of several pith plugs at varying distances from the entrance but did not store any prey. Each of these abortive nests was made by a different individual. I am unable to suggest any reason for this anomalous behavior, unless possibly these were nests in which the wasps were just about to bring in the first fly. (See the later discussion on incompletely stored cells under the heading, Prey of the Hibiscus Wasp.)

LIFE HISTORY OF THE HIBISCUS WASP

The wasps overwinter as resting larvae, transform to pupae early in May, and the adults emerge during the latter half of May. The hibiscus plants are too small and succulent at the time the wasps emerge to permit nesting. In 1963 the female wasps began to penetrate the side of the stem on 26 May, a week or more after their emergence. However, as late as 2 June the pith had not dried out sufficiently to enable the wasps to form the pith partitions which are an integral component of the nest. The wasps began to provision the cells with flies between 2 and 9 June 1963, probably about 7 June judging from one nest which contained 1^+ cells and 19 flies on 9 June.

The wasp lays her egg on the first fly placed in the cell. It is deposited transversely on the venter on the left side between the head and the left foreleg (Fig. 8). It is opaque white, sausage-shaped, and about 1.8 × 0.5 mm.

Very limited data are available on the duration of the various developmental stages, because these early stages are very subject to desiccation after the stem is split. The summer generation requires approximately 24–31 days from egg to adult. Apparently the egg hatches in 2^+ days and the larva reaches maturity about 7–8 days after the egg is laid. The spinning of the cocoon and voiding of the meconium require 1^+ days. The prepupal stage lasts 5–10 days, and 10 to 11 days elapse between pupation and emergence of the adult.

The cocoon is light tan, fusiform, has a small pore at the anterior end, and differs in no essential detail from that of most other species of the subgenus *Hypocrabro* (Figs. 7, 11*b*). The prey remains are compacted around the lower end of the cocoon. Female cocoons are 10–11 mm long (mean 10.3) and male cocoons are 6–10 mm (mean 9.1).

The cocoons are always oriented with the anterior end upward, regardless of whether the cells are below or above the entrance. This is a definite indication that the larva of the hibiscus wasp orients its cocoon according to the influence of gravity. Cooper (1957) found that larvae of vespid wasps in horizontal borings oriented their cocoons in relation to the cell partitions with the anterior end toward the convex, rough, inner surface of the plug closing the cell, and the posterior end toward the smooth, concave surface of the plug closing the preceding cell. This cannot be true in the hibiscus wasp because, although the cell partitions below the entrance have the rough, convex surface downward and the smooth concave surface upward (Fig. 7*b*) the reverse is true with cell partitions above the entrance (Fig. 7*a*).

This raises the problem as to how the wasps in the cells above the entrance get out of the nest. They could do this by turning around in the cell and leaving through the entrance, provided the boring diameter was large enough; or, they could chew their way out through the side of the stem. The latter method is more likely. I found an old nest from which the occupants had escaped by chewing a diagonal boring through the stem 13 cm below the original entrance.

Females from the overwintering population nest throughout June, and possibly to some extent during July. Progeny from their earliest nests emerge early in July, and can construct nests from which additional

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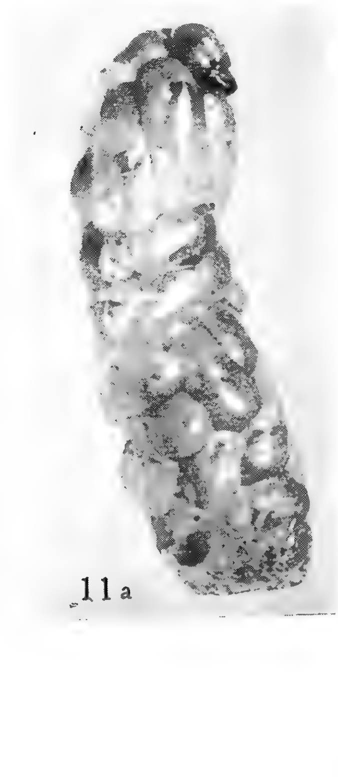
11b



11a

adults will emerge in August. However, progeny from later nests constructed by females of the overwintering population emerge so late that progeny from their nests overwinter as prepupae and emerge as adults the following spring. Consequently, there are two complete generations and a partial third, annually. In 1962 occupants of nests stored early in July emerged that same summer, but occupants of nests provisioned about 20 July or later did not emerge until the following spring. Nesting is more or less continual from early June until early September.

Some nests produced only males, some only females, and some produced both sexes. In nests which produced only males the occupants of individual nests emerged over periods ranging from 1–10 days; the median emergence period for males from a single nests was 3 days. Three nests produced females only, and these emerged respectively over periods of 1, 7 and 10 days. In nests producing both sexes the emergence from a single nest ranged from periods of 6–19 days, with a median emergence period for a single nest of 16 days. Males emerged several days before females; in the mixed nests there was a period of 0–12 days (average 6) between emergence of the latest male and earliest female.

SEX RATIO AND SEQUENCE IN NESTS OF THE HIBISCUS WASP

There was considerable mortality in the nests because of mold, parasites, and injuries sustained when I opened the stem. I reared 5 females and 12 males from 88 cells provisioned during June and early July, and 55 females and 97 males from 306 cells provisioned later in the summer.

After I recorded details of the nest architecture, I placed the cocoons in separate, numbered glass vials for rearing. Therefore, I can give some definite data on arrangement of the sexes in 17 mixed nests. Females were produced in the lower cells and males in the upper cells in seven nests, and the converse was true in three nests. There were 2 to 7 cells in 8 of these nests, and 8 and 13 in the others. Inasmuch as there was some mortality in all but two nests, it is possible that some nests might have shown a random arrangement of sexes had there been more survivors. In the other seven nests, the arrangement was as shown in the following table (an *x* indicates mortality due to parasites or injury). The nest entrance was above the uppermost cell in nests 9162 P, 91662 F, T and CC. In nests 9162 K, 91662 Y and AA the nest entrance was above cells 8, 12 and 7 respectively. The only conclusion which can

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PLATE IV. Prey and parasites of *Ectemnius paucimaculatus* (Pack.), the hibiscus wasp. Fig. 8, *Melanagromyza diantherae* (Mall.) fly with wasp egg attached between head and forelegs, cell 6, nest 71162 C, 11 July 1962, × 6.1. Fig. 9, Puparium of anthomyid fly, *Eustalomyia vittipes* (Zett.), in nest 91662 Z, 20 September 1962, × 0.9; note that maggot destroyed contents of cells 1–3 (below puparium) and then wriggled upward into pith-closing plug to pupate. Fig. 10, The same puparium, × 2.9. Fig. 11*a*, Resting larva (head upward) of hibiscus wasp, cell 1, 9162 D, containing 28 capsule-like, pupal cells of *Tetrabaeus americanus* (Br.), November 1962, × 11.2. Fig. 11*b*, Cocoon from which the resting larva was extracted, × 11.2.

fairly be drawn from these data is that the sequence of sexes in the cells is a purely random one.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
9162 K	♀	♂	♂	♀	♀	♀	♀	♂	*x*	*x*								
9162 P	*x*	*x*	♀	♀	♀	♂	♀											
91662 F	♀	♂	♂	♀	♂	♂	♂	♂	♂									
91662 T	♀	♀	♂	♀	♂	*x*	♂	♂	♂	♂	♂	♂	♂					
91662 Y	♀	♀	*x*	*x*	♂	♀	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*
91662 AA	♀	♀	♀	*x*	♀	*x*	♀	♀	♂	♀								
91662 CC	♀	*x*	♂	♀	*x*	*x*												

PREY OF THE HIBISCUS WASP

I was never so fortunate as to see the wasp catch a fly. I have watched females engaged in what I supposed was hunting behavior. They flew from leaf to leaf, alighting for a few seconds, and then flew on to another leaf. Most of this hunting was done on leaves of the hibiscus, a meter or less above the ground surface, but occasionally the wasps alighted on adjacent scrubby willows. Probably the wasp merely pounces on any fly which it may surprise resting on a leaf. On 28 July I captured a female wasp (72862 A) resting on a leaf of hibiscus at 1200 hours, clutching a muscid fly, *Lispe albitarsis* Stein. The fly was not deeply paralyzed and could wiggle its legs and wings. G. C. Steyskal has pointed out that the Ephydridae, which constitute approximately two-thirds of the prey, are found either on or just a few centimeters above mud flats. Most of the identified specimens of prey belong to several species of Ephydridae and Agromyzidae, which are common in this specialized habitat.

I preserved the prey from a number of completely and partially provisioned cells. Consolidated prey records from 17 nests were determined as follows:

- Dolichopodidae
  - *Dolichopus ovatus* Lw.—1
  - *Dolichopus* n. sp.—1
- Agromyzidae
  - *Melanagromyza diantherae* (Mall.)—85
  - Gen. & sp.—1
- Ephydridae
  - *Notiphila carinata* Lw.—80
  - *Notiphila erythrocera* Lw.—1
  - *Notiphila* sp.—7
  - *Hydrellia* spp.—109
  - *Scatella picea* (Wlkr.)—1
- Otitidae
  - *Eumetopiella rufipes* (Macq.)—4
  - *Chaetopsis* sp.—1
  - Gen. & sp.—1

Lauxaniidae
  Camptoprosopella angulata Shew.—1
Lonchaeidae
  Lonchaea polita Say—1
Sciomyzidae
  Sepedon armipes Lw.—4
  Sepedon sp.—1
  Dictya texensis Curr.—1
Sphaeroceridae
  Leptocera richardsi Sabr.—1
Muscidae
  Coenosia (*Limosia*) *atrata* Wlkr.—1
  Lispe albitarsis Stein—6

The number of flies stored per cell was dependent on two factors, the size of the cell and the size of the prey captured. Of the species stored most commonly the agromyzid is a large, bulky fly, 3.5–5 mm long, and the ephydrids are smaller, 1.8–3.2 mm long. Five cells provisioned entirely with the *Melanagromyza* contained 7, 7, 12, 13, and 13 flies, respectively, and were 10 to 16 mm long; two cells provisioned completely with ephydrids held 15 and 26 flies and were 12 and 16 mm long, respectively. Several completely provisioned cells contained only seven flies, larger species like *Melanagromyza* and *Sepedon*. There were 31 flies in the completely provisioned cell containing the largest number of flies; the cell was 25 mm long and contained 22 *Hydrellia*, 8 *Notiphila* and 1 *Dolichopus*. Some wasps were apparently quite successful in exploiting the population of a single species for prey—for instance, one wasp used only *Melanagromyza* in four cells except for one ephydrid, and another used almost entirely several species of Ephydridae in three cells except for three *Melanagromyza*. Other wasps were much less selective: One put in a single cell 1 lonchaeid, 1 agromyzid, 4 specimens of two species of Otitidae, and 1 ephydrid; another used for one cell one dolichopodid, 2 agromyzids, 1 muscid, and 11 specimens belonging to two species of Ephydridae.

Species of *Melanagromyza*, *Hydrellia*, *Notiphila*, *Dolichopus*, and *Lispe* were preyed on throughout the nesting period of the wasp. Species of the other genera were stored during the latter part of the summer. However, I have prey records from only two nests in the first half of June, so it is quite possible that a larger sample would reveal that additional species are used early in the season.

I opened several stems in which the cells were still being provisioned. Analysis of these showed that probably the wasp usually accumulates the required number of flies for one cell in a space below the entrance before actually storing the cell and placing an egg on the first fly brought into the cell. There are usually one or more loose plugs and one solid plug of pith particles between these flies and the entrance. Presumably these plugs are to keep out parasites or predators, though they can hardly be very effective, judging from the parasitism rate. In one nest (72262 B) which had just been started, there were three paralyzed flies and no wasp egg in a space of 8.2 cm above the firm pith plug at the bottom of the boring, then a loose pith plug 50 mm long, another empty space of 6.5 cm, followed by a firmer pith plug of 5 mm and then empty for 16.6 cm to the entrance. Another nest, which contained five completed cells, showed exactly the same architecture above the incompletely stored sixth cell. Several other nests also had the same arrangement for the incompletely stored cells. In still another nest (9162 J) there was one completed cell, then an empty space 5 cm long containing 29 small flies but no egg, and then 20 mm of loose pith particles almost to the entrance, with some of the particles arranged to form barriers.

Very little information is available on the rate of provisioning. It is likely that the wasp requires ⅔ to 1⅓ days to provision a single cell. In one nest, eggs were present in the three outermost completed cells when the stem was split. In another nest, the larvae in three consecutive cells matured over a 4-day period; when this nest was opened there was a nearly mature larva in the first cell, successively smaller larvae in the next three cells, and an egg in the fifth cell. Earlier I described construction of the entrance boring by one wasp (72862 C). This entrance was completed late on 28 July. I picked up and split this stem early on 3 August, at which time there had been 3¼ sunny days available for provisioning cells. On this date there were two fully stored cells, each containing 26 flies, with 13 additional flies available for cell 3. There was a small larva in cell 1, and an egg ready to hatch in cell 2. In another nest (72163 A) the wasp made the entrance boring on 21 July. I picked up this nest on 27 July and opened it. It contained 8 provisioned cells and a vestibular cell. Probably it was completed on 26 July. Every day between 22 and 27 July was sunny.

When the female wasps returned to their nests, they sometimes flew directly to the entrance and crawled in rapidly. At other times they alighted just below the entrance and crawled in quickly. I timed only one provisioning flight. This particular wasp (8362 A) left her nest at 1103, and returned at 1129 with a fly clutched tightly beneath with her legs.

MISCELLANEOUS BEHAVIORAL NOTES ON THE HIBISCUS WASP

Although males were abundant throughout the nesting period, I never witnessed mating behavior. Apparently the males like to rest in abandoned borings in the cut ends of dead hibiscus stems. On 3 August 1962, at 1015, I found one male in such a boring in one dead stem, and two males in a similar boring in a second dead stem.

I have never observed the hibiscus wasp visiting flowers for nectar or honeydew secretions of other insects on leaves.

The hibiscus wasp was not superseded in its nests by other species of wasps, and so far as I was able to determine, there was never any competition between two females for the same entrance. However, the crabronine wasp, *Euplilis rufigaster* (Packard), appropriated the empty inner cavity above the entrance in seven stems in which the hibiscus wasp nested. A trypoxylonine wasp, *Trypoxylon* (*Trypoxylon*) sp., also constructed one cell in a similar situation in another nest. Presumably the wasps of these other two species did not nest concurrently with the hibiscus wasps, but appropriated these ready-made cavities after the hibiscus wasps had completed their closing plugs.

PARASITES AND SYMBIONTS OF THE HIBISCUS WASP

The hibiscus wasp is subject to attack or infestation by a number of other arthropods. The most common enemy was the scavenger phorid fly, *Megaselia aletiae* (Comstock). It destroyed the contents of 30 out of 93 cells in 18 nests. It also occurred in six other nests on which I made no detailed notes.

There was another group of dipterous parasites which exerted a heavy pressure on the wasp population, not because of the abundance of individuals but because each individual parasite destroyed several wasp cells in order to reach maturity. These were: the anthomyiid, *Eustalomyia vittipes* (Zetterstedt), of which six individuals destroyed 10 of 23 cells in four nests (Figs. 9, 10); the sarcophagid, *Macronychia aurata* (Coquillett), of which one individual destroyed 7 of 9 cells in one nest; the sarcophagid, *Ptychoneura aristalis* (Coquillett), of which one individual destroyed 2 of 10 cells in one nest; and three unidentified muscoid flies which destroyed 10 of 17 cells in three nests (at least one of these flies was different from any of these three muscoids mentioned earlier in this paragraph).

Several species of Hymenoptera are also important parasites of the hibiscus wasp. A perilampid, *Perilampus canadensis* Crawford, parasitized 6 of 34 cells in six nests. The torymid, *Diomorus zabriskiei* Cresson, parasitized 12 of 51 cells in six nests. The platygasterid, *Tetrabaeus americanus* (Brues), infested 17 of 56 cells in eight nests (Fig. 11).

The symbiotic saproglyphid mite, *Vidia cooremani* Baker, was found in 4 of 10 cells in two nests. Hypopi of this mite were also found on the abdomens of four males of the hibiscus wasp (51963 A, 52663 B, C, D) netted on 19 and 26 May 1963.

The toll exacted by these parasites is occasionally quite devastating. For example, in a 9-celled nest (72162 C), *Perilampus* was reared from the second cell, *Macronychia* destroyed the last seven cells; *Megaselia* also occurred as a scavenger on the prey remains left by *Macronychia*. In one 6-celled nest, *Megaselia* infested the second cell, *Diomorus* parasitized the third and fifth cells, *Tetrabaeus* parasitized the sixth cell, and the contents of the fourth cell were attacked by mold. Finally, not a single hibiscus wasp developed in one 12-celled nest: cells 1, 3, 4 and 5 were parasitized by *Diomorus*; the contents of cells 2 and 8 were attacked by mold; cells 6, 7, 10, 11 and 12 were parasitized by *Tetrabaeus* and cell 9 was infested by *Megaselia*.

ASSOCIATES OF THE HIBISCUS WASP

Crossocerus (Blepharipus) stictochilos Pate

This crabronine wasp built one nest (9162 S) in a green hibiscus stem nested in earlier by *Ectemnius paucimaculatus.* The nest of the latter wasp was in the central cavity entirely below the entrance. The *Crossocerus* used only the section of central cavity above the *paucimaculatus* entrance. Both wasps used the same entrance, but not concurrently, because the occupants of the hibiscus wasp nest had emerged prior to 1 September 1962 when I picked up the stem. *C. stictochilos* is about as large as the hibiscus wasp; females from this single nest were 6–7 mm long.

The *Crossocerus* female first constructed a plug of pith particles 8 mm thick about 10 cm above the nest entrance. Then she constructed cells 1 through 5, respectively 11, 8, 12, 7 and 7 mm long, which were sealed below by partitions of pith particles 4, 8, 4, 5 and 12 mm long. The central cavity was empty between the partition capping cell 5 and the entrance, there being no closing plug just above the entrance.

The cocoons contained resting larvae when the nest was opened on 1 September. Females emerged the following spring from the cocoons in cells 1, 3 and 5, a male from that in cell 4; a male wasp died in cell 2 during the pupal stage. There are at least two generations a year because I have taken adult wasps at Plummers Island from early in June until early in September.

The cocoon is light tan, fusiform in shape, and 7–8 mm long. It is superficially very similar in appearance to that of the hibiscus wasp, but is more delicate and lacks the small pore at the anterior end. Dipterous remains, which were too fragmentary for further identification, were massed around the posterior end of the cocoon.

Euplilis coarctata modesta (Rohwer)

This crabronine wasp was reared from six completed nests (101061 F; 8362 L; 9962 C, F, G, H) in dead hibiscus stems. It is a somewhat smaller species than the hibiscus wasp; reared females were 5 to 6.5 mm long. The female wasp always entered the pith at the cut or broken end of the stem rather than using the entrance excavated by a hibiscus wasp. In some cases she probably merely utilized the exposed central cavity, because in three nests there were plugs of pith particles 1 to 8 mm thick at distances of 14 to 42 cm from the cut or broken end of the stem. In the other three nests the wasp or some other insect chewed out a straight or sinuous boring which ended in solid pith 17 to 26 cm from the broken end of the stem. On 27 July 1963 I captured a female *E. coarctata modesta* (72763 A) just after she removed some fine pith particles from the broken tip of a dead hibiscus stem having a diameter of 12 mm. She had chewed out a sinuous boring 10.7 cm long and 1.5–2 mm wide. The pith in which she tunneled must have been almost solid, because the central cavity 10.7 cm below the broken end of the stem had a diameter of only 1 mm.

The wasps constructed a linear series of cells separated by pith partitions formed from small particles chewed from the sides of the boring. Five cells from which females were reared had a mean length of 11.2 mm (range 10–13), and 21 male cells had a mean length of 9.6 mm (range 7–13). The pith partitions closing the cells were formed from rather loose pith particles as compared with the firmly compacted plugs closing the cells of the hibiscus wasp. The partitions of this *Euplilis* had a mean length of 8.5 mm (range 2–28).

Apparently the wasp usually constructed an empty vestibular cell at the upper end of the boring above the last stored cell, and capped this by a long plug of pith particles. In the one nest in which the vestibular cell and closing plug were still present, the cell was 53 mm long; the plug was 30 mm long and ended 13 mm below the cut end of the stem. In the other nests there was just an empty space of varying length above the last provisioned cell. However, I had broken off the ends of these stems to determine whether each held a nest, and the closing plugs were lost during this process. Apparently the vestibular cell must always be fairly lengthy, because there were empty spaces of 25 to 53 mm above the last provisioned cell in each of these nests.

The number of provisioned cells per nest ranged from 3 to 12 (mean 7.5). There were no notable variations in nest architecture in the six nests except for the differences in length of the cells and of the partitions closing them. The opened nest had a somewhat moniliform appearance. The cells were somewhat wider than the pith partitions because the pith opposite each cell was chewed out to provide pith particles for the partition capping the preceding cell.

I did not obtain much data on the life history. The wasps overwintered as resting larvae, and adults emerged the following spring about the middle of May. Occupants of all of the cells were resting larvae or newly transformed adults when I opened the nests for study.

The cocoons, which were covered with prey remains, were very light tan and fusiform in shape with a small pore at the anterior end. Four cocoons, from which two females emerged were 7 to 8 mm in length; ten male cocoons were 6 to 8 mm long. The cocoons were always oriented with the anterior end upward toward the nest entrance.

There are undoubtedly at least three generations a year, because I have collected adults at Plummers Island from 17 May to 17 October.

In individual overwintering nests having five or more occupants, adult emergence required 12 to 20 days. Under laboratory conditions five males emerged from one nest 22 March to 10 April, while a single female emerged 3 April; a male had emerged from the outermost cell of this nest on 5 August the preceding summer. In another nest four males emerged 28 March to 3 April and a single female on 8 April. In the third nest six males emerged 21 March to 4 April and a lone female on 3 April.

I reared 5 females and 20 males from 45 provisioned cells. The sequence of sexes in the nest is probably usually random, as may be seen from the following table of the three nests from which both sexes emerged (*x* indicates mortality):

	1	2	3	4	5	6	7	8	9	10	11	12
8362 L	♀	♂	♂	♂	♂	♂	♂	*x*				
9962 G	♀	♂	♂	*x*	♂	♂	*x*	*x*	*x*	♂	*x*	*x*
9962 H	♂	♂	♂	♀	♂	♂	♂					

The prey of this species consisted of midges. The midges contained in the one cell which I preserved were 1.7 to 4.2 mm long, and there were more males than females. These midges were identified as follows:

Ceratopogonidae
- *Palpomyia subasper* (Coq.)—9

Chironomidae
- *Chironomus* (*Cryptochironomus*) *fulvus* Joh.—5
- *Chironomus* (*Cryptochironomus*) *viridulus* (L.)—5
- *Chironomus* (*Dicrotendipes*) *nervosus* Staeger—1

This species of *Euplilis* is subject to a high rate of parasitism. The occupants of 14 of the 45 provisioned cells were attacked by hymenopterous parasites, and the contents of one additional cell were destroyed by mold. The platygasterid, *Tetrabaeus americanus* (Brues), destroyed the resting larvae in 8 of 26 cells in three nests. The eurytomid, *Eurytoma inornata* Bugbee, parasitized 6 of 11 resting larvae in one nest. I killed a live female eulophid, *Melittobia chalybii* Ashm., on the outside of a wasp cocoon when I opened the nest for study; none of the cells in this nest was parasitized. The highest parasitism rate occurred in an 11-celled nest where *Eurytoma* was reared from cells 1, 2, 5, 6, 8, and 10 and *Tetrabaeus* from cells 3 and 11.

Euplilis (*Corynopus*) *rufigaster* (Packard)

I reared this crabronine wasp from 18 nests, 12 in green stems of *Hibiscus militaris* and 6 in the old dead stems (92361 A, B, E; 101061 E; 8362 E, I, K; 9962 E; 91662 F, G, J, K, P, S, U, V, CC, FF). It is the smallest wasp nesting in hibiscus; reared females were 4–6 mm long. The female wasps entered the pith of the dead stems at the broken or cut upper end of the stems. Those which nested in green stems entered through the entrance boring chewed out by *Ectemnius paucimaculatus*. Most of these *rufigaster* nests were in the empty section of the central cavity above the entrance, but two *rufigaster* females nested in the section below the entrance.

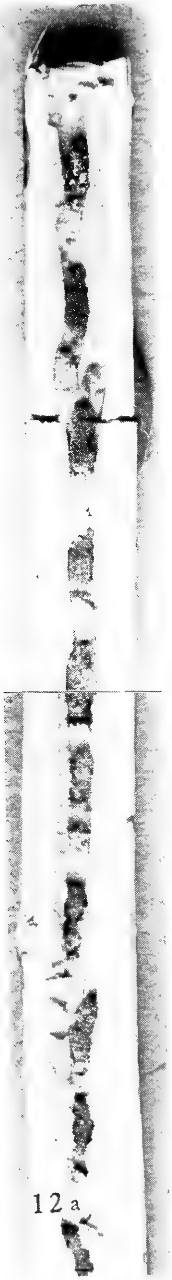
The nest architecture in the dead stems was quite similar to that reported earlier for *Euplilis coarctata modesta*. As in *E. c. modesta*, *rufigaster* used the exposed central cavity in three nests, because there was a basal plug of pith particles 2 to 15 mm thick in three nests at distances ranging from 6 to 18 cm from the broken end of the stem. In the other three nests the wasps either took over an abandoned boring of another insect in the solid pith or chewed out their own straight or sinuous borings; in these nests there was not a basal plug of pith particles. The borings in these latter three stems ended 9 to 20 cm from the broken end of the stem. I did not find an empty vestibular cell in any of these six nests, probably because I had broken off the ends of the stems to determine whether there was actually a nest in each. The diameter of the dead stems was 8.5 to 14 mm. The nest had a moniliform appearance in longitudinal section because the cells were barrel-shaped with a minimum width of 3 mm, and the plugs capping them had a width of only 2 mm. There were 4 to 16 cells (mean 8 cells) in the six nests in dead stems.

In the green stems, where *rufigaster* nested above the *paucimaculatus* entrance, the female usually constructed the first cell at the upper end of the central cavity, or else chewed out a somewhat sinuous boring above the termination of the central cavity. In one nest the wasp did not use the uppermost part of the central cavity, but built a short plug 64.5 cm above the entrance. Then the wasp constructed a series of linear cells working downward toward the entrance, separating adjoining cells by the usual partition of pith particles (Fig. 12). Usually there was an elongate, empty vestibular cell below the last (lowest) provisioned cell, and finally a closing plug of pith particles at or slightly above the nest entrance. These vestibular cells were 11 to 20 mm long, and the closing plugs were 2 to 30 mm in length. The length of the completed nests in green hibiscus stems was 14 to 72 cm. The cells were usually constructed in a linear series having a moniliform appearance (Fig. 13), but occasionally the cells were set obliquely into the side of the stem (Fig. 14). The cells and their closing partitions were similar in length to corresponding parts of *rufigaster* nests in dead stems.

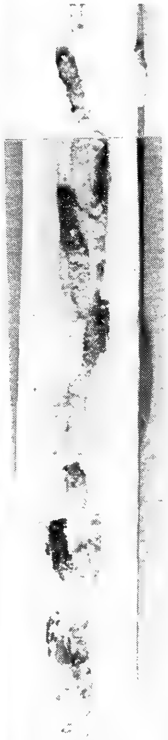
A dozen cells in which female wasps developed were 5–15 mm long (mean 8.4), while seven male cells were 4–10 mm long (mean 6.9). The pith partitions closing the cells were 1 to 32 mm long (mean 7.4).

The mean number of provisioned cells in completed nests was 7 (range 3–16). However, in two incompleted nests in green stems there were 23 and 26 completely provisioned cells respectively; the 24th and 27th cells were being stored when I picked up the nests. Apparently the egg is not laid until sufficient flies for one cell have been accumulated, because I did not find an egg in any of the partially provisioned cells. However, the egg eventually is laid on one of the flies near the inner (lower) end of the cell (Fig. 18). The flies in a partially stored cell are protected from attack by parasites by a temporary closure of pith particles above the cell (Fig. 15).

In dead stems the cocoons were oriented with the anterior end upward toward the entrance. In green stems where nests were constructed above the entrance, the cocoons were oriented with the head end downward. The only difference in the architecture in these two kinds of nests is that the pith partitions had the smooth concave surface upward in the dead



12 a



12 b

13

14

stems, and downward in the green stems. Therefore, larvae of *rufigaster* probably orient their cocoons with reference to the cell partitions, as do those of the vespid wasps observed by Cooper (1957) rather than with reference to gravity as is probably true of larvae of the hibiscus wasp.

The cocoons are very similar in appearance to those of *coarctata modesta* except for being smaller. They were 4 to 6 mm long with a mean length of 4.6 mm.

There are undoubtedly three or more generations of *rufigaster* annually. I have collected adults at Plummers Island from 19 May to 17 October. Emergence must have taken place earlier than the 19 May date because on that date I collected a female carrying a pale green chironomid. Newly hatched larvae were found in nests as late as 30 September.

I obtained very little information on duration of the immature stages. The wasps overwinter as resting larvae, and adults probably emerge fairly early in May. The pupal stage in the overwintering generation requires about 19 days; it is much shorter during the summer, for in one nest there were resting larvae on 3 August and adults emerged on the 13th.

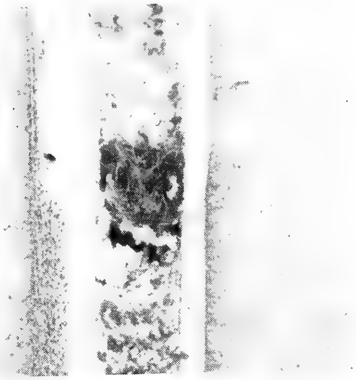
Emergence of adults from multicelled nests may extend over a considerable period, but sometimes lasts only a few days. For example, nine males emerged from one nest in a 6-day period; in another nest four females emerged in the laboratory from 25 March to 1 April, and seven males from 22 March to 6 April; in still a third nest three females emerged 29–30 March, and nine males emerged 22 March to some date between 12 and 29 April, a period when I was away from Washington. Consequently, emergence from nests of nine cells or more required periods of from 6 to 22 + days.

I reared 19 females and 45 males from 158 provisioned cells. The sequence of sexes in the nests is probably a random one as may be seen from the following table (*x* indicates mortality):

	1	2	3	4	5	6	7	8	9	10	11	12
101061 E	*x*	♀	♀	♂	♀							
8362 E	*x*	*x*	*x*	*x*	♂	♀	♀	*x*	*x*	♀	*x*	*x*
91662 J	*x*	♀	♀	♀	♂	♂	♂	♂	♂	♂	♂	♂
91662 U	*x*	♀	♀	♂	♂	♂	♀	*x*	*x*	*x*	♂	*x*

(*Table continued p. 97*)

PLATE V. Nests of *Euplilis rufigaster* (Pack.) in green hibiscus stems. Fig. 12, Completed nest 91662 J split open, 18 September 1962, × 1.5; Fig. 12*a*, cells 1–10 (cell 1 at top); Fig. 12*b*, cells 11–16 (cell 11 at top) and entrance hole (10 mm above the 12*b*) of hibiscus wasp which was used by the *Euplilis* as its nest entrance also; note that boring is sinuous and that some cells are in a linear series, others individually in pockets off the main boring. Fig. 13, Cells 5–6, nest 91662 U, contents removed, showing cells in linear series, 20 September 1962, × 3.0. Fig. 14, Cells 23–24, nest 91662 U, contents removed, showing cells in pockets on side of main boring, 18 September 1962, × 3.4.



15

16

17

18

	13	14	15	16	17	18	19	20	21	22	23
101061 E											
8362 E	*x*	*x*	*x*	*x*							
91662 J	♂	♂	♂	♂							
91662 U	♂	*x*	♂	*x*	♂	*x*	♀	*x*	*x*	*x*	*x*

E. rufigaster, like *coarctata modesta*, preys entirely on midges. However, I have no records of its using anything but Chironomidae. I preserved the prey from eight completely or partially provisioned cells. Consolidated prey records from these five nests are as follows:

Gen. and spp.—10
Orthocladiinae (gen. and sp.)—18
Cricotopus sp.—4
Chironomus (*Cryptochironomus*) sp.—4
Chironomus (*Cryptochironomus*) *fulvus* Joh.—12
Chironomus (*Cryptochironomus*) *nigrovittatus* Mall.—9
Chironomus (*Cryptochironomus*) *viridulus* (L.)—91
Chironomus (*Dicrotendipes*) *nervosus* Staeger—4
Chironomus (*Xenochironomus*) *xenolabis* (K.)—17
Tanytarsus sp.—22

One nest of an *Euplilis* species (92863 B) in a dead stem was probably that of *rufigaster*, because the two completed cells, both containing eggs which failed to hatch, were 6–7 mm long. Cell 1 contained all Chironomidae except for one tipulid, *Polymeda cana* (Wlkr.), and incompleted cell 3 contained all Chironomidae except for one ceratopogonid, *Bezzia setulosa* (Lw.).

The number of midges stored per cell varied according to their size (Fig. 16). There were 50 midges 0.9–3.6 mm long in one cell and 29 midges 1–5 mm long in another cell. Both sexes of midges were stored in each cell, but the majority were males. Usually three to five species were stored per cell. All of the prey reported above were from nests stored during September; undoubtedly nests provisioned earlier in the season would be stored with other species.

Several years ago (Krombein, 1958) I published a few brief notes on a population of *rufigaster* nesting in deserted anobiid borings in the porch steps of the cabin at Plummers Island. These *rufigaster* used the following chironomids in the period 22 August–20 September 1957: *Chironomus nervosus* Staeger, *C. modestus* Say, *C. neomodestus* Mall., *Procladius*

PLATE VI. Nests of *Euplilis* sp. and *Pemphredon lethifer* form *littoralis* Wagn. in dead hibiscus stems. Fig. 15, Partially stored cell 3, nest 8362 J, *Euplilis* sp., 5 August 1962, × 4.0; note loose partial plug of pith particles above midges and no wasp egg. Fig. 16, Completely stored cell, unnumbered nest, *Euplilis* sp., 12 July 1962, × *ca.* 5.0. Fig. 17, Completed nest 72763 B, *Pemphredon lethifer* form *littoralis*, 27 July 1963, × 1.3; note wasp pupae in cells 1 and 3, aphids and interspersed pith particles in cells 2 and 4, wasp prepupae in cells 5–8. Fig. 18, Female midge, *Chironomus fulvus* Joh., with egg of *Euplilis* sp. between head and forelegs, cell 1, nest 92863 B, 29 September 1963, × 7.3.

culiciformis (L.), *Calopsectra* sp., *Cricotopus* sp., and several species belonging to unknown genera and species. One wasp required 5 minutes to leave her nest, capture a midge, and return to the nest with it. The prey is carried beneath the wasp while in flight, venter to venter, and head end forward.

E. rufigaster apparently is not as subject to parasitism as is *coarctata modesta*.[4] Of 158 provisioned cells the occupants of only 13 were destroyed by parasites, 8 by mold, and 2 were attacked from the outside of the stem by an unknown predator. The eurytomid, *Eurytoma inornata* Bugbee, parasitized 6 of 10 cells in one nest. The platygasterid, *Tetrabaeus americanus*, destroyed the resting larvae in 3 of 30 cells in two nests; I found a live female in each of two other nests but neither was successful in parasitizing any of the wasp larvae. The torymid, *Diomorus zabriskiei* Cresson, parasitized one cell in a 5-celled nest. One maggot of the sarcophagid fly, *Ptychoneura aristalis* (Coquillett), fed on the prey in three cells in a 13-celled nest in order to reach maturity. Only one species of parasite occurred in each of the parasitized nests.

Trypoxylon (*Trypoxylon*) sp. or spp.

One cell of this sphecid wasp (or wasps) occurred in hibiscus stems, one in a green stem (91662 I) and two in dead stems (8362 L, 9162 T). The nest in the green stem consisted of a single cell 9 cm above the entrance to an *Ectemnius paucimaculatus* nest which was entirely below the entrance. The cell was 15 mm long, and had a clay partition at each end. The *Trypoxylon* larva was spinning its cocoon on 16 September 1962, when I opened the nest; the larva died a few days later. In the second nest (8362 L) the *Trypoxylon* made a 1-mm clay seal 17 cm below the cut end of the dead stem; its single cell was 35 mm long. It contained a mature larva on 3 August 1962, which died a few days later. The third nest (9162 T) consisted of a cocoon in a single cell in a preexisting boring in the cut end of a dead stem. There was a pupa in this cocoon on 5 September 1962 from which a female *Eurytoma inornata* Bugbee emerged on 10 September. There were two cells in still another nest (82863 A) in a dead hibiscus stem with a diameter of 11 mm. The nest boring was 3 mm wide. There was a clay seal 1 mm thick 66 mm below the entrance in the broken end of the stem. Cell 1 was 20 mm long and contained an empty cocoon from which the *Trypoxylon* emerged prior to 28 August. The second cell was 46 mm long and contained a *Trypoxylon* cocoon in which there was a live ichneumonid pupa; this parasite died a few days later. It was identified as a species of *Messatoporus*, probably *rufiventris* Cush.

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[4] It is quite possible that the actual parasitism rate for *rufigaster* is much higher. I had 20 additional *Euplilis* nests, presumably stored mostly by *rufigaster* and some by *E. c. modesta*, from which I was unable to rear wasps. Many of these nests were quite heavily parasitized by *Tetrabaeus americanus*; other parasites in them were *Perilampus canadensis*, *Eurytoma inornata*, *Habritys latro* Wallace and *Eustalomyia vittipes*.

In Japan, *Trypoxylon obsonator* Smith occasionally uses the empty sections of nests of *Ectemnius rubicola nipponis* Tsuneki as a nesting site; a similar relationship does not appear to occur as commonly between the hibiscus wasp and species of *Trypoxylon.*

Pemphredon (*Cemonus*) *lethifer* form *littoralis* Wagner

Although this pemphredonine wasp, an adventive from Europe, is reasonably common along the margin of the river, I found only one nest (72763 B, Fig. 17). It was in the upper 12 cm of a boring in the broken end of a dead hibiscus stem 13 mm in diameter. At the lower end of this boring was a plug of fine pith particles 10 mm thick, which sealed off an old *Euplilis* nest beneath. The boring occupied by the *Pemphredon* had a diameter of 3 to 3.5 mm.

I found and opened the nest the morning of 27 July. At that time there was a female wasp pupa in the innermost cell and five wasp prepupae in other cells. By that evening one of the prepupae had pupated, and three others pupated the next day; I crushed the fifth one when I closed the split halves of the stem.

There was a series of eight linear cells in the nest, measuring respectively from the innermost 10, 10, 9, 11, 9, 9, 9 and 8 mm in length. Apparently eggs failed to hatch or were absent in the areas which formed cells 2 and 4; these cells contained approximately 100 aphids, mostly nymphs but a few winged adults of *Chaitophorus populicola patchae* H. R. L., and many interspersed fine particles of pith. The other cells did not contain any loose pith particles, but were sealed above by a convex, silken cap, the vestigial cocoon. Each of these silken caps had fine pith particles covering the upper, outer surface. From these data it is reasonable to assume that the mother wasp does not construct partitions between the cells, but merely stores a number of aphids and interspersed fine particles of pith and lays an egg at intervals of about 10 mm. The larvae cannot be cannibalistic. When they reach maturity and are ready to spin cocoons, each one must compact the loose pith particles at the lower end of the cell, void the meconial pellets, spin a silken partition over them, and then spin a silken cap at the upper end against the layer of pith particles at the bottom of the adjacent cell.

Above the eighth cell was a plug of loose pith particles 15 mm thick. The upper 20 mm of the boring were empty and wider than in the provisioned part of the nest. A wasp flew out from this upper empty space when I picked up the stem. About 10 minutes later I captured a female *Pemphredon lethifer* as she hovered in the air in approximately the area where the nest opening had been. I think this was the same wasp that escaped earlier, although its appearance in the area might have been fortuitous. Rau (1948) mentioned that a *lethifer* female continued to use the vestibule of a recently completed nest as a home, while she started another nest in an adjacent stem.

A female wasp emerged from cell 1 on 1 August. From the remaining cells one male emerged on 5 August and two females on 6 August; a male pupa died. It is not possible to present data on the arrangement of sexes in the nest, except for cell 1, because the prepupae in cells 3, 5, 6, 7, and 8 fell out and were mixed when I split open the nest.

Several years ago (Krombein, 1958) I found two nests of this wasp in borings in sumac pith. In one nest, in which larvae were feeding, there were no partitions between the cells. This wasp had stored nymphs of a species of *Aphis*. Earlier still Rau (1948) reported this species (as *inornatus* Say) as nesting in hollow stems of *Weigelia* and provisioning with *Aphis gossypii* Glov. He reported that the cells were 6.3–9.5 mm long; presumably these measurements included the cap for each cell.

Janvier (1960) published a detailed account of the biology of French populations of *P. lethifer* form *littoralis* under the name *unicolor* (Panzer). His description of the nest architecture differs in an important detail from the nest I found in hibiscus and those which I described earlier (Krombein, 1958) from sumac. He reported that the mother wasp capped each cell by a plug of pith particles from one to several millimeters thick, whereas I found that the mother did not make partitions between the cells but scattered bits of pith among the aphids. J. de Beaumont examined the wasps reared by both Janvier and myself, and reports that they are both *lethifer* form *littoralis*. Tsuneki (1952) stated that Ohgushi found nests of *lethifer* form *fabricii* (Müller) in Japan in which there were no separating partitions except in the outermost cells, so that for considerable lengths of the nests there were numerous aphids with eggs or young wasp larvae at intervals. Ohgushi apparently did not mention whether pith particles were interspersed among the aphids, but he reported that there was no cannibalism among the wasp larvae. L. Chandler (personal communication) wrote me that one of his students, working on nesting populations of *lethifer* in sumac in Indiana, found a gradation from nests with extremely long partitions of pith particles between the cells to those with very flimsy partitions or none at all.

PARASITES AND PREDATORS OF THE HIBISCUS WASP AND ITS ASSOCIATES

This hibiscus wasp and its associates, particularly the two crabronine wasps, *Euplilis coarctata modesta* and *E. rufigaster*, are subject to attack by at least a dozen parasites. These include seven species of Hymenoptera, five of Diptera, and one of Acarina. Five of the hymenopterous parasites are chalcidoid wasps, one is an ichneumonid wasp, and one is a proctotrupoid wasp. Of the dipterous parasites, all except *Megaselia* are muscoid flies, either Sarcophagidae or Anthomyiidae. Properly speaking, the *Megaselia* is not a parasite but a scavenger. However, the evidence is rather convincing that its presence in a cell may result in destruction of the host egg or young larva before it begins to feed as a scavenger on the prey stored for the wasp larvae. In the aggregate, except for the mite *Vidia cooremani* Baker, which is a symbiont, these parasites exact a very substantial toll on the eggs or larvae of the wasps.

Messatoporus rufiventris Cushman (?)

I found a live pupa of *Messatoporus* inside the cocoon of a species of *Trypoxylon* (*Trypoxylon*) in a nest in a dead hibiscus stem (82863 A) on 28 August 1963. This pupa died several days later after nearly attaining adult coloration. H. K. Townes was able to place the pupa definitely as a species of *Messatoporus*, and remarked that the color pattern, as so far developed, resembled that of *rufiventris* Cush., rather than the other two species occurring in the United States.

Townes and Townes (1962) reported several rearing records for *rufiventris* from mud cells of the pompilid wasps, *Auplopus* sp. and *Phanagenia bombycina* (Cr.). They remarked that all species of the genus are probably parasitic in nests of mud wasps. The present rearing record extends the host range considerably, but it does not contradict the Townes' prediction that *Messatoporus* parasitizes mud wasps. *Trypoxylon* (*Trypoxylon*) constructs mud partitions between the cells in its nest. It also preys on spiders, although it stores a number of spiders in each cell rather than just one as in the pompilid wasps.

Melittobia chalybii Ashmead

I found a live female of this eulophid wasp in each of two nests (9962 H, 72763 C). One of them was on the outside of a cocoon containing a viable resting larva of *E. coarctata modesta* on 9 September 1962. The other was found in a cell containing a newly hatched larva of a species of *Euplilis* on 27 July 1963. In neither case had the *Melittobia* parasitized any the nest occupants. This eulophid is a very serious parasite of resting larvae or pupae in laboratory cultures; I have found it quite commonly in wooden trap nests of solitary wasps. All the evidence indicates that in nature it attacks primarily resting larvae of wasps in mud cells or in borings in wood, although there are many records of its having been reared from insects other than wasps; however, probably most of these cases occurred in laboratory cultures. Schmieder has discussed the biology very thoroughly in a series of excellent papers (see Muesebeck *et al.*, 1951, for references).

Perilampus canadensis Crawford

This perilampid wasp was reared from one cell each in six nests of the hibiscus wasp containing 3 to 18 cells (72162 C; 72862 E; 9162 G, P; 91662 S, Y) and from one cell in a 10-celled nest of an *Euplilis* sp. (9962 D).

The exact method by which the parasite gains access to the nest is not known. However, if the behavior of *P. canadensis* is similar to that of other *Perilampus* species, we can expect to find the eggs deposited on leaves. The *Perilampus* planidium (first-instar larva) may attach itself to the wasp, or even to one of the flies used as prey before its capture by the wasp, and then be carried into the wasp nest. Once in the nest, the planidium may attach itself to the newly hatched host larva. At any rate the *P. crawfordi* planidium must attach itself to the mature wasp larva so that it is encased in the cocoon spun by the latter. In every case the adult *Perilampus crawfordi* emerged from the wasp cocoon. In one cell I observed the *Perilampus* larva feeding on a pupa of the hibiscus wasp on 29 July; a male *Perilampus* emerged 13 August, about 10 days after one would have expected the host wasp to emerge as an adult.

In an earlier paper (Krombein, 1960) I recorded *P. canadensis* as parasitizing *Ectemnius* (*Hypocrabro*) *stirpicola* (Pack.) in nests in sumac pith. In each of two nests only one cell of several was parasitized by the *Perilampus.* The rearing records for this species of *Perilampus* from a fly, *Zenillia* sp., and from a sawfly, *Macremphytus* sp., given in Muesebeck *et al.* (1951), are probably erroneous (*teste* B. D. Burks, personal communication).

Diomorus zabriskiei Cresson

This torymid wasp is also of secondary significance as a parasite. I reared it from six nests of the hibiscus wasp (91662 X, Y, EE, II; 61663 T, X) and from one nest of *Euplilis rufigaster* (91662 S). One male emerged from one cell of the 6-celled nest of *rufigaster.* It was a more successful parasite of the hibiscus wasp; 4 females and 7 males emerged from 51 cells in the six nests which *Diomorus* attacked. Only one cell was parasitized in each of three nests; in the other nests there were two parasitized cells each in 8- and 18-celled nests, and four parasitized cells in a 12-celled nest. In the nests in which several parasitized cells were found, the arrangement of cells was as follows: (D = *Diomorus*; T = *Tetrabaeus*; W = wasp; P = *Perilampus*; *m* = moldy; *x* = dead; M = *Megaselia*).

	1	2	3	4	5	6	7	8	9
91662 X	♂D	*m*	♀D	♂D	♂D	T	T	*m*	M
91662 Y	♀W	♀W	*m*	♂P	♂W	♀W	*m*	*m*	*m*
91662 II	M	T	*m*	♂W	♂D	♂W	♀D		

	10	11	12	13	14	15	16	17	18
91662 X	T	T	T						
91662 Y	*m*	*m*	*m*	♂D	*x*	*x*	♀D	*x*	*m*
91662 II									

These data suggest that the female *Diomorus* may occasionally parasitize several cells in succession. Inasmuch as this female parasite has a rather long ovipositor, it is assumed that parasitism may take place through the stem wall.

The *Diomorus* is parasitic on the resting larva of the wasp within its cocoon. The full-grown larva of the parasite has long hair. Adults of

Diomorus emerged in the spring at the same time that adult wasps were emerging from adjacent cells. However, in the nests of the summer generation of wasps, the parasites emerged about 12 days after the wasp. In one cell the *Diomorus* larva was full grown on 3 July, pupated on 5 July, and the adult emerged on 18 July.

Earlier (Krombein, 1960) I recorded *D. zabriskiei* as a parasite of *Ectemnius* (*Hypocrabro*) *stirpicola* (Pack.) in nests in sumac twigs. Several cells were parasitized in each of two nests.

Habritys latro Wallace

A few years ago I noted (Krombein, 1960) that this pteromalid wasp was the most successful parasite of the crabronine wasp, *Ectemnius* (*Hypocrabro*) *stirpicola* (Pack.), in nests in sumac twigs. I found *latro* in only one nest of a species of *Euplilis* in a dead hibiscus stem (9962 D). A dead *latro* female was attached to the outer cocoon wall of the wasp in cell 3 from which a number of *Tetrabaeus* emerged later, and another female was found in the incompletely provisioned cell at the outer end of this nest. I found earlier that the *latro* female deposits 6–12 eggs on the resting larva of the *stirpicola*.

Eurytoma inornata Bugbee

This eurytomid species was described (Bugbee, 1962) from a series which I reared during the course of this study on the hibiscus wasp and its associates. It parasitized five nests in dead hibiscus stems (92361 D, F; 9162 T; 9962 E, F), one each of *Euplilis rufigaster* and *E. coarctata modesta*, two of a species of *Euplilis* (either or both of the species named earlier), and one of a species of *Trypoxylon* subg. *Trypoxylon*. The two species of *Euplilis* are undoubtedly the normal hosts for *inornata*, because I obtained 11 females and 5 males from 26 provisioned cells in the four *Euplilis* nests. There was only a single cell in the *Trypoxylon* nest, from which I reared a female *Eurytoma*. The sequence of cells in the three nests which contained more than one cell was as follows: (E = *Eurytoma*; T = *Tetrabaeus*; W = wasp, the sex also being indicated by the appropriate sign where there was no prepupal mortality; *x* = dead from mold)

	1	2	3	4	5	6	7	8	9	10	11
92361 F	♀E	*x*	♂E	♀E							
9962 E	♂E	W	W	W	♀E	♂E	♂E	♂W	♀E	♀E	
9962 F	♀E	♀E	T	♂W	♀E	♀E	♂W	♀E	♂W	♂E	T

It seems probable that the *Eurytoma* parasitizes the wasp cells by inserting the ovipositor through the stem. The *Eurytoma* larva feeds on the resting larva of the wasp.

All of the *Eurytoma* were reared from overwintering nests. However, it must parasitize nests of the wasps throughout the season, because the adult *Eurytoma* usually emerged early in the spring, at the same time as wasps from adjacent cells. However, this is not always true. In nest 9962 E the wasps in cells 2–4 emerged prior to 9 September and the *Eurytoma* in cell 10 emerged 18–20 September; occupants of the outer cells, including the rest of the *Eurytoma*, emerged the following spring. Also, the *Eurytoma* in the *Trypoxylon* cocoon (9162 T) emerged 10 September. In the laboratory a female *Eurytoma* emerged 3 April from one cell; it was a pale pupa on 16 March or earlier. In the field I netted a male *inornata* on 2 June 1963 in a clump of hibiscus, and a female *inornata* similarly on 22 July 1962.

Tetrabaeus americanus (Brues)[5]

This tiny (♀, 1.2 mm long) platygasterid wasp is the most effective parasite of the several crabronine wasps nesting in green or dead stems. I recovered or reared it from 26 nests,[6] 14 of them in green stems and 12 in dead stems. Nine of the nests containing this parasite in green stems were those of the hibiscus wasp, three of *Euplilis rufigaster* and two of *Euplilis* sp., quite possibly *rufigaster*. In the dead stems, three of the nests containing the parasite were of *E. coarctata modesta*, one of *E. rufigaster* and eight of *Euplilis* sp., undoubtedly either of the two preceding species.

In six nests, I found either a live or dead female *Tetrabaeus*, but no parasitized cells. I found three dead females, two in the partition of pith particles capping cell 3 in a 3-celled nest, and the other in a partition capping cell 2 in a 4-celled nest. I recovered four live females, one in each of four nests, in or alongside the partition capping one of the cells.

The female *Tetrabaeus* gains access to the host nest either while the latter is being constructed or after it has been completed. The parasite can easily dig out a tiny tunnel alongside or through the partitions of pith particles capping the cell. Apparently she usually travels downward in the stem depositing her eggs in the host egg or larva in each of several cells in turn. Occasionally, one or several healthy wasp larvae will be found between two parasitized cells; so either the *Tetrabaeus* female fails to oviposit in all of the cells, or perhaps not all of her eggs are viable, or possibly the cells are parasitized by two different females. I do not know what stage of the wasp she attacks, but I judge that it must be either the egg or young larva because I have found females of *Tetrabaeus* in incompletely or recently provisioned nests. Regardless of the stage attacked the wasp larva is able to reach maturity and spin its cocoon

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[5] This species was described by Muesebeck (1963) as a new genus and species, *Crabroborus krombeini*, from material reared during this study. Subsequent examination of type material of *Tetrabaeus americanus*, placed erroneously in Scelionidae by Brues, demonstrated that the two species are conspecific. Brues' type series was reared from crabronine cocoons collected in Wisconsin by Barth.

[6] The account presented here is based on nests 9861 A; 92361 A, E, H; 10761 A, B, C; 8362 A, G; 9162 D, N; 9962 C, D, F, G; 91662 D, J, L, R, S, U, X, DD, EE, II; 61663 I.

before the developing parasites destroy it. Clancy (1944) noted that the platygasterid *Allotropa burrelli* Mues. parasitized all nymphal stages of its coccid hosts.

I did not make any observations on the earlier larval stages of the parasite; presumably it may have only one instar as has been reported for other platygasterids. When the numerous parasite larvae are mature, each one forms a hard, transparent, capsulelike cell, distending the host epidermis (Fig. 11*a*). The host mummy bears a superficial resemblance to that of the lepidopterous *Gnorimoschema* attacked by the polyembryonic encyrtid *Copidosoma*. However, the *Tetrabaeus* cannot be polyembryonic, because at least a few males were obtained from nearly every parasitized wasp larva.

The parasites pupate within the individual cells inside the host. The exact length of the pupal stage is unknown; but it may require 12–15 days, because adults emerged in 7–10 days from cells containing black-eyed pupae. In one nest there were black-eyed pupae on 2 October; on the next day several showed some darkening of the body, and all pupae were dark on 4 October. The first adults eclosed on 6 October. The first adults to leave the cells did so on 8 October. Emergence from a single host mummy usually required 2 to 3 days, although rarely a few stragglers emerged 7–10 days after their siblings.

Emergence of the parasites was not always synchronized with that of the host wasps. In the only parasitized, first-generation hibiscus wasp nest, the *Tetrabaeus* emerged 10–12 days after the single wasp emerged 6 July. In four nests provisioned by the hibiscus wasp and the two species of *Euplilis*, the *Tetrabaeus* emerged in September and October, while wasps from adjacent cells in these nests did not emerge until the following spring. In another five nests provisioned by the hibiscus wasp and by *E. coarctata modesta*, the *Tetrabaeus* emerged in the spring concurrently with the host wasps. It is presumed that the *Tetrabaeus* emerging in the fall may parasitize other nests that same season. If they can overwinter successfully as adults, which is not at all certain, nests would not be available for them to parasitize before the middle of May. Clancy (1944) stated that the adult platygasterid *Allotropa* usually lived no more than 10 days. If *Tetrabaeus* adults are equally short-lived, they certainly could not overwinter and parasitize nests the following spring. Clancy found that *Allotropa* overwintered as resting larvae.

In three other nests provisioned by the hibiscus wasp, by *E. coarctata modesta* and by *Euplilis* sp., there was divided emergence. *Tetrabaeus* emerged from some cells in the fall and from other cells in the spring, and the wasps emerged in the spring only. In the single nest of the hibiscus wasp, *Tetrabaeus* emerged from cells 10–12 in September and from cells 6 and 7 the following spring. In the nest of *E. coarctata modesta*, the *Tetrabaeus* emerged from cells 4 and 7 about 18 September, from cell 8 between 19 and 28 September, and from cells 11 and 12 the following spring. In the *Euplilis* nest, *Tetrabaeus* emerged from cell 3 in September and from cell 1 the following spring. The evidence is rather confusing. Apparently, a single female began parasitizing cells in the *E. coarctata modesta* nest from near the inner end and gradually worked her way toward the entrance; or, perhaps one female may have parasitized cells 4, 7 and 8 and a second female parasitized cells 11 and 12. In the other two nests the mother *Tetrabaeus* must have worked her way from the outer cells toward the inner, unless two females entered each nest.

The following table presents data on the number and sex of *Tetrabaeus* cells found in each infested larva. The nests above the first cross rule are those of the hibiscus wasp; those above the second rule are *Euplilis coarctata modesta*; those above the third rule are *Euplilis rufigaster*; those in the lowest section of the table are *Euplilis* sp., probably both of the preceding species. The number of reared *Tetrabaeus* does not always equal the total number of parasite cells found in the larva. This results from two factors: first, some of the parasites emerged and escaped before I opened some nests; and second, parasites did not mature in some of the cells in the host larva.

Nest and cell	Number of reared *Tetrabaeus*	Number of *Tetrabaeus* cells per infested larva	Range and mean number of parasites per host larva
9162 D, cell 1	22 ♀, 1 ♂	28	
9162 D, cell 2	17 ♀, 2 ♂	19	
91662 R, cell ?	?	?	
91662 R, cell ?	26 ♀, 3 ♂	29	
91662 R, cell ?	?	?	
91662 S, cell 4	21 ♀, 2 ♂	23	
91662 X, cell 6	25 ♀, 1 ♂	26	Range: 17–32 Mean: 24.7 for *Ectemnius paucimaculatus*
91662 X, cell 7	15 ♀, 2 ♂	17	
91662 X, cell 10	?	?	
91662 X, cell 11	?	?	
91662 X, cell 12	?	?	
91662 DD, cell 2	24 ♀, 2 ♂	26	
91662 DD, cell 4	23 ♀, 2 ♂	25	
91662 EE, cell 6	20 ♀	23	
91662 II, cell 2	28 ♀, 1 ♂	32	
61663 I, cell 1	23 ♀, 2 ♂	29	
61663 I, cell 3	12 ♀, 2 ♂	19	
9962 C, cell 1	11 ♀, 1 ♂	12	
9962 F, cell 3	8 ♀, 2 ♂	10	
9962 F, cell 11	7 ♀, 1 ♂	8	Range: 3–23 Mean: 11.4 for *Euplilis coarctata modesta*
9962 G, cell 4	10 ♀, 1 ♂	11	
9962 G, cell 7	20 ♀, 3 ♂	23	
9962 G, cell 8	13 ♀, 1 ♂	14	
9962 G, cell 11	8 ♀, 2 ♂	10	
9962 G, cell 12	3 ♀	3	

(Continued)

Nest and cell	Number of reared *Tetrabaeus*	*Number of Tetrabaeus* cells per infested larva	Range and mean number of parasites per host larva
92361 A, cell 4	?	14	Range: 11–14 Mean: 12.5 for *Euplilis rufigaster*
92361 A, cell 5	?	?	
91662 U, cell 9	5♀	11	
92361 H, cell 1	14♀	15	Range: 6–25 Mean: 15.9 for *Euplilis* spp.
92361 H, cell 2	8♀	15	
92361 H, cell 3	16♀	25	
10761 A, cell 1	?	15	
10761 A, cell 2	?	15	
10761 A, cell 3	?	22	
10761 A, cell 4	18♀, 2♂	20	
10761 A, cell 5	15♀, 3♂	18	
10761 B, cell 1	?	18	
10761 B, cell 2	?	13	
10761 B, cell 3	?	16	
10761 B, cell 4	?	22	
10761 B, cell 5	?	?	
9162 N, cell 1	7♀, 1♂	11	
9162 N, cell 2	5♀, 1♂	6	
9962 D, cell 1	13♀, 1♂	14	
9962 D, cell 3	8♀, 2♂	15	
91662 L, cell 11	6♀, 4♂	10	

As expected from their larger size, the parasitized larvae of the hibiscus wasp yielded more parasites than did the smaller species of *Euplilis*. This was not necessarily because more eggs may be deposited in an hibiscus wasp egg or larva. In his study of the platygasterid *Allotropa burrelli*, Clancy (1944) found definite evidence of cannibalism, which he attributed to chance encounter rather than to aggressive action on the part of the parasite. It seems to me that cannibalism in both of these platygasterid species is more likely to occur when more parasite larvae are present than can reach maturity on the host tissues. If cannibalism occurs in *Tetrabaeus*, it is probably more prevalent in *Euplilis* larvae than in *Ectemnius* larvae because of the smaller size of the former.

I obtained 451 females and 45 males from a total of 682 *Tetrabaeus* cells in 39 parasitized larvae of these three crabronine wasps, giving a sex ratio of 10:1. Clancy reported a sex ratio of 2.7:1 for Japanese material of *Allotropa burrelli* and of 2:1 for laboratory-reared material in New Jersey.

Euplilis rufigaster is smaller than *E. coarctata modesta* and one would expect to obtain fewer *Tetrabaeus* from a *rufigaster* larva. The fact that the mean number of *Tetrabaeus* obtained from *rufigaster* was larger than the mean number reared from *coarctata modesta* was probably due to too few rearings from the former host. In this connection, it can be stated that nests 9162 N and 91662 L, from which no wasps were reared, were almost positively nests of *rufigaster* because they were in green hibiscus stems. If we average the *Tetrabaeus* obtained from those two nests with those from nests 92361 A and 91662 U, we obtain a range of 6 to 14 parasites per *rufigaster* larva and a mean of 10.4.

Earlier in this project I assumed that *Tetrabaeus* had only the two species of *Euplilis* as hosts, because I reared it from them only in the 1961 nests. However, the 1962 nests of the hibiscus wasp yielded a large number of *Tetrabaeus. Tetrabaeus* parasitized 17 of 56 cells in eight nests of the hibiscus wasp, 8 of 26 cells in three nests of *coarctata modesta*, 3 of 30 cells in two nests of *rufigaster*, and 18 of 30 cells in six nests of *Euplilis* spp. Perhaps, after studying many more nests, we may eventually find that *Tetrabaeus* will attack other wasps than Crabroninae nesting in hibiscus.

Inasmuch as the summer generation of *Tetrabaeus* requires 10–12 days more than the host wasps to reach maturity, it seems probable that there are no more than two complete generations annually with possibly a very small third generation.

Megaselia aletiae (Comstock)

This phorid fly is one of the more serious enemies of the hibiscus wasp. I have never found it in nests of the other hibiscus-nesting wasps, even those of *Euplilis rufigaster* which occasionally nests in green hibiscus stems. The fly usually acts as a scavenger, but it is probable that the activities of its larvae in a newly provisioned cell will destroy the wasp egg, and it is certain that the invasion of other wasp cells by *Megaselia* larvae results in the death of the wasp larva in each cell. I reared *aletiae* adults from seven nests (101061 A; 71162 C, E; 72162 C; 91662 H, Q, GG). In addition, *Megaselia* sp., undoubtedly *aletiae*, was noted or reared from 17 other nests (101061 B; 71162 G; 72862 B, C, E; 91662 I, R, CC, DD, EE, HH, II; 61663 E, I, K, R, X; 72163 A). Altogether, these phorids destroyed 30 of 93 provisioned cells in 18 nests.

The phorid female is a very brazen animal. Twice, while I watched females of the hibiscus wasp gnaw out entrances in hibiscus stems, a female phorid was quite persistent in trying to get into the incompleted entrance boring. In one case (72862 C) the persistent investigation by the phorid drove the wasp off. Later, in this same nest, the phorid was still attending the wasp, occasionally crawling beneath the wasp's legs; but the wasp did not again take alarm from the phorid's activity. In the other nest (72862 E), another phorid attended the wasp very persistently while she gnawed at the burrow entrance. Subsequently, when these nests were opened a week later, I did not find any infestation by phorids.

Except in one nest, the phorids attacked cells below the entrance; in this other nest, *aletiae* infested one of two cells *above* the entrance. In several nests infested by phorids the wasp constructed one or more empty intercalary cells above the infested section. These empty cells may have been a device preventing infestation of later cells by maggots from the earlier cells.

I have no data on the early stages of infestation by *aletiae*. Presumably the mother deposits eggs or young larvae in the cell, or at least inside the central cavity of the stem. The larvae, at least older ones, can wriggle through the fine pith particles capping the partitions. The larvae feed on the decomposing prey stored by the hibiscus wasp. If there is insufficient nourishment in the first cell infested, they migrate into adjacent cells. Pupation takes place within the cells where the larva reaches maturity. In one nest, adult flies emerged in July, 11 days after the puparia were formed; in another nest in late September, the period in the puparium lasted 15 days. Flies may emerge as much as a week earlier than wasps in the same nest, or as much as two days later than the wasps. In one nest (72162 C) several newly eclosed adult *aletiae* left the nest when I opened it on 24 July. On this same date there were some full-grown phorid larvae in the same nest. This is an indication that deposition of phorid eggs or larvae may take place over a lengthy period. The nests, of course, are rather poorly protected from attack by phorids. Even in a completed nest, the phorid female can gain the central cavity through the entrance boring, oviposit or deposit larvae on the closing plug, and the phorid larvae can then bore through the pith particles until they reach the cells.

Macronychia aurata (Coquillett)

I reared this sacrophagid fly only once from a nest of the hibiscus wasp (72162 C). This was a 9-celled nest with all cells below the entrance hole. The maggot fed on the contents of cells 3–9 and had formed a puparium when I opened the nest on 24 July. The adult fly eclosed on 29 July.

Presumably the mother fly deposits a larva in the entrance hole during provisioning of the nest. The larva wriggles down to the cells and feeds either upward or downward on the prey stored for the wasp.

I have also reared this species of *Macronychia* (Krombein, in press) from a nest of *Ectemnius* (*Hypocrabro*) *continuus* (Fabricius) in a rotton pear limb. These are the only two rearing records for any species of this genus in North America.

Ptychoneura aristalis (Coquillett)

This sarcophagid fly was reared from two nests, both in stems of green hibiscus. One was a 10-celled nest of the hibiscus wasp (9162 K), and the other was a 13-celled nest of *Euplilis rufigaster* (91662 FF). This is a smaller fly than *Macronychia*, and it does not require as much food to reach maturity as does that genus. The maggot in the hibiscus wasp nest fed on the contents of cell 10 only, while that in the *rufigaster* nest fed on the contents of cells 1–3. Both flies had formed puparia by the time I opened the nests in September. A male fly emerged from each of the puparia the following spring, concurrently with wasps from the same nests.

Probably the fly maggot gains access to the nest in the manner suggested for the preceding species.

This is the first host record for this genus of Miltogrammini.

Eustalomyia vittipes (Zetterstedt)

I reared this anthomyiid from seven nests, five of the hibiscus wasp in green hibiscus stems (101061 C; 9162 L; 91662 L, Z, BB) and two of *Euplilis* sp. or spp. in dead hibiscus stems (101061 G, H). Presumably, maggots of this fly gain access to the nest in the same manner as suggested for *Macronychia aurata.* All of the flies were puparia when I opened the nests in September and October.

There were two puparia in each of the two *Euplilis* nests. In one nest the maggots destroyed the contents of cells 1–8 of a 9-celled nest, and in the other they destroyed the contents of cells 3–8 of an 8-celled nest. There were remains of resting wasp larvae in cocoons in four of the cells destroyed in the former nest, so this fly is capable of maturing on wasp larvae as well as on the prey stored for the wasp.

In hibiscus wasp nests, two maggots destroyed both cells in a 2-celled nest, one maggot destroyed two cells in a 12-celled nest, and one maggot destroyed three cells each in a 4-celled and a 5-celled nest. In the fifth hibiscus wasp nest one maggot destroyed one resting larva in a cocoon, and possibly one or more additional cells.

Most of the adult flies emerged in the spring, concurrently with emergence of wasps from adjacent cells. However, in one nest (91662 L), the fly emerged before the nest was opened for examination, and in another nest (101061 G) one of the flies emerged prior to 10 October, when the nest was opened, and the other fly emerged the following spring.

Except in one nest, the maggots infested wasp cells below the nest entrance. When the maggots were full grown they wriggled upward to form puparia; in some cases the puparia were formed in the closing pith plug (Figs. 9, 10). In the one nest in which the single maggot infested cells above the entrance, it wriggled upward after it was full grown and formed a puparium 12 cm above the nest entrance.

There are no previous host records for this or other North American species of *Eustalomyia.* Several European species have been reared from various crabronine wasps.

UNKNOWN MUSCOID FLY

There were five additional nests of the hibiscus wasp (10761 E; 71162 I; 91662 M, N, V) infested by a muscoid fly or flies, which emerged before the nests were opened for study. Not all of the empty puparia were preserved, but at least two of them were of a different genus and species from any of the three species discussed previously. In these two nests (91662 M, V) one maggot destroyed all cells in a 4-celled nest; in the other nest the maggot destroyed an undetermined number of cells.

Vidia cooremani Baker

This saproglyphid mite was discovered during this study (Baker, 1964). Its host is the hibiscus wasp, *Ectemnius paucimaculatus*. I obtained the first hypopi or deutonymphs on the abdomen of a male wasp (51963 A) netted on 19 May 1963. There were eight, light-tan hypopi on the left side of the first tergum and three more near the base of the second sternum. They were about 200 μ long and 125 μ wide.

I collected three additional hibiscus wasp males (52663 B, C, D) a week later, each bearing one or more hypopi on the abdomen. One had 3 mites on the first tergum; the second had practically all of the first tergum covered by 25 mites plus 4 more on the first sternum and 12 more on the right side of the second sternum; the third wasp had only a single hypopus on the base of the second sternum and a second on the right side of the propodeum.

On 16 June I found three nests in which I discovered mite infestations subsequently. One nest (61663 P) was opened for study on 16 June. The single cell in this completed nest contained a single mite on one of the flies; the contents of this cell shriveled up several days later and I was unable to recover the mite. I opened the other two nests (61663 U, X) on 28 June, on which date all of the wasp occupants were in cocoons. There were a number of mite hypopi clustered around the anterior end of the wasp cocoons in cells 1 and 4 of a 4-celled nest, as well as some dispersed, pale protonymphs on the cocoon walls. I opened one of the cocoons and found a healthy wasp pupa but no mites. In the other 6-celled nest there were mites on the cocoons in cells 1 and 3; the contents of cell 2 were moldy. The pale, 8-legged protonymphs were 233–250 μ long, and the light-tan deutonymphs (hypopi) were 167–200 μ long. I searched through the debris in each mite-infested cell, but I was unable to find dead adult mites or eggs.

Cooreman and Crèvecoeur (1948) published an extensive account of the life cycle of the European *Vidia concellaria* Coor., a symbiont of the ground-nesting sphecid wasp *Cerceris arenaria* L. in Belgium. The scanty data which I obtained for the American species agree very well with some of their observations on *V. concellaria*. It is quite probable that in general details the biology of the two species is similar. In brief, *concellaria* hypopi also occur on the adult wasp and drop off in the wasp's cell as it is being provisioned. The hypopi or deutonymphs transform to tritonymphs and then into adults in a very short time. The adult female mites deposit eggs in the cell soon after the wasp larva has spun a cocoon. The eggs hatch in 24–28 hours and the resulting larvae transform to protonymphs in another 2–3 days. The mite adults, larvae and protonymphs, all live as scavengers on and in the beetle (prey) remains. However, they stated that the deutonymphs were found in the beetle carcasses attached to the *Cerceris* cocoon, rather than on the cocoon itself. When the adult *Cerceris* left the cocoon the following spring, the deutonymphs attached themselves to the wasp's body. *Vidia* *concellaria* has only a single generation a year, at least on *Cerceris arenaria*, which is univoltine in Belgium, whereas the American species must have two or more generations a year.

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LYCENCHELYS BULLISI, A NEW EELPOUT FROM THE GULF OF MEXICO

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The two specimens of eelpout described in this paper were captured by the Bureau of Commercial Fisheries vessels "Oregon" and "Silver Bay" during exploratory fishing investigations in the Gulf of Mexico. They represent, to the best of my knowledge, the only known occurrences of the family Zoarcidae (excepting the bathypelagic genus *Melanostigma*) in the Gulf of Mexico. It is not possible to identify these fishes with any known eelpout, and I therefore consider them to represent a species new to science. The nomenclature of the head pores follows Andriashev (1955). Vertical fin ray elements and vertebrae were counted from an X-ray photograph. Illustrations are by Mildred H. Carrington. I am indebted to Dr. C. Richard Robins of the University of Miami and to Dr. Giles W. Mead of Harvard University for allowing me to examine material in their care.

Lycenchelys bullisi, new species

Holotype: U. S. National Museum no. 188232, "Oregon" station 4038, 28°51′ N, 88°41′ W, 400–410 fathoms (732–750 m); 3 Nov. 1962; 40-foot flat trawl; off the mouth of the Mississippi River. Although no bottom temperature was taken at station 4038, the bottom temperature at 300 fathoms (549 m) at nearby station 4005, 29°07.5′ N, 88°09′ W, was 8.5°C.

Paratype: University of Miami Marine Laboratory no. 5363, "Silver Bay" station 1195, 24°26′ N, 83°33′ W, 350 fathoms (640 m); 8 June 1959; 40-foot flat trawl; west of Key West.

Diagnosis: A *Lycenchelys* with a relatively short body, depth behind vent into total length 11.2 to 12.2 times; a short head, 6.6 to 6.8 in total length; a large eye, 3.6 to 3.9 in head; a relatively great preanal distance, 2.8 in total length; two lateral lines; plain, unpatterned coloration.

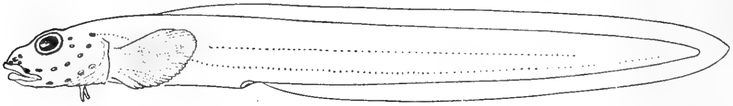

FIG. 1. Holotype of *Lycenchelys bullisi.* Outline drawing.

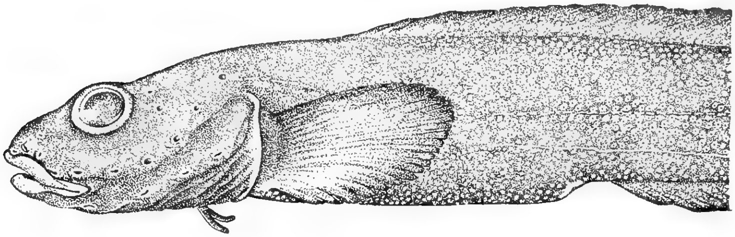

FIG. 2. Holotype of *Lycenchelys bullisi.*

Counts and measurements: Measurements in millimeters; holotype first, followed by paratype in parentheses. Dorsal fin rays 100 (100); anal fin rays 83 (83); caudal fin rays (including only those rays which articulate with the hypural) 11(10); pectoral fin rays 18 (17); ventral fin rays 1 (1); vertebrae (not including hypural) 24 (24) abdominal + 81 (79) caudal = 105 (103); total length 180 (173); standard length 174 (167); snout to anal fin 64 (62); head length 27.1 (25.5); snout length 6.6 (7.0); horizontal diameter of eye 7.5 (6.6); postorbital length of head 13.0 (12.4); tip of snout to origin of ventral fins 21.4 (20.5); length of pectoral fin 19.0 (18.5); depth of body behind level of vent 16.0 (14.2); depth of body at ventral fin 14.0 (14.5); interorbital width 5.6 (5.4); gill opening 8.6 (9.0).

Description: Body relatively short for a *Lycenchelys*, compressed. Greatest depth of body in the trunk region anterior to the vent, decreasing in depth only very gradually along the tail. Width of trunk at level of vent about one-half depth; body more compressed posteriorly. No keel-like ventral fold on the abdomen.

Unpaired fins confluent, their height nearly uniform. Origin of dorsal fin on vertical through midlength of the pectoral fin; length of pectoral fin equal to about one-half the distance from origin of pectoral fin to origin of anal fin. Pectoral fin inserted vertically immediately behind opercle. Each ventral fin ray 3 to 4 mm long.

Scales absent from head, predorsal area of dorsum, and from side of body above proximal one-fourth of pectoral fin. Remainder of body with scales, as are the bases of the vertical fins. Thirty to 35 scales between vent and base of dorsal fin (only 24 shown in Fig. 2). Lateral line originating at the occipital pore, whence it extends posteriorly in a straight line for about 10 mm, then descends to the lower third of the body and extends posteriorly to almost the end of the tail; very difficult to trace beyond the vent. Another lateral line originates in the midline close to the level of the hind margin of the pectoral fin and extends straight back for a distance of 65 to 70 mm, becoming indistinct posteriorly (virtually impossible to see in the paratype).

Head width about equal to head depth, both at nape and at interorbital. The dorsal profile of the head descends gently from the nape and is interrupted by the dorsal rim of the eye in the holotype, not in the paratype. In the holotype an inflection occurs near the level of the tubular anterior nostril, whence the profile descends more steeply. The snout of the paratype is smoothly rounded. Snout short, about equal in length to horizontal diameter of eye. The nostril tube is closer to the tip of the snout than to the anterior rim of the eye and is located a distance about equal to its own diameter above the upper lip. The posterior nostril resembles the sensory pores and is located above and behind the nostril tube.

Seven pores in the maxillary series, the first in front of the anterior nostril; two postorbital pores, both behind the eye; a single occipital pore, near the upper angle of the opercle; a single preopercular pore, about midway between the hind margin of the eye and the hind margin of the opercle; mandibular series with seven pores, the anterior four, which are located along the lower jaw, separated by prominent folds of skin in the holotype.

Posterior margin of maxillary not reaching beyond level of midpoint of eye. Eye large, 3.6 to 3.9 in head. Interorbital region slightly concave in holotype, flat in paratype. Mouth slightly inferior, loose skin on upper lip protruding only slightly, not expanded into fleshy flap.

A slight palatal membrane present. Teeth short and conical; on the dentary in a single row which expands into a patch near the symphysis. Each premaxillary with 6 to 12 teeth in a single row, a second row of 4 teeth at the symphysis in the holotype. Four or five teeth on the vomer, separated by a short gap from 4 teeth in a row on the palatine.

Last abdominal centrum lacking pleural ribs on its parapophyses.

Body color of the holotype a uniform light brown; the darkly pigmented peritoneum shows through the trunk region; the fins are dark. The paratype is faded and was probably dead when preserved.

The holotype is a ripe female containing about 10 large granular unfertilized eggs. One egg measured 3.5 by 4.5 mm. The paratype is probably a male.

Relationships: With the exception of its less elongate body and fewer vertebrae, *L. bullisi* fits fairly well the tentative definition of *Lycenchelys* proposed by Andriashev (1955). Although use of relative body length would place *L. bullisi* in *Lycodes*, the presence of prominent head pores and a palatal membrane are more important characters and are better reasons for relating the species to *Lycenchelys*.

L. bullisi is separable from any known *Lycenchelys* on the basis of its relatively short head, snout and body. It seems to have its closest rela-

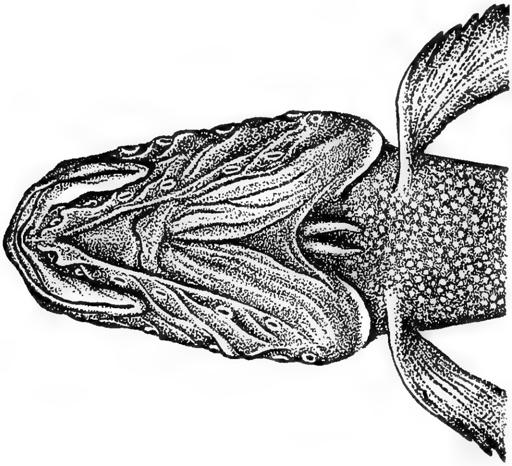

Fig. 3. Holotype of *Lycenchelys bullisi.* Ventral view of head.

tionships with a group of plain-colored species which previous authors have described in *Lycodes* (where they would be relatively elongate forms); these are *L. microcephalus* Jensen (1904) from 1461 meters southwest of Iceland; *L. atratus* Vladykov and Tremblay (1936) from 150 meters in the estuary of the St. Lawrence River, and *L. incisus* Garman (1899) from 1261 meters in the Gulf of Panama. *L. bullisi* is separable from all three of these species on the basis of counts and

Table 1.—Counts and measurements expressed as percent of total length in the types of four species of eelpout

	L. bullisi		*L. microcephalus*	*L. atratus*	*L. incisus*
	Holotype	Paratype			
Total length (mm)	180	173	81	255	196*
Sex	♀	♂?	immature	♀	♀
Dorsal rays	100	100	87	112	101
Anal rays	83	83	71	93	84
Pectoral rays	18	17	15	22	18
Vertebrae	105	103	–	116	–
Preanal distance	35.5	35.8	38.3	41.2	36.0
Head length	15.1	14.7	17.3	22.2	20.6
Snout	3.7	4.0	–	–	5.9
Eye diameter	4.2	3.8	–	4.3	2.2
Body depth at vent	8.9	8.5	8.0	10.2	8.0

* The smaller of two syntypes. The larger is broken behind the vent.

proportions. Comparisons are presented in Table 1. The data for *L. microcephalus* and *L. atratus* are from descriptions of these species. The data for *L. incisus* were taken from one of the syntypes.

Nomenclature: Named for Harvey R. Bullis in recognition of his contributions to knowledge of the marine fauna of the tropical western Atlantic.

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A NEW SPECIES OF FRUIT-EATING BAT (GENUS *ARTIBEUS*) FROM CENTRAL AMERICA*

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During the course of field work in Nicaragua and Honduras in 1962 and 1963, field parties from the Department of Wildlife Management collected several specimens of *Artibeus* that cannot be assigned to any recognized species. Externally they resemble *Artibeus hirsutus*, but they are smaller. They are larger than any member of the "*cinereus*" complex, and they all possess a minute third upper molar which the latter group lacks. Thus, they appear to be the smallest of the "*jamaicensis*" group which normally has three upper molars. For this seemingly new species we propose the name

Artibeus inopinatus, new species

Type: Adult female, skin and skull; No. 9517, Texas Cooperative Wildlife Collections; Choluteca, 10 ft, Depto. de Choluteca, Honduras; collected 1 August 1963, by Jerome V. Mankins, original No. 4576.

Diagnosis: A medium-sized *Artibeus* seemingly most closely allied to *Artibeus hirsutus* of western Mexico, but smaller and with the interfemoral membrane less hairy, although with a noticeable fringe of hairs on its free edge. Forearm 51 to 53 mm in females; 48 to 49 in males; greatest length of skull 15.4 to 16.3 mm; weight 26 to 36 grams.

Comparisons: Considerably smaller than *Artibeus jamaicensis* and *A. lituratus*; needs comparison only with *A. hirsutus* which *inopinatus* resembles in external appearance. From *hirsutus, inopinatus* differs in being smaller in most external and cranial measurements; the cheek teeth are smaller (see Fig. 1 and Table 1). All specimens of *Hirsutus* examined by us have a broad spine on the posterior border of the palate that projects into the interpterygoid space. No spine is present in *inopinatus*, and the posterior outline of the palate is evenly concave.

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* This investigation was supported in whole by Public Health Service Research Grant No. AI-03743, from the National Institute of Allergy and Infectious Diseases. Contribution No. TA 4553 of the Texas Agricultural Experiment Station.

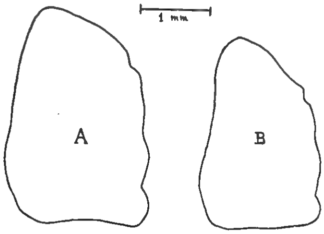

FIG. 1. Outline drawings, occlusal view, of lower left M_1. A, *Artibeus hirsutus* (TCWC No. 4643♀); B, *Artibeus inopinatus* (TCWC No. 9521♀).

Measurements: See Table 1.

Remarks: A single adult male of this species was captured 26 November 1962, in Nicaragua by one of us (Davis) in a mist net set across the mouth of a small tributary that flows into a larger stream at a settlement locally known as San Francisco, 400 ft, at K92 on the Rama Road. At the time it was recognized as being different from *A. jamaicensis* and *A. lituratus*, both of which were being captured in the same net. Although no additional specimens were captured by Davis, nor by Carter and his crew, who collected in Nicaragua throughout the month of May

TABLE 1.—Selected measurements, extremes and means, in millimeters of three species of *Artibeus*

	inopinatus 8 ♀♀	*hirsutus* 6 ♀♀	*jamaicensis* 8♀♀ (from C. A.)
Forearm (inc. wrist)	52.0 (51.7–52.3)	55.7 (52.0–58.4)	59.3 (55.0–64.6)
Metacarpal III	46.4 (45.6–47.0)	50.3 (47.6–52.0)	53.8 (51.0–58.5)
Phalanx 1	14.8 (14.1–15.4)	15.4 (14.5–16.0)	17.5 (16.4–19.0)
Phalanx 2	24.0 (23.0–24.7)	26.8 (25.5–28.5)	27.9 (26.2–30.0)
Phalanx 3 (exc. cart. tip)	12.6 (12.3–13.5)	13.6 (12.8–15.3)	15.6 (15.0–17.1)
Tibia	17.1 (17.0–17.3)	18.6 (18.4–19.2)	21.5 (21.0–23.1)
Weight (gms)	29.3 (24.7–35.9)	39.6 (32.0–47.2)	47.1 (39.0–57.0)
Greatest length of skull to front of canines	25.5 (25.0–26.0)	26.7 (26.2–27.3)	28.0 (27.5–29.2)
Zygomatic breadth	15.7 (15.4–16.3)	16.7 (16.4–17.2)	17.2 (16.3–18.5)
Mastoidal breadth	13.6 (13.3–14.0)	14.3 (14.0–14.6)	14.9 (14.4–16.0)
Interorbital breadth	5.6 (5.5– 5.8)	6.7 (6.6– 6.8)	7.1 (6.7– 7.5)
Palatal length (from incisive foramen)	10.0 (9.6–10.4)	11.2 (10.8–11.6)	10.9 (10.3–11.3)
Postpalatal length	7.7 (7.2– 7.6)	7.5 (7.2– 7.8)	8.7 (8.5– 9.3)
Maxillary toothrow	8.9 (8.8– 9.2)	9.9 (9.8–10.0)	10.0 (9.8–10.2)
Width across M^1–M^1	10.8 (10.5–11.0)	11.7 (11.5–12.0)	12.7 (12.3–13.7)
Length of mandible	17.0 (16.6–17.5)	17.9 (17.8–18.4)	19.3 (18.6–20.3)
Length mandibular toothrow (C–M_3)	9.7 (9.5–10.0)	10.6 (10.5–10.8)	10.9 (10.6–11.2)

1963 and were on the alert for it, Jerome Mankins, Gordon Jarrell and Jack Meyers were fortunate in finding a small colony roosting in a room in a relatively new, unoccupied house in Choluteca, Honduras, on 1 August 1963. They collected the entire group which consisted of one adult male, eight adult females and five young-of-the-year. Two of the young bats appear to be about one month old; the others are older, but still in juvenile pelage.

We wish to thank G. G. Goodwin, American Museum of Natural History, for comparing our specimens with the type of *Artibeus jamaicensis richardsoni*, Matagalpa, Nicaragua. He reported (*in litt.*) that "they need no close comparison with *A. j. richardsoni*." We also wish to thank Charles O. Handley, Jr., U. S. National Museum, who is revising the genus *Artibeus*, for his critical comments concerning the new species.

Although we have not examined them, the five specimens of "*Artibeus hirsutus*" reported from Divisadero, El Salvador, by Burt and Stirton (Misc. Publ. Mus. Zool. Univ. Michigan, 117: 35, 1961) are probably referable to *inopinatus*, since all their measurements are smaller than our *hirsutus* from Mexico and fall within the range of variation of *inopinatus.*

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PROCEEDINGS
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A NEW SUBSPECIES OF HARVEST MOUSE, *REITHRODONTOMYS GRACILIS*, FROM ISLA DEL CARMEN, CAMPECHE

By J. Knox Jones, Jr.

Museum of Natural History, University of Kansas, Lawrence

On 7 and 8 July 1962, two field parties from the Museum of Natural History, The University of Kansas, collected vertebrates on Isla del Carmen, the barrier island separating Laguna de Términos from the Gulf of Campeche in western Campeche, México. Among the mammals obtained by the two groups were seven specimens of the slender harvest mouse, *Reithrodontomys gracilis*, which represent a new subspecies that is named and described below.

Reithrodontomys gracilis insularis, new subspecies

Holotype: Adult male, skin and skull, no. 92262 Museum of Natural History, The University of Kansas, from 8 mi ENE Ciudad del Carmen, Isla del Carmen, Campeche; obtained on 7 July 1962, by William C. Stanley (original no. 373).

Diagnosis and comparisons: The new subspecies is a drab-colored, medium-sized race of *R. gracilis* having the following diagnostic features: Ground color of upper parts pale ochraceous-tawny, palest on sides, darkest on head and back owing to presence of black guard hairs (overall appearance of dorsum grizzled brownish; underparts grayish-white (hairs plumbeous basally, tipped with white) except chin, which is pure white; upper parts of legs pale tawny; forefeet whitish, hind feet grayish white excepting white hairs on toes; tail indistinctly bicolored, pale brownish above, paler below; braincase well inflated but flattened dorsally; zygomatic arches broad, narrowest anteriorly, bowed ventrally to alveolar level of toothrows or beyond; rostrum relatively long and broad; toothrows short; auditory bullae only moderately inflated.

R. g. insularis needs direct comparison only with *R. g. gracilis*, the only other subspecies of the species inhabiting the Caribbean lowlands, from which *insularis* differs as follows: Upper parts drabber (lacking the conspicuous tawny appearance of *gracilis*), sides paler, underparts lacking any trace of buffy color in pectoral region; skull averaging larger in several dimensions, especially greatest length and zygomatic breadth; mesopterygoid fossa broader (average breadth 1.54 mm in seven specimens of *insularis*, 1.28 in seven specimens of *gracilis*); rostrum broader over-all owing partly to more divergent roots of incisors, and averaging longer; braincase broader and deeper.

Measurements: External measurements in millimeters of the holotype, followed in order by those of another adult male, two adult females, and two young adult females, are: Total length, 175, 173, 181 (tip of tail missing), 179, 175, 179; length of tail vertebrae, 97, 98, 99 (tip missing), 101, 98, 102; length of hind foot, 18, 17, 19, 18, 18, 19.5; length of ear from notch, 14, —, 15.5, 13, 14, 14.5; weight in grams, —, 11.4, —, —, 10.6, 10.5.

Respective cranial measurements, also in millimeters, of the same six specimens are: Greatest length of skull, 22.5, 21.6, 22.4, 22.0, 22.0, 21.9; zygomatic breadth, 10.8, 11.2, 11.2, 11.5, 11.0, 10.7; interorbital constriction, 3.3, 3.2, 3.5, 3.5, 3.4, 3.2; breadth of braincase, 10.5, 10.5, 10.4, 10.7, 10.5, 10.5; depth of skull, 8.2, 8.1, 8.1, 8.4, 8.2, 8.1; length of rostrum, 8.1, 7.6, 7.8, 7.8, 7.4, 7.6; breadth of rostrum, 4.2, 3.9, 4.0, 4.1, 3.9, 3.8; length of maxillary toothrow, 3.1, 3.0, 2.9, 3.1, 3.2, 3.1; length of incisive foramen, 3.7, 4.0, 4.0, 3.9, 3.8, 3.7; length of palate, 3.3, 3.4, 3.5, 3.7, 3.5, 3.5. Cranial measurements were taken as described by Hooper (Misc. Publ. Mus. Zool., Univ. Michigan, 77: 9–11, 1952).

Remarks: The three specimens of the new subspecies labeled with reference to Cuidad del Carmen were trapped in coconut groves in company with *Mus musculus*. The ground vegetation was moderately dense and the substrate sandy. The four individuals from 1 km SW Puerto Real also were taken in a coconut grove. Insofar as I am aware, no kind of harvest mouse previously has been reported from Isla del Carmen.

Three of the five females examined were pregnant; each carried three embryos.

Specimens examined: Seven, all from Isla del Carmen, Campeche, as follows: 3 mi E Cuidad del Carmen, 2 (KU 92260–61); 8 mi ENE Cuidad del Carmen, 1 (holotype); 1 km SW Puerto Real, 4 (KU 92263–66).

Specimens of *Reithrodontomys gracilis gracilis* used in comparisons are as follows: 6.5 km WSW Sisal (KU 92253), 3 km N Pisté (KU 92254), and Pisté (KU 92255), Yucatán; Pueblo Nuevo Xcan (KU 92256–57) and 4 km NNE Felipe Carrillo Puerto (KU 92258), Quintana Roo; 7.5 km W Escárcega, Campeche (KU 92259); Uaxactún, Guatemala (KU 65384–85).

Support for field work from the U. S. Army Medical Research and Development Command (Contract DA 49-193 MD-2215) is acknowledged.

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PROCEEDINGS
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A NEW GENUS AND SPECIES FROM THE JUAN FERNANDEZ ISLANDS
(LEPIDOPTERA: BLASTODACNIDAE)

BY J. F. GATES CLARKE
Smithsonian Institution

This new genus of moths is described here to provide a name to be used in my forthcoming Volume V of the Meyrick types of microlepidoptera. I had intended describing this genus and species in another paper, "Microlepidoptera of the Juan Fernandez Islands," but publication of this paper has been long delayed and the name is needed now. Characters of the genus and species will be illustrated in the latter paper.

Nanodacna Clarke, new genus

(Type species: *Nanodacna ancora* Clarke, new species, by present designation.)

Antenna serrulate in male, simple in female, about three-fifths length of forewing; basal segment with pecten. Labial palpus ascending, recurved, smooth except second segment slightly roughened; third segment about as long as second, acute; second segment somewhat thickened toward apex. Head smooth, tongue well developed. Hind tibia smooth except for a few long hairlike scales above. Forewing lanceolate with 12 veins, without accessory cell; 1*c* well preserved at margin; 2 from near angle of cell, connate with 3, closely approximate to 4; 5 short-stalked with 4; 6 obsolete but preserved at margin below apex; 7 and 8 stalked, both to costa; 9 well separated from the stalk of 7 and 8; no accessory cell between 9 and 11; 11 from before middle. Hind wing linear lanceolate, with 8 veins; 2, 3 and 4 well separated and about equidistant; 5 and 6 short-stalked, approximate to 7 at base; discocellular vein very weak.

Male genitalia with uncus absent; gnathos divided.

Female genitalia with double signa.

Nanodacna is very similar to *Blastodacna* but differs from it by the absence of the accessory cell, the presence of vein 1*c*, separate veins 3 and 4 and an obsolete vein 6 of forewing. In *Blastodacna* vein 1*c* is absent, 3 and 4 are coincident and vein 6 is strong. In the hind wing there is no trace of the discocellular vein in *Blastodacna* and vein 7 is out of the stalk of 5 and 6. The female of *Blastodacna* has a single signum but in *Nanodacna* there are two signa. The forewing of *Blastodacna* exhibits well-developed scale-tufts which appear to be wanting in *Nanodacna*. The absence of these scale-tufts in *Nanodacna*, however, may be because of the condition of the specimens. I suspect, though, that the species of this genus are smooth-winged.

Nanodacna ancora Clarke, new species

Alar expanse 10–13 mm.

Labial palpus sordid-white; second segment shaded with fuscous anteriorly and on sides; third segment with subapical fuscous annulus. Antenna fuscous. Head grayish-buff with fuscous irroration. Thorax and ground color of forewing brownish-buff irrorate and suffused with fuscous; basal sixth of forewing fuscous, the outer edge of this patch outwardly oblique from costa to dorsum; a moderately broad, outwardly oblique band of the pale ground color separates the dark basal patch from the outer, darker portion of the wing; stigmata four, blackish-fuscous; one on fold at edge of basal patch, one on fold at two-fifths; one in cell between the foregoing two and one at end of cell; apex rather darkly suffuse fuscous; cilia brownish-buff. Hind wing grayish-fuscous; cilia somewhat paler and distinctly brownish at apex of wing. Legs buff; fore- and midlegs strongly overlaid with blackish-fuscous; hind leg with slight infuscation. Abdomen grayish-fuscous above, buff beneath.

Male genitalia: (Slide No. 10733.) Harpe terminating in a long, recurved slender process; outer end of sacculus armed with a strong digitate process. Anterior edge of vinculum excavated. Anellus a quadrate plate incised posteriorly to admit aedeagus. Aedeagus an open S-shaped structure, sharply pointed distally. Transtilla a sclerotized plate with two fleshy lobes laterally. Socii two small fleshy processes. Gnathos two spined knobs.

Female genitalia: (Slides No. 10446, 10734.) Ostium a small round opening surrounded by a strongly sclerotized ring. Posterior two-fifths of ductus bursae sclerotized, remainder membranous. Inception of ductus seminalis at junction of sclerotized and membranous parts of ductus bursae. Seventh tergite modified by a strongly sclerotized, roughly reniform area.

Type: MASAFUERA: La Correspondencia, 1150 m (28.I.55), in the collection of the University of Chile.

Described from the type male, one male and five female paratypes as follows: ♂, 3♀♀, Quebrada de las Vacas (17.I.52); ♀, Quebrada de las Casas (17.I.52); ♀, La Correspondencia, 1500 m (28.I.55).

The specimens of this species are in relatively poor condition, making it impossible to give an absolutely accurate color description. The genitalia, however, are sufficiently striking to enable an easy identification when additional material is acquired.

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PROCEEDINGS
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STUDIES ON ANDEAN COMPOSITAE: VI

By Jose Cuatrecasas
Department of Botany, Smithsonian Institution,
Washington, D.C.

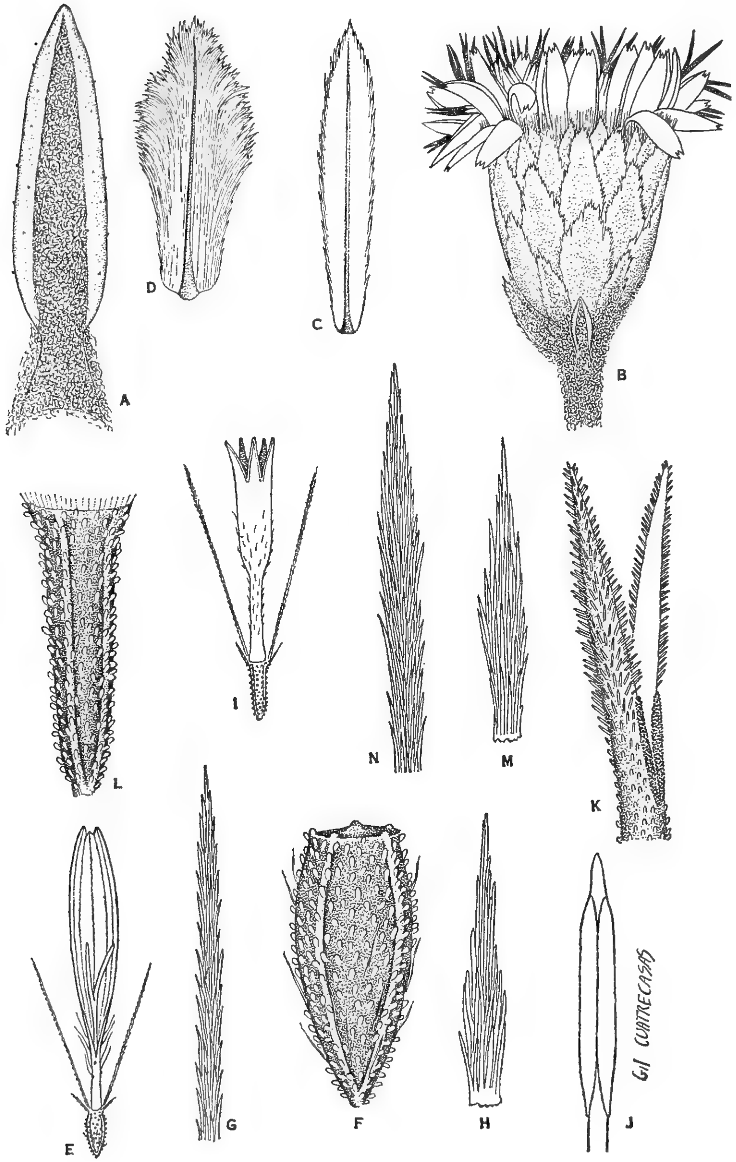
This continuation of my contributions to our knowledge of the Compositae of the Andes deals mainly with interesting collections made by Prof. H. Ellenberg in 1957 in connection with ecological research in several regions of Peru, and with specimens collected by Dr. J. J. Wurdack in his recent explorations of the region of Chachapoyas. Both extensive collections indicate a high degree of affinity between the floras of northern Peru (Jalca region) and the Ecuador-Colombian páramo. A more detailed discussion of these affinities will be presented after completion of the identification of all specimens. Chachapoyas having been the headquarters of Andrew Mathews, Wurdack found many topotype specimens of species based on Mathews' collections, but in his thorough explorations he also encountered a great number of undescribed species. Some of them are described here. A part of the novelties found in the Ellenberg collections of Compositae was published in my contribution IV of this series (Brittonia 12^3, 1960). One of the most interesting findings of Ellenberg is a new genus in the Eupatorieae-Pickerinae, here proposed. An Ecuadorian collection by Barclay is also considered here.

The work upon which this paper is based has been sponsored by the National Science Foundation. The preceding article of this series was published in the same Proceedings, vol. 74: 7–28, 1961.

Diplostephium barclayanum Cuatr., sp. nov.

Frutex ad 1 m altus ramis erectis terminalibus crasse denseque albolanatis.

Folia alterna coriacea, lamina lineari-lanceolata apice brevissime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Gil CUATRECASAS

calloso-acutata basi subite rotundata in brevem petiolum 1.5 mm longum membranaceum amplectentem angustata margine crasse revoluta 5–8 mm longa 1.5–2.6 mm lata; supra viridi nitida sublaevi sed minutis tuberculis spinulosis parcis munita tantum costa impressa notata; subtus dense crasseque albo-lanata, nervatione cum crasso indumento velati.

Capitula heterogama radiata pedunculata circa 1.5 cm diametentia 8–12 corymbos terminales simplices vel subsimplices erectos robustos formantia. Pedunculi 1.5–2.5 cm longi crassiusculi erecti crasse denseque albo-lanati parcis foliis sparsis brevibus 5–3 mm longis supremis bracteiformibus subscariosis lanceolatis lanatis 3–2 mm longis, ad involucrum juxtapositis.

Involucrum campanulatum basi turbinatum circa 6–7 mm altum scariosum basi albido-lanuginosum; phyllariis circi 6-seriatis obtusis stramineis scariosis late marginato-laceratis interioribus glabris circa 6–6.5 mm longis 1.2–1.7 mm latis, mediis gradatim brevioribus oblongis et ovatis 5–4 mm longis 2 mm latis basilaribus late triangularibus dorso lanatis infimis 4–3 mm longis 2 mm latis. Flores radii feminei 22–25 uniseriati; corolla circa 9 mm longa alba tubulo 2 mm longo sursum longe hispido pilis rigidis erectis ad 2 mm longis sparsis glandulis globosis intermixtis, lamina oblonga 3-dentata obscure 4–5 nervata 7 mm longa 1.2–1.5 mm lata; rami styli lineari-subulati 1.5 mm longi margine incrassati minute stigmati-papillosi; ovarium basi cuneatum 5-nervatum leviter compressum copiose glandulosum et sparse pilosum circa 1.5 mm longum; pappus stramineus circa 5 mm longis setis rigidulis minute strigulosis apicem versus vix ampliatis 2-seriatis externis brevibus 0.4–0.8 mm longis. Flores disci hermaphroditi 20–23; corolla lutea 6–7 mm longa tubulo angusto 2–2.2 mm longo pilosulo minutis pilis papillosis crassiusculis alteris longioribus, limbo campanulato-tubuloso pilosulo 5-dentato dentibus triangulari-oblongis 1.2 mm longis margine incrassatis apice acutiusculo plus minusve papilloso-piloso; antherae 2 mm longae basi auriculatae; rami styli 2 mm longi lineari-subulati valde acuti dorso papilloso-hispidulo margine tertio inferiori incrassato papilloso-stigmatico; ovarium oblongum basi cuneatum 5-nervatum copiose glanduloso-granulatum et sparsissimis pilis instructum circa 1.4 mm longum fertile; pappus stramineus 5 mm longus setis biseriatis minute strigulosis sursum paulo dilatatis exterioribus 0.5–0.8 mm longis. Receptaculum

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FIG. 1. *Diplostephium barclayanum.* A, leaf from below, × 7; B, head, × 4; C, inner phyllary, × 7; D, medium-outer phyllary, × 10; E, ray flower, × 5; F, achene from ray flower, × 30; G, upper part of inner pappus bristle in ray flower, × 60; H, outer bristle of same, × 90; I, disc flower, × 5; J, anther, × 20; K, style branches of disc flower, × 25; L, ovary of disc flower, × 25; M, end of inner pappus bristle in disc flower, × 60; N, outer pappus bristle of same, × 90. (Barclay & Juajibioy 9046).

circa 2 mm diam. alveolatum marginibus alveolorum dentatis.

Type: Ecuador, Prov. Napo-Pastaza: near Cordillera de los Llanganati; Chihuila Sacha o Ainchilibí. Shrub, to 1 m tall. Leaves small, to 5 × 2 mm, white-woolly below. Heads profuse, densely woolly in bud, on woolly stems. Invol. bracts long-ciliate; ligul. fls. white; disc fls. yellow. Occasional, lower part of west-facing, grassy slope, south of high campsite under overhang on Ainchilibí, 3700 m alt., 25–29 August 1959, Barclay and Juajibioy 9046. Holotypus, US.

Diplostephium barclayanum belongs to the series *Lavandulifolium* Bl. but the robust flowering branchlets are arranged in erect terminal corymbs. Its obtuse, scariose, lacerate-margined phyllaries, the white rays, and the strongly glandular achenes also distinguish this species from the most closely related *D. hartwegii* Hier., *D. adenachaenium* Bl., and *D. lavandulifolium* HBK.

Diplostephium callaense Cuatr., sp. nov.

Frutex ramosus circa ad 1 m altus ramulis valde patulo-foliatis dense crasseque albo-lanatis, ramis vetustis cortice grisaceo rimoso-lacerato aspectu glabriusculo sed minute piloso. Internodia quam foliis patulis copiosisque valde breviora 1–3 mm longis.

Folia alterna coriacea lineari-oblonga sessilia sensim sine sensu in basin versus angustata apice subite attenuata subacutata breviter calloso-mucronulata, margine crasse revoluta base ampliato-vaginata, 6–15 mm longa 1.5–3 mm lata; supra laete viridia minute copioseque glanduloso-foveolata et resinoso-granulata singulo granulo globoso nitidissimo in singulo foveolo sessile, nervo medio tantum visible plus minusve ad basin albo-lanato reliqua glabra; subtus dense crasseque albo-lanata tantum costa eminenti plus minusve conspicua.

Capitula heterogama radiata 20 mm diametentia pedunculata solitaria ad terminationes ramulorum, pendunculo erecto obsolete angulato dense albo-lanato 5–10 mm longo 1–1.5 mm diametenti, praecipue sursum paucis bracteolis lanceolatis acuminatis rigidulis supra glabriusculis subtus lanuginosis 2–3 mm longis supremis cum involucrum transientibus. Involucrum 7–8 mm altum semiglobosum ad basin subturbinatum phyllariis subscariosis pallidis circa 5-seriatis, interioribus lineari-lanceolatis vel lanceolatis acutis acuminatisque intus glabris planisque extus costa prominula piloso-araneosis vel subglabris plus minusve glandulosis margine lacerato-ciliatis, 6.5–7.5 mm longis 1–1.6 mm latis, exterioribus triangulari-lanceolatis circa 4.5–5.5 cm longis basi 2 mm latis margine lacerato-ciliatis apice acutissimo longe acuminato dorso sparse granulato-glanduloso et araneoso-lanuginoso, intermediis transientibus, omnibus in sicco recurvatis. Flores radii feminei ligulati circa 24–26 biseriati; corolla alba lineari-elliptica apice tridentata 9–11 mm longa 2.5 mm lata 4–5 nervis plus minusve conspicuis tubo 2.8–3 mm longo, basim lamina extus et tubo sursum sparse papilloso-pilosa interdum glandulosa, cetera glabra; stylus glaber 3–4 mm tubum excedentibus, ramulis 1.2–1.5 mm longis lanceolato-linearibus subobtusiusculis, marginibus incrassatis minutissime papilloso-stigmatiferis; ovarium oblongum 2 mm longum subtriquetrum densiuscule glandulosum et hirsutulum; pappus circa 5 mm longus stramineus, setis rigidulis robustiusculis strigulosis ad apicem paulo ampliatis biseriatis exterioribus 0.6–0.8 mm longis. Flores disci hermaphroditi 34–38; corolla lutea 5.2–5.6 mm longa parte media minute sparseque papilloso-pilosula et glandulosa dentibus triangularibus acutis 0.8–1 mm longis extus parce glandulosis cetera glabra, tubulo circa 2 mm longo limbo tubuloso; antherae circa 2 mm longae saccis basi subacutis auriculatis ramis styli lanceolato-subulatis circa 1.4 mm longis extus margineque dense papilloso-hispidulis; ovarium sterile oblongum strictum circa 2.5 m. longum 4–5-nervatum (nervis plus minusve conspicuis) subcompressum dense hirsutulum et glandulosum. Receptaculum convexo-planum 3–3.5 mm diametente alveolatum marginibus alveolorum argute dentatis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: Middle eastern Calla-Calla slopes, near Kms. 416–419 of Leimebaba-Balsas road, 2900–3100 m alt., shrub 0.4–1 m, locally frequent; rays white; disc yellow; 9 July 1962, J. J. Wurdack 1266. Holotypus, US (2373649).

Diplostephium callaense is closely related to *D. empetrifolium* Bl., from which it differs in its larger, somewhat obovate-oblong leaves (broader in their upper third) which are more minutely foveolate and glandular, the foveolae and glands being smaller and more abundant than on the shorter, strictly linear leaves of the Ecuadorian species. In *D. empetrifolium* Bl. the leaves also are more rigid, spreading, or reflexed, and denser, and the ray-corollas are longer and probably bluish or purplish.

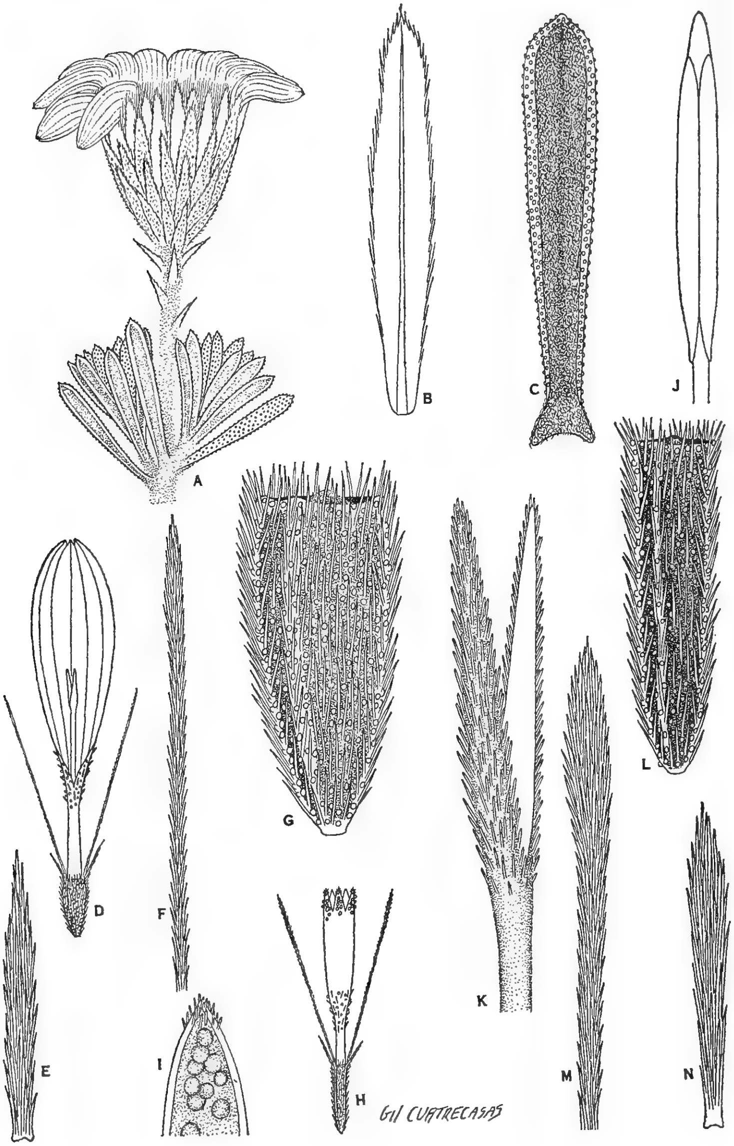
From *D. oblanceolatum* Bl. (a very close relative of *D. glandulosum*), it differs in its smaller and less thick, rigid leaves, in the white rays, and in the glands on the ovary.

From *D. cajamarquillense* Cuatr. it differs in its more rigid, linear leaves that are almost smooth above, and in its hirsute ovaries and violaceous rays.

Diplostephium konotrichum Cuatr., sp. nov.

Arbuscula 4 m alta virgato-ramulosa dense foliosa et floribunda. Ramulis dense lanuginosis ferrugineis pilis pluricellularibus crassis conicis acutis patulis rectis vel hamatis ad 0.5 mm longis copiosis et pilis longissimis tenuibus lanato-intricatis tectis. Ramis vetustis cortice ochraceo vel griseo fissurato-rimoso piloso-tuberculato parce glabrescenti.

Folia alterna coriacea petiolata. Petiolus tener 5–10 mm longus praecipue subtus plus minusve pilosus ad basin in vaginam 2–2.5 mm latam dilatatus. Lamina oblanceolata vel oblanceolato-oblonga apice subacuta saepe minute calloso-mucronulata basi in petiolum sine sensim attenuata margine integra revoluta, 1.5–3 cm longa, 0.5–0.9 cm lata; supra viridis sublaevis juvenile statu parce piloso-arachnoidea demum glabra sed sparsis glandulis minutis globosis munita, nervo medio impresso tantum conspicuo; subtus dense ferrugineo-lanata costa bene


A
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elevata tantum conspicua nervis secundariis 12–14 utroque latere prominentibus patulis cum indumento velatis.

Inflorescentiae corymboso-paniculatae terminales folia suprema excedentes, erectae 3–6 cm diametentes; axi robustiusculo ferrugineo-lanato ramis erectis virgatis teneris extremo ramulosis foliolis subtendentibus inferne foliis similibus sed brevibus superne bracteiformibus linearibus vel subulatis 6–3 mm longis; ramuli ultimi seu pedunculi teneri 3–15 mm longi lanuginosi, ad apicem tantum juxta involucrum 2–4 bracteolis lanceolatis muniti. Capitula heterogama radiata 2 cm diametentia. Involucrum campanulatum circa 6 mm altum 5 mm diametente, phyllariis 4–5 seriatis, interioribus lineari-lanceolatis acutis marginibus sursum eroso-ciliatis dorso glabris viridi-brunnescentibus margine pallidioribus, 5–5.5 mm longis, 1 mm latis, ceteris lanceolatis vel ovato-lanceolatis gradatim brevioribus et amplioribus exterioribus 4–3 mm longis 1.6–1.8 mm latis acutis margine pallidis lacerato-ciliatis dorso apiceque atrobrunneis sparse flexuoso-pilosis et parce papillosis. Flores radii feminei ligulati 14–16 uniseriati; corolla lilacina 11–12 mm longa tubulo 3.5–4 mm longo papilloso-piloso, lamina oblonga 4-nervata circa 2 mm lata apice 3-dentata dentibus obtusis basim versus extus parce papilloso-pilosa; stylus 2.5 mm tubum excendens ramis linearibus 1.4 mm longis marginibus incrassatis stigmato-papillosis; ovarium oblongum basim attenuatum 4–5 nervatum levissime triangulare compressum, copiose setoso-hispidulum et minute granulato-glandulosum circa 2 mm longum; pappus ruber 6 mm longus biseriatus setis strigulosis inaequilongis extremo paulo ampliatis, exterioribus brevibus latioribus 0.4–1 mm longis. Flores disci hermaphroditi 13–15; corolla lutea 6 mm longa tubulo crassiusculo circa 2 mm longo pilis sparsis crassiusculis limbo tubuloso sursum gradatim leviter ampliato deorsum parce pilosulo dentibus 1 mm longis oblongo-triangularibus acutis margine incrassatis glabris sed apice minutissime papillosis; antherae 2 mm longae basi obtusae; rami styli lineares subulati 1.2–1.4 mm longi extus margineque omnino longe papilloso-hispiduli; ovarium lineare 2.5–3 mm longum 5-nervatum longe hispidum et minute granulato-glandulosum; pappus 6 mm longus ruber setis sursum ampliatis acutis strigilosis inaequalibus biseriatis exterioribus latioribus 0.4–1 mm longis. Receptaculum subplanum alveolatum marginibus alveolorum dentatis circa 2 mm diametente.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: Moist scrub

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FIG. 2. *Diplostephium callaense*. A, end of flowering branchlet, × 2.5; B, inner phyllary, × 7.5; C, leaf from below, × 3.5; D, ray flower, × 5; E, outer pappus bristle, × 60; F, upper part of inner pappus bristle of ray flower, × 60; G, ovary of female flower, × 30; H, disc flower, × 5; I, corolla lobe; J, anther, × 25; K, stylar branches of disc flower, × 40; L, ovary of disc flower, × 25; M, part of inner bristle of disc flower, × 60; N, outer bristle of same. (Wurdack 1966).

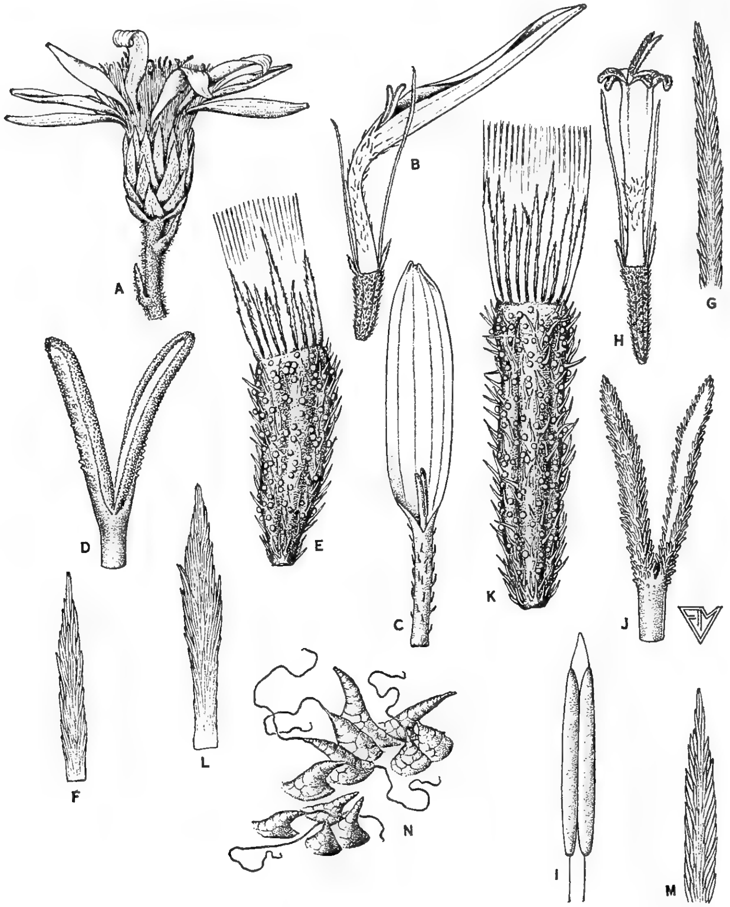

FIG. 3. *Diplostephium konotrichum.* A, head, × 2; B, ray flower, × 5; C, corolla, × 5; D, stylar branches of ray flower, × 20; E, ovary of ray flower, × 15; F, outer pappus bristle of ray flower, × 30; G, end of inner pappus bristle of ray flower, × 30; H, disc flower, × 5; I, anther, × 15; J, stylar branches of disc flower, × 20; K, ovary of disc flower, × 15; L, outer pappus bristle of disc flower, × 30; M, part of inner pappus bristle of disc flower, × 30; N, conic-tubercular, flagellate trichomes at the branches, × 30. (Wurdack 1634).

forest on south side of Molinopampa-Diosan pass, 2700–3100 m alt.; shrub 4 m; rays lilac; disc yellow, 8 August 1962, J. J. Wurdack 1634. Holotypus, US (2373685).

Although *Diplostephium konotrichum* has the leaves and habit of *D. floribundum* HBK., it belongs to the section *Bifidum* and differs mainly in its thick, tuberculate-conical, acute, pluricellular trichomes which are flagellate at the apex, covering the branchlets with acute tubercles and an arachnoid-woolly tomentum. This kind of hair is almost unique in the genus, the only similar hairs being those found in *D. vermiculatum* Cuatr. and *D. hippophae* Blake. The conical hairs of *D. konotrichum* are very persistent and can be seen, at least their basal part, on old branchlets. This species certainly is very showy on account of its spreading lilac rays and abundant heads.

Diplostephium wurdackii Cuatr., sp. nov.

Frutex vel arbuscula 1–2.5 m alta ramis terminalibus griseis cortice leviter fissurato arachnoideo-tomentuloso; ramis foliosis curvatis subteretibus (juvenilibus angulatis) dense adpresseque lanatis ochraceis vel ochraceo-cinereis.

Folia alterna rigide coriacea petiolata bicolora. Petiolus robustus 10–14 mm longus costa subtus crassa margine angusto involuto basi vaginato-dilatatus dense ochraceo-tomentoso-lanatus. Lamina elliptico-oblonga apice leviter attenuata obtusa vel obtusissima basi cuneata in petiolum angustata margine plus minusve revoluta repando dentata dentibus 1 mm longis acutis callosis patulis vel reflexis et cum indumento subtus velatis, 3–8 cm longa 1–2.7 cm lata; supra in sicco atroviridis juvenilis plus minusve lanuginosa deinde glabrata subnitida costa valde impressa nervis secundariis patulis 12–15 utroque latere impressis plus minusve conspicuis venulis minoribus plerumque obsoletis, subtus dense crasseque ochraceo-lanata costa robusta eminentique reliquis nervis elevatis sed pleurumque cum indumento velatis.

Inflorescentiae corymboso-paniculatae floribundae terminales folia suprema paulo excendentes, 5–10 cm latae; axi robusto lanato-ochraceo ramis ascendentibus mediocribus rigidis dense ochraceo-lanatis, bracteis subtendentibus basi foliiformibus sed brevibus ceteris bracteis ovato-lanceolatis acutis amplectentibus ciliatis dorso lanatis 6–2 mm longis; ramusculi ultimi seu pedunculi monocephali plerumque 3–12 mm longi robustiusculi dense ochraceo-lanati tantum ad apicem basi involucri parcis bracteolis instructi. Capitula heterogama radiata 1.6 cm diametentia. Involucrum campanulatum 5–6 mm altum 3.5–4 mm diametente phyllariis imbricatis 5-seriatis interioribus lineari-oblongis obtusiusculis margine sursum erosis dorso villosis, 5 mm longis 1 mm latis, exterioribus ovato-ellipticis subobtusis vel obtusis circa 2 mm longis 1.3 mm latis dorso purpurascenti lanuginosi marginibus lacerato-ciliatis. Flores radii feminei ligulati 11–13 uniseriati; corolla pallide purpurea circa 10 mm longa tubulo 2–2.2 mm longo glabro vel sursum sparsis pilis lamina elliptico-oblonga apice minute tridentata glabra 2–2.3 mm lata; rami styli 1 mm longi lineari-

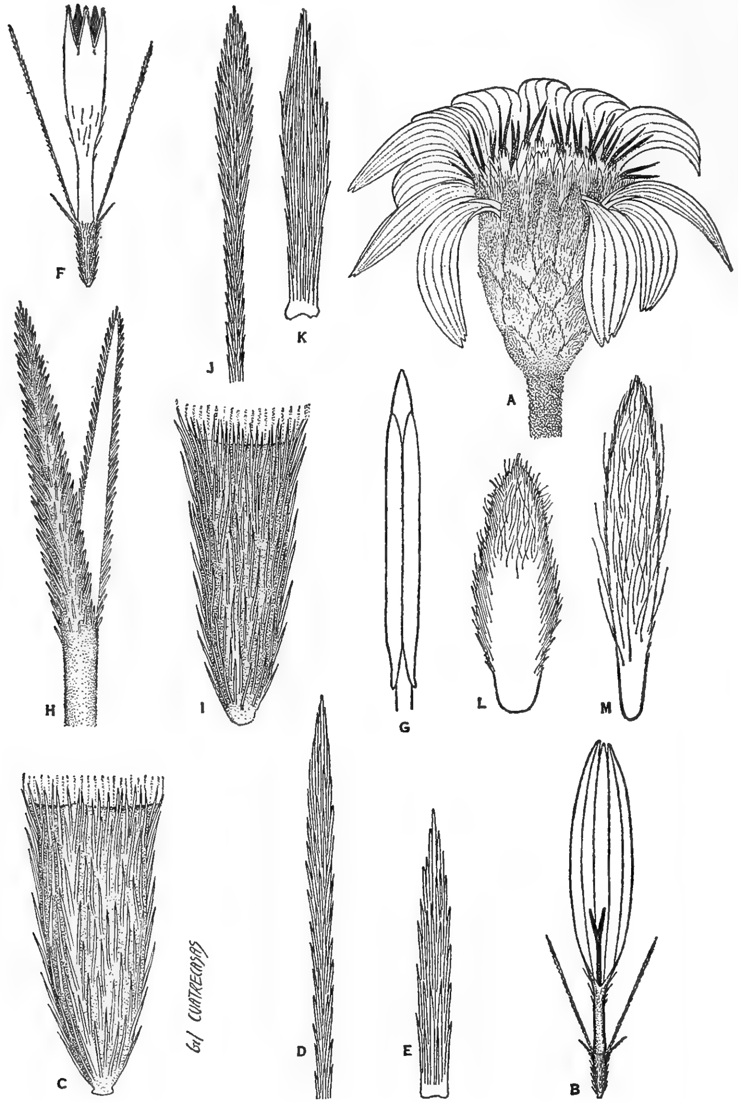

FIG. 4. *Diplostephium wurdackii.* A, head, × 4; B, ray flower, × 4; C, ovary of ray flower, × 24; D, end of the inner pappus bristle, × 48; E, outer bristle of ray flower, × 80; F, disc flower, × 7.5; G, anther, × 20; H, stylar branches of disc flower, × 32; I, ovary of disc flower, × 30; J, end of inner pappus bristle of disc flower, × 48; K, outer pappus bristle of disc flower, × 80; L, medium-outer phyllary, × 8.5; M, inner phyllary, × 8.5. (Wurdack 1672).

lanceolati brunnescenti-rubescentibus margine incrassati minute papilloso-stigmatiferi; ovarium 1.5 mm longum parce triquetrum subcompressum; pappus rubescens 4–4.5 mm longus setis strigulosis extremo dilatatis biseriatis exterioribus brevibus 0.5–1 mm longis. Flores disci hermaphroditi 9–15; corolla lutea glabra tubulo 1.8 mm longo limbo tubuloso sursum gradatim ampliato deorsum sparse piloso dentibus 0.8 mm longis basi triangularibus apicem versus angustato-linearibus subacutis margine incrassatis apice papillosis; antherae 1.8 mm longae basi obtusae; rami styli purpurascentes subulati robustiusculi circa 1.4 mm longi extus marginibusque dense longeque papilloso-hispidi; ovarium lineare leviter 3–5 nervatum villoso-hispidum circa 1 mm longum fertile vel sterile; pappus 4–4.5 mm longum rubescens setis minute strigulosis sursum ampliatis inaequalibus biseriatis exterioribus 0.5–1 mm longis. Receptaculum subplanum circa 2 mm diametente marginibus alveolorum argute dentatis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: Upper slopes and summit of Cerro Yama-uma above Taulia, 12–15 km SSE (145°) of Molinopampa, 3200–3450 m alt.; shrub 1–2.5 m, occasional; rays pale purple; disc yellow; 11 August 1962, J. J. Wurdack 1672. Holotypus, US (2373692).

Diplostephium wurdackii belongs to the Section *Bifidum* Cuatr. and Series *Denticulata* Blake. It is a striking species, differing from the most closely related species, *D. bicolor* Bl., and all others of the same series, in its spreading, large, broad, very showy, violaceous ray flowers. Furthermore, it differs from *D. bicolor* Bl. and *D. ochraceum* (HBK.) Nees in its thicker, smaller, more obtuse leaves, in the thicker, ochraceous, lanate tomentum, and in the densely villous ovaries. From *D. haenkei* (DC.) Wedd. and related species, it differs in its larger inflorescences, smaller heads, obtuse phyllaries, longer petioles, and larger, broader, obtuse leaves.

Oritrophium aciculifolium Cuatr., sp. nov.

Herba humilissima caespitoso-rosulata seu fasciculata scapifera rhizomate crassiusculo molli ramulis apice fasciculum cylindricum compactum vaginis foliorum imbricatorum ferentibus. Radices fibrosae. Folia omnia basalia rosulato-fasciculata 7–15 cm longa, lamina aciculata pallide viridi glabra coriacea rigida stricte lineari crassiuscule subtereti dorsiventraliter paulo compressa tantum nervo medio subtiliter impresso utrinque conspicuo (siccitate utrinque 3–4 striata) superficie visu laevi sed epidermi minutissime glanduloso-punctata, apice attenuato-acutata 3–12 cm longa 1–1.5 mm lata basi in amplam vaginam villosam amplectentem dilatata. Vagina hialino-carnosa circa 10-sulcato-striata (in sicco subscariosa) supra praecipue basim versus marginibusque densissime longissimeque fibroso-villosa, 2–3 cm longa basim versus sensim sine sensu ampliata ad basim circa 1 cm lata. Vaginae foliorum omnium spisse amplectentes basim foliorum fasciculos formantes.

Scapi 1–3 per fasciculum virides vel purpurascentes teneri subcapillares teretes sed levissime striolati fistulosi 0.6–1 mm diametentes 10–24 cm longi erecti recti vel leviter flexuosi deorsum glaberrimum sursum parcissimis pilis tenuibus flexuosis gradatim densiusculis extremo laxe villoso-lanuginosi inferiore parte nudi cetera bracteati bracteis linearibus vel superne lineari-lanceolatis viridibus glabris vel supremis ciliatis quam internodiis brevioribus et sursum gradatim minoribus 12–4 mm longis basi ampliata ad 1.5 mm lata.

Capitula heterogama radiata 1.5 cm diametentia. Involucrum campanulatum basi subrotundatum laete viride 8–9 mm altum 7–8 mm diamentente, phyllariis circa 5 seriatis interioribus linearibus acutis pallide-viridibus vel apice purpurascenti dorso glabro margine scariosis ciliatisque 7–8.5 mm longis 1–1.5 mm latis, mediis exterioribusque gradatim brevioribus subacutis dorso plus minusve brunnescentibus glabris margine bene ciliatis externis 4–5 mm longis 1 mm latis. Flores radii feminei ligulati 1–2-seriati 20–27; corolla alba 8–9.5 mm longa tubulo 3–3.5 mm longo villoso lamina lineari-oblonga obscure 3-nervata minute tridentata glabra 1–1.2 mm lata; rami styli subulati 1 mm longi marginibus incrassatis minute papilloso-stigmatici; ovarium obovato-oblongum basim angustatum dense hispidum; achaenia circa 3 mm longa levissime compressa obscure 5-nervata dense albeque hispida; pappus 4 mm longus stramineus setis subuniseriatis inaequilongis rigidulis acutis minute strigulosis. Flores disci hermaphroditi 23–37; corolla lutea 4–4.5 mm longa tubulo circa 2 mm longo crassiusculis pilis munito limbo tubuloso sursum gradatim ampliato basi paulo pilosulo cetero glabro dentibus 5 oblongis subacutis 1 mm longis margine incrassatis subapicem extus breviter papilloso-pilosis apice minute papillosulo; antherae 1.4 mm longae acutiuscule auriculatae; rami styli subulati 1.2 mm longi extus margineque papilloso-hispiduli; ovarium lineatum 3–3.5 mm longum obscure 5-nervatum densiuscule hispidum sterile; pappus 4–4.5 mm longus subuniseriatis setis rigidulis minute scabrosis acutis inaequilongis parcis minimis 0.3–1 mm longis quam longioribus intermixtis. Receptaculum 2–2.5 mm diametente minute alveolatis marginibus alveolorum longe dentatis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: Middle eastern Calla-Calla slopes, near Kms. 416–419 of Leimebamba-Balsas road, 2900–3100 m alt., locally frequent; rays white, disc yellow; 9 July 1962, J. J. Wurdack 1275. Holotypus US (2373650).

Oritrophium aciculifolium differs from all known species of the genus in its acicular leaves similar in aspect to a long leaf of pine; they are subcylindrical, slightly compressed, smooth but with an impressed fine midrib. In the nature of its scapes and heads it approaches *O. repens* (HBK.) Cuatr., which differs in having coriaceous, oblong-elliptic leaves.

Baccharis chachapoyasensis Cuatr., sp. nov.

Frutex usque ad 2 m alta ramis ascendenti-divaricatis resinosis glabris viridibus angulatis cicatricibus foliorum elapsorum tuberculato-eminentibus ramulis foliosis crassiusculis viridibus internodiis cum foliis satis copiosis valde brevioribus. Partes juveniles valde viscoso-resinosae.

Folia alterna glabra integerrima breviter petiolata crassa in sicco flavescenti-viridia. Lamina oblongo-obovata apice obtusissima vel rotundata basim versus gradatim in brevem petiolum attenuata superficie utrinque minute copioseque glanduloso-granulata glandulis resinosis subimmersis, costa supra paulo subtus magis eminenti nervis lateralibus 5–6 utroque latere valde angulato-ascendentibus prope marginem arcuato-anastomosatis subtus saepe prominulis supra plerumque obsoletis 2–5 cm longa 9–25 mm lata. Petiolus 2–5 mm longus basi valde ampliata incrassato-vaginata tuberculato-persistenti.

Capitula solitaria axillaria sessilia; mascula campanulata 8–9 mm alta 6–7 mm diametentia, basi bibracteata bracteis oppositis limbo patulo brevi crasso viridi ovato subobtuso 2 mm longo 2.5 mm crasso in vaginam crasso-scariosam amplectentem 3–4 mm longam 3 mm latam ampliatis. Involucrum circa 6–7 mm altum 24–30 phyllariis 4–5 seriatis pallide brunneo-viridibus 24–32 exterioribus crassiusculis subscariosis ovato-oblongis apice attenuatis obtusis resinosis 4–5.5 mm longis 3–2 mm latis, intimis scariosis linearibus 5–6 mm longis 0.8–0.6 mm latis ad apicem subacutum eroso-ciliatis ceteris glabris. Flores masculi 32–41 in capitulo; corolla 5.4–6 mm longa tubulo 3.8–4 mm longo sursum minute glanduloso-pilosulo limbo in 5 lobos 1.6–2 mm longos 0.5–0.6 mm latos lineares acutos apice papillosos inciso. Antherae 1.6 mm longae basi obtusae. Stylus crassus apice subpistillato breviterque acutato emarginatoque minute papilloso-piloso. Ovarium brevem glanduloso-granulatum sterile. Pappus albidus circa 20 setis 5.5–6 mm longis sursum dilatatis pennato-ciliatisque saepe setis brevioribus simplicibus circa 1 mm longis munitus. Receptaculum 2.2–2.4 mm diametens convexum alveolatum marginibus alveolorum tenuiter acuteque dentatis.

Capitula feminea cum mascula similiter disposita bibracteata involucro circa 6 mm alta phyllariis circa 33 exterioribus 5 × 2–3 mm, interioribus 5.2 mm longis 0.6–1 mm latis. Flores feminei 50–54; corolla capillari circa 3.5 mm longa apice angustissimo 5 lobulis linearibus acutis circa 0.4 mm longis coniventibus basim versus gradatim dilatata pilis minutis sparsis munita. Stylus 1.5–2 mm corollam excedens, ramulis 0.7–0.8 mm longis linearibus subacutis marginibus incrassatis dense stigmato-papillosis. Ovarium 1.7 mm longum glabrum 10-costatum ellipsoideo-oblongum leviter compressum. Pappus albus 4 mm longus setis inaequilongis biseriatis sericeis minute strigillosis apice haud ampliatis acutis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: Rocky slopes of Caño Santa Lucía just E of Chachapoyas, 2000–2400 m alt.; shrub 0.7–2 m, male, flowers white; frequent; 28 May 1962, J. J. Wurdack 597. Holotypus, US (2373562). Same date, female specimen, Wurdack 598, paratypus US (2373563).

Baccharis tricuneata (L. f.) Pers., fma. **callaensis** Cuatr. fma. nov.

Frutex erectus usque ad 1.5 m altus ramulis valde foliosis viscoso-glandulosisque. Folia viridia glanduloso-punctata chartacea plana breviter petiolata; lamina obovato-oblongo-cuneata obtuse vel subacute tridentata interdum integra 7–13 mm longa 3.5–7 mm lata. Capitula mascula solitaria subsessilia axillaria pauca saepe unum duave ad extremos ramulorum, circa 8 mm longa 4 mm lata. Flores masculi circa 16 corolla circa 6 mm longa tubulo circa 4 mm sursum paulo pilosulo limbo laciniis lanceolato-linearibus 1.5 mm longis. Ovarium brevissimum glabrum. Pappus albidus 4–4.5 mm longus setis apicem dilatatis. Involucrum circa 28 phyllariis scariosis, externis ovatis acutiusculis circa 2.5 mm longis 1.5 mm latis internis lineari-lanceolatis acutis margine ad apicem eroso ciliatis circa 5.5 mm longis 0.7–1.1 mm latis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: Uppermost slopes and summit of Cerros de Calla-Calla, near Kms. 403–407 of Balsas Leimebamba road, elev. 3400–3550 m; shrub 1.5 m, male, flowers white; occasional; 18 August 1962, J. J. Wurdack 1706. Holotypus US (2373700).

The plant of Calla-Calla is a very leafy and typical páramo form of this widely distributed high Andean species. It is distinguished by its obovate-oblong, broadly cuneate leaves and by its solitary heads sparsely borne near the end of the branchlets. This form is closely related to *B. tolimensis* Hieron. from the Central Andes of Colombia and to *B. variifolia* Hieron. from Ecuador, both also merely forms of *B. tricuneata.*

Psilactis brevilingulata Sch. Bip. ex Hemsl., fma. **andina** Cuatr. fma. nov.

Herba annua parce ramosa circa 30 cm alta caule ramisque tenuibus erectis viridi-purpureis pubescentibus pilis albis tenuibus subadpressis et glandulis globosis stipitatis copiosis munitis. Radix simplex verticalis 3.5 cm longa.

Folia lineari vel lineari-lanceolata sessilia basi amplectentia apicem versus gradatim attenuata acuta calloso-mucronulata margine integra utrinque praecipue subtus sparse stipitato-glandulosa triplinervia 3–10 mm longa 0.5–2 mm lata nervis supra impressis subtus prominulis.

Capitula heterogama radiata perparva hemisphaerica 3–4 mm longa et lata solitaria ad ramusculos ultimos erectos plus minusve paniculatos terminalia. Ramusculi seu pedunculi 1–3 cm longi capillares stipitato-gladulosi sparse pilosuli bracteati bracteis cum foliis linearibus acutatis calloso-mucronulatis glandulosis 4–3 mm longis circa 0.5–1 mm latis. Involucrum rotundato-campanulatum 3.5–4 mm altum phyllariis biseriatis lineari-lanceolatis dorso margineque sursum viridulis glandulosis basim margine scariosis, intimis acute acuminatis acumine rubescenti margine eroso-ciliato 4 mm longis 0.3–0.4 mm latis, exterioribus margine glanduloso 3–2.5 mm longis 0.5–0.8 mm latis. Flores radii feminei ligulatae

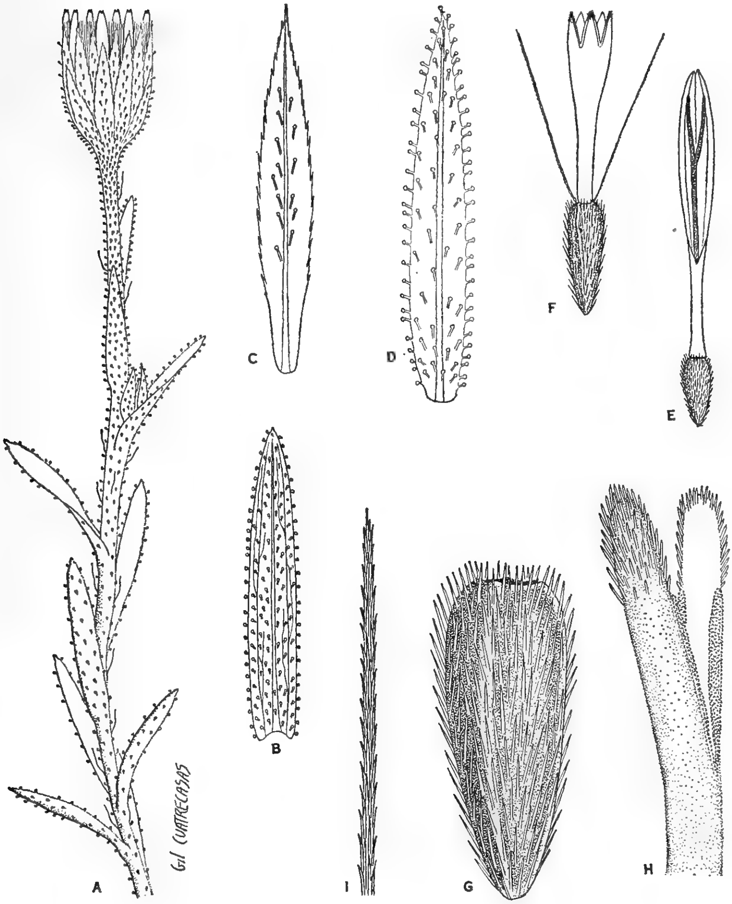

Fig. 5. *Psilactis brevilingulata* fma. *andina.* A, flowering branchlet, × 5; B, outer phyllary, × 17; C, inner phyllary, × 12; E, ray flower, × 12; F, disc flower, × 12; G, achene, × 30; H, stylar branches of disc flower, × 90; I, end of pappus bristle, × 90. (Ellenberg 1919).

involucrum paulo excedentes biseriati 18–20; corolla alba glabra 3–3.2 mm longa tubo capillari 1–1.2 mm longi lamina lineari inaequaliter bidentata 3-nervata 2–2.2 mm longa 0.5–0.6 mm lata; ovarium obovato-oblongum triquetrum dense strigoso-sericeum; stylus 1 mm tubum excedens ramis 6 mm longis anguste linearibus margine incrassato papilloso-stigmatico; pappus nullus; achaenia oblongo-obovata inaequilatera obsolete 5-nervata apice rotundata basi acutata dense sericea. Flores disci hermaphroditi circa 12, corolla flava glabra 2–2.2 mm longa tubulo 0.9 mm longo limbo infundibuliformi-tubuloso dentibus triangularibus acutis marginibus incrassatis minute papillosisque; antherae 0.6 mm longae basi obtusae apice appendiculatae; rami styli 0.4–0.5 mm longi complanati lineares margine papilloso-stigmatico apice elongato-triangulari papilloso-piloso; ovarium obovato-oblongum leviter compressum dense sericeum; achaenia obovato-oblonga basi acuta levissime compressa obsolete 5-nervata dense sericea 1.5 mm longa; pappus stramineus 2 mm longus setis rigidulis acutis minute strigosis uniseriatis basi breviter coalitis. Receptaculum 1.2 mm latum alveolatum marginibus alveolorum elevato-dentatis.

Type: Peru, Cajamarca: 10–15° SW of Chicdén, below Sunchubamba, 2800 m alt.; shady prairie; rainy season, 10 June 1957, H. Ellenberg 1919. Holotypus, U.

The genus *Psilactis* has been mentioned in the literature only as from North America (California, Texas, Mexico). This Ellenberg specimen differs from the descriptions of all known forms and is the first record for the genus from Peru. Several years ago I studied specimens of *Psilactis* from Colombia, which I attributed temporarily to *Psilactis brevilingulata* Sch. Bip. ex Hemsl., but that material was not at hand when I studied the Ellenberg collection. I plan to report on it later.

Ellenbergia Cuatr., gen. nov. Compositarum (Eupatorieae-Piquerinae)

Capitula homogama discoidea parva. Involucrum campanulatum phyllariis paucis (8) aequalibus biseriatis membranaceis. Receptaculum planum foveolatum nudum. Flores omnes hermaphroditi. Corollae campanulatae subite in angustum tubum brevem constrictae 5-dentatae dentibus deltoideis. Antherae oblongae basi integrae apice exappendiculato truncato-emarginato. Filamenta brevissima. Styli rami arcuati longe crasseque clavati obtusissimi papilloso-pilosi marginibus deorsum dimidia inferiori parte stigmatiferis. Achaenia nigra prismatica argutissime 5-angulato-costata faciebus scrobiculatis nitidis. Pappus squamis angustis lanceolatis margine strigoso-ciliatis basi in cupulam connatis.

Species typica: *Ellenbergia glandulata* Cuatr.

Ellenbergia belongs to the subtribe *Piquerinae* Hoffm., being closely related to the genus *Phania*. From this and the other related genera it differs chiefly in the structure of the pappus; its scales, usually about 20, are rigid, lanceolate-subulate, and united at the base into a cupular piece easily separable from the achene.

Ellenbergia glandulata Cuatr., sp. nov.

Herba annua tener 20–35 cm alta caule simplice 1.5–2 mm diametente erecto pauce laxeque ramoso ramulis tenuibus patulis ad 8 cm longis oppositis supremis alternis caule ramisque pubescenti-hirtulis copiosis

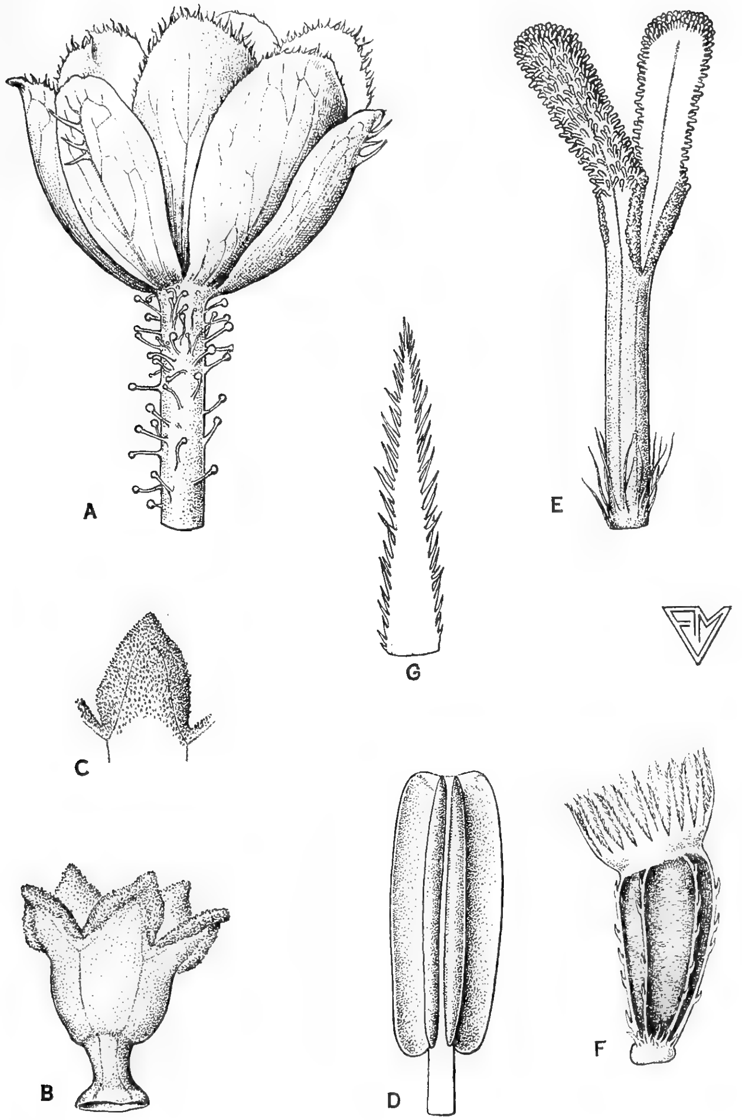

FIG. 6. *Ellenbergia glandulata.* A, involucre and pedicel, × 12; B, corolla, × 15; C, lobe of corolla, × 15; D, anther, × 60; E, style, × 35; F, achene, × 20; G, scale of pappus, × 60. (Ellenberg 982).

pilis patulis circa 1 mm longis (usque ad 2 mm) pluricellularibus rectis vel parce flexuosis acutis apice globoso-glanduliferis instructis.

Folia opposita membranacea viridia, petiolo tenui 2–12-mm longi hirtuli, lamina ovata vel ovato-elliptica grosse crenato-dentata obtusiuscula vel subacuta basi obtuse cuneata vel subtruncata 1–2.5 cm longa 0.6–2 cm lata, utrinque sparse pilosa pilis glanduliferis vel eglandulosis costa conspicua nervis lateralibus 2–3 utroque latere conspicuis patulo-ascendentibus sursum curvato anastomosatis venulis reticulum laxum plus minusve conspicum formantibus.

Inflorescentiae paniculis laxis paucifloris (6–8 capitulis perparvis) ramulis ultimis tenuibus flexuosis instructae.

Pedicelli capillares 5–10 mm longi copiose piloso-glandulosi (glandulis globosis stipitatis). Capitula discoidea minuta 2.5–3 mm longa et ampla in panicula terminali alternifoliata laxa pauciflora instructa.

Involucrum pallide viride phyllariis 8 subaequalibus biseriatis lateraliter imbricatis membranaceis oblongo-ellipticis vel obovato-ellipticis obtusis 2.5–3 mm longis 1.2–1.6 mm latis nervo medio bene conspicuo 2–3 nervis lateralibus tenuibus superne arcuato-anastomosatis glabris sed margine apice obtuso eroso-ciliatis.

Flores omnes hermaphroditi 11–12; corolla 1.7–2 mm longa crassiuscula alba (?) tubulo valde constricto 0.5–0.6 mm longo basi dilatato sparsis glandulis munito limbo late campanulato 1–1.3 mm longo 0.7–0.8 mm diametente parce glanduloso dentibus triangularibus acutis deinde recurvatis marginibus crassiusculis minute papillosis; antherae oblongae apice obtusae emarginato-subtruncatae calloso-incrassatae exappendiculatae basi obtusae 0.6 mm longae; filamenta brevissima; stylus crassiusculus 1.2 mm longus in 2 ramos 1 mm longos recurvatos crassos late oblongo-clavatos dense crasseque papilloso-pilosos marginibus dimidia parte inferiora opacis stigmatiferis productus; achaenia nigra 1.2–1.3 mm longa 0.6 mm lata prismatica basi attenuata argute 5-angulato-costata, costis eminentibus setis ochraceis uniseriatis adpressis instructis faciebus glaberrima nitidissima scrobiculata; pappus 20 squamis circa 0.7 mm longis rigidis lanceolato-subulatis strigoso ciliatis basi in cupulam 0.5–0.6 mm amplam coalitis; receptaculum planum sparse foveolatum nudum.

Type: Peru, Dept. Cuzco, Prov. Urubamba: Mandor below Machupicchu, 80° NW. "Nebelwälder der Ostanden, Regenzeit; feuchte Bromeliaceen-Felswand," 13 April 1957, H. Ellenberg 982. Holotypus, U.

Helianthus lodicatus Cuatr., sp. nov.

Frutex ramosus ramis foliosis densissime crasseque albo-lanatis.

Folia alterna coriacea lanceolato-ovata basi rotundata vel obtuse cuneata apice subacuta margine integra vel leviter sinuata revoluta 15–26 mm longa 7–15 mm lata; supra viridi-cinerea dense strigosa pilis rigidulis acutis albidis basi calloso-tuberculatis subadpressis nervis tribus vel tantum costa filiformi albida impressa notatis venulis reticulatis et superficie rugosa fere obsoletis; subtus flavescenti-alba crassissime denseque lanata, costa nervis lateralibus paucis leviter conspicuis. Petiolus 3–5 mm longus basi ampliato-vaginatus dense lanatus.

Capitula heterogama radiata solitaria terminalia pedunculata radiis expansis 4–5 cm lata disco 1.5 cm diametenti. Pedunculi 1.5–4 cm longi crasse denseque ochroleuco-lanati 2–3 mm diametentes. Involucrum campanulatum circa 15 mm altum 2 cm diametente lanuginosum. Phyllaria 5-seriata lineari-oblonga herbacea basi incrassata apice acutata intima 15–16 mm longa 3–4 mm lata sursum extus lanuginosa, intermedia 11–13 mm longa inferne magis callosa superne herbacea lanata apice reflexo, externa similia gradatim breviora 8–9 mm longa 3–4 mm lata margine revoluta extus dense lanata. Flores radii ligulati steriles; corolla lutea lamina lineari-oblonga 23–26 mm longa circa 5 mm lata 12-venosa apice bidentata extus pubescenti-sericea basi tubulo 1 mm longo; ovarium lineare triquetrum 2–3 mm longum glabrum sterile, pappo 1 aristam subulatam margine eroso-strigosam deciduam reducto. Flores disci hermaphroditi crebri; corolla lutea circa 7 mm longa 1 mm diametenti deorsum minute strigulosa basi in tubum circa 1 mm longum angustata apice dentibus quinque oblongo-deltoideis acutis margine incrassatis papillosisque circa 1 mm longis; antherae 3.2 mm longae oblongae nigrae basi obtusae apice ovato-appendiculatae; rami styli 1.4 mm longi oblongi prope apicem paulo incrassati subite acutati extremo papilloso-pilosi; achaenia nigra plus minusve sordide maculata nitida obovato-oblonga paulo compressa faciebus laevibus circa 3 mm longa 1.4 mm lata; pappus aristis duobus lanceolatis acutissimis margine eroso-ciliatis valde deciduis 2–2.3 mm longis instructus. Receptaculum convexum paleaceum foveolatum. Paleae rigide scariosae stramineae brunnescenti-nervatae ovato-lanceolatae acutaeque parcissime ciliatae naviculares flosculos involventes circa 8 mm longae 3–3.5 mm latae.

Type: Peru, Dept. Cajamarca: Sunchubamba on the way to Huallabamba, upper Chicama valley, 3000–3700 m alt., "Waldstufen und Paramos der westlichen Anden Nordperus. Buschige Viehweiden," 3 June 1957, H. Ellenberg 1756. Holotypus, U.

The interesting high Andean *Helianthus lodicatus* belongs to the relationship of *H. lanatus* Heiser but differs essentially from it in the very thick, compact, lemon-colored indument which covers branches and the under surface of the leaves. It also differs in the thicker, smaller, alternate, and crowded leaves, in the longer rays, and in its almost glabrous pales.

The looser texture of the indument, the opposite, broader, cordate, larger leaves which have another type of strigae above readily distinguish *H. jelskii* Hier. from the new species. *H. microphyllus* HBK. has narrower, linear or oblong leaves and smaller heads and flowers. *Helianthus Stuebelii* Hier. has larger ovate-lanceolate leaves, with looser tomentum beneath, and less crowded and much larger strigose-tuberculate hairs on the upper surface of the leaves. I have examined a fragmentary specimen of Weberbauer (number 4241, US), which could be considered the neotype of *H. Stuebelii* if the type (Stuebel 34*e*), formerly in Berlin, really is destroyed.

Viguiera ellenbergii Cuatr., sp. nov.

Suffrutex caule erecto ramis subteretibus striolatis purpuraceis asperulis hispidulis pilis pluricellularibus rigidulis acutissimis basi dilatato-tuberculata plus minusve persistenti.

Folia alterna rigidule coriacea discolora subsessilia. Petiolus 1–2.5 mm longus planus cum ramo adpressus subvaginatus extus purpurascens hipidulusque. Lamina ovato-lanceolata basi rotundata seu subcordata apice acuta margine dentibus minimis et obsoletis revoluta 4–10 cm longa 1.5–4.5 cm lata; supra viridi-purpurascens nitidula valde bullata rugosa aspera copiosis pilis acutis rigidis basi calloso-tuberculatis munita triplinervia costa duobusque nervis lateralibus ascendentibus valde impresso-conspicuis superne 1–2 nervis secundariis brevioribus utroque latere ascendentibus notatis, reticulum venulorum obcurum impressum; subtus viridi-cinerea dense lanata costa duobusque nervis lateralibus principalibus et parcis nervis secundariis eminentibus densiuscule tuberculato-hispidis, venulis minoribus reticulum elevatum rubellum cum tomento tectum formantibus.

Capitula heterogama radiata longe pedunculata solitaria terminalia expansa 5–6 cm diametentia sed disco 2 cm diametro. Pedunculi robusti erecti striolato densiuscule hispidulo nudo 3–12 cm longo. Involucrum hemisphaericum 4-seriatum. Phyllaria valde imbricata squarrosa crasse herbacea purpurascentia inferne angustiora calloso-incrassata pallidaque limbo oblongo-obovato subobtuso utrinque dense strigoso recurvato, intima 9–10 mm longa 4–5 mm lata intermedia et exteriora 8–7.5 mm longa, 3–4 mm lata. Receptaculum 1 cm diametente convexum paleaceum. Paleae scariosae rigidulae venosae plus minusve rubescentes elliptico-oblongae naviculares apice obtuso minute mucronulato, 7–8 mm longae ad 4 mm latae, flosculos involventes. Flores radii ligulati steriles circa 15; corolla lutea lineari-oblonga obtusiuscula bidentata 12–15-rubronervata 18–22 mm longa 4–5 mm lata extus sparsissime hirtula intus dense minuteque velutino-papillosa basi tubo 0.5–1 mm longo; stylus absens; ovarium oblongum basim versus gradatim angustatum 3 nervatum compressum glaberrimum sterile circa 4 mm longum 1.4 mm latum; pappus squamis scariosis laceratis circa 0.3 mm longis plus minusve in coronam adherentibus. Flores disci hermaphroditi numerosi (circa 200) cum paleis involuti; corolla lutea circa 5–6 mm longa basi tubulo (0.7–1 mm longo) brevi subite contracta limbo tubuloso campanulato sparse basim versus dense striguloso dentibus deltoideis acutis circa 0.9 mm longis margine incrassatis intus minute papillosis nervis commissuralibus dentibusque rubescentibus; antherae 3 mm longae oblongae basi breviter auriculatae apice scarioso-appendiculatae; rami styli 1.6–1.8 mm longi recurvati crassiusculi obtusiusculi extus sursum papilloso-pilosi. Achaenia immatura nigra obovoideo-oblonga basim versus paulo angustata 4 mm longa 1.5 mm lata leviter compressa obtuseque angulata faciebus crassiusculis levissime elevato-angulatis basi breviter callosa sparse setulosa; pappus 2-aristatus squamulosusque; aristis utroque latere 2–4 mm longis acutis ciliato-strigosis, squamis intermediis 0.5–1 mm longis ovalis inaequalibus lacerato-ciliatis basi brevissime coalitis.

Type: Peru, Dept. Cuzco, Prov. Urubamba: Eastern slope of Machupicchu, Andean forest 2400 m alt., rainy season, 6 April 1956, H. Ellenberg 719. Holotypus, U.

Viguiera ellenbergii is a well-defined Peruvian species belonging to the Series *Aureae* Blake. From the other species of this group, it can be distinguished by its sessile, ovate-lanceolate, rigid, subcoriaceous leaves which are strongly rugose, rough and dark above and lanuginose-tomentose, greenish-cinereous beneath. Furthermore, this species differs in its hemispheric and firm 4-seriate involucre, in its obovate, subobtuse, hard, and squarrose phyllaries, in its long rays, and in the size of all these parts.

Viguiera lepidostephana Cuatr., sp. nov.

Herba annua circa 40 cm alta caule tenui erecto striato hirtulo, pilis tenuibus patulis acutis basi dilatatis circa 0.5 (–1) mm longis, sparse folioso parce dichotomo-ramoso ramis patulis 1–3 ramulos graciles monocephalos ferentibus.

Folia alterna membranacea petiolo tenui 3–8 mm longo hirtulo. Lamina ovata vel ovato-lanceolata basi rotundata apice angustata acutaque margine serrata 4–8 cm longa 1.8–3 cm lata utrinque viridis strigulosa copiosis pilis tenuibus sed rigidis acutissimis basi tuberculati subadpressis instructa, nervis tribus (costa unoque nervo secundario utroque latere) valde conspicuis supra filiformibus subtus prominentibus nervulis transversis et venulis minoribus laxe reticulatis supra plus minusve conspicuis subtus prominulis.

Pedunculi erecti capillares striolulati densiuscule hirtuli ebracteati. Capitula radiata primum campanulata 5–6 mm diametentia 6 mm alta deinde semiglobosa ad 9 mm lata. Involucrum phyllariis 2-seriatis lineari-lanceolatis acutis viridibus 3–5 nervatis basi paulo induratis pallidioribusque dorso marginibusque pubescenti-hirtulis, 2.5–3 mm longis 0.5–0.8 mm latis. Receptaculum hemisphaericum foveolatum paleatum 2 mm diametente. Paleae obovatae breviter acuminatae scariosae brunneo-costatae plus minusve venoso-striolatae margine translucidae flosculos involventes juveniles circa 4 mm longae 2 mm latae vetustae rigidiores usque ad 5 mm longae 3 mm latae, praecipue ad costam marginibusque minute ciliatae. Flores radii ligulati steriles circa 6; corolla flava lamina obovata vel elliptica basi cuneata tenuiter 4-nervata margine integra tantum extus apiceque parcissimis pilis 5 mm longa 4 mm lata tubulo obsoleto, ovario lineari striolato piloso sterile, pappo nullo. Flores disci hermaphroditi 25–30; corolla lutea (?) 3–3.2 mm

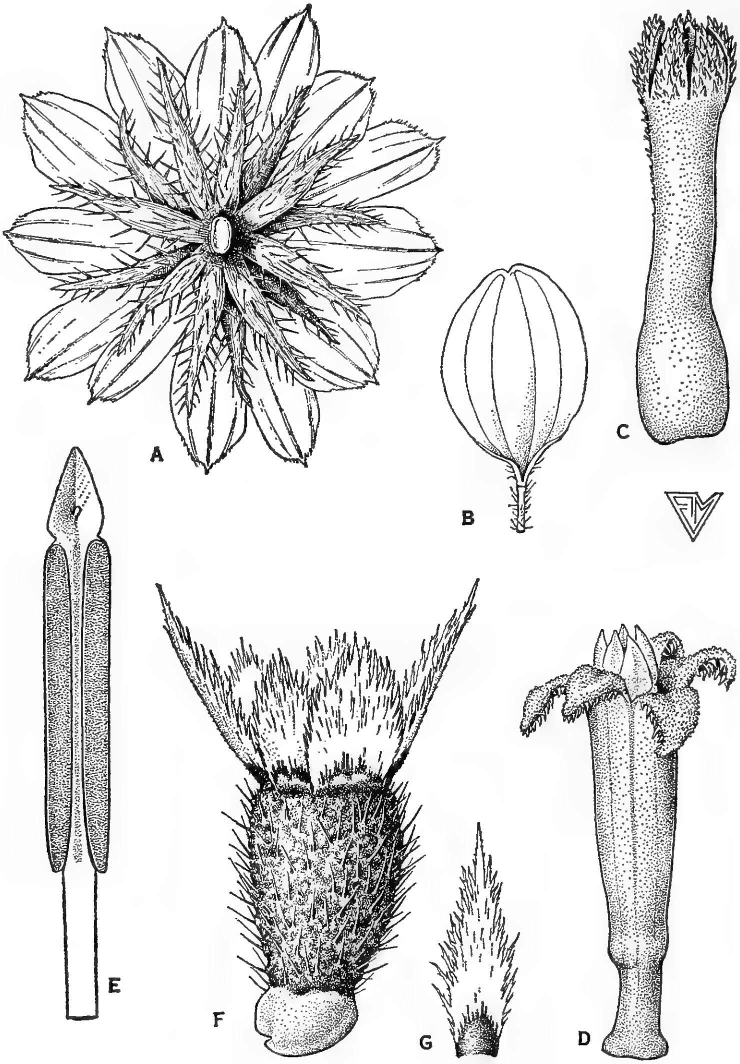

FIG. 7. *Viguiera lepidostephana*. A, involucre, × 7; B, ray corolla, × 5; C, unopened disc corolla; D, ripe disc corolla, × 20; E, anther, × 30; F, achene, × 15; G, scale of pappus, × 15. (Ellenberg 1423).

longa subglabra (sparsis pilis papillosis acutis) tubulo stricto 0.6 mm longo limbo tubuloso sursum leviter sine sensu ampliato dentibus deltoideo-oblongis marginibus incrassatis papillosulis circa 0.8 mm longis; antherae circa 2 mm longae saccis linearibus atribus 1.5 mm longis basi acutiusculis apice appendice scarioso ovato 0.5 mm longo. Stylus ramis 1 mm longis crassiusculis marginibus incrassatis stigmatiferis apice subite acutato papilloso-piloso; ovarium oblongum lateraliter 3 costato-angulatum dilute adpresseque sericeo-villosum; pappus 6 squamis scariosis translucidis duobus oppositis 5 mm longis late lanceolatis acutis, quatuor ovatis vel ellipticis obtusis 1 mm longis, omnibus profunde lacerato-ciliatis; achaenia nigra levissime compressa biangulataque minute tuberculata copiose setifera circa 2 mm longa 1 mm lata basi carpopodium crasso-callosum pallidum circa 0.3 mm longum producta; pappus squamis rigidis chartaceis basi incrassatis et nigro-maculatis sursum sparse atro-lineatis, duabus lateralibus late lanceolatis acutis lacerato-ciliatis circa 2 mm longis quatuor intermediis ovatis seu ellipticis obtusiusculis margine laceratis 1.2–1.3 mm longis 0.7–0.9 mm latis.

Type: Peru, Dept. Tumbes: 7° WSW Cienago, S of Zorritos, 430 m alt., subdesertic coastal zone, 17 May 1957. H. Ellenberg 1423. Holotypus, U.

Viguiera lepidostephana belongs to section *Paradosa* series *Aureae* subseries *Pusillae* Blake. It is similar in habit and most closely related to *V. pusilla* (Gray) Blake, from which it differs in its smaller heads, flowers, and fruits, in the shape of the ligules, and chiefly in the structure of the pappus. In *V. lepidostephana* the two lateral bristles actually are scales of the same texture and character but only narrower and longer than the other four scales. This kind of pappus is not typical for the genus, bringing the new species to a marginal position in *Viguiera*.

Senecio aclydiphyllus Cuatr., sp. nov.

Frutex ad 1 m altus caule robusto basi saepe plus minusve prostrato radicanti extremo erectissimo plerumque simplice vel 2–4 ramis instructo, tantum sursum foliato dense crasseque albo-lanato, deorsum exfoliato cicatricoso vaginis foliorum delapsorum persistentibus crebris et indumento arachnoideo-lanuginoso vestito.

Folia alterna crasse coriacea breviter petiolata confertissima. Petiolus 5–10 mm longus dimida parte inferiori in vaginam amplectentem ad 4–5 mm latam dilatatus dense adpresseque albo-lanatus. Lamina lanceolata basi rotundata vel subcordata apice acuta vel subacuta mucronulataque margine revoluta integra vel levissime sinuata, 2.5–6 cm longa 0.8–1.6 cm lata, supra viridis valde juvenilis arachnoidea mox glabrata costa impressa plus minusve albo-lanata excepta, nervis secundariis congestis bene conspicuis patentibus impressis circa 1 mm inter se distantibus nervulis minoribus parallelis et transversis etiam plus minusve conspicuis; subtus omnia albo lanata costa crassa tantum conspicua cetera cum indumento crassissimo intricato adpresso tecta.

Inflorescentia terminalis paniculata 5–10 cm ampla folia suprema

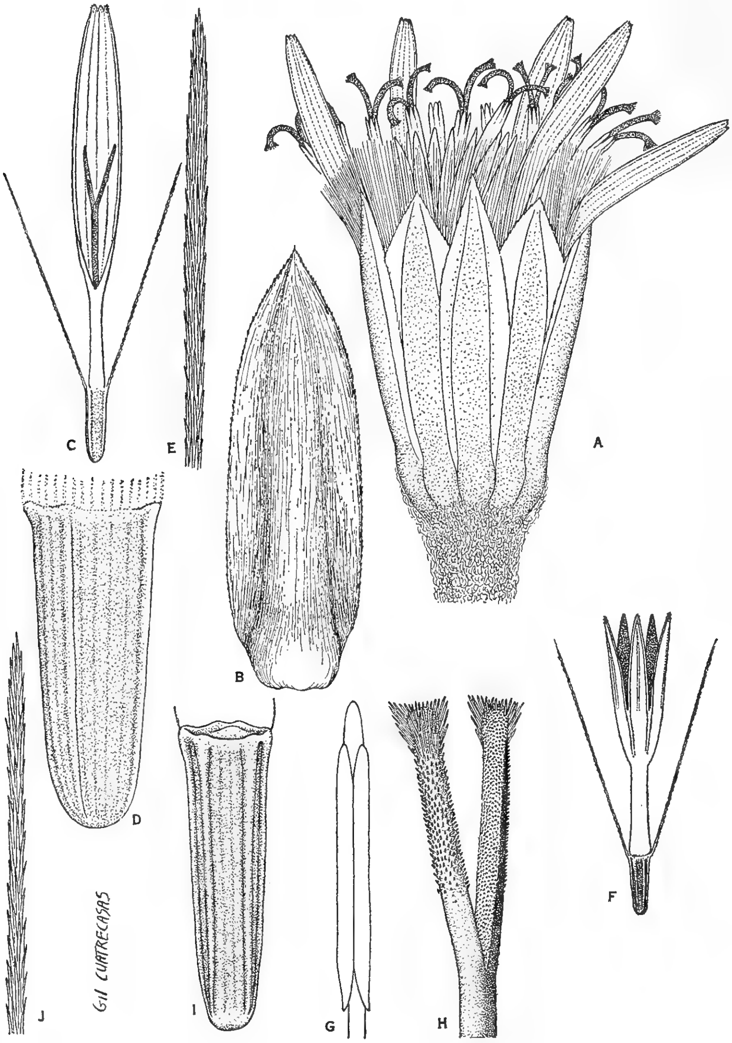

FIG. 8. *Senecio aclydiphyllus.* A, head, × 5; B, inner phyllary, × 7.5; C, ray flower, × 5; D, ovary of ray flower, × 25; E, end of pappus bristle, × 60; F, disc flower, × 4; G, anther, × 17; H, stylar branches of disc flower, × 20; I, ovary of disc flower, × 23; J, end of pappus bristle, × 60. (Wurdack 1196).

excedens basi foliata axi ramisque erectis angulatis dense albo-lanatis bracteis subtendentibus membranaceis flexuosis lanceolatis vel lanceolato-linearibus acutis integris 15–12 mm longis 8–2 mm latis subtus albo-lantis. Pedicelli crassiusculi 2–15 mm longi angulati albo-lanati apice incrassati sursum 3–4 bracteis membranaceis flexuosis 7–12 mm longis 1 mm latis lineari-oblongis acutis uninervis extus lanuginosis ad modum calyculi. Involucrum campanulatum 7–8 mm altum circa 6 mm diametente, phyllariis 8–9 viridibus rigidulis elliptico-oblongis vel oblongis apice attenuato subite acutato margine integro sursum minute ciliato ceteris glabris vel sparsissime araneosis dorso tenuiter obsoleteque nervatis basi valde incrassatis, 6.5–8.5 mm longis exterioribus 1.6–2 mm latis interioribus margine scariosis 2.6–3 mm latis. Receptaculum circa 2.5 mm diametente alveolatum marginibus alveolorum argute dentatis. Flores radii feminei ligulati plerumque 5; corolla lutea glabra 10–14 mm longa tubulo usque ad 2.5 mm longo sed plerumque usque ad basim fisso, lamina lineari-oblonga 1.5–2 mm lata apice minute 2–3-dentata; rami styli lineares circa 2 mm longi marginibus incrassatis papilloso-stigmaticis apice attenuato subtruncato breviter papilloso-laciniato; ovarium glabrum oblongum leviter striatum 2 mm longum; pappus pallide stramineus circa 7 mm longus setis subbiseratis rigidulis strigulosis. Flores disci hermaphroditi 12–19; corolla lutea tubulosa glabra 7.5–8 mm longa tubulo 3–4 mm longo angustiusculo limbo tubuloso-campanulato profunde dentato laciniis oblongo-linearibus acutatis 3-nervatis apice minute papillosis 2.5–3 mm longis; antherae 2.5 mm longae basi breviter auriculatae; rami styli rigidi 2 mm longi marginibus supra incrassatis late papilloso-stigmatiferis apice convexo papilloso-piloso; ovarium et pappus cum in feminis similes.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: open cold swamp on summit of Cerros de Calla-Calla, between Leimebamba-Balsas road pass and the "camino de herradura" (2 hours walk south), 3500–3750 m alt.; wandlike shrub 0.4–1 m; occasional; rays and disc yellow; 8 July 1962, J. J. Wurdack 1196. Holotypus, US.

Senecio aclydiphyllus is closely related to the páramo or subpáramo species of the section *Granata* from Colombia and Ecuador. From all these species it is strikingly different in being radiate and in the unique shape of its leaves combined with their indument.

Senecio callacallensis Cuatr., sp. nov.

Herba caule rhizomatoso radicifero extremo rosulam foliorum scapiferam ferenti.

Folia omnia rosulata crasse herbacea rigidula longe petiolata glabra. Petiolus 3–15 cm longus striolatus supra sulcatus glaber vel sparsissimis minutis pilis supra interdum munitus purpureus vel viridi lilacinus basi ampliato-vaginatus subamplectens. Lamina laete viridis vel subtus purpurascens nitida ovata vel ovato-elliptica basi truncata vel cordata apice obtusa in 5–6 lobos obtuse dentatos circa 1 cm profunde incisa, dentibus late triangularibus breviter calloso-submucronulatis vel subrotudatis 3–5 mm altis, costa lata supra plana subtus crassa nervis secundariis 5–7 utroque latere divaricatis paulo ramosis vel furcatis vix prominulis, margine subtus incrassata plerumque purpurea, utrinque glabra vel sparsis minutis pilis ad costam supra munita.

Scapi floriferi 1–3 axillares foliorum rosularum, erecti rigidi striati lilacini vel purpurascentes glabri copiose bracteolati 15–45 cm longi capitulum singulum radiatum (usque ad 6 cm diametri) erectum ferentes. Bracteolae subulatae acutae obsolete 1–3 venosae parum minuteque ciliolatae erectae vel flexuosae 15–5 mm longae 0.8–0.4 mm latae. Superne versus apicem scaporum bracteolis similibus magis numerosis ascendentibus subimbricatis 9–10 mm longis 1–1.2 mm latis basi capituli ad modum calyculi instructis. Involucrum campanulatum 14–15 mm altum plerumque purpurascente phyllariis 16–25 crassis lanceolato-oblongis acutis obsolete striato-nervatis apice minute ciliolatis ceteris glabris nitidisque, 13–14 mm longis exterioribus 1.5–1.7 mm latis interioribus 3–3.2 mm latis. Flores radii feminei ligulati circa 22; corolla lutea tubulo circa 7 mm longo glabro, lamina 20–25 mm longa 4–5 mm lata obsolete 4–5-nervata basi dorso parce pilosula reliqua glaberrima apice minute 2–3 dentata; rami styli crassiusculi complanati apice obtuse conici apiculato-penicillati. Flores disci creberrimi (circa 250) hermaphroditi; corolla lutea 10–11 mm longa glabra tubulo 6–6.5 mm longo limbo basi angusto lobis linearibus profundis acutis 1-nervatis 2.2–2.5 mm longis 0.6 mm latis; antherae basi obtusae 2 mm longae; styli rami 1.8 mm longi crassi complanati apice obtuse conici apiculato-penicillati (pilis centralibus longioribus). Ovarium circa 3 mm longum breviter villosum pilis crassiusculis copiosis. Pappus albus sericeus 6 mm longus pilis minute strigulosis. Achaenia prismatico-oblonga 5-costata minute copioseque hispidula circa 4.5 mm longa 1.2 mm crassa. Receptaculum conicum circa 7 mm latum minute foveolatum.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: middle eastern Calla-Calla slopes, near Kms. 416–419 of Leimebamba-Balsas road, elev. 2900–3100 m; in sphagnum seepage, infrequent; petioles and peduncle basally lavander; phyllaries dull purple; rays and disc yellow; 9 July 1962, J. J. Wurdack 1277. Holotypus, US.

Senecio callacallensis is very closely related to *S. pimpinellifolius* HBK. and its allies, but it differs from them mainly in the form of its leaves.

Senecio jalcanus Cuatr., sp. nov.

Frutex scandens ramis terminalibus flexuosis viridi-brunnescentibus striatis pubescentibus araneosisque pilis pluricellularibus crassiusculis patulis acutis rectis vel paulo flexuosis circa 0.5 mm longis copiosis et pilis arachnoideis plus minusve floccosis instructis.

Folia alterna chartacea laeteviridia. Petiolus circa 10 mm longus supra sulcatus basi ampliatus rectus vel flexuosus pubescens. Lamina ovata basi rotundata vel obtusa apicem paulo angustata valde acuta margine repando denticulata dentibus minutis calloso-mucronulatis circa 5 mm distantibus et anguste revoluta (integra simulans) 4–7 cm longa 2.4–4 cm lata; supra juvenilis sparse pilosa araneosaque deinde glabrata sed minute granulata costa filiformi impressa pilosulaque nervis secundariis impressis paulo conspicuis minoribus obsoletis; subtus patulo-pubescens costa valde eminenti nervis secundariis bene prominentibus 9–11 utroque latere patulis prope marginem arcuato-anastomosatis nervulis reticulum laxum prominentem et reticulum minutum leviter prominulum formantibus.

Inflorescentiae terminales composite thyrsoideo-paniculatae tantum basi foliosae 10–20 cm longa, axi ramisque patulis striatis densiuscule pubescentibus araneosisque, bracteis inferioribus foliaceis sed brevibus mediis superioribusque lanceolatis vel subulatis 8–2 mm longis 2–0.5 mm latis. Ramusculi ultimi 2–8 mm longi capitula glomerata sessilia vel subsessilia congesta ferentes. Pedicelli nulli vel brevissimi (ad 0.2 mm longi), bracteolis 3–5 lanceolatis acutis 1–2 mm longis 0.3–0.6 mm latis ciliolatis calyculum formantibus. Capitula discoidea circa 4 mm longa 2 mm diametentia. Involucrum campanulatum viride phyllariis 8 oblongis apicem attenuatis subacutis sursum minute papilloso-glandulosis pilosisque margine apiceque ciliatis ceteris glabris, 2.5–2.8 mm longis. Flores omnes tubulosi hermaphroditi 9–12. Corolla 3–3.2 mm longa eburnea glabra tubulo circa 2 mm longo dentibus 0.8 mm obtusiusculis superne apiceque dense papilloso-granulatis. Antherae 1.2 mm longae basi sagittatae. Styli rami circa 1 mm longi crassiusculi complanati apice subtruncato convexo breviter papilloso-piloso-coronato. Ovarium glabrum. Pappus albus 2.3–2.4 mm longus. Receptaculum 0.8 mm diametente alveolatum.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: *jalca* zone 1–5 Km W of Molinopampa, 2400–2450 m alt.; vine 1.5–4 m; frequent; corollas cream; 18 July 1962; J. J. Wurdack 1375. Holotypus, US.

Senecio jalcanus belongs to the group of climbing Senecios with small heads and strongly nerved leaves. It is distinguished from closely related species (*S. subglomerosus* Green., *S. loretensis* Cuatr., *S. urubambensis* Cabr., etc.) by its sessile heads, short involucres (2.5–2.8 mm long) with 8 phyllaries, small corollas (3–3.2 mm long), pubescent branchlets and inflorescences, and by its leaves being rather smooth above and pubescent and prominently nerved beneath.

Senecio wurdackii Cuatr., sp. nov.

Frutex scandens 3 m longus ramis flexuosis mediocribus glabris peridermato subochraceo papyraceo-solubili.

Folia opposita interdum alterna laete viridia glabra crassa in sicco chartacea. Petiolus 5–10 mm longus flexuosus basi dilatatus in pulvinulum articulatum incrassatus. Lamina ovata vel oblongo-ovata basi rotundata vel obtusa apice paulo attenuata obtusiuscula interdum rotundata margine angustissime subrevoluta leviter crenata dentibus brevissime calloso-mucronulatis, utrinque laevis costa supra filiformi impressa subtus crassiuscula nervis lateralibus 5–6 utroque latere adscendentibus prope margine furcatis subtus valde tenuibus supra plerumque obsoletis.

Inflorescentiae terminales paniculatae 5–9 cm amplae folia superantes tantum basi foliosa. Rami ramulique oppositi (interdum alterni) leviter striati puberuli pilis simplicibus flexuosisque sparsis muniti. Bracteis subtendentibus infimis foliis similibus sed brevibus alteris lanceolatis acutis parce puberulis 6–3 mm longis 2–1 mm latis. Pedicelli 2–12 mm longi puberuli recti vel flexuosi bracteolis 3–5 alternis subulatis 2–3 mm longis 0.1 mm latis instructi, ad apicem tantum 1–3 bracteolis lanceolatis 3–5 mm longis ad 1 mm latis vix calyculum formantibus. Capitula discoidea homogama. Involucrum cylindricum 9–9.5 mm longum circa 4 mm diametente. Phyllaria 8 crasse herbacea viridia lineari-subulata basi incrassata apice acuto ciliato marginibus sursum breviter ciliatis reliqua glabra, 8–9 mm longa exterioribus circa 1.5 mm latis interioribus margine scarioso 2 mm latis. Flores omnes hermaphroditi 13 in capitulo; corolla viridi-lutea glabra 8–9.5 mm longa tubulo luteo-viridi 4–5 mm longo limbo tubuloso dentibus oblongis acutiusculis marginibus sursum apiceque intus minute papillosis circa 1.2 mm longis. Antherae 2.3 mm longae basi auriculatae. Rami styli crassiusculi subcomplanati circa 1.4 mm longi apice truncati penicillati. Ovarium oblongum 2.5–3 mm longum leviter nervatum glabrum. Pappus albus sericeus 5–6 mm longus pilis minute strigulosis basi coalitis. Receptaculum 2 mm diametente alveolatum marginibus alveolorum dentato-fimbriatis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: approaches to Cerro Campanario NNE of Diosán, 3200–3500 m alt.; vine climbing 3 m in shrubs; corollas greenish yellow; 3 August 1962, J. J. Wurdack 1599. Holotypus, US.

Senecio wurdackii belongs to the group of Andean Senecio-climbers with rather carnose and smooth, green leaves and cylindrical, discoid heads. From all of these, the Wurdack plant differs in its unique slightly crenate blades and in its usually opposite leaves.

Senecio pleniauritus Cuatr., sp. nov.

Frutex vel arbuscula ad 3 m alta, ramis ultimis tortuosis, arcuato-ascendentibusque costato-striatis cicatricoso-nodosis internodiis brevibus (3–10 mm longis) nodis cum paribus auriculis rotundatis amplectentibus reflexisque satis persistentibus ornatis, extremo foliosis dilute minuteque albo-lanatis denique glabratis.

Folia alterna simplicia coriacea petiolata. Lamina oblanceolata vel elliptico-oblanceolata apice attenuata acuta mucronulata basim versus cuneato-attenuata margine anguste revoluta dentata dentibus calloso-mucronatis patulis, 4–10 cm longa 1.2–2.6 cm lata; supra valde juvenilis lanuginoso arachnoidea mox glabra sed interdum nervo medio immerso lanuginoso, nervis secundariis tenuibus impressis reliquis obsoletis; subtus ochroleuca crasse denseque tomentoso-lanata costa bene elevata nervis secundariis patulis crebris (1–2.5 mm inter se distantibus) prominulis venulis velatis. Petiolus 3–6 mm longus crassiusculus supra planus extus teres basi longe decurrens lateraliter amplectente dilatatus et biauriculatus, auriculis rotundato-cordatis cochlearis reflexis amplectentibus supra araneosis subtus tomentoso-lanatis circa 4–8 mm longis latisque, persistentibus.

Inflorescentiae terminales corymboso-paniculatae folia excedentes 10–26 capitulis, ramis ramulisque erectis striatis ochroleuco-lanuginosis bracteis subtendentibus inferioribus foliis similibus sed brevioribus sessilibusque intermediis supremisque bracteiformibus membranaceis venosis obovatis vel subovato-oblongis supra basim attenuatis basi subamplectenti exauriculatis apice acutiusculis 12–7 mm longis 8–2 mm latis supra glabris extus lanuginosis. Pedicelli erecti 5–15 mm longi striati lanuginosi sursum 1–3 bracteolis lanceolato-oblongis 6–7 mm longis 2–2.5 mm latis.

Capitula erecta heterogama radiata expansa ad 2.5 cm diametentia. Calyculus involucrum excedens vel aequilongus plerumque 4 bracteis oblongo-lanceolatis basim angustatis acutis margine integris membranaceis tenuibus subflexuosis intus glabris nervatisque extus lanuginosis 8–9 mm longis 2–3 mm latis. Involucrum campanulatum 6–8 mm altum 5–6 mm latum phyllariis 8–10 herbaceis basi incrassatis oblongis subite acutatis apice ciliatis margine integris dorso laxe lanuginosis 6–7.5 mm longis exterioribus 1.8–2.6 mm latis interioribus margine scarioso 2.8–3 mm latis. Receptaculum 2.5 diametente alveolatum marginibus alveolorum membranaceis argute dentatis. Flores radii feminei ligulati 7–9; corolla lutea 13–16 mm longa glabra tubulo 3.5–4.5 mm longo, lamina oblonga 11–13 mm longa 2.6–3.2 mm lata apice minute tridentata 5 nervis valde notatis 4 nervis intermediis tenuibus plus minusve conspicuis; styli rami 1–1.5 mm longi supra ad margines late incrassati papilloso-stigmatiferi apice subite attenuato obtusiusculo. Flores disci hermaphroditi 10–22; corolla lutea 6.5–7.5 mm longa glabra tubulo 2.5–3.2 mm longo limbo tubuloso-campanulato lobis triangulari-oblongis acutis trinervis (duobus marginalibus) 2–2.5 mm longis; antheris 2.5 mm longis basi breviter auriculatis apice appendice acutiusculo calloso-incrassato. Styli rami crassiusculi 1–1.3 mm longi intus stigmatiferi extus papillosi apice breviter conico minute papilloso et papilloso-piloso-coronato. Ovarium 2 mm longum glabrum leviter nervatum. Pappus 5–6 mm longus stramineus setis uniseriatis minutissime strigulosis.

Type: Peru, Dept. Amazonas, Prov. Chachapoyas: upper slopes and summit of Cerro Yama-uma above Taulia, 12–15 Km SSE (145°) of Molinopampa, 3200–3450 m alt.; shrub 1.5–3 m; occasional; rays and disc yellow; 11 August 1962, J. J. Wurdack 1669. Holotypus, US.

Senecio pleniauritus is a striking species which lies between *Senecio* and *Gynoxys*. It is related to the Senecios of section *Granata* with leaf-blades like those of *S. colombianus* Cuatr. and *S. tolimensis* Sch. Bip., but it differs from all species of that section in its extraordinary auricular leaf-appendages.

Hypochoeris mucida Domke, var. **integrifolia** Cuatr., var. nov.

Cryptofruticuletum rosulis parvis compactis pulvinulos densos formantibus. Lamina foliorum lineari-lanceolata vel linearia integerrima vel sinuata obtusiuscula vel acutiuscula margine revoluta 5–10 mm longa 2–3.5 mm lata. Achaenia lineari-subfusiformia circa 4 mm longa basi acuta sulcato-striata minutissime tuberculato-strigosa scaberrima. Pappus albus 6 mm longus. Phyllariae interiores 10 mm longae. Palleae receptaculi 10 mm longae dimidia inferiore parte lanceolatae superiore capilari-subulatae.

Type: Peru, Puno: WSW of Checayani, NE of Azangaro, 4150 m alt., rainy season, 29 March 1957, H. Ellenberg 495; Holotypus, U. 1–2° NW Point 4526 ENE of Checayani, 4500 m alt., 2 April 1957, H. Ellenberg 638; Paratypus, U.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW *THRACIA* FROM SOUTH CAROLINA
(MOLLUSCA: PELECYPODA)

BY RICHARD E. PETIT
Ocean Drive Beach, South Carolina

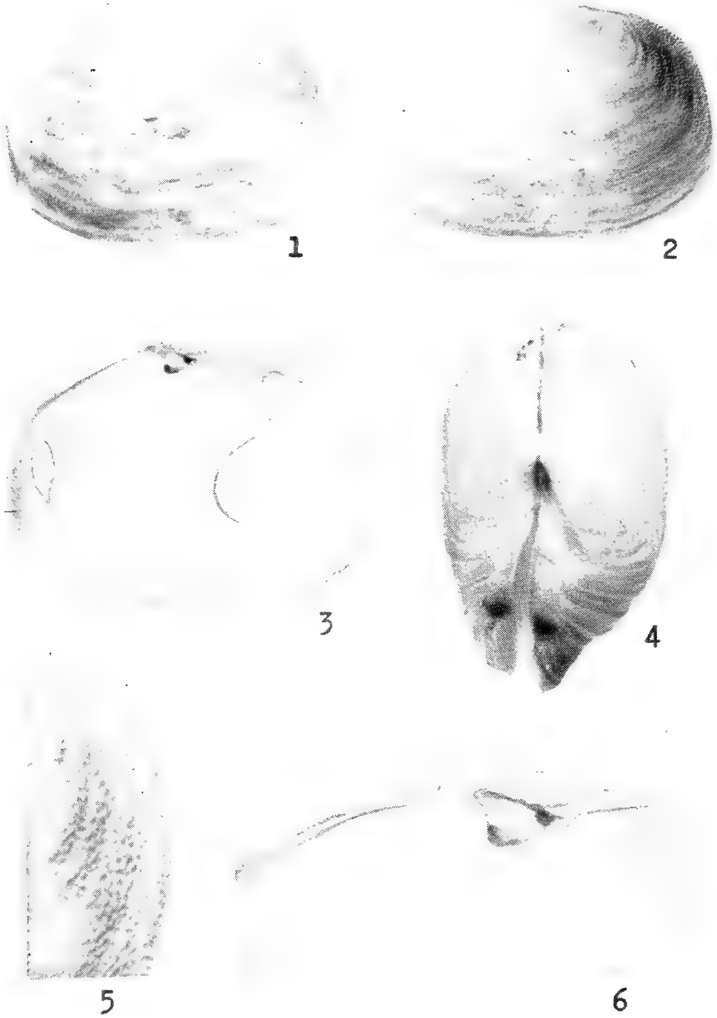
In January of 1958 this writer found three specimens of *Thracia* in beach drift at low tide at Ocean Drive Beach, South Carolina. The specimens were alive when found. Although this is a very distinct species, description has been delayed in hopes that additional specimens would be found. However, no more living specimens have been seen to date. It is probable that this species is a borer in some soft material.

Thracia morrisoni, n. sp.
(Figs. 1–6)

Shell irregularly ovate-quadrate, pure white, the undifferentiated umbones ending in small, inconspicuous beaks, nearly median in position, which touch at the margin, the right beak punctured by the left. The posterior side a little longer, gaping, subtruncated at the end. The anterior end broadly rounded. Valves are nearly equal, convex, the right a little larger. Surface shows a weak posterior umbonal angle, setting apart the posterior dorsal slope, that of the right valve carrying a radial rib near the margin. Surface sculptured with irregular concentric wrinkles, the whole covered with minute, hardly visible, sand-like granules. Hinge without teeth, ligament largely internal. External ligament very small, visible from above, resilium attached to a chrondophore in each valve, which project like a tooth behind an open cut or notch. Pallial sinus large, rounded, extending inward about one-third. Ventral margin smooth.

Holotype (Figs. 1–6), U. S. National Museum catalogue number 635218, measures 13 mm high × 17.7 mm long. Diameter of both valves, 10.5 mm. One paratype (Fig. 4) measuring 11.2 mm high × 15.6 mm long, diameter of both valves 9.3 mm, has been placed in the Museum of Comparative Zoology, catalogue number 245145. Remaining paratype is in the Petit collection.

This species is respectfully named for Dr. Joseph P. E. Morrison, Associate Curator, Division of Mollusks, U.S. National Museum.



FIGS. 1–6. *Thracia morrisoni*, n. sp. All except Fig. 4 are of holotype. 1, right valve; 2, left valve; 3, interior of right valve, showing the pallial sinus faintly; 4, MCZ paratype, dorsal view; the small black space behind the beaks is the small external section of the ligament; 5, greatly enlarged portion of left valve to show fine granulation; 6, enlarged detail of hinge of right valve.

The Panopea-like shape of this species is characteristic. It, or a close relative, has been variously identified by Dall 1886, and Johnson 1934, as *Thracia corbuloidea* Blainville 1824, and *T. distorta* Montagu 1808. This new species from the Carolina coast differs from *T. corbuloidea* Blainville by its regular quadrate-elliptic profile, without sinuosity of the ventral margin. It differs from *T. distorta* Montagu of European waters and from *T. rugosa* Orbigny 1846, of Brazil, by its central umbones. In this new species, anterior and posterior regions of the shell are almost exactly equal in length.

It is proportionately shorter than *T. similis* Couthouy 1839 of Brazil. This species does not have the thinner shell and concentric ridges of *Thracia* (*Cyathodonta*) *cruziana* Dall. The surface is reminiscent of the rugosity (slight pock-marking) of *T. squamosa* Carpenter, from Baja California. I believe this species belongs to the subgenus or group named *Ixartia*.

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PROCEEDINGS
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A REVISED INTERPRETATION OF THE PRIMITIVE CENTIPEDE GENUS *ARRUP*, WITH REDESCRIPTION OF ITS TYPE-SPECIES AND LIST OF KNOWN SPECIES[1]

(CHILOPODA : GEOPHILOMORPHA : MECISTOCEPHALIDAE)

By R. E. Crabill, Jr.
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Washington, D.C.

In 1912 (p. 654), Chamberlin proposed a new genus and species, *Arrup pylorus*, creating for its reception a new family, Arrupidae. In 1920 (p. 184), he reduced Arrupidae to the rank of subfamily within Mecistocephalidae, where it properly remains today.

This genus, represented apparently only by the original species, had long puzzled me. Quite clearly it seemed very similar to the eastern Asian *Prolamnonyx*, but according to the original description of *Arrup*, there was a major intrageneric difference between the two. In *Prolamnonyx* the first maxillary coxosternum is entirely without midlongitudinal division, whereas according to Chamberlin's characterization of *Arrup*, the first maxillary coxosternum is distinctly suturate or divided midlongitudinally (see 1912: 667, Fig. D). The types could not be located, and until quite recently additional specimens of *pylorus* could not be found.

Some years ago a Californian chilopod collection made by R. O. Schuster and L. M. Smith was generously placed in my hands by my friend and colleague, Dr. R. L. Hoffman. Recently, while continuing my perusal of this material, I unexpectedly came upon seven specimens of a genus that I unhesitatingly identified at first as *Prolamnonyx*. Generically they agree in every detail with all of the *Prolamnonyx* speci-

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[1] This study was undertaken with the aid of a grant from the National Science Foundation.

mens that I have seen, including the holotype of the type-species, *holstii* (Pocock), which I had examined in the British Museum (Natural History). Then two discoveries led me to believe that these specimens are in fact referable to *Arrup pylorus.*

First, although in every specimen the first maxillary coxosternum is absolutely entire and has no true midlongitudinal suture or other division, in one specimen the coxosternum is slightly infolded midlongitudinally, grossly giving the erroneous impression that it is divided or suturate. The illusion is further strengthened by the underlying, seemingly divided musculature, which, when viewed by transmitted light, suggests a nonexistent midlongitudinal division. In no specimen is there a true midlongitudinal division such as is seen in all other mecistocephalid genera. In each specimen the areolation is continuous from one side of the coxosternum to the other.

Secondly, apart from this maxillary character, it is apparent that these specimens agree in every other detail with the original description of *Arrup pylorus.* This centipede is bizarre even among the Mecistocephalidae, and in North America it is quite unlike anything else that is known. Therefore I submit that the original description of *pylorus* was in error, and that its first maxillary coxosternum is actually nonsuturate and undivided.

It follows that since *holstii* (Pocock), the type-species of *Prolamnonyx* Silvestri, 1919 (by original designation), is held to be congeneric but not conspecific with *pylorus* Chamberlin, 1912, the type-species of *Arrup* Chamberlin, 1912 (by original designation and monotypy), that *Prolamnonyx* falls as a junior subjective synonym of *Arrup* (New Synonymy).

Before proceeding to a necessary redescription of *pylorus,* I should like to call attention to another long-accepted genus whose name must fall as a junior synonym of *Arrup.* It is *Nodocephalus* Attems, 1928 (p. 115).

Nodocephalus was proposed for the reception of a single species, *edentulus* (Attems, 1904: 119), which was described from "Przewalsk" = Przheval'sk, Siberia (42° 29′ N, 78° 24′ E).

I have examined the mouthparts of the holotype in Vienna and find the original description to be in error. Attems' figure 159 (1929: 148) illustrates the point in question. Both in the text and in this figure he indicates that the second maxillary coxosternum is entire, not suturate, yet the holotype's second maxillary coxosternum is very distinctly suturate midlongitudinally. Other characters as well suggest a very close relationship with *holstii* and *pylorus*. Therefore I conclude, since *edentulus* is congeneric but not conspecific with *pylorus*, that *Nodocephalus* is a junior subjective synonym of *Arrup* (New Synonymy).

The presence of this evidently primitive mecistocephalid genus in central and eastern Asia and on the west coast of North America reflects a familiar distributional pattern with examples in a number of invertebrate groups, one being Chilopoda. The number of chilopod genera known to occur in western North America and eastern Asia is growing steadily, e.g., *Geophilus, Brachygeophilus, Tomotaenia, Strigamia, Escaryus, Dicellophilus, Arrup, Cryptops, Scolopocryptops* (*olim Otocryptops*), and a number of lithobiid groups. It seems reasonable to assume that passage between the two continents was effected by migrations across the Bering Strait during interglacial times.

Arrup Chamberlin

Arrup Chamberlin, 1912, p. 654.
Prolamnonyx Silvestri, 1919, p. 47 (key), p. 84 (new synonymy).
Nodocephalus Attems, 1928, p. 115 (new synonymy).

Type species: *Arrup pylorus* Chamberlin, 1912 (monotypic and by original designation). Its possession of a nonsuturate, undivided first maxillary coxosternum will distinguish *Arrup* from all other known mecistocephalid genera.

Important Correlative Generic Criteria: Head only slightly longer than wide. Clypeal plagulae completely separated and not more than half as long as entire clypeus. Buccal spiculum absent. Labral sidepieces without setae or filaments on posterior edge. First maxillary coxosternum not divided midlongitudinally. Second maxillary isthmus broadly membranous, not areolate, and infolded or not, thus in effect separating the coxosternites; metameric pore opening posteromesally, bounded laterally by a long foraminal process. Trochanteroprefemur of prehensor without a proximal denticle. Sternital porefields absent. Sternital rhachides anteriorly not furcate, each simply formed by a deep sulcus with thickened walls. Anal pores present and large.

Characters of Arrup *and Its Systematic Position*: Heretofore unnoted as a valuable intrageneric (if not suprageneric) character are the orientation and structure of the second maxillary metameric pore and adjacent parts. In the vast majority of Geophilomorpha this pore opens mesally or posteromesally and is bounded laterally by the bulk of the coxosternite. I take this to be the primary or primitive condition.

By contrast, in nearly all of the mecistocephalids concurrent with a general elongation of the entire maxillary apparatus, the mesal portions of the coxosternites undergo hypertrophy with the result that they become extremely elongate posteriorly. As a consequence the lateral portion of each coxosternite atrophies, or tends to, thereby displacing the metameric pore from its original mesal position to a secondary, lateral one. This derivative, lateral orientation is well-illustrated in, e.g., *Mecistocephalus, Tygarrup,* and *Anarrup.*

At least in *Arrup,* however, the original pore orientation and basically the original maxillary structure are retained. Interestingly enough, in *Dicellophilus* (western North America, eastern Asia, south-central Europe), we observe what may be a condition intermediate between these two extremes. The mesal parts of the coxosternite are partly elongate, a foraminal process is partly formed, and the metameric pore is partly oriented laterad.

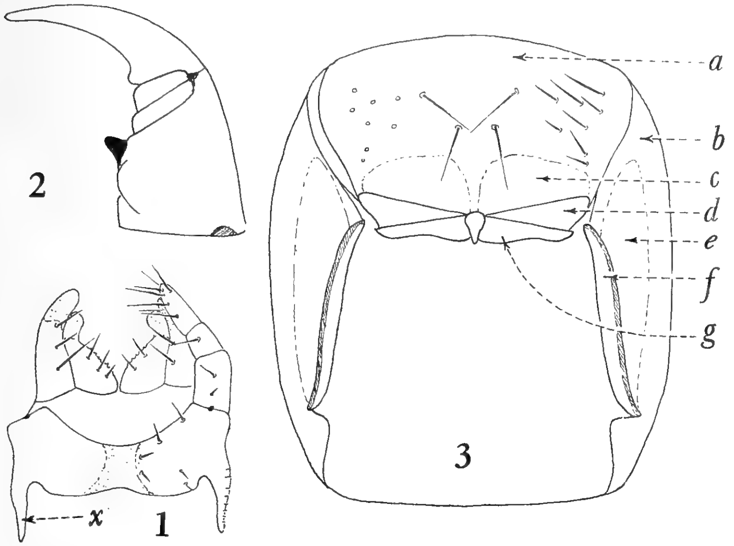
Thus in *Arrup* we see what appears to be only a slightly modified version of the primitive coxosternital condition. The metameric pore opens posteromesally, not laterally, and it is still completely separated from the bucca by the long, thin vestige of the lateral part of the coxosternite. For convenience of designation and to signalize its special significance I shall name this outer coxosternital vestige the *foraminal process.*

The sternital apodemes, which I have previously termed the rhachides (1959: 192, G), also deserve special comment. In *Mecistocephalus,* reflecting a more advanced or more complex habitus than that of *Arrup,* each rhachis is a solid internal extension (through invagination) of the sternite. Depending upon the species, it is anteriorly forked or not. A study of the homologous structure in *Arrup* shows how the more typical rhachis of *Mecistocephalus* must have evolved.

In *Arrup pylorus* and *holstii* each rhachis is represented by a deep midlongitudinal sulcus with thickened walls. Evidently in the course of evolution in order to provide a larger, firmer structure for muscle attachment and support, invagination of the sternital surface continued to form an ever-deepening sulcus which eventually closed over, ultimately giving rise to a solid rod- or fork-like internal apodeme.

In summary, the following features of *Arrup* seem to me to be suggestive of its evolutionary conservatism or primitiveness within the Mecistocephalidae. The head is only slightly longer than wide. The prehensors are shorter and less massive than those of other genera. The prelabral plagulae are entirely separated from each other and are relatively short anteroposteriorly. There is no buccal spiculum. The first maxillary coxosternum is undivided centrally. The second maxillary pore opens posteromesally, not laterally, and has a well-developed foraminal process. The sternital rhachides consist simply of open sulci with thickened walls. Large anal pores are present.

Therefore, I concur with Chamberlin and Attems in their beliefs that *Arrup* is sufficiently distinctive to warrant inclusion within a separate subfamily, Arrupinae, but my reasons for this allocation are different from theirs. I believe that they exaggerate the significance of the second



FIGS. 1–3. *Arrup pylorus* Chamberlin. 1, First and second maxillae; ventral aspect; right telopodite of second maxillae removed; all setae of left sides shown. x = right foraminal process. 2, Left prehensor; ventral aspect; setae deleted. 3, Cephalic capsule; ventral aspect; all setae shown except those of extreme right side of clypeus. *a*, areolate portion of clypeus; *b*, areolate portion of left bucca; *c*, non-areolate portion of clypeus (clypeal plagula); *d*, anterior ala of left labral sidepiece; *e*, non-areolate portion of left bucca; *f*, left buccal stilus; *g*, posterior ala of left labral sidepiece.

maxillary central division, while failing to grasp the classificatory utility and evolutionary implications of two other maxillary features.

First, in possessing an undivided first maxillary coxosternum, *Arrup* differs from all other known members of the family. Secondly, *Arrup* and one other, as yet undescribed, genus, has the maxillary pore posteromesally oriented and laterally bounded by a long, prominent foraminal process. This character-complex, overlooked until now, is a most useful classificatory device but in addition has apparent evolutionary implications.

The Known Species of Arrup

1. *A. pylorus* Chamberlin, 1912. (Type-species of *Arrup.*) California.
2. *A. edentulus* (Attems, 1904). (New combination.) Siberia.
3. *A. holstii* (Pocock, 1895). (New combination.) Japan, China.
4. *A. sauteri* (Silvestri, 1919). (New combination.) Formosa.

5. *A. dentatus* (Takakuwa, 1934). (New combination.) Japan.
6. *A. obtusus* (Takakuwa, 1934). (New combination.) Japan. On the basis of the original description, it is not possible to distinguish *obtusus* from *holstii*, with which it may be conspecific.
7. *A. doii* (Takakuwa, 1940). (New combination.) Korea. This species was originally referred to *Nodocephalus*. Its description is very vague and imprecise and, I suspect, may be in error with respect to several features. I refer it to *Arrup* provisionally.
8. *A. pauroporus* (Takakuwa, 1936). (New combination.) Manchuria. See remarks under *doii*.

Composite Description of A. pylorus

INTRODUCTORY: Length—To 22 mm, the majority 15–20 mm. Pedal segments: 41. Body shape: Very slightly attenuate anteriorly; posterior third of body somewhat more strongly attenuate. Color: Body whitish to pale yellowish; head and antennae yellowish-orange. Antenna: Very short and robust; when expanded in Hoyer's mounting medium about twice longer than head. Setae on successive articles gradually increasing in number and decreasing in length. Ultimate article longer than wide; on lateral and mesal surfaces of distal half with short, hyaline, robust setae. Cephalic plate: Only slightly longer than wide (e.g., $l : w = 27 : 22$). Frontal suture indicated by a weak areolate line. Except for coarsely areolate extreme anterior margin entire dorsal surface very weakly areolate. Shape: Sides slightly excurved, posteriorly weakly convergent; anterior margin projecting forward in a strong angle. Setae long and very robust.

CLYPEUS: Anterocentral fenestra absent. Paraclypeal sutures complete, anteriorly slightly sinuous. Prelabral plagulae* less than half as long as entire clypeus, the plagulae separated by a distinct midlongitudinal areolate strip, entirely without setae. Setae of areolate (anterior) clypeus* disposed essentially in three groups, one central and one on each side. BUCCA: Ventrally without setae. Mesally adjacent to stilus* with a large, triangular, non-areolate area, this bordered anteriorly and laterally by areas of conspicuous areolation. Stilus weak. Spiculum* absent. LABRUM: Midpiece pear-shaped, long, anteriorly very wide. Sidepieces without setae or filaments on posterior edges of posterior alae.* FIRST MAXILLAE: Coxosternum very deep anteroposteriorly; midlongitudinally not suturate, not divided, rarely infolded. Medial lobes and telopodites each hyaline distally and basally separated from coxosternum by distinct suture. SECOND MAXILLAE: Isthmus centrally (*in situ*) broadly membranous and hyaline, not areolate, or the hyaline membrane deeply infolded; the two coxosternites thus in effect separated. Meta-

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* I use here a number of terms which I presented as new in 1959 (p. 192). They will be identified by an asterisk and defined again at the conclusion of this paper. By prelabral plagulae I mean the "posterior clypeus" of authors.

meric pore opening posteromesally, not laterally, the pore bounded laterally by a long, thin, prominent foraminal process. Telopodite: First article basally with vestigial ventral and dorsal condyles; ultimate article without pretarsus.

PROSTERNUM: Anterior denticles blunt, low, unpigmented. Setae long and robust. PREHENSOR: Denticles: Trochanteroprefemoral proximal denticle entirely absent, the distal denticle long, robust, deeply pigmented; intermediate articles without denticles; tarsungular basal denticle very wide, not pointed, low, weakly pigmented. Dorsal and ventral edges of ungula smooth, not serrulate. Poison calyx very short,[2] contained within intermediate articles. Poison gland short, ending posteriorly within the trochanteroprefemur. TERGITES: Basal plate and first 3–4 tergites not bisulcate; remaining tergites (except ultimate pedal tergite) weakly bisulcate, the sulci extraordinarily widely separated. Setae robust, stiff, long.

SPIRACLES: All circular. STERNITES: Porefields absent. Each longer than wide. Approximately the first 8 sternites with very short metasternites that telescope shallowly into succeeding sternites.[3] Rhachides* represented by shallow midlongitudinal thickened sides; anteriorly not furcate;[4] on sternites 1-(12-15).

LEGS: First legs only slightly shorter than those succeeding. Setae long, robust, stiff. Pretarsal parungues very short and approximately equal in length.

ULTIMATE PEDAL SEGMENT: Pretergite bilaterally fissate.[5] Tergite only slightly longer than greatest width; sides slightly excurved, posteriorly not convergent; rear margin evenly rounded. Presternite concealed and completely divided centrally.[6] Sternite: Strongly triangular; anterior width greater than length; posterior apex rounded and lobate; densely, finely setose. Coxopleuron: laterally not swollen; anteriorly not encroaching upon preceding segment; posteromesally with a prominent, finely setose swelling. Ventrally adjacent to sternite with three large hemogenous pores, laterally (but not dorsally) with notably smaller pores. Leg: in both sexes moderately inflated; about ¼ longer than penult leg; with two tarsal articles; pretarsus absent.

POSTPEDAL SEGMENT: Each female gonopod unipartite, semicircular

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[2] This is in notable contrast to the poison calyx of *holstii*, which is extremely long, extending to the base of the trochanteroprefemur and doubling back on itself. This new character, unnoted until now, will prove most useful in distinguishing between species of the genus.

[3] In contrast to the majority of mecistocephalids, where the metasternites project very deeply into the succeeding sternites.

[4] Attems' description, "spitzwinklig gegabelt" (1929: 154), is in error.

[5] In all mecistocephalids known to me the pretergite of the ultimate pedal segment is conspicuously fissate bilaterally. I submit this as a new family characteristic.

[6] In all mecistocephalids this presternite is divided centrally; also, the presternite is always present, although it is often concealed beneath the preceding sternite. The genus *Megethmus* has repeatedly been characterized as lacking this presternite, but I have never failed to find it.

in outline, completely but narrowly separated from its counterpart. Male gonopod bipartite, conical in outline, very widely separated from its counterpart. Anal pores opening laterally, very large, their lumina lines with a prominent sclerotic membrane, homogeneous.

Distribution of A. pylorus: The species is known only from California. Type localities: MARIN Co., Sausalito; ALAMEDA Co., Berkeley.

The specimens used in the present study were collected in the following localities: SONOMA Co., west of Mark West Reservation, in Douglas fir litter; SAN MATEO Co., 6 mi. SE Half Moon Bay, in redwood litter, Pescadero Creek, SE Half Moon Bay; MENDOCINO Co., Caspar.

Terminology: Prelabral plagula (of the clypeus). Plagula means flat, smooth place; thereby I refer to the smooth, non-areolate area anterior to each labral sidepiece. There may be two plagulae separated from each other by a midlongitudinal areolate strip (e.g., *Arrup, Mecistocephalus*), or a single, undivided plagula that extends nearly to the anterior clypeal margin (e.g., *Tygarrup, Dicellophilus*). That portion of the clypeus that is anterior to the plagula(e) may be termed the areolate clypeus or areolate part of the clypeus. By plagula(e) I mean, then, what authors have called the "posterior clypeus," and by *aerolate clypeus* I mean what authors have termed the "anterior clypeus." This older terminology is objectionable, I believe, because it implies a basic, morphological subdivision of the clypeus, which does not in fact exist. Moreover, in genera like *Tygarrup* and *Dicellophilus*, in which the non-areolate area ("posterior clypeus" of authors) occupies virtually the entire clypeal area, the older terminology is most confusing and misleading. The terminology that I propose is neutral and merely descriptive, implying nothing about the basic morphological construction of the clypeus.

SPICULUM (of the bucca): Plural, spicula. In Mecistocephalidae, the pigmented spikelike point on the anterior corner of the bucca. It occurs in three genera: *Mecistocephalus, Megethmus*, and *Takashimaia*.

Stilus (of the bucca): Plural, stili. The heavily sclerotized, elongate, thickened mesal edge of the bucca; at midlength giving attachment to the maxillae.

Rhachis (or rachis): Plural, rhachides. In Mecistocephalidae the elongate, midlongitudinal sternital thickenings or apodemes. Anteriorly the rhachis is bifurcate or not. In its most simple form it may be a deep sulcus with thickened walls (*Arrup*), but in its more developed, complex state it assumes the form of a rodlike apodeme (*Mecistocephalus*).

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PROCEEDINGS
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A THIRD SMOOTH SPECIES OF *POLYLEPISCUS* (POLYDESMIDA: EURYURIDAE)[1]

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Two of the seven species of millipeds referred to the genus *Polylepiscus* in my recent key (1962) are unusual in that the metatergites are entirely smooth and polished, thus lacking the characteristic, elevated, polygonal areas of the more typical forms. At an earlier time, dorsal sculpture was often made the basis for generic distinctions in the Euryuridae, but we now know that this character is a mutable one of only specific importance. Among the known species of *Polylepiscus*—as defined by a concordance of gonopod structure and essentially all details of body form—tergal texture ranges from completely smooth, through flattened polygonal areation, to the extreme condition in which the polygons are tuberculate or even obscured by heavy granulation.

I have just become aware of still another dorsally smooth polylepiscid which was described ten years ago and which I have overlooked in preparing two previous accounts of this genus (1954, 1962). This is the Guatemalan species named *Aphelidesmus major* by Dr. R. V. Chamberlin in 1952.

Comparison of the description and drawings published for *A. major*—based upon a female—with specimens of *Aphelidesmus* and *Polylepiscus*, shows this name to be unquestionably based upon a milliped congeneric with *Polylepiscus stolli* Pocock. I therefore take this occasion to formally transfer the species to *Polylepiscus*, and to distinguish it from its nearest relatives. It may be noted in passing that *major* was allocated to *Aphelidesmus* prior to the discovery of *P. trimaculatus* and

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[1] A contribution from studies supported by a grant (G-21519) from the National Science Foundation.

P. campanulae, thus at a time when all of the known polylepiscids showed the dorsal sculpture thought to characterize the genus.

Polylepiscus major (Chamberlin), new combination

Aphelidesmus major Chamberlin, 1952, Ann. Ent. Soc. Am., 45: 581, Figs. 28, 29. Holotype female, Chicago Nat. Hist. Mus., from Escobas, Guatemala.

Diagnosis: A medium-sized member of the genus characterized by the smooth metatergites, caudal production of the peritremata of segments 5–19, occurrence of strigiles on paranota of segments 4–19, and the presence of a broad, longitudinal, mid-dorsal light stripe.

Remarks: *Polylepiscus major* runs out to couplet 3 in my 1962 key, along with *P. trimaculatus* and *P. campanulae.* It shares some of the characters of these forms, and has at least one unique to itself, as indicated by the table:

	trimaculatus:	*major*:	*campanulae*:
Body width	10–12 mm	10 mm	5–7 mm
Dorsal pattern	A median row of large, sub-oval spots	A broad, light mid-dorsal band	Mid-dorsal area uniformly dark brown
Distribution of strigiles	Segments 6–18	Segments 4–19	Segments 4–19
Spiniform peritremata	5–19	5–19	5–19

I venture the opinion that *major* will eventually be found to be most closely related to *P. trimaculatus*, although it is by no means asserted that tergal sculpture alone indicates a common ancestry in this, or any other milliped genus. Affinity must be determined by the comparison of the entire animals, as we are classifying *organisms*, not tergites, or color patterns, or gonopods.

Although the correct generic placement of female specimens is still a somewhat uncertain undertaking, it is puzzling that the species *major* would have been assigned to *Aphelidesmus*. A number of considerations at once arouse suspicion: the discovery of a large species (10 mm in width) in a genus composed otherwise of numerous species less than 5 mm in width; the occurrence of conspicuous strigiles in a genus where, to the best of my knowledge, they have not been previously recorded; and the occurrence of this unusual species considerably to the north of the known range of its supposed congeners. The generic transfer here proposed disposes of all these anomalies, but does result in the malapropism of a moderate-sized species bearing the name *major* among congeners which are appreciably larger!

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NEW NORTH AND CENTRAL AMERICAN RECORDS OF *ORTHOPORUS* (DIPLOPODA: SPIROSTREPTIDA)

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Most of the specimens upon which this paper is based are in my personal collection. The exceptions are noted. I am grateful to the many collectors. Collections for which no collectors are mentioned were made with the assistance of Dr. David Causey.

Orthoporus boreus Chamberlin

Orthoporus boreus Chamberlin, 1947, Proc. Acad. Nat. Sci. Philadelphia, 99: 55, 57, fig. 69 (Tabor, Snake River Desert, Bingham Co., Idaho. ♀ holotype belongs to the Acad. Nat. Sci. Philadelphia, but is not there; presumably it is in the Chamberlin Coll.).

A curatorial error is suspected in the type locality of this species. I have corresponded with several biologists who have done field work in Bingham County, Idaho, and none can recall having seen large-bodied millipeds there. Bingham, Socorro County, New Mexico, should be investigated as the possible type locality.

Orthoporus dybasi (Chamberlin), new combination

Scaphiostreptus dybasi Chamberlin, 1952, Great Basin Nat., 12 (1–4): 28–29, fig. 16 (El Fortín, Veracruz. ♂ holotype, Chamberlin Coll.).

Width 5.4 to 7.2 mm. 63 to 67 segments. Annulated with two shades of red-brown; legs are red. Curvature of ectal spine of telocoxite varies; in my specimen from El Fortín, it curves strongly, as in *texicolens*; in the Conejos specimen, the curvature is weaker. All other details of the gonopods from the two sites are identical. Telopodites are in the normal position for the genus, not crossed as in the holotype. Resembles *teapensis* in the general appearance of the gonopods; differs in the stronger sternum and in the presence of a lobe on the telopodite.

Distribution: East-central Mexico.

New records: VERACRUZ—Veracruz-Jalapa highway, near Cunejos, ♂,

♀, immature specimens, 14 June 1954. El Fortín, Posada Loma, ♂, ♀, 17 June 1954.

Orthoporus flavior Chamberlin and Mulaik

Orthoporus flavior Chamberlin and Mulaik, 1941, J. New York Ent. Soc., 49: 63–64 (4 mi. E of Dryden, Terrell Co., Texas. Immature ♂ holotype, Chamberlin Coll.). Chamberlin, 1943, Proc. Biol. Soc. Wash., 65: 148. Loomis, 1963, J. Kansas Ent. Soc., 36 (2): 123–124, figs. 8–10.

Orthoporus pontis Chamberlin, 1947, Proc. Acad. Nat. Sci. Philadelphia, 99–53, 55, fig. 66 ("High Bridge" on Pecos River, Val Verde Co., Texas. ♀ holotype, no. 9977, Acad. Nat. Sci. Philadelphia).

Width 5.1 to 9 mm. 67 to 74 segments. Brown and yellow color phases with identical gonopods are known. The color phases are irregularly distributed over the range of the species and sometimes are in close proximity but have not been found in the same collection. Some populations are intermediate in color. Brown specimens are annulated with lighter brown or greenish brown, and the legs are red. In the brightest specimens, the metazonites are orange, the prozonites and legs are yellow, and the eyes and repugnatorial glands are dark brown. In alcohol, some of the yellow specimens darken slowly and eventually are brown and yellow annulated, resembling some of the lighter-colored specimens of *O. ornatus.*

Distribution: Known with certainty from the following west Texas counties: Crockett, Terrell, and Val Verde. Sympatric with *O. ornatus.*

Old records: Texas—Chamberlin (1943) reported females of the yellow phase from Marathon, Brewster County; Sierra Blanca, Hudspeth County; and 10 mi. E of Dryden, Terrell County. Loomis (1963) reported collections containing males from 3.3 mi. W of Sanderson, Terrell County, and Devil's River Bridge, U. S. Highway 90, Val Verde County.

New records of the brown color phase: Crockett Co.: Lancaster Hill, ♂, 21 Aug. 1959, W. H. McAlister. Terrell Co.: about 10 mi. N of Dryden on the Bendele Ranch, 3 ♂, 2 ♀, June 1963, James Reddell. Val Verde Co.: below dam of Lake Walk, Devil's River, 9 Aug. 1963, 5 ♂, 18 ♀, M. S. Mooney.

New records of the yellow color phase: Val Verde Co.: Devil's River Bridge, U. S. Highway 90, 2 ♀, 8 Oct. 1958, H. V. Weems, Jr. (Fla. Dept. Agr.). Canyon of Pecos River near junction with Río Grande, ♀ and many larvae, "apparently feeding on sphagnum moss," 14 April 1960, R. W. Strandtmann. 20 mi. E of Comstock, Bob Williams Ranch, 2 ♀, 30 Sept. 1963, J. Reddell. Osman Canyon, S of Langtry, ♂, 25 Jan. 1964, J. Reddell.

Orthoporus fraternus (Saussure)

Jules fraternus Saussure, 1860, Mem. Soc. Phys. Geneve, 15: 374, pl. 6, fig. 40 (Yautepec, Morelos. Location of ♀ holotype is unknown.).

? *Spirostreptus fraternus*, Saussure and Humbert, 1872, Miss. Sci. Mex., Myr., p. 70.

Orthoporus fraternus, Pocock, 1909, Diplopoda, *in* Biol. Centr.-Amer., p. 101.

Orthoporus amulensis (? *Spirostreptus fraterus*) Pocock, 1909, Diplopoda, *in* Biol. Centr.-Amer., p. 98, pl. 8, fig. 5 (Amula, Guerrero. NEW SYNONYMY.

Orthoporus morelus Chamberlin, 1943, Bull. Univ. Utah, biol. ser., 8 (3): 16, figs. 16, 17 (Tepoztlan, Morelos. ♀ holotype, Chamberlin Coll.) NEW SYNONYMY.

Width 3 to 5 mm. 68 to 79 segments. In alcohol, color varies between dark red-brown and brown annulated with yellow; venter is lighter than dorsum. I have examined topotypes of *fraternus* and *morelus*. Pocock's figure lacks the femoral spine that is on the telopodite of the gonopod but agrees otherwise with my specimens.

Distribution: South-central Mexico.

New records: MORELOS—8 mi. E of Yautepec, under cattle droppings, ♂, ♀, immature specimens, 20 June 1957. Near Amacuzac, ♂, ♀, 27 June 1957. VERACRUZ—Between Jalapa and Banderilla, km. 327, ♂, 24 June 1957. OACACA—Oacaca, under cattle droppings and rocks, very dry, 3 ♂, ♀, 24 June 1955. PUEBLA—Highway 190, km. 275, near Tehuitzingo, under cattle droppings. ♂, 3 ♀, many immature specimens, 20 June 1955.

Orthoporus ornatus (Girard)

Julus ornatus Girard, 1853, *in* Marcy, Exploration of the Red River of Louisiana . . . in 1852, Appendix F, p. 274; "collected on the 27th of June." Type locality restricted by Causey (1954) to Palo Duro Canyon St. Pk., Randall Co., Texas. Holotype, of undetermined sex, is probably lost.

Spirobolus ornatus, Wood, 1865, Trans. Amer. Philos. Soc., 13: 208.

Spirostreptus montezumae, Bollman, 1888, Proc. U. S. Nat. Mus., 11: 343.

Orthoporus punctilliger Chamberlin, 1923, Proc. Calif. Acad. Sci., 12: 405, 407, fig. 41 (San Pedro Bay, Sonora. ♂ holotype, Calif. Acad. Sci.). Loomis, 1963, J. Kansas Ent. Soc., 36 (2): 124–125. NEW SYNONYMY.

Orthoporus wichitanus Chamberlin, 1931, Ent. News, 42: 99, pl. 2, fig. 2 (Elk Mt., Wichita Reserve, Comanche Co., Oklahoma. ♂ holotype, Chamberlin Coll.). NEW SYNONYMY.

Orthoporus vallicolens Chamberlin, 1943, Proc. Biol. Soc. Wash., 56: 149, fig. 15 (Ft. Hancock, Hudspeth Co., Texas. ♀ holotype, Chamberlin Coll.).

Orthoporus arizonicus Loomis, 1953, J. Wash. Acad. Sci., 43 (12): 418, figs. 4, 5 (Patagonia, Santa Cruz Co., Arizona. ♂ holotype, U. S. Nat. Mus.).

Orthoporus ornatus, Causey, 1954, Tulane Studies in Zool., 2 (4): 67, fig. 10.

Loomis (1963) called attention to the variations in the somatic characters and the wide distribution of this species. Width 5 to 11 mm. 63 to 73 segments. Body is usually medium brown annulated either conspicuously or inconspicuously with a lighter shade of brown. Specimens from Big Bend National Park and Chihuahua are annulated with yellow and resemble *flavior*. The gonopods vary slightly as to the shape of the mesiodistal angle of the lateral lamella, the length, thickness, color, and direction of the ectal spine of the telocoxite, and the length of the femoral spine of the telopodite. The mesiodistal angle of the lateral lamella, anterior view, is usually a right angle, but in the northern part of the range it is narrowly rounded, and in the south and west it tends to be acute and prolonged, but never as much as in *texicolens*.

The figure of the gonopods of *punctilliger* is adequate for placing that species in synonymy with *ornatus*. I have examined a male topotype of *wichitanus* and males from sites within 75 and 100 miles of the type locality of *ornatus*. Males of no other spirostreptids have been collected in north Texas and Oklahoma. Several species that were described from sites in Arizona, New Mexico, and northern Mexico are suspected of being synonymous with *ornatus*. Among them is *Spirobolus miles* Chamberlin, 1918 (Pomona Coll. J. Ent. and Zool., 10: 11); the type locality is Fort Grant (not Fort Boutelle, as stated in the original description), Graham County, Arizona. Males of no species except *ornatus* have been collected in Arizona, New Mexico, and northwestern Mexico.

Distribution: The southwestern United States and northern Mexico. The periphery of the range passes through Arizona, New Mexico, northwestern Texas, southwestern Oklahoma, southwestern Texas, Nuevo Leon, San Luis Potosí, Chihuahua, and Sonora. In west Texas, *ornatus* is sympatric with *flavior*. The eastern periphery of the range partially overlaps the range of *texicolens*, which occupies the Gulf Coastal Plain of south Texas and northern Mexico.

Old records: ARIZONA—Pinal Co.: Sacaton, ♂, ♀. TEXAS—El Paso Co.: near El Paso, ♂. Uvalde Co.: between Camp Wood and Uvalde, ♂, ♀. Brewster Co.: Panther Junction, Big Bend National Park, ♂, ♀ (Loomis, 1963).

New records: ARIZONA—Yuma Co.: Tule Mts., Buckhorn Tanks, ♂, 30 Sept. 1956, V. Roth. Graham Co.: 65 mi. N of Willcox, ♂, ♀, 18 July 1956, W. Gertsch and V. Roth (AMNH). OKLAHOMA—Comanche Co.: Wichita Reserve, ♀, 16 June 1932 (Zool. Mus., Univ. Okla.); ♀, June 1963, D. Jackson. Greer Co.: Quartz Mts., ♂, 2 ♀, H. P. Brown (Zool. Mus., Univ. Okla.). TEXAS—Baylor Co.: Seymour, ♂, ♀, 15 Nov. 1960, A. H. Kemp. Crockett Co.: Amaker Ranch, N of Iraan across Pecos River, ♂, June 1963, J. Reddell. Brewster Co.: Big Bend Nat. Pk., Dagger Flat, ♂, 22 Aug. 1959, W. H. McAlister; Tortilla Flat, ♂, 3 ♀, 12 May 1959, E. C. Becker (Ottawa Dept. Agr. Ent.). Childress Co.: Childress, ♂, ♀, 15 July 1961, R. Brandon. Dimmit Co.: 3 mi. SW of Carrizo Springs, many ♂ and ♀, 10 Aug. 1958, R. H. Pluenneke. Culberson Co.: Drake Ranch, 7 mi. N of Kent, ♂, June 1963, J. Reddell. Hardeman Co.: 3 mi. W of Quanah, larvae, 25 April 1954; 2 mi. E of Quanah, ♀, 6 Aug. 1953. King Co.: 2 mi. E of Guthrie, larvae, 20 Aug. 1953, O. Sanders. Lubbock Co.: Lubbock, ♂, ♀, larvae, R. W. Strandthmann. Randall Co.: Palo Duro Canyon St. Pk., ♀, larvae, 27 May 1956, N. Causey; ♀, July 1961, J. Frank. Val Verde Co.: Del Rio airport, many ♂ and ♀ crawlings on surface, 11 June 1962, R. O. Albert. CHIHUAHUA—5 mi. W of Jiménez, 4,550 ft. alt., ♂, ♀, 16 July 1957. 8 mi. E of Villa Ahumada, 4,000 ft. alt., ♂, 7 July 1957. Near Samalayuca, many ♂ and ♀, 6 July 1957. 8 mi. E of Los Lamentos, many ♂ and ♀, 8 July 1957. All Chihuahua collections by S. Anderson (Univ. Kan. Mus. Nat. Hist.). SAN LUIS POTOSÍ—Near Huizache, swarming in great numbers, ♂, ♀, 8 June 1955. TAMAULIPAS—5 mi. W of Palmillas, ♂, ♀, 3 June 1959, R. O. Albert. NUEVO LEON—On and near Candela Peak, Coahuila-Nuevo Leon boundary, 4 ♂, 2 ♀, 13 July 1963, B. Russell.

Orthoporus striatulus Pocock

Orthoporus striatulus Pocock, 1909, Diplopoda, *in* Biol. Centr.-Amer., p. 99, pl. 8, fig. 1 (Tuxtla, Mexico). Width 3.3 to 4.2 mm. 59 to 71 segments.

Orthoporus chiapasus (Chamberlin, 1943, Bull. Univ. Utah, biol. ser., 8 (3): 12–13, fig. 4), which was described from a female from Huixtla, Chiapas, is suspected of being a synonym of *striatulus*.

Pocock did not indicate which one of the several places in Mexico named Tuxtla is the type locality of this species. The records indicate that it is surely Tuxtla-Gutiérrez, also known as Tuxtla Chico, Chiapas. I have not seen *striatulus* in any collections from the Tuxtlas in Veracruz.

Distribution: Southern Mexico.

New records: CHIAPAS—Tuxtla-Gutiérrez, Zoological Garden, 27 June 1955, many immature specimens. Vicinity of Tuxtla-Gutiérrez, many mature specimens, 1955, M. Álvarez del Toro. Pan-American Highway, 31 mi. NW of Tuxtla-Gutiérrez, 28 June 1955, immature specimens. OAXACA—Pan-American Highway near Chiapas-Oaxaca boundary, under logs in farmyard, 27 June 1955, ♂, ♀, immature specimens. TABASCO—Jalapa, west bank of Río de Sierra, 28 Dec. 1963, ♂, ♀, L. D. Ober. Collections of females and immature specimens that have the facies of *striatulus*. CHIAPAS—San Jerónimo, near Tapachula, 2000 ft. alt., ♀, 5 mm., 64 seg., 25 July 1963, Moll and Landry. OAXACA—Tehuantepec, many immature specimens in banana plantation, 27 June 1955.

Orthoporus teapensis Pocock

Orthoporus teapensis Pocock, 1909, Diplopoda, *in* Biol. Centr.-Amer., pp. 97–98, pl. 8, fig. 4 (Teapa, Tabasco. ♂ holotype, Brit. Mus.).

Width 3.2 to 6 mm. 57 to 73 segments. In alcohol yellow-brown annulated with yellow; legs are yellow-brown.

Distribution: Southern Mexico.

New records: CHIAPAS—Tuxtla-Gutiérrez, Zoological Garden, 2 ♂, many immature specimens, 28 June 1955. Vicinity of Tuxtla-Gutiérrez, many mature specimens, 1955, M. Álvarez del Toro. OAXACA—Pan-American Highway near Chiapas-Oaxaca boundary, under logs in yard, 3 ♂, 6 ♀, 27 June 1955. Tehuantepec, under debris in banana plantation, 2 ♂, 2 ♀, 27 June 1955.

Females suspected of being this species were collected at San Jerónimo, near Tapachula, Chiapas, 2200 ft. alt., 18 July 1963, Moll and Landry (Ill. Biol. Sur.).

Orthoporus texicolens Chamberlin

Orthoporus texicolens Chamberlin, 1938, Proc. Biol. Soc. Wash., 51: 207 (Edinburg, Hidalgo Co., Texas. ♂ holotype, Chamberlin Coll.). Loomis, 1963, J. Kansas Ent. Soc., 36 (2): 126, fig. 18.

Scaphiostreptus texicolens, Chamberlin, 1952, Great Basin Nat., 12 (1–4): 28.

Orthoporus victorianus Chamberlin, 1943, Bull. Univ. Utah, biol. ser. 8 (3): 18, pl. 2, figs. 20–22 (3 mi. S of Victoria, Tamaulipas. ♂ holotype, Chamberlin Coll.). NEW SYNONYMY.

Width 6 to 9 mm.; 67 to 79 segments. Body color is brown annulated with dark red. Details of the exoskeleton are as in the congeners with contiguous ranges. There are no significant variations in the gonopods.

The drawing of the gonopod of *victorianus* is adequate for synonymizing it with *texicolens*. I have not examined the holotype.

Distribution: The West Gulf Coastal Plain from the Guadelupe River of Texas to the Tropic of Cancer. The western periphery of the range passes through Uvalde County, Texas, and Victoria, Tamaulipas, and is contiguous with the range of *ornatus*.

Old records: TEXAS—Bexar Co.: Helotes, ♀ (Chamberlin, 1943). Cameron Co.: Brownsville, ♂ (Chamberlin, 1953). Hidalgo Co.: Hidalgo, ♂ (Loomis, 1963). TAMAULIPAS—5 mi. W of El Forlón, 5 ♀ (Chamberlin, 1943).

New records: TEXAS—Cameron Co.: Brownsville, ♂, ♀, 20 May 1959, Bill Butt. Jim Wells Co.: Alice, ♀, 1 Aug. 1961, "many moving at night; no rain, no weather change;" 3 ♂, many ♀, larvae, 4 May 1962, R. O. Albert. Karnes Co.: Falls City, "walking in daylight," 2 ♂, 6 ♀, larvae, 27 June 1961, J. F. Quinlan, Jr. San Patricio Co.: Lake Corpus Christi, ♂, 10 June 1962, R. O. Albert. La Quinta Beach, 5 mi. E of Portland, fragment, R. O. Albert. Uvalde Co.: Pablo's Cave, 2 ♂, 8 ♀, larvae, 5 April 1963, J. Reddell. Victoria Co.: 11 mi. S of Victoria, ♀, June, 1963, R. O. Albert. Wilson Co.: 4 mi. SE of Poth, "24 hours after a heavy rain following a long drought; out in daytime," 5 ♂, 2 ♀, many larvae, 16 June 1961, J. F. Quinlan, Jr.

Records of undetermined collections of the Spirostreptidae: ARIZONA—Yavapai Co.: southern part of county, ♀, 23 Aug. 1962, J. F. Quinlan, Jr. NEW MEXICO—Bernalillo Co.: near Río Puerco, W of Albuquerque, 5,600 ft. alt., ♀ and larvae, 23 July 1954, C. C. Hoff (Amer. Mus. Nat. Hist.). San Miguel Co.: north bank of Perro arm of Conchas Lake, ♀, 29 July 1959, D. B. Jester. Valencia Co.: ½ mi. S of pumice mine, near Grants, 7,200 ft. alt., ♀, 23 July 1953. 1 mi. E of Correo, 18 July 1953, C. C. Hoff (Amer. Mus. Nat. Hist.). DURANGO—5 mi. and 21 mi. SW of Torreón, 2 ♀, width 7–9 mm, 70–75 segments, 4 June 1955. HIDALGO—Jacala, in garden of hotel, ♀, width 5 mm, 75 segments, black-brown strongly annulated with yellow, 23 June 1954. MORELOS—Near Amacuzac, Highway 95, km. 134, ♀, inconspicuously annulated, width 6.2 mm, 62 segments, 27 June 1957. NUEVO LEON—Monterrey, 2 ♀, 15 April 1963, R. O. Albert. SAN LUIS POTOSÍ—30 km. S of Valles, ♀, width 6 mm, 77 segments, brown, 25 June 1954. SONORA—Hermosillo, ♀, width 8.5 mm, 70 segments, 4 Aug. 1959, L. W. Nichols. VERACRUZ—2 mi. E of Catemaco, 1100 ft. alt., ♀, width 6.5 mm, 48 segments, 21 July 1963, G. Ross (Zool. Mus., La. St. Univ.).

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PROCEEDINGS
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THREE NEW POLYDESMOID MILLIPEDS FROM CENTRAL AMERICA

By H. F. Loomis
Miami, Florida

A small collection of millipeds, found in colonies of army ants in Costa Rica and Panama by Mr. Roger D. Akre and Dr. and Mrs. Carl W. Rettenmeyer, has recently been received for identification. Only two species are included but one is new and is here described to make its name available to the collectors for use in their studies of these ants.

Two other new species also are presented; one from the Maya ruins of Tikal, Dept. of Peten, Guatemala, the ninth member of the genus *Aceratophallus.* The second species is from a small but interesting collection made by Dr. G. B. Fairchild, in a remote and previously uncollected area of Panama, at considerable elevation close to the Colombian border. This collection contains females of *Glomeridesmus, Cyrtodesmus, Trichomorpha, Siphonophora,* and an unknown, but probably new, genus of chelodesmid. A second species of *Trichomorpha,* of which a male fortunately is present, allows a description and illustrations of essential features.

The holotype and at least one paratype of each species have been deposited in the U. S. National Museum. Most of the paratypes of the new *Calymmodesmus* have been returned to the collectors.

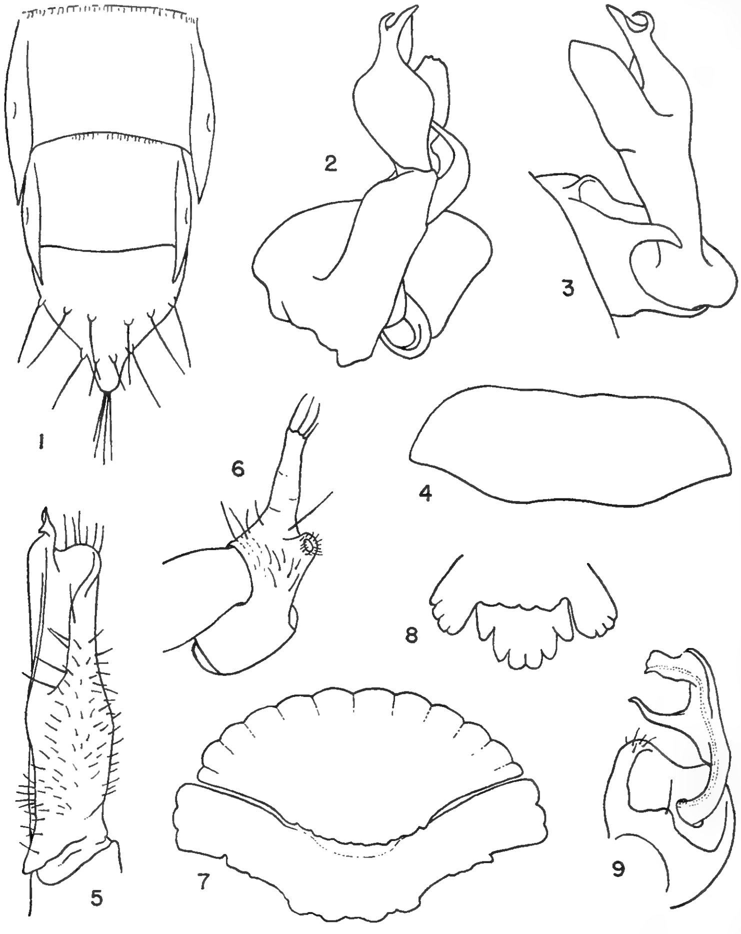
Family CHELODESMIDAE

Trichomorpha tacarcuna, new species

(Figs. 1–3)

Type specimen: Male holotype, U. S. National Museum 2983.

Type locality: Male and female collected from forest floor litter, elevation 1900 ft., Rio Tacarcuna, Darien Prov., Panama, 3–23 July 1963, by Dr. G. B. Fairchild, who stated that "the Rio Tacarcuna is a tributary



FIGS. 1–3. *Trichomorpha tacarcuna,* new species. 1, Segments 18–20 of male, the setae of segments 18 and 19 not shown; 2, Right gonopod, ventral view; 3, Same gonopod, lateral view. FIGS. 4–6. *Aceratophallus maya,* new species. 4, Segment 1 in outline; 5, Left gonopod, ventral view; 6, Left second coxa of male, cephalo-lateral view. FIGS 7–9. *Calymmodesmus montanus,* new species. 7, Segments 1 and 2 of male in outline, dorsal view; 8, Segments 19 and 20 of male in outline, dorsal view; 9, Right gonopod, mesal view.

of the Rio Pacto, which flows into the north side of the Rio Tuira, and is about 5–10 air-line miles from the Colombian border." It is also about due east of the town of El Real.

Diagnosis: Insofar as the structure of the gonopods is concerned, this species appears most closely related to *T. propinqua* Carl, from near Medellin, Colombia, although it is only half the body size. It seems to be unique in the genus in the dense curl of very long setae on joint 1 of the third male legs.

Description: Male 10 mm long, 1.2 mm wide; female about the same length but a little wider and more flattened, with legs shorter and heavier. Dorsum quite uniform medium brown, the raised outer rim of the keels darker.

Head with a fine median sulcus extending forward from near segment 1 to between the antennae, except for a short interruption near upper level of the sockets; surface of head with scattered erect setae, longest behind the labrum.

Body rather conspicuously setose on a few terminal segments, the intervening ones with smaller setae of which many appear to have been rubbed off and indicated only by the tiny supporting granules which are more evident in the male. Surface of segments shining, the metazonites of segments 6–16 with a shallow transverse median depression more evident on segments 7–14, but hardly noticeable in the female. Lateral keels of male rising somewhat obliquely from sides of dorsum, especially on posterior half of body; female keels less extensive and more horizontal; keels with two outer marginal setae; posterior corners of keels long and acute in male, shorter in female, those of segments 18 and 19 of both sexes produced straight back (Fig. 1).

Segment 1 with an anterior submarginal row of approximately 14–16 erect setae, including the large one in each outer angle; a median and posterior row present, each composed of 10–12 setae. Segments 2–4 with three rows of setae, the median one of about 10, others with 12–14. Ensuing segments with setae less evident and none of the rows with full complement. Segments 18 and 19 with setae greatly increased in number and length, indiscriminately scattered, those of segment 19 distinctly longer in both sexes, the posterior ones equalling or exceeding the tips of the lateral keels; all setae set on tiny but easily seen granules. Last segment with dorsal setae on tubercles as seen in Fig. 2, the setae much longer than those projecting behind segment 19.

Males with gonopods as shown in Fig. 3. First and second legs with the two outer joints heavier than on following legs, the penultimate joint with a produced ventral lobe. Third legs with coxal joint bearing a long, narrowly crescentic and very dense cluster of long curving setae so closely in contact, except at tips, as to give the appearance of forming a large tubercle; the cluster borne along the ventral portion of the joint, adjacent to the sternum, and curving around and halfway along the posterior side. Legs 4–7 unmodified.

Family RHACHODESMIDAE

Aceratophallus maya, new species

Type specimen: Male holotype, U. S. National Museum 2984.

Type locality: Two males collected 13 Sept. 1962, at Tikal, Dept. of Peten, Guatemala, by Gerard Pitt, Coconut Grove, Fla., who remarked that he had seen many individuals.

Diagnosis: Most closely related to *A. guatemalae* Chamberlin, as shown by the gonopods, but it is a smaller species. The completely granular metazonites also distinguish it from all other known species.

Description: Holotype 37 mm long, 5.5 mm wide; paratype 32 mm long, 4.8 mm wide. Color bright yellow throughout except that the prozonites are somewhat lighter and the ventral portions of the zonites and the two basal joints of the legs are colorless.

Head not granular, slightly finely rugulose on either side of the impressed vertigial sulcus which extends to between the antennae; below antennae the front more roughened and with more numerous erect setae. Joint 5 of antenna with a long narrow sensory area of dense fine setae extending close to the apical margin on the outer side; a smaller area, similarly placed, on joint 6.

Segment 1 with anterior margin almost straight, only a little undulated behind vertex of head; posterior margin triarcuate as shown in Fig. 4. Surface granular behind, as on other segments, but toward the anterior rim the granules decrease in size but not in number.

Segment 2 slightly wider than any other, its surface and that of ensuing metazonites to segment 18, evenly, densely and finely granular throughout except on the smooth and strongly shining outer rim of the keels. Segment 19 with granules poorly defined, especially on the anterior half. Last segment with surface smooth but not strongly shining. Ventral surface of keels faintly granular but that of metazonites, to the sternum, similar to dorsum. Dorsal arch low; a broad shallow transverse depression on segments 4–18; lateral keels almost horizontal, the outer margin, especially those with pores, slightly raised to about height of mid-dorsum; keels of segments 2–15 or 16 with an acute tooth at anterior corner; posterior corners nearly square, increasingly produced caudad from 16–18, but much reduced in size and projection on 19. Anal valves with numerous vertical striations beginning near margin of scale and continuing upward beyond middle; margins thin, strongly raised and shining. Preanal scale large, triangular, its apex slightly produced; two widely separated seta-bearing tubercles at the apical third.

Gonopods as shown in Fig. 5, the apex much less deeply divided than in any other species. Second legs of male with disto-mesal portion of coxa produced into a subcylindrical process about 2½ times as long as broad; thin and subtruncate at apex which bears three or four long setae; in front of the base of this process is a short, stout, subconic tubercle with an apical pore which apparently is the seminal opening

(Fig. 6). In other species where reference is made to the seminal process it appears to be the longer of the two shown in the figure.

Family STYLODESMIDAE

Calymmodesmus montanus, new species

Type specimen: Male holotype, U. S. National Museum 2985.

Type locality: An exceptional array of specimens collected in association with army ants at Monteverde, in the extreme northeast corner of the Province of Puentarenas, Costa Rica (10° 29′ N, 84° 50′ W), at an elevation of 1400 m, as follows—from Colony 295, *Labidus praedator* (F. Smith), 14 of both sexes, 1 Feb. 1963; 54 of both sexes, including holotype, 2 Feb. 1963; 2 males, 3 Feb. 1963; 16 of both sexes, 7 Feb. 1963, R. D. Akre; 9 of both sexes, 2 Feb. 1963; 25 of both sexes, 6–8 Feb. 1963, C. W. and M. E. Rettenmeyer; from Colony E-294, *Neivamyrmex sumichrasti* (Norton), 1 male, 21 Feb. 1963, R. D. Akre; 1 female, 21 Feb. 1963; 2 females, 1 young male, 22 Feb. 1963, C. W. and M. E. Rettenmeyer.

Diagnosis: Gonopods indicating closest relationship with the Mexican *C. biensifer* Loomis but the apex of the terminal branch of each gonopod is more truncate. Also it is a smaller species with outer marginal lobes of segment 1 more distinct.

Description: Largest male 7 mm long, 1.8 mm wide but the size usually is closer to 6.5 mm long and 1.5 mm wide, some 6 mm long; females a little broader than males of same length, the largest 8 mm long, 2 mm wide.

Vertex of head deeply and narrowly impressed throughout its length; either side irregularly roughened with quite indefinite tubercles of different sizes, those near back of head small and more distinct; side of vertex rather sharply angled, with a long tubercle beginning opposite the middle of the antennal socket directed obliquely outward and upward; behind this tubercle is one about half as long but equally projecting, the two tubercles deeply separated. Front of head strongly contrasting with vertex, being whiter, very smooth and shining, densely and finely setose, but not separated from vertex by an impression.

Expanded margin of segment 1 long, horizontal and composed of 12 areas sharply defined by channels that are longer and even more impressed on ventral surface; outer area on each side about half as wide as the next; marginal areas ending in nearly uniform crenations (Fig. 7). Median area strongly convex, with 10 prominent primary tubercles, the inner two of each row usually largest; secondary tubercles distinct, scattered and about equal in size.

Ensuing segments with dorsum of males strongly convex, more so than in females, the lateral keels set low on the sides and obliquely descending. Primary tubercles large and well defined, only slightly higher on the posterior quarter of body but reduced on segment 18; low and not well marked on segment 19; last segment with surface roughened, at most indistinctly granular. Segment 18 with posterior corners more angular than rounded. Last two segments shown in outline in Fig. 8.

Gonopods as shown in Fig. 9. Males without unusual modifications of anterior legs or sterna.

Cynedesmus trinus Loomis

A male of this species collected in Colony E-316 of *Eciton hamatum* (Fabricius), 2 March 1963, Barro Colorado Island, C. Z. by R. D. Akre. The species previously has been reported in association with *Neivamyrmex mexicanum panamense* Borgmeier, on the same island.

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PROCEEDINGS
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A NEW CAVE-DWELLING CRAYFISH FROM THE GREENBRIER DRAINAGE SYSTEM, WEST VIRGINIA (DECAPODA, ASTACIDAE)

By Horton H. Hobbs, Jr.
Smithsonian Institution, Washington 25, D.C.

The reduced size of the eyes, the white or pale color of the body, and the elongate, comparatively slender chela of this denizen of the caves in the Greenbrier drainage system distinguish it from the only other crayfish known to frequent caves in the area. Although *Cambarus b. bartonii* (Fabricius, 1798: 407) has been found in not too distant caves, the two species have been observed in the same one only in McFerrin's Water Cave (see below).

Too little is known concerning the habits and range of the new species to determine whether or not it is a member of the troglobitic fauna. In spite of the fact that all of the available specimens have been collected from caves, the presence of pigment in the eyes and in the body (except in the holotype) suggest that this crayfish is a troglophile with habits similar to those of *Cambarus tenebrosus* Hay (1902: 232) and *C. bartonii laevis* Faxon (1914: 391). Superficially, it resembles *C. tenebrosus*, *C. cahni* Rhoades (1941: 146), and cave-dwelling members of *C. bartonii bartonii*, but it is suspected that its closest affinities are with *Cambarus sciotensis* Rhoades (1944: 96) and *Cambarus robustus* Girard (1852: 90).

Cambarus nerterius,[1] sp. nov.

Diagnosis: Color white, pale tan, or pale blue; eyes reduced but with pigment; rostrum with slightly convergent margins, angular or subangular at base of acumen but without spines or prominent tubercles; postorbital ridges well developed and terminating cephalically in small acute tuber-

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[1] Nerterius, Gr.—underground; so named because as far as is known this species is confined to subterranean streams.

cles; suborbital angles acute; carapace with or without lateral spines or acute tubercles; areola 3.5 to 6.2 times longer than broad and constituting 37 to 40 per cent of total length of carapace; chela of male 3.3 to 3.5 times longer than greatest width, inner margin of palm with a single, non-cristiform row of tubercles, and fingers not gaping. First pleopod with terminal elements directed caudad at approximately right angles to main shaft of appendage; central projection with a subterminal notch and inflated mesial process with a small terminal projection.

Holotypic Male, Form I: Color "white" (personal communication from Miss Zotter); eyes reduced in size but with distinct pigment areas. Body subcylindrical, only slightly depressed. Abdomen narrower than thorax (21.3 and 25.7 mm in widest parts respectively). Greatest width of carapace slightly anterior to midlength of areola.

Areola moderately broad, 6.2 times longer than wide with five or six punctations across narrowest part. Cephalic section of carapace 1.4 times longer than areola; length of areola 40.4 per cent of entire length of carapace. Rostrum with slightly thickened and gently converging margins forming angles at base of moderately long acumen; upper surface slightly concave with the usual submarginal row of setiferous punctations, cephalomedian area slightly elevated but with no distinct carina; scattered setiferous punctations elsewhere. Acumen with corneous upturned tip extending cephalad slightly beyond distal margin of penultimate segment of antennule. Subrostral ridges weakly developed and scarcely evident in dorsal aspect. Postorbital ridges well defined, each with a prominent groove and terminating cephalically in acute tubercles. Suborbital angle well defined and acute. Branchiostegal spine small but acute. Surface of carapace punctate dorsally and granulate laterally, granules becoming tuberculate cephalolaterally. Usual lateral spines on carpace tuberculiform; a prominent longitudinal row of tubercles immediately ventral to cephalic portions of cervical groove.

Abdomen slightly longer than carapace (53.1 and 52.2 mm). Cephalic section of telson with two spines in sinistral corner and three in dextral.

Epistome (Fig. 6) with elevated, undulating margins and provided with cephalomedian prominence. Antennules of the usual form with a small spine on lower surface of basal segment slightly distal to midlength. Antennae broken but extending caudad to base of telson. Antennal scale (Fig. 4) moderately broad with heavy lateral portion terminating cephalically in a distinct spine; mesial margin of lamellate portion with a gently rounded contour.

Right chela (Fig. 2) distinctly elongate, subovate in cross section and with palm only slightly inflated; left chela apparently regenerated. All surfaces bearing punctations, many with short setae. Inner margin of palm with a row of nine low tubercles flanked by a row of punctations above; no other tubercles on palm except those associated with articular areas; lower distal margin of palm with the usual large tubercle at base of dactyl. Fingers not gaping and both with submedian longitudinal

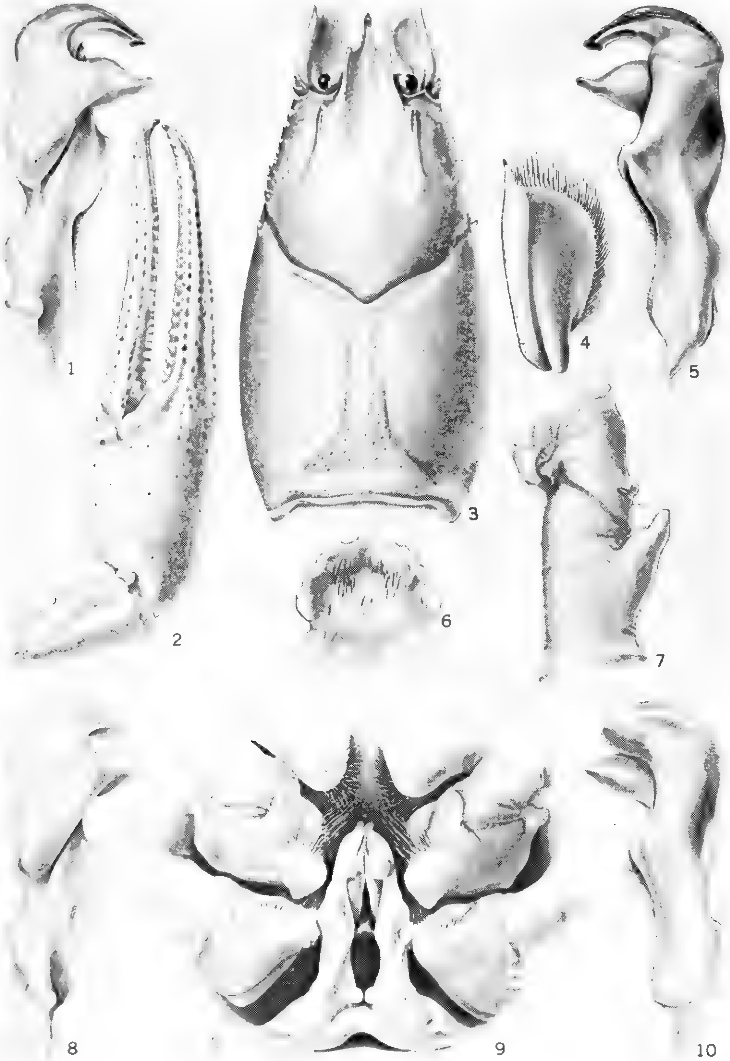

PLATE I. *Cambarus nerterius*, sp. nov. 1, Mesial view of first pleopod of holotype; 2, Distal podomeres of cheliped of holotype; 3, Dorsal view of carapace of holotype; 4, Antennal scale of holotype; 5, Lateral view of first pleopod of holotype; 6, Epistome of holotype; 7, Basipodite and ischiopodite of third pereiopod of holotype; 8, Mesial view of first pleopod of morphotype; 9, Bases of fourth and fifth periopods and first pleopods of holotype; 10, Lateral view of first pleopod of morphotype.

elevations above and below. Opposable margin of immovable finger with two rows of tubercles—an upper row of 10 along promixal three-fifths of finger and the lower of eight along middle third of finger; tubercles of both rows diminish in size distally. Opposable margin of dactyl also with two rows of tubercles, an upper row of 18 along proximal four-fifths of finger and a lower row of five along middle third. Opposable margin of both fingers with minute denticles between and distal to aforementioned tubercles. Mesial margin of dactyl with a row of five tubercles near base.

Carpus distinctly longer than broad with an oblique furrow on upper surface; upper surface punctate. Mesial surface with a single large tubercle and a small one near proximal margin; lower surface with the usual two marginal tubercles and an additional one proximal to the more mesial of the two.

Upper distal surface of merus with three tubercles, two of which conspicuously larger than third; lateral and mesial surfaces with a few scattered punctations; lower surface with a mesial row of nine tubercles and a lateral one of three. Ischiopodite with a ventral row of four small tubercles; punctate elsewhere.

Hooks (Fig. 7) on ischiopodites of third pereiopods only; hooks strong and simple; tips extending proximad of distal margin of basipodites. Caudomesial surfaces of coxopodites of fourth pereiopods with prominent projections (Fig. 9); coxopodites of fifth pereiopods without prominences.

First pleopods (Figs. 1, 5, 9) symmetrical and extending cephalad to coxopodites of third pereiopods when abdomen is flexed. Tips terminating in two parts reflexed at angles of about 90 degrees. Mesial process noncorneous and notched near apex.

Morphotypic Male, Form II: Differs in few details from the holotype. Color pale tan above, cream below; appendages cream but pale blue basally. Rostrum with a pair of minute tubercles at base of acumen; lateral surface of carapace with several tubercles although one distinctly larger than others; antenna extending caudad to sixth abdominal segment; cephalic section of telson with only one spine in each caudolateral corner. Inner margin of palm of chela with a row of 10 tubercles; opposable margin of immovable finger with a single row of 14 tubercles and a larger one situated below row between 11th and 12th tubercles from base; opposable margin of dactyl with a single row of 15 tubercles and a single large one situated below row between 5th and 6th tubercles from base; lower mesial margin of carpus with a row of 14 tubercles. First pleopod as figured (Figs. 8, 10).

Allotypic Female: Differs from the holotype in the following respects: Color two days after preservation as in morphotype. Rostrum with a minute tubercle at sinistral base of acumen; lateral surface of carapace with strongly reduced lateral tubercles. Inner margin of palm of chela with eight tubercles; opposable margin of immovable finger with a single row of six tubercles and one below it at base of distal third of finger;

opposable margin of dactyl with a row of six tubercles; minute denticles along opposable margins of both fingers occurring in single rows; upper distal surface of merus with only two tubercles and lower mesial margin with a row of 11. Cephalic section of telson with two spines in each caudolateral corner.

Annulus ventralis much broader than long with a narrow, longitudinal, cephalomedian depression which expands near midlength of annulus into a subovate depressed area. Caudal wall not thickened or elevated (ventrally). Sinus originating sinistrally along caudal margin of depression, extends mesially and slightly cephalically just across median line where it suddenly turns caudosinistrally to cut caudal wall of annulus along median line.

Measurements: As follows, in millimeters:

	Holotype	*Allotype*	*Morphotype*
Carapace—			
Height	21.7	12.8	16.8
Width	25.7	15.2	19.1
Length	52.2	34.4	42.4
Rostrum—			
Width	7.5	5.7	6.2
Length	10.3	7.0	7.8
Areola—			
Width	3.5	2.3	3.1
Length	21.1	13.0	16.2
Chela—			
Length of inner margin of palm	14.7	6.5	8.7
Width of palm	13.0	6.5	11.1
Length of outer margin of hand	50.4	22.3	36.2
Length of dactyl	32.2	14.1	22.6

Type Locality: Matt's Black Cave, 2 miles south of Renick, Greenbrier County, West Virginia; about 400 feet from the entrance to the cave. Collected 1 July 1962 by Miss Hermine Zotter.

Disposition of Types: The holotypic male, form I, the allotypic female, and the morphotypic male, form II, are deposited in the U. S. National Museum (Nos. 111295, 111296, 111297, respectively). The paratypes, comprising 2 males, form II, 2 females, 2 juvenile males, and 2 juvenile females, are also in the same collection.

Specimens Examined: All of the specimens were collected in Greenbrier County, West Virginia. The holotypic male, as indicated above, was collected on 1 July 1962 by Miss Zotter; a female, a juvenile male, and a juvenile female were taken from the type locality on 17 June 1963 by Mr. John A. Stellmack. Two second form males were collected in Ludington Cave, about 5 miles north of Lewisburg and 2 miles east of

Rt. 219 by Mr. John R. Holsinger. These specimens were found in a stream about ½ mile from the entrance of the cave. On 20 July 1963, Mr. Holsinger collected an additional female from the type locality and a second female from McFerrin's Water Cave; on 17 August 1963 he secured a first form male from General Davis Cave. A juvenile male was found by Mr. Lyle G. Conrad in McClung Cave, also about 5 miles north of Lewisburg, some 2,500 feet from the entrance and in a pool about 5 inches deep. Mr. Conrad collected one second form male, two females, and a juvenile female from McClung Cave on 12 April 1963; the three larger specimens were found some 1.5 miles from the entrance in "Chocolate Avenue"; the smaller one was found in a dry stream bed.

Relationships: *Cambarus nerterius* probably has its closest affinities with *Cambarus sciotensis* Rhoades and *C. robustus* Girard. It differs from the former most conspicuously in lacking thickened rostral margins, and from the latter by the suddenly contracted margins at the base of the acumen. The similarities are in the comparatively broad areola with many punctations and in the conformation of the elongate chela of which the immovable finger is somewhat costate laterally and bears a depression above and below at its base. Superficial resemblance to *C. tenebrosus* Hay and *C. cahni* Rhoades are perhaps results of adaptations to similar environments.

Acknowledgments: I am most grateful to Miss Hermine Zotter, Mr. John R. Holsinger, Mr. Lyle G. Conrad, and Mr. John A. Stellmack for their interest in collecting the specimens on which the above description is based and for donating them to the U. S. National Museum. I also wish to thank Mrs. Carolyn B. Lutz for the excellent illustrations.

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NOTES ON SOME MALLOPHAGA FROM FORMOSAN MAMMALS

By K. C. Emerson
Arlington, Virginia

This is a report on a small collection of Mallophaga, taken during the period 1957–1962, from native mammals on Formosa. This collection constitutes a part of materials taken in a broad program supporting epidemiologic and biomedical studies related to parasite infections and parasite diseases of man and animals. This work was supported in part by funding under Public Law 480, Section 104(c).

Mallophaga were obtained from hosts examined by personnel of the Parasitology Department of the U. S. Naval Medical Research Unit No. 2, Taipei, Taiwan (Formosa) under the direction of Dr. Robert E. Kuntz, Captain, MSC, USN. Representative specimens of this collection are now in the U. S. National Museum. Host identifications were provided by Dr. David H. Johnson, Curator, Division of Mammals, U. S. National Museum.

Felicola juccii (Conci, 1942)

Paradoxuroecus juccii Conci, 1942. Bull. Soc. Ent. Ital., 74: 141.

From *Paguma larvata taivana* Swinhoe, 1862; Wu-lai, Taipei Hsien, 12 January 1960 and 14 March 1962; and Lo-tung, I-lan Hsien, 17 November 1959 and 14 March 1962.

The Formosan specimens agree with specimens from *Paguma larvata grayi* (Bennett), the type host as illustrated by Conci (1947).

Felicola rohani Werneck, 1956

Felicola rohani Werneck, 1956. Rev. Brasil. Biol., 16 (1): 25, figs. 1–5.

From *Herpestes urva* Hodson, 1836; Fen-lin, Hua-lien Hsien, 15 April 1960; and I-lan, I-lan Hsien, 8 December 1959.

Type host for this species is *Herpestes edwardsi edwardsi* (Geoffroy). Hopkins (1960) recorded this species from *Herpestes auropunctatus* *siamensis* (Kloss), after careful comparison of material from the two hosts. The specimens from *Herpestes urva* have been compared with specimens from *Herpestes auropunctatus siamensis* identified by Hopkins, and no significant differences were found.

Tricholipeurus indicus Werneck, 1950

Tricholipeurus indicus Werneck, 1950. Malofagos de Mamiferos, 2: 177, figs. 267–272.

From *Muntiacus reevesi micrurus* Sclater, 1875; Fen-lin, Hua-lien Hsien, 1 April 1960; Chun Yang, 29 January 1958; and Taipei, 23 December 1957.

These specimens agree with Werneck's description and illustrations based on specimens from *Muntiacus muntjak* (Zimmermann), the type host.

Bovicola thompsoni Bedford, 1936

Bovicola thompsoni Bedford, 1936. Onderstepoort J. Vet. Sci., 7: 42, fig. 10.

From *Capricornis swinhoei* Gray, 1862; Pu-li, Nan-tou Hsien, 9 June 1960; Fu-yuan, Hua-lien Hsien, 14 April 1960; Tung-men, Hua-lien Hsien, 13 April 1960; Jui-hui, Hua-lien Hsien, 3 April 1960; Lung-chien, Hua-lien Hsien, 2 March 1960; Pu-li, Nan-tou Hsien, 24 September 1959; and Chou-sheh, Nan-tou Hsien, 25 April 1959.

The type host for this species is *Capricornis sumatraensis* (Bechstein). The type, a female, has been illustrated by Werneck (1950); and the specimens from *Capricornis swinhoei* agree with those illustrations. The male of *Bovicola thompsoni* from the type host is unknown. The male of the Formosan specimens possess genitalia of the type illustrated by Werneck (1950) for *Bovicola dimorphus* Bedford, 1939.

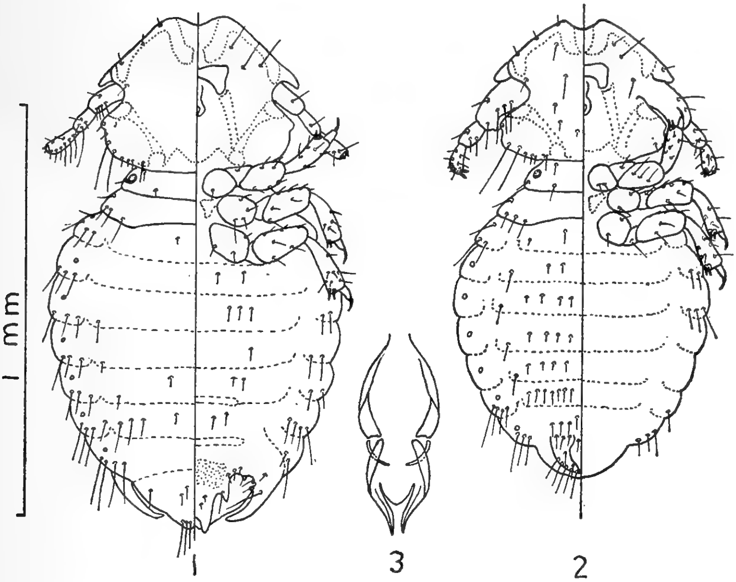
Trichodectes kuntzi n. sp.

From *Melogale moschata subaurantiaca* Swinhoe, 1862; Shih Pa-fen, Taipei Hsien, 19 March 1962; and Tung-men, Hua-lien Hsien, 10 April 1960.

Holotype male: Head slightly wider than long. Anterior margin of head with a wide shallow osculum. First antennal segment wide, and as long as combined length of second and third segments. First antennal segment with four long setae and a short blunt appendage. Terminal antennal segment each with two short stout peg-like spines. Dorsal and ventral chaetotaxy of head as shown in Fig. 2.

Thoracic and abdominal segments short, with weakly sclerotized tergites and sternites. Abdomen slightly longer than wide, with six pairs of spiracles. Chaetotaxy sparse as shown in Fig. 2. Terminal abdominal segments distinctive in structure and chaetotaxy as shown in Fig. 2.

Male genitalia as shown in Fig. 3.



FIGS. 1–3. *Trichodectes kuntzi* n. sp. 1, Dorsal-ventral view of female; 2, dorsal-ventral view of male; 3, male genitalia. Marginal scale applies to Figs. 1 and 2.

Allotype female: Except for antenna, larger but of the same general shape as in the male. Antennae filiform, with chaetotaxy as shown in Fig. 1. Fewer dorsal setae on the head than in the male.

Thoracic and abdominal segments short, with weakly sclerotized tergites and sternites. Abdomen as wide as long; with six pairs of spiracles. Chaetotaxy sparse, even less than in the male, as shown in Fig. 1. Terminal abdominal segment as shown in Fig. 1.

Discussion: This species is closest to *Trichodectes emersoni* Hopkins, 1960, found on *Helictis orientalis everetti* Thomas. In both sexes, the chaetotaxy of *T. kuntzi* is considerably more dense than in *T. emersoni*. The male genitalia of the two species are similar, but in *T. kuntzi* the parameres are separated by a distinct rounded structure which is probably a primitive basal plate. The heavy lateral margins of the genital opening on the male are distinctive and not found in other species of the genus.

Type material: Holotype male (USNM 67139), allotype female and 10 paratypes collected off *Melogale moschata subaurantiaca* Swinhoe, 1862, at Shih Pa-fen, Taipei Hsien; and 31 paratypes collected at Wu-lai, Taipei Hsien, Formosa.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF *COPTOPSYLLA* JORDAN AND ROTHSCHILD, 1908, FROM NORTHERN SAUDI ARABIA WITH COMMENTS AND A KEY TO THE GENUS (SIPHONAPTERA : COPTOPSYLLIDAE)[1,2]

By Robert E. Lewis
American University of Beirut, Beirut, Lebanon

The Trans-Arabian Pipeline Company recently made it possible for me to conduct a limited flea survey on and near their four major pumping stations at Turaif, Badanah, Rafha and Qaisumah, Saudi Arabia. Detailed reports of the fleas (Lewis, 1964) and mammalian hosts (Lewis, Lewis and Harrison, in press) are appearing elsewhere. Specimens of a new species of flea belonging to the genus *Coptopsylla* J. and R., 1908, were collected during the trips and due to the additions to our knowledge of the genus since the appearance of the publications by Ioff (1953) and Hopkins and Rothschild (1956) it seems desirable not only to describe the species but also to review the recent literature.

Coptopsylla joannae, new species

Diagnosis: Near *Coptopsylla bairamaliensis* Wagner, 1928, from which it differs in the male in the following points: a) body bristles not particularly coarse; b) L^2 of fixed process nearly as broad as in *bairamaliensis* but lacking the conspicuous caudal angle of that species; c) movable process triangular, only 2½ times as long as wide; d) apical portion of St. IX triangular, heavily setose on both dorsal and ventral margins, but less so than in *C. bairamaliensis.* In the female, *C. joannae* differs from *C. bairamaliensis* in the following points: a) St. VII with apical margin almost straight; b) bulgae of spermathecae globular, not very angular; c) hilla 1¼ times the length of the bulga; d) lower antepygidial seta 2½ times as long as the upper.

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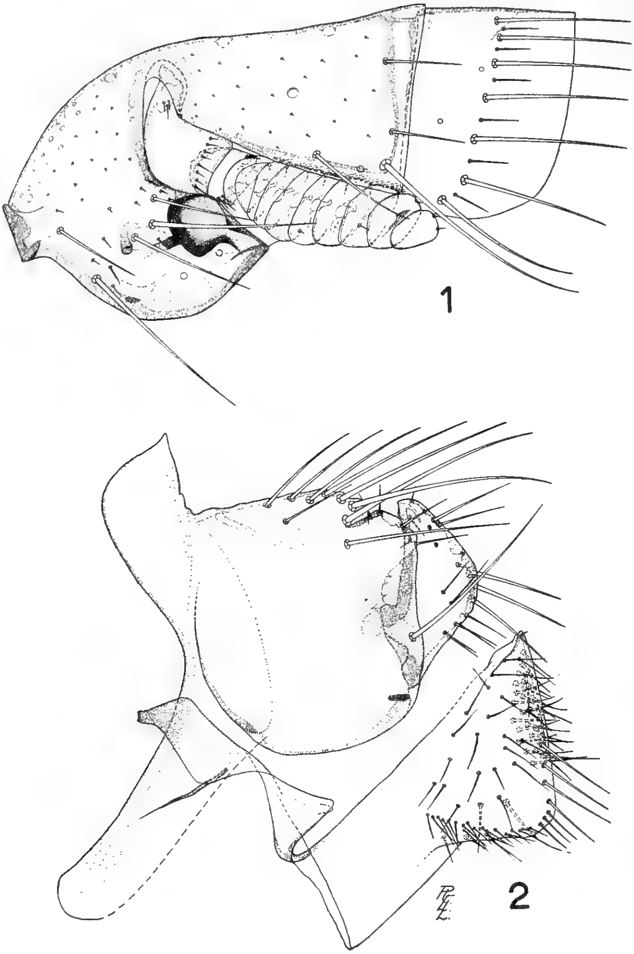
[1] Publication number 7 of the American University of Beirut Museum of Natural History.

[2] Portions of this work were supported by an Arts and Sciences Rockefeller Research Grant.



FIGS. 1–2. *Coptopsylla joannae* n. sp. 1, Head of holotype ♂. 2, Modified abdominal segments of holotype ♂.

Description: HEAD (Fig. 1, male)—Clypeus well developed, strongly sclerotized. Ventral region of frons not strongly sclerotized, with numerous microsetae. Gena ventrally markedly convex. Eye ovoid, heavily pigmented. Antennal fossa open nearly to its dorsal margin, with a row of small setae extending along its dorsal margin nearly the entire length of the clava. First antennal segment with a proximal patch of 3 (rarely 1, occasionally 2) small setae and a distal row of 8 (5 to 9) slightly longer ones. Ocular row composed of three large and one or two small setae.

Preocular row consistently of two large setae: one arising near the base of the clypeus, the other before and above the eye. Occipital row of three setae per side, the lowest being 2½ to 3 times as long as the remaining two. One preoccipital seta present, arising near dorsal margin of the antennal fossa. Maxillary palpi extending to middle of fore trochanter. Maxillary stipes barely as long as basal segment of labial palpi. Labial palpi 5-segmented. One seta of segment 1 longer than segment 2; 1 seta of segment 2 longer than segment 3; no setae of segments 3 and 4 longer than the following segment. The whole of segment 5 extending past distal margin of the trochanter.

THORAX—Pronotum on each side with one row of 7 (6 in three of ten males) large setae, mesonotum with one row of 6 (5 in three males) large setae, metanotum with one row of 5 to 7 large setae. Lateral metanotal area distinct, with two large setae arising in the center. Mesosternosome with 5 large setae. Metepisternum with a single seta near its dorsal apex. Metepimeron with 5 large setae, 2 in the prespiracular row and 3 in the spiracular row.

LEGS (Prothorax)—Anterior margin of prothoracic coxae devoid of setae except for two which protect the coxal-trochanteral joint. Posterior border with 3 or 4 setae on the dorsal margin and a pair of larger ones on the caudo-apical angle. Between these two setae projects a small, papillate extension of the coxal margin in both sexes. Below it the apex of the coxa extends ventrad forming a flap which almost completely covers the trochanter. The inner surface of this flap bears a horizontal row of 4 minute setae. Outer surface of coxa with 12 to 14 setae of variable size. Inner surface without setae. Femur with 2 setae on inner surface and 7 setae on outer surface arranged in two diagonal transverse rows in addition to the setae of the dorsal margin. Tarsal segment V with six pairs of lateral plantar bristles and two pairs of subapical plantar bristles in ten males, six pairs of lateral plantar bristles and one pair of subapical plantar bristles in fourteen females (one specimen had an additional subapical plantar bristle on one side).

(Mesothorax)—Setae of mesothoracic coxae restricted to anterior margin and apex; about 10 in number. Nine to 11 small setae along dorsal margin of the femur with three smaller submarginal setae below them on the outer surface. No other vestiture on outer surface of femur except 3 or 4 setae which are situated near the ventral margin on the distal half of the segment. Inner surface of the femur lined with a row of about 6 to 8 setae distributed longitudinally near the ventral margin. Caudal margin of tibia with seven indentations including apical notch. Each notch except numbers 5 and 7 bears two strong setae while 5 and 7 possess three strong setae. Outer surface with a longitudinal row of 4 smaller setae. Inner surface bare. Tarsal segment I slightly shorter than segment II. Segment II slightly shorter than segments III and IV combined. One apical seta of segment II extending to apex of segment III. Segment V with six pairs of lateral plantar bristles and two pairs of

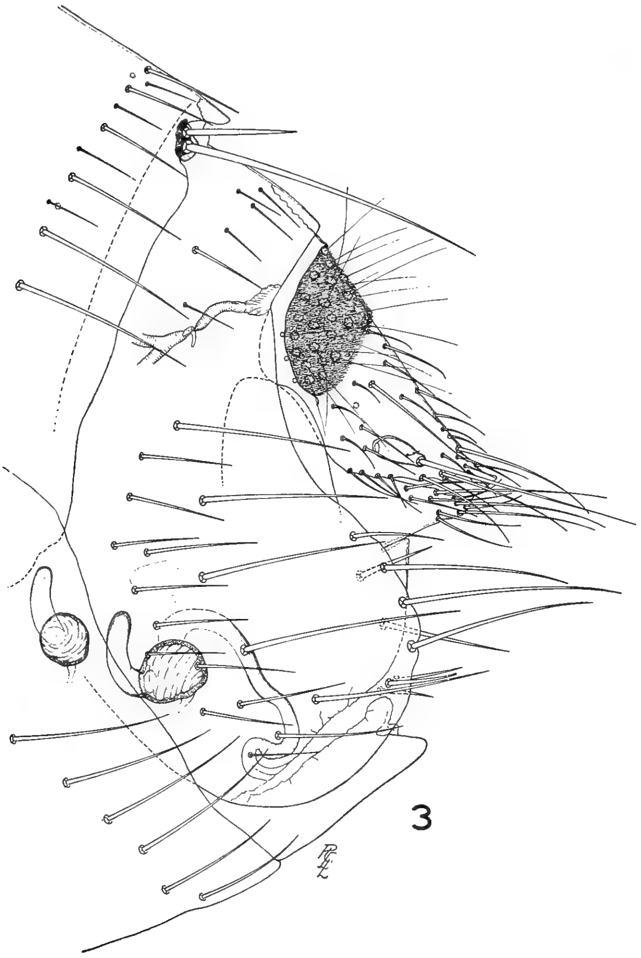
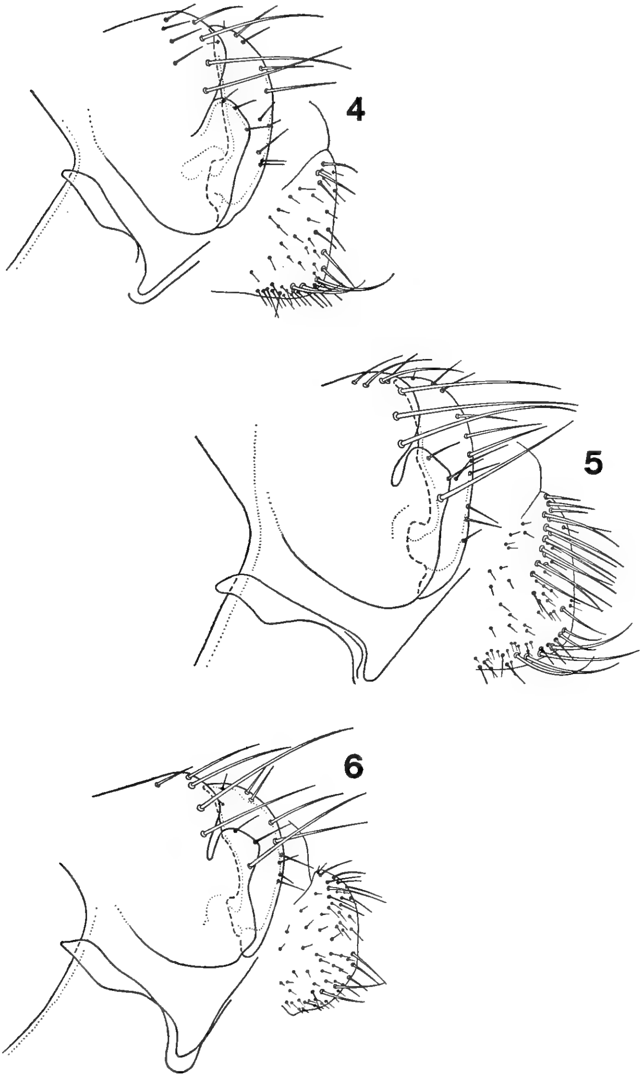


FIG. 3. *Coptopsylla joannae* n. sp. Modified abdominal segments of allotype ♀.

subapical plantar bristles (one and one-half [3] in 20%) in the males; six pairs of lateral plantar bristles and one pair of subapical plantar bristles in the females.

(Metathorax)—Setae of metathoracic coxae also restricted to anterior margin and apex; about 13 in number. In addition the mesal surface bears a vertical row of 4 or 5 submarginal setae. Twelve to 14 small setae along dorsal margin of femur with three smaller submarginal setae below them on the outer surface. Three additional setae near the ventral



FIGS. 4–6. *Coptopsylla lamellifer*. 4, *C. l. lamellifer* (Wagner, 1895) redrawn from Ioff, 1953. 5, *C. l. rostrata* Ioff and Tiflov, 1934, redrawn from Ioff, 1953. 6, *C. l. ardua* Jordan and Rothschild, 1915, redrawn from Ioff, 1953.

margin on the distal half of the femur. Inner surface of the femur lined with a longitudinal row of ten setae near the ventral margin. Tarsal segment I 1½ times as long as segment II; segment II slightly longer than segments III and IV combined. At least one long bristle of segment I extending to apex of segment II; two long bristles of segment II extending past the tip of segment V. Tarsal segment V with six pairs of lateral plantar bristles and one pair of subapical plantar bristles in the males. Of 14 females all but one have six pairs of lateral plantar bristles (the exception possesses 6 pairs on one tarsus and 5½ pairs on the other). While 11 females have one pair of subapical plantar bristles, one specimen has but one on each tarsus and two more lack one bristle of the pair on one tarsus.

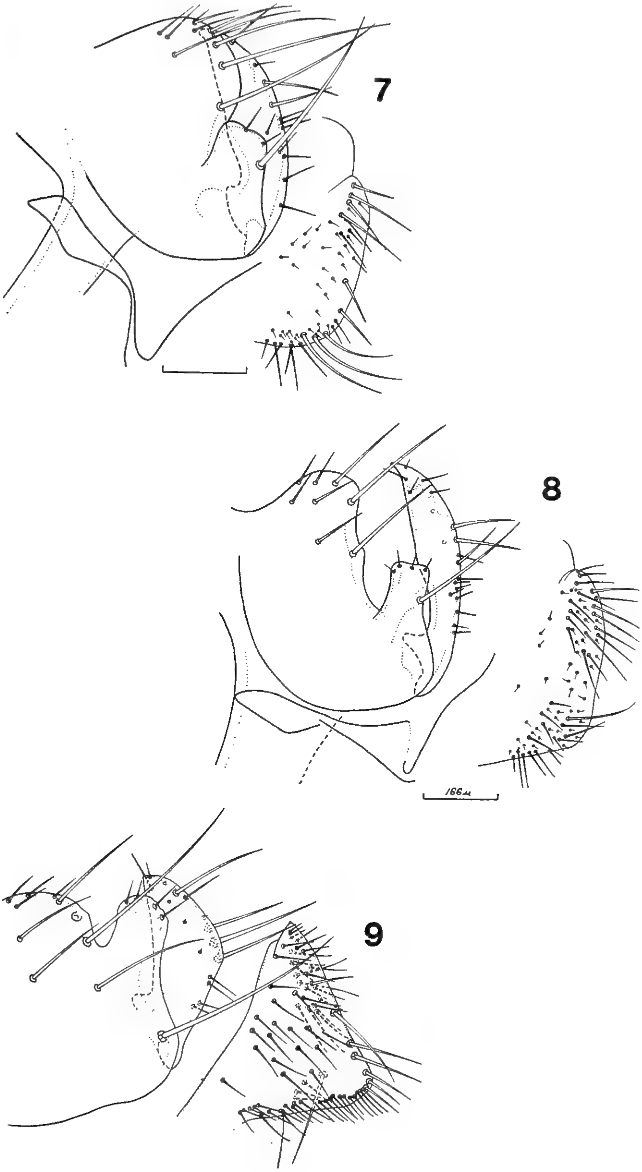
ABDOMEN—All unmodified abdominal tergites and sternites with but one row of setae. Setae on tergites I to VII in males: 5 (5–6), 7 (6–8), 6–7, 6 (6–7), 6 (5–7), 6 (5–6), 5 (4–6); females: 5 (5–6), 7 (6–9), 7 (6–8), 7 (6–8), 7 (5–8), 6 (5–7), 6 (4–6). Setae on sternites II to VIII in males: 1, 3 (2–4), 3 (2–3), 3 (2–3), 3 (2–3), 3 (2–4), 6 (5–8); on sternites II to VII in females: 1, 4 (3–5), 3 (3–5), 3 (2–5), 3–4, 6 (5–7). Males possess a patch of 2 to 5 small setae well up on the side of sternite II while in females there may be from 5 to 10 of these. In some cases they form a vertical row extending from the ventral margin about two-thirds the height of the sternite. Antesensilial setae two per side in both sexes, borne on a tuberculate projection of tergum VII, subequal, the lower seta 2½ times as long as the upper. Modified abdominal segments of holotype male and allotype female as shown in Figs. 2 and 3, respectively.

Length: ♂ 1.7 to 2.5 mm; ♀ 2.5 to 3.5 mm.

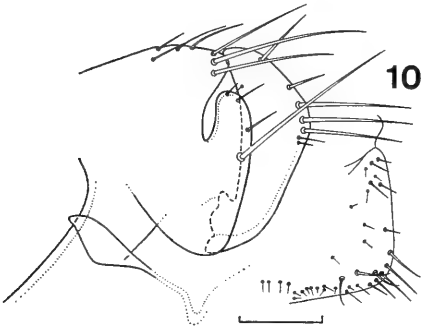
Types: Holotype ♂, allotype ♀ and 2 male and 1 female paratypes, Saudi Arabia: 5 km SSE Badanah, from *Meriones libycus syrius* nest, 24 Dec. 1962. Paratypes as follows: 1♂ and 4♀♀ ex *Vulpes rueppelli*, 40 km W Badanah, 27 Dec. 1962; 1♂ ex *Meriones crassus crassus*, Badanah, 27 Dec. 1961; 1♂ ex *Jaculus jaculus*, 15 km W Badanah, 28 Dec. 1961; 1♂ and 1♀ ex *Meriones libycus syrius* nest, 5 km SSE Badanah, 26 Dec. 1962; 1♀ ex *Meriones c. crassus*, Badanah, 26 Dec. 1962; 1♂ ex *Vulpes rueppelli*, 40 km W Badanah, 28 Dec. 1962; 1♀ ex *Gerbillus cheesmani*, 5 km W Turaif, 4 Jan. 1963; 2♂♂ ex *Meriones c. crassus*, Rafha, 20 Dec. 1962; 3♀♀ ex *Gerbillus dasyurus*, 8 km W Rafha, 21 Dec. 1962 and 2♀♀ ex *Meriones tristrami kariateni*, Palmyra, Syria, 13 Jan. 1962.

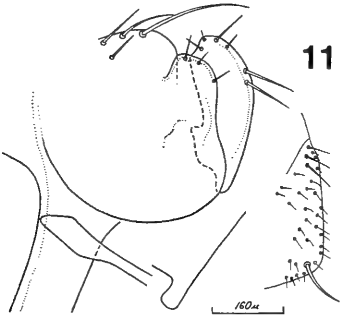
Holotype, allotype and two male and two female paratypes deposited in the British Museum (Natural History) collection of fleas at Tring. Paratypes in the collections of the United States National Museum, Washington, D.C.; Dr. Robert Traub, Bethesda, Maryland; and the Anti-Plague Institute of the Caucasus, Stavropol, U.S.S.R.

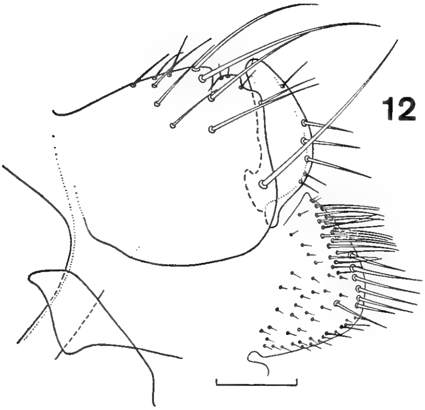
Remarks: *Coptopsylla joannae* appears to be a fairly common flea associated with the rodent populations of north-central Arabia. Collection



FIGS. 7–9. *Coptopsylla* sp. 7, *C. lamellifer dubinini* Ioff, 1950, redrawn from Ioff, 1953. 8, *C. arax* Isayeva-Gurvich, 1950, redrawn from Isayeva, 1956. 9, *C. smiti* Hubbard, 1956, redrawn in modified form from photocopy of original by F. G. A. M. Smit.







FIGS. 10–12. *Coptopsylla* sp. 10, *C. bondari* Ioff, 1946, redrawn from Ioff, 1953. 11, *C. caucasica* Isayeva-Gurvich, 1950, redrawn from Isayeva, 1956. 12, *C. bairamaliensis* Wagner, 1928, redrawn from Ioff, 1953.

records are not sufficient to supply much information about its general distribution but it probably occurs throughout the stony desert and desert steppe region of Syria, Jordan, northern Arabia and possibly western Iraq. The occurrence of the rather distantly related *C. smiti* Hubbard (1956) in Iraq suggests that more collecting in the desert and semidesert portions of the Middle East may yield additional members of this genus.

The new species described above is named in honor of my wife, Joanne, whose tireless efforts both in the field and in the laboratory have been of priceless assistance to me.

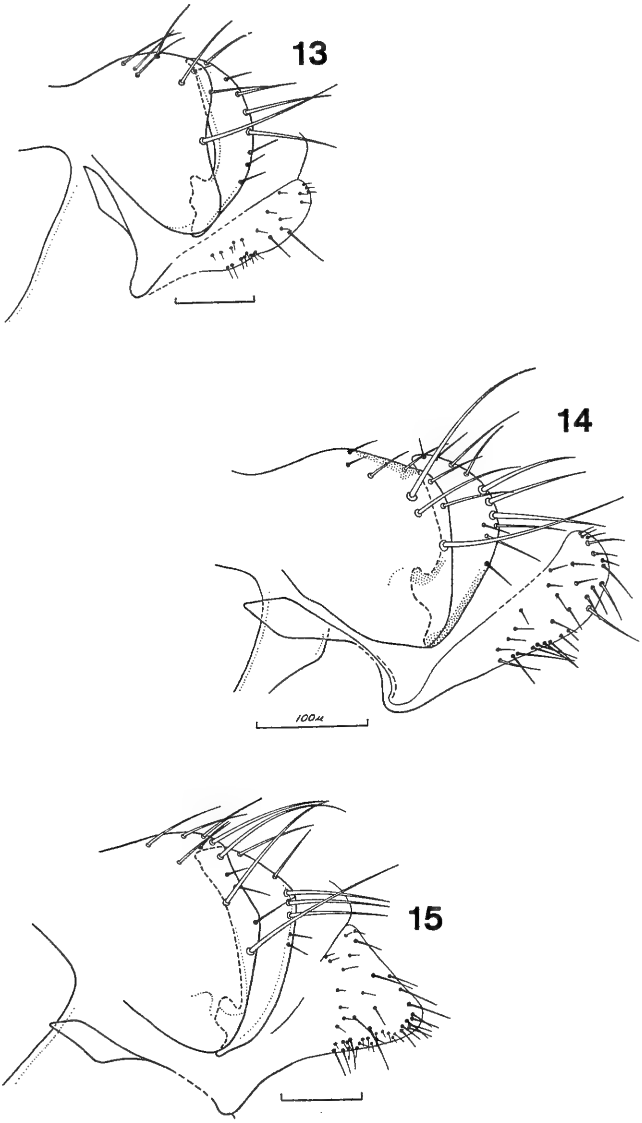
Discussion

It is certainly not practical to attempt a revision of the genus *Coptopsylla* at this time, because of the limited number of specimens available for study. Hopkins and Rothschild (1956) give a total of 33 specimens in the collection of the British Museum (Natural History) representing but seven of the nine species and subspecies in the Catalogue. Even now there are but 52 specimens in the collection representing ten of the 16 known species and subspecies.

Due to the difficulty of obtaining Russian literature, the work of Ioff (1953) was not available for consideration when the Catalogue was prepared. Ioff's work lists 13 species and subspecies and is by far the most comprehensive consideration of the genus to date. Given below is a comparison of the listings given in these two works.

Ioff, 1953:		Hopkins and Rothschild, 1956:
C. lamellifer lamellifer (Wagner, 1895)		*C. lamellifer lamellifer*
C. lamellifer rostrata Ioff & Tiflov, 1934		*C. lamellifer rostrata*
C. lamellifer fallax Ioff & Tiflov, 1934	=	*C. lamellifer ardua* J. & R., 1915
C. lamellifer dubinini Ioff, 1950		
C. lamellifer arax Isayeva-Gurvich, 1950		
C. bondari Ioff, 1946		*C. bondari*
C. bairamaliensis Wagner, 1928		*C. bairamaliensis*
C. olgae Argyropulo, 1946		*C. olgae*
C. trigona Ioff, 1946		*C. trigona*
C. caucasica Isayeva-Gurvich, 1950		
C. africana Wagner, 1932		*C. africana*
C. macrophthalma Ioff, 1950		
C. wassiliewi (Wagner, 1932)		*C. wassiliewi*

The species *C. lamellifer dubinini, arax, caucasica* and *macrophthalma* are not included in Hopkins and Rothschild (1956) even though they were described six years earlier. Although not all of the original descriptions are available to me, Ioff (1953) figures *C. lamellifer dubinini* and *C. macrophthalma* and good figures of *C. arax* and *C. caucasica* may be



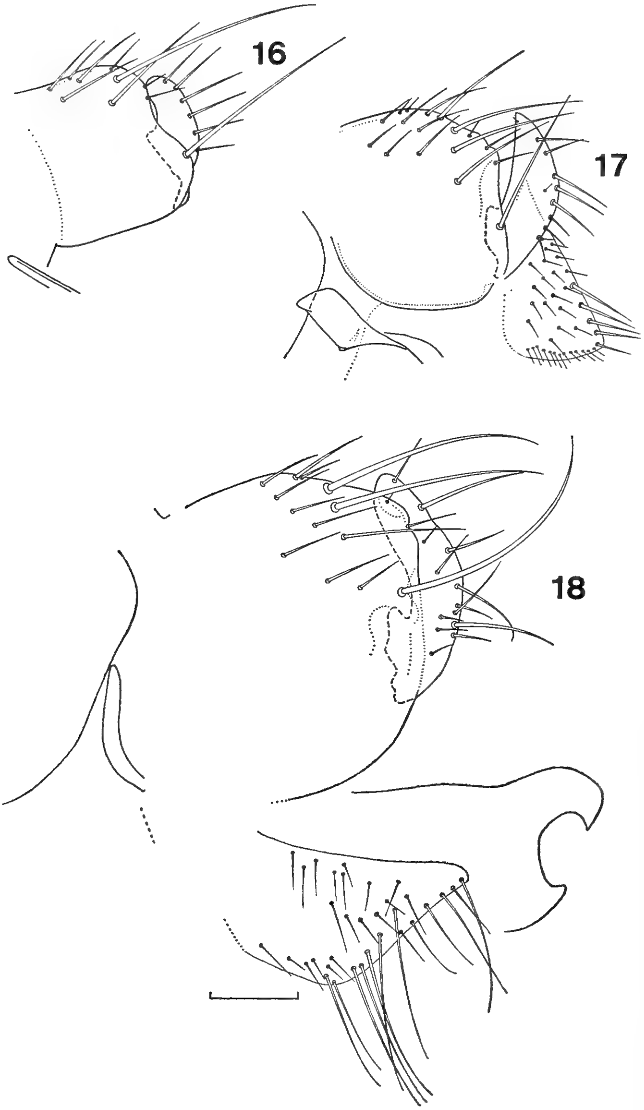
FIGS. 13–15. *Coptopsylla* sp. 13, *C. olgae olgae* Argyropulo, 1946, redrawn from Ioff, 1953. 14, *C. olgae wachschi* Labunets and Kafarskaya, 1961, redrawn from Labunets and Kafarskaya, 1961. 15, *C. trigona* Ioff, 1946, redrawn from Ioff, 1953.

found in a paper by Isayeva (1956) in which she states that figures for these two forms were previously lacking or unsatisfactory.

Hubbard (1956) described *C. smiti* from *Gerbillus dasyurus dasyurus* collected in Baghdad, Iraq. Labunets and Kafarskaya (1961) described *C. olgae wachschi* from *Meriones libycus erythrourus* collected in western Tadzikistan. These, plus the species described above, bring to 16 the recognized species and subspecies of the genus.

The following is an attempt to integrate the species and subspecies not listed by Hopkins and Rothschild (1956) into the system established by them in their treatment of the genus. Except for the drawings of *C. joannae* all of the illustrations are redrawn from the sources cited. The key is a modification of that of Hopkins and Rothschild (1956).

1. Tarsi with only 5 pairs of lateral bristles on segment V (sometimes only 4 on hind tarsus); female with the two antesensilial bristles of each side of almost equal size (North Africa) .... *wassiliewi* (Fig. 16)
   Tarsi with 6 pairs of lateral bristles on segment V; usually one of the antesensilial bristles on each side much smaller than the other 2
2. Males 3
   Females* 17
3. Apex of movable process of clasper obtuse, having a distinct (though rounded-off) posterior angle .... *bairamaliensis* (Fig. 12)
   Apex of movable process without such a conspicuous posterior angle, more or less acute 4
4. Body of clasper conspicuously dorsally divided by a deep and narrow sinus into two lobes (L^1 and L^2) 5
   Margin of body of clasper slightly divided into two lobes or slightly concave 11
5. L^1 of body of the clasper acuminate, directed caudally, movable process extending beyond apex of L^2 by about one-fifth its length .... *bondari* (Fig. 10)
   Not as above 6
6. Movable process subtriangular, extending to, but not beyond, the apex of L^2 (Iraq) .... *smiti* (Fig. 9)
   Movable process elongate, two-fifths or more extending beyond the apex of L^2 7
7. Acetabular bristle absent .... *l. lamellifer* (Fig. 4)
   Acetabular bristle present 8
8. Conspicuous tubercle present on anterior margin of movable process 9
   Anterior margin of movable process undulate but lacking tubercle 10
9. Movable process of clasper over four times as long as broad, the tubercle on its anterior margin below the middle .... *l. rostrata* (Fig. 5)



FIGS. 16–18. *Coptopsylla* sp. 16, *C. wassiliewi* (Wagner, 1932) redrawn in modified form from Wagner, 1932. 17, *C. africana* Wagner, 1932, redrawn in modified form from Wagner, 1932. 18, *C. macrophthalma* Ioff, 1950, redrawn from Ioff, 1953.

Movable process little more than thrice as long as broad, the tubercle above the middle .... *l. ardua* (Fig. 6)

10. L^1 of body of the clasper rounded, the sinus between L^1 and L^2 narrow .... *l. dubinini* (Fig. 7)

 L^1 of body of the clasper obtuse, its posterior margin sinuate, the sinus between L^1 and L^2 wide .... *arax* (Fig. 8)

11. Margin of body of the clasper slightly divided into two lobes 12

 Margin of body of the clasper entire, at most slightly concave 13

12. Acetabular seta absent, movable process ovoid, with blunt apex, about three times as long as wide .... *caucasica* (Fig. 11)

 Acetabular seta present, movable process triangular, with sharp apex, about two and one-half times as long as wide (Middle East) .... *joannae* (Fig. 2)

13. Posterior margin of body of the clasper with a distinct concavity above the articulation of the movable process, sternum IX elongate, not subtriangular .... *o. olgae* (Fig. 13)

 Posterior margin of body of the clasper without such a distinct concavity above the articulation of the movable process 14

14. Sternum IX elongate, not subtriangular or distinctly triangular .... *o. wachschi* (Fig. 14)

 Sternum IX subtriangular or distinctly triangular 15

15. Movable process elongate, not triangular, its apex blunt .... *macrophthalma* (Fig. 18)

 Movable process triangular or subtriangular, its apex sharp 16

16. Posterior margin of body of the clasper with rounded hump in middle, acetabular seta arising considerably above the point of articulation of the movable process, apex of movable process extending two-fifths of its length past caudal angle in posterior margin of body of the clasper (USSR) .... *trigona* (Fig. 15)

 Posterior margin of body of the clasper straight, vertical, dorsal margin sloping caudally, acetabular seta arising over point of articulation of movable process (North Africa) .... *africana* (Fig. 17)

17. Bulga of spermathecae merging gradually into hilla 18

 Transition between bulga and hilla of the spermathecae abrupt 19

18. Hilla of spermathecae with distinct papilla at apex, caudal margin of St. VII with distinct concavity bordered ventrally by pronounced lobe extending to ventral margin .... *caucasica* (Fig. 23)

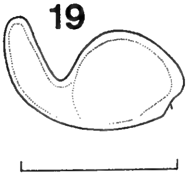
 Hilla of spermathecae lacking apical papilla, lobe of St. VII not extending to ventral margin .... *lamellifer* ssp. (Figs. 19–22)

19. Hilla of spermathecae obviously longer than their bulgae 20

 Bulga and hilla of spermathecae about equal in size 22

20. Hilla of spermathecae twice as long as bulga .... *macrophthalma* (Fig. 31)

 Hilla of spermathecae less than twice as long as bulga 21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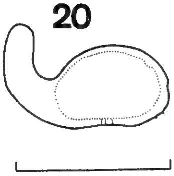
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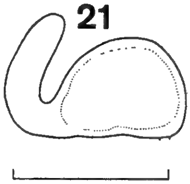
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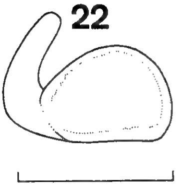
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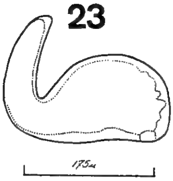
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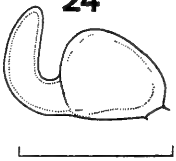
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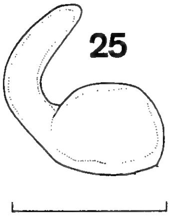
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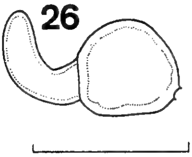
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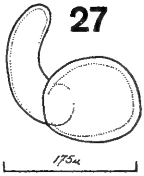
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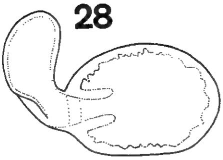
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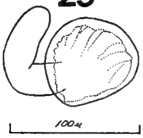
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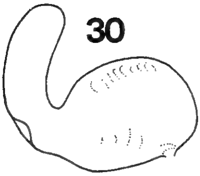
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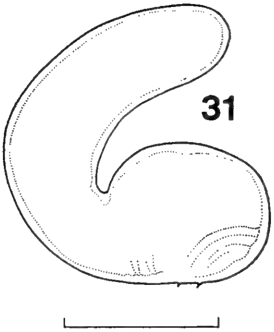
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21. Bulga of spermathecae ovoid, longer than high .... *bairamaliensis* (Fig. 25)
    Bulga of spermathecae spherical as long but not longer than high (Middle East) .... *joannae* (Fig. 3)
22. Bulga of spermathecae strongly triangular .... *bondari* (Fig. 24)
    Bulga of spermathecae not strongly triangular 23
23. Bulga of spermathecae obviously longer than high (North Africa) .... *africana* (Fig. 30)
    Bulga of spermathecae not much if any longer than high 24
24. Ventral wall of bulga of spermathecae flattened, bulging much less than dorsal wall .... *olgae* ssp. (Figs. 26, 29)
    Ventral and dorsal walls of spermathecae about equally curved .... *arax* (Fig. 27)

* Females of *smiti* and *trigona* are unknown.

A point should be made concerning the status of *Coptopsylla arax* and *Coptopsylla caucasica.* Although Ioff (1953) considered *arax* to be a subspecies of *C. lamellifer,* Isayeva (1956) gives it specific rank. Judging from the degree of modification of the genital segments of the male, this course appears to be justified. However, the illustration of the spermatheca of *C. arax* was made from a specimen in which this organ was turned and thus does not show its true profile. It is difficult to ignore the similarity between the shape of the spermatheca in *C. caucasica* and *C. lamellifer* ssp. I would, therefore, suggest the possibility that the drawings of the spermathecae of *C. arax* and *C. caucasica* were somehow switched during the preparation of the paper and that actually the drawing of the spermatheca of *C. caucasica* is that of *C. arax.* If this is true, the relationship of *arax* to the *lamellifer* subspecies is quite close.

I wish to acknowledge the many kindnesses extended by Mr. F. G. A. M. Smit of the British Museum (Natural History) at Tring, Herts., without whose assistance this work could not have been completed.

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FIGS. 19–31. *Coptopsylla* sp. 19–22, *C. lamellifer* ssp., redrawn from Ioff, 1953. 23, *C. caucasica* Isayeva-Gurvich, 1950, redrawn from Isayeva, 1956. 24, *C. bondari* Ioff, 1946, redrawn from Ioff, 1953. 25, *C. bairamaliensis* Wagner, 1928, redrawn from Ioff, 1953. 26, *C. olgae olgae* Argyropulo, 1946, redrawn from Ioff, 1953. 27, *C. arax* Isayeva-Gurvich, 1950, redrawn from Isayeva, 1956. 28, *C. wassiliewi* (Wagner, 1932) drawn from Pl. 12*a*, Hopkins and Rothschild, 1956. 29, *C. olgae wachschi* Labunets and Kafarskaya, 1961, redrawn from Labunets and Kafarskaya, 1961. 30, *C. africana* Wagner, 1932, redrawn from Wagner, 1932. 31, *C. macrophthalma* Ioff, 1950, redrawn from Ioff, 1953.

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PROCEEDINGS
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OBSERVATIONS ON THE NESTING OF *POMPILUS* (*AMMOSPHEX*) *MICHIGANENSIS* (DREISBACH) (HYMENOPTERA; POMPILIDAE)

By Frank E. Kurczewski and Noel F. R. Snyder
Department of Biology, Cornell University, Ithaca, New York

Studies on the Nearctic *Pompilus* have lagged far behind those on the European members of this spider wasp genus. Especially is this the case in the subgenus *Ammosphex* Wilcke where only a single, detailed observation, that by Powell (1957) on the western *occidentalis* (Dreisbach), is available. The only other ethological data which have been published for Nearctic *Ammosphex* take the form of scattered host records (Evans, 1951; Evans, 1959; Evans and Yoshimoto, 1962; Wasbauer and Powell, 1962). It is felt, therefore, that the following notes on *Pompilus* (*Ammosphex*) *michiganensis* (Dreisbach), the first observations on this rarely collected species, will shed light on the behavior of this little known group of wasps.

On 25 May 1963, at about 2:55 PM in an open area of soil occupying a portion of a field directly behind a sand pit in Groton, New York, a female *michiganensis* was seen apparently searching for an area in which to dig her nest. Walking forward rather slowly, tapping the soil with her distal antennal segments and flicking her wings incessantly, she made many small circles on the soil surface. Finally, selecting an area underneath two overhanging stems, the wasp began excavating, loosening the soil with her mandibles. She flung the earth backwards by means of her forelegs, keeping her wings folded nearly flat over the dorsum of her abdomen. We could not ascertain exactly how the forelegs were used but the related Palaearctic *Pompilus trivialis* Dahlbom has been photographed (Olberg, 1959) using its front legs alternately. At times, as she dug deeper into the earth, the female we observed main-

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tained a position nearly vertical while loosening the soil. Disappearing from sight entirely, the wasp continued pushing damp soil into the entrance from below. She removed the accumulation by backing out of her excavation at intervals which varied from about 15 seconds to 1 minute, kicking the soil alternately with her hind legs as well as shoving it backward with the tip of her abdomen. Rarely, she cleared the area in front of the entrance completely, throwing the earth backward with her front legs instead of kicking it with the hind legs (Fig. 1). Powell (1957) found that *occidentalis,* while digging, left her burrow only when bringing up earth from below. Periodically, *occidentalis* backed out of her burrow, "scraping the loose material from the tunnel entrance" with her front legs. Each time *P. michiganensis* cleared the sand from in front of her entrance, she proceeded back into the burrow, throwing sand backwards with her front legs.

Less than 25 minutes from when she began digging, the wasp appeared head first in her entrance, twisting her head to the left and right while cleaning her mandibles and antennae with her forelegs. Having cleaned herself in the entrance for about 3–5 seconds, she came completely out of the burrow onto the soil which had accumulated from digging where she paused motionless for about 20 seconds. She then turned and, leaving her entrance open, made a low, rapid flight of about 1 meter to her prey which she had placed in the grass. Adlerz (1903) found that females of both *Pompilus wesmaeli* Thomson and *P. trivialis* frequently place their prey on the top of vegetation before excavating their nests.

Pulling her prey from the vegetation, *P. michiganensis* began dragging it across the ground, grasping it in her mandibles by the bases of the prey's second or third pair of coxae. Holding the spider so that its body was nearly perpendicular to her own, the wasp walked rapidly backward through vegetation and over stones and other debris, proceeding nearly straight to her nest. Evans (1959) captured a *Pompilus* (*Am-*

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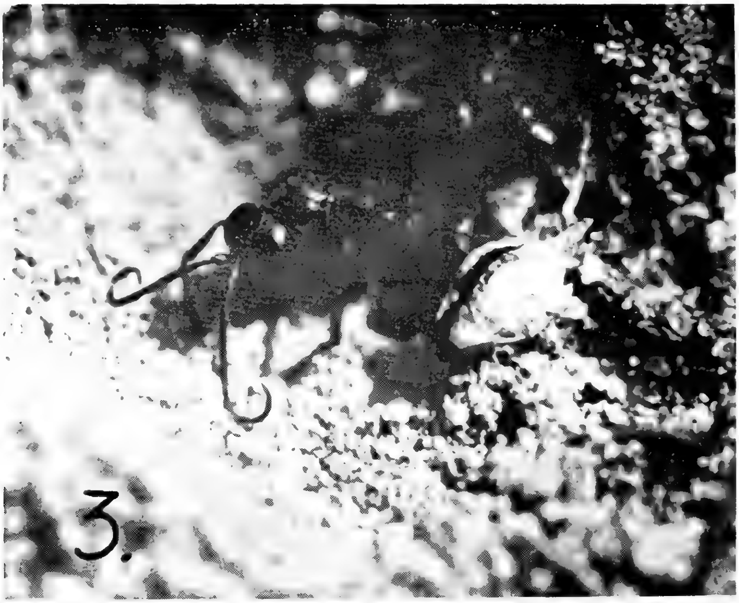
FIGS. 1–2. *Pompilus michiganensis* (Dreisbach). 1, Female clearing soil from entrance, using forelegs. 2, Placement of spider inside wasp's entrance before it is pulled into burrow.



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mosphex) *angularis* (Banks) carrying her prey backward, "grasping the spider near the petiole in such a way that its body was perpendicular to that of the wasp." *P. michiganensis* dropped the spider, leaving it dorsum up 25–30 cm from the nest entrance, reentered the burrow, throwing soil backward, and reappeared head first in the opening about 10 seconds later. Powell (1957) noted similarly that during prey transport, *occidentalis* left her spider and inspected her nest before bringing the prey in. Leaving her burrow again, *michiganensis* proceeded on foot to her prey and grasping it in the same manner as before, pulled it directly to the entrance. Here, she turned around before entering and released the spider momentarily. The spider was now in a position with its abdomen inside the entrance and its cephalothorax directed away from the burrow (Fig. 2). Walking directly over the top of her prey, the wasp entered the burrow head forward, turned around inside the nest, and grasping the spider in her mandibles by its spinnerets, pulled it inside. As the spider disappeared slowly from sight, its legs were the last structures seen in the opening. Olberg (1959) noted that *trivialis* always transports her prey backwards, places it in the entrance, and then, seizing it from below by its spinnerets, drags it into the nest. Powell (1957) observed *occidentalis* backing down into her burrow "dragging the spider in."

Staying inside nearly three minutes, *michiganensis* appeared head first in her burrow, breaking down the sides and top of the tunnel with her mandibles. Hammering the resulting loose soil with the tip of the abdomen, the wasp packed it into place inside the burrow. While hammering, the wasp's antennae were held laterally and curled at the distal ends (Fig. 3). Coming out of her nest with her front legs bent medially so as to form a basket, the wasp pulled soil from in front of the entrance down into the burrow where she continued packing it into place. Powell (1957) noted *occidentalis* reappearing three minutes after ovipositing, "pulling the loose

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FIGS. 3–4. *Pompilus michiganensis* (Dreisbach). 3, Female packing soil into nest with the tip of the abdomen. 4, Female hammering the entire area of the entrance after filling her burrow flush.

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sand left about the entrance into the hole." Olberg (1959) noted that the sand scraped back from time to time with the forelegs is hammered into place with the tip of the abdomen. The female *michiganensis* we observed came out only six times to get loose soil, spending most of the 6 minutes which it took her until final closure, hammering the earth into the burrow. After filling the burrow flush, she spent about 1 minute moving from side to side over the now completely filled nest hammering the soil. During this behavior her abdomen was bent under, nearly forming a letter C (Fig. 4). As well as vibrating up and down while hammering, her abdomen swayed laterally from side to side like a pendulum. At this time we captured the wasp. She had taken 35–40 minutes to dig, store, and fill her nest. The female *occidentalis* which Powell (1957) studied took 26 minutes for similar behavior.

The completed nest of *michiganensis* was toward one side of a small open patch of sandy-loam soil containing many pebbles (Fig. 5). The burrow entered the soil at an angle close to 30° with the horizontal and was dug into an inclined slope of about 5°. The 3–4-mm-wide tunnel was 2.5 cm long, ending in an oval cell 1.2 cm beneath the soil surface. The spider, a female *Xysticus transversatus* (Walckenaer) in the penultimate instar (Det. Wilton Ivie, Ethological No. P-102), was placed in the cell, dorsum up, with its abdomen toward the back of the cell, 5 mm wide, 5 mm high, 8–9 mm long. Evans and Yoshimoto (1962) noted a female of *michiganensis* in the University of Idaho collection pinned with a subadult female *Xysticus conctator* Thorell. The white, curved egg of *michiganensis*, nearly 2 mm long, was placed on the ventral side of the prey's abdomen, laterally and on the right, close to the basal abdominal constriction (Fig. 6). Adlerz (1903) found that the spider of *wesmaeli* lay right side up in the cell with the egg glued on its left side near the base of the abdomen.

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FIGS. 5–6. *Pompilus michiganensis* (Dreisbach). 5, Portion of field at Groton, New York, where female nested. 6, Burrow and terminal cell of wasp's nest with distal end of cell exposed showing wasp's egg attached to the spider's abdomen.

Upon excavating the nest of *occidentalis*, Powell (1957) found a 2-cm-long burrow slanting into the soil at about a 45° angle. An oval cell, 8 mm long, containing the spider ventral side down, head in, was found at the end of the tunnel. "A smooth, white, elongate egg of 2 mm. in length had been placed diagonally in a lower, lateral position near the middle of the prey's abdomen."

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PROCEEDINGS
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NEW SPECIES OF *CHRYSIS* IN THE *LAUTA, PROPRIA* AND *VENUSTA* GROUPS FROM NORTH AMERICA (HYMENOPTERA : CHRYSIDIDAE)

By R. M. Bohart
Department of Entomology, University of California, Davis

The descriptions of new species and clarification of synonymy given below are offered to assist various biological research studies. Institutions which cooperated by furnishing material, and symbols used to designate them, are as follows: Academy of Natural Sciences, Philadelphia (ANSP); American Museum of Natural History (AMNH); California Academy of Sciences (CAS); California State Department of Agriculture (CSDA); Museum of Comparative Zoology, Harvard University (MCZ); Nevada State Department of Agriculture (NSDA); Purdue University (Purdue); University of Arizona (U. Ariz.); University of California at Berkeley (CIS); at Davis (UCD); at Riverside (UCR); University of Idaho (U. Idaho); University of Kansas (KU); Utah State University (USU); U.S. National Museum (USNM).

North American *Chrysis* divide into several well-defined species groups. Four of these were recently outlined (Bohart, R. M., 1962, "A review of the hexadentate species of *Chrysis* of America north of Mexico," Acta Hymenopterologica 1: 361–375). Undescribed species in two of these groups and some new synonymy are presented herein.

Illustrations were prepared by Miss Ellen Montgomery except for Figs. 11, 13, 14–25 which were drawn by Miss Judy Jay.

C. lauta group: Includes *coloradica* Bohart, *florissanticola* Rohwer, *lauta* Cresson, *tripartita* Aaron, *tularensis* Bohart, *vagabunda* Bohart and *xerophila* Bohart. Tergite III with 4 distinct teeth and a usually pronounced sublateral bow or in one species, *tularensis*, 6 distinct teeth; malar space less than 2.0 times mid-ocellus diameter (longest in *lauta* and *tripartita*); flagellomeres I–III in both sexes in descending order of length, I about as long as II and III together (not in *vagabunda*), frontal carina absent or incomplete laterally, sometimes partially enclosing mid-ocellus, transverse area of upper frons often "braised"; ocelli not sunken nor lidded; gena narrow opposite propleuron; median crease of pronotum unusually sharp; mesopleuron not toothed; scutellum and postscutellum simple, rounded; apicolateral corner of tergite II obtuse; body hair pale to light fulvous, longest on vertex, beneath head and on legs.

Chrysis lauta Cresson

Chrysis lauta Cresson, 1865. Proc. Ent. Soc. Philadelphia 4: 311. Holotype female, Boulder, Colorado (ANSP).

Chrysis prasinus Cresson, 1865. Proc. Ent. Soc. Philadelphia 4: 310. Holotype male (not female), Colorado (ANSP). Preoccupied by *prasina* Klug, 1845.

Chrysis chlorophana Mocsáry, 1887. Termes. Fuzetek. 11: 16. New name for *prasinus*.

Chrysis clypeata Mocsáry, 1889. Monogr. Chrysid., p. 393. Holotype male, Chapultepec, Mexico (Vienna Museum). New synonymy.

Chrysis falsifica Buysson, 1891. Rev. Ent. (Caen) 10: 38. New name for *prasinus*.

The type of *prasinus* Cresson is a male rather than a female as originally recorded. It represents the other sex of *lauta*. Also, I have seen the holotype male of *clypeata* Mocsáry at the Natural History Museum in Vienna and it equals *lauta*. Several specimens from other parts of Mexico have been studied.

Characteristic of *lauta* are the long subantennal distance (about 2.5 times mid-ocellus diameter), the moderately long malar space (a little more than a mid-ocellus diameter), the relatively stout flagellomere I (less than twice as long as broad), and the very short teeth of tergite III.

I have seen material from NORTH CAROLINA: Southern Pines; GEORGIA: Lula, Vidalia; MISSISSIPPI: Oxford; TEXAS: Dalhart, Friona; KANSAS: Wallace County, Cheyenne County, Gray County; NEBRASKA: North Platte; COLORADO: Clear Creek County, Boulder, Fort Collins, Crook, Florissant, Fort Lupton; NEW MEXICO: San Jon, Loving, Rodeo; ARIZONA: Willcox; MORELOS (Mexico: 35 mi. S Cuernavaca); JALISCO (Mexico): Catatitlan, San Juan Lagos, Villa Hidalgo.

Chrysis coloradica Bohart, new name

Chrysis pulcherrima Cresson, 1865. Proc. Ent. Soc. Philadelphia 4: 311. Holotype male, Colorado (ANSP). Preoccupied by *pulcherrima* Lepeletier, 1806.

Diagnosis: About 7 mm long, blue-green to blue. Flagellomere I about as long as II and III together, basal five flagellomeres in male with much long fine hair beneath, that under I longer than mid-ocellus diameter; least interocular distance in male about equal to length of flagellomeres I and II together; subantennal distance about 2.0 times mid-ocellus diameter, malar space about 1.0 times and interantennal distance about 0.6 times; no frontal carina (Fig. 6); teeth of tergite III short and blunt, pit row impressed, often partly confluent. Male sternite VIII subtriangular; gonostyle moderately stout, notched on inner edge (Fig. 17); digitus unusually broad, not finely pointed; aedeagus definitely flared subapically.

I have studied material from many Lower Sonoran to Hudsonian localities in California from San Bernardino County to Trinity County. Several specimens have been reared from nests of *Anthidium collectum* Huard by J. W. MacSwain from Antioch, California. Other distribution includes NEVADA: Verdi (M. E. Irwin, UCD); COLORADO (ANSP, USNM); and IDAHO: Craters of the Moon (R. M. Bohart, UCD).

Chrysis vagabunda Bohart, new species

Male: Length 8.0 mm. Green with slight blue and brassy tints (some paratypes extensively brassy); sternite II with a pair of large oval black spots; wings lightly stained in cellular area. Scapal basin nearly completely and densely covered with appressed silvery hair. Punctation moderate, close, but with small intercalary punctures, especially numerous on tergite I; teeth of tergite III more sparsely punctate and with polished interspaces. Head broader than long; least interocular distance about equal to length of flagellomeres I–III combined; flagellomere I with no outstanding hair, about 1.5 times as long as broad and 0.65 times as long as II and III together; subantennal distance 1.3 times mid-ocellus diameter, malar space and interantennal space each 0.5 times; no frontal carina, frons a little grooved longitudinally below mid ocellus. Profile of tergite III strongly indented at pit row, latter deeply excavated with many confluent pits, middle of row curved forward very slightly at middle; teeth of tergite III short, dull, bracketing nearly equal and shallow emarginations, lateral edge of III a little bowed out beyond middle. Sternite VIII broadly cordate (Fig. 24); genitalia with moderately slender gonostyle which is entire along inner edge but has a clear spot (Fig. 25); digitus tapering to a fine point; aedeagus only a little flared subapically.

Female: About as in male. Scapal basin sparsely hairy, inner eye margins more nearly parallel.

Holotype male, Woodland, Yolo Co., California, 20 August 1953 (A. T. McClay, UCD). Paratypes, 32 males, 19 females, May to August, all from CALIFORNIA: Woodland (A. McClay, UCD, USNM), Davis (R. Bohart, R. James, UCD, USNM), Artois (M. Wasbauer, R. F. Smith, H. Hansen, J. MacSwain, CIS, UCD), Antioch (J. MacSwain, W. Barr, CIS, U. Idaho), Mt. Hamilton (E. Linsley, CIS); Tracy (J. MacSwain, P. Hurd, CIS), Stanislaus Co. (C. Moore, J. Grundel, UCD, CAS), Turlock (R. Snelling, CSDA), Plymouth (W. Simonds, CSDA), Tanbark

Flat in San Gabriel Mts. (P. Hurd, R. Bohart, CIS, UCD), La Crescenta (R. Bohart, UCD), Corona (CIS), near Fallbrook (J. A. G. Rehn *et al.*, ANSP). I have seen material also from OREGON: Corvallis; WASHINGTON: Yakima; NEVADA: Elko Co.; IDAHO: Notus, St. Anthony, Boise; and UTAH: Morgan Co.

The deeply impressed and largely confluent pit row together with the rather stout flagellomere I which is practically hairless in the male, the short malar space, and the moderate subantennal distance characterize the species. It appears most closely related to *lauta* which has a longer subantennal distance (2.5 times mid-ocellus diameter), a slightly longer flagellomere I, a more triangular male sternite VIII, and a more slender male gonostyle. Specimens from outside California tend to be more blue than green but agree in structural details. A few females have traces of a flattened carina curved toward the mid ocellus.

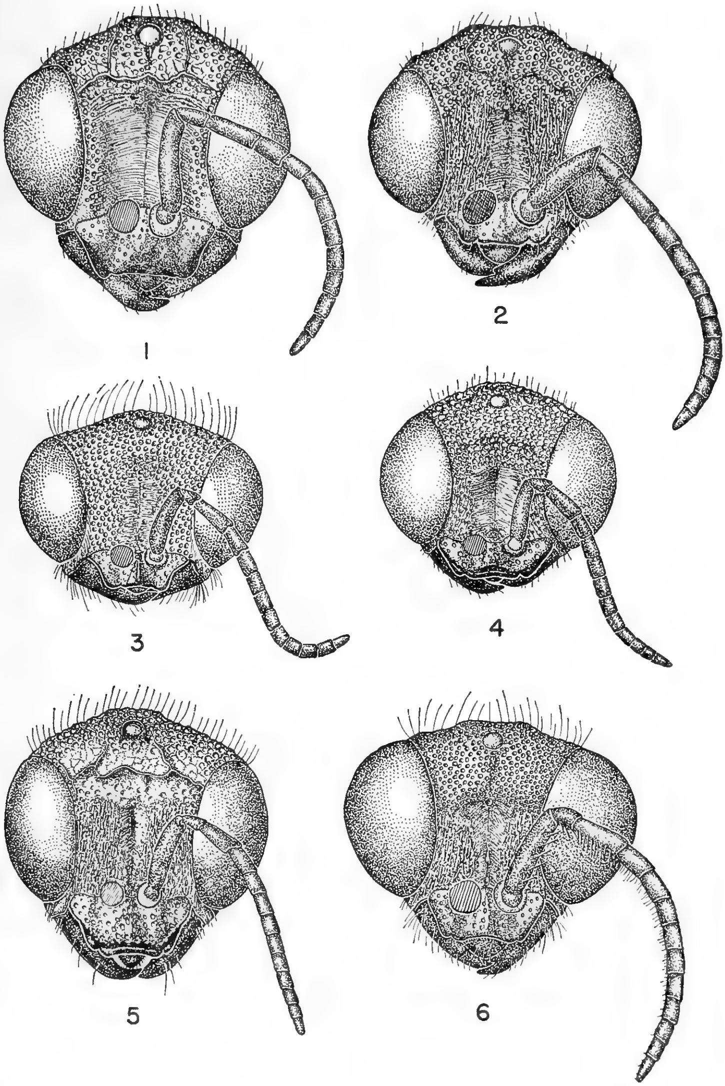
Chrysis xerophila Bohart, new species

Male: Length 7.5 mm. Green and blue mixed, a few brassy tints (more extensive in some paratypes), sternite II with a nearly touching pair of weakly defined dark spots; wings lightly stained. Scapal basin with fairly abundant erect hair only. Punctation moderate, close, slightly confluent on notum, fairly coarse on tergite III but considerable smooth areas present on teeth. Head broader than long, least interocular distance about equal to length of flagellomeres I–III combined (Fig. 3); flagellomere I with no outstanding hair, about 2.0 times as long as broad and as long as II and III together; subantennal distance 1.2 times diameter of mid ocellus, malar space and interantennal space each about 0.7 times; no frontal carina, a broad valley below mid ocellus; profile of tergite III a little humped at middle, slightly indented at weak and irregular pit row; teeth short, blunt, emarginations subequal and shallow, lateral edge of tergite III gently bisinuate. Sternite VIII shield-like (Fig. 20); genitalia with an obtusely indented gonostyle which has the ventral "sac" coarsely spiculate at outer base (Fig. 21); digitus tapering to a fine point; aedeagus flared subapically and with a long oval clear spot in widest area.

Female: About as in male.

Holotype male, Borrego Valley, San Diego Co., California, 19 April 1957 (R. M. Bohart, UCD). Paratypes, 8 males, 10 females, 30 March to 17 July from CALIFORNIA: Borrego Valley (M. Wasbauer, CSDA, USNM; R. W. Bushing, UCD; R. M. Bohart, UCD; H. R. Moffitt, UCD, CAS); Jacumba (R. H. Beamer, KU); Mojave Desert (N. F. Hardman, UCD); Short Canyon near Inyokern (J. W. MacSwain, CIS); Hungry Valley near Gorman (J. Powell, CIS); Mazourka Canyon, Inyo Co. (J. W. MacSwain, CIS).

The subantennal distance is shorter than in most species of the group, being hardly twice as long as the malar space and one-half as long as flagellomere I. The nearest relative seems to be *florissanticola* Rohwer



FIGS. 1–6. Male *Chrysis,* front view of head. 1, *C. vibex* Bohart; 2, *C. tensa* Bohart; 3, *C. xerophila* Bohart; 4, *C. rivalis* Bohart; 5, *C. crotema* Bohart; 6, *C. coloradica* Bohart. Figs. 1–5 are of holotypes.

which has an even weaker pit row and the male has much densely appressed hair on the scapal basin. Also, the subantennal distance in *florissanticola* is about two-thirds as long as flagellomere I.

C. propria group: Includes *propria* Aaron, *aridula* Bohart, *submontana* Rohwer, *crotema* Bohart, *prolata* Bohart, *rivalis* Bohart, *tensa* Bohart and *vibex* Bohart. Tergite III 4-toothed and bowed out laterally, in extreme cases angled (*tensa*) or forming a third pair of teeth (*aridula*); malar space less than subantennal distance, usually about 0.5 times mid-ocellus diameter; flagellomeres I–III in both sexes in descending order of length, I at least twice as long as broad; frontal carina weak or irregular, broken or depressed medially, often with dorsal extensions partially enclosing mid ocellus which is thus lidded (not in *rivalis*); posterior ocelli slightly lidded (not in *rivalis*); gena very narrow opposite propleuron; mesopleuron somewhat rough, carinae irregular, subdentate; scutellum and postscutellum simple, rounded; tergite II but not III usually with very faint indications of a median longitudinal raised area; apicolateral corner of tergite II obtusely angled; body hair generally pale, erect, longest on vertex, beneath head, and on legs; male genitalia with gonostyle distally stout (not in *crotema*) and bearing a long hair fringe; sternite VIII stout, subtriangular (shield-like in *crotema*).

Chrysis crotema Bohart, new species

Male: Length 7.0 mm. Blue with greenish and purplish tints, sternite II with a pair of irregular dark spots; wings lightly stained in cellular area. Scapal basin on lateral two-fifths with rather short but dense and appressed silvery hair. Punctation moderate, close, mostly of one size but with many small intercalary punctures; scapal basin almost completely covered with close fine punctation; middle of postscutellum with unusually coarse punctures; teeth of tergite III closely punctate. Head about as long as broad (Fig. 5); flagellomere I about four-fifths as long as II and III together; subantennal distance about 3.0 times mid-ocellus diameter; interantennal distance about 0.7 times; frontal carina wavy but strong, subtended by weak branches which enclose mid ocellus, latter strongly lidded, all ocelli somewhat sunken, interocular area above transverse carina and below mid ocellus somewhat transversely areolate; tergite III indented at pit row in profile, a perceptible median hump in front of pit row, pits moderate in size, about 14 in number, some partly confluent, mid carina somewhat depressed; teeth moderate, sharp, a little deflected, thickened beneath and bicarinate, median notch deeper than submedian ones, lateral edge of tergite III well rounded out. Sternite VIII peculiarly shield-shaped (Fig. 18); genitalia with gonostyle finger-shaped distally, with long terminal bristles (Fig. 19); digitus slender, saw-like.

Female: About as in male but more green than blue; as much of scapal basin obliquely striate as punctate; hair of scapal basin less prominent.

Holotype male, Rodeo, Hidalgo Co., New Mexico, 23 August 1958 (R. M. Bohart, UCD). Paratypes, 6 males, 4 females, July to September, as follows: ARIZONA: near Portal (M. Statham, C. and M. Cazier, AMNH; P. D. Hurd, CIS), Apache (W. W. Jones, USNM); NEW MEXICO: Rodeo (P. D. HURD, CIS); MEXICO: near Fresnillo, Zacatecas (E. G. Linsley *et al.*, CIS).

The unusually long subantennal distance, which is about five times the malar space, distinguishes *crotema* from others in the group except *prolata*. The latter has tergite III evenly convex in profile, the pits not in a furrow, and no hump before the pit row. The oddly shaped male sternite VIII of *crotema* is distinctive, but since males of *prolata* are unknown, a comparison is not possible.

Chrysis prolata Bohart, new species

Female: Length 6.5 mm. Blue with green and some purple tints, sternite II with a pair of nearly touching oval black spots, wings lightly stained. Scapal basin sparsely haired laterally. Punctation moderate, close, mostly of one size but with numerous small intercalary punctures, teeth of tergite III closely punctate. Head broader than long, appearing "pinched" below eyes in front view; flagellomere I nearly as long as II and III together; subantennal distance about 3.0 mid-ocellus diameters; ocelli somewhat sunken and lidded, mid ocellus nearly enclosed by dorsal branches of frontal carina, latter somewhat fragmentary; tergite III slightly and evenly convex in profile, pits discrete, lodged in a barely perceptible furrow, two most median pairs round, median notch deeper than submedian ones but rounded, teeth thickened and bicarinate beneath; tergite III strongly rounded out laterally, median pair of teeth a little rounded distally.

Holotype female, Riley Co., Kansas (UCD). Paratype female, Washington Co., Wisconsin (S. Graenicher, MCZ).

The only other species of the group with unusually long subantennal distance is *crotema* which has a deeply excavated pit row and a median hump just preceding it.

Chrysis rivalis Bohart, new species

Male: Length 7.5 mm. Blue with green and purple tints, pleuron extensively greenish; sternite II with a black subbasal band; wings nearly clear. Lateral one-fourth of lower scapal basin with moderate, partially appressed silvery hair. Punctation moderate, close, unusually fine and close on tergites II–III, coarser toward base of tergite I where two puncture sizes are evident, even coarser on thorax. Head broader than long (Fig. 4); flagellomere I slightly shorter than II and III together (as long as II and III in some paratypes); subantennal distance 1.5 times diameter of mid ocellus; ocelli not unusually sunken, not lidded, frontal carina very weak, most evident medially, dorsal branches faint; tergite II with a weak longitudinal median ridge on basal two-thirds; tergite III in profile a little humped before pit row, latter weakly indented and containing 10 well-formed but small pits, as well as some smaller and more basal ones; teeth of tergite III rather weak and blunt, not much curved downward, median notch acute, submedian one shallow; lateral edge of tergite III a little biconvex. Sternite VIII broadly subtriangular (Fig. 22); genitalia with a short, broad gonostyle which is curved outward distally and hairy along inner distal margin (Fig. 23), digitus broadly blade-like.

Female: About as in male. Lateral edge of tergite III only a little convex. Color greenish blue to bluish green.

Holotype male, Samuel Springs (now southeast edge of Berryessa Lake), Napa Co., California, 13 May 1956 (S. M. Fidel, UCD). Paratypes, 40 males, 104 females, April to August, from CALIFORNIA: Samuel Springs, Napa Co. (R. Bohart, J. Hall, J. Downey, E. Schlinger, S. Fidel, R. Bechtel, UCD); Tanbark Flat, San Gabriel Mts., Los Angeles Co. (T. Haig, P. Hurd, R. Bohart, J. Linsley, W. Bentinck, J. Hall, B. Bartosh, H. Mathis, S. Miyagawa, A. McClay, M. Stebbins, C. Wiley, R. Schuster, J. MacSwain, H. Hansen, H. Michalk, F. Williams, UCD, CIS, CAS, CSDA); Arroyo Seco, Monterey Co. (P. Torchio, R. Bohart, Don Burdick, CIS, UCD). Mt. Diablo, Contra Costa Co. (J. MacSwain, P. Hurd, J. Rozen, CIS); Mt. Hamilton, Santa Clara Co. (D. Burdick, J. MacSwain); near New Idria, San Benito Co. (J. MacSwain, CIS). Paratypes distributed also to other institutions listed in the introduction as well as to R. R. Dreisbach, W. Linsenmaier and S. Zimmermann.

Other material has been examined from many Upper Sonoran localities in California as well as from OREGON: Harney Co.; IDAHO: Mt. Home, Dixie, Giveout; WYOMING: Jackson Hole; UTAH: Salt Lake Co.; COLORADO: Steamboat Springs; and NEVADA: Emigrant Pass and Paradise Valley.

The fine and very dense punctation of tergites II and III together with the short blunt teeth of tergite III and the hardly developed frontal carina will distinguish *rivalis* from other species in the group. The male genitalia are short, broad, and appear distorted because of the outwardly flared gonostyles.

Chrysis tensa Bohart, new species

Male: Length 7.0 mm. Green with bluish and some brassy tints, legs and pleuron mostly blue, sternite II with a pair of oval black spots angled inward and backward; wings nearly clear. Scapal basin on lateral one-third with dense appressed silvery hair. Punctation moderate, close, mostly of one size but with many small intercalary punctures, teeth of tergite III closely striatopunctate. Head broader than long (Fig. 2); flagellomere I about three-fourths as long as II and III together; subantennal distance about equal to diameter of mid ocellus; ocelli somewhat sunken, lidded, mid ocellus enclosed by broken extensions from frontal carina which bound a depressed striatopunctate area; tergite III slightly and evenly convex in profile, pits discrete, not in a furrow, two most median pairs round, notch between median pair of teeth broadened and doubly carinate; tergite III strongly angled out laterally, teeth long and sharp. Sternite VIII as in Fig. 14; genitalia with broadly rounded gonostyle (Fig. 15), digitus narrow and curved.

Female: About as in male. Malar space even narrower; tergite III with lateral lobe strongly rounded but less so than in male; flagellomere I nearly as long as II and III together.

Holotype male, 15 miles north of Yuma, Arizona, 4 April 1963 (F. D. Parker, UCD). Paratypes, 18 males, 9 females, April to August, as follows: CALIFORNIA: Brawley (G. Bohart, USU); ARIZONA: Phoenix (R. Kunze, Purdue), Willcox (A. D. Telford, UCD), Kansas Settlement (G. D. Butler, U. Ariz.) Tempe (J. Bequaert, MCZ); Mustang Mt. (E. Beamer, KU), Amado (G. Butler, U. Ariz.), near Portal (C. and M. Cazier, AMNH); UTAH: River Heights (S. L. Wood, USNM); NEW MEXICO: Rodeo (E. G. Linsley, CIS), Granite Pass, Hidalgo Co. (P. D. Hurd, CIS); Pedernal (E. L. Kessel, CAS), Fort Sumner (E. L. Kessel, CAS), Torrance Co. (C. H. Martin, KU), Moriarty (L. H. Banker, KU); TEXAS: near Marathon (R. F. Smith, AMNH), Presidio (E. R. Tinkham, UCD), Catarina (C. Michener *et al.*, KU); Mexico: near Alamos, Sonora (M. Cazier *et al.*, AMNH); Matachic, Chihuahua (C. Michener, AMNH).

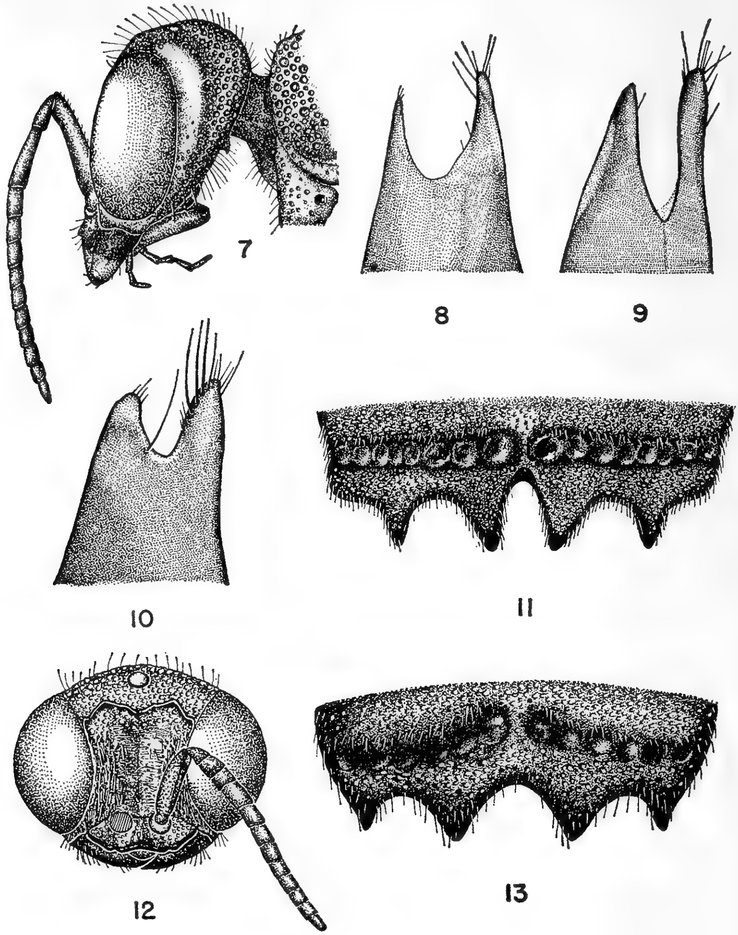
The strongly developed lateral lobe of tergite III is practically diagnostic in the group. The smoothly convex profile of tergite III and the discrete pits are characteristics shared with *prolata, aridula* and some specimens of *propria*. Some of the paratypes are more blue than green.

Chrysis vibex Bohart, new species

Male: Length 7.5 mm. Dark green with some blue and brassy reflections, sternite II with a pair of large transverse spots; wings moderately stained in cellular area. Scapal basin with scant semi-erect silvery hair on lateral one-third. Punctation moderate, close, mostly of one size but with many small intercalary punctures, teeth of tergite III punctate and a little striate. Head about as long as broad (Fig. 1); flagellomere I as long as II and III together, subantennal distance about 2.0 times midocellus diameter, interantennal distance about 0.7 times, frontal carina irregular, divided medially by a groove extending from mid ocellus to near middle of scapal basin, a subocellar area bounded laterally by carinae but mostly open above, ocelli slightly lidded, hind ocelli somewhat sunken, a large smooth shiny, kidney-shaped spot behind and adjacent to compound eye (Fig. 7); tergite III indented at pit row in profile; pits moderate in size, about 16 in number, some partly confluent, mid carina narrow but only a little depressed; teeth moderate, sharp, thickened beneath and bicarinate, median notch narrower and more angled than submedian, lateral edge of tergite III strongly bowed out (Fig. 11). Sternite VIII broadly subtriangular; genitalia with gonostyle broad and distally fringed (Fig. 16), digitus stoutly blade-like.

Female: About as in male, teeth of tergite III a little more blunt.

Holotype male, Portal, Cochise Co., Arizona, 12 August 1958 (R. M.



FIGS. 7–13. Male *Chrysis*. 7, *C. vibex* Bohart, side view of head and prothorax; 8–10, distal one-half of gonostyle; 8, *C. astralia* Bohart; 9, *C. venustella* Bohart; 10, *C. venusta* Cresson; 11, *C. vibex* Bohart, apex of tergite III; 12, *C. venustella*, front view of head; 13, *C. astralia* Bohart, apex of tergite III. Figs. 7, 11–13 are of holotypes.

Bohart, UCD). Paratypes, 29 males, 18 females, April to September, as follows: ARIZONA: Santa Rita Mts. (R. M. Bohart, UCD; R. H. Beamer *et al.*, KU), near Portal (M. Statham, C. and M. Cazier, AMNH), near Apache (E. G. Linsley, P. D. Hurd, CIS), east of Douglas (W. F. Barr, U. Idaho; M. A. Cazier, CIS; R. M. Bohart, UCD), Patagonia (J.

Bequaert, MCZ, U. Ariz.); New Mexico: 18 miles north of Rodeo (P. M. Marsh, CIS); Texas: Alpine (E. C. Van Dyke, CAS; L. D. Beamer, KU), Fort Davis (E. C. Van Dyke, CAS), near Marathon (R. F. Smith, AMNH). In addition to above institutions, paratypes distributed also to USNM, ANSP, Purdue, W. Linsenmaier and S. Zimmermann. Metatypes, 1 male, Guadalajara, Jalisco, Mexico (P. D. Hurd, CIS), 1 male, 25 miles south of Chihuahua, Chihuahua, Mexico (P. D. Hurd); 1 female, El Alamo, Nuevo Leon, Mexico (M. Leonardo, UCD). 1 male, 2 females, 4 miles west of Quincy, California (J. E. Gillaspy, CIS; E. I. Schlinger and R. C. Bechtel, UCD).

The smooth postocular spot (Fig. 7) readily separates *vibex* from the other species in the group with even longer subantennal distance, *crotema* and *prolata*. The metatypes from Quincy have only a small postocular smooth spot but are typical in other respects.

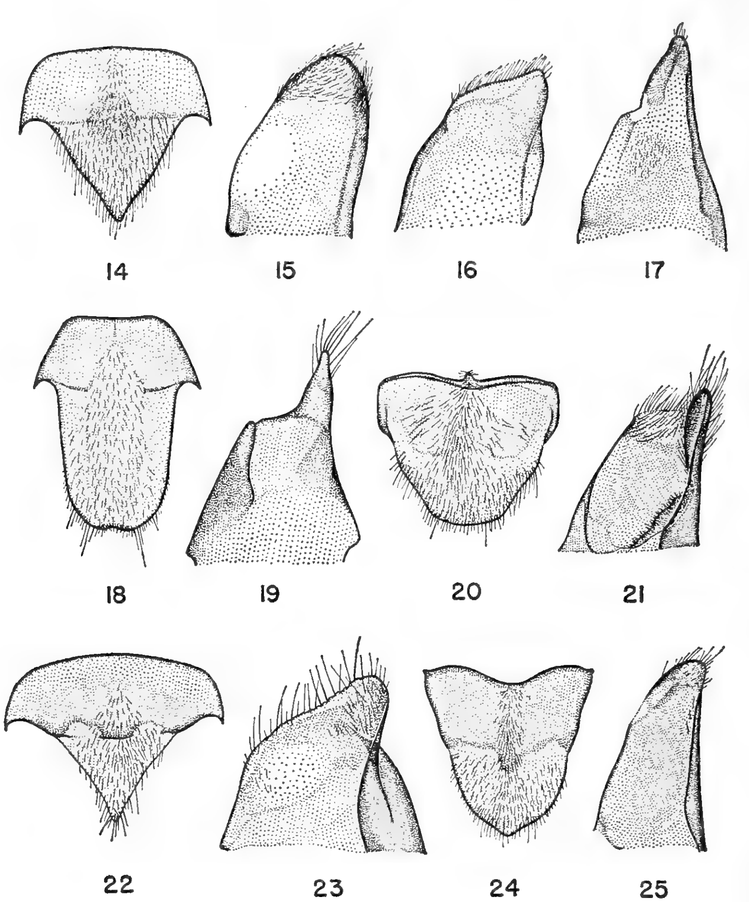
C. venusta group: Includes *venusta* Cresson, *astralia* Bohart and *venustella* Bohart. Tergite III with 4 distinct teeth, median pair strongest, teeth double-edged beneath; pit row rather deep, pits mostly large and often confluent, most median part of row expanded somewhat anteriorly; malar space about as long as or shorter than diameter of mid ocellus, in any case shorter than subantennal distance which is somewhat greater than mid-ocellus diameter; flagellomeres of male with I about as long as pedicel, II shorter, III nearly twice as long as I, IV a little shorter than III; flagellomeres of female with I about 1.7 times as long as broad, II to IV subequal and each about 0.6 times as long as I; frontal carina very broadly M-shaped, continued downward along inner eye margins; ocelli not especially sunken nor lidded; mesopleuron without distinct teeth; scutellum and postscutellum simple, rounded; tergites II–III with a faint longitudinal median raised or smooth line; male genitalia with gonostyle sharply excavated distally.

Chrysis astralia Bohart, new species

Male: Agreeing with description of *venustella* except as follows: teeth of tergite III with well spaced punctures above median emargination; median carina of pit row a little broadened, smooth, not depressed (Fig. 13); tergite III nearly evenly convex in profile. Sternite VIII with subtriangular basal part and a slender "tail"; genitalia with outer arm of forked apex of gonostyle subtriangular (Fig. 8), proportionately intermediate in length between that of *venusta* and that of *venustella* (Figs. 9, 10).

Female: About as in male. Body sometimes bluish, flagollomere I green above; frontal hair bands less thick; teeth of tergite III shorter, lateral pair obtuse.

Holotype male, Davis, Yolo Co., California, 26 August 1956 (A. T. McClay, UCD). Paratypes, 58 males, 42 females, May to September, from California as follows: Trabuco Canyon, Orange Co.; Twentynine Palms (M. Boyer); Wasco (J. Powell); Buttonwillow (P. A. Opler);



Figs. 14–25. Male *Chrysis*. 14, 18, 20, 22, 24, sternite VIII; 15–17, 19, 21, 23, 25, distal one-half of gonostyle, ventral; 14–15, *C. tensa* Bohart; 16, *C. vibex* Bohart; 17, *C. coloradica* Bohart; 18–19, *C. crotema* Bohart; 20–21, *C. xerophila* Bohart; 22–23, *C. rivalis* Bohart; 24–25, *C. vagabunda* Bohart. All Figs. except 17 are of holotypes.

Wood Lake, Tulare Co. (N. W. Frazier); Willow Slough, Madera Co. (R. W. Thorp); Helm (H. Michalk); Ceres (W. W. Middlekauff); Dos Palos (C. A. Hanson); Tracy (P. D. Hurd, J. W. MacSwain); Antioch (E. C. Van Dyke); Davis (A. T. McClay); Elkhorn Ferry, Yolo Co. (R. Bohart); Woodland (A. T. McClay); Artois (H. L. Hansen, J. W. MacSwain). Paratypes returned to or deposited in all of the institutions listed in the introduction; also to R. R. Dreisbach, W. Linsenmaier and

S. Zimmermann. Metatypes: 7 males, 2 females, White Sands, New Mexico (R. H. Beamer, KU); Wilna, New Mexico (J. Rehn, Sr., *et al.*, ANSP); Watson, Utah (F. M. Carpenter, MCZ); Hiko, Nevada (F. D. Parker, NSDA); near Douglas, Arizona (M. A. Cazier, AMNH); Pescadero, Baja California, Mexico (Ross and G. Bohart, CAS); near Sombrerete, Zacatecas, Mexico (P. D. Hurd, CIS).

The moderately incised gonostyle of *astralia,* intermediate between those of *venusta* and *venustella* (Figs. 8–10) is the single most diagnostic feature. The short malar space will separate the species from *venusta,* and the stout, smooth, median carina of the pit row contrasts with that of *venustella.* Since male genitalia are so critical in this group, I have dissected all specimens studied. Among these are a group from Hallelujah Junction, Lassen Co., California and one male from Orovada, Nevada which agree in genitalic characters with *astralia* but have several distinctive features such as longer and more densely punctate teeth on tergite III, sharper mid-carina of the pit row, and blue to purple body color. For the present I regard them as atypical *astralia.*

Chrysis venustella Bohart, new species

Male: Length 7.5 mm. Green with bluish and some brassy tints, sternite II with a pair of oval black spots which are enlarged laterally; wings lightly stained in cellular area. Scapal basin on lateral one-third densely clothed with appressed silvery hair, other body hair erect and pale fulvous. Punctation moderate, close, mostly of one size, numerous smaller punctures between larger ones on tergite II, teeth of tergite III closely punctate. Head broader than long (Fig. 12); eye a little narrower than least interocular distance in front view, malar space about 0.5 times mid-ocellus diameter and 0.4 times subantennal distance; apicolateral corner of tergite II obtusely angled; tergite III in profile convex before pit row, depressed there and humped distally, the teeth acute, curving downward; mid carina of pit row thin, depressed, punctate posteriorly; lateral margin of tergite undulate and a little concave overall. Sternite VIII with a subtriangular basal part and a moderately slender "tail"; genitalia with outer arm of forked apex of gonostyle a long, nearly cylindrical club (Fig. 9).

Female: About as in male. Green with bluish tints or vice versa; flagellomere I green or blue-green above; frons with hair bands but less prominent than in male; teeth of tergite III shorter, lateral pair obtuse; median carina of pit row sharply edged and depressed.

Holotype male, Davis, Yolo Co., California, 2 May 1959 (F. D. Parker, UCD). Paratypes, 27 males, 30 females, May to September, from California as follows: Warner Springs (R. Bohart); Peters Canyon (R. Bohart); Tanbark Flat, Los Angeles Co. (R. Bohart); La Crescenta (C. D. Michener); Greenhorn Mountains (J. Bequaert); Watts Valley, Fresno Co. (R. O. Schuster); Arroyo Seco Camp, Monterey Co. (R. Bohart); San Antonio Valley, Santa Clara Co. (J. E. Gillaspy); Mt.

Hamilton (J. W. MacSwain); Mariposa (R. Bohart); Topaz Lake (E. L. Brazil); Boca, Nevada Co. (M. E. Irwin); Sierraville (R. Bohart); Tracy (P. D. Hurd, J. W. MacSwain); Tesla, Alameda Co. (P. D. Hurd); Walnut Creek (J. A. Chemsak, J. F. Lawrence); Mt. Diablo (J. W. MacSwain); Davis (F. D. Parker, B. M. Bartosh, E. I. Schlinger); Woodland (A. T. McClay); Carmichael (T. Gantenbein); Samuel Springs, Napa Co. (S. M. Fidel, E. I. Schlinger); Manton (R. Bohart); Santa Rosa (K. Frick); Orland (R. F. Smith); Artois (H. R. Hansen, J. W. MacSwain); Blocksburg (H. J. Rayner); from NEVADA as follows: Paradise Valley, Humboldt Co. (F. D. Parker). Paratypes returned to or deposited in all of the institutions listed in the introduction; also to R. R. Dreisbach, W. Linsenmaier and S. Zimmermann. Metatypes: 3 females, Yakima River (MCZ); 1 female, Sparks, Nevada (F. D. Parker, UCD).

The three closely related species of the *venusta* group are best determined by reference to male genitalia (Figs. 8–10). In addition the narrow malar space (broadest in *venusta* Cresson where it usually exceeds a mid-ocellus diameter), sharply edged and sunken mid carina of the pit row, and the closely punctate distal teeth of tergite III will, when taken together serve to distinguish *venustella*.

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PROCEEDINGS
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GLYPHANODINIUM, A NEW DINOFLAGELLATE GENUS FROM THE PALEOCENE OF CALIFORNIA

By Warren S. Drugg
California Research Corporation, La Habra, California

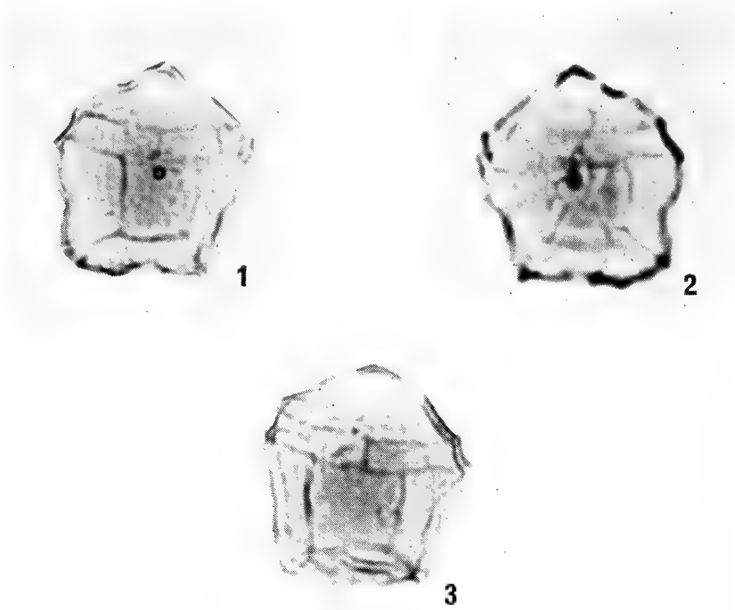
During the course of a palynological investigation of the Dos Palos Shale Member of the Moreno Formation a distinctive dinoflagellate was found to occur in fair abundance. Specimens were obtained from two core holes at Escarpado Canyon in the Panoche Hills, Fresno Co., California. The stratigraphic level of occurrence is in the Dos Palos Shale 95 to 125 feet below the base of the overlying Lodo Formation. A single additional specimen was found 750 feet below the Lodo (330 feet below the Cima sand lentil). Payne (1951: 11) suggested that the Dos Palos Shale is of Paleocene age. Loeblich (1958: 2260) demonstrated on the basis of planktonic Foraminifera that it represents the Danian Stage of the Paleocene.

Glyphanodinium, new genus

Type species: *Glyphanodinium facetum*, new species.

Diagnosis: Test small, angular, five-sided in outline. A transverse furrow divides the test into a small epitheca and a relatively large hypotheca. A longitudinal furrow interrupts the girdle and extends onto both the epitheca and hypotheca. Ventral side of test flat to concave. Dorsal hypotheca is chisel-shaped at the antapex. Tabulation: one (?) apical plate, five precingular plates, six girdle plates, six postcingular plates, one posterior ventral plate, one posterior intercalary plate, and one antapical plate. The test opens by detachment of the apical plate.

Comment: This genus is assignable to the order Peridiniales of the class Dinophyceae. It resembles the genera *Lithodinia* Eisenack 1935, *Microdinium* Cookson and Eisenack 1960, and *Canninginopsis* Cookson and Eisenack 1962, to the extent that all are tabulated, possess apical archeopyles, and presumably represent motile stages. Of the three genera it bears the closest resemblance to *Microdinium* in that both are small and possess girdles located relatively high on the test. They



FIGS. 1–3. *Glyphanodinium facetum*, n. gen., n. sp., Danian, Dos Palos Shale, Fresno Co., California. 1, Holotype, dorsal view; 2, same, ventral view; 3, paratype, dorsal view. All unretouched photographs, × 1000.

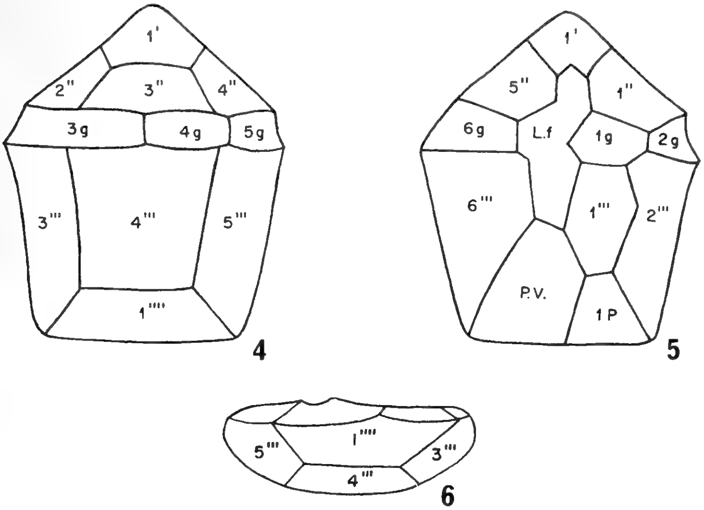
differ in tabulation and in the form of the test. *Glyphanodinium* bears a superficial resemblance to *Phanerodinium* Deflandre, 1937, but differs in tabulation and archeopyle position.

Glyphanodinium facetum, new species
(Figs. 1–6)

Holotype: California Research Corporation Cat. No. 16626, 75–85(3). Paratype: California Research Corporation Cat. No. 16626, 85–95(3).

Age and occurrence: Danian. Dos Palos Shale Member of the Moreno Formation; Sec. 7 & 8, T. 15 S., R. 12 E., M.D.M., Fresno Co., California.

Diagnosis: Same as for the genus with the following additional remarks. The girdle is circular. The slightly sunken longitudinal furrow is displaced a little to the left at the point where it crosses the transverse furrow but the portions above and below the girdle are in alignment. The tabulation of the hypotheca is distinct but that of the epitheca is less easily discernible. The archeopyle operculum is very small and difficult to interpret because the flattened test does not commonly assume



Figs. 4–6. *Glyphanodinium facetum*, n. gen., n. sp., diagrams to show plate arrangement, × 1500. 4, Dorsal view; 5, ventral view; 6, antapical view.

a vertical orientation. The epitheca is in the form of a dorsoventrally flattened cone. The hypotheca is chisel-shaped with the ventral side flat or slightly concave. The dorsal side exhibits a flat central plate (4 ‴) with the lateral plates (3 ‴, 5 ‴) and the antapical plate (1 ⁗) each angled downward from the plane of the central plate. A cross section through the hypotheca is in the form of an isosceles trapezoid, the longer of the parallel sides being the ventral side. A section through the girdle area has a flattened reniform shape, the concave side being ventral. The test membrane is thin, single-layered, translucent. It can be seen to be faintly punctate when observed under high magnification. The sutures are only slightly raised above the surface of the test on the hypotheca and are flush on the epitheca.

Dimensions: Holotype—28 μ high, 26 μ broad. Size range 27 to 32 μ high with operculum in place, 22 to 27 μ without operculum; 20 to 25 μ broad. Thickness front to back ca. 9 μ. Seventy-five specimens located and examined.

Comment: Because of the small size of this species, it is inconspicuous in strewn slides. The brownish color, which resembles that of cuticular debris, adds to the difficulty of locating specimens.

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PROCEEDINGS
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SYNONYMS OF *PROTODORVILLEA EGENA* (EHLERS) (EUNICIDAE, POLYCHAETA)[1]

BY K. BANSE AND G. HARTMANN-SCHRÖDER

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Since we may not have the opportunity to incorporate this note in an appropriate larger paper, we wish to report that we believe now that *Dorvillea mandapamae* and *D. graciloides*, described by us, are synonyms of *Stauronereis egena* Ehlers (1913) from Simonstown, South Africa. Following Pettibone (1961) the species is called *Protodorvillea egena.*

Stauronereis egena Ehlers, 1913, p. 501, pl. 35, figs. 1–6.
Stauronereis egena Augener, 1917, *partim*, p. 379.
Dorvillea egena Day, 1957, p. 95.
Dorvillea mandapamae Banse, 1959, p. 166, fig. 1.
Dorvillea graciloides Hartmann-Schröder, 1960, p. 117, figs. 169–172.
Protodorvillea egena Pettibone, 1961, p. 180.
Protodorvillea egena Day, 1963, p. 412.

There are minor deviations in the various descriptions which do not justify maintaining of separate species: the number and position of eyes differ, but the variability of the character during development has been shown for *D. mandapamae.* The anterior margin of the first segment of the single known specimen of *D. graciloides* is not straight as in the other forms. It is not known whether this is due to contraction or whether its represents nuchal organs not described for any other *Protodorvillea* species. Variations in relative lengths of the first and the second segments may as well be due to variable states of contraction.

None of the later authors has seen two aciculae supporting the two bundles of setae according to Ehlers (1913). A new inspection of a paratype of *D. mandapamae* (Museum Hamburg No. V.13021) shows that the inner margins of the prongs of the forked setae are not smooth but are feathered (Fig. 1) as in *P. egena*; Augener (1917) had already

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[1] Contribution No. 306 from the Department of Oceanography, University of Washington, prepared with partial support by Contract Nonr-477(10), Project NR 083 012, with the Office of Naval Research. We acknowledge also helpful correspondence with Professor J. H. Day in Cape Town.

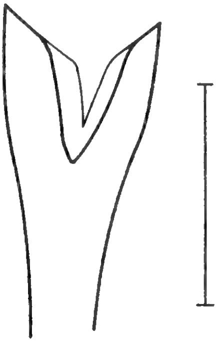

FIG. 1. Tip of forked seta from juvenile specimen from Mandapam.

suggested that Fig. 4 of Ehlers (1913) represents the forked seta but that the caption is wrong. *D. graciloides* seems to possess smooth forked setae. While some compound bristles with blades having tridentate tips were reported for *D. graciloides,* the blades of *D. mandapamae* appear as bidentate under 1000-fold magnification. Day (1963) has observed bidentate blades in new material of *P. egena* from the type locality, so Ehlers may have erred in reporting blades with pointed tips.

Augener (1917) saw the type of *P. egena* and added to the original description. However, his own material from Southwest Africa does not represent this species, as also pointed out by Day (1963). Both the single specimens from Swakopmund (Museum Hamburg No. V.8792) and from Lüderitzbucht (No. V.8753) belong to *Stauronereis sensu* Pettibone (1961), and seem to be identical with the specimens reported as *S. neglecta* from many places in South Africa.

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PROCEEDINGS
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TWO NEW ENTOCYTHERID OSTRACODS FROM THE VICINITY OF WASHINGTON, D.C.

By C. W. Hart, Jr.
Academy of Natural Sciences of Philadelphia

In the course of a recent study of the entocytherid ostracods associated with crayfishes in the collection of the U. S. National Museum in Washington, D.C., a new species of the genus *Ankylocythere* Hart 1962 and a new entocytherid genus were found associated with specimens of the crayfish *Cambarus d. diogenes* Girard from Washington, D.C. and the immediate vicinity. These ostracods are described below, and their relationships to other entocytherid ostracods discussed.

This work was carried out with the aid of grant No. GB-1436 from the National Science Foundation. I also wish to thank Dr. Horton H. Hobbs, Jr. and Dr. Fenner Chace of the U. S. National Museum in Washington, D.C., for their cooperation in making material available for this study.

Okriocythere, new genus

Diagnosis: Terminal tooth of mandible with cusps. No finger guard on copulatory complex. Clasping apparatus heavy, club-shaped, with horizontal ramus reduced and possessing teeth on internal and external borders. Peniferum extending only slightly beyond clasping apparatus; penis large, curved, and situated distally on peniferum.

Name: *Okrios*, Gr.—any roughness + *Cythere*.

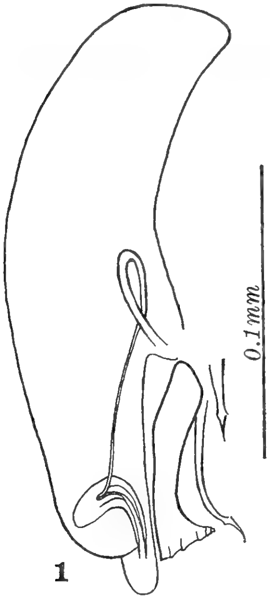
Type Species: *Okriocythere cheia*, new species (see below).

Okriocythere cheia, new species

Male: Eyes reduced or absent; when present, situated ⅓ shell length from anterior end. Shell subelliptical in outline with greatest height about midpoint. Setae scarce; situated on anterior and posterior ends. The shell sizes of four specimens (in mm) are:

Length—	0.47	0.47	0.48	0.47
Height—	0.28	0.28	0.28	0.28

Antennae, mandibles, and maxillae essentially identical with those of *Donnaldsoncythere humesi* (Hoff, 1943: 282).



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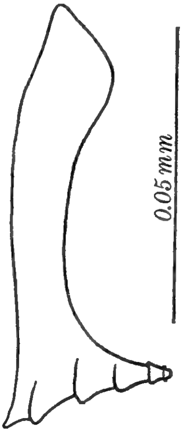

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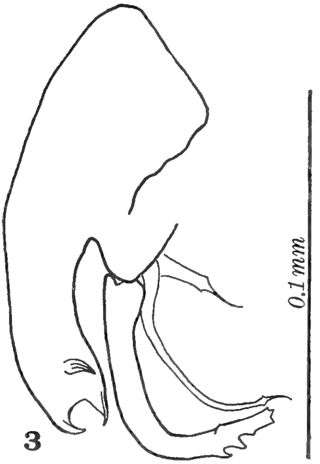

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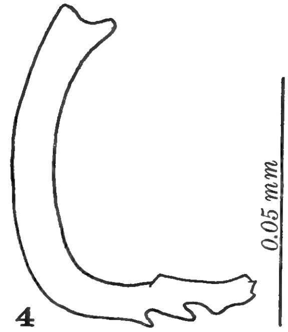

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FIG. 1. Copulatory complex of *Okriocythere cheia*, new species.
FIG. 2. Clasping apparatus of paratype of *O. cheia*.
FIG. 3. Copulatory complex of *Ankylocythere tridentata*, new species.
FIG. 4. Clasping apparatus of *A. tridentata*.

Copulatory complex (Fig. 1) with ventral extremity of peniferum extending ventrally slightly beyond clasping apparatus; distal prominence not heavily cornified. Penis situated in ventral portion of peniferum, and extending slightly beyond base of ventral prominence. Clasping apparatus (Figs. 1 and 2) heavy, club-shaped, with an acute caudoventral angle at junction of horizontal and vertical rami; horizontal ramus much reduced, when compared with other entocytherid ostracods (except the genus *Donnaldsoncythere*). External border of horizontal ramus with five teeth, from which conspicuous elevations extend dorsally on mesial and lateral surfaces as ridges, and the distal two apparently encircle the ramus; internal border of horizontal ramus with two teeth.

Female: Shell of one biunguis female identified, similar to male but slightly smaller (length, 0.43; height, 0.25).

Variations: Slight variations were noted among the four male specimens, the most conspicuous being that the external border of the clasping apparatus may have four or five teeth; the internal border one or two teeth.

Type locality, range, and host: Prince Georges Co., Maryland (from U. S. National Museum crayfish collection No. 42604). Other specimens were taken from Laurel, Prince Georges Co., Maryland (USNM crayfish collection No. 43753); Plummers Island, Potomac River, Montgomery Co., Maryland (USNM crayfish collection No. 43761); and Zoological Park, Washington, D.C. (USNM crayfish collection No. 16974). The host crayfish in all instances was *Cambarus d. diogenes* Girard. Associated with this ostracod in collections No. 42604 and 43761 was a new species of the genus *Dactylocythere*, soon to be described by Dr. Horton H. Hobbs, Jr. In collection No. 43761 it was also associated with a single specimen of a new species of genus *Ankylocythere*, described below.

Disposition of the types: The male holotype and dissected male paratype are deposited in the U. S. National Museum in Washington, D.C. (USNM 110940 and 110941). Other specimens are in the collections of Dr. Horton H. Hobbs, Jr., and the author.

Relationships: Based on the structure of the copulatory complex, this species does not appear to be closely allied with the other entocytherid ostracods. If close relationships exist, they are probably with members of the genus *Donnaldsoncythere*, although the shape of the clasping apparatus indicates considerable divergence from any known entocytherid.

Name: *Cheia*, Gr.—hole in the ground. The reference is to the fact that this ostracod is known only from the burrowing crayfish, *Cambarus d. diogenes*.

Ankylocythere tridentata, new species

Male: Shell subelliptical in outline with greatest shell height at about the midpoint. Marginal setae apparently absent. Eye spot reduced or absent. The only known specimen measures 0.36 mm in length, 0.20 in height.

Antennae, mandibles, and maxillae essentially similar to those of *Ankylocythere tiphophila* (Crawford, 1959: 173, pl. 5).

Copulatory complex (Fig. 3) with clasping apparatus extending beyond peniferum. Clasping apparatus (Figs. 3 and 4) with distinct horizontal and vertical rami, subequal in length. Internal border of horizontal ramus provided with one tooth; external border provided with three teeth, the most distal of which is not as well developed as the other two; distal extremity with three denticles. Peniferum relatively simple; distal extremity bifurcate with points apposed to one another. Penis small, situated in distal portion of peniferum.

Female: Not known.

Relationships: Within the genus *Ankylocythere*, this species appears to have its closest affinities with *A. talirotunda* (Rioja, 1949), *A. heterodonta* (Rioja, 1940), and *A. sinuosa* (Rioja, 1942). These species are known only from Mexico. *A. talirotunda* and *A. heterodonta* show evidence of possible relationships with *A. tridentata* based on the number of teeth on the external border of the horizontal ramus of the clasping apparatus; *A. sinuosa* shows evidence of possible relationships in that it possesses a bifurcate peniferum similar to that found in *A. tridentata*.

The bifurcate peniferum, on the other hand, also indicates possible relationships with certain members of the genus *Uncinocythere* and with a new genus soon to be described by Dr. Horton H. Hobbs, Jr.

Type locality and host: Plummers Island, Montgomery Co., Maryland. This ostracod is known from a single specimen found on the crayfish *Cambarus d. diogenes* Girard, collected by W. Hay (USNM crayfish collection No. 43761). The holotypic male of this ostracod is deposited in the U. S. National Museum (USNM 110942).

This ostracod was associated with *Okriocythere cheia* (described above) and with a new species of the genus *Dactylocythere* soon to be described by Dr. Horton H. Hobbs, Jr.

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PROCEEDINGS
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A NEW SPECIES OF LACEBUG FROM PAKISTAN (HEMIPTERA: TINGIDAE)

BY CARL J. DRAKE AND M. A. H. QUADRI
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The present paper describes a new species of lacebug and records three others along with their respective host plants from Pakistan. These species are as follows: *Monosteira discoidalis* (Jakovlev) on poplar (*Populus euro-americana*); *Corythauma ayyari* (Drake) on *Ocimus* sp.; and *Galeatus scrophicus* Saunders on sunflower, plus the new form described below.

Dictyla eudia, n. sp.
(Fig. 1)

Moderately large, elliptical, grayish testaceous with two small spots on boundary vein separating discoidal and sutural areas, numerous short veinlets in costal and other elytral areas, second and fourth segments of each antenna, pronotal disc, body beneath, and a wide band or elongate mark near dorsal side of each femur fuscous to dark fuscous. Bucculae and laminae of rostral sulcus on thoracic sternum testaceous; rostrum fuscous. Dorsal surface thinly clothed with inconspicuous, scale-like pubescence. Hind wings hyaline. Length 2.75, width 1.35 mm.

Head very short, sharply declivent in front of eyes, armed with five moderately long, testaceous spines, the three frontal ones porrect and hind pair subappressed. Rostrum fuscous, long, tip resting on metasternum; bucculae wide, areolate, closed in front; sternal laminae of rostral sulcus widely separated from each other, nearly parallel on mesosternum, more widely separated and cordate on metasternum, closed behind. Antenna slender, moderately long, inconspicuously pubescent, fourth segment subclavate, measurements: segment I, 8; II, 6; III, 50; IV, 12. Metapleural ostiole and ostiolar canal imperceptible.

Pronotum large, moderately convex, punctate on disc, areolate on triangular projection of hind margin, tricarinate; median carina percurrent, very distinct, non-areolate, slightly more raised than lateral pair; lateral carinae visible on triangular process, convergent anteriorly, beneath paranotum only slightly convergent, but not coming in contact with

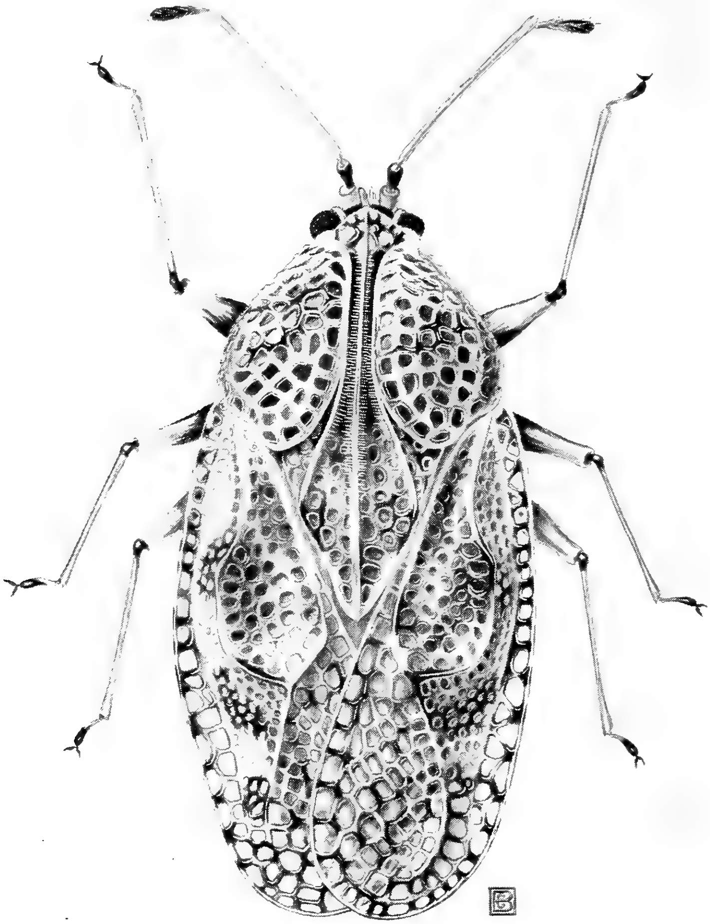

FIG. 1. *Dictyla eudia*, n. sp., paratype.

median carina, terminating anteriorly in front of middle of pronotal disc; paranotum very large, completely reflexed, with only a narrow space left uncovered on each side between median carina and outer margin of paranotum; hood small, inflated, not produced forward.

Elytra not much longer than abdomen, apices within slightly overlapping each other, jointly rounded behind, without tumid elevations;

costal area narrow, mostly uniseriate, biseriate for a short distance opposite apex of discoidal area, with crossveins thickened and dark; subcostal area sloping obliquely downward toward costal area, mostly bi- or triseriate, wider just behind discoidal area, there five or six areolae deep, thence narrowing apically to a single cell; discoidal area extending backward beyond middle of elytron, widest in front of apex, boundary vein separating it from subcostal area deeply concavely extended in apical two-fifths into subcostal area; sutural areas slightly overlapping each other, each on same horizontal level as discoidal area. Hind wings clear, extending slightly beyond apex of genital segments, functional. Legs short, slender, inconspicuously pubescent; femora slightly swollen.

Holotype ♂ and *allotype* ♀: Both macropterous, taken on *Cordia ruthii*, March 1964, West Pakistan, Drake Coll. (USNM).

Paratypes: Four specimens taken on same host along with type, in collections of both authors.

This species can be separated from members of the genus found in Asia and the Malay Archipelago by the very wide, completely reflexed paranota, shape of discoidal areas, and the sparse, erect, scale-like, golden pubescence on dorsal surface. The uncovered space between the median carina and the outer margin of either paranotum is approximately twice that of the height of median carina. A paratype, drawn by Caroline B. Lutz, Washington, D.C., is illustrated.

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PROCEEDINGS
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GEOGRAPHIC VARIATION IN THE COOT IN NEW GUINEA

By Max C. Thompson and Philip Temple
University of Kansas Museum of National History, Lawrence, Kansas, and Bishop Museum, Honolulu, Hawaii

In March 1963, an expedition from the Bernice P. Bishop Museum[1] spent 14 days at Lake Anggi Gidji in the Arfak Mountains of the Vogelkop of West New Guinea (Irian Barat). Among the specimens taken were five coots, *Fulica atra*, that had been known previously from Lake Anggi Gidji by only two specimens deposited in the American Museum of Natural History. The only other place in New Guinea from which coots are known is Lake Habbema in the Oranje Mountains of the Central Highlands; specimens from there also are in the American Museum. When compared with the specimens from Lake Habbema, those from Lake Anggi Gidji prove to differ subspecifically and are named and described below.

Fulica atra anggiensis, new subspecies

Type: Female, adult, No. 483531 U. S. National Museum, Lake Anggi Gidji, Arfak Mountains, 6200 feet, West New Guinea; obtained on 2 March 1963 by Max C. Thompson, original number 3754.

Range: Known only from Lake Anggi Gidji, Arfak Mountains, West New Guinea.

Diagnosis: Similar to *novaeguineae* but wing, frontal shield and bill are smaller.

Measurements: ♂ (1), wing 184 mm, tip of bill to top of frontal shield 51 mm.

♀ (4), wing 174–179 (176) mm, tip of bill to top of frontal shield 45–58 (50) mm. Measurements of the holotype are 174 and 58 mm.

Remarks: Mayr (List of New Guinea Birds. Amer. Mus. Nat. Hist., 1941, p. 27) listed the range of *Fulica atra* as including the Anggi Lakes but indicated that the subspecies there was unknown. The two older

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[1] Partial results of field work supported by the U. S. Army Medical Research and Development Command, Dept. of the Army, DA-MD-49-193-62-G47 and G65.

specimens from Lake Anggi Gidji, in the American Museum, do not agree in coloration with the material from Lake Habbema because the former are foxed, as shown by comparison with the new material from the area (Gilliard, personal comm.). No difference in coloration could be detected between the fresh material of *anggiensis* and the specimens from Lake Habbema of *novaeguineae*. The species was found to be common at Lake Anggi Gidji where pairs were seen in the marshy areas around the shore of the lake as well as rafts of 75–100 birds on the open water. Some of the specimens taken showed evidence of being in breeding condition. Although there are two lakes in the area, we were unable to visit the other. The natives in the area said that the coot also occurs there.

The specimens of *anggiensis* are deposited in the Bishop Museum, University of Kansas Museum of Natural History, American Museum of Natural History and the U. S. National Museum.

Fulica atra novaeguineae Rand

Fulica atra novaeguineae Rand, 1940, Amer. Mus. Novit., No. 1072, p. 4.—Lake Habbema, 3225 m.

Measurements: ♂ (1), wing 196 mm, tip of bill to top of frontal shield 57 mm.

♀ (4), wing 189–199 (191.7) mm, tip of bill to top of frontal shield 57–59 (57.5) mm.

Remarks: The frontal shield of *novaeguineae* when compared with that of *anggiensis* was not only longer (one instance of overlap) but broader. All of the specimens of *novaeguineae* examined were collected in August 1938 at the type locality.

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PROCEEDINGS
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A METAPODIAL OF *ACRATOCNUS* (EDENTATA: MEGALONYCHIDAE) FROM A CAVE IN HISPANIOLA

BY D. A. HOOIJER AND CLAYTON E. RAY[1]
Rijksmuseum van Natuurlijke Historie, Leiden,
and U. S. National Museum

The present note deals with a metapodial of a very small ground sloth collected by Clayton E. Ray and Robert R. Allen in a cave 2 km southeast of Rancho La Guardia, Provincia de San Rafael, Dominican Republic, Hispaniola, between 31 March and 2 April 1963. The field work was supported by National Science Foundation grants GB 178 and G 16066, and was conducted with the cooperation of Ing. Emile de Boyrie Moya and Professor Eugenio de Jesús Marcano F., both of the Universidad Autonoma de Santo Domingo. The specimen (University of Florida Collections, Vertebrate Paleontology, UF 7798: Fig. 1A–D) is a left third metatarsal, fully adult (no distal epiphysial suture shown), only 15.7 mm in total length, and perfectly preserved. The strong carina is very nearly centrally placed, but slightly nearer to the external than to the internal side of the distal trochlear surface. The proximal dorsal process on the internal side, with the facet for metatarsal II, is placed lower and is less prominent than that on the external side, which articulates with the cuboid and metatarsal IV. The extensive proximal surface for the ectocuneiform is concave dorsoventrally and is not depressed between the two metatarsal processes; it ends ventrally in a marked tongue-like process.

The Antillean ground sloths described thus far comprise the genera *Acratocnus* Anthony (two species on Puerto Rico, and one each on Hispaniola and Cuba), *Megalocnus* Leidy (one species on Cuba, and one on Hispaniola), *Mesocnus* Matthew (two species on Cuba exclusively), *Microcnus* Matthew (one species on Cuba), and *Paulocnus*

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

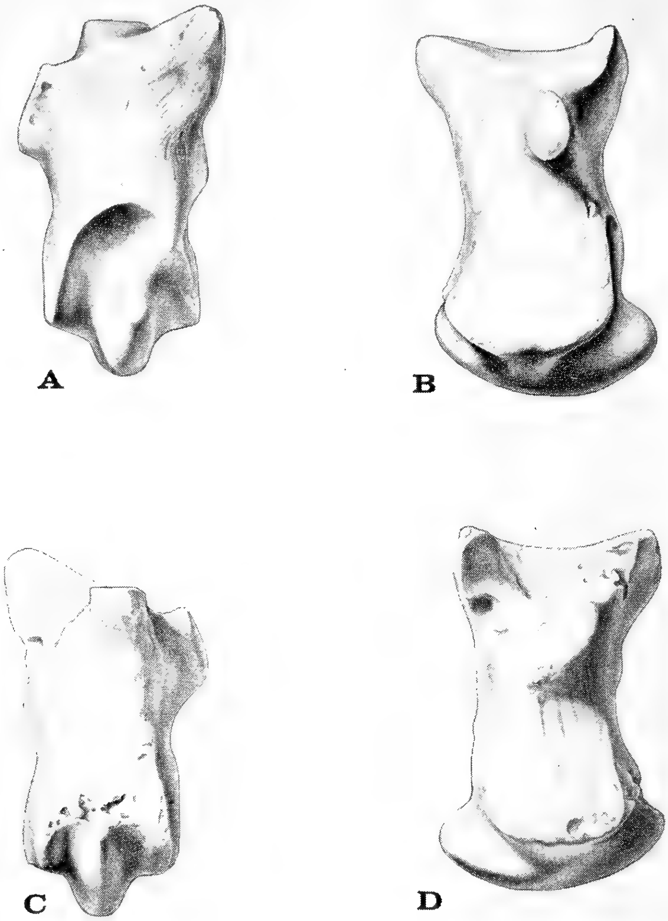

FIG. 1. Left metatarsal III, UF 7798, of *Acratocnus* in dorsal (A), medial (B), ventral (C), and lateral (D) aspects. Illustration prepared by Sue Hirschfeld under NSF GB 178.

Hooijer (one species on Curaçao). Of these, the third metatarsal of *Microcnus* only has been described; it is, therefore, difficult to assess the relationships of the newly found Hispaniolan metatarsal on the basis of the data in the literature.

While in the United States in the winter of 1962–63 the senior author collected data on the foot bones of the Antillean ground sloths in the American Museum of Natural History, New York City, the Museum of Comparative Zoology at Harvard College, Cambridge, Mass., and the U. S. National Museum, Washington, D.C. He wishes to acknowledge his indebtedness to the curators in charge, Dr. Malcolm C. McKenna, Prof. Bryan Patterson, and Dr. David H. Johnson, for permission to study and borrow specimens. The present note concerns only the third metatarsal; a more comprehensive paper is in preparation.

In searching for comparative material to study in connection with the Curaçao ground sloth, *Paulocnus petrifactus* (Hooijer, 1962, 1964), a metatarsal III of which is now available, it was found that the "metatarsal III" of *Megalocnus rodens* Leidy from Cuba listed and figured by Matthew and Paula Couto (1959: 26 and pl. 23, figs. 3–6; AMNH 49899) is the metacarpal III instead, and hence of no use for comparison in the present case. No third metatarsal of *Megalocnus,* the largest of the Antillean ground sloths, appears to be available in the Cuban collections either at the AMNH or at the MCZ. Of the Cuban *Mesocnus* the third metatarsal is not available either. However, among unnumbered *Acratocnus* metapodials from Puerto Rico in the AMNH there is one (left) metatarsal III, measuring 23.7 mm in total length, and hence one-half longer than the Hispaniolan bone. The Puerto Rican bone appears to represent the smaller of the two species of *Acratocnus* on this island (Anthony, 1926), viz., *A. odontrigonus* Anthony. *Acratocnus antillensis* (Matthew), found on Cuba, apparently is somewhat more robust than *A. odontrigonus* (Matthew and Paula Couto, 1959: 42); its third metatarsal has not been found. The third metatarsal of the smallest known Antillean ground sloth, *Microcnus gliriformis* Matthew from Cuba, is in the AMNH collection (No. 49952) and has been described by Paula Couto (in Matthew and Paula Couto, 1959: 46) as very similar to its homologue in the Santacruzean (Miocene) genus *Pelecyodon* but only about three-fifths as large. Measurements have not been published, and are here supplied for the first time, in conjunction with those of the newly found Hispaniolan metatarsal III and that of *Acratocnus odontrigonus* from Puerto Rico.

It will be observed from Table 1 that the Hispaniolan bone, although shorter even than that of *Microcnus,* is very similar in proportions to its homologue in *Acratocnus,* and decidedly more slender than the metatarsal of *Microcnus.* The difference is most noticeable in width; in the Hispaniolan bone the ends and the shaft are only about three-fifths as wide as in the Cuban. The distal carina unfortunately is incomplete dorsally in the Cuban metapodial, but in the depths of shaft and proximal end the Hispaniolan bone is four-fifths as large as that from Cuba, the Hispaniolan bone being only one-tenth shorter than that from Cuba.

Extensive series of metapodials of various Miocene genera of ground sloths, including *Eucholoeops, Pelecyodon, Hapalops,* and *Analcimorphus,* have been examined (details will be given later). While the *Microcnus*

TABLE 1.—Measurements (mm) of metatarsal III of *Microcnus* and of *Acratocnus*

	Microcnus gliriformis Cuba	UF 7798 Hispaniola	*Acratocnus odontrigonus* Puerto Rico
Total length	17.5	15.7	23.7
Least depth of shaft, externally	7.0	5.7	7.1
Greatest extent of carina	ca. 13.	9.4	ca. 13.5
Greatest proximal width	14.0	8.7	11.6
Least width of shaft, dorsally	10.7	6.7	9.1
Greatest distal width	11.0	6.7	10.5
Depth of proximal surface	11.8	9.3	14.0
Ratio distal width : length	0.63	0.43	0.44
Ratio proximal depth : length	0.67	0.59	0.59

metatarsal III indeed, as noted by Paula Couto, is an almost perfect scale reduction of, e.g., *Pelecyodon* from Santa Cruz, the Hispaniolan bone is outside the range of variation of ratios in the Santacruzean sloths, being on the whole more slender in build, as is the *Acratocnus* metatarsal. The metatarsal III of *Paulocnus* can hardly be distinguished from that in the Santacruzean forms. It should be noted that none of the Miocene forms is nearly as small as *Microcnus* or the Hispaniolan form, which latter appears to be the smallest Antillean ground sloth thus far known. It is hoped that further material of this interesting pygmy sloth will be obtained from the Dominican Republic or Haiti to enable us to settle the affinities of this form more precisely than is at present possible. The specimen now available does not represent any of the known forms of ground sloth from the island of Hispaniola, which are definitely larger. The Haitian *Megalocnus serus* (Miller) is considerably larger than *Acratocnus odontrigonus* (Miller, 1929: 29), while the mandible of *Acratocnus comes* Miller from a cave at Bahia de Samaná, Dominican Republic, described by Hoffstetter (1955) is larger than that of *Acratocnus major* Anthony from Puerto Rico, and the remains of *Acratocnus* from Haiti described by Miller (1929: 26) agree with *A. odontrigonus* in general size.

In conclusion, it does seem that the Hispaniolan metatarsal represents a small species of *Acratocnus*, agreeing with this genus in the proportions of the metatarsal, and notwithstanding the resemblance in size should not be referred to *Microcnus*, in which the metatarsal is as heavily built as that in the Miocene forms and in the Curaçao sloth. Such proportional differences in the one element of the foot now available are indicative of similar differences in the other bones of the pes not yet found. Further search for sloth remains in Hispaniola, therefore, is much to be desired.

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(new names in **boldface**; see p. v for list of authors)


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