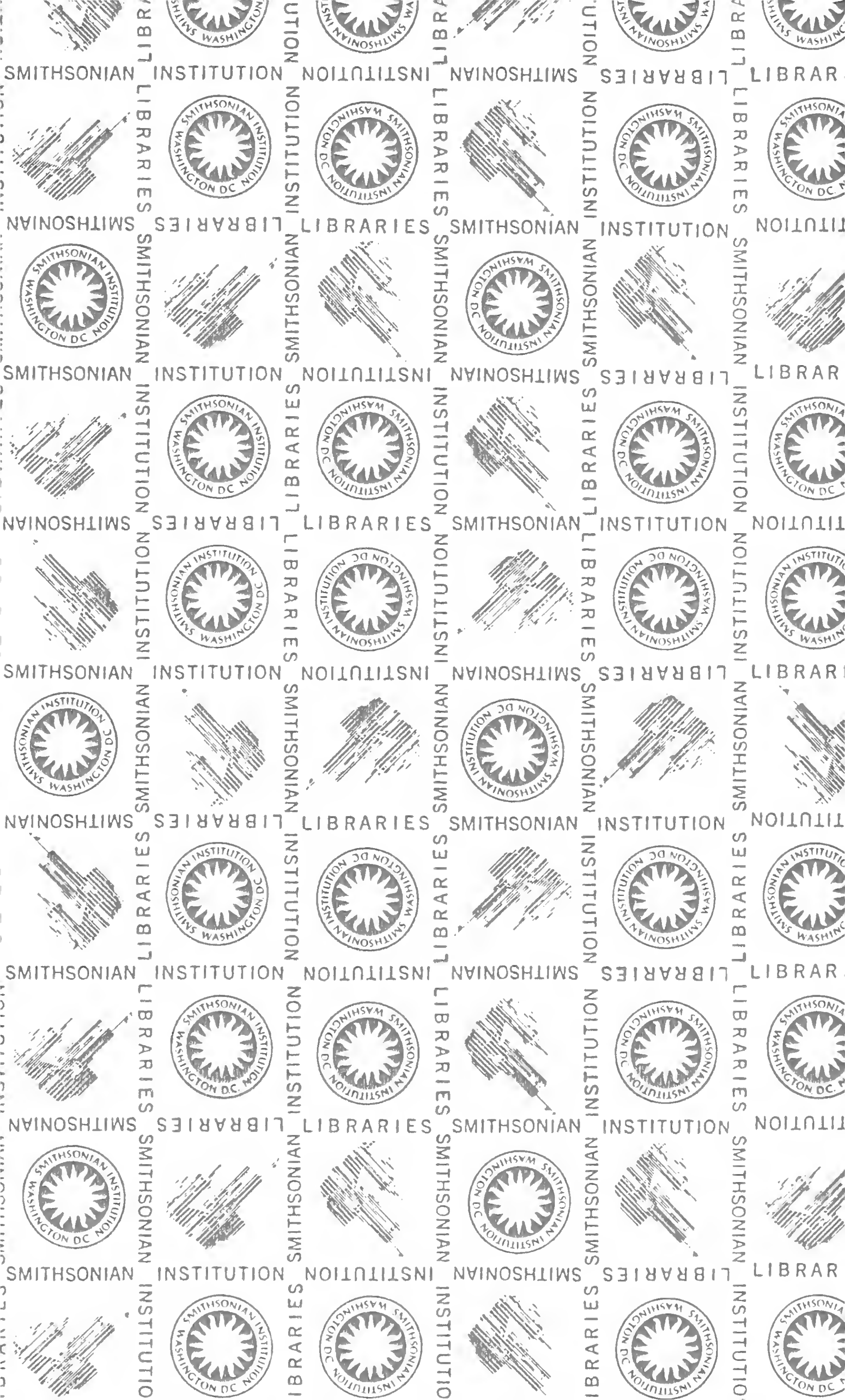
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NEW EXOTIC CRANE–FLIES (TIPULIDAE: DIPTERA) PART XXIV[1]

Charles P. Alexander[2]

The preceding part under this general title was published in Entomological News, vol. 84:23–31. The new species here described are from Thailand and South India, collected by the late Deed C. Thurman and by Dr. Fernand Schmid, to both of whom I express my deep thanks for their cooperation in making known the Oriental crane-fly fauna. I am providing figures of venation and the male hypopygium for various species of Oriental *Limnophila* that had not previously been illustrated, all materials being based on type specimens preserved in the Alexander Collection.

Dolichopeza (Mitopeza) trichochora, NEW SPECIES

General coloration of thorax orange and yellow; head chiefly brownish black, more or less pruinose; antennae of male elongate, about one-half the wing, flagellar segments long-cylindrical, with short erect setulae, major setae very sparse except on first segment; wings weakly suffused, prearcular and costal fields, together with the stigma, slightly darker; outer wing cells with strong black trichia; *Rs* short, transverse; cell M_1 sessile, cell *2nd A* relatively broad; male hypopygium with outer dististyle slightly expanded at near midlength, inner style with beak obtuse, simple; tergite produced into narrow lateral lobes, their mesal parts with short black spinoid setae.

MALE–Length about 7 mm.; wing 9 mm.; antenna about 4.3 mm.

Frontal prolongation of head short, medium brown; palpi brownish black. Antennae of male 12-segmented, elongate, nearly one-half the wing; scape and pedicel yellow, first flagellar segment obscure yellow basally, passing into brown, remaining segments brownish black; long-cylindrical, without basal enlargements, the segments progressively shorter outwardly, outer two subequal; all segments with abundant short erect setulae,

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[1] Accepted for publication: March 21, 1973

[2] Contribution from the Entomological Laboratory, University of Massachusetts, Amherst, MA 01002.

first flagellar with sparse longer black verticils on upper surface, the remaining segments with a single such bristle beyond midlength. Front brownish yellow, anterior vertex obscure yellow, remainder of head brownish black, orbits more pruinose; anterior vertex broad, nearly equal to the exposed diameter of the eye.

Pronotum light yellow. Mesonotal praescutum with ground brownish orange, with four inconspicuous more yellowed stripes, centers of scutal lobes similarly yellowed; scutellum brownish yellow, parascutella and postnotum clearer yellow; mesonotum and pleura glabrous, the latter clear light yellow. Halteres long, black, base of stem yellow. Legs with coxae and trochanters light yellow; remainder of legs broken. Wings (Fig. 1) weakly suffused with brown, prearcular and costal regions, with the stigma, slightly darker; veins brown. Longitudinal veins beyond general level of cord with long trichia, with sparse scattered trichia on *Cu* and *1st A*, virtually lacking on *M* and *2nd A*. Strong black trichia in outer ends of cells R_3 to M_3, most numerous in cell R_5, sparse in medial cells (position indicated in figure by stippling). Venation: *Rs* short, transverse, nearly in alignment with other elements of the anterior cord; R_{1+2} preserved as a short spur, as shown; cell M_1 sessile; *m-cu* about one-half its length before fork of *M*; cell *2nd A* relatively broad.

Proximal abdominal tergites brownish yellow, posterior borders broadly darker brown, outer segments darker, sternites more uniformly pale. Male hypopygium (Fig. 7) with tergite, *t*, relatively small, including a narrow lateral lobe on either side, apex obtusely rounded, mesal portion with short black spinoid setae, more cephalad at base of lateral lobe with a small fingerlike lobule, directed slightly mesad and caudad. Outer dististyle, *d*, slightly expanded on outer margin at near midlength, style with abundant long black setae; inner style yellow, bilobed, the outer major lobe with the beak simple, obtuse, with sparse short setae, outer posterior portion or crest produced slightly into a point, the region with long yellow setae; inner lobe, representing the lower beak, somewhat smaller, pale yellow throughout, without major setae, at base with a microscopic lobule tipped with two strong setae.

HABITAT—India. Holotype: ♂, Perumalmalai, Madras, 5,500 feet, December 9, 1961 (Fernand Schmid).

The most similar species is *Dolichopeza (Mitopeza) amisca* Alexander, likewise from South India. This differs in the coloration and venation of the wings, including the very narrow cell *2nd A*, and in the much more restricted trichia in the wing cells. The hypopygium of the two species is generally similar, differing in the structure of the tergite and both dististyles. The venation and hypopygium of *amisca* have been described and illustrated in another paper by the writer (Philippine Jour. Sci., 90:166–167, fig. 2 (venation), fig. 40 (hypopygium); 1961).

Tipula (Tipulodina) thaiensis, NEW SPECIES

MALE—Length about 15 mm.; wing 15.5 mm.; antenna about 3.5 mm.

Generally similar to *gracillima*, differing expecially in all details of structure of the male hypopygium. Coloration of body, legs and wings virtually the same in both species.

Venation (Fig. 2) as compared with *gracillima* much the same, free tip of Sc_2 more basad, shorter than the section of vein R_1 beyond; no indication of vein R_{1+2}; in *gracillima*, as was indicated by Edwards, the condition is somewhat variable, the vein extremely short and sometimes absent. Male hypopygium (Fig. 8) with tergite, *t*, small, narrowed outwardly, posterior border with a U-shaped emargination, the smaller lateral lobes with about 15 very small apical setae, those of remainder of tergite much longer, especially those near median area. Outer dististyle, *d*, clavate, outer end with very long pale setae; inner style as shown, the region of the beak dilated into an irregular blackened head, with relatively few setae; outer basal lobe a long-oval pale blade, subequal in length to the outer style. Eighth sternite, *s*, truncate, with a fringe of long pale setae, those of remainder of disk very short and dense; sternite dark brown, apical fourth conspicuously light yellow.

HABITAT–Thailand. Holotype: ♂, mounted on slide; Chiengmai, near Dr. Buker's Cabin, February 4, 1953 (Deed C. Thurman).

In the comparison with *gracillima* Brunetti, as above, attention is called to the venation especially of the radial field, with R_3 very long in both species, deflected caudad and ending just before the wing tip and lying very close to the margin. *T. (T.) amabilis* Alexander, of Java is intermediate between the two species above discussed and the numerous other members of the subgenus.

Pseudolimnophila (Pseudolimnophila) dravidica, NEW SPECIES

Mesonotum chestnut brown, mediotergite brownish black, pleura and pleurotergite brownish yellow; legs brown, claws of female very small, stout; wings light brown, stigma slightly darker, small; Sc_1 ending beyond midlength of the nearly straight R_{2+3+4}; veins beyond cord very long, cell R_2 at margin about two and one-half times cell R_3; cell *1st* M_2 small, inner end strongly pointed, cell M_1 very deep, about five times as long as its petiole; abdominal tergites dark brown, sternites light yellow.

FEMALE–Length about 8.5 mm.; wing 8 mm.

Head broken. Prothorax small, dark brown, especially anteriorly, pretergites light yellow. Mesonotal praescutum, scutum and scutellum chestnut brown, the first with indications of a narrow darker central stripe; pseudosutural foveae pale; mediotergite brownish black, sparsely pruinose; pleurotergite and pleura almost uniformly brownish yellow. Halteres brown, base of stem narrowly yellow. Legs with coxae and trochanters yellow; remainder of legs light brown, outer tarsal segments slightly darker brown; legs without interpolated linear scales as in ***zelanica*** and others; claw very small, with more than the basal half stout, apex a slender spine. Wings (Fig. 3) almost uniformly light brown, stigma small, slightly darker brown; veins dark brown. Longitudinal veins beyond general level of origin of *Rs* with conspicuous black trichia. Venation: *Sc* long, Sc_1 ending shortly beyond midlength of R_{2+3+4}, Sc_2 slightly removed, R_{2+3+4} long, nearly straight, about two-thirds *Rs*; longitudinal veins beyond cord very long, generally parallel to one another; outer end of vein R_3 deflected caudad so cell R_2 is about two and one-half times as extensive as cell R_3; cell *1st* M_2 small, its inner end strongly pointed; cell M_1 very deep, about five times its petiole; ***m-cu*** at or just before midlength of M_{3+4}.

Abdominal tergites dark brown, sternites light yellow. Ovipositor with both cerci and hypovalvae long and slender, the former slightly upcurved on outer third.

HABITAT–India. Holotype: ♀, Perumalmalai, Madras, 5,500 feet, December 9, 1961 (Fernand Schmid).

The most similar regional species is *Pseudolimnophila*

(Pseudolimnophila) productivena Alexander (Rec. Indian Mus., 50:354, fig. (venation); 1952) which differs evidently in the details of venation. The fly described as *Pseudolimnophila zelanica* Alexander, has the venation somewhat as in the present fly but is told readily by the leg vestiture, there being abundant interpolated linear scales between the normal setae. This species belongs in the genus *Limnophilaspis* Alexander (Ann. Mag. Nat. Hist. (12) 3:682; 1950) but the male sex still is unavailable. The venation of *P. zelanica* has been figured elsewhere (Philippine Jour. Sci., 86:427, fig. 16; 1957).

Pseudolimnophila (Pseudolimnophila) subhonesta, NEW SPECIES

General coloration of praescutum light brown, lateral margins paler; pleura more yellowish brown, darker dorsally and beneath; legs brown, claws very small; wings light brown, including the base, stigma darker brown; vein R_2 shortly beyond fork of R_{2+3+4} leaving a very short element R_{2+3}, cell R_3 at margin about two and one-half times as extensive as cell R_2; *m-cu* more than one-third its length beyond the fork of M.

FEMALE–Length about 9 mm.; wing 7 mm.

Head with rostrum and palpi brown, terminal segment of latter relatively slender, about one-half longer than the penultimate. Antennae with scape and pedicel dark brown, remainder broken. Head brownish gray behind.

Pronotum brown, cervical region slightly more yellowed. Mesonotal praescutum with disk virtually covered by three confluent light brown stripes, lateral borders paler, pseudosutural foveae brownish black; posterior sclerites of notum dark brown, vaguely pollinose; parascutella and pleurotergite more yellowed, sparsely pruinose. Pleura yellowish brown, sparsely pruinose, dorsopleural region and ventral sternopleurite darker. Halteres with stem obscure yellow, clearer basally, knob brown. Legs with coxae light yellow, trochanters darker yellow; remainder of legs brown, outer tarsal segments slightly darker; tibial spurs small; claws very small, curved into needlelike points. Wings (Fig. 4) light brown, including the base, stigma long-oval, darker brown; veins dark brown, trichia black. Trichia on longitudinal veins beyond general level of origin of *Rs*, lacking on *2nd A*. Venation: R_2 shortly beyond fork of R_{2+3+4}, leaving a very short element R_{2+3}; R_{1+2} about one-half longer than R_2; cell R_3 at margin about two and one-half times as extensive as cell R_2; cell M_1 lacking; *m-cu* more than one-third its length beyond the fork of M.

Abdomen broken beyond the third segment; basal tergites dark brown, sternites light yellow.

HABITAT–India. Holotype: a broken ♀, Velor, Madras, 1,500 feet, December 4, 1961 (Fernand Schmid).

The most similar species is *Pseudolimnophila (Pseudolimnophila) honesta* (Brunetti), distributed in India from Kumaon southward to South Coorg. This differs evidently in the venation of the radial field, especially the position of vein R_2 (Fig. 5).

Hexatoma (Eriocera) arcuaria, NEW SPECIES

Size small (wing of male to 7.5 mm); general coloration brownish black, mesonotum in cases with greenish reflections; antennae short, in male 6-segmented; halteres and legs black; wings strongly infuscated, without trichia in the cells; vein *Sc* ending before level of fork of *Rs*, R_{1+2} slightly longer than R_{2+3+4}; inner end of cell *1st* M_2 strongly arcuated.

MALE–Length about 7–8 mm; wing 7–7.5 mm; antenna about 1–1.1 mm.

Rostrum very small, brownish black; palpi elongate, black, slightly more than one-half the antennae. Antennae of male short, 6-segmented, black throughout; first flagellar segment more enlarged basally, nearly as long as the combined segments two and three, terminal segment long, about one-third longer than the penultimate; verticils of segments long and conspicuous, especially on outer ones where some slightly exceed the segments in length. Head dull brownish black; vertical tubercle low, rounded; anterior vertex with conspicuous porrect black setae.

Thoracic dorsum brownish black, mesonotum with greenish reflections, more evident in the holotype; surface of notum moderately nitidous. Halteres black. Legs with coxae brownish black, trochanters brownish yellow; femora light brown basally, the outer two-thirds and remainder of legs brownish black to black; claws of male very small. Wings (Fig. 6) strongly infuscated, somewhat more intense along costal border, stigma not differentiated; a paler streak in basal half of cell *1st A* adjoining the vein; veins dark brown. No trichia in wing cells, as in *rama*. Longitudinal veins with trichia basad to level of the arculus, on *2nd A* with a very few longer trichia at near midlength of vein. Venation: *Sc* ending a short distance before level of fork of *Rs;* R_{1+2} long, slightly exceeding R_{2+3+4}, R_{2+3} commonly longer than R_2; *Rs* about one-half longer than *R*; inner end of cell *1st* M_2 strongly arcuated, basad of fork of *Rs; m-cu* at near two-thirds the length of M_{3+4}.

Abdomen uniformly dull black.

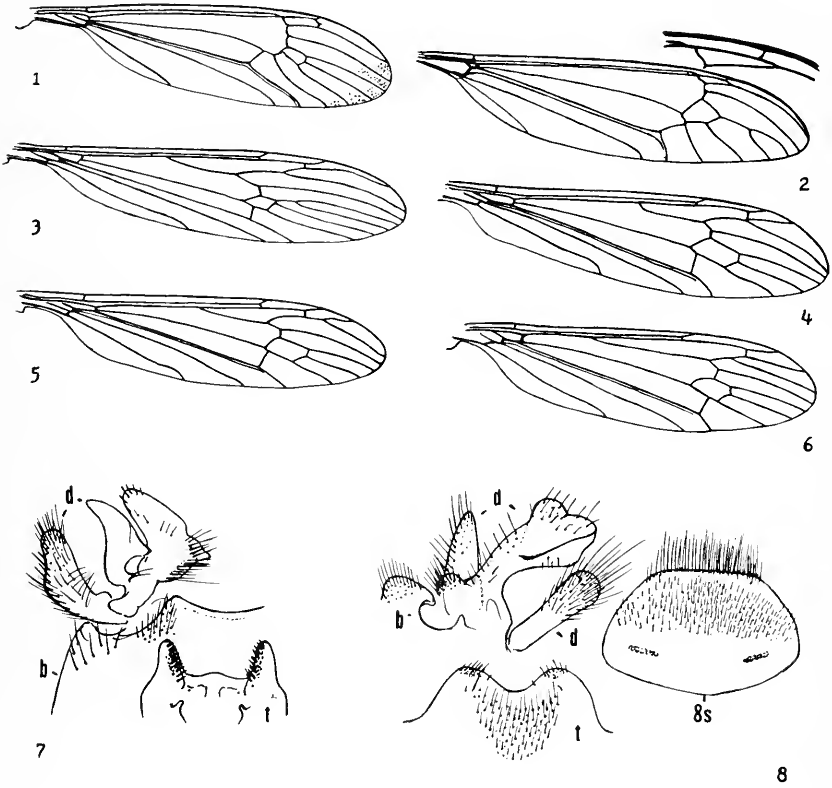
HABITAT–India. Holotype: ♂, Balamore, Madras, 1,500 feet, January 4, 1962 (Fernand Schmid). Paratypes, 3 ♂♂ (on two pins), Munnar, Kerala, 3,500 feet, December 15, 1961 (Fernand Schmid).

Among the numerous regional species in the genus the present fly in general appearance most resembles *Hexatoma (Eriocera) purpurata* Alexander and *H. (E.) rama* Alexander. The latter fly is quite distinct in the presence of macrotrichia in the outer wing cells while the somewhat larger *purpurata* has the male antennae 7-segmented and with the details of coloration and venation distinct.

Limnophila asura Alexander

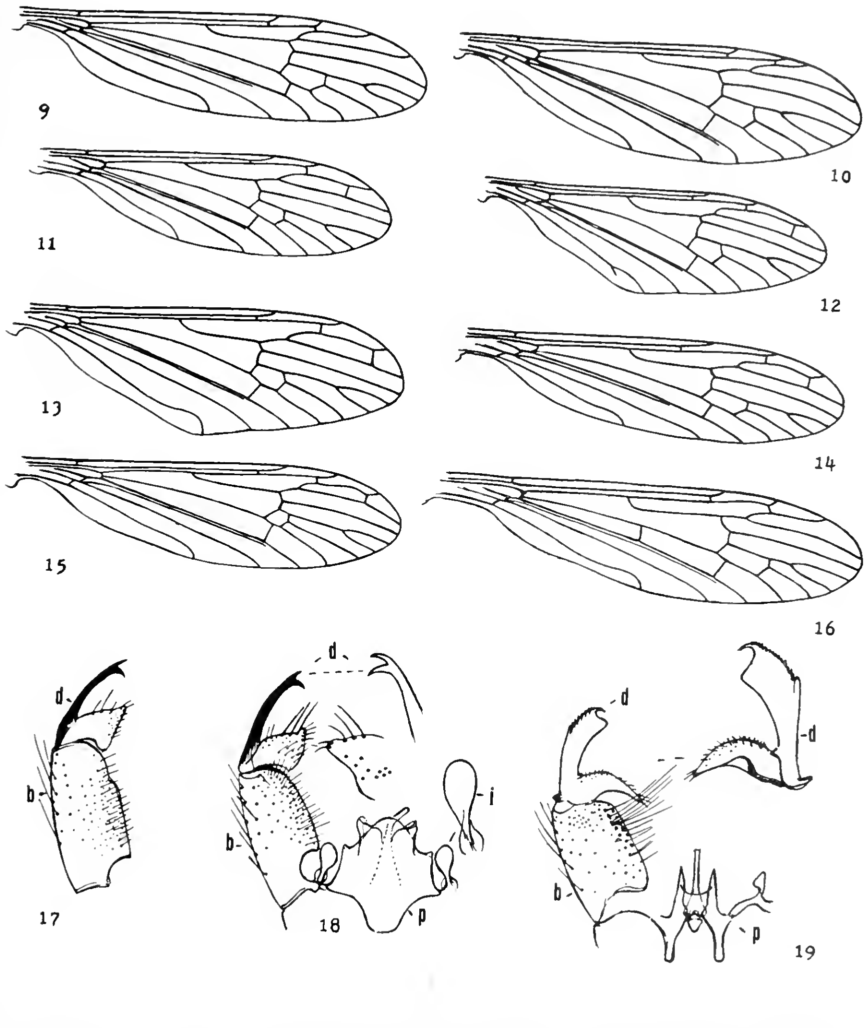
Limnophila asura Alexander; Ann. Mag. Nat. Hist. (12)9:46; 1956.

Type from Cherrapunji, Khasi Hills, Assam, India. Fig. 9 (venation). The subgenus of this fly is uncertain, perhaps in *Afrolimnophila.*



Explanation of Figures:

Figures 1-8 – Fig. 1, *Dolichopeza (Mitopeza) trichochora,* new species; venation. Fig. 2, *Tipula (Tipulodina) thaiensis,* new species; venation. Fig. 3, *Pseudolimnophila (Pseudolimnophila) dravidica,* new species; venation. Fig. 4, *Pseudolimnophila (Pseudolimnophila) subhonesta,* new species; venation. Fig. 5, *Pseudolimnophila (Pseudolimnophila) honesta* (Brunetti); venation. Fig. 6, *Hexatoma (Eriocera) arcuaria,* new species; venation. Fig. 7, *Dolichopeza (Mitopeza) trichochora,* new species; male hypopygium. Fig. 8, *Tipula (Tipulodina) thaiensis,* new species; male hypopygium. (Symbols: *b,* basistyle; *d,* dististyles; *s,* 8th sternite; *t,* 9th tergite.)



Figures 9-19 – Fig. 9, *Limnophila asura* Alexander; venation. Fig. 10, *Limnophila (Afrolimnophila) bicoloripes* Alexander; venation. Fig. 11, *Limnophila (Dicranophragma) analosuffusa* Alexander; venation. Fig. 12, *Limnophila (Dicranophragma) brachyclada* Alexander; venation. Fig. 13, *Limnophila (Dicranophragma) karma* Alexander; venation. Fig. 14, *Limnophila (Dicranophragma) kashongensis* Alexander; venation. Fig. 15, *Limnophila (Dicranophragma) palassoptera* Alexander; venation. Fig. 16, *Limnophila (Elaeophila) fumigata* Alexander; venation. Fig. 17, *Limnophila (Dicranophragma) karma* Alexander; male hypopygium. Fig. 18, *Limnophila (Dicranophragma) kashongensis* Alexander; male hypopygium. Fig. 19, *Limnophila (Elaeophila) fumigata* Alexander; male hypopygium. (Symbols: *b*, basistyle; *d*, dististyles; *i*, interbase; *p*, phallosome.

Limnophila (Afrolimnophila) bicoloripes Alexander

Limnophila (Afrolimnophila) bicoloripes Alexander; Ent. News, 75:63; 1964.

Type from Mapum, Manipur, Assam, India. Fig. 10 (venation).

Limnophila (Dicranophragma) analosuffusa Alexander

Limnophila (Dicranophragma) analosuffusa Alexander; Ent. News, 77:217; 1966.

Type from Sirhoi Kashong, Manipur, Assam, India, Fig. 11 (venation).

Limnophila (Dicranophragma) brachyclada Alexander

Limnophila (Dicranophragma) brachyclada Alexander; Ent. News, 79:245; 1968.

Type from Serrarim, Khasi-Jaintia Hills, Assam, India. Fig. 12 (venation).

Limnophila (Dicranophragma) karma Alexander

Limnophila (Dicranophragma) karma Alexander; Ent. News, 77:218; 1966.

Type from Tarak Tal, Pauri Garhwal, Kumaon, Uttar Pradesh, India. Fig. 13 (venation); Fig. 17 (male hypopygium).

Limnophila (Dicranophragma) kashongensis Alexander

Limnophila (Dicranophragma) kashongensis Alexander; Ent. News, 77:220; 1966.

Type from Sirhoi Kashong, Manipur, Assam, India, Fig. 14 (venation); Fig. 18 (male hypopygium).

Limnophila (Elaeophila) fumigata Alexander

Limnophila (Elaeophila) fumigata Alexander; Ent. News, 77:223; 1966.

Type from Sirhoi Kashong, Manipur, Assam, India. Fig. 16 (venation); Fig. 19 (male hypopygium).

ABSTRACT–Five new species of Oriental Tipulidae are described, these being *Dolichopeza (Mitopeza) trichochora, Pseudolimnophila (Pseudolimnophila) dravidica, P. (P.) subhonesta,* and *Hexatoma (Eriocera) arcuaria,* of South India, and *Tipula (Tipulodina) thaiensis,* of Thailand. In addition figures are provided for seven species of the Hexatomine genus *Limnophila* that had not been illustrated previously.

NOTES ON A COLLECTING TRIP TO MASON STATE FOREST, MASON COUNTY, ILLINOIS WITH COMMENTS ON SOME STAPHYLINIDAE 131. CONTRIBUTION TO THE KNOWLEDGE OF STENINAE[1]

Volker Puthz[2]

On August 13th 1970 my dear colleague, Dr. Milton W. Sanderson and I collected for several hours in Mason State Forest, Mason Co., Illinois.

The State Forest includes about 5,500 acres of land; half of the area is in native timber consisting of Black Oak, Blackjack Oak and Hickory. The remainder has been planted to pine species and hardwoods. There are some small ponds in the forest with duckweed (Lemnaceae) and other aquatic vegetation. At the muddy edge of one pond closest to the Forest Headquarters I collected about 65 species of beetles belonging to 12 families. Next to the carabids, the Staphylinidae were the most numerous beetles present. Species of the following genera were found: *Carpelimus, Stenus, Euaesthetus,* cf. *Lathrobium, Lathrobium, Scopaeus, Medon, Philonthus, Gabrius, Erichsonius, Philonthini* gen. sp. *Acylophorus, Myllaena,* and *Aleocharinae* gen. sp.

I could identify only the *Stenus, Euaesthetus,* and *Acylophorus.* The following species were found:

Stenus femoratus Say

3 males

Widespread over the eastern half of the U.S.; known to me from the following states (numerous new state records!): Me., Mass., N.Y., N.J., Ind., Ill., Mich., Minn., Iowa, Kans., Md., D.C., Va., Miss., La., Tex., Man., Ont.

Stenus virginiae Casey

1 female

A southeastern species; known to me from the following states (numerous new state records!): Ind., Ill., Mo., Iowa, Md., Va., N.C., Tenn., Tex. The Mason State Forest specimen is the first state record for Illinois.

Stenus colonus Erichson

29 males, 17 females

Widespread over the eastern half of the U.S.; known to me from the following states: N.H., Vt., Mass., N.Y., N.J., Pa., Ind., Ill., Mich., Wis., Iowa, S.D., Nebr., Kans., Del., Md., D.C., Va.; Que., Ont.

Stenus alacer Casey

2 males, 1 female

This species has been recorded from Southern Illinois (CASEY, 1884). Mason Co. presently is the northern-most record for the U.S.

Stenus flavicornis Erichson

3 females

Very widespread and very common in North America. I have seen this species from the following states (including numerous new state records!): Me., N.H., Vt., Mass., Conn., N.Y., Pa., Ohio, Ind., Ill., Mich., Wisc., Minn., Iowa, Mo., Kans., Md., D.C., Va., N.C., Tex., Wyo., Calif.; Que., Ont., Man., B.C.

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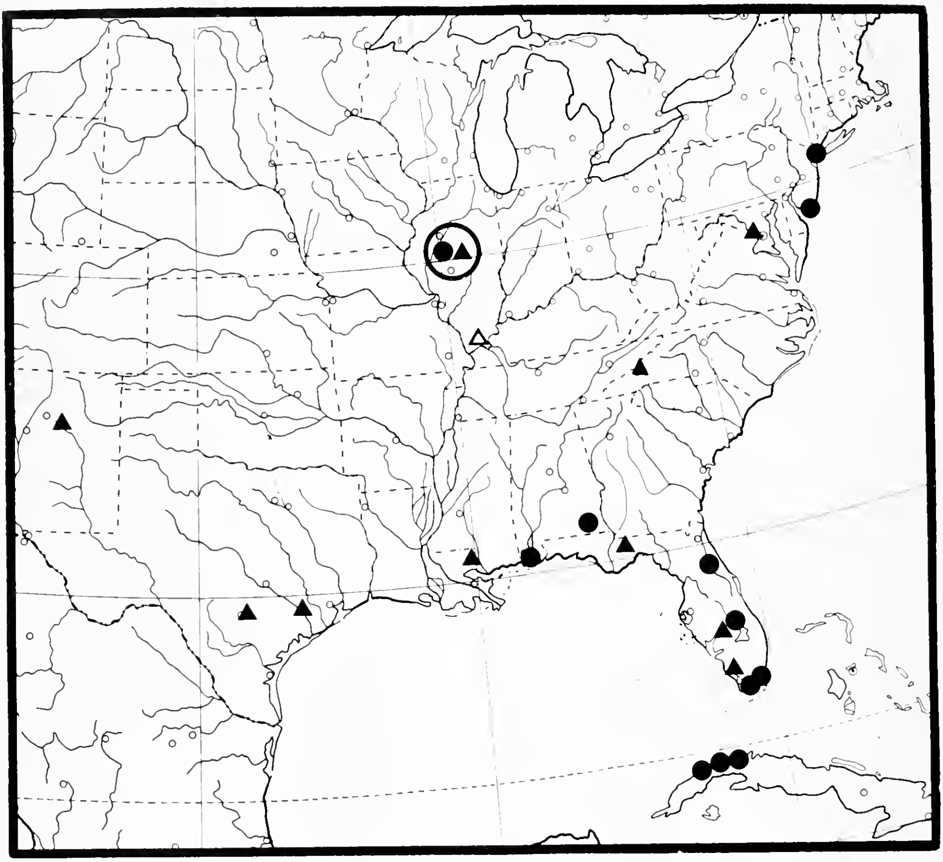
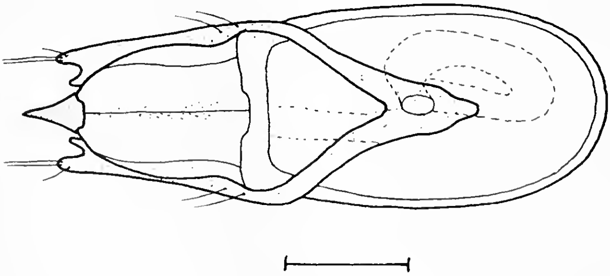
[1] Accepted for publication: September 12, 1972.

[2] Limnologische Fluss-Station des Max-Planck-Instituts fur Limnologie, 6407 Schlitz, Western Germany.





LEGEND OF FIGURES:

Fig. 1. Distribution of *Stenus cubensis* Bernhauer (●) and *Euaesthetus similis* Casey (▲,△ : female, Det.?). Large circle shows Mason State Forest, Illinois.

Fig. 2. *Euaesthetus similis* Casey, Aedeagus (holotype of *E. neomexicanus* Fall) Sacle = 0.1 mm.

Stenus annularis Erichson

1 female

This species is also very widespread in North America but it is less common. than *flavicornis.* It is known to me from the following states (numerous new state records!): N.H., Vt., Mass., N.Y., N.J., Pa., Ill., Mich., Wis., Iowa, Mo., Nebr., Kans., Md., D.C., Va., Ky., Tex., Mont., Colo., Ariz., Wash.; Ont., B.C.

Stenus punctatus Erichson

8 males, 1 female

One of the most common species of the genus in North American and known to me from: Me., H.H., Mass., R.I., Conn., N.Y., N.J., Pa., Ohio, Ill., Mich., Wis., Iowa, Mo., Mebr., Kans., D.C., Va., N.C., S.C., Ga., Ky., Ala., Miss., Arl., La., Tex., Mont., Utah; Ont. (including numerous new state records!).

Stenus cubensis Bernhauer

Stenus cubensis Bernhauer 1910, Verh. zoo.–bot. Ges. Wien 60:364f.

Stenus cubensis.–Puthz, in press. Fieldiana Zool. figs.

1 female NEW FOR NORTH AMERICA!

One female of this remarkable species was found at the edge of a pond in Mason State Forest. Until now *Stenus cubensis* was known only from Cuba, but it is widely distributed in Eastern North America (see map, Fig. 1). The following records are known to me:

2 females: New York: N.Y. & vicinity, coll. Bowditch (MCZ, coll. m.).

1 female: New Jersey: Anglesea, coll. Hubbard & Schwarz (USNM).

1 female: Illinois: Mason Co., Mason State Forest, 13.8. 1970, Puthz (coll. m.): Florida: 1 female: Enterprise (cotype of *meridionalis* Casey)(coll. Casey, USNM): 1 female: Crescent City, 4.1908, Van Duzee (USNM); 1 male, 1 female: Paradise Key, Barber (USNM); 1 female: Biscayne, coll. Hubbard & Schwarz (USNM); 1 male, 2 females: Homestead, 6.1929, Darlington (MCZ); 1 male, 1 female: ibidem, 28.1.1968, Smetana (CNC); 1 female: Okeechobee Co., Brighton, 16.6.1929, Darlington (MCZ); 2 females: 1 mi. W. Brighton, 4.3.1968, Smetana (CNC); 1 male: Miami Beach, 3.1937, Bierig (FMNH).

1 male, 1 female:–North America (coll. Benick, FMch). In addition, I have seen the male holotype (FMNH) and 1 male, 5 females from various localities in Cuba (FMNH, coll. m.).

Stenus cubensis may be easily identified by its peculiar 10th tergum; seen from above it has the usual shape of those found in *S. punctatus* (Puthz, 1967, Fig. 41), *lugens* Casey, and *pueblanus* Bernhauer (Puthz, in press), but the apicomedial spine shows a toothlike ventral carina which is lacking in the other two species. Furthermore, *S. cubensis* may be distinguished from *S. punctatus* by its blackish lustre (*punctatus* mostly has an aeneous tint), less dense punctation of frons, sparser abdominal punctation, darker legs, and the genitalia (Puthz, 1967, Fig. 43), and from *S. lugens* Cas. at first glance by the larger elytra, which are much broader than head.

Euaesthetus similis Casey

Euaesthetus similis Casey 1884, Contr. 1:2e f.

Euaesthetus texanus Casey 1884, l.c.: 26 f. **nov. syn.**

Euaesthetus neomexicanus Fall 1907, Trans. Amer. Ent. Soc. 33:219 f. **nov. syn.**

1 male, 3 females: new state record!

The following specimens of this species have been studied (see map, Fig. 1):

Female holotype and female paratype: Florida: Tallahassee (USNM); female holotype and 1 male, 1 female paratypes (of *texanus* Cas.): Texas: Columbus (USNM); male *holotype (of neomexicanus* Fall): New Mexico: Las Vegas (MCZ); 1 male: Texas: San Antonio, 22.12.1879, through C. V. Riley (USNM); 2 females: Louisiana: Tallulah, 21.3.1934, Folson (MCZ); 1 male, 4 females: Maryland: Plummers Island, Schwarz & Barber (USNM, coll. m.); 2 females: Florida: Collier Co., 2.5 mi. E. of Monroe Stn., hardwood hammock along Tariami Trail, 7.4.1966, Wagner (FMNH, coll. M.); 2 females: Highlands Co., Highlands Hammock State Park, debris along cypress swamp & hammock. 27.3.67, W. suter (FMNH); 1 female (cf. det.): Illinois: Johnson Co., Ferne Clyffe State Park near Goreville, Berlese (B-65), leaf litter in Canyon, 23.6.1958. H. S. Dybas (FMNH): North Carolina: Hot Spring, French Broad River (USNM); 2 males, 2 females.

My revision proved the synonym of the taxa cited above. *Eu. similis* may be identified by its relatively slender appearance, well separated punctation of pronotum, irridescent elytra, and the sexual characters (aedaegus: Fig. 2: most characteristic is the bifid apex of paramere, which is only found in this species). Additional distinguishing characters will be given in a revision of all nearctic *Euaesthetus* (Puthz, in preparation).

Acylophorys filius Smetana

This species recently described by Smetana (1971) and already known from Illinois (from 7 specimens) is very common in Mason State Forest. I captured 21 specimens in less than 3 hours collecting.

From the *Stenus* and *Euaesthetus* found, it is evident that Mason State Forest is inhabited by numerous southern species. I am sure that careful collecting will uncover more new state records from this interesting habitat.

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Puthz, V. in press. Studies on the neotropic *Stenus*-species of BERNHAUER (Coleoptera, Staphylinidae) 78th contribution to the knowledge of Steninae. Fieldiana Zoology.

Smetana, Al. 1971. Revision of the Tribe Quediini of America North of Mexico (Coleoptera:Staphylinidae). Mems. Ent. Soc. Canada, No. 79, 303 pp.

ABSTRACT–Report on Staphylinid beetles captured in Mason State Forest, Mason Co., Ill., with comments: new State records for *Stenus virginiae* and *Euaesthetus similis*. (*E. texanus* Cas. & *E. neomexicanus* Fall new synonyms). *Stenus cubensis* is new for North America.

THE GENERA OF THE SUBFAMILIES PSEUDOPSINAE AND PROTEININAE OF AMERICA NORTH OF MEXICO (COLEOPTERA:STAPHYLINIDAE)[1]

Ian Moore and E. F. Legner[2]

This is one of a series of papers giving keys to the genera of the Staphylinidae of America north of Mexico, a full description of each genus with remarks on distribution and ecology, as well as an illustration of a member of each genus.

Pseudopsinae

This subfamily contains the single genus *Pseudopsis.* It is a very generalized form, having few outstanding morphological characters to distinguish it. However, the combination of the strong diagonal impressions on the abdominal tergites and the longitudinally carinate pronotum and elytra will readily separate its members from other Nearctic staphylinids. Only four other genera of the Nearctic Staphylinidae have carinate pronota and elytra (*Micropeplus, Zalobuis, Asemobius* and *Thoracophorus*). None of these has the abdomen impressed in the manner of *Pseudopsis.*

Pseudopsis Newman

Form.—Small, linear, subfusiform. Elytra and pronotum longitudinally costate.

Head.—Head a little smaller than pronotum, oval, slightly narrowed behind the eyes, with a distinct neck and a nuchal constriction above. Eyes small, not very prominent. Antennae somewhat incrassate, their fossae located anterior to the eys under a slight ridge. Labrum widest apically, the angles rounded, the apex gently arcuate, with several large setae laterally. Mandibles slender, pointed, each with two large pointed teeth internally. Labial palpi four-segmented; first segment short; second elongate, curved, much widened apically; third as long as second, oval, a little wider than second, almost as wide as long; fourth almost as long as second, very slender, very slightly narrowed from base to apex. Inner lobe of maxilla long, slender, hooked at apex, with a row of long spines internally. Outer lobe wider than inner, widest near apex, with a dense brush of curved cilia at tip. Ligula of two diverging rounded lobes. Labial palpi three-segmented; first segment longest and widest, three times as long as wide; second about half as long and a little narrower than first; third a little narrower but somewhat longer than second, almost the same size and shape as the fourth segment of the maxillary palpi. Gular sutures most approximate anteriorly, thence widely diverging to base. Infraorbital carina very faint.

Thorax.—Pronotum transverse, the disc longitudinally carinate. Prosternum well-developed, its process short and acute. Lateral prosternal sutures distinct. Prosternal epimera very narrow, delimited from the hypomera by a suture at which point the hypomera are much enlarged mesally. Trochantin narrow. Mesosternum short, its process short and acute. Metasternum moderate, its process short, acute, delimited by a carina. Elytra quadrate, longitudinally costate; epipleura delimited by a carina. Scutellum

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minute. Anterior and middle coxae large, exserted, contiguous. Posterior coxae moderate, transverse, Tibiae ciliate. Tarsi five-segmented, the first four segments short and subequal, the last about as long as the first four together.

Abdomen.—Narrowed to apex. Paratergites present on first five visible segments. First four or five visible tergites with a deep impression on each side from the center of the base to the outer apical angle. Apical margin of each tergite with a series of large spatulate setae. First visible sternite without a keel between the coxae. First two or three visible sternites vaguely constricted at base. External sexual characters weak.

Distribution.—of our four species, three are confined to the Pacific Coast. The fourth species, *P. sulcata* Newman, is also found in Europe, India and South America. Two other species are known, one from Chile and one from New Zealand. The California species are usually found in leaf litter. In speaking of *sulcata,* Cameron (1930) said, "I have only found this species in loose sandy soil beneath the dejecta of cattle."

Proteininae

The two Nearctic genera associated in this small subfamily have relatively long elytra and the base of the sixth visible sternite has a median projection (covered by the apex of the fifth visible sternite) which resembles a similar structure found in members of the Omaliinae. They, however, have no ocelli and the anterior coxae are small and transverse extending to the hypomera.

Blackwelder (1952) proposed the name *Pteronius* to replace *Proteinus* Latreille with the statement "this name must be moved to the Nitidulidae because of its genotype." Arnett (1961) and Moore (1964) proposed the name Pteroniinae for this subfamily based on *Pteronius* Blackwelder. According to Hatch (1971) *Proteinus* Latreille with its type species *brachypterus* Fabricius was placed on the official list of scientific names in opinion number 876. This action conserves the generic name *Proteinus* and the subfamily name Porteininae.

Members of this subfamily are found in leaf litter. A single species of another genus is recorded from Australia.

KEY TO THE GENERA OF THE PROTEININAE OF AMERICA NORTH OF MEXICO

1 . Pronotum with a central longitudinal groove .... *Megarthrus* Curtis

1' Disc of pronotum evenly convex.. *Proteinus* Latreille

Proteinus Latreille

Form.—Small, robust, ovoid. Integuments finely sculptured.

Head.—Small, transverse, constricted behind to form a distinct neck but inserted somewhat into the thorax so that the neck is sometimes not visible from above. Eyes moderate, prominent. Antennae with first two segments large, the next few slender, the outer ones thickened to form a club; their fossae located in front of the eyes under a ridge. Mandibles stout, pointed, simple. Labrum with the apex truncate, the angles rounded. Maxillary palpi four-segmented; first segment small; second large, curved, widest at apex, about as long as wide; third narrower, transverse; fourth narrower, elongate, a little narrowed at apex. Inner lobe of maxilla narrow, strongly hooked at apex, ciliate within; outer lobe broad, ciliate at apex. Labial palpi three-segmented, segments decreasing in width; first two about as long as wide; last about as long as first two together, pointed. Ligula triangularly emarginate almost to its base. Gular sutures approximate in the middle, widely diverging ahead and behind. Infraorbital carina absent.

Thorax.—Pronotum transverse, the lateral margin entire, not explanate, disc not sulcate. Prosternum short, its process short and pointed. Lateral prosternal sutures distinct, hypomera delimited by a carina. Trochantin very narrow. Epimera delimited by a suture. Mesosternum short, its process short, pointed, meeting the mesosternal process. Elytra long, covering part of the abdomen, epipleura delimited by a carina. Scutellum moderate. Anterior coxae transverse, extending to the hypomera, contiguous. Middle

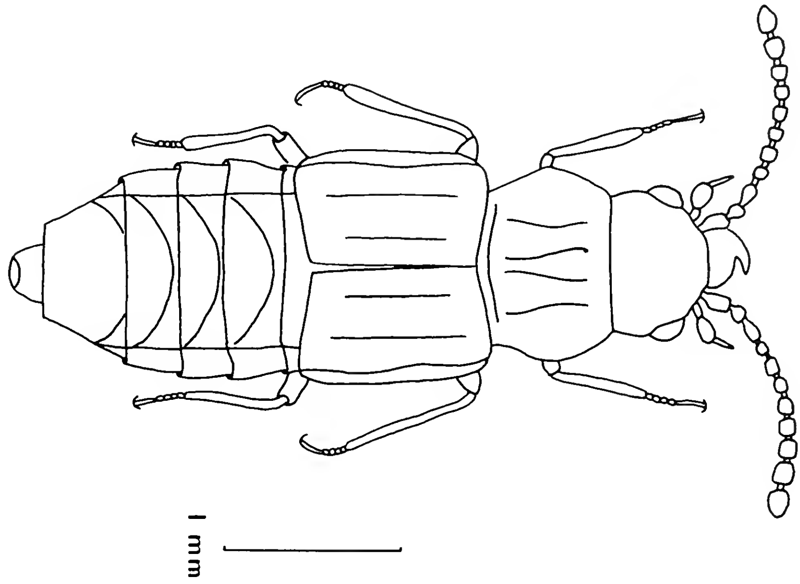

Fig. 1. *Pseudopsis obliterata* LeConte

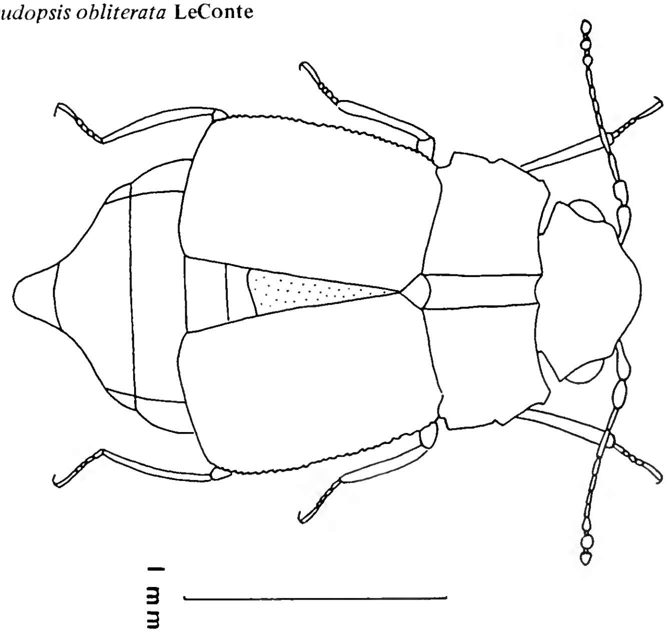

Fig. 2. *Megarthrus pictus* Motschulsky.

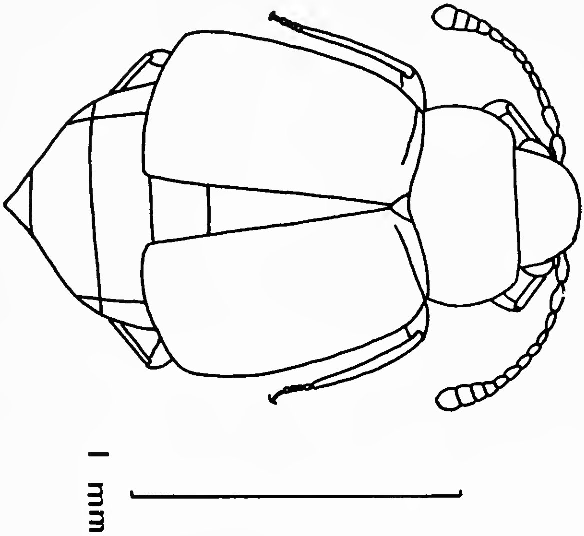

Fig. 3. *Proteinus limbatus* Maklin.

coxae oval, not exserted, narrowly separated. Posterior coxae somewhat triangular, transverse, contiguous. Tibiae without spines. Tarsi five-segmented; first four segments short; last as long as the preceding three together.

Abdomen.—Abdomen pointed. First five visible segments with paratergites. First visible sternite slightly tumid centrally at base but not actually keeled.

Distribution.—Twenty-three species have been described in this genus. Most of the species are Holarctic in distribution, however, three species are known from India, one from Chile and one from Costa Rica.

Megarthrus Curtis

Form—Small, robust. Integuments not coarsely sculptured.

Head.—Transverse, abruptly narrowed behind the eyes to a distinct neck. Eyes moderate, prominent. Antenna with the first two segments large, middle segments slender, outer segments enlarged to form a club; their fossae located in front of the eyes under a distinct ridge. Manidbles stout at base, abruptly narrowed before the apex and thence sharply hooked to the pointed apex. Labrum transverse, the apex truncate, the angles narrowly rounded. Maxillary palpi four-segmented; first segment short; second longer than wide, curved, much widened at apex; third narrower than second, about as long as wide; fourth narrower than third, longer than second, gradually narrowed to the pointed apex. Inner lobe of maxilla very slender, hooked at tip; outer lobe broad, ciliate at apex. Labial palpi three-segmented, segments decreasing in width and length, third segment pointed. Ligula transverse, narrowly emarginate at middle of apex. Gular sutures most approximate at middle, widely divergent ahead and behind. Infraorbital carina absent.

Thorax.—Pronotum transverse, with a strong longitudinal central sulcus, the sides explanate, the side margins usually provided with various teeth, notches, etc. Posternum short, its process short, pointed. Lateral prosternal sutures faint. Hypomera horizontal, separated from the pronotum by the fine outer edge of the latter. Trochantin small, triangular. Epimera delimited by a suture. Mesosternum short, its process long, narrow, carinate, extending nearly the entire distance between the coxae. Metasternum long, its process short, truncate, meeting the mesosternal process. Elytra long, covering part of abdomen, epipleura delimited by a carina. Scutellum moderate. Anterior coxae large, exserted, extending to the hypomera, contiguous. Middle coxae oval, narrowly separated. Posterior coxae transverse, triangular. Tibiae without spines. Tarsi five-segmented, the first four segments short, the last about as long as the preceding three together.

Abdomen.—Abdomen pointed. First five visible segments with paratergites. First visible sternite with a small keel between the coxae.

Distribution.—Sixty-four species have been described in this genus from all parts of the world except Australia. Some of our species are also found in Europe.

ACKNOWLEDGEMENTS

We thank Jacques Helfer and Hugh B. Leach for loan and gift of specimens and other favors.

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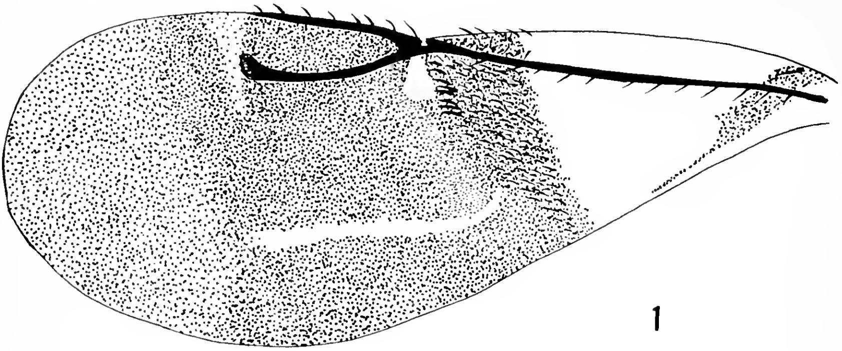
ABSTRACT:—The subfamily Pseudopsinae contains one genus and six species of which four are found in North America. Its members are largely distinguished by their general appearance which is illustrated. The small subfamily Proteininae contains two genera which are keyed. A member of each genus is illustrated.—Ian Moore and E. F. Legner, University of California, Riverside, CA 92502.

Descriptors: Staphylinidae: Pseudopsinae: Proteininae: Key to genera of North America.



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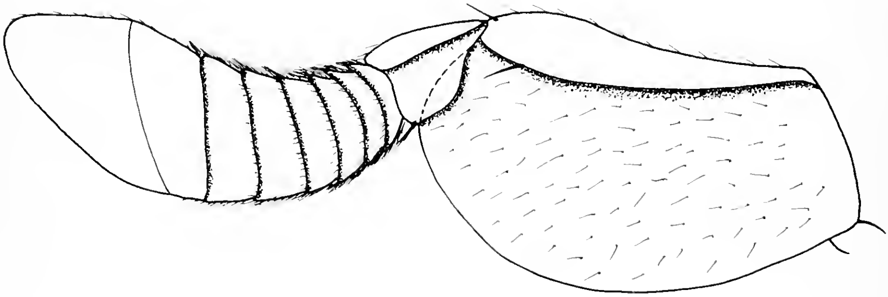

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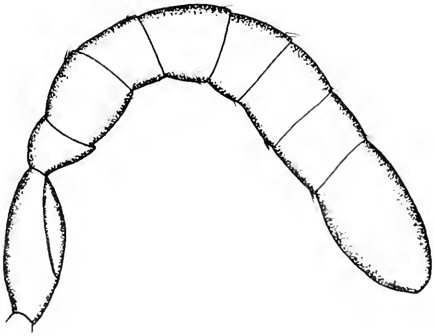

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Figures.–*Paraplatycerus citriculus* n. sp. 1. Female wing, 2. Female antenna, 3. Male antenna.

A NEW GENUS AND SPECIES OF MEALYBUG PARASITE FROM PARAGUAY (HYMENOPTERA:ENCYRTIDAE)[1]

Jack C. Hall[2]

The following descriptions are given at this time in order to make the names available for other publications.

Paraplatycerus NEW GENUS

Closely related to *Chrysoplatycerus* Ashmead and *Zaplatycerus* Timberlake. From both genera *Paraplatycerus* may be rather easily recognized by the raised and sharply ridged scutellum without a posterior tuft of hair and by the tridentate mandibles. The abdomen, antennae and wing venation are like that found in *Chrysoplatycerus.*

Female.–Head from above broadly meniscuform, wider than thorax; face with a deep, semicircular scrobal impression which is sharply margined above. Head when viewed anteriorly much broader than high, laterally much higher than long. Occipital margin acutely margined above, rounded on lower two-thirds. Eyes hemispherical not reaching occipital or scrobal margins, inner orbits only slightly diverging anteriorly; fronto-vertex nearly three times longer than wide as measured from occipital margin to scrobal margin; width at anterior ocellus one-fourth width of head. Ocelli arranged in an equilateral triangle, posterior pair of ocelli nearly touching eye margin but nearly twice their diameter from occipital margin. Gena at its widest point as wide as eye, genal suture weak but distinct. Face convex; oral margin arched; carina surrounding scrobal depression extends downward to just below opposite antennal sockets. Antennae widely separated, distance less than width of scape. Mandible long and narrow, tridentate, middle tooth longest. Antennae strongly laterally compressed, scape swollen, as long as flagellum and club combined, two-thirds longer than wide, apex rounded, base to antennal socket subtruncate, upper margin folded over and flattened; pedicel as wide as long, longer than any of following flagellar segments, flattened dorsally as in scape; funicle six segmented, all segments wider than long, first three saucer shaped, last three more rectangular, flagellum enlarged from base to apex; club solid, at most a single annulus visible, nearly equal in length to flagellum, wider than last flagellar segment.

Pronotum narrow, nearly concealed, Msonotum flat, carinate anteriorly and laterally, side vertically depressed then sloping outward to form a triangular flange-like plate; axillae not medially separated, tips touching, elevated but not above scutellum. Scutellum broadly diamond-shaped, strongly convex and sharply ridged along mid-line,

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at most two strong setae at apex; metanotum depressed, reduced to a narrow plate three times longer than wide; propodeal spiracle large, circular. Abdomen short, narrower than thorax, tapering to truncate apex; ovipositor not exerted. Legs comparatively thick and short. Wing as in *Chrysoplatycerus,* stigmal vein at most only slightly longer than postmarginal vein, gently curved; a patch of coarse setae below apex of marginal vein.

Male.–Unlike the female. Face convexly swollen. Eyes pilose. Antennae nine segmented, uniformly thickened throughout with at most only a few short, inconspicuous setae; scape but little swollen. Mesonotum convex, not margined; axillae rounded but not elevated; scutellum convex, not as strong as in female, without a median ridge. Wing hyaline, stigmal vein much longer than post marginal vein. Abdomen much shorter than thorax.

Type species.–*Paraplatycerus citriculus* n. sp., present designation.

Paraplatycerus citriculus NEW SPECIES

Female.–General color dull flavotestacous. Antennae fuscous, flattened dorsal portion of scape shining; genae black on upper half; anterior margin of mesonotum dusky, depressed sides shining metallic blue-green; scutellum shining metallic greenish-blue; abdomen fuscous; coxae and femora dusky flavotestacous more or less margined with black, fore and mid tibiae dusky on basal half or more, hind tibia completely dusky, nearly as dark as abdomen; fore and mid tarsi dusky flavotestaceous, hind tarsi white except for black basal half of first segment and all of terminal segment; side of propodeum shiny metallic green, in some lights. Setae where present black.

Front with coarse, close-set, circular punctures extending to margin of scrobe; face and genae smooth. Mesonotum granular, without distinct punctures. Scutellum smooth; anterior declivity of axillae minutely punctiform. Antennae as figured.

Costal cell wide, tapering to narrow apex, margin excised at apex of marginal vein; apex of wing broadly rounded; marginal vein with eight to ten bristles, short row of heavy bristles below apex of marginal vein. Wing brown, base hyaline, uniformly ciliated, cilia shorter on apical one-third, see figure.

Male.–Black, lower half or less of front, genae, face subshining bluish-green in some lights. Scape testaceous. Legs fuscous, trochanters, tips of femora, base of tibiae, all of tarsi except last segment white to pale testaceous. Antennae as figured. Setae black more numerous on mesonotum and scutellum than in female. Wing hyaline, cilia confined to margins and along veins; stigmal and postmarginal veins short.

Holotype reared from mummies of *Pseudococcus citriculus* Green collected from citrus at Asuncion, Paraguay, II-9-72 (M. Rose). In collection of University of California at Riverside.

Described from four females and five males all from the same collection.

Paraplatycerus citriculus is currently being mass produced at the California State Department of Agriculture temporary insectary facilities at Porterville, California for release against the comstock mealybug, *Pseudococcus comstocki* (Kuwana) in that area.

ABSTRACT:–One new genus *Paraplatycerus* and a new species *citriculus* are described from Paraguay. Specimens were reared from *Pseudococcus citriculus. Paraplatycerus* is compared with and separate from *Chrysoplatycerus* and *Zaplatycerus..*–Jack C. Hall, Division of Biological Control, University of California, Riverside, CA 92502.

Descriptors: Hymenoptera: Cencyrtidae: *Paraplatycerus,* new genus: *citriculus,* new species; Paraguay. Host, *Pseudococcus citriculus.*

PSEUDOSCORPIONS PHORETIC ON A SPIDER[1]

C. Clayton Hoff[2] and Daniel T. Jennings[3]

On 2 June 1969 Thomas R. Chacon, a U. S. Forest Service employee, found two female pseudoscorpions of the species *Lustrochernes grossus* (Banks) (Chernetidae) clinging to dorsal abdominal setae of a male giant crab spider, *Olios fasciculatus* Simon (Heteropodidae). The spider was collected from mesquite litter in an area predominately of pinyon and juniper near Arizona State Highway 160, 2 miles northeast of Payson, Gila County, Arizona, elevation about 5000 feet. The species of spider is widely distributed in southwestern U.S. and has been reported from several localities in Arizona; the species of pseudoscorpion is common in Colorado, New Mexico, and Arizona. Except for being found beneath the elytra of cerambycid beetles taken in stands of ponderosa pine (Banks, 1902; Hoff, Jennings, and Pase, unpublished data), *L. grossus* has been reported (Hoff, 1956, 1959) as occurring invariably beneath the bark of ponderosa pine (*Pinus ponderosa* Laws.) logs, stumps, and snags. Spider and pseudoscorpions are deposited in the collections of the American Museum of Natural History.

Phoresy involving pseudoscorpions on insects of several orders and on phalangids, birds, and mammals is common. Early records have been compiled by Vachon (1940) and Beier (1948). Strangely absent, however, are records of pseudoscorpions being found attached to spiders, and indeed a very careful search of the literature has failed to uncover a single record of pseudoscorpion-spider phoresy. This is in strong contrast to the many records of pseudoscorpions reported from phalangids (Vachon, 1947; Beier, 1948; Savory, 1966). We are inclined to follow Savory in thinking that the relationship of pseduoscorpion and phalangid is largely by chance. This does not aid in explaining, however, the occurrence of pseudoscorpions on phalangids and the apparent absence or rarity of pseudoscorpions from spiders. Habitatwise there should be as much opportunity for pseudoscorpions to contact spiders as there is for the animals to contact phalangids.

We have considered possible explanations for the difference between phalangids and spiders with respect to pseudoscorpion phoresy. It seems feasible that the pseudoscorpion can cling very tenaciously to the slender leg of the phalangid by means of either one or both pedipalps, while the leg of the spider is too stout to allow the chelae to maintain a strong grip, although pseudoscorpions could certainly cling to the legs of small spiders and to the stout spines often present on the legs of some spiders. While phalangids frequently clean their legs (Cloudsley-Thompson, 1968), they must be unable or have no instinct to dislodge the pseudoscorpions. We considered the possibility that the phalangid does not eat pseudoscorpions and hence gives no attention to those attached to the legs, but Cloudsley-Thompson (1956) observed that while phalangids do not remove and eat pseudoscorpions from the legs, they do eat pseudoscorpions that by their own initiative drop from the legs.

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We believe that the aggressive nature of the spider, in contrast to the behavior of the phalangid, at least partly may explain the absence of pseudoscorpions from the legs of spiders. Because phalangids remain in a resting position for long periods of time and are not disturbed easily, it is probably less difficult for a pseudoscorpion to climb a leg and become attached to a phalangid than to a spider. Phalangids move slowly, are not especially aggressive, do not respond quickly to the presence of prey, and apparently do not react adversely to the presence of a few to several attached pseudoscorpions. In contrast the more agressive and more quickly reacting spider may well capture and eat psuedoscorpions before the pseudoscorpions have an opportunity to attach to the leg or to the body of the spider. The agressive spider may also remove pseudoscorpions from body parts that can be reached by the legs and pedipalps, but that once firmly attached, as in the present instance to the anterior part of the dorsum of the abdomen, the pseudoscorpions cannot be plucked off and eaten by the spider.

Abstract.–Two female pseudoscorpions, *Lustrochernes grossus* (Banks) (Chernetidae), were found attached to the dorsum of the abdomen of a male giant crab spider, *Olios fasciculatus* Simon (Heteropodidae), collected in Gila County, Arizona. This is the first report of pseudoscorpions phoretic on a spider.–C. Clayton Hoff, *Department of Biology, University of New Mexico, Albuquerque, NM 87131* and Daniel T. Jennings, *Rocky Mountain Forest and Range Experiment Station, Albuquerque, NM 87101.*

Descriptors: Pseudoscorpionida; Chernetidae; *Lustrochernes;* Araneae; Heteropodidae; *Olios;* phoresy; Arizona.

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NOTES ON THE BIOLOGY OF *TETRASTICHUS HAGENOWII* (HYMENOPTERA, EULOPHIDAE) A PARASITE OF COCKROACH OOTHECAE[1]

Mario Vargas V. and Francisco Fallas B.[2]

Oothecae of *Periplaneta australasiae* were found parasitized by *Tetrastichus hagenowii* in the building of the Department of Parasitology, of the University of Costa Rica, San Jose. This is the first record of this eulophid in this country.

On 5 October 1971, 33.3% of 24 oothecae collected from the edges of mop boards in our laboratory were found with mature larvae of these parasitic wasps. In a second group of egg cases dissected the same date, and collected mostly from window frames in the same place, 51.9% of 52 were found to be parasitized.

A culture of these microhymenopterons was established to study the biology of the species and to compare our observations with those made in other countries. In addition observations were continued for a year on the naturally occurring population of the wasps in the laboratory.

Individual exposures (Table 2) with mated wasps on nine oothecae of *P. australasiae* yielded from 34 to 90 wasps with an average of 63.3; and from seven oothecae of *Eurycotis biolleyi* 12 to 88 with an average of 52.3.

The wasps were not at all attracted to oothecae removed from *Blatella germanica.* In the oothecae of *P. australasiae* and *E. biolleyi* there were pupae of the wasps that failed to complete their development.

The number of wasps observed by us per egg capsule was very similar to those reported by other workers for *P. australasiae*; 40 to 50 (Cameron, 1955) and 50 (Roth & Willis, 1954) (Table 1). The average number of wasps emerged from *P. australasiae* was a little higher than for *E. biolleyi.*

The average sex ratios of the wasps from isolated oothecae (Table 2) were from *P. australasiae* 38% males and 62% females; and from *E. biolleyi* 32% males and 68% females. In both cockroach species of isolated oothecae the number of wasp males was about half that of the females the number of males from *E. biolleyi* was slightly lower than from *P. australasiae.*

Longevity of adults was also studied (Table 3). The average longevity of males was 6.33 days, varying from 4 to 11 days. Females lived from 12 to 37 days, averaging 14.5

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Table 1. Number of *Tetrastichus hagenowii* emerged per oothecae in several species of Blattaria

Species	No. of exposed oothecae	No. of females ovip.	Mean no. of wasps emerged	Range	Author
Eurycotis floridana	3	20	648	606-685	Roth & Willis, 1954
Nauphoeta rhombifolia	1		73		Roth & Willis, 1960
Parcoblatta sp	2		100		Edmunds, 1955
Periplaneta americana			100		Roth & Willis, 1960
Periplaneta americana			140		Roth & Willis, 1960
Periplaneta americana			25		Roth & Willis, 1960
Periplaneta americana			33	7-38	Usman, 1949
Periplaneta americana			71		Roth & Willis, 1960
Periplaneta americana	4	20	204	164-261	Roth & Willis, 1954
Periplaneta americana				30-40	Cameron, 1955
Periplaneta americana	39		93	12-187	Edmunds, 1955
Periplaneta australasiae				40-50	Cameron, 1955
Periplaneta australasiae			+50		Roth & Willis, 1960

Table 2.

Number and percent of adult *Tetrastichus* that emerged from indicated oothecae of *P. australasiae* and *E. biolleyi.*

No. and % of emerging wasps	1	2	3	4	5	6	7	8	9	mean
				P. australasiae						
Males:										
No.	14	46	35	16	34	16	22	19	15	24.1
%	33.3	60.5	53.8	17.6	56.7	24.2	64.7	24.1	16.7	(38%)
Females:										
No.	28	30	30	42	26	50	12	60	75	39.2
%	66.7	39.5	46.2	72.4	43.3	75.8	35.3	76.0	83.3	(62%)
Total adults	42	76	65	58	60	66	34	79	90	63.3
				E. biolleyi						
Males:										
No.	2	23	28	10	8	18	27			16.6
%	16.7	26.1	41.2	23.8	27.6	32.1	38.0			(32%)
Females:										
No.	10	65	40	32	21	38	44			35.7
%	83.3	73.9	58.8	76.2	72.4	67.9	62.0			(68%)
Total adults	12	88	68	42	29	56	71			52.3

days. Males generally died in 3 to 4 days. It is interesting to note that the feeding of the wasps on sugar, honey or substances from the oothecae did not extend the lifespan of them, in comparison with unfed adults.

Sexual behavior of males was characterized by visual and antennal stimulation first, and vibrating of wing before and after copulation took place. Mating was done rapidly, the male when mounting the female had to lean backwards in order to copulate. The female bent her abdomen upward when receptive and so helped the rather small male accomplish mating. Often, several males tried to copulate at the same time with the same female or even with one another.

Oviposition probably occurred on the second day after emergence of the adults. No special selection of the oothecae exposed to the wasps was noticed, they even oviposited in empty egg capsules. The females touched the oothecae with their antennae and valvae, this lasted for approximately half an hour, then actual oviposition occurred in a short time; from a few seconds to a few minutes.

Adults emerged in 39 days from an egg case that had been exposed to the wasps for 6 days. Two of 3 oothecae kept with the hymenoptera yielded adults in 27 days, the third one in 33 days.

We observed the pupation and development of mature larvae by removing them from parasitized egg cases and placing them in petri dishes with moistened cotton. By this method ninety larvae were followed through the process of getting rid of fecal materials which happened in 1 to 2 days and pupation that took 5 days. The pupal stage lasted from 17 to 22 days.

Table 3. Longevity of adults of *Tetrastichus hagenowii* emerged from oothecae of *Periplaneta australasiae* (male/female)

Ootheca No.	No. wasps emerged	No. of male and female wasps that died at the indicated days:								
		1	2	3	4	5	6	7	8	9
1	65	0/0	1/2	0/20	10/3	4/0	0/8	0/3	0/2	0/3
2	58	0/0	0/1	0/0	16/9	0/4	0/10	0/6	0/5	0/6
3	34	0/0	0/1	0/0	7/0	8/6	0/1	0/5		
4	66	0/0	14/6	1/5	0/14	0/17	1/7	0/1		
5	60	0/0	0/0	2/1	2/2	4/1	17/1	6/1	1/2	0/1

Table 3. (Continued)

Ootheca No.	No. wasps emerged	No. of male and female wasps that died at the indicated days:								
		10	11	12	13	14	15	16	17	18
1	60	0/0	0/2	0/7						
2	58	0/1								
3	34									
4	66									
5	60	1/3	1/1	0/2	0/0	0/0	0/0	0/1	0/2	0/1

Table 3. (Continued)

Ootheca No.	No. wasps emerged	No. of male and female wasps that died at the indicated days:							
		19	20	21	22	23	24	25(*)	34
5	60	0/2	0/2	0/1	0/0	0/0	0/0	0/1	0/1

Note (*)=no deaths occurred during the indicated period.

It is interesting to note the similarity in our observations and those made by other authors, specially concerning sexual behavior (Edmunds, 1955; and Roth & Willis, 1960). However important variations were found relating sex proportions, the number of males was lower in both species than the number reported by other authors (Usman, 1949; Cameron, 1955; Edmunds, 1955; and Roth & Willis, 1954).

Arrhenotokia was not observed in our wasp cultures. Oothecae of *P. australasiae* were exposed to several unmated wasps but none was ever parasitized.

ACKNOWLEDGEMENTS

To Dr. B. D. Burks of the Systematic Entomology Laboratory, U. S. Department of Agriculture, for confirming the identification of the species of *Tetrastichus.*

ABSTRACT:–*Tetrastichus hagenowii* is reported from Costa Rica naturally parasitizing oothecae of *Periplaneta australasiae.* Laboratory tests show that this hymenopteron is also well adapted to oothecae of *Eurycotis biolleyi.* An average of 63.3 *Tetrastichus* adults emerged from *P. australasiae* oothecae and 52.3 from *Eurycotis biolleyi.* The sex ratios of the wasps emerged from isolated oothecae of *P. australasiae* was 38% males and 62% females and from *E. biolleyi* 32% males and 68% females. The average longevity of *Tetrastichus* males is 6.3 days and for females 14.5 days. The pupal stage lasted from 17 to 22 days.–Mario Vargas V. & Francisco Fallas B., Departamento de Parasitologia, Facultad de Microbiologia, Universidad de Costa Rica.

Descriptors: Hymenoptera; Eulophidae; *Tetrastichus hagenowii;* San Jose, Costa Rica. Biology, sex ratios; parasitic on Blattaria: *Periplaneta australasiae, Eurycotis biolleyi.*

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POPULATION AND SUBSPECIFIC VARIATION IN *GERRIS REMIGIS* SAY[1]

Diane Calabrese[2]

Thomas Say (1832) first distinguished *Gerris remigis* Say from *G. paludum* F., a European congener. He described the species from New York State. Drake and Harris (1934) examined *G. remigis* from every state in the U.S. and from Canada and Mexico and found that the species varies greatly from population to population in size, color and wing form. Noteworthy populations in this respect are that of southeastern Ohio-northwestern West Virginia, with sandy-red, slender-bodied members; and those of Utah, Arizona and New Mexico with sandy-red members (and distinct from the similarly colored *G. ampla arizonensis* Kuitert). On the bases of variation in these populations and the notable absence of macropterous forms one might consider them as geographically isolated. However, considering the work of Riley (1920) on migration by legs in this species in times of drought and the nearness of populations fitting more closely the description of *G. remigis,* more data are needed before a determination concerning the geographical isolation of these populations can be made.

One population which cannot be rejected as a subspecies on this basis is that from California and Oregon. Considering the geographical isolation, morphological characters, percentage of macropterous forms in this population and a suggestion by Michel (1961) that on the basis of internal male genital characters what is termed *G. remigis* in the East is not what is termed *G. remigis* in the West, this western population is designated a new sub-species, *G. remigis caloregon,* in recognition of its geographical location. The subspecies is separated from *G. remigis remigis* by the following key:

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Males

Emargination of last abdominal sternite with sides subparallel; posterior margin of emargination fitting closely against first genital segment and not clothed with short dense pubescence.. *G. remigis remigis*

Emargination of last abdominal sternite broadly rounded, sides not sub-parallel; posterior margin of emargination raised and clothed with short, dense pubescence.. *G. remigis caloregon*

G. remigis caloregon (all measurements given in mm. for holotype male, with range for paratypes in parentheses): length 16 (15-17.5), width 3 (3-3.5), antennal segments – I,2.2 (2.2-3), II,1.1 (1.1-1.5), III,1 (1-1.2) and IV,1.2 (1.1-1.5).

Male: impressions on either side of median keel of ventral first genital segment deep; convex posterior projection of median keel of first genital segment and last abdominal sternite distinctly raised and covered by short dense hairs; abdominal sternites much lighter than venter of thorax; venter broad and not narrowing posteriorly.

Female: venter broad and not narrowing posteriorly; abdominal sternites much lighter than venter of thorax.

In *G. remigis remigis* the antennal segments are in the same proportion with respect to one another as in *G. remigis caloregon,* but they are proportionally shorter. In *G. remigis remigis* the venter is consistent in color and in both the male and the female it narrows posteriorly. The male of *G. remigis remigis* does not show the pubescence or raised characters as are present in the genital segments of *G. remigis caloregon.*

Of the type series of *G. remigis caloregon,*just less than 67% are macropters. This is in distinct contrast to the 3% macropter figure obtained for the greatest number of macropters in any population of *G. remigis remigis* (Calabrese, unpublished data). Froeschner (1962) reports a full 33% macropters of *G. remigis* in Missouri, a statement I have not been able to verify. The problem of wing polymorphism will be discussed at greater length in a future publication.

In 1871 Uhler described the species *Hydrotrechus robustus* from Clear Lake, California. Drake and Harris (1934) synonymized the species with *G. remigis.* Because Uhler's description had as its type specimen a damaged, apparently teneral, female, the relationship to *G. remigis caloregon* cannot be ascertained.

Holotype: ♂, macropter, California: Alpine Co., Hope Valley, VII-12-1966 (P. B. Schultz).

Paratypes: 1♀ macropter, 3♀ apters, 2♂ apters, California: S. Barb. Co., Canada del Medio, Sta. Cruz Isl. VI(16-23)1967 (R. C. Schuster); 4♂ macropters, 2♀ macropters, California: Eldorado Co., Pollock Pines VII-4-1967 (R. F. Denno); 1♀ macropter, California: Napa Co. VII-15-1967 (R. F. Denno); 2♀ apters, California: Solano Co., Mix Cyn. IV-19-1970 (L. Johnson); 1♂ macropter, California: Solano Co., Mix Cyn. 1955 (J. A. Riegel); ♀ macropter, California: Napa Co., Gerryassa L. IV-2-1970 (L. Johnson); ♀ macropter, California, Sequoia N. P., Giant Forest IX-1-1970 (A. S. Menke); ♀ macropter, California: Alpine Co., Winnemucca L. VII-14-1964 (C. R. Kovacic); 5♂ macropters, 1♀ macropter, California: Sky Ranch, Madera Co. II-30-2968 (E. A. Kane); 5♀ macropters, 3♀ apters, Oregon: Lane Co., 10 mi. NE Oakridge VII-16-1959 (G. C. Kettunen); 2♂ apters, 3♀ apters, 1♂ macropter, 1♀ macropter, Oregon: Curry Co., Humbug St. Pk. VIII-25-1962 (G. C. Eickwort).

The holotype is in the collection of The University of California at Davis. Paratypes are in the collections of The University of California at Davis, Michigan State University, and the author.

Abstract.–Population variation is widespread in *Gerris remigis* Say. A west coast population is here designated *Gerris remigis caloregon* sub. sp. n.–D. Calabrese, Biological Sciences Group, University of Connecticut, Storrs, Conn. 06268.

MORE ABOUT THE BUFFALO TREEHOPPER ON A MISSISSIPPI RIVER ISLAND (HOMOPTERA:MEMBRACIDAE)

Clifford J. Dennis[1]

I have previously reported (1969a, 1969b) on treehoppers collected on certain Mississippi River islands during 1967, 1968, and 1969.

In the intervening years nothing new was discovered until July 14, 1973, when a single adult male of the buffalo treehopper, *Stictocephala bubalus* (Fabricius), was seen on cottonwood (*Populus deltoides*) on Hovie Island at about mile 623 on the Corps of Engineers navigation chart.

I had never found this species on cottonwood, and I am aware of few past records. Marlatt (1894) mentioned egg-laying scars on cottonwood *(Populus monilifera)*. Funkhouser (1917) reported cottonwood *(Populus deltoides)* as a host. I have no idea what the insect was doing on the cottonwood. I could only speculate. It hopped from a small tree onto my arm. After I released him, he flew off into the trees. No other specimens were found.

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ABSTRACT.–MORE ABOUT THE BUFFALO TREEHOPPER ON A MISSISSIPPI RIVER ISLAND (HOMOPTERA:MEMBRACIDAE).–This paper reports the finding of the buffalo treehopper on an unusual plant on a new island. Clifford J. Dennis, University of Wisconsin-Whitewater, Whitewater, WI 53190.

Descriptors: Homoptera; Membracidae; buffalo treehopper; *Stictocephala bubalus* (Fabricius); island; host.

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DISTRIBUTION RECORDS OF SPONGILLA FLIES (NEUROPTERA:SISYRIDAE)[1]

Harley P. Brown[2]

Records of sisyrids are rather few and scattered. Parfin and Gurney (1956) summarized those of the New World. Of six species of *Sisyra S. panama* was known from but two specimens from Panama, *S. nocturna* from but one partial specimen from British Honduras, and *S. minuta* from but one male from the lower Amazon near Santarém, Pará, Brazil. Of eleven species of *Climacia, C. striata* was known from a single male from Panama, *C. tenebra* from a single female from Honduras, *C. nota* from a lone female from Venezuela, *C. chilena* from one female from southern Chile, *C. carpenteri* from two females from Paraguay, *C. bimaculata* from a female from British Guiana and one from Surinam, *C. chapini* from seven specimens from Texas and New Mexico, and *C. basalis* from fourteen females from one locality in British Guiana and one from a ship. *C. townesi* was known from 41 females taken by one man along the Amazon River between Iquitos, Peru and the vicinity of Santarém, Brazil.

To round out the records presented by Parfin and Gurney: *Sisyra apicalis* was known from Georgia, Florida, Cuba, and Panama; *S. fuscata* from British Columbia, Alaska, Ontario, Minnesota, Wisconsin, Michigan, New York, Massachusetts, and Maine; *S. vicaria* from the Pacific northwest and from most of the eastern half of the United States and southern Canada. *Climacia areolaris* also occurs in most of the eastern half of the United States and Canada. *C. californica* occurs in Oregon and northern California.

Navás (1928:319) listed *C. areolaris* from the Lago de Xochimilco in the central valley of Mexico. It is unlikely that this population is actually *C. areolaris.* If not *C. chapini,* it probably represents a species yet undescribed. Navás (1935:38) reported *C. basalis* from Corumbá, Mato Grosso, Brazil. This population is perhaps more likely to represent *C. carpenteri,* which had not then been described.

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Even in the United States, the records of the best known and most widespread species are scant. I have made no special effort to collect sisyrids within the past twenty years, but in the process of seeking riffle beetles, I have turned up the following records that may be of value to someone. BRAZIL: PARÁ: Riozinho (a tributary of the Rio Fresco which flows into the Xingú), 68/6/10, sponge with 2 sisyrid larvae not identified to genus; MEXICO: BAJA CALIFORNIA: Rio Chorro near Agua Caliente at the southern end of the peninsula, 73/7/29, sponge with old *Climacia* cocoon above water near by; MEXICO: DURANGO; east of La Ciudad at an elevation of about 9,000 feet, 64/11/30,spongewith *Climacia* larvae; MEXICO: DURANGO: Rio Chico west of Durango at an elevation somewhat above 7,000 feet, 64/11/30, sponge with *Climacia* larvae; IOWA: FRANKLIN CO.: east of Hampton, 68/7/8, sponge with 2 sisyrid larvae not identified to genus (there are no records of either *Climacia* or *Sisyra* from Iowa); KENTUCKY: BELL CO.: Pineville, 72/8/20, sponge with 5 larvae of *Sisyra*, presumably *S. vicaria;* NORTH DAKOTA: FOSTER CO.: Juanita Lake, 68/7/31, 4 *Sisyra* larvae taken by Ralph Stoaks (new state record); OKLAHOMA: JOHNSTON CO.: Pennington Creek just above Tishomingo, 72/7/25, 25 cocoons of *Climacia areolaris* (7 adults were reared; other cocoons produced pteromalid wasps).

My larvae from Brazil could well be either *Climacia townesi* or *Sisyra minuta,* or possibly a new species. My larvae from the Mexican state of Durango may belong to the species occurring in the Valle de Mexico or to a new species. The *Climacia* cocoon from southern Baja California very likely represents a new species.

Whereas neither sponges nor sisyrids were observed in Lake Texoma during the first five or ten years after its impoundment in 1946, both sponges and *Climacia areolaris* are now common at least around the boathouse of the University of Oklahoma Biological Station in Marshall County. The situation now approximates that in Lake Erie described by Brown (1952). Pteromalid wasps parasitoid upon the pupae are also now comparable in numbers to those described by Brown (1951).

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Although Chandler (1956:235) indicated that *Sisyra* was not known from Australia, the genus is reasonably well represented on that continent. Smithers (1973) summarizes new and old records of five species of *Sisyrina*, thus extending the known range of that genus from India to Australia.

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ABSTRACT.—Sponges with sisyrid larvae are reported from 2 states of Mexico for the first time: mountain streams in Durango and near Agua Caliente in Southern Baja California. Each of these populations may represent a new species of *Climacia*. Larvae from a headwater tributary of the Xingú River in Pará, Brazil could be those of *Climacia townesi* of *Sisyra minuta*, if not of a new species. New state records from the United States: 2 larvae of undetermined genus near Hampton, Franklin Co., Iowa; 4 *Sisyra* larvae from Juanita Lake, Foster Co., North Dakota. New county records in states with few previous records: *Sisyra vicaria* (?) larvae at Pineville, Bell Co., Kentucky; *S. vicaria* adults in Flint Creek, Delaware Co., Oklahoma; *Climacia areolaris* pupae and associated parasitoid pteromalid wasps near Tichomingo, Johnston Co., Oklahoma. Sponges and *Climacia areolaris* have become common in parts of Lake Texoma, Marshall Co., Oklahoma; so have the parasitoid pteromalid wasps which attack the sisyrid pupae. Attention is called to a new species of *Sisyrina* from Australia. – Harley P. Brown, Department of Zoology, University of Oklahoma, 730 Van Vleet Oval, Norman, Oklahoma 73069.

Descriptors: Neuroptera, Sisyridae, *Climacia, Sisyra, Sisyrina,* distribution records, spongilla flies.

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A NEW SPECIES OF *CHELACHELES* (ACARINA: CHEYLETIDAE) FROM MISSOURI WITH A KEY TO THE KNOWN SPECIES[1]

Siegfried E. Thewke [2]

An outstanding feature of the family Cheyletidae is its occupation of almost every conceivable habitat. One would not normally expect to find the same species occupying a specific niche at two different times of the year. This seemed to be the case for a new species of *Chelacheles* Baker 1958 that was extracted from oak material in southern Missouri normally occupied by another species prior to the discovery of the new species. No species of *Chelacheles* had been collected in the Midwest before, that of Baker (1958) originating in Portugal and that of Summers and Price (1970) in California. A third, *C. michalskii* Samsinak, occurs in Prague, Czechoslovakia.

The genus *Chelacheles* is characterized by the presence of eyes, dorsal plating weak to absent and the idiosoma rather long, with coxae II and III separated by a distance greater than the width of the body.

Key to Species of *Chelacheles*

Females

1. Propodosoma with seven pairs of dorsal setae .... *michalskii* Samsinak
   Propodosoma with six pairs of dorsal setae 2
2. One pair of genital setae present .... *peritremaculatus* sp. nov.
   Two pairs of genital setae present 3
3. With two pairs of anal setae .... *strabismus* Baker
   With three pairs of anal setae .... *bipanus* S. & P.

Chelacheles peritremaculatus sp. nov.
(Figs. 1-2)

Chelacheles Baker, 1958. Proc. Entomol. Soc. Washington 60(5):234-235.

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[1] Accepted for publication: June 5, 1973

[2] Research Specialist, Department of Entomology, University of Missouri, Columbia, MO 65201

Female – Palp tarsus with two sickles and two comb-like setae: inner comb with short, very fine teeth; outer comb with ten teeth. Sensory solenidion present ventrally. Tibial claw with two to five teeth basally. Dorsal tibial setae smooth, lanceolate, 48 microns long; internal ventrals smooth, 20 microns; external ventrals similar, 18 microns long. Palp genu with one smooth seta, 20 microns. Palp femur with four setae: dorsocentrals lanceolate, barbed, 42 microns; internal ventrals smooth, whip-like, 64 microns long; ventrocentrals smooth, whip-like, 32 microns, and external ventrolaterals smooth, acicular, 18 microns long. Rostrum long, conical. Protegmen striate longitudinally. Peritremes with nine chambers: first chamber from point of origin long, unornamented; the remaining chambers expanded inward laterally, each with pepper-spot like maculations. Hypostomal setae smooth, ultralong, 75-80 microns long. Dorsum of idiosoma with 14 pairs of setae plus one pair of ultralong humerals, 87-92 microns long. Eyes present. Dorsal shields absent. Propodosoma with six pairs of spinose dorsals, 18-24 microns long plus one pair of smooth, whip-like humerals. Hysterosoma with six pairs of dorsals, similar in form and length to propodosomals. First marginal setae of hysterosoma lightly barbed, 34 microns long. Propodosoma separated from hysterosoma by a transverse belt of striae. Genitalia terminal: two pairs of fine, acicular paragenitals, four to ten microns long, one pair of genitals similar to paragenitals and three pairs of anals as shown (Fig. 2). Idiosomal venter: one pair of acicular setae between coxae II, 12 microns; two medioventral pairs anterior to coxae III, and one medioventral pair anterior to genital slit. Setae on legs I to IV: coxae 2-1-1-2; trochanters 1-1-2-1; femora 2-2-1-1; genua 2(1)-2-2-2; tibiae 4(1)-4-4-4; tarsi 8(1)-7(1)-7-7. Numbers in parentheses refer to solenidia.

Leg I: coxae each with two setae: anterior inner pair smooth, whip-like, 30 microns; ventral pair smooth, whip-like, 100-110 microns long. Trochanters each with one lightly microns; dorsal pair stout, barbed, 36 microns long. Genua each with two setae and a sensory solenidion: internal dorsolaterals short, smooth to lightly barbed, 10 microns; external dorsolaterals smooth acicular, 18 microns long. Sensory solenidion near anterior portion of segment between dorsals, four microns long. Tibiae each with four setae and a sensory solenidion: internal ventrals smooth, acicular, 14 microns; ventrocentrals smooth, 18 microns long, dorsolaterals smooth, ultralong, 68 microns; dorsocentrals smooth, ultralong, 70-80 microns long. Sensory solenidion anterior to dorsolaterals, four microns long. Tarsi each with eight setae plus sensory solenidion Omega I. Guard seta of Omega I minute, 3-4 microns long. Omega I strongly spine-like, 18 microns long.

Leg II: coxae each with one smooth whip-like seta, 84 microns long. Trochanters each with one smooth seta, 20 microns long. Femora each with two setae: external ventrals smooth, 30 microns; dorsals lightly spinose, 34 microns long. Genua each with two setae: internal laterals smooth, 14 microns long; dorsocentrals smooth, 14 microns long. Tibiae each with four setae: ventrolaterals smooth, acicular, 18 microns; ventrocentrals long, smooth, 36 microns long; dorsocentrals smooth, acicular, 18 microns and dorsolaterals smooth, ultralong, 64 microns long. Tarsi each with seven setae and a long club-like sensory solenidion, 12 microns long.

Leg III: coxae with one smooth seta, 44 microns long. Trochanters each with two setae: ventrocentrals smooth, 24 microns; laterals spinose, stout, 44 microns long. Femora each with one spinose dorsal seta, 44 microns long. Genua each with two setae: dorsal member lightly spinose, 18 microns; lateroventrals spinose, 18 microns long. Tibiae each with four setae: ventrals about equal in length, smooth, 48 microns long; internal dorsals short, spinose, 18-20 microns; external dorsals long, smooth, 60 microns long. Tarsi each with seven setae.

Leg IV: coxae each with two smooth setae: inner pair 24 microns; outer pair shorter, 16 microns. Trochanters each with one smooth seta, 26-28 microns long. Femora each with one stout, spinose seta, 48-50 microns long. Genua each with two setae: dorsal pair spinose, 20-22 microns; ventral pair longer, spinose, 28-30 microns long. Tibiae each with four setae: ventrals smooth, about equal in length, 58-60 microns long; internal dorsals smooth to lightly spinose, 20-22 microns; dorsosublaterals smooth, ultralong, 80 microns long. Tarsi each with seven setae. Average length of ten females, 920 microns; average width 320 microns.

Two gnathosomal forms present themselves on the males of *C. peritremaculatus* sp. nov., while the remainder of the body is essentially the same for each.

Heteromorphic male (Fig.3). – Palp tarsi each with two sickles and two combs: inner comb short, with 5-8 teeth; outer comb robust, with 11 rounded teeth. Sickles normal. Sensory solenidion present ventrally, this structure with a parallel-sided stem portion, 4 microns long, with a bulbous swelling apically. Total length of solenidion 8 microns. Palp tibiae each with a single toothed claw. Three setae present on each palp tibia: ventrocentrals acicular, smooth, 22 microns; ventroexternals similar, 22 microns; and dorsal tibial setae stout, smooth, 42 microns long. Palp genua each with one smooth dorsal seta 32 microns long. Palp femora each with three setae: internal ventrals long, smooth, 70 microns; external ventrals similar, thinner, 57 microns; dorsals stout, spinose, 65 microns long. Rostrum conical, long (fig. 2). Protegmal area extending from in front of peritremes almost halfway to end of beak. Tegmen smooth with lateral cornuae. Peritremes with five to seven chambers, the first from point of origin smooth, the remainder maculate, lateral chambers expanded inward, somewhat lobe-like. Hypostoma with one pair of smooth setae, 90-100 microns long. Idiosoma with 13 pairs of setae plus one pair of humerals, 100-110 microns long. Dorsal setae 18-25 microns long, slender, spinose. Propodosoma with six pairs of spinose dorsals; one pair of humerals: hysterosoma with seven pairs of similar setae except for caudal pair which are spatulate, smooth, 5 microns wide by 10 microns long. Propodosoma separated from hysterosoma by an eliptical band of transverse striae. Idiosoma striate longitudinally. Lateroventral pair of hysterosomals spinose, 30-35 microns long. Genitalia terminal: one pair of paragenital-like setae, 15 microns; one pair of genitals and one pair of anals. Idiosomal venter: one smooth pair between coxae II, 20 microns; one smooth pair of medioventrals, 25 microns, and one smooth pair between coxae III, 11 microns long. Setae on legs I to IV: coxae 2-1-1-2; trochanters 1-1-2-1; femora 2-2-1-1; genua 2(1)-2-2-2; tibiae 4(1)-4-4-4; tarsi 8(1)-7(1)-7(1)-7.

Leg I: coxae each with two setae: ventrocentrals smooth, 64 microns; anterior pair similar, 30 microns long. Trochanters each with one short, smooth seta, 10 microns long. Femora each with two setae: ventrals smooth, 28 microns; dorsals stout, spinose, 30 microns long. Genua each with two dorsal setae similar in length, 20 microns and a dorsal sensory solenidion 4 microns long. Tibiae each with four setae and a sensory solenidion: internal ventrals thin, smooth, 50 microns; externals similar, 16-20 microns long; internal dorsals thin, smooth, 70 microns; externals similar, 64-68 microns long. Sensory solenidion dorsal, 4 microns long. Tarsi each with eight setae and a stout sensory solenidion, 16 microns long. Guard seta of Omega I very fine, short.

Leg II: coxae each with one smooth seta, 80 microns long. Trochanters each with one smooth seta, 14-16 microns long. Femora each with two setae: ventrocentrals smooth, thin, 28 microns; dorsals stout, spinose, 26-28 microns long. Genua each with two dorsal setae similar in length, 10-14 microns long. Tibiae each with four setae: internal ventrals smooth, 16 microns; externals thinner, smooth, 60 microns long; dorsocentrals short, apparently smooth, 8-16 microns; and dorsolaterals smooth, 50 microns long. Tarsi each with seven setae and a stout sensory solenidion 10 microns long.

Leg III: coxae each with one smooth seta, 30-35 microns. Trochanters each with two setae: ventrals smooth, acicular, 12 microns; laterals stout, spinose, 36 microns long. Femora each with one stout, spinose dorsal seta, 46 microns long. Genua each with two setae: ventrals stout, spinose, 16 microns; dorsals similar, 16-18 microns long. Tibiae each with four setae: internal ventrals smooth, whip-like, 46 microns; externals similar, shorter, 34 microns long; dorso-internals smooth, 16 microns; and dorso-externals smooth, 64-70 microns long. Tarsi each with seven setae and a stout ventrolateral sensory solenidion, 8 microns long.

Leg IV: coxae each with two setae: internals smooth, needle-like, 16 microns; externals similar, 12 microns long. Trochanters each with one smooth, whip-like central seta, 18 microns long. Femora each with one stout, spinose dorsal seta, 38-40 microns long. Genua each with two spinose setae: ventrals 22 microns; dorsals 16 microns long. Tibiae each with four setae: internal ventrals smooth, whip-like, 50 microns; externals similar, 40 microns long; dorsolaterals spinose, 20 microns and dorsocentrals smooth, 70 microns long. Tarsi each with seven setae. Claws of all tarsi moderately hooked. Length of male, including rostrum, 368 microns; width 128 microns.

Normal male (Fig. 4)–Palptarsi each with two combs and two sickles: inner comb lightly toothed; outer comb with 9-11 teeth. Sensory solenidion present ventrally, club-shaped. Palptibial claws each with one or two teeth basally. Palp tibiae each with three setae: dorsal tibial setae smooth, long, 20-40 microns; internal laterals smooth, 26 microns; ventrals smooth, 16 microns long. Palp genua each with one smooth dorsal seta, 15 microns long. Palp femora each with three setae: internal ventrals long, smooth, 30-35 microns; ventrocentrals similar, 38-40 microns; dorsocentrals stout, spinose, arising from a tubercle, 34 microns long. Rostrum long, conical, setigerous. Protegmen area short, smooth to lightly striate. Tegmen finely striated, with minute pores. Peritremes with eight to nine chambers: first chamber of peritremes long, smooth, remaining chambers maculate, some expanded inward laterally. Hypostomal setae smooth, ultralong, 46-50 microns long. Idiosoma with 13 pairs of dorsals plus one pair of smooth, ultralong humerals. All dorsals except humerals and last pair of caudodorsals spinose, these paddle-shaped, 5 microns wide by 10 microns long. Propodosoma with six pairs of spinose dorsals, 14-16 microns long, and one pair of humerals, 70-75 microns long. Propodosoma separated from hysterosoma by an elliptical band of transverse striae. Hysterosoma with seven pairs of dorsals similar in length to propodosomals except for the last four pairs of dorsals: fourth pair from genital opening eight microns; second and third pair five to six microns long and first pair from genital opening curved, inflated, bolo-shaped, five microns long. Lateroventral pair of hysterosoma barbed, 22 microns long. Genitalia terminal: one pair of paragenital-like setae, 16 microns; two pairs of genitals; anals absent. Aedeagal opening dorsal. Idiosomal venter: one pair of smooth setae between coxae II, 10 microns; one pair of smooth setae in line with lateroventrals, 14 microns long; and one pair of smooth setae between coxae III, 10 microns long. Setae on legs I to IV: coxae 2-1-1-2; trochanters 1-1-2-1; femora 2-2-1-1; genua 2(1)-2-2-2; tibiae 4(1)-4-4-4; tarsi 8(1)-7(1)-7(1)-7.

Leg I: coxae each with two smooth setae: internal anterior pair fine, whip-like, 14 microns; ventrolaterals long, whip-like, 48 microns long. Trochanters each with one seta, 10 microns long. Femora each with two setae: ventrals smooth, 20 microns; dorsals spinose, stout, 28 microns long. Genua each with two setae and a sensory solenidion: internal dorsals smooth, 10 microns; dorsocentrals smooth, 14 microns long. Sensory solenidion situated between and anterior to dorsals, three to four microns long. Tibiae each with four setae and a sensory solenidion: internal ventrolaterals smooth, 34 microns; ventrocentrals smooth, 18 microns long; internal dorsals smooth, lanceolate, ultralong, 64 microns; external dorsals smooth, 52 microns long. Sensory solenidion present dorsally, near anterior portion of segment, five to seven microns long. Tarsi each with eight setae and a strongly annulated sensory solenidion (Omega I), 16 microns long. Omega I appears to arise from a tubercular base, and guard seta of same very fine and short.

Leg II: coxae each with one smooth, whip-like seta, 54 microns long. Trochanters each with one smooth seta, 14-16 microns long. Femora each with two setae: ventrals smooth, 20 microns; dorsals stout, spinose, 22 microns long. Genua each with two setae: dorso-internals smooth to lightly barbed, 12-18 microns long. Tibiae each with four setae: internal ventrals smooth to lightly barbed, 18-20 microns; ventrals smooth, whip-like, 20 microns long; internal dorsals spinose, 10 microns and external dorsals smooth, ultralong, 44 microns. Tarsi each with seven setae and a sensory solenidion, dorsally located, strongly annulated, 9 microns long.

Leg III: coxae each with one smooth, acicular seta, 32 microns long. Trochanters each with two setae: ventrocentrals smooth, 12 microns; laterals smooth, 30 microns long. Femora each with one stout, barbed seta, 36 microns long. Genua each with two setae: ventro-externals spinose, 12-14 microns; dorsals barbed, 12 microns long. Tibiae each with four setae: internal ventrals smooth to lightly barbed, 36 microns; external ventrals smooth, 18 microns long; internal dorsals spinose, 14 microns and external dorsals smooth, ultralong, 48 microns. Tarsi each with seven setae and a ventro-laterally situated sensory solenidion, 9 microns long.

Leg IV: coxae each with two setae: internals smooth, 22 microns; externals smooth, 12 microns long. Trochanters each with one seta, smooth, 14 microns long. Femora each with one stout, spinose dorsal seta, 30 microns long. Genua each with two setae: ventro-externals spinose, 18 microns long. Tibiae each with four setae: ventrals smooth, about equal in length, 30-34 microns long; internal dorsals spinose, 16 microns and external dorsals smooth, ultralong, 54 microns. Tarsi each with seven setae. Length of male, 270 microns; width 98 microns.

Nymph. – Palp tarsi each with two sickles and two combs: inner comb reduced with three to four teeth; outer comb stout with seven to nine teeth. Club-like sensory solenidion present ventrally. Palptibiae each with three setae: internal ventrals acicular, smooth, 8 microns; ventrals long, smooth, 11 microns; dorsal tibial setae stouter, smooth, 17-19 microns set on a tubercular base. Palp genua each with one smooth seta, 12 microns long. Palp femora each with four setae: dorsocentrals stout, strap-like, barbed, 38-41 microns long; internal ventrals long, whip-like, smooth, 20 microns; external ventrals similar, shorter, 17 microns, and one pair of ventrolaterals near anterolateral portion of segment, these smooth, 6 microns long. Inner basal region of femora adjacent to tegmen-protegmen with discontinuous maculated striae. Palp coxae lightly striate. Rostrum short, somewhat conical. Protegmen short with longitudinal striae. Tegmen lightly striate. Peritremes with seven to eight chambers, the first pair of chambers from point of origin long, smooth; the remainder smaller, expanded inward laterally, with dot like maculations. Hypostoma with one pair of smooth setae, 36 microns. Idiosoma with 12 pairs of dorsal setae, 14-16 microns long. One pair of long humerals, 60 microns. Idiosomal venter: one pair of fine, smooth setae, 14 microns long betweem coxae II; one pair of smooth acicular medioventrals, 12 microns; one pair of short, smooth setae between coxae III, 6 microns; one pair between coxae IV, 8 microns and one pair of smooth setae anterior to genital field, 6 microns long. Genitalia terminal: one pair of stout paragenitals, 6 microns; two pair of smooth, stout genitals: anterior pair 6 microns; posterior pair 10 microns; one pair of smooth anals, 4-6 microns long. Legs I to IV: coxae 2(1)-1-2-2; trochanters 1-1-2-1; femora 2-2-1-1; genua 2(1)-2-2-2; tibiae 4(1)-4-4-4; tarsi 7(1)-7(1)-7-7.

Leg I: coxae with one pair of smooth setae: inner anterior pair fine, 16 microns; ventrocentral pair long, 50 microns. Trochanters with one seta each, situated on inner, antero-lateral portion of segment, smooth, 12 microns long. Femora with one pair of setae: ventro-centrals smooth, acicular, 16 microns; dorsals stout, spinose, 26 microns long. Genua with one pair of short, smooth setae: inner pair of each segment 12 microns; outer 10 microns long. Sensory solenidion present dorsally, 4 microns long. Tibiae with four setae and a stout, club-shaped sensory solenidion dorsally: internal ventrals short, smooth, 12 microns; ventrecentrals smooth, 30 microns long; dorsocentrals smooth, long, 50 microns; external dorsals smooth, 40 microns long. Sensory solenidion 4 microns long. Tarsi with seven setae and a stout sensory solenidion dorsally, 10 microns long.

Leg II: coxae with one smooth ventro-central seta, 40 microns long. Trochanters with one smooth anterolateral seta, 14 microns long. Femora with one pair of setae: ventrals smooth, fine, 20 microns; dorsocentrals stout, spinose, 24 microns long. Genua with one pair of smooth setae, equal in length, 10 microns long. Tibiae with four setae: internal ventrals spinose, 10 microns; ventrocentrals smooth, long, 24 microns; internal dorsals short, acicular, 10 microns, and dorsocentrals smooth, 34 microns long. Tarsi with seven setae and a stout, dorsolateral sensory solenidion, 8-10 microns long.

Leg III: coxae with one smooth seta, 24 microns long. Trochanters with one pair of setea: laterals stout, minutely spinose, 30 microns; ventrals smooth, fine, 12 microns long. Femora each with one stout spinose seta, 38 microns long. Genua with one pair of spinose setae: ventrals stout, 14 microns; dorsals similar, 12 microns long. Tibiae with four setae: internal ventrals smooth, 30 microns; external ventrals smooth, 24 microns long; internal dorsals spinose, stout, 16 microns; external dorsals long, smooth, 30 microns. Tarsi with seven setae.

Leg IV: coxae with one pair of setae: internals smooth, 18 microns; externals similar, shorter, acicular, 12 microns long. Trochanters with one smooth seta, 12 microns long. Femora with one stout, spinose dorsal seta, 32 microns long. Genua with two setae: ventrals spinose, stout, 16 microns; dorsals similar, 14-16 microns long. Tibiae with four setae: ventral pair of each segment smooth, 40 microns; internal dorsals spinose, 18-20 microns long; external dorsals smooth, ultralong, 50 microns. Tarsi with seven setae. Claws of all legs moderately hooked. Body length 278 microns; width 112 microns.

Types: holotype female, allotype heteromorphic male collected seven miles south of West Plains, Howell County, Missouri on October 26, 1972 to be deposited in the collection of the Entomology Research Museum, University of Missouri, Columbia. One paratype normal male and one nymph, same data as on holotype, also to be retained in the Entomology Research Museum, University of Missouri, Columbia. Two paratype females, one paratype heteromorphic male and one nymph, same data as on holotype, to be deposited in the collection of the U. S. National Museum. Two paratype females, same data as holotype, to be deposited in the collection of the Snow Museum, University of Kansas, Lawrence. Two paratype females, same information as holotype, to be deposited in the collection of the University of California, Davis. Two paratype females, same data as holotype, to be deposited in the Canadian National Collection, Ottawa, Canada. The remaining three specimens, of which one was collected on October 4, 1972, to be retained in the collection of the Entomology Research Museum, University of Missouri, Columbia. All specimens were collected by S. E. Thewke.

The specific name of this species is derived from the maculated peritremata which it possesses.

These specimens were collected from sections of oak limbs five to thirteen centimeters in diameter. The oak had decayed to such an extent that indentification of these sections to species was not possible. The surrounding oak trees were a mixture of red oak and white oak. The mites were extracted by use of the Berlese funnel method of arthropod extraction.

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ABSTRACT–A new species of cheyletid mite from south-central Missouri, including the nymphal stage and two forms of the male, is described and illustrated. A key to the known species is also presented.

Descriptors: Acarina: Cheyletidae; *Chelacheles,* a new species, Missouri; Key to known species of *Chelacheles.*

Plate I. *Chelacheles peritremaculatus.*
Fig. 1. Dorsal view of female.
Fig. 2. Genital field of female.

Plate II. *Chelacheles peritremaculatus.*
Fig. 3. Dorsal view of heteromorphic male.
Fig. 4. Dorsal view of gnathosoma of normal male.

A SALT-MARSH POPULATION OF *LYCAENA HELLOIDES* (LEPIDOPTERA:LYCAENIDAE) FEEDING ON *POTENTILLA* (ROSACEAE)[1]

Arthur M. Shapiro[2]

The evolutionary relationships of the populations included under the names *Lycaena helloides* Boisduval, *L. dorcas* Kirby, and *L. florus* Edwards are poorly understood. The status of *florus*, which resembles *dorcas* phenotypically but appears to intergrade with *helloides* (which it replaces altitudinally in the Rockies), is in particular question. Eastern *dorcas* feed on *Potentilla* spp. (Rosaceae) while western lowland *helloides* are everywhere reported from Polygonaceae *(Rumex, Polygonum)* (Clench, 1961). Oviposition tests on Colorado *florus* by Chambers (1963) gave ambiguous results, tending toward a preference for *Rumex* over *Potentilla* under laboratory conditions. This paper reports a lowland population of *"helloides"* feeding on a *Potentilla,* a situation hitherto unrecorded in this taxon. At present data are available only from the tidal marshes on the north edge of Suisun Bay, Solano County, central California.

The Suisun Bay tidal marsh complex occupies part of a structural basin nearly surrounded by the Coast Ranges, connected with San Pablo Bay to the west and the Sacramento-San Joaquin Delta to the east by narrow straits (fig. 1). It contains extensive tracts of nearly undisturbed marshland and is known to botanists as a major source of endemic taxa (e.g., the showy Composites, *Aster chilensis* spp. *lentus* (Greene) Jeps. and *Grindelia* X *paludosa* Greene). *Potentilla egedei* Wormsk. var. *grandis* (Rydb.) Howell is a common component of the vegetation, occurring in nearly pure stands or mixed with Composites, sedges, and Umbellifers in permanently saturated but not strongly saline mud along and near Suisun, Nurse, and Montezuma Sloughs and in isolated pockets within the marshes. *Lycaena helloides* adults occur in these stands, often in numbers and up to a mile or more from the nearest stand

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of potential Polygonaceous hosts. Over 60 of these animals have now been collected and compared with lowland, Polygonaceous-feeding *helloides* from the Central Valley and from elsewhere in the Suisun area. *Lycaena helloides* occurs in vacant lots in Fairfield and Suisun City and, in association with the introduced weed *Rumex crispus* L., on landfill and high ground in the extreme northern part of the marsh. *Potentilla*-associated *helloides* show very minor phenotypic differences as compared with other populations examined (Figs. 2,3). Both sexes average very slightly larger, the females more so than the males; males tend to have the series of orange subterminal lunules on the dorsal hindwing reduced to two or three (occasionally only the one at the anal angle is preserved) and to have the wings more "peaked" or "pointed"; both sexes are more richly colored beneath, the hindwing with a strong orange-brown tint, the black spotting usually reduced and the orange subterminal lunules very pointed and distinct. The most extreme *Potentilla*-associated phenotypes are very distinctive, but most individual specimens could not be placed with assurance in one population or another without ecological data. As might be expected in this group, there are no

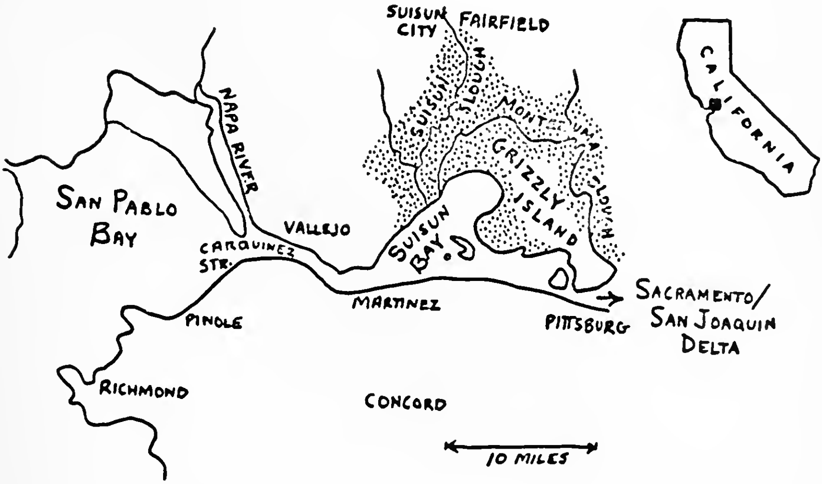

Figure 1. Location map of the Suisun Bay marsh complex. The area is shown in detail on USGS 7.5' topographic quadrangles "Cordelia" and "Fairfield South," California.

male genitalic differences between samples of *Potentilla*- and *Rumex* (or *Polygonum*)- associated *L. helloides.*

Oviposition-preference tests were carried out in 1972 using females collected in stands of *Potentilla* along Suisun Slough, in stands of *Rumex* on landfill in Suisun City; and in the Central Valley in stands of *Rumex* (Woodland sewer ponds, Yolo Co.) and *Polygonum aviculare* L. (Davis, Yolo Co.). They were offered similar-sized cuttings of *Potentilla edgedei* var. *grandis* (foliage only) and *Rumex crispus* (foliage and immature inflorescences), and cuttings of *Mentha* as nectar sources, and allowed to oviposit freely until death. The results are reported in Table 1, and can be considered an unequivocal demonstration of a preference for *Potentilla* by *helloides* from Suisun Slough and for *Rumex* by all others tested.

Rearing was completed on both hosts for the two Suisun strains and the one from Davis (Table 2). All insects developed directly with no diapause, giving adults within 38 days after oviposition, under continuous illumination at 80° F. This is not surprising since all the strains tested are strongly multivoltine in nature. Apparently all the strains can develop without major difficulty on both *Rumex* and *Potentilla* in the laboratory. This suggests that the maintenance of host preference in natural populations is dependent on female oviposition preference. It is tempting to speculate that this preference is behaviorally rather than genetically controlled (cf. "Hopkins host-selection principle," reviewed by Mayr, 1963) and that it is enforced by isolation of *Rumex* and *Potentilla* strains from each other's hosts, which occur in different habitats. If the *Potentilla* strain is very sedentary (females limited by "intrinsic barriers to dispersal," Ehrlich, 1961), its likelihood of encountering *Rumex* would be sharply reduced. On the other hand, mark-recapture experiments done on L. *helloides* at Davis suggest a very high vagility, at least in a predominantly *Polygonum*-feeding population. This would be highly adaptive since stands of *Polygonum aviculare* (unlike the other hosts discussed) are ephemeral, and a multiple-brooded species like *L. helloides* would need to colonize new stands repeatedly during the very long flight season in the Central Valley.

It is, of course, possible that, despite its weak phenotypic differentiation, the *Potentilla* strain of *helloides* has acquired at

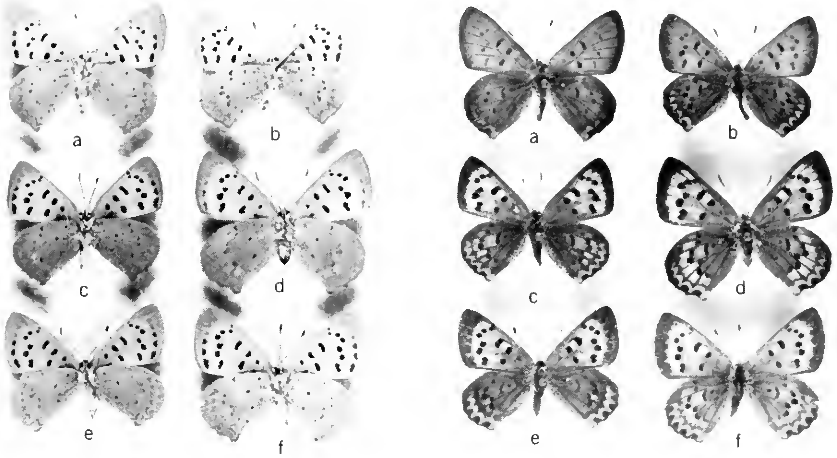

Figure 2. *Lycaena helloides* from Suisun Slough, Solano Co., California showing variation in males (a, b) and females (c-f) of the *Potentilla* strain; all 6 May 1973.

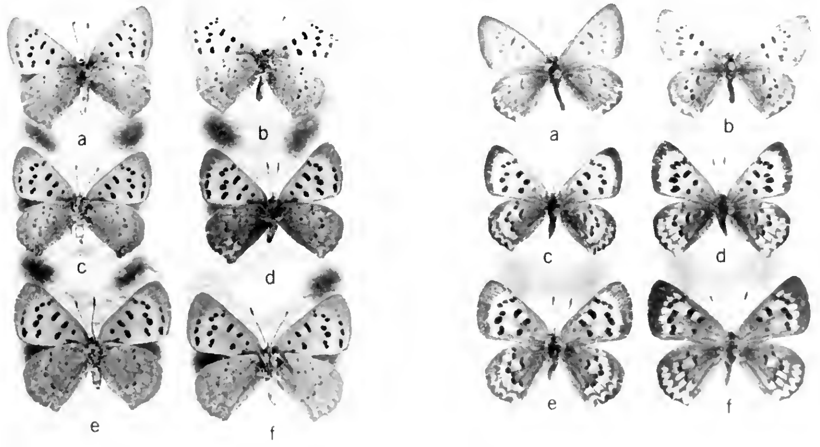

Figure 3. *Lycaena helloides* from Polygonaceous-feeding populations in Yolo Co., California showing variation in males (a, b) and females (c-f). a-c: West Sacramento, 5 May 73; d, Broderick, 18 October 72; e, Davis, 21 September 72; f, Putah Creek, 29 September 72.

least partial reproductive isolation from other strains. In this connection, it is noteworthy that a very small colony of *Potentilla* remains nearly undisturbed within the general area of landfill in Suisun City and maintains a colony of *L. helloides.* This one colony is well within the potential range of *Rumex*-feeding *helloides,* as most of the others do not seem to be.

Potentilla egedei var. *grandis* is widely distributed along the Pacific coast, from Los Angeles County to Alaska (Munz, 1970). It will be of great interest to determine whether populations of *L. helloides* associated with it are widespread, or restricted to the Suisun Bay area. There is no reason at this time to associate the Suisun population with either *florus* or *dorcas* (which it does not resemble phenotypically, except for the reduced orange in males, or in voltinism), but its existence reinforces the impression that this group switches readily from its ancestral hosts (Polygonaceae) to *Potentilla* given the ecological opportunity. The supposed subspecies of *dorcas, dospassosi* McDunnough, from New Brunswick is a salt-marsh endemic and probably feeds on either *P. egedei* var. *groenlandica* (Tratt.) Polunin or *P. anserina* L.; other associations reported for *L. dorcas* are with shrubby Potentillas of the *"fruticosa"* group.

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ABSTRACT–A population of *Lycaena helloides* Boisduval (Lepidoptera, Lycaenidae) from the vicinity of Suisun Bay, California is associated with and shows a laboratory oviposition preference for the plant *Potentilla egedei* (Rosaceae). All other lowland populations of this butterfly which have been examined feed on species of Polygonaceae. Arthur M. Shapiro, Department of Zoology, University of California, Davis, California 95616.

Descriptors: Lycaena helloides; Potentilla egedei; host race; salt marsh.

These two tables were inadvertently excluded from A. M. Shapiros article, *Entomological News*, February 1974, Vol. 85, No. 2, pp. 40-44.

Table 1. Oviposition preferences of female *Lycaena helloides*.

	Ova laid on:	
Source of female	*Potentilla egedei*	*Rumex crispus*
Suisun Slough, marsh 16 July 72	36	4
Suisun Slough, marsh 16 July 72	54	2
Suisun Slough, marsh 16 July 72	16	0
Suisun Slough, marsh 16 July 72	29	13
Suisun City, vacant lot, 16 July 72	5	23
Suisun City, vacant lot, 16 July 72	0	60
Suisun City, vacant lot, 16 July 72	0	18
Suisun City, vacant lot, 16 July 72	2	44
Davis, Yolo Co., 17 July 72	5	51
Davis, Yolo Co., 17 July 72	8	32
Woodland, Yolo Co., 19 July 72	0	69
Woodland, Yolo Co., 19 July 72	4	31

Table 2. Survival of larvae reared on *Potentilla* and *Rumex*.

Source of stock		No. larvae *(start)*	*Pupae*	*Adults*
Suisun Slough, marsh 16 July 72	P	15	11	10
	R	16	13	12
Suisun City, vacant lot 16 July 72	P	7	4	3
	R	18	15	10
Davis, vacant lot, 19 July 72	P	13	10	9
	R	18	14	10

NOVOMESSOR MANNI A SYNONYM OF *APHAENOGASTER ENSIFERA* (HYMENOPTERA:FORMICIDAE)[1]

William L. Brown, Jr.[2]

The genus *Novomessor* as it stands contains 3 species of rather large-sized but slender myrmicine ants living in arid and subarid parts of the southwestern United States and Mexico. The definitive treatment is the revision of Wheeler and Creighton (1934); later discussions of the taxonomy and distribution of *N. cockerelli* and *N. albisetosus* are to be found in Creighton (1950: 155-157; 1955) and of *N. manni* in Kannowski (1954).

Novomessor was originally described as *Aphaenogaster*, and the habitus certainly recalls that genus; in fact, the characters supposed to distinguish the two genera are not very strong when one considers the whole world of fauna of this complex. The worker metanotal groove ("mesoepinotal suture") is obsolete or nearly so in *Novomessor*, but distinct in most *Aphaenogaster;* and the forewing venation of *Novomessor* is of the *Formica* pattern, with a single closed cubital cell, versus 2 closed cubital cells (or a single closed cubital cell with venation of the *Solenopsis* pattern) in *Aphaenogaster*.

The distinction is weak in the case of *N. albisetosus*, which shows a vestigial metanotal "suture", and it should be mentioned that the Japanese *A. osimensis* is well on the way to the sutureless condition. The group of *A. mutica, A. smithi*, and *A. boulderensis* also shows a tendency toward metanotal groove reduction. Wing venation similar to that of *Novomessor* is found in the Madagascan *A. swammerdami*, also a large ant, and one with nests having very large, rough, "rat-hole" type entrances like those of *Novomessor*

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(from personal observations made in central and western Madagascar in 1969). Wing venation is otherwise more variable among *Aphaenogaster* species than is generally realized; for example, *A. mariae* lacks r-m, at least in the queen, and *A. sagei* and all of the Australian species have only one cubital cell. The venation of less than half of the *Aphaenogaster* species is known at the present time.

The posteriorly drawn-out head of workers and some queens is supposed to characterize *Aphaenogaster* subgenera *Deromyrma* and *Planimyrma,* but all degrees of development of the character occur, from heads that are merely subconical behind, to those that are definitely petiolate. *Novomessor manni* also belongs to this series.

In fact the case of *N. manni* is a very instructive one, and I should like to make an important point about it. The point is that fuzzy generic and subgeneric distinctions lead to the same species being described more than once under different names in different genera or subgenera. This point is illustrated by the oft-named *"Ectomymyrmex" brunoi* (Brown, 1963), by *Cerapachys jacobsoni* Forel = *Phyracaces vandermeermohri* Menozzi (Brown, ms.), and by many other cases that I shall document in detail in papers to come. Here I shall add the example of *Aphaenogaster ensifera* Forel (1899: 59) = *Novomessor manni* Wheeler and Creighton (1934), based upon my comparison of the types of the two species. **(New synonymy).** There is no more difference between these two samples than one would expect between workers from different nests of any single *Aphaenogaster* species.

We do not know the exact locality in Mexico whence came Forel's type; Kannowski (1954) speculated that, "it is possible that this ant is restricted to the arid scrub forest on the Pacific slope.... Thus, one might expect to find *manni* from northwestern Jalisco to Guerrero." This prediction has been fulfilled southward, at least, by the collection of a series of *A. ensifera* along Highway 95 about 50 km north of Acapulco in Guerrero (29 July, W. H. Gotwald, Jr. of the Cornell University Mexico Field Party of 1965), representing a considerable extension of the known range. I have already (Brown, 1973: 178 ff.) indicated the preliminary synonymy of *Novomessor* with *Aphaenogaster s. lat.,* and the synonymy also of the *Aphaenogaster* subgenera under the latter genus. In the present paper, I am defending only the synonymy, strictly speaking, of *Novomessor* with *Aphaenogaster (Deromyrma)* and *A. (Attomyrma).* I believe that the formal synonymy of these and the subgenera *Aphaenogaster s. str. (S. Palearctic), Nystalomyrma* Australia-New Guinea) and *Planimyrma* (Melanesia) can be adequately justified, but this must be done in a broader revisionary frame of reference including consideration of other genera in subfamily Myrmicinae, and is reserved for a more extensive publication. Meanwhile, it seems to me, the example of *A. ensifera* and *N. manni* may help to alert myrmecologists to the kinds of changes to be expected of a worldwide reclassification.

One of the changes in status resulting from this study is of course the return of *cockerelli* and *albisetosus* to their original generic assignment in *Aphaenogaster.*

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Forel, A. 1899. Insecta. Hymenoptera (Formicidae). Biologia Centrali-Americana 3:1-160, 4 pl.

Kannowski, P. B. 1954. Notes on the ant *Novomessor manni* Wheeler and Creighton. Occas. Pap. Mus. Zool. Univ. Michigan 556:1-6.

Wheeler, W. M. and W. S. Creighton. 1934. A study of the ant genera *Novomessor* and *Veromessor.* Proc. Amer. Acad. Arts. Sci., Boston, 69:341-387.

ABSTRACT:–*N. manni* and *A. ensifera* were found to represent the same species upon comparison of their types. This synonymy is presented as evidence that *Novomessor* must be included in *Aphaenogaster,* and variation in worker-queen head shape and wing venation of queens and males is cited among species currently placed in *Novomessor, Aphaenogaster* subgenus *Deromyrma* and *A.* subgenus *Attomyrma* in defense of the proposition that these 3 genus-level taxa cannot be separated taxonomically.–Brown, W. L., Jr. Department of Entomology, Cornell University, Ithaca, New York, 14850.

Descriptors: Myrmicinae, head, metanotal groove, wing venation, *Deromyrma, Attomyrma.*

NOMENCLATURAL NOTES ON THE AGRILINAE (COLEOPTERA, BUPRESTIDAE): II *AGRILUS*[1]

Henry A. Hespenheide[2]

Examination of type of members of the genus *Agrilus* and several closely related genera has revealed the necessity for making a number of nomenclatural changes, as well as for designating lectotypes for certain species in the Biologia Centrali–Americana collection in the British Museum.

A major change is the merging of the genus *Paradomorphus* Wat. into *Agrilus.* Waterhouse himself (1889) expressed doubt about the validity of the genus, which is based only on the relative length of the tarsal segments. This character varies between the sexes within certain species in *Agrilus* (e.g. *A. masculinus* Lec.–see Fisher 1928:58). There are several distinct species groups within *Paradomorphus* as presently constituted, each of which has closer relatives (and even synonyms) within *Agrilus* than with the other groups of *Paradomorphus. Agrilus* may yet be conveniently split into genera of more manageable size (cf. Obenberger, 1957), but *Paradomorphus* is clearly not a tenable segregate.

In the following treatment species are arranged in alphabetical order and are mentioned only if a nomenclatural change is necessary, or new synonymy is given. A complete revision of the genus in Central America is presently being prepared, and the author solicits material for this end. Unless stated otherwise, all new combinations are transfers of species from *Paradomorphus* to *Agrilus.*

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Agrilus, Curtis, 1825.

Paradomorphus, Waterhouse, 1887:183. (NEW SYNONYMY)

Agrilus albicollis (Waterhouse, 1887:184). New Combination. This Jamaican species is the genotype of the genus *Paradomorphus* and is very closely related to the Mexican *A.(P.) collaris* Wat. The British Museum has two specimens bearing the handwritten label "Jamai-ca", but only one bears a red "Type" label.

Agrilus angustus Chevrolat, 1835. Synonyms: *A. multinotatus* L. & G., 1837; *A. propinquus* Chevrolat, 1837. *A. patruelis* Kerremans, 1894, Ann. Soc. Ent. France 44:415, New Synonymy. The types of both of Chevrolat's names, and that of Kerreman's *A. patruelis* have been examined, and all represent the same species. The species varies somewhat in size, but is otherwise rather uniform in morphology.

Agrilus aureoviridis Waterhouse, 1889:118. Synonyms: *A. clarus* Kerremans, 1900, Ann. Soc. Ent. Belg. 44:325, New Synonymy. Two specimens in the British Museum may be considered types of *aureoviridis*. One bears the labels "Etla, Mexico. Salle Coll." and, handwritten, "Agrilus aureoviridis, (*Type*) Waterh."; it is here designated the Lectotype. A second specimen bears the label "Chilpancingo, Guerrero, 4600 ft. July, H. H. Smith," and is considered a paratype.

Agrilus biplagiatus (Waterhouse, 1889:55), New Combination. The type is unique.

Agrilus carissimus (Waterhouse, 1889:187), New Combination. There are two specimens with similar collection data. The one bearing the additional label "Paradomorphus carissimus (*Type*) Waterh." is here designated the Lectotype. The other is considered a paratype.

Agrilus cephalotes Waterhouse, 1889:93. Synonyms: *A. humeralis* Kerremans, 1897, Mem. Soc. Ent. Belg. 6:97, New Synonymy. *A. piceolus* Fisher, 1933, Proc. U. S. Nat. Mus. 82(27):17, New Synonymy. Comparison of the unique types of *cephalotes* and *humeralis* with each other and with material identical to that of the type of *piceolus,* shows these three names refer to the same species. The genitalia of this species are very unusual.

Agrilus collaris (Waterhouse, 1889:52), New Combination. Synonym: *A. cinteutli* Fisher, 1938, Sbornik Ent. Odd. Mus., Prague, 16:139, New Synonymy. A specimen from the American Museum of Natural History is identical to the types of both names. (The transfer of *Paradomorphus collaris* to *Agrilus* requires a new name for *Agrilus collaris* Kerremans [1898, Bull. Soc. Ent. France 1898:83] from Africa and Madagascar, for which I propose the name *Agrilus neocollaris* Hespenheide, New Name.)

Agrilus corrugatus (Waterhouse, 1889:56), New Combination. Synonym: *Paradomorphus persimilis* Waterhouse, 1889:56, New Synonymy. Two specimens labeled Juquila, and perhaps a third labelled only "Mexico" qualify as types of *corrugatus.* A specimen from Juquila with the additional label "Agrilus (sic!) corrugatus, (*Type*) Waterh." is designated the Lectotype. The other specimen, a male, is considered a paratype. The unique type of *persimilis* is also a male and the genitalia of the two are identical. The distinctive features of *persimilis* enumerated by Waterhouse are partly developmental deformities.

Agrilus delicatulus Waterhouse, 1889:191. Synonyms: *A. mixcoatli* Fisher, 1938, op. cit., 135, New Synonymy. *A. apachei* Knull, 1938, Ann. Ent. Soc. Am. 31:139, New Synonymy. Four specimens two each, on two pins with identical collection data, qualify as the type of *delicatulus*. One pin bears the additional label "Agrilus delicatulus (*Type*)

Waterhouse", and one of these specimens is arbitrarily designated the Lectotype. A specimen identical with the type of *delicatulus* has been compared with the types of both *mixcoatli* and *apachei* and show them to represent the same species.

Agrilus detractus Waterhouse, 1889:86. Synonym: *A. robustus* Waterhouse, 1889:89, New Synonymy. Thirteen specimens qualify as types of *detractus,* all with the label "Chilpancingo, Guerrero. Höge." One of these bears the additional label "Agrilus detractus, ♂ (*Type*) Waterh." and is here designated the Lectotype; twelve other specimens are considered paratypes. Two somewhat damaged females from Chontales, Nicaragua, qualify as types of *robustus.* One bears the additional label "Agrilus robustus, (*Type*) Waterh." and is designated the Lectottype. Comparison of the two sets of type material shows no significant differences.

Agrilus elegantulus (Waterhouse, 1889:53), New Combination. The type is unique.

Agrilus emarginatus (Waterhouse, 1889:53), New Combination. The type is unique.

Agrilus flohri (*Trypantius flohri* Waterhouse, 1890, Ann. Mag. Nat. Hist. 6,219) New Combination. Synonyms: *A. opacus* Kerremans, 1897. *A. cupreomaculatus* Duges, 1891, La Naturaleza, 2:30, New Synonymy. The types of both *Typantius flohri* and *Agrilus opacus* are unique and deposited in the British Museum. Although I have not seen the type of *cupreomaculatus,* I use that name in the sense of Fisher (1928).

Agrilus gibbifrons (Waterhouse, 1889:187), New Combination. The type is unique.

Agrilus gracilipes Waterhouse, 1889:81). Synonym: *A. carinifer* Waterhouse, 1889:82, New Synonymy. *Agrilus gracilipes* is represented by three specimens in the British Museum that can be considered types. One from Volcan de Chiriqui bears the label "Agrilus gracilipes, ♂ (*Type*) Waterh." and is designated the Lectotype; a female with a similar label is designated the Lecto-allotype. *Agrilus carinifer* is represented by four specimens that can be considered types. One labelled only "Mexico" bears the additional label "Agrilus carinifer ♂ (*Type*) Waterh." and is designated the Lectotype; a female with a similar label is designated the Lecto-allotype. The two male types are identical in all respects, including genitalia.

Agrilus hainesi Hespenheide, New Name for *Paradomorphus plagiatus* Waterhouse, 1889:55. The name *Agrilus plagiatus* is preoccupied by *Agrilus plagiatus* Ganglbauer, 1889, Horae Soc. Ent. Ross. 24: 31. Although both names were published in 1889, the signature containing *Paradomorphus plagistus* is dated December of that year, whereas Ganglbauer's species appears early in its volume. The new name is in honor of Mr. Robert L. Haines who encouraged my early interest in natural history. The type of *Paradomorphus plagiatus* is unique.

Agrilus ignotus Waterhouse, 1889:98. Synonym: *A. silvicola* Fisher, 1933, op. cit., 10, New Synonymy. Although specimens collected by both Höge and Smith are listed in the type description, only one of Höge's specimens bears a type label at the British Museum. Waterhouse discussed possible variability in this species, although he admitted more than one species may have been involved. Although no definite decision can be made now, Fisher's *silvicola* is identical with the type of *ignotus.* One or more other names may eventually prove to be synonyms if a polytypic species concept is adopted for this form.

Agrilus inclinatus Waterhouse, 1889:62. Synonym: *A. subobtusus* Kerremans 1894, op. cit., 415, New Synonymy. Two specimens qualify as the type of *inclinatus,* one each from Vera Cruz and Volcan de Chiriqui. The latter specimen is a male and is designated the Lectotype. No differences could be found between these and the unique type of *subobtusus.*

Agrilus latevittatus (Waterhouse, 1889:54), New Combination. The type is unique.

Agrilus laticeps Waterhouse, 1889:113. Synonyms: *A. subniger* Kerremans, 1897, op. cit., 83, New Synonymy. *A. subviolaceus* Kerremans, 1897, op. cit., 84, New Synonymy. All three names are represented by unique types in the British Museum. The types of *laticeps* and *subviolaceus* are males with identical genitalia; the type of *subniger* is a female. Otherwise I can find no differences among these three individuals.

Agrilus latifrons Waterhouse, 1889:191. Synonym: *A. santaritae* Knull, 1937, Ent. News, 48:39, New Synonymy. Of the three specimens which are type material of *latifrons,* one from Teptlapa, Guerrero, Mexico, bears the additional label "*Agrilus latifrons, (Type)* Waterh." and is designated the Lectotype. Specimens identical with the types of *latifrons* are also identical with those of *santaritae.*

Agrilus neoflohri Hespenheide, New Name for *Paradomorphus flohri* Waterhouse, 1897:664 (nec. *A. ("Trypantius") flohri* (Wat.) – see above.) The type is unique. With the transfer of this species and *Trypantius flohri* to *Agrilus*, the former requires a new name because it thereby becomes a junior homonym.

Agrilus nigripennis Waterhouse, 1889:96. Synonyms: *A. heyenei* Obenberger, 1917, Col. Rundshau, 1917:36, New Synonymy. *A. longus* Kerremans, 1900, op. cit., 333, New Synonymy. Nineteen specimens in the British Museum qualify as the type of *nigripennis.* A female specimen with the labels "V. de Chiriqui, 3-4000 ft. Champion" and "Agrilus nigripennis (Type) Waterh." is here designated the Lectotype. A male from a series of 8 specimens with identical collection data is designated the Lecto-Allotype. The types of both *heyenei* and *longus*, both in the British Museum, are identical with the type of *nigripennis.* Two female specimens labelled "Colombie, Clavareau" are the types of *longus;* one is arbitrarily designated the Lectotype.

Agrilus obscureiguttatus (Waterhouse, 1889:51), New Combination. Synonym: *A. valerii* Fisher, 1938, op. cit., 122, New Synonymy. A total of five specimens qualify as the type of *Paradomorphus obscureiguttatus.* Of these, two on a single card bear the label "David, Panama. Champion", and the additional label "*Paradomorphus obscureiguttatus, (Type)* Waterh." The two specimens are a male-female pair, of which the male is designated the Lectotype, the female the Lecto-allotype. The other two specimens, from Bugaba and Volcan de Chiriqui, (2-3000') are considered paratypes. A single specimen I collected on Cerro Campana, Panama, is identical with types of both names.

Agrilus oculatus Waterhouse 1889:60. Synonym: *A. gestator* Kerremans, 1903, Wytsman, Gen. Ins, 12:273, New Synonymy. Two specimens from Cuernavaca, Morelos, Mexico qualify as types of *oculatus.* One collected by Höge bears the additional label "Agrilus oculatus, (*Type*) Waterh." and is designated the Lectotype. A unique specimen, also from Cuernavaca, is the type of *gestator.* Comparison of the two shows them identical.

Agrilus phoenicopterus Waterhouse, 1889:121. Synonym: *A. resplendens* Fisher, 1933, op. cit., 12, New Synonymy. Five specimens on four pins qualify as type material of *phoenicopterus.* The specimen bearing the labels "Juquila" and "Mexico. Salle Coll. 642" is designated the Lectotype. Two specimens from Cordova on a card, and specimens from Tuxtla and Mexico City are considered paratypes. A paratype of *resplendens* is deposited in the British Museum and was compared with the types of *phoenicopterus.* The coloration is different, but the specimens are otherwise identical.

Agrilus ruginosus (Waterhouse, 1889:52), New Combination. The type is unique.

Agrilus scabrosus Waterhouse, 1889:90. Synonym: *A. aztecus* Fisher, 1933, op. cit., New Synonymy. The type of *scabrosus* is unique. Five paratypes of *aztecus* are deposited in the British Museum and were compared directly with the type of *scabrosus.*

Agrilus sexmaculatus Waterhouse, 1889:117. Synonym: *A. domitor* Kerremans, 1903, op. cit., 269, New Synonymy. Four specimens qualify as the type of *sexmaculatus*. One bears the two labels "Cuernavaca, Morelos. June H.H.S." and "Agrilus sexmaculatus *(Type)* Waterh." and is designated the Lectotype. The other three specimens are paratypes. The unique type of *domitor* is also from Cuernavaca and is inseparable from material of *sexmaculatus.*

Agrilus sparsus Waterhouse, 1889:71. Synonym: *A. centeotlae* Fisher, 1938, op. cit., 123, New Synonymy. A specimen identical with the types of both these names is in my collection.

Agrilus squalus Waterhouse, 1889:114. Synonym: *A. canaluculicollis* Kerremans, 1897, op. cit., 58, New Synonymy. Nine specimens in the British Museum qualify as types of *squalus.* The specimen from Campeche, Mexico is arbitrarily designated as the Lectotype. The type of *canaliculicollis* from Brasil is indistinguishable from type material of *squalus.*

Agrilus subguttatus Waterhouse, 1889:84. Synonyms: *A. errans* Waterhouse, 1889:84, New Synonymy. *A. raptor* Kerremans, 1903, op. cit., 271, New Synonymy. *A. infidelis* Fisher, 1933, op. cit., 24, New Synonymy. Both of Waterhouse's names are represented by abundant type material – 10 specimens for *subguttatus*, 6 for *errans.* One male specimen of *subguttatus* from Misantla bears the additional label "Agrilus subguttatus (*Type*) Waterh." and is designated the Lectotype; another female specimen with similar labels is designated the Lecto-allotype. The types of *errans,* all from the Volcan de Chiriqui, Panama, include a male-female pair on a single pin, which also bears the label "Agrilus errans (*Type*) Waterh." The male is designated the Lectotype, the female the Lecto-allotype. No consistent qualitative differences in genitalia or other morphological characters could be recognized between these two series of specimens, or between these and the unique female type of *raptor* and 12 paratypes of *infidelis* at the British Museum.

Agrilus tacitus Kerremans, 1894, op. cit., 416. Synonym: *A. mentitus* Kerremans, 1894, op. cit., 418, New Synonymy. Two specimens in the Kerremans collection are labelled as types of *A. tacitus* and represent different species. A male has been designated the Lectotype. The unique type of *A. mentitus* lacks both a head and thorax, but is indistinguishable from the Lectotype of *tacitus.*

Agrilus vermiculatus (Waterhouse, 1889:51), New Combination. Two specimens with identical collection data could be considered types of this species. One bears the additional label "Paradomorphus vermiculatus, (*Type*) Waterh." and is designated the Lectotype; the other is considered a paratype.

Agrilus tinctipennis Fisher, 1933, op. cit., 15. Synonym: *A. xiuhtecutli* Fisher, 1938, op. cit., 142, New Synonymy. The type of *xiuhtecutli* is a male whereas that of *tinctipennis* is a female. The differences, largely in color, among these two specimens and a third in the collection of D. A. Verity do not exceed those within the closely-related and variable *A. delicatus* Waterhouse.

Agrilus xanthonotus Waterhouse, 1889:110. Synonym: *A. croceomaculatus* Waterhouse, 1889:111, New Synonymy. The type of *A.croceomaculatus* is unique. Four specimens qualify as types of *xanthonotus;* one of these from Juquila bears the label "Agrilus xanthonotus (*Type*) Waterh." and is designated the Lectotype. A second specimen from Juquila, and specimens from Tehuantepec and Caldera are considered paratypes. *Agrilus croceomaculatus* was distinguished from *xanthonotus* solely on differences in the pattern of spines and teeth on the elytral apices. Examination of numerous specimens shows this characteristic to vary greatly within and between populations. The color and size and shape of the pubescent spots also varies.

ACKNOWLEDGEMENTS

Examination of these types was made possible in part by a grant, number 35-451 to the author from the University of Connecticut Research Foundation, and in part by the author's own funds. Special appreciation for attention during visits or for loans of material is offered Messers. R. D. Pope and Brian Levey and Miss C. M. F. Von Hayek of the British Museum, George B. Vogt of the U. S. National Museum, Josef N. Knull of Ohio State University, Gayle H. Nelson, and D. S. Verity.

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Waterhouse, C. O. 1889. *Agrilus*, Buprestidae. Biol. Cent.–Am., Coleoptera, III, 1:57-123.

ABSTRACT–The taxonomic status of 36 Central American species of the genus *Agrilus* is reviewed. The genus *Paradomorphus* is considered a synonym of *Agrilus*, and 13 species are transferred to *Agrilus*. Transfer of these and one species described in *Trypantius* require three new names: *Agrilus hainesi, A. neocollaris* and *A. neoflohri*. An additional 31 names given to North, Central and South American specimens are considered synonyms. Lectotypes of 22 names of Waterhouse and Kerremans are designated for specimens presently in the British Museum.–Biological Sciences Group, Univ. of Conn., Storrs CT, 06268. Present Address: Dept. of Biology, Univ. of Calif., Los Angeles, CA 90024.

Descriptors: Coleoptera, Buprestidae, *Agrilus, Paradomorphus, Trypantius,* North America, Central America, South America, new synonymy, new names, Lectotypes.

CHLOROMYIA FORMOSA ESTABLISHED IN THE UNITED STATES (DIPTERA: STRATIOMYIDAE)[1]

L. L. Pechuman[2]

James (1941) reported two males of the Palaearctic *Chloromyia formosa* (Scopoli) collected at Rochester (Monroe County), New York on 16 July 1939. This was the first record outside of Europe and North Africa. James (1965), on a basis of these specimens, considered the species as doubtfully established in the United States.

James (1970) reported a second specimen in the Cornell University Collection from Monroe County, N.Y. collected on 23 June 1967. Later a second specimen taken at the same locality and date by another collector was found in the Cornell Collection. These two specimens represented both sexes. Although only the county is given on the locality label, both collectors believe it likely that the specimens were taken in the Town of Hamlin. Hamlin is the extreme northwest town in Monroe County, about 18 miles from Rochester.

On 15 June 1972, I swept a single male from vegetation along the edge of a swamp on the Cole Road, Town of Mendon, Monroe

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County. I returned there on 22 June 1973 and secured a male and female. A few hours later I swept two males from vegetation along a pond at Mendon Ponds Park, about three miles west of the Cole Road site.

The Town of Mendon localities are about 10 miles from Rochester and about 24 miles from the Town of Hamlin. There is little doubt that this attractive and aptly named species is established in this portion of New York.

The larvae of *Chloromyia formosa* have been found in Europe in garden soil, moist earth and in decomposing vegetable material. It is suggested that immatures of the species entered the area with shipments of nursery material from abroad.

LITERATURE CITED

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________________. 1970. A new species, correction of synonymy, and new records of nearctic Stratiomyidae (Diptera). Ent. Soc. Wash. Proc. 72:327-332.

ABSTRACT–Collection records of *Chloromyia formosa* from several localities in Monroe County, New York in 1939, 1967, 1972 and 1973 confirm that it is established in that area. L. L. Pechuman, Dept. of Entomology, Cornell University, Ithaca, New York 14850.

Descriptors: Diptera, Stratiomyidae, *Chloromyia formosa,* U. S. distribution.

OBSERVATIONS ON 'BLACKLIGHTING' IN MISSOURI [1]

Roger L. Heitzman[2]

The popularity of collecting insects with the aid of an ultraviolet light, commonly called "blacklighting", has increased greatly within the last decade or so. The availability of portable outfits of reasonable price and size is certainly one of the main reasons. Another appears to be the increasing interest in moth collecting, especially among beginning lepidopterists. While many other life forms will be found congregated at times within the sphere of the collectors' light, I will restrict my observations to the important factors involved in "blacklighting," flight patterns and behavior specifics relative to light sensitivity as they relate to the Lepidoptera.

The most important factors to be considered in "blacklighting" are the habitat, temperature, stage of the moon, regional moisture factors and wind velocity. The most productive areas seem to be along forest edges, clearings in woods or along an old forest road. The number of species taken usually will be directly proportional to the diversity of plant life in a given area. Open fields and woods with few varieties of trees and plant life yield few species, although the ones taken may be high in numbers. Aside from the locality chosen, the one factor most important to a good catch is the temperature. Once the temperature falls below 60 degrees, there is a sharp decline in moth numbers. The species of early spring and fall are more tolerant, but results are still greatly

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enhanced as the temperature rises. Another dominant factor relating to a good catch is the stage of the moon. Even if all other conditions are ideal and yet there is an old or full moon, the catch will be greatly reduced. Also, prolonged drought in an area greatly reduces the size of the imagine populations, making collecting almost useless. Hard rain and high winds are deterrents, but a warm, misty night is often excellent, and light breezes seem to stir up the moths and improve collecting. In a like manner, a stormy night without high winds or rain usually proves to be a good night.

Moths appear to have two primary flight periods. When the lights are turned on just at dusk, there is a period of perhaps 30 to 45 minutes until total darkness settles in. This short period produces small numbers of specimens, but some species are only taken then: examples are *Schinia ultima* Strecker (Noctuidae) and *Prionoxystus macmutrei* Guerin (Cossidae). Frequently a few early Notodontidae come in during this period, and fair numbers of microlepidoptera. The first heavy flight begins (conditions being favorable) at total darkness and may continue for as long as three hours, but usually less. During this flight, the majority of females taken for the evening, belonging to the families Saturniidae, Sphinidae, Noctuidae, Notodontidae, Arctiidae and Geometridae, will be collected. Males, also are flying in numbers, but in lesser proportion to the later flights. I think it is a safe estimate, with the Saturniidae and most other families, that 90 percent of the females collected will be taken in the early flight. The first or main flight ends sometime before midnight, and if the evening is cold or a bright moon rises, collecting may be over for the night. However, if conditions are favorable, a second flight will commence about one and a half to two hours after the first flight ends. This will be composed of males of all families. The Notodontidae are especially well represented, as are male Saturniidae, Sphingidae, Noctuidae and Arctiidae. The microlepidoptera seem best represented during the first flight. This second flight, depending on local conditions, is hardly noticeable, lasting only a short while, or can be as good or better than the first flight. By 3:00 AM things usually slow down again, and little else will be taken. Occasionally, with perfect conditions, moths will fly all night until dawn, and it is difficult to see any break in the flights. These nights are the rare exception, however. Certain species have very limited arrival times and are only taken for perhaps a one hour period during the entire night. In some instances different species in the same genus have different arrival times, and after a little experience you can tell which species you are catching by their arrival time.

Finally, there appears to be definite specific species behavior exhibited from sensitivity to the ultraviolet light. Many specimens never rest on the light sheet itself, but settle on the trees and bushes or the ground near by. These must be searched for periodically with a flashlight and nearby trees jarred to dislodge those settled on them. Certain species never, or very rarely, come all the way into the sheet. All the specimens of *Itame abruptata* Walker (Geometridae) and *Plusia purpurigera* Walker (Noctuidae) taken, for example, were from nearby bushes and grass. Certain species are usually found on the back of the sheet, others on the front. Some species are not taken at the light. For example, I have never had *Epizeuxis majoralis* Smith (Noctuidae) or *Dyspyralis puncticosta* Smith (Noctuidae) come to the light sheet, but have taken numerous specimens on sugared trees within a dozen strides of the light. Others come rarely, but are common species. One such species is *Plusia biloba* Stephens (Noctuidae), which is frequently taken on nearby flowers. In some instances you can expect only females, since the males are diurnal or crepuscular, such as *Anisota virginiensis* Drury (Saturniddae) and *Phobetron pithecium* J. E. Smith (Limacodidae).

These observations have been based on ten seasons of collecting moths with the ultraviolet light in Missouri and neighboring states, particularly in the "Ozark" region, using four 15-watt ultralviolet lights – two running from the car battery and two more placed at a distance and powered by an extra car battery. On good nights I can expect 200 to 300 species and a total number of specimens into the thousands, but even poor nights yield their surprises, and there is always the expectation of the undescribed or "new" species!

ABSTRACT–Comments and observations are made on collecting with the ultraviolet light in Missouri. Given are the important factors involved in "blacklighting", flight patterns and behavior specifics to light sensitivity as they relate to the *Lepidoptera.*

Descriptors: Lepidoptera, "blacklighting"; "Blacklighting", environmental factors, flight patterns, behavior specifics; Missouri, Lepidoptera.

DISTRIBUTION CARDS FOR THE ENTOMOLOGIST[1]

Roger L. Heitzman[2]

Anyone with a serious interest in entomology soon finds that he is spending as much or more time working with the specimen data as was spent in actual field work making collections. Resident collectors soon find it desirable to have a ready source of information available regarding local distribution of species, their flight times, and other useful information such as food plants, habits, etc.

My own field is the family Geometridae of the Lepidoptera, but the data cards that I am using could work just as well with almost any group of insects. I keep records for the state of Missouri, using a two card (fig.1) system expanded from one proposed by Richard Heitman (i963 Jour. Lep. Soc., 17(1):44-46). Card size is 5" x 8" The map card gives known spatial and temporal distribution of the species at a glance. The information card carries the actual records and any other information that is known regarding the species. If extra data cards are needed, I use regular 5" x 8" narrow lined file cards. In the upper left hand corner, I put the McDunnough *Check List* number and file the cards in that order for easy reference. By using an X for a marker, I can show the distribution of up to five forms involved. In other respects, I think the cards are self-explanatory. I have found this an effective system in my case, and hopefully it may be of use to other workers in similar or altered form.

ABSTRACT–A new form of distribution card is given with an example. A two card system is proposed to utilize other important information regarding the species involved.

Descriptors: Insecta, distribution cards for species; Distribution cards, state-wide, data utilized, example.

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4968

Species Lycia cognataria (Guenee)

January				
February				
March				
April				X
May	X	X	X	X
June				
July			X	X
August	X	X	X	
September				
October				
November				
December				

4968

Species: Lycia cognataria (Guenee)

Pictured: Holland's Moth Book. pl. 44:13 ; Packard. pl 11:4

Original Description: Phal., i, 208, 1857

Type Locality:

Status: Resident multivoltine species

Habits: A local species found in wooded areas. Two distinct broods in Missouri. Frequently taken at UV Light, has never been taken at sugarbait. Females rarely obtained unless bred.

Host Plants: Packard refers to 'Missouri Currant' (Ribes). Rowley, Walnut and Pecan, ex larvae.

Larva: Brief description by Packard. p. 414.

Records: Clay Co., Coolie Lake, 2 May, 18 July, 1968; 18 May. 1972, 25 May, 1967, 13 Aug, 1968
Randolf Co., Rudolf Bennit Wildlife Area, 16 Aug., 1964, 26, 31 July, 1969, 5, 9 Aug., 1967
St. Louis Co, St Louis, Schroers 1914 List of Lepid. (Ent News 25:61)
Clinton Co, Osborn, 7 August, 1968
Benton Co., Warsaw, 7 May, 1970
Jefferson Co., Barnhart, 16, 20 August, 1934, 5 Aug., 1935. leg. E.P. Meiners In M.U. Collection
Boone Co., Columbia 11 May, 1971. leg. D.D. Kopp in M.U. Collection

NOTE ON VERTEBRATE ENEMIES OF DRAGONFLIES (ODONATA).[1]

Tridib Ranjan Mitra[2]

Not much is known about predators of dragonflies. Fraser (1933) listed birds, lizards, frogs, fishes and spiders as enemies of odonates. Among bird predators he listed only swallows, martins, minas and king crows. Corbet (1962) remarks: "There are only a few birds which regularly prey on mature Odonata in flight. Unfortunately it is seldom made clear in published accounts whether or not the dragonflies eaten were mature, but it has been established that certain falcons specialise in catching matures of larger Anisoptera (see Kennedy, 1950)". In this context observations made by me on dragonflies in and around Calcutta since 1967 are worth recording.

On several occasions I have noticed the house sparrow *(Passer domesticus)* catching two species of dragonflies, *viz., Crocothemis servilia servilia* and *Trithemis pallidinervis.* The predation occurred in the month of August on individuals far away from water and invariably on wings. The birds chased the dragonflies, often unsuccessfully.

Of some interest is the behaviour of the house gecko *(Hemidactylus brooki)* common in houses in Calcutta. Three species of odonates, viz., *Crocothemis servilia servilia, Brachythemis contaminata* and *Tholymis tillarga* regularly visit my bed room, attracted by the electric lamp. A number of geckos are always around on the walls, lying in wait for insects attracted by light. Among the three species of odonates mentioned above, the geckos preyed upon *Crocothemis servilia servilia* and *Brachythemis contaminata,* leaving the third one, *viz., Tholymis tillarga,* alone. Even when the individuals of last-named species came too close to the lizards, they did not care to attack them.

A possible explanation of the lizards avoidance of individuals of *Tholymis tillarga* lies in the colouration of wings of the species, which have opalescent white marks, unlike the other two. The wing colouration in *T. tillarga* gives it a superficial resemblance to hymenopterous insects which are shunned by predators. In this context the following remark of Corbet (1962) has some relevance in explaining the reluctance of wall lizards to prey upon this species. "Certain tropical Anisoptera with coloured wings are thought to derive protection from birds on account of their resemblance to large Hymenoptera when in flight". Fraser (1924 & 36) gave a list of such dragonfly-mimics but did not include *T. tillarga* in it. Though Corbet's *(loc. cit)* remarks concerned bird predators of Anisoptera, I believe that the relation between this species and wall lizards can be explained on the basis of this hypothesis.

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[1] Accepted for publication: March 15, 1974

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N.Y. *VERSUS* W.T.[1]

L. L. Pechuman[2]

Most of the Diptera studied by S. W. Williston are in the Snow Entomological Museum, The University of Kansas. However, by exchange and otherwise, many specimens from the Williston collection are found in most of the major insect collections.

Among these specimens are some which carry a written locality label of two letters, usually in red ink. In addition, some of these carry a separate printed label, "det by S. W. Williston". At least some workers have regarded the written label as "N.Y." for New York and as a result some species of a generally western distribution have had New York included in their range.

Recently I borrowed from the National Museum of Natural History two specimens of *Silvius gigantulus* (Loew) which were said to be from New York. I had not seen this species from east of Utah. Both specimens have the written label in red ink (fig. 1, B, C) and one the printed "det by S. W. Williston" label.

Through the kindness of Dr. George W. Byers of The University of Kansas, I was able to borrow the lectotype of *Tabanus fratellus* Williston which Williston (1887) specifically stated was from Washington Territory. The label on this specimen (fig. 1, A) was almost identical to the two mentioned above.

In the library of the Department of Entomology, Cornell University, I located two reprints sent to Professor J. H. Comstock which carry Williston's signature (fig. 1, D, E). The construction of the "W" agrees with the first letter of the labels in question. The second letter, which resembles "Y" is the form of T commonly used in Williston's day but perhaps unfamiliar to younger workers.

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I think there can be little doubt that Williston's labels described and figured above refer to Washington Territory. I might add that Williston (1887) mentions specimens of *Silvius gigantulus* he had seen from Washington Territory.

LITERATURE CITED

Williston, S. W. 1887. Notes and descriptions of North American Tabanidae. Kans. Acad. Trans. Ann. Mtgs. (1885-86) 10:129-142.

ABSTRACT:-Certain two letter locality labels of S. W. Williston are shown to be an abbreviation for Washington Territory, not for New York. L. L. Pechuman, Department of Entomology, Cornell University, Ithaca, N.Y. 14850.

Descriptors: Diptera; locality labels; New York; Washington Territory; S. W. Williston.

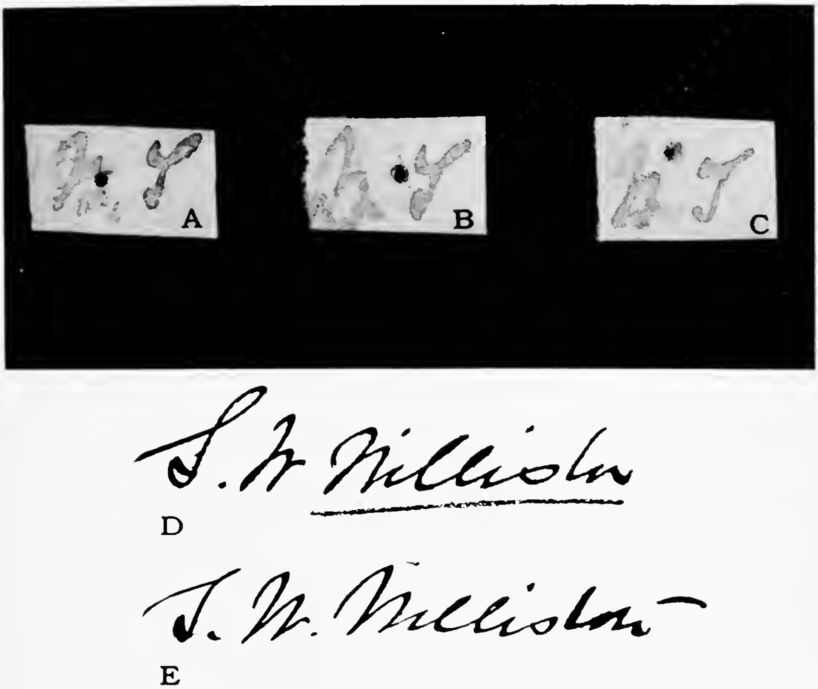

Fig. 1. A, label from lectotype of *Tabanus fratellus;* B and C, labels from *Silvius gigantulus;* D and E, signature of S. W. Williston.

LECTOTYPE DESIGNATION FOR *NOTIPHILA VARIA* JONES (DIPTERA: EPHYDRIDAE)[1]

Wayne N. Mathis[2]

In 1906, Jones published a catalogue of the Ephydridae and descriptions of four new species from California, including *Notiphila varia.* The description of the latter contained no type designation or direct mention of any specimens except that both males and females were examined. Also, the type locality was not mentioned, although Jones did give "middle and southern California" as the distribution of his new species.

The specimens Jones studied were deposited in the University of California, Berkeley collection. Later, they were borrowed by E. T. Cresson, Jr. who revised the genus *Notiphila* in 1917. At that time, Cresson synonymized *N. varia* under Loew's *N. erythrocera,* but did not designate a lectotype. Two males of the type series were later deposited in the California Academy of Science.

Through the courtesy of Dr. Paul H. Arnaud, Jr. and Mr. Vincent F. Lee, who are working on a list of the Diptera type specimens in the California Academy of Science and who suggested the present designation, I was able to examine the two remaining male specimens. Both males bore Cresson's labels, one as type and the other as paratype, but the designations were never published. I am doing so now in preparation for the list of Diptera type specimens which will be submitted for publication before my own work on *Notiphila* is completed.

Designated as lectotype of *Notiphila varia* Jones is the male specimen with the following label information: Riverside, Riverside Co., V-30-98, Cal,: Cresson's determination label dated 1915; a determination label by Wirth with no date; a blue paratype label written by Cresson; a small label with the number 1134; and a small label with the male sex symbol. I have placed a

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red lectotype label on this specimen with the following information: LECTOTYPE, *Notiphila varia* Jones, Wayne N. Mathis. The specimen has also been given California Academy of Science entomology type number 1848.

The second male specimen, here designated as a paralectotype, bears the same label data as the lectotype except as follows: no determination label by Wirth, but a red type label by Cresson. Although Cresson placed a red type label on the paralectotype, its poor condition warrants designating the other specimen as lectotype. Furthermore, Cresson's lectotype designations were never published.

While the specimens were available, the postabdomen of the male paralectotype was prepared for study and is attached to the specimen in a genitalia vial.

LITERATURE CITED

Jones, B. J. 1906. Catalogue of the Ephydridae, with bibliography and description of new species. Calif. Univ., Pubs., Ent. 1:153-198.

Cresson, E. T., Jr. 1917. Studies in American Ephydridae (Diptera). II. A Revision of the species of the genera *Notiphila* and *Dichaeta.* Trans. Am. Ent. Soc. 43:27-66.

ABSTRACT–A lectotype and paralectotype are designated for *Notiphila varia* Jones. Notes on the species' history, synonymical and otherwise, are also given.

Descriptors: Diptera; ephydridae; lectotype designation; *Notiphila varia* Jones; California.

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ENTOMOLOGICAL NEWS

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SECOND-CLASS POSTAGE PAID AT NEWARK, DELAWARE & ADDITIONAL MAILING OFFICES

FAUNISTIC COMPARISON OF ADULT COLEOPTERA RECOVERED FROM CATTLE AND SHEEP MANURE IN EAST-CENTRAL SOUTH DAKOTA[1]

Howard Kessler[2], Edward U. Balsbaugh, Jr.[3], and Burruss McDaniel[3]

Manure has long been recognized as an inviting habitat for many arthropod species. The bulk of investigations have involved the fauna and ecology of those species which prefer bovine manure (Kessler and Balsbaugh 1972), however, there have been some scattered investigations of the insect fauna associated with sheep manure (Pratt 1912, Brown 1927, Wilson 1932, Seamans 1934, Mohr 1943, Landin 1961, and Rainio 1966) and human feces (Miller 1954). While the arthropod fauna of each type of dung has been established, limited information has been reported on the comparisons of adult Coleoptera recovered from sheep and cattle manure from similar environmental conditions. This paper is concerned with just such a faunistic comparison conducted during 1969 in east-central South Dakota.

METHODS AND MATERIALS

The test site was located in Brookings County, South Dakota. Adult Coleoptera were collected from bovine manure as described by Kessler and Balsbaugh (1972). Fresh sheep manure (24 - 96 hr old) was collected from a pasture every 7th day from June 18 - September 10. Each collection period, 2.85 cc of sheep manure was placed into a Berlese funnel for 24 hr. The insects thus extracted were collected and stored in 70% ethyl alcohol for identification.

RESULTS AND DISCUSSION

Twenty-four species of adult Coleoptera were recovered from sheep dung, while 38 species were collected from bovine dung (Table 1). The weekly recovery of each species from sheep and cattle dung during the test period is shown in Table 2. No attempt is made to discuss seasonal occurrence from only 1 year's data.

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[1] Approved by the director of the South Dakota Agricultural Experiment Station as Journal Series No. 1158. Accepted for publication: June 25, 1973

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HISTERIDAE: *Hister abbreviatus* F. adults were recovered from both sheep and cattle manure while *H. americanus* Paykull and *Phelister subrotundus* Say were collected from only bovine manure. Members of this family accounted for less than 0.5% of the beetle population in both dung habitats.

HYDROPHILIDAE: Nine species, including *Cryptopleurum minutum* (F.), *Sphaeridium lunatum* F., *S. scarabaeoides* L., *S. bipustulatum* F., *Cercyon pygmaeus* (Illiger), *C. quisquilius* L., *C. unipunctatus* (L.), *C. lateralis* (Marsham), and *C. praetextatus* (Say), were recovered from cattle dung, while the lst 7 of these species were recovered from sheep manure. Adults of this family constituted 46.40% of the beetle population found in bovine manure vs. only 5.86% in sheep dung. This difference in population percentage may be explained partially by the hydrophilids' preference for the moist environment of the cattle excrement rather than the relatively dry sheep manure.

SCARABAEIDAE: Fourteen species of adult Scarabaeidae were collected from cattle manure. These included *Onthophagus hecate* Panzer, *O. pennsylvanicus* Harold, *Ataenius spretulus* (Harold), *Aphodius haemorrhoidalis* (L.), *A. granarius* (L.), *A. fimetarius* (L.), *A. vittatus* Say, *A. ruricola* Melsheimer, *A. fossor* (L.), *A. prodromus* (Brahm), and *Copris tullius* Olivier. The 1st 9 of these species were recovered from sheep dung. However, these 9 were the most prevalent species in both types of manure. The scarabs comprised 16.59% and 25.15% of the adult Coleoptera in cattle and sheep dung, respectively. *A. granarius* apparently was highly attracted to sheep manure.

STAPHYLINIDAE: Six species, including *Platystethus americanus* Erichson, *Falagria dissecta* Erichson, *Oxytelus suspectus* Casey, *Aleochara bipustulata L.*, *Philonthus cruentatus* Gravenhorst, and *P. rectangularis* Sharp, were collected from both sheep and cattle dung. Six additional species, *P. umbrinus* Gravenhorst, *P. varians* (Paykull), *A. bimaculata* Gravenhorst, *Oxypoda sagulata* Erichson, *Gyrohyphus obsidianus* (Melsheimer), and *Ontholestes cingulatus* Gravenhorst, were recovered only from bovine manure. The staphylinids comprised approximately 37% and 68%, respectively, of the beetles recovered from cattle and sheep manure. Over 65% of the adult beetles collected from sheep manure was P. *americanus*. This species was also most prevalent in bovine dung, comprising 22% of the total population. Staphylinids appeared to be attracted to the drier manure, as were the scarabs.

All 24 species of Coleoptera found in sheep manure were also recovered from cattle excrement. Only 2 species, *O. sagulata* and *C. lateralis,* which were found regularly in bovine manure were absent from sheep manure. The adult coleopterous fauna of sheep and cattle manure is very similar, however, population distribution appears to be dependent on the habitat preference of each species and microenvironmental conditions of the dung.

Landin (1961) found little difference in the species composition of sheep and cow dung on Fargo Island in the Baltic, and stated that temperature and humidity are 2 of the most important environmental factors affecting insects. He contended that within any particular geographic area, the microclimatic conditions of the dung, rather than the kind of manure, determines the species composition. We feel that Landin was correct in this contention.

ACKNOWLEDGEMENTS

We thank Drs. Michael H. Roller and Charles Coffman, and Messrs Richard Applegate, David DeSwarte, Duane Muchmore, and John Wirtz for their help in collecting specimens. We also acknowledge Dr. N. M. Downie of Purdue University for his aid in the identification of several species of Staphylinidae, and Mrs. Diane G. Sutherland for help in the preparation of this manuscript.

Species	Cattle Manure		Sheep Manure	
	Total No.	Percent	Total No.	Percent
HISTERIDAE				
Hister abbreviatus F.	20	.18	1	.04
Phelister subrotundus Say	31	.28	0	0
Hister americanus Paykull	1	.01	0	0
HYDROPHILIDAE				
Sphaeridium lunatum F.	521	4.66	22	.96
Sphaeridium scarabaeoides L.	428	3.83	28	1.23
Sphaeridium bipustulatum F.	294	2.63	9	.39
Cercyon pygmaeus (Illiger)	2262	20.43	46	2.01
Cercyon quisquilius L.	1278	11.43	25	1.09
Cercyon lateralis (Marsham)	136	1.22	0	0
Cercyon unipuctatus (L.)	19	.17	2	.09
Cercyon praetextatus (Say)	1	.01	0	0
Cryptopleurum minutum (F.)	247	2.21	2	.09
SCARABEIDAE				
Onthophagus hecate Panzer	315	2.82	45	1.97
Onthophagus pennsylvanicus Harold	43	.38	10	.43
Aphodius haemorrhoidalis (L.)	824	7.37	47	2.12
Aphodius granarius (L.)	297	2.66	356	15.59
Aphodius fimetarius (L.)	139	1.24	6	.26
Aphodius vittatus Say	45	.40	13	.57
Aphodius distinctus (Muller)	18	.16	18	.79
Aphodius ruricola Melsheimer	24	.21	60	2.63
Aphodius coloradensis Horn	19	.17	0	0
Aphodius sterocorosa Melsheimer	11	.10	0	0
Aphodius fossor (L.)	10	.09	0	0
Aphodius prodromus (Brahm)	1	.01	0	0
Copris tullius Olivier	7	.06	0	0
Ataenius spretulus (Harold)	103	.92	18	.79
STAPHYLINIDAE				
Platystethus americanus Erichson	2466	22.06	1491	65.31
Falagria dissecta Erichson	797	7.12	21	.91
Oxypoda sagulata Erichson	412	3.70	0	0
Oxytelus suspectus Casey	5	.04	5	.22
Aleochara bipustulata L.	40	.36	33	1.45
Aleochara bimaculata Gravenhorst	17	.15	0	0
Philonthus cruentatus Gravenhorst	162	1.45	1	.04
Philonthus umbrinus Gravenhorst	25	.22	0	0
Philonthus rectangularis Sharp	40	.36	1	0
Philonthus varians (Paykull)	13	.12	0	0
Gyrohyplus obsidianus (Melsheimer)	1	.01	0	0
Ontholestes cingulatus Gravenhorst	1	.01	0	0
Aleocharinae	103	.92	23	1.01
Xantholinini	2	.02	0	0
Total	11,178	100.01	2,283	100.03

Table 1. Adult Coleoptera recovered, 1969, from cattle and sheep manure in east central South Dakota.

Species	June		July					August				September	
	18	25	2	9	16	23	30	6	13	20	27	3	10
Histeridae													
H. abbreviatus	C[a]	-	C	-	C	-	C	C	C	C	C	C	C
P. subrotundus	-	-	-	-	-	-	C	C	C	C	C	C	C
H. americanus			-	-	-	-	-	C	-	-	-	-	-
Hydrophilidae													
S. lunatum	C	C	C	C	C&S	C&S	C&S	C	C	C	C	C	C
S. scarabaeiodes	C	C	C	C	C&S	C&S	C	C	C	C	C	C	C
S. bipustulatum	C	C	C	C	C&S	C&S	C	C	C	C	C	C	C
C. quisquilius	C	C	C	C	C&S	C&S	C	C	C&S	C&S	C	C&S	C&S
C. pygmaeus	C	C	C	C	C&S	C&S	C&S	C	C&S	C	C	C	C
C. lateralis	-	-	-	C	C	C	C	C	C	C	C	C	C
C. unipunctatus	-	-	-	-	C	-	C	-	C	C&S	C	C&S	C
C. praetestatus	-	-	-	-	C	-	-	-	-	-	-	-	-
C. minutum	C	C	C	C	C	C	C	C	C	C	C	C	C&S
Scarabaeidae													
O hecate	C	C	C	C	C&S	C&S	C	-	C&S	C&S	C	C	C&S
O. pennsylvanicus	C	C	C	C	C&S	C&S	C	C	C	C	C	C	C
A. haemorrhoidalis	C	C	C	C&S	C&S	C	C	C	C	C	C	C	C&S
A. vittatus	C	C	C	C&S	C	C	C	-	-	-	-	-	-
A. coloradensis	C	C	C	C	C	-	-	-	-	-	-	-	-
A. fossor	C	C	C	C	C	-	-	-	C	C	C	-	-
A. distinctus	C	C	C	C	-	-	-	-	C	C	C	C	C
A. fimetarius	C	C	C	C	C&S	C	C	-	C	C	C	C	C
A ruricola	C&S	C&S	C&S	C&S	C&S	C	C&S	C	C	C&S	C	C	C
A granarius	C&S	C&S	C&S	C&S	C&S	C&S	C	C&S	C&S	C&S	C	C&S	C
A prodromus	-	-	C	-	-	-	-	-	-	-	-	-	-
A sterocorosa	-	-	-	C	-	C	C	C	C	C	C	C	-
C. tullius	C	C	C	C	-	-	-	-	-	-	-	C	C
A spretulus	-	S	-	S	-	-	C	C	C	C	C	C&S	C
Staphylinidae													
F. dissecta	C	C	C	C	C&S	C	C&S	C	C&S	C&S	C	C	C
P. americanus	C&S	C&S	C	C&S	C&S	C&S	C&S	C&S	C&S	C&S	C&S	C&S	C&S
O. sagulata	C	C	C	C	C	C	C	C	C	C	C	C	C
O. cingulatus	-	-	-	-	-	-	-	C	-	-	-	-	-
P. cruentatus	C	C	C	C	C&S	C	C	C	C	C	C	C	C
P varians	-	-	-	C	C	C	C	C	C	C	C	C	C
P. umbrinus	-	-	-	C	C	C	C	C	C	C	C	C	C
P. rectangularis	-	-	-	C	C	C	C	C	C	C&S	C	C	-
A. bimaculata	-	-	C	C	C	C	-	C	C	C	C	C	C
A bipustulata	-	C	C	C	C&S	C&S	C&S	C	C&S	C	-	C	C
G. obsidianus	-	-	-	-	-	C	-	-	-	-	-	-	-
O. suspectus	-	-	-	-	-	-	-	S	C	C	C	C	C

[a] Recovered from:
C = Cattle Manure
S = Sheep Manure

Table 2. Occurrence of adult Coleoptera in cattle and sheep manure, 1969, in east central South Dakota

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SEAMANS, H. L. 1934. An insect weather prophet. Ann. Rept. Quebec Soc. Protect. Plants. p. 111-7.

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ABSTRACT–A comparison of the adult Coleoptera present in both sheep and cattle manure was made in east-central South Dakota during 1969. Totals of 24 and 40 species of beetles were recovered from sheep and cow excrement, respectively. All species collected from sheep dung were also found in bovine manure. Beetles of the families Histeridae, Hydrophilidae, Scarabaeidae, and Staphylinidae were present. *Platystethus americanus* Erichson was the most prevalent adult beetle recovered from both types of manure. Individuals of this species accounted for 22.06% and 65.31%, respectively, of the Coleoptera identified from bovine and sheep excrement. – Howard Kessler, U. S. Environmental Protection Agency, Pesticide Branch, 1421 Peachtree Street, NE, Atlanta, Georgia, 30309; Edward U. Balsbaugh, Jr. and Burruss McDaniel, Entomology-Zoology Department, South Dakota State University, Brookings, South Dakota 57006.

Descriptors: Faunistic, Coleoptera, Cattle Manure, Sheep Manure, South Dakota.

NEW DISTRIBUTION RECORDS FOR ELEVEN SPECIES OF *PHYLLOPHAGA* (COLEOPTERA: SCARABAEIDAE)[1]

Brett C. Ratcliffe[2]

During extensive collecting conducted over the past several years, this author has taken a number of species of *Phyllophaga* where they have not been previously recorded as occurring. The majority of the new records are from Nebraska. Nebraska has been reasonably well-collected by coleopterists, but this was last done between 1900 and 1930 with many parts of the state being neglected. The state is once again undergoing serious and systematic Coleoptera collecting and has been since 1964. These new records cannot really be termed surprising in view of the considerable time gap in collecting which has elapsed since 1930. New species have had time to move into the state from bordering states, and the tremendous increase in interstate transportation has probably been an undeniable factor with regards to new introductions or occurrences. In general, the species recorded as being new to Nebraska may indicate a slightly northwards movement of some of the more common species occurring to the south in Kansas, or, more likely, they simply reflect more thorough collecting in the southern tier of counties. Furthermore, such modern collecting conveniences as blacklight and mercury vapor light were not available to the early collectors in Nebraska, and many common species could have been easily overlooked by not employing these methods.

The remaining species constituting new records in this paper were obtained during a short collecting trip to Mexico and British Honduras in the summer of 1971. Three species new to British

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[1] Contribution Number 367, Department of Entomology, University of Nebraska, Lincoln, Nebraska 68503, and contribution to the Division of Entomology of the University of Nebraska State Museum. Accepted for publication: July 26, 1973

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Honduras (Sanderson, *in litt.*) were collected at blacklight, and I believe these new records are also indicative of more collecting where once there was little or none.

Taxonomic and distributional studies for North American *Phyllophaga (sensu stricto)* and the subgenus *Listrochelus* have been adequately covered by Luginbill and Painter (1953) and Saylor (1940) respectively. Bates (1886-1890) dealt with the Central American Scarabaeidae providing at least some important distributional data as well as describing two of the species dealt with here, and Blackwelder (1944) compiled a generally accurate checklist of Coleoptera from the tropical Americas listing known distributions by country; Dawson (1922) reviewed the scarabs known to occur in Nebraska, and Scott (1951) treated the *Phyllophaga* found in Nebraska. The state records published herein as new were obtained by comparisons of material with the data in the above six works and with the specimens in the collections at the University of Nebraska, the University of Kansas and Kansas State University.

NEW RECORDS

Phyllophaga affabilis (Horn). NEBRASKA, Sarpy Co., Bellevue, VIII-8-65, B. C. Ratcliffe, at blacklight, /BCRC/ (5).

Phyllophaga cinnamomea (Blanchard). BRITISH HONDURAS, Stann Creek, VIII-10-71, B. C. Ratcliffe, at blacklight, /BCRC/ (3); 10 mi. E. Roaring Creek, VIII-9-71, B. C. Ratcliffe, at blacklight, /BCRC/ (6). Previously known to have occurred only in Mexico.

Phyllophaga fraterna Harris. NEBRASKA, Richardson Co., Schubert, V-10-70, B. C. Ratcliffe, at blacklight, /BCRC/ (1).

Phyllophaga gracilis v. angulata Glasgow. NEBRASKA, Thomas Co., Halsey, VIII-25-69, B. C. Ratcliffe, at blacklight, /BCRC/ (3); J. R. Baker, at blacklight, /BCRC/ (14).

Phyllophaga inepta (Horn). NEBRASKA, Lancaster Co., Lincoln, VIII-6-69, B. C. Ratcliffe, at mercury vapor light, /BCRC/ (1).

Phyllophaga marginalis (LeConte). NEBRASKA, Sarpy Co., Papillion, VI-12-68, at light /BCRC/ (1).

Phyllophaga mucorea (LeConte). NEBRASKA, Red Willow Co., McCook, V-31-71, B. C. Ratcliffe, at mercury vapor light, [BCRC] (2); NEBRASKA, McPherson Co., Sandhills Ag Lab, VI-13-73, J. L. Wedburg, in pitfall trap, [BCRC] (1). A Common species in much of the Southwest; this record may indicate a considerable range extension for the species. Along with *fimbripes* (LeConte), two species of the subgenus *Listrochelus* are now found in Nebraska.

Phyllophaga rubiginosa (LeConte). NEBRASKA, Nuckolls Co., Superior, VI-22-71, B. C. Ratcliffe, at blacklight, [BCRC] (2).

Phyllophaga sturmi (Bates). BRITISH HONDURAS, Stann Creek, VIII-10-71, B. C. Ratcliffe, at blacklight, [BCRC] (4); 10 mi. E. Roaring Creek, VIII-9-71, B. C. Ratcliffe, at blacklight, [BCRC] (11). Previously known to have occurred only in Mexico.

Phyllophaga submucida (LeConte). NEBRASKA, Sarpy Co., Bellevue, V-4-64, B. C. Ratcliffe, at mercury vapor light, [BCRC] (1).

Phyllophaga tenuipilis (Bates). BRITISH HONDURAS, Stann Creek, VIII-10-71, B. C. Ratcliffe, at blacklight, [BCRC] (13). Previously known to have occurred only in Mexico, Guatamala and Nicaragua.

ACKNOWLEDGEMENTS

I wish to thank Dr. Milton W. Sanderson, Illinois Natural History Survey, for providing determinations of the three species from British Honduras.

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ABSTRACT–New distributions are listed for eleven species of *Phyllophaga*. These include *P. cinnamomea* (Blanchard), *P. sturmi* (Bates) and *P. tenuipilis* (Bates) new to British Honduras and *P. affabilis* (Horn), *P. fraterna* Harris, *P. gracilis v. angulata* Glasgow, *P. inepta* (Horn), *P. marginalis* (LeConte), *P. mucorea* (LeConte), *P. rubiginosa* (LeConte) and *P. submucida* (LeConte) new to Nebraska. Brett C. Ratcliffe, Department of Entomology, University of Nebraska, Lincoln, Nebraska 68503.

Descriptors: Scarabaeidae; New distribution records; Nebraska; British Honduras.

The Entomologist's Library

This section contains titles of books, monographs, and articles received by the editor that may be of special interest to entomologists and biologists. A brief statement of contents and items of interest are noted. Brief analytical reviews may be submitted for possible publication. All correspondence for this section should be addressed to the editor.

Publications received – As soon as a publication is received, it is listed in this section. The following have come to the attention of the editor.

Ellis, W. N. and P. F. Bellinger. 1973. An annotated list of the generic names of Collembola (Insecta) and their type species. Monografien van de Nederlandse Entomologische Vereniging No. 7. 74 pp.

Obtainable from Bibliotheek der Nederlandse Entomologische Vereniging, Plantage Middenlaan 64 Amsterdam 1004, Nederland – 40 Dutch guilders.

Chapman, R. F. 1974. Oxford Biology Readers, 69: Feeding in leaf-eating insects, Oxford University Press, Ely House, London W.1. 16pp. 30 p. net.

Pest Control in Groundnuts, PANS Manual No. 2. The new edition which has been completely revised and rewritten by all the PANS staff is aimed at extension officers and others concerned directly with the growing crop. It covers all aspects of crop protection including weeds, diseases, nematodes and insects.

The PANS Manual series is avialable free of charge to government, agricultural and educational establishments and research institutes in countries eligible for British Aid.

Foreign and Commonwealth Office, Overseas Development Administration, Centre for Overseas Pest Research, PANS Office, College House, Wrights Lane, London W8 5SJ.

PARTHENOGENESIS IN THE MAYFLY *STENONEMA FERMORATUM* (SAY)[1] EPHEMEROPTERA: HEPTAGENIIDAE)

W. P. McCafferty
and B. L. Huff, Jr.[2]

The first case of parthenogenesis in mayflies was demonstrated by Clemens (1922) for *Ameletus ludens* Needham from eastern North America. Clemens was able to observe larvae hatching from eggs taken from unmated female imagos thus confirming the existence of viable parthenogenetic offspring. Previous to this, Morgan (1911) had suggested that the above species was parthenogenetic based on the fact that male imagos were consistently missing from field collections. Only two male imagos of *A. ludens* are known to date and were reported by Needham (1924).

Britt (1962) showed experimentally that *Ephoron album* (Say) was partially parthenogenetic by obtaining 8 to 10 per cent hatch of eggs taken from virgin females reared in isolation. Numbers of male and female subimagos of this population taken in emergent tent traps by Britt in the field, however, were approximately equal indicating a sex ratio very unlike that of *A. ludens*.

Other North American mayflies which have been implicated with the phenomenon of parthenogenesis on the basis of observed sex ratios (predominately or entirely made up of females), but for which there is no direct experimental proof, include *Ephemerella rotunda* Morgan (Needham et al., 1935), *Ephemerella* sp. from Colorado (Dodds, 1923), and *Ameletus lineatus* Traver (Burks, 1953).

Sequential parthenogenetic generations have not been studied in *A. ludens* and *E. album* nor have cytogenetic analyses been undertaken. The distinct lack of males would indicate that the parthenogensis is possibly geographic, thelytokous, and obligatory in certain populations of *A. ludens;* whereas, the preponderance

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of sexual reproduction in *E. album* (Edmunds et al., 1956; and Britt, 1962) would signify a facultative situation.

The most complete study of parthenogenesis in Ephemeroptera species was carried out by Degrange (1960), wherein he demonstrated the existence of parthenogenesis in 26 of 51 species of European mayflies tested. The type of parthenogenesis was determinable for only three of the species examined (those amenable to being reared for at least two successive parthenogenetic generations in the laboratory). *Centroptilum luteolum* (Müller) was shown to be deuterotokous, while *Cloeon simile* Eaton and one other unidentified species of *Cloeon* were shown to be thelytokous. Degrange's work indicates that parthenogenesis is much more common and of more complex types in mayflies than had been previously thought. The genetic mechanisms involved and the influence of parthenogenesis on the reproductive potential of these species in nature have not been shown.

Certain preliminary observations in the summer of 1971, in conjunction with a study of the biology and ecology of local species belonging to the genus *Stenonema*, prompted consideration of parthenogenesis as a possibly alternate means of natural reproduction in this genus. Constant field inspection had not yielded any observable instances of either swarming or mating in local *Stenonema* populations, yet female imagos were regularly seen ovipositing on the stream surface. We have recently — May, 1973 — witnessed swarming; and mating flights in *Stenonema* have occasionally been reported, e.g. Cooke (1940) and Thew (1958). Any conclusions drawn from our earlier observations alone can be criticized since they may have been coincidental to nonactive periods. However, when such observations were taken into consideration with the following laboratory events they became more convincing inferential evidence.

Female imagos reared from field collected larvae would attempt to oviposit eggs after a period of time and without any prior opportunity for fertilization by a male. Abdominal fibrillation in captive unmated females would proceed on a dry lab bench and partial evacuation of eggs would occur if the females were then placed on a water surface. It could be surmised from this observation that oviposition, irrespective of whether or not the eggs had been fertilized, would proceed either as a response to some stimulus not related to copulation or simply as an innate behavioral mechanism. Oviposition with no chance of egg hatch would seem to be a rather useless and energy consuming evolutionary strategy in a population. A reasonable alternative explanation, therefore, was that there might indeed be present the potential for parthenogenetic reproduction which would insure continuation of the lineage and have adaptive significance. Degrange (1960) found that in several species, virgin females with parthenonenetic eggs would not oviposit in captivity. The lack of oviposition behavior in virgin females cannot therefore be correlated with the presence or absence of parthenogenesis; however, the presence of such behavior in virgins may be a strong evidence for parthenogenesis.

The paucity of information on conditions necessary for normal eclosion of fertilized eggs of *Stenonema* made any experimental design to test for eclosion of unfertilized eggs suspected of being parthenogenetic somewhat haphazard. Our first attempts to gain hatchings from eggs extracted from virgin females of *Stenonema* were made in the summer of 1971. Eggs from *S. femoratum* (Say), *S. nepotellum* (McDunnough), and *S. vicarium* (Walker) were incubated at room temperature for 60 days with no hatchings observed. Recently, however, under more controlled conditions we were able to confirm parthenogenesis in one species.

A series of larvae of *S. femoratum* were collected as follows: Indiana: Jefferson Co., Clifty Creek at Rt. 56, III - 6 - 1973, A.V. Provonsha, collector. The larvae were placed in aerated rearing aquaria and maintained at a temperature of between 72 and 74 F. A solitary female subimago emerged and was immediately isolated in a separate subimago rearing chamber. This individual moulted to the imago approximately 24 hours later. Following another period of 36 hours from the time of the imaginal moult, the individual female was placed on the surface of water in a Petri dish and voluntarily discharged a few eggs. Subsequent dissection yielded most of the remaining eggs. The eggs were then placed in stream water taken at the site of the larval habitat. All incubating eggs were checked under a microscope periodically thereafter. Live larvae were discovered 24 days after incubation was begun. We were unable to keep the newly hatched larvae alive for any extended period of time, and could not determine sex. A tabular summary of conditions and results follows:

Stenonema femoratum (Say)

Emergence of female subimago		III-23-1973
Imaginal moult		III-24-1973
Oviposition by female		III-25-1973
Number of eggs incubated		487
Incubation temperature		68-70 F
Light/dark incubation cycle		14 hrs./10 hrs.
Larval hatch:	4	IV-18-1973
	1	IV-20-1973
	1	IV-23-1973
Post-oviposition embryonic development		24-29 days
Total larval hatch		6
Per cent hatch		1.23

This represents the first reported incidence of parthenogenesis for the genus *Stenonema*, and the third such demonstrated case for North American mayfly species. Degrange (1960) was able to show the existence of parthenogenesis in nine species of the heptageniid genera *Epeorus*, *Ecdyonurus*, *Rhithrogena*, and *Heptagenia*. The per cent of parthenogenetic hatch in these species ranged between 0.18 and 4.46, and in most cases was less than 1.0 per cent hatch. The preliminary data we have for *Stenonema* fits within the above range, and this percentage could conceivably be significant in terms of the population dynamics of this species.

Because the parthenogones of *S. femoratum* died before they were mature enough to be sexed, the type of parthenogenesis is not known. Nevertheless, since sexual reproduction is also found in *S. femoratum* and our preliminary estimate of male to female sex ratio is 1:1, the parthenogenesis may be considered facultative and deuterotokous. Until such time that parthenogones can be shown to live to maturity there remains the remote possibility that the parthenogenesis is of the rudimentary type. Dr. George F. Edmunds, Jr., University of Utah, (Personal communication, 14 May 1973) has pointed out to us that the low percentage of parthenogenetic hatch in so many of the species studied may correspond to the small proportion of those naturally occurring diploid eggs which have not undergone meiosis, and if normally fertilized potentially give rise to triploid individuals. There is only very indirect evidence for this at the present, however.

The results presented herein must be considered preliminary and possibly of limited application except for the mere demonstration of the presence of the phenomenon under consideration. Further study into the reproductive biology of *Stenonema* and the role of parthenogenesis is actively underway. The study of the effect if any of parthenogenesis on the phenotypic character distribution in this taxonomically difficult and ecologically important group is worthy of continued effort and may help to explain historically inadequate species interpretations. Furthermore, the study of behavioral mechanisms as they relate to parthenogenesis in *Stenonema* might well prove rewarding, since Tjonneland (1970) has presented preliminary evidence indicating the decay of diel emergence, flight, and oviposition patterns in certain parthenogenetic aquatic insects.

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ABSTRACT – Parthenogenesis has been confirmed for the heptageniid mayfly, *Stenonema femoratum* (Say) by obtaining larval hatches from eggs taken from a reared unmated female imago. This represents the third demonstrated case of parthenogenesis in North American mayflies and the first such case for the genus *Stenonema.* Preliminary results are comparable to those obtained for European species of Heptageniidae in which parthenogenesis has been studied. Discussion of known cases of mayfly parthenogenesis and associated biology is included. McCafferty, W. P. and B. L. Huff, Jr., Department of Entomology, Purdue University, West Lafayette, Indian 47907.

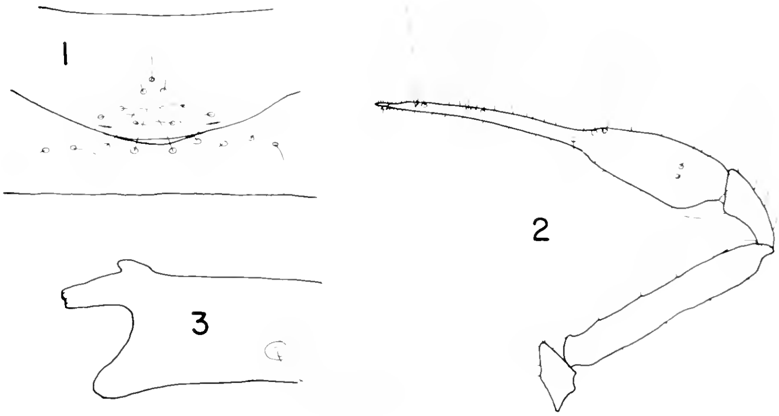
Descriptors: Parthenogenesis, Stenonema, Heptageniidae, mayflies, reproductive biology.

NEW CAVERNICOLOUS SPECIES OF *KLEPTOCHTHONIUS* FROM VIRGINIA AND WEST VIRGINIA (PSEUDOSCORPIONIDA, CHTHONIIDAE)[1]

William B. Muchmore[2]

Cavernicolous *Kleptochthonius* species, usually placed in the subgenus *Chamberlinochthonius*, are widespread and sometimes numerous in caves of Kentucky and Tennessee (see Muchmore, 1965). They also occur in caves in Virginia and West Virginia, but appear to be much less common there than farther south. Therefore, it is appropriate to record and describe a new species from each of these states.

Figs. 1-3



Figs. 1-3. *Kleptochthonius (Chamberlinochthonius) binoculatus*, new species. 1. Genital opercula of female. 2. Dorsal view of right palp. 3. Proximal end of movable finger of chela.

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Kleptochthonius (Chamberlinochthonius) binoculatus, new species

Material: Holotype female (WM 2743.01001) from Hill Cave, 4 miles NNE of Natural Tunnel, Scott County, Virginia, on 17 August 1972. "Specimen was taken from under a stick on a clay bank. The cave is damp to wet and probably floods occasionally" (John R. Holsinger and David C. Culver).

Diagnosis: A moderate sized species, generally similar to *K. (C.) anophthalmus* Muchmore (1970) from Porter's Cave, Bath County Virginia, but with distinct, though weak, eyes in the anterior position, with only three or four spines on each coxa I, and with slightly more attenuated palps and legs.

Description of female: With the general features of the subgenus and with the following particular characters. Carapace a little longer than broad; without an epistome; with weakly corneate eyes in anterior position, but no eyes or eyespots in posterior position. Carpacial chaetotaxy 6-4-4-2-4=20. Coxal chaetotaxy 2-2-1:0-3-1-CS:2-2:-2-3:2-3; four spines on right coxa I and three on left. Abdominal tergal chaetotaxy 3:4:4:4:6:6:6:8:9:7:T2T:0. Sternal chaetotaxy $\frac{3}{6}$:(3)9(3):(3)8(3):10:10:10:10:11:10:0:2; disposition of setae on genital opercula as shown in Fig. 1.

Chelicera with seven setae on hand; movable finger with a row of seven teeth and another tooth distinctly removed from distal end of row; fixed finger with row of eight teeth, distal one largest; spinneret a low, rounded knob; flagellum of eight pinnate setae.

Palps rather long and attenuated; femur 1.5 and chela 2.3 times as long as carapace; proportions of segments as shown in Figure 2; trochanter 1.8, femur 6.4, tibia 2.1, and chela 5.8 times as long as broad; movable finger 1.55 times as long as hand. Trichobothria of chela arranged as in other species of subgenus. Fixed chelal finger with row of 22 spaced, large, sharp macrodenticles and 13 pointed microdenticles alternating at distal end. Movable finger with 14 macrodenticles and 8 very small, rounded, alternating microdenticles distally and 6 low rounded contiguous teeth at proximal end of row. Proximal end of movable finger with short, slightly irregular process on dorsal side (Fig. 3).

Legs rather slender; leg IV with femur 3.4 and tibia 5.35 times as long as deep. Large tactile setae of usual kind on tibia and tarsi of leg IV.

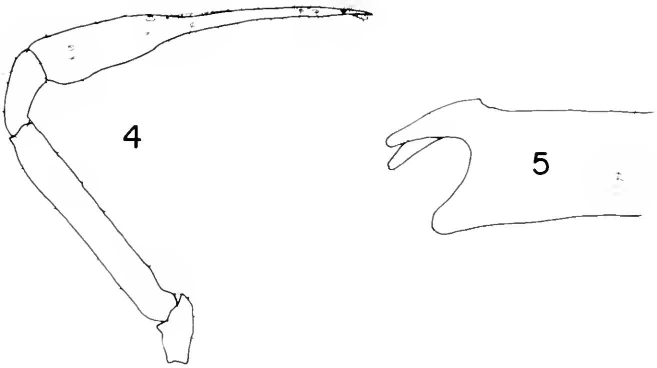
Male: Unknown

Measurements (mm): Body length 2.15. Carapace length 0.59. Chelicera 0.47 by 0.215. Palpal trochanter 0.27 by 0.15; femur 0.895 by 0.14; tibia 0.325 by 0.155; chela 1.37 by 0.235; hand 0.54 by 0.245; movable finger 0.84 long. Leg IV: entire femur 0.73 by 0.215; tibia 0.51 by 0.095; metatarsus 0.27 by 0.075; telotarsus 0.56 by 0.05.

Etymology: The species is called *binoculatus* in reference to its having only two eyes.

Remarks: When the key provided by Muchmore (1965, p. 2) is used, the new species runs more or less to *K. rex* Malcolm and Chamberlin (1961), but it is much smaller than that species, which is found in Pickett County, Tennessee. Its nearest known neighbors are *K. gertschi* Malcolm and Chamberlin from Gilly's Cave, Lee County, *K. lutzi* Malcolm and Chamberlin from Cudjo's Cave, Lee County, and *K. regulus* Muchmore (1970) from Fallen Rock Cave, Tazewell County, all in Virginia. *K. binoculatus* is easily distinguished from *K. gertsehi*, which is completely without eyes. From *K. lutzi* it can be separated by its more attenuated palpal segments and smaller number of coxal spines. And it is very much smaller and less slender than *K. regulus*.

Figs. 4 & 5



Figs. 4 and 5. *Kleptochthonius (Chamberlinochthonius) hetricki*, new species. 4. Dorsal view of left palp. 5. Proximal end of movable finger of chela.

Kleptochthonius (Chamberlinochthonius) hetricki, new species

Material: Holotype male (WM 2657.010001) and paratype female taken in the Greenbrier Caverns System (Masters Section), about two miles SE of Ronceverte, Greenbrier County, West Virginia, on 14 May 1972 (Steven W. Hetrick.)

Diagnosis: A moderate sized species of the *henroti* group (see Muchmore, 1965, p. 3), quite similar to *K. (C). proserpinae* Muchmore from Pollock Cave, Greenbrier County, but with only six setae on hand of chelicera and with relatively shorter and stouter palpal segements.

Description: (The male and female are very similar and are discribed together. Figures are given first for the holotype male, followed in parentheses by those for the female). With the general features of the subgenus and with the following particular characters. Carapace longer than broad; without epistome; with weakly corneate eyes in the anterior position only. Carapacial chaetotaxy 4-3-5-2-2=16 (4-4-4-2-2=16). Coxal chaetotaxy of male 2-2-1:0-3-0(1)-CS:2-2:2-3:2-3; six spines of the usual type on each coxa I (female with eight spines on right and four on left coxa I). Abdominal tergal chaetotaxy of holotype 4:4:4:4:5:5:6:7:7:6:T12T2:0 (female similar). Sternal chaetotaxy of male $\frac{2}{12}$:(4-4):(3)$\frac{7\text{-}8}{8}$(3):(3)7(3):10:9:10:11:11:9:0:2; of female $\frac{3}{6}$:(3)7(3):(3)7(3):11:9:11:12:12:9:0:2.

Chelicera with six setae on hand; movable finger with a row of seven or eight teeth and another one distinctly removed from the row at the distal end; fixed finger with row of 8-10 teeth; spinneret a low rounded elevation, somewhat more distinct in the female; flagellum of eight pinnate setae.

Palps rather long and attenuated; femur 1.7(1.7) and chela 2.4(2.45) times as long as carapace; proportions of segments as shown in Fig. 4; trochanter 1.9(1.9), femur 6.7(6.4), tibia 2.4(2.2), and chela 6.7(6.05) times as long as broad; movable finger

1.66(1.54) times as long as hand. Arrangement of trichobothria of chela typical. Fixed finger of chela with row of 33(31) spaced, long, sharp macrodenticles and 19(19) short, sharp microdenticles alternating at distal end. Movable finger with 18(20) macrodenticles and 15(15) alternating microdenticles distally and 13(11) low, rounded, contiguous teeth in proximal end of row. Proximal end of movable finger with moderate sized, bifurcate process on dorsal side (apodeme for attachment of adductor muscle) (Fig. 5).

Legs rather slender; leg IV with entire femur 3.7(3.5) and tibia 5.6(5.6) times as long as deep. Large tactile setae of usual kind on tibia and tarsi of leg IV.

Measurements (mm): Body length 2.11(2.15). Carapace length 0.63(0.635), greatest breadth 0.57(0.57). Chelicera 0.525(0.525) by 0.25(0.25). Palpal trochanter 0.30(0.325) by 0.16(0.17); femur 1.07(1.09) by 0.16(0.17); tibia 0.385(0.40) by 0.16(0.18); chela 1.54(1.57) by 0.23(0.26); hand 0.59(0.63) by 0.245(0.265); movable finger 0.985(0.97) long. Leg IV: entire femur 0.92(0.91) by 0.25(0.26); tibia 0.62(0.62) by 0.11(0.11); metatarsus 0.33(0.34) by 0.085(0.09); telotarsus 0.77(0.75) by 0.06(0.06).

Etymology: The species is named for Steven Hetrick who found the type specimens.

Remarks: Kleptochthonius hetricki is the third species known to belong to the *henroti* group of the subgenus *Chamberlinochthonius* (see Muchmore, 1965, p. 3). The other two are *K. henroti* (Vachon) from McClung Cave and a number of other caves in central and northcentral Greenbrier County and from Blue Springs Cave in southwestern Pocohontas County, and *K. proserpinae* Muchmore from Pollock Cave in southwestern Greenbrier County, all in West Virginia. The new species occupies the extensive Greenbrier Caverns System in southcentral Greenbrier County which apparently is well isolated from the others to the north and west.

ACKNOWLEDGEMENTS

I am indebted to John R. Holsinger and his associates for a continuing supply of specimens from caves in Virginia and West Virginia. This work was supported in part by grants GB 17964 and GB 37570 from the National Science Foundation.

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________________. 1970. New *Kleptochthonius* spp. from Virginia (Arachnida, Pseudoscorpionida, Chthoniidae). Ent. News, 81: 210-212.

ABSTRACT – Two new species are described: *Kleptochthonius (Chamberlinochthonius) binoculatus* from Scott County, Virginia, and *K. (C.) hetricki* from Greenbrier County, West Virginia. – William B. Muchmore, Department of Biology, University of Rochester, Rochester, New York 14627.

Descriptors: Arachnida; Pseudoscorpionida; Chthoniidae; *Kleptochthonius (Chamberlinochthonius) binoculatus*, new species, from Virginia; *Kleptochthonius (Chamberlinochthonius) hetricki*, new species, from West Virginia.

NOTE ON THE REARING OF *DERMESTES MACULATUS* DeGEER (COLEOPTERA: DERMESTIDAE)[1]

Charles D. Roche and Lawrence W. Smith, Jr.[2]

Rearing procedures for insects that infest military subsistence and materials are variable and each laboratory uses methods suitable for its own needs. Detailed rearing conditions are essential to meet the following requirements:

1) provide standardized methods for the most efficient use of equipment, space, and time.
2) control populations to avoid variable physiological conditions of test insects.
3) eliminate time-consuming operations such as separating adults to start new cultures and the sorting of larvae.
4) produce sufficient insects of known age and sex for scheduled experiments.
5) provide precise, continuous maintenance of experimental stock.

Our rearing procedures include modifications and additions to those of Shepard (1943), Gray (1943), Laudani (1940), Sweetman (1956), Pence (1958), Russell (1961), Boles and Marzke (1966), Strong *et al.* (1967 and 1968).

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[1] Accepted for publication: August 9, 1973.

[2] Applied Entomology Group, Pioneering Research Laboratory, U. S. Army Natick Laboratories, Natick, Massachusetts, 01760.

Of the twenty (20) species of Coleoptera in our insectary, the hide beetle, *Dermestes maculatus* DeGeer, is the most difficult to rear because of cannibalism. Von Dobkiewicz (1928) recognized this problem and observed that adult stages ate younger larvae and that older larvae ate fresh pupae. Scoggin and Tauber (1949) removed pupae daily from cultures to avoid predation by larvae.

Separation and subsequent isolation of *D. maculatus* pupae are essential to satisfy requirement number four. Our method utilizes "Lab Chow" (available from Ralston Purina Company, St. Louis, Missouri as the basis food for young larvae and a plastic box to isolate late instars, pupae, and adults. The plastic box (available from Tri-State Plastics, Henderson, Kentucky) is made of clear polystyrene with overall dimensions 6-5/16" wide x 9-1/2" long x 1-1/2" deep; the interior is divided into one rectangular compartment *2-9/16" w* x *9-1/2" l* x *1-1/2" d*, and twelve individual

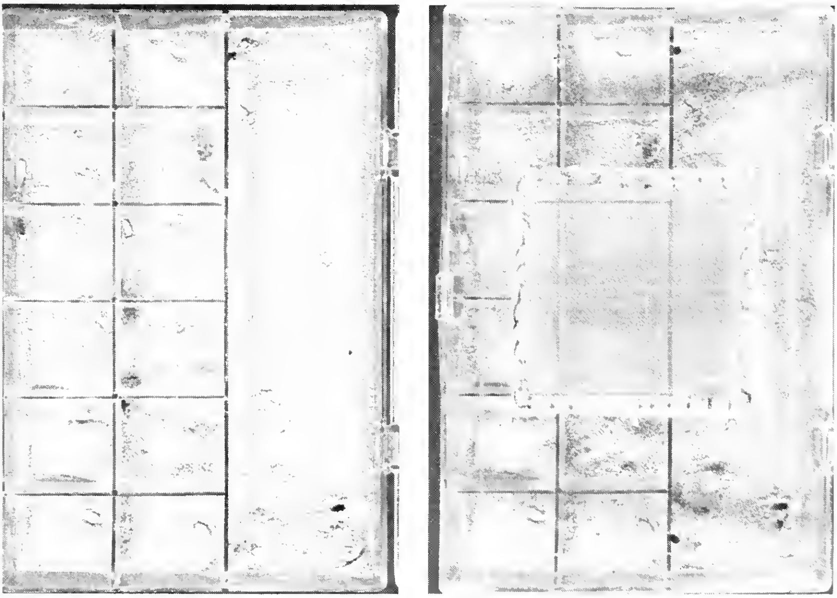

Fig. 1 - Closed and open views of plastic box for rearing *Dermestes maculatus* DeGeer.

compartments, each measuring *1-3/4" w x 1-9/16" l x 1-1/2" d* (fig. 1). Late instar larvae are placed on "Lab Chow" in the long compartment and as pre-pupae occur, they are placed in the smaller compartments. The plastic box has a hinged, snap-fitting lid that was modified with a screen window to allow for gas exchange. These plastic boxes are easily handled, require small storage space, prevent cannibalism of pupae, and ultimately provide sufficient specimens for experimental purposes.

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SCANNING ELECTRON MICROSCOPY OF BOOK-LUNGS OF THE SCORPION[1] *HETEROMETRUS FULVIPES*

A. B. Vyas[2]

The book-lungs have been considered as the ancestral arachnid respiratory organs (Kaestner, 1968) and are intermediate structures between the book-gills of merostomes and the tracheal system of the araeneid spiders (Mill, 1972). Although a comprehensive account on the structure of a book-lung of scorpions and some other arachnids is available from the recent publications of Vyas and Laliwala (1972) and Mill (1972), the steroscopic micrographs presented here reveal certain additional information about the structure of the lamellae of *Heterometrus fulvipes* and correct some misconceptions about the nomenclature of certain structures described by Mill (1972) in the anatomy of the arachnid book-lungs.

MATERIALS AND METHODS

Live specimens collected from the Gujarat University Campus, Ahmedabad (India) were stored in scorpion preservative (Vyas, 1972) and were transported by air mail to University of Georgia, Athens, U.S.A. for scanning electron microscopy. The book-lungs were carefully taken out by dissecting the specimens under a steroscopic binocular microscope and were transferred to 70% ethanol. Sections of the book-lungs passing through desired planes were cut. Preparation of samples for scanning electron microscopy involved dehydration, critical point drying and gold coating. Dehydration was performed by passing the samples through ethanol-amyl acetate grades. The tissue was critical point dried according to the method of Anderson (1956). Gold coating, at two different angles was done in a Varian VE - 10 vacuum evaporator with the specimens on the rotating stage. Because of the difficulty

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with specimen charging, the specimens had to be coated with four times the amount of gold usually used (800 - 1200 A^{O} approximately). A cambridge stereoscan Mark 2A electron microscope was used for the observations. Micrographs of desired magnification were instantly obtained by the polaroid camera attached.

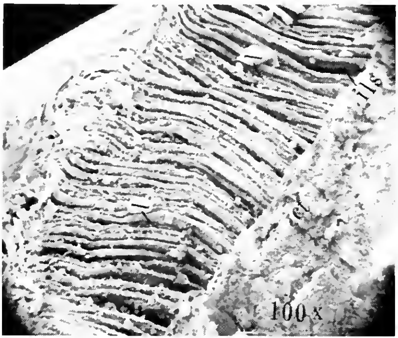
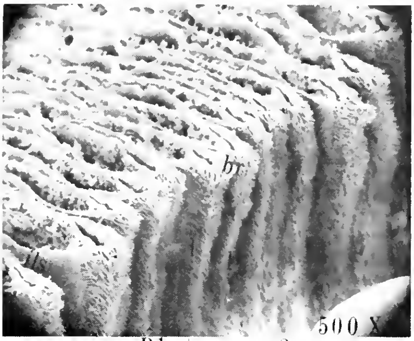


Plate 1



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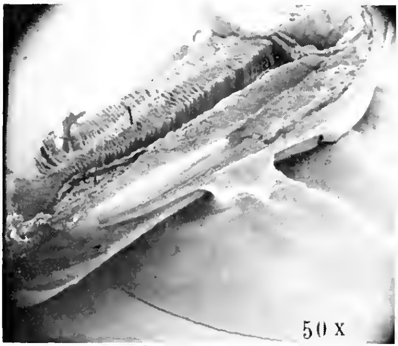

Plate 2

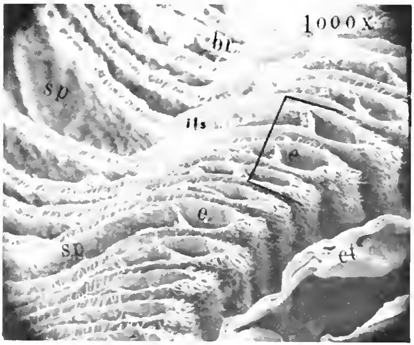

Plate 4

OBSERVATIONS

On removing the connective tissue sheath (et) from the atrial facet of the book-lungs a series of vertically arranged lamellae can be observed (plates-1,2). In *H. fulvipes* the number of the lamellae ranges from 140 to 150 (Vyas and Laliwala, 1972). As is known, while the atrial end of the lamellae remains free (plates-2,3), the other end attaches to the posterior wall of the pulmonary chamber. The space between two adjacent lamellae (plates-3,4,5) is known as inter-lamellar space (ils). The inter-lamellar spaces are continuous

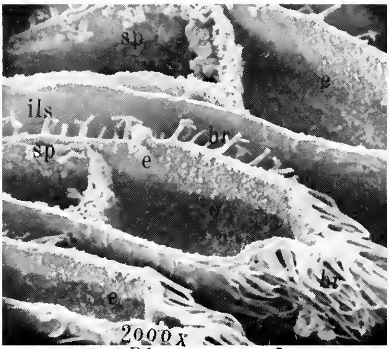

Plate 5

with the space of the atrial chamber (at) which communicates to the exterior through stigmata (also called spiracles according to Stahnke, 1970).

In a longitudinal section each lamella appears as a hollow tubular structure (plates- 3,4,5). The lumen of the lamella (sp) is partitioned towards its atrial end and forms a small distinct space called the epithelial sinus (e). The outer wall of the lamellae is lined by cuticle (c) which frequently forms bristles (br).

DISCUSSION

The above observations indicated that the 'lumina' in book-lungs described by Mill (1972) is comparable to the inter-lamellar space. Each lamellar loop contains a lumen (sp) of its own which is an extension of the pulmonary sinus. Hence in literature to avoid confusion instead of lumina (Mill, 1972), the usage of the term inter-lamellar space is recommended. Moreover, this term is very common in various text-books describing the structure of book-lungs. The cuticular bars mentioned by Mill (1972) are equivalent to bristles. These structures, at least in *Heterometrus* do not have the form of continuous bars between two lamellae. However, during process of breathing the bristles of the opposing facets serve as a means of preventing the lamellae from collapsing.

The magnified stereomicrograph of the atrial end of the lamellae revealed the presence of the epithelial sinus not observed earlier (Vyas and Laliwala, 1972) under light microscopy. The sinus along with its surrounding wall has been described as an epithelial glandular cell by Awati and Tembe (1956) in *Buthus*. According to these authors, this part of the lamella receives the blood for respiration by the way of diverticula and not directly from the pulmonary sinus.

ACKNOWLEDGEMENT

I take this opportunity to thank Dr. Vinod Shah, Head, Zoology Department, Gujarat University (India) for sending the material from India to U.S.A. for the present study. My thanks are also due to Dr. Ivan Roth, for candid help during various stages of the study and the preparation of the manuscript and Dr. William Wiebe and Dr. Frank Golley (all from University of Georgia) for providing funds and encouragement. The assistance of Janet Johnson of E-M Laboratory of UGA is highly appreciated.

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ABSTRACT – Early description of the book-lungs in the scorpion *Heterometrus fulvipes* included its gross anatomy and mechanism of respiration. The following study provides the first three dimensional stereoscopic observations of the lamellae of an arachnid book-lung. The investigation shows the presence of a well defined space called the epithelial sinus towards the atrial end of each lamella in *H. fulvipes*. Bristles on the outer surface of lamellae constitute separating bars and help prevent the lamellae from collapsing during the ventilatory movement of the book-lung. Distinction between the lumen within the lamellae and the inter-lamellar space is essential to avoid confusion. Institute of Ecology, University of Georgia, Athens, Georgia 30602, present address: University School of Sciences, Gujarat University, Ahmedabad - 9, India.

Descriptors: Scorpion, Scorpionida, Scanning electron microscopy, book lungs, anatomical terminology.

THE IDENTITY OF *ENTYPUS* DAHLBOM (HYMENOPTERA: POMPILIDAE)[1]

Michael C. Day[2]

Dahlbom (1843) described *Entypus* in his Hymenoptera Europaea, with *E. ochrocerus* Dahlbom, 1843 as type-species by monotypy. The type-material listed by Dahlbom consists of two males sent to him by Lefebvre in 1835, which are purported to have been collected in Algeria. Since description, the name *Entypus* has appeared in various synonymies, and has been incorrectly used: it has never been properly identified.

Smith (1855) placed the type-species in *Pompilus*, but did not list *Entypus* in his generic synonymy. Saussure (1867) described a second species from Argentina, *E. cephalotes.* Kohl (1884), in his review of Pompilid genera, placed *Entypus* in the synonymy of *Salius* Fabricius, which was used to include most of the Old World Pepsinae. Dalla Torre (1897) followed Smith (1855) and placed *E. ochrocerus* in *Pompilus*, also listing *Entypus* in the generic synonymy. However, he placed *E. cephalotes* in *Salius* in the broad sense as employed by Kohl, and listed *Entypus* 'Saussure nec Dahlbom' as a generic synonym of *Salius.*

Ashmead (1902) added to the confusion when he used *Entypus* as a genus for certain species of *Anoplius* Dufour, subgenus *Arachnophroctonus* Howard, which have the first three tergites of the abdomen reddish. Ashmead also proposed *Hypoferreola*, with *E. cephalotes* as type-species. I have not succeeded in tracing Saussure's type-material, but I believe that *Hypoferreola* may prove to be a senior synonym of *Lepidocnemis* Haupt, 1930, also described from Argentina. This synonymy is not here formalised.

Cameron (1910) followed Ashmead's interpretation of the identity of *Entypus*, but used the name as a subgenus of *Pompilus* when describing certain African species, thus combining the actions of Smith, Dalla Torre and Ashmead. Sustera (1912), in a review of

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the Palaearctic genera of Pompilidae, placed *Entypus* in the synonymy of *Cryptocheilus* Panzer, a component of *Salius* employed by Kohl. However, he did not identify the type-species. In 1924, he published a revision of Palaearctic *Cryptocheilus*, and listed *Entypus* in the generic synonymy, but with a question mark. Pate (1946) included the name in his catalogue of the generic names of spider-wasps.

I have been able, through the kindness of Dr. Roy Danielsson of the Zoological Institute, Lund, to examine the syntypes of *E. ochrocerus* from the Dahlbom collection. The material consists of two males of the species currently known (Townes, 1957) as *Priocnemioides flammipennis* Smith, 1855, from the West Indies. Synonymies are formalised below.

GENUS ENTYPUS Dahlbom

Entypus Dahlbom, 1843: 35. Type-species: *Entypus ochrocerus* Dahlbom, 1843, by monotypy.

Priocnemioides Radoszkowski, 1888: 482. Type-species: *Pompilus (Priocnemis) fulvicornis* Cresson, 1867, by subsequent designation (Banks, 1944: 102). Syn. n.

Prionocnemoides Dalla Torre, 1897: 211. Unjustified emendation of *Priocnemioides*.

Priocnemoides Ashmead, 1900: 187. Incorrect subsequent spelling of *Priocnemioides*.

Cheilotus Bradley, 1946: 124, (as subgenus of *Cryptocheilus*). Type-species: *Pompilus ignipennis* Cresson, 1865 [= *Entypus ochrocerus* Dahlbom, 1843], by original designation (Synonymy with *Priocnemioides* by Townes, 1957). Syn. n.

Entypus ochrocerus Dahlbom

Entypus ochrocerus Dahlbom, 1843: 35. LECTOTYPE ♂, CUBA? (Zoological Institute, Lund), here designated [examined]. Provenance incorrectly reported to be "Algeria".

Pompilus flammipennis Smith, 1855: 155. LECTOTYPE ♀, DOMINICAN REPUBLIC (British Museum [Natural History]), here designated [examined]. Syn. n.

Pompilus ignipennis Cresson, 1865: 121. 3♀, 4♂ syntypes, CUBA (Academy of Natural Sciences, Philadelphia) [not examined]. (Synonymy with *P. flammipennis* by Townes, 1957). Syn. n.

Lectotype designations.

Entypus ochrocerus Dahlbom. Two conspecific males in the Dahlbom collection, Lund, bear labels in Dahlbom's handwriting. One bears firstly a small label "Lefebvre", secondly a label "E. ochrocerus♂. Kl. mB.", thirdly a red label, "TYP". The second syntype bears firstly a small label "a Lefebvre", secondly a number, "96", and thirdly "Pomp. ochrocerus Berl. m. Cub. Lefbr.". Both specimens agree well with the description; in addition, Dahlbom's key (1845:442) specifically refers to the unusual and distinctive sulcate groove situated antero-laterally on the pronotum. I have labelled, and here designate as lectotype, the first specimen referred to above.

Pompilus flammipennis Smith. Smith describes the female and adds comments on the male. One female specimen in the British Museum collections agrees with the description and bears Smith's label, "flammipennis type Sm.". The accessions number, "55.1" on a separate label, refers to a register which states that the specimen was collected by Tweedie in Santo Domingo. A male specimen conspecific with the female bears an identical accessions label. I have labelled, and here designate as lectotype, the female specimen.

I am unable to discover how the discrepancy originated with regard to the locality data (Algeria) given by Dahlbom for *E. ochrocerus.* Abbreviated information on the syntype labels ("Kl. m.B." and "Berl. m. Cub. Lefbr.") indicate that the material may have come to Dahlbom via Klug in Berlin, rather than direct from Lefebvre. Since Dahlbom probably received other, undoubtedly Palaearctic, material from Lefebvre, he may thus have casually misplaced the specimens of *Entypus.* The abbreviation "Cub." is of particular interest, since the species has most frequently been collected in Cuba. An additional male in the Lund collections bears two labels, one "New York Kreigbaum 1848", the other "*Entyp. ochrocerus* H.E. 35: 19. ♂Pompilus id, Kl. mB.", which, though post-dating description, reinforces the possible link with Klug in Berlin.

Additional material in the British Museum consists of a female (determined as *Pompilus ignipennis* Cresson) and a male, both from Smith's collection, and both labelled "Cuba". Another male labelled "Havana. Cuba. Baker" has been determined by Cameron as *Salius? ignipennis* Cresson.

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ABSTRACT – *Entypus ochrocerus* Dahlbom, 1843, was described from Algeria. The genus and type-species have never been properly identified. After study of type specimens, *Entypus* is here recorded as a senior synonym of the New World genus Priocnemioides Radoszkowski, 1888. *E. ochrocerus* is a senior synonym of *P. flammipennis* Smith, 1855, described from the West Indies. Lectotypes are designated for *E. ochrocerus* and *P. flammipennis.* – Michael C. Day, Entomology Department, British Museum (Natural History), Cromwell Road, London S.W.7 5 BD.

NOTES ON THE LIFE HISTORY OF *UTETHESIA ORNATRIX BELLA* LINNAEUS (LEPIDOPTERA: ARCTIIDAE) AND ITS PARASITIC RELATIONSHIP TO *CROTALARIA* (LEGUMINOSAE)[1]

D. R. Windler and B. K. Windler

During the years 1966 to 1969 the authors conducted research on the native unifoliolate Crotalarias of North America (*C. sagittalis*, et. al.). In 1966 and 1967 extensive field trips were made in the eastern United States and Mexico. While collecting Crotalarias many fruits were found to have circular holes in the valves and lack seed. Some green fruits were observed to have larvae sealed inside. Each of the fruits in which larvae were sealed had a circular area on one of its valves which was more membrane-like than the rest of the valve.

Since no adults were collected in the field, an attempt was made to identify the larval forms. Members of the entomological staff at the Field Museum of Natural History in Chicago determined the larvae to be members of the genus *Utethesia*. In order to get a more specific identification of the organism an attempt was made to rear some of the larvae to adulthood. Following instructions obtained from the Field Museum staff, a layer of soil was placed in the bottom of a ventilated jar. A twig was placed in an inclined position above the soil to provide a place for an emerging adult to hang while drying its wings. Fresh cuttings of *Crotalaria sp.* were placed in the jar to provide a food source for the larvae. All caged larvae ate flower petals and young fruit tissue in preference to leaves, stipules, and stems. One of the larvae was successfully reared to adulthood, and was determined to be *Utethesia ornatrix bella* Linnaeus.

In 1968 a common garden planting was made of ca. 1400 unifoliolate *Crotalaria* seedlings in the North Carolina Botanical

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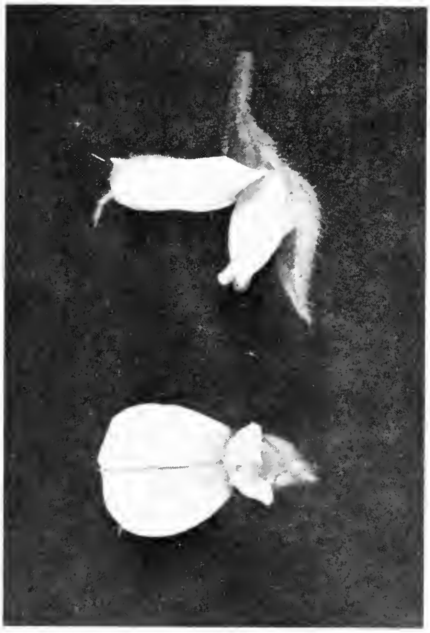
[1] Contribution number 9 from the Towson State College Herbarium, Baltimore, Maryland 21204.

Garden. During the growing season the garden also became a feed lot for a large *U. o. bella* population. All stages of the life history of the moth were present during the summer and the data recorded by the authors is presented below.

The adult moth is a weak and low flying organism which flys during the day and lays its eggs on the banner of the *Crotalaria* flowers (see Fig. 1). The usual number of eggs is one with two or three occasionally on a banner. Eight eggs were observed on the exterior of one calyx, but this was unusual. Caged egg-laying females each deposited about 200 eggs on the glass walls of the jar in which they were housed. The eggs in the jars were 0.5 to 0.6 mm in diameter and hatched in two to four days at 70° F. After emergence the young larvae normally began feeding on petal



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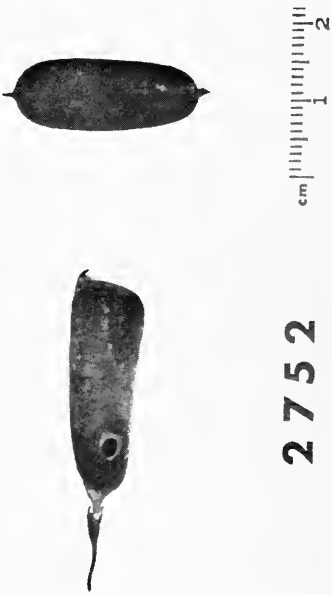

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Figure 1. Flower of *Crotalaria* plant grown in the botanical garden in Chapel Hill, North Carolina, showing an egg of *U. ornatrix bella* in the position deposited. Figure 2. Fruit of garden grown *Crotalaria* showing the pore from which mature larvae emerge after feeding.

tissue and when the ovulary began to enlarge, they chewed their way into it. In most cases only one larva invaded a fruit, but in a few cases two larvae were observed in a single fruit. After the larva entered, a thin membranous covering developed over the entry. The growing black and yellow larvae then fed on the young developing seeds and upon reaching a size adequate for pupation (ca. 2.5 cm long) or upon exhaustion of the food supply, they chewed their way out of the pod through the membrane-covered hole (Fig. 2). If further food was required, the larvae fed on other available young fruits, flowers or foliaceous plant parts in open sunlight. The larval stage lasted about 2 to 2 1/2 weeks. Pupal cases have been observed under leaves near the ground, on the side of culms in thick grass and in other situations with low illumination. Under caged conditions emergence of the adult occured in 14 to 15 days after the initiation of pupation.

The life span of the free adult was not determined, but in cages some lived over a week without feeding. Kettlewell (1963), who studied the life history of *U. pulchella*, reported that adults lived to about one month when fed honey-water.

Data on variation and hybridization in the *Utethesia ornatrix* complex have been published by Pease (1968), but very little information was presented on life histories. Pease did indicate that *U. ornatrix* was associated with *Crotalaria* plants of various species.

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PEASE, R. W. Jr. (1968). Evolution and Hybridization in the *Utethesia ornatrix* complex (Lepidoptera: Arctiidae). Evolution 22: 719-735.

ABSTRACT – Observations on the life history of *Utethesia ornatrix bella* Linnaeus are presented.

Descriptors: Lepidoptera, Arctiidae, *Utethesia Crotalaria.*

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

A.(N.S.)92

ANNOUNCEMENT

Required six-months' notice is given of the possible use of the plenary powers by the International Commission on Zoological Nomenclature in connection with the following cases:

(See *Bull. zool. Nomencl.* 30, parts 3/4, 28th June 1974)

794. Suppression of *Anas punctata* Burchell, 1822 *(Aves)*
1724. Validation of *Acanthomys leucopus* Gray, 1867 (Mammalia)
1748. Suppression of *Scoptes* Hübner/1819/ (Insecta, Lepidoptera)
1798. Suppression of Argiope J. A. Eudes-Deslongchamps, 1842 (Brachiopoda)
1826. Designation of a neotype for *Eschara spongites* Pallas, 1766 (Bryozoa)
1923. Designation of a type-species for *Latona* Schumacher, 1817 (Mollusca)
2020. Designation of a type-species for *Pseudanisakis* Layman & Borovkova, 1926 (Nematoda)
2039. Designation of a lectotype for *Ammonites defossus* Simpson, 1843 (Ammonoidea)
2042. Designation of a neotype for *Apis rotundata* Fabricius, 1793 (Insecta, Hymenoptera)
2043. Suppression of *Renoidea* Brown, 1827 (Protozoa, Foraminifera)
2044. Designation of type-species for *Eriophyes* Siebold, 1851 and *Phytoptus* Dujardin, 1851 (Acarina, Eriophyoidea)
2046. Designation of a neotype for *Geloius decorsei* I. Bolivar, 1905 (Insecta, Orthoptera)
2049. Designation of a type-species for *Lonomia* Walker, 1855 (Insecta, Lepidoptera)
2052. Suppression of PLATYCHOEROPIDAE Lyddeker, 1887 (Mammalia)
2055. Validation of *Nysson* Latreille, 1796 (Insecta, Hymenoptera)
2056. Suppression of *Euplilis* Risso, 1826 (Insecta, Hymenoptera)

Comments should be sent in duplicate, citing case number, c/o British Museum (Natural History), Cromwell Road, LONDON S.W.7 5 BD, England. Those received early enough will be published in the Bulletin of Zoological Nomenclature.

MARGARET GREEN
Scientific Assistant

June 1974

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Advertisements of goods or services for sale are accepted at $1.00 per line, payable in advance to the editor. Notices of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

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ENTOMOLOGICAL NEWS

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Short notes will be promptly published in *The Entomologist's Record*. Literature notices, short reviews, and books received will be published in *The Entomologist's Library*. Study notices, want items, and for sale notices are published in *The Entomologist's Market Place*. All manuscripts should follow the format recommended in the CBE "Style Manual".

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OBSERVATIONS ON THE BIOLOGY OF SOME TIGER BEETLES[1]

Andre Larochelle[2]

Tiger beetles have been reported as preys of toads by Kirkland (1897), Garman (1901), Force (1925), Schonberger (1945), Smith and Bragg (1949), Bush and Menhinick (1962), and also by Klimstra and Myers (1965). From April to September 1973, I analyzed the stomach contents of 283 American toads, *Bufo americanus* Holbrook from southern Quebec, and I found three *Cicindela punctulata* Olivier.

Within the same period, I also examined the alimentary tracts of 434 Leopard frogs, *Rana pipiens* Schreber from the same area, and I identified two *Cicindela repanda* Dejean and one *Cicindela sexguttata* Fabricius. Frogs have been previously recorded as enemies of tiger beetles by Frost (1924), Force (1925), Turner (1959), and by Korschgen and Baskett (1963).

According to my experience, toads and frogs are apparently minor enemies of cicindelids.

On April 24, 1973, while collecting tiger beetles in a sand-pit, in Choisy, three miles from Rigaud, a 9-year-old boy, A. Dube saw a spider seizing a *Cicindela repanda* Dejean. I quickly caught both animals. C. D. Dondale of the Entomology Research Institute, Ottawa, identified the spider as a female *Arctosa littoralis* (Jentz), family Lycosidae (Wolf spiders). Spiders are never mentioned as enemies of cicindelids.

In the spring and summer of 1973, some friends and I also observed the mating periods of *Cicindela* from Quebec. Mating has been observed in the daytime only.

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[1] Accepted for publication: October 1, 1973

[2] College Bourget, C. P. 1000, Rigaud, Quebec.

Cicindela duodecimguttata Dejean: Port-au-Saumon, July 2, in captivity, a pair (C. Gelinas).

Cicindela formosa generosa Dejean: Lanoraie, June 4, in captivity, a pair (F. Liard). Saint-Lazare, May 27 to 30, in captivity, fourteen pairs (A. Larochelle, P. Duval and J.-P. Pilotte).

Cicindela punctulata Olivier: Dollard-des-Ormeaux, July 24, in the field, a pair (J.-P. Tchang). Saint-Eustache, August 8, in the field, a pair (P. Duval).

Cicindela repanda Dejean: Choisy, May 26, in captivity, two pairs (A. Larochelle, P. Duval and J.-P. Tchang).

Cicindela scutellaris lecontei Haldeman: Rigaud, May 7, in captivity, a pair.

Cicndela sexguttata Fabricius: Dollard-des-Ormeaux, May 20 to June 19, in the field and in captivity, nine pairs (F. Marcotte and J.-P. Tchang). Sainte-Agathe, May 20, in the field, a pair (P. Cloutier).

Cicindela tranquebarica Herbst: Lanoraie, June 4, in the field, a pair (F. Liard). Port-au-Persil, July 9, in the field, a pair (C. Gelinas). Port-au-Saumon, July 9, in captivity, a pair (C. Gelinas). Rigaud, June 13, in captivity, two pairs (A. Larochelle and J.-P. Pilotte).

These dates of copulation suggest hibernation in the adult stage for the above species, except for *C. punctulata.*

Furthermore, J.-P. Tchang and I had the opportunity to observe three interspecific copulations.

Cicindela scutellaris lecontei Haldeman (a male) with *C. sexguttata* Fabricius (a female): Rigaud, May 7, in captivity, a pair; the coitus lasted 3.5 minutes. Dollard-des-Ormeaux, May 20, in the field, a pair.

Cicindela scutellaris lecontei Haldeman (a male) with *C. tranquebarica* Herbst (a female): Rigaud, June 13, in captivity, a paid; the coitus lasted 15 minutes.

Interspecific copulation has been occasionally noted in the literature (Horn, 1915; Fattig, 1951).

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ABSTRACT. Enemies (toads, frogs, a spider) and mating periods are reported in some cicindelids, in southern Quebec. A. Larochelle, College Bourget, C. P. 1000, Rigaud, Quebec.

Descriptors: Coleoptera; Cicindelidae; southern Quebec, Canada.

The Entomologist's Library

In this section is published each month titles of books, monographs, and articles received and of special interest to entomologists. The contents of each is noted by the editor or invited reviewers. Brief analytical reviews may be submitted for possible publication even if the work has been previously noted here.—Ed.

CASTRI, F. D. and H. A. MOONEY ed. 1974. Mediterranean type Ecosystems, origin and structure. Ecological Studies 7, Springer-Verlag, N. Y., Heidelburg, Berlin. 405 pp. $31.10

BARTON BROWNE, L. ed. Experimental analysis of insect behaviour. Springer-Verlag N. Y., Heidelburg, Berlin. 366 pp. $15.40.

SLAMA, K., M. ROMANUK, and F. SORM. Insect Hormones and Bioanalogues Springer-Verlag, N. Y., Wien 477 pp. $45.90.

NOMENCLATURAL NOTES ON THE AGRILINAE (COLEOPTERA: BUPRESTIDAE): *III. PACHYSCHELUS* AND *HYLAEOGENA*[1]

Henry A. Hespenheide[2]

Recent examination of types of members of the subfamily Agrilinae of the Buprestidae in the British Museum and the U.S. National Museum has revealed a number of necessary nomenclatural changes. Studies on the larval biology of certain of these forms by Vogt and collaborators (in prep.) require certain of these changes to be published. Study of these types is part of a general study of the biogeography and ecology of the subfamily in Central America.

The genus *Pachyschelus* presently includes about 265 species (Blackwelder, 1944) distributed primarily in the Americas, but with a dozen species in the Old World, principally in Southeast Asia. Of these, 87 named forms have been described or reported from Central America. Some of these, however, belong to the genus *Hylaeogena,* which was described by Obenberger in 1923 after many species had been described by Waterhouse and Fisher. *Hylaeogena* presently includes 61 species of which 16 named forms have been recorded from Central America. After the changes suggested here, 72 forms of *Pachyschelus* and 27 of *Hylaeogena* would be recognized. The following species of Waterhouse, Kerremans and Fisher have been arranged for consideration in alphabetical order.

Pachyschelus Solier

Pachyschelus affinis Waterhouse, 1889: 143. Only two of the three specimens reported by Waterhouse are presently in the British Museum. The specimen bearing the labels "V. Chiriqui, 3-4000 ft. Champion" and, partially handwritten, "Pachyschelus affinis, *(Type)* Waterh." is here designated as the Lectotype. It is a female for, as Fisher pointed out (1922:6), Waterhouse consistently considered males females, and vice versa.

Pachyschelus ardens Waterhouse, 1889: 144. Four specimens in the British Museum can be considered types. One of these – a female bearing the labels "Cordova Mexico, Salle Coll." and, partly handwritten "*Pachyschelus* ardens, *(Type)* Waterh." is designated as the Lectotype. Two other specimens labelled "Cordova Mexico. Salle Coll." and one labelled just "Mexico. Salle Coll 784" are considered paratypes.

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[1] Accepted for publication: October 15, 1973.

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Pachyschelus bifasciatus Waterhouse, 1889: 151. Synonym: *P. carmineus* Kerremans, 1894: 420, New Synonymy. Types of both species are unique females in the British Museum. The type of *carmineus* is identical to that of *bifasciatus* except that the teeth on the anal comb of *carmineus* are worn down or broken off, except for the outermost teeth.

Pachyschelus biguttatus Waterhouse, 1889: 153. A total of 11 specimens in the British Museum can be considered type material. One of these is a female and bears the labels "V. Chiriqui 25-4000 ft. Champion" and, partly handwritten, "Pachyschelus biguttatus, *(Type)* Waterh."; it is here designated as the Lectotype. A male bearing the handwritten label "V. de Chiriqui, 3000 ft. Champion" is designated as the Lecto-allotype. Specimens considered to be paratypes bear the same label as the lectotype, as well as the following: "V. de Chiriqui, 3-4000 ft. Champion"; "Bugaba, 800-1500 ft. Champion"; "Bugaba, Panama. Champion"; and "David, Panama. Champion".

Pachyschelus communis Waterhouse, 1889: 141. Synonym: *P. familiaris* Waterhouse, 1889: 141, New Synonymy. The type series of *P. communis* includes 18 specimens on 13 pins. All bear the data "Taboga I. Panama, Champion." One male specimen bears the additional, partly handwritten label "Pachyschelus communis, *(Type)* Waterh." and is designated the Lectotype. A second, female specimen bears the additional label "Pachyschelus communis *(Type)* Waterh." and is designated the Lecto-allotype. Two specimens can be considered types of *P. familiaris*. A male bears the labels "Teapa, Tabasco March. H.H.S." and, partly handwritten, "Pachyschelus familiaris, ♀ *(Type)* Waterh."; it is designated the Lectotype. The second specimen is a female and bears the same collecting data except that the month is "Feb." rather than March, as well as a second label – "Pachyschelus familiaris, ♂ *(Type)* Waterh.". The second specimen is designated a Lecto-allotype. Waterhouse expressed doubts about the distinctness of these forms (1889: 142), and separated them solely on differences in color. The male genitalia of this species is very distinctive among all those seen within the genus by the author and identical between the two types.

Pachyschelus dubius Waterhouse, 1889: 143. Three specimens in the B. M. can be considered type material. A female specimen with the label "Teleman, Vera Paz. Champion." also bears the partly handwritten label "Pachyschelus dubius *(Type)* Waterh."; it is designated the Lectotype. Two other females can be considered paratypes: one bears the label "V. de Chiriqui, 25-4000 ft. Champion"; the other has the same label, except for the altitude, which is "2-3000 ft."

Pachyschelus incertus Waterhouse, 1889: 142. The type is unique. It is certainly distinct from *communis*, although Waterhouse expressed doubt in the original description.

Pachyschelus irroratus Waterhouse, 1889: 149. Two specimens in the British Museum could be considered types. Both bear the label "Mazatlan, Sinaloa Hoge." One of these, a female, bears the additional, partly handwritten label "Pachyschelus irroratus, *(Type)* Waterh." and is here designated the Lectotype. The other specimen is a male and is designated a Lecto-allotype.

Pachyschelus octodentatus Waterhouse 1889: 142. This species, whose hosts are various species of *Desmodium*, is perhaps the most common species of the genus in Central America. Waterhouse separated two species on slight, relative difference between specimens from Panama on the one hand, and Guatemala on the other. Specimens from southern Mexico and Guatemala do tend to be larger than those from Costa Rica and Panama, but the male genitalia and female anal combs are identical. In view of the consistent geographic differences, it seems worthwhile to retain both names as subspecies.

Eleven specimens in the British Museum can be considered types of *P. octodentatus*. Two of these on a card bear the labels "Bugaba, Panama. Champion" and, partly handwritten, "Pachyschelus octodentatus, *(Type)* Waterh.". Of these two, the right-hand specimen is a male and is here designated the Lectotype; the left-hand specimen is a female and is designated the Lecto-allotype. The other specimens are considered paratypes and bear the label above or "Bugaba, 800-1500 ft. Champion" or "David, Panama. Champion."

Pachyschelus octodentatus robustus Waterhouse, 1889: 141, New Combination. Eleven specimens on 6 pins could be considered types of *P. robustus.* Two of these on a card bear the labels "San Geronimo, Vera Paz. Champion." and, partly handwritten, "Pachyschelus robustus, *(Type)* Waterh." Of these two, the left-hand specimen is a male and is here designated the Lectotype; the right-hand specimen is a female and is designated the Lecto-allotype. The other specimens bear the same data label or one of two variants: "S. Geronimo, Guatemala Champion." or "S. Geronimo. 3000 ft. Champion."

Pachyschelus pubicollis Waterhouse, 1889: 153. Ten specimens in the British Museum could be considered types. A female bearing the handwritten label "Taboga I. Champion" also bears a partly handwritten label "Pachyschelus pubicollis, *(Type)* Waterh." and is here designated the Lectotype. A male bearing the label "Toboga Isl. Panama. Champion" is here designated the Lecto-allotype. Eight other specimens which could be considered types bear the latter label, or one of the following: "San Juan Vera Paz. Champion."; "Teapa, Tabasco. Feb. H.H.S."; "Teapa, Tabasco. March H.H.S."; or "San Miguel. Pearl Isl. Champion."

Pachyschelus purpureipennis Waterhouse, 1889: 144. Five specimens in the British Museum could be considered types. Four of these, on 3 pins, bear the label "Bugaba, Panama. Champion", and the fifth "V. de Chiriqui, 25-4000 ft. Champion". A female from Bugaba also bears the partly handwritten label "Pachyschelus purpureipennis, *(Type)* Waterh." and is here designated the Lectotype. A single male from Bugaba is here designated a Lecto-allotype.

Pachyschelus purpureus (Say, 1836: 164). Recent extensive biological studies by Vogt and collaborators (in prep.) suggest that the following names refer to series of apparently interbreeding populations that range from northeastern United States well into South America. Examination of types shows only minor differences in morphology. The beetles occur on a variety of host plants, primarily *Geranium maculatum* L. *(P. p. purpureus)* and species of *Acalypha* (other subspecies). The host relationships will be discussed in further papers by Vogt and others and only morphological characteristics will be considered here. Each of the subspecies referable to this polytypic species shares with little differentiation the following major morphological characters: male genitalia, female anal comb, and a subterminal band of more or less dense pubescence. The forms differ most conspicuously in the amount of pubescence on the elytra and the color of the metallic reflections on the elytra. In addition to the nominate race, the following subspecies are recognized:

Pachyschelus purpureus uvaldei Knull 1941: 387, New Combination. This form was described from south Texas and recorded by Knull from *Acalypha hederacea* Torr. The subspecies is smaller than typical *P. p. purpureus,* has violaceous rather than bluish or greenish metallic reflections on the elytra, and is characterized by uniform pubescence on the elytra in addition to medial and apical bands of condensed pubescence.

Pachyschelus purpureus bicolor Kerremans, 1894: 420, New Combination. This form is more like nominate *purpureus,* but is smaller, has more bluish or violaceous reflections on the elytra, two medial spots of pubescence on the elytra, and uses *Acalypha* as the larval host. It ranges from Mexico through Pacific coastal Central America at least as far as Costa Rica. The type of *bicolor* is a unique female at the British Museum.

Pachyschelus purpureus azureus Waterhouse, 1889: 152, New Combination. This subspecies was described from Atlantic coastal Guatemala, has bluish-green metallic reflections on the elytra, and lacks elytral pubescence except for the apical bands. Seven specimens in the British Museum can be considered type material of *P. azureus.* Two specimens bear the data "Chiacaman, Vera Paz. Champion."; one of these, a female, also bears the partly handwritten label "Pachyschelus azureus. *(Type)* Waterh." and is designated the Lectotype. The other specimen is a male and is designated the Lecto-allotype. Specimens with the following labels are considered paratypes: "El Zumbador, 2500 ft. Champion", two specimens on a card; "Chacoj Vera Paz. Champion," the left hand specimen only – the right hand specimen is *P. biguttatus* Wat.; and "Cahabon, Vera Paz. Champion.", two specimens on a card.

Pachyschelus secedens Waterhouse, 1889: 145. Synonym: *Brachys chapuisi* Dugès, 1891: 36, New Synonymy. Six specimens bear the label "Tupataro Guanajuato. Hoge." and can be considered types of *P. secedems;* One female bears the additional partly handwritten label "Pachyschelus secedens, *(Type)* Waterh." and is here designated the Lectotype. Another specimen, a male, is designated the Lecto-allotype. The others are considered paratypes. Fisher (1922 : 35) pointed out that the name *Brachys chapuisi* Dugès belonged in *Pachyschelus* on the basis of one of Dugès' specimens in the U.S. National Museum. Examination of that specimen shows it to be identical with material compared with the type of *secedens.*

Pachyschelus signatus Waterhouse, 1889: 150. It is obvious from Waterhouse's discussion that the specimen in the British Museum labelled "Cahabon, Vera Paz. Champion," should be considered the Holotype; it is a female and it bears a second label, partly handwritten, "Pachyschelus signatus, *(Type)* Waterh." There are no specimens presently in the British Museum from "Chiacam," although that locality is cited by Waterhouse as a type locality. Two cards each bear two specimens with the specimens with the data "San Juan, Vera Paz. Champion." Only one specimen on each card, however, is identical with the type and can therefore be considered a paratype.

Pachyschelus sticticus Waterhouse, 1889: 153. Eight specimens in the British Museum could be considered types. Five of these bear the label "San Juan, Vera Paz. Champion.," one of which, a female, bears the additional label "Pachyschelus sticticus. *(Type)* Waterh." and is here designated the Lectotype. A male specimen with the label "Senahu, Vera Paz. Champion." is here designated the Lecto-allotype. A specimen labelled "Tamahu, Vera Paz. Champion." and the other specimens from San Juan are considered paratypes.

Pachyschelus trapezoidalis Waterhouse, 1889: 151. Five specimens on three pins in the British Museum bear the label "Chilpancingo, Guerrero, 4600 ft. June. H. H. Smith." One card of two specimens bears the additional, partly handwritten label "Pachyschelus trapezoidalis, *(Type)* Waterh."; the specimen on the right is a female and is designated the Lectotype. The specimen on the left is a male and is designated the Lecto-allotype. The other 3 specimens are considered paratypes.

Pachyschelus undulatus Waterhouse, 1889: 151. Synonym: *P. atrifrons* Fisher, 1922: 25, New Synonymy. Three specimens in the British Museum can be considered types of *undulatus.* A female bearing the labels "Bugaba, Panama, Champion." and, partially handwritten, "Pachyschelus undulatus, *(Type)* Waterh." is designated here to be the Lectotype. A male bearing the label "San Lorenzo, Panama. Champion" is designated a Lecto-allotype. Another male with the label "Bugaba, 800-1500 ft. Champion." is considered a paratype. Fisher's male type of *atrifrons* is identical to a male compared with and identical to the Lecto-allotype of *undulatus;* the male genitalia are unusual in the genus.

Hylaeogena Obenberger

The characters which distinguish the genus *Hylaeogena* have been systematically compared to those of *Pachyschelus* by Obenberger in his general revision of the two genera in 1925. Beside the morphological characters, *Hylaeogena* is unified by its nearly exclusive preference for members of the Bignoniaceae as the larval host (G. B. Vogt and the author, unpubl. observations).

Hylaeogena astraea (Waterhouse, 1889: 147). Four specimens in the British Museum can be considered types. A female bearing the labels "Sept.bre," "Cordova Mexico, Salle Coll.," and, partly handwritten, "Pachyschelus astraeus, *(Type)* Waterh.," is here designated as the Lectotype. A male bearing the labels "Cordova Mexico Salle Coll." and "754" is designated a Lecto-allotype. One other specimen from Cordova and a specimen labelled "Atoyac, Vera Cruz. April H.H.S." are considered paratypes.

Hylaeogena atroviridis (Fisher, 1922:13), New Combination.

Hylaeogena centralis (Waterhouse, 1889: 148), New Combination. Two specimens in the British Museum mounted on a single card bear the labels "El Zumbador, 2500 ft. Champion." and Pachyschelus centralis, *(Type)* Waterh." The right-hand specimen is designated the Lectotype. The left-hand specimen is considered a paratype.

Hylaeogena cincta (Waterhouse, 1889: 149), New Combination. Three specimens in the British Museum qualify as types. A female bears the labels "V. de Chiriqui, 3-4000 ft. Champion." and, partly handwritten, "Pachyschelus cinctus, *(Type)* Waterh." and is designated the Lectotype. Two other specimens considered paratypes bear the labels "V. de Chiriqui, 2-3000 ft. Champion." and "Rio Maria Linda, 500 ft. Champion."

Hylaeogena compacta (Waterhouse, 1889: 138). This species was described by Waterhouse with a number of varieties. These varieties represent very similar but distinct species. There are 17 specimens in the British Museum considered to be typical *compactus* by Waterhouse. Ten of these bear the label "V. de Chiriqui, 25-4000 ft. Champion." One of these bears the additional partly handwritten label "Pachyschelus compactus, ♀ *(Type)* Waterh." and is designated the Lectotype. A second specimen bears the additional label "Pachyschelus compactus ♂ *(Type)* Waterh." and is designated a Lecto-allotype. The other 8 specimens in this series, plus the following 6, are considered paratypes: 2 specimens with the label "V. de Chiriqui, 3-400 ft. Champion."; 4 specimens on 3 pins with the label "Bugaba, 800-1500 ft. Champion."; one specimen with the label "Bugaba, Panama. Champion."

Hylaeogena constans (Waterhouse, 1889: 137). Sixteen specimens in the British Museum can be considered types. Eight bear the label "V. de Chiriqui, 3-4000 ft. Champion." Two of these on a card, both females, bear the additional handwritten label "Pachyschelus constans, *(Type)* Waterh."; the left-hand specimen is designated the Lectotype. The other 7 specimens in this series are considered paratypes, as are 8 specimens with identical data except for the altitudes, which are "25-4000 ft." (6 specimens) or "2-3000 ft." (2 specimens).

Hylaeogena discoidalis (Waterhouse, 1889: 145), New Combination. The type is unique.

Hylaeogena festiva (Fisher, 1922: 14), New Combination.

Hylaeogena hydroporoides (Waterhouse, 1889: 140). There are 11 specimens in the British Museum that can be considered types. Three of these on 2 pins bear the label "S. Geronimo, Guatemala. Champion." One of these, a male, bears the additional, partly handwritten label "Pachyschelus hydroporoides *(Type)* Waterh." and is here designated the Lectotype. Specimens considered paratypes bear the following additional labels: "Chacoj, Vera Paz. Champion."; "Belize. Blancaneaux." (2 specimens); "Rio Hondo. B. Honduras. Blancaneau."; "Costa Rica. Van Patten."; "V. de Chiriqui, 2-3000 ft. Champion." (2 specimens); and "V. de Chiriqui, 25-4000 ft. Champion."

Hylaeogena lunifer (Waterhouse, 1889: 148), New Combination. The female type is unique.

Hylaeogena modesta (Waterhouse, 1889: 147), New Combination. Although two specimens in the British Museum carry handwritten labels indicating they were considered types by Waterhouse, only one of these is cited at the beginning of the description; the second is referred to as a variant in the description. The specimen bearing the labels "Bugaba, Panama. Champion." and, partly handwritten, "Pachyschelus modestus *(Type)* Waterh." is therefore considered here to be the unique Holotype. The second specimen bears the label "V. de Chiriqui, 2-3000 ft. Champion." A third specimen, also cited in the text of the description, bears the label "David, Chiriqui. Champion."; these last two may be considered paratypes.

Hylaeogena ovalis (Waterhouse, 1889: 140), New Combination. Five specimens in the British Museum can be considered types. A female with the label "S. Geronimo, Guatemala. Champion." also bears the partly handwritten label "Pachyschelus ovalis *(Type)* Waterh." and is here designated the Lectotype. Specimens are considered paratypes which bear the labels "El Zumbador, 2500 ft. Champion." (2 specimens on a card); "Chiacaman, Vera Paz. Champion."; and "Rio Hondo, B. Honduras. Blancaneau."

Hylaeogena pilosa (Fisher, 1922: 16), New Combination.

Hylaeogena rotundipennis (Fisher, 1922: 11), New Combination.

Hylaeogena thoracica (Waterhouse, 1889: 139), New Combination. Two specimens in the British Museum could be considered types of *thoracicus*. A female bearing the label "Chiacaman, Vera Paz. Champion." also bears the label "Pachyschelus thoracicus, *(Type)* Waterh." and is here designated the Lectotype. The second specimen, labelled "Capetillo, Guatemala. G. C. Champion." also bears the label "Pachyschelus thoracicus. var. Waterh.", but is considered a paratype.

ACKNOWLEDGEMENTS

Examination of these types was made possible in part by a grant number 35-451 to the author from the University of Connecticut Research Foundation. Special appreciation is offered R. D. Pope and Brian Levey of the British Museum for assistance during visits. George B. Vogt suggested or first discovered many of the taxonomic changes, shared unpublished ecological data, and critically read early drafts of this manuscript.

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ABSTRACT. The taxonomic status of 40 names referable to the genera *Pachyschelus* and *Hylaeogena* in Central America is reviewed. Lectotypes are designated for 24 names proposed by Waterhouse, 4 new synonymies are established, and 11 species are transferred to *Hylaeogena* from *Pachyschelus*. *P. octodentatus* Wat. and *P. purpureus* (Say) are considered geographically polytypic and 4 other specific names are subsumed as subspecies under these two.

VEJOVIS CALIDUS, A NEW SPECIES OF SCORPION FROM COAHUILA, MEXICO (SCORPIONIDA: VEJOVIDAE)[1]

Michael E. Soleglad[2]

In 1972 I presented a set of characters that I thought best defined the wupatkiensis group of the genus *Vejovis*. Recently, Dr. Herbert L. Stahnke called to my attention an interesting character found on the pectines of the female members of this group. After having examined many species of *Vejovis* I feel this character should be included in the wupatkiensis group definition. This character can be described as follows. Proximal pectinal teeth 1 and 2 of female members are elongate and symmetric in shape, longer than the other adjacent racket-shaped teeth. The sensorial areas of these teeth are absent. The most proximal fulcrum sometimes is reduced, or rarely missing (fig. 2). This character holds true for most species in the wupatkiensis group, but is very variable within a species and sometimes even on a single specimen. The variability of this character may present itself in the following manner. The elongate symmetric form is sometimes found on tooth 1 only, or rarely, on proximal teeth 1-3, showing up in a lesser degree on tooth 3. Occasionally the distal portion of the proximal teeth is slightly angled, approaching the normal racket-shaped form of the other teeth. In some cases the sensorial area is present but somewhat reduced. *Vejovis joshuaensis* Soleglad provides a distinct deviation from this character however, by displaying a very stunted proximal tooth which is much shorter than the other teeth. This stunted form is also present in a somewhat lesser degree on *V. calidus*, new species. Figures 1-6 illustrate this character for various wupatkiensis group species.

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[1] Accepted for publication: November 12, 1973

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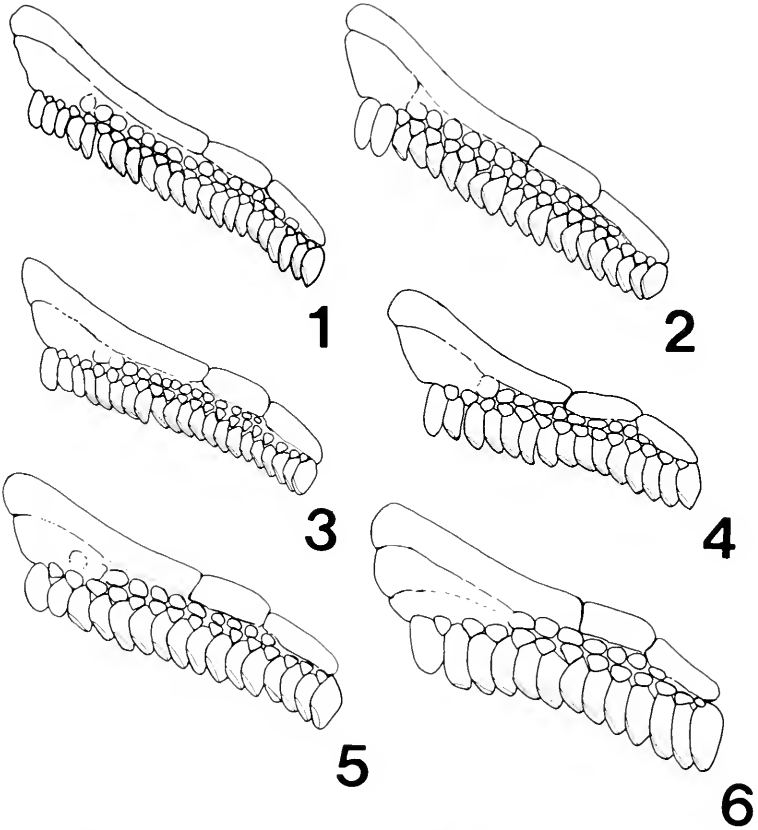

FIG. 1. *Vejovis harbisoni* Williams, pectin of female.
FIG. 2. *Vejovis subtilimanus* Soleglad, pectin of female.
FIG. 3. *Vejovis deserticola* Williams, pectin of female.
FIG. 4. *Vejovis gertschi gertschi* Williams, pectin of female.
FIG. 5. *Vejovis calidus*, new species, pectin of holotype female.
FIG. 6. *Vejovis joshuaensis* Soleglad, pectin of female.

Vejovis calidus, new species
Figures 5, 7-13, 15

Diagnosis: Small species of wupatkiensis group defined by following characters: Cauda very wide, first two segments definitely wider than long, segment III wider on female only; inferior median keels smooth to obsolete on caudal segment I, smooth to crenulate on II-III, and crenulate on IV. Chelal movable finger of female approximately same length as carapace and fifth caudal segment; equal to carapace only on male. Pectinal tooth counts 15-17 for female and 17 for male. Subaculear tubercle essentially obsolete. *Vejovis gertschi gertschi* Williams and *V. joshuaensis* Soleglad closest relatives, key characters differentiated in Table 1.

ETYMOLOGY: Specific name from Latin *calidus*, warm or hot, based on the hot climate of the Cuatro Cienegas basin of Coahuila, Mexico where the type specimens were found.

TABLE I
CHARACTERS OF SOME *VEJOVIS* SPECIES OF THE WUPATKIENSIS GROUP

	V. calidus, new species	*V. gertschi gertschi* Williams	*V. joshuaensis* Soleglad
Coloration of Carapace	Yellow grey; faded brown pattern on anterior and lateral areas	Yellow brown; dark distinct variegated pattern on entire surface	Yellow brown; faded to dark distinct variegated pattern on entire surface
Pectinal tooth Counts	Male, 17 Female, 15-17	Male, 16-18 Female, 14-16	Male, 13-15 Female, 12-14
Proximal Tooth of Pectines of Female	Equal to length of other teeth	Longer than other teeth	Stunted, definitely shorter than other teeth
Inferior Median Keels of Cauda	Obsolete to smooth on segment I, smooth to crenulate on II-III, crenulate on IV	Crenulate on segments I-IV	Weakly crenulate on segments I-II, crenulate on III-IV
Caudal Segment III	Width greater than length on female	Width equal to length	Width equal to length
Supernumerary Teeth	Fixed finger, 6 Movable finger, 7	Fixed finger, 6 Movable finger, 7	Fixed finger, 4 Movable finger, 5
Trichobothrium *it* to Fixed Finger Ratio (Figs. 13-14)	Ratio 42/100; distal to supernumerary tooth 5	Ratio 37/100; proximal to supernumerary tooth 5	Ratio 30/100
Geograpbical Distribution	State of Coahuila, Mexico (single record)	Extreme southern coastal California; Northern coastal Baja California	Colorado Desert; Southern Mojave Desert

HOLOTYPE. Female (fig. 7). Coloration: Base color dull grey yellow; legs dull yellow. Anterior edge of carapace with variegated brown markings, extending through lateral eyes; faint brown markings found lateral to median ocular tubercle, extending to carapace midpoint. Proximal area of chelal fingers and chelal carinae faintly pigmented brown; fifth caudal segment and telson brown dorsally; posterior half of segment IV, and all of segment V brown ventrally. Three faint, wide brown stripes on vesicle venter. Subtle brown pigmentation on femur and patella of walking legs.

STRUCTURE: Measurements of holotype female, allotype male, and female paratype given in Table 2.

CARAPACE: Interocular area rough but essentially void of granulation, remainder of carapace covered sparingly with small granules. Anterior edge broadly indented, set with six setae (fig. 8). Lateral eyes three per side, posterior eye smallest. Median eyes situated anterior of middle, in ratio 115/330, one-fifth width of carapace at that point.

PREABDOMEN: Tergites covered with medium sized granules, more concentrated posteriorly. Smooth median keel weakly defined on tergites III-VI; two pairs of serrate keels on tergite VII. Sternites smooth with short slit-like stigmata; one pair of crenulate lateral keels and one pair of very weak median keels present on sternite V.

CAUDA: First three segments wider than long. Segments I–IV: Dorsal and dorsal lateral keels serrate, ending in elongate spine on dorsal keels of segments I-IV and on dorsal lateral keels of I-III. Lateral keels crenulate on segment I, crenulate on posterior two-fifths of II, posterior one-third of III, and absent on IV. Inferior lateral keels smooth to crenulate on segment I, weakly crenulate on II-III, and crenulate on IV. Inferior median keels smooth to obsolete on I, smooth to crenulate on II-III, and crenulate on IV; inferior median keels equipped with 3-3-3-3 pairs of setae. Segment V: Dorsal keels serrate on extreme anterior, granulate on remainder. Lateral keels granulate on anterior three-quarter. Inferior lateral and median keels crenulate. Intercarinal spaces generally smooth except for slight scattered granulation on dorsal face.

TELSON: Vesicle polished, essentially void of definite granulation; 6-8 pairs of small setae on ventral and lateral aspects. Vesicle width and depth less than width of caudal segment V. Subaculear tubercle essentially obsolete (figs. 9-10). Aculeus average length and curve, 2-3 small pairs of setae at base.

TABLE 2
MEASUREMENTS (IN MILLIMETERS) OF
Vejovis calidus, new species

	Holotype Female	Allotype Male	Paratype Female
Total length	20.75	16.3	20.5
Carapace, length	3.3	2.5	3.3
Width at lateral eyes	1.7	1.3	1.7
Width at caudal edge	3.0	2.1	3.2
Preabdomen, length	6.3	4.9	6.5
Postabdomen, length	11.15	8.9	10.7
Caudal segment I			
Length	1.5	1.2	1.5
Width	2.0	----	2.0
Depth	1.55	----	1.6
Caudal segment II			
Length	1.75	1.3	1.7
Width	2.0	1.55	2.0
Depth	1.55	1.15	1.6
Caudal segment III			
Length	1.9	1.5	1.8
Width	1.95	1.5	1.95
Depth	1.55	1.2	1.6
Caudal segment IV			
Length	2.5	1.9	2.4
Width	1.9	1.45	1.9
Depth	1.5	1.2	1.55
Caudal segment V			
Length	3.5	3.0	3.3
Width	1.85	-----	1.9
Depth	1.55	-----	1.55
Telson, length	3.3	2.4	3.2
Vesicle			
Length	1.9	1.4	1.9
Width	1.4	0.95	1.4
Depth	0.95	0.6	0.95
Aculeus, length	1.4	1.0	1.3
Pedipalp, length	11.2	8.4	11.1
Femur			
Length	2.8	2.2	2.8
Depth	0.9	0.6	0.9
Tibia			
Length	3.2	2.4	3.2
Depth	1.2	0.8	1.1
Chela, length	5.2	3.8	5.1
Palm			
Length	1.9	1.4	1.8
Width	1.35	1.0	1.35
Depth	1.2	0.8	1.1
Fixed finger, length	2.9	2.0	2.8
Movable finger, length	3.4	2.4	3.3
Pectines			
Teeth	15/16	17/17	16/17
Middle lamellae	10	10	10

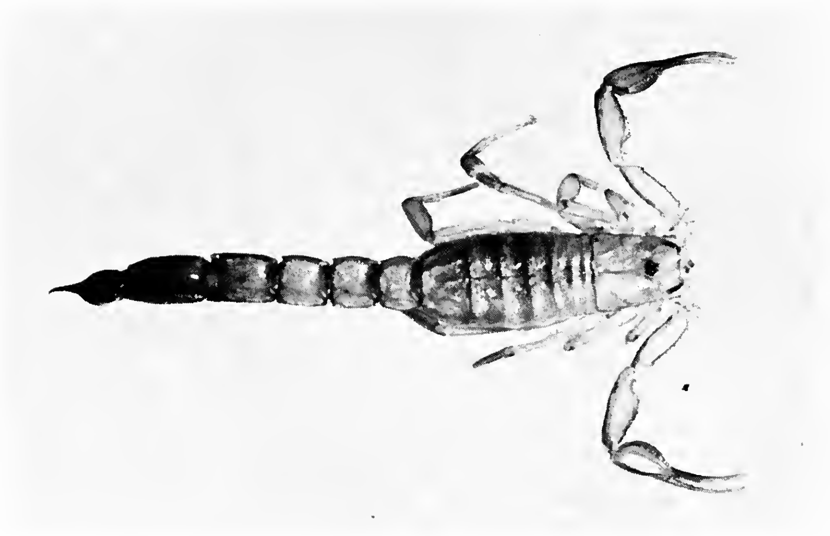

FIG. 7. *Vejovis calidus*, new species, holotype female, dorsal view.

PECTINES: Proximal tooth somewhat rounded, lacking sensorial area, equal in length to other teeth. Second proximal tooth variable, same as tooth 1 but smaller, or racket-shaped as other teeth. Pectin length to width ratio 5/1.5. Pectinal tooth counts 15/16, middle lamellae 10. Scattered small brown setae on exterior edges of anterior lamellae, 2 setae on most middle lamellae, and 3 setae on fulcra. Basal piece indented on anterior half; length to width ratio 5/9.

GENITAL OPERCULUM: Essentially fused on entirety, slight separation on extreme distal tips (fig. 12).

CHELICERAE: Chunky appendages with short fingers. Ventral edge of movable finger smooth with heavy growth of serrulae on distal half. Other dentition standard for genus. Distal tip of fixed finger meets dorsal distal tip of movable finger when fingers closed.

PEDIPALPS: Slender appendages, femur and tibia roughly three times as long than wide; chelal fingers elongate, movable finger approximately same length as carapace and fifth caudal segment. Femoral carinae crenulate to serrate; dorsal and ventral faces smooth, outer face crenulate to serrate; approximately 10 small to medium granules in two roughly formed rows on inner face. Dorsal inner carina of tibia smooth or weakly granulated; dorsal outer carina crenulate to serrate; ventral inner carina smooth; ventral outer carina smooth to crenulate. Dorsal and ventral faces smooth; outer face rough but lacking definite granulation; 10 medium sized granules formed in one line or inner face. Chelae with eight carinae structured as follows: Inner secondary and inner carinae roughly crenulate to serrate; inner accessory carina smooth with minute granulation distally; superior carina smooth and polished; outer and outer accessory carinae smooth to rough; inner ventral carina weak and smooth; inferior carina weakly granulate. Fingers long with exaggerated distal teeth, overlapping when fingers closed (fig. 11); movable finger more than one and one-half times longer than palm; single row of highly serrate teeth on edges; fingers slightly

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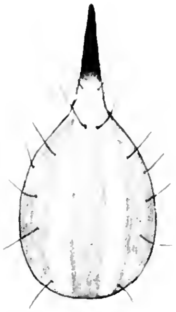

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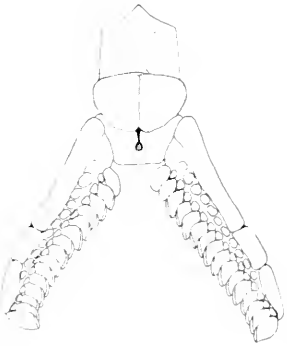

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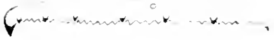

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FIG. 8. *Vejovis calidus*, new species, carapace of female.
FIG. 9. *Vejovis calidus*, new species, telson of female, lateral view.
FIG. 10. *Vejovis calidus*, new species, telson of holotype female, ventral view.
FIG. 11. *Vejovis calidus*, new species, chela of holotype female.
FIG. 12. *Vejovis calidus*, new species, sternum, genital operculum, and pectines of holotype female.
FIG. 13. *Vejovis calidus*, new species, fixed finger of holotype female, inner view.
FIG. 14. *Vejovis gertschi gertschi* Williams, fixed finger of female, inner view.

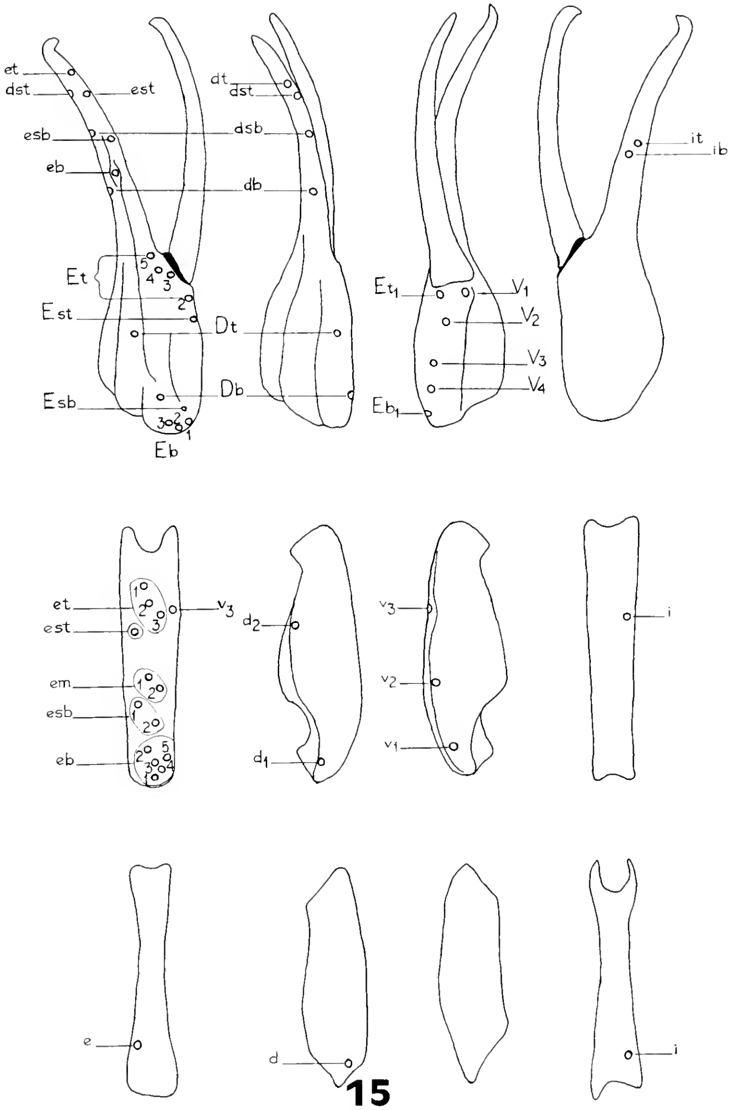

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FIG. 15. *Vejovis calidus*, new species, trichobothrial pattern of holotype female, chela (top row), tibia (middle row), femur (bottom row). External (left column), dorsal (left middle column), ventral (right middle column), and internal (right column) views. Letter abbreviations: E and e, external; D and d dorsal; V and v, ventral; i, internal; b, basal; t, terminal; m, median; sb, suprabasal;st, subterminal.

scalloped distally. Supernumerary teeth of medium development, 6 and 7 for fixed and movable fingers respectively. Trichobothrial counts standard for family, 26 chela, 19 tibia, and 3 femur, pattern as shown in figure 15. Internal trichobothria of chela placed proximally on fixed finger, in ratio 42/100 (measured at trichobothrium *it*); trichobothrium *it* distal to supernumerary tooth 5. (fig. 13).

WALKING LEGS: Small median row of ventral spines on tarsus; five delicate carinae on patella, all granulate to crenulate. Unques short, sharply curved.

ALLOTYPE. Male: Smaller than female in overall size. Movable finger shorter than caudal segment V; pectines larger, length to width ratio 6/2.3; tooth counts larger on average, 17. Genital operculum separated medianly, genital papillae visible externally.

PARATYPE VARIATION: Single female paratype presented no deviation from holotype female except for larger number of pectinal teeth, 16/17.

TYPE DATA: Female holotype and male allotype from 2 miles east of Cuatro Cienegas, Coahuila, Mexico, August 10, 1973 (L. R. Erickson, M. E. Soleglad). The holotype and allotype are permanently deposited in the American Museum of Natural History.

DISTRIBUTION: Known from type locality only.

RECORDS: Coahuila, Mexico: 2 miles east Cuatro Cienegas, August 10, 1973 (L. R. Erickson, M. E. Soleglad), 2 adult females and 1 adult male.

COMMENTS: This uncommon species was encountered in a very rocky terrain. The rocky terrain coupled with the species ability for rapid locomotion made this a difficult scorpion to collect. All three specimens were encountered by the use of ultraviolet light detection.

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1972. Two New Scorpions of the Wupatkiensis Group of the Genus *Vejovis* (Scorpionida: Vejovidae). The Wasmann Journal of Biology, vol. 30, nos. 1 and 2, pp. 179-195.

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ABSTRACT: A new species of the wupatkiensis group of the genus *Vejovis*, *Vejovis calidus*, is described. This new scorpion is from Cuatro Cienegas, Coahuila, Mexico. – Michael E. Soleglad, 1502 Dupont Dr., Lemon Grove, California 92045.

Descriptors: Scorpionida; scorpion; Vejovidae; wupatkiensis group; *Vejovis calidus*; Coahuila, Mexico.

SOME DIFFERENCES BETWEEN TEMPERATE AND TROPICAL POPULATIONS OF MONARCH *(DANAUS PLEXIPPUS)* AND QUEEN *(DANAUS GILIPPUS)* BUTTERFLIES (LEPIDOPTERA: DANAIDAE)[1]

Allen M. Young[2]

This report concerns some preliminary studies on the comparative population structure and incidence of parasitism by tachinid flies (Tachinidae) in temperate and tropical populations of the Monarch Butterfly, *Danaus plexippus*, and the Queen Butterfly, *Danaus gilippus* (Lepidoptera: Nymphalidae: Danainae). Various aspects of population structure and mortality from tachinids are given for one mixed tropical population of Monarchs and Queens during wet and dry seasons, and lesser data of this sort are summarized for two temperate populations of the Monarch alone. From these findings the testable hypothesis is advanced that tropical populations of these ecologically similar butterflies should, on the average, (1) suffer from higher amounts of biotic mortality, especially on immature stages, than comparable temperate populations, and (2) further studies should reveal that Monarchs and Queens in the tropics are biologically-accommodated species while physically-controlled species at northern latitudes.

METHODS

Intermittently during the period March 1969 through April 1970, censuses of oviposition and caterpillars of both butterflies were taken in a small (approximately 400 m^2) field containing an abundance of *Asclepias curassavica* (Asclepiadaceae), a larval food plant of both butterflies, in northeastern lowland Costa Rica. In my experience, both species are unusually abundant at this site, which is just southwest of La Virgen (about 10° 26'N Lat; 90 m elev.) and along the road going to the neighboring town of Puerto Viejo. But the third species of *Danaus* known to occur in Costa

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Rica, namely, *D. eresimus*, was absent during this study at this site. Census of ovipositing females and caterpillars was limited to this patch. Through census of ovipositing adults, eggs on *A. curassavica*, and caterpillars in this patch, I hoped to obtain some descriptive data on the populations of these butterflies. Both adults and caterpillars are easy to speciate in the wild, but this cannot be easily done with eggs. Therefore, the relative abundance of eggs between the two species discussed in this paper refer only to eggs actually witnessed to be oviposited, and not to eggs discovered on plants.

In order to estimate relative abundance of the adults on a given day, I counted the number of each seen during a 15-minute interval. As the patch is low with all parts of it easily visible, it was possible to keep tract of most of the butterflies in it for 15 minutes or less.

During the census of caterpillars, fifth instars were usually collected and brought into the laboratory to complete ontogeny. Their pupae were then scored for frequency of parasitic attacks. Earlier, I had discovered that pupae of both species are killed by larvae of at least two species of Tachinidae in this general region of Costa Rica. The caterpillars of both species are apparently infected with larvae of two tachinid genera: *Hyphantrophaga* and *Patelloa* (with both of these being undescribed species – Dr. Curtis W. Sabrosky, pers. comm.). In my experience the larvae of these two parasites seldom reach maturity prior to the pupa state in both butterflies. Thus by censusing the pupae from caterpillars brought in from the wild in late fifth instar, I hoped to obtain estimates of mortality rates on both species by scoring for pupae bearing flies. The caterpillars were kept separate by species in clear plastic bags containing sprigs of *A. curassavica* that was refreshed until pupation.

Other studies summarized here include observations on densities of immatures and incidence of parasitism in two temperate zone population of the Monarch: one of these, located along a roadside (Stony Island Ave.) in south Chicago, was censused during August and September of 1966, and the other located in an old field in Appleton, Wisconsin was sampled during September 1971. Approximately the same number of days were spent sampling eggs and caterpillars (by instars) at these localities. The area of dense

Asclepias syrica sampled in Appleton was 400 m^2, in Chicago, the area was 400 m^2, and in Costa Rica, 396 m^2. These areas were used to calculate densities. The species of *Asclepias* in the Chicago plot was not identified. Both temperate sites support Monarchs in abundance.

RESULTS

Both butterflies occur regularly at the study site, in Costa Rica although there is a decline of adults during the drier months (Table 1). The dry season in this region of Costa Rica is very variable in both duration and intensity (dryness) in different years, as seen from the accurate weather records for La Virgen provided by the Servicio Meteorologico de Costa Rica. But a dry season generally falls between January and April. The Queen is never as abundant as the Monarch, and the source of this difference remains obscure at the present (Table 1). As the numbers of both Monarch and Queen caterpillars in this field are rather comparable (Table 2),

Table 1. Summary of adult numbers of the Monarch Butterfly *(Danaus plexippus)* and the Queen Butterfly *(D. gilippus)* seen in 15-minute sightings (once per day)[a] over a large patch of *Asclepias* sp., near La Virgen (de Sarapiqui) Costa Rica, 1969-1970.

NUMBERS OF ADULT:

Months	N[b]	Monarchs (mean ± S.E.)	Queens (mean ± S.E.)
March, 1969	2	3 ± 0.0	2 ± 0.0
April	3	5 ± 0.5	2 ± 0.4
May	2	22 ± 2.0	6 ± 0.0
June	3	31 ± 2.4	13 ± 0.8
July	3	28 ± 3.0	10 ± 0.6
August	2	25 ± 2.4	10 ± 1.0
September	4	27 ± 3.0	12 ± 0.4
October	2	30 ± 2.0	9 ± 0.4
November[c]	2	24 ± 1.4	10 ± 0.2
January, 1970	3	5 ± 0.2	2 + 0.0
February	1	2 ± 0.0	0 ---
March	2	4 ± 0.0	1 ± 0.0
April	3	5 ± 0.2	5 ± 0.0
May	3	19 ± 1.0	13 ± 0.0
June	2	25 ± 2.0	11 ± 0.4

[a] Censusing was conducted at the same time (10:00 A.M. – 1:00 P.M. C.S.T.) on different days.

[b] N is the number of days each month on which adults were censused.

[c] No data are available for December, 1969

the discrepancy in adult numbers between the species may reside in some somponent of the adult ecology. A decline of the adults in both species during the drier months may be due in part to a reduction in recruitment of new individuals as reflected in the paucity of caterpillars during these months (Table 2).

The oviposition activity of both butterflies is high in this field, but once again with a noticeable reduction during the dry season (Table 3). It thus appears that the general decline in the mixed population of these two butterflies during the dry season results from a reduction in egg-laying in the field due to fewer adults being present. But it is not known if there is an increased mortality of adult butterflies during this period, or whether adults emigrate to wetter sites in this region. Differential mortality of immatures for both butterflies here but in different seasons likewise cannot be ruled out here as a factor causing population decline.

The estimations of densities of immatures in both temperate and tropical regions indicates that there are no major shifts associated

Table 2. Summary of the relative abundance of Monarch and Queen caterpillars[a] in a large roadside patch of *Asclepias* sp., near La Virgen (de Sarapiqui), Costa Rica, 1969-1970.

		NUMBERS OF LARVAE:	
Months	N[b]	Monarchs (mean ± S.E.)	Queens (mean ± S.E.)
March, 1969	4	0	0
April	5	0	0
May	3	7 ± 0.0	5 ± 0.0
June	5	18 ± 2.2	20 ± 1.0
July	6	33 ± 4.0	23 ± 1.0
August	3	45 ± 3.0	29 ± 0.5
September	4	50 ± 3.5	12 ± 0.0
October	6	41 ± 3.0	21 ± 0.0
November	2	35 ± 1.0	18 ± 1.0
January, 1970	3	22 ± 1.0	20 ± 1.0
February	5	0	1 ± 0.0
March	4	2 ± 0.0	0
April	4	38 ± 1.0	22 ± 1.0
May	5	35 ± 2.0	25 ± 2.0
June	2	30 ± 1.5	20 ± 1.0

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[a] Excluding first and second instars

[b] N is the number of days of census in each month.

with latitude for the populations studied (Table 4). Densities of eggs on food plants in butterflies is the result of several factors including (1) the pattern of movement of the ovipositing females, (2) the spatial availability of the food plant used for egg-laying, (3) the number of eggs a female produces, and (4) the rate of egg-laying. The movement patterns of temperate and tropical Monarchs are very similar, involving an erratic searching flight over a field, and the spatial distribution of *Asclepias* in both situations is also similar, with large clumps of individual plants distributed over the field. And temperate and tropical females have the same number of eggs as teneral adults: 63 females dissected from the Appleton population gave an average of 54 ± 6.2 eggs ($\bar{X}$ ± S.E.), and 49 females from the Costa Rica site gave an average of 59 ± 8.3 eggs. The rates of egg-laying are not known, and with this exception, we can predict that egg density might be very similar since the other factors contributing to egg density on food plants are similar for the populations studied. The apparently high density feature of these populations contributes to conditions favorable to substantial attack by parasitic tachinids at least in the tropics (Table 5). But such mortality is absent in both Chicago and

Table. 3. The relative numbers of eggs witnessed being oviposited[a] by Monarchs and Queens.

Months	N[b]	Monarch eggs	Queen eggs
March, 1969	2	3	0
April	3	6	0
May	2	16	12
June	4	38	43
July	4	13	30
August	2	20	19
September	4	12	30
October	5	40	26
November	5	33	40
January, 1970	3	11	47
February	1	2	4
March	2	5	3
April	2	40	38
May	3	38	29
June	3	44	42

[a] Observations on oviposition sequences of Monarchs and Queens were made for a 45-minute period on each day.

[b] N is the number of days each month that oviposition was censused.

Appleton populations of the Monarch, although this might be attributed to sampling error. At least two genera of tachinid flies contribute equally to the mortality of pupae observed for the Monarch and Queen tropical populations (Table 6).

Table 4. Average densities[a] of immature life stages for the Monarch butterfly, *Danus plexippus* in Costa Rica (La Virgen), Illinois (Chicago), and Wisconsin (Appleton).

			mean numbers (per ft^2) with standard errors (S.E.)					
LOCALITY	SAMPLING PERIOD	N[b]	EGG	INSTAR 1	INSTAR 2	INSTAR 3	INSTAR 4	INSTAR 5
COSTA RICA	APR-JUNE 1970	18	1.2+0.4	0.82+0.03	0.80+0.04	0.75+0.06	0.20+0.05	0.13+0.04
ILLINOIS	SEPT-OCT 1966	13	1.4+0.3	1.1+0.09	1.0+0.03	1.0+0.06	0.9+0.07	0.9+0.05
WISCONSIN	SEPT-OCT 1971	16	1.8+0.4	1.6+0.04	1.5+0.02	1.2+0.04	1.2+0.05	1.1+0.07

[a] Averages computed from a specified number of days of sampling within the "sampling periods" given in the table.

[b] N is the number of days used to compute average densities of life stages.

Table 5. Relative frequencies of pupal mortality due to parasitic attack by *Hyphantrophaga* sp. and *Patelloa* sp. (combined data) in sympatric larval populations of the Monarch and Queen butterflies.

	Monarch Butterfly			Queen Butterfly		
Monthly samples[a]	Total No. of pupations	No. pupae yielding flies	% mortality	Total No. of pupations	No. pupae yielding flies	% mortality
March, '69	0	-		0	-	
April	0	-		0	-	
May	5	3	60%	5	4	80%
June	16	9	56%	20	16	80%
July	33	17	52%	23	18	78%
August	43	14	33%	28	12	43%
September	48	22	47%	10	6	60%
October	41	22	54%	17	10	59%
November	32	18	57%	18	14	77%
Jan., '70	22	19	86%	20	12	60%
February	0	-	-	1	1	100%
March	1	1	100%	0	-	-
April	36	24	67%	20	15	75%
May	35	19	54%	25	15	60%
June	30	17	57%	18	14	78%

[a] These refer to the numbers of fifth instar larvae collected in the wild and allowed to pupate in the laboratory.

Table 6. Relative contributions of two tachinid parasites, to the overall mortality of pupae in tropical populations of the Monarch and Queen butterflies.

Parasite	% pupal mortality in a Monarch population	% pupal mortality in a Queen population
Hyphantrophaga sp.	34%	37%
Patelloa sp.	28%	31%

DISCUSSION

Both the Monarch and Queen in Costa Rica apparently occupy very similar ecological niches, being congeners, and this clearly includes their susceptability to parasitism by some tachinids. The caterpillars of both species feed on the same food plant, and such food selection might make it easier for adult parasitic flies to locate the "correct" plants for egg deposition, a condition studied in other insect host-parasite associations and involving a chemical cue from the plant (Read, Feeny, and Root, 1970). It is generally known the certain dipterous parasites of Danaid butterflies lay their eggs on leaves of the plants and from there parasitize the caterpillars. Too little is currently known about the natural history of *Hyphantrophaga* and *Patelloa* tachinid flies to know if this is the case here. Both species appear to be non-discriminatory between Monarch and Queens, and we might predict that selection would favor dipterous parasites to be "generalists" in the tropics since any one host on the average may be rarer and a fly will lose more energy in being species-specific under these conditions. Thus we might predict that species in different tachinid genera and other parasitic dipterous families are non-specific in host preference, and such a feeding strategy would be well suited in species that lay their eggs on plants and other substrates rather than directly on the bodies of their hosts. In this way, eggs could be ingested by a variety of herbivorous insects on a given plant species and given the proper range of internal physiological conditions in hosts, a good proportion of eggs may survive to produce new adults. The toxic properties of *Asclepias* (see Ehrlich and Raven, 1964 for comments) may make it a very suitable "candidate" plant species for a variety of tachinid flies to cue into by olfaction and allow them to infest several lepidopterous, coleopterous, and hemipterous herbivores that are able to feed on these milkweeds.

The size of the study site is large enough to support breeding (egg-laying) populations of both butterflies and this is very likely due to the abundance of *Asclepias* plants found there. As data were not recorded on seasonal patterns of flowering in this plant nor on any deciduous response to the dry season, it is difficult to pin down the causes of population decline at this time. Adults of both species feed primarily on nectar of *Asclepias* in this field. Although many woody trees and shrubs bloom during the tropical dry season (Janzen, 1967) little has been published on seasonality of flowering in secondary growth herbaceous forms. The toughness and succulent properties of *Asclepias* plants suggests that they do not become leafless during the moderate to weak dry season characteristic of this region of Costa Rica, thus suggesting the larval food does not become scarce. But I have noticed qualitatively that milkweed blooming is greatly reduced during the dry season in this field. This has two impacts on the Monarch-Queen populations here: (1) a highly preferred adult food source becomes scarce, and (2) the likelihood of oviposition in the field is also reduced. This second prediction stems from the observation of Brower (1961) that young blossoming milkweeds are more likely to have eggs than either young or old plants not in bloom. Brower suggests that the blossom serves a visual stimulus that is *Asclepias*-specific for Monarchs. But such a mechanism may not be operative in the northern spring breeding populations of the Monarch. On June 12, 1971 I censused 244 very young *A. syrica* plants in one field in Appleton for Monarch eggs; none of these very small plants (average height about 25 cm) had blossoms. Out of the 244 plants surveyed, 63 or 25.8% had at least one Monarch egg. There were only two plants with two eggs apiece, and the total number of eggs was 65, of which 26 or 40% were oviposited on the dorsal leaf surfaces. No caterpillars were present and the young *A. syrica* plants were often covered with various ant species.

Further studies are needed to explain seasonal patterns of population age-structure and numerical abundance. Increased dryness may also cause adults to become subject to dessication in open fields and cause them to move into wetter sites. The paucity of immatures on *Asclepias* during the drier months at this site suggests that adults previously left the area, but increased mortality of immatures during the dry season cannot be ruled out. The problem of dry season effects on populations even becomes more complex in more seasonal Costa Rican environments: On March 8, 1970, I observed many fresh adults of the Queen at Palo Verde, near the Rio Tempisque in Guanacaste Province, a tropical dry forest region, and at the same time there were only a few very old Monarchs in the same area. In this situation it appears that the species are responding differently to the severe dry season of this region if seasonality is affecting population age-structure.

In light of the apparent similarities in densities of immatures among temperate zone and tropical populations of the Monarch, it is extremely interesting that tachinid parasitism should be high in the tropics and virtually non-existent in the temperate populations. If we assume for the moment that the very limited data given here are in fact representative of a general latitudinal trend, then it appears that tropical Monarch populations during the "growing season" experience greater mortality from tachinid parasitism than do similar temperate zone populations. Such a latitudinal pattern may also be true for the Queen. If this is true, then we might predict that selection increases the vagility of adults in tropical populations as a means of escaping in space from parasitism through colonization of new food plant patches, assuming that other mortality factors are held constant. This discussion assumes that no other biotic mortality factors are killing immatures of Monarchs or Queens in temperate areas – an assumption that may be faulty since the eggs and younger caterpillars may be parasitized by other parasites and predators. The total spectrum of biotic mortality on immatures in both temperate and tropical populations of the butterflies should be investigated in order to substantiate this hypothesis.

In closing, I have found that large numbers of young Monarch caterpillars are killed off during early or middle October in Appleton each year, although quantitative estimates of this mortality are not determined. The mortality corresponds with the date of the first killing frost, which from 1959 through 1970, generally occurs within the first three weeks of October in Appleton. The average date is October 17, and the range is October 5 to October 29. Variability of the date of the first killing frost within the three weeks period is difficult to label as being predictable or unpredictable from year to year, but I suspect that it might be the latter owing to Monarchs having a developmental time of more than three weeks. Although some years are "exceptional" for Monarchs, presumably resulting from an unseasonally late first killing frost date and allowing many more young Monarchs to successfully complete development, the unpredictability of this environmental factor results, on the average, in large numbers being killed off. Thus temperate populations of Monarchs are at least in part physically-controlled by killing frost. It is less likely that comparable mortality from climatic instability would occur in the Costa Rican population studied through a dry season effect. If we may extend this speculation further, temperate zone populations of Monarchs, especially those far north, are physically-controlled while tropical populations are biologically accommodated (Slobodkin and Sanders, 1969) with part of the latter including high rates of parasitism. Clearly we need more data from several populations along a latitudinal gradient to confirm some of these ideas; butterflies like Monarchs and Queens are especially suited for such studies owing to (1) the widespread latitudinal occurrence of both from temperate-zones to the tropics, and (2) their apparent dependence upon Asclepiadaceae as larval food plants.

ACKNOWLEDGEMENTS

The tropical aspects of this work were supported by N.S.F. Grant GB-7805, Dr. Daniel H. Janzen, principal investigator, and through the Organization for Tropical Studies, Inc. Dr. Lincoln P. Brower provided information on field identification of Monarch and Queen caterpillars, and Dr. Curtis W. Sabrosky identified the tachinids. I am very grateful to Dr. Brower for suggesting an examination of first killing frost dates and these data were generously provided by the Wisconsin Michigan Power Company.

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SLOBODKIN, L. B., and H. L. SANDERS. 1969. On the contribution of environmental predictability to species diversity, pp. 82-95, *In* Diversity and Stability in Ecological Systems, G. M. Woodwell and H. H. Smith (eds.). Brookhaven Symposium in Biology, No. 22.

ABSTRACT: A mixed population of Monarch and Queen butterflies was investigated intermittently over several months in a small field of *Asclepias curassavica* (Asclepiadaceae) in northeastern lowland Costa Rica. Ecological parameters measured included number of adults of both species seen on selected days, frequency of oviposition in both species, numbers of caterpillars of both species on *A. curassavica*, and the number of pupae producing *Hyphantrophaga* and *Patelloa* parasitic flies (Tachinidae) from fifth instar caterpillars brought into the laboratory. These studied extended over both wet and dry seasons. In addition to this Costa Rican site, densities of immatures for the Monarch were also studied in Illinois (Chicago) and Wisconsin (Appleton), and examinations for parasites in caterpillars and pupae were also conducted. The Costa Rican field supported roughly equal numbers of Monarchs and Queens and there was a very sharp decline in adults during the dry months, perhaps due to an exodus of butterflies since the frequency of oviposition also dropped severely. Although larval densities in the temperate zone and tropical populations of the Monarch were very similar, both the Monarch and Queen in Costa Rica suffer very high levels (about 60%) of mortality from tachinids while none was found in Illinois and Wisconsin. The hypothesis is advanced that tropical populations of these butterflies are biologically-accommodated and suffer high levels of biotic mortality while temperate populations are physically accommodated. Allen M. Young, Department of Biology, Lawrence University, Appleton, Wisconsin, 54911.

Descriptors: Monarch, Queen, butterflies, populations, temperate, tropical, parasitism, Tachinidae, biologically-accommodated, physically-controlled, environment.

ERRATA

Vol. 85 (1) January, 1974 – Cover – A New Genus and Species of Mealbug should read Mealybug.

p. 30 – References: This should follow article on p. 28 "Population and Subspecific Variation in *Gerris Remigis* Say."

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Required six-months' notice is given of the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names listed by case number:

(See *Bull. zool. Nomencl.* 31, part 1, 31st July 1974)

482. Preservation of *Pan* Oken, 1816 and *Panthera* Oken, 1816 (Mammalia).
1974. Suppression of *Delphinus pernettensis* de Blainville, 1827 and *Delphinus pernettyi* Desmarest, 1820 (Mammalia).
2016. Suppression of *Sesarma trapezium* Dana, 1852 (Crustacea: Decapoda).
2041. Suppression of *Loligo stearnsii* Hemphill, 1892 (Mollusca, Cephalopoda).
2051. Suppression of *Cyclogyra* Wood, 1842 (Foraminifera).
2053. Suppression of Achiidae Fleming, 1821 (Insecta, Diptera)
2055. Suppression of *Phagocata cornuta* Shishkov, 1903 (Platyhelminthes, Turbellaria).
2058. Suppression of *Hypacantus* Rafinesque, 1810 (Pisces, Carangidae).

Comments should be sent in duplicate, citing case number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London SW7 5BD, England. Those received early enough will be published in the Bulletin of Zoological Nomenclature.

MARGARET GREEN
Scientific Assistant

July, 1974

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ENTOMOLOGICAL NEWS

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Books for review and book publication announcements should be sent to the editor, Howard P. Boyd. For address, see under "manuscripts" above. Literature notices, books received and short reviews will be published in **The Entomologist's Library**.

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(Continued on inside back cover)

SECOND CLASS POSTAGE PAID AT VINCENTOWN, NEW JERSEY, 08088,

MESSAGE TO MEMBERSHIP

D. C. Rentz,[1] W. H. Day[2]

A number of decisions relating to Society operations have been made recently and we would like to take this opportunity to convey them to our members.

Judging by the mail received, considerable concern has been expressed over delays and irregularity in the appearance of ENTOMOLOGICAL NEWS. For this we apologize. The prime reason for the delay has been the difficulty in finding a printer who will produce the NEWS over a period of time. Hopefully, publication problems have been overcome and future issues will be received on time.

With this issue of ENTOMOLOGICAL NEWS, we welcome a new editor and a new printer. The new editor is Howard P. Boyd, Tabernacle, New Jersey. He is both an entomologist and an editor and has the time necessary to maintain the high quality of ENTOMOLOGICAL NEWS.

With this issue (May-June), ENTOMOLOGICAL NEWS becomes a bi-monthly publication. This will help reduce publication and mailing costs. No decrease in the annual number of pages is planned. Page charges and editorial policy are found on the inside covers of the magazine.

Inflation has struck the Society just as it has everyone else. To bring charges in line with actual costs, membership and subscription fees will be raised effective *1 January 1976* as follows:

		Subscriptions			
Membership		Members		Non-Members	
Student	$4.00	TRANSACTIONS	$7.00	TRANSACTIONS	$15.00
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Meetings of the Society for members and guests are held regularly at the Academy of Natural Sciences of Philadelphia or the University of Delaware. All members and interested institutions in the immediate geographical area receive meeting notices. If you are not included on the list, or have other comments, please address them to the American Entomological Society, Academy of Natural Sciences of Philadelphia, 19th and The Parkway, Philadelphia, Pa., 19103.

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[1] President, American Entomological Society

[2] Immediate Past President, American Entomological Society.

The Entomologist's Record

To encourage the publication of concise and useful new distribution records, corrections of previously published erroneous records, misidentifications, short field notes, and current news items about Entomologists, amateur and professional, Entomology Departments and Museums, prompt publication is offered in this Department.

SOUTHERN RANGE EXTENSION OF *DIAULOTA DENSISSIMA* WITH NOTES ON DISPERSAL OF MARINE INSECTS (COLEOPTERA: STAPHYLINIDAE)[1]

Ian Moore[2]

Steinbeck and Ricketts (1941, The Sea of Cortez---. 598 p., The Viking Press, New York.) along with some other marine zoologists considered Point Conception a barrier between the tropical and temperate marine faunas with a somewhat indeterminate large overlap area on either side.

Moore (1957, Pan-Pac. Ent. 33:40) suggested that the Big Sur region might be a barrier to dispersal of marine insects because certain species are known only north or only south of that area.

Diaulota densissima Casey has been reported from Dutch Harbor, Alaska to Pacific Grove, Monterey County, California (Moore 1956, Trans. San Diego Soc. Nat. Hist. 12:121). The very similar species *D. fulviventris* Moore replaces it to the south being found with it at Pacific Grove but becoming more common into Baja California.

On August 9, 1973 I collected a specimen of *D. densissima* at Piedras Blancas Point, San Luis Obispo County, California just south of the Big Sur region but north of Point Conception.

It now seems likely that that part of the coast lying between Point Conception and the Monterey Peninsula may be an overlap area with certain southern species extending to the Monterey area and some northern species being found as far south as Point Conception. I hope to further elaborate on the concept as more data becomes available.

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[1] Accepted for publication: June 7, 1974

[2] Staff Research Associate, University of California, Riverside, 92502.

ENT. NEWS, 85 : 5 & 6 : 130 May & June 1974

WILLIAM D. FUNKHOUSER (1881-1948) BIBLIOGRAPHY AND LIST OF NAMES PROPOSED [1] [2]

Dennis D. Kopp, Thomas R. Yonke[3]

ABSTRACT: A list of the 83 papers by W. D. Funkhouser is presented. Also listed are the 428 new names and one new variety of the family Membracidae proposed in his works with a citation to the original description. Nomenclatural changes are indicated, bringing the Funkhouser names into accordance with Metcalf and Wade (1965). The present confirmed location of the holotype is given, when possible.

From 1918 to 1948 W. D. Funkhouser was the most outstanding student and authority on the family Membracidae. His determinations are present in most membracid collections throughout the world. His productive entomological works were interspersed with his responsibilities at the University of Kentucky (1918-1948). At the University of Kentucky he was a Professor of Zoology and Head of the Department of Zoology. Later he was also Professor of Anthropology, Dean of the Graduate School, member of the Athletic Committee and representative of the institution on the Southern Athletic Association, member of many and varied social and civic clubs, and author of many articles and several books in the various fields in which he was interested. He was the president of the Entomological Society of America in 1940 and presided at the Philadelphia meeting that year. This paper will concern itself with only his entomological publications.

After his death, his collection remained at the University of Kentucky from whom it was purchased by the USNM. Allen (1951) summarizes the content of this collection. Today the collection is housed as a unit at the USNM with the holotypes incorporated in the USNM Membracidae Type Collection.

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[1] Accepted for publication: September 2, 1973.

[2] Contribution from the Missouri Agricultural Experiment Station. Journal Series No. 6757.

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LIST OF NAMES PROPOSED

Listed below in their original forms are the 12 genera, 403 species, 12 nomen nova, and 1 variety (a total of 428 names) proposed by W. D. Funkhouser. All names are in the family Membracidae unless otherwise noted. In this paper, the genera as Dr. Funkhouser originally used them are listed alphabetically and species placed alphabetically under the genera. After each Funkhouser name the year of description (century omitted) with a serial letter indicates the paper in which the description appears, after the colon is cited the page on which the description is found; followed by a small "f" when one or more figures were included with the description; followed by nomenclatural changes; followed by the abbreviated location of the holotype.

The location of the holotypes have been confirmed by the respective institutions with the exçeption of those followed by an asterisk (*). Nomenclatural changes are listed after the appropriate names bringing this list into accordance with Metcalf and Wade (1965).

The following list of abbreviations is used to designate the present locality of the holotype.

AMS	Australian Museum, Sidney.
BM	British Museum, Natural History, London.
CUEM	Cornell University Entomology Museum, Ithaca.
EMMH	Shanghai Entomological Institute.
EMZSI	Entomological Museum of the Zoological Survey of India, Calcutta.
IFRM	Indian Forest Research Institute Museum, Dehra Dun.
LUEM	Lingnan University Entomological Museum, Canton.
MDEI	Museum of the Deutsches Entomologisches Institut, Eberswalde.
MRAC	Musee Royal de l'Afrique Centrale, Tervuren.
MZB	Museum Zoologicum Bogoriense, Bogor.
NCIP	National Collection of Insects, Plant Protection Research Institute, Pretoria.
NMBE	Naturhistorisches Museum-Entomologie, Basel.
OSUM	Ohio State University Entomological Museum, Columbus.
OUEM	Oxford University Entomology Museum, Oxford.
USNM	National Museum of Natural History, Washington, D.C.
ZISSR	Zoological Institute of the Academy of Science USSR, Leningrad.

MEMBRACIDAE

- *Acanthophyes Stål*
  - *walkeri*, 27d: 338, nom. nov. pro *Centrotus chloroticus* Walker 1858 BM
- *Acanthuchus Stål*
  - *carinatus*, (*Acanthucus* [*sic*]), 27c: 311, f AMS
  - *minutispinus*, 22b: 323, f EMZSI
  - *pyramidatus*, (*Acanthucus* [*sic*]), 27 c: 310, f AMS
- *Aconophora* Fairmaire
  - *brevicornis*, 43c: 467, f USNM
  - *brunnea*, 40a: 281, f USNM
  - *coffea*, 43c: 466, f USNM
  - *erecta*, 40a: 280, f USNM
  - *lutea*, 43c: 466, f USNM
  - *projecta*, 27e: 160, f CUEM
- *Aconophoroides* Fowler (junior synonym of *Potnia* Stål)
  - *projecta*, 14d: 405, f (a junior synonym of *Potnia jacula* Fab.) USNM
  - *rectispina*, 14d: 405, f USNM
- *Adippe* Stål
  - *nigrorubra*, 22a: 32, f USNM
- *Alchisme* Kirkaldy
  - *laticornis*, 40a: 277, f USNM
  - *pinguicornis*, 40a: 277, f USNM
  - *projecta*, 30a: 414, f USNM
  - *spinosa*, 40a: 278, f USNM
- *Amastris* Stål
  - *brunneipennis*, 22a: 31, f USNM
  - *elevata*, 22a: 27, f USNM
  - *maculata*, 22a: 31, f USNM
  - *minuta*, 22a: 30, f (a junior synonym of *Amastris citrina* Fairmaire) USNM
  - *pacifica*, 43c: 478, f USNM
  - *peruviana*, 40a: 286, f USNM
  - *projecta*, 22a: 28 USNM
  - *sabulosa*, 22a: 29, f USNM
- *Anchon* Buckton
  - *brunneus*, 37d: 241, f USNM
  - *gunni*, 19c: 220, f USNM
  - *lineatus*, 38b: 199, f LUEM*
- *Anchonoides* Distant [preoccupied] (the following species are in *Evanchon* Goding 1930)
  - *minutus*, 19c: 221, f USNM
  - *serpentinus*, 20a: 209, f USNM
  - *sordidus*, 28a: 13 BM
  - *variegatus*, 18c: 4 USNM
- *Antialcidas* Distant
  - *attenuatus*, 22b: 327, f EMZSI
  - *erectus*, 21b: 47, f USNM
- *Antianthe* Fowler
  - *chichiana*, 43c: 476, f USNM
- *Antonae* Stål
  - *bulbosa*, 30a: 415, f USNM
  - *nodosa*, 14d: 403, f (*Antonea* [sic]) USNM

Aphetea Fowler
- *maculata*, 27e: 163, f CUEM
- *nigropicta*, 43c: 476, f USNM
- *punctata*, 27g: 145, f ZISSR

Atynma Stål
- *pilosa*, 19d: 273 USNM

Boethoos Kirkaldy
- *brunnea*, 22a: 26, f (a junior synonym of *Tynelia longula* Burmeister) USNM
- *hirsuta*, 22a: 25, f (moved to *Tynelia* Stål by Funkhouser 1927) USNM
- *nitida*, 22a: 25, f (moved to *Tynelia* Stål by Funkhouser 1927) USNM

Bolbonota Amyot and Serville
- *atitla*, 43c: 455, f USNM
- *lutea*, 14c: 360, f [a junior synonym of *Bolbonota* [*Bolbonota*] *aureosericea* Stål] USNM
- *nigrata*, 14c: 361, f USNM (in subg. *Bolbonota* Amyot and Serville)

Campylocentrus Stål
- *nigris*, 30a: 410, f USNM

Carynota Fitch
- *maculata*, 15a: 98, f USNM

Centrochares Stål
- *foliatus*, 29a: 113, f USNM
- *spiniferus*, 27a: 19, f BM

Centrogonia Stål
- *lutea*, 19d: 269 (moved to *Penichrophorus* by Richter 1943) USNM
- *pinguicornis*, 19d: 270 USNM

Centronodus, 30a: 405
- *denticulus*, 30a: 405, f USNM
- *flavus*, 30a: 406, f USNM

Centrotoscelus, 14a: 72
- *borneensis*, 20a: 215, f USNM
- *brevispinis*, 20a: 216, f USNM
- *brunneus*, 27f: 117, f USNM
- *concavus*, 18a: 311, f USNM
- *handschini*, 36b: 196, f NMBE
- *luteus*, 18a: 30, f USNM
- *maculipennis*, 34b: 579, f BM
- *pseudocornis*, 20a: 217, f (moved to *Xanthosticta* Buckton by Goding 1934) USNM
- *typus*, 14a: 73, f USNM

Centrotus Fab.
- *distanti*, 51a: 197, nom. nov. pro *Beaufortiana cornuta* Distant 1916 BM
- *walkeri*, 27d: 372, nom. nov. pro *C. costalis* Walker 1858 (a junior synonym of *Centrotypus assamensis* Fairmaire)

Centrotypus Stål
- *brunneus*, 20a: 207, f (a junior synonym of *C. aduncus* Buckton) USNM
- *laticornis*, 21b: 44, f USNM
- *nigris*, 27c: 306 f (moved to *Periaman* Distant by Goding 1950) AMS
- *parvus*, 22b: 325, f (moved to *Cryptoparma* by Goding 1931) USNM

Centruchus Stål
- *brevicornis*, 36c: 247, f BM
- *laticornis*, 18c: 9 USNM

- *Ceresa* Amyot and Serville
  - *cuprea,* 27e: 160, f CUEM
  - *curvicornis,* 42e: 181, f (moved to *Vestistilus* by Caldwell 1949) USNM
  - *grisescens,* 40a: 283, f USNM
  - *luteimaculata,* 40a: 282, f USNM
  - *occidentalis,* 15a: 100, f (moved to *Spissistilus* by Caldwell 1949) USNM
  - *projecta,* 27e: 161, f CUEM
  - *rubra,* 43c: 471, f USNM
  - *viridilineata,* 43c: 472, f USNM
- *Chelyoidea* Buckton (a junior synonym of *Tragopa* Latreille)
  - *brunnea,* 22a: 23, f (a junior synonym of *Tragopa peruviana* Funkhouser) USNM
  - *fasciata,* 22a: 21, f USNM
  - *maculata,* 22a: 22, f (a junior synonym of *Tragopa cimicoides* Coquebert) USNM
- *Clonauchenia,* 21c: 679 (a junior synonym of *Bulbauchenia* Schumacher)
  - *mirabilis,* 21c: 680, f USNM
- *Coccosterphus* Stål
  - *luteus,* 33a: 9, f IFRM
- *Cryptaspidia* Stål
  - *auriculata,* 29a: 114, f USNM
  - *elevata,* 19a: 26, f USNM
  - *fasciata,* 36c: 248, f BM
  - *longa,* 19a: 27, f USNM
  - *lustra,* 29a: 114, f USNM
  - *magna,* 27h: 254, f BM
  - *minuta,* 27f: 118, f USNM
  - *nigris,* 18a: 36, f USNM
  - *pilosa,* 21c: 686, f USNM
- *Cymbomorpho* Stål
  - *nitidipennis,* 22a: 14, f USNM
- *Dontonodus,* 30a: 407
  - *serraticornis,* 30a: 408, f USNM
- *Ebhul* Distant
  - *carinatus,* 15e: 393, f USNM
  - *elegans,* 29a: 117, f USNM
  - *maculipennis,* 22b: 326, f EMZSI
  - *notatus,* 27a: 17, f BM
  - *uniformis,* 27a: 18, f missing from USNM
- *Elaphiceps* Buckton
  - *javanensis,* 37c: 121, f USNM
- *Emphusis* Buckton
  - *bakeri,* 15e: 381, f USNM
  - *bicornis,* 27c: 305, f (a junior synonym of *E. ansata* Buckton) AMS
  - *bulbifera,* 27b: 106, f BM
  - *globosus,* 21c: 683, f USNM
  - *nigris,* 39b: 377, f BM
  - *rugosus,* 27f: 111, f USNM
- *Enchenopa* Amyot and Serville
  - *ansera,* 43c: 456, f USNM
  - *bifenestrata,* 22a: 1, f (moved to *Tritropidia* Stål by Funkhouser 1927) USNM
  - *pulchella,* 22a: 2, f (a junior synonym of *Tritropidia alticollum* Olivier) USNM
- *Ennya* Stål
  - *pulchella,* 14d: 403, f USNM

Erechtia Walker
  trinotata, 30a: 412, f USNM
Eufairmairia Distant
  laticornis, 27c: 307, f AMS
Eufrenchia Goding
  bucktoni, 51a: 241, nom. nov. pro *Ibiceps falcatus* Buckton 1903 BM
Euritea Stål
  albifasciata, 22a: 24, f USNM
Eustellia [sic] *Eustollia* Goding
  variegata, 30a: 408, f (moved to *Orekthen* by Funkhouser 1951, listed in family Biturritiidae by Metcalf and Wade 1965) OSUM
Evanchon Goding
  javanensis, 51a: 200, nom. nov. pro *Magura sinuata* Funkhouser 1935 (a junior synonym of *Magura nigra* Funkhouser) MZB
  maculatus, 37c: 123, f USNM
  nitida, 43f: 8, f MRAC
  sinuatus, 35c: 428, f BM
Flexocentrus Goding
  brunneus, 30a: 410, f USNM
Gargara Amyot and Serville
  albolinea, 27h: 255, f BM
  albomacula, 27h: 254, f (a junior synonym of *G. akonis* Matsumura) BM
  albopleura, 40b: 145, f MDEI
  alini, 40b: 144, f (moved to *Kotogargara* Matsumura by Jacobi 1955) MDEI
  attenuata, 14b: 236, f USNM
  aurea, 33a: 8, f IFRM
  australiensis, 36b: 197, f NMBE
  bicolor, 27a: 9, f BM
  brunnea, 14b: 235, f USNM
  brunneidorsata, 29a: 128, f USNM
  brunneifasciata, 38b: 204, f LUEM*
  carinata, 35b: 129, f MZB
  dorsata, 35d: 717, f USNM
  fasceifrontis, 27f: 122, f USNM
  flaviceps, 37a: 31, f EMMH*
  flavocarinata, 27a: 8, f BM
  fragila, 27f: 121, f USNM
  gracila, 27f: 120, f USNM
  granulata, 27f: 123, f USNM
  gressitti, 42a: 64, f USNM
  grisea, 19a: 24 USNM
  hainanensis, 37d: 244, f USNM
  hoffmanni, 37d: 245, f USNM
  hyalifascia, 27a: 8, f BM
  irrorata, 18a: 35 USNM
  lata, 21b: 51 USNM
  luteinervis, 36b: 198, f NMBE
  luteipennis, 14a: 71, f USNM
  maculata, 36c: 249, f BM
  maculipennis, 18a: 32, f USNM
  minor, 34d: 22, f EMMH*
  minuta, 14b: 236, f USNM

nervosa, 18c: 13 USNM
nigra, 20a: 223 USNM
nigroapica, 27f: 119, f USNM
nigrocarinata, 14b: 234, f USNM
nigromaculata, 27a: 10, f BM
nitidipennis, 14a: 71 USNM
nodinervis, 27f: 122, f USNM
nodipennis, 27a: 9, f BM
nodulata, 42a: 63, f USNM
nyanzai, 27g: 154, f ZISSR
opaca, 38b: 201, f LUEM*
orientalis, 27g: 155, f ZISSR
ornata, 29a: 128, f USNM
penangi, 18c: 11 USNM
pilinervosa, 20a: 222 USNM
pilosa, 27a: 7, f BM
pinquis, 18a: 33, f USNM
projecta, 18c: 10 USNM
pseudocornis, 37a: 32, f EMMH*
pulchella, 35b: 129, f MZB
rufula, 35c: 429, f BM
rugonervosa, 18a: 34 USNM
selangori, 35d: 718, f USNM
semibrunnea, 29b: 477, f BM
setosa, 35b: 128, f Missing from MZB
sinensis, 34d: 21, f EMMH*
sinuata, 14b: 237, f USNM
sordida, 18c: 13 USNM
sumbawae, 14b: 237, f USNM
tectiforma, 38b: 204, f LUEM*
tigris, 35d: 719, f USNM
tonkini, 42a: 65, f USNM
triangulata, 18c: 12 USNM
trifoliata, 14b: 235, f (moved to *Cryptaspidia* Stål by Allen 1951) USNM
tuberculata, 14a: 70, f USNM
virescens, 27h: 256, f BM

Gongroneura Jacobi
carinata, 27g: 147, f (moved to *Kombazana* Distant by Capener 1952) ZISSR
Hoplophora Germar
rubripes, 22a: 10 (moved to *Hoplophorion* Kirkaldy by Funkhouser 1927) USNM
Horiola Fairmaire
fenestrata, 22a: 20, f (a junior synonym of *H. ferruginea* Fairmaire) USNM
Hybanda Distant
bifurca, 27g: 148, f (moved to *Eumonocentrus* Schmidt by Goding 1932) ZISSR
Hybandoides Distant
sumatrensis, 27a: 15, f BM
Hypsauchenia Germar
recurva, 29a: 112, f (moved to *Pyrgauchenia* Breddin by Goding 1951) USNM
Hypsoprora Stål
albopicta, 22a: 7, f USNM
Insitoroides, 33a: 3
typicus, 33a: 4, f IFRM

Iria Stål
lethierryi, 27d: 147, nom. nov. pro *Darnoides carinata* Lethierry 1881
Lallemandia, 22a: 33
nodosa, 22a: 33, f USNM
Leioscyta Fowler
brunnea, 19d: 268 USNM
ferruginea, 22a: 6, f USNM
pulchella, 30a: 411, f USNM
trimaculata, 22a: 5, f USNM
Leptobelus Stål
decurvatus, 21b: 43, f USNM
elevatus, 21c: 685, f USNM
nigris, 29b: 473, f BM
Leptocentrus Stål
alba, 29b: 470, f BM
albescens, 35c: 427, f [moved to *Tricoceps* Buckton by Capener 1953) BM
albolineatus, 37d: 238, f USNM
arcuatus, 27f: 113, f USNM
brunneus, 35c: 428, f BM
gracilis, 27c: 307, f AMS
jacobsoni, 27a: 12, f BM
luteinervis, 36c: 245, f BM
manilaensis, 27f: 112, f USNM
pilosus, 36b: 191, f NMBE
pubescens, 37c: 122, f USNM
purpureus, 29b: 471, f BM
rufospinus, 27a: 13, f BM
tenuicornis, 27a: 11, f BM
Lycoderes Germar
luteus, 40a: 275, f USNM
triangulata, 19d: 276, USNM
Machaerotypus Uhler
brunneus, 22b: 328, f (moved to *Boccar* Jacobi by Metcalf and Wade 1965) EMZSI
rubronigris, 38a: 17, f (moved to *Subrincator* Distant by Jacobi 1944) EMMH*
Maguva Melichar
brunnea, 37b: 100, f BM
cornuta, 32a: 116, f BM
nigra, 29a: 116, f USNM
sinuata, 35b: 121, f (a junior synonym of *M. nigra* Funkhouser) MZB
Maturna Stål [preoccupied] (the following species are in *Maturnaria* Metcalf 1952)
lloydi, 14e: 280, f USNM
maculara, 30a: 417, f USNM
Maurya Distant
angulatus, 21b: 48, f USNM
bicolor, 36c: 246, f BM
brevicornis, 21b: 49, f USNM (a junior synonym of *Machaerotypus sibiricus* Lethierry)
decorata, 37a: 29, f EMMH*
denticula, 38a: 18, f EMMH*
nodosa, 40b: 145, f MDEI
Membracis Fab.
bucktoni, 21a: 151, nom. nov. pro *Cryptonotus militaris* Buckton 1903
humilis var. *aurora,* 19d: 267 (a junior synonym of *M. peruviana* Fairmaire) USNM
nigrolutea, 27e: 159, f [moved to *Enchophyllum* [*Enchophyllum*] Amyot and Serville by Goding 1928] CUEM

schmidti, 27d: 53, nom. nov. pro *Phyllotropis trimaculata* Schmidt 1924 [a junior synonym of *Enchophyllum* [*Phyllotropis*] *trimaculatum* Schmidt 1924]
Mesocentrus, 21c: 681 [preoccupied] (changed to *Mesocentrina* Metcalf 1952)
    pyramidatus, 21 c: 681, f USNM
Metheisa Fowler
    fowleri, 27d: 321, nom. nov. pro *M. sinuata* Funkhouser 1914 (moved to *Ecuatoriana* Goding by Metcalf and Wade 1965)
    sinuata, 14c: 362, f USNM (a junior synonym for *Ecuatoriana fowleri* Funkhouser)
Micrutalis Fowler
    nigromarginata, 40a: 289, f USNM
Mina Walker (listed in family Nicomiidae by Metcalf and Wade 1965)
    spinosa, 30a: 409, f USNM
Nassunia Stål
    nigrofascia, 22a: 13, f USNM
Nilautama Distant
    minutispina, 18c: 3 USNM
Ochropepla Stål
    carinata, 22a: 11, f [moved to *Hoplophorion* [*Trinarea*] by Goding 1929] USNM
Ophiderma Fairmaire
    fascipennis, 19d: 274 USNM
Orekthen, 30a: 406 (listed in family Biturritiidae by Metcalf and Wade 1965)
    osborni, 30a: 407, f USNM
    darwini, 34c: 203, f BM
Orekthophora, 30a: 412
    cornuta, 30a: 412, f USNM
Otinotoides Distant
    brevicornis, 35c: 432, f BM
    brunneus, 27c: 309, f AMS
    bulbosus, 35b: 124, f Missing from MZB
    dorsatus, 36b: 192, f NMBE
    elevatus, 35c: 431, f BM
    minuticornis, 35c: 431, f BM
    pubescens, 29a: 115, f USNM
Otinotus Buckton
    arcuatus, 19c: 222, f (moved to *Izzardiana* by Capener 1952) USNM
    pilosus, 19c: 222, f USNM
Pantaleon Distant
    brunneus, 21b: 45, f USNM
    bulbosus, 37b: 101, f OUEM
Paragargara Goding
    nigra, 40a: 279, f USNM
Parayasa Distant
    maculipennis, 20a: 224, f USNM
Periaman Distant
    acuticornis, 36d: 187, f BM
    brevifrons, 15e: 383, f USNM
    rectidorsum, 27b: 107, f BM
Platybelus Stål
    albescens, 27g: 146, f (moved to *Stalobelus* by Capener 1954) ZISSR
    brunneus, 34a: 339, f (moved to *Distantobelus* by Capener 1954) NCIP
    luteus, 14b: 239 USNM
    projectus, 36b: 193, f NMBE

Polyglypta Burmeister
    buctoni [sic] *bucktoni*, 27d: 324, nom. nov. pro *P. strigata* Buckton 1903 (a junior synonym of *P. costata* Burmeister) BM
Poppea Stål
    nitida, 30a: 416, f USNM
    zebrina, 30a: 416, f USNM
Potnia Stål
    brunneifrontis, 43c, 464, f USNM
    maculata, 43c: 463 USNM
Pyrgauchenia Breddin
    angulata, 32a: 114, f BM
    brevinota, 32a: 115, f BM
    brunnea, 32a: 113, f BM
Pyrgonota Stål
    arborea, 37d: 242, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) USNM
    binodis, 27f: 110, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) USNM
    brevifurca, 27f: 110, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) USNM
    bulbicornis, 27h: 253, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) BM
    bulbiturris, 27f: 109, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) USNM
    longiturris, 18a: 23, f USNM
    nodituris, 21c: 684, f USNM
    pinguiturris, 15e: 374, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) USNM
    sinuata, 29a: 111, f (moved to *Funkhouserella* Schmidt by Funkhouser 1951) USNM
Rhexia Stål
    rubra, 35c: 433, f BM
Sarritor Distant (junior synonym of *Hemicentrus* Melicher, listed in family Aetalionidae by Metcalf and Wade 1965)
    attenuatus, 21b: 50, f USNM
    cornutus, 27g: 150, f ZISSR
Scaphula Fairmaire
    maculata, 22a: 15, f (moved to *Rhexia* Stål by Goding 1929) USNM
Scytodepsa Stål (listed in Family Aetalionidae by Metcalf and Wade (1965)
    tricarinata, 27e: 163, f CUEM
Sextius Stål
    projectus, 27c: 312, f AMS
Sipylus Stål
    acuticornis, 18a: 30, f USNM
    auriculatus, 37d: 243, f USNM
    nodipennis, 14a: 72, f (a junior synonym of *S. dilatatus* Walker) USNM
    rotundatus, 27f: 118, f USNM
    sericeus, 38b: 200, f LUEM*
    truncaticornis, 36d: 188, f BM
Spalirisis Distant
    nigris, 51a: 205, f, nom. nov. pro *S. majusculum* Distant, a MS name (moved to *Anchon* Buckton by Capener 1954)
Spinodarnoides, 30a: 413
    typus, 30a: 413, f USNM
Spongophorus Fairmaire
    foliatus, 22a: 8, f USNM (in subgen. *Cladonota* Stål)
Stegaspis Germar
    viridis, 15f: 104, f USNM

- *Stictocephala* Stål
  - *elevata,* 19d: 271 USNM
  - *minuta,* 15a: 99, f (moved to *Stictolobus* Metcalf by Caldwell 1949) USNM
  - *nigriventris,* 19d: 272 (moved to *Melusinella* by Metcalf 1952) USNM
- *Stictolobus* Metcalf
  - *erectus,* 19d: 272 USNM
  - *lateralis,* 36a: 21, f USNM (moved to *Tortistilus* Caldwell 1949)
  - *maculatus,* 27e: 162, f CUEM
  - *marginatus,* 40a: 285, f USNM
  - *nitidus,* 40a: 284, f USNM
  - *trilineatus,* 18b: 186, f USNM (moved to *Tortistilus* Caldwell 1949)
  - *viridis,* 43b: 75, f (a junior synonym of *Anisostylus fulgidus* Ball) USNM
- *Stylocentrus* Stål
  - *rubrinigris,* 40a: 276, f USNM
- *Sundarion* Kirkaldy
  - *nigromacula,* 40a: 281, f USNM
- *Takliwa,* 35c: 430
  - *carteri,* 35c: 430, f BM
- *Telamona* Fitch
  - *alta,* 15a: 97, f (moved to *Telonaca* by Ball 1931) USNM
- *Telingana* Distant
  - *depressa,* 35b: 122, f Missing from MZB
- *Terentius* Stål
  - *niger,* 36b: 194, f NMBE
- *Thrasymedes* Kirkaldy
  - *virescens,* 40a: 288, f USNM
- *Thuris,* 43d: 229
  - *fenestratus,* 43d: 231, f USNM
- *Tragopa* Latreille
  - *albifascia,* 22a: 16, f USNM
  - *bitriangulata,* 30a: 414, f USNM
  - *brunneimaculata,* 22a: 18, f USNM
  - *bucktoni,* 27d: 172, nom. nov. pro *Chelyoidea nitida* Buckton 1903 BM
  - *decorata,* 14d: 407, f Location of type unknown
  - *longa,* 22a: 17, f USNM
  - *luteimaculata,* 14d: 406, f USNM
  - *maculidorsa,* 22a: 19, f USNM
  - *parishi,* 27d : 177, nom. nov. pro *Chelyoidea maculata* Funkhouser 1922 (a junior synonym of *Tragopa cimicoides* Coquebert)
  - *peruviana,* 27d: 177, nom. nov. pro *Chelyoidea brunnea* Funkhouser 1922 USNM
  - *pubescens,* 22a: 17, f USNM
  - *testudina,* 43c: 470, f USNM
- *Tricentrus* Stål
  - *acuticornis,* 19a: 22, f USNM
  - *aequicornis,* 27f: 116, f USNM
  - *aiyura,* 33a: 5, f IFRM
  - *albescens,* 29a: 121, f USNM
  - *albipes,* 27a: 4, f BM
  - *altidorsus,* 29a: 124, f USNM
  - *amplicornis,* 37d: 240, f USNM
  - *attenuatus,* 15e: 388, f USNM
  - *attenuicornis,* 29a: 120, f USNM
  - *bakeri,* 29a: 119, f USNM

banguensis, 14b: 238, f USNM
bergeri, 27g: 151, f ZISSR
brevicornis, 20a: 214, f USNM
brevis, 14b: 239 USNM
brevispinis, 38b: 206, f LUEM*
brunneicornis, 29a: 126, f USNM
brunneus, 18c: 7 USNM
carinatus, 37c: 125, f USNM
curvicornis, 27g: 153, f ZISSR
decurvatus, 14b: 238, f USNM
depressicornis, 35a: 82, f EMMH*
dyaki, 37b: 102, f OUEM
fasciipennis, 18a: 28, f USNM
ferruginosus, 29a: 123, f USNM
forticornis, 29a: 118, f USNM
fukienesis, 35a: 81, f EMMH*
fulgidus, 29a: 122, f USNM
kriegeli, 32a: 118, f BM
laticornis, 18a: 27, f USNM
latus, 27a: 5, f (moved to *Otaris* Buckton by Goding 1934) BM
maacki, 27g: 152, f ZISSR
maculus [sic] (*maculatus*), 38b: 202, f LUEM*
manilaensis, 27f: 115, f USNM
minutus, 36b: 195, f NMBE
nigris, 20a: 212, f USNM
nigroapicalis, 27a: 3, f BM
nigrofrontis, 29a: 125, f USNM
nitidus, 27a: 2, f BM
nivis, 32a: 119, f BM
obesus, 42a: 61, f USNM
orientalis, 35a: 83, f EMMH*
ornatus, 38b: 205, f LUEM*
panayensis, 27f: 114, f USNM
papuaensis, 29a: 122, f USNM
pieli, 34d: 19, f EMMH*
pilinervosus, 14a: 68, f USNM
pilosis, 32a: 120, f BM
pinguidorsis, 27c: 308, f AMS
plicatus, 15e: 387, f USNM
porrectus, 29a: 118, f (moved to *Otaris* Buckton by Goding 1934) USNM
pubescens, 29a: 127, f USNM
purpureus, 42a: 62, f USNM
robustus, 18a: 26, f USNM
rufipennis, 35b: 125, f Missing from MZB
samai, 37a: 30, f Location of type unknown
spinicornis, 18c: 6 USNM
spinidorsis, 29b: 475, f BM
spininervis, 27f: 115, f USNM
spinis, 35d: 720, f USNM
suluensis, 29a: 125, f USNM
taurus, 42a: 62, f USNM
truncaticornis, 18c: 8 (moved to *Otaris* Buckton by Goding 1934) USNM

Tricoceps Buckton
    rugosa, 27g: 149, f (a junior synonym of *Spalirises alticornis* Jacobi) ZISSR
Tropidoscyta Stål (a junior synonym of *Erechtia* Walker)
    albipes, 22a: 4, f USNM
    binotata, 14c: 359, f USNM
    brunneidorsata, 14c: 357, f USNM
    immaculata, 22a: 3, f USNM
    maculata, 14c: 360 f (moved to *Leioscyta* Fowler by Goding 1928) USNM
    minuta, 22a: 5, f USNM
Tylocentrus Van Duzee
    quadricornis, 19b: 217, f USNM
Tynelia Stål
    cerulea, 35c: 434, f BM
    nigra, 40a: 287, f USNM
Umbonia Burmeister
    antigua, 43c: 462, f USNM
    immaculata, 43c: 463 USNM
    lutea, 22a: 10 USNM
Vanduzea [sic] *Vanduzeea* Goding
    decorata, 40a: 287, f USNM
    mayana, 43c: 480, f USNM
    punctipennis, 19d: 275 USNM
Xantholobus Van Duzee
    arizonensis, 43b: 76, f USNM
Xiphistes Stål
    maculipennis, 39a: 35, f USNM
    orientalis, 18c: 1 (moved to *Sinenodus* by Goding 1951) USNM

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The Entomologist's Record

THE BEE GENUS PROTERIADES IN WYOMING (HYMENOPTERA: MEGACHILIDAE) [1]

V. J. Tepedino[2]

ABSTRACT: This note reports the initial collection of the bee genus *Proteriades* in Wyoming. Examination of pollen grains carried in the scopa of each of three female specimens revealed that only pollen from *Cryptantha flavoculata* had been collected.

DESCRIPTORS: Hymenoptera; *Proteriades; Cryptantha;* distribution; flower constancy.

LaBerge (1973) has recently reported the collection of two females of *Proteriades incanescens* (Cockerell) in South Dakota. This species had previously been recorded only from California, Arizona and Nevada (Timberlake and Michener, 1950). Other species of the genus are confined to California with the exception of one species which has been collected in the Northwest (Stephen, Bohart and Torchio, 1969). This note further documents the extension in range of this species. Three female specimens were collected in Albany County, Wyoming approximately seven miles S.S.E. of Laramie on June 20 and 22, 1974 between 1100 and 1300 hours. The individuals were captured in shortgrass prairie on the flowers of *Cryptantha flavoculata* (A. Nels.) Payson (Boraginaceae). Species identification has been confirmed by F. D. Parker, Bee Biology and Systematics Laboratory, USDA, Logan, Utah. Examination of pollen loads carried by each of the specimens revealed only *Cryptantha* pollen. Previous and subsequent collections made at a similar site one-half mile northwest of the collection site did not contain *Proteriades.*

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GENUS *CALLOPISTROMYIA* HENDEL (DIPTERA: OTITIDAE)[1]

George C. Steyskal[2]

ABSTRACT: *Pterocalla strigula* Loew, until now considered as the only North American species of an otherwise wholly neotropical genus, is transferred to *Callopistromyia* Hendel, a hitherto monotypic genus based upon *Platystoma annulipes* Macquart. The 2 species *Callopistromyia annulipes* (Macquart) and *C. strigula* (Loew), new comb., are compared. *Pseudotephritis* Malloch, previously a subgenus of *Pseudotephritis* Johnson, is raised to generic rank.

DESCRIPTORS: Otitidae; Diptera; *Callopistromyia, Pterocalla, Pseudotephritis, Pseudotephritina.*

In revising my key to the genera of Otitidae (Steyskal, 1961) for the manual of North American Diptera now in preparation, I tried to improve the section referring to the genera *Callopistromyia, Diacrita, Pseudotephritis,* and *Pterocalla. Diacrita* differs considerably from the other 3 genera, which are quite similar. It became apparent that *Pterocalla strigula* Loew was poorly placed generically, inasmuch as it has an entirely straight vein r_{2+3} and lacks the eye-spots on the wing and the expanded pterostigma characteristic of *Pterocalla.* The species is in fact extremely similar to *Callopistromyia annulipes* (Macquart) and is found in the same habitat and geographic area. True *Pterocalla* species are not known outside the neotropical region.

The only differences I can discern between *Callopistromyia annulipes* and *Pterocalla strigula* lie in the shape, pattern, and some features of the venation of the wing. I am therefore transferring *Pterocalla strigula* to the genus *Callopistromyia* Hendel, a genus including only *Platystoma annulipes* Macquart. *Callopistromyia* in this expanded sense is very close to *Pseudotephritis* Johnson, less the subgenus *Pseudotephritina* Malloch, which deserves elevation to generic rank as indicated in the key below. The

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group of genera including *Pseudotephritis, Pseudotephritina*, and *Callopistromyia* has the following characters in common: extension of anal cell as long as or shorter than free part of anal vein; dorsocentral bristles 2, sometimes preceded by 1 or 2 much finer setae, all of which are postsutural; tibiae usually distinctly banded. The 3 genera may be distinguished as follows.

Key to Genera of *Pseudotephritis* Group

1 (2) Scutellum laterally with pair of extensive shining black areas; tibiae with at most lightly infuscated subbasal and apical sections, not distinctly banded; small stump vein projecting from vein m_{1+2} into discal cell . . . . new status *Pseudotephritina* Malloch,

2 (1) Scutellum wholly tomentose, gray and brown; tibiae contrastingly banded; stump vein lacking.

3 (4) Anterior apical angle of discal cell close to 90°; discal cell with extensive areas of solid color; extension of anal cell half or less than half as long as free part of anal vein . . . . *Pseudotephritis* Johnson

4 (3) Anterior apical angle of discal cell about 60°; discal cell largely dark brown, mottled; extension of anal cell half as long or as long as free part of anal cell . . . . *Callopistromyia* Hendel

The 2 species of *Callopistromyia* are distinguished as follows:

Key to Species of *Callopistromyia* Hendel

1 (2) Wing ovate, not over 2.25 times as long as wide; vein r_1 ending well apicad of anterior crossvein; discal cell largely dark brown, mottled with vermiculate subhyaline pattern . . . . *C. annulipes* (Macquart)

2 (1) Wing with costal and hind margins subparallel, about 3 times as long as wide; vein r_1 ending about at level of anterior crossvein; discal cell dark brown, mottled with slightly paler brown . . . . *C. strigula* (Loew), new comb.

Bibliographic references to all taxa will be found in Steyskal (1965).

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NOTES ON NESTS AND PREY OF TWO SPECIES OF GROUND-NESTING EUMENIDAE FROM SO. AMERICA (HYMENOPTERA)[1]

By Howard E. Evans, Robert W. Matthews[2]

ABSTRACT: Descriptions are provided of the nests and prey of *Stenodynerus otomitus* Saussure, studied in Colombia, and *Ancistrocerus clarazianus* Saussure, studied in Argentina. A description of the mature larva of *S. otomitus* is also included.

DESCRIPTORS: Hymenoptera; Eumenidae; *Stenodynerus; Ancistrocerus;* nests.

The following notes may be of some interest as confirming behavioral consistencies in wasps of the Eumenidae as a group, and at the same time confirming inconsistencies in behavior among species of the genera involved. Both *Stenodynerus* and *Ancistrocerus* include ground-nesters, twig-nesters, and makers of free mud cells, the inhabitants of different substrates behaving similarly regardless of generic assignments. Similar remarks might be extended to other genera of Eumenidae, suggesting that in this family one finds little of the close concordance of behavior and structure that occurs in the Sphecidae (Nielsen, 1932; Evans, 1956).

Stenodynerus otomitus Saussure

We found this species nesting in small numbers in eroded hillsides just west of the city of Cali, Colombia, in January, 1972. Nests were in bare, firm clay soil and were widely spaced (at least a meter apart) and intermingled with those of *Trachypus petiolatus* (Spinola), *Bicyrtes discisa* (Taschenberg), and species of halictid bees. Five nests of *S. otomitus* were

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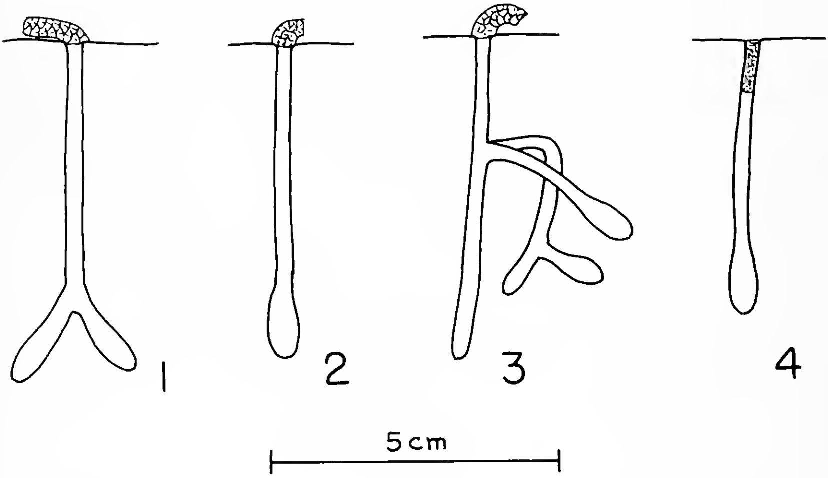
marked at one site and later excavated (EC2, 21, 32, 37; MC1). Another nest was found about 5 km away, again in an eroded hillside but in a hard-packed gravel road (MC3); here the major associate was *Rubrica surinamensis* (DeGeer).

Each of the six nests was surmounted by a small turret consisting of ringlets of mud. These turrets measured 5-6 mm in outside diameter, 4-4.5 mm in inside diameter; four of them measured 10-11 mm in length, but two were only about 5 mm long, i.e., no longer than their diameter. All were curved to a horizontal position, the opening facing down-slope in the two nests that were on a slope. One turret that was accidentally knocked off on 9 January had not been replaced on 16 January, although the female was still in the nest. Possibly these turrets play a role in preventing rain from washing into the vertical burrows.

The six nests were all of much the same depth, 4-7 cm, all but two approximately 6 cm in depth. In three cases the vertical burrow was unbranched (Fig. 2), in two there was a fork in the burrow either near the bottom or about halfway down (Fig. 1), and in one there were three branches arising part way down, one of them bifurcate apically, so that there were 4 termini in all (Fig. 3). Generally each branch terminated in a cell, although one unbranched burrow appeared to terminate in two cells in series, separated by a small earthen barrier. Burrow diameter was 3-4 mm; cells measured 5 x 12 mm.



Figs. 1-4. Nests of South American Eumenidae. Fig. 1. *Stenodynerus otomitus* Saussure, no. EC2. Fig. 2. *S. otomitus*, no. EC37. Fig. 3. *S. otomitus*, no. MC3. Fig. 4. *Ancistrocerus claraziarius* Saussure, no. EC59.

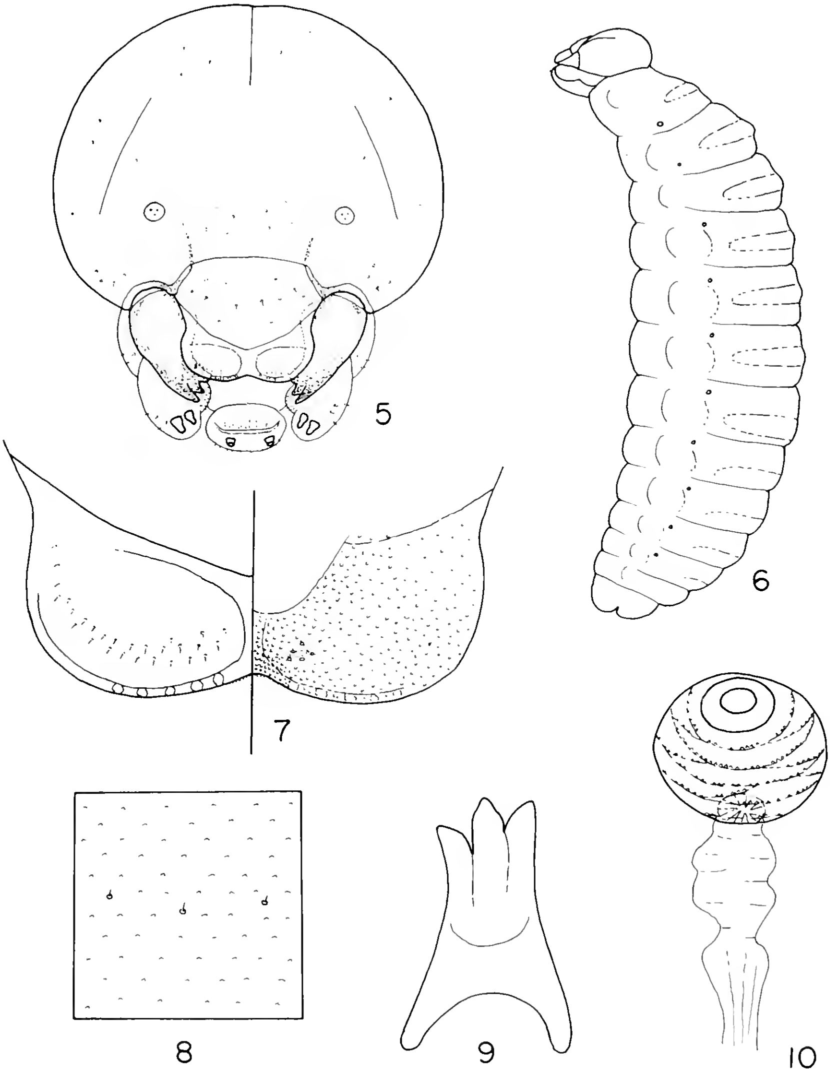
Females were occasionally seen entering or leaving their nests, but none was observed digging, building turrets, or provisioning. In three cases females were in the burrow, facing out, when the nest was excavated. One cell, the only cell at the terminus of the vertical burrow of EC37, contained an egg. The egg was lying flat on the bottom of the empty cell when found; it is possible that had been dislodged from its original position. Cells of three other nests contained larvae partially grown. In two cases there was no prey in the cell, suggesting that provisioning may have been delayed by showers. In one case (MC1) a partly grown larva was accompanied by 16 paralyzed lepidopterous larvae, 2-8 mm long, a mixture of Gelechiidae, Pterophoridae, and Pyraustidae. The largest of the wasp larvae was preserved and is described below.

One cell contained the pupa of a bombyliid fly, which was not successfully reared to adulthood. Other cells were empty or contained fragments of old cocoons, while other termini had apparently not yet been expanded into cells. We obtained the impression that these wasps build and provision very slowly, and the presence of cocoon fragments in some nests suggests that females may reoccupy the nests from which they emerged.

Description of larva: Length 9.5 mm; maximum width 2.9 mm. Body cylindrical, abruptly tapered both anterior and posteriorly; terminal segment somewhat rounded, the anus a transverse slit at about the middle of the segment (Fig. 6). Pleural lobes moderately developed, each body segment except last two crossed by a transverse dorsal elevation. Spiracles about .08 mm in diameter except most anterior pair very slightly larger; external opening small, peritreme well developed; walls of atrium lined with anastomosing ridges which are armed with small asperities; opening into subatrium apparently armed with several teeth (Fig. 10). Integument smooth, although under high power a few minute setae can be observed on the dorsum, as well as sparse, minute granules (Fig. 8).

Head width 1.4 mm, height (exclusive of labrum) 1.3 mm (Fig. 5). Coronal suture short, weak; parietal bands long but unpigmented; clypeofrontal suture nearly straight; head capsule and clypeus with scattered small punctures, a very few of them with minute setae. Antennal orbits circular, .08 mm in diameter, each bearing three minute sensilla in the membrane of the orbit. Clypeus 1.7 x as wide as its median height, apical margin subangulate. Labrum .55 mm wide, bilobed, each lobe bearing a band of about 28 minute setae; apical margin somewhat thickened, bearing several sensory cones; epipharynx densely spinulose medially, elsewhere with sparse, weak spinules, sensory pores five on each side, rather close to the midline (Fig. 7). Mandibles .5 mm long, .32 mm wide at the base; apex with three large, broad teeth; mesal surface somewhat hollowed (Fig. 9). Maxillary palpi about .08 mm long, galeae very slightly shorter; maxillae with a few very small setae laterally, mesal margin produced, minutely spinulose. Spinneret a transverse slit with raised lips, .25 mm long; labial palpi very short; oral surface of prementum weakly spinulose.

Remarks: This larva resembles closely that of *S. canus* Bohart as recently described by Clement (1973), although the shape of the palpi and of the spiracular subatrium is somewhat different. Resemblance to Grandi's (1961) more detailed sketches of *Ancistrocerus gazella* Panzer is also close aside from a major difference in shape of the cranium; features of the mouthparts are virtually identical, indeed the mandibles of all three of these species are much the same.



Figs. 5-10. Mature larva of *Stenodynerus otomitus* Saussure. Fig. 5. Head, anterior view. Fig. 6. Body, lateral view. Fig. 7. Labrum (left) and epipharynx (right). Fig. 8. Portion of dorsum of prothorax, under high magnification. Fig. 9. Mandible, mesal surface. Fig. 10. Anterior thoracic spiracle, under high magnification.

Ancistrocerus claraziānus Saussure

This wasp was common in and near the city of Cafayate, Salta, Argentina, during February, 1972, and we found three nests in flat, hard-packed sandy soil. One was found in an athletic field inside the city limits (EC59), two others in areas of bare soil at Yacochuya, 8 km NW of Cafayate (EC47, MC21). One of these nests was in an early stage of construction, the vertical burrow reaching a depth of only 4 cm. The female was seen carrying small pellets of earth from the nest in flight and dropping them 3-5 cm away, all on one side of the hole, so that there was a scattering of pellets on this side over a band about 4 cm wide, starting about 3 cm from the hole and extending about 5 cm from the hole. Another female was seen flying with small pellets in a similar manner, but dropping them 30-60 cm from the hole. This nest appeared to have a very small, probably incipient turret at the entrance, only 2mm high. This nest was also incomplete, the vertical burrow, 3-4 mm in diameter, ending blindly at a depth of 5 cm.

The third nest (EC59) was being closed by the wasp when we discovered it. The top 1 cm of the burrow was filled solidly with a slightly moist earthen plug. The female was evidently smoothing over the top of the plug when she was captured. The burrow was vertical, 5.5 cm in length, terminating in a single cell which contained an egg that had been laid erect in the bottom center of the cell (Fig. 4). The cell also contained three paralyzed caterpillars, all about 1 cm long, *Loxostege* sp. (Pyralididae). We judge this to have been the final closure of a completed nest; it is possible that the turret had been used up in making the closing plug.

We found a paralyzed male *A. clarazianus* in a nest of *Trachypus petiolatus* in Cafayate (Evans and Matthews, 1973).

ACKNOWLEDGMENTS

We thank W.G. and M.J.W. Eberhard for their hospitality while were in Colombia and A. Willink for much assistance while we were in Argentina. A. Willink and R.M. Bohart identified the wasps, D.M. Weisman the lepidopterous larvae. Specimens of wasps have been deposited at the Museum of Comparative Zoology, Harvard University, along with copies of our field notes, referred to by number in the text.

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A EUROPEAN HARVESTMAN IN NORTH AMERICA (PHALANGIDA, PHALANGIIDAE)[1]

Ross T. Bell[2]

ABSTRACT: The first record of the European harvestman, *Oligolophus tridens* Koch is recorded from North American in northwestern Vermont. A general description of the phalangid is given which will distinguish it from two other common northeastern species, *Odiellus pictus* (Wood) and *Mitopus morio* Fab.

DESCRIPTORS: A European Harvestman in North America (Phalangida,Phalangiidae)

I have long sought to identify a local species of phalangid which is not in the most detailed revision of the group for northeastern U.S. (Bishop, 1949). Dr. Vladimir Silhavy, of Trebic, Czechoslovakia has very kindly determined it as *Oligolophus tridens* Koch. In Bishop (1949) it will trace to the subfamily Oligolophinae, since the basal segment of the chelicera has a spiniform process on the ventral side. It agrees with the common northeastern *Odiellus pictus* (Wood) in having three strong spines on the anterior margin of the carapace but it lacks the femoral spines on the pedipalp which characterize the latter species. The other northeastern Oligolophine, *Mitopus morio* Fab. is a high montane species which lacks both the 3 anterior marginal spines and the femoral spines.

Large immatures of this species are mostly pale dull yellow with small scattered brown spots. They coalesce at maturity to form a vitta with indefinite lateral borders. In the male, the vitta is usually interrupted on the first and second abdominal segments. The male is more narrowed posteriorly than is the female, and the eyes are somewhat larger and more separated.

Both sexes have well developed dorsal spines on the coxae with one on the anterior face of the fourth coxae being especially prominent. The female has prominent mesal lobes on the pedipalpi, but these are lacking in the male.

This is the first record of the species from North America, although unidentified immature *Oligolophus* were reported from Newfoundland by Hackman (1956). *Oligolophus tridens* is found in areas of disturbed soil, such as gardens, pastures, and floodplains. It has been caught at Burlington, Colchester, Isle La Motte, and on the shores of the Winooski River opposite to Bolton. All these localities are in northwestern Vermont. The species seems to be strictly nocturnal, hiding under dense bushes, in tall grass, or under driftwood by day. It is caught frequently in pitfall traps.

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NEW GENUS AND SPECIES OF AMPHIPSOCIDAE FROM SOUTHEASTERN ASIA (PSOCOPTERA) [1]

Edward L. Mockford[2]

ABSTRACT: *Calocaecilius* n. gen. is described with *C. decipiens* n. sp. as its type and only known species. The species occurs in Malaysia and the Philippine Islands. The genus is assigned to Amphipsocidae but is not closely related to any known amphipsocid genera. It is similar in superficial appearance to the psocids of the family Calopsocidae. It is suggested that both groups mimic coccinellid beetles.

DESCRIPTORS: Psocoptera; Amphipsocidae; *Calocaecilius* new genus, *Calocaecilius decipiens* new species.

A new genus described below shows in general the characters of Group Caecilietae as stated by Badonnel (1951). It is placed in Amphipsocidae as defined by Badonnel (1955) because of possession of the following characters: (1) robust wings, (2) costa broad and densely setose from base of pterostigma to apical curve in forewing, (3) forewing veins bearing long, strong, upright setae in more than one rank. The new genus is apparently not very closely related to any of the known amphipsocid genera.

Abbreviations used for the measurements in the description are explained as follows: FW.L. = forewing length; T = length of posterior tibia; t_1 = length of posterior basal tarsomere; t_2 = length of posterior distal tarsomere; $t_1$ct = number of ctenidia on posterior basal tarsomere; IO/D = smallest distance between compound eyes dorsally divided by greatest antero-posterior diameter of compound eye in dorsal view; PO = greatest lateral diameter of compound eye in dorsal view divided by greatest antero-posterior diameter of the eye in dorsal view.

Calocaecilius gen. nov.

Type species: *Calocaecilius decipiens* n.sp.

Vertex slightly extended and flattened behind compound eyes. Antennae slender, about two-thirds length of forewing, bearing sparse semi-upright setae. Lacinial tip (Fig. 3) bicuspid. Forewing (Fig. 1) somewhat coriaceous and elytriform, the surface textured with

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slight wrinkling. Hairs on veins in forewing restricted to dorsal surface. Pterostigma greatly shortened. Areola postica open basally due to absence of vein Cu_{1b}. Hindwing (Fig. 2) broad, with ciliation developed around entire margin except for a hiatus on anterior margin from near wing base to end of vein R_1. Two ventral abdominal vesicles present, one between segments four and five, the other between segments five and six. Gonapophyses of either side (Fig. 6) arising close together from a strongly sclerotized basal shaft; first valvula curving gradually from its departure from shaft nearly to its tip; rudimentary third valvula bearing a single seta. Subgenital plate (Fig. 7) cornered laterally on posterior margin but without protruding apophyses at corners; its pigmentation two diverging arms broadly separated medially. Glandular area of spermathecal duct (Fig. 4) elongate and slender. Epiproct (Fig. 5A) short and wide, densely setose in distal half. Paraproct (Fig. 5B) setose along posterior margin and with scattered setae elsewhere; a small field of short spines on posterior margin ventrally; sense cushion rounded, bearing approximately 26 trichobothria.

***Calocaecilius decipiens*, n.sp. (♀)**

Measurements (in microns).--

	FW.L.	T	t_1	t_2	t_1ct	IO/D	PO
Holotype	3200	975	224	125	9	2.43	0.70
Paratype	2772	971	281	106	13	2.54	0.78
Other ♀	3194	967	223	115	8	2.41	0.68

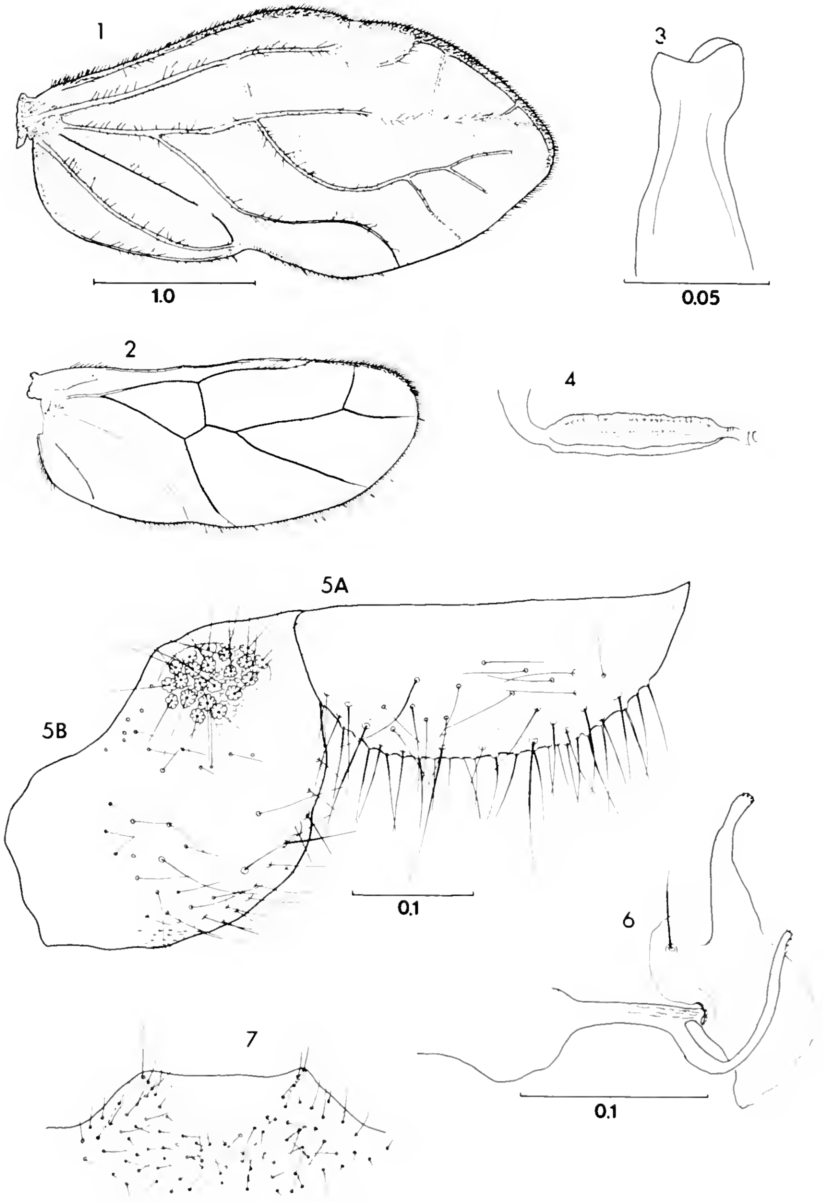
Morphology.--As described for the genus.

Color (in alcohol).--Compound eyes black. Head in general pale yellowish-brown; ocellar interval and labrum medium brown. Antennae and legs pale yellowish-brown. Thoracic terga medium brown except creamy yellow along sutures. Thoracic pleura pale reddish-brown. Wings brown-washed, forewings more strongly so than hindwings. Preclunial abdominal segments dark reddish-brown. Clunium, epiproct, and paraprocts medium brown.

Holotype ♀ and 1♀ paratype.--Philippine Islands: Mindanao: Davao Prov.: eastern slope of Mount McKinley, 7 Sept. 1946, el. 3300 ft., coll. F. G. Werner. Types will be deposited in the Field Museum, Chicago, Ill.

Additional record.--Malaysia: Pahang State: road from 'The Gap' to Frazer's Hill, 24 Nov. 1966, beating dry leaves of low trees, 1♀, coll. E. L. Mockford.

Discussion.--This insect has a striking superficial resemblance to the psocids of the family Calopsocidae, which are also southeast-Asian. The resemblance is caused primarily by the broad, coriaceous forewings of both and by presence of a decided bend in the costa on the anterior margin of the forewing. In *Calocaecilius*, the bend occurs at the base of the pterostigma, while in the calopsocids it occurs at the distal end of the pterostigma. In either case, the wing margin distal to the bend stands at about 130 degrees to the margin basal to the bend. The bend continues across the wing, but posterior to the margin it is not so strongly expressed. The result is that the wing surface from the region of the bend to the tip appears rounded downward when the wings are folded, so that they resemble the elytra of a beetle. The flattening of the posterior head margin is only slight in *Calocaecilius* as opposed to the calopsocids, in which the posterior head margin is blade-like. In both groups, however, the head



Figs. 1-7. Structures of *Calocaecilius decipiens*, n. gen., n.sp., holotype ♀. Fig. 1. Forewing (fork of vein R_{4+5} is an anomaly present only on one side of one individual). Fig. 2. Hindwing (same scale as forewing). Fig. 3. Lacinial tip. Fig. 4. Duct of spermatheca (same scale as Fig. 6). Fig. 5A. Epiproct. Fig. 5B. Paraproct. Fig. 6. Right gonapophyses. Fig. 7. Subgenital plate (half scale of Fig. 5). Scales in mm.

flattening allows the head to be closely appressed to the pronotum. I have observed living calopsocids in the field in Assam and Queensland, and I find the total effect of their appearance and gait is reminiscent of a coccinellid beetle. Accordingly, I believe that the calopsocids are coccinellid mimics. The resemblances between *Calocaecilius* and the calopsocids are explainable, then, on the basis of the former being a member of the same mimetic complex as the latter.

ACKNOWLEDGEMENTS

I wish to thank Mr. Henry Dybas of the Field Museum of Natural History for initiating the loan of material which included the types of species described here.

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The Entomologist's Library

This section contains titles of books, monographs, and articles received by the editor that may be of special interest to entomologists and biologists. A brief statement of contents and items of interest are noted. Brief analytical reviews may be submitted for possible publication. All correspondence for this section should be addressed to the editor.

BOOK REVIEW

THE PEST WAR. W. W. Fletcher. 1974. Halsted Press, John Wiley & Sons, N.Y. 218 pages. 19 photos. $11.95.

Although not limited to insect pests (other pests treated are insect relatives, weeds, fungi and certain vertebrate pests), the main thrust of this book is a review of the various methods of insect and weed control. The development and use of chemicals for pest control forms the main bulk of this book and methods discussed include pesticides, insecticides, herbicides and fungicides.

Also included is a chapter on so-called novel control methods such as sterilization and sex and food lures, and a fine chapter on biological control, following which the author, who is "internationally known as an expert on pesticides" concedes that the future may lie with *integrated* control, making use of both chemical and biological methods.

Concluding chapters document the breat benefits accrued to mankind through the use of pesticides and review how their use can and must be controlled by government and other agencies so that no permanent damage will be sustained by the environment. A very complete list of references is provided for further reading, together with listings of the common and scientific names of all pests and the common and chemical names of all pesticides mentioned in the text.

STUDIES ON THE BIOLOGY OF THE CHRYSOPIDAE V. THE DEVELOPMENTAL AND REPRODUCTIVE MATURATION RATES OF *CHRYSOPA CARNEA* NEUROPTERA: CHRYSOPIDAE) [1 2]

Joseph K. Sheldon,[3] Ellis G. MacLeod[4,5]

ABSTRACT: The effect on the developmental rate of *Chrysopa carnea* Stephens of the variables photoperiod, temperature, geographic locality, diapause state, and sex was examined by multiple regression analysis. A significant three-way interaction between photoperiod, temperature, and locality was found. Both diapause state and sex were also found to have a significant effect on development, although neither were involved in interactions with other factors.

A study of the effect of photoperiod on the reproductive maturation rate of nondiapausing adults was also made. A significant difference was found in the response of females reared under LD = 14/10 vs. LD = 16/8. The significance appears to lie in the degree of heterogeneity of the female's response once yolk depostion has begun. No effect was found on the males examined.

Chrysopa carnea Stephens, one of the more common North American members of the ubiquitous family Chrysopidae, is widely distributed throughout the temperate regions of the world. Recently this species has gained attention as a potential biological control agent because of its highly predaceous larval stages (Lingren et al. 1968a,b; Ridgway and Jones 1969) and a number of studies examining aspects of its biology have appeared. These include work on the adult feeding habits (Hagen et al. 1970a, b; Sheldon and MacLeod 1971), characteristics of the diapause phenology (MacLeod 1967; Honek 1973; Honek and Hodek 1973; Tauber and Tauber 1969, 1970a,b, 1972, 1973a,b; Tauber et al. 1970a,b), and more general studies of the over-all seasonal cycle (Zeleny 1965, Sheldon and MacLeod 1974).

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[2] The work was supported by a grant from the National Science Foundation (GB8644). This study is part 5 of a series published under the general title "Studies on the Biology of the Chrysopidae." Part 4 appears in the bibliography as Sheldon and MacLeod (1974). The present paper was incorrectly cited in part 4 where it was listed as part 3 instead of part 5.

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[5] We are indebted to R.B. Selander for his suggestions and assistance in the statistical analysis of our data.

The data presented here relate to yet another phase of the biology of *C. carnea*, the developmental and reproductive maturation rates. We have examined the influence of the variables photoperiod, temperature, geographic origin, diapause state, and sex, plus their interactions on the developmental rate from egg to adult. This is then followed by a consideration of the response of newly emerged, nondiapausing adults to different photoperiods above the diapause inducing level in order to determine whether, once the critical photoperiod has been surpassed, if there is a photoperiodic effect on the reproductive maturation rate.

MATERIALS AND METHODS

The investigation of the pre-imaginal developmental rate utilized the offspring of 54 field-collected adult females from 3 localities, Paducah, Kentucky (37°N, 16 females); Urbana, Illinois (40 N, 22 females); and Madison, Wisconsin (43°N, 16 females). The work was carried out over a period of about 2 years (1969-1970) and involved 5 rearing experiments which examined the effects of 18 different photoperiods ranging from LD = 10/14 to LD = 16/8 at 2 temperatures, 19°C and 25°C on the developmental rate of the 3 geographic stocks. Results of the five rearings were pooled for the final analysis. Approximately 2200 individuals were reared in the study. In each rearing, the adults utilized for oviposition had constant access to both food (described by MacLeod 1967) and water. They were maintained at 25°C, LD = 16/8 prior to and during egg collection and an equal number of eggs was collected daily from each female. These were randomly distributed among the photoperiod and temperature regimes utilized during the rearing. The larvae were maintained as described by MacLeod (1967) except for the addition of a relative humidity control (see Sheldon and MacLeod 1971). After the adults emerged, they were held for six days, dissected, and analyzed for diapause as described elsewhere (Sheldon and MacLeod 1974). The ultimate fate, diapause vs. nondiapause, was considered a variable in the analysis.

The offspring of 12 females collected at Urbana, Illinois on 9 and 12 June 1969 were utilized to examine the effect of photoperiod on the reproductive maturation rate. These females were maintained as a mass culture at 25°C, LD = 16/8. Eggs were collected daily and were placed individually into cotton-stoppered, 2-dram shell vials. They were then divided equally between the 2 photoperiodic regimes, LD = 14/10 and LD = 16/8. The larvae were reared as above. These 2 photoperiods were chosen because they are on opposite ends of the ecologically relevant, nondipause-inducing photoperiods experienced by the Urbana population. LD = 14/10 is near the

Table 1. ANOVA of time to reach successive growth stages of *Chrysopa carnea*. The error mean square is used as the denominator in the F ratio as test of significance. * < 5%, ** < 1%, *** < 0.5%, **** < 0.1%

		MS values: Number of days to:					
Source	df	1st Instar	2nd	3rd	Cocoon	Pupa	Adult
Regression	26	90.35****	276.73****	533.08****	841.83****	1378.20****	2606.40****
Temperature (T)	1	369.00****	1175.16****	2061.44****	3387.32****	5858.70****	11552.07****
Sex (S)	1	0.86*	9.12****	44.07****	129.36****	119.48****	139.62****
Locality (L)	2	0.41	5.66****	19.67****	19.03****	15.20****	26.11****
Photoperiod (P)	4	2.63****	15.98****	50.94****	88.65****	80.98****	110.86****
T x L	2	0.29	1.50	7.80***	3.69	4.31	7.00
T x P	3	5.83****	4.19****	4.60**	13.33****	15.51****	16.54****
L x P	6	0.21	1.67*	4.33****	9.31****	7.56****	5.42*
T x L x P	6	0.33*	0.55	0.74	4.74**	4.42*	3.32[a]
Diapause (cov.)	1	< 0.01	2.37	9.53***	26.17****	26.66****	17.80**
Residual	2165	0.13	0.67	1.14	1.67	1.99	2.41
Terms dropped	34	0.12	0.80	1.16	1.17	1.55	2.37
Error	2131	0.14	0.67	1.14	1.68	2.00	2.41
R^2		0.889	0.832	0.849	0.858	0.893	0.929

[a] T x L^2 x P^2 and T x L^2 x P^3 terms significant at <5% level.

critical photoperiod, but enough above it that there is no diapause (Sheldon and MacLeod 1974). LD = 16/8, on the other hand, is approximately the longest photoperiod experienced at a latitude of 40°N.

Upon emergence, the adults of each photoperiod were separated by sex and were randomly divided into groups to be dissected at the adult ages shown in Figs. 4 and 5. Prior to dissection, the adults were maintained under their rearing conditions. The analysis of the degree of reproductive maturation in the females was based on a measurement of the diameter of the basal oocyte of the largest ovariole in each ovary. A diameter of approximately 0.41 mm indicates the presence of a mature oocyte, while a teneral or diapausing individual has ovarioles with a maximum diameter of about 0.07 mm. In the males the position of the sperm was noted. A shift of sperm from the testis to the seminal vesicle indicates a sexually mature individual.

With the exception of the males in the reproductive maturation experiment where a chi square test was utilized, the results of both studies were analyzed with a multiple regression analysis.

RESULTS

Developmental Rate. The results of our analysis are presented in Table 1. The analysis was partitioned such that the separate contributions of each instar from egg to adult could be determined. All possible interactions for main factors and the covariate were considered. Terms were dropped only after examination of their contributions to regression sum of squares indicated that the terms were unnecessary. Retained interactions involving locality include both its linear and quadratic components; retained interactions involving photoperiod include its linear, quadratic, and cubic components.

In the periods to the 1st instar, cocoon, pupa, and adult, the analysis indicates that T (temperature) , L (locality) , and P (photoperiod) are involved in three-way interaction in the sense that the effect of any one factor depends on the levels of the other 2 factors. It should be pointed out that for the adult stage, although the 3-way interaction was not significant, 2 of the terms, of the 6 that are included in this interaction, are significant at less that the 5% level. Therefore, there is significant 3-way interaction if the interaction is partitioned into its individual components; then the 2 terms would be shown as significant. In the case of the 2nd and 3rd instars, the overall 3-way interaction is not significant, nor is any of the 6 terms included in each of these interactions significant.

The high degree of significance that was found in the lower-level terms, especially in the 2nd and 3rd instars and the adult stage where the 3-way interaction was lacking or only partially present, should also be noted. Of the 2-way interactions, L x P and T x P, all are significant with the exception of L x P in the 1st instar. Also T x L in the 3rd instar proved highly significant. The main factors, T, L, and P were all significant with the exception of locality in the 1st instar. Sex (S) was also found to be highly significant even though its interactions were not. The males consistently developed faster than the females. Diapause, the covariate, was also found to have a significant effect in all except the 1st 2 periods, the diapausing individuals developing, on the average, slightly faster (0.46 days) than the nondiapausers.

The developmental rates for all instars (sexes combined) of the Paducah, Ky.; Urbana, Ill.; and Madison, Wisc. populations are shown in Figs. 1-3 respectively. A close examination of these figures reveals where some of the complexity lies. The effect of temperature alone is striking, but it is also evident that the general shape of the photoperiodic response curve is consistently different at the 2 temperatures (compare A and B in all 3 figures), a feature which is not surprising considering the high degree of significance for the T x P interaction shown in Table 1. The response of

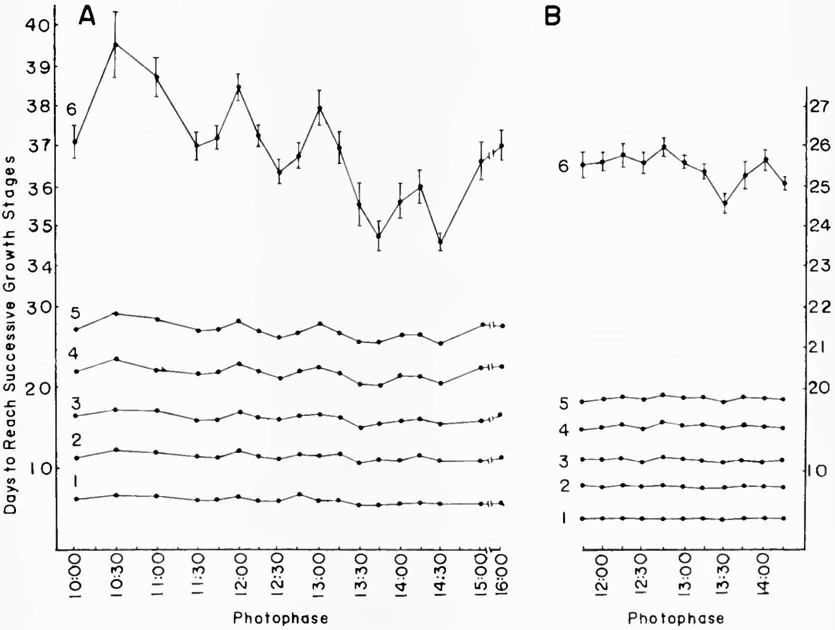

Fig. 1. Time to reach successive growth stages of C. *carnea,* Paducah, Kentucky population. A = 19°C; B = 25°C. 1 = the length of time to reach the 1st instar (hatching of egg); 2 = time to 2nd instar; 3 = time to 3rd instar; 4 = time to pre-pupa (spinning of cocoon; 5 = time to pupation; 6 = time to adult eclosion. The standard error for each photophase is given for the adult.

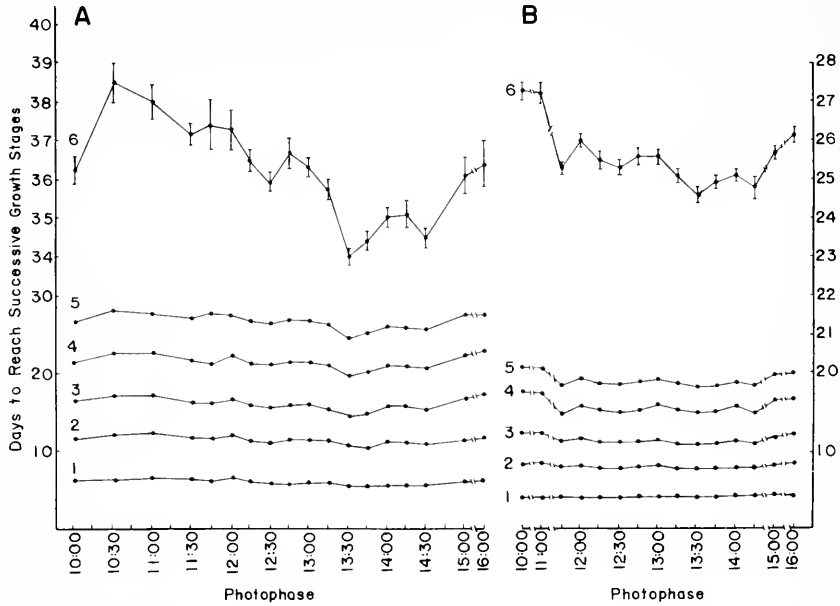

Fig. 2. Time to reach successive growth stages of C. *carnea,* Urbana, Illinois population. A = 19°C; B = 25°C. 1 = the length of time to reach the 1st instar (hatching of egg); 2 = time to 2nd instar; 3 = time to 3rd instar; 4 = time to pre-pupa (spinning of cocoon); 5 = time to pupation; 6 = time to adult eclosion. The standard error for each photophase is given for the adult.

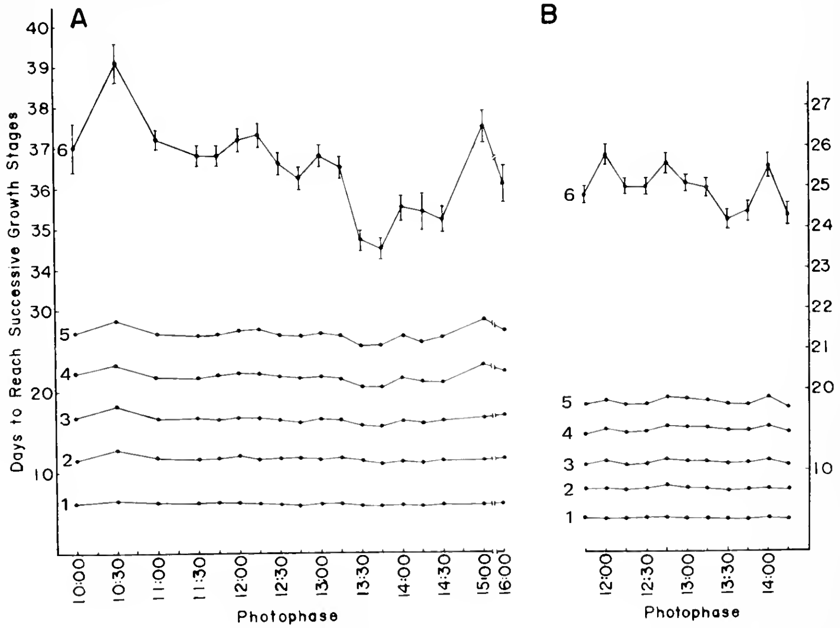

Fig. 3. Time to reach successive growth stages of C. *carnea,* Madison, Wisconsin population. A = 19°C; B = 25°C. 1 = the length of time to reach the 1st instar (hatching of egg); 2 = time to 2nd instar; 3 = time to 3rd instar; 4 = time to pre-pupa (spinning of cocoon); 5 = time to pupation; 6 = time to adult eclosion. The standard error for each photophase is given for the adult.

the 3 geographic populations also can be seen to vary with the temperature and photoperiod. A 19°C the Urbana population developed most rapidly under 12 of the 18 photoperiods examined, while Paducah was the slowest in 11 cases. The results were noticeably different at 25°C where the Madison population was found to develop most rapidly under 8 of the 11 photoperiods examined, with Paducah again the slowest 8 out of the 11 times.

Reproductive Maturation Rate. The results of this study are presented in Figs. 4 and 5. Females were found to initiate ovariole swelling, the first indication of yolk deposition, at about 48 h following adult eclosion and most individuals examined had mature eggs by 120 h (Fig. 4 A,B). Some difference was present between the 2 groups with respect to the degree of variance once yolk deposition has begun. This was particularly apparent in the 84- and 108-h groups in the LD = 14/10 series in which there was significantly less yolk deposition present than in the corresponding groups at LD = 16/8. A differential response between the 2 groups was also indicated by multiple regression analysis ($P < 0.05$).

The results of the males (Fig. 5A,B) show that maturation occurs much earlier in this sex. The first males to undergo a sperm shift were encountered after 15 h in the LD = 14/10 group and after 21 h in the LD = 16/8 group. By 42 h all males examined at LD = 16/8 and all but 3 at LD = 14/10 had shifted sperm. The response of the LD = 14/10 group seemed to be somewhat more scattered (although not significantly so), since the first shift appeared 6 h earlier and the last shift 6 h later than that found in the LD = 16/8 group.

DISCUSSION

Developmental Rate. That the developmental rate may be affected by a number of parameters has been common knowledge for many years. Most of the studies examining the influence of these parameters have been restricted to single factor analysis, with the effect of temperature receiving by far the most attention (see Wigglesworth 1965). Other factors whose effect on the developmental rate have been examined include the length of the photoperiod (reviewed by Beck 1968, and dealt with in more recent studies such as those by Lutz 1968, Benschoter 1968, Clark 1969); sex (innumerable cases are known in which one sex develops faster than the other); and intraspecific differences due to geographic origin (Danilevskii 1965).

Recently attempts have been made to examine simultaneously the influence of some of these environmental parameters to determine their joint effect (see for example Selander and Weddle 1972). This latter approach has the potential of providing a great deal more information

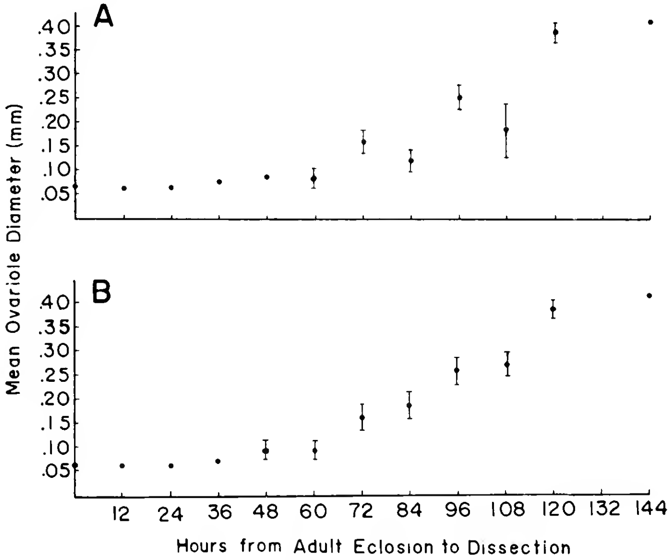

Fig. 4. The ovariole maturation rate of C. *carnea* females at two different photoperiod. A. LD = 14/10; B. LD = 16/8. N = 8 for each point. The standard error is given where equal to or greater than 0.01.

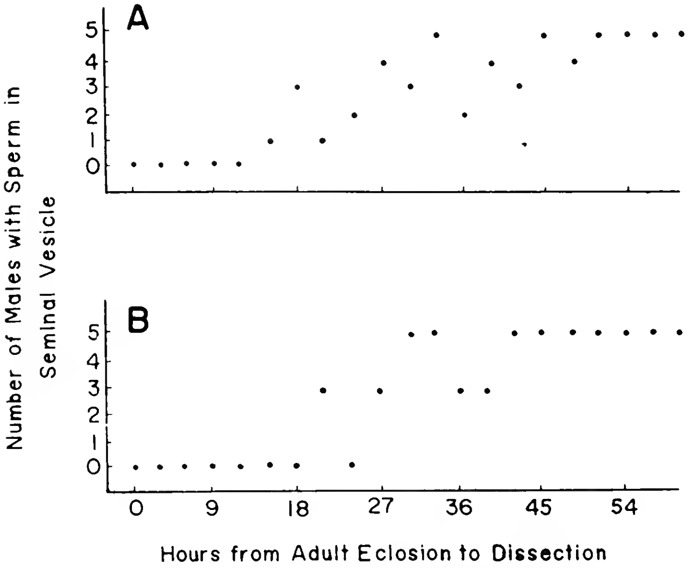

Fig. 5. The timing of the sequence of sperm shift from the testis to the seminal vesicle in C. *carnea* males at two different photoperiods. A. LD = 14/10; B. LD = 16/8. N = 5 for each point.

concerning the nature of the response as well as information about the organism's monitoring system since, as we have demonstrated, and it was also shown to be the case in the beetles examined by Selander and Weddle, multifactor control systems with high levels interaction are present in some species and are probably quite common. An attempt to deal with such complex problems by using single factor analysis will provide some information, but it is also likely to give a gross oversimplification of the actual conditions.

The significant 3-way interaction between temperature, locality, and photoperiod that we encountered in our analysis provides a good example of the complexity that may be involved. This is in marked contrast to the results reported by Benschoter 1968, working on *Heliothis zea* (Boddie) and *H. virescens* (Fabricius) who examined only the effect of photoperiod and found that an increase in the amount of light accelerated the developmental rate in approximately a linear manner. Although we found the slowest growth rates were at the short photoperiods, it was at the middle photoperiods that the most rapid development took place rather than at the long photoperiods as reported by Benschoter. This was true in all geographic populations at 19°C and in the Urbana group at 25° C. Unfortunately, the extreme photoperiods were not examined at 25°C for the Paducah and Madison strains.

The high degree of significance of the locality effect encountered in our study, outside of its part in the interaction, should also be noted since, in general, insects have not been found to show a geographic effect of locality on the developmental rate (Danilevskii 1965). Danilevskii suggests that this probably is due to the relatively uniform distribution of temperatures throughout the range of most species during the growing season. It would seem reasonable, however, that a southern population might develop more slowly at a given temperature e.g., Paducah, Ky. than its northern counterparts since the longer growing season would not necessitate a rapid growth rate to complete the life cycle-up to the point where additional generations are added. Since we have analyzed only the number of generations in the Urbana population (Sheldon and MacLeod 1974), we are unable to provide precise information on this point. The ecological reason why the Urbana population develops more rapidly at 25°C than Madison and then reverses itself at 19°C is also unclear at this time.

The more rapid development of the males would seem to indicate the presence of a selective advantage for a large early population of this sex. This same phenomenon was also encountered in the study of the overwintering generation discussed elsewhere (Sheldon and MacLeod 1974) in which the males were found to leave the overwintering sites first and undergo their sperm shift well before the females reach sexual maturity. Since both sexes undergo multiple matings (Sheldon and

MacLeod, unpublished data; Tauber and Tauber 1969) this would seem to maximize the likelihood of an adequate initial supply of males and, combined with the relatively long life span of both sexes (up to several weeks), it should also provide a sufficient number of males for subsequent matings.

Reproductive Maturation Rate. The initial motivation for this study was the need to determine the optimal time for performing dissections in the analysis for diapause in an investigation reported by Sheldon and MacLeod 1974. Individuals emerging in diapause cause no problems since their reproductive status remains constant, assuming that they are held under diapause maintaining conditions, for several weeks (see Sheldon and MacLeod 1974 and Tauber et al. 1970a for details). Our primary concern was the type of response shown by individuals reared at photoperiods very close to, but slightly above those inducing diapause vs. the typical long-day conditions during mid-summer.

It is clear, for the purpose of diapause analysis, that the response to the 2 photoperiods examined is essentially uniform. The difference in the rate of maturation encountered in the females was of little importance to the analysis since yolk deposition was initiated and mature eggs were encountered at approximately the same time in both groups. At 25°C a delay of 48 h in the dissection of males following adult eclosion provided sufficient time to permit those individuals not going into diapause to shift sperm to the seminal vesicle. Likewise, a delay of 5 days is sufficient for virtually all nondiapausing females to develop mature eggs.

The increased heterogeneity in the response at LD = 14/10 may indicate that at the shorter photoperiods, above the diapause-inducing levels, that individuals may not be entirely turned off to diapause. They may, in fact, undergo a periodic regression toward diapause which is then followed by another period of yolk deposition. It would seem likely that one might encounter some evidence of yolk resorption and/or an increase in the length of time required for development, however we did not detect either.

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The Entomologist's Record

To encourage the publication of concise and useful new distribution records, corrections or previously published erroneous records, misidentifications, short field notes, and current news items about entomologists, amateur and professional, entomology departments and museums, prompt publication is offered in this department.

TWO SPECIES OF ODONATA NEW TO PENNSYLVANIA [1]

Clark Shiffer[2]

ABSTRACT: Two species of Odonata are reported from Pennsylvania for the first time. These are *Coenagrion resolutum* (Hagen) (Coenagrionidae), the first member of this genus to be taken in the state, and *Sympetrum costiferum* (Hagen) (Libellulidae).

DESCRIPTORS: *Coenagrion resolutum* (Hagen); *Sympetrum costiferum* (Hagen); New distribution records; Pennsylvania.

On 24 June, 1971, a single mature male specimen of *Coenagrion resolutum* (Hagen) was taken by the writer at Hills Creek State Park, Tioga County, Pennsylvania. This is the first representative of the genus *Coenagrion* to be taken in Pennsylvania.

A total of four mature male specimens of *Sympetrum costiferum* (Hagen) were taken by the writer on 13 and 14 August, 1974, at Beechwood Lake, about 13.5 miles northwest of Wellsboro, Tioga County, Pennsylvania. Several tandem pairs of this species were seen but could not be captured. The collection of *costiferum* raises to seven the number of species of *Sympetrum* which are known from Pennsylvania.

Both species are known to occur in New York and Ohio, so their occurrence in Pennsylvania was anticipated.

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[1] Accepted for publication: December 2, 1974.

[2] 254 S. Gill Street, State College, Pennsylvania 16801

ENT. NEWS, 85 : 5 & 6 : 170, May & June 1974

NEW SPECIES OF *PANORPA* (MECOPTERA: PANORPIDAE) [1]

Donald W. Webb[2]

ABSTRACT: A new species of Nearctic *Panorpa* is described and its relationship to closely related species is discussed.

DESCRIPTORS: Mecoptera; Panorpidae: *Panorpa setifera,* new species: *P. helena; P. insolens;* Wisconsin.

While collecting specimens of Mecoptera for a faunistic study of the midwestern species, an unidentifiable male specimen of *Panorpa* was collected at Parfrey's Glen, Wisconsin. This specimen resembled *Panorpa helena* in the characters of the wing membranes and in having several large, black setae at the apex of the basistyle. A recent collecting trip to Wisconsin added seven additional specimens (four males, three females). On the basis of this material and after examination of the male by Dr. George Byers, at the University of Kansas it has been determined that these specimens are a new species. On the basis of the female terminalia and wing membranes the females of this species are closely associated with *P. helena* (Byers, 1962) and *P. insolens* (Carpenter, 1935; Byers, 1973) and at this time no definitive character can separate these females from those of *P. insolens*.

Panorpa setifera, new species

The description of this species is based on eight specimens (four males, three females in alcohol; 1 male pinned).

Head.--Eyes dark brown to black. Occiput, vertex, front, and rostrum dark yellowish brown. Labial palps dark brown. Ocelli pale yellow to amber on dark brown to black subtriangular pad. Scape of antenna dark yellowish brown; pedicel and flagellar segments black.

Thorax.--Pleura pale yellow, the dorsum somewhat darker. Pronotum with 12 long, black setae along anterior margin. Legs pale yellow, tarsi darkened toward apex, apical segment dark brown to black.

Wings.--Wing length 11.1-11.6 mm. Membranes (Fig. 1) pale yellow to amber. Apical band entire, dark brown to black with 2-4 small pale spots. Pterostigmal band dark brown to black, broad, continuous, anterior fork broken with apical branch reduced to small dark spot. Basal band dark brown to black, broken into two small spots. Marginal spot(s) and second basal spot absent. First basal spot small, dark brown to black. Crossveins not margined.

Abdomen.--Venter pale yellow to brown in both sexes. Dorsum of males pale to dark yellow with abdominal terga 2-4 dark brown. In females all abdominal terga dark reddish brown.

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[1] Accepted for publication: January 10, 1974.

[2] Illinois Natural History Survey, University of Illinois, Urbana, Illinois 61801.

Third abdominal tergum of male with dark brown to black notal organ along posterior margin. Sixth abdominal tergum of male with dark yellowish anal horn.

Terminalia.--Genital bulb of male pale to dark yellow. Ninth tergum (Fig. 2) narrow, elongate, apex emarginate forming two thick lateral lobes. Hypovalves (ninth sternum) (Fig. 3) narrow, elongate, of nearly uniform width throughout, fused near base of basistyle and extending to base of dististyle. Dististyle (Fig. 3) simple, falcate, two-thirds length of basistyle, with shallow, saucerlike excavation on mesal surface. Basistyle (Fig. 3) short, broad, with large tubercle bearing six thick, strong, black setae at mesal apex of basistyle. Ventral parameres (Figs. 3, 4, and 5) broad, sinuate, barbed along mesal margin with ventral valves extending slightly beyond base of dististyle, fused basally to form two narrow elongate extensions which extend over half the length of ventral valves. Lobes of aedeagus short (Fig. 4), broad, not extending beyond base of dististyle.

Subgenital plate of female(Fig. 6) cone-shaped, rounded apically. Genital plate (Fig. 6) short, 0.95 ± 0.004 mm (N = 3) in length. Distal plate 0.59 mm in length, broad, emarginate apically to form two moderately thick lateral lobes. Spermathecal apodeme narrow, elongate, extending beyond base of distal plate 0.63 times length of distal plate, not extending apically to base of apical emargination of distal plate. Basal plate absent.

This species is known from a single locality in southern Wisconsin and is closely associated with *P. helena* and *P. insolens*. Collections made at various localities within a radius of thirty miles around Parfrey's Glen produced no additional specimens. The males of *P. setifera* resemble *helena* in the characters of the wing membranes and in the presence of coarse, dark setae at the apex of the basistyle. The males of *setifera* differ from *helena* in the presence of a broad, mesal tubercle at the apex of the basistyle bearing six dark, thick setae (Fig. 3) and with the ventral parameres fused basally to form a pair of narrow elongate projections (Fig. 3). The females of *setifera* resemble closely both *P. helena* and *P. insolens* in the characters of the wing membranes and the genital plate. No morphological characters could be found to separate *setifera* from *insolens* and both of these species are separated from *helena* only on the length of the genital plate.

Specimens Examined. –Holotype ♂ (INHS), WISCONSIN, Sauk County, Parfrey's Glen, 3.0 miles north of Merrimac, July 21, 1973, D.W. Webb. Allotype♀, Paratypes 3 ♂♂ 2 ♀♀ (INHS, SEM), same data as holotype; 1 ♂ (INHS) August 5, 1972, same locality as holotype. Type specimens are deposited in the Illinois Natural History Survey (INHS) and the Snow Entomological Museum (SEM), University of Kansas.

Habitat.--All specimens were collected on jewel-weed (*Impatiens* sp.) and stinging wood nettle (*Laportea canadensis*) in a oak-maple woods along the spring fed stream in Parfrey's Glen.

Key to Related Species of *Panorpa*

Because no new keys to the species of *Panorpa* have been published since Carpenters' (1931) revision of the Nearctic Mecoptera and because certain synonymy and new species have been determined the keys to this new species are modifications of the keys present in a forth coming paper on the Mecoptera of Illinois which is now in press.

The males of *P. setifera* separate out in couplet 14 of the Mecoptera of Illinois which is modified here to include *setifera*.

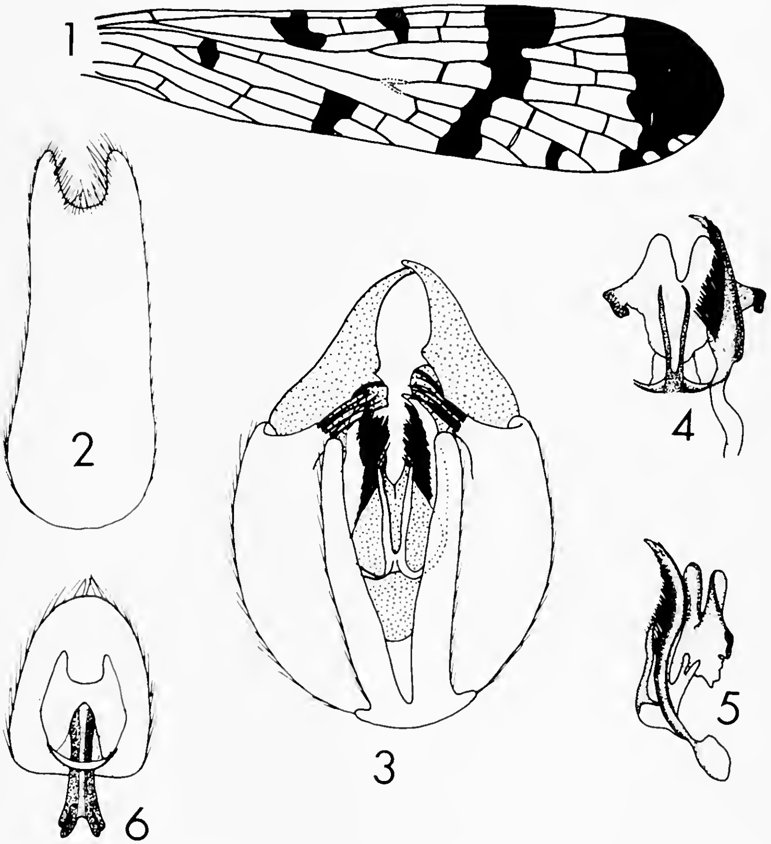
14. Basistyle with 1-6 dark, thick mesal setae (Fig. 3) at apex 14a
Basistyle without dark, thick setae at apex 15

14a. Basistyle with large, mesal, apical tubercle bearing six thick, black setae (Fig. 3). Ventral parameres broad, sinuate, barbed along mesal margin (Fig. 4), and fused basally to form two, narrow, elongate projections which extend posteriorly over half the length of ventral parameres

Basistyle without apical tubercle but with 1-3 dark, mesal setae at apex. Ventral parameres barbed along mesal margin, but not fused basally to form two mesal projections .... *helena*

The female genital plate of *P. setifera* separates out in couplet 22 of the Mecoptera of Illinois which is modified here to include *setifera*.

22. Genital plate over 1.04 mm in length .... *helena*
Genital plate (Fig. 6) less than 1.00 mm in length .... *setifera*
.... *insolens*



Figures 1-6 *Panorpa setifera*. 1) right fore wing. 2) dorsal view of ninth tergum. 3) ventral view of male terminalia. 4) ventral view of ventral parameres and aedeagus. 5) lateral view of ventral parameres and aedeagus. 6) dorsal view of female genital and subgenital plate.

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NEW RECORDS OF TWO RARE ROVE BEETLES FOR ARIZONA (COLEOPTERA: STAPHYLINIDAE) [1]

Ian Moore[2]

This short note is to verify two new records of rove beetles to be included in the new check list being produced for the *North American Beetle Fauna Project*.

Dacnochilus fresnoensis Leech was known from Fresno, Fresno County, and Sunnymead, Riverside County, California. A specimen in the collection of the University of California at Riverside is from Tucson, Pima County, Arizona, June 15, 1948, collected by R. H. Crandall, Sr.

Deleaster trimaculatus Fall was described from Colorado. I have seen specimens from California which are not before me at present. The collection at the University of California at Riverside contains three specimens, two from Prescott, Yavapai County, Arizona, August 15, 1964, collected by R. H. Crandall, Jr. and one from Pine Flat Campground, 12 miles south of Flagstaff on U.S. 89a, Coconino County, Arizona, collected by M. J. Wargo.

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[1] Accepted for publication: September 6, 1974.

[2] Staff Research Associate, Division of Biological Control, University of California, Riverside, California 92502.

An entomologist from Italy has written expressing a wish to correspond and exchange material on American Coleoptera and Lepidoptera. Name and address: Orselli Geom. Franco, Via Garzoni 5, 48012 B. Cavallo (RA), Italia.

ENT. NEWS, 85 : 5 & 6 : 174, May & June 1974

HOST-PLANT SPECTRUM OF STRAWBERRY SPIDER MITE[1 2 3]

D. J. Miller[4], W. A. Connell[5]

ABSTRACT: Eighty six species or varieties of angiosperms from 30 families were evaluated for suitability as hosts for *Tetranychus turkestani* Ugarov and Nikolski, the strawberry spider mite, and were rated as follows: 44.2% excellent, 16.3% acceptable, 8.1% poor and 31.4% unacceptable. The excellent hosts generally were concentrated in the upper middle portion of this subdivision of the plant kingdom, in the Rosaceae, Fabaceae, Malvaceae and their near relatives, but 2 of 4 Graminae and all 5 Cucurbitaceae tested also were excellent hosts.

DESCRIPTORS: Strawberry Spider Mite, Soybean Pests, Spider Mite Host Plants, *Tetranychus turkestani* U. & N.

In Delaware during dry summers, the strawberry spider mite, *Tetranychus turkestani* Ugarov and Nikolski, causes severe injury to soybeans (Simpson and Connell, 1973).

This study evaluates the suitability of a wide range of plants as hosts for *T. turkestani,* and gives information on possible overwintering hosts as well as on hosts from which the mite could migrate to soybeans. Mellott and Connell (1965) reported *T. turkestani* (under the synonym *T. atlanticus* McGregor) from 63 plant species, but said little about their suitability as hosts. Their list included plants reported as hosts in the literature which they were not able to confirm through collections.

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[1] Accepted for publication: December 5, 1973.

[2] Published as Miscellaneous Paper No. 664 with the approval of the Director of the Delaware Agricultural Experiment Station, Publication No. 423 of the Department of Entomology and Applied Ecology, University of Delaware, February, 1973. Part of a thesis submitted by the senior author in partial fulfillment of the requirements for the Master of Science degree.

[3] Acarina: Tetranychidae.

[4] Research Fellow (resigned June 30, 1972; now at Department of Entomology, Michigan State University, East Lansing, Mich.).

[5] Associate Professor.

ENT. NEWS, 85 : 5 & 6 : 175-179, May & June 1974

Materials and Methods--86 angiosperm species or varieties from 30 families were studied. Most of these were either potted with their root system intact in the field and transferred to the greenhouse or raised from seed. In the case of a few, which could not be transplanted easily, a leaf, or part of a leaf was evaluated on wet filter paper in a petri dish, a modification of Rodriquez' (1951) technique.

A soybean leaf infested with *T. turkestani*, from a greenhouse colony, was placed on each plant or isolated leaf being tested. The mites which migrated from this material then were allowed to feed for 9 days. The life cycle of this mite is about 8 days at 21° C and 4 days at 27°C (Cagle, 1956). Our tests were conducted at 21° to 38° C so there was sufficient time for completion of at least one generation. At the end of the test period a few leaves were removed from each plant in the immediate area of introduction of the mites and eggs were counted, using a stereomicroscope, on the leaf on which they appeared most abundant. Egg production probably gives an indication of host suitability, since with spider mites there is a direct relation between food uptake and oviposition rate (Boudreaux, 1958).

Results and Discussion--The results of these tests are recorded in Table 1, where the plants are listed according to the classification of Britton and Brown (Gleason, 1963); Gray's Manual (Fernald, 1950) was the source of common names. The plants are rated, according to the number of *T. turkestani* eggs per leaf, in 4 categories; 0 to 4 eggs - unacceptable; 5 to 24 - poor; 25 to 49 - suitable and 50 or more - excellent hosts. Overall, 60.5% appear to be excellent or suitable hosts and the remaining 39.5% poor or unacceptable. Included were 37 of the 63 species from which Mellott and Connell (1965) reported that this mite had been collected; of these, 21, or 57% were found to be excellent or suitable hosts.

Suitable to excellent hosts were found throughout this subdivision of the plant kingdom, but the greatest concentration was in the upper middle portion: the families Rosaceae to Asclepiadaceae. This includes the Fabaceae, or legumes, one of which is the soybean; the closely related Rosaceae; and Malvaceae, the family containing the economically important cotton plant. Sixty-six percent of 29 plants tested in this portion of the Angiospermae were excellent hosts and only 14% were unacceptable. This compares with 33% excellent hosts and 40% unacceptable among 57 plant species less closely related to the soybean. Notable among plant families not so closely related to the soybean, but containing excellent hosts, were two near opposite ends of the hierarchy, the monocotyledon family Graminae with two of four species excellent and the higher dictoyledon family Cucurbitaceae with all five tested being excellent.

Admittedly, the methods used provide only a rough estimate of host suitability. Therefore the host list developed is only a tentative one. We did not attempt a critical evaluation, since it is probably that fecundity in this spider mite is influenced by many things that we were in no position to control; air temperature and humidity at the leaf surface, fertility requirements of each plant species, age and conditions of prior exposure of plants, to mention a few. However, we believe the study provided a list of plants that we can now follow in nature to determine in what way they may contribute to maintenance of natural populations of *T. turkestani.* We anticipate that natural hosts will be found only among those rated here as excellent, since we know that *T. turkestani* has the ability, when it has no other choice, to maintain a population in the laboratory on plant species that we have never been able to associate it with in nature.

Suitability of selected plants as hosts of *T. turkestani.*

Family and Species	Common Name	Rating[a]
GRAMINAE		
Festuca rubra	red fescue	-
Lolium multiflorum	Italian rye grass	-
Sorgum vulgare cv.	sorghum	+ + +
Zea Mays	corn	+ + +
LILIACEAE		
Smilacina racemosa[b]	false solomon's seal	-
MORACEAE		
Morus alba[b,c]	white mulberry	+ + +
URTICACEAE		
Boehmeria cylindrica[b,c]	bog hemp	+
POLYGONACEAE		
Rumex crispus[b,c]	yellow dock	+ +
CHENOPODIACEAE		
Chenopodium album[b]	lamb's quarters	+
Beta vulgaris	red beet	+ + +
AMARANTHACEAE		
Amaranthus sp.[b]	amaranth	+ + +
PHYTOLACCACEAE		
Phytolacca americana[b,c]	poke	+ + +
AIZOACEAE		
Mollugo verticillata[b]	carpetweed	-
CARYOPHYLLACEAE		
Stellaria media	chickweed	+ + +
Dianthus Caryophyllus	carnation	+ + +
RANUNCULACEAE		
Thalictrum polygamum[b,c]	tall meadow rue	+
LAURACEAE		
Sassafras albidum[b,c]	white sassafras	+
PAPAVERACEAE		
Papaver sp.	poppy	+ + +

CRUCIFERAE				
Brassica oleracea botrytis	cauliflower			-
B. oleracea capitata	cabbage			-
Raphanus Raphanistrum[b]	wild radish		+	+
R. sativus	radish	+	+	+
Lobularia maritima	sweet alyssum			-
Barbarea vulgaris	yellow rocket			-
Matthiola incana	stock			-
ROSACEAE				
Fragaria virginiana[b]	strawberry	+	+	+
Potentilla norvegica[b]	cinquefoil	+	+	+
P. recta[b]	cinquefoil		+	+
Rubus sp.[b,c]	blackberry	+	+	+
FABACEAE				
Trifolium pratense[b]	red clover	+	+	+
T. repens[b]	white clover	+	+	+
T. repens cv.	Ladino clover	+	+	+
T. hybridum	alsike clover	+	+	+
T. procumbens	low hop-clover	+	+	+
Lespedeza intermedia[b, c]			+	+
L. cuneata	lespedeza			-
Arachis hypogaea	peanut	+	+	+
Lathyrus odoratus nanellus	dwarf sweet pea			-
Phaseolus limensis[b]	lima bean	+	+	+
P. vulgaris[b]	kidney bean	+	+	+
Pisum sativum	garden pea	+	+	+
Glycine Max[b]	soybean	+	+	+
OXALIDACEAE				
Oxalis stricta	wood sorrel			-
O. europaea cymosa[b]	wood sorrel			-
EUPHORBIACEAE				
Ricinus communis	castor bean	+	+	+
Euphorbia maculata[b]	eyebane			+
MALVACEAE				
Althaea officinalis[c]	marshmallow	+	+	+
A. rosea	hollyhock		+	+
Malva neglecta	common mallow	+	+	+
Gossypium hirsutum	cotton	+	+	+
UMBELLIFERAE				
Daucus Carota[b]	Queen Anne's Lace	+	+	+
D. carota sativa	carrot		+	+
APOCYNACEAE				
Apocynum cannabinum[b,c]	Indian hemp		+	+
ASCLEPIADACEAE				
Asclepias syriaca[b]	common milkweed	+	+	+
CONVOLVULACEAE				
Ipomoea hederacea[b]	morning glory			-
Convolvulus sepium	hedge bindweed	+	+	+
LABIATAE				
Mentha spicata	spearmint			-
SOLANACEAE				
Solanum tuberosum	potato			-
S. carolinense[b]	horse nettle			-

S. Melongena	eggplant	+ + +
Lycopersicon esculentum	tomato	-
Nicotiana sp.	nicotiana	-
Petunia sp.	petunia	-
Capsicum frutescens grossum	sweet pepper	-
SCROPHULARIACEAE		
Verbascum Blattaria[b]	moth mullein	-
Veronica persica	bird's eye	+ + +
PLANTAGINACEAE		
Plantago lanceolata[b]	buckhorn	+ +
CUCURBITACEAE		
Cucurbita maxima	butternut squash	+ + +
C. Pepo	pumpkin	+ + +
C. Pepo Melopepo[b]	summer squash	+ + +
Cucumis Melo	cantaloupe	+ + +
C. sativus	cucumber	+ + +
LOBELIACEAE		
Lobelia inflata[b]	Indian tobacco	+
COMPOSITAE		
Zinnia elegans	zinnia	-
Cosmos sp.	cosmos	+ +
Ambrosia artemisiifolia[b]	common ragweed	-
Tagetes patula	French marigold	+ +
Heterotheca subaxillaris[b]	camphorweed	-
Erigeron annuus[b]	daisy fleabane	-
Aster sp.	aster	+ +
Centaurea Cyanus	bachelor's button	+ +
Taraxacum officinale[b]	common dandelion	+ +
Lactuca sativa crispa	leaf lettuce	+ + +
L. sativa capitata	head lettuce	-
Chichorium Intybus[b]	common chicory	+
Ageratum Houstonianum	ageratum	+ +

a. + + + excellent host, + + suitable host, + poor host, - unacceptable
b. Hosts reported by Mellott and Connell (1965)
c. Evaluated by detached leaf technique

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INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE A.(n.s.)94

Required six-months' notice is given of the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names listed by case number: (see *Bull. zool. Nom.* 31, part 3, 20th September 1974)

1779. Suppression of *Didermocerus* Brooke, 1828 (Mammalia).
1888. Suppression of *Cicada cingulata* (Fabricius) var. *obscura* Hudson, 1891 (Insecta, Homoptera).
1959. Suppression of *Donacilla* De Blainville, 1819 (Mollusca).
2014. Suppression of *Hymenosoma laeve* Targioni Tozzetti, 1877 (Crustacea, Brachyura).
2031. Designation of a type-species for *Oxystomina* Filipjev, 1918 (Nematoda).
2048. Suppression of *Polygramma* Chevrolat, 1837 (Coleoptera, Chrysomelidae).
2057. Suppression of *Coccus sativus* Lancry, 1791, *Coccus mexicanus* Lamarck, 1801 and *Coccus silvestris* Lancry, 1791 (Insecta, Homoptera).
2059. Request for a rulling on the authorship of *Conus moluccensis* (Mollusca, Gastropoda).
2062. Conservation of *Aphis pyri* Boyer de Fonscolombe, 1841 and the suppression of *Aphis pyri* Kittel, 1827 and *Aphis pyri* Vallot, 1802 and seven other binominals proposed by Kittel in 1827 (Insecta, Homoptera).
2091. Designation of type-species for *Dactylopius* Costa, 1835 and *Pseudococcus* Westwood, 1840; proposed suppression of Diaprosteci Costa, 1828 (Insecta, Homoptera).

(see *Bull. zool. Nom.* 31, part 4, 13th January 1975 Lexact [exact publication]).

1092. Validation of *Aglaja* Renier, 1807, *Aglaja depicta* Renier, 1807 and *Aglaja tricolorata* Renier, 1807 (Mollusca, Opisthobranhica).
1746. Suppression of *Amphisbaena mildei* Peters, 1878 (Reptilia).
1884. Suppression of *Parnalius* Rafinesque, 1815 (Insecta, Rhopalocera).
2012. Suppression of *Calomicrus taeniatus* Wollaston, 1867 (Insecta, Coleoptera).
1980. Rejection of all usages of THRAUPIDAE, prior to that of Wetmore & Miller, 1926 (Aves).
2025. *Striglina* Guenee, 1877 to be given precedence over *Daristane* Walker, 1859 (Insecta, Lepidoptera).
2036. Designation of *Hydrophorus binotatus* Fallen, 1823 as type-species of *Hydrophorus Fallen, 1823 [Insecta, Diptera]*.
2060. Suppression of Xiphidium glaberrimum *Burmeister, 1838 and* Orchelimum
2063. Designation of a type-species for *Kerrichiella* Rosanov, 1965 (Insecta, Hymenoptera).
2064. Validation of *Echis coloratus* Gunther, 1878 (Reptillia, Serpentes).
2066. Suppression of *Heterodera urticae* Pogosyan, 1962 (Nematoda).
2067. Suppression of *Thrips rufa* Gmelin, 1790 (Insecta, Thysanoptera).

(Continued on page 185)

SURVEY OF FOOD PREFERENCES OF SOME NO. AMERICAN CANTHONINI (COLEOPTERA: SCARABAEIDAE) [1]

Robert D. Gordon,[2] O. L. Cartwright[3]

ABSTRACT: The food preferences of some species of North American Canthonini are discussed and pertinent literature sources cited.

DESCRIPTORS: Coleoptera; *Canthon*, s. str., *Boreocanthon; Melanocanthon; Glaphyrocanthon; Pseudocanthon;* food preferences; association with rodents.

The food preferences of most North American Canthonini are either unknown or unrecorded and there is a paucity of this information because most museum specimens bear no habitat or host data. During a recent field trip to Colorado, North Dakota and South Dakota, Gordon made several observations on *Boreocanthon praticola* (LeConte) . As a result of these observations, we decided to search the literature and examine museum specimens for additional food preference data.

Most papers dealing with food and/or habitat preferences have been written by Eric Matthews and refer primarily to West Indian or Neotropical species (e.g., Matthews, 1966; Halffter and Matthews, 1966) . Papers by Brown (1927) , Matthews (1963) , Robinson (1948) , and Woodruff (1973) present necessary information on food and habitat preferences of North American Canthonini, but two of these papers are not generally known and do not appear in recent bibliographies.

The genus *Canthon* Hoffmannsegg has recently been split into several genera and subgenera. Doubts have been expressed by Matthews (1966) and Howden (1966) as to the validity of some of these proposed taxa. Although we share some of these doubts, several of the recently recognized taxa appear to form distinct biological and morphological units. For the purposes of this paper we are using the most recent classification prepared by Halffter and Martinez (1966-1970) .

The sight of specimens of *Canthon*, s. lat., rolling dung balls is a common one, especially some of the large species of *Canthon,* s. str., which

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roll balls made of cow or horse dung. Because of this it has been generally assumed that most or all species of *Canthon*, s. lat., either made their balls from cow or horse dung, or had no dung preference. Robinson (1948) and Woodruff (1973) listed a few examples of dung preference, but Robinson's observations have not become generally known.

Specimens of *Boreocanthon praticola* (LeConte) were taken by Gordon in early June 1970, in prairie dog burrows in southwestern North Dakota in large numbers feeding on prairie dog pellets buried in the prairie dog mound. An occasional specimen was found inside the mouth of the prairie dog burrow. No dung ball formation or rolling was observed. In August 1973, a similar situation was observed at a prairie dog town eleven miles west of Nunn, Colorado. Here *praticola* was extremely common feeding on and in prairie dog pellets, which were usually buried in the mound. In addition to feeding, in three instances pairs of *praticola* were observed rolling whole pellets away from a mound, making no attempt to fashion a ball. Two identical observations were made at a prairie dog town in Theodore Roosevelt National Park, Medora, North Dakota, two weeks later. Here bison dung was available in large quantities and in all stages of deterioration in the prairie dog town. Here specimens of *praticola* were present in large numbers inside the burrow mouth and were flying from burrow to burrow. The mounds were very dry and packed and obviously not a suitable habitat for *praticola* at that particular time. In spite of careful examination, no specimens of *praticola* could be found at bison dung, or was there any evidence that dung balls had been formed from any of the chips. A brief stop was made at a prairie dog town in Wind Cave National Park, Hot Springs, South Dakota. Here *praticola* was taken commonly inside the mouth of the prairie dog burrow, but no dung rolling activity was observed. In all three areas, the prairie dog involved was *Cynomys ludovicianus ludovicianus* (Ord) , or the black-tailed prairie dog.

Based on Gordon's observations, it seems reasonable to presume that the food preference of *praticola* is not bison dung, as has been generally assumed, but prairie dog dung. However, because Brown (1927) reported this species at the excrement of horses and cattle in addition to prairie dogs, we suspect that other food types may be used when preferred dung is not available. Gordon observed *praticola* rolling balls of cow dung in Santa Cruz Co., Arizona, in July 1972. It should be noted here that *praticola* was the only species of *Canthon*, s. lat., found associated with prairie dog towns from southeastern Utah to southwestern North Dakota. It is likely that *praticola* is the only species of *Canthon*, s. lat., utilizing the prairie dog dung niche.

Boreocanthon and *Melanocanthon* form a group of small, mostly black, dull species which appear to have similar food preferences. The following records bear this out. Robinson (1948) observed *Melanocanthon bispinatus* (Robinson) and *Boreocanthon probus* (Germar) rolling deer pellets in New Jersey. Robinson's actual statement was "rolling balls of deer droppings" but a paratype of *bispinatus* in the USNM collection has an entire deer pellet pinned with it. Whether Robinson realized that *bispinatus* had not formed a ball but simply rolled an entire pellet is not known. Woodruff (1973) recorded *probus* as "in" rabbit pellets at Gainesville, Florida. At Clemson, South Carolina, 30 April 1931, Cartwright observed *probus* utilizing rabbit pellets. Among sparse weeds on a fan of sand formed by a rain of the night before, 84 specimens were collected rolling rabbit pellets in all directions. The area covered was not more than 10 by 15 feet. Brown (1927) found *Boreocanthon lecontei* (Harold) common in very sandy Oklahoma localities using rabbit droppings. The species was active during the early part of the morning and spent the remainder of the day with its' food in vertical burrows. We suspect that members of this group, while having a definite preference for the type of dung discussed above, would utilize many kinds of dung (cow, horse, human, etc.) if the preferred dung were not available. Woodruff (1973) recorded *Boreocanthon depressipennis* (LeConte) as being a fairly common species in cow dung in open, sandy pastures. Robinson (1948) recorded *Melanocanthon granulifer* (Schmidt) as rolling balls of cow dung in a pasture at Romeo, Florida. Gordon observed *Boreocanthon melanus* (Robinson) and *B. puncticollis* (LeConte) rolling balls of cow dung in a pasture at Tumacacori, Arizona, in July 1972.

Glaphyrocanthon is a genus of mostly tropical species with only *viridis viridis* (P. de B.) extending into the U.S. Woodruff (1973) lists a single observation of *viridis* rolling a rabbit pellet near Citico, Tennessee. This species has been observed by Cartwright at various bird droppings in South Carolina woods and at chicken droppings at Jocassee, South Carolina. In Payne County, Oklahoma, Brown (1927) found *viridis* constructing and rolling balls of human excrement and rabbit droppings.

Pseudocanthon is a highly distinctive genus with a single species occurring in North America. Cartwright found it at chicken droppings at Jocassee, S.C. Woodruff (1973) recorded four specimens in a dung chamber of a packrat [*Neotoma floridana smalli* Sherman) on Key Largo, Florida. *P. perplexus* (LeConte) is relatively common in collections as it is often attracted to light, but, until Woodruff's observation, no tenable supposition as to host preference had been proposed. The distribution of *perplexus* is quite similar to that recorded in Hall and Kelson (1959) for *Neotoma* spp. in eastern and southern United States.

At least some species of *Canthon*, s. str., are not as restricted in their dung preferences as members of the other genera discussed above. *Canthon pilularius* (L.) is commonly observed rolling balls of cow and horse dung, but has also been observed rolling balls made from human dung (Matthews, 1963). Brown (1927) confirmed the use of horse and cattle dung. W. T. Davis (1910) reported *Canthon chalcites* (Haldeman) at Clayton, Georgia, using pig manure. A pair was observed forming a ball from human dung at Paris, Virginia, by Gordon. At South Carolina mountain localities Cartwright collected this species in mule and cow dung. *Canthon vigilans* LeConte has unusually large eyes and is active at night. At Meredith, South Carolina, early in the morning before the dew was off the grass, Cartwright found fresh cow dung showing abandoned balls and extensive work by *Canthon*, but he found no beetles then in the dung. Specimens of *vigilans,* each with a ball of cow dung, were found under fresh push-ups of dirt located in a circle 5 to 15 feet from the dung. Brown (1927) reported *vigilans* frequently at the excrement of horses and cattle in Oklahoma, on soil containing little or no sand. Gordon observed *Canthon imitator* Brown rolling balls of cow dung at Tumacacori and Sonoita, Arizona, in July 1972. Also at Tumacacori were thousands of specimens of *Canthon indigaceous* LeConte rolling balls of cow dung. The bottom of a concrete irrigation ditch was paved with these balls which had fallen in and could not be gotten out by the beetles.

Fungi and dead animals are also attractive to various species of *Canthon*, s. lat. In Cartwright's notes are the following: *Melanocanthon bispinatus* Robinson, Beaufort, South Carolina, under dead chicken; Walterboro, 3 under dead toad; Hamton, under fungi. *Boreocanthon probus* and *Canthon pilularius*, Govan, South Carolina, under dead snake. *Glaphyrocanthon viridis*, Clemson, South Carolina, 3 on fungi. There are numerous records in the literature of species of *Canthon*, s. lat. being attracted to fungi, carrion and rotting fruit.

From the available data, it appears that the large species belonging to the genus *Canthon* are the most specialized members of *Canthon*, s. lat., in that they seem to always form dung balls rather than utilize preformed balls. Members of the genera *Boreocanthon* and *Melanocanthon* have a decided tendency to utilize preformed dung pellets (e.g., deer dung, rodent dung, etc.) and at least some species definitely prefer this type of dung to dung which must be formed into a ball. It seems reasonable to assume that the habit of utilizing preformed dung balls would be more primitive than the habit of forming dung balls. The ease with which a preformed dung pellet can be rolled is obvious and rolling these would be a logical early step in the development of the ball forming habit. The Canthonini are, in general, a highly successful group of beetles as evidenced by the wide distribution of most species and the abundance with which they often occur. One reason for this success could be that most of the species are not restricted to one type of food but can use nearly any available food. As indicated above, many species have definite preferences but in the absence of the preferred food will accept any reasonable substitute.

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(Continued from page 180)

2069. Suppression of *Phloeotrogus* Motschulsky, 1863 (Insecta, Coleoptera, SCOLYTIDAE).
2070. Suppression of *Anodius* Motschulsky, 1860 (Insecta, Coleoptera, SCOLYTIDAE).
2071. Suppression of *Leiparthrum* Wollaston, 1854 (Insecta, Coleoptera, SCOLYTIDAE).
2072. Suppression of *Olonthogaster* Motschulsky, 1866 (Insecta, Coleoptera, SCOLYTIDAE).
2073. Suppression of *Cardium boreale* Broderip & Sowerby, 1829 (Mollusca: BIVALVIA CARDIIDAE).
2074. Suppression of *Plyctolophus ducrops* Bonaparte, 1850 (Aves).
2075. Designation of type-species for *Megasternum* Mulsant, 1844 and *Cryptopleurum* Mulsant, 1844 (Insecta, Coleoptera, HYDROPHILIDAE).
2077. Validation of *Pseudoboa nigra* (Dumeril, Bibron and Dumeril, 1854) (Reptilia, Serpentes).
2078. Designation of type-species of *Platyrhacus* Koch, 1847 (Diplopoda).

Comments should be sent in duplicate, citing case number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London SW7 5BD, England. Those received early enough will be published in the Bulletin of Zoological Nomenclature.

SCOLIA (CLYPEISCOLIA, N. SUBG.) *CLYPEALIS*, N. SP. (HYMENOPTERA: SCOLIIDAE) [1]

J. Chester Bradley[2,3]

Clypeiscolia, n. subg.

Female: Surface of the clypeus flat, depressed below the sloping area frontalis, its median area polished and impunctate, the laterally densely punctate lateral margins slightly reflexed, the anterior margin rounded, without a median tooth. Two submarginal cells. Metasternum not carinate.

Male: Similar in structure to other *Scolia*.

The shape of the clypeus is monotonous through almost all Scoliidae. In Clypeiscolia it is transverse.

Scolia [Clypeiscolia] clypealis, new species

Female: Head. Clypeus as described for the genus; laminae frontales short, weak, polished. Area frontalis closely punctate on the sides, medially forming an elevated impunctate carina. Front polished, shining, with a few punctures on the sides and a very deep frontal pit; scattered punctures within the emargination of the eyes; vertex polished and shining with scattered punctures. Temples full, not retracted, their length equal to about one and one-half times the diameter of an upper eye lobe.

Thorax piceous black. Lateral lobes of the pronotum closely and finely punctate. Mesonotum polished and impunctate, medially punctate towards the parapsidal furrows and anteriorly; a median punctate furrow extending backward less than half way from the anterior margin; no callus; scutellum with scattered punctures. Mesopleura with small punctures on the anterior portion, somewhat fewer on the posterior part of the swelling. Metapleural upper plate with its upper posterior third closely punctate, lower plate largely impuncate. Metasternum with a very feeble median tubercle and a median posterior pit, its hind margin reflexed and subtruncate.

Wings deeply infuscated, with feeble violaceous reflection; the first submarginal cell almost entirely without pilosity.

Legs, including the coxae, rufous.

Abdomen entirely rufous; its entire dorsum punctate; no tubercle on tergite 2(1); the setae of the last segment very copious laterally.

Vestiture short and inconspicuous, sericeous on the black areas, red on the red areas.

Male: Head, including clypeus, black; antennae black.

Thorax black, except its dorsum red.

Wings uniformly deeply infuscated.

All legs red.

Abdomen red; the apical fringes of t.5-7 (4-6) and sometimes of t.3-4 (2-3) red or coppery; tergites not spotted.

Holotype is in the Hungarian National Museum in Budapest and is labeled "Brasil." I have placed a red pin-label on it reading "Holotype." Possibly the name "*clypealis*" is omitted.

Distribution: the valley of the Paraguay River in Brazil; western Argentina.

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TWO NEW PINE-INHABITING *PHYTOCORIS* FROM PENNSYLVANIA (HEMIPTERA: MIRIDAE)[1]

Thomas J. Henry[2]

ABSTRACT: *Phytocoris discoidalis* and *P. schuylkillensis* are described to provide names for a paper discussing the biology of the Miridae associated with *Pinus* spp. in Pennsylvania. The adult male of *discoidalis* and male genitalia of both species are illustrated.

DESCRIPTORS: Hemiptera, Miridae, *Phytocoris discoidalis* and *P. schuylkillensis* new species, *Pinus* spp., Pennsylvania.

In 1972-3 the Bureau of Plant Industry, Pennsylvania Department of Agriculture placed a major emphasis on a survey of the arthropods associated with conifers in Pennsylvania. As a result of this survey, four European plant bugs new to North America were discovered (Henry and Wheeler, 1973, 1974; Wheeler and Henry, 1973). The biology of the conifer-inhabiting Miridae in Pennsylvania will be reported in a series of papers; to provide names for use in the paper on species associated with pine, two new species of *Phytocoris* are here described.

Phytocoris discoidalis n. sp.

(Fig. 1)

Male: length 7.40 mm, width 2.50 mm; elongate, subparallel, generally brown to dark-brown, occasionally black. **Head**: width 1.20 mm, vertex 0.41 mm; shiny, fuscous in dark specimens, areas along outer margin of frons and vertex pale in light specimens. **Rostrum**: length 3.30 mm, reaching to 6th abdominal sternite. **Antennae**: segment I, length 1.30 mm, fuscous, slightly paler beneath, upper surface mottled with pale, clothed with closely appressed black to brown setae and 8-10 erect bristle-like setae on dorsal half; II, 3.04 mm, fuscous, clothed with closely appressed black setae: III, 1.6 mm, fuscous; IV, 1.00 mm, fuscous. **Pronotum**: length 1.20 mm, width at base 2.04 mm; basal and lateral margin fuscous with extreme basal margin pale; pronotal disk pale, posterior margin of calli bordered by shallow depression, dorsal surface clothed with closely appressed black setae intermixed on anterior half with silvery-white sericeous pubescence. **Scutellum**: fuscous, median line, basal angles and apex pale. **Hemelytra**: brown to fuscous, claval vein and suture and radial vein pale-bordered, giving a striped appearance; white patches invaded by brown present at base, middle and apex of corium, the middle one usually the largest; cuneus pale, invaded by brown, apical half fuscous. **Membrane**: conspurcate, spots coalescing apically and around inner margins of large areoles. **Ventral Surface**: propleura fuscous, with area bordering coxal cleft, basalar, plate and ostiolar peritreme pale; mesosternum fuscous; abdomen fuscous, paler ventrally; coxae pale, sometimes with a red spot at base. **Legs**: femora fuscous to reddish-brown, marked with pale spots, these becoming smaller towards

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[2] Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pa. 17120.

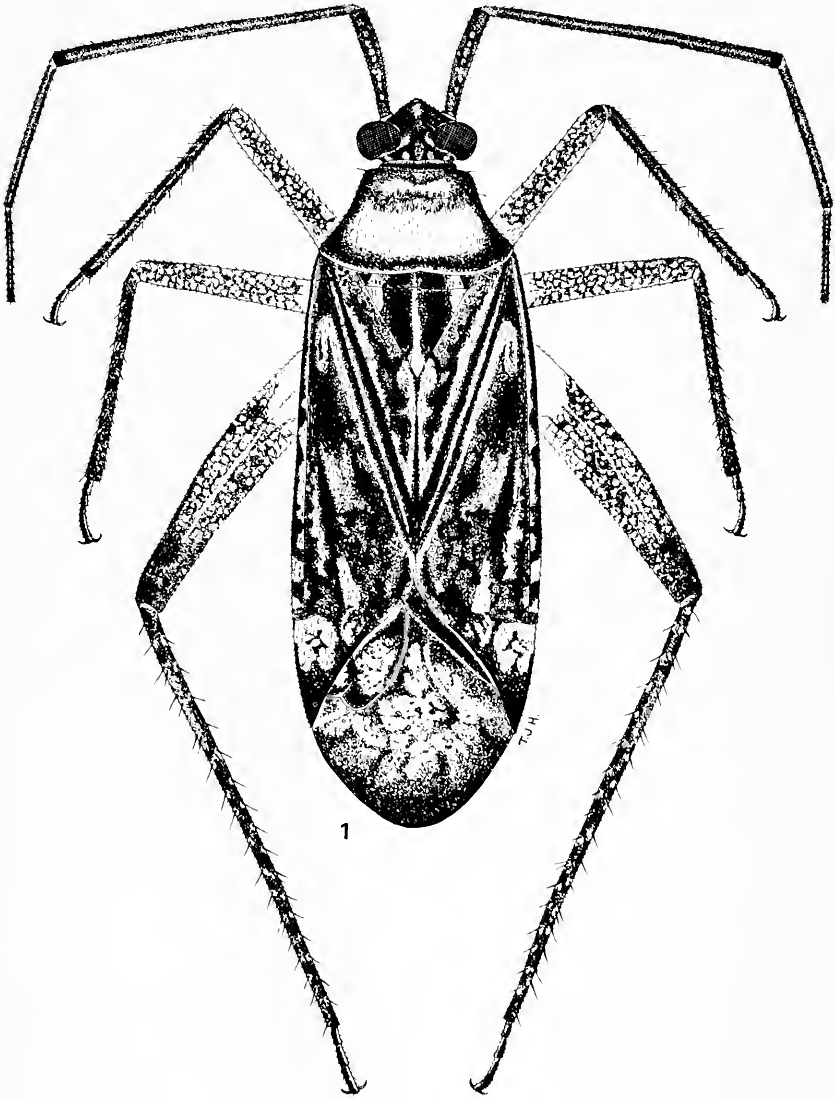
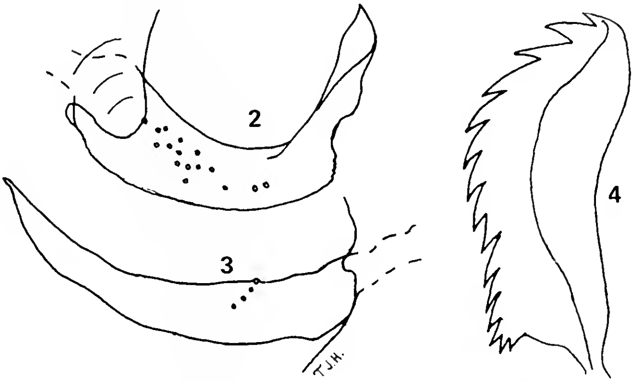


Fig. 1, *Phytocoris discoidalis* n. sp., adult male.

apex, medial spots on front and hind femora combining to form a white lateral line on basal half, becoming more obscured distally; tibiae fuscous to black, lightly mottled with pale markings, two vague white bands on hind tibiae, spines black with white spots at base, especially on hind tibiae; tarsi and claws fuscous. **Male Genitalia**: (Fig. 2-4) left clasper with a broad tubercle above base on genital segment; right clasper with a very short tubercle above base; lateral serrations of flagellum 12-15 depending on development of basal spines.

Female: length 7.39 mm, width 2.60 mm; similar to male in color and markings, slightly broader in form. **Head**: width 1.20 mm, vertex 0.50 mm. **Rostrum**: length 3.52 mm, reaching 6th or 7th abdominal segment. **Antennae**: segment I, 1.37 mm; II, 3.28 mm; III, 1.64 mm; IV, 0.96 mm. **Pronotum**: width at base 2.10 mm.

Holotype: ♂, June 5, 1973, Cumberland Co., Pennsylvania, 8 mi. E. of Blue Mt. exit on Turnpike, T.J. Henry and A.G. Wheeler, Jr., on *Pinus virginiana* (USNM Type No. 73350). **Allotype**: ♀, May 24, 1974, Cumberland Co., Pa., 9 mi. E. of Blue Mt. Exit on Turnpike, T.J. Henry and A.G. Wheeler, Jr., on *P. virginiana*. (USNM collection).



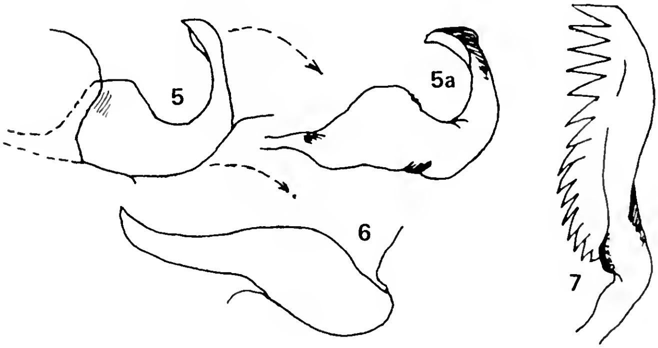


Fig. 2-4. *Phytocoris discoidalis* n. sp., male genitalia. 2, left clasper. 3, right clasper. 4, flagellum of aedeagus. Fig. 5-7. *Phytocoris schuylkillensis* n.sp. 5, left clasper. 5a, left clasper slightly turned. 6, right clasper. 7, flagellum of aedeagus.

Paratypes: 5 ♂♂, July 4, 6, 12, 1947, Wood Co., Wis., Griffin St. Nursery, D. Shenefelt; 1 ♂, 1 ♀, July 8, 1965, Barage Co., Mich., D.C. Allen (USNM collection); 1 ♂, June 1, 1970, Dauphin Co., Pa. Hershey, W.H. Yackley; 1 ♂, 1 ♀, June 16, 1972, Adams Co., Pa., Biglerville, R. Colburn, taken in light trap placed in peach and apple orchard; 1 ♂, June 6, 1973, Indiana Co., Pa., Indiana nr. Canale's Nurs., T.J. Henry, on *P. banksiana*; 2 ♀♀, May 24, 1974, Cumberland Co., Pa., 12 mi. west of Carlisle, T.J. Henry and A.G. Wheeler, Jr., on *P. virginiana*; 1 ♂, June 5, 1974, Union Co., Pa., nr. White Deer exit along Rt. 11-15, T.J. Henry and A.G. Wheeler, Jr., on *P. virgininiana* (PDA, BPI collection); 1 ♀, May 18, 1974, Dauphin Co., Pa., Cedar Rd., Conewago Twp., T.J. Henry, reared from *P. virginiana* (author's collection).

Remarks: This early-season mirid closely resembles and is often taken with *Phytocoris fenestratus* Reuter (1909), but may be separated from *fenestratus* by its broader form, longer rostrum, pale pronotal disk, markings on the hemelytra, browner color and male genitalia. *P. discoidalis* varies in color from light brown in specimens collected from Michigan and Wisconsin to almost black in locally collected specimens. The striped pattern of the hemelytra is sometimes obscured in darker specimens and is more prominent in lighter or older specimens. Lengths ranged from 7.20 to 7.90 mm in males and from 7.20 to 7.80 mm in females. Both adults and nymphs of *discoidalis* were taken on Virginia pine, *Pinus virginiana* Mill; one adult was collected on jack pine, *P. banksiana* Lamb.

Phytocoris schuylkillensis n. sp.

Male: length 5.38 mm, width 1.89 mm, light brown to fulvus. **Head:** width 1.10 mm, vertex 0.38 mm. **Rostrum:** 2.06 mm, fulvus, black at apex, reaching to 1st or 2nd abdominal segment. **Antennae:** segment I, length 0.74 mm, width 0.10 mm, fulvus, interspersed with reddish markings, clothed with fine brownish to golden pubescence and 6-8 bristle-like setae (length 0.16 mm); II, 2.17 mm, black on apical half to entirely black except for narrow white annulus at base; III, 1.13 mm, black, narrow white ring at base; IV, 0.92 mm, black. **Pronotum:** length 0.87 mm, width at base 1.62 mm, brownish, sometimes tinged with red, clothed with recumbent golden-brown simple setae. **Scutellum:** brown, tinged with red or brown with red median line, clothed with simple golden-brown setae intermixed with sericeous white pubescence. **Hemelytra:** translucent brown, radial vein, apical area of corium and base of cuneus often tinged with red; clothed with suberect golden setae, those on cuneus darker, intermixed with silvery sericeous pubescence, especially along either side of claval suture. **Membrane:** smoky yellow, veins brown as in hemelytra. **Ventral Surface:** brownish to fulvus, pleura frequently reddish; coxae and ostiolar peritreme paler; abdomen darker near genital segment. **Legs:** reddish to brown; femora spotted with white, spots on hind femora more prominent with a white dorsal blotch formed by spots on apical third; tibiae mottled with white, distinct white spots formed on hind tibiae, spines golden to dark-brown with indistinct brown spots at base; tarsi brown, last segment fuscous. **Male genitalia:** (Fig. 5-7) right clasper strongly curved upwards at apex; 1st five serrations of flagellum perpendicular to their base.

Female: length 5.40 mm, width 2.02 mm, similar to male in color and markings. **Head:** width 1.02 mm, vertex 0.48 mm. **Rostrum:** length 1.98 mm. **Antennae:** I, 0.75 mm; II, 2.01 mm; III, 1.12 mm; IV, 0.93 mm. **Pronotum:** length 0.83 mm, width 1.55 mm.

Holotype: ♂, Aug. 7, 1974, Schuylkill Co., Pa., I-81 nr. Rt. 901, A. G. Wheeler, Jr., on *Pinus rigida* (USNM Type No. 73351); **Allotype:** ♀, same data as for holotype; **Paratypes:** 1♂, 1♀, same data as for holotype; 1♂, July 29, 1972, Franklin Co., Pa., Rt. 641 nr. Roxbury, A. G. Wheeler, Jr., on *P. banksiana*; 1♂, 1♀, July 24, 1972, Schuylkill Co., Pa., Schuylkill Haven, Omlar's Nursery, A. G. Wheeler, Jr., on *P. sylvestris;* 1♂, July 7, 1973, Schuylkill Co., Pa., I-81 at Jct. of Rt. 61, A. G. Wheeler, Jr., reared from *P. rigida;* 5♀♀, Aug. 11, 1973, Schuylkill Co., Pa., I-81 4 miles north of Rt. 209, A. G. Wheeler, Jr., on *P. rigida* (PDA, BPI collection).

Remarks: *P. schuylkillensis* (pronounced skoo·kill·en'sis) closely resembles *P. uniformis* Knight (1923), but may be separated by the browner color, darker second antennal segment, broader form, lack of distinct tufts of sericeous pubescence on dorsum, and male genitalia. The genital claspers most closely resemble those of *P. fulvus* Knight (1920), especially the right clasper. Lengths ranged from 4.70 to 5.40 mm in males and from 5.00 to 5.50 mm in females. Females of *schuylkillensis* cannot be reliably separated from those of *uniformis* unless taken in association with males of the species. *P. schuylkillensis* is restricted to breeding on *Pinus* spp. as are most *Phytocoris* in this group (Knight, 1941), and has been taken most often on pitch pine, *P. rigida* Mill.

ACKNOWLEDGEMENTS

I thank Drs. Karl R. Valley and A. G. Wheeler, Jr., Bureau of Plant Industry, Pennsylvania Department of Agriculture for their useful suggestions in improving this manuscript; and special thanks to Dr. Wheeler who collected most of the specimens used in this study. Dr. J. L. Herring, Systematic Entomology Laboratory, U.S.D.A., Washington, D.C., kindly loaned specimens of *P. discoidalis*.

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WARNING NOTICE TO RESEARCHERS ABOUT AGRICULTURAL QUARANTINE RESTRICTIONS AND NEED FOR PERMITS

The U.S. Department of Agriculture has issued a warning that, in their zeal to obtain organisms for experimentation, some scientists are violating federal statutes. Of particular concern, are entomologists who circumvent quarantine restrictions against bringing plant and animal pests into this country.

"Persons intending to import or receive live plant or animal pests, pathogens, or vectors intended for research must apply to the U.S. Department of Agriculture (USDA) for a permit," said Leo G. K. Iverson, deputy administrator of USDA's Animal and Plant Health Inspection Service (APHIS). "Scientists attempting to bring such organisms into the country without obtaining a permit are violating federal statutes and risking loss of their collections."

Permits are issued on an "agricultural risk versus expected benefits" basis. They usually specify safeguards to prevent the escape and spread of pest organisms.

Securing a permit before importation requires little time or effort. Applications are generally processed within a week to 10 days. Scientists are advised, however, to begin the application process 30 days before shipment of live organisms. If a pest presents a particularly high risk, the head of a laboratory will be asked to apply for a permit, rather than the individual scientist.

Iverson pointed out that issuance of a federal import permit does not necessarily mean research organisms can travel freely between the states, or even within a state. Permits also may be required for interstate and intrastate transport.

For example, a scientist authorized to import the velvet bean caterpillar (which feeds on soybeans) from Brazil to Florida unwittingly sent some of the insects to a Missouri lab. Because of the danger of tapping a new gene pool, his original application did not allow interstate transport of the pest. When the USDA became aware of the violation, the shipment was ordered destroyed.

Another recent violation involved the unauthorized movement of the Chinese silk moth [*Antherea pernyi*], which defoliates oak, chestnut, and other deciduous trees. The pest, which is not known to be established in the United States, could pose a severe threat to this country's green resources if it escaped in the field.

In this instance, breeding stock was shipping from a Massachusetts scientist to a researcher in Illinois, who in turn made several exchanges of viable ova and breeding stock with a private laboratory in Pennsylvania. In cases such as this, colonies are either destroyed, or, if possible, brought into compliance with permit regulations.

"Agricultural quarantine restrictions on importing pest organisms are not intended as barriers to research," Iverson emphasized. "Rather, they are designed to insure the entry of materials necessary for continued biological advances, while also safeguarding the environment."

Because of the danger of new plant and animal pests gaining a foothold in this country, APHIS is tightening monitoring of pest movement and quarantine regulations.

"In the future, the type of materials permitted entry will be more closely regulated, violations will be publicized, and facilities where specimens are housed will be inspected more frequently," Iverson said.

Because of the extreme consequences to scientific projects--i.e., destruction of pest colonies--APHIS officials are stressing the importance of being aware of quarantine restrictions and the need for permits. Permit applications and a pamphlet outlining the process of application, evaluation, and issuance of permits may be obtained from:

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ULTRAVIOLET-REFLECTIVE SURFACES ON *OCHTHERA MANTIS MANTIS* (DEGEER) (DIPTERA: EPHYDRIDAE). PRELIMINARY REPORT[1]

D. L. Deonier[2]

ABSTRACT: Ultraviolet-reflective surfaces in *Ochthera mantis mantis* (DeGeer) (Diptera: Ephydridae). Preliminary Report. Ultraviolet reflectance has been investigated in Lepidoptera, but investigation of the phenomenon in Diptera has been largely neglected. Adults of the predaceous shore fly *Ochthera mantis mantis* have silvery pruinose fore coxae and a golden pruinose face. When approached closely by another insect of equal or larger size, this fly repeatedly spreads and flexes its fore legs thus exposing the silvery fore coxae. The flies, when placed individually in a mirror box, spread their fore legs repeatedly when they initially approached a mirror surface. When photographed through a Wratten ultraviolet filter, the fore coxae and face of this species are shown to reflect relatively much more ultraviolet radiation (range of 300-400 nm) than do unmarked body regions. Obliteration of the reflective fore-coxal surfaces seemed to interfere with courtship; this is interpreted as evidence for a signal function of the reflectance.

DESCRIPTORS: Diptera, Ephydridae; *Ochthera mantis mantis*: ultraviolet reflectance, species-recognition signal.

Although ultraviolet reflectance has been investigated in several species of Lepidoptera (Lutz, 1924; Mazokhin-Porshnyakov, 1957, 1969; Eisner et al, 1969; Ghiradella et al, 1973, and others), investigation of this phenomenon in Diptera has been largely neglected. This situation has prevailed despite considerable field and behavioral evidence for ultraviolet sensitivity in various dipterans and despite even more specific evidence in terms of attraction curves and retinograms in *Drosophila* (Wolken et al 1957; Wehner and Schuemperli, 1970, Schuemperli, 1972) and in *Musca* and *Calliphora* (Cameron, 1938; Kirschfeld and Franceschini, 1968; Eckert, 1971; Burkhardt and de la Motte, 1972).

In 1966, I hypothesized that the predominant silvery and golden pruinose markings on adult Diptera reflect relatively much more ultraviolet radiation than do unmarked areas of the body and that these reflection patterns vary specifically and constitute species-recognition signals (Deonier, 1966, 1971). This hypothesis was developed primarily from:

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[1] Accepted for publication: March 27, 1974

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1) Observations of silvery or golden pruinose facial and pleural markings bordered by contrasting velvety black or brown zones in numerous species of Ephydridae and other acalyptrates;
2) Knowledge that silver and other polished metals are highly reflective for ultraviolet radiation;
3) An apparent signal function of ultraviolet-reflective surfaces in several butterfly species;
4) A general absence of evidence for widespread occurrence of strong sex pheromones functioning at a distance in the higher Diptera;
5) A generally low number of attempted matings between species in *Parydra, Ochthera, Notiphila,* and *Hydrellia* in natural multispecies assemblages observed in the course of over 8,000 field hours. Few if any of the species in these observations required touching of antennae or any other appendages during courtship.

During the last two summers when specimens have become available, this hypothesis has been tested on the predatory shore fly, *Ochthera mantis mantis.* This fly ranges from 3.8 to 6.0 mm in body length and possesses large raptorial fore legs held flexed when in a stationary mantislike posture (Figs. 1,2). The species is predaceous as larva and adult; the adult appears to have a broad general diet, but it predominantly uses small dipterans and homopterans in its habitat. Adults of this species have been observed excavating chironomid larvae from mud, extracting culicid larvae from the water surface, capturing chironomid, psyllid, and *Hydrellia* adults on the wing, and stalking and capturing these same kinds of prey (Deonier, 1972). In captivity, they feed readily upon *Drosophila* and *Scaptomyza* species (Sturtevant and Wheeler, 1954).

Ochthera mantis mantis was considered a good test species for the hypothesis because it begins mating generally within the first 7 days after emergence from the puparium, stores the spermatozoa within a sizeable female ventral receptacle visible through the ventral abdominal membrane, has a highly reflective face and fore coxae (Fig. 3), and because the adults repeatedly spread their fore legs and expose the silvery fore coxae when approached closely by another insect of equal or larger size.

Figure 1. *O. mantis mantis* in situ on emergent vegetation. (3.2 X; original on High Speed Ektachrome, Daylight).

Figure 2. Photomicrograph (stereomicroscope). Note raptorial fore leg. (10 X; original on High Speed Ektachrome, 3200 K).

METHODS AND MATERIALS

The tests conducted thus far on the ultraviolet reflection hypothesis have been:

1) Observation of the reactions of the flies to their mirror images when placed in a box with walls made of four mirrors (each 8.8 X 6.3 cm).
2) Photographing the reflective surfaces with the use of a Kodak Wratten Ultraviolet Filter No. 18A for evidence of greater ultraviolet reflectivity (filter window range 300-400 nm).
3) Obliteration of reflective fore-coxal surfaces in 10 captive virgin pairs followed after 3 days by removal of the ventral receptacles from the females and examination of their contents for presence of spermatozoa (fore coxal nonreflectance test). The flies were first anesthetized in an etherizer for 0.5-1.0 minute and then the silvery pruinose surfaces were obliterated by rubbing with toothpicks (Fig. 7). Controls consisted of 10 virgin pairs with unaltered fore coxae. The experimental and control flies were maintained in cotton-plugged vials (125 X 25 mm internal dimensions) on a diet of *Drosophila hydei* and *D. melanogaster* adults.

All photographs were taken with a Nikkormat camera body equipped with a 55 mm F: 3.5 Micro Nikkor Auto lens, frequently augmented with an extension ring (M) or bellows (PB-4). Film types used were Kodak High Speed Ektachrome (daylight type and 3200 K type) for visible light and Kodak Tri-X Pan (ASA 400) for the ultraviolet series. The ultraviolet radiation source was direct sunlight for all except one short series (Fig. 10) for which a mercury-vapor ultraviolet lamp (Raytech, Model LS-7, 254 nm) was used. Use of this lamp facilitated testing the efficiency of the filter and adjusting the film speed. The exposure time range for the ultraviolet photographs was 0.8-2.0 seconds and the lens aperture setting was 8.

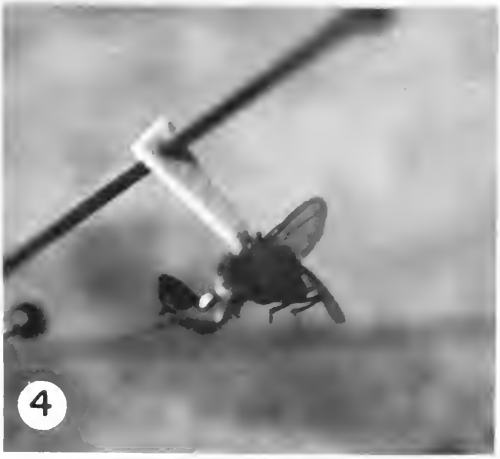


Figure 3. Photomicrograph (stereomicroscope). Note reflective face and fore coxae. (27 X; original on High Speed Ektachrome, 3200 K).

Figure 4. Ultraviolet photograph. Note greater reflectivity of fore coxae compared with face and paper point. (3.7 X; original on Tri-X Pan, f:8, 0.8 sec.).

RESULTS

The reaction of the 10 males and 10 females following individual introduction into the mirror box was a consistent spreading of the fore legs when they initially approached the mirror walls (Figs. 5, 6). This reaction was elicited when the mirror box was covered with either 2-mm thick transparent glass or very thin ultraviolet-transmissible plastic film.

The ultraviolet photographs revealed markedly greater reflection of ultraviolet radiation from the silvery pruinose fore coxae and golden pruinose face (Figs. 4, 7-10). In addition, these photographs provide more evidence for previously observed angular reflectance shifts on both the fore coxae and the face (Figs. 4, 8, 10). In visible light when these pruinose surfaces are viewed from different angles to the incident light beam, the reflectance intensity changes.

The fore coxal nonreflectance test conducted on 10 virgin pairs showed spermatozoa in the ventral receptacles of 2 experimental females. Spermatozoa were found in the ventral receptacles of 6 control females.

DISCUSSION

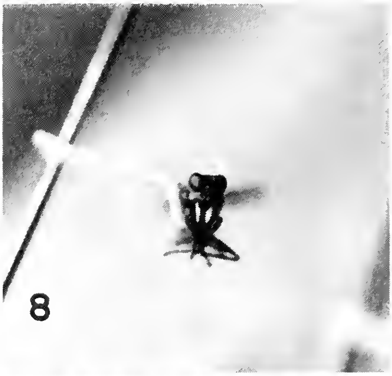
Evidence is herein presented for the differential ultraviolet reflectance from the surfaces of adult *Ochthera mantis mantis* and although the sample size is small, the results of the nonreflectance test indicate the distinct possibility that adults having the reflective fore coxal surfaces altered or obliterated are not recognized specifically by a prospective mate and thus are unable to court and copulate. The presence of spermatozoa in two of the experimental females cannot now be explained definitely, but it may have resulted from what may be termed courtless mating in which the male is able to successfully mount and inseminate the female without courtship. Additional experimentation is planned in nonreflectance and also in alternate male-female coxal and facial nonreflectance tests. As a corroborative test on the signal function of the reflectance pattern, virgin pairs will be maintained in darkbox conditions interrupted only six times per day with lighted feeding periods during which the flies will be under

5

6

Figure 5. *O. mantis mantis* "semaphoring" to mirror image. (2 X; original on High Speed Ektachrome, Daylight).

Figure 6. Same specimen wheeling and "semaphoring" to side mirror image. (2 X; original as in Figure 5).



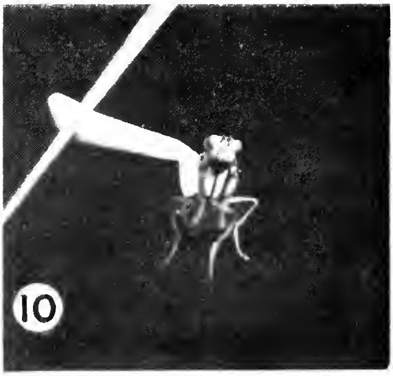


Figure 7. Ultraviolet photograph (with PB-4 bellows). Note fore coxae from which reflective pruinosity has been rubbed. (12 X; original on Tri-X Pan, f:8, 1 sec.).

Figure 8. Ultraviolet photograph. Angle of view lessens reflection from face. (3.2 X; original as in Figure 7).

Figure 9. Ultraviolet photograph. Angle of view showing equal reflection from fore coxae and face. (3.7 X; original on Tri-X Pan, f:8, 2 sec.).

Figure 10. Ultraviolet photograph. Source was mercury-vapor lamp used in darkroom with ultraviolet filter. Angle of view lessens reflection from face. (3.2 X; original as in Figure 9).

surveillance. Surveys for sexual dimorphism in the reflected pattern will continue and the structural nature of the pruinosity in this species will be studied by scanning-electron microscopy.

ACKNOWLEDGEMENTS

Acknowledgement is made to Mr. T.J. Swisher, Technical Representative of Eastman Kodak Company, for providing the Wratten ultraviolet filter and technical assistance. The assistance of Mary Deonier, Rommel Beck, Richard Slade, Steven Ash, Cynthia Blakely, and Linda Konrad is gratefully acknowledged. The Audiovisual Service of Miami University provided certain photographic equipment. Some of the work was done at the Highlands Biological Station, Highlands, North Carolina.

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A NEW SPECIES OF *PHYLLOCOPTES* (ACARINA: ERIOPHYIDAE) FROM ROSE[1],[2]

William E. Styer[3]

ABSTRACT: *Phyllocoptes linegranulatus* is described from rose. A detailed description and a plate are given.

DESCRIPTORS: Acarina; Eriophyidae; *Phyllocoptes-linegranulatus;* new-species.

This is the fourth Nearctic *Phyllocoptes* sp. (Acarina: Eriophyidae) to be described from *Rosa* sp. This species differs from those previously described by having the design on the cephalothoracic shield composed of dashes or granulations, rather than solid lines. Further, it differs from *P. slinkardensis* Keifer (1966) by having the microtubercles less sharply spinulate. It differs from *P. fructiphilus* Keifer (1940) by having pointed microtubercles and more lines on the female genital coverflap, and from *P. adalius* Keifer (1939) by having one less ray in the featherclaw, and more lines on the female genital coverflap.

The following description and the characters illustrated are based on Keifer's terminology (1952):

Phyllocoptes linegranulatus, n. sp.

Female 160 μ long, 62 μ wide; fusiform; color yellow-white to white. Rostrum 21 μ long, curving downward; antapical seta 7 μ long. Shield 45 μ long, 50 μ wide, subtriangular with pointed anterior lobe over rostral base; median line granular, present

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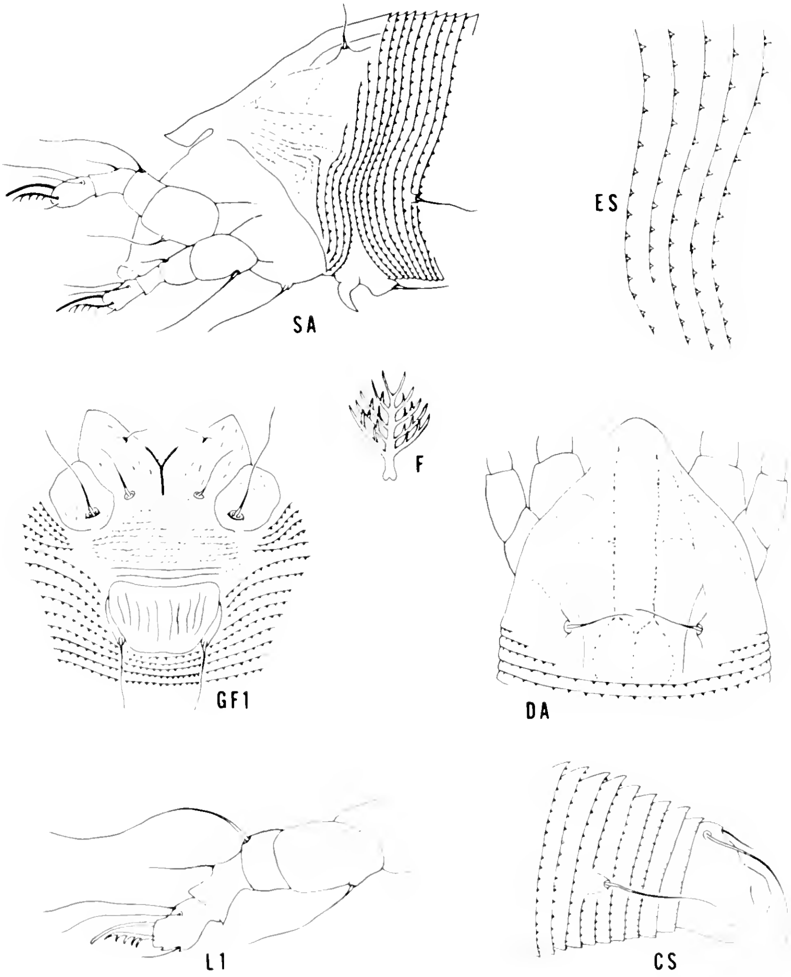

Figure 1. *P. linegranulatus*, adult female. SA, side view of anterior section; ES, lateral rings and microtubercles; GF1, female genitalia and coxae; F, featherclaw; DA, dorsal view of shield; L1, left anterior leg; CS, side view of caudal section.

only on posterior 1/4 of shield where it arises from rear margin to form a Y-shaped mark that touches the admedian lines. Admedian lines of dashes and granulations arise at rear of shield where they curve to touch the median Y, then continue anteriorly towards shield lobe. First submedian lines present, arising from base of dorsal tubercles and extending anteriorly towards shield lobe. A cross line connects admedian with submedian at about midpoint. A branch off the submedian just ahead of the dorsal tubercle curves back centrally to rear shield margin. Outer submedians present, running laterally from partial ring at rear of shield, converging towards first submedian line with short cross line present. Partial rings present below dorsal tubercle. Dorsal tubercles 22 μ apart; dorsal setae 14 μ long. Foreleg 30μ long; tibia 6 μ long, with seta; tarsus 7 μ long; claw 8 μ long, curved and tapering; featherclaw 5-rayed. Hindleg 26 μ long, tibia 4 μ long, tarsus 6 μ long, and claw 9 μ long. Coxae ornamented with short curved lines and dashes; anterior coxae divergent with moderate sternal line. First setiferous coxal tubercles farther apart than second and ahead of the anterior coxal approximation. Second tubercles ahead of line across third tubercles. Abdominal thanosome with rings somewhat wider dorsally. Microtubercles acuminate. Lateral seta 17 μ long, on ring 9; first ventral seta 16 μ long, on ring 23; second ventral sets 15 μ long, on ring 42. Telosome with 5-6 rings, completely microtuberculate. Telosomal seta 28 μ long. Accessory sets 6 μ long. Female coverflap 22 μ across, 14 μ long, with about 10 longitudinal lines; seta 14 μ long.

Male: Not seen.

Type Locality: Wooster, Ohio.

Collection Data: June 16, 1968 by Makoto Kawase.

Host: *Rosa* sp., a cultivated hybrid rose.

Relation to Host: The mites were found in high numbers in association with chlorotic leaves.

Type Material: A type slide to be deposited in the U.S. National Museum, and a paratype slide to be on file in the Institute of Acarology, Columbus, Ohio. A second paratype slide and dried mites retained in the collection at the Ohio Agricultural Research and Development Center.

ACKNOWLEDGEMENT

Appreciation is extended to L.R. Nault for comments on the manuscript, and to H.H. Keifer, Sacramento, California for his confirmation of the new species.

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ON THE HABITAT OF SOME CARABID BEETLES (COLEOPTERA: CARABIDAE)[1]

Andre Larochelle[2]

ABSTRACT: In this paper, the habitat of forty-one species of Carabidae from Quebec is given.

DESCRIPTORS: Coleoptera; Carabidae; Quebec, Canada.

For the last thirteen years, I have collected 60,000 carabid beetles in Quebec in order to get the "biological status" of their habitat. I have kept journals, in which the explored biotopes are described. Finally, I became acquainted with many Carabidae whose habitat is poorly known in the entomological literature. I hope these notes will be useful to other entomologists.

SPECIES ACCOUNTS

Agonum crenistriatum Leconte: A xerophilous species occurring in open sandy country, where the vegetation is scarce, under stones and logs. It prefers hills.

Agonum fidele Casey: At the borders of ponds, marshes and brooks, in more or less shady places, where the soil is wet, under willows and alders.

Agonum mutatum Gemminger and Harold: At the borders of pools and lakes, where Sweet Gale (*Myrica gale* Linne) grows, in pillows of Sphagnum. It prefers acid bogs and is found with *Blethisa quadricollis* Haldeman.

Agonum picicornoides Lindroth: On moist places, in the vicinity of open water. On rather firm soil, often clay lightly mixed with sand, with more or less dense vegetation, under dead leaves and other vegetal debris, under willows and alders.

Agonum tenuicolle Leconte: Along stony, shady margins of streams and lakes, mostly in montaneous areas. It is often found with *Nebria lacustris* Casey.

Agonum trigeminum Lindroth: At the borders of brooks, ponds and marshes, on wet usually clayey soil, under alders or willows.

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Anisodactylus discoideus Dejean: At the borders of rivers, brooks and ponds, on wet sandy soil, with sparse vegetation or none at all. During the day, it hides under stones. It is commonly found with *Anisodactylus sanctaecrucis* Fabricius and *Stenolophus comma* Fabricius.

Anisodactylus nigerrimus Dejean: On open, very dry, sandy ground, with scattered vegetation. It is found with *Anisodactylus merula* Germar and *A. rusticus* Say.

Anisodactylus verticalis Leconte: In deciduous woods, on moist clayey soil, often near water. During the day, it hides under dead leaves and bark of fallen trees.

Axinopalpus biplagiatus Dejean: On open, dry sandy or gravelly ground, with more or less abundant vegetation, under stones and boards. It prefers hills.

Badister notatus Haldeman: On open dry gravelly country, with sparse or moderate vegetation, often in gravel-pits, but also in waste places and gardens. By day, it hides under stones, on slopes.

Badister obtusus Leconte: In light deciduous forests, on stony or gravelly ground, under dead leaves. It prefers lightly damp places.

Badister transversus Casey: In deciduous marshy places, on wet soil with mixture of organic matters, under bark or other vegetal debris.

Bembidion canadianum Casey: Along brooks and roadside ditches, on open damp clayey soil, with sparse vegetation or none at all. In the daytime, it is found under stones.

Bembidion nigrum Say: On barren soil, usually gravel mixed with sand and clay, on river banks. During the day, it is often found under stones and in the crevices of steep banks. It is often associated with *Schizogenius lineolatus* Say and *Tachys tripunctatus* Say.

Bembidion sejunctum Casey: On open barren sandy soil, under logs and boards, along the edges of large salty water bodies. Its shelter being lifted, it remains motionless a long while before running away.

Bradycellus kirbyi Horn: On moderately shaded marshy places, with a rich vegetation, under willows and alders.

Bradycellus nigriceps Leconte: An hygrophilous species occurring on moist soil, with rich vegetation, at the borders of woody marshes and ponds.

Calleida punctata Leconte: In fields, under stones or on goldenrod flowers.

Calosoma frigidum Kirby: In deciduous forests, especially in maple forests. During daytime, it hides under dead leaves. In spring, it emerges only on rather warm days.

Chlaenius tomentosus Say: In open, dry country with sandy or gravelly soil, in hilly fields, with more or less low vegetation. During daytime, it hides under stones.

Cymindis americana Dejean: In deciduous woods, clearings, bush hedges and along fence rows, under stones and boards. It prefers hills and uplands.

Cymindis borealis Leconte: On open, dry, sandy or gravelly ground, with sparse vegetation. In sand-pits, gravel-pits and roadsides.

Cymindis pilosa Say: Same habitat as *C. borealis* Leconte.

Diplocheila impressicollis Dejean: Very hygrophilous. At the borders of standing waters, with rich vegetation of cat's-tails and willows. It is found with *Badister neopulchellus* Lindroth and *Diplocheila striatopunctata* Leconte.

Galerita janus Fabricius: In deciduous woods, in the mountains and uplands, under stones.

Brachinus cordicollis Dejean: On river banks and lake shores, on sandy or gravelly soil, more or less mixed with clay, under stones.

Brachinus cyanipennis Say: Same habitat as *Brachinus cordicollis* Dejean.

Brachinus tenuicollis Leconte: On river banks and lake shores, under stones.

Harpalus faunus Say: In open country, in sandy dry fields with scarce vegetation, under bark and boards; in waste places, sand-pits and roadsides. It was repeatedly found with *Calosoma calidum* Fabricius and *Harpalus lewisi* Leconte.

Harpalus laticeps Leconte: In dry, open country with scarce vegetation, on sandy or gravelly soil, under dead leaves and logs. It prefers hills and uplands, often in the vicinity of bushes and trees.

Harpalus viduus Leconte: Always at the borders of woods (preferably maple woods), on rather dry sandy soil. It prefers hills and uplands. During the daytime, it buries into the soil or hides under dead leaves. It likes clearings and woody roads.

Lebia ornata Say: In deciduous and mixed forests, on goldenrod flowers.

Lebia solea Hentz: In deciduous forests, preferably maple forests, under dead leaves or on the flowers of the Blue-stemmed Goldenrod (*Solidago caesia* Linne).

Myas cyanescens Dejean: In deciduous and mixed forests of mountains and hills, in lightly damp gravelly soil, where the litter is rich. By day, it buries deep into the soil or hides under dead leaves.

Olisthopus parmatus Say: In light deciduous and mixed forest, on gravelly or sandy soil, under dead leaves and stones. It prefers a thick litter.

Notiophilus aeneus Herbst: In light deciduous forests, mostly maple forests, where the soil is damp and more or less gravelly. It usually hides under dead leaves, but sometimes runs on stones, moss or logs, in the daytime.

Pseudamara arenaria Leconte: In deciduous forests, preferably maple forests, where the soil is damp and gravelly, with a rich litter, usually under dead leaves, but also under stones, in the fall.

Selenophorus gagatinus Dejean: A xerophilous species, occurring under stones, on gravelly or sandy places, with sparse vegetation. It prefers hills and uplands.

Selenophorus opalinus Leconte: On open dry hills, on sandy soil, with scarce vegetation, under stones. It is commonly found with *Agonum crenistriatum* Leconte, *Chlaenius tomentosus* Say and *Harpalus indigens* Casey.

Trichotichnus vulpeculus Say: A deciduous forest species, found under the barks of logs. It prefers hills and is found with *Pterostichus honestus* Say and *P. tristis* Dejean.

ADDITIONS TO THE ODONATA OF MASSACHUSETTS[1]

Harold B. White, III[2], Paul S. Miliotis[3] and Christopher W. Leahy[4]

ABSTRACT: The following Odonata are reported from Massachusetts for the first time: *Argia apicalis* (Say), *Argis translata* Hagen, *Coenagrion resolutum* (Hagen), *Enallagma vernale* Gloyd, *Gomphus scudderi* Selys, *Somatochlora cingulata* (Selys), *Somatochlora elongata* (Scudder), *Somatochlora forcipata* (Scudder), *Somatochlora georgiana* Walker, *Somatochlora linearis* (Hagen), *Somatochlora williamsoni* Walker and *Pantala hymanaea* (Say).

DESCRIPTORS: Odonata, Massachusetts

Howe (1917-1920; 1921) compiled the records of New England Odonata listing 139 species from Massachusetts. Subsequent additions (Bromley, 1924; Montgomery, 1943; Gibbs and Gibbs, 1954; Needham and Westfall, 1955; Beatty and Beatty, 1969; and White, 1969) and the elimination of some questionable records listed by Howe leave approximately 143 species. We have collected extensively in Massachusetts since 1965 and have confirmed the presence of all but 17 of the previously reported species. In this note we document our records of 12 species of Odonata which are new for Massachusetts. They are *Argia apicalis* (Say), *Argia translata* Hagen, *Coenagrion resolutum* (Hagen), *Enallagma vernale* Gloyd, *Gomphus scudderi* Selys, *Somatochlora cingulata* (Selys), *Somatochlora elongata* (Scudder), *Somatochlora forcipata* (Scudder), *Somatochlora georgiana* Walker, *Somatochlora linearis* (Hagen), *Somatochlora williamsoni* Walker and *Pantala hymanaea* (Say). The occurrence of *Somatochlora georgiana* is particularly notable since its previously known range was confined to five contiguous states in the extreme southeastern United States.

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In the annotated list that follows, the collector's initials will appear with each record. We are grateful to Drs. Thomas W. Donnelly and Rudolf A. Raff for records of theirs included here.

Argia apicalis (Say): Ponkapoag Pond, Canton, 1♂, 7/25/70 (HBW); Charles River, Dover, 1♂, 9/6/70 (HBW); Charles River, South Natick, 2♂, 3 pr., 7/10/71 (HBW); Charles River, Wellesley, seen 6/30/71 (HBW); North Pond, Hopkinton, 2♂, 7/28/72 (PSM); Concord River, Concord, 1♂, 8/6/72 (PSM); Merrimack River, Dracut, 1♂, 7/17/73 (PSM).

These are the first records for *A. apicalis* in New England. It would appear that it is generally distributed along the major rivers of eastern Massachusetts.

Argia translata Hagen: Walden Pond, Concord, 1♂, 1pr., 9/11/66; 1♀, 1pr., 9/12/70; 1♂, 1pr., 8/14/71 (HBW); North Pond, Hopkinton, 2♂, 8/17/72 (PSM).

Both ponds where we have taken *A. translata* have rock and gravel shores with virtually no emergent vegetation. Other species of Odonata are quite scarce at both locations. The specimens were collected on rocks and dead twigs in and near the water.

Coenagrion resolutum (Hagen): Cranberry Swamp, Hawley, 2♂, 6/23/71 (HBW), 1♂, 7/2/72 (PSM); beaver pond on Mill Brook, Hawley, 1♂, 1pr., 7/4/71 (HBW).

This species is undoubtedly more widespread in the Berkshires than is indicated here.

Enallagma vernale Gloyd: Wallace Pond, Ashburnham, 4♂, 6/1/69 (HBW); unnamed pond east of Fort Pond, Lancaster, 1♂, 6/7/69 (HBW); unnamed pond west of Shirley Airport, Shirley, 2♂, 6/7/69 (HBW); Priest Brook, Royalston, 1♂, 6/14/70 (HBW); Cheshire Pond, Ashburnham, 1♂, 6/10/71 (HBW); Hawk Swamp, Dunstable, tenerals 5/7/73; 3♂, 5/17-20/73 (PSM).

Specimens from Ashburnham, Royalston, and Shirley were determined by Mrs. Leonora K. Gloyd. It is quite possible that most of the pre-1943 records for *Enallagma cyathigerum* (Charp.) in Massachusetts (Howe, 1917-1920) are *E. vernale.*

Gomphus scudderi Selys: Squannacook River, West Groton, 1♂ emerged July 1971 from a larva collected 5/16/71 (HBW).

Somatochlora cingulata (Selys): Unnamed pond on Mt. Greylock at an elevation of 3173 feet, Adams, 1♂, 7/9/73 (CWL).

Somatochlora elongata (Scudder): Stream into Bog Pond, Florida, 1♂, 8/22/70 (HBW); Cranberry Swamp, Hawley, 1♂ emerged 5/29/73 from larva collected earlier in the month (PSM).

Somatochlora forcipata (Scudder): County Road, Washington, 1♀, 7/10/73 (CWL).

Somatochlora georgiana Walker: Rantoul Pond, Ipswich, 1♀ (found dead in the water) 8/6/72 (CWL); Willow Dale State Forest, Ipswich, 3♂, 3♀, 8/18/73 (CWL).

The presence of this species in Massachusetts is entirely unexpected and quite remarkable. Its previous known distribution includes Alabama, Florida, Georgia, North Carolina and South Carolina. The fact that several specimens have been collected in successive years would indicate that a breeding population exists in northeastern

Massachusetts and that other specimens could be expected from any of the states on the Atlantic Coast. The six specimens from Willow Dale State Forest were taken in the late afternoon as they swarmed with other Odonata in a small clearing near a temporary pond. In this swarm were *Somatochlora tenebrosa* (Say), *Epitheca princeps* Hagen, and five species of *Aeshna: A. clepsydra* Say, *A. constricta* Say, *A. tuberculifera* Walker, *A. umbrosa* Walker, and *A. verticalis* Hagen. Of these species, *A. constricta* was the most abundant.

We thank Kenneth Knopf for loaning the specimens of *S. georgiana* from western Florida which we used in confirming our identification.

Somatochlora linearis Hagen: Cranberry Pond, Braintree, 2♂, 7/21/68 (HBW); 1♀, 6/29/69 (HBW); 2♀, 7/12/70 (HBW,RAR); Massachusetts Audubon Broadmoor Sanctuary, South Natick, 1♂, 7/10/71 (HBW); Boston Brook, North Andover, 1♂, 8/17/71; 1♂, 2♀, 8/12/73 (CWL); Bedford Road, Lincoln, 1♂, 7/27/72 (CWL).

Somatochlora williamsoni Walker: Cranberry Brook, Braintree, 1♂, 7/28/69 (TWD); Ponkapoag Bog, Canton, 1♂, 8/21/69; 1♂, 8/8/70; seen 7/11/71 (HBW); Tyler Pond, Florida, 1♂, 8/22/70 (HBW); Depot Street, Dunstable, 1♂, 8/18/71; 2♂, 1♀, 8/3/73 (PSM); Lowell Dracut State Forest, Dracut, 1♂, 7/13/73 (PSM); Willow Dale State Forest, Ipswich, 1♀, 7/16/72 (CWL); Center Street, Savoy, 1♂, 8/1/72 (CWL).

Pantala hymanaea (Say): Great Blue Hill, Milton, seen 8/20/67 (HBW).

Although sight records of Odonata are not always reliable, this species is quite distinctive and is reasonable to expect in Massachusetts (White and Morse, 1973).

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NEW DISTRIBUTION AND HABITAT RECORDS OF BITING MIDGES AND MANGROVE FLIES FROM THE COASTS OF SOUTHERN BAJA CALIFORNIA, MEXICO (DIPTERA: CERATOPOGONIDAE, CULICIDAE, CHIRONOMIDAE, AND PHORIDAE)[1]

Lanna Cheng[2] and Charles L. Hogue[3]

ABSTRACT: *Megaselia minutior* Borgmeier (Phoridae) is reported here for the first time for Baja California. At least in the spring months, *Culicoides furens* (Poey) (Ceratopogonidae) is the commonest biting midge around Isla San José, Bahía Balandra and neighboring sites. It was found breeding around the aerial roots of the mangrove *Avicennia nitida* in swamp mud and burrows of the crab *Sesarma sulcatum*. *Smittia* sp. (Chironomidae) and an apparently undescribed species of *Dasyhelea* (Ceratopogonidae) were collected from the same habitat on Isla San José. We present also some quantitative results for *C. furens* from emergence traps and preliminary behavior experiments. *Deinocerites mcdonaldi* Belkin & Hogue (Culicidae) was found breeding in burrows of the crabs *Cardisoma crassum* and *S. sulcatum* at several sites north of La Paz; these records extend the known northern limit for its distribution.

In separate and unrelated field trips along the southern coasts of the peninsula of Baja California, Mexico, the authors have collected species of biting midges and other Diptera associated with mud flats and mangrove vegetation. In citing these collections, this paper adds several species to the region's fauna and new information of their ecology.

Cheng's work has centered mainly on Isla San José, a small island about 26 Km long and 3-10 Km wide, situated in the Gulf of California off the coast approximately 90 Km NNW of La Paz. At the southern end of the island there is a rather extensive tidal lagoon, covering an area of 5-8 Km^2 and surrounded by mangrove swamps. The mud flats associated with the mangrove swamp provide ideal breeding grounds for biting midges of the family Ceratopogonidae.

Since these midges have constituted quite a nuisance to human visitors, including members of Scripps Institution of Oceanography expeditions to the area, and since no information on the

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biting midges of Baja California could be found in the literature other than the brief citations of Ryckman and Ryckman (1963), a one-week expedition was made to the island in the spring of 1972 (15-22 April), on the R/V DOLPHIN to collect specimens and to investigate their ecology.

Hogue's contributions derive from a reconnaissance by boat along the entire western coast of the peninsula and two excursions to the vicinity of La Paz. The former was conducted in March of 1966 from the private vessel SEA QUEST. Hogue visited all bays and lagoons likely to support mangroves and populations of land crabs whose burrows often contain larvae of biting midges and mosquitoes. These landing sites, with dates, in 1972, included Bahia Tortola (=B. Bartholome′ - 8 March), Bahía de Ballenas (9 March), Laguna San Ignacio (10 March), Bahía Magdalena (11-13 March), and Laguna Saltea, San Jose del Cabo (15 March). In later excursions he concentrated on the small bays (primarily Bahía Balandra) on the west shore of the peninsula north of La Paz in June of 1968, and in September of 1969 on Isla Espíritu Santo (Bahía San Gabriel), and a small estuary west of Todos Santos (Punta Lobos).

MATERIALS AND METHODS

Cheng's Studies

Most of the samples were collected from the mangrove swamp at the southern end of Isla San José; several additional samples were collected from a saltern at the northern end. Adult midges were collected with conventional sweep nets, or were aspirated from human skin or caught in specially devised emergence traps made of galvanized iron in the form of a box top, 10cm deep, with an area of 0.5m^2. Each trap had two glass vials screwed into diagonally opposed corners (Fig. 1). Twelve such traps were set at approximately 1-meter intervals in two transects in different areas of the southern mangrove swamp. Traps 1-5 were set on sandy beaches between high- and low-water level around low bushes of *Rhizophora mangle*, traps 6 and 7 on a muddy bank below high-water mark in the same area, and traps 8-12 between high- and low-water levels on muddy flats around aerial roots of *Avicennia nitida*.

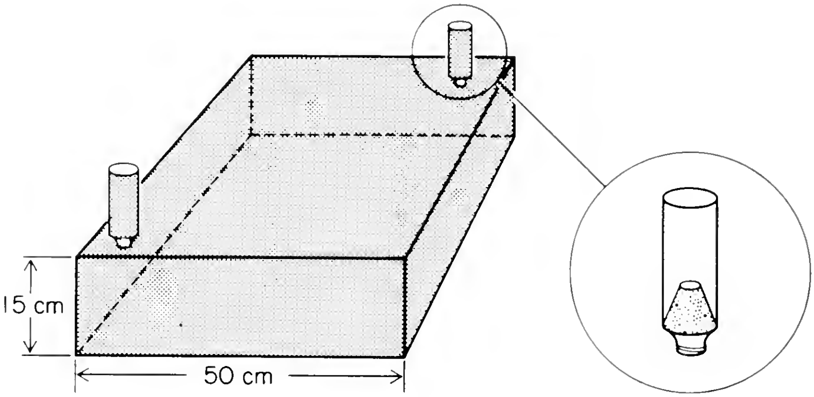

Figure 1. Schematic Diagram of Emergence Trap Showing Positions of Two Screw-Cap Vials in Situ. Each Vial Has a Plastic Cone Glued Into the Opening.

During the first two days vials were emptied four times daily: at 0800, 1200, 1600 and 1800 hours; after it was found that few flies emerged in the afternoons, the vials were emptied only twice a day: at 0800 and 1200 hours.

Mud samples taken from cores made at specific areas in the midge-infested mud flats were kept in the laboratory for over 30 days, during which time various midges and other insects emerged.

In addition, several short experiments were carried out to study the behavior of the biting midges in the field, using variously colored sheets of paper ($\sim 1 m^2$) sprayed with "tanglefoot"* (a non-drying adhesive similar to that used on ordinary fly-paper).

Hogue's Studies

Hogue's collecting was restricted to the vicinity of burrows of land crabs (*Sesarma sulcatum* and *Cardisoma crassum*). Adult flies were collected from burrow mouths and human skin; water samples containing larvae and pupae were taken with a bottle pump (described by Belkin et al., 1965).

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*The Tanglefoot Co., Grand Rapids, Michigan

RESULTS

Culicoides, Ceratopogonidae

All the midges attracted to and aspirated from human skin both by Cheng at Isla San Jose' and by Hogue at Bahia Balandra were *Culicoides furens* (Poey), one of the commonest biting flies of salt-marsh areas on the American continents. This species, which occurs along the Atlantic coasts of North and South America, and the Pacific coast from Mexico to Ecuador, has been recorded only once from Baja California (Ryckman and Ryckman, 1963). It is an economically important species, especially in the southeastern and Gulf coasts of North America where its biology has been extensively studied by Linley (1968, 1969) and Linley et al. (1970a, 1970b). As was to be expected, all of the aspirated specimens were females. Males of this species were collected by sweeping a net through midge swarms flying over flowering branches of the *Avicennia* or from emergence traps.

The mud samples collected by Cheng from both ends of the island yielded biting midges of only two species: *Culicoides furens* and *Dasyhelea* sp. (evidently a new species: Wirth, personal communication). Adults of both species were found to emerge from only the top 3cm. *Culicoides mojave* Wirth, a second anthropophilic species known from the area (Ryckman and Ryckman, 1963) was not found.

In general, adult ceratopogonids were caught only in the traps placed amongst the aerial roots of *Avicennia.* The flies caught in traps 8-12 were of particular interest to one of us -Cheng- since they had emerged in presumably one of the biggest and most accessible breeding grounds of biting midges on Isla San Jose'. *C. furens* emerged only from the three upper traps, not from the two lower ones where the mud surface remained submerged except during low spring tides. *Dasyhelea* emerged only from the lowermost trap. These results probably reflect differences in the larval ecology of the two species.

Out of 97 trapped flies, 77 emerged during the morning hours; the rest emerged during the afternoons or at night. More individuals emerged on warm sunny days, and none were trapped on the only overcast, cool day during the experimental period.

The results of the few simple experiments designed to study possible color and odor preferences of the adult female biting midges indicated that they prefer red and orange to green, white or black surfaces, and are more attracted to surfaces sprayed with iso-butyric acid, which occurs in human sweat, but are repelled by propionic acid. They were apparently less active on cold, windy days when one could work a few meters from their breeding ground without being bitten; whereas on warmer days they soon made their presence felt for several hundred meters downwind.

The adult males of the same species generally swarmed in sheltered areas above branches of *Avicennia.* Very few were caught from above exposed bushes, and none were caught on any windy day. Obviously more extensive observations and more sophisticated experiments are needed to understand the biting and swarming behavior of these insects.

Hogue took one female *C. furens* from the burrow of the marsh crab *Sesarma sulcatum* at Bahia Balandra on 11 June 68. There are no previous records of this species breeding in land crab burrows, although the habit is well known for several other species of *Culicoides* (Bright and Hogue, 1972: 44-45). Larvae of an unidentified *Culicoides,* collected by Hogue from burrows of *Sesarma* (possibly *magdalensis*) at Howland's Lagoon (north of Puerto Magdalena in Magdalena Bay – 11 March 66), may be of this species or *C. alahialinus.* The latter was collected for the first time north of Panama by Hogue, from holes of *Sesarma sulcatum,* in association with *C. furens* at Bahía Balandra (W.W. Wirth, personal communication).

Deinocerites, Culicidae

Hogue found a thriving population of *Deinocerites mcdonaldi* Belkin & Hogue in the burrows of the mouthless crab, *Cardisoma crassum,* at Laguna Saltea, near San José del Cabo (15 March 66), confirming a previous record of Downs (Adames, 1971: 82). This had been the most northerly point of the genus' known range on the Pacific Coast. Since that collection, however, Hogue and Bright found the same mosquito breeding in burrows of *C. crassum* and *Sesarma sulcatum* still further north: on the west coast at Punta Lobos, near Todos Santos (19 September 69), Bahía San Gabriel on Isla Espíritu Santo (17-18 September 69) and Mulege (mouth of Arroyo San Gregoria; D. Bright, collector; 31 August 71).

The association of *Deinocerites* with land crabs, *Cardisoma, Ucides* and *Uca*, is unquestionably specific or obligatory (Bright and Hogue, 1972: 3-4, 38). For this reason we would not expect the mosquito to occur very far north of Todos Santos along the outer western coast of the peninsula, because the prevailing cold surface current flowing southward carries the planktonic crab larvae in the opposite direction. In fact, Hogue found neither *C. crassum* nor *Deinocerites* in *Sesarma* burrows north of there.

Other Diptera

Possibly the most important record of a non-biting fly (caught in one of Cheng's emergence traps) was the phorid, *Megaselia minutior* Borgmeier, kindly identified for us by Dr. W.R. Robinson. It is known from the western United States, but has hitherto not been recorded from Baja California (W.R. Robinson, personal communication). In addition, some non-biting chironomids of the genus *Smittia* emerged from deeper samples of mud, collected 3-6cm below the surface at the southern end of the island.

A summary of the trap emergence data for the four major dipteran genera is presented in Table 1.

ACKNOWLEDGEMENTS

We wish to thank Dr. W.W. Wirth, Agricultural Research Service, U.S. Dept. of Agriculture, U.S. National Museum, and Dr. W.R. Robinson, Virginia Polytechnic Institute and State University, for identifying some of the flies for us. Cheng wishes to thank Dr. R.A. Lewin for assistance in the field, the Foundation for Ocean Research, San Diego, for financing the expedition to Isla San José, and all those who assisted in the operation of R/V DOLPHIN.

Hogue's appreciation is extended to Mr. Richard Dwyer, Los Angeles, owner and captain of SEA QUEST, for making it possible for Hogue to survey the west coast of the peninsula. During the latter's trips, in company with Dr. Donald B. Bright and Carlos Villalobos, facilities and assistance was extended by the Estacion de Biologia Pesquera, La Paz, through Biol. Jose J. Diaz. Permission to collect specimens was extended by the Departmento de Conservacion de la Fauna Silvestre, Republic of Mexico.

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Table 1. **Summary of trap emergence data.**

Trap No.	Tide level	Type of substrate		*Culicoides* (no.)	*Megaselia* (no.)	*Dasyhelia* (no.)	*Smittia* (no.)
1	A	open	sand	1	–	–	–
2	D	mangrove	sand	–	–	–	–
3	B	open	sand	–	–	–	–
4	C	open	sand	–	–	–	–
5	E	mangrove	sand	–	2	–	–
6	E	open	mud	–	–	–	–
7	D	mangrove	mud	–	–	–	–
8	C	mangrove	mud	6	9	1	1
9	E	mangrove	mud	–	1	1	–
10	D	mangrove	mud	–	–	–	–
11	A	mangrove	mud	5	7	–	13
12	B	mangrove	mud	6	3	–	–

A = highest high water mark
B = medium high water mark
C = lowest high water mark
D = medium low water mark
E = lowest low water mark

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ADDENDUM

In March and April of 1974 the authors visited several of the southern islands in the Gulf of California from the R/V Dolphin where additional collections were made which are pertinent to the subject of this paper:

Deinocerites mcdonaldi. – The range of this species in the Gulf of California is extended, with collections from Isla San José, lagoon east of Bahía Amortejada, 1-2 April 1974 and Isla Carmen, Bahía Balandra, 4 April 1974. In both localities the larvae and pupae were siphoned from burrows of the land crab, *Cardisoma crassum.* The greatest numbers of specimens were found in black, very saline water (41-53 ppt, as determined with a portable optical refractometer) with a strong odor of hydrogen sulfide. Only a few adults were taken, resting on the sides of the burrow.

Thalassomyia bureni **Wirth.** – A large number of these marine midges were attracted to a table lamp near a cabin door of the ship during the night of 4 April 1974. The ship was anchored in Bahía Balandra, Isla Carmen, about 150 m from the shore. The sky was clear, with the moon at three-quarter phase, the air temperature was approximately 20°C. This species has hitherto been recorded only from Florida; these specimens were identified by H. Hashimoto.

For this additional opportunity to study the coastal insect fauna of Baja California we are again indebted to the Foundation of Ocean Research, San Diego and Mr. Richard F. Dwyer of Los Angeles.

THE BROWN RECLUSE SPIDER IN GEORGIA (ARANEIDA: LOXOSCELIDAE)[1]

James O. Howell[2]

ABSTRACT: The brown recluse spider, *Loxosceles reclusa,* was first reported from Georgia in 1968. Unaided dispersal of this species is apparently very slow, and man undoubtedly plays an important role in the movement of this pest. It is apparently much more common than previous collection records indicate, and is presently known from 12 counties. Egg sacs are first produced in June, and contain from 21-78 eggs each. The species overwinters as various instars or adults in Georgia. Good control was obtained using 0.02% Lindane spray.

DESCRIPTORS: *Loxosceles reclusa,* brown recluse spider, biology, control.

The brown recluse spider, *Loxosceles reclusa* Gertsch and Mulaik, has received much publicity in the last few years since Atkins, et al. (1958) proved that it was the species producing "necrotic arachnidism" in the United States. It was first collected in Georgia by Vazquez in 1961 under the loose bark of a white oak tree in Pike County. Large portions of this tree had been dead for several years. Since then, several other collections have been reported from the State, but these were always associated with man made structures. Gorham, et al. (1969) returned to the original collection site in 1968, and found the basal portion of the tree still standing, but the remainder had fallen to the ground. They found several males and females in various instars, all occupying the fallen portion of the trunk. They searched the surrounding area within a half mile radius but did not find other sites of infestation.

Because this is the only known collection in Georgia from a completely natural habitat, the author went to the collection site on June 3 and September 23, 1972 to determine if any dispersal had taken place from the rotten log. On June 3, six immature brown recluse spiders were found but no adults or early instar spiderlings were observed. On September 23, three adult males, 2 adult females, and 3 immature specimens were collected. Three of the adults were collected beneath the standing portion of the trunk. Gorham, et al. (1969) reported this portion of the tree harbored no spiders at the time of their collections

A diligent search was conducted by the author in the area in a 200 yd. radius surrounding the log but none of the spiders could be found in any other location, although several places appeared

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to be ideal habitats for this species. The unaided dispersal of the brown recluse spider is apparently very slow, and man undoubtedly plays a major role in the movement of this pest from one locality to another.

In another locality, in Spalding Co., Ga., a heavy infestation was found in an old wooden frame shed about 100 yards from the owner's residence. Although 3 other unused buildings were located within 60 feet, no spiders were found in them, again indicating the poor dispersal ability of *L. reclusa.*

The Spalding Co. population was observed for over a year. Egg sacs were first observed on June 8, 1973, and numbered up to 3 per female. The number of eggs per sac ranged from 21-78 in 20 egg sacs observed. In summer months spiders of all stages were abundant on beams in the ceiling and along the exposed frame of the walls. Usually 3 or 4 cast skins were located near adult spiders, suggesting that the spider stakes out and occupies a very small territory when it reaches the 3rd or 4th instar, and stays within this area into adulthood. It appears that the spider may overwinter in almost any stage. Early instars through adults were collected as late as January 15, 1973, and again on June 8 before any new broods were seen. Adult females marked with red paint on January 15 were later collected with egg sacs on July 6. After mid-January, the spiders were very difficult to find. The colder temperatures apparently had forced them to seek refuge in cracks and crevices providing more protection.

On September 28, 1973, the Spalding Co. population was sprayed with 0.02% Lindane. There was 100% mortality on 20 caged specimens, and after 3 weeks, no live spiders were seen in the building.

Loxosceles reclusa is presently known from Butts, Cobb, Coweta, Douglas, Fulton, Gordon, Henry, Paulding, Pike, Spalding, Troup, and Walton Counties. It is probably more common in Georgia than previous collection records indicate, but because of its reclusive nature has gone unnoticed.

ACKNOWLEDGMENT

Grateful appreciation is extended to Dr. Richard Gorham, Food and Drug Administration, Washington, D.C., for his assistance in compiling distributional records for *Loxosceles reclusa.*

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BATFLIES (STREBLIDAE AND NYCTERIBIIDAE) IN THE EASTERN UNITED STATES, AND A NYCTERIBIID RECORD FROM SASKATCHEWAN[1]

John O. Whitaker, Jr.,[2] David A. Easterla[3]

ABSTRACT: Batflies (Streblidae and Nycteribiidae) are uncommon on bats of the eastern United States, east of Kansas, Oklahoma and Texas, but two species of streblids and three of nycteribiids have been reported from this area. The streblids are *Trichobius corynorhini* from *Plecotus townsendii* and *P. rafinesquii* and *T. major* from *Myotis austroriparius*.. The nycteribiids are *Basilia boardmani* from *Myotis austroriparius* and *M. lucifugus*, and *B. forcipata* and *B. antrozoi* from *Tadarida brasiliensis*.

DESCRIPTORS: Batflies of eastern U.S. bats

There are a number of records of streblid and nycteribiid flies on bats from Central and South America and in the western United States from Texas, Oklahoma and Kansas westward. There are few records east of these states. The purpose of this paper is to summarize records of Streblidae and Nycteribiidae of the eastern states and to present new state and host records for *Trichobius corynorhini*.

Two species of Streblidae and three of Nycteribiidae are known from the eastern United States as follows.

STREBLIDAE

Trichobius corynorhini Cockerell, 1910: *T. corynorhini* has been reported from West Virginia by Wilson (1946), Whitaker (1957) and Handley (1959), and from Arkansas by Sealander and Young (1955). Handley (1959) reported *T. corynorhini* on *P. townsendii*, but the other three reports cited *P. rafinesquii* as the host. However, the genus *Plecotus*

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was revised by Handley (1959). Following Handley's classification, the bats examined by Wilson (1946), Whitaker (1957) and Sealander and Young (1955) were all *Plecotus townsendii* (Handley, 1959; reidentification by Whitaker; and Personal Communication from Sealander, respectively). In addition, we (Easterla) also took 4 individuals of *T. corynorhini* on *Plecotus townsendii ingens* on 23 February, 1963, at Meade Cave, Stone Co., Missouri. Also, B.V. Peterson (Pers. Comm.) reports one male *Trichobius coryhorhini* from a bat (species not clear) from Mud Cave, Reed's Spring, Stone County, Missouri, September 11, 1946, taken by J. Brennan. These constitute the first records of streblid flies in Missouri. Thus, all reports of *T. corynorhini* in the eastern United States refer to *P. townsendii* as the host. *Plecotus townsendii* is the normal host for this parasite. There are no previous records of *Trichobius corynorhini* on *Plecotus rafinesquii.*

On 24 October 1971 Easterla took two individuals of *Trichobius corynorhini* on *Plecotus rafinesquii* from Bill Johnson's Cave, Sand Gap, Jackson County, Kentucky. This constituted the first record of this parasite on *P. rafinesquii.* B.V. Peterson (Pers. Comm.) reports 10 male and 11 female *Trichobius corynorhini* from *Plecotus townsendii* taken 28 March 1964 by W.H. Davis from a cave in northwestern Lee County, Kentucky. R.L. Wenzel (Pers. Comm.) reports this fly from Tulip Cave, Cave Hollow, Lee County, Kentucky, taken 10 January 1968. These are the first records of streblids from Kentucky.

Trichobius major Coquillett 1899: In the eastern United States, *T. major* has been reported from *Myotis austroriparius* in Florida by Jobling (1938) and Rice (1957). In addition, R.L. Wenzel (Pers. Comm.) reports 2 flies of this species from *M. austroriparius* from Cavern State Park, 3 miles N. Marianna, Florida, Fall, 1953, and 2 from *Myotis grisescens* from Indian Cave, Marianna, Florida, taken 4 February 1951. Rice stated that this is the most conspicuous parasite on *M. austroriparius* in Florida, with bats carrying one to six flies. Ross (1961) states that *Myotis velifer incautus* is the normal host for this species in the western United States.

NYCTERIBIIDAE

Basilia boardmani Rozeboom, 1934: *B. boardmani* is an eastern species and was first described from *Myotis austroriparius* from Florida (Rozeboom, 1934), where Rice (1957) reported it to be common. It has since been reported from *Myotis lucifugus* from Georgia (Peterson, 1960), and from *Myotis austroriparius* from Illinois (Parmalee, 1955).

Basilia forcipata Ferris, 1924: This is a parasite of western species of *Myotis.* The single eastern record is from *Tadarida brasiliensis* from Louisiana (Ferris, 1924). In addition, B.V. Peterson (Pers. Comm.) identified a *Basilia forcipata* from *Lasionycteris noctivagans* from Govenlock, Saskatchewan, taken June 7, 1933, by H.F. Hughes. This represents the second province from which nycteribiids have been taken, and is by far the most eastern Canadian record.

Basilia antrozoi (Townsend, 1893): The single eastern record is from *Tadarida brasiliensis* from Louisiana (Ferris, 1924).

Key to Eastern Batflies

1. Winged forms . . . . Streblidae: *Trichobius* . 2
   Wingless forms . . . . Nycteribiidae: *Basilia*. . 3

2. Eight scutellar setae; setae in center of mesonotum reduced in
   size, much smaller than lateral setae . . . . Trichobius major

   Four scutellar setae; setae in center of mesonotum not reduced,
   nearly equal in size to lateral setae of mesonotum . . . . Trichobius corynorhini

3. Posterior margin of mesonotum with a prolonged, upright, finger-like process
   . . . . .Basilia boardmani

   No such process 4

4. Abdomen with 2 visible tergites . . . . *Basilia corynorhini*
   Abdomen with 3 visible tergites . . . . *Basilia antrozoi*

ACKNOWLEDGEMENTS

We are grateful to Dr. B.V. Peterson (Biosystematics Research Institute, Research Branch, Agriculture Canada, Ottawa, Ontario) and to Dr. R.L. Wenzel for allowing us to use their records.

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NEW MISSISSIPPI RECORDS FOR *ZOROTYPUS HUBBARDI* (ZORAPTERA)[1]

P.H. Darst[2], C.M. Cooper[3], R.N. Paul[3], and J.P. Steen[3]

ABSTRACT: New Mississippi records for *Zorotypus hubbardi* Caudell are Calhoun, Lafayette, Marshall, Panola, Pontotoc, Stone, and Tishomingo Counties. Except for Tishomingo County, where a specimen was found under dead pine bark, all were obtained at sawmills.

DESCRIPTORS: Zoraptera, *Zorotypus hubbardi,* Mississippi

The insectan order Zoraptera has been considered rare by most entomologists. *Zorotypus hubbardi* Caudell, the only widely distributed United States species, was collected in 7 Mississippi counties during a 2 week period (21 Apr. 1974 to 5 May 1974). These collections constitute 7 new county records. Four county records previously existed: Pearl River Co. and Lamar Co. (Copeland 1954); Holmes Co. and Rankin Co. (Riegel 1963). The new county records reported here extend the recorded distribution to the Tennessee and Alabama state lines.

Except for the specimen from Tishomingo Co. all Zoraptera collected were associated with sawmill operations. Six of 7 functioning sawmills visited yielded Zoraptera. Previous reports indicate that Zoraptera were collected from sawdust or from wood in sawdust piles. All our specimens, collected at sawmills, were found associated with fairly large pieces of wood, occasionally severely charred, which were protruding from either pine bark fragments or ash residue from sawdust burners. Four of the 7 collections were from sawmills handling only hardwoods or hardwoods and cypress. A total of 145 *Zorotypus hubbardi* were collected. Twenty-nine nymphs (2 with wing pads), 62 apterous females, 2 dealate females, and 52 apterous males were obtained. Four of these specimens were obtained from Berlese funnel extractions of pine bark fragments from Bond, Miss.

New county records for Mississippi are as follows: Bond, Stone Co., 21 Apr. 1974, from pieces of wood in pine bark fragments; Taylor, Lafayette Co., 24 Apr. 1974, under short pine post discarded near post mill; Bruce, Calhoun Co., 24 Apr. 1974, from pieces of wood in sawdust burner residue; Tishmingo Co., 27 Apr. 1974, under bark of a dead pine; Sardis, Panola Co., 1 May 1974, from pieces of wood in sawdust burner residue; Pontotoc, Pontotoc Co., 5 May 1974, from pieces of charred wood at sawmill; Potts Camp, Marshall Co., 5 May 1974, from pieces of wood in sawdust burner residue.

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ODONATA NAIADS FROM CANADOHTA LAKE, CRAWFORD COUNTY, PENNSYLVANIA[1,2,3]

Frank B. Peairs[4], Robert E. Bugbee[5]

ABSTRACT: Twelve species of naiads are listed and six are new records for Crawford County, Pennsylvania.

DESCRIPTORS: Odonata naiads; Crawford County, Pa.,; Zygoptera; Anisoptera.

During October 1970, and May 1971, 222 Odonata naiads were collected by dip net from Canadohta Lake in Crawford County, Pennsylvania. The lake is located in the northern part of the county at an altitude of 1389 feet and is approximately 1 1/8 miles long and 1/3 mile wide. The insects collected represented 12 species of which six appear to be new county records. Other county lists include Kormondy and Gower, 1965, and Williamson, 1902.

Listed below are the species collected and the numbers of each. Those marked with an asterisk are new county records.

ZYGOPTERA

**Lestes inaequalis* Walsh	14
Ischnura verticallis (Say)	30
**Enallagma divagans* Selys	23
E. ebrium (Hagen)	34
E. signatum (Hagen)	17
**E. traviatum* Selys ??	3
**E. vesperum* Calvert	20

ANISOPTERA

Gomphus (*Gomphus*) sp.	1
**Basiaeschna janata* Say	4
**Epicordulia princeps* (Hagen)	5
Tetragoneuria cynosura Say	69
Libellula luctuosa Burmeister	2

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[2] Part of a senior thesis submitted to the faculty of the Biology Department of Allegheny College, Meadville, Pennsylvania in partial fulfillment of the requirements of the Bachelor of Science.

[3] The authors express appreciation to Dr. M. J. Westfal of the University of Florida for assistance in identification of the species.

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The Entomologist's Library

This section contains titles of books, monographs, and articles received by the editor that may be of special interest to entomologists and biologists. A brief statement of contents and items of interest are noted. Brief analytical reviews may be submitted for possible publication. All correspondence for this section should be addressed to the editor.

BOOK REVIEW

Dr. Charles D. Michener, in the preface to his new book[1], refers to the eight years of its consideration and preparation. The work actually represents an academic lifetime's interest and study of the various social bees, a pursuit and avocation that will continue to increase our knowledge concerning these fascinating animals.

The book is divided into three parts: Melittological Background, Comparative Social Behavior and Natural History. Melittological Background briefly explores the external and internal morphology, life history and evolution of the social bees and the terminology associated with bee nests and social existence. Comparative Social Behavior examines in some 16 chapters the various social interactions observed within the different families, genera and species from the non-social interactions of sleeping clusters and nesting aggregations to a final chapter on speculations regarding the evolution of social behavior in the bees. Individual chapters in this section examine the topics of caste differences, caste determination, division of labor, reproductive activities of workers, foraging, and communication of resource location. The mechanisms of how different species control physical conditions of the nest and define the nest are also treated. A small, but extremely fascinating chapter discusses the parasitic and robber bees associated with social bees. The last chapter in this section provides an analysis of bee social behavior, its features, origins and selection. Here Michener adds mutualistic social behavior as another principle component along with altruism in the evolution of bee social systems. The final section, Natural History, treats each taxonomic group of social bees and includes discussion of their bionomics and various social characteristics. The three parts are well-integrated with numerous cross-references between chapters. The text is followed by an adequate glossary and an extensive literature section with over 700 citations.

This book is a necessity for animal behaviorists, especially those interested in the development of social systems, and all entomologists will find this book enjoyable, interesting and extremely informative. One regrettable thing about the book is its high price. Hopefully, the book will appear in paperback form.

Richard Rust,
University of Delaware

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[1] Michener, C.D. 1974. The social behavior of the bees. Harvard Univ. Press, Cambridge MA. 404 p. $25.00.

ON THE BIOLOGY OF *GODYRIS ZAVALETA CAESIOPICTA* (LEPIDOPTERA: NYMPHALIDAE: ITHOMIINAE)[1]

Allen M. Young[2]

ABSTRACT: Various aspects of the biology of the Ithomiine butterfly *Godyris zavaleta caesiopicta* (Niepett), also known as *G. z. sorites* Fox, are presented for the first time. Field observations on habitat, adult habits, and oviposition were made in a ravine forest in the central highlands of Costa Rica, a region where the Ithomiine fauna is very rich. The butterfly is a forest species and eggs are laid singly on *Solanum brenesii* Morton & Standley (Solanaceae), an understory tree. The life stages and egg-to-adult developmental time (about 33 days), as studied in the laboratory, are described. The larva and pupa are cryptically colored, and the resting behavior of the larva is also cryptic. It is suggested that selection favors cryptic coloration and behavior in immatures of many Ithomiinae to reduce predation by visually-hunting predators with learning abilities during a critical period when systemic toxicity is being perfected during ontogeny. Crypsis is also effective against non-learning visual predators. But larvae may succumb to other forms of mortality, including microbial diseases that infect larvae through ingestion. A secondary consequence of this may provide a feeding niche for the larvae of the saprophytic fly *Fannia canicularis* (Linneaus). The strong sexual dimorphism in adult coloration is believed to provide a means for this species to enter into different mimicry complexes with other Ithomiinae, Heliconiinae, and Danainae. The hypothesis is discussed that the high richness of Ithomiinae in this region is due to pronounced divergence in larval host plants among the rich solanaceous flora found here.

DESCRIPTORS: butterfly, *Godyris zavaleta caesiopicta*, Ithomiinae, Costa Rica, life stages, developmental time, larval host plant, oviposition behavior, larval behavior, sexual dimorphism, crypsis, toxicity, mimicry, community.

Thanks to the late Richard M. Fox, there is available a wealth of excellent systematic data (Fox, 1968) on the Central American fauna of Ithomiinae (Lepidoptera: Nymphalidae). Such monumental studies provide a useful groundwork for observations on the natural history of species and genera in various ithomiine tribes in Central America (e.g., Young, 1972a; 1973a; 1974a,b). In fact, other studies of Fox (e.g., Fox, 1940; 1961; 1967) have prompted natural historical studies of the Ithomiinae in South America (D'Almeida and Mielke, 1967; Brown, Mielke, and Ebert, 1970; Brown and D'Almeida, 1970). And aside from the systematic clarity for several tribes within this subfamily of exclusively Neotropical butterflies, these insects are useful for the study of local habitat selection and larval resource divergence since most or all species of Ithomiinae feed on Solanaceae (e.g., Brower and Brower, 1964). Although it is therefore suspected that the local faunal diversity of these butterflies is due in part to behavioral and

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ecological divergence in host plant preference within the local solanaceous flora for oviposition and larval development, there have been very few field studies to support such an interesting contention. But Young (1973; 1974a,b) found that three different ithomiine butterflies (*Hymenitis nero, Pteronymia notilla,* and *Oleria zelica,* respectively) feed on different species of Solanaceae in the larval stage in the same habitat in montane tropical rain forest. However, exhaustive searches for other host plants used by each of these species (and possibly revealing resource overlap, or confirming lack thereof) were not undertaken in these studies.

The present paper is an account of the natural history of still yet another ithomiine butterfly in a habitat where it is sympatric with the other species I have studied. This interesting and elusive species is *Godyris zavaleta caesiopicta* (Niepett, 1915), also called *G. z. sorites* by Fox (1968). This species is very strongly sexually-dimorphic for wing coloration (Fig. 1): the females are reddish and the males are yellowish and quite transparent. In fact, the males resemble *Olyras insignis* (Ithomiinae). It is one of the larger-sized members of the Central American Ithomiinae and nothing has been published on its biology. This paper gives an account of the life stages, developmental time, larval host plant, and miscellaneous observations on the behavior of immatures and adults for this species.

STUDY METHODS

After observing several acts of oviposition by a single female of *G. zavaleta caesiopicta* (hereafter referred to as *G. zavaleta* for brevity) during the early afternoon (1:00 P.M. – C.S.T.) on 16 August, 1973 along a path at the bottom of a forest ravine in the central highlands of Costa Rica, I collected nine eggs for rearing in the laboratory. The region where oviposition was observed is known as "Cuesta Angel", a rugged steep virgin forest ravine in the Central Cordillera in Costa Rica, northeast of the capitol city of San Jose. Further descriptions of the region are explained and figured in other reports (Young, 1972b; 1973a,b). At the time that oviposition was observed, records were taken on the host plant and its position in the dense secondary growth along the forest trail. Specimens of the plant were taken for identification. The oviposition behavior was also recorded. Individuals of the host plant where oviposition was observed were also inspected for other eggs and larvae; attention was paid to the (1) number of eggs and larvae per leaf, and (2) the positions of the larva on a leaf. It was

Fig. 1. Sexual dimorphism in *Godyris zavaleta caesiopicta* (Niepelt) (also known as *G. z. sorites* Fox). Dorsal view of female (above), male (below). The large, central light areas of both wings in the female are reddish, those of the male, yellowish. The scale is in mm.

hoped that these observations would provide some insight into how individuals of this butterfly are distributed spatially on the host plant.

The collected eggs were immediately confined to a large (60 x 25 cm) clear plastic bag, along with cuttings of the host plant, a method used with considerable success in the rearing of other Ithomiinae (Young, 1972a; 1973a; 1974a,b). The bag is kept tightly shut and the animals are examined with ease on a pre-determined daily schedule throughout development. All life stages were photographed and size measurements (in mm.) were taken, along with notes on gross morphology and coloration. Rearing conditions were 60-70°C and 45-65% relative humidity. Occasional notes were made on the feeding and resting behavior patterns of larvae, including interactions among individuals. After pupation, the insects were transferred to a small, wire-mesh eclosion cage. Voucher specimens of the adults were saved for identification and further study.

RESULTS

Habitat and Oviposition Behavior

On several visits to the general study area at Cuesta Angel over the past three years, I have noticed that *G. zavaleta* is a species that is most frequently encountered in the heavily-shaded forest understory that covers the steep rocky slope that rises very abruptly from the river-bottom (Rio Sarapiqui - headwaters). The butterfly is seldom seen in the more open places such as forest edge and patches of secondary growth. Like the rare and elusive *Oleria zelica pagasa* also found here (Young, 1974b), *G. zavaleta* is a forest species. Both males and females are seen flying together in the dark understory along the river-bottom forest and also at higher places on the ravine. Adults appear to be patchy in spatial distribution: as an example, in the study area, there is one spot along the shaded forest path where several adults can be seen within a few minutes. About 100 meters up the side of the ravine, only accessible over very treacherous terrain, there is a second spot where adults are frequent. If similar waiting periods are spent in the intervening forest, very few adults are seen. At both spots I have found a few individuals of the plant used for oviposition, namely, *Solanum brenesii* Morton & Standley (Solanaceae). This plant grows as a small (2-4 meters tall) understory forest tree and it has a growth form very similar to another solanaceous tree found in this forest, *Cestrum megalophyllum,* used for oviposition by another ithomiine, *Pteronymia notilla* (Young, 1974a). *Solanum brenesii* possesses very large dark green leaves and when branches are bent over, straight, vertical suckers are produced bearing many leaves.

The eggs are laid singly on older leaves of the host plant. The female alights on the upper surface of the selected leaf and backs up to the edge; the abdomen is then curled under the leaf edge and an egg is released and affixed to the ventral surface. In a total of eleven acts of oviposition witnessed for a single female, the egg was always laid edgewise along the lateral region of the leaf and never at the tip. Such an oviposition pattern is typical for many Ithomiinae (Brown and Mielke, 1970; Young, 1972a; 1973a; 1974a,b). The oviposition acts lasts from five to eight seconds. Between acts of oviposition, the female observed would fly around the host plant and occasionally rest on a leaf. Several eggs were laid on the same plant that afternoon but the female never laid more than one egg on a leaf. But subsequent inspection of several leaves revealed that more than one egg may be found on a leaf; this is presumably the result of oviposition by different females. It was also noted that a female would leave the area after laying several eggs on the plant; such movement by females presents the possibility that females of this butterfly lay eggs on more than one individual of the host plant (i.e., eggs of each female may be distributed over more than one resource patch).

Life Stages and Developmental Time

The white egg (Fig. 2-A) is slightly conical and about one mm tall. About one day before hatching, the egg turns yellow. The egg stage lasts six days.

When it hatches, the first instar is about three mm long and translucent yellow. With first ingestion of plant material, the body of the first instar larva darkens; the head capsule remains yellow. Just after the first molt, which occurs two days after hatching, the young larva is about five mm long. This second instar (Fig. 2-B) is characterized by a bright green body and yellow head capsule that bears a small brown spot in the region of the ocelli. The anal clasper is green and ringed dorsally with yellow. The second molt occurs three days later and immediately following this molt, the larva is about eight mm long. The third instar (Fig. 2-C) is uniformly light green with a light blue line barely visible just above the spiracles. The gut contents give the posterior region of the body a darker green hue than the anterior (thoracic) region. The last abdominal segment bears a pair of lateral, swollen patches that are very light green. The head capsule is very pale yellow-green, glossy, and it still bears the small brown patches in the ocelli regions. The third instar lasts about three days, and just after the third molt, the larva is about 15 mm long. The fourth instar (Fig. 2-D) is very fat and the basic colors are light green and yellow. The body is light green and translucent; the gut is clearly visible dorsally as a dark green tube owing to the translucence of the body wall. There is a yellowish haze surrounding each spiracle and together they form a diffuse line running through the spiracles, which are also yellow. The head is very small relative to the width of the body; it is still glossy yellowish-green but now the pigmented areas of the ocelli are black. The last abdominal is swollen laterally as in the previous instar. This instar attains a body length of about 21 mm by the time of the fourth molt; the head capsule width is 2.8 mm and the width of the body through the metathoracic region is about 3.8 mm. The fourth instar lasts about three days, and the fifth instar is very similar in overall appearance (Fig. 2-E,F). It lasts three days and attains a body length of about 30 mm and width (through the metathoracic region) of about 5.0 mm. One day prior to pupation, it turns into a very active prepupa that is about 26 mm long and uniformly very light, translucent green with no visible markings. Including the prepupal period, the larval stage lasts 15 days.

The coloration of the pupa (Fig. 2-G) is precisely the same shade of green as the prepupa. The pupa is 11 mm long, eight mm dorso-ventrally through the wing pad region and seven mm wide laterally in the same section of the body. The width between the small head forks is 2.1 mm. The spiracles are light yellow and the cremaster is black. Sets of small black dots adorn the ends of the head forks and a black spot is present where each forewing is attached to the thorax. A doublet of very tiny black spots occur on the forelegs and a pair of black spots occur on each forewing. As the time of eclosion approaches, the pupa darkens progressively from the head forks to the last segments of the abdomen. Eclosion takes place early in the morning (7:00-9:00 A.M.) under laboratory conditions and adults (Fig. 2-H) are ready to fly within one hour. Copious discharge of a pink-colored meconium accompanies eclosion and occurs intermittently through wing expansion (Fig. 3). Adults of both sexes are described in Fox (1968) and original descriptions are given in the old *Lepidoptera Niepettiana* (vol.

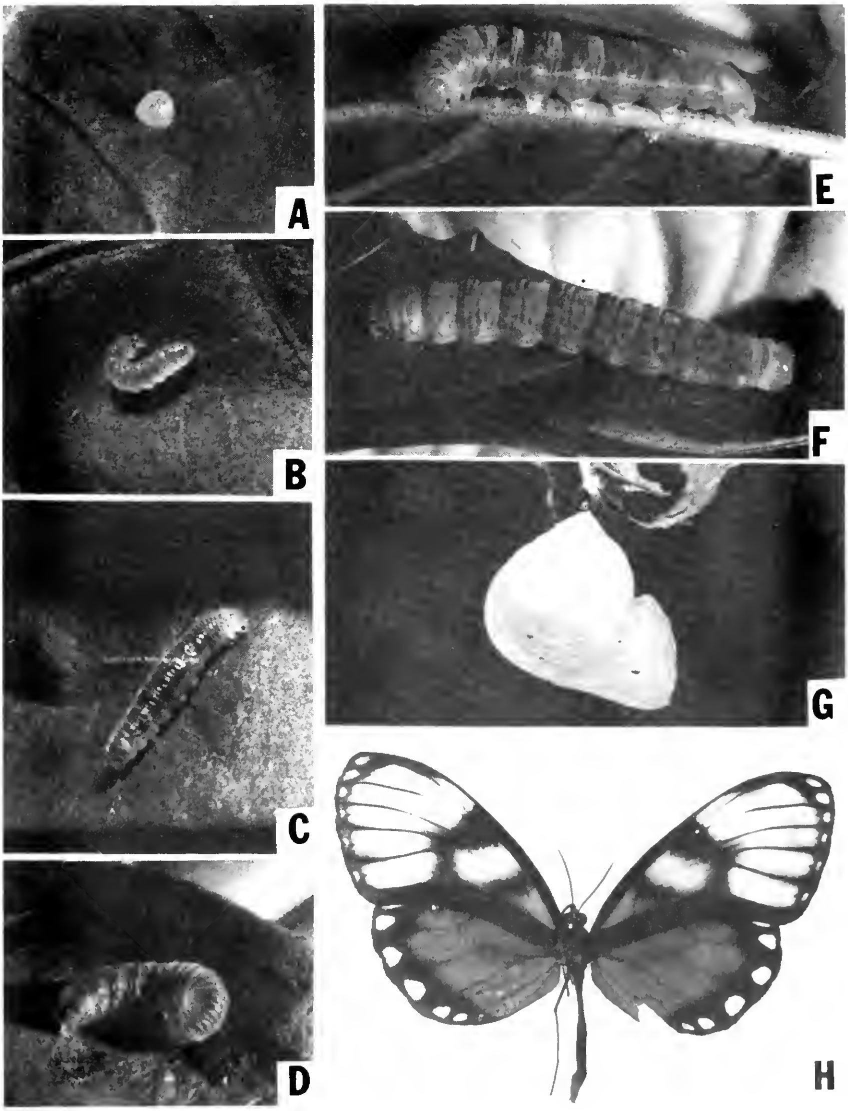

Fig. 2. Life stages of *G. z. caesiopicta,* egg (A), second instar larva (B), third instar (C), fourth instar (D), fifth instar (E-F), pupa (G), and adult female (H).

2-1915). The butterfly has been renamed *G. z. sorites* by Richard M. Fox.

Behavior of the Larvae

Following a molt, the larva devours the exuvium, and this behavior occurs in all of the first four instars. Individuals during instars 1-3 rest on the ventral sides of leaves in the wild, but this behavior is inconsistent in the laboratory. In both the wild and laboratory, fourth and fifth instar larvae construct individual shelters by one of two methods: (1) opposite edges of a single leaf are pulled together with several silken strands, or (2) two adjacent leaves are joined along the lateral edges to form a flat tent-like structure. Whether resting on the exposed leaf surface (young instars) or in the shelter, the larva invariably assumes a "J" position so characteristic of many Ithomiinae.

Both in the wild and laboratory, only one larva after the third instar is found on a leaf. If two or more larvae are placed next to each on a leaf, many times there are signs of biting and attack. Such movements are very suggestive of aggressive behavior and low tolerance for group existence. In terms of the population biology of the butterfly, such preliminary observations suggest that individual fecundated females of this species should distribute their reproductive activities over several host plant individuals (patches) in the forest, rather than concentrating oviposition in one small area. But this strategy, of course, will also be highly dependent upon the total egg productivity and age-specific fecundity curve of the female.

Larvae brought in from the wild, and even three of the nine reared in the laboratory, died as an apparent result of some sort of microbial infection. In the fatal sickness, the gut contents are ejected prior to death and the body disintegrates very rapidly thereafter. One larva afflicted with the disease produced three dipterous pupae at the time of death. The flies that emerged from these pupae are *Fannia canicularis* (Linnaeus), a species that is usually considered as a saprophyte and not a parasite (Dr. Richard H. Foote, pers. comm.). But Dr. Wayne Gagne has encountered this species in the diseased larvae of the North American gypsy moth (pers. comm. to R. H. Foote) and under no circumstances did healthy larvae produce flies. This species has also been reported as a parasite of some Orthoptera, Coleoptera, and snails (Misc. Publicat. 631, U.S. Dept. Agriculture, p. 130). Healthy

Fig. 3. A freshly-eclosed male resting on the pupal shell.

larvae of *G. zavaleta* have not produced the fly, even in the pupa stage. Although the relationship between diseases and fly remain obscure, it is likely that the fly is not a true parasite of *G. zavaleta.* Other cases of attack by Diptera or Hymenoptera on *G. zavaleta* have not been found.

DISCUSSION

The ithomiine "community" is rich in the forest at Cuesta Angel, and it is therefore interesting to cast the various data on *G. zavaleta* in terms of selection pressures that are predicted to be operative on this species and other members of this butterfly ensemble. We can speak of how *G. zavaleta* fits into the ithomiine community, and also in terms of predation pressures that might be operative on such an insect.

First, the time required to reach the age of first reproduction (adulthood) is about 33 days, which is similar to developmental times of other ithomiines in this habitat reared under very similar conditions (Young, 1972a; 1973a; 1974a,b). While certainly we might expect variation in developmental time to be in part the result of host plant differences (since the physical and chemical properties of different solanaceous host plants may vary considerably), there is also remarkable uniformity in duration of the egg stage. Natural selection should always favor an evolutionary reduction in the amount of time required for an organism to reach the age of first reproduction since this will increase fitness by decreasing the risk of predation in immatures. Thus under selection from predation, the range of egg-to-adult developmental times reported for different ithomiine butterflies in a given geographical region may be indicative of the best these insects can do given host plant types, ingestion rates, and rate of assimilation.

If selection has favored reduction in developmental time to reduce the amount of time immatures are exposed to predation, many of these butterflies, including *G. zavaleta,* have evolved cryptic coloration and behavior patterns that are very evident during the larval and pupa stages. The green coloration of the larva and pupa in *G. zavaleta* and the resting behavior of the larva suggest crypsis. Crypsis is a protective adaptation from visual-hunting predators, and for immature stages of Ithomiinae, it may be highly adaptive in concealing the insects until other protective mechanisms such as systemic toxicity are perfected during development. Crypsis is also effective against visually-hunting predators with little or no learning abilities; such predators would include invertebrates such as spiders and ants. Assuming a lack of passive chorionic defense, the egg of Ithomiines may be the most vulnerable stage in the life cycle, especially from predation by ants. Whether or not leaf-wandering predatory ants search along the ventral edges of leaves for eggs of insects needs to be studied in the wild. It is generally believed that the Ithomiinae are toxic in the adult stage as a result of larvae feeding on Solanaceae (e.g., Brower and Brower, 1964), but virtually nothing is known about the toxicity of the larva and pupa stages. The high toxicity of the adult stage in different species is reflected in the evolution of warning coloration, which is an adaptation for learning in visually-hunting predators, especially birds.

Single oviposition is prevalent in most butterflies. Although the reasons as to why single oviposition is the rule remain obscure, such behavior may be adaptive in many species primarily in two ways. First, a butterfly like *G. zavaleta* exploits a very spatially patchy resource (host plant) that is characterized by individually large patches relative to egg size and consumption (ingestion) levels of individual larvae. The result is that several eggs can be laid by each female within a single patch without reduction in individual inability resulting from crowding, but selection also favors dispersal to other patches so that the total average egg productivity is distributed in space (over more than one patch) to reduce intraspecific crowding that could arise if all eggs were laid on one plant. Second, selection pressure arising from predation on eggs (or larvae) favors increased dispersal of oviposition over many resource patches in order to reduce the likelihood of a predator finding all of the eggs (or larvae).

The marked sexual dimorphism in wing coloration has been interpreted in terms of how this butterfly may participate in mimicry complexes: Dr. Gerardo Lamas M. suggests that males and females partake in different mimicry complexes (pers. comm.), creating selection pressures that favor this dimorphism. The possible mimetic associations of this butterfly at Cuesta Angel have not been investigated, but owing to the rather rich fauna of Ithomiinae, Danainae, and Heliconiinae that is found here, there is very likely a high potential for the development of such interactions. The bright coloration of both sexes suggests warning coloration.

It is often held that tropical lowland forests support the richest levels of faunal diversity, and that high elevation habitats are marked by a paucity of species in many animal groups. But at Cuesta Angel, the ithomiine fauna is very rich. The maintenance of this richness at high elevations in Costa Rica is in part due to the richness of Solanaceae. I would therefore like to suggest that the richness of Ithomiinae in the forest at Cuesta Angel is due to the richness of various genera and species of Solanaceae that provide suitable feeding niches for different genera and species of these butterflies. To date, all species reared from Cuesta Angel have oviposition records with different host plants, and to this, we can add *G. zavaleta* on *Solanum brenesii*. A complete list of these butterflies and their host plants is given in Young (1974b). If further studies reveal different host plants by other Ithomiinae, these observations will confirm the hypothesis of larval feeding niche diversification as a major mechanism accounting for the high species richness of this butterfly group in this region of Costa Rica. The forest understory, river edge, and forest edges contain many species of solanaceous plants, some of which provide oviposition and larval feeding niches for Ithomiinae and other insect herbivores of this alkaloid-rich plant group. The occurrence of many species of Solanaceae in secondary habitats at Cuesta

Angel, created by cut back of the forest, provides a base for some Ithomiinae to invade new plant communities. But some of these butterflies, such as the tiny *Oleria zelica pagasa* and the big *Godyris zavaleta caesiopicta* still have not left the forest.

ACKNOWLEDGEMENTS

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THE POPULATION BIOLOGY OF NEOTROPICAL CICADAS III BEHAVIORAL NATURAL HISTORY OF *PACARINA* IN COSTA RICAN GRASSLANDS[1]

Allen M. Young[2]

ABSTRACT: Various aspects of behavioral natural history, including habitat selection, seasonal occurrence of adults, eclosion sites and density of nymphal skins, and a variety of diurnal activities of adults including singing, feeding, and oviposition, are described for a species of small *Pacarina* cicada. Studies on this undescribed species were conducted at two localities in northwestern Costa Rica and both habitats were grasslands. At one locality in the lowlands of Guanacaste Province, adults are most abundant during the wet season and at the other locality, which is in the mountains, adults are probably active throughout most of the year. Collections of nymphal skins in lowland Guanacaste support the contention that adult abundance there is very seasonal. Singing activity is most prevalent on clear mornings when the air temperature is still rising and later in the day when it is very hot, feeding and oviposition occur. Adults feed on a variety of shrubs in grasslands and oviposition occurs in dead tissues of grasses and shrubs. The eggs are laid in bifid arrangement within the tissues. The singing behavior is variable in this cicada in that males either sing alone or in small choral groups. Several choral groups can be found and distinguished in a single small tree by asynchrony in singing among the groups. It is suggested that members of a single choral group stay together primarily through visual interactions at close distances on branches. The function of the song in this cicada remains obscure, but it very likely serves to attract females for mating and oviposition. The diurnal singing pattern is influenced greatly by weather conditions. The cryptic coloration and behavior patterns of adults and nymphs are suggested to be adaptations to escape from visual-hunting predators.

DESCRIPTORS: neotropical cicada, Costa Rica, wet season, dry season, grasslands, habitat preference, reproductive behavior, thermoregulatory behavior, choral groups.

Very little is known about the behavioral natural history of cicadas in the Central American tropics. This paper reports various descriptive and experimental studies on a little *Pacarina* cicada (Tibicinidae) conducted in grassland localities in northwestern Costa Rica. Two similar appearing genera of cicadas, *Pacarina* and *Proarna,* contain small to medium-sized mottled grayish-brown species that are most characteristic of dry and often disturbed habitats. *Pacarina* is a dust bowl and dry grassland genus containing small cicadas that are distributed throughout Central America and into the southwestern United States (Beamer, 1928), while *Proarna* contains medium-sized cicadas with a Central and South American distribution. From my studies in Costa Rica over

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the past several years, I have found that *Pacarina* cicadas are most abundant in the northern region and particularly on the Pacific slopes of the Cordillera Centrale and in the dry lowlands of Guanacaste Province. I have not encountered any species on the Caribbean drainage of the Cordillera Centrale nor in the wet lowlands in the northeast. Thus the genus is represented by complexes of species in the northern-Pacific regions of Costa Rica where grassland habitats and now coffee plantations prevail.

In this paper, I present data on the natural history of one species of *Pacarina,* although the species name is not yet available as it is likely a new species (Dr. Thomas E. Moore, pers. comm.). The natural historical data given include: habitat of adults, location of final instar exuviae, oviposition, diurnal activity patterns, and spacing patterns of adults over small portions of their habitat. It is hoped that these observations will be useful in subsequent studies on the population biology and behavior of the genus over a larger geographical region of Central America.

DESCRIPTION OF FIELD STUDIES

The major study site was near Puntarenas, a 20 x 35 meter area (75 m. elev.) of roadside embankment along the eastern side of the Pan-American Highway about three kilometers northeast after the highway divides to Puntarenas; it is about seven kilometers south of the "Barranca site" discussed in Orians (1969) and Janzen (1971). I studied *Pacarina* at this site during the following periods: June 10-12, 1970; July 6-10, 1971; July 25-27, 1971; July 3-6, 1972; January 4-5, 1973; June 18-20, 1973; July 27-29, 1973; December 10-13, 1973; December 25-27, 1973. Usually the site was visited from 8:00 A.M. to 4:00 P.M. (C.S.T.) on each day, and during the 1971-1973 (excluding December), I was accompanied by one or more trained assistants. Air temperature readings were taken at this site several times each day.

The other study site (600 m. elev.), which was visited only for a few successive days during January, 1973, is about four kilometers east of the village of Esparta, along the Pan-American Highway. It is located in the steep lower hills on the Pacific slopes of the Cordillera Central; it is approximately 40 kilometers from the major study site in lowland Guanacaste, but this species of *Pacarina* is found at many places between these two sites. Both localities experience a severe dry season, generally between

January and April, causing most of the woody vegetation to become deciduous, save for patches and strips of forest along permanent streams in gullies. Much of the grass cover in open areas dries up during the dry season at both localities.

Field studies conducted at the Puntarenas site during the 1971 study periods were qualitative notes on: habitat selection by adults, reproductive behavior, and adult abundance. During 1972, a census was made of nymphal skins (exuviae) in a plot of ground along with a record of an emergence plant used by nymphs. Other visits to this site (1970 and 1973) allowed censuses of adult abundance and nymphal skins. It was hoped that these data would provide a preliminary view of seasonality in this cicada, despite lack of quantitative data on population emergences throughout the year. The Esparta site was used to observe chorusing positions along localized topographic gradients created by steep hills. In addition to these studies, observations were also made on diurnal singing, feeding and oviposition patterns, adult positions on plants, and one instance of predation on an adult.

Habitat selection was studied by walking through large areas and noting where males were chorusing. It was also noted as to whether males were singing in trees or grasses, etc. Unlike many other neotropical cicadas, it is possible to approach adult individuals of *Pacarina* within inches to observe feeding, etc. The initial difficulty is spotting the tiny, cryptically-colored cicada among branches or grass stalks.

Reproductive behavior was studied by marking individual cicadas with small spots of bright paint ("Flo-Paque", Floquil Products, Cobleskill, New York) on the dorsal area of the mesothorax, and then observing within-day and day-to-day movements of these marked individuals. The cicada was netted, color-coded, and released immediately at the place of capture; whenever possible, the marked cicada was returned to the perch where it was captured. Individuals were color-coded with a variety of symbols (dots, bars, etc.) and these were translated into numbers in a data book, so that each marked cicada was assigned a number (1-25); the tiny size of the cicada prevented writing numbers directly on them. During the two 1971 study periods, a total of 25 males were marked in this manner and observed on subsequent days. The interest here was to observe how choral groups are formed, positions of choral groups, and the amount of turnover in composition of choral groups. Although this sample of marked adults is very small, it nevertheless provided some interesting data on location and habits of individuals within a small area of habitat. A larger sample was not taken since (1) we marked most of the individuals in this area for a given day of

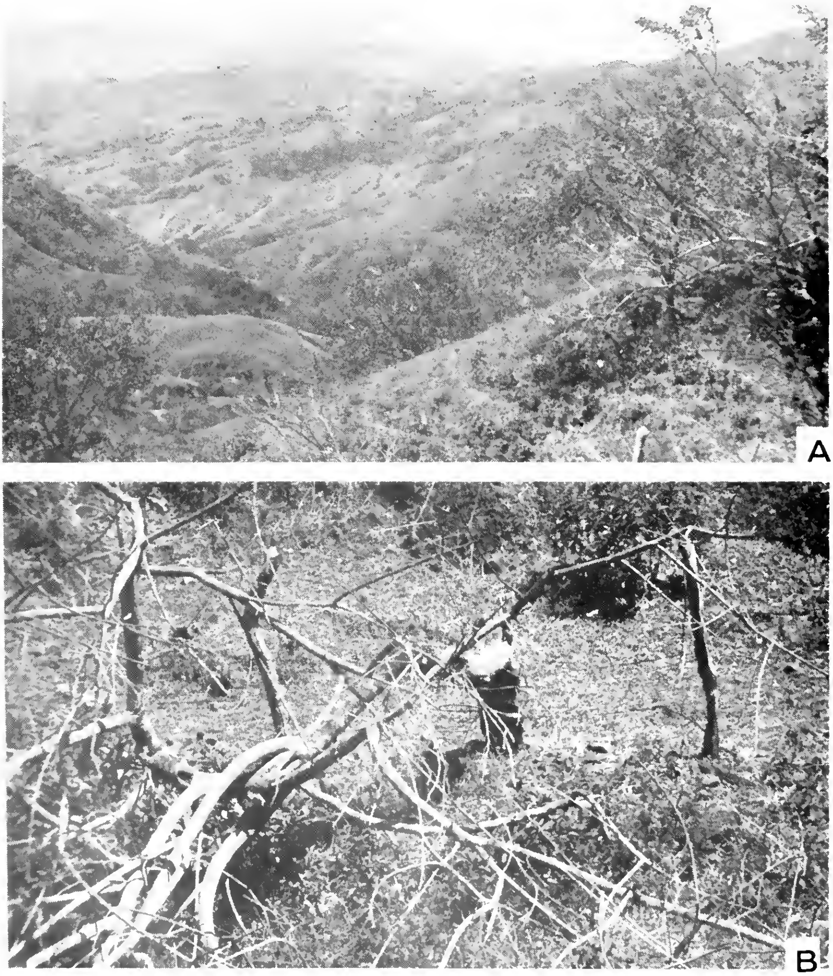

Figure 1. Habitats of *Pacarina* in northern Pacific Costa Rica. Rolling, steep hills at the Esparta site, showing the grassland habitat during the dry season (A). Dead tree branches that formed a chorusing site for several males, January 16, 1973, Esparta site (B).

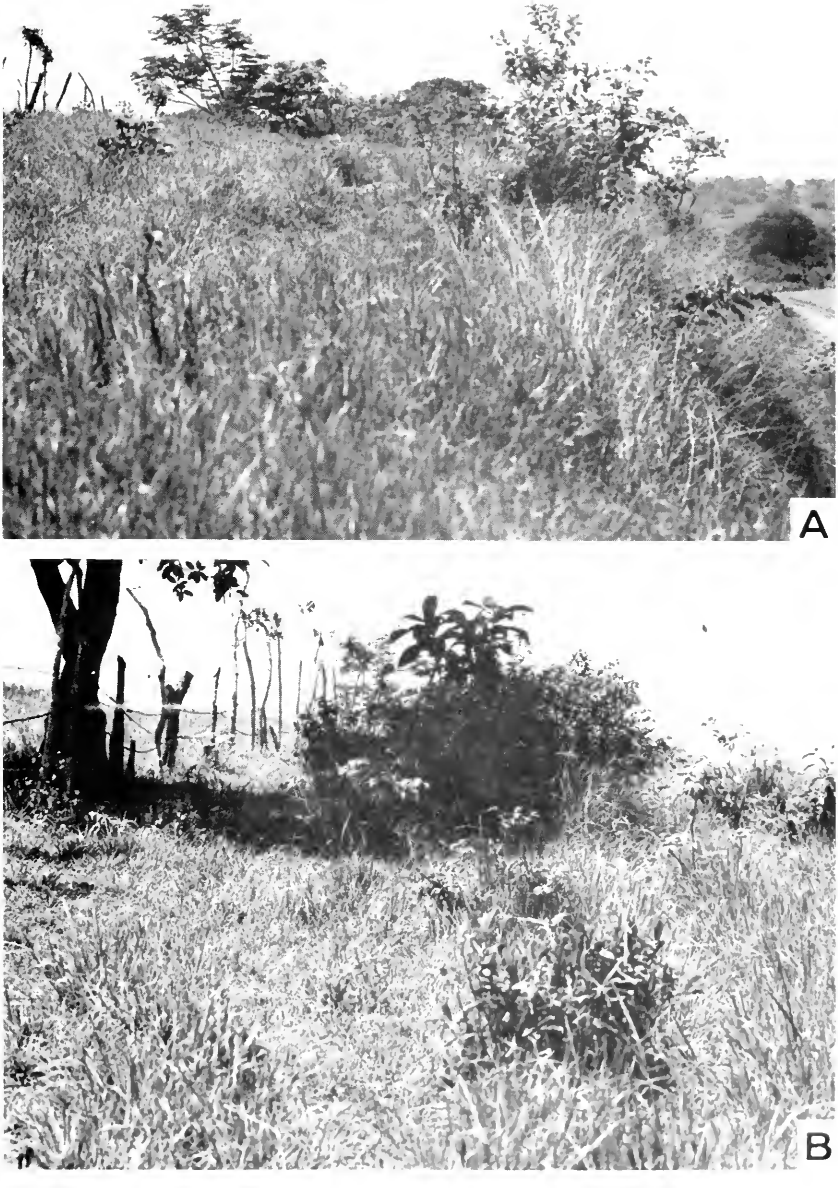

Figure 2. Habitats of *Pacarina* in northern Pacific Costa Rica. View of the Puntarenas study site, showing the thick, dead grass cover (*Dichromena*) during the dry season (A). Scattered trees and shrubs at the Puntarenas site; one boundary of the study plot ran from the highway (right side in A) to the fence posts (B).

observations, and (2) we wanted to minimize general disturbance of the vegetation in the area that might be used as perches for these cicadas. This information provided data on the spacing patterns of singing males in the habitat. Also, the positions of ovipositing females relative to choral groups was also studied. Copulatory behavior and courtship were not observed.

Nymphal skins were censused during 1972 at the Puntarenas site by setting up a 3 x 20-meter quadrat along one side of a steep gully that bounded one side of the study area; this strip extended lengthwise from the highway (at the beginning of the embankment) back to a wire fence. The census technique was to crawl slowly through the quadrat, three workers abreast and working at about the same rate, and examine very thoroughly the bases of dried grass clumps and the litter between clumps. The tiny nymphal skins match the color of dead grass very closely, and every effort was made to be as thorough as possible. The quadrat was a large patch of grass clumps, but also containing a few assorted shrubs, including *Leuhea* sp. (Tiliaceae) and *Tecoma stans* (Bignoniaceae). The most abundant grass here, *Dichromena ciliata* Vahl., was probably only grass in the quadrat and it formed an almost homogeneous cover. The census period ran for six hours on one day. The plot was also examined two times during the 1973 dry season and two additional censuses were taken during the following wet season (June 19 and July 29, 1973).

RESULTS

Habitat Selection and General Biology

At both Esparta and Puntarenas, *Pacarina* is very common in roadside grass patches, where males chorus on bare branches or tall dead grasses (figs. 1, 2). Adults were absent at the Puntarenas site during January and February, but very abundant during June and July; at the Esparta site, they were found during all of these months. In a given area, more than 50% of the chorusing population is found in dead grasses, and when a tree is close by, it becomes a major chorusing site. Very often, fallen dead branches (fig. 1-B) are used as chorusing sites for several males. In all instances, this *Pacarina* selects very sunny spots for a variety of adult activities, including singing, oviposition, and feeding. At Esparta, *Pacarina*, judging from singing males, is most abundant at the tops of hills and generally absent from the valleys. As pointed out below, such a distribution of adults is due at least in part to the association of nymphs with grasses which predominate in valleys, and not with forests in gullies (fig. 1-A); but another aspect is undoubtedly the fact that adults are active in open, sunny places. The song is a strong, persistent buzz which seems to carry very well in strong winds that blow across hill tops in this region, as well as in the dry lowlands.

Of a total of 20 males observed on a July morning in 1971 at the Puntarenas site, only two were seen feeding at various times from 8:00 A.M. to 12:00 noon; but all of them were feeding after 2:00 P.M. the same day. Nine days of similar observation for six hours daily support the view that *Pacarina* males (a total of 26 additional observations of individuals feeding) generally restrict feeding to afternoon hours when the amount of overcast has increased substantially and singing, although not eliminated, is greatly diminished. Singing is most characteristic of the morning, especially between 8:00 and 10:00 A.M. when the skies are very sunny and clear. The actual diurnal pattern of singing is extremely variable, depending greatly upon daily weather conditions. In the absence of very strong winds, overcast does not diminish singing, but strong winds, on overcast days, are characterized by considerably fewer singing cicadas. Singing is also greatly diminished during the late morning and early afternoon hours on clear, sunny days, during which air temperature may rise from 25°C (at 9:30 A.M.) to 30°C (at 11:30 A.M.) during June or July. On days of heavy overcast, however, singing continues during these hours.

Oviposition is generally confined to late afternoon (4:00 P.M.) on clear, sunny days but occurs throughout the day when there is overcast or light rains. The oviposition behavior is described below. During the 1971 study periods at Puntarenas, a total of 9 females was seen ovipositing in the study area. Like feeding, oviposition occurs at the hottest hours of the day.

Marked males (fig. 3-A) exhibit very localized day-to-day movements. Out of a total of 20 males marked during the period July 6-8, 1971, 14 were registered at least once over the next 2-3 days in the same area. This high incidence of resightings is discussed below in terms of choral group formation, but here, our concern is the spatial distribution of eclosing adults. In the quadrat used to sample nymphal skins, a total of 36 skins (18

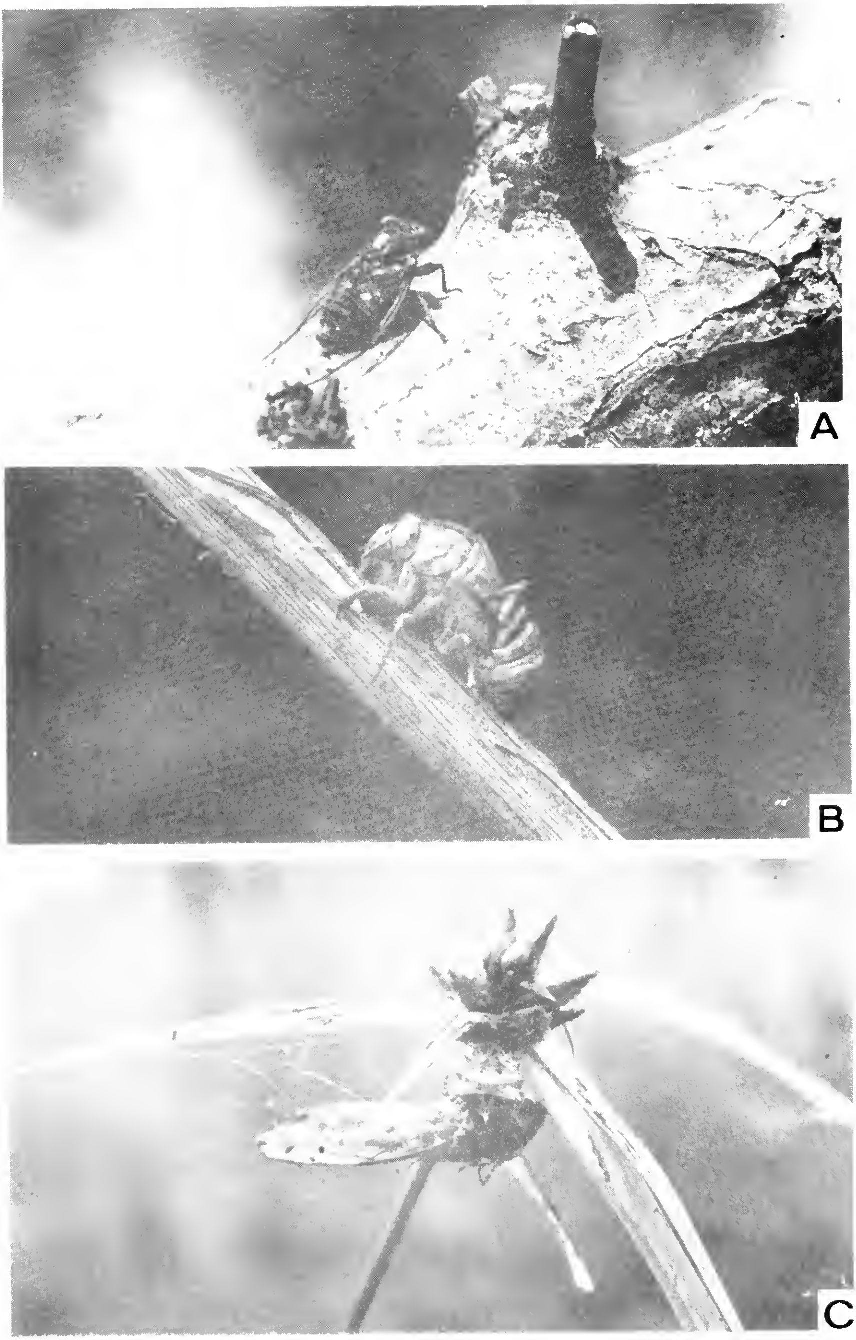

Figure 3. General biology of *Pacarina.* Marked male sitting in full sun on a dead branch (A). An exuvium on dead grass stalk (B). The spider *Acanthepeira stellata* feeding on a female Pacarina (C).

females, 15 males, and 3 undetermined because crushed) were censused on one day in the 1972 wet season, giving a density of 0.6 cicadas per square meter. All of these skins (fig. 3-B) were fresh and most (28) were still clinging to dead grass stalks, suggesting that emergence was recent. Within the quadrat, the skins were distributed very clearly among three different patches of grass (*Dichromena ciliata*), suggesting a food plant relationship. Judging from (1) the distance to shrubs, (2) the tiny size of the cicada, and (3) the dense but short root systems of the grass, the inference is one of *Dichromena* being the major food plant for *Pacarina* juveniles at this site. Until actual feeding can be observed, this food plant association must remain tentative. Undoubtedly the estimate of density is lower than the real density, since (1) we very likely missed several skins, and (2) hoof impressions made by cattle may have contained a few badly crushed skins which could have been overlooked easily. Although we have not marked recently eclosed adults, it is my impression, based on mark-resight data on older males, that adults are relatively sedentary during their lifetime. Individual mobility is primarily in the form of movement over a small area, and range of movement is determined at least in part by sites of eclosion. The factor promoting the greatest amount of mobility within a study area such as the Puntarenas site is movement between dead grass clumps and succulent tree branches used for feeding. Singing perches and oviposition substrates are dead grass stalks, but this cicada feeds on living shrubs and small trees (fig. 2). Thus, there is movement of both sexes between dead grasses and feeding sites in trees and shrubs. In order to understand this movement pattern, we can make an illustration with marked male no. 4 on July 8, 1971. This individual was marked along with six other males, during the interval 12:10 - 12:30 P.M. Upon release, it flew away and was resighted at 1:45 singing on a tall dead grass stalk about five meters from the place of capture and marking. Once resighted, we watched its movements, along with other marked males, for the remainder of that afternoon. After the initial resighting, male no. 4 was seen 20 minutes later on another dead grass stalk, where it was silent. Ten minutes later, it was found in a small leguminous tree (*Gliridicia sepium*-"Madero negro") along the fence, where it had the proboscis clearly inserted into a live branch. It remained here for 18 minutes, after which it was seen in another clump of dead grass, singing with two other males. It was seen feeding in another nearby tree at 3:50. Very similar movements were seen in other marked males on several days.

Although it is very difficult to detect mortality factors operating on adult cicadas, we did make one observation of predation on adult *Pacarina.* At 2:00 P.M. on July 6, 1971, we saw the spider *Acanthepeira stellata* (Walckenaer) feeding on a female *Pacarina* trapped in loose web just beneath the crown of *Dichromena* grass (fig. 3-C). Such predation is probably incidental locally, since sweep samples of nearby areas reveal very few individuals of the spider (personal observations). It is also unlikely that this spider is specialized for feeding on small cicadas such as *Pacarina* since most spiders are generalized predators on a variety of arthropods.

Reproductive Behavior

Pacarina males form small choral groups of usually 2-4 individuals, with members spaced within 2-3 inches of each other (1) side by side on adjacent dead grass stalks, or (2) above one another on thick branches of shrubs and trees. The result of this behavior is that males occur in small patchily-distributed "pockets" where each group may be a few meters from the next one. Also, males sing individually, but in our experience, solitary males may eventually join a choral group, attracted to it apparently by the songs of prior members. Choral groups are most active in the early morning, although singing may also occur in the late afternoon on cooler, overcast days. To give an example of the typical spatial distribution of *Pacarina* choral groups, on one morning (July 8, 1971) there were six different groups of singing males and each group was positioned in a different grass clump or shrub. All of these groups were within the 20 x 35 meter study plot. On occasion, there occur two or more different clusters of singing males within the same small tree; but these groups do not always sing in unison. Sometimes one or more of the groups within a tree are silent while another is chorusing; other times two or three groups chorus without synchrony among them. Sometimes all groups chorus in unison (synchronously). On a single branch the males comprising a single choral group can be spaced out over about a one-meter length; another group would be on a second branch.

One important component of choral group singing in *Pacarina* is the apparent high turnover in membership of the group. From observing a total of 14 different choral groups over several days, it was found that the average duration of a group is about 40 minutes, and with no difference dependent upon the size of the group. A marked male is a member of a given choral group for an average of 16 minutes, after which he leaves and either assumes a solitary perch or joins another choral group close by the first one. Complete breakdown of a choral group is dependent upon several different factors, of which accidental "bumping" by one male into another causes either some or all individuals to fly away. In the early stages of choral group formation on a given morning, individuals are attracted by the singing of a single male. A good example is the morning of July 9, 1971 when we witnessed the formation of a choral group in a patch of tall, dead grass stalks, just above the embankment. A single marked male (no. 7) was singing at 7:55 when we arrived at the site. Within 10 minutes an unmarked male flew in and landed on an adjacent grass stalk and walked to within 2 inches of the singing male; the second male began to sing within 45 seconds, after walking had ceased. These two males sang for 18 minutes, with intermittent pauses (the mean length of song for male *Pacarina* here is 7+1.4 minutes, as measured on 10 individuals during a single morning) before a third, and marked male flew to the pair. This was marked male no. 3 and it eventually positioned itself within 3 inches of the other males and also began to sing. When a strong wind would cause singing to stop, usually one male, but not always the same individual, would initiate singing again and the others would then follow suit; there are times, however, when a male remains completely silent while others sing in the group. Between song sessions, there may be considerable walking movements among members of a choral group. Walking involves a very noticeable clicking noise which is characteristic of *Pacarina* and *Proarna* males in general, and it is produced in both forward and backward stepping. Depending on their positions relative to one another, males in a choral group tend to walk towards one another, and often bump into one another. This behavior, when bumping does not occur, tends to tighten up the choral group and perhaps subsequently strengthen the joint acoustical properties of the participants in singing sessions. Walking is prevalent during the early stages of choral group formation, as new males are recruited to the spot where one or more are already singing. Whether or not the clicking is a means of communication between individuals is unknown.

Marking does not affect choral activities of males. At 8:15 A.M. one day (July 8, 1971) we found a choral group containing four males, two of which were marked (nos. 2 & 7) on the previous day. Marked individuals survive for at least three days, as indicated by our daily resightings (over a three-day period) of 20 out of 25 marked cicadas for the combined July, 1971 study periods. For the first period, the mark-resight data was as follows: nos. 1-7 marked July 7, 6 resighted July 8; nos. 8-13 marked July 8, total of 9 resighted July 9; nos. 14-20 marked July 9, total of 13 resighted July 10. For the second period: nos. 21-23 marked July 27, one (no. 21) resighted July 28; nos. 24-25 marked July 28, total of three resighted July 29. Cicadas marked during the first period were not resighted in the area during the second period, suggesting (1) a life expectancy in male *Pacarina* of less than 20 days, or (2) emigration from the area. Our high percentage of total resightings (80%) for both periods combined suggests residentiality in male *Pacarina* and that these cicadas may live less than 20 days, assuming they were very young at the time of marking during the first period.

Another aspect of reproductive behavior studied was the association of females with choral groups at the Puntarenas site. Females fly to where males are singing and oviposition may begin shortly thereafter. One example illustrates this behavior, although it has been observed only nine times. Two males were singing in dead grass stalks at 9:51 A.M. (July 10, 1971), and three minutes later, a third cicada joined the group. This individual perched on an adjacent grass stalk and walked up and down it for about one minute. The two males continued to sing, raising their abdomens in an arched manner as shown in figure 4-A,B. In the meantime, the third cicada, a female, had begun to oviposit in the grass stalk.

The oviposition posture is very easy to recognize (fig. 4-C,D,E) and eggs are laid only in dead plant tissues. For a total of 13 different oviposition acts witnessed, all of these were in dead plant tissue with 10 of them in dead grass stalks and three in dead branches of shrubs. On the substrate of her choice, the female will make from three to eight tiny holes or pockets (fig. 4-F) with her ovipositor, and deposit several elongate, flattened eggs in each cavity. Each egg is about 1.8 mm long and they are arranged in bifid rows within the dead plant tissue. The number of eggs per cavity varies greatly in our experience, there being from 20 to 35 eggs in each. The total egg productivity of a single female must be over 200, judging from the number of cavities (fig. 4-E) and eggs

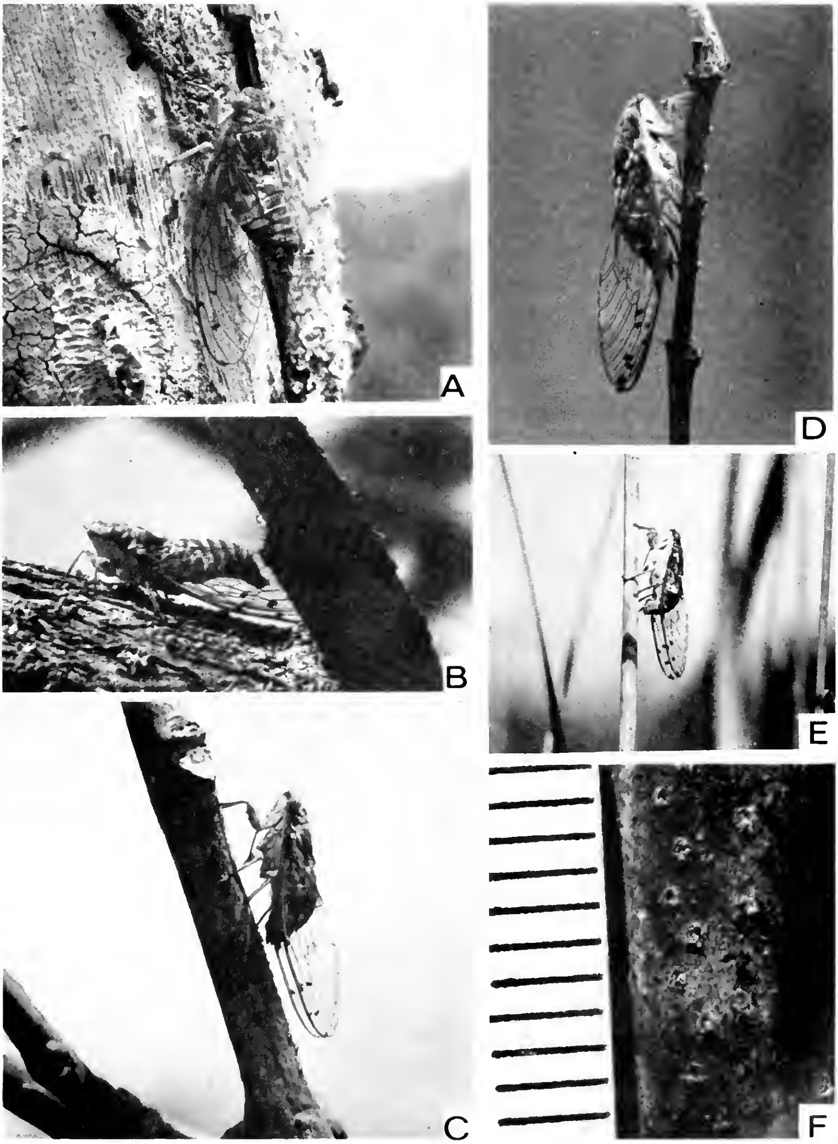

Figure 4. Reproductive behavior of *Pacarina*. The cryptic positioning of a singing male (note arched abdomen) on a tree trunk at the Puntarenas site (A). Lateral view of singing male perched on a dead branch in a fallen tree (see Figure 1-B) at the Esparta site (B); the song of this individual was recorded by T. E. Moore. Females ovipositing in dead branches at the Puntarenas site (C-D). Oviposition in a dead grass stalk at the Puntarenas site (E). Marks of egg pockets (the scale to the left is in mm) in a dead woody stem (F) at the Puntarenas site.

per cavity produced by a single female. Oviposition is usually uninterrupted, and it lasts from 15 to 45 minutes, depending on the number of eggs to be laid and perhaps the toughness of the plant tissue. The female flies away after egg laying is completed.

A most consistent feature of oviposition behavior in *Pacarina* is that it invariably occurs very close to a choral group; females, apparently already mated, fly into the vicinity of the choral group and begin to lay eggs. This pattern has been observed at different times of the day and under a variety of weather conditions; females only fly into the choral group when at least one member is singing. Females do not appear when choral groups are silent. Courtship behavior has not been observed, although it is likely that choral groups function in this aspect of reproductive behavior as well.

Seasonal Adult Abundance

The degree to which *Pacarina* is a seasonal cicada depends greatly upon the region where it is found. For example, at the higher elevations around Esparta, adults may be heard singing in large numbers throughout the year, except during periods of extreme dryness, which occur irregularly in this region of Costa Rica. For lowland Guanacaste, we know that eclosion is high during the wet season and non-existent during the dry season: during the 1973 dry season (which was very severe), the census plot was examined two times for skins and none were found; no adults of this species were heard singing in the area (although another, larger species was seen and heard). Furthermore, during the early part of the following dry season (December, 1973 for the 1974 dry season) no fresh exuviae were found at the Puntarenas study site. The 1972 census data from this plot during the wet season has already been summarized in connection with the food plant. But on a comparable date (June 19) the following year, a total of 36 skins (14 females and 22 males) were again obtained from this plot. Forty days later (July 29), only 18 skins (12 females and 6 males) were found in the plot, suggesting a decline in the emergence at this time. The emergence declines late in the wet season is also indicated by the preponderance of female skins over male skins; other studies of Costa Rican cicadas also showed a similar sex ratio trend in species with strongly seasonal emergence patterns (Young 1972). The very noticeable absence of *Pacarina* adults at the Puntarenas site during the peak of the dry season also suggests that this cicada is essentially a wet season species at this locality. It is not determined whether or not all nymphs of equal age emerge during one year at either locality, but it is likely that annual emergence patterns are different between Esparta and Puntarenas since adults are probably active throughout most of the year at the former locality.

DISCUSSION

Although we can say very little regarding the initial adaptive radiation of *Pacarina* cicadas at various places along their extensive present-day geographical distribution in Central America, it is nevertheless apparent that most species, including the one studied here, are inhabitants of tropical dry areas such as northwestern Costa Rica. Much of the behavioral aspects of the natural history in selected species are therefore expected to be related to survival and reproduction in seasonally dry tropical habitats such as lowland Guanacaste, Costa Rica.

The species of *Pacarina* studied is probably one of the smallest-sized members of the genus in Central America, and it is therefore interesting that adults are most active during the wet season in lowland Guanacaste rather than during the severe annual dry season of this region. If it is assumed that the preliminary data on emergence from the Puntarenas site is indicative of a wet season adult emergence pattern in this region, there may exist environmental conditions associated with the dry season which preclude this cicada from being very active (i.e., abundant in large numbers) during this season. In the absence of thorough monthly data on annual emergence patterns, the reduction or absence of adult *Pacarina* during the dry months in Guanacaste is indicated by the lack of singing males. It is interesting to also note in this context that another species of *Pacarina*, which is about twice the body length of the species studied (fig. 5), is active in Guanacaste during the dry season (Allen M. Young, unpubl. obs.). If it is assumed that body size is an important factor limiting the activity of insects during tropical dry seasons (Janzen and Schoener, 1968), these preliminary suggest the interesting hypothesis that there is a replacement of *Pacarina* species in at least some areas of lowland Guanacaste: the small species is active primarily during the wet season and the large species is active during the major dry season (December-March). Selection is predicted to favor the small species being active during wetter months as a means of escaping desiccation problems that would prevail for small insects during the dry season. It is more difficult to suggest why the larger species would not also be active during the wet season; further studies with these ideas in mind should perhaps be directed to an examination of possible competitive interactions between the two cicadas in order to account for the apparent limitation of the large *Pacarina* to the dry season.

Studies on the thermoregulatory behavior of cicadas in the southwestern United States have demonstrated that these insects change their behavior patterns in response to increased air temperatures during the day (Heath and Wilkin, 1970; Heath, Wilkin, and Heath, 1971). In general, these studies revealed that

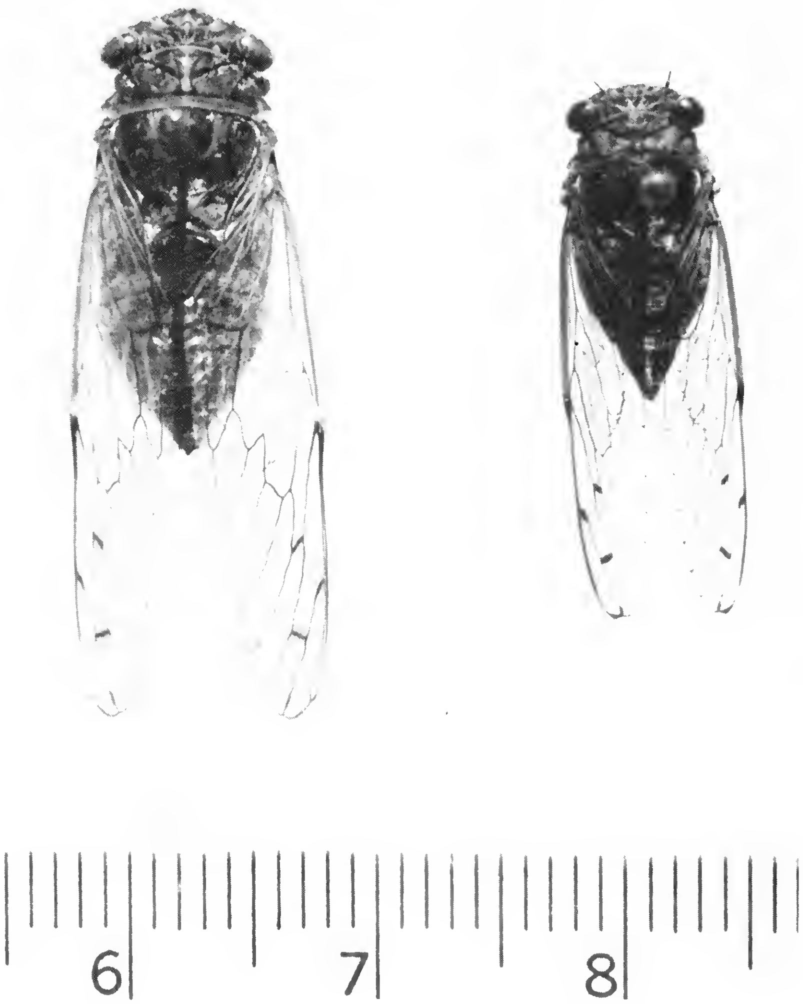

Figure 5. Large and small species of *Pacarina* from lowland Guanacaste, Costa Rica. The larger species is active during the dry season, while the smaller one is active during the wet season.

adult cicadas will move out of direct sunlight into shade in response to overheating of their bodies. In the present study, it was found that adults of *Pacarina* feed and oviposit at the hottest times of the day, and perhaps this represents a preference for remaining relatively inactive (non-moving) to reduce overheating. Singing is most intense (the greatest numbers are singing in an area) while temperatures are rising during the morning and both sexes are active in courtship before it is too hot. Such diurnal patterns of behavior in *Pacarina* are adaptations for living in hot and dry conditions.

The function of choral groups in *Pacarina* may be related to courtship and oviposition. Acoustically, the grouped singing of several males in unison provides a stronger song that could attract females for courtship. Oviposition occurs near choral groups and eggs are laid in the most abundant vegetation, including dry grasses and dead branches of small shrubs. The song of the individual male is very strong and the necessity of choral groups for acoustical aspects of behavior may be limited in this species of *Pacarina.* This is also suspected from the observation that several males may sing from solitary, scattered positions within a grassland area and choral groups are not the rule. Further evidence in support of this view includes (1) asynchronous singing among different choral groups within the same tree, and (2) the presence of silent individuals in the immediate vicinity of singing by others. All of these observations indicate that *Pacarina* males exploit their acoustical abilities in several different ways, and choral group formation is only one of these. Some singing by individual males may represent an early stage in the actual formation of choral groups: such individuals may be focal points for recruitment of other males. Other instances of males singing alone may be the result of disruption of choral groups resulting from environmental disturbances.

The integrity of a single choral group in a tree may result from visual proximity of individual males. Such a mechanism might be especially important when more than one choral group is present in a tree. Observations indicate that all males within a choral group are in visual contact with one another: when a male begins walking, a nearby individual will often begin to walk away as the first approaches.

The very cryptic nymphs eclose primarily among dead stalks at the bottom of grass clumps and the grass *Dichromena* is the major eclosion plant at the Puntarenas site. Eclosion probably occurs near the bottom of these grass clumps as suggested by the positions of some exuviae on grass stems; eclosion near the ground may prevent eclosing adults from being knocked off vegetation by gusty winds characteristic of grasslands and also reduce desiccation during the actual molt.

In addition to the final instar nymphs, the adults of this *Pacarina* are cryptically colored and this adaptation could function to reduce predation by visual-hunting predators with color vision. The behavioral pattern of nymphs eclosing on dead grass stalks is one example of crypsis, and the excellent color-matching of the adults by positioning themselves on grayish branches, grass stalks, and fence posts in Guanacaste is another example of behavior undoubtedly associated with escape from predators. But eclosing adults and even nymphs above or just below the soil surface may be prey for a variety of predatory arthropods that do not rely mainly upon visual detection of coloration. Adults, being rather low fliers through grasses and small shrubs in Guanacaste, may become occasionally the prey of a variety of orb spinners such as the case recorded here.

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NOTES FOR A REVISION OF THE ANT GENUS *FORMICA*.
1. NEW IDENTIFICATIONS AND SYNONYMIES FOR SOME NEARCTIC SPECIMENS FROM EMERY, FOREL AND MAYR COLLECTIONS.[1]

Andre Francoeur[2]

ABSTRACT: Specimens of the ant genus *Formica* belonging to Emery, Forel and Mayr Collections have been examined and reidentified according to the actual taxonomic knowledge. These new identifications and synonymies influence the known geographic distribution of the species involved. The status of a number of types is precised.

DESCRIPTORS: Ants, *Formica* species, taxonomy, reidentification, type status, distribution.

During the course of a revision of the nearctic species belonging to *Formica fusca* group, it has been possible to examine a number of specimens mentioned by Mayr and Emery in papers published respectively in 1886 and 1893. Most of them were named under the description of new taxa. Confrontations between texts and specimens reveal that in many cases there were included under a new name series of specimens belonging to more than one taxon. Therefore new identifications and synonymies are needed to give a full account of the facts. Most of those pertaining to nearctic species of the *Formica fusca* group are already published (Francoeur, 1973). The remaining ones and those concerning other species groups are presented here. New revised identifications are also listed for nearctic specimens from the Forel Collection. Status and labelling of types are discussed for a number of species.

This kind of analysis has been almost completely neglected for the nearctic species of the genus *Formica*. Based on the examination of old collections and not just on old papers that contained most often inaccurate descriptions according to the present morphological standards in myrmecology, it will allow us to understand more precisely the nature of past authors' new taxa, to sort out misinterpretations, particularly those continuing in recent years, and to neutralise aberrant publications on the systematics and geographic distribution of ants (see Brown's comments on

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[1] Accepted for publication: June 12, 1974

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that matter, 1950 and 1951). This beginning paper will present among other data the results of the study of ant collections containing *Formica* specimens.

FORMICA NEOGAGATES GROUP

Neogagates complex

Formica lasioides Emery

Formica lasioides Emery, 1893, p. 664.

Formica *fusca* r. *subpolita* var. *neogagates:* Forel (in part), 1904, p. 153.

Emery Collection:

– under *lasioides:* 2 ☿ with a typus label from Hill City, S. Dakota (no. 151, 21-IX-1890, T. Pergande), one ☿ is labelled by me lectotype and the other paratype; the third specimen of the type series is in the W.M. Wheeler Collection in the Museum of Comparative Zoology, Harvard University; 6 ☿ from Boulder, Colorado (W.M. Wheeler);

– under *neogagates::* 1 ☿ from Kittery Point, Maine (VIII-1891, probably T. Pergande).

Forel Collection:

– under *neogagates lasioides:* 1 ☿ with a cotypus label from S. Dakota (T. Pergande); this specimen cannot be a paratype of *lasioides*, at most it is a topotype; 3 ♀ from Colorado;

– under *neogagates lasioides vetula:* 1 ☿ with a cotypus label from Lawrence, U.S.; this specimen cannot be a type of *vetula;* 5 ☿ and 1 ♂ from Colorado; 14 ☿ from New Hampshire;

– under *fusca subpolita neogagates* (Forel, 1904): 2 ☿ from Vermillon Pass, Alberta (E. Whymper); the ♀ mentioned with them belongs to *F. hewitti;*

– under *neogagates:* 1 ♀ (Denny) and 5 ☿ from Connecticut; 3 ☿ from MacLean, Boston (A. Forel); 2 ☿ from Nebraska (Wilby); 3 ☿ (A. Forel) and 1 ☿ from New Hampshire; 3 ☿ from New Jersey (Treat); 19 ☿ from Toronto, Ontario (A. Forel); 2 ☿ from U.S.A. (G. B. King);

– under *fusca subpolita* (first labelled *F. gagates* var. americaine): 4 ☿ from New Hampshire (Treat); also 1 ☿ from North America.

Formica neogagates Emery

Formica fusca subsp. *subpolita* var. *neogagates* Emery, 1893, p. 661-663.

Emery Collection, under *neogagates:* 3 ☿ and 1 ♀ from Beatty, Pennsylvania (no. 334, T. Pergande); this is the type locality selected by Wheeler, 1913; one ☿ is labelled by me lectotype, and other specimens paratypes; 4 ☿ from New York (Schmilken); 3 ☿ and 1 ♂ from Salt Lake, Utah; 1 ☿ and 1 ♀ from Louisiana; all these specimens are mentioned by Emery (1893), no ant has been seen from S. Dakota nor Maryland, but 3 ☿ have no locality label; also 4 ☿ from Rockford, Illinois (W.M. Wheeler).

Forel Collection, under *neogagates:* 4 ☿ with cotypus labels from Beatty, Pennsylvania (no. 334, T. Pergande), labelled by me paratypes; 2 ☿ from New York (C. Emery); 10 ☿ from Worcester (A. Forel) and 24 ☿ from Franklin Park, Boston (A. Forel), Massachusetts; 6 ☿ from Berkeley, California; 1 ☿ from Mt. Mitchell, N. Carolina.

Obtusopilosa complex

Formica perpilosa Wheeler

Formica fusca subsp. *subpolita* var.? *montana* Emery (in part), 1893, p. 663.

Emery Collection:

– under *montana:* 1 ☿ from West Point, Nebraska; this specimen was in the type series of *montana;*

– under *subpolita:* 3 ☿ from Globe, Arizona (no. 172, 2-VI-1884, probably T. Pergande).

Forel Collection, under *montana:* 4 ☿ and 1 ♀ from San Jacinto, California (no. 323, 14-XI-1891, T. Pergande).

Mayr Collection, under *subpolita:* 1 ☿ and 1 ♀ from Nebraska (T. Pergande) and 1 ☿ from Colorado (E. Norton).

FORMICA FUSCA GROUP

Cinerea complex

Formica cinerea Mayr

Formica cinerea Mayr, 1853, p. 281-282.

This palearctic species is listed here to illustrate the messy situation of the *fusca* group in Eurasia. I have examined 21 specimens, all identified as *cinerea* in the Mayr Collection:

– 7 ☿ (including one type worker) and 3 ♂ belong to *F. cinerea;*
– 1 ☿, 1 ♀ and 1 ♂ are species X of the *cinerea* complex;
– 4 ☿ are species Y of the *cinerea* complex;
– 1 ♂ is species Z of the *rufa* group;
– 1 ☿ is probably *F. fusca.*

Formica canadensis Santschi

Emery Collection, under *fusca subsericea:* 3 ☿ from Breckenridge, Colorado.

Formica montana Emery

Forel Collection:

– under *cinerea:* 3 ☿ from Rockford, Illinois, labelled by me topotypes of *montana;*

– under *cinerea neocinerea:* 1 ♀ with a cotypus label from Rockford, Illinois (25-VIII-1902, W.M. Wheeler), labelled by me paratype of *neocinerea;* 3 ☿ from Iowa City, Iowa (nest no. 3, 15-IV-1894, H.F. Wickham);

– under *cinerea rutilans:* 2 ☿ from Illinois.

Mayr Collection. Identified to *cinerea* by G. Mayr, I have seen 6 ☿ from Illinois; this state was not listed in Mayr's paper of 1886.

Formica pilicornis Emery

Formica fusca var. *cinerea* Mayr (in part), 1886, p. 427.

Forel Collection, under *cinerea pilicornis:* 4 ☿ from San Jacinto (T. Pergande?) and 2 ☿ from San Francisco (Turner), with cotypus labels; 3 ☿ from California (illegible locality).

Mayr Collection. The specimens reported from California by Mayr (1886) under the name *cinerea* were identified as a new species by Emery (1893). I have seen 4 ☿ from Tres Pinos (T. Pergande) and labelled them paratypes; also 1 ♂ from Milde, mentioned in

Emery's paper (1893, p. 664). Mayr listed *cinerea* from New Mexico; according to the actually known geographic distribution of the nearctic species of the *cinerea* complex (Francoeur, 1973), there could not be specimens of *pilicornis,* but were probably *canadensis.* This point will be solved only if the specimens are ever found.

Neoclara complex

Formica neoclara Emery

Formica fusca var. *neorufibarbis:* Forel (in part), 1904, p. 153.

Forel Collection:

– under *fusca neoclara:* 6 ☿ with a cotypus label from (no locality) Colorado (no. 165, T. Pergande), labelled by me paratypes; 3 ♀ with cotypus labels and 2 ☿ from Canon City, Colorado (P.J. Schmitt);

– under *fusca neorufibarbis:* 1 ☿ from Field, British Columbia (VIII-IX-1901, E. Whymper); 3 ☿ and 1 ♀ from Rockies, U.S.A. (G. Rothney).

Formica occulta Francoeur

Forel Collection, under *fusca subaenescens:* 7 ☿ from Lakin, Kansas (1887, S.H. Scudder).

Subpolita complex

Formica subpolita Mayr

Formica fusca var. *subpolita* Mayr (in part), 1886, p. 426-427.

Forel Collection, under *subpolita:* 2 ☿ with a cotypus label from San Francisco, California (L.W. Schaufuss), labelled by me paratypes; 1 ♂ with cotypus label from San Gregorio, California.

Mayr Collection. I have received and examined 25 workers and 4 females which were actually classified under the name *Formica gagates* ssp. *subpolita:*

- 14 ☿ and 2 ♀ from San Francisco, California (L.W. Schaufuss). Since Wheeler (1913) selected this city as the type locality, only these specimens were considered to constitute the type series. One worker was labelled lectotype and the others paratypes;
- 1 ☿ from Sacramento, California (L.W. Schaufuss) and 1 ☿ from Connecticut (E. Norton) are also *F. subpolita.* The locality label of the last worker is erroneous without doubt, for this species is restricted to the Pacific side of North America (Francoeur, 1973);
- All the remaining specimens are not *subpolita;* they represent *F. neogagates, F. perpilosa* and *F. fusca* (*marcida* form).

Why did Mayr gather all these specimens under his *subpolita*? Because they all share the three main characters used by him to establish his new variety: shining tegument, dilute pubescence and long flexuous erect hairs on the dorsum of body. In the case of *F. fusca* (*marcida* form), only the female shows such features. It is noteworthy that those characters are also found in *F. gagates* Latreille. This situation explains why some authors have associated *subpolita* with Latreille's species. After the description Mayr (1886) cited the geographic origin "aus Connecticut, Colorado und Californien". The first two states are wrongly cited according to the material examined.

Lepida complex

Formica aerata Francoeur

Forel Collection, under *cinerea neocinerea:* 3 ☿ with a cotypus label from San Jose, California (H. Heath); these specimens are not types of *neocinerea.*

Subsericea complex

Formica argentea Wheeler

Forel Collection:

– under *fusca subsericea argentata:* 5 ☿ with a cotypus label from Rockford, Illinois, labelled by me paratypes; 26 ☿ from Nebraska (Wilby), first named *F. fusca;*

– under *fusca subsericea:* 1 ☿ and 1 ♂ from Virginia (4-VII-1880, T. Pergande);

– under *fusca subaenescens:* 1 ☿ from Lake Tahoe, Nevada.

Formica glacialis Wheeler

Formica fusca r. *subsericea:* Forel (in part), 1899.
Formica subsericea: Forel (in part), 1900.

Emery Collection, under *fusca subsericea subaenescens:* 1 ☿ from Utica, New York (no. 147, probably T. Pergande).

Forel Collection:

– under *fusca subsericea:* 6 ☿ from U.S.A. (G.B. King); 1 ☿ from Toronto, Ontario (A. Forel);

– under *fusca subaenescens:* 51 ☿, and 1 ♀ and 21 ♂ from Niagara, 2 ☿ from High Park, Toronto, and 2 ☿ from illegible locality, Ontario (A. Forel); 3 ☿ from Ottawa, Ontario (F. Santschi).

Formica podzolica Francoeur

Formica fusca var. *subaenescens:* Forel, 1902, p. 699.

Forel Collection:

– under *fusca subsericea:* 2 ☿ from Hill City, S. Dakota (VI-1890, T. Pergande);

– under *fusca subaenescens:* 6 ☿ from Ottawa, Ontario (F. Santschi); 1 ☿ from Mount Goodsir, British Columbia.

Formica subsericea Say

Formica fusca r. *subsericea:* Forel (in part), 1899.
Formica subsericea: Forel (in part), 1900.

Emery Collection:

– under *fusca subsericea argentea:* 3 ☿ and 3 ♀ from New York (Schmidt); 2 ☿ from Woodbridge, Connecticut (28-VI-1891); 1 ☿ without locality label;

– under *fusca subsericea:* 3 ☿ and 2 ♂ from Virginia (no. 10, 23-VII-1882, T. Pergande); 1 ☿ without locality label;

– under *fusca subsericea subaenescens:* 1 ☿ from New Haven, Connecticut (1-VI-1897).

Forel Collection:

– under *fusca:* 2 ☿ from New Jersey (Treat); 3 ☿ from Baltimore, Maryland (Ris); 2 ☿ from New York (Holl);

– under *fusca subsericea:* 10 ☿ from Cromwell, Connecticut (A. Forel); 3 ☿ and 1 ♂ from Washington, D.C. (A. Forel); 1 ☿ from Kansas City, Kansas; 30 ☿ from Baltimore, Maryland; 11 ☿, 8 ♀ and 2 ♂ from Franklin Park, Boston; 20 ☿ from Worcester and 1 ☿ without locality label, Massachusetts (A. Forel); 2 ☿ from Ann Arbor, Michigan; 6 ☿ from illegible locality and 1 ☿ from White Mountains Valleys (S.H. Scudder), New Hampshire; 1 ♀ from New York; 5 ☿ from Mount Mitchell (A. Forel) and 34 ☿ from N. Carolina; 3 ☿ from High Park, Toronto, Ontario (A. Forel); 2 ☿ from U.S.A. (G.B. King); 3 ☿ from Philadelphia, Pennsylvania; 1 ☿ without locality (10-VII-1881, T. Pergande), Virginia; 11 ☿ from Morganton, N. Carolina (A. Forel); 4 ☿ with illegible labels;

– under *fusca subaenescens*: 1 ☿ from Worcester, Massachusetts; 3 ☿ from Morganton, N. Carolina (A. Forel); 2 ☿ from Niagara, Ontario (A. Forel).

Fusca complex

Formica accreta Francoeur

Forel Collection, under *fusca subsericea subaenescens:* 1 ☿ from Yale, British Columbia (Dieck).

Formica fusca Linne

Formica fusca: Francoeur, 1973, p. 189-201.

Specimens classified in the *marcida* form:

Emery Collection, under *fusca subsericea subaenescens:* 4 ☿ from Yale, British Columbia.

Forel Collection, under *fusca subaenescens:* 1 ☿ from California.

Mayr Collection, under *gagates subpolita:* 1 ♀ from California (Luckett).

Specimens classified in the *subaenescens* form:

Emery Collection, under *fusca subsericea subaenescens:* 4 ☿ from New Jersey.

Forel Collection:

– under *fusca subsericea:* 2 ☿ from Virginia (T. Pergande);

– under *fusca subaenescens:* 1 ☿ from Hill City, S. Dakota (VII-1890, T. Pergande), labelled by me paratype; 7 ☿ with a cotypus label from Colebrooke, Connecticut; these are not types; 24 ☿ from Toronto, Ontario (A. Forel); 4 ☿ from Ann Arbor, Michigan (no. 14, Gaige).

Neorufibarbis complex

Formica hewitti Wheeler

Formica fusca r. *subpolita* var. *neogagates:* Forel (in part), 1904, p. 153.

Formica fusca var. *subaenescens:* Forel, 1904, p. 153.

Forel Collection:

– under *neogagates:* 1 ♀ from Vermillon Pass, Alberta (E. Whymper);

– under *fusca subaenescens:* 13 ☿ from Vermillon Pass, British Columbia (E. Whymper).

Formica neorufibarbis Emery

Formica fusca var. *neorufibarbis:* Forel, 1902, p. 699; Forel (in part), 1904, p. 153.

Emery Collection:

– under *fusca subsericea neorufibarbis:* 3 ☿ from Ouray (VIII-1891, T. Pergande), 4 ☿ from Breckenridge (no. 273), 2 ☿ from Ward (W.M. Wheeler), 8 ☿ from Argentine Pass, 1 ☿ from Georgetown and 1 ☿ from Meadow Peak, Colorado (A.C. Burrill).

Forel Collection:

– under *neogagates:* 5 ☿ from Argentine Pass, Colorado (S.H. Scudder), first named *fusco-rufibarbis;*

– under *lasioides vetula:* 1 ♀ from Hill City, S. Dakota (no. 151, T. Pergande), labelled by me topotype;

– under *fusca gelida:* 2 ☿ and 1 ♀ from Cripple Creek and 6 ☿ from Georgetown (1877, S.H. Scudder), Colorado, with cotypus labels; they are not types of *gelida;* 13 ☿ from Argentine Pass, Colorado;

– under *fusca neorufibarbis:* 6 ☿ with cotypus label from Hill City, S. Dakota (8-VII-1890, T. Pergande), labelled by me paratypes; 1 ☿ from Vermillon Pass and 2 ☿ from Vermillon Valley, Alberta (E. Whymper); 2 ☿ from Field (VIII-IX-1901, E. Whymper), 1 ♀ from Emerald Summit Lake (VII-1901, E. Whymper), 1 ♀ from Yoho Valley, 3 ☿ from Ice River Valley, British Columbia; 2 ☿ from Argentine Pass, Colorado (1877, S.H. Scudder);

– under *subpolita:* 1 ♀ from Ossipee (?), New Hampshire (1877, Denny).

Rufibarbis complex

Formica gnava Buckley

Emery Collection, under *fusca subsericea neorufibarbis:* 7 ☿ from Canon City, Colorado (W.M. Wheeler); 8 ☿ from Austin, Texas (W.M. Wheeler), labelled by me neoparatypes.

Forel Collection, under *rufibarbis gnava:* 10 ☿ and 3 ♀ from Austin, Texas (W.M. Wheeler), labelled by me neoparatypes; 3 ☿ from San Angelo, Texas.

Subcyanea complex

Formica subcyanea Wheeler

Formica fusca var. *subsericea:* Forel, 1899, p. 128; Wheeler, 1913, p. 565.

Forel Collection:

– under *fusca subsericea:* 1 ☿ from Moyoapam, Mexico;

– under *fusca subaenescens:* 1 ☿ from Moyoapam, Mexico;

– under *subcyanea:* 3 ☿ with a cotypus label from Guerrero Mill, Mexico, labelled by me paratypes.

Occidua complex

Formica occidua Wheeler

Forel Collection:

– under *moki:* 3 ☿ with a cotypus label from Arizona, labelled by me paratypes of *moki;*

– under *rufibarbis occidua:* 7 ☿ from Oakland, 4 ☿ with a cotypus label from San Jose (H. Heath) and 6 ☿ from Berkeley, California.

FORMICA RUFA GROUP

Formica dakotensis Emery

Emery Collection: 3 ☿ with typus label from Hill City, S. Dakota; 1 ☿ is labelled by me lectotype and the others paratypes.

MISCELLANEOUS GENERA

Camponotus noveboracensis (Fitch)

Forel Collection, under *F. subaenescens:* 1 ♀ from Toronto, Ontario.

Camponotus pennsylvanicus (DeGeer)

Forel Collection, under *F. fusca subsericea:* 4 ♀ from Kansas City, Kansas and 1 ♀ from Morganton, N. Carolina (A. Forel).

Lasius pallitarsis (Provancher)

Forel Collection, under *F. fusca neorufibarbis:* 1 ♀ from Yoho Valley, British Columbia.

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THE ITHOMIINES OF BRAZIL (LEPIDOPTERA: NYMPHALIDAE). III. REDISCOVERY AND SYSTEMATIC POSITION OF *NAPEOGENES XANTHONE.*[1]

Keith S. Brown, Jr.[2]

ABSTRACT: The Ithomiines of Brazil (Lepidoptera: Nymphalidae). III. Rediscovery and systematic position of *Napeogenes xanthone.* Abstract. - The "lost" east Brazilian butterfly species *Napeogenes xanthone* Bates was recently rediscovered in Itamaraju, in the south of the state of Bahia, where it occurs very rarely in large ithomiine pockets also occupied by much greater numbers of the very similar *Hypothyris euclea laphria.* Morphological considerations indicate it to be conspecific with *Napeogenes yanetta* Hewitson, which occurs locally farther south in the states of Espirito Santo and Rio de Janeiro; *xanthone* takes date preference for the name of the combined species. The variable form "richardi" Fruhstorfer represents a clinal series between *N.x. xanthone* and *N.x. yanetta,* found principally in northern Espirito Santo and adjacent eastern Minas Gerais. The recently described form "haenschi" Fox and Real is regarded as an intrapopulational variant of *N.x. yanetta,* though it may be seasonally predominant in local areas southward. The relationships of *N. xanthone* to the Amazonian *N. inachia* and *N. cyrianassa* are uncertain, but are surely much more distant than that to *N.x. yanetta.* The ambiguous name *Mechanitis rhezia* Geyer should be regarded as a "species inquerenda".

DESCRIPTORS: Lepidoptera; Nymphalidae; Ithomiinae; *Napeogenes xanthone; Napeogenes yanetta; Napeogenes inachia; Napeogenes cyrianassa;* rare "Bahia-species" from eastern Brazil; ecology; zoogeography; polymorphism; integradation; mimicry; mechanisms of extinction of forest insects.

I. HISTORICAL BACKGROUND

The rich endemic entomological fauna of southern Bahia, in eastern Brazil, was originally discovered by naturalists working out from boats docked in the port of Ilheus. The forms were mostly described in the last century, but many have had little contact since their descriptions with the world of science. Ecological changes wrought in this area by man and nature, coupled with the general inaccessibility of the region until the late 1960's and its reputation as

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a seedbed of malaria and schistosomiasis, turned many of the classical "Bahia species" into riddles and stumbling-blocks for modern taxonomists. The few ancient museum specimens available were often insufficient to resolve even fundamental questions of morphology and systematic placement, and obviously could not lend themselves to studies of karyology, ethology, juvenile biology, or ecological and population parameters.

Such was the case with *Heliconius nattereri* Felder 1865, a key primitive member of its genus which was finally rediscovered in 1967, by Claudionor Elias of the Universidade Federal do Parana, at the southern extreme of its range in central Espirito Santo (Brown, 1970). The narrow ecological specialization of this butterfly to large tracts of steep, humid forest, and usually fatal competition against the larvae on the unique, slow-growing forest foodplant by more abundant and aggressive heliconians which have multiplied greatly in clearings made by man, have driven it near to natural extinction. The conditions needed for survival of a colony are rarely found in Bahia or Espirito Santo today, and the few remaining tracts are rapidly disappearing due to indisciminate destruction by unchecked agricultural and timber interests (Brown, 1970, 1972).

The uniquely dimorphic and mimetic female of *H. nattereri* closely resembles another "lost" species described from Bahia in the same decade, *Napeogenes xanthone* Bates, 1862. There appears to exist only a single short series of this form (four males and a female, including the holotype) in the British Museum (Natural History); no specimens are available in collections in the western hemisphere, and there seem to be none in European mainland collections. Its systematic position is at present unresolved.

A specimen of *xanthone* from the Bates collection (but not the holotype) was figured by d'Almeida (1960, fig. 7-3; reproduced in Figure 1). He discussed the difference between true *xanthone* and a different, south Brazilian species to which the name was usually applied, properly called *Napeogenes yanetta* (Hewitson, 1867) (Figure 2). d'Almeida also figured a form named *richardi* by Fruhstorfer (1898), found in eastern Minas Gerais; he regarded this as a further good species, since the yellow forewing postmedian band invaded the black costal margin, a condition which d'Almeida claimed was never seen in specimens of *yanetta.*

The holotype of *xanthone*, very similar to the specimen examined by d'Almeida, was figured by Fox and Real (1971) in their revision of the tribe Napeogenini. These authors admitted that the status of this form was still uncertain, but on the basis of color-pattern homologies, they placed it with the Amazonian *N. inachia* (Hewitson, 1855) (Figure 3). Fruhstorfer's *richardi* was regarded as a subspecies of *yanetta*, and the latter was further divided to give a new southern subspecies *N.y. haenschi* Fox and Real, 1971. The *richardi* figured by these authors, from the Munich collection (Zoologisches Sammlung des Bayerischen Staates), is not very similar to the one photographed by d'Almeida, from the Museum National d'Histoire Naturelle in Paris (on loan to the Museu Nacional, Rio de Janeiro). Both specimens are probably part of Fruhstorfer's original type-series, but that figured by Fox and Real represents a transition between d'Almeida's conception of this name and typical *N. y. yanetta.*

N.y. haenschi must be regarded as a synonym of *yanetta.* Both forms occur commonly in all known populations of this rather plastic species, although the sample taken at the type locality of *haenschi* may have been more uniform on the collecting date; other samples from the area are typical *yanetta* (Figure 4).

The wide range of variation in the appearance of *richardi* (Figure 5), and its occurrence in central Espirito Santo and northeastern Minas Gerais, strongly suggest that it could represent a cline between *yanetta* and the Bahian *xanthone.* Unfortunately, the holotype of *xanthone,* dissected by Fox, bore a false abdomen (probably from *Hypothyris euclea laphria*), so the morphological affinities of this form could not be established in the revision of Fox and Real. As the use of color-pattern homologies is notoriously dangerous in the taxonomy of the mimetic Ithomiinae, it seemed necessary to obtain fresh specimens of the lost *xanthone,* in order to determine its correct systematic position.

II. REDISCOVERY

The many excursions into northern Espirito Santo and southern Bahia during the *nattereri* project failed to reveal the presence of any *xanthone* in the woods of this region. The very similar *Hypothyris euclea laphria* was abundant in the area, and rapidly saturated a collector's interest, however, so *xanthone* could have easily passed unnoticed in this crowd. The closely related *Napeogenes sulphurina* was always present and frequently common in the forest areas visited. From central Espirito Santo southward, *N. yanetta* was found very sparsely, with northerly populations often including many *richardi*-like individuals (Figure 6).

The necessary elements for the rediscovery of *xanthone* converged in January 1972. Claudionor Elias, now stationed in Linhares (see Map) and his son Paulo Cesar were exploring a new road, BR-101 (now a modern paved highway, but then an unimproved and often-interrupted track) in southern Bahia. Submersion of their Jeep station wagon up to the windshield in an unexpectedly deep waterhole in a detour, caused a forced stay of several days in Itamaraju, at the base of some scenic granite hills well inland from the sea (Map), in an area where some wise landowners had preserved much forest. Paulo Cesar had the uninspiring task of collecting abundant ithomiines in quantity for this author's chemical investigations, so he set to work in a large nearby woods trying to place some dents in the hordes of *laphria* flying about. These butterflies were enveloped, boxed, and sent down to Rio de Janeiro in July.

This lot, from a previously unsampled area, was preliminarily analyzed for species ratios and the possible presence of aberrations or unusual forms, before being crammed into envelopes destined for the Waring blendor. Among large numbers of *laphria, N. sulphurina, Pteronymia euritea, Ceratiscada canaria* (see Brown and d'Almeida, 1970), *Oleria ?thiemei,* and a new subspecies of *Ithomia lichyi* (to be described in a forthcoming part of this series), two rather strange-looking mimetic male ithomiines came to light. Both lacked the discal forewing black marks of *laphria* and looked generally "cleaner" than this form. One could be assigned as an extreme specimen of *Napeogenes yanetta richardi,* near the original description but even more heavily overprinted with orange on the forewing. The other was identical with d'Almeida's figure of *Napeogenes xanthone.*

Thus, once again Claudionor Elias figured in the relocation of a lost "Bahia species". He was instructed immediately as to the identifying characteristics of *xanthone,* and urged to return to Itamaraju as soon as road conditions permitted.

Figures 1-7: *Napeogenes* adults, slightly less than life size; black, yellow, and orange. Fig. 1, *N. xanthone,* Bates collection, British Museum (Natural History), reproduced from d'Almeida (1960). Fig. 2, *N.x. yanetta,* reproduced from type-figure in Hewitson (1867). Fig. 3, *N.i. inachia,* Ourem, Para, O. Mielke leg., Museu Nacional, Rio de Janeiro; note greater transparency than in *xanthone.* Fig. 4, *N. xanthone yanetta,* form "haenschi", topotype (from series of the holotype), Angra dos Reis, Rio de Janeiro (upper); typical *N.x. yanetta,* Tingua, Rio de Janeiro, near Angra dos Reis (second); and four examples of *N.x. yanetta* from Colatina, Espirito Santo, including "haenschi" and transitions to "richardi"; all in the Museu Nacional. Fig. 5, six examples of form "richardi" and transitions thereto from both subspecies: upper two, syntypes of Fruhstorfer (second specimen also illustrated by d'Almeida, 1960, and corresponding to his idea of the form), eastern Minas Gerais, Museu Nacional (on loan from the Museum National d'Histoire Naturelle, Paris); middle two, recent specimens from Santa Teresa, Espirito Santo, in the central highlands, upper with hindwing of *xanthone,* lower with full yellow forewing postmedian band as in *xanthone* but no orange coloration (collection of the author); lower two, "richardi"-like specimens from the recently discovered *xanthone* colony, Itamaraju, Bahia (collection of the author). Fig. 6, six specimens of *N.x. yanetta* from Linhares, central Espirito Santo (coastal lowlands), showing transitional forms from *yanetta* towards *xanthone* (upper two in Museu Nacional, the second from near Nova Venezia northwest of Linhares; other four in author's collection). Fig. 7, six specimens from the rediscovered colony of *N.x. xanthone,* Itamaraju, Bahia, 1972-73; lower a female, others males; fifth ventral (collection of the author).

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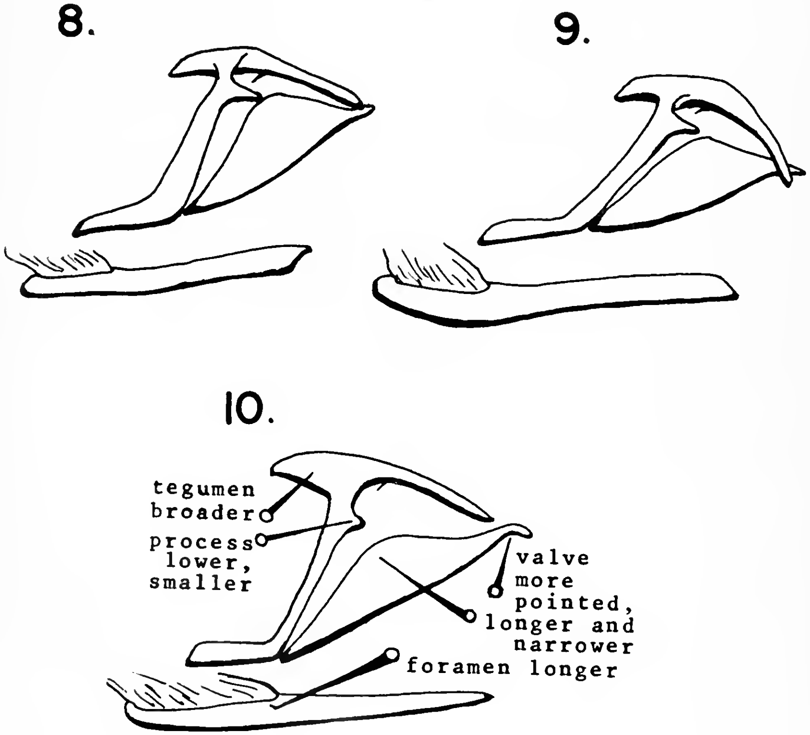
The next opportunity came in April 1973, when a single day was spent with Claudionor in the same woods, now on the edge of a high-speed road and but a few hours' drive from Linhares. Ithomiines in general were exceedingly scarce, and even with *Heliotropium* bait it was difficult to turn up a few *laphria* and other usually abundant species.

As the fall and winter ithomiine season came into full swing, Claudionor revisited Itamaraju in July and thoroughly explored another woods to the south of town. In two widely separated ithomiine pockets, he captured another three males of *xanthone;* once again, one of these was somewhat transitional to *richardi.*



Figures 8-10: *Napeogenes*, schematic left aspect of sclerotized male genital armatures, left valve removed, penis figured beneath. Fig. 8, *N.x. xanthone*, Itamaraju, Bahia, January 1972. Fig. 9, *N.x. yanetta*, Corrego do Sabia, Nova Venezia, Espirito Santo (Museu Nacional). Fig. 10, *N.i. inachia*, Ourem, Para (Museu Nacional).

Finally, two full days in these same pockets (September 1-2, 1973) in the company of Claudionor and using much *Heliotropium,* produced for the author a short series (two males and six females) of this unusual form, confirming its regular presence in the Itamaraju area.

A selection of the thirteen specimens from Itamaraju is illustrated in Figure 7; two *richardi*-like individuals (of the four, representing 30% of the sample) are included in Figure 5. One typical pair has been donated to the Museu Nacional, Rio de Janeiro; the others are presently retained in the author's collection.

III. SYSTEMATICS

Although a reasonably complete morphological study of the now available *xanthone* was projected, in order to clarify its taxonomic position, this proved unnecessary. The clear intergradation to *yanetta* through the variable forms of *richardi* strongly indicated conspecificity (Figures 5 and 6). The male genitalia of *xanthone* (Figure 8) are essentially identical with those of *N. yanetta* (Figure 9), and sufficiently distinct from those of Para *N. inachia* (Figure 10) to permit the association of *xanthone* with the former (taking name preference over it) and its divorce from the latter. Its close relationship with *inachia* and perhaps even closer relationship (in both color-pattern and genitalia) with *N. cyrianassa* are indisputable, however. In spite of long and very complete geographic separation of *xanthone* from these common Amazonian species (at least since the breakup of the last major forest connection across northeastern and central Brazil to south Bahia), it may still prove to be interfertile with one of them. Until appropriate tests can be made in the insectary, however, it seems best to maintain *Napeogenes xanthone* and its southern subspecies *N.x. yanetta* as a separate species, like the majority of other ithomiine forms endemic to southern Bahia which show affinities with Amazonian relatives. The highly variable form "richardi", regarded as a cline between *xanthone* and *yanetta,* is normally found in northern Espirito Santo and adjacent Minas Gerais, but may be expected occasionally well into typical populations of *yanetta* as far south as southern Espirito Santo, and of *xanthone* well north into Bahia.

The relationships of the various taxa are indicated in the following key.

1\. a. Orange coloration on the dorsal hindwing absent or confined to the anal submarginal region (central Espirito Santo to southern Rio de Janeiro) . . . . *yanetta*
    i. Orange color on forewing restricted to behind the anal vein . . form *yanetta*
    ii. Orange color on the forewing invading the discal cell . . . . form "haenschi"
  b. Orange color on the dorsal hindwing forming a complete submarginal band from the anal margin to the apex (Bahia, eastern Minas Gerais, Espirito Santo) . . . . *xanthone*
    i. Forewing basal area orange to a heavy postmedian black bar, and yellow stripe beyond this essentially contiguous with the black apex . . . . form *xanthone*
    ii. Forewing basal area orange mixed with yellow (the latter often predominant), and postmedian yellow bar separated from black apex by a transparent area . . . . form "richardi"

Both d'Almeida (1960) and Fox and Real (1971) mention the close correspondence of *xanthone* with Geyer's figures (1834) of *Mechanites* [sic] *rhezia,* but both conclude that the two are not identical. Ignoring obvious errors in drawing, the figures of *rhezia* are indeed extremely similar to *xanthone.* However, they could equally well apply to some, especially Guianan, forms of *Napeogenes cyrianassa.* In view of this ambiguity and in the absence of the types, it might be best to regard *rhezia* as a "species inquerenda", so that it does not introduce further confusion into the usage of the well-established names for the two species it may represent.

IV. ECOLOGICAL NOTES

N. xanthone, like many members of its genus (but not the sympatric *N. sulphurina*), is both extremely local and very sparse in occurrence. The ratio of *Hypothyris euclea laphria* to *N. xanthone* in the Itamaraju forests is several hundred to one; the odds of encountering *xanthone* among the *laphria* are not increased by the use of *Heliotropium,* to which both are strongly attracted, but this dried plant does make the individuals sit down where they can be better identified with binoculars. *Xanthone* is a very wary and relatively high-flying species, and leaves *Heliotropium* quickly when any danger threatens within five meters; it returns in a few minutes if the disturbance is removed, however. More individuals were captured flying high through the dark shady woods, especially in mid-afternoon, than on the bait. All were found in central areas of large ithomiine pockets (dark, humid, but relatively open undergrowth areas in heavy forest), to which *N.x. yanetta* has also been observed to be closely restricted.

No information was obtained on the early stages or the foodplant of *xanthone;* eggs expressed from the females did not hatch. Females of *N. inachia johnsoni* (Meta, Colombia) and *N. sulphurina* (Pernambuco) have been observed to swarm around the solanaceous foodplants and lay eggs for only a short period of their lives, apparently ignoring it most of the time. Thus, the study of the juvenile biology of *xanthone* may have to await a fortunate observation of such an "oviposition dance".

Sympatric ithomiines in the two pockets observed, in addition to the six common species mentioned above, include *Tithorea harmonia pseudethra, Melinaea ludovica paraiya, Melinaea ethra, Thyridia psidii hippodamia*[3], *Mechanitis lysimnia lysimnia* and (much rarer) *I. nesaea, Mechanitis polymnia casabranca, Scada karschina, Hypothyris daeta daeta, Oleria aquata, Aeria olena olena, Callithomia xantho,* and *Prittwitzia hymenaea hymenaea.*

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[3] This nomenclature is based on the Doctor's thesis of Gerardo Lamas Muller, Universidade de Sao Paulo (Museu de Zoologia), December 1973.

V. THE FUTURE

The Itamaraju woods is essentially contiguous with the large and ecologically identical forest preserve of the Parque Nacional de Monte Pascoal (Map). This fact would seem to guarantee that *xanthone* will continue to be present, even though rare, in the area for the foreseeable future. However, as no other colonies have been located in recent work in southern Bahia, the subspecies must continue to be regarded as possessing a fragile existence on the modern scene. The confinement of this species to scattered large "ithomiine pockets" probably indicates specialization both in choice and in utilization of a unique foodplant. This in turn may be sparsely distributed for

MAP
EAST-CENTRAL BRASIL

ecological reasons, or perhaps frequently preoccupied by other more common ithomiines (this was the case with the unique foodplant of *Heliconius nattereri*, the other very rare and probably rapidly disappearing "Bahia species" mentioned above). If a similar situation be present in *xanthone*, local colonies may be expected to be easily eliminated, not only by direct interference with plant cover or soil conditions in the immediate area, but also by nearby cutting which could promote multiplication of more adaptable competitors on common disturbed-forest species of Solanaceae.

ACKNOWLEDGEMENTS

The author is very grateful to Claudionor and Paulo Cesar Elias for invaluable information and field accompaniment, which permitted this work to be initiated and carried to its present stage. Access to the collection of the Museu Nacional in Rio de Janeiro was made possible by the cooperation of its curator, Dr. A.R. de Rego Barros. Thanks are due to the Conselho de Pesquisas e Ensino para Graduados of the U.F.R.J., for funds for the purchase of specimens in quantity, surface travel within Brazil, and photographic enlargements. The preparation of the plate was greatly aided by Jorge H. Leao and Ismael Gioia, and the map was redrawn by Maria Isabel Agnello. The author received a stipend as Pesquisador-Conferencista of the Conselho Nacional de Pesquisas, and a supplement from the Ministerio do Planejamento (FINEP/FNDCT, contract 140/CT) during 1972-1973.

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THE ECOLOGY OF HONEY CREEK

A PRELIMINARY EVALUATION OF THE INFLUENCE OF *SIMULIUM* SPP. (DIPTERA: SIMULIIDAE) LARVAL POPULATIONS ON THE CONCENTRATION OF TOTAL SUSPENDED PARTICLES.[1]

William K. Reisen[2]

ABSTRACT: *Simulium* spp. populations filtered significant quantities of suspended particles from Honey Creek as indexed by the differences in Coulter Particle Counts taken upstream and downstream from larval concentrations. These differences were not correlated with water temperature, depth, current velocity, or *Simulium* spp. benthic density, but were inversely correlated with total numbers of larvae.

DESCRIPTORS: Simuliidae larvae, suspended particles, particle filtration

Simulium spp. larvae are predominantly filter feeders straining suspended particles from the water by means of their cephalic fans (Carlsson, 1962; Ivasshenko, 1972; Hynes, 1972; and many others), but also occassionally feeding on periphyton (Burton, 1973) and other blackflies (Burton, 1971). The aufwuchs travertine community at Honey Creek, Murray County, Oklahoma supported dense populations of *Simulium* species A, *S. virgatum* Coquillet, and *S. trivittatum* Malloch in specific microhabitats with favorable current relationships (Reisen, 1974). These organisms were assumed to feed randomly on size specific suspended particles as was determined by a preliminary evaluation of gut contents. Other filter feeders such as the Hydropsychidae (Trichoptera) have been found to show a positive relationship with the amount of suspended particles, i.e. food, as indexed by Coulter Particle Counter evaluation of water samples (Williams and Hynes, 1973). The purpose of this investigation was to determine: 1. if simullid larval populations could significantly reduce the quantity of suspended particles as indexed by changes in Coulter Particle Counter data; and 2. if this removal of particles varied with temperature, depth, current velocity, and simuliid larval abundance.

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METHODS AND MATERIALS

Simullid benthic densities and the calculation of population area and total numbers followed the procedures outlined in Reisen (1974). Water temperatures were measured concomitantly with a field thermometer; depths were estimated with a ruler; and current velocities were measured with a modification of Darcy's Pitot tube (Reisen, 1974). Duplicate 5 ml water samples were taken immediately above and below larval blackfly concentrations and were fixed in the field by mixing with 100 ml of commercial Isotone. Samples were then taken back to the laboratory and the total number of suspended particles estimated by means of a Coulter Particle Counter (Reisen, 1974). Triplicate counts were made along with a background count for each sample. Counts were averaged, corrected for background "noise" and expressed as counts/ml. Operating parameters for the Coulter Particle Counter have been presented previously in Reisen (1974). Differences between the upstream and downstream readings were calculated by averaging the duplicate samples and then taking the difference between the means. This difference was attributed to the number of particles removed from the water by the actively filtering blackfly population.

Differences between the upstream and downstream readings were evaluated statistically using a 2 way factorial analysis of variance with replication. The main effects were considered random and the differences were tested using the interaction term (Sokal and Rohlf, 1969). Factor interactions were evaluated using the simple product moment correlation coefficient (Sokal and Rohlf, 1969).

RESULTS AND DISCUSSION

The environmental conditions, *Simulium* spp. larval population parameters (*S. virgatum*, *S.* species A, and *S. trivittatum* pooled), and the number of suspended particles removed by *Simulium* filtration are presented in Table 1 and the correlation among these presented in Table 2. Blackfly larvae were able to remove a significant number of suspended particles as particle counts taken above and below larval concentrations were significantly different (F ratio = 7.788, $\alpha = 0.05$). The number of particles removed was independent of benthic density, water temperature, depth and current velocity which was in good agreement with the findings of Reisen (1974), but was significantly negatively correlated with the total number of individuals in the population. This relationship was difficult to interpret for it would seem that the number of particles removed would be proportional to the number of blackfly larvae

Table 1. Environmental conditions, *Simulium* population parameters, and the number of suspended particles removed by *Simulium* populations as indexed by differences in the number of coulter counts in samples taken upstream and downstream from *Simulium* concentrations.

Date	Water Temperature (°C.)	Depth (cm)	Current Velocity (cm/sec)	*Simulium* spp. Benthic density (Nos/cm^2)	Population Area (cm^2)	Number in population	Differences in the Number of Coulter Counts (cts/ml)
8 Jul 72	26	–	126.15	5.949	–	–	17104.33
15 Jul 72	28	–	130.00	5.564	–	–	6800.00
22 Jul 72	28	5.00	136.84	7.360	–	–	8567.50
29 Jul 72	29	2.54	–	7.949	–	–	6305.00
5 Aug 72	29	2.00	–	6.770	3445.15	23322.66	4785.00
19 Aug 72	25	2.50	207.53	9.487	860.00	8158.82	16476.00
9 Sep 72	29	2.54	193.52	5.357	11483.00	61523.58	2987.50
23 Sep 72	20	2.00	200.00	10.356	13000.00	134631.90	4090.00
14 Oct 72	25	1.91	237.02	1.878	25187.05	47308.84	6063.00
22 Oct 72	17	1.90	237.02	4.590	37741.86	173220.04	115.00

Table 2. Simple product moment correlation coefficients between the number of suspended particles removed by the simuliid populations and environmental conditions and simuliid population parameters.

Parameter	Number of Replicates	Correlation Coefficent
Water temperature	10	0.2645
Depth	8	0.3221
Current velocity	8	-0.4642
Benthic density	10	0.2756
Total number in population	6	-0.7034*

*Significant at $\alpha = 0.10$

present between sampling locations. Perhaps the older, larger larvae consumed more particles than younger, smaller individuals which were more numerous. Normal population attrition through mortality and/or emigration would reduce total population numbers while the filtration rates could have remained constant or even increased since total cohort biomass was observed to remain relatively constant (Reisen, 1974).

Particles cleared were predominantly between 3 and 10 cubic microns in size and consisted of both organic and inorganic debris as well as bacteria. A single water sample was filtered through a millipore filter and the residue streaked on nutrient agar. The resulting bacterial colonies were predominantly gram (-) rods which were considered suitable food for simuliid larvae (Fredeen, 1964).

ACKNOWLEDGEMENTS

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A NEW SPECIES OF ECUADOREAN *TOXOMERUS* (DIPTERA: SYRPHIDAE)[1]

Charles Gerdes[2]

ABSTRACT: In the course of a study (Gerdes, 1974) of species of the genus *Toxomerus* (Diptera: Syrphidae) from Ecuador, one undescribed new species was discovered. The external characteristics and genitalia were examined for all species in this study. Drawings of the genitalia for all identified species were made. Keys by Curran (1930) and Hull (1943) were used. Comparisons were made with the genitalia of several holotypes, allotypes, and paratypes from the American Museum of Natural History.

DESCRIPTORS: Diptera, Syrphidae, *Toxomerus pichinchae* n. sp., from Pichincha, Ecuador.

Toxomerus pichinchae, n. sp.
(Figures 1 - 8)

Length of male and female 7.1 mm. Face (figure 7) yellow and truncate in side view. Antennae yellowish-orange; darker dorsad on third segment. Front in male black centrally with all margins narrowly yellow; in female black medially, yellow laterally. Face produced slightly beyond antennae. Vertex golden brown in front of and within area of ocelli; shining violet to black behind ocelli; covered with black hair. Black area of cheeks extends onto face baso-laterally.

Thorax.—Humeri, scutellum, and margins of scutum yellow to orange. Scutellum covered with long erect black hair. On each side of thorax the posterior half of mesopleuron and dorsal sternopleural spot are yellow; no propleural yellow spot is present. All femora and tibiae yellow with black hair and without darker-colored bands. Posterior tarsi dark brown, other tarsi yellow.

Abdomen (figure 8).—Long and oval, almost parallel-sided in dorsal view, with second to fourth segments each having a wide black posterior fascia. Wide black basal fascia on second segment. Third and fourth segments each with narrow, medially incised, basal fascia; same segments each with a pair of subbasal spots, often loosely connected to basal fascia. Linear basal fascia and wider posterior black fascia on fifth segment; a tiny spot may be attached to the basal fascia of the fifth segment. Background color of first through fifth segments yellow to orange.

Male genitalia (figure 1 - 3).—In side view superior lobe with convex ventral margin; rounded basal and distal corners; dorsal extension forked distad; smaller baso-lateral protuberance; ventral margin and disto-ventral corner covered with short bristles; a few hairs on dorsal extension and baso-lateral protuberance; a few scattered hairs on lateral

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surface. Stylus in dorsal view fairly parallel-sided; truncate distal end; distal half and baso-lateral area of dorsal surface covered with scattered hairs, a few medial hairs appearing longer and thicker; distal half of ventral surface covered with a few scattered shorter hairs. Triangular process one-third length of styli. Epandrium two-thirds length of styli. Ejaculatory hood in dorsal view with straight distal margin; in side view dorsal margin concave distad; disto-dorsal tip formed into a slightly up-turned tip, which proceeds directly ventrad and flares laterad; with baso-medial flap on each side, rounded distad. In side view small dorsal and ventral keels on sustentacular apodeme. Ejaculatory apodeme in side view enlarged and rounded distad. Ejaculatory sac in side view thin, only slightly enlarged at articulation with ejaculatory apodeme; in dorsal view prominent lateral projections. Chitinous box with pointed medial projection inside ejaculatory hood.

Female genitalia (figures 4 - 6).--Hypogynium in ventral view constricted baso-laterad; with straight basal margin, rounded disto-lateral margins, and disto-medial depression. On each side in side view dorsal valve half length of ventral valve; straight dorsal margin and convex ventral margin on ventral valve. Genital plate in ventral view with concave basal margin and slightly concave disto-lateral margins; in side view basal end curves upward to dorsal margin of ventral valve. Epigynium in dorsal view fairly straight on basal margin, continuously curved on lateral and distal margins, and triangular sclerotized spot immediately basal to middle of epigynium; in side view small hump above sclerotized spot.

All specimens were collected at Aloag, Pichincha, Ecuador, at an elevation of 2600 meters, by E. Velastiqui.

Holotype: male, 21 June 1967. Allotype: female, same date. Paratypes: 9 males and 4 females, same date; 3 males and 3 females, 23 June 1967; 1 male and 3 females, 27 June 1967.

The holotype and allotype have been deposited in the American Museum of Natural History, New York.

DISCUSSION

This is a slightly variable species in external characteristics. Various paratypes display absence or fusion of abdominal spots, brownish femora or anterior tarsi, or even a faint subapical femoral band. The allotype lacks subbasal spots on the fourth abdominal segment. Paratypes displaying such anomalies were examined, and in all cases the paratype genitalia that were examined appeared identical to the holotype or allotype genitalia.

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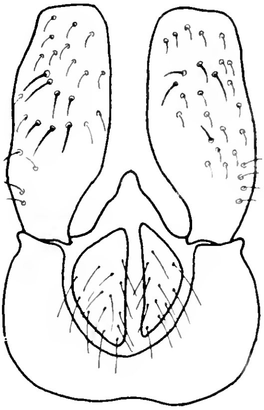

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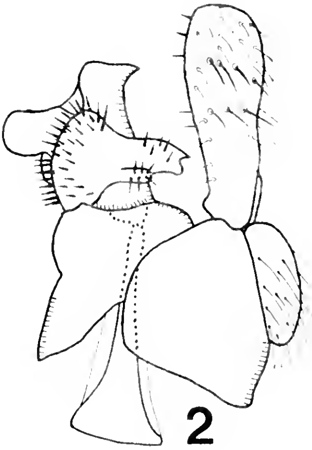

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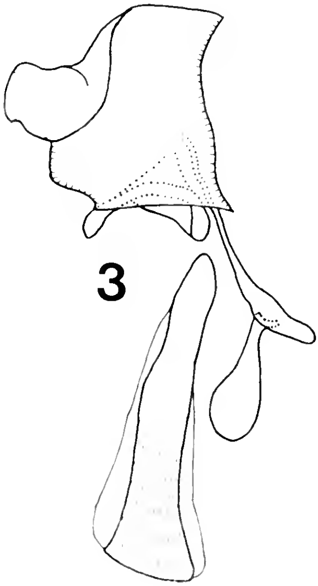

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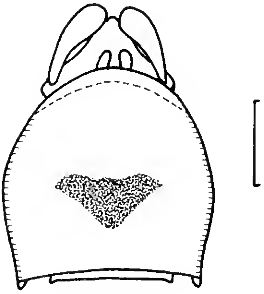
Figure 1. Male genitalia, dorsal view, line = 0.17 mm.
Figure 2. Male genitalia, right side view, line = 0.17 mm.
Figure 3. Male genitalia, axial system, line = 0.12 mm.



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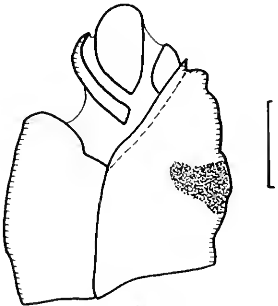

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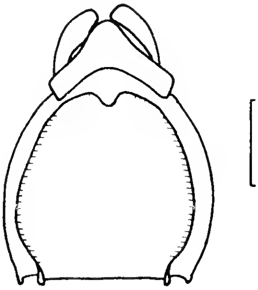

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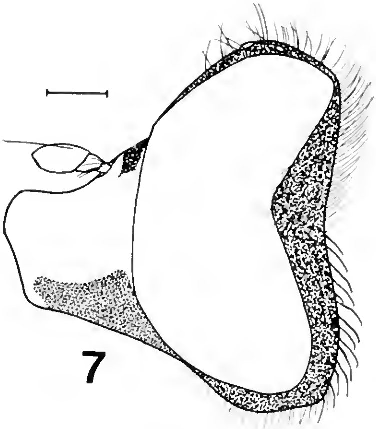
Figure 4. Female genitalia, dorsal view, line = 0.17 mm.
Figure 5. Female genitalia, right side view, line = 0.17 mm.
Figure 6. Female genitalia, ventral view, line = 0.17 mm.



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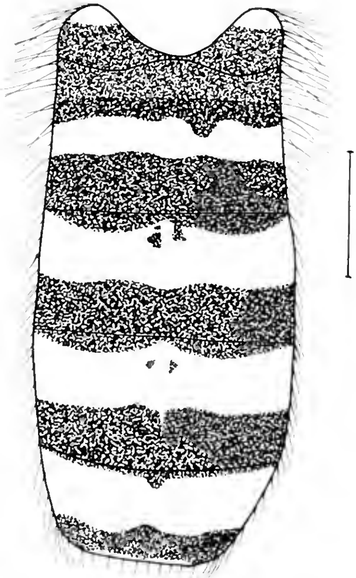

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Figure 7. Left side of head, line = 0.3 mm.
Figure 8. Dorsal abdominal view, line = 0.8 mm.

PHENOLPHTHALEIN-ACETONE SOLUTION

A VERSATILE INSECT MARKING TECHNIQUE.[1]

D. L. Deonier[2]

A large number of insect population estimates could have a greater degree of accuracy if a mark-recapture technique were employed.

Numerous materials have been used for marking insects – oil plants (various art brands and Testor^{TM} enamels) poster and tempera paints, fluorescent spray paints (flat and enamel), aniline dyes in shellac or alcohol, and fluorescent and nonfluorescent dye powders, to name a few. An external marking material that is aerosolizable, but invisible is needed for many mark-recapture situations to promote rapid marking and to avoid bias during recapture as well as to minimize behavioral or ecological alteration in the subject animals. A 6 percent solution of phenolphthalein in acetone (originally conceived and used by Peffly and Labrecque, 1956) meets these criteria. The solution can be sprayed (with various bomb aerosolizers such as Sprayon Jet-Pak^{TM}) onto grouped or individual insects, dries rapidly, and is fairly difficult to wash off with water. After 3 washings in distilled water, 15 adult flies marked with this material retained sufficient phenolphthalein to test lavender when placed in a 1 percent sodium hydroxide solution. The same test with 50 third-instar larvae of the eastern tent caterpillar resulted in all larvae retaining their invisible marks. I have used this marking material extensively in research on shore flies of the genera *Hydrellia* and *Ochthera* (Diptera: Ephydridae).

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ADDITIONS AND CORRECTIONS TO A LIST OF MONTANA STONEFLIES[1]

Arden R. Gaufin[2] and W.E. Ricker[3]

ABSTRACT: Questionable Montana distribution records are reviewed and new state records are given. *Nemoura venusta* Banks and *Eucapnopsis vedderensis* Ricker are removed from the list but the addition of *Capnia cheama Ricker* and *Brachyptera fosketti* Ricker leaves the list of Montana stoneflies at 119. Close examination of *Nemoura (Soyedina) nevadensis interrupta* Claassen showed it to be similar enough to the eastern *Nemoura washingtoni* Claassen and *Nemoura vallicularia* Wu to justify recognition of a new species *Nemoura (Soyedina) potteri* Baumann and Gaufin for Montana. A detailed study of *Leuctra (Paraleuctra) sara* Jewett pointed out that the western specimens of this species were so different from the eastern *sara,* as to justify the renaming of the western taxon.

DESCRIPTORS: Plecoptera, holotype, allotype, paratype, lectotype, distribution.

The notes to follow supplement the recent "Stoneflies (Plecoptera) of Montana," by A.R. Gaufin, W.E. Ricker, Michael Miner, Paul Milam and R.A. Hays (Trans. Am. Ent. Soc. 98:1-161, 1972).

4. *Nemoura (Amphinemura) venusta* Banks

This species should be deleted from the list on page 14. All past records of *venusta* from Montana prove to be *banksi* (Baumann and Gaufin) (cf. p. 30).

13. *Nemoura (Soyedina) nevadensis interrupta* Claassen

This species should be deleted from the list on page 15. Specimens from Montana identified as *Nemoura nevadensis interrupta* have been found to be more similar to the eastern *Nemoura washingtoni* Claassen and *Nemoura vallicularia* Wu but are different enough to justify recognition as a new species, *Nemoura (Soyedina) potteri* Baumann and Gaufin (cf. p. 38).

26. ***Paraleuctra vershina*** Gaufin and Ricker (new species)

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1964 *Leuctra (Paraleuctra) sara* Gaufin, Proc. Utah Acad. 41(2):223.
1964 *Leuctra (Paraleuctra) sara* Ricker (in part), Gewasser and Abwasser 34/35:fig. 16. The dots west of the plains all refer to *vershina.*
1966 *Paraleuctra sara* Gaufin, Nebeker and Sessions, Univ. Utah Biol. Ser. 14(1):42.
1966 *Paraleuctra occidentalis* Illies, Tierreich 82:114 (in part).
1966 *Paraleuctra sara* Illies, Tierreich 82:115 (in part).
1967 *Leuctra sara* Sheldon and Jewett, Pan-Pac. Ent. 43(1):4.
1972 *Leuctra (Paraleuctra) sara* Gaufin et al., Trans. Am. Ent. Soc. 98:52.

In the past this frequently-collected species has been reported using names that properly belong to two other species: *occidentalis* Banks and *sara* Claassen. Ricker (1954) showed that the type of *occidentalis* Banks is the same as *bradleyi* Claassen, but mistakenly applied the name *sara* Claassen to what most authors had been calling *occidentalis.* Hanson (1962) pointed out that the western specimens so named were different from eastern *sara,* but unfortunately he refrained from naming the western taxon.

A fresh description of this species seems unnecessary. Needham and Claassen's (1925) description and illustrations (as *Leuctra occidentalis*) are adequate, and Hanson (1962, p. 136) has two views of the male cercus. The species has also been illustrated by Jewett (1956, 1959, 1960) and by Gaufin et al. (1966, 1972), under the names indicated above.

A key to separate male *vershina* from its two closest relatives is as follows:

1a. Basal body of the cercus much deeper than long, subrectangular, with a spine at the upper and lower posterior corners, these approximately equal in length; the upper spine lacks any protuberance, but a short spur or callus is present on the hind margin of the basal body near that spine; lower spine with a callus on its mesal surface near its base; western . . . . *forcipata* Frison

1b. Basal body of the cercus no deeper than long, lacking any hind margin that appears distinct from the two spines, which meet each other at an obtuse angle; upper spine always with a spur or callus on its hind margin 2

2a. Lower spine of the cercus always much shorter than the upper, and lacking any spur or callus; the spur on the upper spine closer to the tip of the spine than to its base; western . . . . *vershina* n. sp.

2b. The two spines of the cercus almost or quite equal in length (the upper usually slightly longer); a spur or callus present on the hind margin of the upper spine, about midway between tip and base; a callus present on the mesal surface of the lower spine near its base; eastern . . . . *sara* Claassen

The females of these three species are very similar.

Paraleuctra vershina

Holotype ♂, allotype ♀ and 1 male and 7 female paratypes City Creek, Salt Lake County, Utah, 10-VI-1965, R.W. Baumann (USNM). Paratypes: COLORADO: Delta Co., stream at Grand Mesa, 27-VI-1961, S.G. Jewett, Jr., 1♂, 7♀♀ (USNM). Eagle Co., Eagle River, Hwy 24, above Minturn, 29-VI-1962, 1♂, 1♀ (USNM). La Plata Co., Lime Creek, Purgatory Campground, 24-VI-1961, S. G. Jewett, Jr., 2♂♂, 10♀♀ (USNM). Routt Co., Rocky Creek, 1 mile from Fish Creek Falls, 17-VI-1968, B. R. Oblad, 12♂♂ 6♀♀ (USNM); Yampa River, Steamboat Springs, 26-VI-1968, B. R. Oblad, 8♂♂, 5♀♀ (USNM). IDAHO: Custer Co., Valley Creek, Stanley, 17-VI-1964, 25♂♂, 33♀♀ (USNM). NEW MEXICO: San Miguel Co., Holy Ghost Creek, near Tererro, 19-VI-1961, S. G. Jewett, Jr., 23♂♂, 31♀♀ (USNM); Pecos River, near Field Tract Campground, 18 to 20-VI-1961, S. G. Jewett, Jr., 2♂♂, 2♀♀ (USNM). Santa Fe Co., Sante Fe Basin Ski Area, 18-VI-1961, S. G. Jewett, Jr., 2♂♂, 4♀♀ (USNM). UTAH: Davis Co., Mueller Park, 28-V-1948, D. Merkley, 1♂, 4♀♀ (USNM) Salt Lake Co., Big Cottonwood Creek, 14-V-1965, A. V. Nebeker, 1♂ (USNM); 4-VIII-1965, A. V. Nebeker, 3♂♂, 2♀♀ (USNM); 16-V-1966, R. W. Baumann, 11♂♂, 4♀♀ (USNM); City Creek, Rotary Park, 15-V-1966, D. Uresk, 7♂♂, 5♀♀ (USNM). WYOMING: Fremont Co., Willow Creek, near South Pass, 20-VIII-1967, R. W. Baumann, 7♂♂, 9♀♀ (USNM). Sublette Co., Surveyor Creek, above Half Moon Lake, 18-VII-1967, R. W. Baumann, 3♂♂, 3♀♀ (USNM), Teton Co., Cottonwood Creek, Teton National Forest, 19-VII-1967, R. W. Baumann, 2♂♂, 2♀♀ (USNM); Pacific Creek, Hwy 89, 1 mile NW Moran, 19-VII, 1967, R. W. Baumann, 1♂, 7♀♀ (USNM); river draining Jenny Lake, 19-VII-1967, R. W. Baumann, 3♂♂, 13♀♀ (USNM). Holotype ♂, #72944 and allotype ♀ deposited at the United States National Museum, Washington, D.C.

36. *Capnia (Capnia) limata* Frison

The name *Capnia limata* has been given to specimens from the western United States, while the name *Capnia vernalis* (Newport) has been used in Canada and the northeastern United States. After careful examination of both type specimens, Baumann (1973) concluded that a single, widely separated species *Capnia vernalis* (Newport) was involved. This synonymy is recorded in Zwick (1973).

41. *Capnia (Capnia) projecta* Frison

As was indicated in the list of The Stoneflies of Montana, p. 69, no records of this species' presence in the state are known. However, its range and that of *Capnia porrecta* Jewett are such as to indicate that either or both are likely to be present in the farthest northwestern section of the state.

50. *Eucapnopsis vedderensis* Ricker

This is a duplication of no. 55, *Isocapnia vedderensis* (Ricker), and should be deleted from pages 16 and 76 and from figure 4. The Montana records on page 76 should be transferred to *Isocapnia vedderensis* on page 84.

110. *Alloperla (Sweltsa) occidens* Frison

The Montana record for this species was based on a specimen taken near Missoula on July 7, 1950, by Borys Malkin, and identified by Mr. S. G. Jewett, Jr.

112. *Alloperla (Sweltsa) revelstoka* Jewett

The name of this species was misspelled as *revelstoki.*

The following species should be added to the list of Montana Stoneflies.

Capnia (Capnia) cheama Ricker

Montana, Lincoln Co., Kootenai River, 19-III-1970, R. L. Newell.

Brachyptera (Oemopteryx) fosketti Ricker

Treasure Co., Yellowstone River, 2 miles south of Hysham, 24-III-1966, J. R. Grierson; Custer Co., Yellowstone River at Miles City, 22-III-1973, Roemhild, 5♂, Dawson Co., Yellowstone River, Intake 22-III-1973, Roemhild, 8♂; Custer Co., Tongue River, 14 miles south of Miles City, 22-III-1973, Roemhild, 5♂.

With the removal of *Nemoura venusta* and *Eucapnopsis vedderensis,* but the addition of *Capnia cheama* and *Brachtyptera fosketti,* the list of Montana stoneflies stands at 119, of which 117 have actually been collected. *Perlomyia utahensis* and *Capnia projecta* are listed as "probables" because of their occurrence in adjacent states.

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AESHNA SUBARCTICA WALKER AND OTHER ODONATA NEW FOR MAINE[1]

Harold B. White, III[2]

ABSTRACT: *Aeshna subarctica* Walker, *Somatochlora cingulata* (Selys), and *Enallagma carunculatum* Morse occur in Maine. The southernmost known breeding population of *A. subarctica* in North America is on Mount Desert Island.

DESCRIPTORS: Odonata, *Aeshna subarctica* Walker, Mount Desert Island, Maine.

Borror (1944) published an annotated list of 115 species of Odonata occurring in Maine. To this list have been added six species by Borror (1951 & 1957) and a seventh species by White (1969). In a report on the Odonata of New Hampshire (White & Morse, 1973), four additional species new for Maine are mentioned. Specific data on the collection of *Progomphus obscurus* (Rambur) and *Gomphus borealis* Needham were provided while records for *Aeshna subarctica* Walker and *Enallagma carunculatum* Morse were undocumented. Specific locality and dates for the latter two species are presented here along with the first report of *Somatochlora cingulata* (Selys) in Maine.

Aeshna subarctica Walker

Over a five year period I sampled a population of *Aeshna subarctica* at Big Heath, a large sphagnum and spruce bog about 10 m above sea level near the southern tip of Mount Desert Island, Hancock County (44° 14′ N lat.). During this period 15♂ and 7♀ were collected, mostly during August (1♀ 31.VII.69; 1♂, 1♀ 18.VIII.69; 7♂, 1♀ 25.VIII.70; 2♂ 26.VIII.70; 3♂, 1♀ 18.VIII.71; 2♀ 7.VIII.73; 2♂, 1♀ 21.VIII.73). Judging by the number of mature adults present, emergence at this location must begin in mid to late July. Although this species is by no means abundant, by mid August it is the predominant Anisopteran, and its flying season undoubtedly extends well into September. In 1973, emergence seemed to be late, and no mature adults were seen on 7

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August; however, many exuviae were found and two recently emerged females were collected with their exuviae. Oviposition takes place just below the water surface in the vegetation bordering the many small bog pools which have well-defined margins. Oviposition was never observed at the pools which are choked with sphagnum nor do the males patrol over these pools. On 21 August 1973, an ovipositing *A. subarctica* was captured by a green frog, *Rana clamitans melanota.* The presence of a number of these frogs in the bog pools suggests that they may prey heavily on ovipositing Odonata.

Aeshna subarctica is well-known from British Columbia to Newfoundland in Canada and from middle and northern Europe (Walker, 1958). It is also known from Japan (Asahina, 1972). In the United States it has been reported only from the Northern Peninsula of Michigan (Kormondy, 1958) and from New York (Beatty & Beatty, 1968). Big Heath represents the southernmost known breeding population of *Aeshna subarctica* in North America. The nearby Atlantic Ocean creates a cool damp environment typical in the summer of higher elevations and more northerly regions. This modified climate along the coast of Maine may explain in part the simultaneous occurrence at Big Heath of *A. subarctica, A. sitchensis* Walker (Ahrens, 1941), and *Somatochlora incurvata* Walker (White, 1969), three species of boreal Odonata known nowhere else in New England.

It is interesting to note that when I first visited Big Heath on 30 August 1968 (White, 1969), *A. subarctica* was not collected. *A. canadensis* Walker was quite common while *A. sitchensis* and *S. incurvata* were less frequent. On all subsequent visits during August, these three species have been absent or scarce while *A. subarctica* has been relatively common.

Somatochlora cingulata (Selys)

A single female *Somatochlora cingulata* was collected on 8 August 1973 as it flew over the water at the southern end of Eagle Lake, Mount Desert Island, Hancock County. Since this species is known from New Hampshire (Hagen, 1875), southern New Brunswick (Walker, 1925), and Nova Scotia (Walker, 1942), its presence in Maine was expected.

Enallagma carunculatum Morse

Two male *Enallagma carunculatum* were collected on 27 August 1970 near the breast of the Eagle Lake Dam. They were the only ones seen and both were taken from a single rock which projected above the splash zone near shore. This species is known from nearby New Brunswick and Nova Scotia (Walker, 1942) to the east and Connecticut (Howe, 1917) and Massachusetts (Howe, 1918) to the southwest.

ACKNOWLEDGEMENTS AND DEPOSITION OF SPECIMENS

I thank the National Parks Service for permission to collect within Acadia National Park. I also thank G.H. & A.F. Beatty for their discussions on the distribution of *A. subarctica.* Specimens of *A. subarctica* from Maine have been deposited in the U.S. National Museum, the Canadian National Collection, the Royal Ontario Museum, the Florida State Collection of Arthropods, and the University of Michigan Museum of Zoology.

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The Entomologist's Library

This section contains titles of books, monographs, and articles received by the editor that may be of special interest to entomologists and biologists. A brief statement of contents and items of interest are noted. Brief analytical reviews may be submitted for possible publication. All correspondence for this section should be addressed to the editor.

BOOK REVIEW

THE FANTASTIC WORLD OF ANTS, A Microview of Earth's Most Ingenious Insect. Herbert M. Mason, Jr. 1974. David McKay & Co., N.Y. 120 pages 12, photos. $5.95.

A very readable account of the natural history of some of the more than 8000 kinds of ants found on our earth. Following introductory chapters on the evolution, simple anatomy and reproductive habits of ants, separate chapters are devoted to the characteristics of different types of ants such as the harvesters, the leaf cutters and gardeners, army ants, Argentine ants, the slave makers, carpenter ants, honey ants and fire ants. There are numerous references throughout comparing the fascinating social life of ants and the organized societies of man. The concluding chapter centers on methods of constructing and maintaining ant colonies as household pets and objects of study. Although written primarily for young adults, the text makes very interesting and valuable reading for budding entomologists of all ages.

BOOKS RECEIVED AND BRIEFLY NOTED

HISTORY OF ENTOMOLOGY IN THE PENNSYLVANIA DEPARTMENT OF AGRICULTURE. A.G. Wheeler, Jr. and Karl Valley. Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania. April 1975. 37 pages.

A pamphlet recounting the history of entomology in the Pennsylvania Department of Agriculture from its inception in 1895 to the present time. Also included is a brief history of the arthropod collection.

VARIATION IN WING VENATION OF FOUR ODONATES[1]

Diane M. Calabrese[2]

ABSTRACT: Abnormal wing venation of four odonates is described.

DESCRIPTORS: Odonata, Aeschnidae, Lestidae, wing venation, oxygen concentration.

Two male specimens of *Anax junius* (Drury) collected in July, 1970, at a marsh in Presque Isle State Park, Erie, Pennsylvania, show variations in wing venation.

An adventitious crossvein parallel to the subcosta appears between the second and third antenodal crossveins in the left forewing of one male (Fig. 1) and a dichotomy of the third and fourth antenodal crossveins occurs in the right forewing of the other male (Fig. 2).

Two specimens of *Lestes* sp. collected at the same site and time as the specimens of *Anax junius* also show variations in wing venation. In one there is a dichotomy of cross veins in the

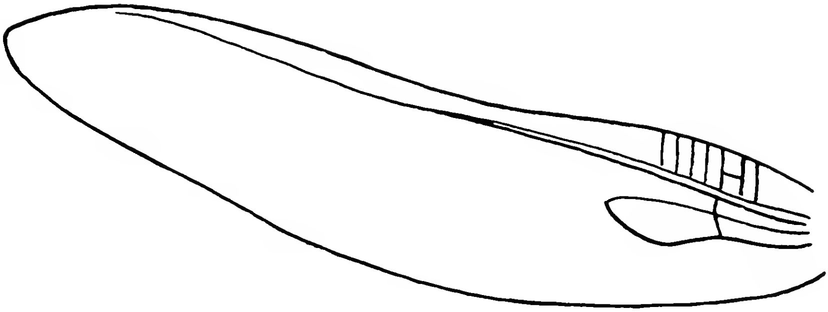

Fig. 1. Left forewing with adventitious crossvein between second and third antenodal crossveins in *Anax junius* male.

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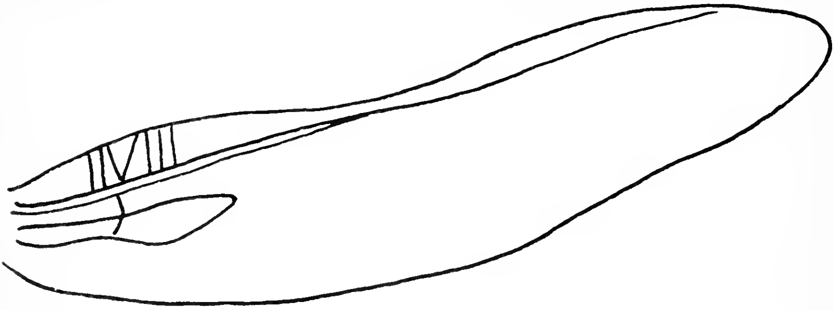

Fig. 2. Right forewing with dichotomy of third and fourth antenodal crossveins in *Anax junius* male.

postnodal veins of the left forewing and there is a similar dichotomy of sub-radial crossveins in the left forewing of the other specimen.

Considerable intraspecific variation in numbers of crossveins is not uncommon among primitive orders of insects. Chutter (1962) gives an excellent example of this within individual specimens of *Pseudoagrion vaalense* Chutter.

A further purpose of this note is to point out the interesting possibility for more research, in the light of Wiggleworth's (1954) work with *Rhodnius prolixus* Stal (Hemiptera: Reduviidae), which demonstrated that lowered oxygen concentration in the nymphal stage of this bug can stimulate the migration of tracheoles, increase tracheation, and consequently result in incipient wing veins in the adult; and with respect to the body of water – Lake Erie – which feeds the marsh, a body of water in which the concentration of oxygen has declined steadily since the late 1950's, concommittant with the increase in the levels of pollution (Ehrlich, 1970).

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A NEW EASTERN NEARCTIC *HEMERODROMIA* (DIPTERA: EMPIDIDAE)[1]

P.P. Harper[2]

ABSTRACT: *Hemerodromia chillcotti* n. sp. is described from Quebec and North Carolina.

DESCRIPTORS: aquatic insect, Diptera, Empididae, Hemerodrominae.

During an investigation of stream fauna in the Laurentian Highlands north of Montreal, Quebec, an undescribed species of *Hemerodromia* was encountered. Specimens of the same species were later found in the Canadian National Collection of Insects (CNCI) in Ottawa; these had been labelled "n. sp. near *melanosoma*" by the late Dr. J.G. Chillcott. The species is described below and named in memory of Dr. Chillcott.

The holotype and the allotype (in alcohol) are deposited in the insect collection of the Departement des Sciences Biologiques of the Universite de Montreal (UM); paratypes are in the same collection and the CNCI.

Hemerodromia chillcotti, new species

Total length 2.5-3mm. The species agrees in most respects with previous descriptions of *Hemerodromia* spp. (cf. Collin 1961) particularly with regard to general morphology, body setation, and wing venation. The distinguishing characters are as follows:

Face linear; eyes nearly contiguous on face separated by a distance of less than one ommatidium. Front legs raptorial; femora bearing on their ventral margin two rows of long yellow spines between which are two rows of small black knobs; basal spine somewhat larger than the others but not borne on a basal tubercule; tibiae armed with a dark subterminal spine. Wing venation typical; second vein ending opposite end of fifth vein and fork of fourth vein.

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General colour of body dark; head black subshining; underside of head, antennae and mouthparts creamy white. Thorax dark brown polished, pleura lighter; wing veins brown; halteres white; legs whitish without any marked darkening at joints. First abdominal segment white; terga of segments 2-6 dark brown with some lighter mottlings laterally; segments 7 and 8 white; genital segments dark brown.

Male genitalia: general aspect of the hypopygium typical of the genus (Fig. 1). Upper lamellae fused anteriorly and prolonged distally by two flat lobes, one horizontal (Fig. 6), the other vertical (Figs. 1 & 2). Side lamellae irregularly oval bearing a distal lobe (Fig. 3) which fits in between the upper lamellae. Penis of the usual type (Fig. 4). Fused ventral lamellae forming the main structure of the hypopygium and bearing small dorsal appendages (Fig. 5).

Female genitalia: ovipositor well chitinized, long and pointed (Fig. 7).

Immature stages: unknown.

Holotype ♂: stream at Station de Biologie (Universite de Montreal), St-Hippolyte de Kilkenny, comte de Terrebonne, Quebec, July 20th 1972.

Allotype ♀: same data.

Paratypes: QUEBEC, same locality, 36♂, 146♀, June 22 - August 14, 1972 (UM); Wakefield, 2♂, 4♀, July 9, 1946, G.F. Shewell (CNCI). NORTH CAROLINA, Wayah Bald, 4100', ♂, July 28, 1947, W.R. Richards (CNCI).

Among North American species, *H. chillcotti* resembles most *H. melanosoma* Melander, and it will key out to this species in Melander's (1947) key to the Central and North American species. The main distinguishing features are summarized in the following couplet:

Seventh abdominal tergum brownish (especially in the female where the venter is also darkened); upper lamellae of male hypopygium linear in side view, without a downturned lobe (Melander 1947, Fig. 12); female ovipositor short and rounded (Fig. 8) . . . . *H. melanosoma* Melander
Seventh abdominal segment pale; upper lamellae with a conspicuous downturned lobe (Fig. 2); ovipositor long and pointed (Fig. 7). . . . . *H. chillcotti* n. sp.

ACKNOWLEDGEMENTS

I thank Mr. J.E.H. Martin and Dr. J.F. McAlpine for allowing me to examine material in the Canadian National Collection of Insects. This study was supported by the National Research Council of Canada.

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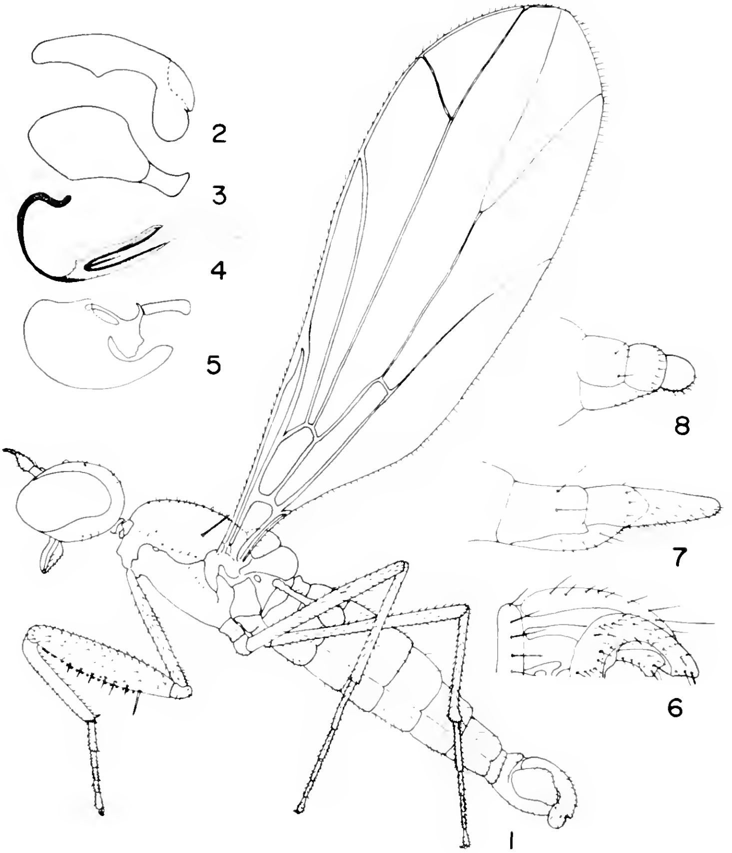

Figs. 1-7. *Hemerodromia chillcotti* new species.

Fig. 1. General aspect of male.

Fig. 2. Upper lamella of male genitalia.

Fig. 3. Side lamella of same.

Fig. 4. Penis.

Fig. 5. Ventral lamella.

Fig. 6. Top view of male hypopygium (right half).

Fig. 7. Female ovipositor (side view).

Fig. 8 *Hemerodromia melanosoma,* female ovipositor.

THE FATHER OF THE SCHMITT BOX[1],[2]

Walter R. Suter[3], and
the Rev. Jerome Rupprecht, O.S.B.[4]

ABSTRACT: The origins of the Schmitt Box and collection are traced to the Rev. P. Jerome Schmitt at St. Vincent Archabbey, Latrobe, Pennsylvania. The ants in the collection are noted as being especially worthy of study.

DESCRIPTORS: Schmitt Box, ants, microcoleoptera, collection.

Have you ever wondered who it was that first designed the Schmitt Box, or when and under what circumstances this valuable device came into use? Written records of the origin are virtually non-existent, but Dr. Dean L. Gamble, formerly board chairman of Ward's Natural Science Establishment, which owns the rights to the original design, was very helpful and cooperative when we located him in retirement in California, and we thank both him and the Rev. Ambrose Keefe, reference librarian of Belmont Abbey College, who not only helped locate official records of the designer, but also provided valuable historical insights.

A century ago the Rev. P. Hieronymus (Jerome) Schmitt, O.S.B. began an illustrious career in entomology which was to result in a major collection amassed during the next three decades, and the insect storage and transfer device bearing his name. This latter device, used in some form currently by virtually every American entomologist, was not even mentioned by Father Jerome's eulogists, and the extent of his collection and its location were only briefly mentioned. This historical note will record information gleaned from the collection and from personal contacts, while outlining the life of this turn-of-the-century formicologist and pioneer microcoleopterologist.

An obituary in ENTOMOLOGICAL NEWS (1904), apparently written by one of the brothers at St. Vincent Archabbey, includes a photograph and some personal insights of this man born Gebhard Schmitt in 1857 in Wurttemburg, Germany. He was part of a group chosen for their industry who undertook clerical studies at St. Vincent in 1869. His ordination in 1881 coincided with his first teaching assignment at Belmont Abbey College (1880-82), which introduced him to the diversity of fauna in this

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[2] Research aided by a grant-in-aid from the Highlands Biological Station.

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North Carolina locale, and may have spurred him into the intensive collecting which marked the greater part of his later life. He returned to St. Vincent in the Appalachians of Pennsylvania for the remainder of his life, occasionally finding time to collect elsewhere, especially on visits to other institutions founded by the brothers of St. Vincent.

Since he was indefatigable as a collector and willing to send material he collected to specialists, he recognized the need for a sturdy, compact shipping box to supplement the cumbersome drawers used for the major collection. His original design for dermestid resistant boxes was turned over to the American Entomological Company of Brooklyn, probably about 1890. This company sold out to Ward's in 1913. Ward's not only purchased the business from Mr. George Franck, but hired Frank Rogowitz from the Brooklyn company's woodworking department so that they could truly claim to have "The Original Schmitt Box."

Father Jerome's collection, which narrowly escaped destruction in a major fire January 28, 1963, which claimed the extensive botany museum, suffers from the incompleteness of data common to most older collections, but usually has place names and/or dates on different animals in the same series. From these data on clavicorne microcoleoptera an itinerary can be reconstructed for use in establishing localities where only dates are given, and approximate dates for material with only locales. Material collected before 1891 lacks dates, but probably is largely from St. Vincent, and is primarily ants. 1892 material from Mississippi and 1892 and 1893 material from California were apparently obtained by trades, but later collections often have valid data. He amassed most of his collection at St. Vincent (Beatty), west of Latrobe, Westmoreland Co., Pennsylvania[5] from 1894 through 1904, but this was supplemented by the following interludes: an 1895 return to Belmont, N.C. from February through April 29, interrupted by a brief sojourn at St. Vincent from April 6 to 20; three short visits to Cullman, Alabama (St. Bernard's) occupying March 1, 1896, May 12 to 19, 1896, and February 1, 1898; and a trip to Canon City, Colorado (Holy Cross Abbey) from February 21 to April 2, 1900 (probably a bonus for time served the previous year as

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[5] A few collections labelled Chestnut Ridge, or "ridge" are from the area immediately east of the Abbey (St. Boniface Parish). Minor discrepancies noted in the Schmitt material in the Casey collection (NMNH) may have resulted from Casey incorrectly reattaching date labels.

subprior). Material labelled Covington, Kentucky is undated but probably resulted from a visit to St. Joseph's, a St. Vincent priory. Other material in the collection was received in trades, such as Iowa and Kansas series from H.F. Wickham.

Although there is no indication of special techniques used in collecting, Rev. Schmitt was primarily interested in ants, and these represent the largest single unit in his collection, including many paratypes among series identified by Wheeler, Wasmann, and Emery. The twelve drawers housing ants are at once the oldest, largest, and least curated, but will hopefully be reworked by an interested formicologist to try to analyze the specimens and the information they represent.

Lepidoptera are also extensively represented in the overall collection, filling 42 drawers, many of these being added recently by the current Father Jerome. And 22 drawers of hemipteroids, the work of Rev. Modestus Wirlner, O.S.B., are also available for study.

Father Jerome Schmitt developed an extensive coleopteran collection, with strengths in the clavicorne microcoleoptera, totalling 46 drawers. His interest in these latter probably developed because of the numbers of Pselaphidae and Scydmaenidae coinhabiting ant nests. Because these were small and poorly known he often collected them in relatively long series, and sent material to at least Col. John Casey, and H.F. Wickham (working with Emil Brendel). In fact, he sometimes split series of new species with resultant synonomy through publication of different new names by the two authorities. Synoptic collections of these are currently housed at St. Vincent. Uniques present in the original material sent to Casey are housed largely at the NMNH, and duplicates have been transferred to the collection at the Field Museum.

Although Rev. Schmitt's collecting ended in 1904, both his collection and the box which bears his name are available to present-day entomologists, insuring him a niche in entomological history. The Schmitt Box represents something of an investment, but the Schmitt collection is also worthy of some investment of time, and anyone wishing to examine it should contact the Rev. Jerome Rupprecht at St. Vincent Archabbey.

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XEROXED DATA LABELS[1]

Larry J. Orsak[2]

ABSTRACT: A rapid and economical method to produce permanent specimen labels utilizing Xerox is described.

DESCRIPTORS: Data storage, labels, museum techniques.

Most collectors now realize the importance of having complete and intelligible locality and biological data to accompany each speciman in a collection. The principle drawbacks for this ideal were once simply a matter of having too little time and space to write everything on a small label. Such problems were somewhat alleviated with the introduction of lithograph-offset and photographic labels. However, making these labels is also often time-consuming. With the offset method, a sheet of labels must be typed, and then sent to a printer to be transfered to a metal or paper master plate (Stuckenberg and Irvin, 1973). Adams (1962) has developed a rather rapid method by which limited numbers of labels can be printed. However, such labels are handwritten and the amount of data which can be put on a small label is severely limited.

Xeroxed labels have been used by some collectors with considerable success. The advantages of these labels are great – the print (baked-in carbon) will not run in alcohol and is unlikely to fade with time. High quality rag paper which will not easily yellow can be used for the labels. Most importantly, these labels can be made extremely fast and at very low cost if a Xerox machine is readily available. A method I have used to produce high quality labels quickly and economically is described here.

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[1] Accepted for publication: September 15, 1974

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The desired labels are first typed. Paper with a smooth glossy finish should be used, as it seems to Xerox the best. A horizontal row of labels is typed and recorded on an IBM MT/ST or other automatic typewriter. The machine then automatically copies this row over and over until stopped, or until the end of the page is reached. If such a machine is not available, an electric typewriter with a plastic carbon ribbon should be used. Manual typewriters do not produce the required sharp print.

The finished sheets of typed labels are next copied, using the Xerox 7000 copier. This machine contains a reducing feature which will reduce two printed pages to the size of one. First, I reduce all the typewritten pages to this reduced size. Then I take these half-size sheets and reduce them again, so that the printing is now approximately one-quarter of the original size. The finished quarter-size print sheets can be used as masters for making the actual labels. It should be mentioned that the "Light Original" feature is always used when copying in order to produce the darkest image possible.

The actual labels can be made on almost any copying machine. The quarter-size print sheet serves as the master, and labels are copied directly from this onto high quality rag paper. The finished label (4 rows) measures approximately 10 mm x 15 mm.

The cost for these labels in terms of both material and labor is small. Most of the actual time spent preparing these labels comes from typing them up. Xerox costs range from 3-5 cents per page and one page can contain hundreds of labels. It is also advantageous to note that there are no negatives or etched plates to keep track of, as with other methods. Only the master sheets need be retained if more labels are to be printed at a later date.

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ISOLATION OF ATTINI BROOD FROM THE SOCIAL ENVIRONMENT (HYMENOPTERA: FORMICIDAE)[1]

John R. Schreiber[2]

ABSTRACT: Brood from several species of the fungus-growing Attini ants, including *Atta colombica tonsipes, Atta cephalotes* and *Atta sexdens,* were isolated from the social environment and artifically reared on sterile agar plates. Though isolate larvae would accept fungal food on the end of a needle and subsequently pupate, isolate brood seemed unable to fully develop to adulthood even with laboratory imitation of adult worker care. This was due to the inability of pupae to emerge from the pupal skin, and to the consistent onset of contamination. By contrast, brood in control plates consisting of workers and bits of fungus garden as well as brood, developed to adulthood. This apparently occurred since contamination was inhibited by the social environment and because worker licking and manipulation removed pupal coverings. An anomalous condition, however, arose in one *Atta cephalotes* control where emerging callows retained abnormally pale coloration. Developmental coloration of isolate pupae was also studied, with eyes noted as darkening first, followed by the mandibular masticatory border, and, finally, the head and gaster, the results conforming to previous studies.

DESCRIPTORS: Attini, brood, isolation, social environment, contamination, pupa, coloration.

It has frequently been noted that ant broods cannot develop to adulthood in absence of the social environment (Wilson, 1972). This is particularly true of the fungus-growing Attini ants (Weber, 1966 a, b). The present studies were undertaken primarily to determine the possibility of rearing Attini brood to adulthood in isolation from the social environment. The development of such a technique would aid in the determination of the factors of social care necessary for complete brood development, and would have implications for genetic and caste research. Also desired were close observations of the developmental color changes which occur during the pupal and callow stages.

Attini brood (worker larvae and pupae only) were taken from the laboratory colonies of Dr. Neal Weber, Swarthmore College, Swarthmore Pennsylvania, and isolated on petri dishes of sterile 1% non-nutrient agar. A grid was superimposed on the bottom of each dish, and one piece of brood placed on each grid box. This was designed to aid in the observation of each specific developing larva or pupa. A method was devised (after Weber, 1972) to feed isolate larvae by placing small fragments of fungal hyphae on the tip of a dissecting needle and thrusting the clump at the larval mouthparts. Several isolate larvae responded to such feeding, two

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[2] Box 742, Haverford College, Haverford, Pa., 19041 Prepared under the direction of Dr. Neal Weber, Swarthmore College

of which subsequently pupated. Pupal pigmentation was noted until the onset of movement within the pupal covering. The removal of the exuviae was unseccessfully attempted by stroking the skin with a moist, fine paintbrush while tugging with a dissecting needle.

Two experimental series were run, the isolates being placed on petri dishes, while controls of bits of fungus garden, workers and brood taken from the same laboratory colonies as the isolates were also placed on petri dishes. This was designed to determine (1) whether any inherent contamination or infection would prevent brood development even in the presence of social care, and (2) to compare worker brood development with and without the benefits of the social environment. Series #1 consisted of two petri dishes of control material containing approximately five grams garden, five media workers, five minima workers and several pupae embedded in the garden fragments. Materials for both dishes were taken from two separate *Atta colombica tonsipes* laboratory colonies. Isolate brood from the same colonies were placed in numbered grid boxes of two petri dishes. Dish #1 contained five isolate larvae, and dish #2 five isolate pupae. Series #2 utilized material from three Attini species, *Atta colombica tonsipes, Atta cephalotes,* and *Atta sexdens.* Each control dish and isolate brood dish was taken from the same laboratory colony. Thus, three controls were established, controls A, B, C respectively. Control A contained five to seven grams garden, five media and two larvae of *Atta colombica tonsipes.* Control B consisted of five grams garden, five media, five minima, two pupae and one larva of *Atta cephalotes,* while control C contained five to six grams garden, six minima, two media and two larvae of *Atta sexdens.* Isolate dish #1 held four *tonsipes* larvae only one of which responded to artificial feeding efforts. Isolate dish #2 consisted of six *cephalotes* pupae in varying degrees of development. Isolate dish #3 contained two *sexdens* pupae and two larvae.

RESULTS

Results of series #1 appear in tables 1 and 2, where feeding, coloration development and contamination are tabulated against progressive dates of observation of isolated brood. In dish #1, two larvae pupated in isolation, one of them after two periods of artificial feeding. Streaks of brown were noted in the three larvae that responded to feeding and are possibly the gut full of food or uric acid metabolites. Though larvae would pupate in isolation

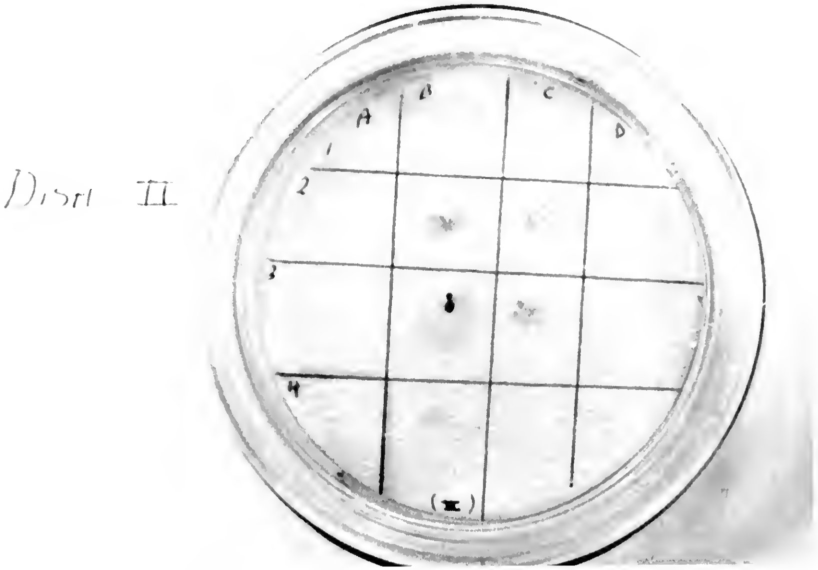

Figure 1a. Dish #2 series #1. The pupa in the center (grid box #3B) was moving at time of photographing–see Fig.2.

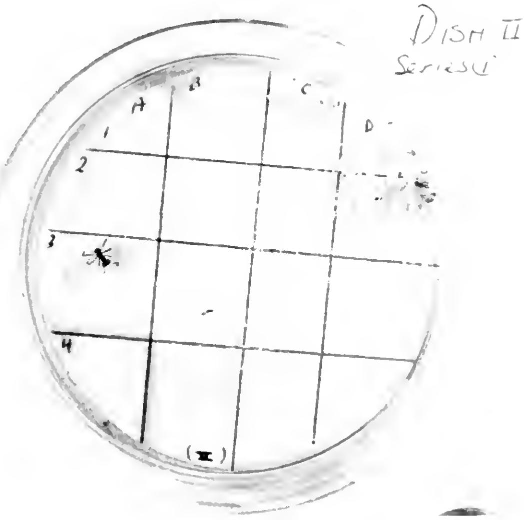

Figure 1b. Dish #2 series #1 after adult *tonsipes* worker was introduced by the experimentor in an effort to induce nursing behavior after artificial attempts at removing the pupal skin had failed. Note how the worker has discarded the pupae and has excavated around a small piece of fungal contamination. The ant was dying at time of photographing. See text.

Figure 2. Pupa from dish #2 series #1. Note the dark eyes and dark masticatory border of the mandibles. The pupa was moving at time of photographing and would have emerged in the presence of licking by workers.

Figure 3. Semi-pupa from dish #1 series #1. Originally isolated as a larva, this *Atta colombica tonsipes* brood pupated several days after being fed fungus from the tip of a dissecting needle.

Figure 4. Close-up of control B, series #2, *Atta cephalotes*. Note the pale head of the media (in the upper center) which hatched in the control, an anomaly which remained until the media's death. A normal worker appears in the lower center.

Figure 5a. A typical control dish with workers and garden fragment after one week of isolation from the main colony. Extensive excavation of agar and exhausted substrate particles are evident.

from worker care, contamination occurred in all cases before the brownish coloration of a developing pupa began. Data of pupal development in dish #2 are found in table 2. One of the pupae became contaminated soon after isolation. Pupa #3B was constantly moving the tips of its limbs and antennae by March 1, as well as its mandibles. Eyes were blackish, the cutting edge of the mandibles dark brown. Unsuccessful attempts were made to release this pupa from its covering with a fine paintbrush and dissecting needle. Pupa #3C when poked moved slightly and exuded a small brownish droplet from the tip of its gaster. Since attempts to remove the exuviae failed, an adult *tonsipes* worker from the control dish was introduced to isolate dish #2 in an effort to induce nursing behavior. However, instead of removing

Figure 5b. A control dish one week after the workers had died. Contamination is extensive. Note the pupa embedded in the dying garden. This was the only case in which brood did not reach adulthood in the control dishes.

the pupal skins from the struggling pupae, the worker discarded the pupae within one day and proceeded to excavate agar around some fungal contamination in a manner similar to normal worker treatment of garden fragments in the control situation (see Fig. 1 a and b).

The second series was designed to increase gross numbers of brood utilized and to use brood from three different species to compare results across species. Results are tabulated in tables 3 and 4. Dish #1 of the second series (data not listed) contained four larvae none of which would respond to feeding. Larva #3B pupated after four days isolation. After six days complete contamination of the isolated brood occurred. All became soft and mushy with a yellowish-gray tinge. Dish #2 contained six pupae (see table 3) four of which were free of contamination for nineteen days. Pupal coloration began first in the compound eyes which gradually deepened in their brown color. The mandibular masticatory border assumed pigmentation next, after the eyes had already taken on a dark brown hue. Coloration of the head and gaster followed until the entire pupa had a dark brown pigmentation and movement began (see Fig. 2). Several of the pupae were covered with strands of fungus, but this may have been species specific fungus and not contaminants (Weber, 1966b). By March 14 slight movement was observed in pupa #3B, but it became contaminated before any attempts at removing the pupal skin were performed. By March 20 all the isolate pupae in this dish had become contaminated. Dish #3 consisted of two larvae and two pupae. The larvae did not feed though pupating after two days isolation. The two pupae were immature and though eye coloration deepened, their body coloration remained white throughout

TABLE 1

FIVE ISOLATE LARVAE, *Atta colombica tonsipes*, FIRST SERIES, DISH #1

DATE	RESPONSE TO FEEDING					BODY COLORATION					CONTAMINATION				
	1C	2B	2C	3B	3C	1C	2B	2C	3B	3C	1C	2B	2C	3B	3C
2-13	+	–	+	–	+	W/B	W	W/B	W	W/B	–	–	–	–	–
2-18	–	–	–	–	+	W	W	W	W	W/B	–	–	–	+	–
2-22	–	–	–	–	+	W	W	W	W	W/B	–	–	–	+	–
2-27	–*	–**	–	–	–	W	W	W	W	W/B	–	–	+	+	+
3-1	–	–	–	–	–	W	W	W	W	W/B	–	–	+	+	+

W=white; B=brownish streak; + = positive response; – = negative response, *;** Pupation occurred.

TABLE 2

FIVE ISOLATE PUPAE, *Atta colombica tonsipes*, FIRST SERIES, DISH #2

DATE	EYE COLORATION					BODY COLORATION					CONTAMINATION				
	2B	2C	3B	3C	4B	2B	2C	3B	3C	4B	2B	2C	3B	3C	4B
2-13	B	W	Br	LBr	W	LBr	W	LBr	W	W	–	–	–	–	–
2-18		Br	B	DBr	Br		W	Br	W	W	+	–	–	–	–
2-22		DBr	B	DBr	Br		W	DBr	LBr	W	+	–	+	–	–
2-27*		DBr	B	DBr	DBr		LBr	DBr	LBr	W	+	–	+	–	–

*An adult *tonsipes* worker was introduced to the dish on March 1, See text.

W=white; B=black; Br=brown; LBr=light brown; DBr=dark brown; + = positive response; – = negative response.

TABLE 3

SIX ISOLATE PUPAE OF *Atta cephalotes;* SECOND SERIES, DISH #2*

DATE	EYE COLORATION						BODY COLORATION						CONTAMINATION					
	2B	2C	3B	3C	4B	4C	2B	2C	3B	3C	4B	4C	2B	2C	3B	3C	4B	4C
3-1	W	LBr	LBr	DBr	B	LBr	W	W	W	W	LBr	W	–	–	–	–	–	–
3-7	W	DBr	DBr	B	B	DBr	W	LBr	LBr	Br	Br	LBr	–	–	–	–	–	–
3-14	Br	B	B	B	B	B	LBr	Br	Br	DBr	DBr	B	–	–	+	+	–	–
3-20	Br	B	B	B	B	B	LBr	Br	Br	DBr	DBr	Br	+	+	+	+	+	+

W=white; Br=Brown; LBr=light brown; DBr=dark brown; B=black; + = positive; – = negative.

*Dish #1 became completely contaminated after six days; data not shown.

TABLE 4

TWO ISOLATE PUPAE** AND TWO ISOLATE LARVAE*OF *Atta sexdens;* SECOND SERIES, DISH #3

DATE	RESPONSE TO FEEDING		EYE COLORATION				BODY COLORATION				CONTAIMINATION			
	2C*	3B*	1B	2B	2C	3B	1B	2B	2C	3B	1B	2B	2C	3B
3-5	–	–	W	LBr			W	W	W	W	–	–	–	–
3-7	pupated		W	LBr	W	W	W	W	W	W	–	–	–	–
3-14			LBr	Br	W	W	W	W	W	W	–	–	+	–
3-20			Br	Br	W	W	LBr	W	W	W	+	+	+	–

*2C & 3B are larvae, ** 1B & 2B are pupae

On 3-20, 3Bwas returned to *Atta sexdens* Control C since artificial means of removing the pupal shell failed. See text.

W=white; Br=brown, LBr=light brown; + = positive; – = negative.

their isolation period. On March 20 one of the larvae which had pupated in isolation was returned to its control (C) in an effort to induce the adult *sexdens* control workers to resume nursing care. Though initially attracted to the pupa (including licking, nipping and other tactile manipulation), the ants soon discarded it.

CONTROL RESULTS

Series #1 controls survived in isolation from the larger colony approximately ten days after which the garden fragments became dessicated and workers died. No contamination of brood receiving control worker care occurred, and these workers were able to bring all but one piece of brood to adulthood before dying. No contamination was allowed to approach the garden since the control groups excavated agar in a circle around the garden fragment. Extensive contamination began to occur after one week and workers were unable to prevent the contamination from spreading. Pupal coloration under control conditions appeared no different than isolate developmental coloration mentioned previously. Series #2 controls utilizing three different Attini species, generally remained viable longer than series #1 controls. Control A (*Atta colombica tonsipes*) survived nineteen days, the ants excavating heavily around the garden fragment as well as around the edge of the petri dish. The garden fragment was maintained in a fluffy, healthy condition for over two weeks, while one pupa developed to the callow stage. All workers died by March 19. Control B *(Atta cephalotes)* had two pupae embedded in its garden fragment. One underwent color changes identical to those noted in dish #2 series #2. The workers excavated extensively around the edge of the petri dish as well as around the garden itself. Minima, unlike media, seldom ventured off the garden fragment onto the agar surface. One of the pupae ecdyced on March 11 and was licked extensively by both minima and media. The resultant callow (a media) was unable to walk for two days and was exceptionally pale. This callow subsequently darkened abnormally, its gaster and thorax assuming normal darkness, while its head remained pale (see Fig. 4). This anomalous condition contrasted sharply with the normal dark head coloration of the control medias. Another media callow emerged on March 20 again after extensive licking and manipulation by workers. By March 25, its head had also remained pale eventhough its gaster and other parts of its body had darkened normally. No contamination was visible in this control until April 1. Control B remained viable a total of forty days and some of the workers were still alive at the time of this writing. Control C remained viable for over thirty-five days at which time the garden fragment began to deteriorate probably from lack of adequate substrate. However, several minima survived several days beyond garden deterioration. Workers (primarily media) excavated around the edges of the petri dish but not around the garden fragment.

DISCUSSION

Attempts at artificially rearing Attini brood were successful up to a point. Larvae would accept food and pupate in isolation from the social environment and pupae would develop to the pre-callow stage. Pupae, however, were unable to extricate themselves from their coverings without worker aid. All attempts to duplicate the licking and tactile manipulation of the workers failed. In addition, contamination invariably killed the isolate brood if inability to emerge from the pupal covering did not. The inability of the isolate brood to develop to adulthood seems to center around their susceptibility to contamination and their incapacity to emerge from the pupal skin without worker aid. By comparison, control brood development was uninhibited, and contamination in no cases affected or killed brood. Contamination in general took far longer to appear in the controls than in the isolates, and when it did was kept from proximity of the garden fragment in which the brood was embedded (Weber, 1956a, 1966a, 1972 and Martin, 1974). The brood apparently do not possess any inherent contamination-inhibiting qualities since contamination in the isolate dishes was unrestricted. Rather, the social environment seems instrumental in contamination inhibitation (Weber, 1966a). Coloration of pupae during development conformed to previous studies (Weber, 1966b), with the compound eyes darkening first, then the masticatory border of the mandibles, and finally the gaster and head. Upon emerging, callows were pale and weak and gradually darkened to normal coloration. In the *Atta cephalotes* control, callows retained a pale head long after the rest of the body had darkened to normal specie coloration. Since the original control material was taken from a laboratory colony collected several years ago, it is possible that genetic mutation or type of substrate supplied may be affecting head coloration. Further study with this laboratory *Atta cephalotes* colony is indicated. Though the small numbers of brood and control material by no means show this to be conclusive, *Atta colombica tonsipes* isolate brood and controls remained viable for a significantly shorter time than either *Atta cephalotes* or *Atta sexdens* material.

SUMMARY

Ant brood particularly the Attini brood is totally dependent on social care for the complete development to the adult stage. Three species of Attini were used, *Atta colombica tonsipes, Atta cephalotes,* and *Atta sexdens.* Attempts at rearing Attini brood in isolation from the social environment failed not because of failure to induce larvae to eat, but because pupae were unable to emerge from the pupal skin and because contamination invariably occurred. Licking by the workers during the pre-callow stage and inhibition of contaminants seem to be two of the essential elements provided by the social environment which enable the brood to develop to adulthood. This was shown by the removal of the pupal skin by workers and the inhibition of contaminants which occurred in the controls. Progressive coloration of pupae indicating relative maturity conformed to previous studies.

ACKNOWLEDGEMENTS

The author wishes to thank Mr. Wally Herrington and Mr. Richard Malone for their photographic assistance.

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INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

ANNOUNCEMENTS A.N.(S.)95

Required six months' notice is given of the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names listed by case number: (see *Bull. zool. Nom.* 32, part 1, 27th March 1975)

1079. *Forcipomyia* Meigen, 1818 (Insecta, Diptera): designation of type-species.

1505. Suppression of *Ligulops* Hall, 1871 (Brachiopoda)

1749. Suppression of *Cornufer unicolor* Tschudi, 1838 (Amphibia, Salientia)

1807. Suppression of the following works: Hemprich & Ehrenberg, 1828a. *Symbolae Physicae seu Icones et Descriptiones Piscium* Berlin (Mittler); Hemprich & Ehrenberg, 1828b. *Symbolae Physicae seu Icones et Descriptiones Zootomicrorum* Berlin (Mittler).

1892. Ruling on the stem of the family-group name based on *Sphaerius* Waltl, 1838 (Insecta, Coleoptera)

Comments should be sent in duplicate, citing case number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London SW7 5BD, England. Those received early enough will be published in the Bulletin of Zoological Nomenclature.

MARGARET GREEN
March, 1975 Scientific Assistant

Word has just been received from the International Commission requesting a correction of the announcement on page 52 of the February 1973 issue of ENTOMOLOGICAL NEWS (84:2:52) regarding a new edition of the International Code. Although an editorial committee is now hard at work preparing a third edition of the code, it is not certain, but is hoped, that this edition will be ready to seek formal approval of the Division of Zoology of I.U.B.S. in time for the 1976 general assembly. It was and is not currently at the printers, as erroneously published in ENT. NEWS.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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11. EXTENT AND NATURE OF CIRCULATION	Average No. Copies Each Issue During Preceding 12 Months	Actual Number of Copies of Single Issue Published Nearest To Filing Date
A. TOTAL NO. COPIES PRINTED	1000	1000
B. PAID CIRCULATION		
1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES	0	0
2. MAIL SUBSCRIPTIONS		
C. TOTAL PAID CIRCULATION	753	753
D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS	3	
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E. TOTAL DISTRIBUTION	756	756
F. OFFICE USE, LEFT-OVER, UNACCOUNTED, SPOILED AFTER PRINTING	244	244
G. TOTAL	1000	1000

12. I certify that the statements made by me above are correct and complete. Signed: Robert W. Lake, former editor, and Howard P. Boyd

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PUBLICATION AND MAILING DATES
VOLUME 85, 1974

No.	Date of Issue	Pages	Pub. Date	Mailing Date
1	January	1 - 32	July 22, 1974	Aug. 3, 1974
2	February	33 - 64	Aug. 9, 1974	Aug. 19, 1974
3	March	67 - 98	Nov. 13, 1974	Nov. 16, 1974
4	April	99 - 126	Dec. 13, 1974	Dec. 21, 1974
5 & 6	May & June	129 - 192	Apr. 18, 1975	Apr. 30, 1975
7 & 8	July & Oct.	193 - 256	May 21, 1975	June 13, 1975
9 & 10	Nov. & Dec.	257 - 320	Aug. 30, 1975	Sept. 10, 1975

MANUSCRIPTS SOLICITED

In the present effort to speed up schedules and make dates of issue coincide with publication dates, all submitted manuscripts approved for publication are now at the printer or in various subsequent stages of production. This amount of material will carry ENT NEWS through the May - June 1975 issue.

Thus, instead of there being a backlog of articles, there now is a need for considerable new material. To meet this need, manuscripts of high quality are earnestly solicited.

The editor.

The Entomologist's Market Place

Advertisements of goods or services for sale are accepted at $1.00 per line, payable in advance to the editor. Notices of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

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Wanted: DRAGONFLIES OF NORTH AMERICA by Needham and Westfall. Please contact James H. Kennedy, 24 Walnut Lane, Camp Hill, Pa. 17011.

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Wanted: North American Fishflies (adults and/or larvae): needed for distribution records and emergence patterns. Send loan materials to: Dr. Donald Tarter, Marshall University, Department of Biological Sciences, Huntington, W. Va. 25701.

Wanted: "The Odonata of Canada and Alaska", Vol. 1 by E.M. Walker, Univ. Toronto Press, 1953. Advise Donald F.J. Hilton, Dep't. Biological Sciences, Bishop's University, Lennoxville, Quebec, Job 1Z0, Canada.

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